DISTRICT OF COLUMBIA
WATER AND SEWER AUTHORITY
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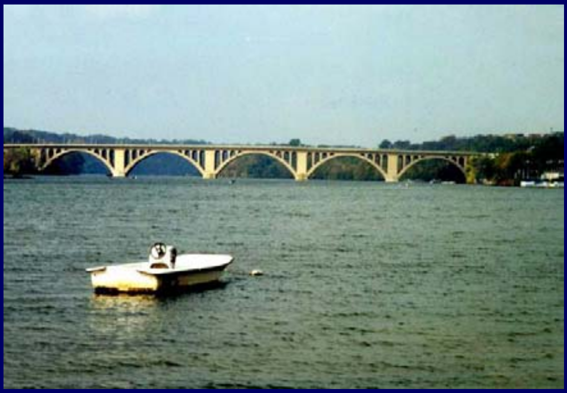
Anacostia River



Potomac River

Rock Creek

Combined Sewer System Long Term Control Plan

Final Report

July 2002

DISTRICT OF COLUMBIA
WATER AND SEWER AUTHORITY

Combined Sewer System Long Term Control Plan

Submitted by:

District of Columbia Water and Sewer Authority

Prepared by:

Greeley and Hansen LLC

July 2002

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The following District of Columbia Water and Sewer Authority (WASA) Board Members and staff had key roles in the completion of this project:

- Glenn S. Gerstell, Chairman of the Board
- Charles C. Johnson, Jr., Chairman, Operations Committee
- David J. Bardin, Chairman, CSO/Stormwater Subcommittee
- Jerry N. Johnson, General Manager
- Michael S. Marcotte, Deputy General Manager and Chief Engineer
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- Martin B. Sultan, Manager of Program Management, and
- Mohsin R. Siddique, CSO Control Program Manager

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- Greeley and Hansen LLC – Program Manager
- Advanced Engineering, P. C.
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Principal Greeley and Hansen staff for the project are: Ronald E. Bizzari, Lawrence P. Jaworski and John F. Cassidy.

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DISTRICT OF COLUMBIA
WATER AND SEWER AUTHORITY
Washington, D.C.

Combined Sewer System Long Term Control Plan

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Engineering Program Management Consultant - III
Program Manager - Greeley and Hansen LLC
July 2002

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Executive Summary

1. PURPOSE

The District of Columbia Water and Sewer Authority (WASA or Authority) has prepared this report to describe the development and selection of the plan for controlling combined sewer overflows (CSOs) in the District of Columbia. The plan for controlling CSOs is called a Long Term Control Plan or LTCP.

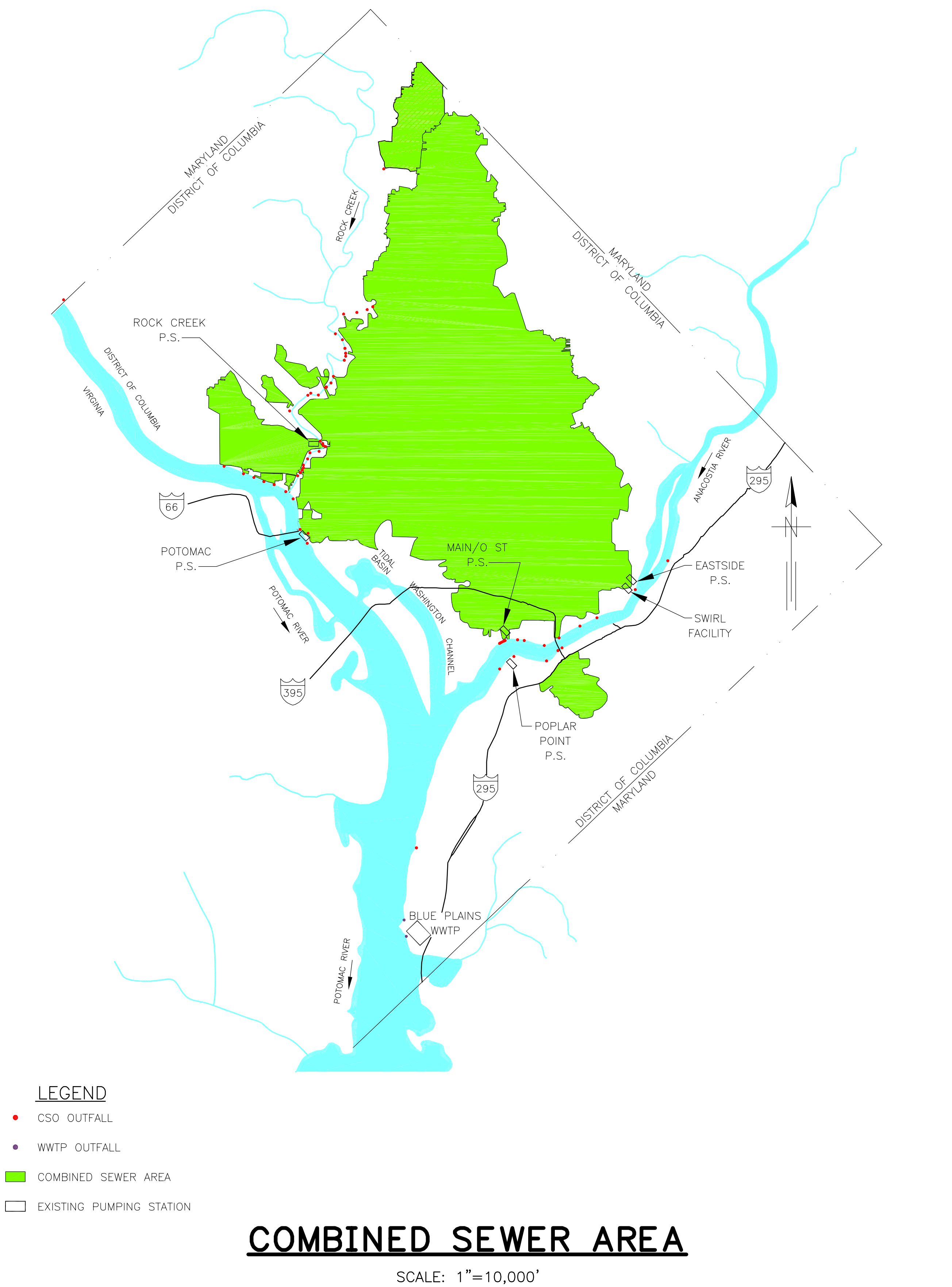
In June 2001, WASA submitted a Draft LTCP to regulatory agencies and the public for review and comment. An extensive public outreach and comment period followed in the summer and autumn of 2001. This report presents the proposed Final LTCP. It has been developed taking into consideration regulatory agency comments, public comments, and additional water quality standard and total maximum daily load (TMDL) requirements.

2. BACKGROUND

Like many older cities in the United States, the sewer system in the District is comprised of both combined sewers and separate sanitary sewers. A combined sewer carries both sewage and runoff from storms. Modern practice is to build separate sewers for sewage and storm water, and no new combined sewers have been built in the District since the early 1900's. Approximately one-third of the District (12,478 acres) is served by combined sewers. The majority of the area served by combined sewers is in the older developed sections of the District. The combined sewer area is shown on Figure ES-1.

In the combined sewer system, sewage from homes and businesses during dry weather conditions is conveyed to the District of Columbia Wastewater Treatment Plant at Blue Plains, which is located in the southwestern part of the District on the east bank of the Potomac River. There, the wastewater is treated to remove pollutants before being discharged to the Potomac River. When the capacity of a combined sewer is exceeded during storms, the excess flow, which is a mixture of sewage and storm water runoff, is discharged to the Anacostia and Potomac Rivers, Rock Creek and tributary waters. The excess flow is called Combined Sewer Overflow (CSO). There are a total of 60 CSO outfalls in the combined sewer system listed in the National Pollutant Discharge Elimination System (NPDES) Permit issued by the Environmental Protection Agency (EPA) to WASA.

Discharges of CSOs can adversely impact the quality of the receiving waters. The primary purpose of the LTCP is to control CSOs such that water quality standards are met. In the District of Columbia water quality standards, the designated use of the Anacostia River, Potomac River and Rock Creek is Class A or suitable for primary contact recreation. Because the water quality in the receiving waters currently does not meet these standards much of the time, the actual use of the water body is Class B or suitable for secondary contact recreation and aquatic enjoyment. In recognition of



COMBINED SEWER AREA

SCALE: 1"=10,000'

EPMC-III
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D.C. WATER AND SEWER AUTHORITY
CSS LONG TERM CONTROL PLAN

FILE: J:\1160\DWGS\LTCP\FINAL-LTCP\EXFFES-1 1:1 07/01/02 10:04 GH-G this condition, District law prohibits primary contact recreation such as swimming in each of the receiving waters.

Information collected to develop the LTCP demonstrates that water quality is affected by many sources other than CSOs, including storm water, upstream sources outside of the District, and in the Anacostia River by the sediments in the bottom of the river. While the LTCP is only required to address CSOs, WASA has considered these other sources to identify the impact of CSOs as compared to other sources of pollution. This will assist in developing a watershed-based approach to improving water quality beyond the CSO control described in the LTCP.

3. EXISTING CONDITIONS

In order to assess the impact of CSO control on receiving water quality, computer models of the combined sewer system, separate storm water system and of Rock Creek were developed. In addition, existing computer models of the Anacostia River and the Potomac River were adapted for use in the study. The computer models were calibrated based on historical data and on 9 to 12 months of monitoring data collected in the receiving waters, the combined sewer system, CSOs and in the separate storm water system.

In accordance with EPA guidelines, CSO planning was based on “average year” conditions. The rainfall in the period 1988-1990 was selected as representative of average conditions based on review of 50 years of rainfall data at Ronald Reagan National Airport. The representative three-year period contains a relatively wet year, a dry year and an average year. Average year conditions are defined as the arithmetic average of the predictions for years 1988, 1989 and 1990. In the process of developing the Final LTCP, other rainfall conditions such as the 1-year and 5-year design storms were also investigated.

Using the combined sewer system model, CSO overflow volumes and frequencies were predicted for existing conditions in the average year. The predicted CSO overflow volumes for the average year conditions are shown on Table ES-1.

Table ES-1
Existing Conditions: Annual CSO Overflow Predictions for Average Year

Item	*Anacostia River*	*Potomac River*	*Rock Creek*	*Total System*
CSO Overflow Volume (million gallons/yr)				
No Phase I Controls (prior to 1991)	2,142	1,063	49	3,254
With Phase I Controls (after 1991)	1,485	953	52	2,490
Number of Overflows/yr				
No Phase I Controls (prior to 1991)	82	74	30	-
With Phase I Controls (after 1991)	75	74	30	-

The Phase I CSO controls consist of in-system storage devices called inflatable dams and a CSO treatment system called the Northeast Boundary Swirl Facility. These controls were completed in 1991. As of the writing of this report, certain inflatable dams are not functional and are in the process of being replaced.

Using the predicted pollutant loads from the combined sewer system, separate storm water system and the upstream boundary, the water quality in each receiving water was predicted for average year conditions. The following summarizes the characteristics of each receiving water:

Anacostia River - The Anacostia River is a relatively stagnant water body with a long residence time that is significantly affected by the tide. Both dissolved oxygen and bacteria concentrations are problems. Low dissolved oxygen levels typically occur in the summer months of June to August and typically follow a significant local or upstream wet weather event. The low dissolved oxygen is driven by the naturally low saturation level of oxygen in the water due to the high water temperature and the influx of pollutant loads from wet weather events. The sluggish nature of the river does not allow effective re-aeration, contributing to the low dissolved oxygen. In addition to direct loads of oxygen consuming pollutants from CSO, storm water, and the upstream boundary, the sediments in the Anacostia River are known to exert a substantial oxygen demand. Dissolved oxygen levels below 2.0 mg/L can occur several times per summer month, with each episode lasting 1 to 2 days. Fish kills have been observed in the past under these conditions. Bacteria concentrations (fecal coliform) are relatively high and are predicted to exceed the Class A monthly standard for the majority of the average year. In addition to CSO, bacterial pollution from storm water and the upstream boundary are significant.

Rock Creek - Rock Creek is a free-flowing stream that is unaffected by the tide for the majority of its length. The stream is naturally aerated by turbulence as it flows over the irregular bottom of the creek bed. There is no evidence of low dissolved oxygen problems in Rock Creek and bacteriological concentrations are the primary concern. Bacteria (fecal coliform) concentrations in Rock Creek are predicted to be above the Class A monthly standard every month in the average year under existing conditions. The majority of the load comes from storm water and upstream sources. The volume of water in Rock Creek in any particular reach is relatively small. As a result, it is not able to absorb significant wet weather loads without causing relatively high bacteria concentrations in the creek. The free-flowing nature of the creek causes relatively short residence time of wet weather pollution.

Potomac River - The water quality of the Potomac River is much better than that in the Anacostia River or Rock Creek. This is due both to the low pollutant loads and the size and assimilative capacity of the river. In the upstream reaches of the river from the Memorial Bridge to Georgetown, the Class A bacteria standard is only predicted to be exceeded one month out of the year by a relatively small amount. Downstream of the Memorial Bridge, no exceedances are predicted on a monthly basis. Low oxygen is not a significant problem in the Potomac River.

4. ALTERNATIVES EVALUATION

A wide range of technologies was considered to control CSOs. The technologies are grouped into the following general categories:

- Source Controls– such as public education, a higher level of street sweeping, additional construction site controls, more frequent catch basin cleaning, garbage disposal bans and combined sewer flushing;
- Inflow Controls – such as Low Impact Development-Retrofit, rooftop greening, storm water treatment, street storage of storm water, rain leader disconnections, extending storm sewers to receiving waters;
- Sewer System Optimization - such as real time control, storing combined sewage in existing sewers, revision to facility operations;
- Sewer Separation – such as partial or complete separation;
- Storage Technologies – such as retention basins and tunnels;
- Treatment Technologies - such as screening, sedimentation, high rate physical chemical treatment, swirl concentrators and disinfection;
- Receiving Water Improvement – such as aeration and flow augmentation

Each technology was evaluated for its ability to reduce CSO volume and the pollutants in CSO. After the initial screening, groups of technologies were assembled into control plans for each receiving water. The alternatives were evaluated against the following criteria:

- Regulatory Compliance – Ability to meet the EPA CSO Policy which is now part of the Clean Water Act, D.C. Water Quality Standards, WASA's National Pollutant Discharge Elimination System (NPDES) Permit and the total maximum daily load (TMDL) allocations for the Anacostia River for dissolved oxygen (biochemical oxygen demand or BOD) and water clarity (total suspended solids or TSS).
- Cost effectiveness – Ability to achieve the greatest benefit at the lowest reasonable cost.
- Northeast Boundary Flooding – Ability to relieve street flooding and basement sewer back-ups from the combined sewer system in the Northeast Boundary area.
- Non-monetary factors – Implementability, operational complexity, ability to upgrade and other non-monetary factors.
- Public Acceptance – Responsiveness to public comments.

In accordance with EPA guidelines, each alternative was configured and evaluated to reduce CSO overflows to between zero and 12 events per average year. Note that control plans which achieve zero overflows for all storms in the 1988-1990 analysis period would not eliminate overflows under all conditions. Rainfall conditions more severe than those represented in the three-year analysis period will occur and can cause CSO events. For that reason, complete sewer separation that would achieve zero CSO overflows under all conditions was also evaluated. In response to public comments, control plans were also developed for various return frequency design storms such as the 1-year, 2-year and 5-year storms. Costs, CSO overflow volume reductions, and benefits to receiving waters were evaluated for each level of CSO control.

5. PUBLIC PARTICIPATION

WASA conducted an extensive public participation program designed to educate the affected public and to obtain their input and consultation in selecting the long term CSO controls. The public participation process included public meetings, establishment of a Stakeholder Advisory Panel, and an elaborate public information process. Four public meetings have been held to educate the public and to obtain feedback about CSO issues. At the request of the public during the first public meeting, a Stakeholder Advisory Panel was formed. The panel consisted of representatives from government agencies, regulatory agencies, citizens' groups, and environmental advocacy groups that are concerned about water quality issues within the District. Twelve Panel meetings were held during development of the LTCP.

In addition, the public outreach program included educational mailers in water and sewer bills, establishment of a CSO website, creation of a CSO mailing list, informational CSO newsletters, and establishment of public information depositories.

After release of the Draft LTCP, nine neighborhood meeting were held throughout the District to explain the program and obtain public comments. The D.C. Council and WASA held public hearings on the plan. Informational mailers, WASA's website and presentations to interested groups were also used to obtain input on plan. The Draft LTCP was well publicized and members of the public provided thoughtful comments. Over 2,300 comments were received on the Draft LTCP.

6. RECOMMENDED PLAN

WASA is committed to improving the quality of the Anacostia River, Rock Creek, and the Potomac River. The recommended LTCP has been selected to provide a significant improvement in the quality of each receiving water while balancing the affordability to ratepayers. The recommended LTCP consists of many elements and program components. Table ES-2 lists the components by receiving water. Figure ES-2 shows the location of the principal elements.

Table ES-2

Recommended Control Program Elements and Estimated Costs

Component	*Capital Cost Opinion (Millions, ENR=6383)*	*Annual Operation and Maintenance (Millions, ENR=6383)*
System Wide		
Low Impact Development – Retrofit (LID-R)– Advocate implementation of LID-R throughout entire District. Provide technical and regulatory assistance to District Government. Implement LID-R projects on WASA facilities where feasible.	$3	$0.11
Anacostia River		
Rehabilitate Pumping Stations – Rehabilitate existing pumping stations as follows: • Interim improvements at Main and 'O' Street Pumping Stations necessary for reliable operation until rehabilitation of stations is performed. • Rehabilitate Main Pumping Station to 240 mgd firm sanitary capacity. Screening facilities for firm sanitary pumping capacity only. • Rehabilitate Eastside and 'O' Street Pumping stations to 45 mgd firm sanitary capacity • Interim improvements at existing Poplar Point Pumping Station necessary for reliable operation until replacement pumping station is constructed as part of storage tunnel	$115	$0[1]
Storage Tunnel from Poplar Point to Northeast Boundary Outfall – 49 million gallon storage tunnel between Poplar Point and Northeast Boundary. Tunnel will intercept CSOs 009 through 019 on the west side of the Anacostia. Project includes new tunnel dewatering pump station and low lift pumping station at Poplar Point.	$332	$7.98
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. Abandon Northeast Boundary Swirl Facility upon completion of main tunnel.	$452	
Outfall Consolidation – Consolidate the following CSOs in the Anacostia Marina area: CSO 016, 017 and 018	$27	$0[1]
Separate CSO 006 – Separate this CSO in the Fort Stanton Drainage Area	$3	$0.01
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.	$11	$0.04
Anacostia Subtotal	**$940**	**$8.03**
Rock Creek		
Separate Luzon Valley – Completed in 2002.	Completed	$0
Separation – Separate CSOs 031, 037, 053, and 058.	$5	$0.02
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	$3	$0.01

Component	Capital Cost Opinion (Millions, ENR=6383)	Annual Operation and Maintenance (Millions, ENR=6383)
Storage Tunnel for Piney Branch (CSO 049) – 9.5 million gallon storage tunnel	$42	$0.60
Rock Creek Subtotal	**$50**	**$0.63**
Potomac River		
Rehabilitate Potomac Pumping Station – Rehabilitate station to firm 460 mgd pumping capacity	$12	$0[1]
Outfall Consolidation – Consolidate CSOs 023 through 028 in the Georgetown Waterfront Area.	$20	$0[1]
Potomac Storage Tunnel – 58 million gallon storage tunnel from Georgetown to Potomac Pumping Station. Includes tunnel dewatering pumping station.	$218	$2.78
Potomac River Subtotal	**$250**	**$2.78**
Blue Plains Wastewater Treatment Plant		
Excess Flow Treatment Improvements – Four new primary clarifiers, improvements to excess flow treatment control and operations	$22	$1.81
Grand Total	**$1,265**	**$13.36**

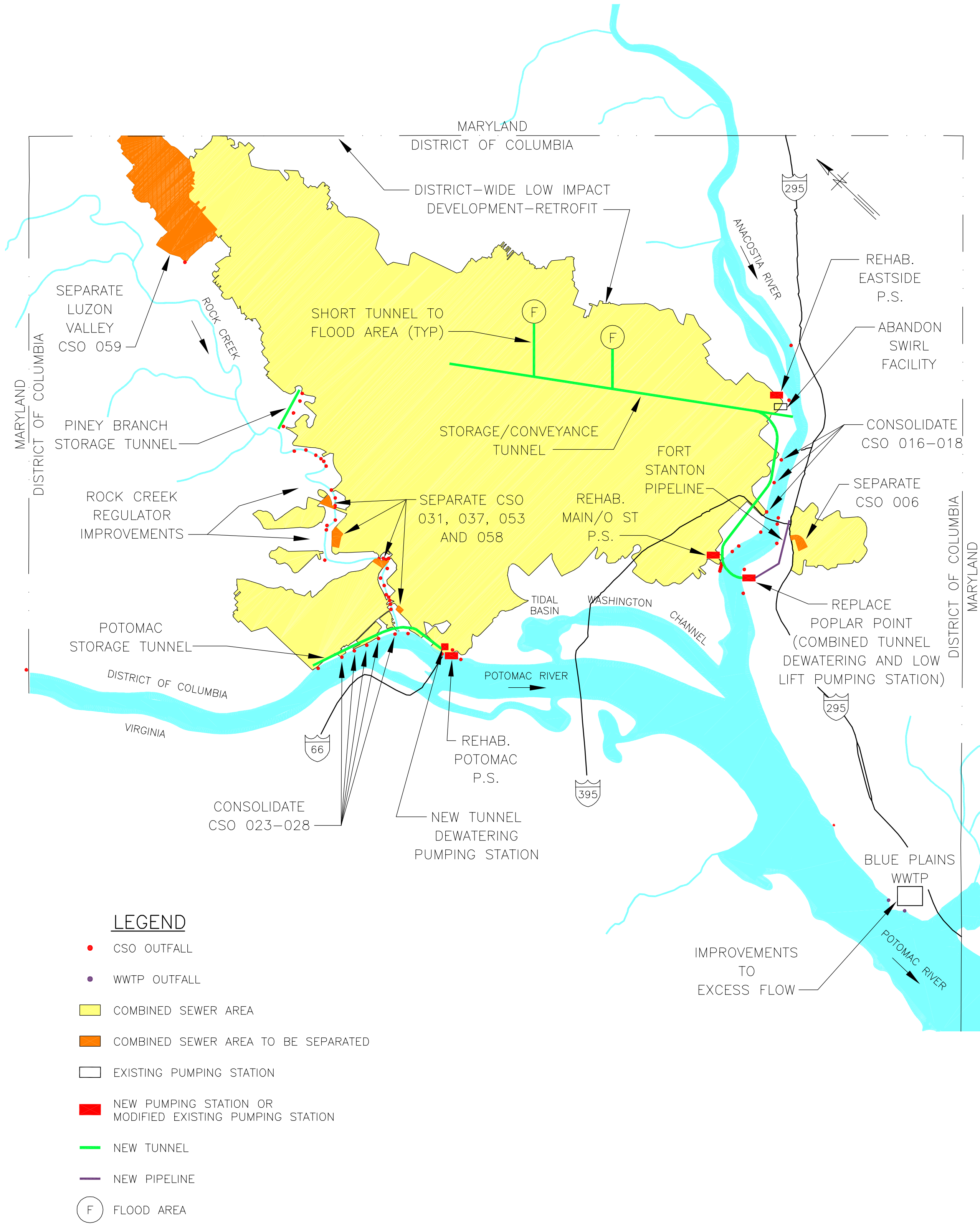
Notes:
1. No significant change from existing.

The principal components of the control program are described below, while detailed recommendations are included in Section 13 of this report.

System Wide Controls - WASA recommends the implementation of Low Impact Development Retrofit (LID-R) in the District. In addition to reducing CSOs, LID-R also has ancillary benefits such as reducing storm water volume and pollutant concentrations, reducing cooling costs and increasing aesthetic value. Reduction of storm water pollution is a part of the District's storm water management efforts as part of its Municipal Separate Storm Sewer (MS4) Permit. Since WASA does not control development or redevelopment in the District, WASA cannot mandate application of LID-R. WASA will, however, incorporate LID-R techniques into new construction or reconstruction on WASA facilities where applicable, and will act as an advocate for LID-R in the District. In addition, WASA recommends that the District Government develop and adopt the necessary laws and regulations to enable implementation of LID-R. Detailed recommendations are included in Section 13 of this report.

In addition to these, WASA looks forward to participating in a partnership with others to investigate the feasibility of apply LID-R in an urban setting. Possible goals of the partnership would be to demonstrate and evaluate LID-R effectiveness on a sewershed basis, establish design, construction and performance standards, assess costs, and determine practicality. Given the Federal Government's role in the District and its interest is identifying techniques that could be applied elsewhere, a significant Federal participation in such a partnership would be appropriate.

FIGURE ES-2



RECOMMENDED CONTROL PROGRAM

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CSS LONG TERM CONTROL PLAN

WASA would also be willing to participate in a watershed forum or planning group, with a Federal presence, to address pollution in the watershed. The LTCP has identified that storm water is one of the major pollution sources for all of the urban watersheds. Storm water pollution is a common concern of the District, Virginia and Maryland. This could serve as a catalyst to create the forum and to strive for solutions.

Anacostia River Components - The control measures selected for the Anacostia River are predicted to limit overflows to two events per average year. During the three year analysis period (1988-1990), the frequency of overflow ranged from one per year to three per year for dry and wet years, respectively. The controls were selected to make maximum use of existing facilities and to provide supplemental storage via a tunnel to control overflows. Major elements of the controls include the rehabilitation of Main, 'O' Street, and Eastside pumping stations, separation of a CSO on the east side of the Anacostia River, construction of a storage/conveyance tunnel from Poplar Point to Northeast Boundary and construction of a pipeline from Fort Stanton to Poplar Point to address the remaining CSOs on the east side of the Anacostia. An additional leg of the tunnel will be constructed parallel to the Northeast Boundary Sewer and to several low lying areas to provide additional storage for CSO and to relieve street and basement flooding in the Northeast Boundary area. The existing Poplar Point Pumping Station will be replaced by a new facility located at the end of the tunnel that both dewaters the tunnel and replaces the function of the existing pumping station. In addition three CSOs on the west side of the River near the marinas will be consolidated to eliminate their impacts to this area of the River. One CSO on the east side of the river will be eliminated by separation. Once the tunnel is operational, the Northeast Boundary Swirl Facility will be abandoned.

Rock Creek Components - The control measures selected for Rock Creek are predicted to limit Piney Branch overflows to one per average year. At Piney Branch, the frequency of overflow ranged from zero per year to two per year for dry and wet years, respectively, during the three-year analysis period. The remaining overflows in Rock Creek will be controlled to 4 events per average year. For these overflows, the frequency of overflow ranged from one per year to six per year for dry and wet years, respectively, during the three year analysis period. The principal control measures include separation of four CSOs, construction of a storage tunnel at Piney Branch, and monitoring and regulator improvements to four CSOs south of Piney Branch.

Potomac River Components - The control measures selected for the Potomac River are predicted to limit overflows to four events per average year. During the three year analysis period, the frequency of overflow ranged from zero per year to five per year for dry and wet years, respectively. The principal control measures include rehabilitation of the Potomac Pumping Station and construction of a storage tunnel from west of the Key Bridge, along the Potomac River waterfront parallel to Georgetown, and terminating at Potomac Pumping Station. The tunnel will intercept the Georgetown CSOs and the large CSOs downstream of Rock Creek. A new pumping station would be constructed at Potomac Pump Station to dewater the tunnel. In addition, the LTCP will consolidate and close all CSOs between the Key Bridge and Rock Creek to remove the impact of these CSOs from the Georgetown waterfront area.

Blue Plains Wastewater Treatment Plant (BPWWTP) Components – BPWWTP has an existing excess flow treatment system designed to provide screening, grit removal, primary treatment, and disinfection to storm flows up to 336 mgd. Improvements to the excess flow treatment train are recommended to improve performance and reliability. These improvements consist of the addition of four new clarifiers and appurtenant weir and control system improvements. In addition, the BPWWTP conducts voluntary denitrification in accordance with the Chesapeake Bay Agreement. The plant uses the existing nitrification reactors to conduct both nitrification and denitrification. Nitrification capacity was reduced to the first four stages of the reactor, to accommodate denitrification in the last stage. This approach to denitrification utilizes one facility for two processes. There are difficulties in conducting denitrification under all conditions of flow, load and temperature. This was shown to be the case when implementation of nitrogen removal was negotiated with regulatory agencies. Experience with the full scale facility has shown that the denitrification process produces poorly settling solids which contribute to solids washouts and blinding of the effluent filters at high flow rates. This is due to attempting to treat high flows during storm events simultaneously with nitrification-denitrification using the same tankage, particularly during cold weather. Based on this experience, it appears that BPWWTP will not be able to reliably denitrify under high flow conditions. Because the Chesapeake Bay Program is considering revised nitrogen limits for the Bay, future NPDES permits may require nitrogen removal at Blue Plains to an effluent concentration as low as 3 mg/L. Chesapeake Bay Program Goals may thus dictate nitrogen removal requirements at the plant, and further measures should be based on the final outcome of the Bay Program. No costs for additional nitrogen removal are included in the LTCP.

The selected CSO control program is expected to greatly reduce the frequency and volume of CSO overflows. Table ES-3 illustrates the reduction in overflows.

Table ES-3
CSO Overflow Reduction of Recommended CSO Plan (Average Year)

Item	*Anacostia River*	*Potomac River*	*Rock Creek*	*Total System*	*% Capture of Combined Sewage per CSO Policy*
CSO Overflow Volume (mg/yr)					
No Phase I Controls	2,142	1,063	49	3,254	76%
With Phase I Controls	1,485	953	52	2,490	82%
Recommended Plan	*54*	*79*	*5*	*138*	*99%*
% Reduction from No Phase I Controls	97.5%	92.5%	89.8%	95.8%	-
Number of Overflows/yr					
No Phase I Controls	82	74	30	-	-
With Phase I Controls	75	74	30	-	-
Recommended Plan	*2*	*4*	*1 / 4*[1]	-	-

Notes: 1. One at Piney Branch, four at the other Rock Creek CSOs.

In addition to demonstrating reductions in overflows from current levels, EPA's CSO Policy calls for calculating the percentage of combined sewage that is captured for treatment in the combined sewer system. The percentage of capture without the Phase I CSO controls is already very high at 76%, primarily due to the ability of BPWWTP to treat high flows during wet weather events. With implementation of the recommended LTCP, the CSO capture rate is predicted to be 99% on a system wide, annual average basis. This is extremely high when compared to EPA's guideline of 85% capture under the presumptive approach as described in Section 2 of this report.

The following are findings regarding the impact of the recommended LTCP on water quality:

- Bacteria conditions are a problem in all three receiving waters. CSO control will significantly reduce the concentrations of bacteria, but will not result in conditions in the river that meet water quality standards all the time because of pollution from storm water and upstream sources. Control of other sources coupled with CSO control is required to meet current water quality standards

- Elimination (by separation) of combined sewer discharges to the receiving waters is not economically feasible for the District and has numerous drawbacks, including the disruption associated with constructing essentially a new sewer system for one-third of the District. The recommended plan is predicted to provide better water quality than separation. This is due to the large amount of storm water that is collected in the combined sewer system and treated prior to discharge. Note that CSO control alternatives which allow zero overflows in the three year analysis period (1988-1990) were also analyzed. These alternatives still allow overflows under more extreme climate conditions not represented in the three year analysis period. These items are discussed in more detail in Sections 8 and 9.

- Significant sources of bacteria are found in storm water runoff and in water entering the District from upstream sources. Cost-effective and reliable technical programs to reduce these pollution sources to the degree required to meet current water quality standards may not be available for the foreseeable future.

- The recommended plan for CSO control will meet the geometric mean bacteria standard in all receiving waters. Initial discussions with the D.C. Department of Health indicate it will also meet the fecal coliform TMDL which is expected to be promulgated for all receiving waters.

- CSO control will improve the dissolved oxygen levels in the Anacostia River. However, CSO control alone will not allow the dissolved oxygen standard to be met and will not prevent the dissolved oxygen from dropping below the level where fish kills are possible. Control of storm water and upstream sources are required to achieve this standard.

- The recommended control plan will virtually eliminate solids and floatables from the combined sewer system because the majority of CSOs will be captured and treated. For storms which are beyond the capacity of the proposed control system, the first flush of CSO which contains the vast majority of solids and floatables will be captured and treated. Overflows from the proposed control system will typically occur near the end of extreme storm events after most of the solids and floatables have been washed from the streets and captured by the control facilities. After implementation of the recommended plan, a large amount of trash may still be present due to sources other than CSO. Control of these other sources in a watershed-based approach is recommended.

7. COMPARISON OF FINAL LTCP TO DRAFT LTCP

The Final LTCP described in this report represents a major increase in CSO control over the Draft LTCP that was released in June 2001. In developing the Final LTCP, consideration was given to public and regulatory agency comments, the CSO Policy, the need to meet D.C. water quality standards, and existing and prospective TMDLs for the receiving waters. Particular attention was paid to separation, outfall elimination, low impact development and increasing the level of CSO control. Major advances in each of these categories have been made. The Final LTCP is compared to the Draft in Table ES-4.

Table ES-4
Comparison of Final and Draft LTCPs

Item	*Draft LTCP*	*Final LTCP*
No. CSO Overflows/Avg. Year		
Anacostia	4	2
Potomac	12	4
Rock Creek at Piney Branch	4	1
Rock Creek – other outfalls	4	4
CSO Overflow Volume (mg/avg yr)		
Anacostia	93	54
Potomac	153	79
Rock Creek	13	5
Total	259	138
% Reduction From Existing	92%	96%
% Reduction on Anacostia	96%	98%
System Characteristics		
CSO Storage Volume (mg)	147	193
No of CSO Outfalls	60	46
Water Quality Criteria		
Meets Oxygen and Bacteria Water Quality Standard for Design Condition?	Yes	Yes
Meets Anacostia BOD and TSS TMDLs?	BOD - Yes TSS - Yes	Yes
Cost		
Capital Cost (Year 2001)	$1.05 Billion	$1.265 Billion
Cost Increase over Draft LTCP	-	20%

8. FINANCIAL IMPACTS

Financing CSO programs in an equitable manner without placing an unreasonable burden on ratepayers is one of the most challenging aspects facing CSO communities. WASA has used the following two methods to document the burden on the District of the proposed LTCP:

- Long-term rate impact analyses using the Authority's financial planning and rates model, and
- Affordability analysis using procedures developed by EPA.

A key indicator of the affordability of the proposed LTCP is the impact on the annual household budgets for District ratepayers as measured by the timing and extent of the required annual rate increases. To document the actual impact on household budgets and to supplement the EPA approach, WASA conducted an analysis of the impacts of the CSO program on wastewater rates.

To finance its current $1.6 billion capital program, annual increases in retail rates of approximately 6.5% to 7.0% through FY 2008 followed by 6% annual increases from FY 2009 through FY 2012 will be required. Over the long-term, WASA is projecting that future necessary infrastructure re-investment will continue to require steady rate increases of about 5% per year. This longer-term outlook is consistent with national infrastructure studies that document the need for doubling of rates over 20 years for infrastructure investment. Under this "baseline" scenario, the annual cost for water and wastewater for a typical residential customer with metered consumption of 100 CCF per year will increase 113% (from $290 to $617) in fifteen years.

Implementation of the LTCP will result in additional rate increases and higher costs to the Authority's customers over and above the increases needed to fund the baseline capital program. Through analysis of a range of LTCP implementation schedules WASA has determined that the only rates impacts that are feasible are those associated with the longest implementation schedules. Table ES-5 displays the impacts for a 100 CCF customer over 15 years for the baseline and for several LTCP implementation schedules.

Table ES -5
Rate Impacts of the CSO LTCP on 100 CCF Residential Customer

	FY 2003 Annual Bill	*Annual Bill in 15 Years*	*Annual Rate Increases Over 15 Years*
Baseline – No LTCP	$290	$617	6.0%
Baseline Plus LTCP – 40 Years	$290	$722	7.2%
Baseline Plus LTCP – 30 Years	$290	$795	8.0%
Baseline Plus LTCP – 20 Years	$290	$942	9.4%
Baseline Plus LTCP – 15 Years	$290	$1,002	9.9%

If WASA implemented the proposed LTCP over a 40-year period, a typical residential customer with annual metered water consumption of 100 CCF will see their annual wastewater costs rise from $290 to $722 in 15-years; a 150% increase.

Shorter LTCP implementation schedules create too high a burden on the Authority's rate payers in terms of rapid escalation of the cost of wastewater services. The 15 and 20-year LTCP implementation schedules would require a large number of consecutive "double-digit" rate increases when the costs of those programs are added to the demands imposed by the baseline investment in water and wastewater infrastructure. As shown in Figure ES-3, the 15-year program is projected to require 8 consecutive increases over 10% per year. Such rate increases would outpace expected growth in household incomes by two to three times, thereby eroding household resources for other items. As shown in Figure ES-4, longer implementation schedules require lower peak rate increases and reduce the number of increases over 10% from 8 consecutive increases to fund the 15-year schedule to a single increase exceeding 10% in the case of the 40-year schedule.

Figure ES -3

Annual Rate Increases Required for 15 and 20-year LTCP Plans

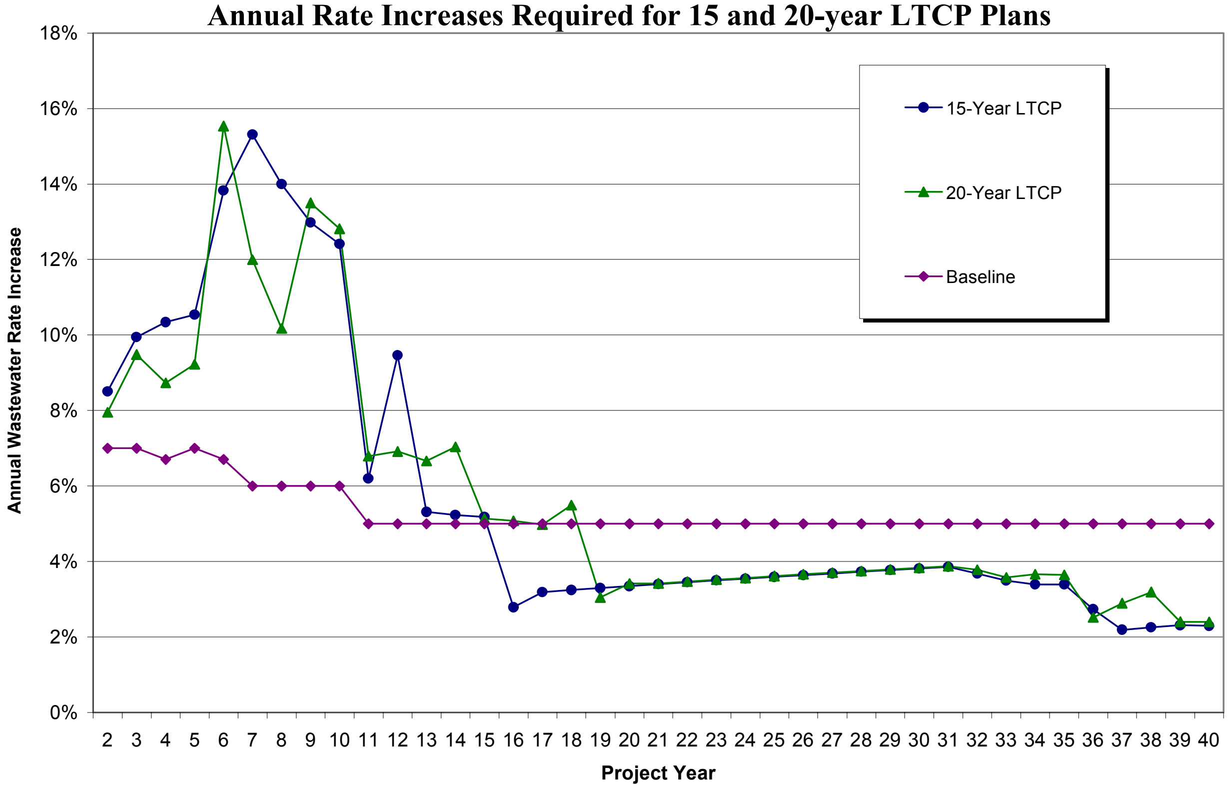
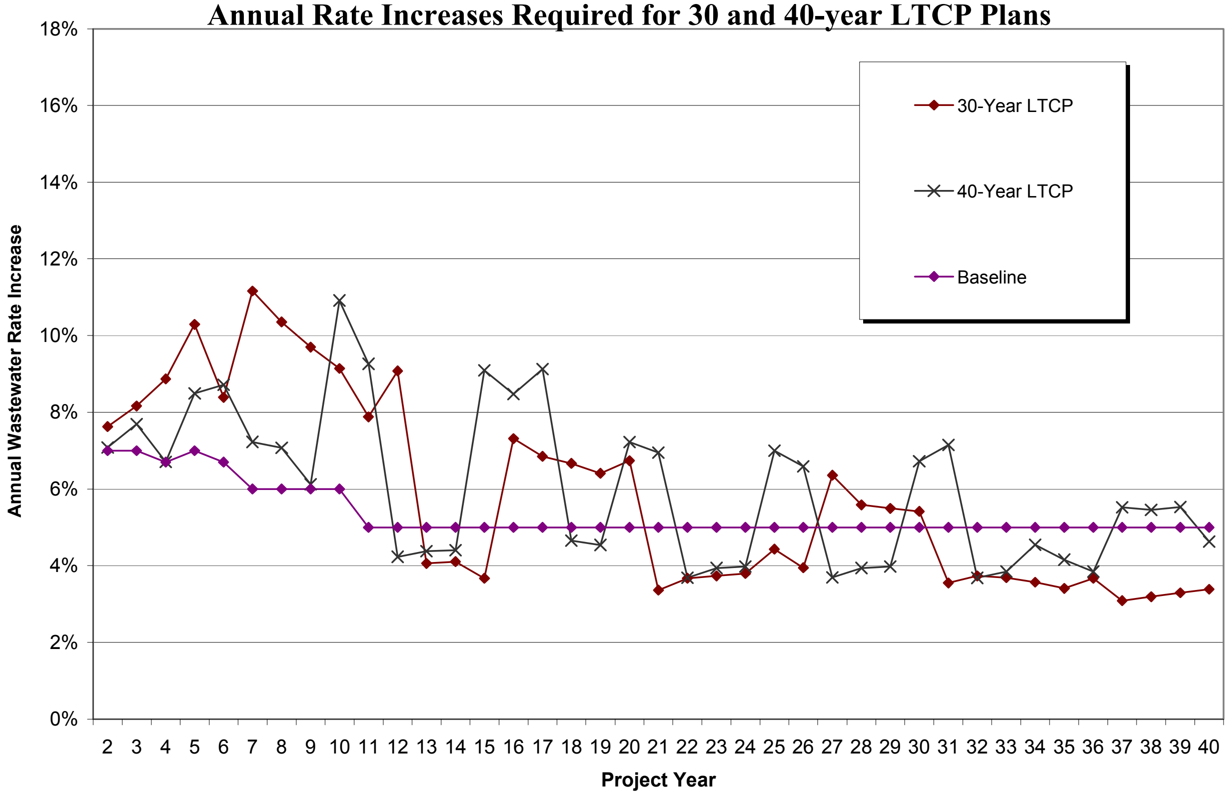


Figure ES- 4

Annual Rate Increases Required for 30 and 40-year LTCP Plans



There are two ways to reduce the rate impacts of a shorter LTCP implementation schedule, external funding assistance and deferral of other water and wastewater capital expenditures. External assistance targeted at limiting peak rate increases can reduce the severe impacts of high annual rate increases associated with the shorter programs. External assistance of approximately 62% of the capital cost of the program can keep rate increases to 8% per year as shown in the following chart. Total external capital assistance under this scenario would be $960 million. It is important for any external assistance to reflect year-of-expenditure values or the actual "cost to complete" the project. If external assistance is determined on current dollars or on an amount per year, the cost to complete and inflation risks are shifted to ratepayers.

The EPA's approach involves calculating the cost per household (CPH) for residential customers for current and proposed wastewater treatment and CSO control costs. The CPH is used in conjunction with the median household income (MHI), estimated at $39,760 per year in 2001, to estimate residential impacts. Residential impacts are considered by EPA to be 'low' if the CPH is less than 1% of the MHI, 'medium' if the CPH is between 1% and 2% of the MHI, and 'high' if the CPH is greater than 2% of the MHI. The CPH is combined with other factors such as unemployment rate, property tax collection rates and other factors to develop an overall assessment of financial burden.

In the District, there is a distinct clustering of household incomes at the lower and upper extremes of the income spectrum. Because of the disproportionate number of low-income households in the District, the impact of wastewater treatment and CSO control costs on the lowest 20% of income distribution in the District was calculated. The analysis was performed for the maximum income in this category, which is $18,000 per year.

Table ES-6 summarizes the results of the analysis. For median incomes, wastewater treatment costs including the proposed CSO controls are projected to impose a medium burden according to EPA guidelines. Current wastewater treatment costs alone impose a medium burden on lower income households. Addition of CSO controls to low income households increases the burden level to EPA's highest level, reaching nearly 3.5% of household income alone for wastewater costs. Various levels of Federal assistance are also listed showing the degree to which they reduce the CPH as a percent of median income.

Table ES-6
Cost Impacts on Residential Customers (Year 2001 Dollars)

Scenario	*Cost Per Household for Wastewater Treatment ($/yr)*	*Cost Per Household as % of Income*	
		Median Incomes	*Upper end of Lower 24% of Incomes ($18,000/yr Income)*
Current Residential Bill (April 2001)	$271	0.8%	1.5 %
After Completion of Current Capital Improvement Program, but no additional CSO controls[1]	$329	0.83%	1.83%
Current Capital Improvement Program Plus Additional Recommended CSO Controls:			
0% Assistance	$602	1.51%	3.35%
25% Assistance	$539	1.36%	3.00%
75% Assistance	$413	1.04%	2.30%

Notes: 1. Includes cost of rehabilitation of Main, 'O' Street, Eastside and Poplar Point Pumping Stations.

9. SCHEDULE

In accordance with public comments, the schedule for implementing the recommended control plan was developed by giving priority to projects that benefit the Anacostia River. The projects in the LTCP can be divided into two categories: those in the existing Capital Improvement Program (CIP) and those not currently in the CIP. Projects in the CIP have been budgeted and scheduled and these projects will move forward without approval of the LTCP. For projects not currently in the CIP, an implementation schedule has been developed based on years after approval of the LTCP. Based on the financial capability assessment and in order to mitigate the annual rate increases that would be required to fund the full LTCP, a 40-year implementation time is proposed for the entire recommended plan if no outside financial assistance is received. If significant outside financial assistance is obtained, it is technically feasible to accelerate the schedule to a 15-year implementation time frame. Significant outside assistance on the order of 62% would be required to achieve this schedule.

10. WATER QUALITY STANDARDS REVIEW

The current water quality standards for the District of Columbia do not address the transient nature of wet weather events. The standards also include a narrative component, which, among other items, require that discharges be free of untreated sewage. Given the current standards, no alternative short of complete separation can completely eliminate overflows (and thereby comply with current standards) during all conditions. The analyses conducted as part of the LTCP have shown that complete separation is not economically feasible, has numerous technical drawbacks, and is less beneficial in terms of water quality than the recommended control program. As a result, WASA has selected a LTCP that offers an effective combination of costs, benefits and environmental protection. However, although greatly reduced, CSO discharges will continue to occur under the LTCP and water quality provisions will need to be adopted that address wet weather discharges from the combined sewer system.

Studies conducted as part of the LTCP have demonstrated that pollution sources other than CSOs (storm water, upstream sources, non point sources) cause substantial impairment to the receiving waters. These sources will have to be significantly reduced to reach the equivalent degree of protection that can be achieved by the LTCP. Cost-effective and reliable technical programs to effectively reduce the impact of the other pollution sources may not be available for the foreseeable future. Besides the technical uncertainties of reduction of the other pollution sources, a significant component of these sources originate in political jurisdictions outside the District. Given the history and experience of dealing with diverse pollution sources and other political jurisdictions, the results of future efforts to control these sources cannot be predicted with any degree of certainty. The CSO studies have shown that the benefits of the LTCP are reliable and implementable. As WASA and the District develop provisions to implement the LTCP, consideration should be given to formation of a watershed based forum to reduce the other pollution sources.

In view of the complex and technically difficult situation regarding control of diverse and undocumented pollution sources, consistent "fishable and swimmable" water quality conditions for District waters receiving CSO discharges may not be achievable, particularly during wet weather. In any case, the recommended LTCP would provide the foundation to work towards "fishable-swimmable" conditions. To such an end, the recommended LTCP would accomplish the following:

- A situation whereby the remaining CSO discharges would not negatively affect achieving the "fishable" component of the "fishable-swimmable" use designation. In this regard, fishing could be practiced whether or not a CSO discharge was occurring.
- A situation wherein the remaining CSO discharges would preclude achieving full body contact a small percentage of the time. However, there would be few occurrences throughout the warm weather recreational period when the public might occasionally be precluded from full body contact by CSO discharges.

Given the magnitude of the investment proposed for CSO control, WASA has a responsibility to protect the investment in the LTCP and to seek wet weather discharge provisions in the water quality standards prior to implementation. Implementing the LTCP without such provisions would expose rate payers to significant economic risk since the control plan would not technically meet water quality standards and would be subject to challenge. A framework for such provisions in the standards could be as follows:

- Provide for the limited discharges as included in the LTCP to continue. The designated use would be restricted during times of discharge and for a limited time thereafter.

- Develop compliance requirements based on the physical elements of the control plan (e.g. capacity to store a set volume or to convey CSO at a set rate).
- Exclude those wet weather events over and above the capacity of those facilities included in the plan.
- Provide for public notification when discharges are occurring and for established times after discharges cease.
- Provide for a post construction-monitoring program to measure instream conditions.

Additional information is presented in Section 14 of this report.

11. POST CONSTRUCTION MONITORING

A program will be required to monitor performance of the final LTCP. This program would commence as usable components of the final LTCP are placed in operation. The monitoring program would comprise elements as follows:

- Flow monitoring and sampling at representative CSO outfalls on each receiving water system.
- Flow monitoring on representative facilities that transfer flow from CSO outfalls to storage and a system to measure the degree to which storage facilities are filled.
- A visual notification system placed at three or four locations on each receiving water at public access locations. This system would serve to notify the public of the occurrence of overflows based on the flow monitoring at the representative CSO outfalls. The system would comprise a series of colored lights, flags or pendents.
- An instream monitoring program would be developed to periodically obtain information on water quality. This program could be structured similar to that employed to obtain information for the LTCP.

Section 1
Introduction

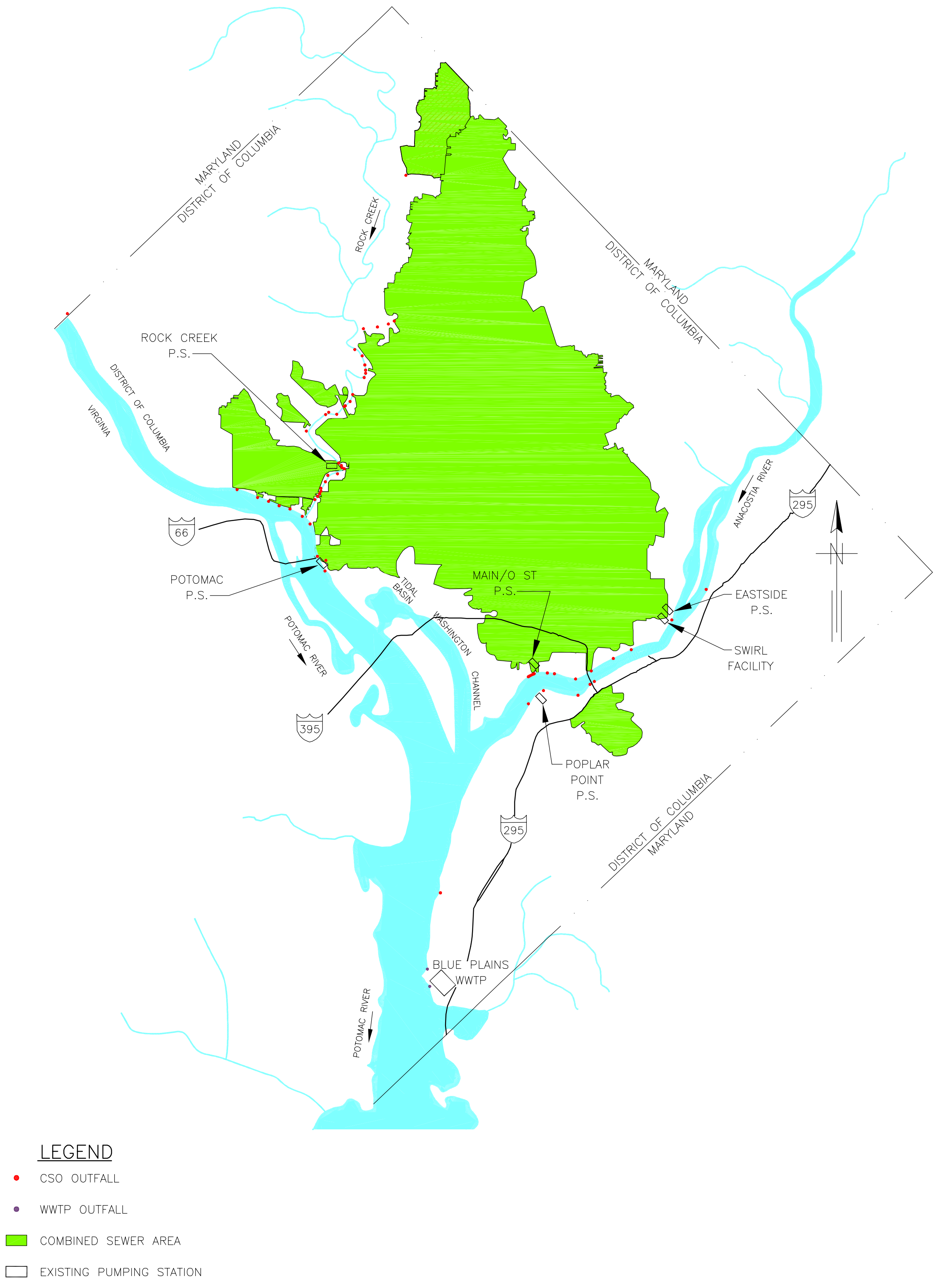
1.1 OVERVIEW AND PURPOSE

The District of Columbia Water and Sewer Authority (WASA or Authority) operates a wastewater collection system comprised of separate and combined sewers. Approximately two-thirds of the District is served by separate systems, which consist of two independent piping systems: one system for "sanitary" wastewater (i.e. sewage from homes and businesses) and one system for storm water. The remaining one-third or approximately 12,478 acres is served by a combined sewer system (CSS), which conveys both storm water and sanitary wastewater in one piping system. The combined sewer service area is located primarily in the older central part of the District. The location of the combined sewer area in the District is shown on Figure 1-1.

During dry weather, sanitary wastewater collected in the CSS is conveyed to the Authority's Blue Plains Advanced Wastewater Treatment Plant (BPWWTP). During periods of heavy rainfall, the capacity of a combined sewer may be exceeded and the excess flow, which is a mixture of storm water and sanitary wastewater, is discharged directly to the Anacostia River, Rock Creek, the Potomac River or their tributary waters. This excess flow is called Combined Sewer Overflow (CSO). Release of this excess flow is necessary to prevent flooding in homes, businesses, and streets. Figure1-2 depicts how a combined sewer system and separate sewer system function.

The occurrence of a CSO event depends on many factors other than the total rainfall amount. These include temporal and spatial rainfall distribution, rainfall intensity, antecedent moisture conditions, and the operations of the control measures in the combined sewer system. Because of this complexity, it is not possible to develop a simple rule relating rainfall volume to the occurrence of an overflow.

There are a total of 60 outfalls listed in WASA's existing National Pollutant Discharge Elimination System (NPDES) Permit. The NPDES permit is issued and administered by the U.S. Environmental Protection Agency (EPA). In addition to other conditions, the permit requires preparation of a Long Term Control Plan (LTCP) for the CSS to reduce the impact of CSO on the water quality of receiving waters. This report has been developed to fulfill this requirement and is the result of a three-year effort by WASA and its team of consultants known as Engineering Program Management Consultant–III (EPMC-III). Key WASA staff members involved in developing the LTCP are noted in the Acknowledgements, as are the participating firms that make up the consulting team.



COMBINED SEWER AREA

SCALE: 1"=10,000'

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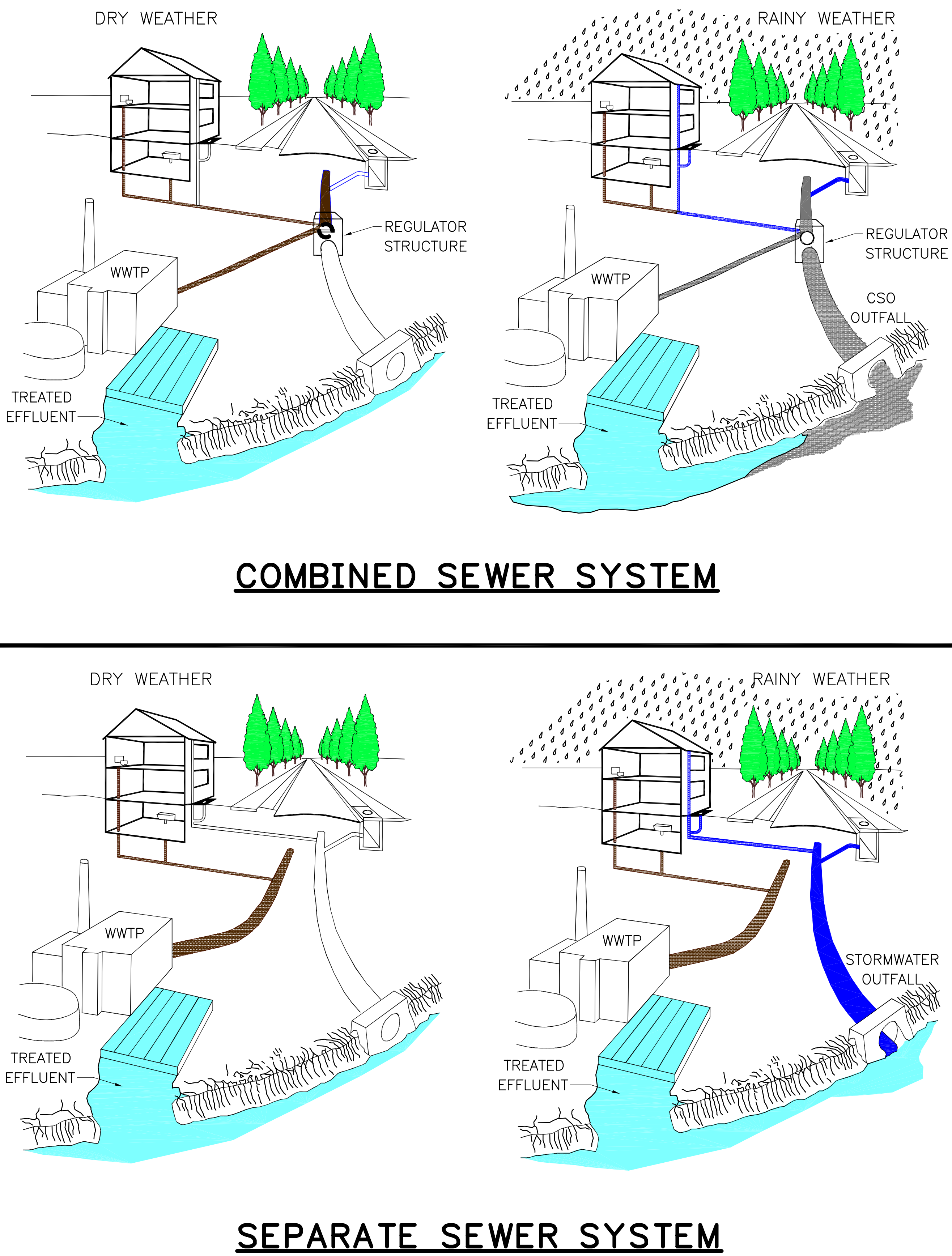
FIGURE 1–2



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1.2 HISTORICAL BACKGROUND

1.2.1 Late 1800's to 1950

Prior to the late 1800's, sewage in the District drained through natural streambeds and natural waterways such as Tiber Creek and Slash Run, which became open sewers. Many of these streams discharged into the Washington City canal that had been built in the early 1800's through the central part of the District for commercial purposes. The canal ran from the Potomac River near 17th Street to the Anacostia River at New Jersey Avenue. Sewage was discharged to the canal at such low elevations that it would not be carried into the river during high tides. The continual accumulation of the foul deposits in the canal caused many nuisance problems. There was also periodic flooding of low-lying areas of the rapidly growing City.

A Board of Public Works initiated underground sewer pipe construction in 1871. This program was taken over by three presidentially-appointed commissioners in 1874 and, from 1878, by the U.S. Army Corps of Engineers. Combined sewers discharged untreated sewage and storm water runoff into rivers and canals with some interceptors built piecemeal to enclose parts of the old canals and move discharge points away from developed downtown areas. In 1890, President Harrison sent Congress an overall engineering plan (much of which was implemented) for new interceptors to carry sanitary and storm water runoff considerably farther from the then-populated areas, to enclose the remaining canals and to pump most of the City's sewage across the Anacostia River for discharge into the Potomac downstream from the developed City. Main Pumping Station was put into service to that end in 1907.

In 1916, Congress authorized the State of Maryland to connect to the District's sewer system. Agreements were subsequently developed between the District and the Washington Suburban Sanitary District (WSSD) to accept wastewater from Montgomery County and Prince George's County. As the population of the District grew and District sewers were extended to serve parts of Maryland, pollution loadings began to exceed the assimilative capacity of the river. In 1938, BPWWTP, providing primary sedimentation processes, was placed in operation. By this time the District sewer system was also carrying sanitary flows from adjacent Prince Georges and Montgomery Counties, primarily from the lower Anacostia Valley, Rock Creek, and the Little Falls area just upstream of the city along the Potomac River.

1.2.2 1950's to 1980's

The rapid population expansion of the city during and after World War II greatly taxed the sewer system. Major studies of the city's combined sewer system were conducted in the mid-1950s, resulting in the preparation of two companion reports documenting the then-current conditions of the system and recommending a major capital program for system development (Metcalf and Eddy 1955, Board of Engineers 1957). The Board of Engineers (consisting of three prominent engineers, Frank A. Marston, Samuel A. Greeley, and Gustav V. Requardt) recommended a plan of new relief interceptors and pumping stations to greatly increase the system's conveyance capacity to the Blue Plains Wastewater Treatment Plant (WWTP). This plan became known as "Project C", and the following key elements were constructed, starting in the early 1960's:

- Relief sewers to parallel existing sewers and provide additional capacity, which included the Upper Potomac Interceptor Relief Sewer, Rock Creek Main Interceptor Relief Sewer, and the East Side Interceptor Relief Sewer.
- Pumping stations to convey wastewater to the BPWWTP, which included the Potomac, "O" Street, and East Side Pumping Stations.
- Force mains to convey flow from the aforementioned pumping stations, which included the Potomac River Force Mains, East Side Force Main, and the Anacostia Force Main and Gravity Sewer.

In 1960, the District adopted a policy to ultimately separate the system over an extended period, extending well past the year 2000. Following this policy, active separation projects were under taken in several smaller drainage areas on the west side of Rock Creek in the early 1960's; however, the difficulty associated with the construction of these projects brought the active program to a halt.

In 1970 and 1973, two engineering planning studies were conducted on the combined sewer system to assess the feasibility of using off-line storage in the form of deep tunnels, mined caverns and surface reservoirs for containment of combined sewer flows (Roy F. Weston 1970, Metcalf and Eddy 1973). This option was studied in the light of adoption of a similar plan for the city of Chicago in its Tunnel and Reservoir Plan (TARP). The first study called for a total storage volume of 1.05 billion gallons throughout the District, sized to hold storm events occurring up to once in 15 years, at a projected cost of $1.1 billion, in 1999 dollars. The second study proposed an alternate storage configuration of 600 million gallons for an overflow frequency of once per year, at a cost of $1.2 billion, in 1999 dollars. Both plans were rejected by the District because of the magnitude of the estimated costs.

1.2.3 1980's to present

Under EPA mandate, and with EPA grant supported funding, the District conducted another facility plan for CSO abatement resulting in a report that was issued in 1983 (O'Brien and Gere 1983). This facility plan was conducted under the then current EPA program guidance for federal grant support, which required the identification and quantification of beneficial uses to be achieved as a result of CSO control measure, and prescribed a marginal cost-benefit analysis for the selection of the abatement measure in which the federal government would participate. A two phase program was developed that focused primarily on overflows to the Anacostia River. Phase I was completed in 1991 and consisted of two main elements. It consisted of a 400 mgd CSO treatment facility called the Northeast Boundary Swirl Facility and the installation of "inflatable dams" at eight of the largest

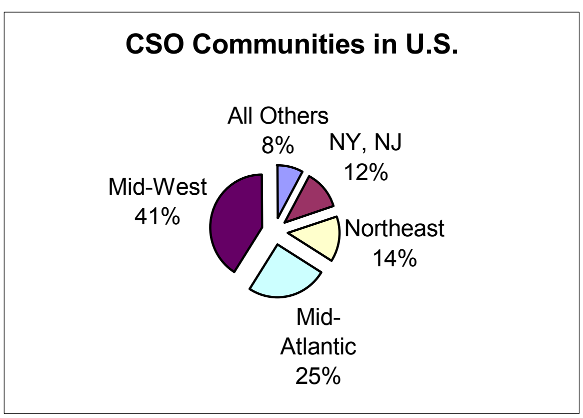
CSOs. The inflatable dams are balloon-like devices installed in existing sewers to store CSO in the sewer to prevent overflows. Both of these technologies were innovative at the time of implementation. Phase II, consisting of two additional swirl concentrator facilities, a sewer separation project, and a screening facility for the Piney Branch drainage area, was never implemented due to lack of funding.

1n 1998, an evaluation of WASA's pumping stations and conveyance system was performed (Delon Hampton & Associates, 1998.). The report recommended rehabilitation of the existing pumping stations to restore capacity. Further improvements were dependent on long term CSO planning.

The sewage system was repeatedly the subject of study, design, and construction decade after decade to expand service to a growing, spreading population and to improve public health and water quality for the Metropolitan Washington area. However, during certain wet weather events, the old 19th century combined sewer portion of the system still overflows into receiving waters. The current LTCP development effort addresses this legacy. Figure 1-3 highlights some of the key milestones in the CSS development.

1.3 NATIONAL PERSPECTIVE

Combined sewers are located in many older U.S. cities. There are currently 899 CSO permit holders with 10,115 CSO outfalls in the United States. The general locations of these systems are shown in the following chart. These CSO systems serve approximately 43 million people (EPA, 2000). Permit holders are at various stages of LTCP development and implementation as shown in the chart. WASA conducted a review of projects completed and underway at other CSO communities to incorporate lessons learned into their LTCP planning process.



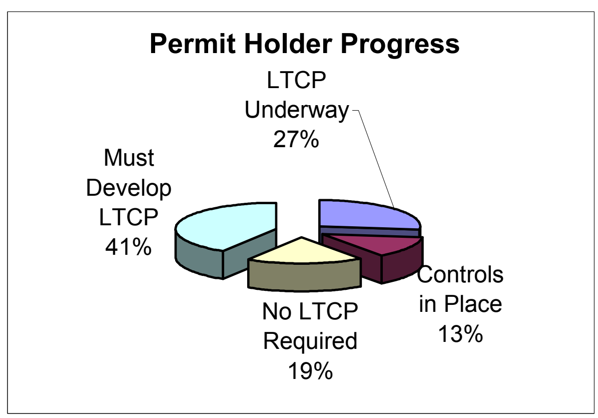
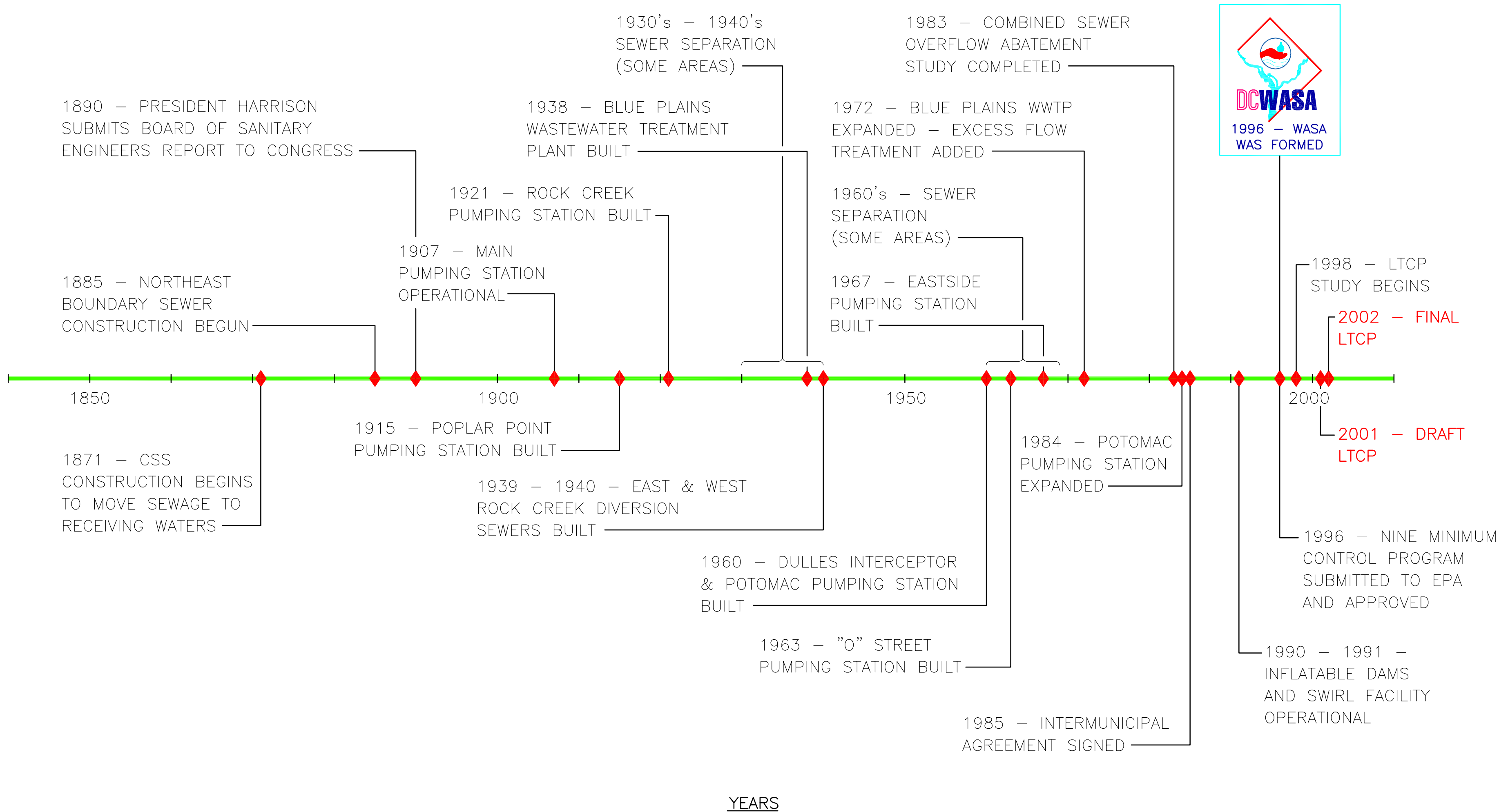


FIGURE 1-3



COMBINED SEWER SYSTEM MILESTONES

NOT TO SCALE

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1.4 EPA SPECIAL PANEL

In 1998, the Environmental Protection Agency convened a "Special Panel on Combined Sewer Overflows and Storm Water Management in the District of Columbia." The Special Panel was chaired by Ms. Rebecca Hanmer, who at that time was the EPA Liaison to the District of Columbia. The Panel comprised representatives from over 25 local, regional, and federal agencies that have an interest in water quality issues in the District of Columbia. The Special Panel issued a report in September 1998 that included a wide range of recommendations generally grouped into the following categories:

- Actions the District of Columbia should take immediately
- Implementation of a watershed approach and cooperation with Maryland
- Federal agency responsibilities
- Public information and participation actions
- Improved assessment and monitoring programs
- Pollution prevention including a "war on trash"
- Financing wet weather pollution prevention and control

WASA has incorporated many of the recommendations of the Special Panel. Most notably, WASA prepared a report titled "Combined Sewer System Nine Minimum Controls Summary Report" (Summary Report) in July 1999, which represented an update of the earlier Nine Minimum Controls Report submitted to the EPA in 1996. The Summary Report provided an update on various activities undertaken by WASA as part of the Nine Minimum Controls (NMC) program and included recommendations for enhancement of several activities associated with this program. An "NMC Action Plan Report" was prepared in February 2000, which detailed a schedule for implementing the recommended enhancements.

WASA has continued to abide by the recommendations of the Special Panel and many of the recommendations of this Long Term Control Plan are directed towards addressing recommendations in the Special Panel Report.

1.5 LTCP – PLANNING APPROACH

In 1994 the EPA issued a national CSO Policy, which requires municipalities to develop a long term plan for controlling CSOs (i.e. a Long Term Control Plan or LTCP). The CSO policy became law with the passage of the Wet Weather Water Quality Act of 2000 in December 2000.

The approach to developing the LTCP is specified in EPA's CSO Control Policy and Guidance Documents, and involves the following elements:

- System Characterization, Monitoring and Modeling

- Public Participation
- Consideration of Sensitive Areas
- Evaluation of Alternatives
- Cost/Performance Consideration
- Operational Plan
- Maximizing Treatment at the Treatment Plant
- Implementation Schedule
- Post Construction Compliance Monitoring Program
- Coordination with State Water Quality Standards

Subsequent sections of the report will discuss each of these elements in more depth.

WASA submitted its LTCP Program Plan to EPA in July 1999. An extensive monitoring program in accordance with an EPA-approved Quality Assurance Project Plan was conducted from August 1999 – June 2000. The data gathered from this monitoring effort was used to develop computer models to evaluate alternatives for mitigating the impact of CSO's on the receiving waters. Study memoranda were prepared throughout the development of the LTCP to present significant data and findings. These memoranda were distributed to regulatory agency for review as they were developed. A list of these documents is included in Appendix A. Review meetings were also held with regulatory agencies during development of the LTCP.

In June 2001, a Draft LTCP was submitted to regulatory agencies and the public. An extensive public outreach program was conducted and many comments on the Draft LTCP were received. WASA has prepared this Final LTCP taking into regulatory agency comments, public comments, and additional water quality standard and total maximum daily load (TMDL) requirements.

Section 2
Existing Conditions

2.1 INTRODUCTION

This section discusses physical features and the framework of regulations that affect the development and selection of the CSS Long Term Control Plan. Physical features that have the greatest impact on the District receiving waters are their watersheds and the regional rainfall patterns. Governing regulations are concerned with water quality and sensitive areas; and establish criteria upon which the LTCP will be selected.

2.2 WATERSHEDS

The USEPA CSO Control Policy emphasizes the importance of the watershed approach in the development of a Long Term Control Plan (LTCP) for CSOs. Of particular importance to CSO control planning and management is the NPDES Watershed Strategy (USEPA, 1994). This strategy outlines national objectives and implementation activities to integrate the NPDES program into the broader watershed protection approach. The major advantage in using a watershed-based approach in LTCP development is that it allows for the site-specific determination of the relative impacts of CSOs and non-CSO sources of pollution on water quality (USEPA, 1995).

There are three principal waterbodies within the District. These are the Potomac River, Anacostia River and Rock Creek. Figure 2-1 shows the watersheds of these waterbodies with drainage areas extending across multiple states and/or jurisdictions. Both the Anacostia River and Rock Creek watersheds include land area in Maryland and the District. The Potomac watershed includes land area in Virginia, West Virginia, Maryland, Pennsylvania and the District. As shown in the Figure 2-1, the Anacostia and Rock Creek are sub-watersheds of the entire Potomac River basin (EPMC-III, 1999c). The District encompasses only a small portion of each watershed. General information about each of the three watersheds including physical characteristics and pollution sources is summarized in Table 2-1 below.

Table 2-1
Watershed Characteristics

Characteristic	*Anacostia River*	*Potomac River*	*Rock Creek*
Population	Population – Slightly over 761,000	Population – the majority exist along the river in the Washington Metropolitan area	Population – slightly over 408,000
Land Use	Land Use – Primarily residential, agricultural and commercial/industrial	Land Use – Primarily agricultural and forest land	Land Use – Primarily residential, agricultural and commercial/industrial
Topography	Generally flat within the District, flat and rolling hills upstream of the District	Upper Watershed – steep mountainous terrain Lower Watershed – rolling hills and flat within the District	Generally moderate grades within the District, rolling hills upstream of the District

Table 2-1
Watershed Characteristics

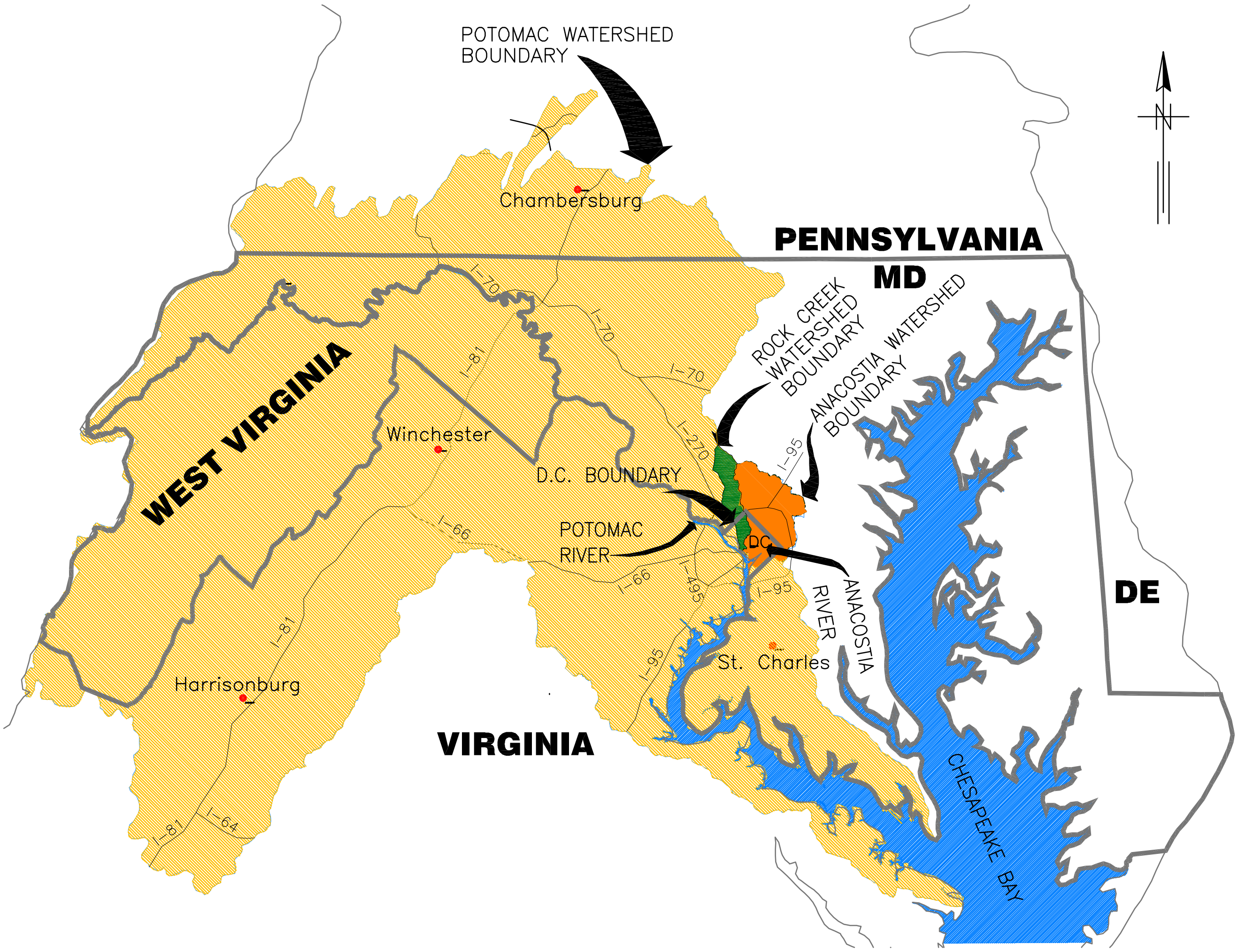
Characteristic	*Anacostia River*	*Potomac River*	*Rock Creek*
Geology	Piedmont and Coastal Plain	Upper Basin – sedimentary rocks Middle Basin – crystalline rocks Lower Basin – unconsolidated deposits	Mostly Piedmont Physiographic Province
Hydrology	Drainage Area – 176 sq. mi. Annual Average Flow - 139 cfs	Drainage Area – 14,670 sq. mi. Annual Average Flow - 10,790 cfs	Drainage Area – 76.5 sq. mi Annual Average Flow – 63.7 cfs
Wetlands Area	3%	1.1%	1.7%
Pollution Sources	Municipal Treatment Plants Industrial Plants Mining Operations Agricultural Runoff Combined Sewer Overflow Storm Water Runoff	Municipal Treatment Plants Industrial Plants Mining Operations Agricultural Runoff Combined Sewer Overflow Storm Water Runoff	Municipal Treatment Plants Agricultural Runoff Combined Sewer Overflow Storm Water Runoff
Portion of Watershed Area within The District	17%	0.5%	20%
Average Flow Rate	139.4 cfs (90.1 mgd)	10,790 cfs (6,975 mgd)	63.7 cfs (41.2 mgd)
Gauging Location	Sum of the following three gauges: Northeast Branch, Northwest Branch and Watts Branch	Near Washington D.C. upstream of Little Falls Branch	Sherrill Drive
Period of Record	1938-1998	1930-1998	1929-1999

Each water body has unique flow characteristics and can be characterized as follows:

- Anacostia River – the entire main stem of the Anacostia River within the District is tidal and often sluggish. During low flow conditions, the residence time of water in the river can be as long as 100 to 110 days. The average tidal range is about three feet.
- Rock Creek - Rock Creek is a free flowing stream for the majority of its length, except for the last quarter mile, which is affected by the tide. The creek is relatively shallow and fast moving. It is also turbulent due to the irregular bottom of the creek bed.
- Potomac River – the Potomac River is much larger that the Anacostia or Rock Creek. The river has substantial flow rates and the water is generally of better quality that the Anacostia or Rock Creek. The fall line separating the riverine and estuarine sections of the Potomac is located just above Chain Bridge and the District. The Potomac is tidal as it passes through the District and the average tidal range is about three feet in the District.

2.3 RAINFALL CONDITIONS

EPA's CSO Control Policy (1994) requires the effectiveness of CSO controls to be evaluated on a "system-wide, annual average basis." Identification of annual average rainfall conditions is thus a fundamental step in the LTCP process. Once selected, the average rainfall conditions become the



LEGEND

POTOMAC WATERSHED

ROCK CREEK WATERSHED

ANACOSTIA WATERSHED

POTOMAC, ANACOSTIA AND ROCK CREEK WATERSHEDS

NOT TO SCALE

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CSS LONG TERM CONTROL PLAN

basis for modeling the sewer system and receiving waters to evaluate the occurrence of CSOs, their impact on receiving waters, and the efficacy of CSO controls.

Table 2-2 summarizes historical and annual average rainfall conditions within the District. Over the 50-year period of record, the years 1988 – 1990 were selected as a combination of years that best represents system-wide, annual average rainfall conditions in the District. The years chosen represent a fairly conservative approach, since they are equivalent to the 68th percentile year in terms of rainfall. The rainfall statistics for these three years are presented in Table 2-2 (EPMC-III, 1999d).

Table 2-2

Annual Average Rainfall Conditions in the District

Statistic	*1988*	*1989*	*1990*	*Average of 1988-1990*	*Long Term Average*[1]
Annual Rainfall (inches)	31.74	50.32	40.84	40.97	38.95
No. Events > 0.05 inches[2]	61	79	74	71	74
Average Storm Duration (Hours)[2]	9.6	11.2	9.6	10.1	9.9
Average Maximum Intensity (in/hr)	0.15	0.18	0.15	0.16	0.15
Maximum Intensity (in/hr)	1.32	1.31	1.25	1.29	1.30
Percentile[3]	14th	90th	68th	68th	

Notes:
1. Ronald Reagan National Airport hourly data, 1949-1998
2. Individual events separated by a minimum of 6 hours with no rain. A threshold of 0.05" was selected since rainfall less than this produces minimal, if any, runoff.
3. Percentile is based on total annual rainfall.

2.4 REGULATORY REQUIREMENTS

Regulatory requirements affect the development of WASA's Long Term Control Plan (LTCP) to control discharges from its Combined Sewer System (CSS). The applicable regulations are listed and their effect on LTCP development is described below (EPMC-III, 2001a).

2.4.1 DC Water Quality Standards (WQS)

- **Current Water Quality Standards**

  The three major waterways in the District are assigned current use classifications, designated use classifications and associated WQS by the District of Columbia Department of Health (DOH). The designated uses, current classification and water quality standards of the District receiving waters are shown in Tables 2-3 and 2-4 (DC Register, 2000). In addition to numeric standards the WQS also include narrative language that require Class A waters be free from discharges of untreated sewage and litter, and surface waters to be free from substances discharged in amounts that cause injury to, are toxic to, or produce adverse physiological or behavioral changes in humans, plants and animals. The LTCP must address the differences between current and designated receiving water uses and water quality standards for each of the three District waters.

Table 2-3
Receiving Water Use Classifications

Receiving Water	*Current use*	*Designated Use*
Anacostia River	B, C, D, E	A, B, C, D, E
Potomac River	B, C, D, E	A, B, C, D, E
Rock Creek	B, C, D, E	A, B, C, D, E

Use Classes
A – Primary contact recreation
B – Secondary contact recreation and aesthetic enjoyment
C – Protection and propagation of fish, shellfish and wildlife
D – Protection of human health related to consumption of fish and shellfish
E – Navigation

Table 2-4
D.C. Water Quality Standards (DC Register, 2000)

Constituent	*Criteria for Classes*		
	A	*B*	*C*
Bacteriological (Number/100 ml)			
Fecal coliform	200	1000	
(maximum, 30 day geometric mean for 5 samples)			
Physical			
Dissolved oxygen (mg/L)			
Minimum daily average			
(3 samples per 24 hrs, once per 8 hrs)			5.0
One hour minimum			
March through June			5.0
July through February			4.0
Temperature (Celsius)			
Maximum			32.2
Maximum change above ambient			2.8
PH			
Greater than	6.0	6.0	6.0
and less than	8.5	8.5	8.5
Turbidity			
increase above ambient (NTU)	20	20	20
Total dissolved gases (maximum % saturation)			110
Hydrogen Sulfide (maximum ug/L)			2.0
Oil & Grease (mg/L)			10.0

- **Possible Water Quality Standards Modifications**

  In EPA's May 2000 draft guidance on implementing WQS, the EPA recommended moving from a fecal coliform standard to an e. coli and enterococci standard for Class A fresh and marine waters, respectively. The recommended WQS for e. coli is a geometric mean of equal to or less than 126 MPN/100 ml for Class A waters. The recommended standard for Class B is 5 times the geometric mean of the Class A standard or 630 MPN/100 ml. EPA also recommended single sample maximums which can range from 235 MPN/100 for designated beach areas to 576 MPN/100 for infrequently used full body contact recreation. Thus far, 12 of the 34 states with CSO-impacted waters have adopted the new standards. The DOH is aware of this new criteria and plans to consider the adoption of the new bacteria standard in its WQS at its next triennial review scheduled for late 2002 or early 2003. Therefore, e-coli concentrations have been monitored and modeled as part of the LTCP development effort to evaluate the performance of alternatives in relation to this potential new standard.

2.4.2 EPA Combined Sewer Overflow (CSO) Control Policy

The EPA first issued requirements for control of CSOs with publication of a Control Strategy in September 1989. In April 1994, the agency issued its CSO Control Policy designed to elaborate on the Strategy and to expedite compliance with the requirements of the CWA. The purpose of the policy is to coordinate the planning, selection, design and implementation of CSO management practices and controls, to meet the requirements of the CWA and to involve the public fully during the decision-making process.

The policy is framed around the principal elements as follows:

- Implementation of minimum technology-based CSO controls; and
- Development of long-term CSO control plans which evaluate alternatives for attaining compliance with the CWA, including compliance with water quality standards and protection of designated uses, and modifications to the standards if warranted.

CSO policy became law with the passage of the Wet Weather Water Quality Act of 2000 in December 2000. EPA implements the CSO Control Policy through the NPDES Permit Program.

2.4.2.1 Minimum Technology-Based CSO Controls

Minimum requirements for technology-based controls have been developed by EPA for combined sewer systems. These requirements are included in EPA's list of "Nine Minimum Controls" (NMC) which are summarized as follows:

1. Proper operation and regular maintenance programs for the sewer system and the CSOs;
2. Maximize use of the collection system for storage;
3. Review and modification of pretreatment requirements to assure CSO impacts are minimized;
4. Maximize flow to the POTW (public owned treatment works) for treatment;
5. Prohibition of CSOs during dry weather;
6. Control of solid and floatable materials in CSOs;
7. Pollution prevention;
8. Public notification to ensure that the public receives adequate notification of CSO occurrences and CSO impacts; and
9. Monitoring to effectively characterize CSO impacts and the efficacy of CSO controls.

The policy is based on implementation of the nine minimum controls through effective management programs with only minor construction. Any major construction is viewed as being part of long-term CSO control plans. Permittees are required to implement and document implementation of the nine minimum controls. WASA has been implementing its NMC Program in accordance with the CSO Policy. WASA's nine minimum controls program was first approved by EPA in 1996.

2.4.2.2 Long Term CSO Control Plans

Under the policy, a long-term CSO control plan comprises principal elements as follows:

1. System Characterization, Monitoring and Modeling, which includes compilation of background information, field monitoring and development of predictive models tailored to the complexity of the CSO system and information needs associated with evaluation of CSO control options and water quality impacts.
2. Public Participation, which requires the permittee to employ a public participation process that actively involves the affected public in the decision-making to select the long term CSO controls.
3. Consideration of Sensitive Areas, which requires permittees to give the highest priority to controlling overflows to sensitive areas such as outstanding natural resource waters, public drinking water intakes and protection areas, waters with threatened or endangered species and their habitat, waters with primary contact recreation, and shellfish beds.
4. Evaluation of Alternatives, which includes controls necessary to achieve zero overflow events per year, a range of overflow events from one to twelve per year and expansion of treatment capacity.
5. Cost/Performance Consideration, which requires that appropriate cost/performance curves be developed to demonstrate the relationships among a comprehensive set of reasonable control alternatives that correspond to the specified range of control levels. This should include analysis to determine where the increment of pollution reduction achieved in the receiving water diminishes compared to increased cost.
6. Operational Plan, which requires that after the NPDES permitting authority and permittee agree on necessary CSO controls to be implemented under the LTCP, the permittee will revise their operation and maintenance program to include the agreed-upon long term CSO controls.
7. Maximizing Treatment at the Treatment Plant, one goal of the CSO Control Policy is to increase the amount of wet weather flow receiving full treatment.
8. Implementation Schedule, which requires the development of a construction and financing schedule for the implementation of the LTCP. Schedules for implementation of CSO controls may be phased based on the relative importance of adverse impacts upon WQS and designated uses, identified priority projects and on financial capability.
9. Post-Construction Compliance Monitoring Program, which requires that implementation of a

post-construction water quality monitoring program adequate to verify compliance with water quality standards and protection of designated uses as well as ascertain the effectiveness of CSO controls.

10. Coordination with State Water Quality Standards, EPA requires the review of WQS as part of the LTCP development process. EPA regulations and guidance provide states with the flexibility to adapt their WQS, and implementation procedures to reflect site-specific conditions including those related to CSOs. For example, states could adopt partial uses by defining when primary contact recreation such as swimming is suspended, such as during a particular type of storm event. In making such adjustments to their uses, states must ensure that downstream uses are protected, and that after the storm event passes, the use is fully protected.

This report summarizes WASA's efforts to complete the elements above. Additional reports developed in support of the LTCP development process are listed in the Appendix A.

2.4.2.3 Control Approaches Under CSO Policy

The policy outlines two basic approaches as a framework for developing and evaluating alternatives. These two approaches are:

"Presumption" Approach

The "presumption" approach states that a CSO program that meets one of the following three conditions is presumed to provide an adequate level of control to meet applicable state and local WQS in the receiving body of water. The acceptability of the "presumption" approach is subject to the approval of the permitting authority. If implementation of CSO controls based on the presumption approach do not result in attainment of WQS, additional controls beyond those already implemented may be required. The three conditions quoted directly from the Policy are:

"1. No more than an average of four overflow events per year, provided that the permitting authority may allow up to two additional overflow events per year. For the purpose of this criterion, an overflow event is one or more overflows from a combined sewer system as a result of a precipitation event that does not receive the minimum treatment specified."

The CSO policy defines an overflow event as "*…one or more overflows from a CSS as the result of a precipitation event that does not receive the minimum treatment specified…*". In terms of defining an overflow event, a municipality may be considered to have more than one CSS. For each CSS, a single overflow event under the Policy will have occurred if one or more of the CSO outfalls discharges untreated or inadequately treated combined sewage during a single rain event. The calculation of four overflow events per average year would thus apply to each CSS individually. For example, if the Anacostia CSOs are considered to be a single CSS and if a single precipitation event causes five of the 17 outfalls to overflow, this is counted as one overflow under the Policy. Note that the NPDES permitting authority may approve up to two more overflows (total six overflows) per average year.

In addition, note that the limit of four overflows per year applies to overflows not receiving the minimum treatment of primary clarification, solids and floatables disposal, and disinfection. Outfalls may overflow more frequently if they receive the minimum level of treatment. For this evaluation, excess flow discharged from Blue Plains Outfall 001 is not considered a CSO overflow since it receives the required minimum treatment.

"2. The elimination or the capture for treatment of no less than 85% by volume of the combined sewage collected in the combined sewer system during precipitation events on a system-wide annual average basis."

Under this criterion, the 85% by volume applies to the flow collected in the CSS, not 85% of the volume discharged. Thus, no more than 15% of the total flow collected in the CSS during storm events should be discharged without receiving the minimum level of treatment. The total volume applies on a system-wide, annual average basis. CSS modeling results indicate that once WASA completes its current efforts to rehabilitate existing pump stations and inflatable dams it will meet this criterion. However, receiving water models of this condition indicate that WQS will not be met; therefore evaluation efforts will focus on the demonstration approach.

"3. The elimination or removal of no less than the mass of the pollutants, identified as causing water quality impairment through the sewer system characterization, monitoring, and modeling effort, for the volumes which would be eliminated or captured for treatment under paragraph 2 above." (EPA, 1994).

Under this approach, a CSO plan could be devised which removed 85% of the specific pollutants which cause water quality impairment. This is not necessarily 85% of the CSO volume. In addition, the pollutants that are currently removed by existing controls can be credited toward the 85% total.

"Demonstration" Approach

The "demonstration" approach states that a CSO program is adequate if it meets the state and local WQS of the receiving body(ies) of water. With this approach there are no specific limits on CSO events, flow or pollutant loading. A successful "demonstration" approach must meet each of the following criteria:

"1. The planned control program is adequate to meet WQS and protect designated uses, unless WQS or uses cannot be met as a result of natural background conditions or pollution sources other than CSO's;

2. The CSO discharges remaining after implementation of the proposed control program will not preclude the attainment of WQS or the receiving waters' designated uses or contribution to their impairment. Where WQS are not met in part because of natural background conditions or pollution sources other than CSO discharges, a total maximum daily load, including a wasteload allocation and a load allocation or other means should be used to apportion pollutant loads;

3. The planned control program will provide the maximum pollution reduction benefits reasonably attainable; and.

4. The planned control program is designed to allow cost effective expansion or cost effective retrofitting if additional controls are determined to be necessary to meet WQS or designated uses" (EPA, 1994).

The demonstration approach requires that CSO discharges that remain after LTCP implementation do not preclude attainment of WQS. Modeling indicates that natural background conditions or pollution sources other than CSOs are contributing to WQS violations in the District, and that control of CSOs alone will not permit attainment of WQS. In order to assess this, pollutant loads other than CSOs were estimated and evaluated as part of the LTCP development effort. An assessment of the relative contribution of CSO loads to the receiving waters was made and then a range of CSO controls were identified to determine the quantifiable benefit. The effect of reduction in non-CSO loads to the receiving water was also evaluated. In cases where natural background conditions or pollution sources other than CSOs are contributing to WQS violations and where application of controls is not expected to meet WQS, regulatory agencies are responsible for developing a total maximum daily load (TMDL) for CSOs and other loads. The EPA CSO guidance documents also specify that the permitting authority should consider the maximum pollution reduction benefits that can be reasonably obtained. "Reasonably obtained" refers to the consideration of the cost of implementation of the control program in relation to the anticipated benefits to water quality.

2.4.3 Use Attainability Analysis (UAA)

As part of the water quality standards review required by the CSO Control Policy; a UAA, which is defined as "*a structured scientific assessment of the chemical, biological, and economic condition in a waterway*" (EPA, 2000), may be used to determine if currently enforceable WQS can be achieved and if justification for reclassification exists. In the case of the District, the DOH would be responsible for UAA preparation. Some CSO cities are pursuing UAAs for wet weather conditions due to the urban nature of their watersheds and the large storm flow volumes. This is a path that WASA and DOH could choose to pursue, if desired.

2.4.4 Total Maximum Daily Loads

The federal CWA requires that impaired waterways be identified (commonly called the 303d List) and stipulates that total maximum daily loads (TMDLs) be developed for pollutants of concern to bring impaired waterways up to water quality standards. The DOH is responsible for listing impaired District waters and developing associated TMDLs. Waterbodies on the District's 303d list that are thought to be partially impaired due to combined sewer overflows are listed in Table 2-5 (DOH, 1998).

Table 2-5
Impaired District Waters Impacted by CSOs

Waterbody	*Pollutants of Concern*	*Priority*	*Rank*	*Action Needed*
Lower Anacostia	BOD, bacteria, organics, metals, TSS, grease & oil	High	1	Control CSOs, Point and Nonpoint Pollution
Upper Anacostia	BOD, bacteria, organics, metals, TSS, grease & oil	High	2	Control CSOs, Point, Nonpoint and Upstream Pollution
Kingman Lake	BOD, bacteria, organics, metals, TSS, grease & oil	High	6	Control CSOs and Nonpoint Pollution
Upper Rock Creek	Organics, metals and bacteria	Medium	15	Control CSOs, Nonpoint and Upstream Pollution
Lower Rock Creek	Organics, metals and bacteria	Medium	16	Control CSOs and Nonpoint Pollution
Luzon Branch	Organics	Low	25	Control CSOs and Nonpoint Pollution
Piney Branch	Organics and metals	Low	30	Control CSOs and Nonpoint Pollution
Upper Potomac	Organics and bacteria	Low	34	Control CSOs, Nonpoint and Upstream Pollution
Middle Potomac	Organics, bacteria and pH	Low	35	Control CSOs and Nonpoint Pollution
Lower Potomac	Organics and bacteria	Low	36	Control CSOs, Point and Nonpoint Pollution

As of June 2001, there are three TMDLs in the District:

- Oil and Grease – in January 1999, DOH issued a TMDL for oil and grease for Hickey Run, a tributary to the Anacostia River. There are no CSOs discharging to Hickey Run and this TMDL does not affect selection of the CSO controls.

- Biochemical Oxygen Demand (BOD) - In December 2001, EPA approved DOH's TMDL for dissolved oxygen (expressed as BOD) for the Upper and Lower Anacostia River. The load allocations were expressed in terms of the average year based on the average of the period 1988-1990. A load allocation for CSO is shown in Table 2-6. Note that CSOs do discharge to the Upper Anacostia, but no loads were allocated to CSO in this section of the river.

- Total Suspended Solids (TSS) – In March 2002, EPA established a TMDL for TSS for the Upper and Lower Anacostia Rivers. The purpose of the TMDL was to address water clarity. The TMDL was expressed in tons of TSS for the growing season of April to October 1989. A load allocation for CSO is shown in Table 2-6.

Table 2-6
Anacostia TMDL Load Summary

Load Source	*Biochemical Oxygen Demand (lbs/yr)*		*Total Suspended Solids(Tons/yr)*	
	Existing Load[1]	*TMD Allocation*	*Existing Load*[2]	*TMD Allocation*
CSO in Upper Anacostia	0	0	252	58
CSO in Lower Anacostia	1,574,132	152,906	198	45.4
Total CSO	**1,574,132**	**152,906**	**450**	**103.4**

Notes:
1. As reported by DOH. The estimated loads developed as part of the LTCP differ from the loads in the TMDL.
2. As reported by EPA. The estimated loads developed as part of the LTCP differ from the loads in the TMDL.

DOH is also developing TMDLs for fecal coliform for the Anacostia River, Potomac River and Rock Creek. Additional TMDLs are expected in the future.

2.4.5 WASA's National Pollutant Discharge Elimination System (NPDES) Permit

The latest WASA NPDES Permit No. DC0021199, issued by EPA, was effective on 1/22/97 and had an expiration date of 7/1/99. Since a reapplication was made but a new permit has not yet been issued, the existing permit remains in effect. The permit stipulates limits on flow and effluent pollutants for WASA's two outfalls at Blue Plains WWTP as well as requirements associated with operating the combined sewer system. Plans to expand or change discharge operations with regards to CSO control may require changes to the existing permit. Since EPA issues the permit, the EPA will play a primary role in the development, approval and implementation of the LTCP; however, certification of the permit is required from DOH.

2.4.6 District's Storm Water MS4 Permit

An MS4 permit for the separate storm sewer system has been issued to the District of Columbia

Government (not WASA). The permit, NPDES Permit No. DC0000221 gives the District the authority under the provisions of the CWA to discharge from its separate storm water sewer system to the local waterways. The latest permit became effective on April 19, 2000, and is scheduled to expire on April 19, 2003. The permit describes the types of discharges that are authorized and has conditions requiring identification of sources, the implementation and enforcement of Storm Water Pollution Prevention and Management Program (SWMP) practices and monitoring and reporting requirements. Details on the numerous activities, focused on further reducing the discharge of pollutants to receiving waters, are discussed in Section 3 of this report and presented in the *Municipal Separate Storm Sewer System First Annual Review* (April 19, 2001).

The storm water permit will have a limited affect on the preparation of the LTCP. Generally, the LTCP should consider any benefits of load reduction from the separate storm water system due to implementation of the SWMP. The financial burden for implementing both programs will be born by District residents and should be considered.

2.4.7 Chesapeake Bay Agreement

The Chesapeake Bay Agreement, signed by the states of Maryland, Virginia, Pennsylvania, the District of Columbia, the Chesapeake Bay Commission and EPA, is a series of guidelines designed to improve the quality of the life and water in and around the Chesapeake Bay. The guidelines of the policy in terms of water quality are to achieve and maintain the 40% nutrient reduction goal of 1987 based on 1985 pollutant discharge levels, develop nutrient and sediment loading criteria, limits and water quality standards, eliminate the discharge of chemical contaminants and restore the Anacostia River to previously established water quality and wildlife habitat standards. As the agreement represents a partnership arrangement, compliance is non-regulatory. The selected CSS LTCP will help move the region closer to achieving its goals. It is also expected that the Chesapeake Bay Program, the organization that administers the Chesapeake Bay Agreement, will be involved in the review of WQS and the WASA LTCP.

2.5 SENSITIVE AREAS

2.5.1 CSO Policy Requirements

The CSO Policy states that sensitive areas are to be determined by the NPDES Permitting Authority in coordination with State and Federal Agencies. For WASA, the NPDES Permitting Authority is Region III of EPA, and the District Government functions as the State regulatory agency. The CSO Policy indicates that sensitive areas may include the following:

- Waters designated as Outstanding National Resource Waters (ONRW)
- National Marine Sanctuaries
- Public drinking water intakes
- Waters designated as protected areas for public water supply intakes

- Shellfish beds
- Waters with threatened or endangered species and their habitat
- Waters with primary contact recreation

For such areas, the CSO Policy indicates the LTCP should:

a. Prohibit new or significantly increased overflows;

b. i. Eliminate or relocate overflows that discharge to sensitive areas wherever physically possible and economically achievable, except where elimination or relocation would provide less environmental protection than additional treatment; or

ii. Where elimination or relocation is not physically possible and economically achievable, or would provide less environmental protection than additional treatment, provide the level of treatment for remaining overflows deemed necessary to meet WQS for full protection of existing and designated uses. In any event, the level of control should not be less than those described in Evaluation of Alternatives below; and

c. *Where elimination or relocation has been proven not to be physically possible and economically achievable, permitting authorities should require, for each subsequent permit term, a reassessment based on new or improved techniques to eliminate or relocate, or on changed circumstances that influence economic achievability.* (EPA, 1994)

2.5.2 General Assessment

CSO oufalls can discharge to the following receiving waters:

- The Potomac River (below Three Sisters Islands)
- The Anacostia River (below East Capitol Street)
- Rock Creek (below Military Road)

Table 2-7 compares the existing uses of District waters receiving CSO discharges to sensitive areas classifications:

Table 2-7
Comparison of District Waters to Sensitive Areas Classifications

Sensitive Areas Classification	*Assessment*
Waters Designated as Outstanding National Resource Waters (ONRW)	None of the waters are designated ONRW
National Marine Sanctuaries	None of the waters are National Marine Sanctuaries
Public drinking water intakes	None of the waters have public water supply intakes
Waters designated as protected areas for public water supply intakes	None of the waters are designated as a protected area for public water supply.
Shellfish beds	None of the waters support shellfishing.

The two remaining classifications, waters with threatened or endangered species and primary contact recreation, are described below.

2.5.3 Waters With Threatened or Endangered Species or Their Habitat

Two federally listed species have been identified in the vicinity of the receiving waters in the District as follows:

- Hay's Spring Amphipod (*Stygobromus hayi*) – this is a federally listed endangered species which occurs in Rock Creek at two locations: south of Military Road approximately between Nicholson and Emerson Streets, NW and approximately between the National Zoo and the Connecticut Avenue Bridge (See Figure 2-2, end of this section). These are the only known locations of the amphipod in the country. The amphipod is a small crustacean (resembling a tiny shrimp) about one-quarter inch long that lives in decaying deciduous leaf litter and mud at the exit of springs and groundwater seeps. The springs in Rock Creek are reported to issue forth from crevices in rocks. The species is believed to feed on decaying leaves, organic matter and decomposer bacteria and fungi found on organic matter. The species was first discovered in 1938, and was listed in 1982. One of the reasons for its listing was reportedly its vulnerability to extinction due to its extremely restricted distribution. Little is known about the species, but it is reported to be adversely affected by high water flows/flooding in Rock Creek, pollution of the groundwater and surface water, and siltation (USFWS, 2000a, 2000b)

- Bald Eagle (*Haliaeetus leucocephalus*) – the bald eagle is a federally listed threatened species. In 1995, the species was reclassified from endangered to threatened due to its recovery. Active bald eagle nest sites are reported just south of the Wilson Bridge in Maryland, and near the confluence of the Potomac and Anacostia Rivers (See Figure 2-1). During nesting season, eagles are typically limited to areas within one mile of their nest sites. However, eagles may venture much farther from their nest sites outside nesting season. Numerous foraging bald eagles have been observed within the District along the Potomac shoreline between the Wilson Bridge and the Blue Plains Wastewater Treatment Plant. In addition, it is reported that bald eagles may occur sporadically at any location along the Potomac River or mainstem Anacostia Rivers. (USFWS, 2000a, 2000b)

2.5.4 Waters With Primary Contact Recreation

District of Columbia regulations list two uses for each water body in the District as follows: the current use and the designated use. The current use is the use which is generally and usually met in the water body in spite of numeric water quality criteria which may not be met sometimes. The designated use is the use specified for the water body in the water quality standards whether or not it is being attained. The D.C. Department of Health (DOH) has established the current use of the Anacostia, Potomac and Rock Creek as Class B, secondary contact recreation and aesthetic enjoyment. None of the waters are used for primary contact recreation. Indeed, a ban on swimming in waters of the District was issued in 1971. The designated use of the waters includes class A, primary contact recreation (DC Register, 2000). A review of the literature was conducted to identify the past uses of the receiving waters and the occurrence of facilities such as beaches which would facilitate primary contact recreation. This review is summarized below:

Past Uses

- Anacostia River

  Prior to the arrival of Europeans in 1608, many wetlands were located along the banks of the Anacostia River. Settlement along the Anacostia River for tobacco farming resulted in the use of the Anacostia River as a shipping channel for trade. Bladensburg emerged as the leading tobacco trading port and the river was reported to be navigable north of the town in 1742. As development and farming increased along the river, erosion on the banks filled the river, reducing its navigability. Dredging of the channel first began around 1800 to allow farmers relying on Bladensburg to continue to use the river to market their products. By the mid 1800s, siltation had completely isolated Bladensburg as ships could no longer reach this port town. By 1876, dredging of the river occurred at regular intervals to keep up with worsening siltation problem. (Engineering Science, 1989).

  The dredging process created tidal mud flats on the banks of the river. The rich sediments in the river mud combined with runoff and raw sewage to create a haven for mosquitoes. The mosquitoes began to convey malaria to riverfront residents and workers, reaching epidemic proportions in the late 1890s. Beginning in 1902 Congress approved funds for land reclamation of the mud flats up to the Navy Yard Bridge. Dredging and land reclamation continued all along the Anacostia River through the 1920s and a seawall was constructed on the riverbanks by the Army Corps of Engineers to contain the dredged material. By 1930, the

Anacostia River was contained to its present banks, the mud flats reclaimed, and malaria mostly eradicated. Around this time, the Federal Government established Kingman Lake and other protected parklands along the shores of the river (Engineering-Science, 1989).

During the suburban expansion of the 1940s and 1950s, siltation and pollution increased in the Anacostia River and its health decreased accordingly. From the 1940s – 1960s, marinas were established along the western shore of the river just north of the Navy Yard, changing the main use of the river from commercial to recreational (Engineering-Science, 1989).

- Potomac River

  Commercial activity began early in the 1700s in the Georgetown area at the outlet of Rock Creek. A prominent shipping route which came to be known as the Georgetown Channel existed at the time extending from Easby Point to the south. Eventually, due to the expansion of tobacco and grain farming in the Potomac River and Rock Creek watersheds, siltation problems increased in severity, forcing dredging operations beginning in the 1800s. In 1837, the US Coast Survey indicated that above Long Bridge (at the site of present day 14th Street Bridge), the prevailing depth was only 3 feet (Engineering-Science, 1989). Dredging reopened the Georgetown Channel throughout the 1833 - 1881 period, but only temporarily due to the severity of the siltation problems. Similar to the Anacostia River, the dredging produced open mud flats that spurred the growth of malaria-transmitting mosquitoes. Land reclamation on the Potomac River occurred simultaneously with the work on the Anacostia River, virtually eliminating the malaria problem by 1930 (Engineering-Science, 1989).

  Beginning in 1892 but more pervasively in the 1940s, marinas and boating clubs began to appear along the banks of the Potomac River, signaling the change in use patterns from commercial to recreational (Engineering-Science, 1989).

- Rock Creek

  Tobacco farming occurred within the Rock Creek watershed beginning in the mid to late 1600s. As more of the land in the Rock Creek watershed became cultivated, siltation grew as a problem. As early as 1703, a trading post was founded on the eastern shore of Rock Creek at its confluence with the Potomac River. Throughout the 1700s, Georgetown dominated the area in terms of trade and commerce as it served as the major trading port for farms along the upper Rock Creek basin. Historical records indicate that Rock Creek was navigable at this time up to the present P Street Bridge. Rock Creek was much wider at the confluence in the 1700s - 1800s before land reclamation projects in the 1800s – 1900s narrowed the Potomac River to its present width. Due to the limited navigability of Rock Creek, it was not used as a principal shipping channel above Georgetown. (Engineering-Science, 1989).

In the 1900s, farms were replaced with suburban development. Although the immediate area around Rock Creek was surrounded by parkland, the characteristics of flows in the creek changed substantially due to increased imperviousness of the watershed.

Past Public Beaches/Facilities

A review of published records associated with the three waterways indicate the following:

- Anacostia River
  No records of public beaches or swimming locations on the Anacostia River have been found in the literature. However, it is likely that river bathing and pleasure swimming was practiced to some degree in the river at various locations in the past.

- Potomac River
  River bathing was reportedly common in the pre-colonial and colonial period. The literature indicates that in the 1920s, Decoration Day was considered the customary opening day for water sports on the Potomac including swimming. Hundreds of swimmers reportedly took part in opening day ceremonies. Two public facilities enabling swimming have been identified:

  - Tidal Basin - a supervised public bathing beach on the Tidal Basin south of the Washington Monument operated from 1918-1924. Officially, the beach was closed at the end of the 1924 season due to pollution.

  - Above the Key Bridge – swimming was reported in the literature from summer cottages that used to line the sides of the Potomac. In addition, swimming access was reportedly provided by entrepreneurs who placed floats in the river for swimmers. It is unclear when swimming from the cottages, camps and commercial floats above Key Bridge was discontinued. The literature speculates that the acquisition of the C&O Canal Company property in 1938 by the Federal Government and the construction of the George Washington Memorial Parkway may have ended swimming in this portion of the River. (ICPRB, 1982)

  As early as 1894 it was reported by the USPHS that fecal bacteria made the water at certain locations in the Potomac River unsafe for swimming. In 1932, bacterial contamination forced the closure to swimming of the Potomac River from Three Sisters Island to Fort Washington. In 1957 the USPHS declared the entire Potomac River unsafe for swimming (ICPRB, 2000a). On August 27, 1971, the District of Columbia regulations prohibited all primary contact in any District waterway. Since that time the ban on swimming has not been lifted.

- Rock Creek
  As with the Anacostia River, it is likely that creek wading and bathing was practiced to some degree in Rock Creek in the past. One public facility was identified. It is described as a bathing beach at 25th and N Street, NW. The bathing beach was reportedly adjoining the Francis Junior High School and included a bathhouse. (Washington Post, 1928). There is also a reference in the literature to swimming in Rock Creek at a location called "Big Rock" (The Mayflower's Log, 1935). Its location is unknown.

<u>Current Uses</u>

Today, the 1971 ban on primary contact recreation in all District waters remains in effect. The waters are not legally used for primary contact recreation. All of the waters are used to some degree for secondary contact recreation. Many of the marinas built in District waters from the 1890s – 1970s are still in use today. The three primary areas with marinas are the lower east Anacostia just upstream of the Navy Yard, along the Washington Ship Channel and along the Potomac River in Georgetown. A boat ramp exists on the east side of the Anacostia along Anacostia Park adjacent to the railroad bridge just upstream of the Skating Pavilion. The marinas/boat ramps currently in operation are:

- Anacostia River
  - Buzzard Point Marina, 2200 1st St. SW
  - District Yacht Club, 1409 Water St. SE
  - Washington Yacht Club, 1500 M St. SE
  - Anacostia Community Rowing Center, 115 "O" St, SE
  - Anacostia Marina, 1900 M St. SE
  - National Park East Boat Ramp
  - Seafarer's Boat Club, M St. SE
  - James Creek Marina, 200 V St. SW

- Potomac River
  - Capital Yacht Club 11th Street, SW
  - Columbia Island Marina, Columbia Island
  - Spirit of Washington Cruise Line, 6th and Water Streets, SW
  - Washington Marina, 1300 Maine Ave. SW
  - Tidal Basin Boat House, 1501 Maine Ave. SW,
  - Gangplank Marina, 600 Water St. SW
  - Thompson Boat Center, Rock Creek Parkway & Virginia Ave., NW
  - Jack's Rental Canoe Rowboats, 3500 K St., NW
  - Potomac Boat Club, 3530 Water St., NW
  - Washington Canoe Club, 3700 K St., NW

DOH has issued a health advisory for fish caught in the Anacostia and Potomac Rivers and Rock Creek due to PCBs and other chemical contaminants which have been found in certain fish species. DOH recommends that catfish, carp or eel not be eaten. Largemouth bass, sunfish or other fish may be eaten in limited quantities. Younger and smaller fish of legal size can be eaten. DOH recommends a catch and release policy.

Commercial activity in District waterways has been almost completely replaced with recreational activity. However, military ships still port at the Navy Yard and Fort McNair on the southwest side of the lower Anacostia River.

2.5.5 Findings

An analysis of the District waters with respect to the CSO Policy was conducted and is summarized in Table 2-8.

Table 2-8
Sensitive Areas Assessment

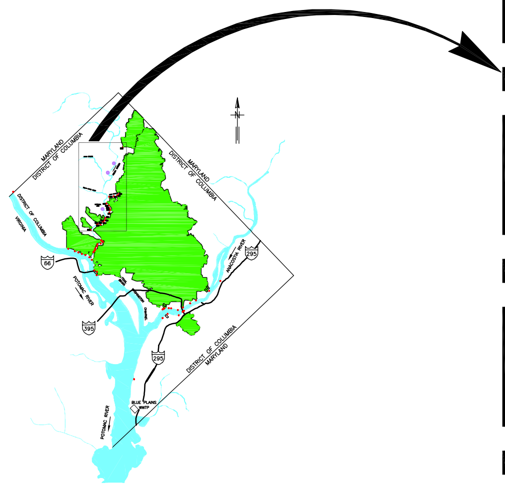
CSO Discharge Receiving Water Segments	*Current Uses Classification of District Waters Receiving CSO Discharges Compared to Sensitive Areas Classifications or Designations (1)*						
	ONRW	*National Marine Sanctuaries*	*Threatened or Endangered Species or habitat*	*Primary Contact Recreation*	*Public Water Supply Intake*	*PWS Protected Area*	*Shellfish Bed*
Potomac River (below Three Sisters Islands)	None	None	Threatened Bald Eagle – sporadic locations	None (2)	None (3)	None	None
Anacostia River (below Benning Road)	None	None	Threatened Bald Eagle – sporadic locations	None (2)	None	None	None
Rock Creek	None(4)	None	Endangered Hay's Spring Amphipod – Three locations	None (2)	None	None	None
Little Falls Branch	None	None	None	None	None	None	None

Notes:
(1) Classifications or Designations per CSO Policy and WASA's NPDES Permit
(2) Existing uses include secondary contact recreation such as boating, fishing and wading
(3) The nearest public water supply intake is above the dam at Little Falls, about 4.3 miles above Three Sisters Islands and upstream of the area impacted by CSOs.
(4) Rock Creek and its tributaries are designated Special Waters of the District of Columbia.

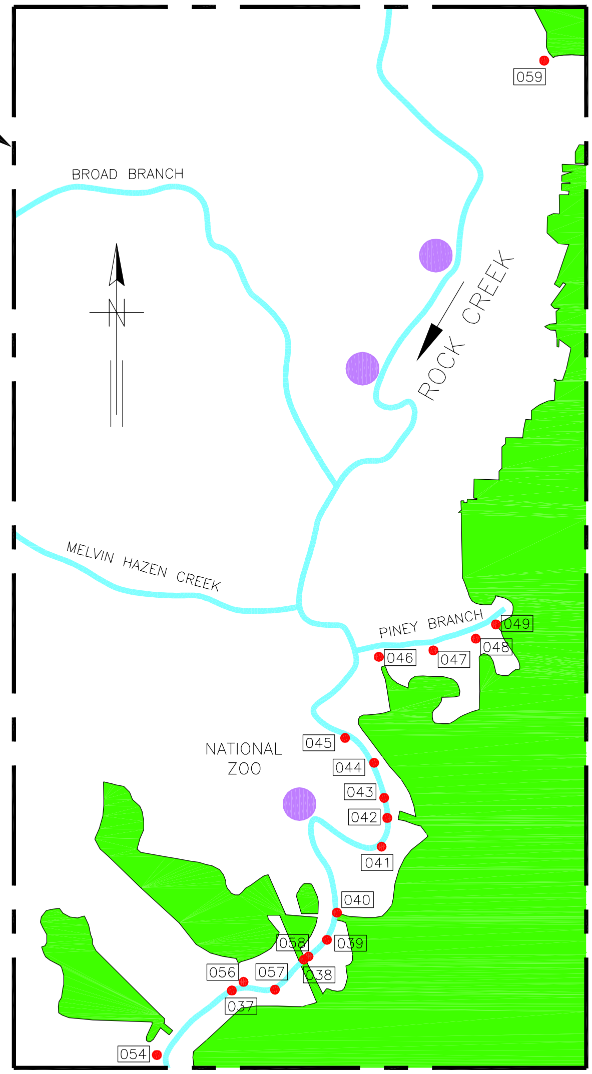
The status of the Bald Eagle was recently reclassified from endangered to threatened. This was due to the significant increase in the bird's numbers and its expanding range. This increase in the bird's proliferation has occurred without the benefit of additional CSO controls. It is likely that any additional CSO controls identified as part of the LTCP will assist in the continued recovery of the eagle. In addition, the eagle is reported to occur sporadically along the main stem of the Potomac and Anacostia Rivers. The intent of the CSO Policy is to focus on portions of waterways which may be classified as sensitive. It is impractical and inconsistent with the CSO Policy to classify entire waterways as sensitive due to the possible sporadic occurrence of eagles anywhere along their length.

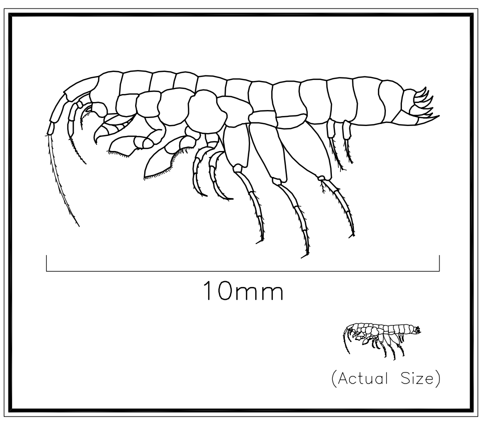
None of the District waters are currently used for primary contact recreation, while all of the waters are used to some degree for secondary contact recreation. The designated use of the waters includes primary contact recreation. Research of the literature indicates that while swimming was practiced in each receiving water to some degree in the past, there were limited public facilities enabling primary contact recreation. No facilities were identified in the Anacostia River. One facility which has long been abandoned has been identified in Rock Creek. Two facilities were identified in the Potomac River. One facility in the Potomac is the Tidal Basin, which does not receive CSO discharges. The other area was upstream of the Key Bridge, which is upstream of the majority of CSO discharges. There are no known current plans for construction of public swimming facilities along the waterways. Given that the intent of the CSO Policy is to focus on portions of waterways which may be classified as sensitive, it is impractical to classify all waterways as sensitive based on the future potential for primary contact recreation.

The endangered Hay's Spring amphipod is reported to have habitats in two limited sections of Rock Creek: just downstream of the Zoo and at a location upstream of the Zoo. These sections of Rock Creek can receive CSO discharges from the outfalls to Rock Creek. As a result, these portions of Rock Creek are eligible for consideration as sensitive areas, pending determination by regulatory agencies. This has been considered in greater detail in Section 9. Figure 2-2 shows the general location of the reported amphipod colonies. No other District waters are proposed for consideration as sensitive areas as defined by the CSO Policy.



KEY MAP





HAY'S SPRING AMPHIPOD

LEGEND

- CSO OUTFALL
- 048 CSO OUTFALL NUMBERS
- COMBINED SEWER AREA
- HABITAT OF HAY'S SPRING AMPHIPOD LOCATIONS (ENDANGERED)

LOCATIONS OF HAY'S SPRING AMPHIPOD

NOT TO SCALE

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CSS LONG TERM CONTROL PLAN

Section 3
Existing Systems

3.1 INTRODUCTION

The District of Columbia Water and Sewer Authority (WASA) operates and maintains the wastewater collection and treatment system for the District of Columbia, and also provides wastewater treatment for surrounding areas including parts of suburban Virginia and Maryland. The service area for the Blue Plains Wastewater Treatment Plant (BPWWTP) covers approximately 735 square miles.

With a population of approximately 600,000, the District of Columbia occupies 61 square miles within the Blue Plains Service Area. Storm water and sanitary wastewater flows in this area are collected as follows:

- Separate storm water and sanitary sewer collection systems cover 41 square miles (26,200 acres) and serve a population of approximately 250,000.
- A combined storm water and sanitary sewer collection system covers 20 square miles (12,955 acres) serves a population of approximately 350,000.

The remainder of this section provides more specific information on the configuration of the existing systems.

3.2 COMBINED SEWER SYSTEM (CSS)

The CSS generally serves the central, older portions of the District of Columbia. Approximately 66% of this area drains to the lower Anacostia River, with the remainder tributary to Rock Creek and the Potomac River.

There are 60 outfalls listed in WASA's current NPDES permit. One outfall discharges treated excess flow at the BPWWTP, while the remainder are located at various points across the District. The outfalls are distributed as follows:

- 17 are located on the Anacostia River
- 14 are located on the Potomac River (1 abandoned, CSO No. 30; includes one outfall at Blue Plains WWTP, and one outfall at Little Falls Branch, tributary to the Potomac)
- 29 Rock Creek (1 abandoned, CSO No. 55)

Table 3-1 lists the outfalls, their location, associated CSO drainage areas and receiving waters. The locations of the outfalls and combined sewersheds are presented on Figure 3-1 through 3-3.

Table 3-1
Summary of Permitted Outfalls

NPDES Outfall No.	*Permitted Outfall Location*	*CSO Drainage Area*	*Drainage Area (acres)*	*Receiving Water*
001	Blue Plains Wastewater Treatment Plant, Excess Flow Treatment Outfall	Entire Service Area	--	Potomac River
002	Blue Plains Wastewater Treatment Plant Main Outfall	Entire Service Area	--	Potomac River
003	Bolling Air Force Base, at Giavanolli and Chanute, SW	Entire Service Area	--	Potomac River
004	Downstream side of Fredrick Douglas Bridge	No tributary area, Emergency Bypass for combined Poplar Pt. P.S.	--	Anacostia River
005	Across from Navy Yard, aligned with Parsons Ave., SE	Fort Stanton	65.51	Anacostia River
006	Good Hope Road and Welsh Memorial Bridge	Fort Stanton	13.56	Anacostia River
007	Between 11th St. and Anacostia Bridges, SE	Fort Stanton	188.13	Anacostia River
008	Anacostia Avenue, west of Blaine St. NE	No tributary area, Emergency Bypass for separate Anacostia Main Interceptor	--	Anacostia River
009	O St. Sewage Pumping Station, SE	B St./N.J. Ave	41.27	Anacostia River
010	O St. Sewage Pumping Station, SE	B St/N.J Ave- O St. pumped	732.72	Anacostia River
011	Main Sewage Pumping Station, SE			
011(a)	Main Sewage Pumping Station, SE			
012	Main Sewage Pumping Station, SE	Tiber Creek	1,153.83	Anacostia River
013	Southeast Federal Center, aligned with 4th St.	Canal Street Sewer	20.10	Anacostia River
014	Navy Yard, aligned with 6th St., SE	Navy Yard/M St.: 6th St – 7th St	128.06	Anacostia River
015	Navy Yard, aligned with 9th Street, SE	Navy Yard/9th St-M St.	30.82	Anacostia River
016	12th and O Streets, SE	Navy Yard/M St.: 12th St.– 9th St.	152.58	Anacostia River
017	M and Water Street, SE	Navy Yard/M St.: 14th to Penn Ave.	259.91	Anacostia River
018	East of Barney Circle and South of Pennsylvania Avenue Bridge, SE	Barney Circle	48.93	Anacostia River
019	Adjacent to Service Drive behind	Northeast Boundary	4,242.39	Anacostia River

Table 3-1
Summary of Permitted Outfalls

NPDES Outfall No.	*Permitted Outfall Location*	*CSO Drainage Area*	*Drainage Area (acres)*	*Receiving Water*
	swirl facility and D.C. General Hospital			
020	Rock Creek Parkway and Independence, NW	Easby Point	573.14	Potomac River
021	Rock Creek Parkway and C St., NW	Slash Run	473.78	Potomac River
022	Rock Creek Parkway and G St., NW	I St.- 22nd St., NW	125.23	Potomac River
023	South of 30th and K Streets, NW	West of Rock Creek Diversion Sewer – K St. To Wisconsin Ave.	41.66	Potomac River
024	South of 30th and K Streets, NW			Potomac River
025	South of 31st and K Streets, NW	31st & K St NW	9.89	Potomac River
026	Wisconsin Avenue and Water Street, NW	Water St District (WRC)	13.88	Potomac River
027	33rd and Water Sts., NW	Georgetown	179.38	Potomac River
028	Key bridge and Whitehurst Freeway, NW	37th St-Georgetown	21.06	Potomac River
029	Adjacent to C&O Canal, aligned with 38th St. NW	College Pond	300.79	Potomac River
030	Fox Hall and Canal Road	(Abandoned)	--	Potomac River
031	Rock Creek Pkwy and Pennsylvania Avenue, NW.	Penn Ave-Middle East Rock Creek	1.11	Rock Creek
032	26th and M Street, NW.	26th St- M St. -Middle E. Rock Creek	10.38	Rock Creek
033	Across street from St. Francis Jr. High and aligned with N St., NW.	N St.-25th –Middle E. Rock Creek	13.08	Rock Creek
034	Just west of St. Francis Jr. High and north of N St., NW	Slash Run	(1)	Rock Creek
035	P St. Bridge and Rock Creek Parkway	Northwest Boundary	546.69	Rock Creek
036	22nd Street, South of Q Street NW.	Mass Ave & 24th – E. Rock	69.76	Rock Creek
037	Waterside Dr. and Rock Creek Parkway	Kalorama Circle West – E. Rock Creek	16.61	Rock Creek
038	Between arch footbridge and Connecticut Ave., north of Kalorama Circle, NW.	Kalorama Circle East – E. Rock Creek	9.54	Rock Creek
039	Connecticut Avenue Bridge and	Belmont Rd – East Rock Creek	54.25	Rock Creek

Table 3-1
Summary of Permitted Outfalls

NPDES Outfall No.	*Permitted Outfall Location*	*CSO Drainage Area*	*Drainage Area (acres)*	*Receiving Water*
	Rock Creek Parkway, NW.			
040	Aligned with Biltmore Rd., between Connecticut Ave and Ellington Bridge.	Biltmore St – East Rock Creek	24.52	Rock Creek
041	Beach Dr. and Ontario Pl., NW	Ontario Rd – Upper E. Rock Creek	27.17	Rock Creek
042	Harvard St. and Beach Dr NW.	Quarry Rd – Upper E. Rock Creek	36.22	Rock Creek
043	Upstream of Harvard St. and Beach Dr NW.	Irving St. – Upper E. Rock Creek	70.31	Rock Creek
044	Kenyon Street and Beach Dr.., NW.	Kenyon St. – Upper E. Rock Creek	17.07	Rock Creek
045	North of Beach Dr. and Walbridge Pl, NW.	LamontSt. – Upper E. Rock Creek	17.17	Rock Creek
046	Piney Branch Parkway and Park Road, NW.	Park Road – Upper E. Rock Creek	17.38	Rock Creek
047	Piney Branch Parkway and Ingleside Terrace	Ingleside Terr. – Upper E. Rock Crk.	18.16	Rock Creek
048	South of Piney Branch Parkway and 17th St.	Oak St-Mt. Pleasant Upper E. Rock Creek	26.06	Rock Creek
049	North of Piney Branch Parkway and 17th St.	Piney Branch	2,433.20	Rock Creek
050	Rock Creek Parkway and L St., NW	M St. – 27th St – West Rock Creek	36.41	Rock Creek
051	Across Rock Creek Parkway, aligned with Olive St., NW.	Olive – 29th St. – West Rock Creek	11.87	Rock Creek
052	Between P and Penna. Ave Bridges, aligned with O Street, NW.	O St.-31st St., NW	108.50	Rock Creek
053	Q St. Bridge and Rock Creek Parkway, NW.	Q St. – West Rock Creek	5.50	Rock Creek
054	Massachusetts Avenue and Rock Creek Parkway, NW.	No tributary area, relief for combined West Rock Creek Diversion Sewer	--	Rock Creek
055	Massachusetts Avenue and Rock Creek Parkway, NW.	(Abandoned)	--	Rock Creek
		No tributary area, relief for		Rock Creek

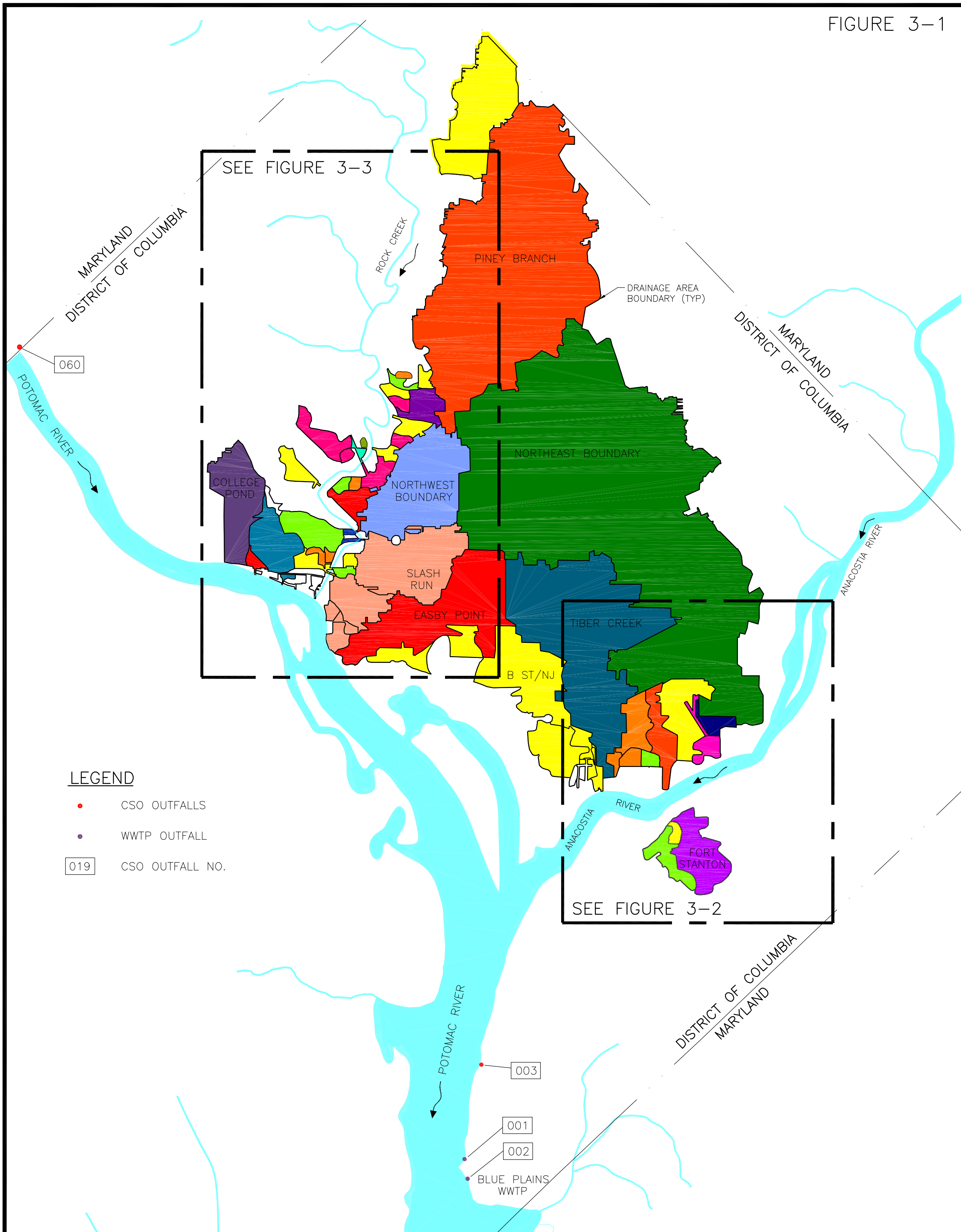
Table 3-1
Summary of Permitted Outfalls

NPDES Outfall No.	*Permitted Outfall Location*	*CSO Drainage Area*	*Drainage Area (acres)*	*Receiving Water*
056	Normanstone Dr. and Rock Creek Parkway, NW.	combined West Rock Creek Diversion Sewer	--	
057	28th Street and Rock Creek Parkway, NW	Cleveland – 28th St. & Conn. Ave.	84.50	Rock Creek
058	Connecticut Avenue and Rock Creek Parkway, NW.	Connecticut Avenue	5.24	Rock Creek
059	16th and Rittenhouse Streets, NW.	Separated (Luzon Valley)	--	Rock Creek
060	Clara Barton Parkway and Broad St., NW	(2)	--	Potomac River tributary
Total CSO Drainage Area			**12,477.76**	

Notes (1): Common Drainage Area shared with CSO outfall 021.
(2): CSO 060 is Little Falls Emergency Bypass located just outside the District of Columbia on WSSC's section of the separate Potomac Interceptor. WASA feels this outfall has been placed on their permit in error and is working with EPA to have it removed.

3.2.1 Collection System

A schematic of the major conveyance pipelines and pumping stations in the WASA's sewer system is presented in Figure 3-4. It is convenient to think of the drainage areas and CSS as being divided into two subsystems - an Anacostia system and a Potomac/Rock Creek system. The Northeast Boundary, Navy Yard, Fort Stanton, and Tiber Creek drainage areas are part of the Anacostia system. The other drainage areas are part of the Potomac/Rock Creek system, with the B St/NJ Ave drainage area serving as a link between the Anacostia and Potomac/Rock Creek systems. The ratio of maximum design capacity to dry weather capacity of the two systems is significantly different. Prior studies (Board of Engineers, 1955) indicate this factor is approximately two for the Northeast Boundary Trunk Sewer. However, this factor is typically significantly higher for trunk sewers and interceptors serving the Potomac/Rock Creek system, allowing them to carry more wet weather flow before discharging to receiving waters.



CSO OUTFALLS AND CSS DRAINAGE AREAS

NOT TO SCALE

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CSS LONG TERM CONTROL PLAN

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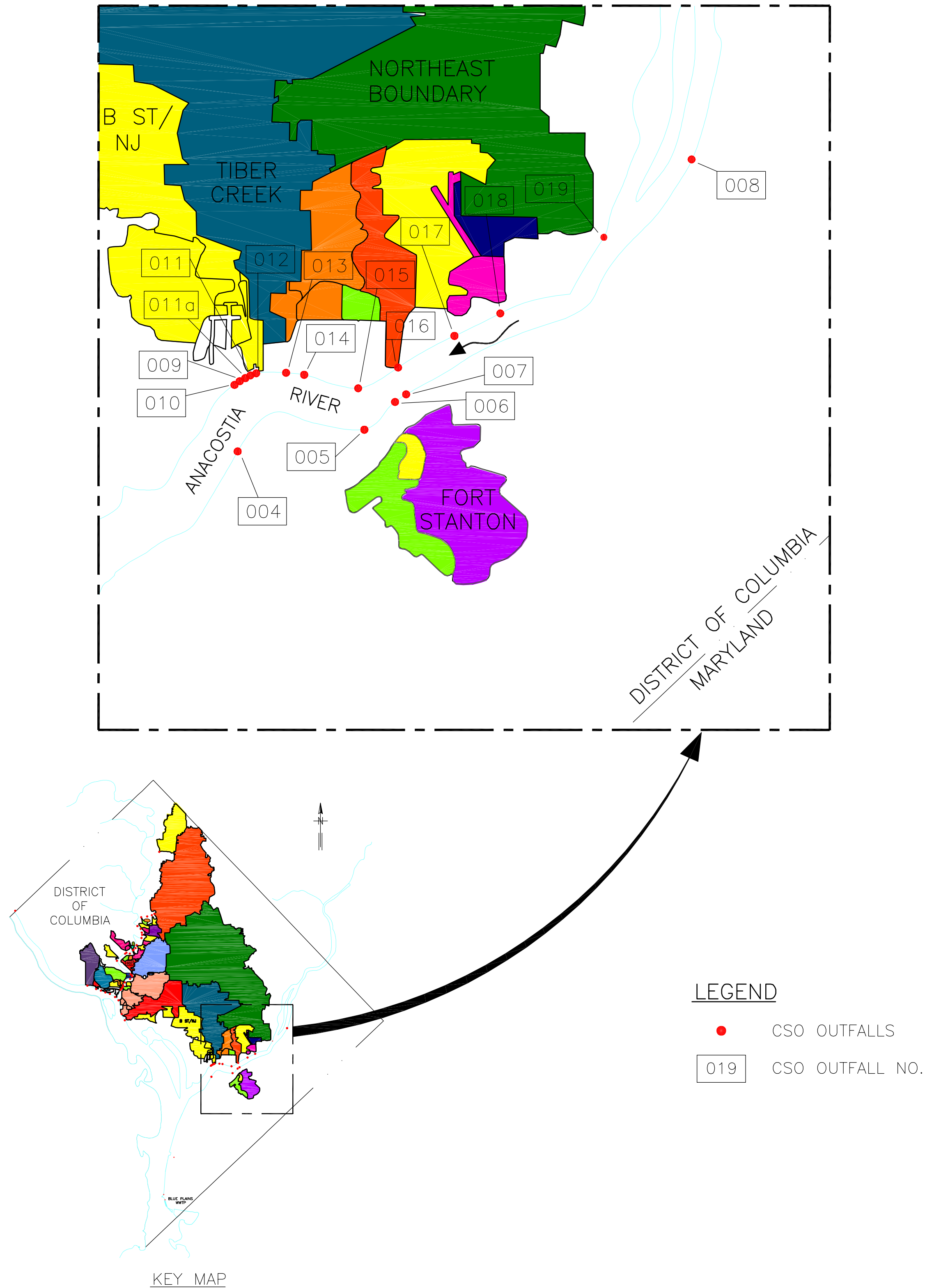
FIGURE 3–2



ANACOSTIA CSO OUTFALLS AND CSS DRAINAGE AREAS

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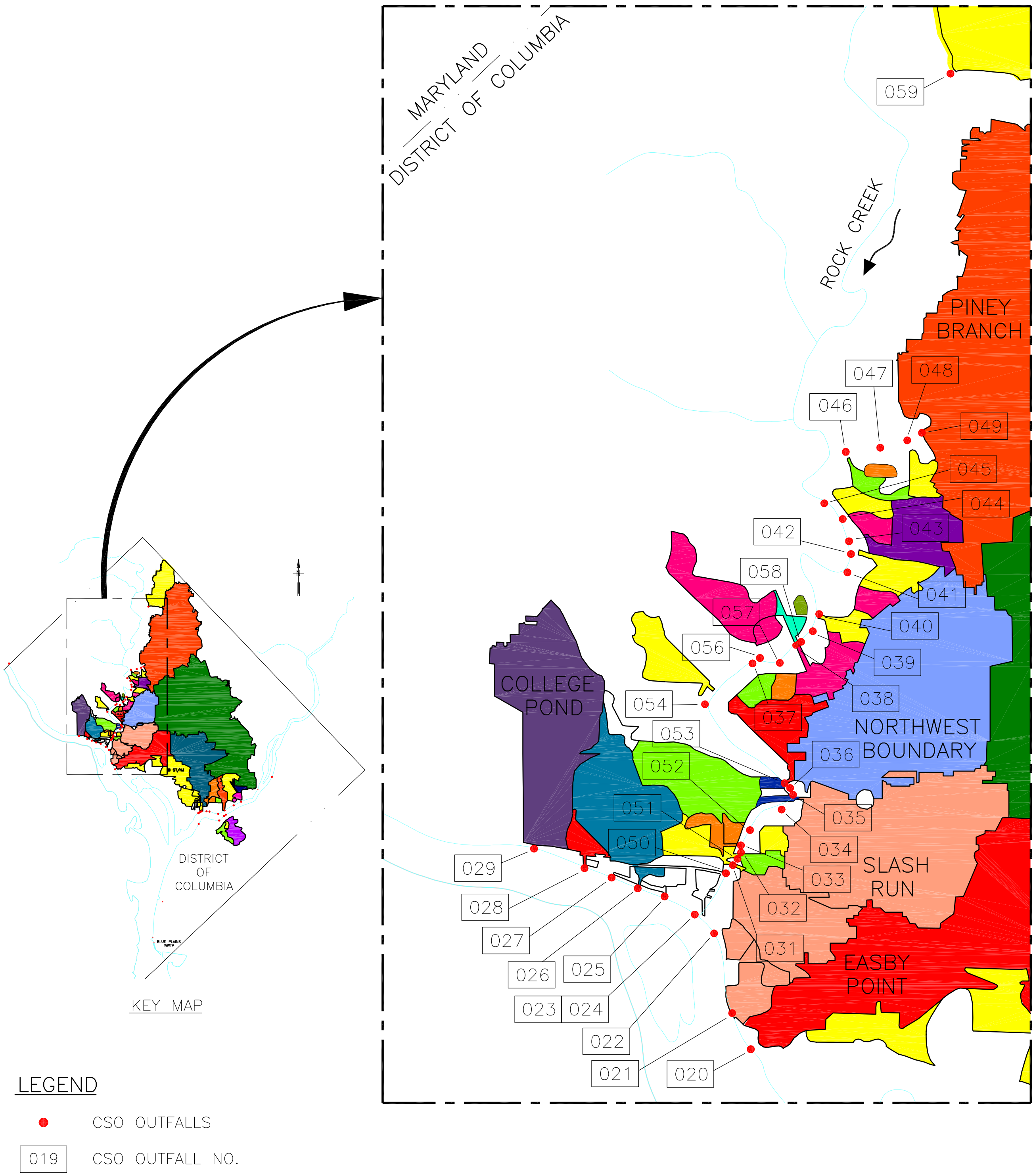

POTOMAC AND ROCK CREEK CSO OUTFALLS AND CSS DRAINAGE AREAS

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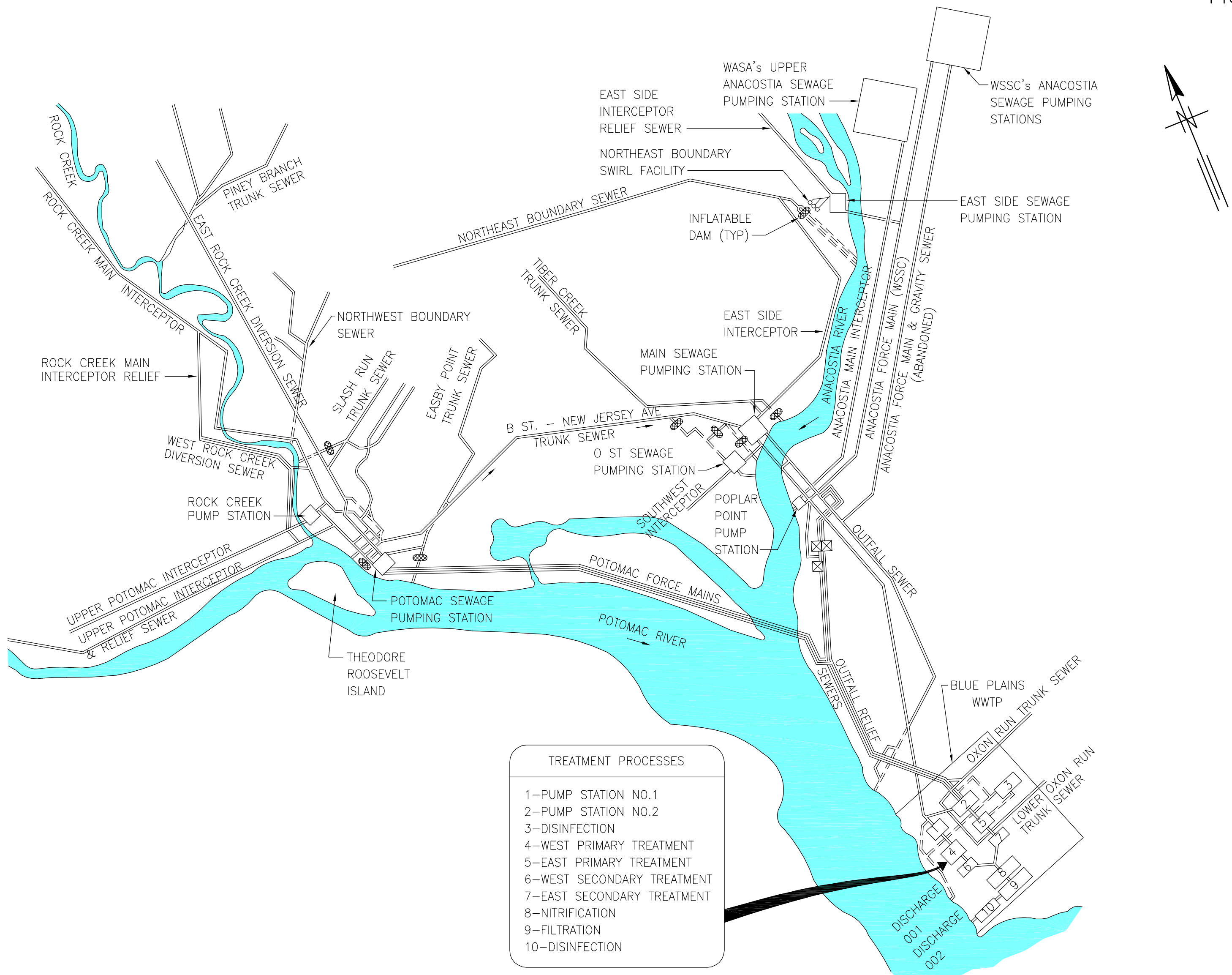
FIGURE 3-4



TREATMENT PROCESSES
1-PUMP STATION NO.1
2-PUMP STATION NO.2
3-DISINFECTION
4-WEST PRIMARY TREATMENT
5-EAST PRIMARY TREATMENT
6-WEST SECONDARY TREATMENT
7-EAST SECONDARY TREATMENT
8-NITRIFICATION
9-FILTRATION
10-DISINFECTION

SEWER SYSTEM SCHEMATIC

NOT TO SCALE

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Existing Systems

Under the Intermunicipal Agreement (IMA) with surrounding jurisdictions, WASA conveys up to an average of 212 mgd of separate sanitary flow from outside District boundaries through both its combined and separate sanitary systems to the BPWWTP. The IMA flows in the separate sanitary system as well as the combined system have substantial peaks during wet weather events. In addition to the flow from surrounding jurisdictions, WASA also conveys and treats the wastewater from federal facilities in the District. Federal properties cover about 25% of the District's total land area and about 14% in the combined sewer area as shown in Figure 3-5. Modeling conducted as part of the Long Term Control Plan indicates that approximately 18% of the combined sewer overflow is contributed by Federal properties on a system-wide annual average basis. This percentage is greater than the direct percentage of land area because many Federal properties in the combined sewer area are in highly urbanized locations with little pervious area.

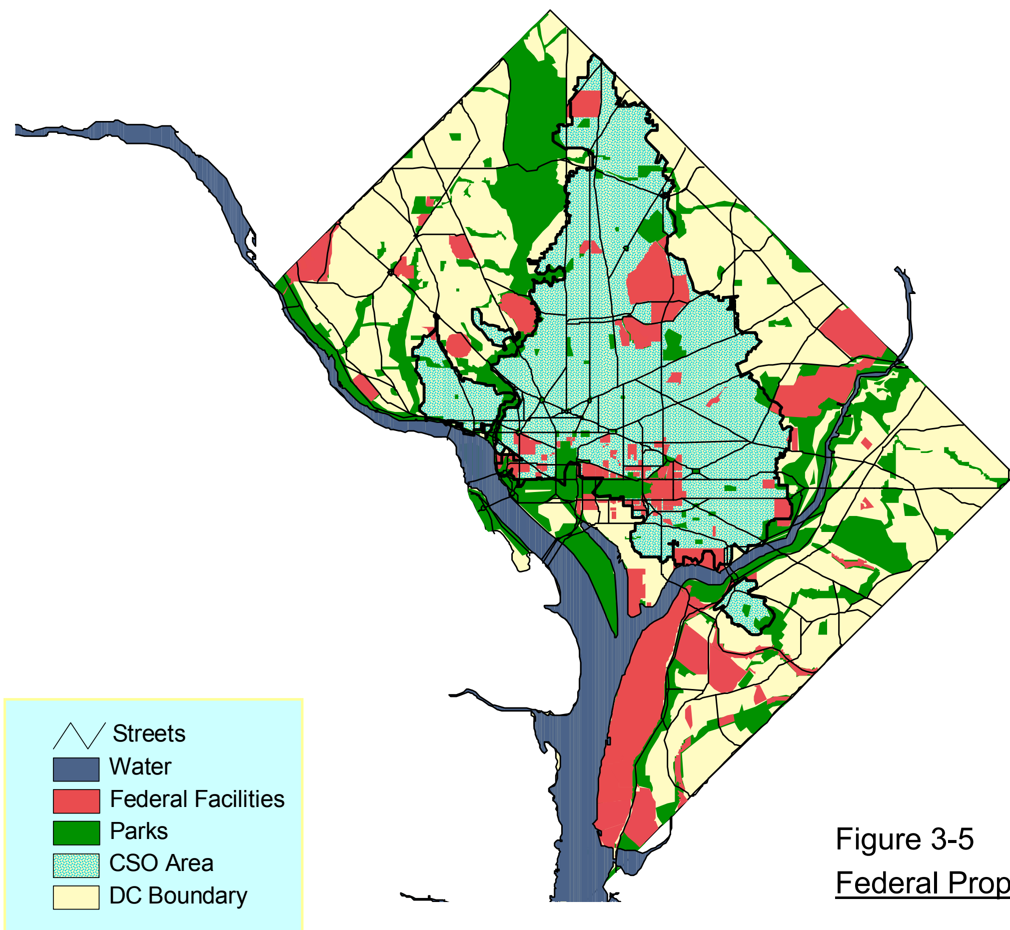

Figure 3-5
Federal Properties

Virtually all the wastewater that is conveyed to BPWWTP, including the contribution from surrounding jurisdictions and federal facilities, must be pumped. The major facilities that pump wastewater to Blue Plains are as follows:

- Potomac Pumping Station: This station was designed to have a firm capacity of 460 mgd and pumps the wastewater from the Potomac/Rock Creek system to BPWWTP via force mains that cross under the Anacostia River at the confluence with the Potomac River. It also conveys wastewater loads from surrounding jurisdictions that enter the District via the Rock Creek Main Interceptor and the Potomac Interceptor.
- Main Pumping Station: This station is split into a sanitary side and a storm side. The sanitary side primarily handles dry weather sanitary flows, designed to have a firm capacity of 240 mgd. It pumps wastewater from the Tiber Creek and B Street/New Jersey Ave. drainage areas, as well as flows from the Potomac/Rock Creek system that enter the B St/NJ Ave. Trunk Sewer, under the Anacostia River via siphons to BPWWTP. The storm side is used during wet weather events, with a firm capacity of 400 mgd, to lift storm overflows into the Anacostia River and prevent flooding of basements and streets in the surrounding low-lying drainage areas.
- "O" Street Pumping Station: Like the Main Pumping Station, this station is split into sanitary and storm sides and is designed to have firm capacities of 45 and 500 mgd, respectively. The sanitary side pumps wastewater from the Southwest Interceptor, which serves a low-lying area, to one of the siphons that run under the Anacostia and to BPWWTP. The storm side pumps combined sewage from the B Street/New Jersey Avenue Relief Sewer, which serves a low-lying area of the B Street/New Jersey Avenue drainage area, to the Anacostia River.
- Poplar Point Pumping Station: This station was designed to have a firm capacity of 45 mgd and pumps combined wastewater from the Anacostia Main Interceptor to the Outfall Sewers that lead to BPWWTP. The Anacostia Main Interceptor conveys the combined and sanitary flows from the portion of the District that is east of the Anacostia River.
- Eastside Pumping Station: This station was designed to have a firm capacity of 45 mgd and pumps separate sanitary wastewater from the East Side Interceptor Relief Sewer. During storm events it also transports the material removed by the Northeast Boundary Swirl Facility (NEBSF). All flows are pumped across the Anacostia River via a force main and into the 108" Anacostia River Force Main. The operation of the NEBSF is discussed further in Section 3.2.3.
- Rock Creek Pumping Station: This station was designed to have a firm capacity of 40 mgd and pumps combined wastewater flows from the Georgetown and West Rock Creek Area on to the Potomac Pumping Station for transport to BPWWTP.
- WSSC Anacostia Pumping Stations #1 and #2: As stipulated in the IMA, these stations can pump an average of 83.2 mgd and a peak of 185.0 mgd of WSSC flow into the 108" Anacostia River Force Main. Some District sanitary sewers near the boundary drain to Maryland because of the nature of the topography. As a result, these pumping stations are permitted to convey an additional 14 mgd of District flow. This results in a net peak of 199 mgd (185 mgd WSSC flow + 14 mgd District flow).

The capacities of the pumping stations are summarized in Table 3-2.

Table 3-2
Pumping Station Design Capacities

Facility	*Design Firm Capacity*[1]
Potomac Pumping Station	460 mgd
Main Pumping Station	Sanitary Pumps – 240 mgd Storm Pumps – 400 mgd
O Street Pumping Station	Sanitary Pumps – 45 mgd Storm Pumps – 500 mgd
Poplar Point Pumping Station	45 mgd
East Side Pumping Station	45 mgd
Rock Creek Pumping Station	40 mgd
WSSC's Anacostia Pumping Station No. 1 and 2	199 mgd peak

Notes: 1. Designed to have indicated capacity with largest pump out of service.

3.2.2 Blue Plains Wastewater Treatment Plant

A process flow schematic for the BPWWTP is shown in Figure 3-6. The facility is rated for an annual average flow of 370 mgd, and the treatment train consists of screening, grit removal, primary treatment, secondary treatment, nutrient removal, filtration and disinfection. During wet weather events, flows up to 740 mgd can receive treatment for up to 4 hours. After the first 4 hours, the treatment capacity is reduced to 511 mgd to protect the biological process. Additional flows of up to 336 mgd that exceed the treatment capacity of the plant receive excess flow treatment, which consists of screening, grit removal, primary treatment and disinfection before discharge to the Potomac River. This results in an overall plant capacity of 1076 mgd for the first four hours and 847 mgd thereafter. The amount of flow that is diverted and the duration during which it is diverted to excess flow treatment depends on the flow rates and durations of the storm events.

3.2.3 Existing CSO Controls and Programs

In addition to the excess flow treatment capacity of BPWWTP, WASA has several facilities and programs in place to address CSOs. The Phase I CSO Controls completed in 1991 include the Northeast Boundary Swirl Facility and the inflatable dam system for in-system storage. These and other CSO controls are described below.

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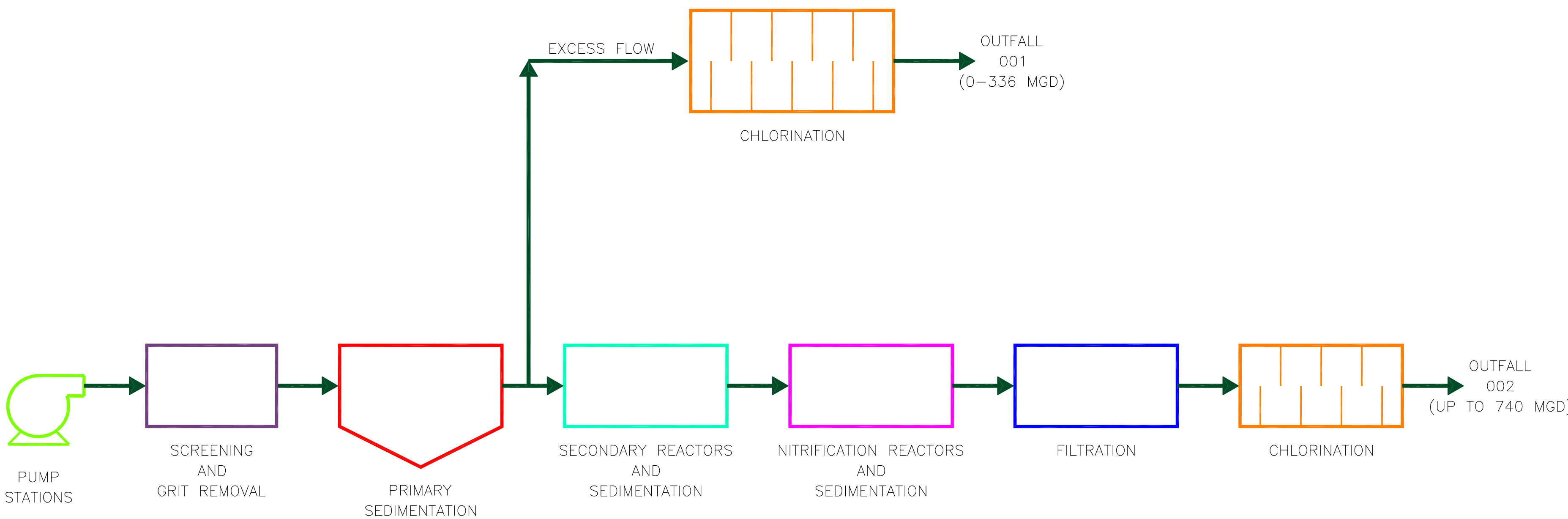
FIGURE 3-6



NOTE:

AVERAGE DESIGN CAPACITY IS 370 MGD.

PROCESS SCHEMATIC
BLUE PLAINS WASTEWATER TREATMENT PLANT

NOT TO SCALE

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CSO Regulators: Regulator structures associated with each CSO outfall control the amount of flow diverted to interceptors, which convey wastewater to BPWWTP. During dry weather, flows are diverted to BPWWTP for treatment. During wet weather events, the regulators divert combined sewage, the mixture of sanitary wastewater and storm water, within the system up to design capacities. When flows exceed the design capacities of the system, the regulator structures divert excess flow to CSO outfalls, which discharge to the receiving waters. Release of the combined sewer overflow to the outfalls is necessary to prevent flooding in homes, businesses, and streets. The frequency and volume of discharge from each of these structures varies depending on the relative capacity of the downstream interceptor, the hydraulic geometry of the overflow structure itself, storm intensities and duration, and the size of the contributing drainage area.

Northeast Boundary Swirl Facility (NEBSF): The NEBSF is located at the south end of the RFK Stadium parking lot, on the west bank of the Anacostia River, and adjacent to the East Side Pump Station. This facility went into operation in January 1991. During storm events, this facility provides treatment and disinfection for up to 400 mgd of combined sewer overflow before discharging to the Anacostia River at CSO Outfall 019. Flow in excess of 400 mgd overflows directly to the Anacostia River without treatment and disinfection. The routing of flows to the NEBSF and to the Anacostia River is controlled by three inflatable dams. Treatment processes include mechanical screening of influent combined sewage, followed by concentration of solid materials in three swirl concentrator tanks and disinfection of the treated effluent. The concentrated, solids-bearing underflow is discharged to the 48-inch East Side Interceptor Relief Sewer, where it flows by gravity to the East Side Pumping Station. The East Side Pumping Station then pumps the discharge to BPWWTP as described earlier in Section 3.2.1.

In-System Storage: WASA operates and maintains twelve inflatable dams at eight different locations. The structure number, location and number of dams per site are presented in Table 3-3. The inflatable dams consist of multi-ply elastomeric (i.e., "rubber") fabric dams installed in major overflow conduits within the combined sewer system. The installation consists of the dam, attachment hardware, mechanical inflation equipment housed in a nearby vault, air piping and valves, an over-pressure blowoff tank and an automatic control system. The objective of the inflatable dam installation is to increase the effective depth to which the sewage must rise in the combined sewer before overflows occur. The effect of the installation is to retain a greater volume of combined sewage flow resulting from low to moderate intensity storms by maximizing storage within the CSS. During higher intensity storms, when the full carrying capacity of the overflow conduit is required to prevent upstream flooding, the dam is deflated automatically based on a signal from an upstream level sensor or a supervisory override command from an operator. During dry weather conditions the dams are normally maintained fully inflated under low pressure. The six dams at structures 14, 15, 15a, and 16 are currently out of service. However, an effort is currently underway to upgrade and replace inflatable dams and appurtenances at all existing inflatable dam locations.

Table 3-3
Inflatable Dam Locations

Structure Number	*Location*	*Combined Sewer*	*Number of Dams*
14	Main Pumping Station – West Side	B St. – New Jersey Ave. Trunk Sewer	2
15	South Capitol and E Sts., SE	B St. – New Jersey Ave. Trunk Sewer	1
15a	Half and L Sts., SE	B St. – New Jersey Ave. Trunk Sewer	1
16	Main Pumping Station – East Side	Tiber Creek Trunk Sewer	2
24	RFK Memorial Stadium – South Parking Lot	Northeast Boundary Sewer	3
34	23rd and Constitution, NW	Easby Point Trunk Sewer	1
35	Kennedy Center - East Parking Lot	East Rock Creek Diversion Sewer	1
52	22nd St., between M and N Sts., NW	Slash Run Trunk Sewer	1
		Total Number of Inflatable Dams	12

Nine Minimum Controls: In addition to the aforementioned devices and facilities, WASA also has a Nine Minimum Controls (NMC) program in place to address the issue of CSO's. WASA first provided documentation on its NMC program in a December 1996 report entitled "Nine Minimum Controls Compliance Report". As part of its continuous improvement effort, WASA prepared a report titled "Combined Sewer System Nine Minimum Controls Summary Report" in July 1999, which represented an update of the earlier Nine Minimum Controls Report submitted to the EPA. The Summary Report provided an update on various activities undertaken by WASA as part of the Nine Minimum Controls (NMC) program and included recommendations for enhancement of several activities associated with this program. A "NMC Action Plan Report" was prepared in February 2000, which detailed a schedule for implementing the recommended enhancements. Examples of measures that have been implemented include:

- Inspections of critical facilities such as outfalls, regulators, pump stations and tide gates
- Maximization of storage in the collection system through the use of inflatable dams
- Implementation of a pretreatment program for industrial users
- Inspection, maintenance and improvement of regulators and outfalls to prevent and correct dry weather overflows
- Operation of the Northeast Boundary Swirl facility to control CSOs and floatables
- Operation of skimmer boats on the Anacostia and screens at certain pump stations to control floatables
- Installation and demonstration evaluation of End-of-Pipe Netting system for floatables control at CSO Outfall 018
- Placement of notification signs at outfalls for public notification
- Development of a CSO web page on the D. C. WASA website

- Major maintenance projects such as the cleaning of the Eastside Interceptor and the sonar inspection of the Anacostia siphons

LTCP Development Effort: WASA submitted its LTCP Program Plan to EPA in July 1999. An extensive monitoring program for the LTCP was carried out from August 1999 – June 2000. The data gathered from this monitoring effort has been used to develop computer models to evaluate alternatives for mitigating the impact of CSO's and other major sources of pollution on the receiving waters. A Draft LTCP was submitted in June 2001. This report describes the proposed Final LTCP.

3.3 SEPARATE SANITARY SEWER SYSTEM

Generally the newer sections of the District surrounding the older central portion are served by a separate sanitary sewer system. In these areas sanitary sewage is collected in a system of service sewers typically located at a depth of 11 feet below ground to allow for gravity flow from basements of adjacent buildings. The sanitary sewer system typically has smaller pipes than the combined sewer system, since it does not handle storm water flows. The separate system has three pump stations that convey only sanitary sewage as follows:

- Earl Place Pump Station
- Third and Constitution Avenue Pump Station
- Upper Anacostia Pump Station

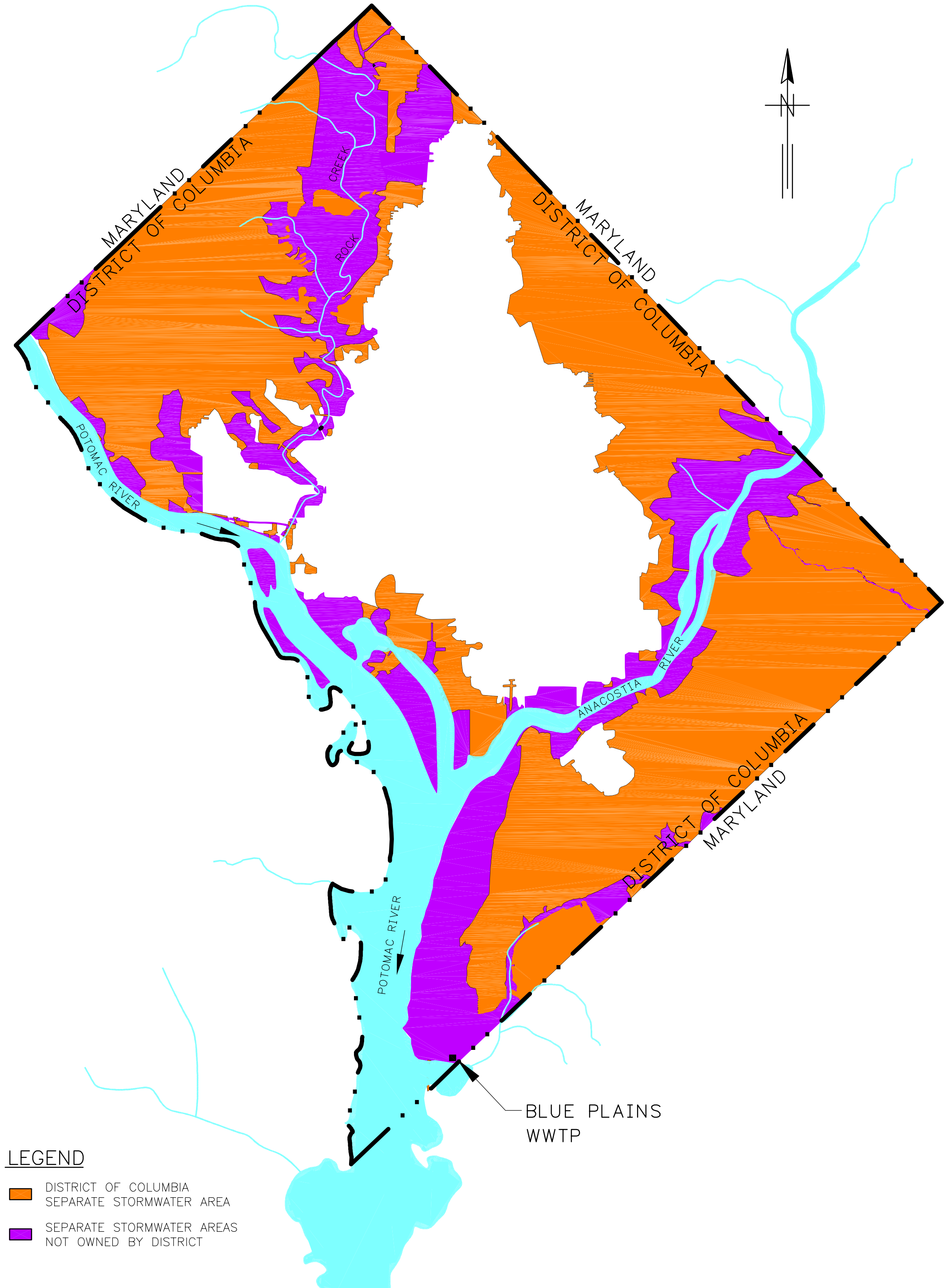
The majority of the District's separate sanitary sewer system sewersheds discharge into the combined sewer system for final conveyance to BPWWTP for treatment except for a portion of the Southeast area of the District.

3.4 SEPARATE STORM WATER SYSTEM

3.4.1 Collection System

The areas surrounding the core of the District of Columbia are served by a separate storm sewer system. The location of the District Government's separate storm sewer shed is presented on Figure 3-7. These areas generally consist of neighborhoods that have been developed or redeveloped during the 20th century. A total of 447 separate storm sewer sheds and storm sewer outfalls have been identified as being owned by the District of Columbia (Peer Consultants, 1996). An additional 627 separate storm sewer outfalls and associated storm sewer sheds in the District of Columbia were identified as being owned by other agencies such as the National Park Service, the Air Force, and other federal agencies. A database was developed for all of the separate storm sewer outfalls and sewer sheds owned by the District as part of the District of Columbia's Part 2 Storm Water Permit Application (Peer Consultants, 1996).

FIGURE 3-7



SEPARATE STORMWATER AREA

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3.4.2 Existing Controls and Programs

On April 19, 2000, the U.S. Environmental Protection Agency issued NPDES Permit No. DC0000221 to the Government of the District of Columbia authorizing discharges from the District's Municipal Separate Storm Water System (MS4) under certain specified conditions. As part of that permit, the District is obligated to comply with various reporting requirements and perform numerous activities focused on further reducing the discharge of pollutants to receiving waters. Details of these activities are presented in the *Municipal Separate Storm Sewer System First Annual Review* (April 19, 2001). Presented below is a summary of some of the major activities planned or currently underway.

3.4.2.1 MS4 Retrofits

Plans are currently underway to conduct an evaluation to determine the location, sizing and number of MS4 retrofits necessary to meet the requirements of the CWA and EPA regulations. The results of these evaluations will be presented in the First Annual Report due April 19, 2002.

3.4.2.2 Management Plan For Commercial, Residential & Government Areas

The District's DOH is applying greater focus on its storm water controls to encourage the use of functional landscape at parking lots and/or new developments by implementing low impact development such as reduced road length and width, infiltration ditches, porous pavements, grassy swales and filter strips.

Approximately 800 storm water BMPs (Best Management Practices) have been approved in the District of Columbia. Most are designed for small parcels of land that are undergoing redevelopment. Many are for sites that are less then one acre. Eighty percent are sand filters and the rest are primarily oil and grit separators, wet and dry ponds, and rooftop detention facilities. Approximately 50 - 60 percent have been constructed. The storm water BMPs are spread across the combined and separate sewer systems.

A limited number of BMP performance and maintenance studies have been conducted and the results are not finalized and therefore not yet available. The DC Department of Health is currently transferring the BMP information to an electronic database. No report on BMP status will be available until the database is complete. (Personal Communication with Hamid Karami 4/2001).

There are plans to expand the requirements of the BMPs to include road construction and Federal facilities. The District Department of Health (DOH) also intends to hire additional staff to assist in the review and enforcement of the BMPs.

Listed below are additional elements of the Management Plan that are underway or being pursued by the District, and generally include the joint efforts and coordination between DOH, DCRA, DPW, DOT, and WASA:

- Coordinated catch basin cleaning and street sweeping strategy
- Solid waste program to include leaf collection
- Preventive maintenance inspections for all existing SWM (Stormwater Management) facilities
- Rain leader disconnect program
- Phased approach to public education including collecting pet feces and environmentally friendly fertilizing and landscaping techniques.
- Modeling of storm water impacts
- Method to measure performance of these activities.
- Strengthen erosion control program for new construction.
- Program to control storm water discharges from Federal and District government areas to same extent as that for commercial, residential and industrial areas.

3.4.2.3 Management Plan For Industrial Facilities

The District's DOH is presently working towards implementation of a program to monitor and control pollutants discharged to the storm sewer system from industrial facilities including: private solid waste transfer stations; hazardous waste treatment, disposal and or recovery plants; those subject to the Emergency Planning and Community Right-to-Know Act (also know as SARA Title III or EPCRA); those with NPDES permits; and those with a discharge to the storm sewer system. In keeping with this effort, the District maintains and updates an industrial facilities database as well as performs on-site assistance, inspections and outreach programs to industrial facilities. In addition the DOH has developed a Water Pollution Control Contingency Plan in response to accidental spills that provides guidance on response to non-permitted hazardous material releases.

3.4.2.4 Management Plan For Construction Sites

Pollutant discharges from construction sites is controlled through the sediment and erosion control review process based on the guidelines published by the DOH. Although comprehensive enforcement regulations are in-place, a single written enforcement strategy has not been prepared. The number of sediment and erosion control site inspections for fiscal year 2000 was 5,172, which exceeded the target of 3000 (First Annual Review, April 19, 2001).

The DOH also implements educational measures for construction site operators through site inspections and dissemination of its Storm Water Management Guidebook and Sediment & Erosion Control Handbook to owners and project designers.

3.4.2.5 Control Of Pollution From Municipal Landfills & Other Municipal Waste Facilities

The DPW collects solid waste from approximately 100,000 single-family residences throughout the City. In FY 2000, DPW crews collected approximately 118,000 tons of waste. All District government collected waste (including bulk waste, litter receptacle waste, street cleaning debris, and other material) totals approximately 207,000 tons per year. Commercial haulers collect waste and recyclable materials from multi-family and commercial and institutional properties. Commercial haulers collect approximately 423,000 tons per year (First Annual Review, April 19, 2001).

As part of the District's plan to reduce pollutants from District-owned or operated solid waste transfer stations, and maintenance and storage yards for waste transportation fleets and equipment, the District has established a solid waste facility permitting process for private solid waste transfer stations, which includes performance standards for operation. These regulations are currently being challenged in court and cannot be enforced at this time.

3.4.2.6 Control Of Pollutants From Hazardous Waste Sites

The District has or is in the process of implementing a number of programs aimed at controlling pollutant discharges to the MS4 from hazardous waste sites. The DOH has developed a document entitled "Hazardous Waste Management", which describes the procedures for proper identification, handling and reporting of hazardous materials. A general plan for a hazardous waste monitoring and control program is given in DOH's "Strategic Plan for Enhancement of Environmental Health Administration Hazardous Waste Division". A standard operating procedure for hazardous waste reporting has been written by DOH. The District plans to integrate these documents into a unified program.

In addition to the above, the DOH has prepared standard operating procedures for hazardous waste site identification numbering and entry into the Resource Conservation and Recovery Information System (RCRIS) national database.

3.4.2.7 Pesticides, Herbicides And Fertilizer Application

The DOH's Pesticide Management Program describes its applicator certification and training, licensing and enforcement of pesticide regulations. In addition, the District makes educational literature available to the general public regarding pesticide control and reduction by private property owners.

3.4.2.8 Deicing Activities

In an effort to minimize water quality degradation from chemical deicers, salt, sand and/or salt/deicer mixtures, the District had developed a scope-of-work with Howard University Department of Engineering to conduct a study of Best Management Practices related to roadway construction and maintenance and snow management. The investigation being prepared focuses on the effectiveness of alternative management practices and not on the environmental impacts of these practices.

3.4.2.9 Additional Activities

Additional activities that are planned or currently underway through DOH include the following:

- Management Plan to detect and remove illicit discharges
- Enforcement Plan
- Public Education Program
- Monitoring Program for storm water outfalls.

Section 4
Sewer Systems Characterization

4.1 INTRODUCTION

The purpose of sewer system characterization is to assess the magnitude, frequency, duration and nature of CSO and separate storm water discharges to facilitate assessment of their water quality impacts and to evaluate of control measures. Characterization was performed by:

- Assembling data on the sewer system – developing and organizing basic data on the construction of the sewer systems
- Monitoring – collecting measurements in the field on combined sewer overflow (CSO) and separate storm water system (SSWS) flow volumes, durations, overflow rates, and pollutant concentrations
- Computer modeling – developing a predictive model for both the combined sewer system (CSS) and SSWS

Each of these is described below.

4.2 BASIC SEWER SYSTEM DATA

Basic data on the sewer system and the sewer sheds was obtained from a variety of sources as shown in Table 4-1. Furthermore, previous studies provided valuable background information on the history and previous assessments of the CSS:

- Metcalf & Eddy Engineers, 1955: The capacities of existing sewers and pump stations, the physical conditions of existing sewers, and the extent of CSO problems in the District were evaluated.
- Boards of Engineers, 1957: Using the findings in the Metcalf & Eddy Engineers, 1955 report as a design basis, recommendations on new construction and modifications to the existing sewer system were issued to serve the year 2000 projected population in the District and surrounding areas.
- O’Brien & Gere, 1983: Data was gathered during a monitoring program, and entered into a sewer system and receiving water computer model, whose output results were used to develop recommendations to address the CSO problem. Many of the recommendations of this report, such as regulator modifications, inflatable dam installations, and the building of the NEBSF, were implemented.
- Delon Hampton & Associates, 1998: Recommendations were issued for upgrades and rehabilitations of the major pump stations, as well as for the increase of wet weather conveyance capacity to BPWWTP. WASA has moved ahead with the procurement of a

program manager and designer for these rehabilitation projects and is ready to begin implementation once the sizing, layout and location of facilities are finalized as part of the selection of the Final LTCP.

- Engineering Program Management Consultant-III, 2000a: This document, otherwise known as the "Structures Book" was updated based on detailed inspections of each regulator structure. To-scale drawings of each regulator structure, including dimensions and invert elevations were included.

Table 4-1
Sources of Data

Type	Data	Source(s)
Hydrologic	1. Urban catchments and sewershed areas	• Digitization of paper maps from Metcalf & Eddy (1955) and Board of Engineers (1957) • GIS images from Peer Consultants (1996)
	2. Surface Slopes	• 10' contours from the USGS Quad Sheets
	3. Surface Roughness and Percent Imperviousness	• Peers Consultants (1996)
	4. Infiltration Parameters	• Soil Coverage Maps
	5. Rainfall Data	• NCDC data for Ronald Reagan National Airport • Daily data from U.S. Soldiers' Home, Dalecarlia Reservoir and the National Arboretum • 15-minute data from the four internal gages set up during EPMC-III Study
Hydraulic	1. Pipes and Manholes (invert elevations, slopes, profiles, dimensions)	• Digitization of paper maps from the Metcalf & Eddy (1955) and Board of Engineers (1957) • As-built and counter maps from WASA Archives
	2. Diversion Structures	• EPMC- III (2000a) • Field inspections • As-built drawings from WASA archives
	3. Pump Stations/ Inflatable Dams (capacities, operational schemes)	• Logs maintained by WASA • Field experience of WASA Staff • Direct observation during both wet and dry weather
	4. Tide Levels	• NOAA Data for the Washington Shipping Channel
	5. Dry Weather Flow	• SCADA Data maintained by WASA • Monitoring Data from EPMC-III Study • Monitoring Data from MWCOG's Study on Upper Potomac Interceptor

4.3 MONITORING PROGRAM

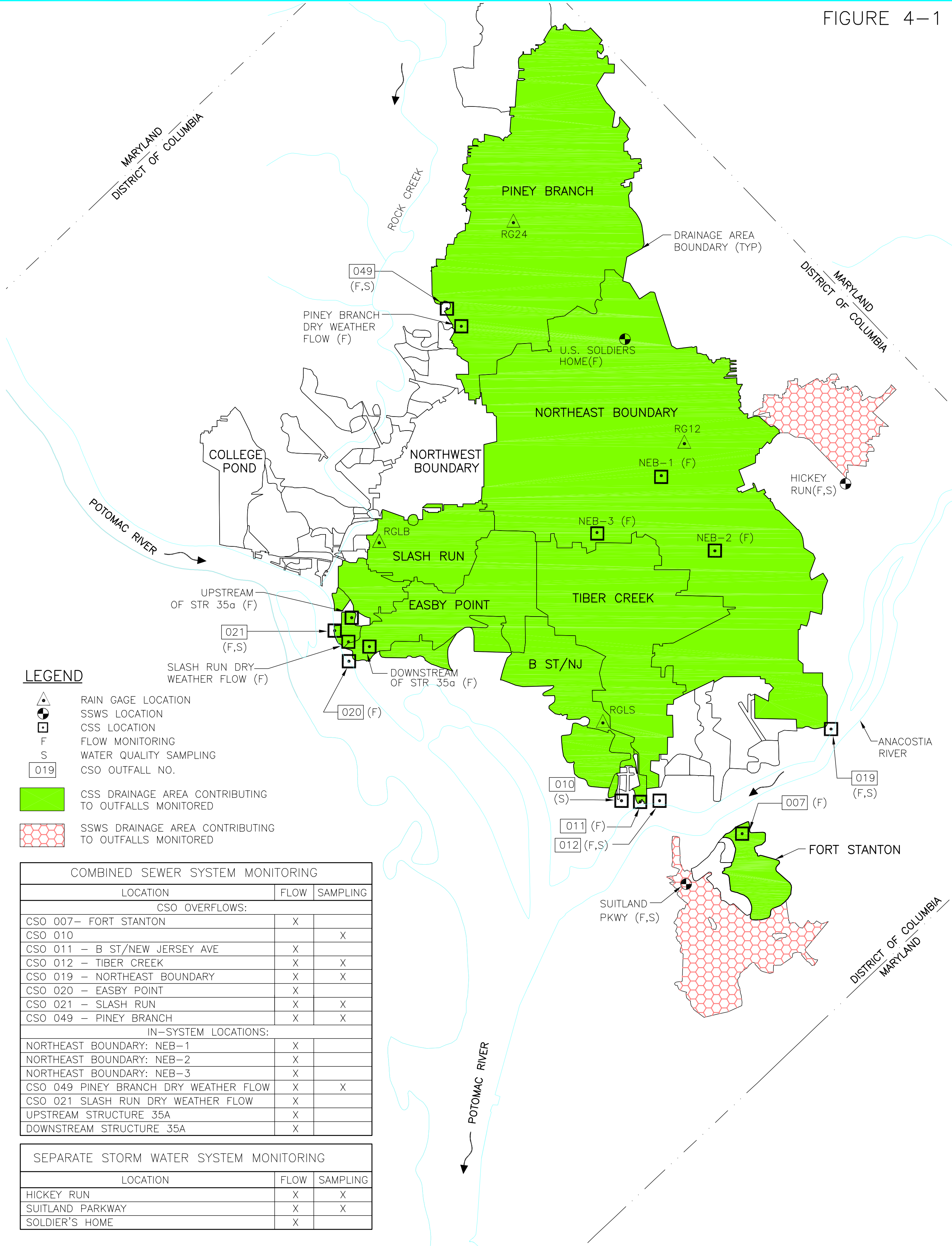
Monitoring of both the CSS and SSWS was undertaken as part of the LTCP from August 1999 – August 2000. The purpose of the monitoring was to collect data on the magnitude and nature of CSO and SSWS discharges to enable calibration of the computer models and to assess receiving water impacts. The monitoring consisted of the following major components:

- Rain Gages and NEXRAD Radar Data
  Four rain gages were installed in the CSS to collect data on rainfall in selected drainage areas in the CSS. The drainage areas were selected to correspond with the major CSO outfalls that were monitored. The rain gages were situated, to the extent possible, in the centroids of their drainage areas to obtain representative measurements of rainfall. However, rainfall can vary widely over even a small geographic area. Therefore, NEXRAD radar rainfall data at a 2 km x 2 km (1.25 mile x 1.25 mile) grid resolution was used to calculate the total rainfall in each drainage area during each rain event. This radar rainfall data was then corrected and adjusted using the measurements recorded at the rain gages. Rain gage locations are shown on Figure 4-1.

- CSS Flow Monitoring and Sampling
  Flow monitors were installed at 15 locations in the combined sewer system, as shown on Figure 4-1 and in Table 4-2. Eight of these locations were CSO outfalls, while the remainder were internal system points in the CSS. The monitors at the internal system points were used to measure dry weather flows to better calibrate the CSS computer model. At some locations, more than one flow monitor was required due to the configuration of the sewers. Flow monitors operated continuously and collected data at five or fifteen minute intervals depending on locations. Samples were collected at seven locations to characterize the nature of CSO overflows. Samples were typically collected at ½ hour to 1 hour intervals throughout the overflow events. Table 4-3 summarizes the rain events during which samples were taken at the CSS monitoring locations. Figure 4-2 graphically depicts the relative amounts of CSO volume that came out of the outfalls during the monitoring period.

  In addition to the data available from the installed flow monitors, flow data at various locations was also obtained from WASA's SCADA system. Although most of the SCADA points measure flows into WASA's sewer system from surrounding jurisdictions, some measure flows from WASA's pump stations to BPWWTP, and were thus valuable in constructing the computer model.

FIGURE 4-1



LEGEND

- RAIN GAGE LOCATION
- SSWS LOCATION
- CSS LOCATION
- F FLOW MONITORING
- S WATER QUALITY SAMPLING
- 019 CSO OUTFALL NO.
- CSS DRAINAGE AREA CONTRIBUTING TO OUTFALLS MONITORED
- SSWS DRAINAGE AREA CONTRIBUTING TO OUTFALLS MONITORED

COMBINED SEWER SYSTEM MONITORING		
LOCATION	FLOW	SAMPLING
CSO OVERFLOWS:		
CSO 007- FORT STANTON	X	
CSO 010		X
CSO 011 - B ST/NEW JERSEY AVE	X	
CSO 012 - TIBER CREEK	X	X
CSO 019 - NORTHEAST BOUNDARY	X	X
CSO 020 - EASBY POINT	X	
CSO 021 - SLASH RUN	X	X
CSO 049 - PINEY BRANCH	X	X
IN-SYSTEM LOCATIONS:		
NORTHEAST BOUNDARY: NEB-1	X	
NORTHEAST BOUNDARY: NEB-2	X	
NORTHEAST BOUNDARY: NEB-3	X	
CSO 049 PINEY BRANCH DRY WEATHER FLOW	X	X
CSO 021 SLASH RUN DRY WEATHER FLOW	X	
UPSTREAM STRUCTURE 35A	X	
DOWNSTREAM STRUCTURE 35A	X	

SEPARATE STORM WATER SYSTEM MONITORING		
LOCATION	FLOW	SAMPLING
HICKEY RUN	X	X
SUITLAND PARKWAY	X	X
SOLDIER'S HOME	X	

CSS AND SSWS MONITORING LOCATIONS

NOT TO SCALE

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D.C. WATER AND SEWER AUTHORITY
CSS LONG TERM CONTROL PLAN

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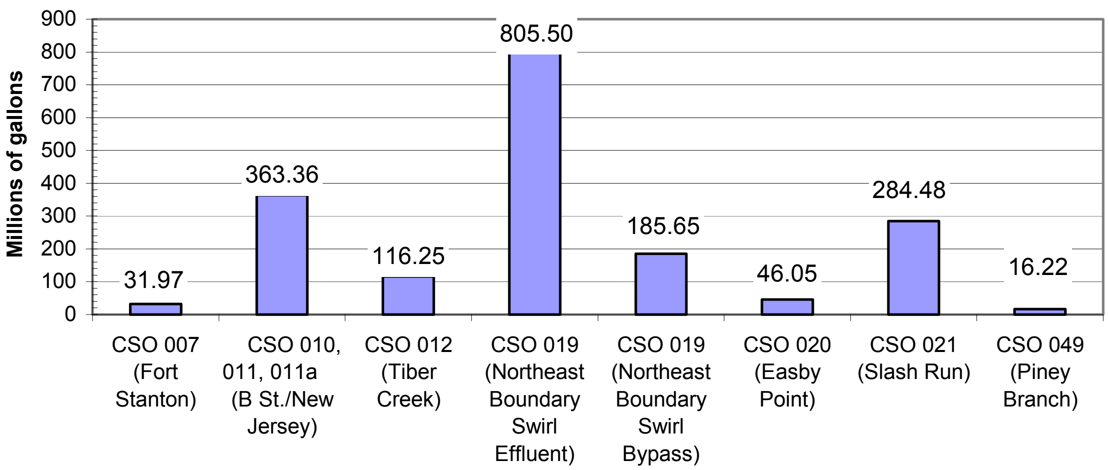
Overflows from the sampled and flow monitored outfalls comprised approximately 70% of the total combined sewer drainage area. The remainder of the CSS drainage areas are composed of over twenty other smaller drainage areas, most of which are under 200 acres.

- SSWS Flow Monitoring and Sampling
  Flow monitors were installed on three storm sewers in the SSWS to collect data on flow and water quality. One of these flow monitors was installed on a storm sewer which ultimately discharges to a combined sewer in the Soldier's Home area. This flow monitor provided data on the storm water generated from relatively undeveloped green space in the CSS. The SWSS monitoring locations are summarized in Table 4-2. Table 4-3 summarizes the rain events during which samples were taken at the SWSS monitoring locations.

Figure 4-2
Total Monitored CSO Overflow Volume (mg)
November 1999 - August 2000
Total Rainfall[1] = 32.69"



[1]Average of four installed rain gages and National Airport rain gage.

CSO Outfall and Drainage Area

Table 4-2
CSS and SWSS Monitoring Sites

Drainage Area	*Site*	*Sampler*	*Location*	*Type of Monitoring*
Rain Gages				
Northeast Boundary	Company 12 Fire Station		Rhode Island Ave and 5th St. NE	Rainfall
Piney Branch	Company 24 Fire Station		Gallatin St and Georgia Ave NW	Rainfall
Slash Run	West End Branch Library		24th/L St. NW	Rainfall
Tiber Creek/B. St. N.J.	WASA Storm Water Lift Station		1st and D St. SE	Rainfall
Combined Sewer System				
Fort Stanton	CSO 007		13th and Ridge St. S.E.	CSO overflow
B St./New Jersey Ave	CSO 010	X	'O' Street Pumping Station	CSO sampling, no flow monitoring
	CSO 011		B St. N.J. Ave. Trunk Sewer (Main P.S.)	CSO overflow
	Upstream of Structure 35a		"F" St/New Hampshire N.W.	In-system hydraulics
	Downstream of Structure 35a		23rd/Constitution, State Dept. Parking Lot	In-system hydraulics
Tiber Creek	CSO 012	X	Tiber Creek Trunk Sewer (Main P.S.)	CSO overflow
Northeast Boundary	Flooding Area #1		"W" St/5th St. N.E.	In-system hydraulics
	Flooding Area #2		Neal Street N.E.	In-system hydraulics
	Flooding Area #3		"O" St/ N. Capitol St. N.W.	In-system hydraulics
	CSO 019	X	Northeast Boundary Swirl Effluent	CSO overflow
	CSO 019	X	Northeast Boundary Swirl Bypass	CSO overflow
Easby Point	CSO 020		Easby Point Sewer (23rd and Constitution, Mall Area)	CSO overflow
Slash Run	CSO 021	X	Slash Run Trunk Sewer Overflow (Near Kennedy Center)	Overflow
	CSO 021		Slash Run Trunk Sewer Dry Weather Flow (Near Kennedy Center)	Diverted flow
Piney Branch	CSO 049	X	Piney Branch Sewer	CSO overflow
	CSO 049	X	Piney Branch Diverted Flow (East Rock Creek Diversion Sewer)	Diverted flow
Separate Storm Water System				
Suitland Parkway	Suitland Pkwy Storm Water	X	Martin Luther King Jr. Ave. and Suitland Pkwy, S.E.	Storm water
Hickey Run	Hickey Run Storm Water	X	Route 50 (New York Ave) Access Road, N.E.	Storm water
Soldier's Home	Soldier's Home Storm Water		Irving St/N. Capitol St N.E.	Storm water

Table 4-3
Summary of CSS and SWSS Sampling

Rain Events	*Site*								
	Suitland Pkwy-- (Separate Storm water)	Hickey Run- (Separate Storm water)	CSO 010 – "O" Street P.S.	CSO 012 – Tiber Creek	CSO 019 – Northeast Boundary (Swirl Effluent)	CSO 019 – Northeast Boundary (Swirl Bypass)	CSO 021 – Slash Run	CSO 049 – Piney Branch (dry weather flow side)	CSO 049 – Piney Branch (overflow side)
9/14/99	x	x							
9/21/99	x	x							
10/17/99	x	x							
2/13 –2/14/00	x	x							
2/18 –2/19/00	x	x							
2/27 –2/28/00				x	x		x		
3/21/00				x	x		x		x
3/27/00				x	x		x		
4/8/00					x		x		
4/25/00					x		x		
5/19/00							x		
5/22/00					x				
6/15/00					x	x			
6/22/00			x			x			
7/14/00			x					x	
7/16/00			x						
8/3/00						x			
8/6/00			x						
8/27/00				x	x	x			
9/19/00						x	x	x	
9/25/00								x	
TOTAL	5	5	4	4	8	5	7	3	1

4.4 EVENT MEAN CONCENTRATIONS

Event mean concentrations (EMCs) were used to calculate conventional pollutant loads from the CSS, SSWS, and the Authority's wastewater treatment plant at Blue Plains (BPWWTP). EMCs are defined as the total mass of pollutants discharged divided by the total flow volume. EMCs for each monitored storm were calculated by computing a flow weighted average concentration of all the samples that were taken during the storm. In addition, overall EMCs for each site were calculated by computing flow weighted averages over all the monitored storm events. The EMCs were compared with EMCs calculated in previous studies (EPMC-III, 2000b) as a quality assurance check.

To generate loads to receiving waters, EMCs were multiplied by the modeled overflow volume from the CSS and the modeled flow volumes from the SSWS and BPWWTP effluent. The resulting pollutant loads served as inputs to the receiving water models.
Important details concerning the calculation of EMCs are as follows:

- At one CSO site (CSO 019 – Northeast Boundary), separate EMCs were calculated for the Swirl Effluent versus the Swirl Bypass, as the concentrations of key constituents were different after treatment and disinfection.

- Fecal coliform and e. coli concentrations were found to be extremely variable by site and by storm. At the same site, concentrations were found to vary by many orders of magnitude within the same storm and between different storms. A "first flush" effect was not always observed. This is consistent with CSO sampling results of other CSO programs. The lack of consistent first flush effect could be due to the spatial and temporal variations in rainfall, particularly in large drainage areas like Northeast Boundary. Given the high variability in bacteriological results, employing separate EMCs for each site may have distorted CSO loads during the evaluation phase. In order to provide a consistent framework for evaluating the effects of CSOs, a single EMC for fecal coliform and e. coli was used for all untreated CSOs. Each EMC was calculated by dividing the total number of organisms by the total volume of CSO at all sampled storms for all sites to generate an overall system EMC.

The EMCs for conventional parameters are summarized in Table 4-4.

Table 4-4
Event Mean Concentrations for Conventional Pollutants

Parameter	Units	Anacostia CSOs					Potomac and Rock Creek CSOs	Blue Plains		Separate Storm Water System
		B St./NJ Ave. (CSO 009, 010, 011, 011a)	Tiber Creek (CSO 012)	NEB Swirl Effluent (CSO 019)	NEB Swirl Bypass (CSO 019)	All Other Anacostia CSOs		Outfall 001 (Excess Flow)	Outfall 002	
$CBOD_5$, Total	mg/L	51	74	39	34	53	36	56.6	5	19
$CBOD_5$, Dissolved	mg/L	7	15	12	9	10	11			15
Chemical oxygen demand	mg/L	110	161	135	143	138	107			73
Dissolved Organic Carbon	mg/L	9	24	12	10	15				16
Total Suspended Solids	mg/L	147	186	118	182	171	130	130.1	7	94
Volatile Suspended Solids	mg/L	77	81	48	58	72	0			18
Ammonia-as N	mg/L	2.90	0.66	0.69	0.46	1.34	0.96	8.7	3.8	0.84
Nitrate+Nitrate-as N	mg/L	0.60	0.81	0.79	0.78	0.73	0.85	0.7	9.3	0.94
Total Kjeldahl Nitrogen	mg/L	6.0	4.0	4.0	2.4	4.1	3.8	16.3	1.54	2.2
Organic Nitrogen	mg/L	3.1	3.34	3.31	1.94	2.76	2.84	7.6	?	1.36
Total Organic Carbon	mg/L	14	30	16	12	19	0			19
Total Phosphorus	mg/L	1.31	0.98	0.85	0.83	1.04	1.04	2.4	0.18	0.44
Ortho Phosphorus (dissolved)	mg/L	0.37	0.11	0.23	0.15	0.21	0.22	0.8	0.05	0.22
Hardness	mg/L	85	71	43	40	66	37			56
Fecal Coliform	MPN/ 100 ml	939,270	939,270	191,309	939,270	939,270	939,270	70,206	200	28,265
E. Coli	MPN/ 100 ml	686,429	686,429	122,011	686,429	686,429	686,429	51,250	126	16,238
Dissolved Oxygen	mg/L	6	6	6	6	6	6	6	6.8	6
Organic Phosphorus	mg/L	0.94	0.87	0.62	0.68	0.83	0.82	1.6	0.13	0.22

4.5 TOXICS MONITORING AND ANALYSIS

4.5.1 Priority Pollutants

Monitoring was carried out for both CSO and storm water discharges for the 127 priority pollutants, which include the following classes of pollutants:

- Total Recoverable Metals and Cyanide
- Dissolved Metals
- Pesticides/PCBs
- Volatiles and Semivolatiles

In accordance with the monitoring program approved by regulatory agencies, manual grab samples were collected during one storm event at each of the following locations:

- Northeast Boundary (NEB) Swirl Facility Effluent at CSO 019
- Piney Branch – East Rock Creek Diversion Sewer located adjacent to CSO 049
- Hickey Run separate storm water monitoring site

Two samples were collected during the course of each storm event at each location. One sample was collected near the beginning of the event and the second sample was collected near the end of the event. At Piney Branch, samples were collected during a storm event in the East Rock Creek Diversion Sewer (ERCDS) and not at the CSO outfall. The ERCDS represents combined sewage captured in the combined sewer system and not CSO overflow. This was done because the infrequent and short durations of overflows at Piney Branch made sampling CSO overflow extremely difficult. The captured flow in the CSS is typically more concentrated than CSO overflow. This sampling is thus a conservative assessment of the overflow at Piney Branch.

For CSO, all results were below the laboratory method reporting limits for all priority pollutants except cyanide, chloroform and several metals. For storm water, asbestos, cyanide and chloroform and several metals were detected above the laboratory reporting limits. Metals will be discussed further in section 4.5.2. Results for the detected pollutants are summarized in Table 4-5.

Due to the intermittent and fairly short-term nature of CSOs, only acute standards (one hour average) are applicable. Chronic standards (4 day average) are not applicable. A comparison of the monitoring results for asbestos, cyanide and chloroform against the acute water quality standards are shown below:

Table 4-5
Detected Priority Pollutant Parameters
(Not including Metals)

Location	*Parameter*	*Sampling Results*	*Criteria Maximum Concentration /Acute (one hour average)*
CSO			
NEB Swirl	Cyanide	14 and 3 ug/l	22 ug/l
NEB Swirl	Chloroform	5 ug/l	No Acute Standard[1]
Storm water			
Hickey Run	Cyanide	4 ug/l	
Hickey Run	Chloroform	9 ug/l	No Acute Standard[1]
Hickey Run	Asbestos	510.811 mf/l	No Acute Standard

Note 1: Human health criteria is 470 ug/l.

It can be seen from the comparison above that the sampling results for cyanide and chloroform are well below applicable water quality standards. In addition, Notices of Violations for the period July 1999 to June 2001 from the WASA pretreatment program were reviewed. No violations for Significant Industrial Users (SIUs) within the combined sewer drainage area were found for the pollutants of concern in the table above. Therefore, cyanide and chloroform are not considered to be substances that require further control as part of the LTCP.

4.5.2 Metals

In addition to the metals analyses carried out as a part of the priority pollutant scans, additional total recoverable and dissolved metals sampling and laboratory analyses were completed. Table 4-6 shows the number of storm events and total number of samples collected over the monitoring period.

Table 4-6
Summary of Metals Sampling

Item	*Location*							
	Suitland Pkwy- (Separate Storm water)	Hickey Runt- (Separate Storm water)	CSO 010 – "O" Street P.S.	CSO 012 – Tiber Creek	CSO 019 – Northeast Boundary (Swirl Effluent)	CSO 019 – Northeast Boundary (Swirl Bypass)	CSO 021 – Slash Run	CSO 049 – Piney Branch (dry weather flow side)
Waterbody	Anacostia River						Potomac River	Rock Creek
No. of storms	3	5	1	5	5	4	6	4
Total samples	3	5[1]	2	7	17[2]	8	12	13

Note 1: 5 samples were analyzed for metals except for mercury which had 4 samples and hexavalent chromium which had 1 sample.

Note 2: 17 samples for metals except for hexavalent chromium, which had 15 samples.

For detected metals with existing WQS, 97th percentile daily values were calculated using the statistics model developed by the Virginia Department of Environmental Quality using the monitored sample results. The 97th percentile is typically used to establish permit limits for continuous discharges to protect against acute toxicity. Therefore, it is a conservative evaluation technique for short, intermittent discharges such as CSO.

The 97th percentile concentrations are compared against the criteria maximum concentrations (acute) water quality standard in Table 4-7.

Table 4-7
Summary of 97^{th} Percentile Daily Values for Metals at Monitored CSO and Storm Water Outfalls

		Calculated 97^{th} Percentile Daily Value (mg/L)							
		Anacostia River						*Rock Creek*	*Potomac River*
Parameter (all except Hg and Se are dissolved)	*CMC/Acute Water Quality Standard (mg/L)*[4]	*Suitland Parkway (Separate Storm Water)*	*Hickey Run (Separate Storm Water)*	*O St. Pump Station (CSO 010)*	*Tiber Creek (CSO 012)*	*CSO 019 (Swirl Bypass)*	*CSO 019 (Swirl Effluent)*	*Piney Branch (CSO 049)*	*Slash Run (CSO 021)*
Mercury(Hg)	0.0024	<RL	<RL	0.0006	0.0003	0.0002	0.0002	<RL	0.0005
Arsenic(As)	0.3600	<RL	<RL	<RL	<RL	0.0098	0.0060	<RL	<RL
Cadmium(Cd)	0.0019	0.00181	0.001232	<RL	0.0008	0.0012	0.0012	0.0015	0.0010
Total Chromium(Cr)	0.3313[3]	0.005644	0.004448	<RL	0.0064	<RL	0.0059	0.0061	0.0042
Copper(Cu)	0.0095	0.064079	0.046234	0.0590	0.0258	0.0334	0.0240	0.0230	0.0222
Lead(Pb)	0.0328	<RL	0.016328	0.0207	0.0129	0.0027	0.0127	0.0108	0.0181
Nickel(Ni)	0.8404	0.018108	0.016328	<RL	<RL	<RL	0.0060	0.0065	<RL
Selenium(Se)	0.0200	<RL	<RL	<RL	<RL	<RL	<RL	<RL	<RL
Silver(Ag)	0.0012	<RL	<RL	<RL	0.0016	<RL	<RL	0.001[1]	<RL
Zinc(Zn)	0.0679	0.12167	0.194673	0.1300	0.1180	0.1490	0.1329	0.0823	0.1093
Chromium VI(Cr)	0.0157	0.011288	<RL	0.0142	0.0080	<RL	0.0002	0.0076	0.0098

Notes:

1. One sample out of 13 was detected at 0.001 mg/L. This detected value is presented in the table.
2. RL = reporting limit
3. The water quality standard is for Chromium III not Total Chromium. The comparison of Total Chromium values as sampled to Chromium III is conservative.
4. Calculated based on system wide average CSO hardness of 54 mg/L.

This evaluation technique indicated that only dissolved copper and dissolved zinc were at levels that warranted further analysis. These two water quality standards are hardness dependent and it is therefore important to consider whether dilution is available in the receiving water to determine the appropriate hardness to use for calculation of the CMC /Acute standard.

Additional analyses carried out using the CORMIX model indicated that adequate dilution and mixing zone are present in the Potomac River at the representative outfall, Slash Run CSO Outfall 021, such that effective copper and zinc concentrations are below the calculated CMC/Acute water quality criteria as shown in Table 4-8.

Table 4-8
Results of Mixing Zone Analysis for CSO 021 /Potomac River as Compared to DOH WQS

Parameter	*Effective Concentration (ug/l)*	*Calculated Criteria Maximum Concentration/ Acute (one hour average)*[1]
Dissolved Copper	13.7	15.0
Dissolved Zinc	57.3	102.2

Note 1: Calculated using an in-stream hardness of 87.5 mg/l based on mixing of an upstream hardness in the Potomac River of 118 mg/l and the CSO mean hardness of 54 mg/l.

It was determined that the mixing zone modeling was not applicable for the Anacostia River and Piney Branch/Rock Creek representative outfalls, NEB CSO 019 and Piney Branch 049 evaluated for these waterbodies. This is due to the low 7Q10 flow rate in these receiving waters in relation to the CSO overflow rate modeled at these outfalls. As a result, there is no significant dilution available, during these low flow conditions.

The EPA has been developing an improved method, the Biotic Ligand Model (BLM), to assess the metal availability and toxicity for biota. The EPA Ecological Processes and Effects Committee of the Science Advisory Board has found that the BLM can significantly improve predictions of the acute toxicity of certain metals, such as copper. The EPA is currently drafting new copper criteria that will incorporate the BLM for criteria calculations. In anticipation of BLM being implemented by EPA, it was used to estimate what prospective recalculated acute standards values for copper would be when the method is issued.

The BLM approach takes into account other constituents such as dissolved organic carbon (DOC) in CSO that compete for the available dissolved copper, thus reducing its bioavailablity. Therefore, the BLM method recalculates the CMC/Acute standard taking into account that some of the dissolved copper is not bioavailable, allowing a higher standard that is just as protective. Table 4-9 displays the 97th Percentile Daily value as compared to the average condition and a conservative (worst case) scenario for the CSO overflow, demonstrating that the prospective recalculated acute copper water quality criteria based on the BLM would be above the maximum CSO concentrations for average and extreme water quality conditions.

Table 4-9
BLM Calculated CMCs for Dissolved Copper

Waterbody	*Parameter*	*97th Percentile Daily Value (ug/l)*	*BLM Calculated Criteria Maximum Concentration/ Acute (one hour average)[1] (ug/l)*	
			Average Condition[1]	*Worst Case Scenario[2]*
NEB CSO 019 Anacostia River	Dissolved Copper	25.8	113	28
Piney Branch CSO 049/Rock Creek	Dissolved Copper	22.2	113	28

Note 1: Calculated using the CSO mean hardness of 54 mg/l.
Note 2: Calculated using a hardness of 6 mg/l.

It is unclear whether the BLM method will be developed for zinc in the future. Note that dissolved zinc and dissolved copper concentrations in storm water are comparable to measured CSO overflow concentrations indicating that the source of these constituents in CSO is mostly likely runoff (See Table 4-7 above).

Since metals in SSWS are similar to metals levels in CSO, this suggests that sources are diffuse, part of the urban environment, and are picked up by runoff. Elimination of CSOs by separation would increase SSWS loads and increase metals discharge. CSO control captures and treats a large part of the storm water, reducing metals loads. The recommended CSS LTCP will provide significant reductions in CSO discharges. Discharges remaining after the recommended LTCP is implemented will typically occur well after the first flush and therefore, metals concentrations may be lower.

Moreover since metals appear to be picked up from the urban environment in runoff, storm water management programs (SWMP) might afford the most reasoned approach to achieving the overall goal of meeting WQS in the waterbodies. SWMPs may further reduce metals in CSO as well. In the interim, the selected LTCP described in Section 13 provides an effective solution to mitigate dissolved metals discharges to receiving waters by reducing CSO discharges.

4.6 MODELING PROGRAM

4.6.1 Combined Sewer System

The basic sewer system data and monitoring data were input into computer models that simulated the operation of the CSS and SSWS. The models were calibrated and validated using the monitoring data from October 1999 to June 2000, and various LTCP alternatives were evaluated by the predicted behavior of the CSS and SSWS for rain events during the forecast period of 1988 through 1990. Detailed descriptions of the model inputs are provided for reference in the respective study memoranda of model documentation for the combined sewer and separate storm water systems (EPMC-III 1999a and 1999b).

CSS Model Description

The MOUSE model was selected and calibrated as a tool for characterization and evaluation of the CSS. After an extensive evaluation of commercially available computer models, MOUSE was selected specifically for its ability to model the performance of additional real time controls. MOUSE, developed by DHI Inc. of Denmark, is a comprehensive package of programs developed specifically for the evaluation of complex hydraulic systems. It contains components that replicate the generation of runoff across urban watersheds, and the transport of both runoff and sanitary flow through combined sewer systems. The key inputs and sources of data are listed in Table 4-1. All the hydrologic and hydraulic elements present in the calibrated model (1999-2000) were retained in the forecast model (1988-1990).

Calibration of the combined sewer model was performed using the data from the flow monitors installed at the internal system points and the monitored outfalls, log data from all the pump stations and flow meter data from the surrounding jurisdictions which deliver flow to the District. The hydrologic model of MOUSE was run for each precipitation event, and the hydraulic model was run subsequently to characterize hydraulic routing to the pump stations and outfalls. About half of the precipitation events from the monitoring period of October 1999 through June 2000 were used for model calibration, and the remaining half were used for model validation.

Post-processing programs were developed to group the results from all the precipitation events used for model calibration and validation. The percent differences between the monitored and modeled flow volumes at the meters and pump stations were used to determine the adequacy of calibration.

For the forecast model, the hydrologic/ hydraulic model elements required modification based on the long-term control alternative being evaluated, for example:

- Implementing surface storage measures such as roof-top retention and low-impact development
- Building real time controls, such as new inflatable dams or repairing the ones that are not operational
- Building new storage structures in the collection system such as retention basins and deep tunnel
- Retrofitting diversion structures/ pipes with capacity limitations
- Rehabilitating existing pumps or building new pump stations.

Rainfall Characterization

Precipitation data was available at the Ronald Reagan National Airport (hourly intervals), four installed rain gages (15-minute intervals), and the daily-recording gages at the U.S. Soldier's and Airman's Home, National Arboretum, and Dalecarlia Reservoir for the calibration period. As described in Section 4.3, this rain gage data was used in conjunction with radar rainfall data (NEXRAIN) to obtain a more accurate estimate of rainfall patterns and amounts. This data was input into a 2 km by 2 km resolution grid in the model. All the hydrologic and hydraulic elements were input in the MOUSE model with their geographical coordinates. The model automatically uses the data from the closest grid for hydrologic modeling in a sewer shed.

However, during the forecast period, only the daily data at the Dalecarlia Reservoir and National Arboretum, along with the hourly data at Ronald Reagan National Airport were available. Rainfall disaggregation procedures and linear interpolation techniques were used to estimate spatially-varied hourly precipitation data for 4 km by 4 km grids in the District. Some long-term control alternatives utilize storage structures in the collection system such as retention basins and deep tunnels that would increase the travel time within the sewer system. Assuming that the stored water would be dewatered over a 48-hour period, the precipitation events in the forecast period of 1988-1990 that were separated by less than 48-hours were clustered. This clustering process yielded 171 unique precipitation events over the three year period that were run in batch mode similar to the calibration/validation model.

Wastewater Flows in Dry Weather

For the calibration/validation period, the flows observed at all the metered locations during each wet weather event were separated into a dry weather flow and a wet weather component caused by the rain event. The dry weather flow during a wet weather event was estimated by taking an average of the dry weather flows immediately before and after the wet weather event. The incremental flows between any two metered locations (flow meters or pumps) were used to apportion the flows contributed by individual sewer sheds located between these two locations. Where available, the log sheets of pump stations and SCADA data maintained by WASA were used to supplement the above data in order to determine flow contributions from the sewer sheds in the District and the surrounding boundaries.

BPWWTP has a rated annual average flow capacity of 370 mgd. This capacity is projected to meet the needs of the Blue Plains service area (District plus surrounding jurisdictions) until the year 2020 based on the Flow Projection Model developed by the Metropolitan Washington Council of Governments. The Blue Plains Intermunicipal Agreement of 1985 (IMA) allocates wastewater treatment capacity between the District and the surrounding jurisdictions. The surrounding jurisdictions are allocated an annual average capacity of 212 mgd. The District is allocated a capacity of 148 mgd with 10 mgd reserved to accommodate additional Potomac Interceptor flows for a total of 158 mgd. Currently, wastewater flows from the District to BPWWTP average about 170 mgd. However, the surrounding counties served by BPWWTP are not fully utilizing their allocated wastewater treatment capacity. During the calibration period (1999-2000), the flows to BPWWTP averaged about 320 mgd, significantly less than the 370 annual average plant capacity.

WASA has a wastewater flow reduction and water conservation program in place to reduce the dry weather flow from the District to meet its IMA allowance. For purposes of the LTCP, the annual average dry weather flows allowed by the IMA were used in the model for the forecast period. This is conservative since current flows are significantly less than the flows allowed by the IMA. Average annual flows for the District and the surrounding areas for the calibration/ validation period, for the forecast period, and as specified in the IMA are listed in Table 4-10.

Table 4-10

Average Annual Flows

Location	*Average Flow During Calibration Period (mgd) (1999-2000)*	*Average Dry Weather Flow During Forecast Period (mgd) (1988-1990)*	*IMA Allowance (mgd)*
Surrounding Jurisdictions			
Potomac Interceptor	46.9	54.6	54.6
Upper Potomac Interceptor	6.5	10.3	10.3
Total Rock Creek	19.0	33.5	33.5
Total WSSC Anacostia Pump Station	57.4	83.2	83.2
Chain Bridge	4.2	9.4	9.4
Little Falls	3.3	7.6	7.6
Watts Branch	0.9	1.3	1.3
Upper Oxon Run	4.6	6.1	6.1
Lower Oxon Run	2.0	6.0	6.0
Subtotals	**144.8**	**212.0**	**212.0**
District			
East Rock Creek	18.8	25.9	None
Piney Branch	9.9	in East Rock Creek	None
Rock Creek Main	22.0	19.9	None
Upper Potomac Interceptor- West Rock Creek (Above Rock Creek PS)	7.5	6.8	None
Upper Potomac Interceptor Relief Sewer	15.4	13.9	None
B Street/ New Jersey	44.5	40.2	None
Anacostia Main Interceptor (Poplar Point PS)	13.9	12.6	None
Upper Eastside Interceptor	18.6	16.7	None
O Street	3.7	3.3	None
Oxon Run-Twin Outfall Sewers	20.8	18.7	None
Subtotals	**175.1**	**158.0**	**158.0**
TOTAL SYSTEM	**319.9**	**370.0**	**370.0**

GIS maps of the District's combined and separate storm water areas, along with the suburban service areas, were used to define input for the flow projection model, and future flows were estimated for major sewersheds such as Piney Branch, Northeast Boundary, and Total Rock Creek Service Area. These estimates, in turn, were apportioned on the area-weighted basis to smaller portions of the major sewersheds for use in the forecast model.

Dry weather flows typically vary with water usage during the day. Therefore, diurnal variations in flows are modeled using diurnal peaking factors within the District and surrounding areas. These diurnal peaking factors were estimated from the variations of dry weather flows observed during select dry days in the calibration/ validation period. The diurnal peaking factors for flows from the major boundary points as well as the District are listed in Table 4-11.

Table 4-11
Diurnal Dry Weather Flow Factors

Hour	*Potomac Interceptor*	*Upper Potomac Interceptor*	*Total Rock Creek*	*WSSC Anacostia Pump Stations*	*Chain Bridge*	*Little Falls*	*Watts Branch*	*Upper Oxon Run*	*Lower Oxon Run*	*District*
0	1.14	1.11	1.04	1.06	0.33	0.82	0.86	0.88	0.79	0.93
1	1.12	1.08	0.95	0.91	0.01	0.64	0.71	0.76	0.62	0.90
2	1.08	0.98	0.83	0.78	0.01	0.50	0.60	0.71	0.51	0.85
3	0.99	0.78	0.72	0.79	0.02	0.43	0.53	0.66	0.46	0.83
4	0.91	0.68	0.63	0.68	0.06	0.40	0.52	0.65	0.47	0.82
5	0.78	0.62	0.54	0.49	0.16	0.40	0.57	0.68	0.60	0.86
6	0.66	0.58	0.51	0.53	0.42	0.49	0.80	0.86	0.86	0.95
7	0.59	0.59	0.64	0.67	0.87	0.90	1.10	1.09	1.17	1.01
8	0.56	0.76	0.87	0.77	1.44	1.34	1.21	1.18	1.20	1.11
9	0.60	0.96	1.07	1.05	1.89	1.43	1.15	1.16	1.19	1.22
10	0.66	1.07	1.17	1.20	1.78	1.41	1.15	1.14	1.18	1.18
11	0.87	1.11	1.23	1.27	1.59	1.38	1.14	1.10	1.21	1.11
12	1.05	1.14	1.26	1.22	1.47	1.32	1.15	1.06	1.14	1.06
13	1.19	1.14	1.25	1.25	1.37	1.25	1.10	1.03	1.14	1.04
14	1.24	1.14	1.21	1.23	1.28	1.20	1.07	1.02	1.06	1.00
15	1.28	1.14	1.17	1.13	1.26	1.15	1.07	1.01	1.08	0.98
16	1.28	1.13	1.12	1.00	1.16	1.11	1.08	1.03	1.09	1.00
17	1.23	1.13	1.09	1.02	1.14	1.10	1.10	1.08	1.12	1.04
18	1.16	1.13	1.08	1.15	1.30	1.15	1.16	1.13	1.21	1.04
19	1.14	1.14	1.10	1.18	1.37	1.17	1.22	1.18	1.28	1.02
20	1.12	1.15	1.13	1.16	1.39	1.16	1.24	1.21	1.29	1.03
21	1.11	1.16	1.14	1.16	1.34	1.13	1.22	1.19	1.21	1.04
22	1.11	1.15	1.14	1.15	1.26	1.08	1.17	1.15	1.14	1.01
23	1.14	1.12	1.11	1.14	1.06	1.02	1.07	1.05	0.96	0.97

Wet Weather Influence on Flow from Separate Sanitary Systems

Besides diurnal variations, the dry weather flow in the separate sanitary system of the District and the surrounding jurisdictions increases during wet weather periods. This increase in dry weather flow was modeled by applying a wet weather peaking factor developed for individual major locations listed above. For all the locations except the District, regression equations were developed between rainfall at the Ronald Reagan National Airport and the flows observed in each of those locations during wet days in the calibration/ validation period. The time of concentration for individual service areas up to the District boundary for each of the locations were also determined from the regression equations. The time of concentration was then included in the model as lag time for runoff from the surrounding service areas to reach the District boundary. The magnitude of the peaking factors depended on the amount of rain.

For the separate sanitary portion of the District, a constant wet weather peaking factor of 1.25 was used to account for increases in flow rates during wet weather. This was based on reviewing wet weather peaking factors for comparably large areas of the surrounding jurisdictions. The range of wet weather peaking factors used is summarized in Table 4-12.

Table 4-12
Wet Weather Peaking Factors for Dry Weather Flow

Location	*Range of Wet Weather Peaking Factors for Dry Weather Flow*[1]
Potomac Interceptor	1.04 to 1.32
Upper Potomac Interceptor	1.34
Total Rock Creek	1.03 to 1.29
Total WSSC Anacostia Pump Station	1.03 to 1.63
Chain Bridge	1.26 to 1.92
Little Falls	1.01 to 1.37
Watts Branch	1.01 to 1.90
Upper Oxon Run	1.01 to 1.74
Lower Oxon Run	1.49 to 2.08
District	1.25

Notes: 1. Flow Rate as a function of time = annual average dry weather flow x wet weather peaking factor x diurnal peaking factor.

River Tide Levels

Long-term hourly tide data was available at the Washington Shipping Channel for the calibration/ validation period as well as for the forecast period of 1988 through 1990. Correction factors developed from the ground elevation data were used to estimate tide level time-series at each of the sixty outfall locations.

Model Calibration and Validation and Forecast Model Application

Continuous time-series of precipitation, dry weather flow and tide levels developed above were input as boundary conditions in the calibration/validation model. The diversion structures were modeled appropriately as overflow weirs or pipes. Operation rules for the pumps and inflatable dams were established based on the rating curves and the procedures used by WASA's staff. The model was calibrated against all storms where reliable data was collected during the monitoring period. All the precipitation events chosen for calibration and validation were run successively. Post-processing programs developed in FORTRAN and in Microsoft ACCESS were used to disaggregate the dry weather flow and runoff at all the metered locations. The modeled dry weather flows and runoffs were then compared with the monitored flows at those locations. Finally, the hydrologic and hydraulic parameters were adjusted until the calibration percent difference between the modeled and monitored flows was minimized and so that the overall modeled CSO overflow volumes were estimated conservatively. Table 4-13 compares the monitored and modeled flow volumes at the major metered locations and shows that the modeled flows were conservatively estimated at 10% above monitored flows.

Table 4-13
Calibration Results

Location	*Monitored Flow Volume (mg)*	*Modeled Flow Volume (mg)*	*Difference (%)*
Overflow Locations			
CSO 007 (Fort Stanton)	20.1	26.5	31.9
CSO 010 (O Street Storm)	255.0	272.7	6.9
CSO 010, 011, 011a, 012 (Main and O Street Area Total)	323.8	358.2	10.6
CSO 049 (Piney Branch)	12.5	9.0	-28.3
CSO 021 (Slash Run)	230.4	252.9	9.7
CSO 020 (Easby Point)	41.2	40.9	-0.6
CSO 019 (Northeast Boundary Total, Swirl and Bypass)	772.6	865.0	12.0
Total CSO Overflow	1,655.6	1,825.2	+10
Pump Station Outputs			
Main Pump Station	3,594.0	3,635.3	1.1
Potomac Pump Station	6,904.6	6,943.2	0.6
Blue Plains Raw Wastewater Pump Stations 1 & 2	17,442.0	17,468.0	0.2

Additional post-processing programs were developed to group the model results for individual calibration/ validation events into a continuous time-series of overflows for receiving water model application.

The calibrated model was adapted for evaluation of long-term control alternatives by replacing the appropriate rainfall, dry weather flow and tide databases. The existing system, as well as the system with immediate controls such as cleaning interceptors and rehabilitating pumps and inflatable dams, were run to establish baseline conditions. All the 171 precipitation events in the forecast period were run successively in the MOUSE model, and the post-processing programs were again used to group the model results into continuous time-series of overflows for receiving water model application.

Once the baseline scenarios were modeled, the long-term control alternatives involving surface and collection system storage, retrofitting under-capacity pipes and diversion structures were modeled by appropriately modifying the hydrologic/ hydraulic elements.

4.6.2 Separate Storm Water System

In the separate storm water system, the estimation of pollutant loads discharged to individual receiving waters is of primary interest as opposed to a detailed representation of flows within the storm sewer system. Therefore, the level of sewer shed and pipe conveyance characterization is simpler compared to the combined sewer system.

In the calibrated model, the individual sewer sheds were grouped into hydrologically similar clusters, and the outfall for each cluster was identified from the geographic locations of the storm sewer outfalls of all the sewer sheds in that cluster. Weighted average values of the hydrological parameters including surface slope, roughness, percent imperviousness and infiltration capacity were calculated for a cluster from the parameters of individual sewer sheds encompassed in the cluster. The MOUSE model automatically assigned precipitation data from the closest 2 km by 2 km grid to each of the clusters. Calibration of the hydrologic parameters was achieved using the flow data monitored during the calibration/ validation period in three hydrologically unique sewer sheds in the District. In addition, the parameters developed using more rigorous calibration procedures in the adjacent combined sewer system were used as guidance in the finalization of calibration parameters. The MOUSE model was run successively for all the calibration/ validation events, and the post-processing programs were used to develop continuous time-series of flow data for receiving water model application.

Since the separate storm water system does not include detailed hydraulic elements, only the precipitation database required modification in the adaptation of the calibrated model for forecasting purposes. The MOUSE model was again run successively for all the 171 precipitation events, and the continuous pollutographs for receiving water model application were developed using the post-processing programs.

Section 5
Receiving Waters Characterization

5.1 INTRODUCTION

A receiving water monitoring and modeling program for the Anacostia River, Potomac River, and Rock Creek was conducted concurrently with the CSS and SSWS monitoring and modeling programs to collect a sufficient amount of water quality data to quantify real-time impacts associated with CSOs and other pollutant sources. Other objectives of monitoring were to identify existing pollutant sources and impacts, define baseline conditions, and to support the development of reliable models. Event mean concentrations for the receiving waters for the forecast period 1988-1990 were calculated and calibrated using the monitoring data. Each of the three receiving waters was divided into a number of discrete segments for modeling purposes. Water quality parameter concentrations were then calculated for each discrete segment. Receiving water data collected by other municipalities and jurisdictions, as well as historical data were considered. The receiving water monitoring program was conducted by the Metropolitan Washington Council of Governments (COG). The receiving water modeling program utilized existing models for each receiving water. The models were updated and modified to assess water quality impacts as part of the LTCP development effort. Wet weather impacts on water quality in the receiving waters, as determined by monitoring and modeling programs, are discussed in Section 6.

5.2 MONITORING PROGRAM

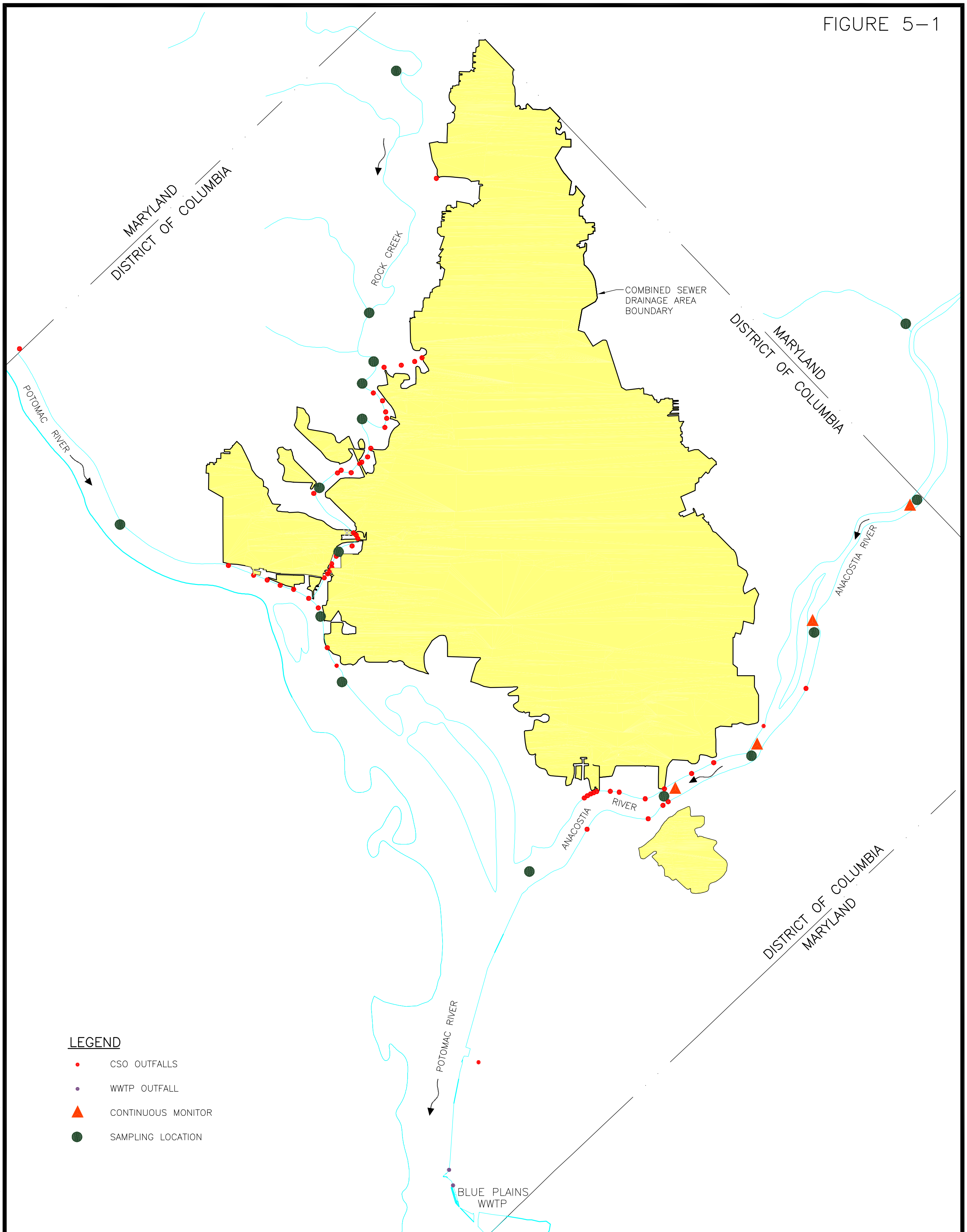
Table 5-1 lists the parameters that were analyzed during each component of the receiving water monitoring program. The sampling locations for the fecal coliform and e. coli monitoring, wet weather surveys, continuous monitoring, and boundary condition monitoring are shown on Figure 5-1.

5.2.1 Baseline Bacteriological Monitoring (Fecal Coliform and E. Coli Monitoring)

Regular sampling for total coliform and fecal coliform, as well as field parameters (temperature, D.O., pH and conductivity) was performed at six (6) locations on the Anacostia, three (3) on the Potomac, and seven (7) on Rock Creek. In addition, samples for e. coli were collected at three (3) locations on the Anacostia, two (2) on the Potomac, and three (3) on Rock Creek. The sampling was conducted twice per week for a ten (10) month period between December 1999 and October 2000. Since the sampling was at regular intervals, the data collected represents wet and dry weather conditions. The complete data is in MWCOG 2000a, 2000b, 2000c, and 2001a.

5.2.2 Anacostia Wet Weather Surveys

Wet weather surveys were performed to determine impacts of CSO and stormwater on water quality during and after a storm. This data is also used to support model calibration and verification. In the Anacostia River, four (4) wet weather surveys were performed. For each survey, samples were



RECEIVING WATER MONITORING LOCATIONS

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EPMC-III
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D.C. WATER AND SEWER AUTHORITY
CSS LONG TERM CONTROL PLAN

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collected at five (5) locations in the Anacostia every 4 hours for a 48-hour period. Analyses included field parameters, conventional pollutants, and bacteriological parameters for one of the storms. The data is presented in MWCOG 2001b.

Table 5-1
Parameters for Receiving Water Monitoring

	Wet Weather	Baseline Weekly		Continuous Monitoring	Boundary Condition Monitoring			SOD Study
Parameter	**Anacostia**	**Anacostia**	**Rock Creek/ Potomac**	**Anacostia**	**Anacostia**	**Potomac**	**Rock Creek**	**Anacostia**
Temperature	x	x	x	x		x		
PH	x	x	x	x		x	x	
D.O.	x	x	x	x		x	x	
Conductivity	x	x	x	x		x	x	
Turbidity				x	x	x	x	
Fecal Coliform	x	x	x		x	x	x	
Total Coliform	x	x	x		x	x	x	
E. coli	x		x					
Alkalinity						x	x	
BOD						x	x	
COD						x		
Chlorophyll a					x	x	x	
CBOD5 (total)		x			x			
Hardness						x		
Dis. Org. Carbon		x			x	x		
Total Org. Carbon		x			x	x		
Total Phosphorus		x			x	x		x
Ortho Phosphate		x			x	x	x	
Total Soluble Phos.					x	x		
TKN		x			x	x	x	
SKN					x	x		
Total Nitrogen						x		
NH3 as N		x			x	x		x
(NO2 +NO3) as N		x			x	x	x	x
TSS		x			x	x		
TDS					x			
VSS		x			x			
Hydrogen sulfide								x
Oxygen demand								x
Methane								x
Carbon Isotopes								x
Nitrogen Isotopes								x

5.2.3 Continuous Monitoring Program – Anacostia River

COG operated continuous monitors at three locations on the Anacostia (Seafarer's Marina, Benning Road, and below the Navy Yard CSO Area). The monitors were operated from April through October, 1999-2000. Data (temperature, D.O. pH and conductivity) was collected every 30 minutes at these locations. The complete data is in MWCOG 2000a, 2000b, 2000c, and 2001a.

5.2.4 Boundary Condition Monitoring

The purpose of boundary condition monitoring was to assess the pollutant load in the receiving waters at the District Boundaries, upstream of CSOs.

For Rock Creek, bacteriological constituents are the primary parameters of concern and were collected as part of the baseline bacteriological program (5.2.1). For the other parameters, historical data from 1985-1995 was used to develop the boundary conditions needed for the water quality models.

For the Potomac River, COG currently operates an existing monitoring system at Chain Bridge. Samples collected at this station were tested for many parameters, including: temperature, DO, pH, conductivity, TSS, turbidity, dissolved organic carbon, TKN, ammonia, alkalinity, BOD, fecal coliform, total coliform, chlorophyll, alkalinity, and hardness. The fecal data was collected approximately once per month. In order to characterize the boundary conditions of the bacteriological parameters, sampling was conducted upstream of the CSOs as described in the baseline bacteriological monitoring (5.2.1).

For the Anacostia River, two boundary monitors were installed just above the confluence of the Northwest and Northeast Branches of the river upstream of the District boundary. They were installed at the USGS Flow Gage Stations located in Bladensburg MD. The program operated between August 1999 and April 2000. Base flow samples were collected weekly and/or biweekly during the monitoring period, storm samples were collected using automatic flow samplers that were programmed to automatically composite samples. Samplers were programmed to automatically collect a sample aliquot when the incremental flow differential in the river exceeded a threshold level. Samples aliquots were then taken on an equal flow-paced interval so that a flow-weighed composite sample was collected. Fifteen to sixteen storm samples were collected during the monitoring period.

In addition to this monitoring, additional bacteriological monitoring was conducted at the Anacostia boundary stations. Total and fecal coliform samples and e. coli samples were collected between March 2000 and October 2000 to increase the database of bacteriological data at the upstream boundary.

5.2.5 Sediment Oxygen Demand (SOD) Study

The oxygen demand exerted by sediment in the Anacostia River affects dissolved oxygen levels in the water body. Dissolved oxygen is a water quality parameter of concern. In addition, CSOs, separate storm water discharges, and upstream sources contribute to the sediment load in receiving waters. Three separate sampling events were conducted between June 2000 and December 2000 to characterize the oxygen demands from the Anacostia Sediments. The results of this sampling program are presented in "Sediment Oxygen Demand in the Anacostia River" MWCOG 2001c.

5.2.6 Quality Assurance Project Plan

All of the receiving water monitoring activities were conducted in accordance with the Quality Assurance Project Plan (QAPP) that was approved by the EPA and DC DOH in August 1999 (EPMC-III, 1999). The purpose of the QAPP was to document the type and quality of data needed, and the procedures required to assure that the data was collected and managed in a manner consistent with applicable requirements and generally accepted and approved quality assurance objectives. Analytical data and documentation of QA/QC procedures was submitted to the EPA in February 2000, June 2000, October 2000, and January 2001.

5.3 EVENT MEAN CONCENTRATIONS

Running the receiving water models requires the input of flows and loads from many sources. This includes both upstream sources and sources within the District. Water quality of these sources was characterized by event mean concentrations (EMCs). EMCs were developed for all of the water quality constituents required for modeling. Loads were developed by multiplying the EMCs by flow and appropriate conversion factors.

EMCs were calculated for the upstream boundary of each receiving water. For the Potomac River, the boundary is at Chain Bridge. In Rock Creek, the boundary of the model was the DC/MD line. In the model of the Anacostia River, the confluence of the NW & NE branches of the river was used as the upstream boundary. In all three receiving waters, monitoring data was available near these boundaries, and this data was used to calculate the EMCs. The monitoring stations used include stations at Chain Bridge on the Potomac River and a station on Rock Creek just north of the DC boundary in Montgomery County. Stations on the NW and NE branches of the Anacostia just upstream of their confluence were used for the Anacostia boundary.

Base flow and storm flow EMCs were calculated for each of these boundaries. This was done to allow for the different constituent concentrations observed under dry and wet weather flow conditions. This is particularly important for bacteria (fecal coliform and e. coli) and total suspended solids (TSS) where the base flow or dry weather concentration is often much smaller than the storm flow or wet weather concentration. The flow record for the USGS gage closest to each of the monitoring stations was analyzed to determine whether a certain day is a base flow or storm flow day. This was accomplished by applying HYSEP, a USGS program that separates a hydrograph or flow series into base flow and storm flow days. This record of base flow and storm flow was then used to sort the monitoring data according to base flow and storm flow days, and lead to the identification of the EMCs given in Table 5-2.

Table 5-2

Receiving Water Boundary Conditions – Event Mean Concentrations

		Rock Creek[1]		Anacostia River – Northwest Branch[2]		Anacostia River – Northeast Branch[2]		Potomac River	
Parameter	Units	Base Flow	Storm Flow	Base Flow	Storm Flow	Base Flow	Storm Flow	Base Flow	Storm Flow
$CBOD_5$	mg/L	2.7	3.2	1	8.02	1.08	5.55	2.7	3.2
NH3	mg/L as N	0.2	0.22	0.03	0.08	0.05	0.08	0.02	0.07
TSS	mg/L	12	94	3	311	7	475	5 to 15[3]	35 to 212[3]
DO	mg/L	8.6 to 15.3[4]		7.6 to 15.8[5]		7.6 to 15.8[5]		7.4 to 15.3[4]	
OrgN	mg/L as N	0.5	0.53	0.38	2.91	0.49	2.11	0.54 to 1.3[3]	0.34 to 0.42[3]
NOx	mg/L as N	1.1	1.17	1.06	0.54	0.85	0.59	0.99 to 1.47[3]	0.79 to 1.56[3]
PO4	mg/L	0.02	0.04	0.03	0.05	0.02	0.05	0.04 to 0.06[3]	0.02
OrgP	mg/L	0.07	0.11	0.01	0.41	0.05	0.46	0.01 to 0.04[3]	0.01 to 0.02[3]
Chla	mg/L	0	0	1.37	1	1.09	1	0	0
Fecal coliform	#/100 ml	280	2,100	500	8,000	500	8,000	60	350
E. coli	#/100 ml	230	900	200	3,500	200	3,500	30	190

Notes:
1. The EMC values for Rock Creek are also used for Cameron Run and Four Mile Run in Virginia
2. A flow weighted composite of the NE & NW Branch Anacostia EMCs was used for Lower Beaverdam
3. The EMC varied with flow. See Table 5-5 for detailed information
4. The dissolved oxygen EMC varies by month. See Table 5-4 for detailed information
5. The Anacostia River dissolved oxygen concentration was given as 90% of saturation

EMC values for tributaries and other inputs to the receiving waters were also calculated. Monitoring data on Piscataway Creek and Pimmit Run were used to determine EMCs for these streams. A combination of monitoring data and DMR reports were used to calculate EMCs for the Alexandria, Arlington and Blue Plains Wastewater Treatment Plants. The EMC's for the Alexandria and Arlington Wastewater Treatment Plants are shown in Table 5-3. The EMCs for Blue Plains are presented in Section 4.

Table 5-3
Event Mean Concentrations for Streams and other Permitted Discharges

Parameter	Units	Piscataway Creek[1]		Pimmit Run		Alexandria and Arlington WWTP
		Base Flow	Storm Flow	Base Flow	Storm Fow	All Data
$CBOD_5$	mg/L	2.2	2.2	1.3	1.5	2
NH3	mg/L as N	0.13	0.09	0.03	0.04	1.5
TSS	mg/L	12	12	12	94	7
DO	mg/L	5.7 to 12.6[2]		8.7 to 13.8[2]		6
OrgN	mg/L as N	1.14	0.98	0.2	0.27	NA
Nox	mg/L as N	1.41	1.01	0.17	0.22	NA
PO4	mg/L	0.05	0.06	0.02	0.03	NA
OrgP	mg/L	0.06	0.08	0.09	0.08	NA
Chla	mg/L	0	0	0	0	0
Fecal coliform.	#/100 ml	750	2,200	200	890	1.8
E. coli	#/100 ml	420	1,220	110	490	0.9

Notes:
1. The EMC values for Piscataway Creek were also used for Henson Creek and Oxon Run
2. The dissolved oxygen value varies by month. See Table 5-4 for detailed information

The variability of dissolved oxygen at the boundary as a function of month is shown in Table 5-4.

Table 5-4
Monthly Dissolved Oxygen Event Mean Concentrations at Boundaries

Location	Dissolved Oxygen Concentration in mg/L											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rock Creek	14.9	15.3	12	11	8.9	8.6	8.6	8.6	9.5	10.3	11.7	13.6
Potomac	14.9	15.3	12	11	8.9	8.6	7.4	7.8	8.2	10.3	11.7	13.6
Piscataway	12.3	12.6	11.3	10.2	8.6	6.9	5.7	5.8	6.6	7.6	9.5	11.6
Pimmit Run	13.2	13.8	12.4	11.1	10.1	8.9	8.7	8.9	8.8	10.2	11.6	13.6

Some constituents in the Potomac received even further breakdown based upon season and flow. The EMCs were determined as a function of wet and dry weather and of flow rate in the Potomac. The EMCs are shown in Table 5-5. This follows previous work done by MWCOG in the Potomac (MWCOG, 1987).

Table 5-5
Flow Varying Event Mean Concentrations for the Potomac River Boundary

		Base Flow (cfs)				Storm Flow (cfs)			
Parameter	Units	Q < 2,000	Q<5,000	Q<8,700	Q>8,700	Q<7,500	Q<20,000	Q<35,000	Q>35,000
TSS	mg/L	4.5	7.6	10	15.4	35	46.5	104	212
OrgN	mg/L	0.62	0.54	0.89	1.3	0.4	0.34	0.42	0.37
NOx	mg/L	0.99	1.4	1.47	1.28	0.79	1.12	1.33	1.56
PO4	mg/L	0.06	0.05	0.05	0.04	0.02	0.02	0.02	0.02
OrgP	mg/L	0.04	0.01	0.01	0.02	0.01	0.01	0.02	0.01

5.4 MODELING PROGRAM

5.4.1 Anacostia River

The Anacostia River was modeled using a hybrid model incorporating features of the Tidal Anacostia Model (TAM) developed by COG (Sullivan and Brown, 1988) and refined by LTI (1992a and 1992b), and EPA's WASP or Water Quality Analysis Simulation Program (Ambrose, et al, 1993). Referred to as TAM/WASP, this model was developed by the DOH and ICPRB (ICPRB. 2000b) for TMDL studies.

TAM/WASP is a one-dimensional model that uses the hydraulic features of TAM and the water quality characteristics of WASP to characterize the Anacostia River. The model encompasses the full length of the tidal portion of the Anacostia River that extends from the confluence of the Northeast and Northwest branches in Bladensburg, MD to the confluence with the Potomac River at Hains Point. The DOH/ICPRB version of TAM/WASP was further modified and recalibrated for the CSO-related water quality assessment undertaken as part of LTCP development. The modifications are summarized as follows:

- The geometry of the tidal Anacostia River (length, depth and width) was updated with new bathymetric data provided by the Corp of Engineers based upon recent surveys and further verified by a dye tracer study conducted during the summer of 2000. The result of this was an approximate 25 percent reduction in the volume of water modeled in the tidal Anacostia system, a better representation of water volume.
- The network of model segments used to describe the tidal Anacostia River was expanded from 15 segments to 35 segments. This change was necessitated during recalibration of the hydraulic model with dye survey data collected specifically for this purpose (LTI, 2000). The result of increasing the number of segments was improved capability to simulate advection and dispersion processes with the new geometry.

A schematic of the model segmentation showing 35 completely mixed segments is presented in Figure 5-2 along with CSO outfalls.

The state variables simulated within TAM/WASP are as follows:

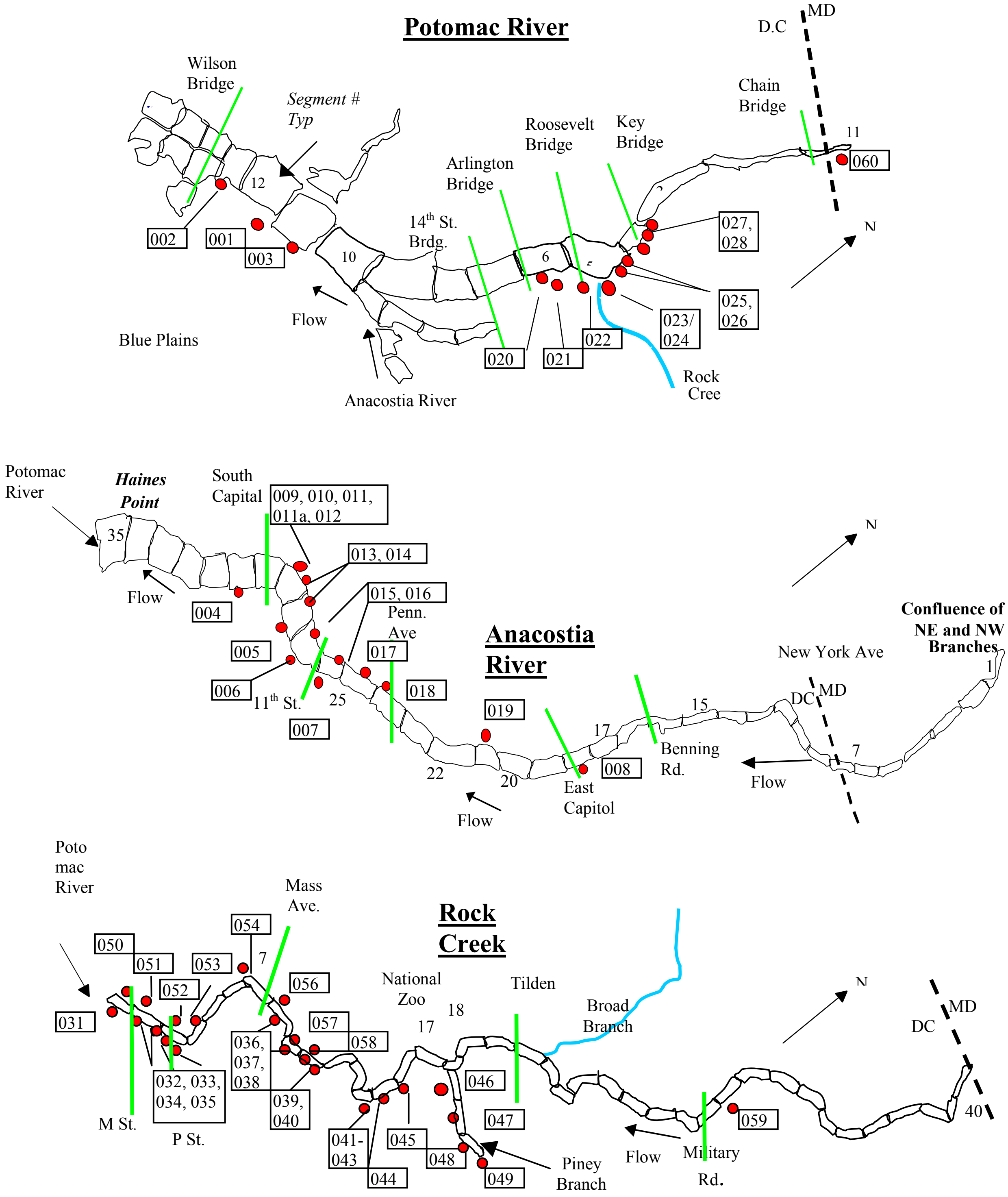
- Fecal coliform
- E. coli
- Oxidized nitrogen (NO2 and NO3)
- Ammonia
- Organic nitrogen
- Organic phosphorus
- Inorganic phosphorus
- Phytoplankton (chl-a)
- $CBOD_5$
- Dissolved Oxygen

Fecal coliform and e. coli are new state variables, as they were not previously modeled within TAM/WASP.

TAM/WASP also contains a sediment oxygen demand sub-model that predicts sediment oxygen demand and associated fluxes of aqueous methane, gaseous methane, ammonia, and gaseous nitrogen. The state variables of principal interest in the assessment of CSO impacts and the ability of CSO controls to improve water quality were dissolved oxygen, fecal coliform and e. coli.

The water quality model was calibrated with observed data available for a nine-month period extending from October 1999 through June 2000. Loads from the combined sewer system and separate storm water system were obtained by running the calibrated models for the sewer systems, using the actual rainfall measured during the monitoring period. Flow and pollutant loads at the District/Maryland Boundary were obtained from data collected during the monitoring period. Additional detail on the development and calibration of TAM/WASP is described in Study Memorandum LTCP 6-7.

Application of the model in development of the LTCP focused on a three-year simulation period of 1988 to 1990 wherein observed rainfall and upstream flow for this period were the principal driving mechanisms. The major loading inputs to the model are upstream loads generated in Maryland, separate storm water loads generated within DC, and the CSO loads generated within DC.



Legend

CSO Outfall No.

CSO Location

17 Model Segment No.

Figure 5-2
Receiving Water Models Segmentation

5.4.2 Potomac River

The Potomac River was modeled using EPA's Dynamic Estuary Model, or DEM (EPA, 1979). DEM is a one-dimensional model that consists of a hydrodynamic model (DYNHYD) that simulates water movement, and a water quality model (DYNQUAL) that simulates mass transport and the water quality. DEM encompasses the entire length of the tidal Potomac River from the head of tide at Chain Bridge in DC to the mouth of the Potomac at its confluence with the Chesapeake Bay. The zone of interest for the LTCP was limited to the upper tidal Potomac between Chain Bridge and the Woodrow Wilson Bridge. The model segments and CSO discharges within this area are presented in Figure 5-2.

DEM is an approved regulatory modeling tool that has been used on several major studies and feasibility plans including the original DC CSO Abatement Study (O'Brien & Gere, 1983), the Blue Plains Feasibility Study (Greeley and Hansen, 1985), and the Potomac Dissolved Oxygen Study (LTI, 1988). The state variables within DEM include:

- Fecal coliform
- E. coli
- Total Kjeldahl Nitrogen (TKN)
- Total phosphorus
- $CBOD_5$
- Dissolved Oxygen

While it was originally developed as a eutrophication model, application of DEM since the early 1980s has been limited to the assessment of bacteria and dissolved oxygen issues. The state variables of principal interest in the assessment of CSO impacts and the ability of CSO controls to improve water quality were dissolved oxygen, fecal coliform and e. coli.

The hydraulic model was retested but not calibrated in this study as it had been calibrated in earlier efforts. A limited calibration of the bacteria variables was undertaken with the available data for a nine-month period extending from October 1999 through June 2000.

Application of the model in development of the LTCP focused on a three-year simulation period of 1988 to 1990 wherein observed rainfall and upstream flow for this period were the principal driving mechanisms. The major loading inputs to the model are upstream loads generated in the Potomac Watershed, separate storm water loads generated within DC, separate storm water loads generated within Maryland and Virginia tributaries that flow directly to the tidal Potomac, DC and Northern Virginia WWTP discharges, and the CSO loads generated within DC.

5.4.3 Rock Creek

Rock Creek was modeled using EPA's Storm Water Management Model, or SWMM (Huber and Dickinson, 1988). The TRANSPORT Block of SWMM was applied to model hydraulics and pollutant transport. This application built upon earlier modeling efforts undertaken as part of the original CSO Abatement Study (LTI, 1981). In particular, the cross-sectional data and slope information from the earlier effort were used extensively in construction of SWMM input. SWMM is a one-dimensional model. A network of 40 model segments were utilized to describe the DC portion of Rock Creek extending from the MD/DC line to the mouth near Thompson's Boat House. An additional 3 model segments were utilized to describe a short section of Piney Branch. The model segments and CSO discharges within this area are presented in Figure 5-2.

The state variables incorporated within the Rock Creek Model were fecal coliform and e. coli. The hydraulic model was tested for conservation of mass. Centering largely on adjustment of first-order decay, the bacteria components of the model were calibrated with the available data for the nine-month period extending from October 1999 through June 2000. Dissolved oxygen was not modeled as there is no evidence of dissolved oxygen problems in Rock Creek.

Application of the model in development of the LTCP focused on a three-year simulation period of 1988 to 1990 wherein observed rainfall and upstream flow for this period were the principal driving mechanisms. The major loading inputs to the model are upstream loads generated in the Montgomery County portion of the watershed, separate storm water loads generated within DC, and the CSO loads generated within DC.

Section 6
Pollutant Loads and Predicted Water Quality

6.1 INTRODUCTION

This section describes the pollutant loads on the receiving waters and the predicted water quality for each receiving water based on WASA's past CSO abatement efforts and currently planned improvements. In addition to CSOs, pollution sources such as storm water, sediments (in the Anacostia River) and natural background sources also affect water quality. Much of the time, the water flowing into the District does not meet water quality standards due to upstream sources of pollution. In many cases, these other factors would prohibit the attainment of water quality standards even if no CSO discharges occurred. While the LTCP is required only to address CSO issues, WASA is considering these other factors as part of a watershed approach to improving water quality.

6.2 CSO OVERFLOW PREDICTIONS

The combined sewer system model was used to predict CSO overflow frequency and volume for the average year conditions. As described previously in Sections 2 and 3, the average year is defined as the arithmetic average of the predictions for years 1988, 1989 and 1990. Overflow predictions were made to determine the benefits provided by the existing Phase I CSO Controls and the expected benefits from the planned Pump Stations Rehabilitation as follows:

- Scenario B1- Prior to Phase I CSO Controls – This was the configuration of the CSS prior to implementation of the Phase I CSO controls in the early 1980's. No inflatable dams were present and the Northeast Boundary Swirl Facility did not exist. The capacities of the Main and Potomac Pumping Stations were 200 mgd and 265 mgd, respectively.

- Scenario C2 – Phase I CSO Controls – This was the system configuration after the Phase I CSO controls were constructed. It includes the addition of the inflatable dams for in-system storage and the Northeast Boundary Swirl Facility. The capacities of the Main and Potomac Pumping Stations were 200 mgd and 265 mgd, respectively.

- Scenario C3 – Phase I CSO Controls and Pump Stations Rehabilitation – This scenario includes the Phase I CSO controls and rehabilitation of Main and Potomac Pumping Stations to achieve firm pumping capacities of 240 and 460 mgd, respectively. WASA's current capital improvement program as of June 2001 includes rehabilitation of the Main, Eastside, and Poplar Point Pump stations and replacement of the inflatable dams. Rehabilitation of the Potomac Pump Station is currently in the study phase.

The predicted CSO overflow volumes for each of the scenarios is summarized in Table 6-1.

Table 6-1
Annual CSO Overflow Predictions for Average Year
(Average of 1988-1990)

No.	Scenario	Overflow Volume (mg) Anacostia River CSOs	Potomac River CSOs	Rock Creek CSOs (Excluding Luzon Valley , CSO 059)	CSO Total	Blue Plains Excess Flow (Outfall 001)
B1	Prior to CSO Phase I Controls	2,142	1,063	49	3,254	1,517
C2	Phase I CSO Controls	1,485	953	52	2,490	2,012
C3	With Phase I CSO Controls and Pump Station Rehabilitation (Main at 240 mgd, Potomac at 460 mgd)	1,282	639	49	1,969	2,428

As can be seen in the table above, Phase I Controls provided significant CSO reduction and increased the amount of flow receiving excess flow treatment at BPWWTP. The planned Pump Stations Rehabilitation program will also reduce CSOs and increase flow receiving excess flow treatment.

Note that the total CSO overflow volume to Rock Creek is calculated excluding Luzon Valley (CSO 059) since this area has been separated. The predicted CSO overflow volume and frequency for each CSO in scenario C3 is shown in Table 6-2.

Table 6-2
Annual CSO Overflow Predictions for Average Year (Average of 1988-1990)[1]
Scenario C3 – Phase I Controls and Pump Station Rehabilitation

CSO NPDES No.	Description	No. of Overflows	CSO Overflow Volume (mg)	CSO NPDES No.	Description	No. Overflows No. /yr	CSO Overflow Volume (mg)
Anacostia River CSOs				**Rock Creek CSOs**			
004	Poplar Point Emergency Relief	0	0.00	031	Penn Ave	9	0.22
005	Ft. Stanton	73	16.54	032	26th - M St	0	0.00
006	Ft. Stanton	5	0.11	033	N St. - 25th St	6	4.48
007	Ft. Stanton	64	36.97	034	Slash Run Trunk Sewer	0	0.00
008	Anacostia Main Interceptor Relief	0	0.00	035	Northwest Boundary	0	0.00
009	B St./New Jersey Avenue	54	16.84	036	Mass Ave & 24th	29	1.64
010	B St./New Jersey Avenue	18	247.21	037	Kalorama Circle West	3	0.05
011	B St./New Jersey Avenue	0	0.00	038	Kalorama Circle East	0	0.00
011a	B St./New Jersey Avenue	0	0.00	039	Belmont Rd	0	0.00
012	Tiber Creek	6	21.74	040	Biltmore St	1	0.03
013	Canal Street Sewer	28	9.78	041	Ontario Rd	0	0.00
014	Navy Yard	49	38.98	042	Quarry Rd	0	0.00
015	Navy Yard	12	0.72	043	Irving St.	1	0.15

CSO NPDES No.	Description	No. of Overflows	CSO Overflow Volume (mg)
Anacostia River CSOs			
016	Navy Yard	24	13.30
017	Navy Yard	32	20.05
018	Navy Yard	35	4.70
019	Northeast Boundary Swirl Effluent	36	645.64
019	Northeast Boundary Swirl Bypass	13	209.17
Anacostia Subtotal			**1,282**
Potomac River CSOs			
003	Bolling Overflow	0	0
020	Easby Point	21	54.81
021	Potomac Pump Station	30	458.43
022	I St. – 22nd St. NW	30	30.04
023/024	West Rock Creek Diversion Sewer	17	16.23
025	31st & K St NW	14	0.16
026	Water St District (WRC)	0	0.00
027	Georgetown	72	52.50
028	37th St- Georgetown	13	0.49
029	College Pond	56	26.00
030	Abandoned	0	0
060	Little Falls Branch	0	0.00
	Potomac Subtotal		**639**

CSO NPDES No.	Description	No. Overflows No. /yr	CSO Overflow Volume (mg)
Rock Creek CSOs			
044	Kenyon St.	0	0.00
045	Lamont St.	2	0.03
046	Park Road	2	0.01
047	Ingleside Terr.	3	0.25
048	Oak St-Mt Pleasant	2	0.08
049	Piney Branch	25	39.73
050	M St -27th St	0	0.00
051	Olive - 29th St.	0	0.00
052	O St.-31st St,	0	0.00
053	Q St	0	0.00
054	West Rock Creek Diversion Sewer	0	0.00
055	Abandoned	0	
056	Normanstone Dr.	0	0.00
057	Cleveland - 28th St & Conn. Ave	15	2.33
058	Connecticut Ave.	0	0.00
059	Luzon Valley	87	171.56
Rock Creek Subtotal (Including Luzon Valley)			**221**
Rock Creek Subtotal (Excluding Luzon Valley)			**49**

6.3 ANACOSTIA RIVER

6.3.1 Pollutant Loads to Anacostia River

Using the models for the CSS, SSWS, data on boundary condition flow rates for the years 1988-1990, and the event mean concentrations for each pollutant source; the pollutant load to the Anacostia River was calculated for the average year. The load sources were divided into the following categories:

- CSO Overflow – represents overflow from the CSS and includes CSO that is treated by the Northeast Boundary Swirl Facility.
- D.C. Storm Water – this consists of District's separate storm water system and flow from Hickey Run and Watts Branch.
- Other Storm Water – represents storm water from park lands on each side of the Anacostia that are not conveyed through storm pipes, but instead run off directly to the river. Examples include Anacostia Park and portions of the National Arboretum.

Load estimates are summarized in Table 6-3 and on Figures 6-1 through 6-2.

Table 6-3
Sources of Pollutant Loads to Anacostia River Within District
Phase I Controls and Pump Station Rehabilitation (Average 1988-1990)

Pollutant Source	CBOD5 (lb/yr x 1000)	TSS (lb/yr x 1000)	Fecal Coliforms (#/yr x 10^{14})	E. Coli (#/yr x 10^{14})
CSO Overflow	443	1,490	254	181
D.C. Storm Water	771	3,815	52	30
Other Storm Water	44	376	5	3
Upstream	1,937	115,967	104	46
Total	**3,195**	**121,648**	**415**	**260**

Figure 6-1
Sources of CBOD5 to Anacostia River

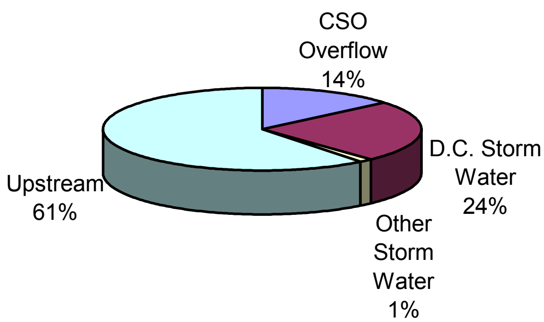
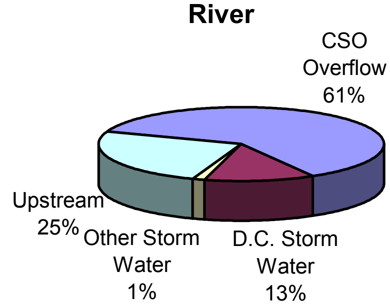


Figure 6-2
Sources of Fecal Coliform to Anacostia River

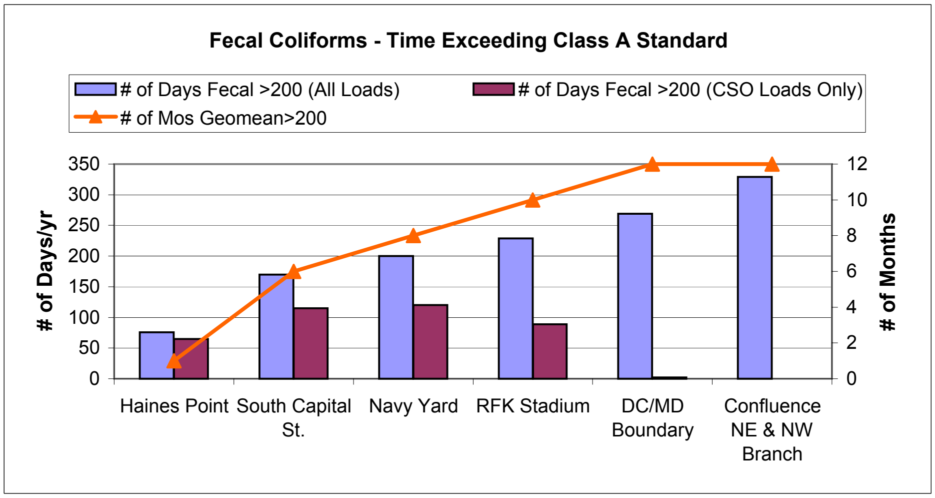


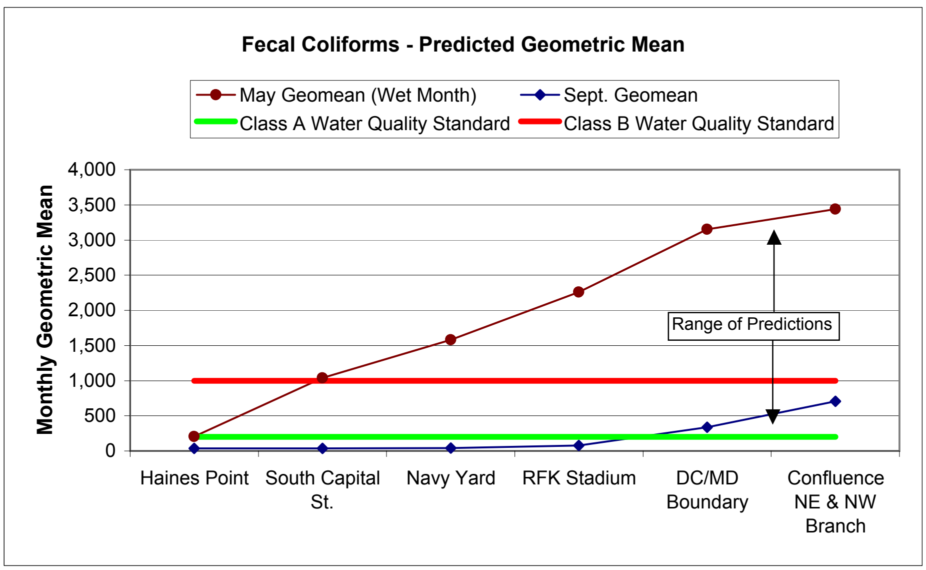
Note that for CBOD5 and TSS, upstream load sources predominate. For bacteriological parameters, CSOs are a significant source but modeling indicates that even with total CSO removal the remaining loads to not allow water quality standards to be met.

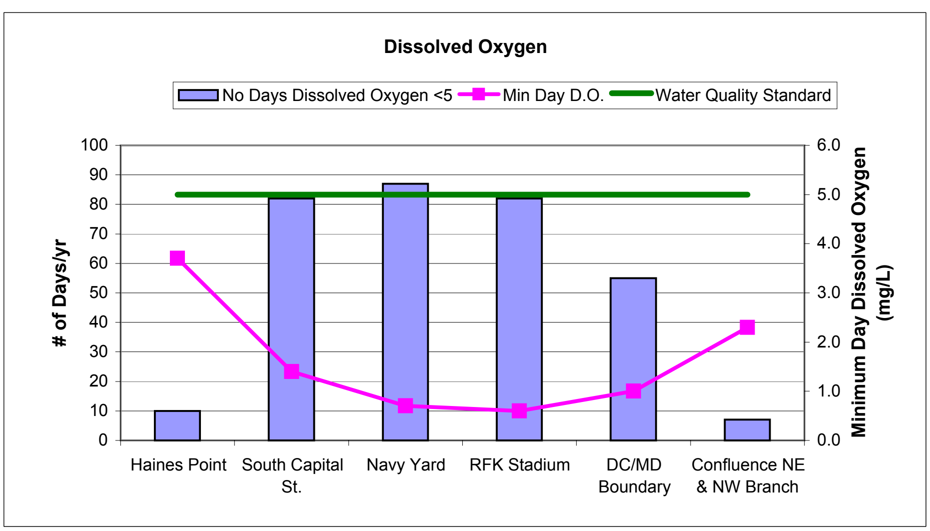
6.3.2 Predicted Water Quality for the Anacostia River

Using the loads and flows predicted above, the Anacostia River receiving water model was run continuously for the period 1988-1990. The arithmetic average of the three years is defined as the average year condition. The predicted water quality with the loads sources for the C3 Scenario is shown on Figure 6-3.

Figure 6-3
Anacostia River Predicted Water Quality
Phase I Controls and Pump Station Rehabilitation (Scenario C3)







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6.4 ROCK CREEK

6.4.1 Pollutant Loads in Rock Creek

Using the models for the CSS, SSWS, data on boundary condition flow rates for the years 1988-1990, and the event mean concentrations for each pollutant source, the pollutant load to Rock Creek was calculated for the average year. The load sources were divided into the following categories:

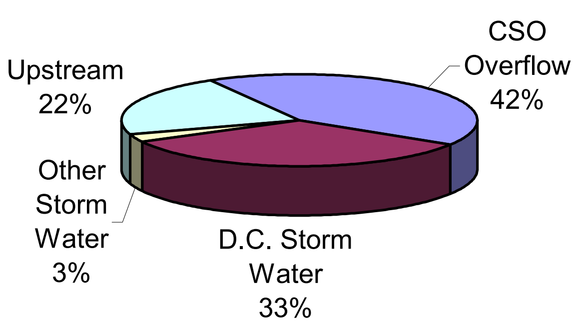
- CSO Overflow – this is overflow from the CSS.
- D.C. Storm Water – this is comprised of District's separate storm water system and includes Broad Branch and Luzon Valley.
- Other Storm water – this is comprised of storm water from park lands on each side of Rock Creek, such as from Rock Creek Park.

Load estimates are summarized Table 6-4 and in Figure 6-4.

Table 6-4
Sources of Pollutant Loads to Rock Creek Within District
Scenario C3- Phase I Controls and Pump Station Rehabilitation
Average Year (Average 1988-1990)

Pollutant Source	CBOD5 (lb/yr x 1000)	TSS (lb/yr x 1000)	Fecal Coliforms (#/yr x 10^{14})	E. Coli (#/yr x 10^{14})
CSO Overflow	42	189	18	14
D.C. Storm Water	226	1,116	15	9
Other Storm water	10	90	1	1
Upstream	419	9,765	10	4
Total	**697**	**11,160**	**44**	**28**

Figure 6-4
Sources of Fecal Coliform to Rock Creek



6.4.2 Predicted Water Quality in Rock Creek

Using the loads and flows predicted above, the Rock Creek receiving water model was run continuously for the period 1988-1990. The arithmetic average of the three years is defined as the average year condition. The predicted water quality with the loads sources for the C3 Scenario is shown on Figure 6-5.

6.5 POTOMAC RIVER

6.5.1 Pollutant Loads to the Potomac River

Using the models for the CSS, SSWS, data on boundary condition flow rates for the years 1988-1990, and the event mean concentrations for each pollutant source, the pollutant load to Potomac River was calculated for the average year. The load sources were divided into the following categories:

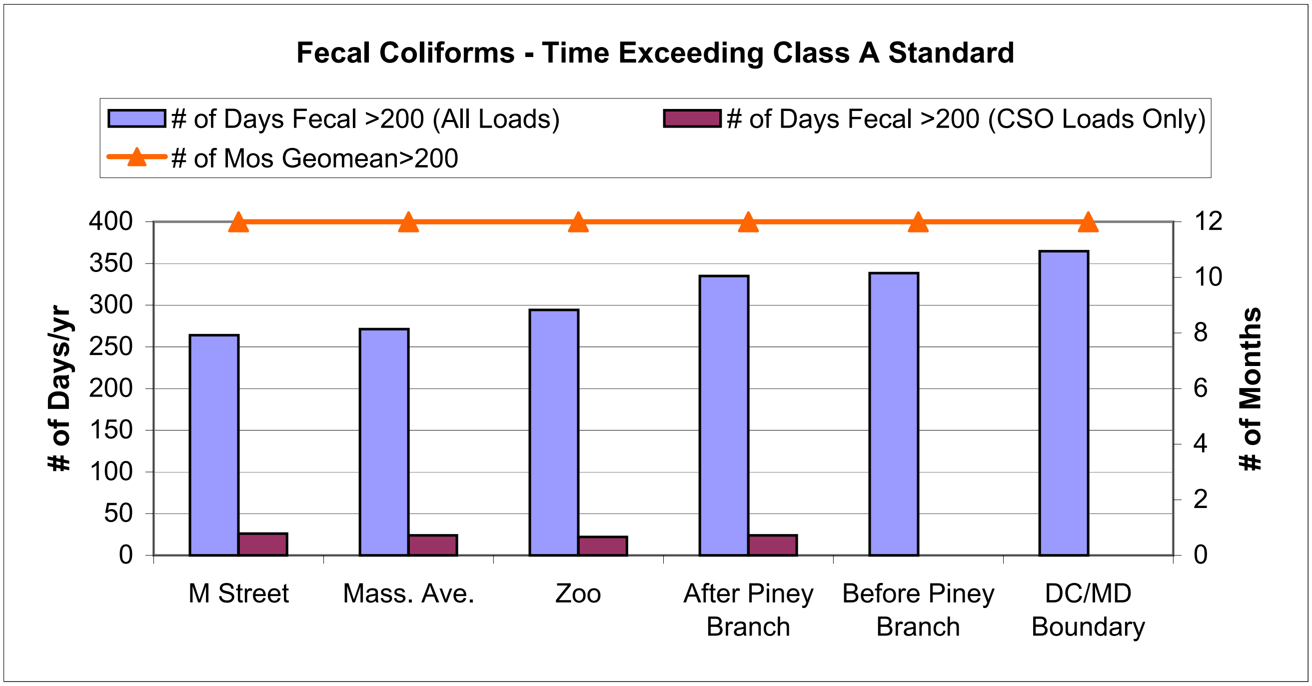
- CSO Overflow – this is overflow from the CSS.
- D.C. Storm Water – this is comprised of District's separate storm water system
- Other Storm Water – this consists of Alexandria and Arlington storm water and Virginia streams such as Four Mile Run, Spout Run and others.
- Wastewater Treatment Plants - comprises loads from Arlington, Alexandria and Blue Plains Wastewater Treatment Plants, including Blue Plains excess flow treatment.

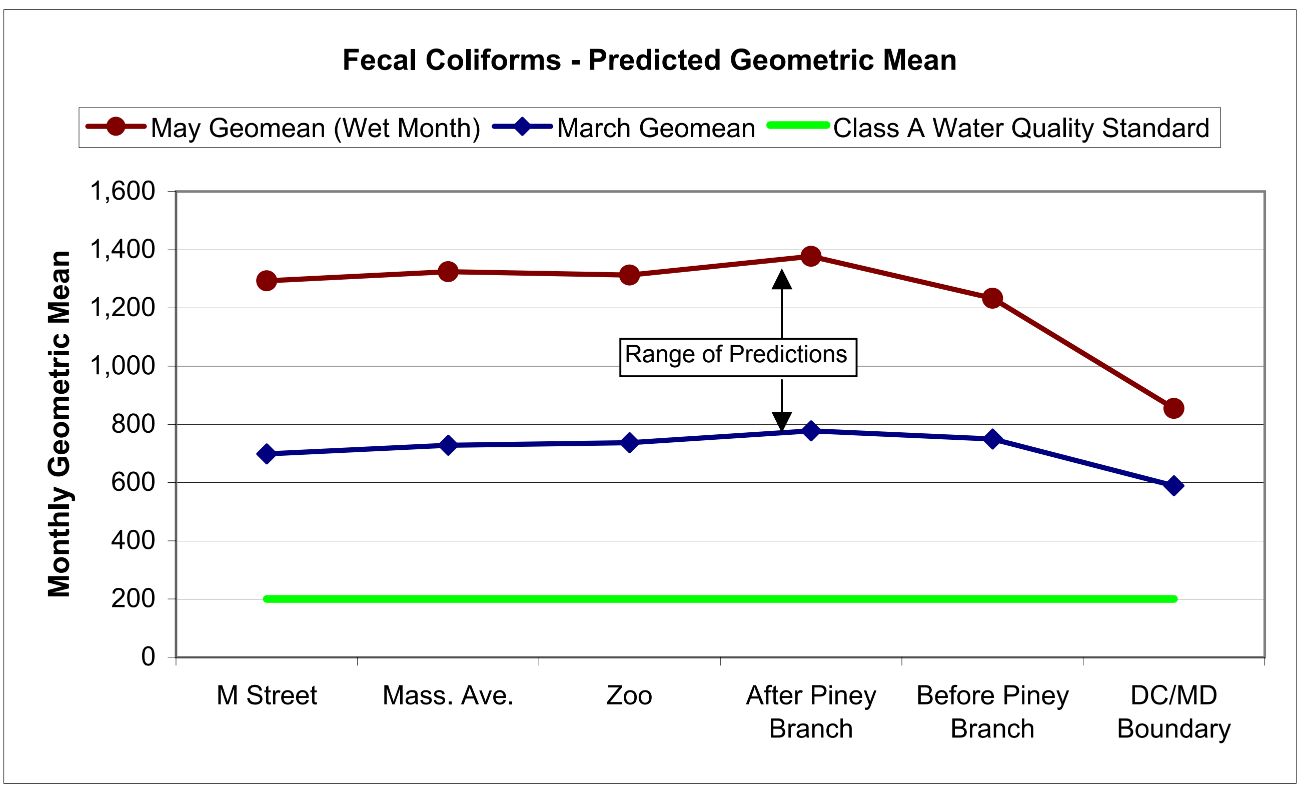
Load estimates are summarized Table 6-5 and in Figures 6-6 and 6-7.

Table 6-5
Sources of Pollutant Loads to Potomac River Within District
Scenario C3- Phase I Controls and Pump Station Rehabilitation
Average Year (Average 1988-1990)

Pollutant Source	CBOD5 (lb/yr x 1000)	TSS (lb/yr x 1000)	Fecal Coliforms (#/yr x 10^{14})	E. Coli (#/yr x 10^{14})
CSO Overflow	214	791	237	173
D.C. Storm Water	386	1,910	26	15
Other Storm water	1,323	20,424	59	32
Upstream	64,942	1,770,113	273	148
Wastewater Treatment Plants	7,564	12,712	75	54
Total	**74,429**	**1,805,950**	**670**	**422**

Figure 6-5
Rock Creek Predicted Water Quality
Phase I Controls and Pump Station Rehabilitation (Scenario C3)





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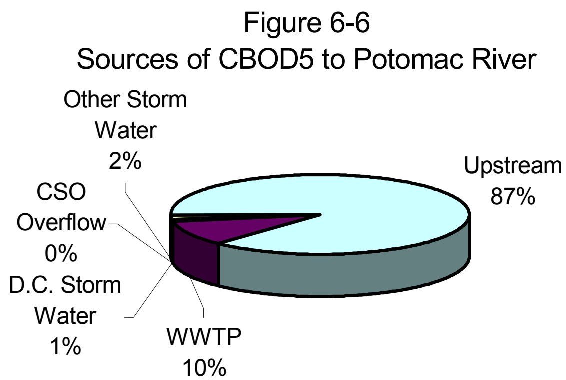
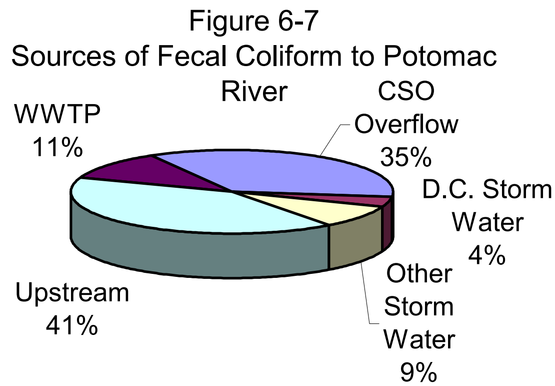




6.5.2 Predicted Water Quality in the Potomac River

Using the loads and flows predicted above, the Potomac River receiving water model was run continuously for the period 1988-1990. The arithmetic average of the three years is defined as the average year condition. The predicted water quality with the loads sources for the C3 Scenario is shown on Figure 6-8.

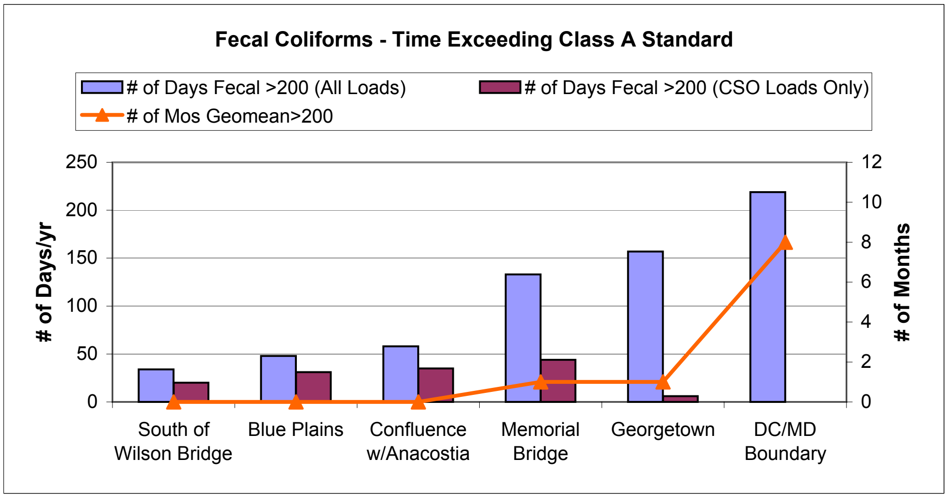
6.6 NEED FOR WATERSHED APPROACH

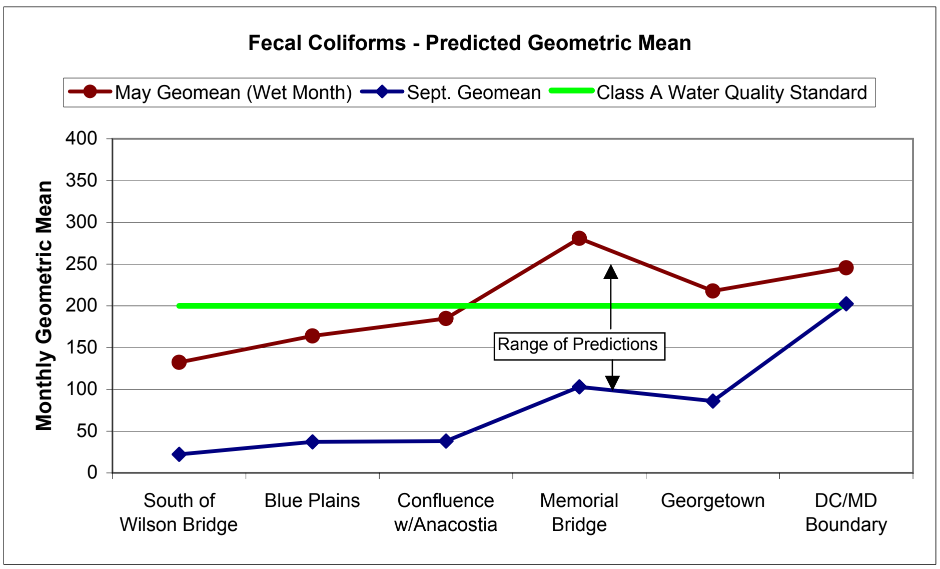
Based on the analysis above it is clear that all three receiving waters are impacted by a variety of pollutant sources. While the control of CSO discharges into each receiving water will have a beneficial impact on water quality, to achieve the goal of fishable and swimmable for these waterbodies, a comprehensive watershed wide effort must be implemented in conjunction with the selected LTCP.

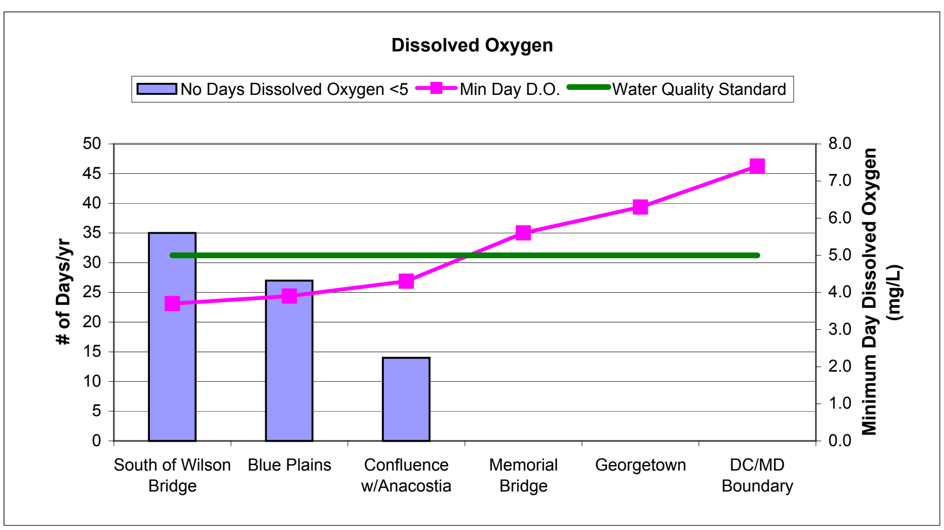
Maryland is currently developing a TMDL for the Upper Anacostia River and it is not yet known if a Use Attainability Analysis will be pursued for wet weather conditions. Such decisions will impact the water quality entering the District.

In addition, the District is working to improve the quality of storm flows to District waters as discussed in Section 3 – Existing Systems. The relative cost and benefits of the storm water improvements and CSO reduction must be balanced to achieve the greatest benefits with the funds provided by District ratepayers.

Figure 6-8
Potomac River Predicted Water Quality
(Phase I Controls and Pump Station Rehabilitation (Scenario C3)







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Section 7
Screening of CSO Control Technologies

7.1 INTRODUCTION

A wide range of CSO control technologies was considered for application to WASA's Combined Sewer System (CSS). The technologies are grouped into the following general categories:

- Source Control
- Inflow Control
- Sewer System Optimization
- Sewer Separation
- Storage
- Treatment
- Receiving Water Improvement
- Floatables Control

Each technology is described below, and a summary assessment is provided in Table 7-1.

7.2 SOURCE CONTROL

To control pollutants at their source, management practices can be applied where pollutants accumulate. Source management practices are described below:

- Public Education – Public education programs can be aimed at reducing (1) littering by the public and the potential for litter to be discharged to receiving waters during CSO events and (2) illegal dumping of contaminants in the sewer system that could be discharged to receiving waters during rain events. As part of its nine minimum controls program, WASA has implemented a public education program. Elements of the program include tours of Blue Plains WWTP, a CSO web site, inserts in water and sewer bills, a CSO newsletter, water conservation educational leaflets and presentations to community groups. In addition, the District Government has programs in place and under development that address litter control. (EPMC-III, 1999a). Public education programs cannot reduce the volume, frequency or duration of CSO overflows, but can help improve CSO quality by reducing floatable debris in particular. Public education and information is an integral part of any LTCP. It is recommended that the education programs be coupled with other control measures to provide significant benefits to receiving water quality.

Table 7-1
Assessment of CSO Control Technologies

CSO Control Technology	Performance: CSO Volume	Bacteria	Floatables	Suspended Solids	Implementation and Operational Factors
Source Control					
Public Education	None	Low	Medium	Medium	Part of ongoing WASA NMC Plan.
Street Sweeping	None	Low	Medium	Medium	Ineffective at reducing CSO volume, bacteria and very fine particulate pollution. District has mechanical sweepers. Effective at floatables removal, cost-intensive O & M. District would need a new fleet of vacuum sweepers for removal of fine particulates.
Construction Site Erosion Control	None	Low	Low	Medium	DCRA has program in place. Contractor pays for controls. Reduces sewer sediment loading, enforcement required.
Catch Basin Cleaning	None	Low	Medium	Low	Part of ongoing WASA NMC Plan, labor intensive, requires specialized equipment.
Industrial Pretreatment	Low	Low	Low	Low	WASA has program in place. There is limited industrial activity in and out of combined sewer area.
Garbage Disposal Ban	None	Low	Adverse	High	Requires increased allocation of resources to enforce, alternative dumping alternatives recommended.
Combined Sewer Flushing	None	Low	Low	Medium	Maximizes existing collection system volume, reduces first flush effect, subject to resettling problems, labor intensive.
Inflow Control					
"Daylight" orphaned storm sewers	Medium	Medium	Medium	Medium	Reduces CSO volume during storm events, potential for increased stormwater pollution loads, construction would be disruptive to effected areas, cost intensive.
Offload Ground Water Pumpage	Low	Low	Low	Low	Relatively low volume, construction would be disruptive to effected areas, not cost effective.
Storm Water Detention	Medium	Medium	Medium	Medium	Requires large area in congested urban environment, potential siting difficulties and public opposition, construction would be disruptive to affected areas, increased O & M.
Street Storage of Storm Water	Medium	Medium	Medium	Medium	Potential flooding and freezing problems, public opposition, low operational cost.
Water Conservation	Low	Low	Low	Low	Potentially reduces dry weather flow making room for CSO, ancillary benefit is reduced water consumption
Inflow/Infiltration Control	Low	Low	Low	Low	Infiltration usually lower volume than inflow, infiltration can be difficult to control
Stream Diversion	Low	None	None	None	Study undertaken by WASA shows no free-flowing streams entering the CSS.
Low Impact Development-Retrofit					
Bioretention	Medium	Medium	Medium	Medium	Site specific, requires widespread application across District to be effective, potential to be cost intensive in some areas.
Dry Wells	Medium	Medium	Low	Medium	Site specific, low cost, good BMP for residential areas, requires interaction with homeowners and businesses, widespread participation required to be effective.
Filter Strips	Medium	Medium	Low	Medium	Site specific, low cost, good BMP for parking lots, requires interaction with private owners in residential areas, requires widespread application across District to be effective.

CSO Control Technology	Performance: CSO Volume	Performance: Bacteria	Performance: Floatables	Performance: Suspended Solids	Implementation and Operational Factors
Vegetated Buffers	Medium	Medium	Medium	Medium	Site specific, low cost, good BMP for parking lots, requires interaction with homeowners in residential areas, requires widespread application across District to be effective.
Level Spreader	Low	Low	Low	Medium	Site specific, must be used in conjunction with other LID-R techniques, low cost.
Grassed Swales	Medium	Medium	Low	Medium	Site specific, requires widespread application across District to be effective, potential to be cost-intensive in some areas.
Rain Barrels	Low	Medium	Low	Medium	Good BMP for residential areas, minimal capture of total runoff volume, requires barrel coverage to inhibit mosquitoes, low cost, requires interaction with home and business owners.
Cisterns	Medium	Medium	Low	Medium	Site specific, requires widespread application across District to be effective, potential to be cost-intensive in some areas.
Infiltration Trenches/Catch Basins	Medium	Medium	Medium	Medium	Site specific, low cost, good BMP for residential areas, widespread participation required to be effective.
Rooftop Greening	Medium	Low	Low	Medium	Site specific, cost intensive, non-intrusive construction, other beneficial effects to city, requires widespread application to be effective, requires interaction with all property owners.
Increased Tree Cover	Low	Low	None	Low	Site specific, low cost, little capture of stormwater runoff, other beneficial effects to city.
Permeable Pavements	Medium	Medium	Low	Medium	Site specific, cost intensive, subject to clogging, increased O & M costs, labor intensive.
Sewer System Optimization					
Optimize Existing System	Medium	Medium	Medium	Medium	Part of ongoing WASA NMC Plan, low cost relative to large scale structural BMPs, limited by existing system volume and dry weather flow dam elevations.
Real Time Control	Medium	Medium	Medium	Medium	Highly automated system, increased O & M, increased potential for sewer backups.
Sewer Separation					
Complete Separation	High	Medium	Low	Low	Disruptive to affected areas, cost intensive, potential for increased stormwater pollutant loads, requires homeowner participation.
Partial Separation	High	Medium	Low	Low	Disruptive to affected areas, cost intensive, potential for increased stormwater pollutant loads.
Rain Leader Disconnection	Medium	Medium	Low	Low	Low cost, requires home and business owner participation, potential for increased storm water pollutant loads.
Storage					
In - stream storage of CSO	High	High	High	High	Limited space for siting, limited storage volume, potential odor problems, aesthetically unpleasing.
Earthen Basins	High	High	High	High	Disruptive to affected areas, lack of space in urban environment, potential odor problems.
Open Concrete Tanks	High	High	High	High	Requires large space, potential odor control problems, disruptive to effected area, public opposition.
Closed Concrete Tanks	High	High	High	High	Requires large space, disruptive to affected area, cost intensive, aesthetically acceptable.
Storage Pipelines/Conduits	High	High	High	High	Disruptive to affected areas, potentially expensive in congested urban areas, aesthetically acceptable, provides storage and conveyance.

CSO Control Technology	Performance: CSO Volume	Bacteria	Floatables	Suspended Solids	Implementation and Operational Factors
Tunnels	High	High	High	High	Non-disruptive, requires little area at ground level, capital intensive, provides storage and conveyance, pump station required to lift stored flow out of tunnel.
Treatment					
Screening/ Netting Systems	None	None	High	None	Controls only floatables.
Primary Sedimentation[1]	Low	Medium	High	Medium	Limited space at Blue Plains WWTP, difficult to site in urban areas.
Swirl Concentrator[1]	None	Medium	High	Low	Variable pollutant removal performance, increased O & M. Foul sewer flow requires pumping to WWTP.
Vortex Separator[1]	None	Medium	High	Low	Variable pollutant removal performance, increased O & M. Foul sewer flow requires pumping to WWTP.
High Rate Physical/Chemical Treatment[1]	None	Medium	High	High	Limited space at Blue Plains WWTP, requires construction of extensive new conveyance conduits, high O&M costs.
Disinfection	None	High	Low	Low	Limited space at Blue Plains, increased O & M.
Constructed Wetlands	Medium	Medium	Low	Medium	Requires large space and long detention times, reduced effectiveness in winter, low cost O & M, ineffective for floatables.
Expansion of BPWWTP	High	High	High	High	Limited by space at Blue Plains WWTP, increased O & M.
Receiving Water Improvement					
Side Stream Aeration	None	None	None	None	High O & M, only effective for increasing DO, limited effective area.
In-stream Aeration	None	None	None	None	High O & M, only effective for increasing DO, limited effective area.
Divert Blue Plains Effluent to Anacostia River	None	None	None	None	Cost-intensive, high O & M, limited beneficial effects to water quality.
Pump Ground Water to Anacostia River	None	None	None	None	Cost-intensive, disruptive to effected areas, limited beneficial effects to water quality increased O & M.
Solids and Floatables Controls					
Netting Systems	None	None	High	None	Easy to implement, potential negative aesthetic impact
Containment Booms	None	None	High	None	Simple to install, difficult to clean, negative aesthetic impact
Manual Bar Screens	None	None	High	None	Prone to clogging, requires manual maintenance
Weir Mounted Screens	None	None	High	None	Relatively low maintenance, requires suitable physical configuration, must bring power to site
Screens with Backwash	None	None	High	None	Limited hydraulic capacity makes these suitable for small outfalls only
Fixed baffles	None	None	High	None	Low maintenance, easy to install, requires proper hydraulic configuration
Floating Baffles	None	None	High	None	Moving parts make them susceptible to failure
Catch Basin Modifications	None	None	High	None	Requires suitable catch basin configuration, potential for street flooding and increased maintenance efforts

1. Process includes pretreatment screening and disinfection.

- Street Sweeping – The major objectives of municipal street cleaning are to enhance the aesthetic appearance of streets by periodically removing the surface accumulation of litter, debris, dust and dirt, and to prevent these pollutants from entering storm or combined sewers. Common methods of street cleaning are manual, mechanical and vacuum sweepers, and street flushing. Studies on the effect of street sweeping on the reduction of floatables and pollutants in runoff have been conducted. New York City found that street cleaning can be effective in removing floatables. Increasing street cleaning frequency from twice per week to six times per week reduced floatables by about 42% on an item count basis. A significant quantity of floatables was found to be located on sidewalks that were not cleanable by conventional equipment. (HydroQual, 1995).

  In the National Urban Renewal Program (NURP)- funded studies of the late 1970s to the early 1980s, street sweeping was found to be generally ineffective at removing pollutants and improving the quality of urban runoff (MWCOG, 1983 and EPA, 1983). The principal reason for this is that mechanical sweepers were employed at the time. Mechanical sweepers cannot pick up the finer particles (diameter < 60 microns). Studies have shown that these fine particles contain a majority of the target pollutants along city streets that are washed into sewer systems (Sutherland, 1995). In the early 1990s new vacuum-assisted sweeper technology was introduced that can pick up the finer particles along city streets. A recent study showed that these vacuum-assisted sweepers have a 70% pickup efficiency for particles less than 60 microns (Sutherland, 1995).

  Street sweeping only affects the pollutant concentration in the storm water component of combined sewer flows. Thus, a street sweeping program is ineffective at reducing the volume and frequency of CSO events. Furthermore, the total area accessible to sweepers is limited. Areas such as sidewalks, traffic islands, and congested street parking areas can not be cleaned by this method. Although a street sweeping program employing high efficiency sweepers could reduce the concentrations of some pollutants in CSOs, bacteriological pollution originates primarily from the sanitary component of sewer flows. Thus, minimal reductions in fecal coliform and e. coli concentrations of CSOs would be expected. Enhanced street sweeping might thus be more appropriate to consider as part of an enhanced storm water management program.

- Construction Site Erosion Control – Construction site erosion control involves management practices aimed at controlling the washing of sediment and silt from disturbed land associated with construction activity. Erosion control has the potential to reduce solids concentrations in CSOs and reduce sewer cleanout O & M costs. The District government (not WASA) is responsible for sediment and erosion control and has a program in place to regulate land disturbance (DCRA, 1988). Given the extremely small amount of land under construction at any one time and that District Government programs are already in place, this alternative is considered to be implemented to a satisfactory level and will not be considered further.

- Catch Basin Cleaning – The major objective of catch basin cleaning is to reduce conveyance of solids and floatables to the combined sewer system by regularly removing accumulated catch basin deposits. Methods to clean catch basins include manual, bucket, and vacuum removal. Cleaning catch basins can only remove an average of 1-2% of the BOD_5 produced by a combined sewer watershed (EPA, 1978). As a result catch basins cannot be considered an effective pollution control alternative for BOD removal. However, catch basins can be effective in reducing floatables in combined sewer. WASA has a catch basin cleaning program in place, for the District's 25,000 catch basins, as part of its NMC program. The program was recently upgraded and includes cleaning catch basins an average of once per year with areas susceptible to flooding cleaned on a more frequent basis. This alternative is considered to be implemented to a satisfactory level.

- Industrial Pretreatment – Industrial pretreatment programs are geared toward reducing potential contaminants in CSO by controlling industrial discharges to the sewer system. WASA has an approved local pretreatment program consistent with the Clean Water Act and its amendments.

- Garbage Disposal Ban – The rationale behind a garbage disposal ban is to reduce solids and organic loading to the combined sewer system by prohibiting garbage disposals. Note that this is only effective for CSO events that occurred when significant numbers of people would be using disposals (e.g. dinner time). Dislike for this alternative was voiced at the Stakeholder Advisory Panel due to the inconvenience it would cause to the public. Due to its limited benefit and public opposition, this alternative has been eliminated from further consideration.

- Combined Sewer Flushing – The major objective of combined sewer flushing is to re-suspend deposited sewage solids and transmit these solids to the wastewater treatment plant during dry-weather to prevent a storm event from flushing them to a receiving water. Combined sewer flushing consists of introducing a controlled volume of water over a short duration at key points in the collection system. This can be done using external water from a tank truck by gravity or pressurized feed or using internal water detained manually or automatically.

  A recent feasibility study of combined sewer flushing indicated that manual flushing using an external pressurized source of water is most effective. However, repeated sewer flushing achieved no important gain in the fraction of pollutants removed, and 70 percent of the flushed solids quickly resettled. Therefore, repeated flushing in a downstream sequence is probably necessary to achieve control of pollutants.

Combined sewer flushing is most effective when applied to flat collection systems since solids are more likely to become deposited in flat systems. A 2% BOD_5 removal has been estimated for sewer flushing (EPA, 1978). Due to the limited benefits of this alternative, it will not be considered further.

7.3 INFLOW CONTROL

Inflow control involves eliminating or retarding storm water inflow to the CSS, lowering the magnitude of the peak flow through the system, and thereby reducing overflows. Methods for inflow control are described below:

- Daylight "Orphaned" Storm Sewers – Over time, redevelopment has occurred at certain locations within the combined sewer system. When this redevelopment has occurred, sewers have been locally separated as part of the construction project. In many locations, locally separated storm sewers discharge to an existing combined sewer because there is no other outlet for the sewer. This alternative involves extending storm sewers so they discharge to a receiving water, thereby offloading the combined sewer system and reducing CSO discharges. However, this alternative increases storm water flows and its associated pollutant loads to the receiving waters. This alternative has been retained for consideration.

- Offload Groundwater Pumpage – Several buildings in the District, particularly those in the Federal Triangle, have basements below the ground water table that are kept dry by dewatering pumps. In many cases, these pumps discharge to the CSS. This alternative involves routing this groundwater pumpage to a storm sewer and then to a receiving water to offload the CSS, thereby reducing CSO discharges. This alternative has been retained for consideration.

- Water Conservation, Infiltration/Inflow (I/I) Reduction - Water conservation and infiltration control are both geared toward reducing the dry weather flow in the system, thereby allowing the system to accommodate more CSO. Water conservation includes measures such as installing low flow fixtures, public education to reduce wasted water, leak detection and correction, and other programs. Infiltration is ground water that enters the collection system through leaking pipe joints, cracked pipes, manholes, and other similar sources. Excessive amounts of infiltration can take up hydraulic capacity in the collection system. In contrast, inflow in the form of surface drainage is intended to enter the CSS. For combined sewer communities, sources of inflow that might be controlled include leaking or missing tide gates and inflow in the separate sanitary system located upstream of the CSS.

It can be difficult and expensive to achieve significant reductions in flow from water conservation and I/I measures. The measures involve disparate sources of flow spread throughout a large area. In addition, modeling conducted as part of the LTCP has shown that reduction of these sources is predicted to have a minor impact on reducing CSO. This is because the relative magnitude of the dry weather flow is small compared to the storm water runoff which causes CSO overflows.

As described in Section 4, the Blue Plains Intermunicipal Agreement of 1985 (IMA) allocates the District 148 mgd of capacity at BPWWTP with 10 mgd reserved to accommodate additional Potomac Interceptor flows for a total of 158 mgd. Currently, wastewater flows from the District to BPWWTP average about 170 mgd. WASA has a wastewater flow reduction and water conservation program in place to reduce the dry weather flow from the District. The LTCP has been prepared on the basis that the District portion of the DWF will be reduced to the IMA allowance of 158 mgd. The LTCP prepared herein thus already takes advantage of a significant amount of reduction in flow due to these programs. If this does not occur, modeling indicates that combined sewer storage volumes may need to be increased by about 2.5% to provide an equivalent degree of control.

- Stream Diversion – In many old cities like the District, creeks and streams were used as open sewers and then eventually bricked over to contain the foul odors as development occurred. In some cases headwaters of streams may still flow into combined sewers and take up capacity of the CSS. This alternative consists of piping creek flow to a receiving water body or constructing a detention pond to contain a portion of the creek flow during wet weather to reduce the load on the combined sewer system. Although old District maps show the past existence of free-running streams in the combined sewer area of District, most notably Tiber Creek, recent field investigations could not identify any streams entering the combined sewer system. A highly urbanized area that quickly directs all rainfall to catch basins and roof leaders connected to the CSS has replaced the natural land hydrology of the past. Thus, stream diversion is not applicable in the District and this alternative has been eliminated from further consideration.

- Low Impact Development Retrofit – The goal of low impact development (LID) is to mimic predevelopment site hydrology by using site design techniques that store, infiltrate, evaporate and detain runoff. LID has the potential to reduce both the volume of storm water generated by a site and its peak overflow rate, thereby improving the quality of the storm water. Low Impact Development Retrofit (LID-R) refers to the modification of an existing site to accomplish LID goals. Since most of the District is developed, LID-R is most relevant.

Data is available to assess the cost and benefits of LID to undeveloped sites. However, due to the complications of existing infrastructure and the cost of acquiring land, few studies have been conducted for applying LID-R to urban areas. These costs are also highly site specific. Therefore, in order to assess the implementability and costs of applying LID-R within the District, a site specific cost estimation approach is required using some of the common LID-R techniques as described below:

- Bioretention (Rain Garden) – a planting bed or landscaped area used to hold runoff and to allow it to infiltrate.
- Dry Wells – an excavated pit, backfilled with granular material to allow infiltration.
- Filter Strips – a band of vegetation located between the runoff location and the receiving channel or water body. Overland flow over the filter strip allows infiltration and filtering of storm water.
- Vegetated Buffers – a strip of vegetation around sensitive areas such as water bodies that provides infiltration, slows and disperses storm water and allows some trapping of sediment.
- Level Spreader – an aggregate filled trench designed to convert concentrated flow to sheet flow to promote infiltration and reduce erosion.
- Grassed Swales – depressions designed to collect, treat, and retain runoff from a storm event. Swales can be designed to be dry or wet (with standing water) between rain events. Wet swales typically contain water tolerant vegetation and use natural processes to remove pollutants.
- Rain Barrels – a barrel placed at the end of a roof downspout to capture and hold runoff from roofs. The water in the barrel must be manually emptied onto the ground, or it can be put to beneficial use to water vegetation. The barrel top typically has a protective screen to inhibit mosquitoes. WASA currently has a demonstration program underway that applies this technology to residential properties.
- Cisterns – rain water from roofs is diverted into underground tanks and stored for non-potable uses.
- Infiltration Trenches – an excavated trench backfilled with stone to create a subsurface basin that provides storage for water and allows infiltration.
- Rooftop Greening – the practice of constructing precultivated vegetation mats on rooftops to capture rainfall, thereby reducing runoff and CSO.
- Increased Tree Cover – planting trees in the City to capture a portion of rainfall.
- Permeable Pavements – reduces runoff to the combined sewer drainage system by allowing precipitation to infiltrate through the pavement and into the earth.

As LID-R techniques are distributive by design, they must be applied over a large area in order to achieve any significant reductions in runoff volume and/or flow rate to the combined sewer system. In urban areas, it is not cost-effective to demolish existing infrastructure just for the purpose of LID-R application alone. It is generally accepted that LID-R becomes cost-effective when redevelopment is under construction simultaneously within an urban area. This is because the streets and sidewalks are already dug up, allowing substantial construction cost savings. To take advantage of applying LID-R during redevelopment projects, the District would need to supplement its existing storm water management regulations to include or require LID techniques for new construction. The disadvantage of this approach is that substantial redevelopment typically occurs over a long period of time. In the case of roof top greening, it requires significant participation and cooperation of business and private property owners. It may take many decades for the elimination of significant runoff volume. The District government is responsible for setting storm water management regulations; therefore, any implementation effort for this alternative requires that they be the lead organization. Due to its potential in combination with other CSO abatement programs and technologies, LID-R has been retained for further consideration.

7.4 SEWER SYSTEM OPTIMIZATION

This CSO control technology involves making the best use of existing facilities to limit overflows. The techniques are described below:

- Optimize Existing System – This approach involves evaluating the current standard operating procedures for facilities such as pumps stations, control gates, inflatable dams, and treatment facilities to determine if improved operating procedures can be developed to provide benefit in terms of CSO control.
- Real Time Control (RTC) – In RTC, sewer level and flow data are measured in "real time" at key points in the sewer system. The collected data is typically transferred to a control device such as a central computer where decisions are made to operate gates, pump stations, inflatable dams and other control components to maximize use of the existing sewer system and to limit overflows. Local dynamic controls are used to control regulators to prevent flooding and system wide dynamic controls are used to implement control objectives such as maximizing flow to the WWTP or transferring flows from portion of the CSS to another to fully utilize the system. Predicative control, which incorporates use of weather forecast data is also possible, but is complex and requires sophisticated operational capabilities. RTC can reduce CSO volumes where in-system storage capacity is available. In-system storage is a method of using excess sewer capacity by containing combined sewage within a sewer and releasing it to the WWTP after a storm event when capacity for treatment becomes available. Methods of equipping sewers for in-system storage include inflatable dams, mechanical gates and increased overflow weir elevations. RTC has been used in other cities such as Quebec, Canada; Louisville, Kentucky; and Cleveland, Ohio. Refer to Figure 7-1 for a diagram of an example inflatable dam system. WASA's inflatable dam system is an RTC system using the

storage in the existing large combined sewers to limit overflows. Enhancement or addition to this system will be considered.

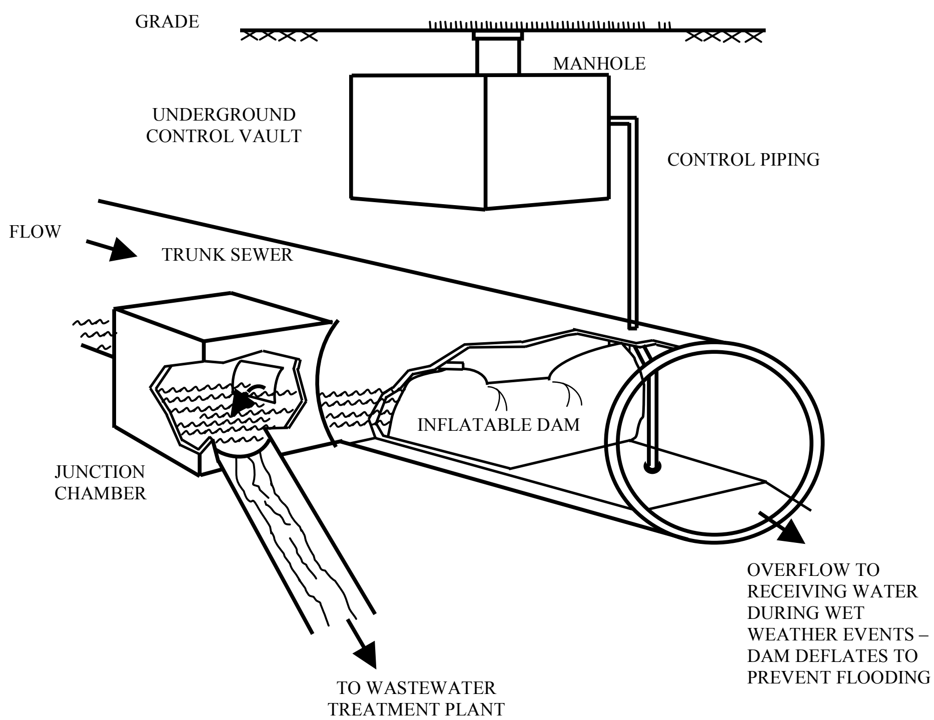

FIGURE 7-1
TYPICAL INFLATABLE DAM

7.5 SEWER SEPARATION

Sewer separation is the conversion of a combined sewer system into a system of separate sanitary sewers and storm sewers. This alternative prevents sanitary wastewater from being discharged to receiving waters. However when combined sewers are separated, storm sewer discharges will greatly increase and contribute more pollutant load to the receiving waters since storm water will no longer be captured and treated in the combined sewer system. New stringent storm water regulations may require some type of pollutant control on the storm water system. In addition, this alternative involves substantial city-wide excavation, thus exasperating street disruption problems in the District.

Varying degrees of sewer separation could be achieved as follows:

- Rain Leader (Gutters and Downspouts) Disconnection – Rain leaders are disconnected from the combined sewer system and the storm runoff is diverted elsewhere. Depending on the neighborhood, the leaders may be run to a dry well, vegetation bed, a lawn, a storm sewer or the street. For most residences in the District's combined sewer area, the most feasible rain leader disconnection scheme is diversion to the street. Unfortunately, this scheme contributes to nuisance street flooding and only briefly delays the water from entering the combined sewer system through catch basins.

- Partial Separation – Combined sewers are separated in the streets only, or other public right-of way. This is accomplished by constructing either a new sanitary wastewater system or a new storm water system.
- Complete Separation – In addition to separation of sewers in the streets, storm water runoff from each private residence or building such as from rooftops and parking lots is also separated.

Figure 7-2 shows a diagram of these methods of separation. For other cities, separation has proved most feasible for CSO areas of 200 acres or less. This alternative will be considered further in the Section 8.

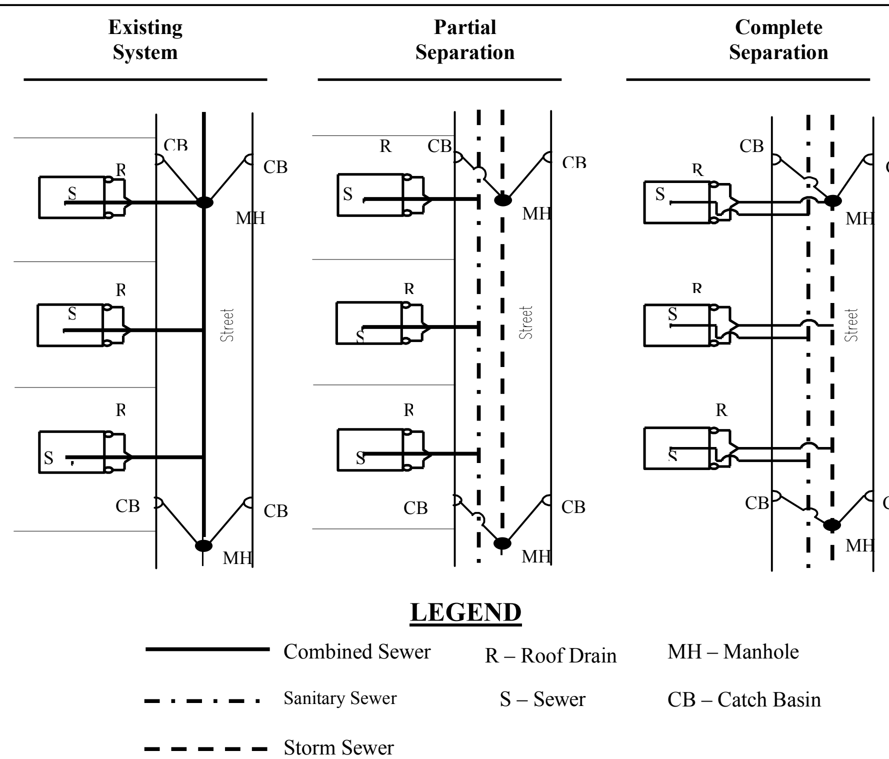

FIGURE 7-2
SEWER SEPARATION ALTERNATIVES

7.6 STORAGE

The objective of retention basins (also referred to as off-line storage) is to reduce overflows by capturing combined sewage in excess of WWTP capacity during wet weather for controlled release into wastewater treatment facilities after the storm. Retention basins can provide a relatively constant flow into the treatment plant and thus reduce the size of treatment facilities required. Retention basins have had considerable use and are well documented. Retention facilities may be located at overflow points or near dry-weather or wet weather treatment facilities. A major factor determining the feasibility of using retention basins is land availability. Operation and maintenance cost are generally small, requiring only collection and disposal cost for residual sludge solids, unless inlet or outlet pumping is required. Many demonstration projects have included storage of peak storm water flows, including those in Richmond, Virginia; Chippewa Falls, Wisconsin; Boston, Massachusetts; Milwaukee, Wisconsin; and Columbus, Ohio. The following are types of CSO retention facilities that have been considered:

- In-Stream Storage – EquiFlow is a proprietary system sold by Fresh Creek Technologies, Inc. for storing CSO in the receiving water at the discharge of a CSO outfall. Floating curtains are constructed around the outfall creating a storage chamber in the water body for CSO. In fresh water applications as would be encountered in the District, CSO discharging from the combined sewer would be conveyed through the storage structure created by the curtains around a series of baffles to prevent short-circuiting of the storage. CSO entering the storage area displaces river water. Heavy materials in the CSO sink to the river bottom and lighter materials (also called "floatables") rise to the surface. If the CSO overflow is large enough, it eventually fills the storage volume and is relieved through openings in the curtain to the receiving water. After CSO conditions subside, the contents within the curtain would be pumped back into the existing sewer system for treatment at the wastewater treatment plant. The storage chamber is not covered and any CSO stored in the chamber is exposed to the atmosphere. No bottom is constructed in the storage chamber, thereby placing the CSO in direct contact with the native material on the bottom of the water body. WASA conducted a study to identify potential sites to apply the Equiflow System (EPMC-III, 2000a). The site at Main and O Street Pumping Stations was the only site identified to be suitable based on system requirements. Approximately 5 mg of storage was estimated to be available at this site, which is much less than the volume associated with a typical overflow event. In addition, the Anacostia waterfront is being redeveloped to provide for public access to river. In-stream storage of CSO would negatively impact that effort due to aesthetic, odor and sanitation concerns. In addition, members of the Stakeholder Advisory Panel expressed a dislike to the aesthetic impact of such a system and to the prospects of open storage of CSO. Given these factors, in-stream storage of CSO has been eliminated from further consideration.

- Earthen Basins – Earthen basins are CSO storage facilities at locations where land is available. Basins typically have sloped sides, are typically uncovered, and include a synthetic liner or concrete lining to prevent exfiltration and to facilitate maintenance. Earthen basins are typically used in relatively unpopulated areas where land is plentiful and odors are not objectionable. Considering the lack of available land and the highly urbanized environment of the District, earthen basins have been eliminated from further consideration.

- Open Concrete Tanks – Open concrete tanks can be used for storage of CSO. Open concrete tanks are similar to earthen basins except the side walls are vertical instead of being sloped and the tank is constructed of reinforced concrete. The tanks can also include equipment to facilitate cleaning and dewatering of the basin. Since there is no top, odors and wildlife can cause a nuisance. Open concrete tanks have typically been used at remote wastewater treatment plant sites or in rural areas where land and aesthetic concerns are less of an issue. Given the lack of available land and the urban nature of the District, open concrete tanks have been eliminated from further consideration.

- Closed Concrete Tanks – Closed concrete tanks are similar to open tanks except that the tanks are covered and include many mechanical facilities to minimize their aesthetic and environmental impact. Closed concrete tanks typically include odor control systems, washdown/solids removal systems, and access for cleaning and maintenance. Closed concrete tanks have been constructed below grade such that the surface at grade can be used for parks, playgrounds, parking or other light uses. Closed concrete tanks are potentially viable alternatives for WASA's CSS and have therefore been retained for further consideration.

- Storage Pipelines/Conduits – Large diameter pipelines or conduits can provide significant storage in addition to the ability to convey flow. Pipelines are typically constructed between an overflow point and a pump station or treatment facility. The pipelines include some type of discharge control to allow flow to be stored within the pipeline during wet weather. After the rain event, the contents of the pipeline are allowed to flow by gravity along its length. Pipelines have the advantage of requiring a relatively small right of way for construction. Disadvantages are that it takes a relatively large diameter pipeline or cast-in-place conduit to provide the volume required to accommodate large CSO drainage areas and requires street excavation causing traffic disruption. For large CSO areas, pipeline sizes may become so large that construction from the surface becomes impractical and construction of a tunnel is more feasible.

- Tunnels – Tunnels are similar to storage pipelines in that they can provide significant storage volume in addition to offering the ability to convey flow. Tunnels have the advantage of causing minimal surface disruption and of requiring little right of way for construction. Excavation to construct the tunnel is carried out deep beneath the city and therefore would not impact traffic. The ability to construct tunnels at a reasonable cost depends on the geology. Tunnels have been used in many CSO control plans including Chicago, Illinois; Rochester, New York; Cleveland, Ohio; Richmond, Virginia; Toronto, Canada and others. A schematic diagram of a storage tunnel system is shown in Figure 7-3. The storage tunnel stores flow and conveys it to a dewatering station where floatables are removed at a screening house and then flows are lifted for conveyance to the WWTP.

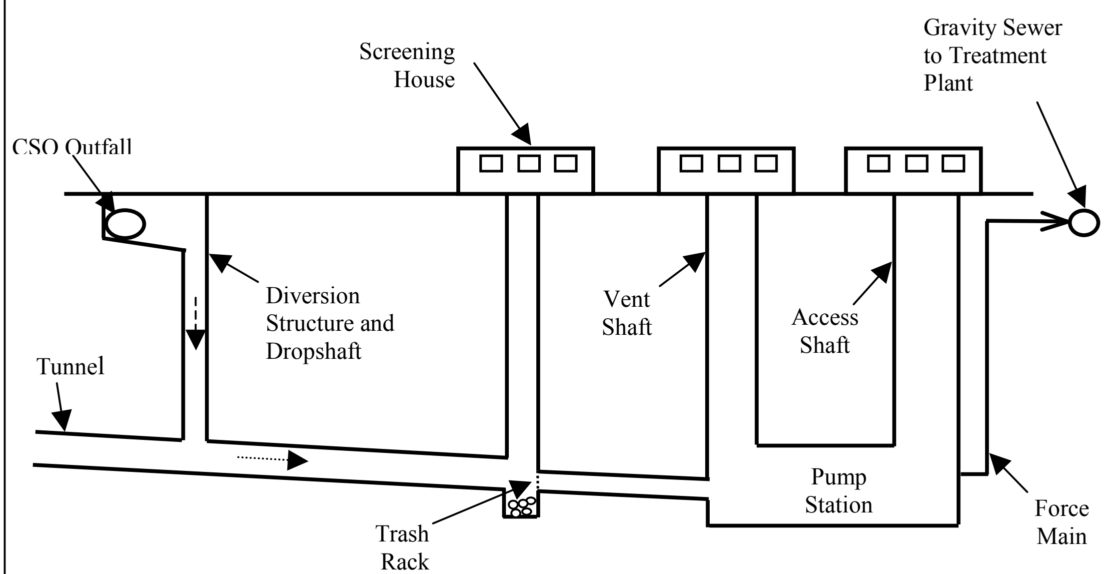

FIGURE 7-3
STORAGE TUNNEL SCHEMATIC

7.7 TREATMENT

- Screening – The major objective of screening is to provide high rate solids/liquid separation for combined sewer floatables and debris thereby preventing floatables from entering receiving waters. The following categories of screens are applicable to CSO outfall applications.
  - Trash Racks and Manually Cleaned Bar Racks – Trash racks are intended to remove large objects from overflow and have a clear spacing between approximately 1.5 to 3.0 inches. Manually cleaned bar racks are similar and have clear spacings between 1.0 to 2.0 inches. Both screens must be manually raked and the screenings allowed to drain before disposal. WASA has installed one bar rack at CSO 040 in Rock Creek.
  - Netting Systems – Netting Systems are intended to remove floatables and debris at CSO outfalls. A system of disposable mesh bags is installed in either a floating structure at the end of the outfall or in an underground chamber on the land side of the outfall. Nets and captured debris must be periodically removed using a boom truck and disposed of in a landfill. WASA has installed an end-of-pipe netting system at CSO outfall 018 on the Anacostia River and has contracted COG to independently evaluate the effectiveness and O&M concerns for this demonstration program.

- Mechanically Cleaned Bar Screens – Mechanically cleaned bar screens typically have clear spacing between 0.25 and 1.0 inches. Bars are mounted 0 to 39 degrees from the vertical and rake mechanisms periodically remove material trapped on the bar screen. Facilities are typically located in a building to house collected screenings that must be collected after a CSO event and then transported to a landfill. The Northeast Boundary Swirl Facility is equipped with mechanically cleaned bar screens to treat the influent to the facility.
- Fine Screens – Fine screens in CSO facilities typically follow bar screens and have openings between 0.010 and 0.5 inches. Flow is passed through the opening and solids are retained on the surface. Screens can be in the shape of a rotary drum or linear horizontal or vertical screens. Proprietary screens such as ROMAG have been specifically designed for wet weather applications. These screens retain solids on the dry weather side of the system so they can be conveyed to the wastewater treatment plant with the sanitary wastewater thereby minimizing the need for manual collection of screenings.

Manually cleaned screens for CSO control at remote locations have not been widely applied due to the need to clean screens, and the potential to cause flooding if screens blind. Mechanically cleaned screens have had much greater application at CSO facilities. Due to the widely varying nature of CSO flow rates, even mechanically cleaned screens are subject to blinding under certain conditions. In addition, the screening must be housed in a building to limit aesthetic concerns and may require odor facilities as well. Fine screens have had more limited application for CSOs in the United States. ROMAG reports that over 250 fine screens have been installed in Europe and several screens have been installed in the United States (EPA, 1999a).

- Primary Sedimentation – The objective of sedimentation is to produce a clarified effluent by gravitational settling of the suspended particles that are heavier than water. It is one of the most common and well-established unit operations for wastewater treatment. Sedimentation also provides storage capacity, and disinfection can occur concurrently in the same tank. It is also very adaptable to chemical additives, such as lime, alum, ferric chloride, and polymers, which provide higher suspended solids and BOD removal. Many CSO control demonstration projects have included sedimentation. These include Dallas, Texas; New York City, New York; Saginaw, Michigan; and Mt. Clements, Michigan (EPA, 1978). Studies on existing storm water basins indicate suspended solids removals of 15 to 89 percent; BOD_5 removals of 10 to 52 percent (EPA, 1978, Fair and Geyer, 1965, Ferrara and Witkowski, 1983, Oliver and Gigoropolulos, 1981). WASA's existing excess flow treatment train at BPWWTP utilizes this process to treat up to 336 mgd during storm events.

- Swirl/Vortex Concentrators – Three vortex technologies are currently marketed: USEPA Swirl Concentrator, Storm King Hydrodynamic Separator of British design, and the FluidSep vortex separator of German design. Although each of the three is configured somewhat differently, the operation of each unit and the mechanisms for solids separation are similar. Flow enters the unit at a controlled tangential velocity and is directed around the perimeter of a cylindrical shell, creating a swirling, vortex pattern. The swirling action causes solids to move to the outside wall and fall toward the bottom, where the solids concentrated flow is conveyed through a sewer line to the WWTP. The overflow is discharged over a weir at the top of the unit. Various baffle arrangements capture floatables that are subsequently carried out in the underflow. Principal attributes of the swirl concentrator are the ability to treat high flows in a very small footprint, and a lack of mechanical components and moving parts, thereby making it less operation and maintenance intensive.

  Swirl/Vortex separators have been operated in Decatur Illinois; Columbus, Georgia; Syracuse, New York; West Roxbury, Massachusetts; Rochester, New York; Lancaster, Pennsylvania; Toronto, Ontario, Canada. Swirl concentrator prototypes have achieved suspended solids removals of 12 to 86 percent in Lancaster, Pennsylvania; 18 to 55 percent in Syracuse, New York; and 6 to 36 percent in West Roxbury, Massachusetts. BOD_5 removals from 29 to 79 percent have been achieved with the swirl concentrator prototype in Syracuse New York. (Alquier, 1982). New York City is currently evaluating the performance of the three swirl/vortex technologies at full scale (133 mgd each) at the Corona Avenue Vortex Facility (Zaccagnino et al, 2000).

  The performance of vortex separators has been found to be inconsistent in many cases. A pilot study in Richmond, Virginia showed that the performance of two vortex separators was irregular and ranged from <0% to 26% with an average removal efficiency of about 6% (Greeley and Hansen, 1995). The performance of vortex separators is also a strong function of influent TSS concentrations. A high average influent TSS concentration will yield a higher percent removal. As a result, if influent CSO is very dilute with storm water, the overall TSS removal will be low. Suspended solids removal in the beginning of a storm may be better if there is a pronounced first flush period with high solids concentrations (City of Indianapolis, 1996). Removal effectiveness is also a function of the hydraulic loading rate with better performance observed at lower loading rates.

  WASA currently operates a 400 mgd swirl concentrator based on the USEPA design at Northeast Boundary near RFK Stadium. The facility has been operating since 1991. A performance evaluation of the facility was conducted in 1992 that suggested overall TSS removal due to diversion was about 18%, while the removal rate due to solids concentration was about 15%, resulting in an overall mass removal of approximately 33%. Difficulties with sample pumps and possible stratification in the influent conduit have raised some concerns about the accuracy of the performance evaluation. In the spring of 2001, WASA initiated another performance evaluation of the facility using a new sampling system.

However due the inconsistent performance and limited benefits of this technology, additional swirl/vortex facilities are not being considered.

- High Rate Physical Chemical Treatment (HRPCT) – High rate physical/chemical treatment is a traditional gravity settling process enhanced with flocculation and settling aids to increase loading rates and improve performance. The pretreatment requirements for high rate treatment are screening and degritting, identical to that required prior to primary sedimentation. The first stage of HRPCT is coagulant addition, where ferric chloride, alum or a similar coagulant is added and rapidly mixed into solution. Degritting may be incorporated into the coagulation stage with a larger tank designed for gravity settling of grit material. The coagulation stage is followed by a flocculation stage where polymer is added and mixed to form floc particles that will settle in the following stage. Also in this stage recycled sludge or micro sand from the settling stage is added back in to improve the flocculation process. Finally, the wastewater enters the gravity settling stage that is enhanced by lamella tubes or plates. Disinfection, which is not part of the HRPCT process, typically is completed after treatment to the HRPCT effluent. Sludge is collected at the bottom of the clarifier and either pumped back to the flocculation stage or wasted periodically when sludge blanket depths become too high. The two principal manufacturers of HRPCT processes are Infilco Degremont Incorporated, which manufacturers the DensaDeg process, and US Filter, which manufactures the Actiflo process. Each is described in more detail below:

  - IDI DensaDeg – Infilco Degremont offers the DensaDeg 2D and 4D processes, both of which require screening upstream. The 2D process requires upstream grit removal as well, but the 4D process integrates grit removal into the coagulation stage. Otherwise the 2D and 4D processes are identical. Figure 7-4 shows a schematic diagram of an IDI DensaDeg 4D system.

    There have been 138 DensaDeg systems installed worldwide since 1984, 46 of which are for wastewater applications. There are currently four DensaDeg systems installed for CSOs, all of which started up in France in 1999 with capacities from 13 to 63.5 mgd. In the US there have been five pilot tests of the DensaDeg system for CSOs, and of these there are at least two that are currently under construction for full-scale operation. DensaDeg performance varies with rise rate and chemical dosages, but in general removal rates of 80 - 95% for TSS and 30 - 60% for BOD can be expected. Phosphorous and nitrogen are also removable with this process, although the removal efficiencies are dependent on the solubility of these compounds present in the wastewater. Removal efficiencies are also dependent on start-up time. Typically the DensaDeg process takes about 30 minutes before optimum removal rates are achieved to allow for the build-up of sludge solids.

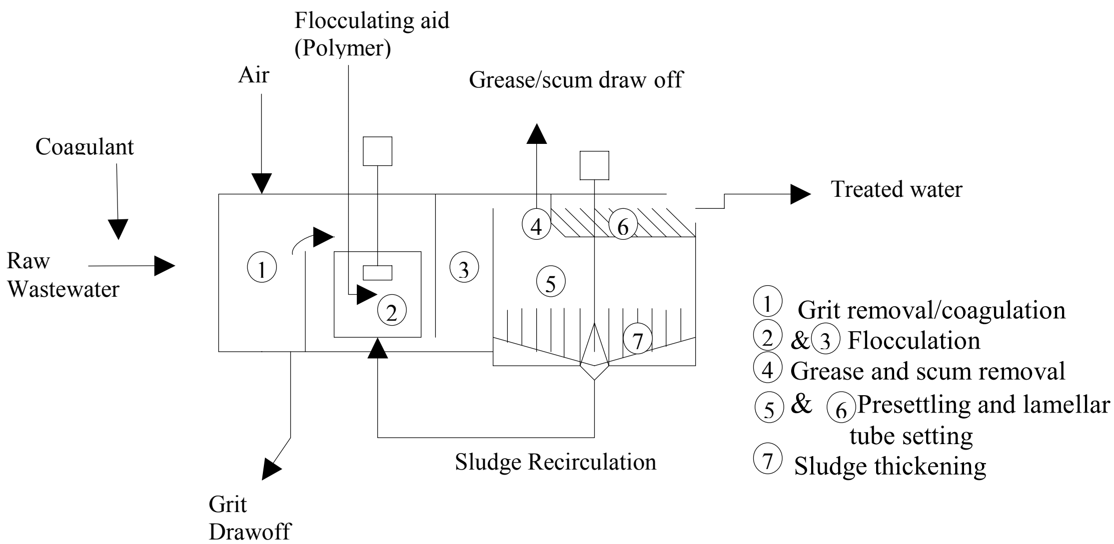

Figure 7-4
IDI DensaDeg HRPCT

- U.S. Filter Actiflo – The US Filter Actiflo process is different from the DensaDeg process in that fine sand is used to ballast the sludge solids. As a result, the solids settle faster, but specialized equipment must be incorporated in the system to accommodate the handling sand throughout the system. Figure 7-5 shows the components of a typical US Filter Actiflo system.

  The US Filter Actiflo process does require screening upstream. Grit removal is recommended, but since the system uses microsand as ballast in the process, the presence of grit is tolerable in the system. If grit removal does not precede the process, the tanks must be flushed of accumulated grit every few months to a year, depending on the accumulation of grit and system run times.

  There are 113 Actiflo systems in operation or under construction worldwide since 1991, 32 of which are for wastewater applications. Of the 32 wastewater applications, 14 are in operation and 18 are under construction. There are currently two Actiflo systems operational for CSOs in Europe, and at least four under construction, three of which are in the US. The 4 sites under construction are scheduled for start-up in 2001. The CSO sites either in operation or under construction range from 1 to 510 mgd. In the US there have been 74 pilot tests of the Actiflo system since September of 1995, 24 of which have been for wastewater applications including CSOs. Actiflo performance varies with rise rate and chemical dosages, but in general removal rates of 80 - 95% for TSS and 30 - 60% for BOD are typical. Phosphorous and nitrogen are also removable with this process, although the removal efficiencies are dependent on the solubility of these compounds present in the wastewater. Phosphorous removal is typically between 60 – 90%, and nitrogen removal is typically between 15 – 35%. Removal efficiencies are also dependent on start-up time. Typically the Actiflo process takes about 15 minutes before optimum removal rates are achieved.

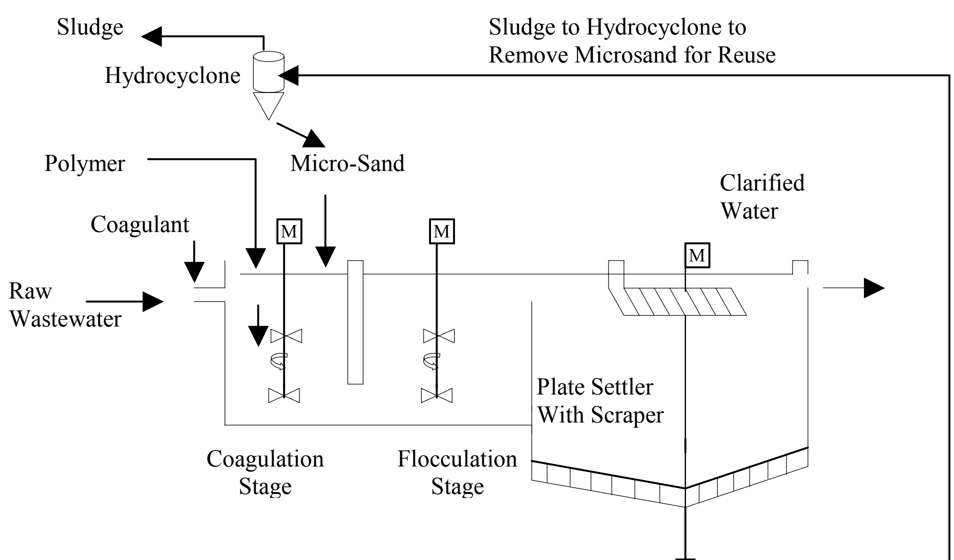

Figure 7-5
U.S. Filter Actiflo HRPCT

- Disinfection – The major objective of disinfection is to control the discharge of pathogenic microorganisms in receiving waters. Disinfection of combined sewer overflow is included as part of many CSO treatment facilities, including those in Washington, D.C.; Boston, Massachusetts; Rochester, New York; and Syracuse, New York. The disinfection methods considered for use in combined sewer overflow treatment are chlorine gas, calcium or sodium hypochlorite, chloride dioxide, peracetic acid, ozone, ultraviolet radiation, and electron beam irradiation. The chemicals are all oxidizing agents that are corrosive to equipment and in concentrated forms are highly toxic to both microorganisms and people. Each is described below.

- Chlorine gas – Chlorine gas is extremely effective and relatively inexpensive. However, it is extremely toxic and its use and transportation must be monitored or controlled to protect the public. Chlorine gas is a respiratory irritant and in high concentrations can be deadly. Therefore, it is not well suited to populous or potentially non-secure areas. The use of gaseous chlorine for disinfection is not suitable for WASA because of the dangers involved.
- Calcium or Sodium Hypochlorite – Hypochlorite systems are common in wastewater treatment installations. For years, large, densely populated metropolitan areas have employed hypochlorite systems in lieu of chlorine gas for safety reasons. The hypochlorite system uses sodium hypochlorite in a liquid form much like household bleach and is similarly effective as chlorine gas although more expensive. It can be delivered in tank trucks and stored in aboveground tanks. The storage life of the solution is 60 to 90 days (before the disinfecting ability of the solution starts to degrade).
- Chlorine Dioxide – Chlorine dioxide is an extremely unstable and explosive gas and any means of transport is potentially very hazardous. Therefore, it must be generated on site. The overall system is relatively complex to operate and maintain compared to more conventional chlorination.
- Ozone – Ozone is a strong oxidizer and must be applied to CSO as a gas. Due to the instability of ozone, it must also be generated on site. Ozone disinfection is relatively expensive, with the cost of the ozone generation equipment being the primary capital cost item. Operating costs can be very high depending on power costs, since ozonation is a power intensive system. Ozonation is also relatively complex to operate and maintain compared to chlorination. Ozone is not considered practical for CSO applications because it must be generated on site in an intermittent fashion in response to variable and fluctuating CSO flow rates.
- UV Disinfection – UV disinfection uses light with wavelengths between 40 and 400 nanometers for disinfection. Light of the correct wavelength can penetrate cells of pathogenic organisms, structurally altering DNA and preventing cell function. Because UV light must penetrate the water to be effective, the TSS level of CSOs can affect the disinfection ability.
- Electron Beam Irradiation – Electron Beam Irradiation uses a stream of high energy electrons directed into a thin film of water. The electrons break apart water molecules and produce a number of reactive chemical species, which can kill pathogenic organisms. Electron beam irradiation is not considered practical since it has not been evaluated or applied for CSO treatment (EPA 1999b; EPA 1999c).

Disinfection reduces potential public health impacts from CSOs but needs to be used in conjunction with other technologies.

In order to protect aquatic life in the receiving waters, dechlorination facilities would be installed whenever chlorination is used as a disinfectant. Dechlorination would be accomplished by injection of sodium bisulfite in the flow stream before discharge of treated CSO flow to waterways. Dechlorination with sodium bisulfite is rapid; hence no contact chamber is required since the reaction with chlorine is immediate.

- Constructed Wetlands – Constructed wetlands use natural biotic systems to treat wastewater. Elements of a modern wastewater treatment plant occur naturally in wetlands. Aquatic plants, animals and bacteria utilize the organic wastes, nutrients, greases and bacteriological pollution found in CSOs. Complex relationships between roots and nitrifying bacteria convert ammonia to nitrates that is consumed by algae and other aquatic life. A benefit of constructed wetlands is that no energy is required to maintain treatment processes (aside from pumping if required to deliver CSOs to the wetland area). However, major drawbacks with constructed wetlands are (1) they require large areas of land, and (2) treatment processes are extremely slow (especially in winter) and (3) CSO is left open to the environment requiring constructed wetland areas to be fenced off to prevent public contact. There are few places in the District near major CSOs where large tracts of land could be reclaimed as constructed wetlands and removed from public use. Given the large flow rates and volumes associated with District CSOs, constructed wetlands are an unsuitable alternative and have been eliminated from further consideration.

- Expansion of BPWWTP – Over the years, Blue Plains WWTP has been steadily increasing its capacity to accommodate the rapid population growth in the District and surrounding suburbs. At the present time, space is very limited at the site. Although there is room for four more primary clarifiers, the resulting extra capacity would be insufficient to address CSO treatment requirements. The higher loading rates associated with high rate physical/chemical treatment processes are much more feasible given the limited space. However, space for disinfection facilities would also be required. Finally, there is insufficient conveyance capacity in the existing pumping stations and outfall sewers to convey CSOs to the Blue Plains facility. Significant pipelines or tunnels are required in addition to any expansion in plant capacity.

7.8 RECEIVING WATER IMPROVEMENT

Receiving waters can also be treated directly with various technologies that improve water quality. The Anacostia River, a sluggish river significantly impacted by the tidal flux, appears to be suited for this alternative. Below are described the different treatment options that could aid in improving water quality in conjunction with CSO control measures:

- Aeration – Aeration improves the dissolved oxygen content of the river by adding air. Air could be added directly to the river ("in stream") or a portion of the river could be diverted to a side channel ("side stream") for the addition of air and then rejoined with the main river. Refer to Figure 7-6 for a schematic diagram of a typical side stream aeration facility. The Metropolitan Water Reclamation District of Greater Chicago uses side stream aeration to improve the water quality of the Calumet River and the Cal-Sag Channel. The Chicago water authority operates five Sidestream Elevated Pool Aeration Stations (SEPA) along the Cal-Sag Channel. The SEPA stations lift 100 – 800 mgd of water from 12 to 15 feet, allowing it to drop down a series of steps and aerate the water. The SEPA stations and waterfalls have been incorporated into park settings that allow and encourage public use of the area. Side stream aeration has been retained for consideration, but in-stream aeration has been eliminated due to difficulties in implementation, such as the potential for disrupting Anacostia River sediments and the natural thermocline of the receiving water.

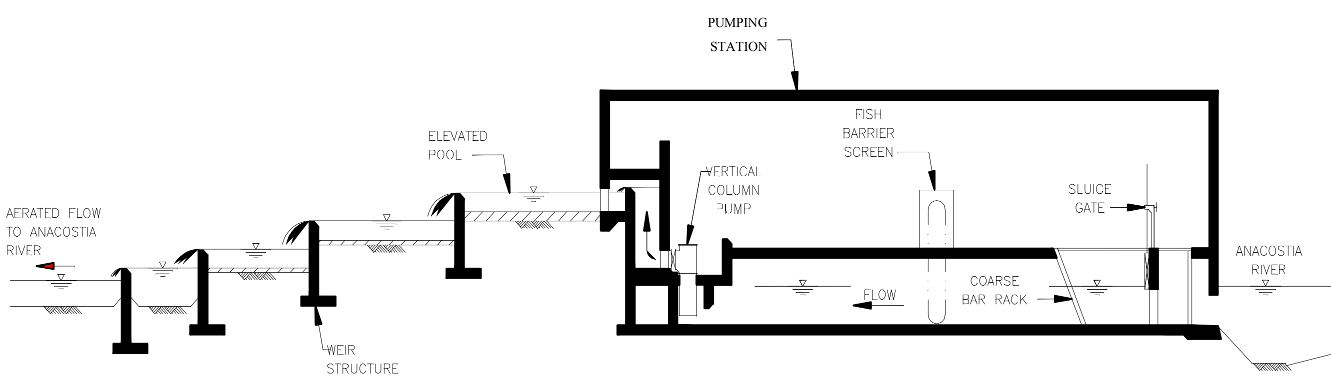

FIGURE 7-6
SIDESTREAM AERATION FACILITY

- Flow Augmentation of Anacostia River – Adding water upstream of the CSO outfalls could achieve improved flushing action of the Anacostia River and its pollutants downstream toward the Potomac River where there is greater assimilative capacity. Potential sources of water that could be pumped to the Anacostia River are:

    - Blue Plains Effluent – Treated effluent from the BPWWTP would be pumped to the Anacostia River. A new pumping station and extensive pipeline between Blue Plains and the Anacostia River north of CSO 019 would be required. A receiving water model run incorporating this scheme showed no significant water quality improvement to the Anacostia River. As a result it has been eliminated from further consideration.

- Existing groundwater pumpage in District – Several buildings in the District, particularly those in the Federal Triangle, have basements below the ground water table that are kept dry by pumping groundwater to the combined and separate sanitary sewer system. WASA has estimated this pumpage to be approximately 8.6 mgd on an annual average basis. Given the small volume of this pumpage, the significant disruptive construction and high cost required to deliver it from buildings all over the District to a receiving water, this alternative is unlikely to provide cost effective CSO control. However, it has been retained for possible combination with other inflow control options.

7.9 SOLIDS AND FLOATABLES CONTROL

Technologies that provide solids and floatables control do not reduce the frequency or magnitude of CSO overflows, but can reduce the presence of aesthetically objectionable items such as cups, paper, styrofoam and sanitary matter, etc. The full range of technologies was investigated to determine which might be applicable to WASA's combined sewer system. These included both end of pipe technologies such as netting and screens, as well as BMPs such as catch basin modifications and street cleaning which could be implemented upstream of outfalls in the drainage area. Each of these technologies is summarized below:

- Netting Devices **-** Netting devices can be used to separate floatables from CSOs by passing the flow through a set of netted bags. Floatables are retained in the bags, and the bags are periodically removed for disposal. Netting systems can be located in-water at the end of the pipe, or can be placed in-line to remove the floatables before discharge to the receiving waters. WASA has installed a floating end of pipe netting system at CSO 018 as a demonstration project and is currently evaluating its performance.

- Containment Booms - Containment booms are specially fabricated floatation structures with suspended curtains designed to capture buoyant materials. They are typically anchored to a shoreline structure and to the bottom of the receiving water. After a rain event, collected materials can be removed using either a skimmer vessel or a land-based vacuum truck. A 2-year pilot study of containment booms was conducted by New York City in Jamaica Bay. An assessment of the effectiveness indicated that the containment booms provided a retention efficiency of approximately 75%.

- Bar Screens - Manually Cleaned **-** Manually cleaned bar screens can be located within in-line CSO chambers or at the point of outfall to capture floatables. The configuration of the screen would be similar to that found in the influent channels of small wastewater pumping stations or treatment facilities. Retained materials must be manually raked and removed from the sites after every storm. For multiple CSOs, this would result in very high maintenance requirements. Previous experience with manually cleaned screens in CSO applications has shown these units to have a propensity for clogging. In Louisville, KY, screens installed in CSO locations became almost completely clogged with leaves from fall runoff. Because of the high frequency of cleaning required, it was decided to remove the screens.

- Weir-Mounted Screens - Mechanically Cleaned - Horizontal mechanical screens are weir-mounted mechanically cleaned screens driven by electric motors or hydraulic power packs. The rake mechanism is triggered by a float switch in the influent channel and returns the screened materials to the interceptor sewer. Various screen configurations and bar openings are available depending on the manufacturer. Horizontal screens can be installed in new overflow weir chambers or retrofitted into existing structures if adequate space is available. Electric power service must be brought to each site.

- Overflow Screen with Automatic Backwash - H.I.L. Technology Inc. has recently introduced an overflow screening system called the Hydro-Jet Screen, which is equipped with an air regulated siphon to control automatic backwashing of the screen. This system functions as a regulator within the sewer system. Dry weather flows are contained within the system and are conveyed to the wastewater treatment plant (WWTP). Wet weather flows which cannot be passed on to the WWTP rise in the Hydro-Jet Screen inlet channel and discharge over the weir to an inclined polymer coated screen which traps floatables and other solids greater than 6mm. The screened flow passes through a self priming auto break siphon which initiates the screen backwash cycle. The water level below the screen rises forcing air through, dislodging floatables and flushing them to a screenings collection channel. The collection channel returns the screenings to the pass on flow to the WWTP. The backwash cycle typically occurs every 30-45 seconds during a storm event. No external power source is required for operation. The energy within the water flow drives the system. This is a new technology with the first installation just constructed in England at the end of 1998.

- Baffles Mounted in Regulator
  - Fixed Underflow Baffles - Underflow baffles consist of a transverse baffle mounted in front of and perpendicular to the overflow pipe. During a storm event, the baffle prevents the discharge of floatables by blocking their path to the overflow pipe. As the storm subsides, the floatables are conveyed to downstream facilities by the dry weather flow in the interceptor sewer. The applicability and effectiveness of the

baffle depends on the configuration and hydraulic conditions at the regulator structure.

  - Floating Underflow Baffles - A variation on the fixed underflow baffle is the floating underflow baffle developed in Germany and marketed under the name HydroSwitch by Grande, Novac & Associates. The floating baffle is mounted within a regulator chamber sized to provide floatables storage during wet weather events. All floatables trapped behind the floating baffle are be directed to the WWTP through the dry weather flow pipe. By allowing the baffle to float, a greater range of hydraulic conditions can be accommodated. This technology has not yet been demonstrated in the United States, however, there are operating units in Germany.

- Overflow Siphon **-** The overflow siphon consists of an air regulated siphon with a vertical suction tube, a trumpet-like inlet, and a V-shaped discharge section. This setup allows conveyance of a large volume of flow over the discharge weir in a relatively small area. The floatables are retained behind the weir as flow is discharge through the siphon inlet below the water surface. The retained floatables are then returned the interceptor sewer when flow subsides.

- Catch Basin Modifications - Catch basin modifications consist of various devices to prevent floatables from entering the CSS. Inlet grates reduce the amount of street litter and debris that enters the catch basin. Catch basin modifications such as hoods, submerged outlets and vortex valves, alter the outlet pipe conditions and keep floatables from entering the CSS. Catch basin hoods are similar to the underflow baffle concept described previously for installation in regulator chambers. These devices also provide a water seal for containing sewer gas. The success of a catch basin modification program is dependent on having catch basins with sumps deep enough to install hoods-type devices. Surveys of WASA's catch basins indicate there are limited numbers of basins suitable for this in the combined sewer system. A potential disadvantage of catch basin outlet modifications and other insert-type devices is the fact that retained materials could clog the outlet if cleaning is not performed frequently enough. This could result in backup of storm flows and increased street flooding.

- Best Management Practices (BMPS) – BMPs such as street cleaning and public education have the potential to reduce solids and floatables in CSO. These are described in the beginning of this section.

A comparison of floatables control technologies is presented in Table 7-2.

Table 7-2

Comparison of Solids and Floatable Control Technologies

Technology	*Implementation Effort*	*Required Maintenance*	*Effectiveness*	*Relative Cost*
End-of-Pipe Netting	Moderate	Moderate	High	Moderate
In-Line Netting	High	Moderate	High	High
Containment Booms	Moderate	Moderate	Moderate	Moderate
Bar Screens - Manual	Low	High	Moderate	Low
Weir-Mounted Screens	Low	Moderate	High	Moderate
Screen with Backwash	High	Low	High	High
Fixed Baffles	Low	Low	Moderate	Low
Floating Baffles	High	Low	Moderate	Moderate
Street Cleaning	Low	High	High	Moderate
Catch Basin Modifications	Low	Moderate	Moderate	Low
Public Education	Moderate	Low	Variable	Moderate

7.10 SCREENING OF CONTROL TECHNOLOGIES

The various treatment technologies described previously have been screened for further, in-depth consideration. The results of the analysis are summarized below in Table 7-3.

Table 7-3
Screening of CSO Control Technologies

CSO Control Technology	*Retain for Consideration*	*Implemented to Satisfactory Level*	*Eliminate from Further Consideration*	*Consider Combining with Other Control Technologies*
Source Control				
Public Education				X
Street Sweeping		X		
Construction Site Erosion Control		X		
Catch Basin Cleaning		X		
Industrial Pretreatment		X		
Garbage Disposal Ban			X	
Combined Sewer Flushing			X	
Inflow Control				
"Daylight" orphaned storm sewer	X			
Offload Ground Water Pumpage	X			
Storm Water Detention	X			
Street Storage of Storm Water			X	
Water Conservation			X	
Infiltration/Inflow Reduction			X	
Stream Diversion			X	
Low Impact Development-Retrofit	X			
Bioretention				X
Dry Wells				X
Filter Strips				X
Vegetated Buffers				X
Level Spreader				X
Grassed Swales				X
Rain Barrels				X
Cisterns				X
Infiltration Trenches/catch basins				X
Rooftop Greening				X
Increased Tree cover				X
Permeable Pavements				X
Sewer System Optimization				
Optimize Existing System	X			
Real Time Control	X			
Sewer Separation				
Complete Separation	X			
Partial Separation	X			
Rain Leader Disconnection				X
Storage				
In - stream storage of CSO			X	
Earthen Basins			X	
Open Concrete Tanks			X	
Closed Concrete Tanks	X			

CSO Control Technology	*Retain for Consideration*	*Implemented to Satisfactory Level*	*Eliminate from Further Consideration*	*Consider Combining with Other Control Technologies*
Storage Pipelines/Conduits	X			
Tunnels	X			
Treatment				
Screening	X			
Primary Sedimentation			X	
Swirl Concentrator			X	
Vortex Separator			X	
High Rate Physical Chemical Treatment	X			
Disinfection				X
Constructed Wetlands			X	
Expansion of BPWWTP	X			
Receiving Water Improvement				
Side Stream Aeration	X			
In-stream Aeration			X	
Divert Blue Plains Effluent to Anacostia River			X	
Pump Ground Water to Anacostia			X	
Solids and Floatable Controls				
Netting Systems	X			
Containment Booms			X	
Manual Bar Screens	X			
Weir Mounted Screens	X			
Screens with Backwash			X	
Fixed baffles	X			
Floating Baffles			X	
Catch Basin Modifications			X	

Section 8
Preliminary Control Program Alternatives

8.1 INTRODUCTION

This section describes the development of preliminary control plan alternatives and the factors used to evaluate the alternative plans. Alternative elements that apply to the entire District, as well as those specific to each of the three receiving waters were evaluated. These alternative elements were evaluated based on criteria such as ability to comply with regulatory requirements, public acceptance, feasibility, and ease of operation and maintenance. Final alternatives were selected based on the merits of the alternative as compared to the criteria. Final alternatives will be analyzed further and evaluated for cost effectiveness in Section 9.

8.2 ALTERNATIVE ELEMENTS

Options for CSO control can be divided into the following categories: System wide elements, Anacostia River elements, Rock Creek elements, and Potomac River elements. Elements in each of these categories can be combined to constitute a complete LTCP.

8.2.1 System Wide Elements

The following system wide alternatives were evaluated:

- Low Impact Development-Retrofit (LID-R)
  LID-R involves small scale projects such as filter strips, dry wells, bioretention(rain gardens), cisterns, porous pavement, and sand filtration reduce the amount of storm water runoff to the combined sewer system, as well as reduce pollutant loads.
- Rooftop Greening
  Rooftop greening involves installation of roofing systems that incorporate vegetation such as various plants, shrubs, and trees. The vegetation and accompanying soil absorb a portion of the storm water that would otherwise enter the CSS.
- Inflow Control
  Inflow Control involves diverting flows from separate storm sewers and groundwater sump pumps connected to the CSS reduces the volume of water entering the CSS during storm events.
- Real Time Control (RTC)
  RTC involves expansion of the WASA's existing RTC system with additional inflatable dams and improved pump station operations to increase in-system storage.
- Sewer Separation
  Partially or completely separating the combined sewer system.
- Pump and Treat or Pump and Store
  These two system-wide elements are similar in scope requiring the construction of an extensive collection and conveyance system, which essentially parallels the existing CSS.

Due to the extremely high flow rates involved with wet weather events, components of the system such as pumping stations and intercepting sewers are large, creating an extremely complex system and with large operation and maintenance requirements. Conveyed flows could be either stored or receive high rate treatment a site near Blue Plains WWTP.

- Pump Stations Rehabilitation
  Several pumping stations are currently functioning below their designed capacity due to aging pumps, controls and screening facilities. Rehabilitating these stations will provide significant benefits for CSO reduction. This element also takes into account the upgrade and replacement of the existing inflatable dams.

- Tunnel Systems
  Includes various configurations of a large diameter deep tunnel system (approximately 70 to 250 ft. below grade) to store overflow from the CSS. Regulator structures at CSO locations would direct overflow to drop shafts and into the tunnel. After the storm event, the tunnel systems would be dewatered over a period of one or two days, with the stored wastewater being sent to BPWWTP for treatment.

Each of the system wide alternatives can constitute a LTCP and will be evaluated in subsection 8.3 as preliminary control plans.

8.2.2 Anacostia River Elements

The following Anacostia River Elements were evaluated:

- Use of Capitol Hill Relief Sewer (CHRS) for Storage
  The Capitol Hill Relief Sewer was originally designed to provide flooding relief in the Capital Hill Area. The CHRS tunnel was to function as a storm water outlet to the Anacostia River to which separate storm water pipelines could be connected. The tunnel was never completed due to the CSX railroad tunnel being constructed in conflict with the original CHRS profile. This sewer is approximately 4700 feet long, extending from 6th/Pennsylvania Ave. SE down to its outfall into the Anacostia River, in the Navy Yard. Its cross section ranges from 18'6" diameter circular pipe, to a 19'6" x 14'10" elliptical pipe, to an 18' x 13' box sewer. As shown in Figure 8-1, there is a 300' gap in the sewer where it would cross under the CSX railroad near 6th St. and Virginia Ave.

  For the purposes of the LTCP evaluation, the CHRS tunnel was evaluated for its potential to store CSOs. Calculations show that if the missing section was redesigned and constructed the entire length of the sewer could provide only 3.7 million gallons of storage volume.

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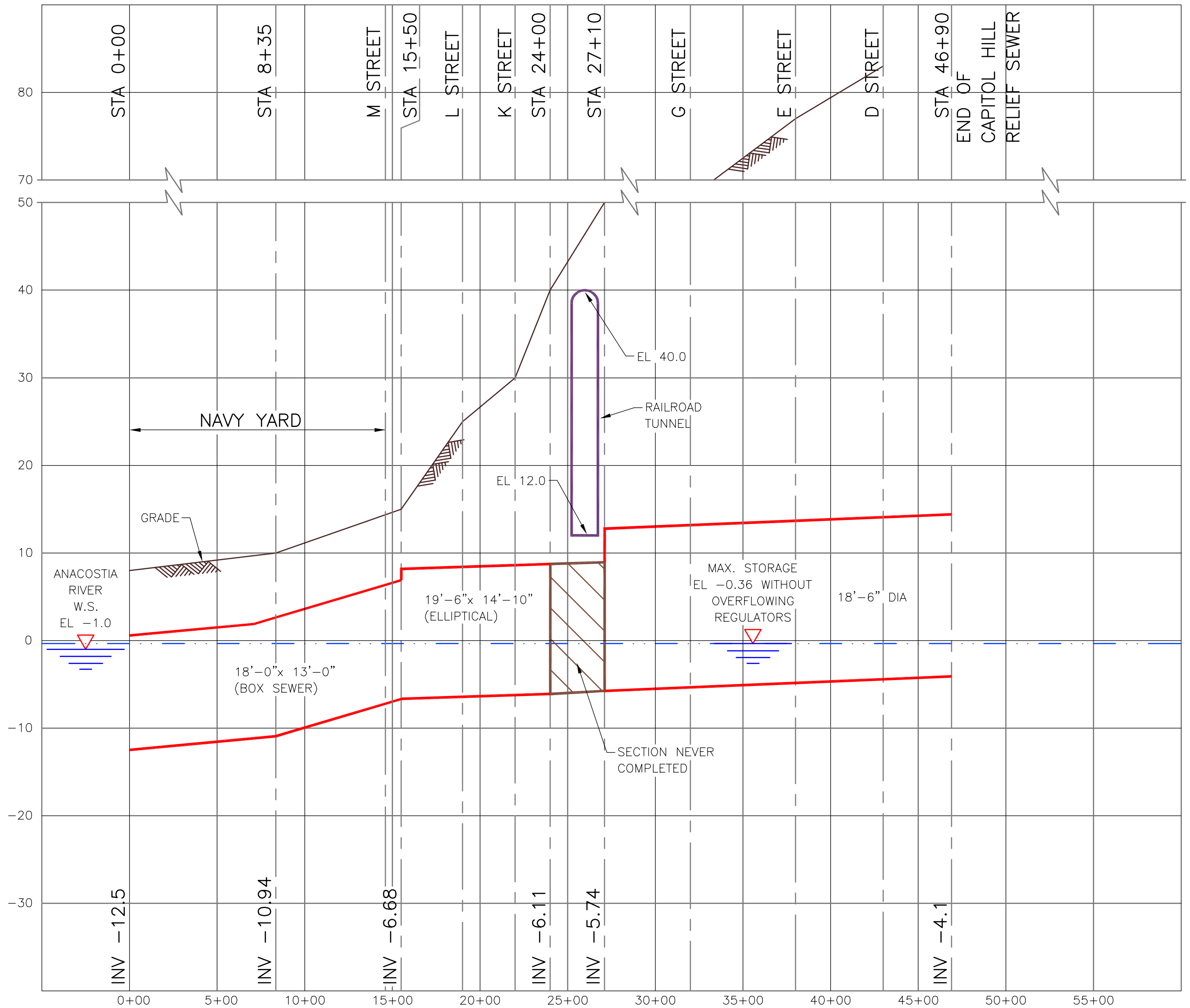
FIGURE 8-1



SEWER PROFILE - EXISTING CAPITOL HILL RELIEF SEWER

SCALE: 1"=1000' HORIZONTAL
SCALE: 1"=20' VERTICAL

EPMC-III
GREELEY AND HANSEN LLC

D.C. WATER AND SEWER AUTHORITY
CSS LONG TERM CONTROL PLAN

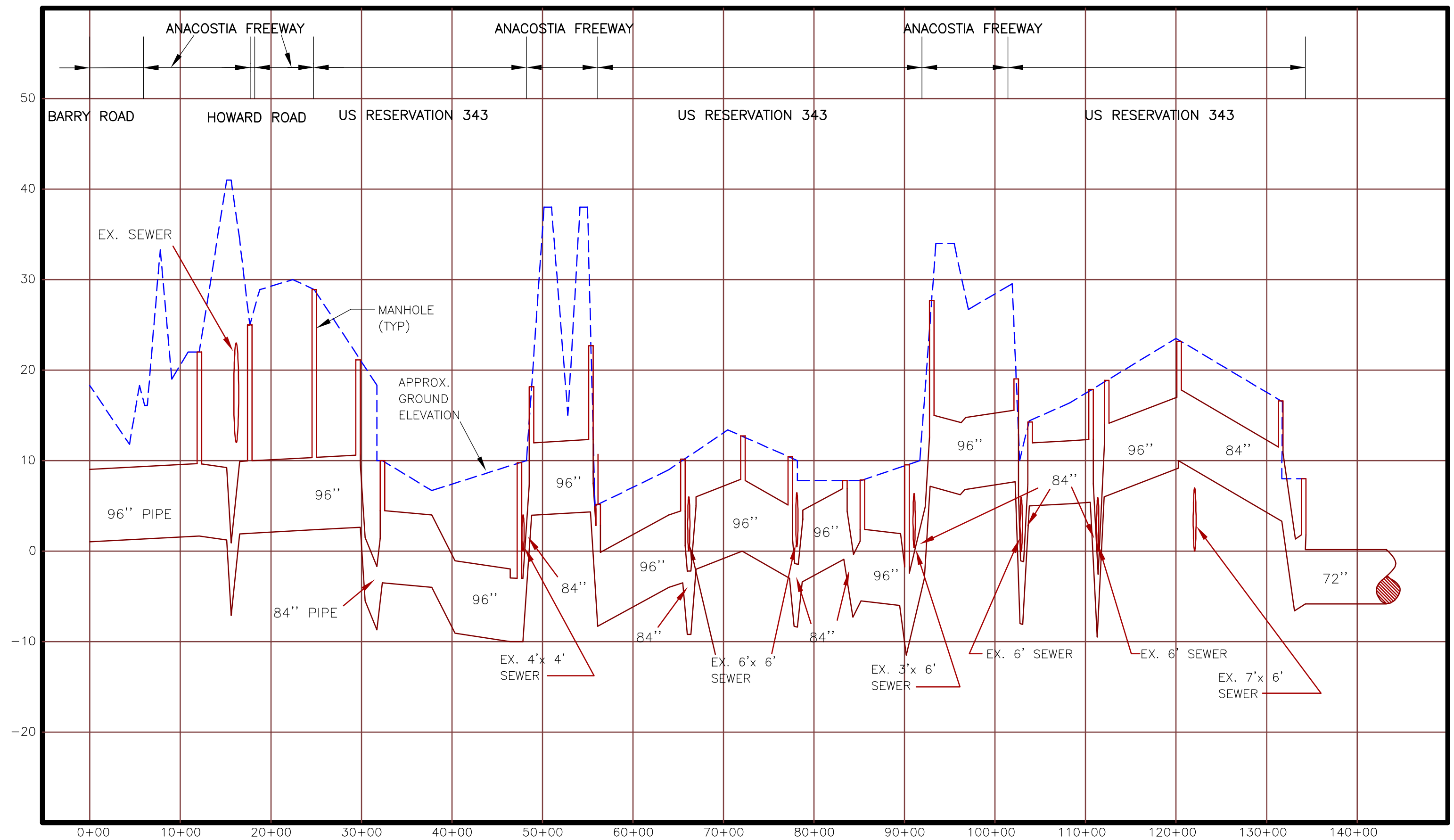
The maximum storage elevation is limited by the elevation of the lowest regulator elevation of the Navy Yard CSO's and this storage capacity may be further reduced by river water intrusion. In addition to completing the missing section, a dewatering pump station and bulkhead for the terminus at the Anacostia River as well as new pipelines sized to carry overflows from the CSO regulators to the CHRS tunnel would need to be constructed to utilize all of the potential storage volume. Under the C3 scenario (currently planned projects), the projected storage volume required to reduce CSOs to 4 overflows per year from the CSO's on the west side of the Anacostia (009, 010, 011, 011a, 012, 013 – 018) is more than 34 million gallons. Therefore, the configuration of the Capitol Hill Relief Sewer allows insufficient volume to be stored to attain significant reduction in CSO overflows and would require significant effort to retrofit for very little benefit. This element will not be considered further.

- Use of Anacostia Force Main and Gravity Sewer

  The abandoned Anacostia Force Main and Gravity Sewer has a total volume of 4.6 mg and was evaluated for potential use as a storage facility and for use as a conveyance pipeline. Investigations indicate that the pipeline is in poor condition and would required extensive rehabilitation. As shown in Figure 8-2, the pipeline has multiple sections of inverted siphons or pressure sewer sections, which create an irregular profile. This undulating profile makes this sewer unsuitable for application as CSO storage facility. Numerous pump stations would be required to dewater the conduit after each storm event and solids deposition would be a continuing problem. According to WASA staff, the configuration of the Anacostia Force Main and Gravity Sewer resulted in serious odor problems while in operation. In addition, some CSOs on the east side of the Anacostia are below the elevation of the conduit, which would preclude gravity flow into the conduit at these locations. Therefore, this element will not be considered further for storage.

  The Anacostia Force Main and Gravity Sewer was also evaluated for use as a conveyance pipeline. Use of the sewer to convey the Fort Stanton outfalls (CSO 005, 006 and 007) on the east side of the Anacostia was determined not to be feasible because gravity flow is not achievable, necessitating pumping stations at each CSO. If the sewer were rehabilitated or replaced, it could be used to convey additional Northeast Boundary Flow to the Outfall Sewers and then to BPWWTP. This would require expansion of East Side Pumping Station, construction of an additional force main across the Anacostia, rehabilitation and/or replacement of the Anacostia Force Main and Gravity Sewer, and expansion of BPWWTP. Expansion of BPWWTP is required since there is no additional treatment capacity at the plant. Based on its size, the maximum flow that might be expected if the existing sewer were rehabilitated as a force main is on the order of 175 mgd.

FIGURE 8–2



SEWER PROFILE - EXISTING ANACOSTIA RIVER FORCE MAIN AND GRAVITY SEWER

SCALE: 1"=2000' HORIZONTAL
SCALE: 1"=20' VERTICAL

EPMC–III
GREELEY AND HANSEN LLC

D.C. WATER AND SEWER AUTHORITY
CSS LONG TERM CONTROL PLAN

Overflow rates in excess of 1,000 mgd are regularly seen at Northeast Boundary, with rates at the larger events exceeding 1,350 mgd. Use of the Anacostia Force Main and Gravity Sewer would thus require a large amount of expensive and disruptive construction but would not provide an acceptable level of control for Northeast Boundary. This alternative was thus eliminated from further consideration.

- Satellite Storage
  A review of land in the District was conducted to identify potential sites for satellite storage. Few sites were identified. Those that were identified were found to be owned by the National Park Service or the Federal Government. Satellite storage facilities capturing CSO's at the locations noted below were considered.

  - RFK Stadium parking lot: CSO 019
  - Bolling AFB athletic field: CSO's 009 - 018
  - East Anacostia Park athletic field: CSO's 005 – 007

  After the wet weather event, the stored combined sewage would be released in a controlled manner to the conveyance system for transport to the BPWWTP for treatment. Satellite storage facilities can be sized to obtain the range of 2 to 12 overflows per year. This element will be evaluated further in subsection 8.3.

- Satellite High Rate Treatment
  A satellite treatment facility with high rate treatment, located at the RFK parking lot in Anacostia Park was considered. However, the need to adequately staff and maintain a sophisticated treatment facility at this location would add a significant layer of complexity to WASA's existing system operations. In addition, high rate treatment generates a significant sludge stream that must receive further processing before disposal. Such processes are not compatible with an urban park area. This element will not be considered further.

- Side Stream Aeration
  Side stream aeration was evaluated for its potential to aid in improving the Anacostia River's dissolved oxygen water quality in conjunction with CSO control measures. Analysis was performed on a test scenario of two side stream aeration stations, one located upstream of Benning Road and one in the vicinity of RFK stadium and no other controls. Results indicate that downstream reaches affected by the stations can be maintained at 3.0 mg/l. To achieve a level of 3.0 mg/l throughout the District, another station would be required at the District Boundary. Also, without pollution load reductions, side stream aeration cannot achieve the 5.0 mg/l water quality standard for dissolved oxygen.

Side stream aeration will not be considered further for the LTCP since it does not reduce CSO overflows. However, its benefits may be appropriate as part of a watershed wide effort to improve dissolved oxygen.

8.2.3 Rock Creek Elements

Of the three receiving waters, Rock Creek has the most protective CSO conveyance facilities currently in place. Discharges to this receiving water are a fraction of those to the Anacostia and Potomac Rivers as discussed in Section 6 of the report. In the late 1930's a large CSO Control project was under taken that constructed two large interceptor sewers, known as the East and West Rock Creek Diversion Sewers, which parallel the creek on each side. The intent of this design was to intercept combined sewer flows along Rock Creek and convey the flow to the Potomac combined system where its conveyed on to BPWWTP or discharged to the Potomac River where a greater dilution capacity is available.

Model runs indicate that most of the Rock Creek CSOs will not activate during the average year. However, one substantial CSO remains in this system, which is the Piney Branch Outfall (CSO 049). Several other outfalls along the system are projected to activate sporadically for short durations of time.

The following Rock Creek elements were evaluated:

- <u>Preliminary Alternatives for Piney Branch Outfall (049)</u>
    - Local Tunnel – The overflow from CSO 049 would be stored in a tunnel dug into a nearby rock embankment with stored flow released by gravity into the Piney Branch Interceptor after wet weather events. The tunnel can be sized to achieve the 2 to 12 overflows once the desired level of protection is chosen.
    - Satellite Storage – The overflow from CSO 049 could also be diverted to a new storage basin just south of the outfall and released by gravity into the East Rock Creek Diversion Sewer after the wet weather event. The storage basin can be sized to achieve 2 to 12 overflows once the desired level of protection is chosen.

These elements will be evaluated further in subsection 8.3.

- <u>Other Rock Creek CSOs</u>

  Several outfalls located south of 'N' Street NW in the flat section of Rock Creek are predicted to overflow because of surcharging in the Rock Creek Main Interceptor and because of low dam settings in the regulators. Preliminary alternatives evaluated for reducing other Rock Creek CSOs are as follows:

- Rock Creek regulator improvements and interconnection to the Potomac portion of the CSS to prevent surcharging in the Rock Creek Main Interceptor.
- Construction of a relief sewer parallel to the Rock Creek Main Interceptor for a portion of its length

These elements will be utilized in conjunction with all preliminary control plans evaluated in subsection 8.3.

8.2.4 Potomac River Elements

The following Potomac River elements were evaluated:

- Satellite Storage
  Satellite storage facilities in the following locations, and for the following outfalls, would capture CSOs during wet weather events in retention basins:
  - Georgetown D.C. Dept. of Public Works parking lot: CSO's 023-029
  - Bolling AFB athletic field: CSO's 020-022

  After the wet weather event, the combined sewage could be released in a controlled manner to the conveyance system for transport to BPWWTP for treatment.

8.3 PRELIMINARY CONTROL PLAN ALTERNATIVES

The alternative elements described above were assembled, based on the evaluation factors, to form complete CSO control programs. The set of preliminary control program alternatives that have been considered is presented below.

8.3.1 Pump Stations Rehabilitation (Alternative C3)

This alternative includes upgrade/replacement of the existing inflatable dams and rehabilitation of Main and Potomac Pumping Stations to achieve firm pumping capacities of 240 and 460 mgd, respectively. WASA's current capital improvement program as of May 2001 includes rehabilitation of the Main, Eastside, and Poplar Point Pump Stations and replacement of the inflatable dams. Rehabilitation of the Potomac Pump Station is currently in the study phase.

8.3.2 Real Time Control (Alternative D4)

The real time control (RTC) alternative involves the expansion of WASA's existing inflatable dams system and improved pump station operations in conjunction with local and system wide dynamic control scheme to store combined sewage and reduce CSOs. WASA currently has in-place a system of inflatable dams installed at locations noted in Table 8-1 below.

Table 8-1

Existing Inflatable Dams

Structure Number	*Combined Sewer*	*No. of Dams*	*Control Method*	*Storage Elevation*	*Storage Volume (mg)*
14	B St./N.J Ave. Trunk Sewer	2	upstream level	3.00	18.32
15		1	upstream level	-1.00	Note 1
15a		1	upstream level	-1.00	Note 1
16	Tiber Creek Trunk Sewer	2	upstream level	4.00	9.07
24 (west & middle dams)	Northeast Boundary Sewer	2	Flow & upstream level	12.00	7.61
24 (east dam)		1	Flow & upstream level	12.50	
34	Easby Point Trunk Sewer	1	upstream level	8.50	1.12
35	East Rock Creek Diversion Sewer	1	upstream level	8.50	1.93
52	Slash Run Trunk Sewer	1	upstream level	30.00	0.18
				Total Existing RTC Storage Volume	**36.30**

Notes: 1. This dam does not store any sewage. Instead, it deflates to allow overflow to enter a Relief Sewer.

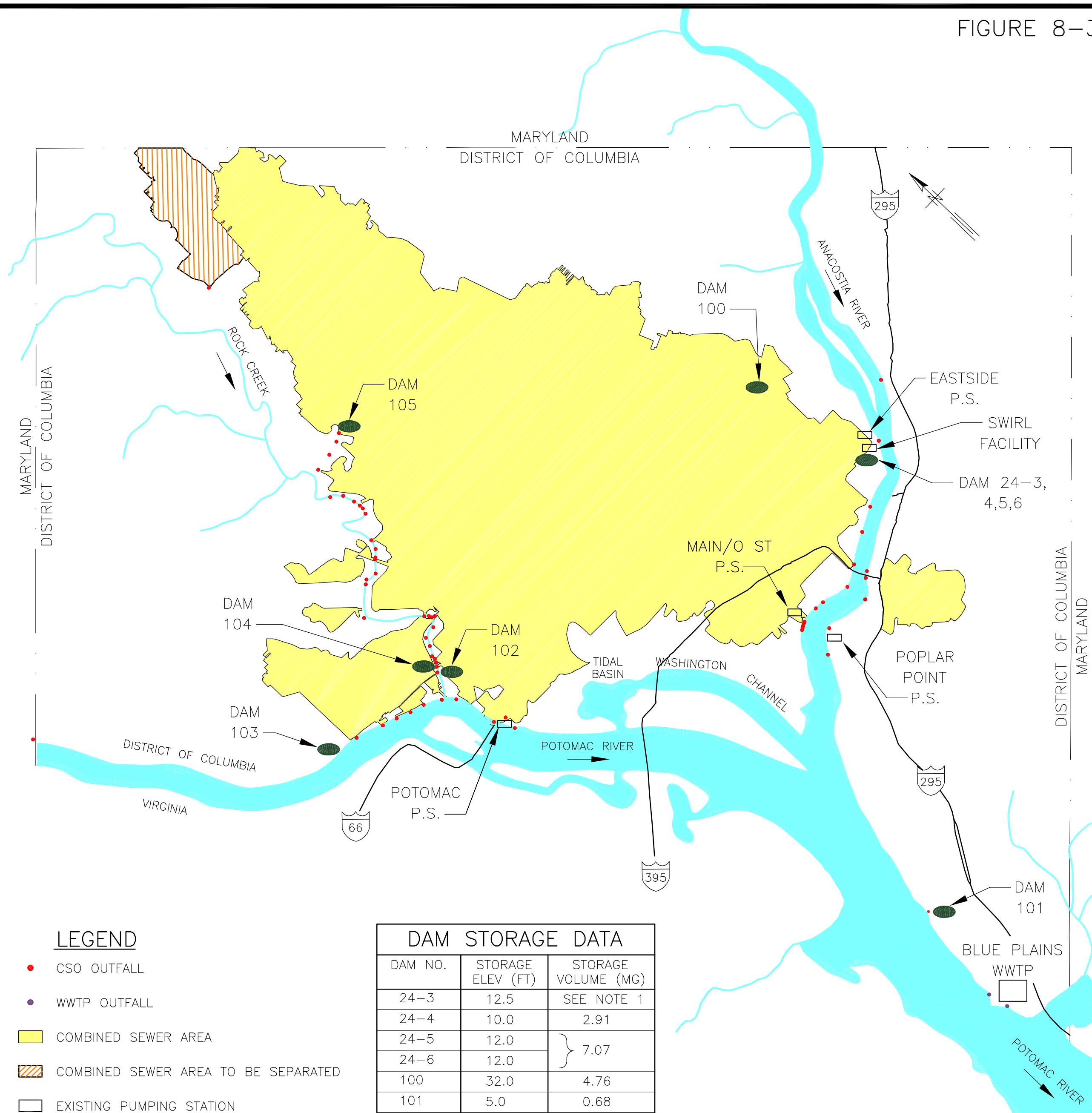
The feasibility of installing additional inflatable dam installations to store combined sewage was assessed. The following criteria were used to consider several large sewers within the CSS:

- The diameter or width of the sewer needed to be at least six feet. Sewers less than this size have very little storage volume compared to large diameter sewers.
- The slope of the sewer needed to be low enough to allow a sufficient storage volume.
- The elevations of upstream lateral connections were examined to avoid possible basement flooding problems.

The proposed modifications to the existing system that were simulated in the model for each of the three receiving waters are described below and are also shown on Figure 8-3. Local dynamic controls were simulated to deflate dams to prevent flooding and maintain a hydraulic stability in the CSS. System wide dynamic controls for the modifications were utilized at key locations in the CSS to maximize control objectives such as transferring overflows from the Anacostia system to Potomac River where greater dilution is available for pollutant loads.

For the Anacostia River:

- Existing dams 24-1 and 24-2 in the west and middle conduits of the triple span of the NEBTS in the vicinity of the Swirl Facility were removed and replaced with new dams 24-5 and 24-6, which were placed further downstream. This was done to increase the storage volume in the



DAM STORAGE DATA		
DAM NO.	STORAGE ELEV (FT)	STORAGE VOLUME (MG)
24-3	12.5	SEE NOTE 1
24-4	10.0	2.91
24-5	12.0	7.07
24-6	12.0	
100	32.0	4.76
101	5.0	0.68
102	25.0	5.51
103	27.0	5.39
104	10.0	1.37
105	110.0	1.97
TOTAL STORAGE		29.66

NOTE:
1. DAM 24-3 DIVERTS FLOW INTO SWIRL AFTER DAM 24-4 DEFLATES.

PRELIMINARY ALTERNATIVE: REAL TIME CONTROL (D4)

1 MILE 1/2 0 1 MILE

triple span of the NEBTS. These new dams would be installed in an isolated area of National Park Service property close to the Anacostia shoreline.

- Dam 24-4 was added to the east conduit of the triple span of the NEBTS in the vicinity of the Swirl Facility to allow upstream storage before flow needed to be diverted to the Swirl Facility. This new dam would be installed within the NEBTS, between the existing Swirl Facility and D.C. General Hospital.
- Dam 100 was added for additional storage in the 20' diameter span of the NEBTS near Florida St and H St NE, a residential area.
- The Main, "O" Street, Poplar Point, and Eastside pump stations were run at full capacity to force overflows to occur at CSO 003 (Bolling) to the Potomac River where greater dilution is available rather than at local Anacostia waters where feasible.

For Rock Creek:

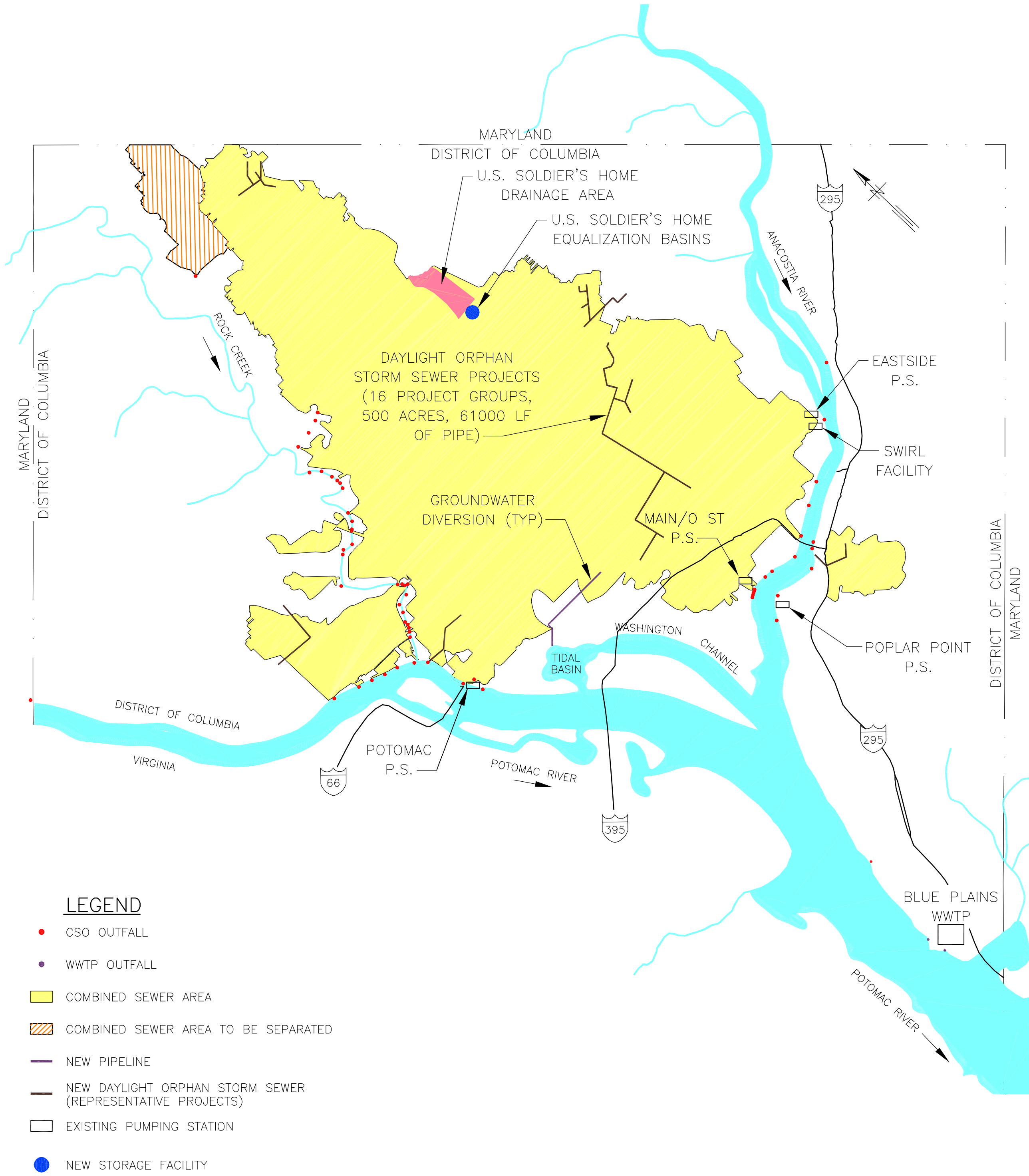
- An additional inflatable dam (Dam 105), installed on the Piney Branch Trunk Sewer on National Park Service property near 16th/Arkansas St NW, was simulated in the model.

For the Potomac River:

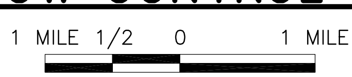
- The wet well elevations at BPWWTP raw wastewater pump stations #1 and #2 were maintained at +4.0 to maximize storage of combined sewage in the Outfall Sewers. The Potomac Pump Station was run at full capacity to force overflows to occur at CSO 003 (Bolling) to the Potomac River where greater dilution is available rather than at local Potomac waters where feasible.
- The Upper Potomac Interceptor was rehabilitated, south of Georgetown University, where it is currently diverted to the Upper Potomac Interceptor and Relief Sewer for a short section due to a section of collapsed pipe.
- Dam 102 was installed in the Upper Piggy Back portion of the Upper Potomac Interceptor, just south of the Rock Creek Pump Station, near the intersections of 27th and K Streets NW.
- Dam 103 was installed in the Lower Piggy Back portion of Upper Potomac Interceptor and Relief Sewer.
- Dam 104 was installed in the West Rock Creek Diversion Sewer, east of the intersection of the C&O Canal and 29th St NW.

8.3.3 Inflow Control (Alternative D10)

Inflow control alternatives reduce the amount of combined sewage volume by decreasing or regulating the amount of storm water and groundwater that enters the combined sewer system. Three major inflow control alternatives, as shown in Figure 8-4, were identified and incorporated into the computer model:



PRELIMINARY ALTERNATIVE: INFLOW CONTROL (D10)



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- Groundwater diversion: At many locations in the District, groundwater that infiltrates into the underground portions of large buildings is pumped to the combined sewer system. This groundwater could be diverted to a storm sewer. In a previous study (Peer Consultants 1999), several potential groundwater diversion projects were identified, mostly concentrating on Metro subway stations. The proposed projects, estimated diverted groundwater flows, and their corresponding drainage areas are listed in Table 8-2. For modeling purposes, the dry weather flows in the corresponding drainage areas were reduced by the amount of estimated diverted groundwater flows.

Table 8 -2
Groundwater Diversion Projects

No.	*Project Description*	*Flow Estimate (gpd)*	*Drainage Area*	*Location*
1	Metro Primary Network	**223,500**	Tiber Creek	7th/G St NW
2	Metro Primary Network	223,500	B Street/New Jersey	14th/Constitution Ave NW
3	Federal Triangle Project	1,800,000	B Street/New Jersey	12th/Constitution Ave NW
4	Archives Metro Project	72,000	B Street/New Jersey	7th/Independence Ave SW
5	Federal Center Metro Project	122,000	B Street/New Jersey	2nd/D St SW
6	Federal Triangle Metro Project	72,000	B Street/New Jersey	12th/Constitution Ave NW
	Subtotal	**2,289,500**		
7	Brookland/CUA Metro Project	173,000	Northeast Boundary	8th/Irving St NE
8	Stadium Armory #1 Metro Project	72,000	Northeast Boundary	19th/C St SE
	Subtotal	**245,000**		
9	Dupont Circle Metro Project	173,000	Slash Run	Connecticut/O St NW
10	Secondary Metro Project	5,514,000	Slash Run	15th/K St NW
11	GW University Project	173,000	Slash Run	21st/Pennsylvania Ave NW
	Subtotal	**5,860,000**		
	Grand Total	**8,618,000**		

- Daylighting “orphan” storm sewers: The aforementioned study (Peer Consultants 1999) also identified many “orphan” storm sewers, that is, storm sewers that ultimately discharge into a combined sewer, rather than a receiving water. Several of these orphan storm sewers were selected for inclusion into projects to divert them to a nearby receiving water. Such projects would effectively separate parts of a combined sewer area and convert them to separate storm water areas. This alternative would require substantial excavation in the downtown area. Selected orphan storm sewers were grouped into sixteen distinct project groups, based on their geographical relationships. The project groups, and the acres of combined sewer area converted to separate storm area, are summarized in Table 8-3.

Table 8-3
Orphan Storm Sewer Separation Project Summary

Group No.	CSO Drainage Area	Total Pipe length (ft)	Total Acreage Offloaded from CSO Area (becomes SSWS Area)	Project Location	New Storm Sewer's Receiving Water	Discharge Location
1	NEB	800	5.87	17th/Potomac SE	Anacostia	Near CSO 018
2	CSO 046	660	3.8	18th/Park Road NW	Rock Creek	Near CSO 046
3	Easby Point	1400	6.68	14th/Pennsylvania NW	Potomac	Tidal Basin
4	NEB	400	5.5	12/th/Monroe NE	Anacostia	Storm sewer at District Line at Eastern/22nd NE
5	Piney Branch	5680	42.3	3rd/Aspen NW	Rock Creek	Near CSO 059
6	Piney Branch	4100	30.8	13th/Decatur NW	Rock Creek	Into Rock Creek, 3000' north of CSO 046
7	Easby Point	4100	43	21st/C St NW	Potomac	Near CSO 020
8	Slash Run	4300	39.7	25th/Eye St NW	Potomac	Near CSO 021
9	Fort Stanton	1236	18.4	Martin Luther King Ave and Morris Rd SE	Anacostia	Suitland Pkwy storm sewer (near CSO 005)
10	Fort Stanton	3372	53.36	16th/Galen St SE	Anacostia	Existing storm sewer at 16th/W St SE (near CSO 007)
11	Fort Stanton	2500	6.9	13th/T St SE	Anacostia	Near CSO 007
12	Fort Stanton	1200	6.44	W. of Morris Rd/RR tracks	Anacostia	Near CSO 007
13	NEB	7200	38.53	6th/Brentwood Pkwy NE	Potomac	Tidal Basin
13	Tiber Creek	8700	68.87	N. Capitol and E St NE	Potomac	Tidal Basin
13	B St/NJ Ave	7900	34.19	6th/Constitution Ave NW	Potomac	Tidal Basin
14	NEB	2976	64.4	Downing/13th NE	Anacostia	Hickey Run Storm Sewer (into Anacostia 3000' north of Benning Road Bridge)
15	CSO 029	3662	28.3	37th/Whitehaven St NW	Potomac	Foundry Branch Trunk Sewer (near CSO 029)
16	Easby Point	1100	4.61	12th/Pennsylvania NW	Potomac	Tidal Basin
TOTALS		**61,286**	**501.65**			

- U.S. Soldier's and Airman's Home: The U.S. Soldier's Home is an approximately 351 acre site located in the Northeast Boundary drainage area. While a portion of the site is separated, some of the storm sewers discharge to the combined sewer system because there are no other outlets available. Consideration has been given reducing CSO overflows by detaining or otherwise offloading this storm water from the combined sewer system. In addition to conducting several site visits, detailed sewer and topographic maps were obtained from the U.S. Soldier's Home. Analysis of the sewer plans indicated that combined sewers serve approximately 83 acres or 24% of the site. Offloading of this drainage area would require conventional separation, which is considered as part of another alternative. Plans indicated that the remainder of the site was separated. Existing storm water holding ponds were observed on the site. These detention ponds serve approximately 102 acres or 29% of the site. Additional detention ponds for this drainage area would not serve a benefical purpose to CSO control. The plans indicate that the remaining 166 acres or 47% of the site is separated. To address this acreage, two storm water detention basins were incorporated in the model to offload flows from the 166 acres. Key design parameters for these two theoretical basins are shown below in Table 8-4. The basins would both offload storm water volume and would dampen the peak flow rates once the basin capacity was exceeded.

Table 8-4
U.S. Soldier's and Airman's Home Project Summary

Parameter	*Basin #1*	*Basin #2*
Drainage Area	53 ac	113 ac
Location	See Figure 8-4	
Design Storm	2 year – 24 hour storm = 3.5"	
Design Criteria	Limit basin outflow rate to 10% of existing condition	
Basin Volume	1.59 mg	2.7 mg

8.3.4 Low Impact Development -Retrofit (Alternative D11)

The objective of this alternative is to reduce the frequency and volume of CSOs by applying LID-R techniques within the District. These techniques would reduce the volume of storm water runoff and improve its water quality. The entire District area was considered for the application of LID-R since reduction of storm water pollution can improve the quality of the receiving waters. Aerial photographs of representative land uses in the District were reviewed to determine which technologies might be applicable, and the degree to which they could practically be applied. The actual LID-R technologies that were applied depended on the nature of the area. For example, in commercial settings, rooftop greening is an example of a technology that was found to be applicable. In residential settings, rain barrels and bioretention are examples of applicable technologies. The mix of LID-R technologies included the following: rain barrels, rooftop greening, bioretention, drywells, filter strips, grass swales, porous pavement, and sand filters. For this alternative, the achievable application rate for LID-R was estimated at 15% of the total District impervious area or 1,963 acres. The quantity of water, which could be offloaded was calculated as a function of the impervious acreage for each land use type. The calculation was made for the entire District, not just the combined sewer area. It was assumed that LID-R technologies would capture up to the first 0.5" of rainfall. Once this limit was exceeded, runoff was assumed to discharge normally. Table 8-5 summarizes the results.

In addition as a part of the LID-R analysis, rooftop greening was applied to approximately 200 roof acres based on the application rates shown in Table 8-6.

In addition to offloading storm water, some LID-R technologies can remove pollutants. To account for this, the pollutant concentration in storm water was reduced. Literature values of pollutant removal efficiencies were used in combination with the overall percent of impervious acres treated.

Table 8-5
Areas Treated by LID-R

Land Use	*% of Impervious Acres Treated @ 0.5" of Rain Based on Analysis Areas*	*Total Land Area in District (ac)*	*Impervious Area in District (ac)*	*Impervious Area Treated at 0.5"of rain (ac)*	*Notes*
Institutional	33%	2,762	498	163	
Federal	23%	2,755	333	77	
Commercial	9%	1,666	1,072	99	
Residential	13%	19,081	8,845	1,143	
Industrial	22%	1,235	927	201	Average of institutional , federal and commercial
Mixed Use	19%	2,012	869	169	Average of institutional , federal and commercial
Parks	13%	9,864	861	111	
Water	-	4,542	-	-	
Totals		**43,917**	**13,405**	**1,963**	
Overall % of impervious acres treated at 0.5" of rain				**15%**	

Table 8-6
Rooftop Greening Application Rates used for Low Impact Development – Retrofit

District Land Use	*Total Roof Area (Acres)*	*% Applied*	*Rooftop Greening Roof Area (Acres)*
Institutional	778	5	38.9
Federal	851	10	85.1
Commercial	726	10	72.6
Totals	2355		196.6

8.3.5 Rooftop Greening (Alternative D12)

For this alternative, an aggressive application of rooftop greening was analyzed for the benefits it could provide independent of other efforts. For this alternative, government, commercial and institutional buildings were selected for application. These types of buildings typically have lower pitched roofs increasing the ease of roof retrofit versus the steep pitched roofs of residential buildings and private houses. Of the 7,183 acres of land in the use categories selected, approximately one third

(33% or 2,355 acres) is roof area. The models were then run to with an application rate of 25% of the roof area or 589 acres to determine the benefits and impact to CSOs.

8.3.6 Satellite Storage (Alternative D7)

As shown in Figure 8-5, satellite storage facilities would be constructed to address CSO's for each of the three receiving waters, as follows:

For the CSO's along the Anacostia River, this alternative would consist of the four major components as follows:

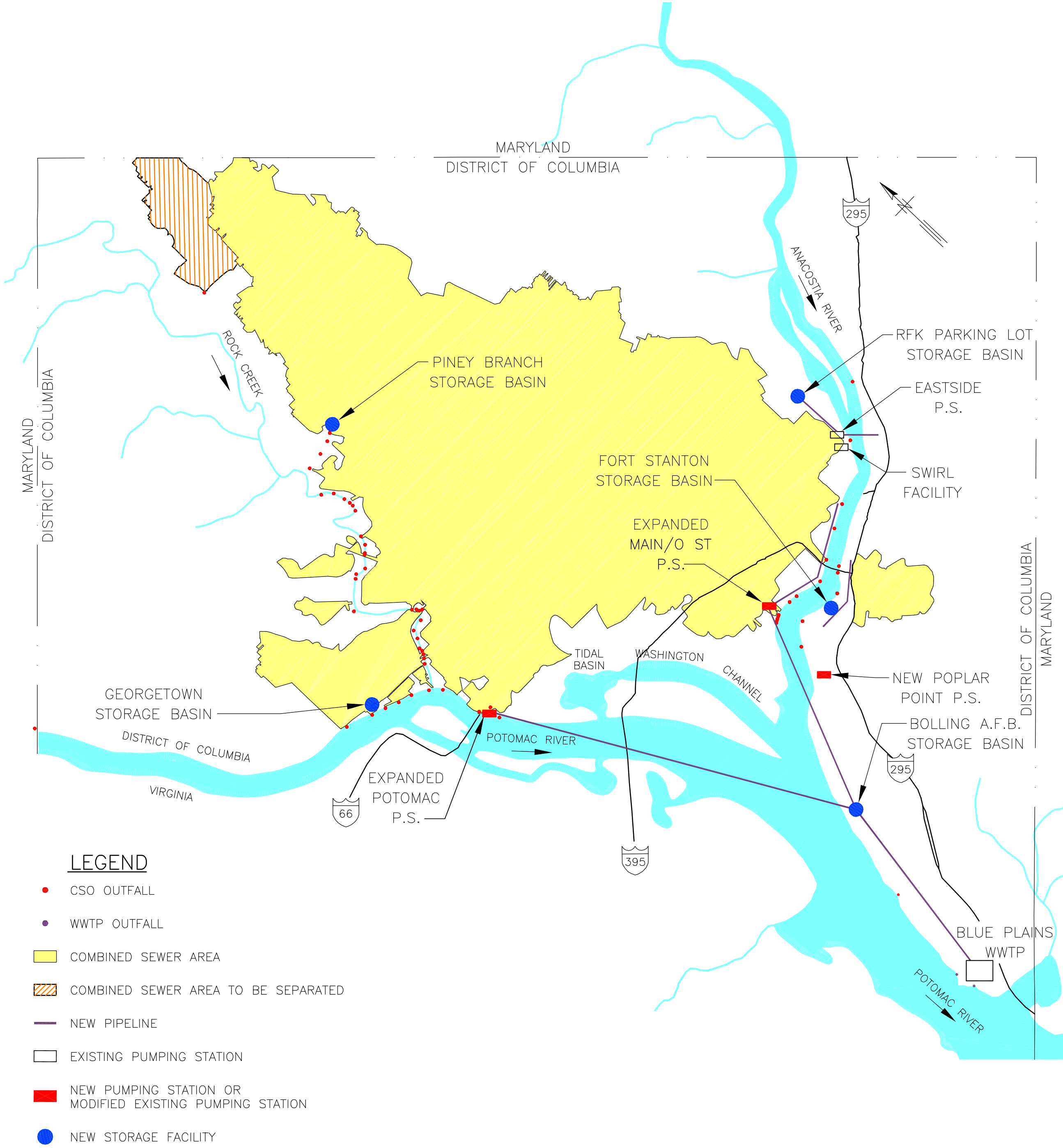
- The Bolling Air Force Base Storage Basin would be located underneath an athletic field on Bolling Air Force Base. It would have enough capacity to hold the combined sewage from all the CSO's on the west side of the Anacostia (009, 010, 011, 011a, and 012 – 018). After a rain event, the combined sewage would be pumped via a new force main to the Outfall Sewers that lead to BPWWTP. If the satellite storage option were also to be selected for CSO's 020, 021, and 022 on the Potomac, this basin would need to be sized to hold the combined sewage from those CSO's as well.

- The Main Pump Station would be augmented to receive and pump the overflows from CSO's 009, 010, 011, 011a, and 012 – 018 to the aforementioned Bolling AFB Storage Basin.

- The Fort Stanton Storage Basin would be located underneath Anacostia Park, on the east side of the Anacostia. It would receive the overflows from CSO's 005, 006, and 007. After a rain event, an upgraded Poplar Point Pump Station would pump the combined sewage into the Anacostia Main Interceptor.

- The Northeast Boundary Storage Basin would be located underneath a parking lot on the south side of RFK Stadium. It would store the overflow from CSO 019. After a rain event, the combined sewage would be pumped by the existing East Side Pump Station into the 108" Anacostia River Force Main.

FIGURE 8–5



PRELIMINARY ALTERNATIVE: SATELLITE STORAGE (D7)

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For the CSO's along Rock Creek, this alternative would involve the construction of the Piney Branch Short Storage Tunnel underneath a ridge north of Piney Branch, on National Park Service property. It would store the overflow from CSO 049. After a rain event, the combined sewage would be conveyed by gravity into the 2.75' x 4.125' Piney Branch Interceptor.

For the CSO's along the Potomac River, this alternative would consist of two major components as described below:

- A new interceptor and pumping station adjacent to the existing Potomac Pump Station to convey the overflows from CSO's 020, 021, and 022 via new force mains across the Potomac River to the Bolling AFB Storage Basin described earlier.

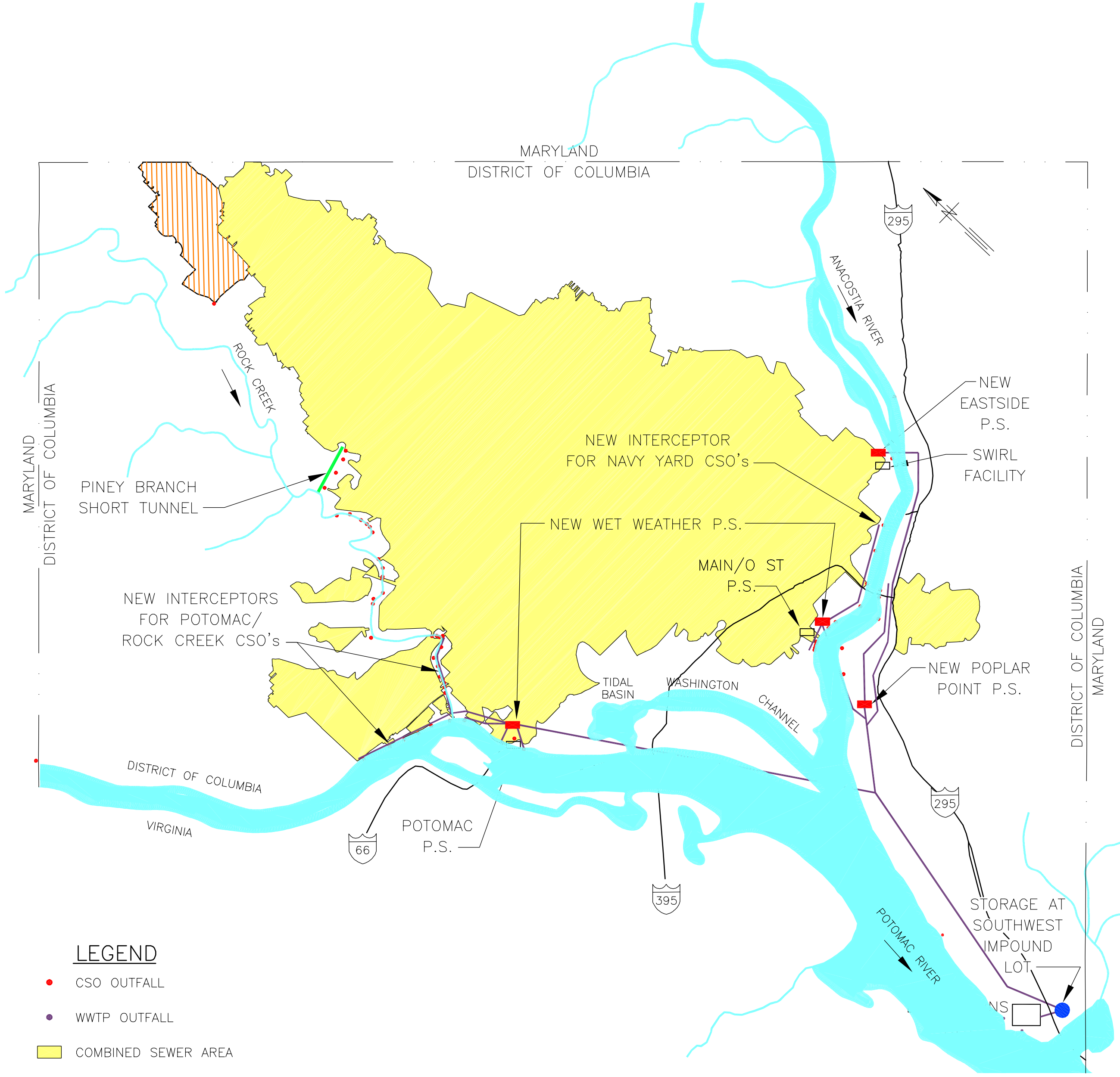
- The Georgetown Storage Basin would be located underneath a D.C. Department of Public Works parking lot between Water Street and the Potomac River, in Georgetown. It would store the overflow from CSO's 023/024, 025, 026, 027, 028, and 029. After a rain event, a new pump station would pump the combined sewage into the 96" Upper Potomac Interceptor and Relief Sewer.

8.3.7 Pump to Blue Plains and Store (Alternative D8)

Pumping and storing involves the construction of new pumping stations and pipelines to collect CSOs at their outfalls and convey them to a centrally located storage facility. After the wet weather event, the stored combined sewage would be released to the BPWWTP. The ideal location for the storage facility would be Blue Plains WWTP, but there is not enough space. Based on an analysis of the area surrounding Blue Plains, the storage facility could potentially be located at the DC impound lot just east of Blue Plains WWTP, as shown in Figure 8-6.

This alternative requires major construction throughout the District, especially along local waterways. Underground pipelines would be placed along the Potomac River from Georgetown to East Potomac Park, along Rock Creek south of Pennsylvania Avenue and along both sides of the Anacostia from the NEB Swirl Facility to Main Pump Station. Five new pumping stations would be constructed adjacent to East Side, Main, 'O' Street, Poplar Point and Potomac Pump Stations. In addition, several large pipelines would be required along the B&O Railroad track route from Poplar Point Pump Station to the DC impound lot.

FIGURE 8-6



LEGEND

- CSO OUTFALL
- WWTP OUTFALL
- COMBINED SEWER AREA
- COMBINED SEWER AREA TO BE SEPARATED
- NEW PIPELINE
- NEW TUNNEL
- EXISTING PUMPING STATION
- NEW PUMPING STATION OR MODIFIED EXISTING PUMPING STATION
- NEW STORAGE FACILITY

PRELIMINARY ALTERNATIVE: PUMP AND STORE (D8)

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8.3.8 Pump to Blue Plains and Treat (Alternative D9)

Pumping and treating involves the construction new pumping stations and pipelines to collect CSOs at their outfalls and convey them to a centrally located high rate treatment facility. There would be no storage of the combined sewage to shave the peak flows. The ideal location for the high rate treatment facility would be Blue Plains WWTP, but, as in the case of Alternative D8, there is not enough space. The high rate treatment facility could also potentially be located at the DC impound lot just east of Blue Plains WWTP, as shown in Figure 8-7.

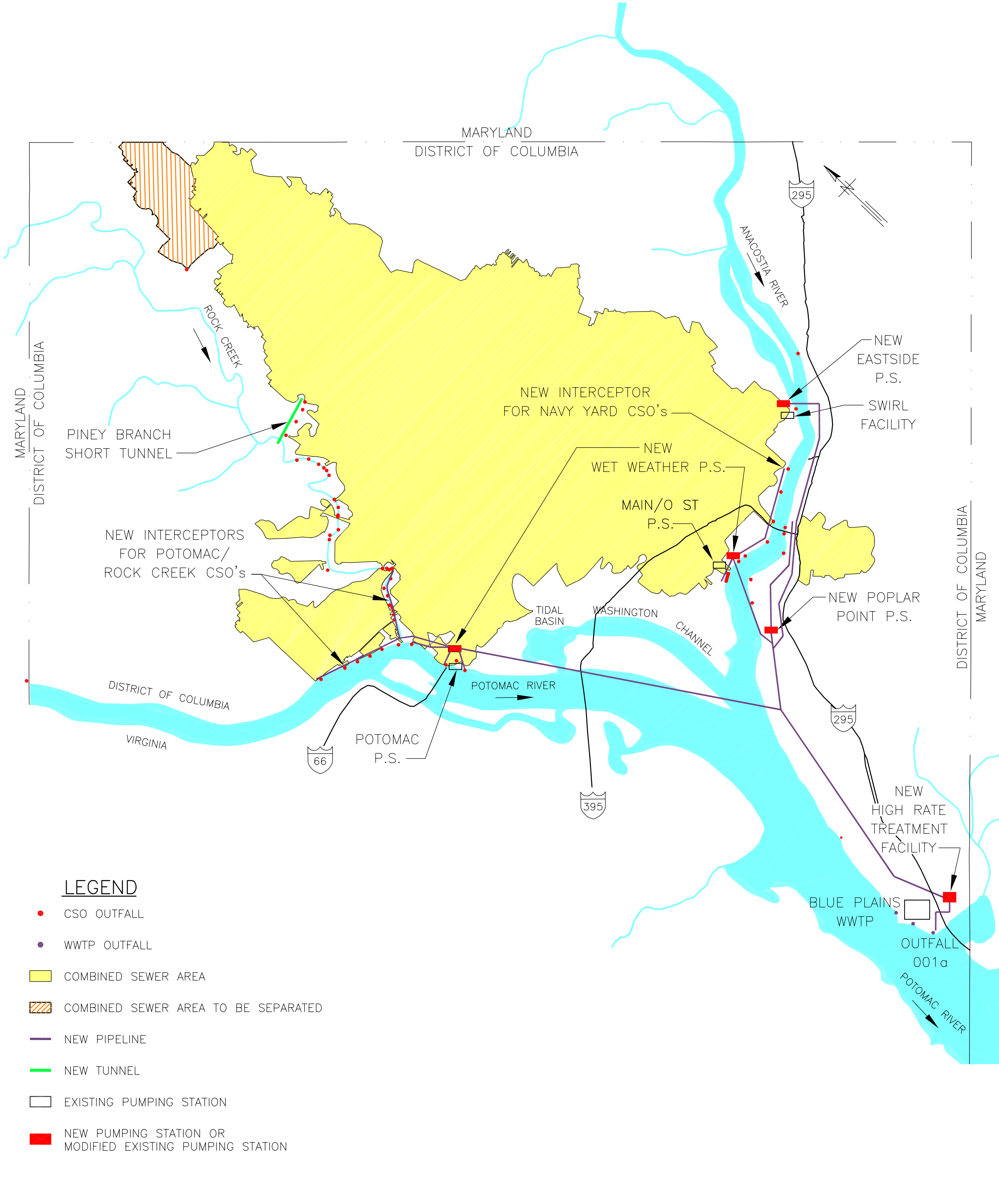
As in the case of Alternative D8, this alternative requires major construction throughout the District, especially along local waterways. Underground pipelines would be placed along the Potomac River from Georgetown to East Potomac Park, along Rock Creek south of Pennsylvania Avenue and along both sides of the Anacostia from the NEB Swirl Facility to Main Pump Station. Five new pumping stations would be constructed adjacent to East Side, Main, ‘O’ Street, Poplar Point and Potomac Pump Stations. In addition, several large pipelines would be required along the B&O Railroad track route from Poplar Point Pump Station to the DC impound lot. This alternative would significantly increase the operation and maintenance requirements of the CSS.

8.3.9 Local Tunnels

Various tunnel configurations were considered to store and convey combined sewer flows from the Anacostia drainage area, as listed in Table 8-7 below.

Table 8-7
Anacostia River Tunnel Alternatives

Name	*No.*	*Description*
Tunnel From Poplar Point to Northeast Boundary	D27-1	Retain Main and ‘O Pumping Stations at Present Location
	D27-2	Add Low Impact Redevelopment
	D27-3	Add Real Time Control
	D27-4	Add Low Impact Development and Real Time Control
	D28	Relocate Main and ‘O’ Pumping Stations to Poplar Point
Tunnel from Blue Plains to Northeast Boundary	D29-1	Retain Main and ‘O’ Pumping Stations at Present Location
	D29-2	Add Low Impact Redevelopment
	D29-3	Add Real Time Control
	D29-4	Add Low Impact Development and Real Time Control
	D30	Relocate Main and ‘O’ Pumping Stations to Poplar Point and BPWWTP



PRELIMINARY ALTERNATIVE: PUMP AND TREAT (D9)

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For the Potomac River CSOs the following tunnel configuration sized to meet the 2 to 12 overflows per year range was evaluated.

- Storage Tunnel from Georgetown to Potomac Pumping Station
  This consists of a rehabilitating the Potomac Pumping Station to a firm capacity of 460 mgd and constructing a CSO storage tunnel. The tunnel would begin at CSO 029 west of the Key Bridge, run parallel to Georgetown, and terminate in Potomac Pumping Station. The low point of the tunnel would be at the existing Potomac Pumping Station. A new tunnel dewatering pump station would be construct at Potomac Pump Station to dewater the tunnel for conveyance of flows by the existing station to Blue Plains WWTP.

For Rock Creek CSOs, the Piney Branch Tunnel would be constructed in conjunction with ancillary projects to modify several regulators.

8.3.10 Sewer Separation (Alternative A1)

For this alternative, the benefits of complete separation of the combined sewer system were evaluated. The alternative was evaluated on the premise that a new separate sanitary system would be constructed and the existing combined sewer system piping convert to a separate storm water system discharging to the receiving water. District dry weather flows with a peaking factor of 1.25 for wet weather were modeled as being routed to BPWWTP for treatment. All storm water runoff was routed directly to the receiving waters. Storm water discharges were model using pollutant event mean concentrations as determined as part of the monitoring program discussed in Section 4. Issues associated with this alternative are as follows:

- Disruption – Separation essentially involves constructing a duplicate sewer system for the central one third of the District. Sewer construction would be necessary in every neighborhood and in the vast majority of streets in each neighborhood. Disruption associated with construction would be significant, widespread, and long lasting. While the installation of fiber optic cable in portions of the District require a relatively shallow and narrow trench, the installation of a separate sewer system would generally require closing of streets during construction. Construction might last 15 to 20 years or more. In addition to the nuisance, the degree of disruption associated with separation could have a significant negative impact on the economic well being of the District.

- Impacts to Private Property – the majority of buildings in the combined sewer area have roof drains and gutters discharging to the building sanitary system, which in turn discharges to the combined sewer system. Separation on private property would thus be required. Past separation experience in the District and in other cities has shown that obtaining access and permission from private property owners can be difficult, time consuming, and, in some cases, not achievable. In addition, many row houses in the District do not have alleys along the back of the house to route the roof and backyard drainage to separate storm sewers. This could necessitate extremely expensive and disruptive construction on private property to achieve true separation.

- Technical Difficulty – Other cities have discovered some separation projects to be much more difficult to construct that originally anticipated. In some cases, the efforts to separate sewer systems have been abandoned. Part of the reason for this is that there are many unknowns involved in working with sewer systems which have been constructed over a long period of time. Records showing the location and nature of existing facilities may not exist. Costs and difficulties of construction can be much greater than originally anticipated depending on what is actually discovered. Public opposition to such a program may increase as actual construction proceeds.

- Impact on Receiving Water Quality – the analyses conducted as part of the LTCP indicate that separation does not provide as good water quality as a high degree of CSO control. Appendices B, C and D and Section 9 of this report present the predicted water quality. Table 8-8 summarizes the loads to the receiving waters for varying degrees of CSO control as compared to separation. In most cases, a high degree of CSO controls results in less pollutant load to the receiving waters when compared to separation. For fecal coliforms, separation is some cases results in less overall load to the receiving waters. This is true for the Potomac River at 4, 8 and 12 events per year. While there may be less load on an annual basis, the modeling indicated that this did not translate into better water quality. This is because the separate storm water system delivers pollutants to the receiving waters practically every time it rains, thereby adversely impacting water quality a great many times per year. With a high degree of CSO control, the loads is only delivered to the receiving water between 2 and 12 times per year (depending on the degree of control selected). Even though the overall load may be somewhat higher, CSO discharges have a more limited impact because they are occurring far less frequently than storm water discharges which occur more than 70 times per average year.

Table 8-8
Load Comparison: Separation vs. CSO Control

Parameter	*Anacostia.*				*Rock Creek*				*Potomac*			
	CSO	*Storm Water*	*Up-stream*	*Total*	*CSO*	*Storm Water*	*Up-stream*	*Total*	*CSO*	*Storm Water*	*Up-stream and WWTP*	*Total*
Annual Volume (mg/yr)												
No Phase 1 Controls	2142			52,024	49			17,961	1063		2,369,262	2,648,297
Phase 1 Controls	1485			51,367	52			17,964	953		2,369,262	2,648,187
Pump Sta. Rehab.	1,282			51,164	49			17,961	639		2,369,262	2,647,873
12 Overflows/yr	515	5,348	44,534	50,397	28	1,534	16,378	17,940	157	7,972	2,369,262	2,647,391
8 Overflows/yr	262			50,144	22			17,934	96		2,369,262	2,647,330
4 Overflows/yr	96			49,978	11			17,923	54		2,369,262	2,647,288
2 Overflows/yr	32			49,914	9			17,921	22		2,369,262	2,647,256
0 Overflows/yr[2]	0			49,882	0			17,912	0		2,369,262	2,647,234
Complete Separation	0	9,667	44,534	54,201	0	3,885	16,378	20,263	0	8,939	2,369,262	2,648,201
$CBOD_5$ (lb/yr x 1000)												
No Phase 1 Controls	755			3,507	42			697	335		72,063	74,107
Phase 1 Controls	526			3,278	45			700	301		72,307	74,317
Pump Sta. Rehab.	443			3,195	42			697	214		72,506	74,429
12 Overflows/yr	174	815	1937	2,926	29	236	419	684	47	1,709	72,126	73,882
8 Overflows/yr	89			2,841	27			682	28		72,129	73,866
4 Overflows/yr	32			2,784	24			679	16		72,136	73,861
2 Overflows/yr	10			2,762	23			678	6		72,137	73,852
0 Overflows/yr[2]	0			2,752	0			655	0		71,914	73.623
Complete Separation	0	1,499	1937	3,436	0	608	419	1,027	0	1,862	71,401	73,263
Fecal Coliforms (#/yr x 10^{14})												
No Phase 1 Controls	764			925	18			44	381		324	790
Phase 1 Controls	322			483	19			45	341		337	763
Pump Sta. Rehab.	254			415	18			44	237		348	670
12 Overflows/yr	183	57	104	344	11	16	10	37	56	85	331	472
8 Overflows/yr	93			254	9			35	34		330	449
4 Overflows/yr	34			195	5.5			32	19		331	435
2 Overflows/yr	10			171	4.5			31	7		331	423
0 Overflows/yr[2]	0			161	0			26	0		317	402
Complete Separation	0	103	104	207	0	41	10	51	11	106	292	399

8.4 EVALUATION OF PRELIMINARY CONTROL PLANS

8.4.1 Evaluation Factors

The following evaluation factors were considered as part of the preliminary alternatives evaluation and selection of final control plans for further evaluation.

Regulatory Compliance

Preliminary alternatives were evaluated on their ability to conform to CSO Policy requirements and to achieve CBOD5 load reductions required to meet the BOD TMDL for the Anacostia River. Preliminary control plans selected for further evaluation are analyzed for their ability to help achieve water quality standards in Section 9.

- CSO Policy – Preliminary alternatives were evaluated on their ability to perform below the maximum of 12 overflows per year as stipulated in Section II. 4. C. *Evaluation of Alternatives* of the CSO Policy.

- D.C. TMDL for BOD for Anacostia River – Preliminary alternatives were assessed for their potential to meet BOD loads allocated to CSOs in the draft DOH BOD TMDL.

Northeast Boundary Flooding

The Northeast Boundary Sewer (NEB Sewer) is a combined sewer that begins on the west side of McMillian Reservoir and flows to the southeast primarily along Florida Avenue toward the Anacostia River. The sewer is approximately 23,000 feet long and varies in size and shape from about 4.5' x 3' in the upper reaches to over 22' x 18' in the lower reaches. The drainage area of the NEB Sewer is approximately 4,242 acres and comprises highly developed areas in the District. Numerous branch sewers convey wastewater and storm water to the NEB Sewer.

Complaints of flooding have been reported along the NEB Sewer and its branch sewer system. As a result, several engineering studies have been conducted over the years in an attempt to address these flooding complaints. These studies have determined the following:

- The NEB Sewer and portions of its branch sewers have inadequate capacities to carry storm water flows generated by moderate rain storms.
- Surcharge of the trunk and branch sewer can occur during intense storms sufficient to cause overflow from catch basins and basement backups in certain areas.
- Certain collecting sewers that drain the area were of adequate capacity, but operated ineffectively due to backwater conditions in the NEB Sewer.
- Certain areas served by branch sewers were at a lower elevation than the crown of the NEB Sewer at the point of connection.

In addition to general capacity issues associated with the NEB sewer, the following locations were identified as susceptible to local flooding:

- Area 1 - Rhode Island Avenue N.E. between 4th and 6th Streets
- Area 2 - West Virginia Avenue N.E. near Mt. Olivet Road
- Area 3 - P Street and 1st Street N.W.
- Area 4 - Sherman Avenue and Harvard Street N.W.
- Area 5 - Constitution Avenue N.E., near Tennessee and 12th Street
- Area 6 - Rhode Island Avenue N.W., near 6th and R Street

Prior studies indicated that nuisance flooding in Areas 3 through 6 could be remedied by local drainage projects such as regrading and additional catch basins. Flooding in Areas 1 and 2 was determined to primarily be caused by inadequate capacity of the branch sewers serving the areas and could not be addressed with local remedial work.

Given the long standing nature of the flooding problems and the fact that combined sewage is potential component of the flood waters, preliminary alternatives were evaluated on their ability to address flooding in the NEB sewer and local flood Areas 1 and 2.

Implementability

The preliminary alternatives were rated on implementability factors, which included whether acquisition of land was required, and, if so, how difficult it would be.

The complexity of construction was also taken into consideration. If the preliminary alternative required land within a military facility or involved difficult construction in confined urban areas, it was considered less desirable to implement.

Operational Complexity

The degree of operational complexity for each system alternative included such factors as the complexity of the treatment technologies involved and the number of satellite facilities required.

Ability to Upgrade

Each system alternative was rated on how difficult it would be to upgrade the facilities planned. This consideration included the acreage of additional land available at the site for future expansion.

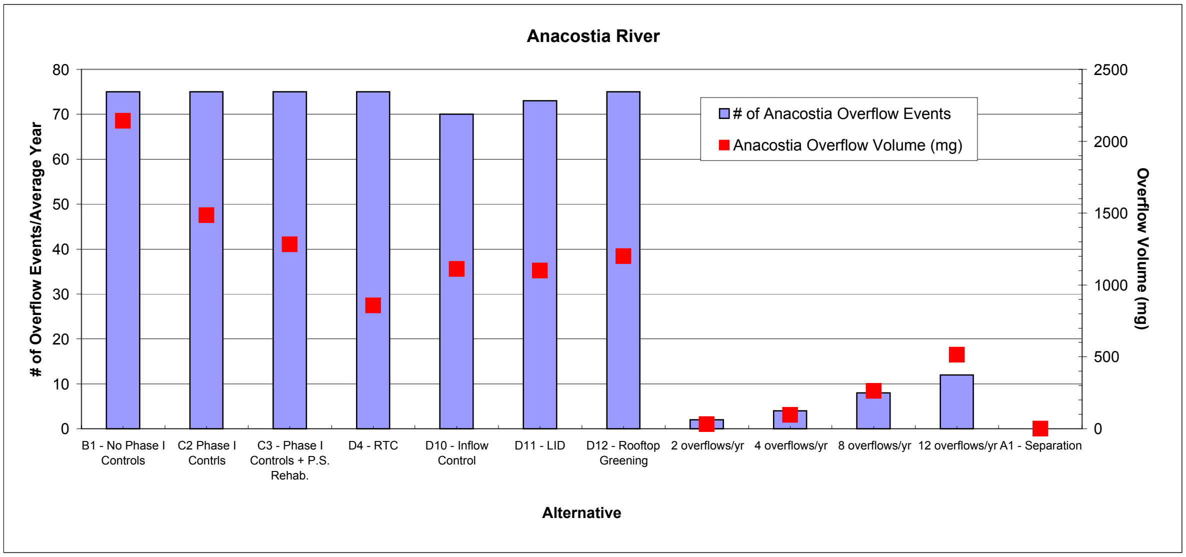
Public Acceptance

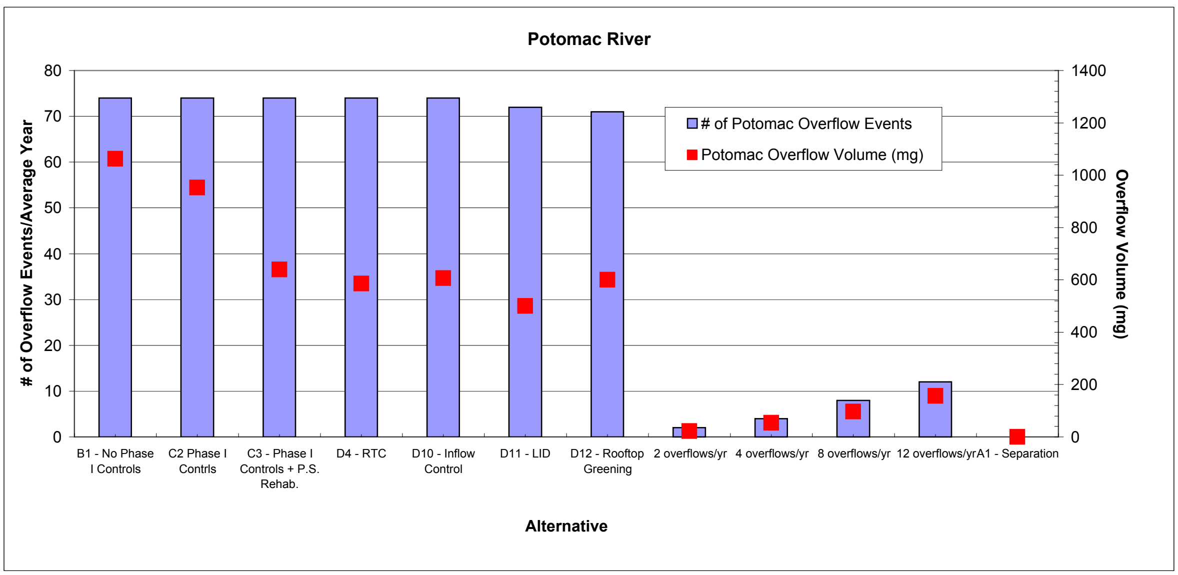
Public acceptance of the system alternatives was rated based on comments received to date. Also included in the consideration of public acceptance was the degree of treatment, the disruption of streets or private property whether there was a potential odor problem with CSO control facilities.

8.4.2 Regulatory Compliance

The ability to meet the range of overflows stipulated in the CSO Policy is shown graphically on Figure 8-8. The ability to conform to the CSO Policy and BOD TMDL Allocations for the Anacostia River is presented in Table 8-9.

Figure 8-8
Number of Events and Overflow Volumes per year





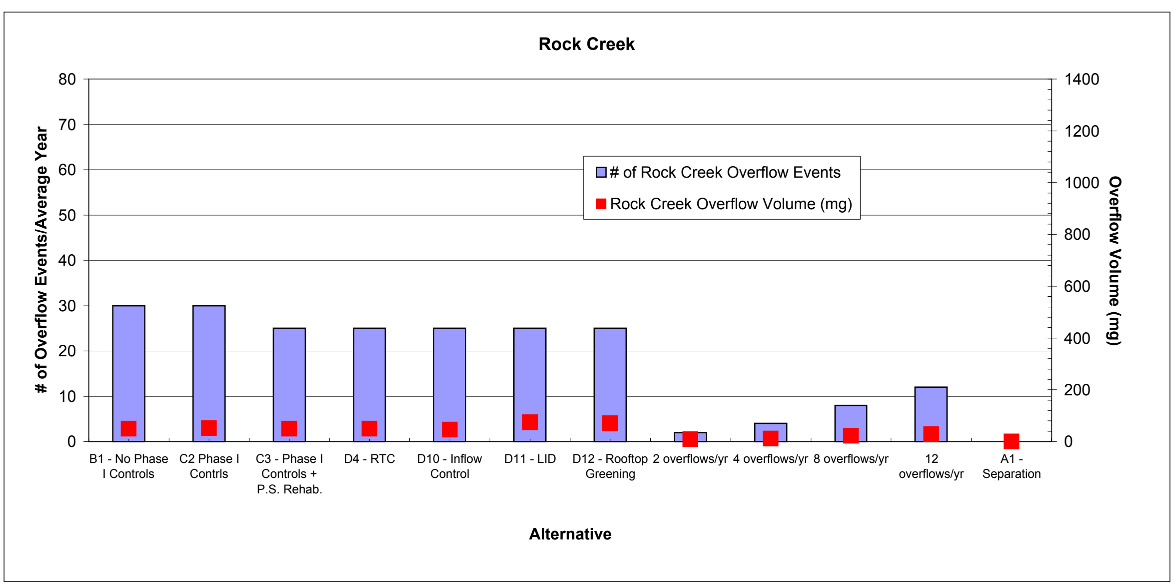


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Table 8-9
Performance of Preliminary CSO Control Alternatives
Average Year 1988-1990

No.	Preliminary Control Alternative	CSO Overflow							Annual lbs of CBOD5 to Anacostia	Meets Annual Anacositia BOD TMDL Allocation (overall)
		Anacostia River		Potomac River (1)		Rock Creek		Total		
		# Events	Volume (mg)	# Events	Volume (mg)	# Events	Volume (mg)	Volume (mg)		
B1	No Phase I Controls	75	2,142	74	1,063	30	49	3,254	754,965	No
C2	Phase I Controls	75	1,485	74	953	30	52	2,490	526,050	No
C3	P.S. Rehab.	75	1,282	74	639	30	49	1969	442,985	No
D4	P.S. Rehab. & Real Time Control	75	858	74	586	30	49	1493	308,796	No
D10	P.S. Rehab & Inflow Control	70	1,111	74	607	30	46	1764	380,504	No
D11	P.S. Rehab & Low Impact Development	73	1090	72	543	30	41	1674	419,391	No
D12	P.S. Rehab & Rooftop Greening	75	1218	71	607	30	47	1871		No
D7- Satellite Storage D8 - Pump to Blue Plains and Store D9 – Pump to Blue Plains and Treat D27, D28 - Tunnel From Poplar Point to Main and 'O' St. Pumping Stations D29, D30- Tunnel from Blue Plains to Main and 'O' St. Pumping Stations		2	32	2	22	2	9	63	10,253	Yes
		4	96	4	54	4	11	161	33,135	Yes
		8	262	8	96	8	22	380	89,097	Yes
		12	515	12	157	12	28	700	173,504	No
A1	Sewer Separation	0	0	0	0	0	0	0	(2)	Yes (3)

Notes:

1. Excludes discharges from Blue Plains Outfalls 001 and 002, which discharge treated flow and are not CSOs.
2. CBOD5 load from increased storm water discharges due to CSO Separation would be about 684,000 lbs/yr.
3. Technically CSO would meet its allocation, since CSO discharges would be eliminated. However, the increased storm water loads due to separation of the combined sewer system would exceed the allocated load.

8.4.3 Selection of Final Alternatives

The evaluation of the preliminary control plans is summarized in Table 8-10. Based on this evaluation, the preliminary alternatives selected for further analysis in Section 9 are as follows:

Tunnel Systems: These alternatives can provide storage capacity to the levels required by the CSO Policy with little disruption to surface facilities and does not impact the use of land above the tunnel. In addition, DOH's draft BOD TMDL for the Anacostia River can also be achieved. Though satellite storage is also capable of providing a similar capacity, satellite facilities limit the uses of the surface and therefore obtaining sitting approval from land owners was expected to be quite difficult.

Pumps Station Rehabilitation, Real Time Control, and LID-R with Rooftop Greening: Though these alternatives cannot provide the needed level of control independently, they will be evaluated further for benefits as a component of the LTCP in conjunction with the various tunnel configurations.

Sewer Separation: This is the one alternative that will eliminate all CSO overflows and therefore will be considered in more depth.

Table 8-10
Comparison of Preliminary Control Plan Alternatives

No.	Preliminary Control Alternative	Potential to Meet Evaluation Factors							**Retain as Final Alternative**
		CSO Policy	D.C. Water Quality Standards	D.C. TMDL for BOD	Northeast Boundary Flooding	Public Acceptance	Implementable/ Operational Factors	Ability to Upgrade	
B1	No Phase I Controls	No	No	No	No	High	Medium	Medium	**No**
C2	Phase I Controls	No	No	No	No	High	Medium	Medium	**No**
C3	Phase I Controls + PS. Rehab.	No	No	No	No	High	Medium	Medium	**Yes[2]**
D4	Real Time Control	No	Low	No	No	Medium	Low	Low	**Yes[2]**
D10	Inflow Control	No	Low	No	No	Low	Low	Low	**No**
D11	Low Impact Development[1]	No	Low	No	Low	High	Medium	Medium	**Yes[2]**
D12	Rooftop Greening Only	No	Low	No	Low	Medium	Medium	Low	**No**
D7	Satellite Storage	Yes	High	Yes	High	Low	Low	Low	**No**
D8	Pump to Blue Plains and Store	Yes	High	Yes	No	Low	Low	Medium	**No**
D9	Pump to Blue Plains and Treat	Yes	High	Yes	No	Low	Low	Medium	**No**
D27	Tunnel System – Retain Main and O St Pumping Stations	Yes	High	Yes	High	High	Medium	Medium	**Yes**
D29	Tunnel System – Relocate Main and O Pumping Stations	Yes	High	Yes	High	High	Medium	Medium	**Yes**
A1	Sewer Separation	Yes	No	No	High	Low	Low	Low	**Yes**

1. Includes some Roof Top Greening.
2. Retained as an element to be used in conjunction with the Tunnel Systems.

Section 9
Selection of Draft LTCP

9.1 INTRODUCTION

This section describes the detailed analysis used to select the Draft LTCP. The evaluation was conducted for each receiving water so that different levels and types of control could be considered for the Anacostia River, Potomac River and Rock Creek. At the completion of the alternatives evaluation, the selected alternatives for each receiving water were assembled into a comprehensive Draft LTCP entire combined sewer system. The Draft LTCP was issued in June 2001. Subsequent sections describe comments received on the plan, additional evaluations conducted and the section of the Final LTCP.

9.2 EVALUATION APPROACH

The current water quality standards for the District of Columbia do not address the transient nature of wet weather events. The standards also include a narrative component, which, among other items, require that discharges be "free of untreated sewage". Given the current standards, no alternative short of complete separation can completely eliminate overflows (and thereby comply with current standards) during all conditions. However, the CSO Policy calls for an evaluation of controls necessary to reduce overflows to between zero and 12 events per average year. As a result, this section evaluates the effect on sizing, water quality and cost of alternative controls sized for between zero and 12 overflows per average year. The zero overflow per year option was evaluated in two ways. First, plans which would achieve zero overflows under all conditions (i.e. separation) were evaluated. Second, controls which would achieve zero overflows for all storms occurring in the 1988 to 1990 analysis period were also developed. Note that plans which achieve zero overflows for all storms in the 1988-1990 analysis period would not prohibit overflows under all climate conditions. Individual storms or groupings of storms not represented in the three years could still cause overflows.

The effect of CSO controls on the ability to meet water quality standards was evaluated by determining the impact of CSO control on bacteria and dissolved oxygen levels. For bacteria, both fecal coliform and e. coli were evaluated. The following summarizes the evaluation procedures:

<u>Bacteria</u>

- <u>Fecal Coliform</u> – the existing water quality standards are written in terms of fecal coliform concentrations. The following parameters were evaluated:
    - o <u>Number of months exceeding Class A and Class B standards</u> – the existing water quality standard is a 30 day geometric mean. The receiving water model produced a daily average fecal coliform concentration for each day in each month. Geometric means were calculated on a monthly basis using the daily values. The number of

months exceeding the Class A standard of 200 organisms/100 ml and the Class B standard of 1,000 organisms/100 ml was tabulated.

- Number of days predicted fecal coliform concentration exceeds 200/100 ml – there is no water quality standard limiting daily fecal coliform concentrations. However, wet weather conditions can produce elevated levels of fecal coliform during and after rain events. While these elevated levels of coliform may not have a significant effect on the 30 day geometric mean, they can affect the use of the water body. In order to assess the effect of this phenomenon, the number of days that the predicted concentration of fecal coliform would exceed 200/100 ml in the receiving waters was calculated. The value of 200/100 ml was selected to be consistent with the geometric mean. Note that a daily value of 200/100ml is much more conservative than a geometric mean of 200/100ml.
- Number of days of CSO impact – Like the separate storm water system and the DC/Maryland boundary, CSO discharges can contribute to elevated fecal coliform concentrations during and immediately after rain events. In order to assess the effect of CSO controls on their own, other load sources were set to zero, and the number of days that CSOs would cause the fecal coliform concentration in the receiving water to exceed 200 was calculated. This is called the number of days of CSO impact and is a conservative way of estimating bacteriological CSO impacts.

- E. Coli – while there is no current water quality standard for e. coli, EPA has recommended that states move from a fecal coliform standard to an e. coli standard (EPA, 1986). E. coli was thus evaluated in the event this occurs in the District. The following parameters were evaluated:
    - Number of months exceeding geometric mean of 126/100 ml – EPA has recommended an e. coli geometric mean of equal to or less than 126/100 ml for Class A waters. As with fecal coliform, the receiving water model produced a daily average e. coli concentration for each day in each month. Geometric means were calculated on a monthly basis using the daily values. The number of months where the geometric mean exceeded 126/100 ml was tabulated.
    - Number of days predicted e. coli concentration exceeds 126/100 ml and 576/100 ml – EPA's documents suggest a range of single sample maximum e. coli concentrations depending on the use of the water body. The suggested maximums range between 235/100 ml for "designated beach areas" to 576/100 ml for "infrequently used full body contact recreation" areas. In order to be consistent with the analysis performed for fecal coliform where no single sample maximum exists, the number of days where the predicted e. coli concentration exceeded 126/100 ml (the value for the 30 day geometric mean) was calculated. In order to bracket the range, the number of days

exceeding the upper limit on the single sample maximum of 576/100 ml was also evaluated.

- o Number of days of CSO impact – In order to assess the effect of CSO controls on their own, other load sources were set to zero, and the number of days that CSOs would cause the e. coli concentration in the receiving water to exceed 126/100 ml and 576/100 ml was calculated.

Dissolved Oxygen

- Number of Days less than 5.0 mg/L, 4.0 mg/L and 2.0 mg/L – The water quality standards require a minimum dissolved oxygen level of 5.0 mg/L. The number of days where the average daily dissolved oxygen level was predicted to be less than this value was calculated. In addition, discussions with DOH indicate that dissolved oxygen levels less than 4.0 mg/L can produce stress for certain fish species. DOH has identified 2.0 mg/L as the threshold below which fish kills become a significant risk. For the Anacostia River, which experiences low dissolved oxygen levels, the number of days where the dissolved oxygen is predicted to be below 4.0 mg/L and 2.0 mg/L were also calculated.
- Minimum Day Dissolved Oxygen – The value of the minimum day dissolved oxygen level was calculated for each alternative in order to assess the degree of deviation from the standard.

Non-CSO Loads

Load sources other than CSOs were found to have a significant impact on water quality, particularly in the Anacostia River and Rock Creek. Analyses conclusively demonstrated that CSO control alone could not improve the water quality in the receiving waters to a level that would meet the existing water quality standards. As a result, CSO control was coupled with reductions in loads from other sources to establish the combined benefit to the receiving waters. The load reductions were applied as follows:

- Separate Storm Water – A 40% reduction in D.C. storm water pollutant loads was tested. The storm water volume was left unchanged. There is little information in the literature on the degree to which storm water controls can achieve pollutant reductions on a city-wide basis. A study in Seneca, Maryland suggested that reductions in the 40% range might be achievable if controls were integrated with development. As such this would represent an extremely aggressive storm water program and probably is an optimistic assessment of what might be achievable in the District.
- Upstream Boundary Loads – Upstream nutrients (CBOD5, nitrogen and phosphorus) were reduced by 40%. In addition the upstream fecal coliform and e. coli concentration were reduced to 80% of the current water quality standards. This resulted in a fecal coliform concentration entering the District of 160/100ml or 80% of the Class A standard. This

concentration was selected to allow the District some allowance for storm and CSO discharges.

9.3 LOW IMPACT DEVELOPMENT RETROFIT

Public comments indicated a strong preference for consideration and inclusion of Low Impact Development Retrofit (LID-R) in the final alternatives. LID-R consists of retrofitting existing development in the District with micro-scale storage and treatment facilities. Examples of such facilities are biofilters, tree planting, rain gardens, sand filters, porous pavement, storm water detention, rooftop greening and others. These facilities have the potential to reduce CSOs by offloading storm water run off. In addition, they can reduce the concentration of pollutants in storm water.

Analyses indicate that LID-R on its own or coupled with Real Time Control (RTC) cannot reduce the frequency of CSO overflows from current levels to the range of zero to 12 per year on their own. However, LID-R can be coupled with structural controls to reduce CSOs. In this capacity, LID-R has the potential to reduce the size of capital facilities. In addition, LID-R can provide ancillary benefits such as reduced cooling costs, aesthetic value and reduction in pollutants from the separate storm water system (SSWS).

There are several institutional and implementation issues associated with LID-R. Each is described below:

- WASA does not control development or redevelopment in the District. As a result, WASA is not able to mandate application of LID-R. Laws and building codes in the District would need to be changed in order for this to occur. WASA can, however, recommend these types of changes to the District and provide technical assistance in their development.
- Application of LID-R on the scale of the entire District (44,000 acres) for the purpose of CSO control has not been implemented before. As a result, there is some uncertainty as to the practicality and benefits to CSO control.
- The most practical and cost-effective way to implement LID-R would be in conjunction with redevelopment and reconstruction within the District. It would be much more costly to implement LID-R separate from reconstruction that was already planned. As a result, the implementation time associated with LID-R would be a function of the rate and magnitude of redevelopment. This may make the implementation time for LID-R very long, on the order of 30 years or more. The CSO policy requires development of a schedule for implementing CSO controls. EPA guidance discusses implementation time frames on the order of 15 years. It may be very difficult to effectively implement a large degree of LID within that time frame.
- After the LTCP is implemented, WASA's discharge permit will require a specified degree of performance for the CSO controls. Violations of the permit are subject to penalties by law.

If LID-R is relied on to provide the degree of control specified in the permit, this could place WASA in an impractical situation of having to meet a permit but being unable to control LID-R, which is relied upon to meet the permit. One way to avoid this would be to construct the long term controls assuming LID-R was not in place. Once LID-R measures were constructed, the structural control measures would yield a higher degree of control.

- LID-R can have a significant cost to society. Preliminary estimates indicate that applying LID-R over 15% of the impervious land area in the District would cost about $453 million. This cost could be reduced if the construction is coupled with existing redevelopment. In addition, costs could decrease as LID-R measures become more common and contractors and developers become more experienced in their application.
- Some LID-R measures may experience challenges in gaining public acceptance. In 2000, WASA conducted a rain barrel demonstration project by installing 16 rain barrels at 10 residences in the District. The barrels were monitoring for approximately seven months and the homeowners were interviewed at the end of the demonstration. The survey found that 40% of the homeowners did not want to keep the rain barrels at the end of the demonstration period because of maintenance needs, lack of need of water, or insufficient yard area. This indicates that LID-R measures directed toward individual homeowners may experience some difficulty unless they are unobtrusive and very low maintenance.

Most LID-R technologies have a limit on how much rain can be treated. Once this limit is exceeded, runoff is discharged normally. This limit is typically 0.5" and this value was used in the analysis. As a result of this, LID-R is very effective in eliminating or reducing runoff from small storms. The combined sewer system has a significant wet weather capacity and can usually accommodate these smaller storms without overflows. The level of CSO control required in the CSO Policy is in the range of zero to 12 events per year. The storms that cause these events are typically the extreme, intense events that can overwhelm LID-R systems. In these large storms, LID-R systems can offload some of the water which would otherwise appear as runoff. Assuming the application of LID-R over 15% of the impervious land in the District, and assuming that the technologies capture the first 0.5" of rainfall, the required storage volumes for CSO control could be reduced by about 6 million gallons for Anacostia CSOs, 2 million gallons for the Potomac CSOs and about 0.5 million gallons for Piney Branch along Rock Creek. If LID-R were implemented more or less intensely, the required CSO storage volume would increase or decrease accordingly. Because the separate storm water system discharges practically every time it rains, LID-R can have a more significant benefit in reducing pollutants from this source.

Even though LID-R has significant implementation and institutional issues associated with its application, that does not mean it should not be implemented. In addition to assisting with CSO control, LID-R has significant benefits to storm water controls, quality of life and other environmental benefits. It is good public policy. The approach taken in this section is to evaluate the sizing and cost of structural CSO controls with and without LID-R so that a sound decision can be made as to the final sizing of the structural control measures.

9.4 REAL TIME CONTROL

The real time control (RTC) alternative discussed in Section 8 can be divided into two categories as follows:

- Operational changes in pumping stations
- Additional in-system storage

The operational changes at the pump stations consist of operating the facilities delivering flow to BPWWTP at capacity so as to minimize overflows to local waters of the Anacostia and the Potomac. Under certain conditions, the pumping capacity will exceed the treatment capacity of BPWWTP. In these events, overflows will occur at CSO 003, Bolling Air Force Base to the Potomac River. The river at this location is much better able to accommodate overflows. This operational scheme is appropriate until the structural CSO storage facilities (i.e. tunnels) described in this section are constructed. Once the tunnel storage is constructed, it would be better to allow CSOs to fill the storage tunnel first rather than allowing overflows at CSO 003.

The second element of RTC involves additional in-system storage. In Rock Creek, significant in-system storage was not available, mostly due to the steepness of the watershed. Dams were tested at several locations, but they did not reduce overflows. In the Potomac, several potential in-system storage locations were identified. However, the storage did not significantly reduce overflow volumes, mostly because the storage was normally filled under existing conditions. Additional storage beyond the existing inflatable dams is thus not proposed for the Potomac and Rock Creek systems.

In the Anacostia, two potential sites were identified for additional in-system storage. One site is in the Northeast Boundary Trunk Sewer (NEBTS) near Florida St. and H St. NE to take advantage of additional storage in the 20’ span of sewer. The second site is also in the NEBTS, between the Swirl Facility and the river. The second site takes advantage of storage capacity in the triple span of the NEBTS downstream of the existing swirl facility. As described in Section 8, the in-system storage in the Anacostia system was not able to reduce overflows to the level required by the CSO Policy, but was able to measurably reduce the annual CSO overflow volume. The approach taken in this section is to evaluate the sizing and cost of structural CSO controls with and without RTC in the Anacostia system to enable making a decision as to the final sizing of the structural control measures.

9.5 ANACOSTIA RIVER ALTERNATIVES

9.5.1 Description

Based on the preliminary alternatives evaluation, the final alternatives for the Anacostia River CSOs are summarized in Table 9-1.

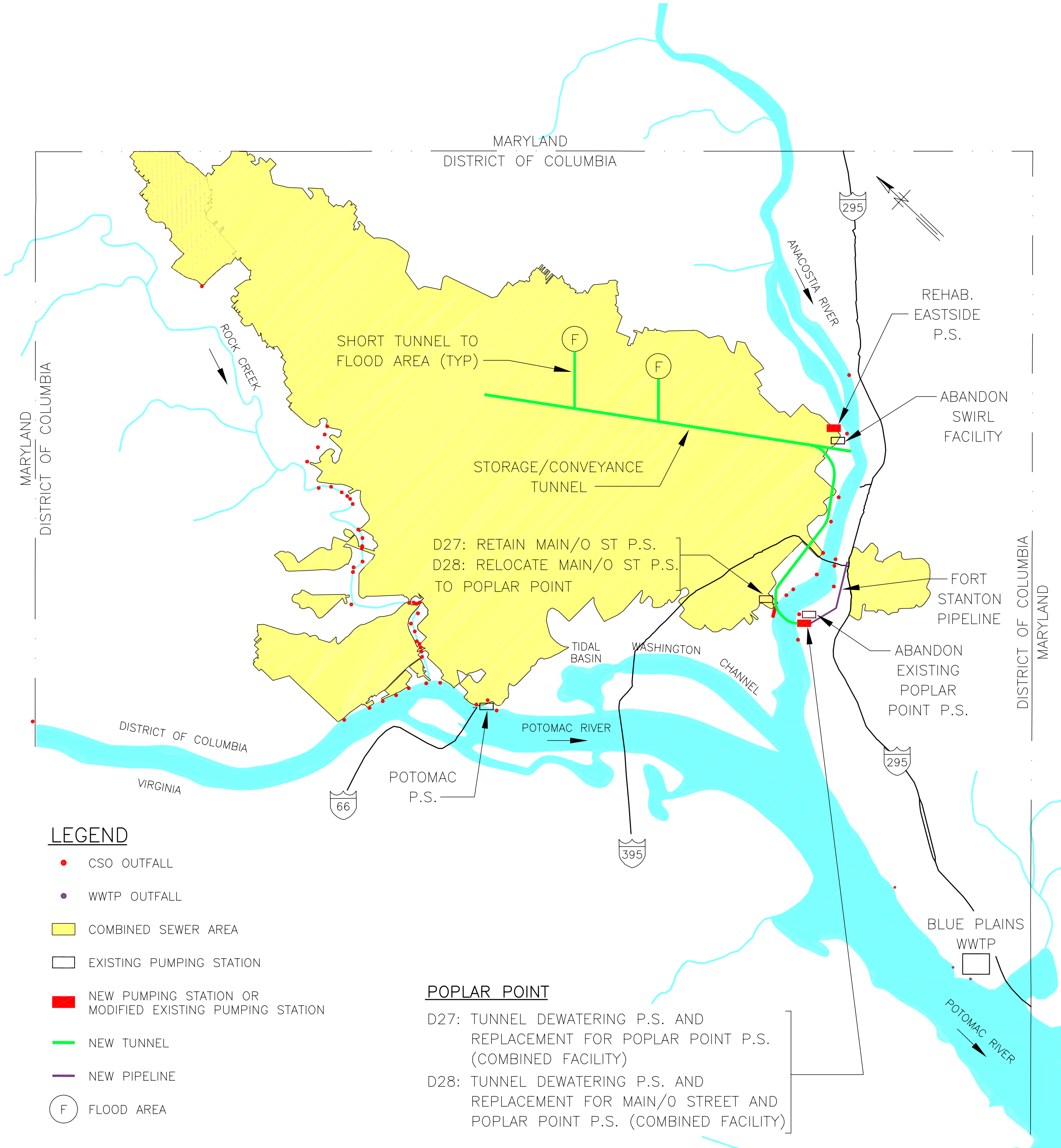
Table 9-1
Anacostia River Final Alternatives

Name	*No.*	*Description*
Tunnel From Poplar Point to Northeast Boundary	D27-1	Retain Main and 'O' Pumping Stations at Present Location
	D27-2	Add Low Impact Development Retrofit
	D27-3	Add Real Time Control
	D27-4	Add Low Impact Development Retrofit and Real Time Control
	D28	Relocate Main and 'O' Pumping Stations to Poplar Point
Tunnel from BPWWTP to Northeast Boundary	D29-1	Retain Main and 'O' Pumping Stations at Present Location
	D29-2	Add Low Impact Development Retrofit
	D29-3	Add Real Time Control
	D29-4	Add Low Impact Development Retrofit and Real Time Control
	D30	Relocate Main and 'O' Pumping Stations to Poplar Point and BPWWTP

The alternatives are described below:

- *<u>Alternative D27:</u> Tunnel from Poplar Point to Northeast Boundary (Retain Main and 'O' Pumping Stations at Present Location)*
  This alternative is shown on Figure 9-1 and consists of a storage tunnel from Poplar Point to the Main and O Street Pumping Station site, then continuing to the Northeast Boundary outfall. From the Northeast Boundary outfall, the tunnel would parallel the existing Northeast Boundary Sewer to relieve street flooding in the Northeast Boundary Area. The following are key features of this alternative:

  - The low point of the tunnel would be at Poplar Point. A new Poplar Point pumping station would be required with two levels. The low level would dewater the tunnel after rain events, while the upper level would replace the function of the existing station, which is lifting sewage from the area east of the Anacostia into the outfall sewers.
  - A new conveyance pipeline from Fort Stanton to Poplar Point is required to pick up CSO 005, 006 and 007.
  - The Navy Yard and M Street CSOs would drop into the tunnel as it travels from Main and 'O' to Northeast Boundary.



ANACOSTIA FINAL CONTROL ALTERNATIVES: TUNNEL FROM POPLAR POINT TO NORTHEAST BOUNDARY D27 - RETAIN MAIN & O ST D28 - RELOCATE MAIN & O ST

1 MILE 1/2 0 1 MILE

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EPMC-III
GREELEY AND HANSEN LLC

D.C. WATER AND SEWER AUTHORITY
CSS LONG TERM CONTROL PLAN

- The tunnel parallel to the Northeast Boundary Sewer would be designed to provide relief to the Northeast Boundary Sewer to provide flooding protection at the 15-year storm. Two side tunnels from the main tunnel to West Virginia and Mt. Olive, NE and to Rhode Island and 4th St. NE are required to relieve these local flood areas.
- The existing Northeast Boundary Sewer outfall does not have adequate capacity to convey the 15 year storm. A new outfall from the tunnel to the river is required to provide the necessary flooding protection.
- No changes would be made at BPWWTP.

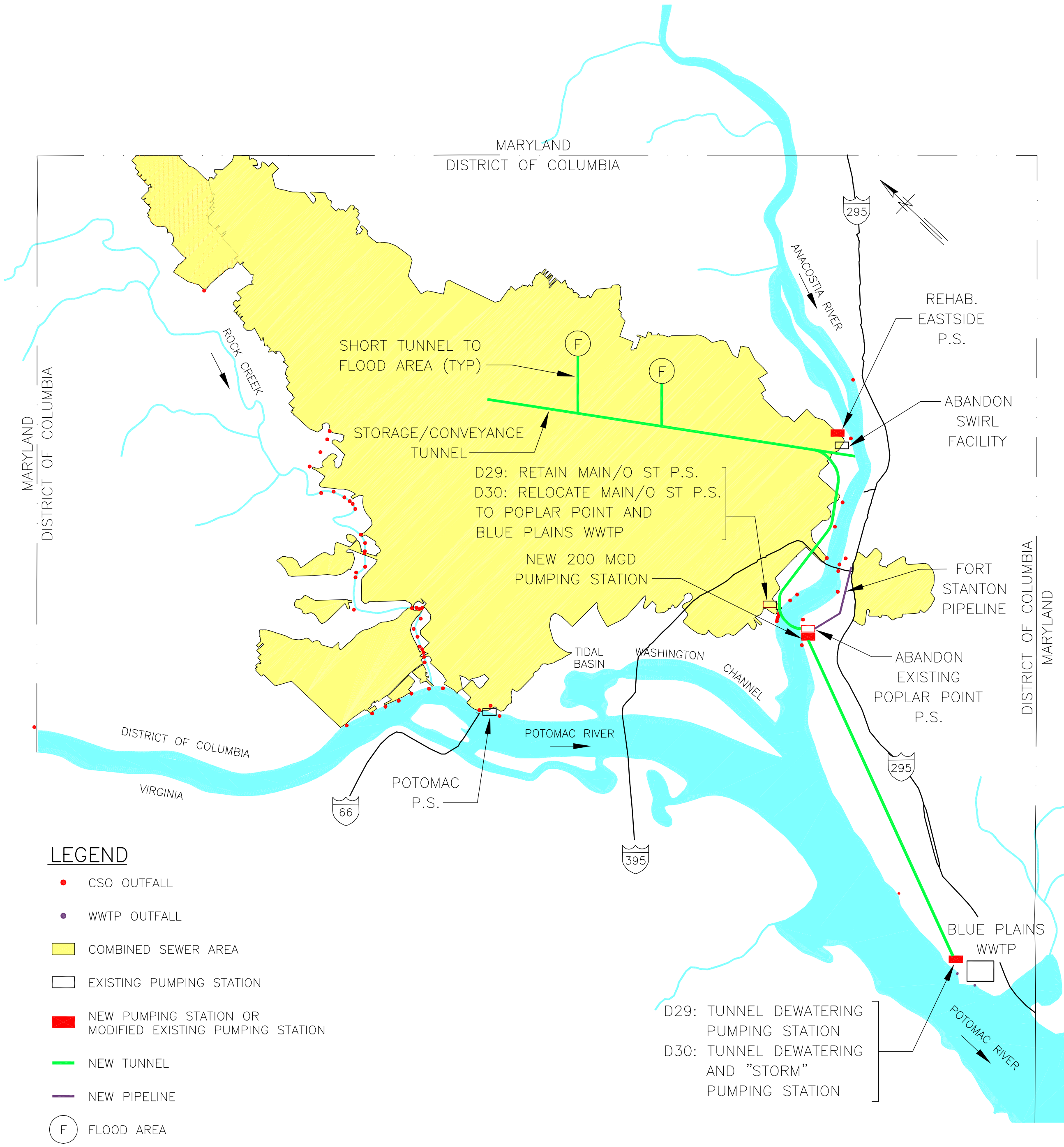
- *Alternative D27-2: Alternative D27-1 Plus Low Impact Development Retrofit*
  Alternative D27-3: Alternative D27-1 Plus Real Time Control
  Alternative D27-4: Alternative D27-1 Plus Low Impact Development Retrofit and Real Time Control

  These alternatives are identical to Alternative D27-1 except the features of LID-R and Real Time Control (RTC) are added separately and in combination with each other. Adding LID-R and/or RTC have the ability to reduce CSO overflows, thereby reducing the sizing and cost of capital facilities. The main feature of this additional features are presented below:
  - LID–R - Micro scale urban storage and treatment devices were assumed to have been installed throughout the District. Based on review of the technologies and their application, approximately 15% of the impervious acres in the District were assumed to have been connected to LID-R that captures up to 0.5" of rainfall. Because LID-R technologies also can remove pollutants, the pollutant concentration in storm water was also reduced.
  - RTC – In the Anacostia system, RTC consisted of the following modifications to the system:
    - Two existing dams in the west and middle conduits of the triple span of the Northeast Boundary Trunk Sewer (NEBTS) in the vicinity of the Swirl Facility were removed and replaced with two new dams which were placed further downstream. This was done to take advantage of additional unused storage volume in the triple span of the NEBTS. The stored CSO would drain by gravity to East Side Pump Station and then be pumped to BPWWTP.
    - An additional dam was added to the east conduit of the triple span of the NEBTS in the vicinity of the Swirl Facility to allow upstream storage before flow needed to be diverted to the Swirl Facility.
    - An additional dam was added to the NEBTS near Florida St. and H St. NE to take advantage of additional storage in the 20' span of sewer.
    - The Main, "O" Street, Poplar Point, and Eastside pump stations were operated so as to minimize overflows to the Anacostia and instead to allow them to occur to the Potomac River at Bolling, CSO 003.

- *<u>Alternative D28</u>: Tunnel from Poplar Point to Northeast Boundary (Relocate Main and 'O' Pumping Stations to Poplar Point)*
  This is identical to alternative D27-1, except that the pumping facilities associated with the Main and 'O' Street site would be abandoned and a single replacement pumping station would be constructed in the Poplar Point area. The new facility would provide both sanitary, storm, and tunnel dewatering pumping capabilities. The sanitary pumping would lift combined sewage to the outfall sewers, replacing the sanitary portion of the existing Main, 'O' Street and Poplar Point Pumping stations. In order to prevent flooding downtown, the combined pump station would need a storm pumping capability to discharge CSO and storm water to the river via a new outfall. The pump station would also dewater CSO stored in the tunnel to the existing outfall sewer for treatment at BPWWTP.

- *<u>Alternative D29-1</u>: Tunnel from BPWWTP to Northeast Boundary (Retain Main and 'O' Pumping Stations at Present Location)*
  This alternative is shown on Figure 9-2. The alternative is similar to Alternative D27 except the tunnel extends from BPWWTP to Northeast Boundary. The low point of the tunnel would be at BPWWTP and a tunnel dewatering pump station would be constructed there. The existing Poplar Point Pumping Station would be replaced at its existing 45 mgd capacity. Flooding protection of Northeast Boundary is provided by the Northeast Boundary tunnel. Other features are identical to Alternative D27-1

- *<u>Alternative D29-2</u>: Alternative D29 Plus Low Impact Development Retrofit*
  <u>Alternative D29-3</u>: Alternative D29 Plus Real Time Control
  <u>Alternative D29-4</u>: Alternative D29 Plus Low Impact Development Retrofit and Real Time Control
  These alternatives are identical to Alternative D29-1 except the additional features of LID-R, RTC, and the combination of the two features added together. The LID-R and RTC components are identical to those described Alternative D27-2 through D27-4.



ANACOSTIA FINAL CONTROL ALTERNATIVES:
TUNNEL FROM BLUE PLAINS WWTP TO NORTHEAST BOUNDARY
D29 - RETAIN MAIN & O ST
D30 - RELOCATE MAIN & O ST

1 MILE 1/2 0 1 MILE

EPMC–III
GREELEY AND HANSEN LLC

D.C. WATER AND SEWER AUTHORITY
CSS LONG TERM CONTROL PLAN

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- *Alternative D30: Tunnel from BPWWTP to Northeast Boundary (Relocate Main and 'O' Pumping Stations to Poplar Point and BPWWTP)*
  This alternative consists of a storage/conveyance tunnel from BPWWTP to Northeast Boundary. The pumping facilities associated with Main and 'O' Street Pumping Stations would be abandoned and replacement facilities would be constructed at Poplar Point and BPWWTP. The following are the primary features of the plan:
  - Since Main and 'O' pumping facilities would be abandoned, a replacement pumping facility would be required in the vicinity of Poplar Point. The new pumping station would replace the function of the existing sanitary pumps at Main, 'O' Street and Poplar Point facilities and handle the flow from the Fort Stanton Interceptor.
  - The existing Tiber Creek and B Street/New Jersey Avenue sewers are low compared to the elevation of the river. Depending on tidal level, these sewers cannot flow by gravity to the river without causing flooding downtown. As a result, the existing Main and 'O' Street Pumping Stations include storm pumps which lift water to the river to prevent flooding. With Main & 'O' Street Pumping Stations abandoned, a new storm water pumping station would need to be constructed at BPWWTP. High flows from the existing sewers at Main & O Street Pumping Stations would drop into the tunnel, travel down to BPWWTP via the tunnel, and be pumped to the Potomac River. Since the low point of the tunnel will also be at BPWWTP, the storm pump station could be integrated with a tunnel dewatering pump station into a single facility.
  - Currently flows receiving full treatment and those receiving excess flow treatment at BPWWTP are commingled. This causes a degree of operation difficulty at the plant. Under this alternative, the existing excess flow treatment train at BPWWTP would be eliminated and the plant influent would be limited to 740 mgd for the first 4 hours and 511 mgd after that. Flows in excess of 740/511 mgd would be handled by the tunnel. Flows in excess of the tunnel storage tunnel capacity would be pumped from the tunnel and be treated by a combination settling/disinfection basin. This configuration would separate excess flows from other flows and would simplify operations at the plant.
  - Other aspects of this alternative are identical to Alternative D27-1.

The sizing of major facilities for each alternative is summarized in Table 9-2

Table 9-2
Facility Sizing: Anacostia River Final Alternatives

No.	Facility Sizes for Indicated Level of CSO Control	# CSO Overflows per Average Year				
		0[1]	2	4	8	12
		Annual CSO Overflow Volume per Average Year				
		0 mg	54 mg	93 mg	262 mg	515 mg
D27	***Tunnel From Poplar Point to Northeast Boundary***					
D27-1	**Retain Main & 'O' Street Pumping Stations at Present Location**					
	Tunnel From Poplar Point to BPWWTP					
	Length, (ft)	20,695'	-	-	-	-
	Diameter, (ft)	28.5'	-	-	-	-
	Tunnel From Poplar Point to Northeast Boundary Outfall					
	Length, (ft)	13,785'	13,785'	13,785'	13,785'	13,785'
	Diameter, (ft)	28.5'	24.5'	22.5'	12'	10'
	Tunnel Parallel to Northeast Boundary Sewer					
	Length, (ft)	20,230'	20,230'	20,230'	20,230'	20,230'
	Diameter, (ft)	28.5'	24.5'	22.5'	18'	18'
	Tunnel from NEB Sewer to Rhode Island & 4th NE					
	Length, (ft)	5,915'	5,915'	5,915'	5,915'	5,915'
	Diameter, (ft)	12'	12'	12'	12'	12'
	Tunnel from NEB Sewer to West Virginia & Mt. Olivet, NE					
	Length, (ft)	3,935'	3,935'	3,935'	3,935'	3,935'
	Diameter, (ft)	8'	8'	8'	8'	8'
	Total System Storage Volume, (mg)	267	126	108	57	53
	Fort Stanton Interceptor					
	Length, (ft)	4,900'	4,900'	4,900'	4,900'	4,900'
	Diameter, (ft)	7'	6'	5.5'	4.5'	4'
	Firm Pumping[2] and Treatment Capacities					
	Main – Sanitary Capacity/ Storm Capacity, (mgd)	240/400	240/400	240/400	240/400	240/400
	'O' St. – Sanitary Capacity/ Storm Capacity, (mgd)	45/500	45/500	45/500	45/500	45/500
	New Poplar Point – Tunnel Dewatering Side, (mgd)	250	125	95	60	60
	New Poplar Point – Low Lift Sanitary Side, (mgd)	45	45	45	45	45
	Eastside, (mgd)	45	45	45	45	45
	Northeast Boundary Swirl	Abandon	Abandon	Abandon	Abandon	Abandon
	BPWWTP Treatment (mgd)	740/511	740/511	740/511	740/511	740/511
	BPWWTP Excess Flow Treatment (mgd)	336	336	336	336	336
D27-2	**D27-1 Plus Low Impact Development Retrofit**					
	Same as D27-1 with Following Changes:					
	Tunnel From BPWWTP to Poplar Point, Dia, (ft)	28'	-	-	-	-
	Tunnel From Poplar Point to Northeast Boundary Outfall Dia, (ft)	28'	24'	22'	12'	10'
	Tunnel Parallel to Northeast Boundary Sewer, Dia, (ft)	28'	24'	22'	18'	18'
	Total System Storage Volume, (mg)	258	122	103	57	53
D27-3	**D27-1 Plus Real Time Control**					
	Same as D27-1 with Following Changes:					
	Tunnel From BPWWTP to Poplar Point, Dia, (ft)	28'	-	-	-	-
	Tunnel From Poplar Point to Northeast Boundary Outfall Dia, (ft)	28'	23.5'	21.5'	12'	10'
	Tunnel Parallel to Northeast Boundary Sewer, Dia, (ft)	28'	23.5'	21.5'	18'	18'
	Total System Storage Volume, (mg)	258	117	99	57	53
D27-4	**D27-1 Plus Low Impact Development Retrofit and Real Time Control**					
	Same as D27-1 with Following Changes:					

No.	Facility Sizes for Indicated Level of CSO Control	# CSO Overflows per Average Year				
		0[1]	2	4	8	12
		Annual CSO Overflow Volume per Average Year				
		0 mg	54 mg	93 mg	262 mg	515 mg
	Tunnel From Poplar Point to BPWWTP, Dia, (ft)	27.5’	-	-	-	-
	Tunnel From Poplar Point to Northeast Boundary Outfall Dia, (ft)	27.5’	23’	20.75’	12’	10’
	Tunnel Parallel to Northeast Boundary Sewer, Dia, (ft)	27.5’	23’	20.75’	18’	18’
	Total System Storage Volume, (mg)	249	112	92	57	53
D28	**Relocate Main & ‘O’ Street Pumping Stations to Poplar Point**					
	Same as D27-1, with the following revisions:					
	Firm Pumping[2] and Treatment Capacities					
	Main – Sanitary Capacity/ Storm Capacity, (mgd)	Relocate	Relocate	Relocate	Relocate	Relocate
	‘O’ St. – Sanitary Capacity/ Storm Capacity, (mgd)	Relocate	Relocate	Relocate	Relocate	Relocate
	New Poplar Point – Low Lift Sanitary Side, (mgd)	320	320	320	320	320
	New Poplar Point – Storm Side, (mgd)	1000	1000	1000	1000	1000
D29	***Tunnel From BPWWTP to Northeast Boundary***					
D29-1	**Retain Main & ‘O’ Street Pumping Stations at Present Location**					
	Tunnel From BPWWTP to Main & ‘O’					
	Length, (ft)	20,695’	20,695’	20,695’	20,695’	20,695’
	Diameter, (ft)	29’	20’	18.25’	6’	6’
	Tunnel from Main & ‘O’ to Northeast Boundary Outfall					
	Length ,(ft)	11,227’	11,227’	11,227’	11,227’	11,227’
	Diameter, (ft)	29’	20’	18.25’	12’	10’
	Tunnel Parallel to Northeast Boundary Sewer					
	Length, (ft)	20,230’	20,230’	20,230’	20,230’	20,230’
	Diameter, (ft)	29’	20’	18.25’	18’	18’
	Tunnel from NEB Sewer to Rhode Island & 4th NE					
	Length, (ft)	5,915’	5,915’	5,915’	5,915’	5,915’
	Diameter, (ft)	12’	12’	12’	12’	12’
	Tunnel from NEB Sewer to West Virginia & Mt. Olivet, NE					
	Length, (ft)	3,935’	3,935’	3,935’	3,935’	3,935’
	Diameter, (ft)	8’	8’	8’	8’	8’
	Total System Storage Volume	264	129	109	59	56
	Firm Pumping[2] and Treatment Capacities					
	Main – Sanitary Capacity/ Storm Capacity, (mgd)	240/400	240/400	240/400	240/400	240/400
	‘O’ St. – Sanitary Capacity/ Storm Capacity, (mgd)	45/500	45/500	45/500	45/500	45/500
	Replace Poplar Point, (mgd)	45	45	45	45	45
	Eastside, (mgd)	45	45	45	45	45
	Northeast Boundary Swirl	Abandon	Abandon	Abandon	Abandon	Abandon
	Tunnel Dewatering Pump Sta. at BPWWTP, (mgd)	250	125	95	60	60
	BPWWTP Treatment (mgd)	740/511	740/511	740/511	740/511	740/511
	BPWWTP Excess Flow Treatment (mgd)	336	336	336	336	336
D29-2	**D29-1 Plus Low Impact Development Retrofit**					
	Same as D29-1 with Following Changes:					
	Tunnel From BPWWTP to Main & ‘O’ Street, Diameter, (ft)	28.75’	19.25’	17.5’	6’	6’
	Tunnel from Main & O to Northeast Boundary Outfall, Dia, (ft)	28.75’	19.25’	17.5’	12’	10’
	Tunnel Parallel to Northeast Boundary Sewer, Diameter, (ft)	28.75’	19.25’	18’	18’	18’
	Total System Storage Volume, (mg)	260	120	102	59	56
D29-3	**D29-1 Plus Real Time Control**					
	Same as D29-1 with Following Changes:					
	Tunnel From BPWWTP to Main & ‘O’ Street, Diameter, (ft)	27.25’	19’	16.75’	6’	6’
	Tunnel from Main & O to Northeast Boundary Outfall, Dia, (ft)	27.25’	19’	16.75’	12’	10’
	Tunnel Parallel to Northeast Boundary Sewer, Diameter, (ft)	27.25’	19’	18’	18’	18’
	Total System Storage Volume, (mg)	234	117	98	59	56

No.	Facility Sizes for Indicated Level of CSO Control	# CSO Overflows per Average Year				
		0[1]	2	4	8	12
		Annual CSO Overflow Volume per Average Year				
		0 mg	54 mg	93 mg	262 mg	515 mg
D29-4	**D29-1 Plus Low Impact Development Retrofit and Real Time Control**					
	Same as D29-1 with Following Changes:					
	Tunnel From BPWWTP to Main & 'O' Street, Diameter, (ft)	27'	18.5'	15.75'	6'	6'
	Tunnel from Main & O to Northeast Boundary Outfall, Dia, (ft)	27'	18.5'	15.75'	12'	10'
	Tunnel Parallel to Northeast Boundary Sewer, Diameter, (ft)	27'	18.5'	18'	18'	18'
	Total System Storage Volume, (mg)	230	111	92	59	56
D30	**Relocate Main & 'O' Street Pumping Stations to Poplar Point and BPWWTP**					
	Tunnel From BPWWTP to Main & 'O'					
	Length, (ft)	20,695'	20,695'	20,695'	20,695'	20,695'
	Diameter, (ft)	29'	20'	18.25'	16'	16'
	Tunnel from Main & 'O' to Northeast Boundary Outfall					
	Length, (ft)	11,227'	11,227'	11,227'	11,227'	11,227'
	Diameter, (ft)	29'	20'	18.25'	12'	12'
	Tunnel Parallel to Northeast Boundary Sewer					
	Length, (ft)	20,230'	20,230'	20,230'	20,230'	20,230'
	Diameter, (ft)	29'	20'	18.25'	18'	18'
	Tunnel from NEB Sewer to Rhode Island & 4th NE					
	Length, (ft)	5,915'	5,915'	5,915'	5,915'	5,915'
	Diameter, (ft)	12'	12'	12'	12'	12'
	Tunnel from NEB Sewer to West Virginia & Mt. Olivet, NE					
	Length, (ft)	3,935'	3,935'	3,935'	3,935'	3,935'
	Diameter, (ft)	8'	8'	8'	8'	8'
	Total System Storage Volume	263	129	108	85	85
	Firm Pumping[2] and Treatment Capacities					
	Main – Sanitary Capacity/ Storm Capacity, (mgd)	Relocate	Relocate	Relocate	Relocate	Relocate
	'O' St. – Sanitary Capacity/ Storm Capacity, (mgd)	Relocate	Relocate	Relocate	Relocate	Relocate
	Replace Poplar Point, (mgd)	320	320	320	320	320
	Eastside, (mgd)	45	45	45	45	45
	Northeast Boundary Swirl	Abandon	Abandon	Abandon	Abandon	Abandon
	Tunnel Dewatering Pump Sta. at BPWWTP, (mgd)	250	125	95	90	90
	Storm Pump Station at BPWWTP, (mgd)	1000	1000	1000	1000	1000
	BPWWTP Treatment (mgd)	740/511	740/511	740/511	740/511	740/511
	Existing BPWWTP Excess Flow Treatment (mgd)	Abandon	Abandon	Abandon	Abandon	Abandon
	New Disinfection Facility for Excess Flow (mgd)	1,000	1,000	1,000	1,000	1,000

Notes:

1. Zero overflows for all storms during analysis period 1988-1990. There will still be overflows under other climatic conditions
2. Capacity with largest pump out of service.

In many cases, the need for conveyance capacity set the minimum size of tunnel facilities rather than the CSO storage volume needed. These instances are as follows:

- In order to provide the Northeast Boundary with flooding protection, the minimum size of tunnel was determined to be 18' diameter based on conveyance capacity required at the 15 year storm.

- The minimum size of tunnel between Main and O Street and Northeast Boundary is 12' diameter for 8 overflows/year and 10' diameter for 12 overflows/year based on conveyance capacity.
- The minimum size of tunnel between Main and O Street and BPWWTP is 6' diameter for Alternative D29. This is based on the need to convey flows to the plant for tunnel dewatering.
- The minimum size of tunnel between Main and O Street and BPWWTP is 16' diameter for Alternative D30. This is based on the need to convey flows to the storm water pumping station at BPWWTP to prevent flooding downtown.

In several cases, the minimum conveyance sizes for facilities resulted in providing more storage volume than that needed strictly for CSO control. This was particularly true for 8 and 12 overflows per year.

9.5.2 Remaining Overflows

The overflows predicted to remain after implementation of controls designed to reduce CSO overflows to between zero and 12 per average year are summarized in Table 9-3.

Table 9-3
Remaining CSO Overflows - Anacostia River (Average of 1988-1990)

		# CSO Events/Average Year									
		0[1]		*2*		*4*		*8*		*12*	
CSO No.	*Description*	*# Events*	*Vol. (mg)*	*# Events*	*Vol. (mg)*	*# Events*	*Vol. (mg)*	*# Events*	*Vol. (mg)*	*# Events*	*Vol. (mg)*
004	Poplar Point P.S. Emergency Bypass	-	-	-	-	-	-	-	-	-	-
005	Ft. Stanton	-	-	-	-	-	-	-	-	-	-
006		-	-	-	-	-	-	-	-	-	-
007		-	-	-	-	-	-	-	-	-	-
008	AMI Relief	-	-	-	-	-	-	-	-	-	-
009	B St /NJ Ave at Main & O Street	-	-	-	-	-	-	-	-	-	-
010		-	-	1	21	3	40	6	105	9	191
011		-	-	-	-	-	-	-	-	1	2
011a		-	-	-	-	-	-	-	-	-	-
012	Tiber Creek at Main & O Street	-	-	-	-	-	-	-	-	-	-
013	Canal St. Sewer	-	-	-	-	-	-	-	-	-	-
014	Navy Yard/ M St	-	-	-	-	-	-	-	-	1	0.13
015		-	-	-	-	-	-	-	-	-	-
016		-	-	-	-	-	-	-	-	1	0.05
017		-	-	-	-	-	-	-	-	-	
018	Barney Circle	-	-	-	-	-	-	-	-	1	0.14
019	Northeast Boundary	-	-	2	33	4	53	7	157	11	322
	Total		**-**		**54**		**93**		**262**		**515**

1. Zero overflows for all storms during analysis period 1988-1990. There will still be overflows under other climatic conditions.

Note that, in accordance with the CSO Policy, one CSO overflow is defined as one or more CSOs discharging during a single rain event. The frequency of overflows is thus calculated on a rain event basis. When multiple CSOs are predicted to overflow during a single rain event, this is counted as one CSO overflow. Similarly, there are some rain events that cause some CSOs to discharge but not others. As an example, for the 8 overflow per year level of control, CSO 010 and CSO 019 are each predicted to overflow less than 8 times per year. However, on a rain event basis, there are 8 times when at least one of the CSOs is predicted to overflow.

9.5.3 Ability to Meet Water Quality Standards

9.5.3.1 Fecal Coliform

The effect of varying levels of CSO control on fecal coliform levels was evaluated for the entire calendar year as well as for the period May through September. May through September is the period of most likely primary contact recreation since the ambient and water temperatures rise to levels for comfortable recreation. In this period of time, the water temperature is above 60-65 degrees Fahrenheit.

In addition to evaluating the effects of CSO control, the upstream and separate storm water loads were also reduced as described earlier in this section.

Complete results are included in Appendix B. Selected results are shown in Table 9-4.

Table 9-4
Effect of CSO Control On Fecal Coliform in Anacostia River

	South Capital St.				*RFK Stadium*				*DC/MD Boundary*			
	Existing SSWS and Upstream Loads		*Reduced SSWS and Upstream Loads[1]*		*Existing SSWS and Upstream Loads*		*Reduced SSWS and Upstream Loads[1]*		*Existing SSWS and Upstream Loads*		*Reduced SSWS and Upstream Loads[1]*	
Parameter	*All Year*	*May to Sept.*	*All Year*	*May to Sept.*	*All Year*	*May to Sept.*	*All Year*	*May to Sept.*	*All Year*	*May to Sept.*	*All Year*	*May to Sept.*
# Months Exceeding Class A Fecal Coliform Standard												
No Phase 1 Controls	9	3	9	3	12	5	11	4	12	5	3	1
Phase 1 Controls	8	2	5	2	10	3	7	2	12	5	3	1
Pump Sta. Rehab.	6	2	2	1	10	3	7	2	12	5	3	1
12 Overflows/yr	5	2	1	1	8	2	3	1	12	5	3	1
8 Overflows/yr	4	1	0	0	8	2	3	1	12	5	3	1
4 Overflows/yr	4	1	0	0	8	2	3	1	12	5	3	1
2 Overflows/yr	4	1	0	0	8	2	3	1	12	5	3	1
0 Overflows/yr[2]	4	1	0	0	8	2	3	1	12	5	3	1
Separation	6	1	3	1	8	2	7	1	12	5	3	1
# Days Fecal Coliform > 200/100 ml												
No Phase 1 Controls	215	78	202	75	260	101	234	95	270	92	137	56
Phase 1 Controls	172	66	138	59	230	84	167	63	269	91	132	53
Pump Sta. Rehab.	170	64	134	58	229	84	166	63	269	91	132	53
12 Overflows/yr	143	47	78	32	226	81	151	55	269	91	133	53
8 Overflows/yr	137	45	66	26	225	81	147	54	269	91	132	53
4 Overflows/yr	134	43	58	23	223	80	144	52	269	91	132	53
2 Overflows/yr	131	42	52	20	223	80	142	52	268	91	131	53
0 Overflows/yr[2]	130	41	50	18	223	80	141	51	268	91	131	52
Separation	182	61	151	54	238	87	194	72	268	91	136	54
# Days Fecal CSO Impact												
No Phase 1 Controls	192	74	N/A	N/A	216	90	N/A	N/A	8	6	N/A	N/A
Phase 1 Controls	121	56	N/A	N/A	92	43	N/A	N/A	3	2	N/A	N/A
Pump Sta. Rehab.	115	53	N/A	N/A	89	43	N/A	N/A	2	1	N/A	N/A
12 Overflows/yr	51	24	N/A	N/A	39	19	N/A	N/A	3	2	N/A	N/A
8 Overflows/yr	32	15	N/A	N/A	24	12	N/A	N/A	2	2	N/A	N/A
4 Overflows/yr	15	9	N/A	N/A	14	8	N/A	N/A	1	1	N/A	N/A
2 Overflows/yr	4	4	N/A	N/A	4	4	N/A	N/A	0	0	N/A	N/A
0 Overflows/yr[2]	0	0	N/A	N/A	0	0	N/A	N/A	0	0	N/A	N/A
Separation	0	0	N/A	N/A	0	0	N/A	N/A	0	0	N/A	N/A

Notes:

1. Separate storm water load reduced by 40%. Upstream nutrients reduced by 40%. Upstream fecal coliform reduced to 80% of water quality standards or 160 organism/100ml.
2. Zero overflows for all storms during analysis period 1988-1990. There will still be overflows under other climatic conditions

The following observations are made:

- CSO control alone reduces the number of months exceeding the fecal water quality standard at South Capitol Street by approximately one half when compared to no CSO control.

- High levels of CSO control (i.e. between 0 and 12 overflows per year) provide better water quality than separation alone due to the capture and treatment of storm water in the combined sewer system.
- The monthly fecal coliform geometric mean is most affected by the coliform concentrations at the upstream boundary. Transient wet weather pollution sources like CSOs and storm water have less impact on the geometric mean.
- Each CSO event appears to affect fecal coliform concentrations in the river for a period of between 2-4 days per event.
- At four overflow events per average year, there are an estimated 14 to 15 days per year where CSOs are impacting fecal levels in the river. During the contact period (May- Sept.), there are 8 to 9 days or about 1.6 to 1.8 days per month. For two overflow events per year, the number of days of estimated CSO impact is reduced to 4 days per calendar year, all of which occur between May and September.

CSO control alone reduces the frequency and magnitude of fecal coliform exceedances of the Class A standard, but cannot enable the river to meet the standard all months. Control of other sources is required to meet the bacteria standard in terms of a geometric mean during all months. High levels of CSO control in the range of 2-4 overflows per average year can reduce the time that CSOs impact bacteria levels in the river to between 4 to 15 days per calendar year and between 4 to 9 days during May through September.

9.5.3.2 E. Coli

As with fecal coliform, the effect of varying levels of CSO control on e. coli concentrations was analyzed. Complete data is presented in Appendix B, while selected results are shown in Table 9-5.

Table 9-5

Effect of CSO Control On E. Coli in Anacostia River

Parameter	South Capital St.				RFK Stadium				DC/MD Boundary			
	Existing SSWS and Upstream Loads		Reduced SSWS and Upstream Loads[1]		Existing SSWS and Upstream Loads		Reduced SSWS and Upstream Loads[1]		Existing SSWS and Upstream Loads		Reduced SSWS and Upstream Loads[1]	
	All Year	May to Sept.	All Year	May to Sept.	All Year	May to Sept.	All Year	May to Sept.	All Year	May to Sept.	All Year	May to Sept.
# Months Exceeding 126/100 ml Geometric Mean												
No Phase 1 Controls	10	3	9	3	12	5	12	5	12	5	2	1
Phase 1 Controls	7	2	4	2	9	3	6	2	12	5	2	1
Pump Sta. Rehab.	5	2	2	1	9	3	6	2	12	5	2	1
12 Overflows/yr	4	1	1	1	8	2	3	1	12	5	2	1
8 Overflows/yr	3	1	0	0	8	2	3	1	12	5	2	1
4 Overflows/yr	3	1	0	0	8	2	3	1	12	5	2	1
2 Overflows/yr	3	1	0	0	8	2	3	1	12	5	2	1
0 Overflows/yr[2]	3	1	0	0	8	2	3	1	12	5	2	1
Separation	4	1	3	1	8	2	6	1	12	5	3	1
# Days E. Coli > 126/100 ml												
No Phase 1 Controls	216	79	205	77	259	101	237	95	234	87	133	54
Phase 1 Controls	167	65	140	60	222	82	164	62	232	87	128	52
Pump Sta. Rehab.	165	64	136	59	221	82	163	61	232	87	128	52
12 Overflows/yr	132	45	75	32	216	78	145	53	232	87	128	52
8 Overflows/yr	125	42	63	26	215	78	140	52	232	86	128	52
4 Overflows/yr	121	39	54	22	213	77	137	50	232	86	128	52
2 Overflows/yr	116	37	46	18	212	76	134	50	232	86	127	52
0 Overflows/yr[2]	116	37	43	15	212	76	134	49	232	86	127	51
Separation	173	59	146	51	231	85	188	70	232	86	131	53
# Days E. Coli CSO Impact (>126/100 ml)												
No Phase 1 Controls	197	75	N/A	N/A	222	93	N/A	N/A	9	6	N/A	N/A
Phase 1 Controls	127	57	N/A	N/A	94	44	N/A	N/A	3	2	N/A	N/A
Pump Sta. Rehab.	120	54	N/A	N/A	90	44	N/A	N/A	2	1	N/A	N/A
12 Overflows/yr	52	25	N/A	N/A	40	19	N/A	N/A	3	2	N/A	N/A
8 Overflows/yr	33	16	N/A	N/A	25	12	N/A	N/A	2	2	N/A	N/A
4 Overflows/yr	15	9	N/A	N/A	15	8	N/A	N/A	1	1	N/A	N/A
2 Overflows/yr	4	4	N/A	N/A	4	4	N/A	N/A	0	0	N/A	N/A
0 Overflows/yr[2]	0	0	N/A	N/A	0	0	N/A	N/A	0	0	N/A	N/A
Separation	0	0	N/A	N/A	0	0	N/A	N/A	0	0	N/A	N/A
# Days E. Coli CSO Impact (>576/100 ml)												
No Phase 1 Controls	123	53	N/A	N/A	154	68	N/A	N/A	2	2	N/A	N/A
Phase 1 Controls	75	38	N/A	N/A	62	32	N/A	N/A	0	0	N/A	N/A
Pump Sta. Rehab.	68	34	N/A	N/A	61	32	N/A	N/A	0	0	N/A	N/A
12 Overflows/yr	37	17	N/A	N/A	30	15	N/A	N/A	0	0	N/A	N/A
8 Overflows/yr	21	10	N/A	N/A	16	10	N/A	N/A	0	0	N/A	N/A
4 Overflows/yr	11	7	N/A	N/A	11	7	N/A	N/A	0	0	N/A	N/A
2 Overflows/yr	1	1	N/A	N/A	3	3	N/A	N/A	0	0	N/A	N/A
0 Overflows/yr[2]	0	0	N/A	N/A	0	0	N/A	N/A	0	0	N/A	N/A
Separation	0	0	N/A	N/A	0	0	N/A	N/A	0	0	N/A	N/A

Notes:

1. Separate storm water load reduced by 40%. Upstream nutrients reduced by 40%. Upstream fecal coliform reduced to 80% of water quality standards or 160 organism/100ml.
2. Zero overflows for all storms during analysis period 1988-1990. There will still be overflows under other climatic conditions.

The e. coli and fecal coliform results track each other very closely. The number of months and days are typically equal or within less than 5% of each other. This suggests that there is no significant difference between using e. coli or fecal coliform as an bacteriological indicator.

9.5.3.3 Dissolved Oxygen

Low dissolved oxygen levels in the Anacostia typically occur in the summer months of June to August and typically follow a significant local or upstream wet weather event. The low dissolved oxygen is driven by the naturally low saturation level of oxygen in the water due to the high water temperature and the influx of pollutant loads from wet weather events. The sluggish nature of the Anacostia River does not allow effective re-aeration of the river, contributing to the low dissolved oxygen. Dissolved oxygen levels below 2.0 mg/L can occur several times per summer month, with each episode lasting 1 to 2 days. Fish kills have been observed in the past.

In addition to direct loads of oxygen consuming pollutants from CSO, storm water, and the upstream boundary, the sediments in the Anacostia River are known to exert a substantial oxygen demand. This sediment oxygen demand (SOD) and the change in the SOD in response to pollutant loads were included in the receiving water modeling. The SOD in the model is driven by the particulate fraction of carbonaceous biochemical oxygen demand (CBOD). Testing with the model indicated that reducing pollutant loads from any source (CSO, SSWS, or upstream) reduced the deposition of settleable matter and produced a corresponding reduction in SOD. The reduction in SOD was approximately proportional to the amount of particulate CBOD removed. In addition, the reduction in SOD was found to lag the load reduction in the pollutant source by approximately three to six years. Thus, the effects of pollutant load reduction will not be immediately realized in the SOD and may take on the order of five to ten years to be fully realized.

The effects of varying levels of CSO control on dissolved oxygen were evaluated alone and in conjunction with control of SSWS and upstream sources. The dissolved oxygen numbers in the table represent the predicted concentration after the SOD has equilibrated to the loading condition of the scenario. Complete results are shown in Appendix B, while summary results are shown in Table 9-6.

Table 9-6

Effect of CSO Control On Dissolved Oxygen in the Anacostia River

Parameter	South Capital St.		RFK Stadium		DC/MD Boundary	
	Existing SSWS and Upstream Loads	*Reduced SSWS and Upstream Loads*[1]	*Existing SSWS and Upstream Loads*	*Reduced SSWS and Upstream Loads*[1]	*Existing SSWS and Upstream Loads*	*Reduced SSWS and Upstream Loads*[1]
# Days Dissolved Oxygen <5.0 mg/L						
No CSO Control	93	28	88	23	55	8
Phase 1 Controls	85	22	83	19	55	8
Pump Sta. Rehab.	82	21	82	19	55	8
12 Overflows/yr	71	12	76	16	55	7
8 Overflows/yr	69	9	73	15	55	7
4 Overflows/yr	67	7	72	13	55	7
2 Overflows/yr	66	5	71	11	55	7
0 Overflows/yr[2]	65	5	71	11	55	7
Separation	89	24	86	22	55	8
# Days Dissolved Oxygen <4.0 mg/L						
No CSO Control	49	8	43	7	25	1
Phase 1 Controls	42	5	41	6	24	1
Pump Sta. Rehab.	40	4	40	6	24	1
12 Overflows/yr	31	1	34	3	23	1
8 Overflows/yr	30	0	32	2	23	1
4 Overflows/yr	29	0	31	2	23	1
2 Overflows/yr	28	0	31	1	23	1
0 Overflows/yr[2]	28	0	31	1	23	1
Separation	43	4	43	5	25	1
# Days Dissolved Oxygen <2.0 mg/L						
No CSO Control	6	0	7	0	2	0
Phase 1 Controls	4	0	6	0	1	0
Pump Sta. Rehab.	4	0	6	0	1	0
12 Overflows/yr	2	0	4	0	1	0
8 Overflows/yr	1	0	4	0	1	0
4 Overflows/yr	0	0	4	0	1	0
2 Overflows/yr	0	0	3	0	1	0
0 Overflows/yr[2]	0	0	3	0	1	0
Separation	4	0	6	0	1	0
Minimum Day Dissolved Oxygen						
No CSO Control	1.1	3.0	0.5	2.6	1.0	3.6
Phase 1 Controls	1.4	3.3	0.5	2.8	1.0	3.6
Pump Sta. Rehab.	1.4	3.5	0.6	2.8	1.0	3.7
12 Overflows/yr	1.8	4.0	0.8	3.2	1.0	3.8
8 Overflows/yr	2.0	4.1	0.9	3.3	1.1	3.8
4 Overflows/yr	2.1	4.3	1.0	3.5	1.1	3.8
2 Overflows/yr	2.2	4.4	1.1	3.6	1.1	3.8
0 Overflows/yr[2]	2.2	4.4	1.1	3.7	1.1	3.9
Separation	1.5	3.5	0.6	2.8	1.0	3.7

Notes:

1. Separate storm water load reduced by 40%. Upstream nutrients reduced by 40%. Upstream fecal coliform reduced to 80% of water quality standards or 160 organism/100ml.
2. Zero overflows for all storms during analysis period 1988-1990. There will still be overflows under other climatic conditions.

The following observations are made:

- CSO control alone cannot meet the minimum dissolved oxygen standard in the Anacostia River. Reduction of other sources beyond the 40% level shown in the table is required to meet the standard during all months.
- CSO control alone can reduce the number of days where the dissolved oxygen is less than 5 mg/L from about 93 to a range of 65 to 71 days per year.
- In terms of effect on dissolved oxygen, there is minimal difference between 12 and 2 overflows per year. It appears that once CSO loads to the river are reduced to the 12 per year level, that additional controls do not have a significant benefit in terms of dissolved oxygen.
- CSO control alone can prevent the dissolved oxygen from dropping below 2.0 mg/L at South Capitol Street, but cannot at RFK Stadium.
- CSO control in the range of 2 to 12 overflows per year increases the minimum day dissolved oxygen by about 0.5 mg/L at RFK Stadium and about 1.0 mg/L at South Capital Street.

In addition to meeting the water quality standard, there exists a draft Total Maximum Daily Load (TMDL) for dissolved oxygen in the Anacostia River. The TMDL has proposed load limits for each load source, including CSO. The TMDL load limits for CSO are compared against the projected $CBOD_5$ loads for various levels of CSO control in Table 9-7.

Table 9-7
CSO Controls vs. Draft TMDL for Dissolved Oxygen (Anacostia River)

Scenario	*Projected Annual $CBOD_5$ load (lb/yr)*	*Draft TMDL Annual Load Limit for CSO ($CBOD_5$ lb/yr)*	*Is TMDL met on Annual and River Wide Basis?*
No CSO Control	754,965	152,906	No
Phase 1 Controls	526,050	152,906	No
Pump Sta. Rehab.	442,985	152,906	No
12 Overflows/yr	173,504	152,906	No
8 Overflows/yr	89,097	152,906	Yes
4 Overflows/yr	33,135	152,906	Yes
2 Overflows/yr	18,391	152,906	Yes
0 Overflows/yr	0	152,906	Yes
Separation	0	152,906	Yes

Control programs that reduce overflows to at least 8 times per year are projected to meet the annual load allocation for CSO. The method by which the TMDL will be applied is not clear as of the writing of this report. If the TMDL is applied on a daily basis, then it is unlikely that any program short of complete separation could meet such a TMDL. This is because CSOs are short, intense, episodic events. For example, if the 152,906 lbs of allowable CBOD5 in the draft TMDL were converted to a daily value, it would equal about 418.9 lbs per day of allowable load for CSOs. For the 2 overflows per year option, the entire BOD load for CSOs occurs in two discrete days of the year, or at least 5,126 lbs/day. As result, any CSO plan short of separation would need for the TMDL to be applied on an annual average basis.

Another important point is that the projected pounds of CBOD5 for various levels of CSO control are based on average year conditions in accordance with the CSO Policy. Intense rain events outside the average year condition will overwhelm any control measure, resulting in substantially more CBOD5 discharges from CSO. A TMDL would need to make allowance for events which were outside of the average year condition.

9.5.4 Non-Monetary Factors

The following non-monetary factors were evaluated for each of the alternatives:

- Ability to relieve Northeast Boundary Flooding
- Public Acceptance
- Ability to Implement
- Reliability
- Ease of Operation
- Ease of Maintenance
- Ability to Upgrade

Table 9-8 summarizes the non-monetary evaluations for each alternative.

Table 9-8
Non-Monetary Evaluation Factors: Anacostia River Final Alternatives

No.	*Alternative*	*Northeast Boundary Flooding*	*Public Acceptance*	*Ability to Implement*	*Reliability*	*Ease of Operation*	*Ease of Maintenance*	*Ability to Upgrade*
	Tunnel From Poplar Point to Northeast Boundary							
D27-1	Retain Main & O Pumping Stations at Present Location	Excellent	Good	Excellent	Excellent	Moderate	Good	Good
D27-2	D27-1 and Low Impact Development Retrofit	Excellent	Good	Uncertain	Uncertain	Moderate	Uncertain	Good
D27-3	D27-1 and Real Time Control	Excellent	Good	Excellent	Moderate	Poor	Good	Good
D27-4	D27-1, Real Time Control and Low Impact Development Retrofit	Excellent	Good	Uncertain	Uncertain	Poor	Uncertain	Good
D28	Relocate Main & O Pumping Stations to Poplar Point	Excellent	Uncertain	Excellent	Excellent	Very Good	Good	Good

No.	Alternative	*Northeast Boundary Flooding*	*Public Acceptance*	*Ability to Implement*	*Reliability*	*Ease of Operation*	*Ease of Maintenance*	*Ability to Upgrade*
	Tunnel From BPWWTP to Northeast Boundary							
D29-1	Retain Main & O Pumping Stations at Present Location	Excellent	Good	Excellent	Excellent	Moderate	Good	Good
D29-2	D29A and Low Impact Development Retrofit	Excellent	Good	Uncertain	Uncertain	Moderate	Uncertain	Good
D29-3	D29A and Real Time Control	Excellent	Good	Excellent	Moderate	Poor	Good	Good
D29-4	D29A, Real Time Control and Low Impact Development Retrofit	Excellent	Good	Uncertain	Uncertain	Poor	Uncertain	Good
D30-	Relocate Main & O Pumping Stations to Poplar Point and BPWWTP	Excellent	Excellent	Excellent	Excellent	Excellent	Good	Good

Principle points are described below:

- Northeast Boundary Flooding - All of the alternatives have been developed to provide flooding protection at the 15 year storm to the Northeast Boundary Sewer and known local flooding areas.
- Public Acceptance - Public comments indicated a low acceptability of storage facilities in neighborhoods and of disruption associated with construction. The vast majority of CSOs cross National Park Service land to reach the receiving waters. In many cases, the park land is the only land available for treatment or storage facilities. The National Park Service has also expressed a strong reluctance to supporting use of parkland for storage or treatment facilities. The tunnel options will minimize disruption and the need for significant land when compared to other options. These options are thus responsive to public comment. The public also expressed a strong preference for LID-R and inclusion of this is thus responsive to public comments. Due to the institutional and technical issues associated with LID-R described previously, the ability to implement it is uncertain.
- Ability to implement – Tunnels and pumping stations have been constructed by other CSO communities and are practical. In addition, Metro has constructed many miles of tunnels as part of the subway system and has demonstrated the feasibility of this technology in the Washington area. Because of the institutional issues associated with LID-R described previously, the ability to implement this option has been classified as uncertain.
- Reliability – Deep tunnels for storage can be designed to fill by gravity and their dewatering can be automated. Because the application of LID-R on a large scale for CSO control has not been attempted before, the long term reliability of these types of controls is unknown and has been assessed as uncertain.
- Ease of operation – Since deep tunnels can be designed to fill by gravity, they are relatively easy to operate. Real time control requires making adjustments to the system in response to changing conditions. This type of system requires reliance on sensors in the sewer system and on

compressors, gates and other mechanical equipment to respond to changing conditions in the system. The ease of operation has thus been classified as poor.

- Ease of Maintenance – Since deep tunnels have few mechanical components, they are relatively easy to maintain. Pumping facilities associated with the tunnel will require maintenance which is of comparable complexity to that already experienced by WASA. For LID-R, the micro scale measures themselves are relatively simple to maintain. However this item has been assessed as uncertain since the responsibility for maintenance of dispersed facilities is unclear. If LID-R facilities are necessary for satisfactory functioning of a control plan, there would need to be an institutional system with the power to inspect and issue notices requiring corrective maintenance.
- Ability to Upgrade – Each of the structural CSO control plans can be upgraded if required. The tunnel from Poplar Point to Main and 'O' Street Pumping Stations could be upgraded by extending the tunnel to BPWWTP to provide additional storage. The tunnel from BPWWTP to Main and 'O' Street Pumping Stations can be upgraded by increasing the pumping and treatment capacity of the disinfection system at the plant.

9.5.5 Cost Opinions

The capital and operating and maintenance costs for each alternative were estimated and the net present worth was calculated in order to compare options. The net present worth was calculated using the following assumptions:

- 20 year return period
- Inflation rate of 3% per year
- Interest rate of 6.5 % per year

For LID-R, there is a significant cost associated with its implementation that would be borne by others. Preliminary estimates indicate that applying LID-R over 15% of the impervious land area in the District would cost about $453 million. This cost could be reduced if the construction is coupled with existing redevelopment. In addition, costs could decrease as LID-R measures become more common and contractors and developers become more experienced in their application. Cost opinions for each alternative are summarized in Table 9-9.

Table 9-9
Cost Opinion: Anacostia River Final Alternatives (ENR = 6383)

No.	*Alternative*	*# of Overflows/ yr*	*Cost to WASA*			*Cost to Others*
			Capital Cost ($M)	*Annual O &M ($M/yr)*	*20 Year Net Present Worth ($M)*	
	Tunnel From Poplar Point to Northeast Boundary					
D27-1	Retain Main & O Pumping Stations	0	$1,578	$17.80	$1,833	-
		2	$911	$8.10	$1,027	-
		4	$855	$7.30	$960	-
		8	$771	$6.40	$863	-
		12	$759	$6.00	$845	-
D27-2	D27-1 and Low Impact Development Retrofit	0	$1,553	$17.52	$1,804	Significant, see text
		2	$903	$8.03	$1,018	
		4	$850	$7.25	$954	
		8	$771	$6.40	$863	
		12	$759	$6.00	$845	
D27-3	D27-1 and Real Time Control	0	$1,586	$17.89	$1,843	-
		2	$918	$8.16	$1,035	-
		4	$865	$7.38	$971	-
		8	$794	$6.59	$888	-
		12	$781	$6.18	$870	-
D27-4	D27-1, Real Time Control and Low Impact Development Retrofit	0	$1,571	$17.72	$1,825	Significant, see text
		2	$911	$8.10	$1,027	
		4	$855	$7.30	$960	
		8	$794	$6.59	$888	
		12	$781	$6.18	$870	
D28	Relocate Main & O Pumping Stations to Poplar Point	0	$1,945	$21.94	$2,260	-
		2	$1,278	$11.36	$1,441	-
		4	$1,222	$10.43	$1,372	-
		8	$1,138	$9.44	$1,273	-
		12	$1,127	$8.91	$1,255	-
	Tunnel From BPWWTP to Northeast Boundary					
D29-1	Retain Main & O Pumping Stations	0	$1,590	$17.94	$1,847	-
		2	$1,061	$9.43	$1,196	-
		4	$1,022	$8.72	$1,147	-
		8	$953	$7.91	$1,066	-
		12	$946	$7.48	$1,053	-
D29-2	D29-1 and Low Impact Development Retrofit	0	$1,583	$17.86	$1,839	Significant, see text
		2	$1,049	$9.32	$1,183	
		4	$1,014	$8.65	$1,138	
		8	$953	$7.91	$1,066	
		12	$946	$7.48	$1,053	

No.	Alternative	# of Overflows/ yr	Cost to WASA			Cost to Others
			Capital Cost ($M)	Annual O &M ($M/yr)	20 Year Net Present Worth ($M)	
D29-3	D29-1 and Real Time Control	0	$1,564	$17.64	$1,817	-
		2	$1,067	$9.48	$1,203	-
		4	$1,030	$8.79	$1,156	-
		8	$976	$8.10	$1,092	-
		12	$969	$7.66	$1,079	-
D29-4	D29-1, Real Time Control and Low Impact Development Retrofit	0	$1,557	$17.56	$1,809	Significant, see text
		2	$1,058	$9.41	$1,193	
		4	$1,022	$8.72	$1,147	
		8	$976	$8.10	$1,092	
		12	$969	$7.66	$1,079	
D30	Relocate Main & O Pumping Stations to Poplar Point and BPWWTP	0	$1,945	$21.94	$2,260	-
		2	$1,417	$12.59	$1,598	-
		4	$1,376	$11.74	$1,544	-
		8	$1,331	$11.05	$1,489	-
		12	$1,327	$10.49	$1,478	-
	Separation					
	Complete Separation	0	$2,113	$7.60	$2,221	

9.5.6 Selection of Recommended Anacostia Control Plan

Alternatives D28 and D30 involve relocating Main and 'O' Street Pumping Stations. The cost of relocating these stations and constructing replacement infrastructure at Poplar Point or BPWWTP ranges from approximately $300 to $375 million. While relocating the stations offers significant development benefits to the District, its cost makes it prohibitively expensive without outside funding assistance. These alternatives have thus been eliminated from further consideration.

Alternatives D29-1 through D29-4 involve constructing a tunnel to BPWWTP. Because of the long length of that tunnel, these alternatives are approximately $170 million more expensive than stopping the tunnel at Poplar Point. As a result, these alternatives have been eliminated from further consideration.

LID-R is predicted to decrease the cost of the capital program by about 1.7%. This is primarily due to the nature of tunneling and not the benefit provided by LID-R. There is not much cost difference between tunnels which are within 1 to 2 feet of each other in diameter. Because of the uncertainty as to the ability to implement LID and because of the relatively low cost difference in the tunnel costs, it is recommended that LID-R be implemented but that the tunnel size be selected without taking advantage of the benefits of LID-R. When LID-R is implemented, the CSO controls will perform more effectively.

RTC does reduce the CSO storage volume required. However, the cost of installing the dams is more than the reduction in cost achieved by reducing tunnel size. Again, this is due to the nature of tunneling costs. In addition to being more expensive on a capital cost basis, the additional inflatable dams will be difficult to reliably operate and maintain. The dam in the Northeast Boundary Trunk Sewer (NEBTS) near Florida St. and H St. NE would be located in a pipe continuously exposed to dry weather flow in the NEBTS. This would make the dam much more difficult to maintain than the existing dams and could potentially make it more unreliable. The additional dams in the NEBTS downstream of the swirl facility would be located in a section of conduit that is flat and does not frequently see substantial flows. Storage of CSO in this line may cause significant deposition making cleaning and long term reliability difficult. The fundamental reason why additional dams will not provide cost effective and reliable CSO control is that the existing dams are already installed at the optimum locations based on CSO control and reliability considerations. For this reason, installation of additional dams is not recommended.

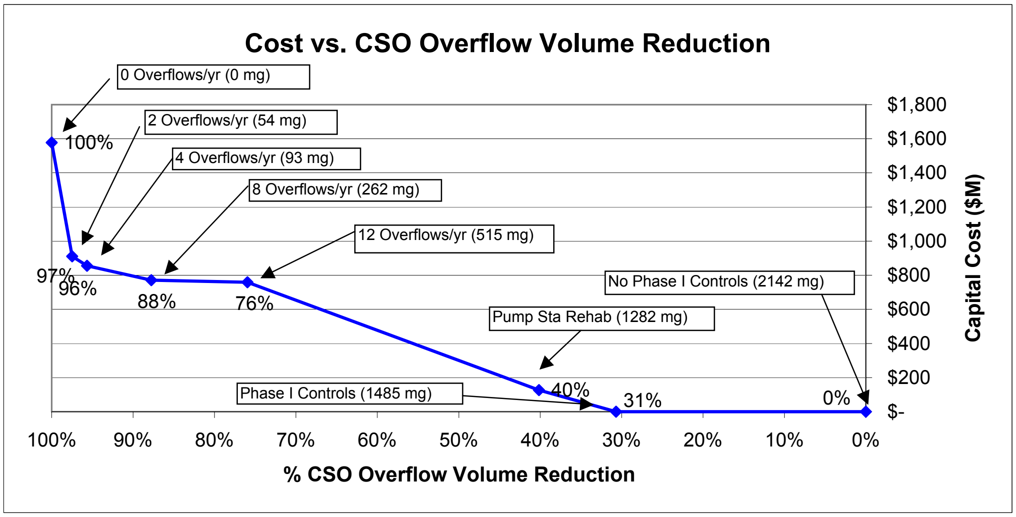
Based on this evaluation, the tunnel from Poplar Point to Northeast Boundary is the recommended alternative for the Anacostia CSOs. This alternative may be sized to limit overflows to between zero and 12 per average year. An evaluation of the cost effectiveness of this alternative has been performed to enable selection of the proposed level of CSO control. Figure 9-3 presents the cost effectiveness of the tunnel from Poplar Point to Northeast Boundary. In terms of the percent of CSO volume reduced, Phase I CSO controls (inflatable dams and Northeast Boundary Swirl) swirl reduced the CSO volume by 31%. Rehabilitation of the pumping stations reduces overflows by another 9 percent. The costs associated with reducing overflows to between 12 and zero per year are also plotted. Based on CSO volume reduced, there appears to be a point of lessening returns (‘knee of the curve’) at about two overflows per year. At that point, the cost curve begins to turn vertical, which implies increasing costs for less benefit. Two overflows per year appears to be the approximate knee of the curve for CSO overflow volume.

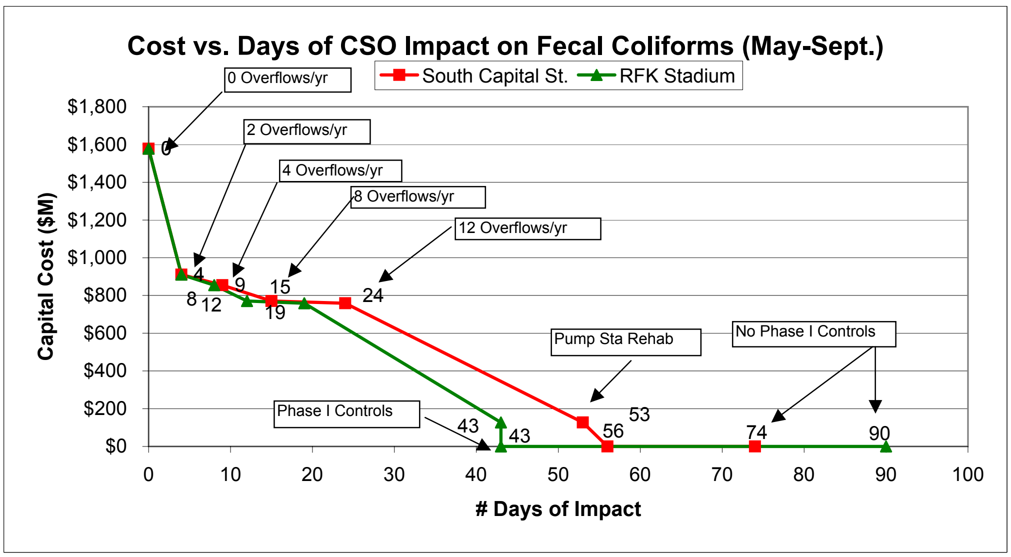
In Figure 9-3, the cost of CSO control is also plotted against the number of days that CSOs have an impact on fecal coliform levels between May and September, the period of most likely contact recreation. Again, the ‘knee of the curve’ appears to be at approximately the two overflows per year range. For controls beyond two overflows per year, a significant increase in cost occurs for a marginal number of days gained per year.

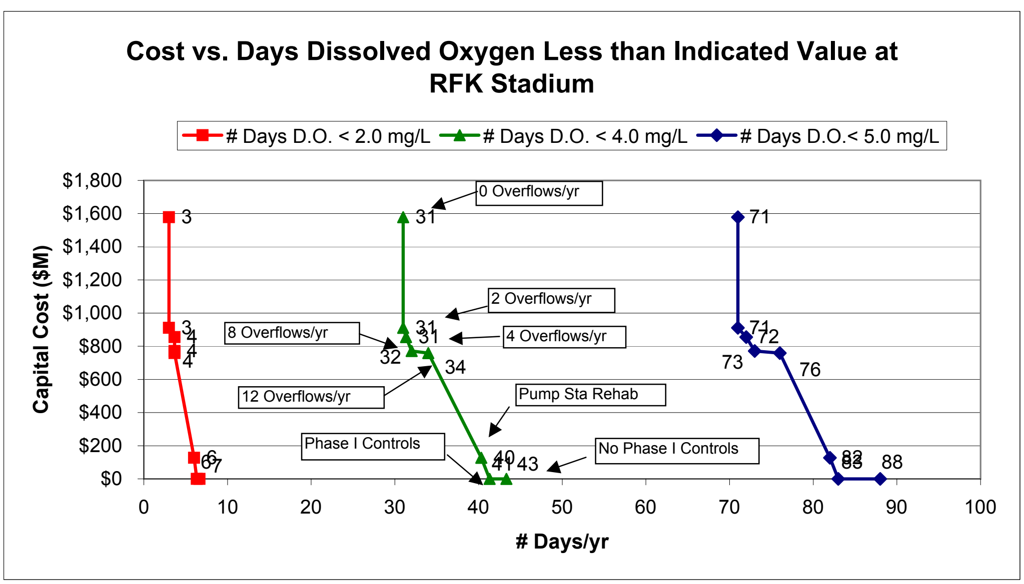
In Figure 9-3, the number of days the dissolved oxygen is less than 5 mg/l, 4 mg/l and 2 mg/L is also plotted versus cost. For this parameter, 12 overflows per year appears to be the threshold beyond which marginal benefits in terms of number of days occur.

Based on this evaluation, the recommended control for the Anacostia CSOs is LID-R, with a tunnel from Poplar Point to Northeast Boundary sized for two overflows per year.

Figure 9-3
Anacostia River: Cost Benefit Analysis







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9.6 ROCK CREEK ALTERNATIVES

9.6.1 Sensitive Areas

9.6.1.1 Background

As described in Section 2, portions of Rock Creek area may be classified as sensitive areas due to the presence of the endangered Hay's Spring Amphipod. The Hay's Spring Amphipod (*Stygobromus hayi*) is a federally listed endangered species which is reported to occur in Rock Creek at two locations: south of Military Road approximately between Nicholson and Emerson Streets, NW and approximately between the National Zoo and the Connecticut Avenue Bridge (See Figure 9-4). These are the only known locations of the amphipod in the country. The amphipod is a small crustacean (resembling a tiny shrimp) about one-quarter inch long that lives in decaying deciduous leaf litter and mud at the exit of springs and groundwater seeps. The springs in Rock Creek are reported to issue forth from crevices in rocks. The species is believed to feed on decaying leaves, organic matter and decomposer bacteria and fungi found on organic matter. The species was first discovered in 1938, and was listed in 1982. One of the reasons for its listing was reportedly its vulnerability to extinction due to its extremely restricted distribution. Little is known about the species, but it is reported to be adversely affected by high water flows/flooding in Rock Creek, pollution of the groundwater and surface water, and siltation (USFWS, 2000a, 2000b).

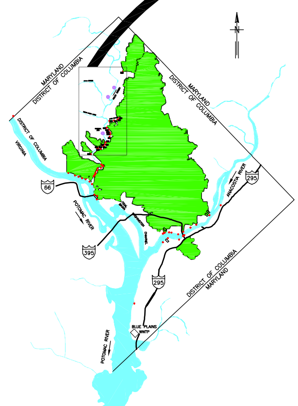
At the reported location in the vicinity of the Zoo, the amphipod is reportedly located above the normal flow level in Rock Creek. At this location, the amphipod may only be exposed to the creek during flooding conditions. In the area south of Military Road , the amphipod is reportedly located in several locations, some of which are exposed to slightly elevated creek flows.

For areas classified as sensitive, the CSO policy indicates the LTCP should:

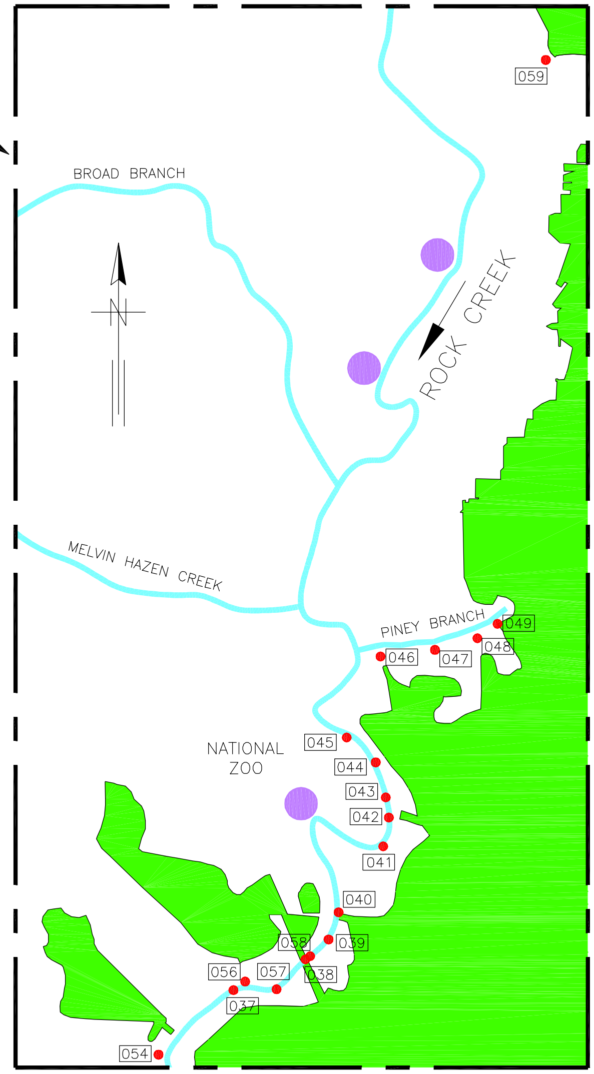
> *Prohibit new or significantly increased overflows; Eliminate or relocate overflows wherever physically possible and economically achievable, except where elimination or relocation would provide less environmental protection than additional treatment;or, where elimination or relocation is not physically possible and economically achievable, or would provide less environmental protection than additional treatment, provide the level of treatment for remaining overflows deemed necessary to meet WQS for full protection of existing and designated uses.* (EPA, 1994)

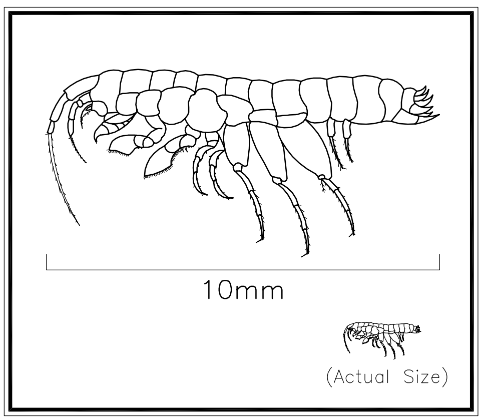
9.6.1.2 Amphipod Locations Near Military Road

The only CSO upstream of the reported amphipod location near the zoo is CSO 059, Luzon Valley. This CSO drainage area has been almost completely separated (over 99%). It is believed that there may be a few remaining connections at Walter Reed Army Medical Center. Whether or not the amphipod's habitat is classified as a sensitive area, the most practical and economical control is to complete separation. Investigation of possible connections at Walter Reed Army Medical Center and



KEY MAP





HAY'S SPRING AMPHIPOD

LEGEND

- CSO OUTFALL
- 048 CSO OUTFALL NUMBERS
- COMBINED SEWER AREA
- HABITAT OF HAY'S SPRING AMPHIPOD LOCATIONS (ENDANGERED)

LOCATIONS OF HAY'S SPRING AMPHIPOD

NOT TO SCALE

completion of separation as required is recommended for CSO 059.

9.6.1.3 Amphipod Location Near National Zoo

The discharge frequency and volume in the average year, for Scenario C3 (Phase I Controls and Pump Station Rehabilitation) for CSOs located upstream of the reported amphipod location at the Zoo are listed in Table 9-10.

Table 9-10
Predicted CSO Overflow Volume and Frequency for CSOs Upstream of Amphipod at Zoo
(Average Year - Average of 1988-1990)

CSO NPDES No.	*Description*	*No. Overflows /yr*	*CSO Overflow Volume (mg/yr)*
041	Ontario Rd	0	0.00
042	Quarry Rd	0	0.00
043	Irving St.	1	0.15
044	Kenyon St.	0	0.00
045	Lamont St.	2	0.03
046	Park Road	2	0.01
047	Ingleside Terr.	3	0.25
048	Oak St-Mt Pleasant	2	0.08
049	Piney Branch	25	39.73
Total			**40.25**

Piney Branch is the only CSO with a discharge frequency more than four times per year and with a discharge volume of more than 0.3 million gallons per year. In accordance with the CSO Policy, the following alternatives are considered:

- Separation – Separation of CSOs 041 through 049 would entail separating approximately 2,662 acres of combined sewer area. The estimated capital cost is $515 million (Year 2001, ENR = 6383). Section 12 addresses WASA's financial capability. Considering the conclusion of that section and the relatively small overflow volume, separation is not economically achievable or practical.
- Relocation – The only feasible places to relocate the CSOs are to Rock Creek downstream of the reported amphipod location, or all the way to the Potomac River. Both Rock Creek and the Potomac are designated as Class A waters with primary contact recreation. Thus relocation of the outfalls would shift the problem away from the amphipods but cause additional problems due to potential human contact. In addition, preliminary sizing indicates a 25' to 30' diameter conveyance system would be needed to convey the 15 year storm downstream. Conveyance facilities of this size would consist of a tunnel. Because of its depth, the tunnel would not dewater by gravity and would require a pump station. The

capital cost of such a project is estimated to be approximately $277 million (Year 2001, ENR = 6383). This project would provide more environmental disruption and is not economically viable for the benefits obtained.

- Treatment – the outfalls are located at the bottom of a steep valley formed by Rock Creek. The adjacent land is limited and owned by the National Park Service. Treatment is not a viable alternative.

Given that separation, relocation and treatment are not feasible, the remaining alternative under the policy is to provide the level of control necessary to meet water quality standards and protect designated uses. This is addressed in the following sections with the alternatives for Rock Creek.

9.6.2 Description

There are 29 CSO outfalls to Rock Creek. Of these, 13 are predicted to overflow in the average year, under Scenario C3 (Phase I Controls and Pump Station Rehabilitation), as shown in Table 9-11.

Table 9-11
Rock Creek CSO Outfalls with Predicted Discharges During Average Year

CSO NPDES No.	*Description*	*No. Overflows No. /yr*	*CSO Overflow Volume (mg)*
031	Penn Ave	9	0.22
033	N St. - 25th St	6	4.48
036	Mass Ave & 24th	29	1.64
037	Kalorama Circle West	3	0.05
040	Biltmore St	1	0.03
043	Irving St.	1	0.15
045	Lamont St.	2	0.03
046	Park Road	2	0.01
047	Ingleside Terr.	3	0.25
048	Oak St-Mt Pleasant	2	0.08
049	Piney Branch	25	39.73
057	Cleveland – 28th St & Conn. Ave	15	2.33
059	Luzon Valley	87	171.56[1]
Rock Creek Subtotal (Including Luzon Valley)			**221**
Rock Creek Subtotal (Excluding Luzon Valley)			**49**

Notes: 1. Luzon Valley is almost completely separated (over 99%). This discharge volume is thus essentially storm water.

Each of the CSOs that have discharge frequencies of more than 4 per year are addressed below. In a subsequent section, the rationale for the selection of the 4 per year threshold is addressed.

- CSO 059 (CSO 059) - as indicated above, completion of separation is recommended for Luzon Valley.

- CSO 049 (Piney Branch) - the reason Piney Branch overflows is inadequate conveyance capacity between the outfall and the Potomac Pumping Station. Improvement of this conveyance capacity is impractical for two reasons: 1). the long distance to Potomac Pumping Station, and 2) if the conveyance capacity were improved, the transfer of flow would increase the overflow at Potomac Pumping Station. Because of the relatively small storage volume required, local storage in the form a tunnel is practical. The tunnel could be constructed between the outfall and Rock Creek in the embankment north of Piney Branch parkway. Because the grade of the embankment is high, the tunnel can dewater by gravity to existing sewer after overflow conditions cease.
- CSO 036 and CSO 057- these outfalls are predicted to overflow because of inadequate diversion capacity. Revisions to the regulator settings are predicted to reduce overflows to the four per year level.
- CSO 037 and 047 – While these outfalls are predicted to overflow at a frequency of less than 4 per year, it was determined that it was necessary to reduce overflows even further to reduce the frequency of overflows to Rock Creek as a system to the 4 per year level. Regulator improvements can accomplish this.
- CSO 031 and 033 – these outfalls are located south of N Street NW in the flat section of Rock Creek. The outfalls are predicted to overflow because of surcharging in the Rock Creek Main Interceptor (RCMI) and because of low dam settings in the regulators. Options for reducing these overflows include:
    - Providing an overflow connection from the RCMI to the proposed Potomac Storage Tunnel. This would serve to limit the hydraulic grade line in the RCMI and limit overflows.
    - Constructing a relief sewer parallel to the RCMI. A large part of this sewer would likely be in tunnel due to the topography.

The alternative controls for each CSO have been assembled into the control plan options for Rock Creek listed below. Figure 9-5 shows the major features of the alternatives.

- <u>Alternative A-1</u>: this consists of the following:
    - Complete separation of CSO 059, Luzon Valley
    - Storage tunnel at CSO 049, Piney Branch
    - Regulator revisions for CSO 036, 037, 047, and 057
    - Relief of Rock Creek Main Interceptor via overflow to proposed Potomac storage tunnel and regulator reconstruction for CSO 031 and CSO 033

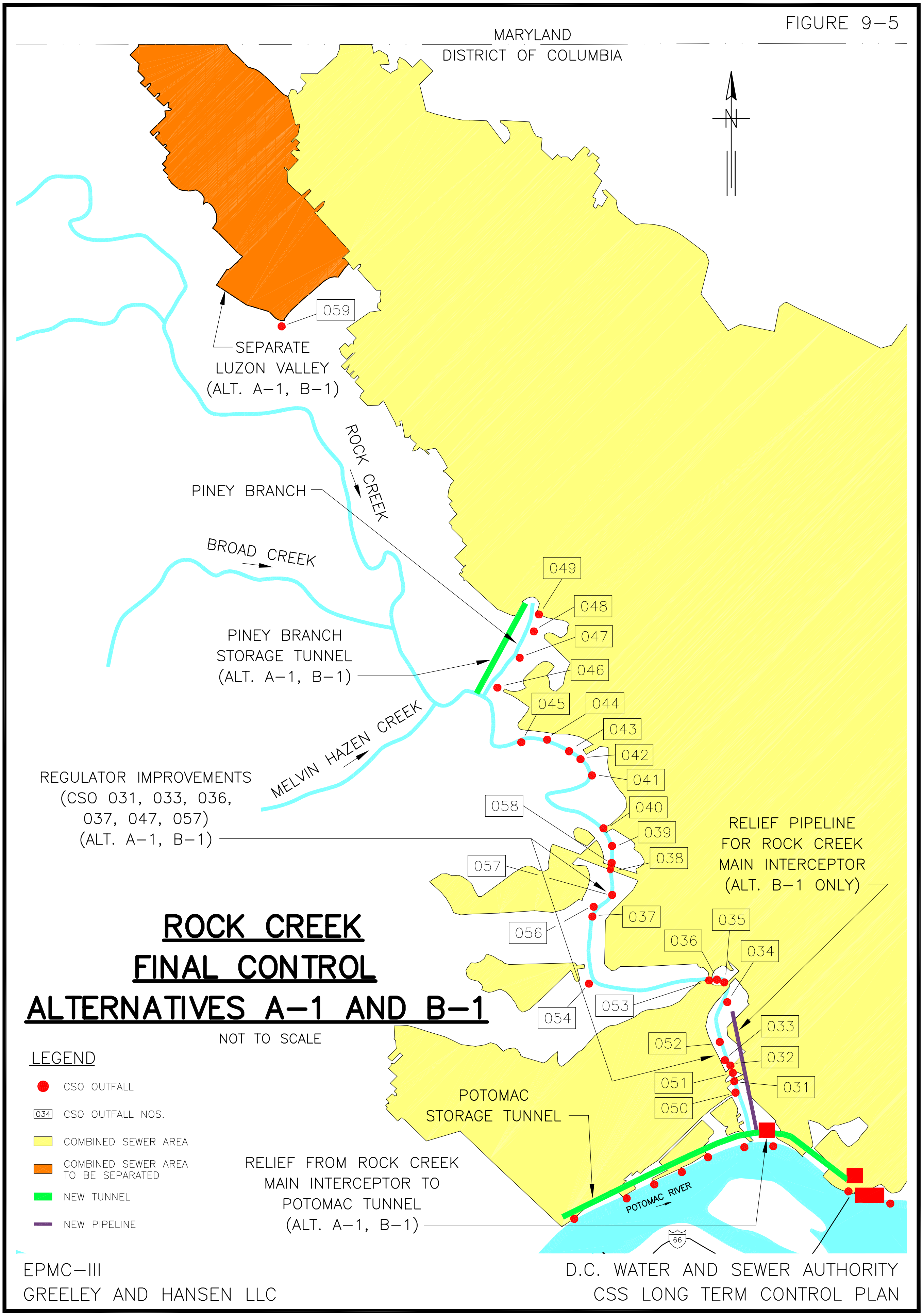


FIGURE 9-5
MARYLAND
DISTRICT OF COLUMBIA
N
059
SEPARATE
LUZON VALLEY
(ALT. A-1, B-1)
ROCK CREEK
PINEY BRANCH
BROAD CREEK
PINEY BRANCH
STORAGE TUNNEL
(ALT. A-1, B-1)
MELVIN HAZEN CREEK
REGULATOR IMPROVEMENTS
(CSO 031, 033, 036,
037, 047, 057)
(ALT. A-1, B-1)
049
048
047
046
045
044
043
042
041
040
039
038
058
057
056
037
036
035
034
033
032
031
054
053
052
051
050
RELIEF PIPELINE
FOR ROCK CREEK
MAIN INTERCEPTOR
(ALT. B-1 ONLY)
ROCK CREEK
FINAL CONTROL
ALTERNATIVES A-1 AND B-1
NOT TO SCALE
LEGEND
CSO OUTFALL
034 CSO OUTFALL NOS.
COMBINED SEWER AREA
COMBINED SEWER AREA TO BE SEPARATED
NEW TUNNEL
NEW PIPELINE
POTOMAC
STORAGE TUNNEL
RELIEF FROM ROCK CREEK
MAIN INTERCEPTOR TO
POTOMAC TUNNEL
(ALT. A-1, B-1)
POTOMAC RIVER
66
EPMC-III
GREELEY AND HANSEN LLC
D.C. WATER AND SEWER AUTHORITY
CSS LONG TERM CONTROL PLAN

- Alternative A-2: same as Alternative A-1, with LID-R

- Alternative B-1: this is identical to A-1, except that the relief of the Rock Creek Main interceptor is achieved by constructing a relief sewer parallel to the RCMI.

- Alternative B-2: same as Alternative B-1, with LID-R

The sizing of major facilities for each alternative is summarized in Table 9-12

Table 9-12
Facility Sizing: Rock Creek Final Alternatives

No.	Facility Sizes for Indicated Level of CSO Control	*# CSO Overflows per Average Year*				
		0[1]	*2*	*4*	*8*	*12*
		Annual CSO Overflow Volume per Average Year				
		0 mg	*9 mg*	*13 mg*	*22 mg*	*28 mg*
A-1	Piney Branch Storage Tunnel					
	Length, (ft)	10,000’	2,900’	2,900’	2,900’	2,900’
	Diameter, (ft)	28’	16.5’	14’	7.5’	4.75’
	Storage Volume, (mg)	46.0	4.6	3.3	1.0	0.4
	Separate CSO 059; Reconstruct Regulators for CSO 031, 033, 036, 037, 047 and 057; Relieve RCMI to proposed Potomac Tunnel,					
A-2	Same as A-1, but with LID-R					
	Piney Branch Storage Tunnel,					
	Length, (ft)	10,000’	2,900’	2,900’	2,900’	2,900’
	Diameter, (ft)	27.75’	14.75’	11.75’	5.25’	3.25’
	Storage Volume, (mg)	45.2	3.7	2.4	0.5	0.2
B-1	Same as A-1, but with Relief Sewer for Rock Creek Main Interceptor					
	Diameter, (ft)	3,200’	3,200’	3,200’	3,200’	3,200’
	Length, (in)	108”	84”	72”	60”	48”
B-2	Same as B-1, but with LID-R	Same as A-2	Same as A-2	Same as A-2	Same as A-2	Same as A-2

Notes:
1. Zero overflows for all storms during analysis period 1988-1990. There will still be overflows under other climatic conditions

9.6.3 Remaining Overflows

The overflows predicted to remain after implementation of controls designed to reduce CSO overflows to between zero and 12 events per average year are summarized in Table 9-13. The procedure that was applied to the Anacostia River CSOs was used for the Rock Creek CSOs.

Table 9-13

Remaining CSO Overflows - Rock Creek (Average of 1988-1990)

CSO No.	Description	# CSO Events/Average Year									
		0[1]		2		4		8		12	
		# Events	Vol. (mg)	# Events	Vol. (mg)	# Events	Vol. (mg)	# Events	Vol. (mg)	# Events	Vol. (mg)
031	Penn Ave	-	-	2	0.02	3	0.02	3	0.03	3	0.03
033	N St. - 25th St	-	-	2	1.18	3	1.18	3	1.32	3	1.37
036	Mass Ave & 24th St.			2	0.27	3	0.29	3	0.3	3	0.31
037	Kalorama Cir W.			-	-	4	0.36	-	-	-	-
039	Conn. Ave	-	-	1	0.02	1	0.02	1	0.03	1	0.03
040	Biltmore St	-	-	1	0.05	1	0.05	1	0.06	1	0.06
043	Irving St.			1	0.29	1	0.26	1	0.31	1	0.31
044	Kenyon St & Beach Dr.			1	0.01	1	0.01	1	0.02	1	0.01
045	Lamont St.			2	0.03	4	0.76	2	0.03	2	0.03
046	Park Road			2	0.01	2	0.01	2	0.01	2	0.01
047	Ingleside Terr.	-	-	1	0.02	1	0.01	1	0.02	1	0.02
048	Oak St-Mt Pleasant			2	0.15	2	0.14	2	0.16	2	0.16
049	Piney Branch			2	6.3	4	9.1	8	19.1	12	25.5
057	Cleveland - 28th St & Conn. Ave	-	-	2	0.38	2	0.38	2	0.39	2	0.39
Total			**-**		**9**		**13**		**22**		**28**

1. Zero overflows for all storms during analysis period 1988-1990. There will still be overflows under other climatic conditions

9.6.4 Ability to Meet Water Quality Standards

9.6.4.1 Fecal Coliform

Rock Creek is a free-flowing stream that is unaffected by the tide for the majority of its length. The stream is naturally aerated by turbulence as it flows over the irregular bottom of the creek bed. There is no evidence of dissolved oxygen problems in Rock Creek. Bacteriological concentrations are the primary concerns in Rock Creek.

Rock Creek is shallow and its banks are not very steep in many places. Parks, trails and walking paths parallel the creek for its entire length in the District. While primary contact recreation is prohibited in Rock Creek by District law, occasional wading in the creek has been observed, particularly in the summer.

Fecal coliform concentrations in Rock Creek are predicted to be above the Class A monthly geometric mean standard of 200/100ml every month in the average year. Concentrations are predicted to be above the Class B standard of 1,000/100ml three to six months out of the year. The majority of the load comes from District storm water and the upstream sources. The volume of water in Rock Creek in any particular reach is relatively small. As a result, it is not able to absorb significant wet weather loads without causing relatively high concentrations in the creek. The free flowing nature of the creek causes relatively short residence time of wet weather pollution. Even under small rain storms, the creek can flush itself in 8 to 12 hours after a wet weather event.

The effect of varying levels of CSO control on fecal coliform levels was evaluated for the entire calendar year as well as for the period of most likely contact, May through September. In addition to evaluating the effects of CSO control, the upstream and separate storm water loads were also reduced as described earlier in this section. Complete results are included in Appendix D. Selected results are shown in Table 9-14.

Table 9-14

Effect of CSO Control On Fecal Coliform in Rock Creek

	M Street				*Zoo*				*DC/MD Boundary*			
	Existing SSWS and Upstream Loads		*Reduced SSWS and Upstream Loads*[1]		*Existing SSWS and Upstream Loads*		*Reduced SSWS and Upstream Loads*[1]		*Existing SSWS and Upstream Loads*		*Reduced SSWS and Upstream Loads*[1]	
Parameter	*All Year*	*May to Sept.*	*All Year*	*May to Sept.*	*All Year*	*May to Sept.*	*All Year*	*May to Sept.*	*All Year*	*May to Sept.*	*All Year*	*May to Sept.*
# Months Exceeding Class A Fecal Coliform Standard												
No CSO Control	12	5	12	5	12	5	12	5	12	5	0	0
Phase 1 Controls	12	5	12	5	12	5	12	5	12	5	0	0
Pump Sta. Rehab.	12	5	12	5	12	5	12	5	12	5	0	0
12 Overflows/yr	12	5	12	5	12	5	12	5	12	5	0	0
8 Overflows/yr	12	5	12	5	12	5	12	5	12	5	0	0
4 Overflows/yr	12	5	12	5	12	5	12	5	12	5	0	0
2 Overflows/yr	12	5	12	5	12	5	12	5	12	5	0	0
0 Overflows/yr[2]	12	5	12	5	12	5	12	5	12	5	0	0
Separation	12	5	12	5	12	5	12	5	12	5	0	0
# Days Fecal Coliform > 200/100 ml												
No CSO Control	264	108	171	75	294	119	174	77	365	153	4	2
Phase 1 Controls	264	108	171	75	294	119	174	77	365	153	4	2
Pump Sta. Rehab.	264	108	171	75	294	119	174	77	365	153	4	2
12 Overflows/yr	264	108	170	75	294	119	173	77	365	153	4	2
8 Overflows/yr	264	108	170	75	294	119	173	77	365	153	4	2
4 Overflows/yr	264	108	170	75	294	119	173	77	365	153	4	2
2 Overflows/yr	264	108	170	75	294	119	173	77	365	153	4	2
0 Overflows/yr[2]	264	108	170	75	294	119	173	77	365	153	4	2
Separation	295	120	234	99	312	125	224	97	365	153	1	1
# Days Fecal CSO Impact												
No CSO Control	26	17	N/A	N/A	22	14	N/A	N/A	0	0	N/A	N/A
Phase 1 Controls	26	17	N/A	N/A	22	14	N/A	N/A	0	0	N/A	N/A
Pump Sta. Rehab.	26	17	N/A	N/A	22	14	N/A	N/A	0	0	N/A	N/A
12 Overflows/yr	10	7	N/A	N/A	11	8	N/A	N/A	0	0	N/A	N/A
8 Overflows/yr	7	5	N/A	N/A	7	5	N/A	N/A	0	0	N/A	N/A
4 Overflows/yr	4	3	N/A	N/A	3	2	N/A	N/A	0	0	N/A	N/A
2 Overflows/yr	3	2	N/A	N/A	2	1	N/A	N/A	0	0	N/A	N/A
0 Overflows/yr[2]	0	0	N/A	N/A	0	0	N/A	N/A	0	0	N/A	N/A
Separation	0	0	N/A	N/A	0	0	N/A	N/A	0	0	N/A	N/A

Notes:

1. Separate storm water load reduced by 40%. Upstream nutrients reduced by 40%. Upstream fecal coliform reduced to 80% of water quality standards or 160 organism/100ml.
2. Zero overflows for all storms during analysis period 1988-1990. There will still be overflows under other climatic conditions.

The following observations are made:

- The monthly fecal coliform geometric mean is most affected by the boundary conditions. Transient wet weather pollution sources like CSOs have less impact on the geometric mean. This is particularly true because the magnitude of CSO discharges to Rock Creek is small.
- Rock Creek is predicted to exceed the Class A standard every month of the year. Providing a high degree of CSO control of between zero and 12 overflows per year still will not enable the standard to be met.
- CSO control does not have a large effect on the geometric mean. In May (the wet month), the predicted fecal geometric mean at the zoo is 1313. Reducing overflows to 12 and 2 per year change the predicted geometric mean to 1,276 and 1,233, respectively.
- CSOs can affect the hourly or daily concentrations of fecal coliform in Rock Creek. Because the travel time in Rock Creek is so short, the number of days CSOs impact the Creek is a function of the number of overflows. As shown in the table, reducing overflows to 4 per year, reduces the number of days of impact to 3 days. Reducing overflows to 2 per year, reduces the days of impact to 2 days per year.
- Separation produces worse water quality than a high degree of CSO control because a large amount of storm water is treated in the combined sewer system.

9.6.4.2 E. Coli

As with fecal coliform, the effect of varying levels of CSO control on e. coli concentrations was analyzed. Complete data is presented in Appendix D, while selected results are shown in Table 9-15. The e. coli and fecal coliform results track each other very closely and the observations made for fecal coliform apply to e. coli.

Table 9-15

Effect of CSO Control On E. Coli in Rock Creek

Parameter	*M Street*				*Zoo*				*DC/MD Boundary*			
	Existing SSWS and Upstream Loads		*Reduced SSWS and Upstream Loads*[1]		*Existing SSWS and Upstream Loads*		*Reduced SSWS and Upstream Loads*[1]		*Existing SSWS and Upstream Loads*		*Reduced SSWS and Upstream Loads*[1]	
	All Year	*May to Sept.*	*All Year*	*May to Sept.*	*All Year*	*May to Sept.*	*All Year*	*May to Sept.*	*All Year*	*May to Sept.*	*All Year*	*May to Sept.*
# Months Exceeding 126/100 ml Geometric Mean												
No Phase 1 Controls	12	5	12	2	12	5	12	3	12	5	0	0
Phase 1 Controls	12	5	12	2	12	5	12	3	12	5	0	0
Pump Sta. Rehab.	12	5	12	2	12	5	12	3	12	5	0	0
12 Overflows/yr	12	5	12	2	12	5	12	3	12	5	0	0
8 Overflows/yr	12	5	12	2	12	5	12	3	12	5	0	0
4 Overflows/yr	12	5	12	2	12	5	12	2	12	5	0	0
2 Overflows/yr	12	5	12	2	12	5	12	2	12	5	0	0
0 Overflows/yr[2]	12	5	12	2	12	5	12	2	12	5	0	0
Separation	12	5	12	5	12	5	12	5	12	5	0	0
# Days E. Coli > 126/100 ml												
No Phase 1 Controls	331	132	169	75	362	153	171	75	365	153	4	2
Phase 1 Controls	331	132	169	75	362	153	171	75	365	153	4	2
Pump Sta. Rehab.	331	132	169	75	362	153	171	75	365	153	4	2
12 Overflows/yr	331	132	168	75	362	153	170	75	365	153	4	2
8 Overflows/yr	331	132	168	75	362	153	170	75	365	153	4	2
4 Overflows/yr	331	132	168	75	362	153	170	75	365	153	4	2
2 Overflows/yr	331	132	168	75	362	153	170	75	365	153	4	2
0 Overflows/yr[2]	331	132	168	75	362	153	170	75	365	153	4	2
Separation	337	135	232	99	363	153	220	95	365	153	1	1
# Days E. Coli CSO Impact (>126/100 ml)												
No Phase 1 Controls	26	18	N/A	N/A	23	14	N/A	N/A	0	0	N/A	N/A
Phase 1 Controls	26	18	N/A	N/A	23	14	N/A	N/A	0	0	N/A	N/A
Pump Sta. Rehab.	26	18	N/A	N/A	23	14	N/A	N/A	0	0	N/A	N/A
12 Overflows/yr	10	7	N/A	N/A	12	8	N/A	N/A	0	0	N/A	N/A
8 Overflows/yr	7	5	N/A	N/A	7	5	N/A	N/A	0	0	N/A	N/A
4 Overflows/yr	4	3	N/A	N/A	4	2	N/A	N/A	0	0	N/A	N/A
2 Overflows/yr	3	2	N/A	N/A	2	1	N/A	N/A	0	0	N/A	N/A
0 Overflows/yr[2]	0	0	N/A	N/A	0	0	N/A	N/A	0	0	N/A	N/A
Separation	0	0	N/A	N/A	0	0	N/A	N/A	0	0	N/A	N/A
# Days E. Coli CSO Impact (>576/100 ml)												
No Phase 1 Controls	16	11	N/A	N/A	14	9	N/A	N/A	0	0	N/A	N/A
Phase 1 Controls	16	11	N/A	N/A	14	9	N/A	N/A	0	0	N/A	N/A
Pump Sta. Rehab.	16	11	N/A	N/A	14	9	N/A	N/A	0	0	N/A	N/A
12 Overflows/yr	9	6	N/A	N/A	10	7	N/A	N/A	0	0	N/A	N/A
8 Overflows/yr	6	4	N/A	N/A	6	4	N/A	N/A	0	0	N/A	N/A
4 Overflows/yr	2	1	N/A	N/A	2	1	N/A	N/A	0	0	N/A	N/A
2 Overflows/yr	2	1	N/A	N/A	2	1	N/A	N/A	0	0	N/A	N/A
0 Overflows/yr[2]	0	0	N/A	N/A	0	0	N/A	N/A	0	0	N/A	N/A
Separation	0	0	N/A	N/A	0	0	N/A	N/A	0	0	N/A	N/A

Notes:

1. Separate storm water load reduced by 40%. Upstream nutrients reduced by 40%. Upstream fecal coliform reduced to 80% of water quality standards or 160 organism/100ml.
2. Zero overflows for all storms during analysis period 1988-1990. There will still be overflows under other climatic conditions.

9.6.5 Non-Monetary Factors

With the exception of Northeast Boundary Flooding, the same non-monetary factors that were evaluated for the Anacostia River were assessed for Rock Creek

Table 9-16 summarizes the non-monetary evaluations for each alternative.

Table 9-16
Non-Monetary Evaluation Factors: Rock Creek River Final Alternatives

No.	*Alternative*	*Public Acceptance*	*Ability to Implement*	*Reliability*	*Ease of Operation*	*Ease of Maintenance*	*Ability to Upgrade*
A-1	Piney Branch Storage Tunnel; Separate CSO 059; Reconstruct Regulators for CSO 031, 033, 036 and 057; Relieve RCMI to proposed Potomac Tunnel	Good	Excellent	Excellent	Excellent	Good	Moderate
A-2	Same as A-1, but with LID-R	Good	Uncertain	Uncertain	Excellent	Uncertain	Moderate
B-1	Same as A-1, but with Relief Sewer for Rock Creek Main Interceptor	Moderate	Good	Excellent	Excellent	Good	Moderate
B-2	Same as B-2, but with LID-R	Good	Uncertain	Uncertain	Excellent	Uncertain	Moderate

Principle points are described below:

- Public Acceptance – Rock Creek Parkway and Piney Branch Parkway are major commuter thoroughfares. In addition, the walking and biking trails are heavily used throughout the year. Disruption caused by construction was an important issue for the public. The storage tunnel at Piney Branch and the regulator reconstructions will minimize disruption. Alternative B-1 entails constructing a relief sewer parallel to the Rock Creek Main Interceptor. This has the potential to cause significant disruption and it would have moderate public acceptance. For both the relief a sewer and the storage tunnel options, issues associated with right of way, construction access, disruption, and environmental impact would need to be addressed with the National Park Service. The public also expressed a strong preference for LID-R and inclusion of this is responsive to public comments.
- Ability to implement – Tunnels and regulators have been constructed by WASA and other CSO communities and are practical. Because of the institutional issues associated with LID-R, the ability to implement this option has been classified as uncertain.
- Reliability – Tunnels for storage can be designed to fill by gravity and their dewatering can be automated. The Piney Branch storage tunnel can dewater by gravity, eliminating the need for a pump station making it more reliable. Because the application of LID-R on a large scale for CSO control has not been attempted before, the long term reliability of these types of controls is unknown and has been assessed as uncertain.

- Ease of operation – The storage tunnel, regulator reconstructions and relief sewer projects operate by gravity and require practically no operation.
- Ease of Maintenance – Since the storage tunnel has few mechanical components and no pumping station, it is relatively easy to maintain. Reconstructed regulators would be designed to facilitate inspection and maintenance. For LID-R, the micro scale measures themselves are relatively simple to maintain. However, this item has been assessed as uncertain since the responsibility for maintenance of dispersed facilities is unclear. If those facilities are necessary for satisfactory functioning of a control plan, there would need to be an institutional system with the power to inspect and issue notices requiring corrective maintenance.
- Ability to Upgrade – Upgrade of the Piney Branch tunnel will be challenging. A possible solution is to extend the tunnel upstream of Piney branch. This would preserve the ability to dewater the tunnel by gravity.

9.6.6 Cost Opinion

The capital and operating and maintenance costs for each alternative were estimated and the net present worth was calculated in order to compare options. The net present worth was calculated using the same assumptions used for the Anacostia evaluations.

For LID-R, there is a significant cost associated with its implementation that would be borne by others. Preliminary estimates indicate that applying LID-R over 15% of the impervious land area in the District would cost about $453 million. This cost could be reduced if the construction is coupled with existing redevelopment. In addition, costs could decrease as LID-R measures become more common and contractors and developers become more experienced in their application. Cost opinions for each alternative are summarized in Table 9-17.

Table 9-17
Cost Opinion: Rock Creek Final Alternatives (ENR = 6383)

No.	Alternative	# of Overflows /yr	*Cost to WASA* Capital Cost ($M)	Annual O &M ($M/yr)	20 Year Net Present Worth ($M)	Cost to Others
A-1	Piney Branch Storage Tunnel; Separate CSO 059; Reconstruct Regulators for CSO 031, 033, 036, 037, 047 and 057; Relieve RCMI to proposed Potomac Tunnel	0	$138	$1.80	$164	-
		2	$40	$0.70	$50	-
		4	$38	$0.70	$48	-
		8	$34	$0.70	$44	-
		12	$34	$0.70	$44	-
A-2	Same as A-1, but with LID-R	0	$137	$1.79	$163	Significant, see text
		2	$39	$0.68	$49	
		4	$37	$0.68	$47	
		8	$33	$0.68	$43	
		12	$33	$0.68	$43	

No.	Alternative	# of Overflows /yr	Cost to WASA Capital Cost ($M)	Annual O &M ($M/yr)	20 Year Net Present Worth ($M)	Cost to Others
B-1	Same as A-1, but with Relief Sewer for Rock Creek Main Interceptor	0	$159	$2.07	$189	-
		2	$61	$1.06	$76	-
		4	$57	$1.05	$72	-
		8	$50	$1.03	$65	-
		12	$47	$0.98	$61	-
B-2	Same as B-2, but with LID-R	0	$158	$2.06	$187	Significant, see text
		2	$60	$1.04	$75	
		4	$56	$1.03	$71	
		8	$49	$1.01	$63	
		12	$47	$0.97	$61	
	Separation	0	$958	$3.42	$1,007	-

9.6.7 Selection of Recommended Rock Creek Control Plan

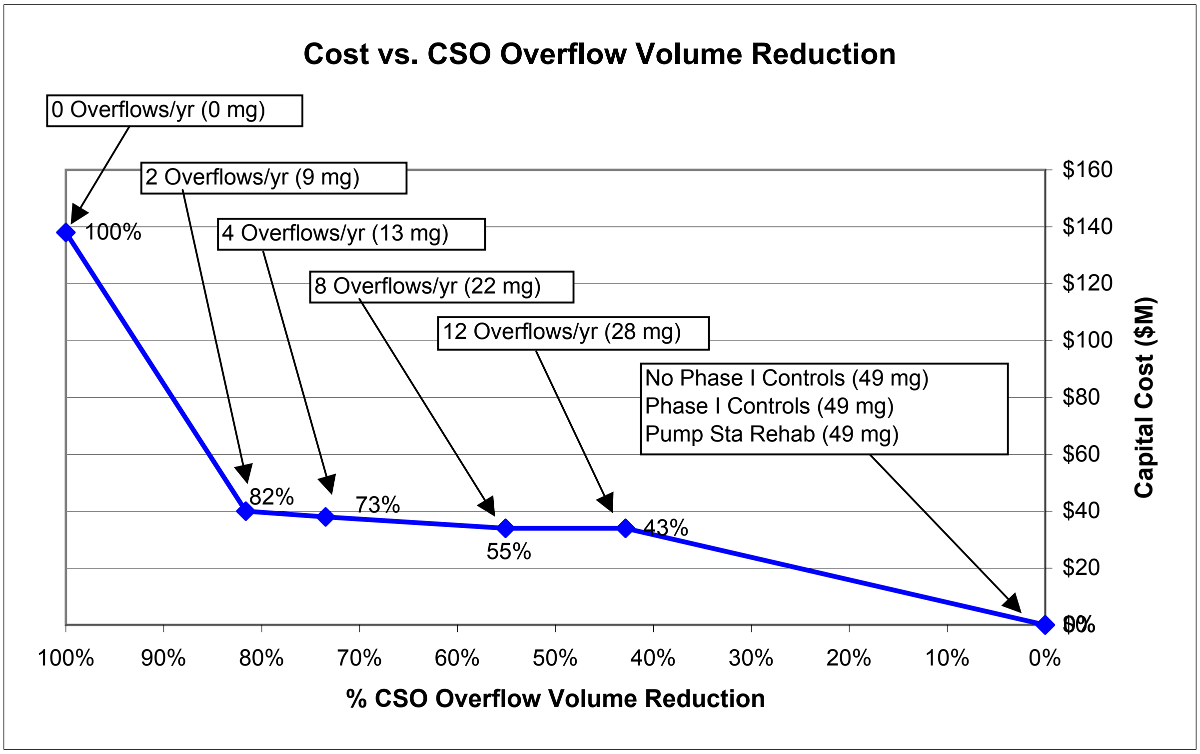
Aside from Piney Branch, the overflows predicted for Rock Creek CSO are very small and relatively infrequent compared to other receiving waters. Modeling these infrequent and minor overflows is difficult and monitoring is recommended at these locations to confirm that overflows are actually occurring. Monitoring should be performed prior to construction of regulator improvements.

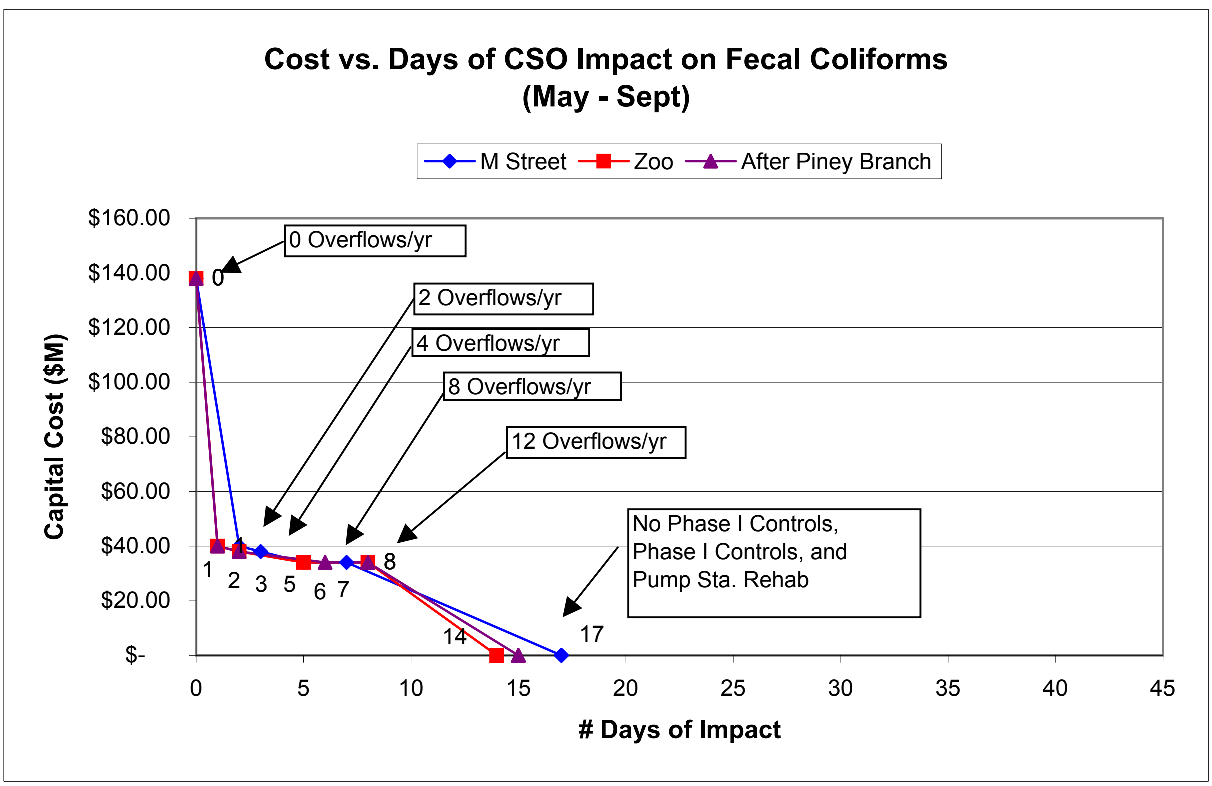
Because of the uncertainty as to the ability to implement LID-R and because of the relatively low cost difference in the tunnel costs, it is recommended that LID-R be implemented but that the Piney Branch tunnel size be selected without taking advantage of the benefits of LID-R. When LID-R is implemented, the CSO controls will perform more effectively.

Alternative A-1 is much more cost effective and less disruptive that Alternative B-1. If the results of the monitoring recommended above confirm the hydraulic grade line predictions in the model, then Alternative A-1 is recommended and a relief sewer parallel to the RCMI is not required. If the monitoring determines that hydraulic grade lines are higher or otherwise different than the model results, then the relief sewer proposed in Alternative B-1 may be required. Pending the results of the monitoring Alternative A-1 is recommended.

Alternative A-1 may be sized to limit overflows to between zero and 12 per average year. An evaluation of the cost effectiveness of this alternative has been performed to enable selection of the proposed level of CSO control. Figure 9-6 presents the cost effectiveness of Alternative A-1. The costs associated with reducing overflows to between 12 and zero per year are plotted. Based on CSO volume reduced, the knee of the curve appears to be between zero and two overflows per year. At that point, the cost curve turns vertical, which implies increasing costs for less benefit. One overflow per year appears to be the approximate knee of the curve for CSO overflow volume.

Figure 9-6
Rock Creek: Cost Benefit Analysis





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In terms of fecal coliform, the 'knee of the curve' appears to be at approximately the two overflows per year range. For controls beyond the two overflows per year range, significant increases in cost occur for a marginal number of days gained per year.

The recommended alternative for the Rock Creek System is LID-R and Alternative A-1 sized for one overflow per year.

9.7 POTOMAC RIVER ALTERNATIVES

9.7.1 Description

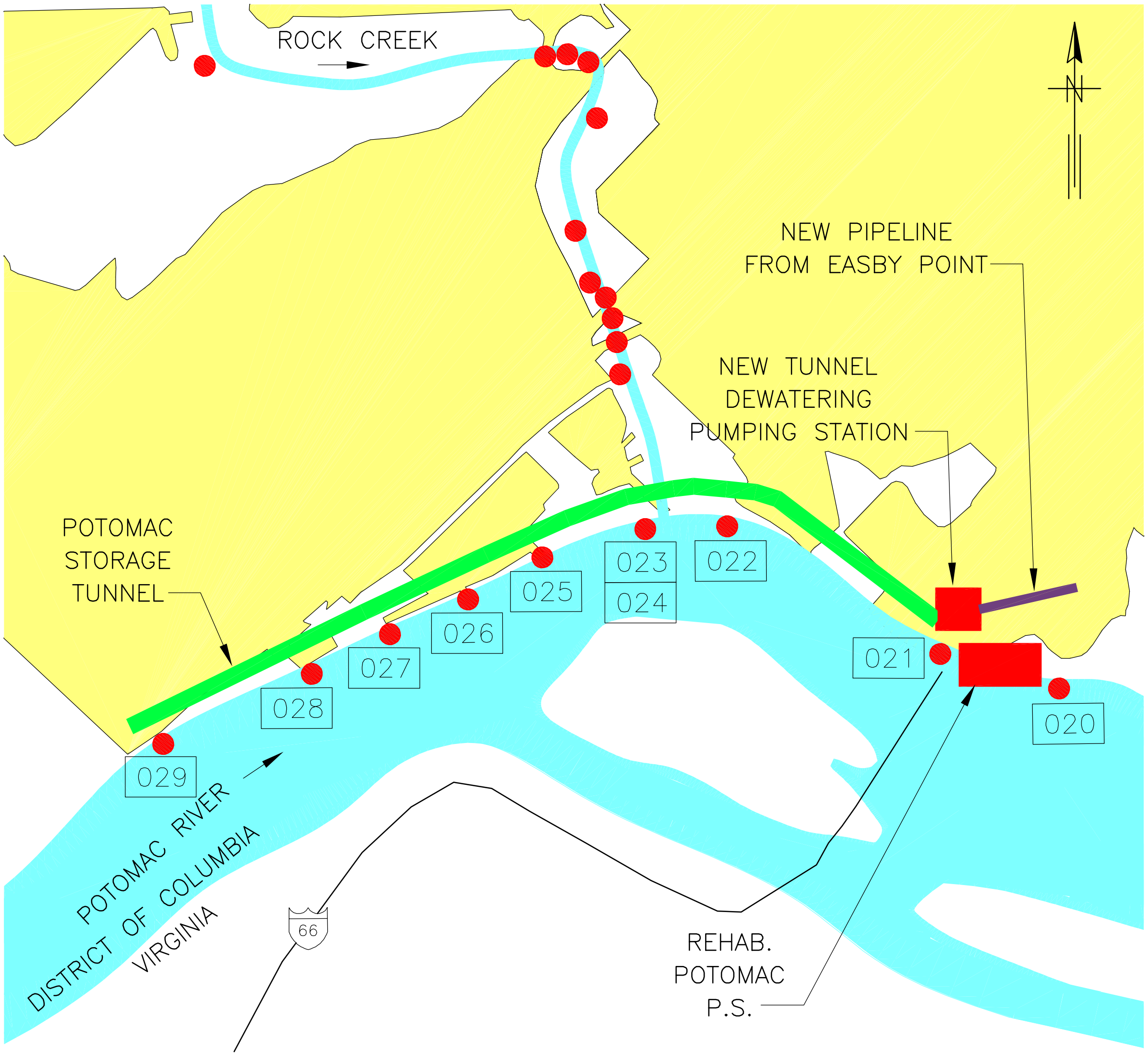
Based on the preliminary alternatives evaluation, four alternatives were selected for further evaluation. They are shown on Figure 9-7 and are described below:

- <u>Storage Tunnel from Georgetown to Potomac Pumping Station</u>
  This consists of rehabilitating the Potomac Pumping Station to a firm capacity of 460 mgd and constructing a CSO storage tunnel. The tunnel would begin at CSO 029 west of the Key Bridge, run parallel to Georgetown, and terminate in Potomac Pumping Station. The low point of the tunnel would be at the existing Potomac Pumping Station. A new tunnel dewatering pump station would be constructed at Potomac Pump Station to dewater the tunnel. The Georgetown CSOs would overflow into the tunnel and a short pipeline would be required from Easby Point to convey CSO flow to the tunnel.

  For the zero overflow per year option, the storage volume becomes so large, that the diameter of the tunnel becomes too large to practically construct to obtain the necessary volume in the short length available. As a result, this option consists of extending the storage tunnel to the Main and O Street pumping station site to allow obtaining the necessary volume within a range of diameters that can practically be constructed.

- <u>Low Impact Development Retrofit</u>:
  As with the Anacostia CSOs, LID-R as a stand alone CSO option was not able to reduce overflows to the 2 to 12 per year range. As a result, this option consists of combining LID with the storage tunnel alternative described above.

The sizing of major facilities for each alternative is summarized in Table 9-18.



LEGEND

- CSO OUTFALL
- 020 CSO OUTFALL NO.
- COMBINED SEWER AREA
- NEW PIPELINE
- NEW PUMPING STATION OR MODIFIED EXISTING PUMPING STATION
- NEW TUNNEL

POTOMAC RIVER FINAL CONTROL ALTERNATIVE: STORAGE TUNNEL

NOT TO SCALE

EPMC-III
GREELEY AND HANSEN LLC

D.C. WATER AND SEWER AUTHORITY
CSS LONG TERM CONTROL PLAN

FILE: J:\1160\DWGS\LTCP\FINAL-LTCP\FINFF9-7 1:1 07/01/02 10:14 GH-G

Table 9-18
Facility Sizing: Potomac River Final Alternatives

Facility Sizes for Indicated Level of CSO Control	# CSO Overflows per Average Year				
	0	2	4	8	12
	Annual CSO Overflow Volume per Average Year				
	0 mg	35 mg	79 mg	152 mg	256 mg
Tunnel From Georgetown to Potomac Pumping Station					
Storage Tunnel Length and Diameter, (ft)	26,500'@ 28'	8,500' @ 39.25'	8,500' @ 34'	8500' @ 27'	8500' @ 22.5'
Total System Storage Volume, (mg)	122	77	58	36	25
Firm Pumping Capacities[1]					
Existing Potomac Pumping Station (mgd)	460	460	460	460	460
New Tunnel Dewatering Pumping Station (mgd)	Note 2	80	65	50	50
Tunnel Plus Low Impact Development Retrofit					
Same as Tunnel from Georgetown to Potomac Pumping Station with Following Changes:					
Storage Tunnel Length and Diameter, (ft)	26,500'@ 28'	8,500' @ 38.75'	8,500' @ 33.5'	8,500' @ 26.25'	8,500' @ 21.5'
Total System Storage Volume, (mg)	122	75	56	34	23

Notes:
1. Zero overflows for all storms during analysis period 1988-1990. There will still be overflows under other climatic conditions.
2. For zero overflows per year, there will be one tunnel dewatering pump station that will be part of the Anacostia system.

9.7.2 Remaining Overflows

The overflows predicted to remain after implementation of controls designed to reduce CSO overflows to between zero and 12 events per average year are summarized in Table 9-19. The procedure that was applied to the Anacostia River CSOs was used for the Potomac CSOs.

Table 9-19
Remaining CSO Overflows - Potomac River (Average of 1988-1990)

CSO No.	Description	# CSO Events/Average Year									
		0[1]		2		4		8		12	
		# Events	Vol. (mg)	# Events	Vol. (mg)	# Events	Vol. (mg)	# Events	Vol. (mg)	# Events	Vol. (mg)
003	Bolling Air Force Base	-	-	1	2.0	2	9.8	2	10.1	1	2.2
020	Easby Point	-	-	2	9.0	3	20.7	7	43.7	11	77.1
021	Potomac P.S. – Slash Run	-	-	2	6.7	3	14.8	7	28.6	11	54.1
022	I St-22nd St NW	-	-	2	13.0	3	28.5	7	60.6	11	105.7
023/024	West Rock Creek Diversion Sewer at Georgetown	-	-	1	1.5	1	2.1	3	3.3	6	6.0
025	Georgetown	-	-	1	0.1	1	0.2	3	0.3	6	0.5
026		-	-	1	0.1	2	0.2	3	0.4	7	0.7
027		-	-	1	1.3	1	2.0	3	3.2	8	6.2
028		-	-	-	-	-	-	-	-	-	-
029		-	-	1	0.8	1	1.0	2	1.7	5	3.4
030	Abandoned	-	-	-	-	-	-	-	-	-	-
060	Little Falls Branch	-	-	-	-	-	-	-	-	-	-
	Total		-		**35**		**79**		**152**		**256**

1. Zero overflows for all storms during analysis period 1988-1990. There will still be overflows under other climatic conditions

9.7.3 Ability to Meet Water Quality Standards

9.7.3.1 Fecal Coliform

The water quality of the Potomac River is much better than that in the Anacostia or Rock Creek. In the upstream reaches of the river from the Memorial Bridge to Georgetown, the class A fecal coliform geometric mean is only exceeded 1 month out of the year after rehabilitation of Potomac Pumping Station. The exceedance is by a relatively small amount. Downstream of the Memorial Bridge, no exceedances are predicted on a monthly basis. This is due both to the low pollutant loads and the size and absorption capacity of the river. Elevated levels of fecal coliform can occur on a daily basis in response to wet weather events. The sources of pollutant loads are CSOs, separate storm water and the upstream loads.

The effect of varying levels of CSO control on fecal coliform levels was evaluated for the entire calendar year as well as for the period May through September. May through September is the period of most likely primary contact recreation based on ambient and water temperature. In addition to evaluating the effects of CSO control, the upstream and separate storm water loads were also reduced as described earlier in this section.

Complete results are included in tabular and graphic form in Appendix C. Selected results are shown in Table 9-20.

Table 9-20
Effect of CSO Control On Fecal Coliform in Potomac River

	BPWWTP.				*Memorial Bridge*				*DC/MD Boundary*			
	Existing SSWS and Upstream Loads		*Reduced SSWS and Upstream Loads*[1]		*Existing SSWS and Upstream Loads*		*Reduced SSWS and Upstream Loads*[1]		*Existing SSWS and Upstream Loads*		*Reduced SSWS and Upstream Loads*[1]	
Parameter	*All Year*	*May to Sept.*	*All Year*	*May to Sept.*	*All Year*	*May to Sept.*	*All Year*	*May to Sept.*	*All Year*	*May to Sept.*	*All Year*	*May to Sept.*
# Months Exceeding Class A Fecal Coliform Standard												
No CSO Control	0	0	0	0	3	3	1	1	8	5	0	0
Phase 1 Controls	0	0	0	0	2	2	1	1	8	5	0	0
Pump Sta. Rehab.	0	0	0	0	1	1	0	0	8	5	0	0
12 Overflows/yr	0	0	0	0	1	1	0	0	8	5	0	0
8 Overflows/yr	0	0	0	0	1	1	0	0	8	5	0	0
4 Overflows/yr	0	0	0	0	1	1	0	0	8	5	0	0
2 Overflows/yr	0	0	0	0	1	1	0	0	8	5	0	0
0 Overflows/yr[2]	0	0	0	0	0	0	0	0	8	5	0	0
Separation	0	0	0	0	1	1	0	0	8	5	0	0
# Days Fecal Coliform > 200/100 ml												
No CSO Control	52	30	39	21	142	64	68	37	219	98	19	10
Phase 1 Controls	48	28	39	21	138	61	61	33	219	98	19	10
Pump Sta. Rehab.	48	28	38	21	133	59	54	32	219	98	19	10
12 Overflows/yr	36	23	23	14	112	45	19	11	219	98	19	9
8 Overflows/yr	29	20	17	10	110	44	13	8	219	98	19	9
4 Overflows/yr	27	19	14	8	109	44	8	6	219	98	19	9
2 Overflows/yr	26	18	12	7	109	44	5	4	219	98	19	9
0 Overflows/yr[2]	21	11	6	3	109	34	3	2	219	98	19	9
Separation	12	7	0	0	126	42	20	11	219	98	19	9
# Days Fecal CSO Impact												
No CSO Control	34	19	N/A	N/A	57	33	N/A	N/A	0	0	N/A	N/A
Phase 1 Controls	33	18	N/A	N/A	51	30	N/A	N/A	0	0	N/A	N/A
Pump Sta. Rehab.	31	18	N/A	N/A	44	27	N/A	N/A	0	0	N/A	N/A
12 Overflows/yr	17	11	N/A	N/A	16	10	N/A	N/A	0	0	N/A	N/A
8 Overflows/yr	12	7	N/A	N/A	10	6	N/A	N/A	0	0	N/A	N/A
4 Overflows/yr	9	6	N/A	N/A	6	4	N/A	N/A	0	0	N/A	N/A
2 Overflows/yr	7	5	N/A	N/A	2	2	N/A	N/A	0	0	N/A	N/A
0 Overflows/yr[2]	0	0	N/A	N/A	0	0	N/A	N/A	0	0	N/A	N/A
Separation	0	0	N/A	N/A	0	0	N/A	N/A	0	0	N/A	N/A

Notes:
1. Separate storm water load reduced by 40%. Upstream nutrients reduced by 40%. Upstream fecal coliform reduced to 80% of water quality standards or 160 organism/100ml.
2. Zero overflows for all storms during analysis period 1988-1990. There will still be overflows under other climatic conditions.

The following observations are made:

- CSO control has a very small effect on the monthly geometric mean. At Georgetown, the predicted geometric mean for May (wettest month) is 221, slightly above the Class A standard. Reducing the number of CSO events from 74 per year to 12 per year reduces the geometric mean to 204. Reducing the number of overflows to zero per year decreases the geometric mean to 203. This is more a function of the nature of the geometric mean than of the benefit provided by CSO control.

- The monthly fecal coliform geometric mean is most affected by the boundary conditions. Transient wet weather pollution sources like CSOs and storm water have less impact on the geometric mean.
- At Georgetown and the Memorial Bridge, the monthly geometric mean is exceeded for one month for the 12 overflows per year option. The amount of the exceedance is very small. At Georgetown, the predicted concentration is 205/100ml, slightly above the standard of 200/100ml. At Memorial Bridge, the exceedance is 220/100ml. The amount by which the Potomac River is exceeding the Class A Standard during this one month is small.
- Each CSO event appears to affect fecal coliform concentrations in the river about 1.5 days, depending on location.
- At twelve overflow events per average year, there are an estimated 16 days per year where CSOs are impacting fecal levels in the river at the Memorial Bridge. During the contact period (May- Sept.), there are 10 days or about 2 days per month. For eight overflow events per year, the number of days of estimated CSO impact is reduced to 10 days per calendar year and 6 days between May and September.
- Because the CSOs in Georgetown are very small, they have a minimal impact on the river.

In the Potomac River, CSOs mostly cause transient elevations of fecal coliform levels in river reaches immediate downstream of outfalls. There is a very small impact on the geometric mean.

9.7.3.2 E. Coli

As with fecal coliform, the effect of varying levels of CSO control on e. coli concentrations was analyzed. Complete data is presented in Appendix C, while selected results are shown in Table 9-21. The e. coli and fecal coliform results track each other very closely and the observations made for fecal coliform apply to e. coli.

Table 9-21

Effect of CSO Control On E. Coli in Potomac River

Parameter	*BPWWTP.*				*Memorial Bridge*				*DC/MD Boundary*			
	Existing SSWS and Upstream Loads		*Reduced SSWS and Upstream Loads[1]*		*Existing SSWS and Upstream Loads*		*Reduced SSWS and Upstream Loads[1]*		*Existing SSWS and Upstream Loads*		*Reduced SSWS and Upstream Loads[1]*	
	All Year	*May to Sept.*	*All Year*	*May to Sept.*	*All Year*	*May to Sept.*	*All Year*	*May to Sept.*	*All Year*	*May to Sept.*	*All Year*	*May to Sept.*
# Months Exceeding 126/100 ml Geometric Mean												
No CSO Control	0	0	0	0	2	2	1	1	1	1	0	0
Phase 1 Controls	0	0	0	0	1	1	1	1	1	1	0	0
Pump Sta. Rehab.	0	0	0	0	1	1	0	0	1	1	0	0
12 Overflows/yr	0	0	0	0	0	0	0	0	1	1	0	0
8 Overflows/yr	0	0	0	0	0	0	0	0	1	1	0	0
4 Overflows/yr	0	0	0	0	0	0	0	0	1	1	0	0
2 Overflows/yr	0	0	0	0	0	0	0	0	1	1	0	0
0 Overflows/yr[1]	0	0	0	0	0	0	0	0	1	1	0	0
Separation	0	0	0	0	0	0	0	0	1	1	0	0
# Days E. Coli> 126/100 ml												
No CSO Control	52	29	44	23	118	57	69	39	218	98	16	8
Phase 1 Controls	48	27	41	22	112	54	62	33	218	98	17	8
Pump Sta. Rehab.	48	27	40	22	108	52	55	32	218	98	16	8
12 Overflows/yr	34	21	26	15	82	37	20	11	218	98	16	8
8 Overflows/yr	28	19	18	11	79	36	13	8	218	98	16	8
4 Overflows/yr	25	16	15	9	77	36	7	6	218	98	16	8
2 Overflows/yr	23	15	13	8	77	35	4	3	218	98	16	8
0 Overflows/yr[1]	17	11	7	4	76	34	3	2	218	98	16	8
Separation	8	7	0	0	98	42	16	8	218	98	16	8
# Days E. Coli CSO Impact (>126/100 ml)												
No CSO Control	38	21	N/A	N/A	60	35	N/A	N/A	0	0	N/A	N/A
Phase 1 Controls	38	21	N/A	N/A	52	31	N/A	N/A	0	0	N/A	N/A
Pump Sta. Rehab.	35	19	N/A	N/A	46	29	N/A	N/A	0	0	N/A	N/A
12 Overflows/yr	20	12	N/A	N/A	17	10	N/A	N/A	0	0	N/A	N/A
8 Overflows/yr	14	8	N/A	N/A	10	7	N/A	N/A	0	0	N/A	N/A
4 Overflows/yr	12	7	N/A	N/A	6	5	N/A	N/A	0	0	N/A	N/A
2 Overflows/yr	9	6	N/A	N/A	3	2	N/A	N/A	0	0	N/A	N/A
0 Overflows/yr[1]	0	0	N/A	N/A	0	0	N/A	N/A	0	0	N/A	N/A
Separation	0	0	N/A	N/A	0	0	N/A	N/A	0	0	N/A	N/A
# Days E. Coli CSO Impact (>576/100 ml)												
No CSO Control	8	6	N/A	N/A	39	24	N/A	N/A	0	0	N/A	N/A
Phase 1 Controls	7	5	N/A	N/A	36	23	N/A	N/A	0	0	N/A	N/A
Pump Sta. Rehab.	4	3	N/A	N/A	31	20	N/A	N/A	0	0	N/A	N/A
12 Overflows/yr	1	0	N/A	N/A	10	6	N/A	N/A	0	0	N/A	N/A
8 Overflows/yr	0	0	N/A	N/A	6	4	N/A	N/A	0	0	N/A	N/A
4 Overflows/yr	0	0	N/A	N/A	3	3	N/A	N/A	0	0	N/A	N/A
2 Overflows/yr	0	0	N/A	N/A	0	0	N/A	N/A	0	0	N/A	N/A
0 Overflows/yr[1]	0	0	N/A	N/A	0	0	N/A	N/A	0	0	N/A	N/A
Separation	0	0	N/A	N/A	0	0	N/A	N/A	0	0	N/A	N/A

Notes:

1. Separate storm water load reduced by 40%. Upstream nutrients reduced by 40%. Upstream fecal coliform reduced to 80% of water quality standards or 160 organism/100ml.
2. Zero overflows for all storms during analysis period 1988-1990. There will still be overflows under other climatic conditions.

9.7.3.3 Dissolved Oxygen

The dissolved oxygen level in the Potomac River is generally very good. Fish kills have not been recently reported. The effects of varying levels of CSO control on dissolved oxygen were evaluated alone and in conjunction with control of SSWS and upstream sources. Complete results are shown in Appendix C, while summary results are shown in Table 9-22.

Table 9-22
Effect of CSO Control On Dissolved Oxygen in the Potomac River

	BPWWTP		*Memorial Bridge*		*DC/MD Boundary*	
Parameter	*Existing SSWS and Upstream Loads*	*Reduced SSWS and Upstream Loads*[1]	*Existing SSWS and Upstream Loads*	*Reduced SSWS and Upstream Loads*[1]	*Existing SSWS and Upstream Loads*	*Reduced SSWS and Upstream Loads*[1]
# Days Dissolved Oxygen <5.0 mg/L						
No CSO Control	28	9	0	0	0	0
Phase 1 Controls	27	9	0	0	0	0
Pump Sta. Rehab.	27	9	0	0	0	0
12 Overflows/yr	27	8	0	0	0	0
8 Overflows/yr	27	7	0	0	0	0
4 Overflows/yr	27	7	0	0	0	0
2 Overflows/yr	27	7	0	0	0	0
0 Overflows/yr	27	5	0	0	0	0
Separation	28	6	0	0	0	0
Minimum Day Dissolved Oxygen						
No CSO Control	3.8	4.5	5.6	6.4	7.4	7.4
Phase 1 Controls	3.8	4.6	5.6	6.4	7.4	7.4
Pump Sta. Rehab.	3.9	4.6	5.6	6.4	7.4	7.4
12 Overflows/yr	4.0	4.7	5.6	6.4	7.4	7.4
8 Overflows/yr	4.0	4.7	5.6	6.4	7.4	7.4
4 Overflows/yr	4.0	4.8	5.6	6.4	7.4	7.4
2 Overflows/yr	4.1	4.8	5.6	6.4	7.4	7.4
0 Overflows/yr	4.1	4.8	5.6	6.4	7.4	7.4
Separation	4.0	4.7	5.6	6.4	7.4	7.4

Notes:

1. Separate storm water load reduced by 40%. Upstream nutrients reduced by 40%. Upstream fecal coliform reduced to 80% of water quality standards or 160 organism/100ml.
2. Zero overflows for all storms during analysis period 1988-1990. There will still be overflows under other climatic conditions.

The following observations are made:

- The model predicts that the water quality standard for dissolved oxygen is always met at Memorial Bridge and upstream. Slight depressions from the standard are predicted from the confluence with the Anacostia to the south of the Wilson Bridge.
- When the dissolved oxygen standard is not met, it is typically not met by a very small amount.

- For zero to 12 overflows per year, the dissolved oxygen is not predicted to be below 4 mg/L, the level at which stress in some fish begins.
- CSO control has a 0.2 mg/l or less effect on the minimum day dissolved oxygen.
- CSO control has little effect on the number of days that the predicted dissolved oxygen is less than 5.0 mg/L.

9.7.4 Non-Monetary Factors

With the exception of Northeast Boundary Flooding, the same non-monetary factors that were evaluated for the Anacostia River were assessed for the Potomac

Table 9-23 summarizes the non-monetary evaluations for each alternative.

Table 9-23
Non-Monetary Evaluation Factors: Potomac River Final Alternatives

No.	*Alternative*	*Public Acceptance*	*Ability to Implement*	*Reliability*	*Ease of Operation*	*Ease of Maintenance*	*Ability to Upgrade*
	Tunnel form Georgetown to Potomac pumping Station	Good	Excellent	Excellent	Moderate	Good	Good
	Low Impact Development Retrofit	Good	Uncertain	Uncertain	Moderate	Uncertain	Good

Principal points are described below:

- Public Acceptance – The Georgetown waterfront is highly developed and has a high intensity of use. No land was identified with adequate space to accommodate treatment or surface –type storage facilities. In addition, many of the roads such as Rock Creek Parkway are high traveled during rush hour. Limiting adverse impacts associated with construction and with the location of wastewater facilities is a top public priority. The tunnel options will minimize disruption and the need for significant land when compared to other options. The public also expressed a strong preference for LID-R and inclusion of this is thus responsive to public comments.
- Ability to implement – Tunnels and pumping stations have been constructed by other CSO communities and are practical. In addition, Metro has constructed many miles of tunnels as part of the subway system and has demonstrated the feasibility of this technology in the Washington area. Because of the institutional issues associated with LID-R described previously, the ability to implement this option has been classified as uncertain.
- Reliability – Deep tunnels for storage can be designed to fill by gravity and their dewatering can be automated. Because the application of LID-R on a large scale for CSO control has not been attempted before, the long term reliability of these types of controls is unknown and has been assessed as uncertain.

- Ease of operation – Since deep tunnels can be designed to fill by gravity, they are relatively easy to operate.
- Ease of Maintenance – Since deep tunnels have few mechanical components, they are relatively easy to maintain. Pumping facilities associated with the tunnel will require maintenance which is of comparable complexity to that already experienced by WASA. For LID-R, the micro scale measures themselves are relatively simple to maintain. However this item has been assessed as uncertain since the responsibility for maintenance of dispersed facilities is unclear. If those facilities are necessary for satisfactory functioning of a control plan, there would need to be an institutional system with the power to inspect and issue notices requiring corrective maintenance.
- Ability to Upgrade – Upgrade of the Potomac tunnel system could be accomplished by extending the tunnel to Main and 'O' Street Pumping stations to provide additional storage.

9.7.5 Cost Opinion

The capital and operating and maintenance costs for each alternative were estimated and the net present worth was calculated in order to compare options. The net present worth was calculated using the same assumptions used for the Anacostia and Rock Creek evaluations.

For LID-R, there is a significant cost associated with its implementation that would be borne by others. Preliminary estimates indicate that applying LID-R over 15% of the impervious land area in the District would cost about $453 million. This cost could be reduced if the construction is coupled with existing redevelopment. In addition, costs could decrease as LID-R measures become more common and contractors and developers become more experienced in their application. Cost opinions for each alternative are summarized in Table 9-24. The cost of separation for the Potomac River includes the cost of separation for Rock Creek, as all Rock Creek CSO's eventually enter the Potomac River.

Table 9-24
Cost Opinion: Potomac River Final Alternatives (ENR = 6383)

Alternative	*# of Overflows/ yr*	*Cost to WASA*			*Cost to Others*
		Capital Cost ($M)	*Annual O &M ($M/yr)*	*20 Year Net Present Worth ($M)*	
Tunnel from Georgetown to Potomac Pumping Station	0	$451	$3.70	$504	-
	2	$279	$3.50	$329	-
	4	$237	$3.00	$280	-
	8	$185	$2.50	$221	-
	12	$171	$2.30	$204	-
With Low Impact Development Retrofit	0	$451	$3.70	$504	Significant, see text
	2	$274	$3.45	$323	
	4	$234	$2.96	$277	
	8	$182	$2.46	$217	

Alternative	# of Overflows/ yr	Cost to WASA			Cost to Others
		Capital Cost ($M)	Annual O &M ($M/yr)	20 Year Net Present Worth ($M)	
	12	$167	$2.24	$199	
Separation	0	$1,397	$4.99	$1,469	

9.7.6 Selection of Recommended Potomac River Control Plan

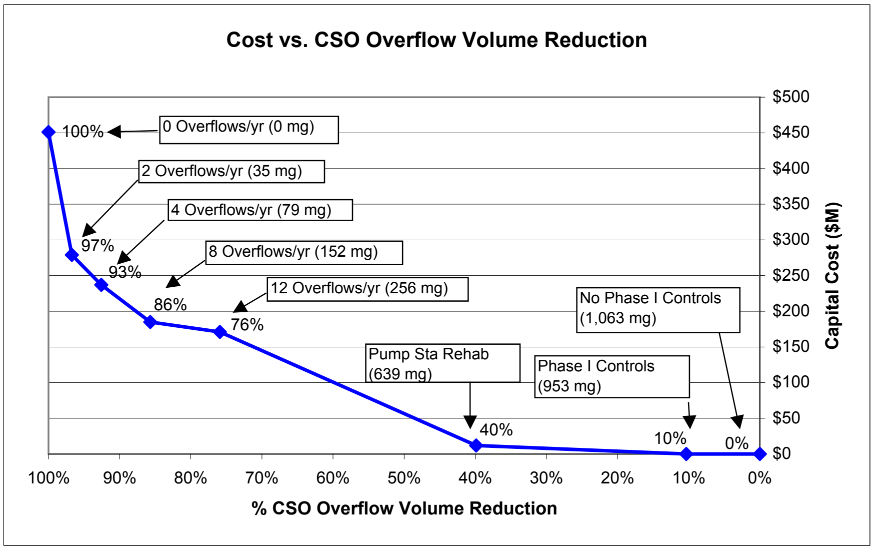
The tunnel from Georgetown to Potomac Pumping Station is the recommended control plan for the Potomac River. As with the Anacostia River alternatives, LID-R can provide some reduction in the size of storage necessary. However, because of the uncertainty as to the ability to implement LID and because of the relatively low cost difference in the capital structures required, it is recommended that LID-R be implemented but that the storage facility be constructed without counting on the implementation of LID. When LID-R is implemented, the CSO controls will perform more effectively.

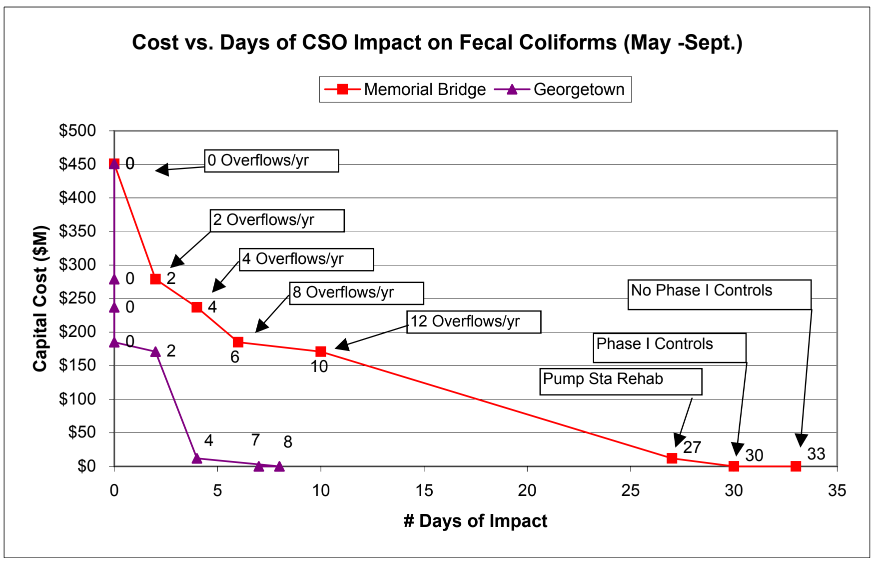
The recommended storage tunnel can be sized to limit overflows to between zero and 12 per average year. An evaluation of the cost effectiveness of this alternative has been performed to enable selection of the recommended level of CSO control. Figure 9-8 presents the cost effectiveness evaluation. In terms of the percentage of CSO volume reduced, rehabilitation of Potomac Pumping Station can reduce CSOs by 30%. The costs associated with reducing overflows to between 12 and 2 per year are also plotted. Based on CSO volume reduced, there appears to be a point of lessening returns ('knee of the curve') at about four overflows per year. At that point, the cost curve turns vertical, which implies increasing costs for less benefit.

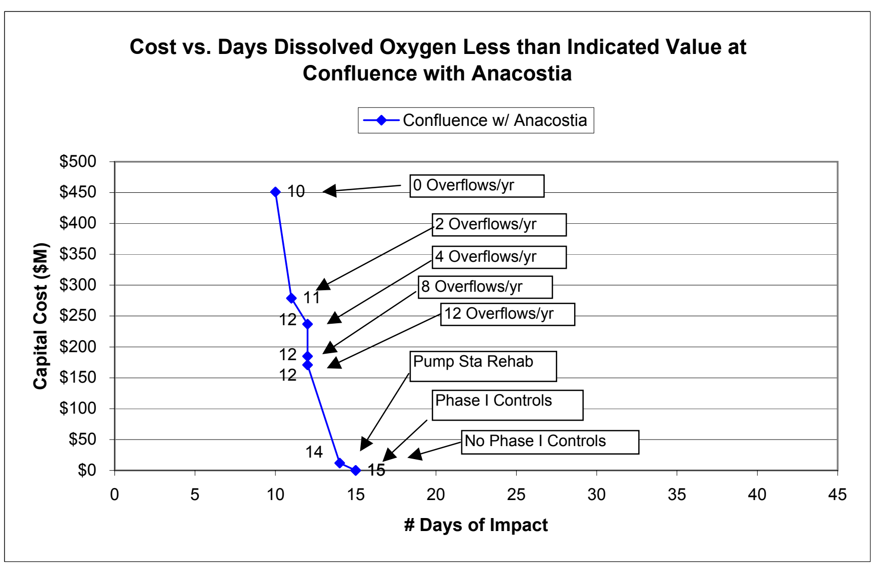
In Figure 9-8, the cost of CSO control is also plotted against the number of days that CSOs have an impact on fecal coliform levels between May and September, the period of most likely contact recreation. For controls beyond four overflows per year, a significant increase in cost occurs for a marginal number of days gained per year.

The recommended alternative for the Potomac System is LID-R and the Potomac Storage Tunnel sized for four overflows per year.

Figure 9-8
Potomac River: Cost Benefit Analysis







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9.8 DESCRIPTION OF DRAFT LTCP

In June 2001, after extensive study, WASA released a Draft LTCP to regulatory agencies and the public for review and comment. The plan provided for reducing CSOs in the average year to 4 per year in the Anacostia, 12 per year on the Potomac and 4 per year on Rock Creek. The plan provided for a 92% overall reduction in CSO volume with the highest reduction of 95.5% for the Anacostia River. The cost of the plan was estimated to be $1.05 billion (year 2001 dollars), with an implementation schedule of 20 years. Elements of the plan benefiting the Anacostia River were accelerated in the schedule for completion in 14 years.

The following summarizes the major components of the Draft LTCP:

- System Wide Controls - WASA recommended the implementation of Low Impact Development Retrofit (LID-R) in the District. Since WASA does not control development or redevelopment in the District, WASA could mandate application of LID-R. As a result, WASA committed to incorporating LID-R techniques into new construction or reconstruction on WASA facilities, where applicable. In addition, WASA recommended that the District Government develop and adopt the necessary laws and regulations to enable implementation of LID-R.

- Anacostia River Components - The control measures selected for the Anacostia River were predicted to limit overflows to four events per average year. During the three year analysis period (1988-1990), the frequency of overflow ranged from two per year to six per year for dry and wet years, respectively. The controls were selected to make maximum use of existing facilities and to provide supplemental storage via a tunnel to control overflows. Major elements of the controls included the rehabilitation of Main, 'O' Street, and Eastside pumping stations, construction of a storage/conveyance tunnel from Poplar Point to Northeast Boundary and construction of a pipeline from Fort Stanton to Poplar Point to address the CSOs on the east side of the Anacostia. An additional leg of the tunnel was proposed to be constructed parallel to the Northeast Boundary Sewer and to several low lying areas to provide additional storage for CSO and to relieve street and basement flooding in the Northeast Boundary area. The existing Poplar Point Pumping Station was proposed to be replaced by a new facility located at the end of the tunnel that both dewaters the tunnel and replaces the function of the existing pumping station. Once the tunnel was operational, the Northeast Boundary Swirl Facility was proposed to be abandoned.

- Rock Creek Components - The control measures selected for Rock Creek were also predicted to limit overflows to four events per average year. The frequency of overflow ranged from one per year to six per year for dry and wet years, respectively, during the three year analysis period. The principal control measures included completion of the separation of Luzon

Valley (CSO 059), construction of a storage tunnel at Piney Branch, and monitoring and regulator improvements to several small CSOs south of Piney Branch.

- Potomac River Components - The control measures selected for the Potomac River were predicted to limit overflows to 12 events per average year. During the three year analysis period, the frequency of overflow ranged from seven per year to 15 per year for dry and wet years, respectively. The principal control measures included rehabilitation of the Potomac Pumping Station and construction of a storage tunnel from west of the Key Bridge, along the Potomac River waterfront parallel to Georgetown, and terminating at Potomac Pumping Station. The tunnel would intercept the Georgetown CSOs and the large CSOs downstream of Rock Creek. A new pumping station was proposed to be constructed at Potomac Pump Station to dewater the tunnel.

- Blue Plains Wastewater Treatment Plant (BPWWTP) Components – BPWWTP has an existing excess flow treatment system designed to provide screening, grit removal, primary treatment, and disinfection to storm flows up to 336 mgd. Improvements to the excess flow treatment train were recommended to improve performance and reliability. These improvements consist of the addition of four new clarifiers and appurtenant weir and control system improvements.

The selected CSO control program was predicted to greatly reduce the frequency and volume of CSO overflows. Table 9-25 illustrates the reduction in overflows.

Table 9-25
CSO Overflow Reduction of Draft LTCP (June 2001)

Item	*Anacostia River*	*Potomac River*	*Rock Creek*	*Total System*	*% Capture of Combined Sewage per CSO Policy*
CSO Overflow Volume (mg/yr)					
No Phase I Controls	2,142	1,063	49	3,254	76%
With Phase I Controls	1,485	953	52	2,490	82%
Recommended Plan	*96*	*157*	*11*	*264*	*98%*
% Reduction from No Phase I Controls	95.5%	85%	78%	92%	-
Number of Overflows/yr					
No Phase I Controls	75	74	30	-	-
With Phase I Controls	75	74	30	-	-
Recommended Plan	*4*	*12*	*4*	-	-

Notes: 1. The Phase I CSO controls consisted of the inflatable dams and Northeast Boundary Swirl Facility. These controls were completed in 1991.

Selection of Draft LTCP

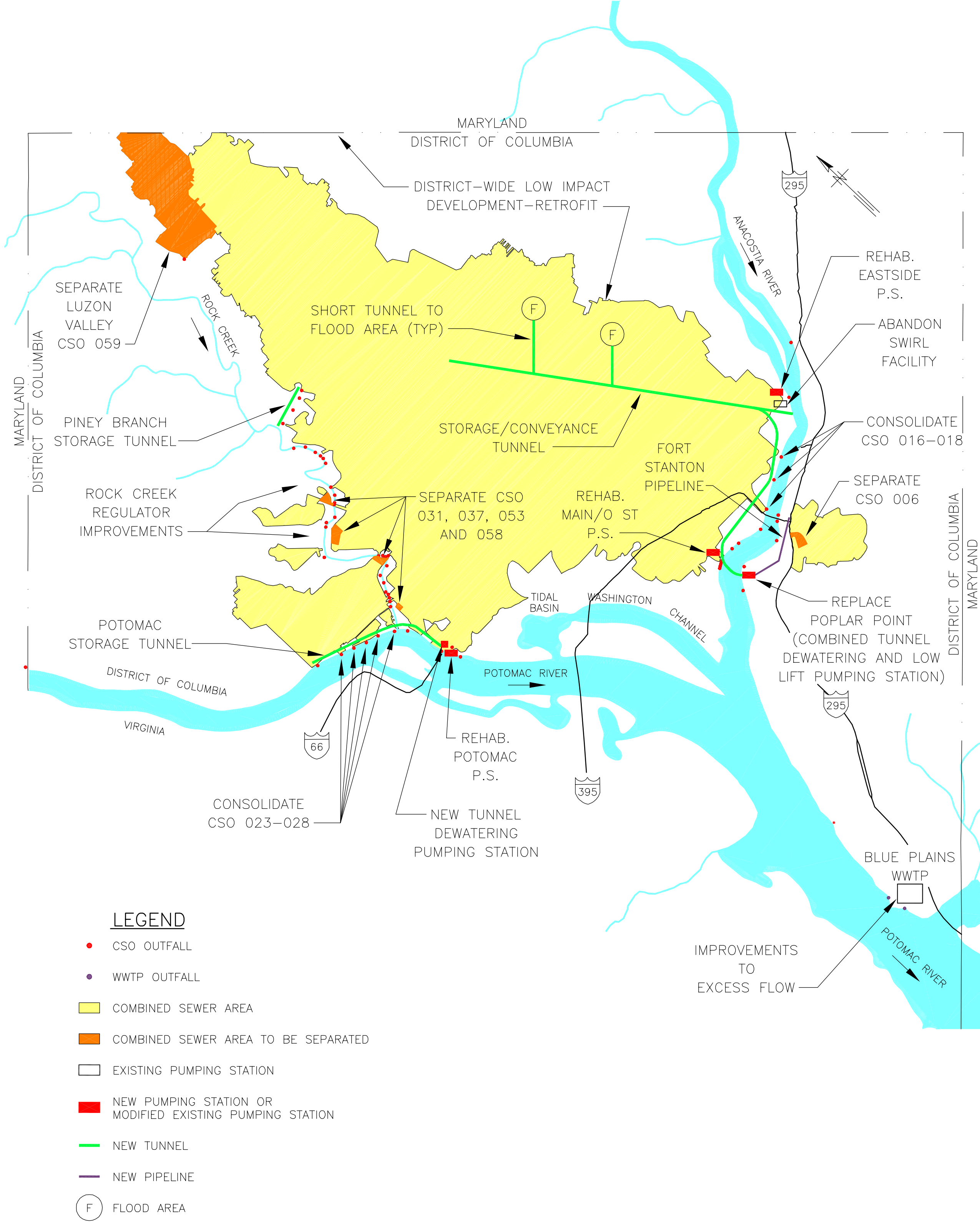
The major elements of the Draft LTCP are summarized in Table 9-26, and are shown on Figure 9-9. The following sections describe the comments received on the Draft LTCP, the additional evaluations conducted, and the selection of the Final LTCP.

Table 9-26
Draft LTCP Elements and Estimated Costs

Component	*Capital Cost Opinion (Millions, ENR=6383)*	*Annual Operation and Maintenance (Millions, ENR=6383)*
System Wide		
Low Impact Development – Retrofit (LID-R)– advocate implementation of LID-R throughout entire District. Provide technical and regulatory assistance to District Government. Implement LID-R projects on WASA facilities where feasible.	$3	$0.15
Anacostia River		
Rehabilitate Pumping Stations – Rehabilitate existing pumping stations as follows: • Interim improvements at Main and 'O' Street Pumping Stations necessary for reliable operation until rehabilitation of stations is performed. • Rehabilitate Main Pumping Station to 240 mgd firm sanitary capacity. Screening facilities for firm sanitary pumping capacity only. • Rehabilitate Eastside and 'O' Street Pumping stations to 45 mgd firm sanitary capacity • Interim improvements at existing Poplar Point Pumping Station necessary for reliable operation until replacement pumping station is constructed as part of storage tunnel	$115	$0[1]
Storage Tunnel from Poplar Point to Northeast Boundary Outfall – 36 million gallon storage tunnel between Poplar Point and Northeast Boundary. Tunnel will intercept CSOs 009 through 019 on the west side of the Anacostia. Project includes new tunnel dewatering pump station and low lift pumping station at Poplar Point.	$276	$9.05
Storage/Conveyance Tunnel Parallel to Northeast Boundary Sewer – 59 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. Abandon Northeast Boundary Swirl Facility upon completion of main tunnel.	$414	
Ft Stanton Interceptor – 66" 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.	$11	$0.05
Anacostia Subtotal	**$816**	**$9.10**
Rock Creek		
Separate Luzon Valley (CSO 059) – Complete separation of this drainage area.	$2	$0
Storage Tunnel for Piney Branch (CSO 049) – 3.8 million gallon storage tunnel	$32	$0.45
Monitoring at CSO 031, 033, 036, 037, 047 and 057 – Conduct monitoring to confirm prediction of overflows. If overflows confirmed, then perform the following: • Regulator Improvements: Improve regulators for CSO 031, 033, 036, 037, 047	$5	$0.05

Component	*Capital Cost Opinion (Millions, ENR=6383)*	*Annual Operation and Maintenance (Millions, ENR=6383)*
and 057 • Connection to Potomac Storage Tunnel: Relieve Rock Creek Main Interceptor to proposed Potomac Storage Tunnel when it is constructed		
Rock Creek Subtotal	**$39**	**$0.50**
Potomac River		
Rehabilitate Potomac Pumping Station – • Rehabilitate station to firm 460 mgd pumping capacity	$12	$0[1]
Potomac Storage Tunnel – 28 million gallon storage tunnel from Georgetown to Potomac Pumping Station. Includes new tunnel dewatering pumping station.	$158	$2.70
Potomac River Subtotal	**$170**	**$2.70**
Blue Plains Wastewater Treatment Plant		
Excess Flow Treatment Improvements – four new primary clarifiers, improvements to excess flow treatment control and operations	$22	$0.4
Grand Total	**$1,050**	**$12.85**

FIGURE 9–9



DRAFT LONG TERM CONTROL PLAN

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EPMC–III
GREELEY AND HANSEN LLC

D.C. WATER AND SEWER AUTHORITY
CSS LONG TERM CONTROL PLAN

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Section 10
Public Participation

10.1 INTRODUCTION

A public participation program and associated activities were conducted as part of the development of the LTCP. The goals of the program were to foster public awareness, and to facilitate public involvement in the decision-making process to develop and select the final LTCP. This section describes public input during development of the LTCP and comments received on the Draft LTCP.

10.2 PUBLIC INVOLVEMENT DURING DEVELOPMENT OF DRAFT LTCP

10.2.1 Public Meetings

Notifications and advertisements for the public meetings were disseminated via the following media:

- Newspapers: Advance notices of public meetings were published in at least four local newspapers between 30 and 45 days before each public meeting or hearing. Public meetings no. 1 and 2 were advertised in the following newspapers:
  - Alexandria Gazette
  - La Nación
  - The Washington Afro-American
  - The Washington Post
  - The Washington Times

  An expanded notification effort was initiated for public meeting no. 3, which was advertised in the following newspapers as well as the aforementioned ones:
  - The Common Denominator
  - El Tiempo Latino
  - The Northwest Current
  - The Washington Informer

- Radio: Public service announcements were broadcast on WAMU National Public Radio

- Internet Websites: Notices of the public meetings were also placed on the following websites:
  - WASA's CSO Website
  - DC Watch Website

- Notice by Mail: A list of over 500 citizens and representatives of businesses, interest groups, federal government, local government, regulatory agencies, neighboring jurisdictions, and interjurisdictional agencies was developed and accumulated as the study progressed. Any person or group who provided a name and address was added to the list. Persons on the mailing list were sent special notices of upcoming public meetings, as well as the responsiveness summaries for each meeting.

- Public Information Depository: An Information Document was prepared and placed on reserve at a public library in each District Ward to provide background information for public review. These libraries are listed below:

  - Martin Luther King, Jr.: 901 G St, NW, Washingtoniana Room
  - Capitol View: 5001 Central Avenue, SE
  - Mount Pleasant: 31 16th Street, NW
  - Woodridge: 18th and Rhode Island Avenue, NE
  - Northeast: 330 7th Street, NE
  - Southeast: 403 7th Street, SE
  - Shepherd Park: 7420 Georgia Avenue, NW
  - Tenley-Friendship: 4450 Wisconsin Avenue, NW
  - Washington Highlands: 115 Atlantic Street, SE

Public meetings were held over the course of the LTCP development effort to facilitate the exchange of information with the general public, to present findings and to obtain their views. Meetings were held on the following dates:

Public Meeting No. 1:	June 7, 1999
Public Meeting No. 2:	April 5, 2000
Public Meeting No. 3:	May 8, 2001

The first public meeting was used to brief the public on the scope and purpose of the study and to obtain their general views on the study. The second public meeting focused on updating the public on the development of the LTCP and the Nine Minimum Control Program and to obtain public input and comments. At the third public meeting, the “short-list” of feasible alternatives and their associated water quality benefits and costs were discussed. Concerns raised by the public at these meetings are listed in Table 10-1.

Table 10-1
Summary of Public Meetings

Public Meeting No.	No. of Attendees[1]	Presentation Topics	Public Concerns/Comments
1	44 (13)	• CSO issues in the District • WASA's past CSO control efforts • Water quality as a watershed issue • Introduction to Combined Sewer System Long Term Control Plan (CSS LTCP) planning approach • Public participation opportunities • Ongoing Nine Minimum Controls (NMC) Program	• The goal should be zero discharge of combined sewage overflow to the Anacostia River. • A stakeholders group that actively participates in the decision-making process should be formed. • Signs at CSO outfalls on National Park Service property must be posted. • Silt buildup in the Anacostia is affecting navigation in the waterway. • The financial cost of the CSS LTCP must be considered. • WASA should study how other cities addressed their CSO problems. • The problem of water quality in the District is a watershed issue that comprises several jurisdictions, not just the District. • Litter entering the sewer system is a serious problem and requires public education. • Sewer separation is not a preferred method of addressing CSO's.
2	31 (9)	• WASA's present NMC program • Short-term projects: Eastside Interceptor cleaning, netting system installation, Swirl Facility evaluation, Rain barrel demonstration program, planned siphon inspection • Major capital projects: Dam replacement, pump station rehab. • Monitoring program update • CSO control alternatives	• WASA should contact Office of Planning and coordinate LTCP efforts with redevelopment along the Anacopstia • Consider the benefits afforded by flow and pollutant reduction technologies in the LTCP • Consider alternate locations for siting possible Equiflow system • Maryland pollutant loads are significantly affecting water quality and should be quantified as part of the LTCP. • Storm water loads must be addressed • Invite the Department of Public Works to stakeholder meetings.
3	40 (14)	• Criteria for evaluating alternatives • Description of range of alternatives considered • Final alternatives for Anacostia CSOs, Rock Creek CSOs and Potomac CSOs. • Financial capabilty assessment	• Show the combined effect of structural CSO controls with diffuse controls such as Low Impact Development Retrofit and and Real Time Control. • Show the effect on water quality of upstream and storm water reductions in pollutant loads combined with CSO control • The federal government constructed the sewer system and should bear a portion of the costs of CSO control. • Show the effect of CSO control on rates both with and without outside financial assistance.

[1]Number in parentheses indicate number of staff associated with development of LTCP (WASA, Greeley and Hansen LLP and subconsultants, and in some cases, MWCOG employees)

For each public meeting, handouts were prepared regarding information presented. These handouts were made available to everyone who attended. After each of the public meetings, a responsiveness summary was prepared describing the presentations made, the issues raised by the public and the responses to those issues. The responsiveness summaries were mailed to all those who provided their address at the meeting and to all members of the Stakeholder Advisory Panel.

10.2.2 Stakeholder Advisory Panel

At the request of the public during the first public meeting, a stakeholder advisory panel was formed. Panel meetings were held over the course of the study to provide an opportunity for public input and consultation on the LTCP development process at more frequent intervals than that afforded by the general public meetings.

The panel consisted of representatives from government agencies, regulatory agencies, citizens' groups, and environmental advocacy groups that are concerned about water quality issues within the District. The panel meetings were typically held every six to eight weeks, and all the meetings were open to the public. The organizations that were represented by each type of group are listed in Table 10-2.

Table 10-2
Stakeholder Advisory Panel Members

Group	*Organization*
Business	• PEPCO
Citizen Groups	• ANC 3F04 • Chesapeake Bay Project Office Citizen's Advisory Committee • Kingman Park Civic Association
Federal Government	• U.S. Army Corps of Engineers • General Services Administration (GSA) • National Park Service (NPS) • National Zoological Park • Naval District- Washington • U.S. Soldiers' and Airmens' Home
Interest Groups	• Anacostia Watershed Society • Audubon Naturalist Society • Earth Conservation Corps • Sierra Club • Natural Resources Defense Council • Earth Justice Legal Defense Fund • District Yacht Club
Local/Multijurisdictional Government Agencies	• Montgomery County Dept. of Environmental Services • D.C. Office of Planning • Interstate Commission on the Potomac River Basin (ICPRB) • Metropolitan Washington Council of Governments (MWCOG)
Regulatory Agencies	• U.S. Environmental Protection Agency (EPA) • D.C. Department of Health

Panel meetings were held on the following dates:

Panel Meeting No. 1: October 28, 1999
Panel Meeting No. 2: December 9, 1999
Panel Meeting No. 3: February 24, 2000
Panel Meeting No. 4: April 4, 2000
Panel Meeting No. 5: June 8, 2000
Panel Meeting No. 6: August 3, 2000
Panel Meeting No. 7: October 26, 2000
Panel Meeting No. 8: February 7, 2001
Panel Meeting No. 9: March 29, 2001
Panel Meeting No. 10: April 26, 2001

The presentation topics and comments received from stakeholders are presented in Table 10-3.

Table 10-3
Summary of Stakeholder Advisory Panel Meetings

Panel Meeting No.	No. of Attendees[1]	Presentation Topics	Stakeholder Feedback
1	31 (9)	• What is a CSO? • WASA's Combined Sewer System • EPA's CSO Policy • Water quality is watershed issue • Progress on developing a long term control plan • Rain barrel demonstration program	• The panel requested a field trip to view WASA's CSO facilities • Public must be educated concerning litter and trash entering sewers • Invite representative from Maryland to attend meetings on a regular basis • Consider the experience of other CSO cities when evaluating controls • Consider and quantify the pollutant contribution from upstream sources • Trash and floatable debris in the Anacostia are important considerations
2	32 (10)	• Update on Nine Minimum Control projects, particularly BMP demonstration projects • Monitoring program update • Equiflow system evaluation • Review of CSO programs in other cities	• The Equiflow system is aesthetically unattractive and does not seem to provide major benefits. • Consider expanding the pumping capacity at Main and O Street Pumping Stations • Investigate how other utilities work with the National Park Service. • Present data on location and type of samples being collected in combined sewer overflows
3	32 (10)	• Preliminary monitoring program results • CSO control technologies • Examples of CSO controls from Richmond, VA • Anacostia Restoration - Indicators of Progress • Rain Barrel Program	• Make a Nine Minimum Controls update a standard part of the stakeholder agenda • DOT should act to control solids and floatabels in storm water and CSO. Each agency needs to do their fair share. • Look at what other CSO cities are doing in terms of public education

Panel Meeting No.	No. of Attendees[1]	Presentation Topics	Stakeholder Feedback
4	31 (9)	• Stakeholder Panel Draft Work Plan • Receiving water monitoring update • Preliminary storm water and CSO analytical data • Update on Eastside Interceptor cleaning and end-of-pipe netting system installation	• Consider the impact of tide on the Anacostia River. • Assess the impact of the sediments on oxygen demand in the Anacostia River • Significant rate increases to fund CSO controls would be viewed unfavorably • Estimate the maximum amount that rate payers can afford for CSO control • Consider the non-monetary benefits of CSO control
5	24 (9)	• Rain barrel demonstration project update • Presentation of overflow volumes and rainfall depths from monitoring program • Preliminary observations concerning monitoring data • CSO control options and degree of control • Nine Minimum Control program update	• Consider how other municipalities controlled CSOs and obtained federal funding. • Consider coordinating with the Mayor's appointee on CSO control issues • Consider the potential negative impacts of CSO storage including impacts on groundwater, aesthetics and public health • Look into relocating the "O" Street pump station
6	25 (8)	• Nine Minimum Control program update • Presentation of overflow volumes and rainfall depths August 99 – June 00 • How monitoring data will be input into the computer model • Preliminary list of CSO control alternatives	• Make sure signs at CSO outfalls are visible from both land and water. • In the modeling, take into account the effect of existing CSO controls. • Describe the performance of the floating end of pipe netting system. • Show the locations of Federal Facilities in the CSO area • Consider Low Impact Development Retrofit as a CSO control • Consider a tunnel between Main and O and BPWWTP for CSO control. • Effect of groundwater and street sweeping on CSO's
7	28 (11)	• Final CSO and storm water monitoring results • Proposed CSO and Storm water event mean concentrations • Receiving water monitoring results • Feasibility of tunnels • Nine Minimum Control program update	• When separation is evaluated, make sure the pollutants in the new storm water are included. • Flow reduction and pollutant management technologies are of interest to stakeholders
8	27 (9)	• Model calibration results • Results of model runs for Year 1990 conditions: flow and water quality • Sensitivity analysis on effect of load reductions on receiving waters • Review of CSO control technologies • Stream diversion • Nine Minimum Control program update	• Evaluate Anacostia River conditions with Maryland meeting water quality standards at the District Boundary • Evaluate Anacostia River conditions with load reductions for both the DC/Maryland Boundary and District storm water. • Compare costs and benefits for CSO control alternatives • Consider Low Impact Development Retrofit
9	35 (8)	• Description of alternatives • Preliminary results of the alternatives evaluations • Procedure for stakeholders to present their opinion on the proposed LTCP	• Projects such as aeration of the Anacostia and flow augmentation of the Anacostia will not reduce CSOs . If they are considered further, they must be coupled with CSO controls • Stakeholders concerned about reliability of inflatable dams • Consider storage upstream in the system such as at Soldier's Home or McMillan Reservoir

Panel Meeting No.	No. of Attendees[1]	Presentation Topics	Stakeholder Feedback
			• Look at some other measure of receiving water quality other than the geometric mean for fecal coliform • Present information by water body to allow them to select various alternatives
10	30 (17)	• Description of final alternatives • Preliminary results of final alternatives evaluations • A survey to obtain comments was distributed	• Fecal coliform impacts during the warm season are more important than year round. Present results in this manner • In the LTCP, include a discussion about the degree of storm water and upstream load reductions required to meet water quality standards • Consider alternatives that combine structural projects with Low Impact Development Retrofit, real time control and others

[1]Number in parentheses indicate number of staff associated with development of LTCP (WASA, Greeley and Hansen LLP and subconsultants, and in some cases, MWCOG employees)

As requested by the stakeholders, WASA arranged for a field trip to visit key WASA facilities on May 18, 2000. The Main Pumping Station, "O" Street Pumping Station, NEBSF, and the end-of-pipe netting system at CSO 018 were visited. In addition, the stakeholders also went on a field trip to Richmond, VA, on June 30, 2000. The stakeholders and members of the Mayor's Environmental Council were briefed on the specifics of the Richmond program to control CSO's into the James River. Presentations were made by representatives of the City of Richmond, representatives from the Virginia State Water Control Board, environmental groups that were involved as stakeholders, and Greeley and Hansen staff. The group also toured several of the CSO control facilities located along the James River.

10.2.3 DC DOH/WASA Model Workshops

As part of DOH's effort to develop a BOD TMDL for the Anacostia River and WASA's effort to develop the LTCP, model workshop meetings were started in 1998 and continue to be regularly held as of the writing of this report (May 2001). Model workshop meetings were held to keep all parties informed of issues associated with the development and use of the Anacostia model for the tidal Anacostia. DOH with the assistance of ICPRB modified the Anacostia computer model for use in developing the BOD TMDL. DOH then turned the model over to WASA for use in developing the LTCP. WASA subsequently updated and improved the model for the LTCP. WASA has turned the updated model back to DOH for work related to the anticipated fecal coliform TMDL.

The parties that were regularly in attendance include the following:

- DOH
- EPA Region III
- Montgomery County
- Princes Georges County

- Maryland Dept. of the Environment
- MWCOG
- ICPRB
- WASA and its consultants

10.2.4 Public Information

A concerted effort was made to make the public aware of the CSS LTCP development process and to actively involve and educate them about CSO issues through the following media:

- Educational Mailer in Water and Sewer Bills – A program of periodic education mailers to WASA customers was initiated in the Autumn of 1999 and was broadened to include recreational water activity groups in Autumn 2000. Mailing inserts were prepared and included in 133,000 sewer and water bills mailed out to WASA customers during Autumn 1999 and Autumn 2000. During the Autumn of 2000, copies of the mailer were provided to various recreational water activity groups for distribution to their members.

The topics discussed in the Autumn 1999 mailing insert were as follows:

- Definition of combined sewers and how they function
- Explanation of the LTCP development effort
- Invitation for the public to become involved and provide input
- Illustration of how a combined sewer system functions

The topics discussed in the Autumn 2000 mailing insert were as follows:

- Reporting of dry weather overflows
- The role of littering in causing dry weather overflows
- Illustrations of how a CSO regulator structure functions during dry and wet weather

- CSO Website – WASA created a special section of its Internet website devoted exclusively to CSO issues. The website included information on the nature of CSOs, maps showing the location of outfalls, descriptions of the LTCP development process, CSO monitoring results, information on pollution prevention, ways for the public to get involved and stay informed, and other items. Notices for public meetings were also posted on the website.

- Public Information Depositories - Copies of information documents containing background information and other information relative to the LTCP were available throughout the duration of the study at eight public libraries in each District Ward. Documents directly related to public meetings and the planned public hearing were placed in the information depository at least 30 days prior to the respective meeting or hearing.

- CSO Newsletters – Two newsletters were sent out to the mailing list of 500 parties mentioned in Section 10.2 in June 1999 and March 2000. The topics discussed in these newsletters included the following:
  - Explanation of combined sewers, CSO's, and the LTCP process
  - Schedule for public meetings
  - Netting system demonstration project
  - Monitoring program update and illustration
  - Meeting schedule for Stakeholder Advisory Panel

- Handouts - For each public meeting, public hearing, and Stakeholder Advisory Panel (Panel) meeting, handouts were prepared regarding information presented. These handouts were made available to everyone who attended.

- Literature and Documentation – Responsiveness summaries as described for the public meetings in Section 10.2.1 were prepared for each stakeholders' meeting.

- Presentations to Other Groups – Presentations were also made to other citizens', government, and environmental groups, including:
  - Mayor's Environmental Council
  - The Summit Fund of Washington
  - Anacostia Trash Management Group
  - Women Like Us (2 presentations)
  - U.S. EPA Special Panel to Address Combined Sewer Overflow and Storm Water Issues in the District of Columbia
  - Anacostia Watershed Toxics Alliance
  - Anacostia River Forum
  - Various EPA and D.C. Department of Health briefings and presentations
  - D.C. Office of Planning

10.2.5 Publicity Received From Media

During the course of the LTCP development effort, WASA's sewer system and combined sewer overflow issues were covered in the local media, as described below:

- WAMU National Public Radio aired a segment on February 13, 2001 on the CSO problem in the District. The segment contained a explanation of what CSO's are and how they occur, WASA's present control measures for CSO's, and the District government's plans for addressing CSO's.

- Newspaper articles

- “Cleaning Up and Celebrating the Anacostia”, Washington Post, 4/15/2000: An editorial article concerning water quality problems in the Anacostia River.
- “A Toast to D.C. Water: How WASA Works for District Residents”, Washington Times, 6/19/2000: An overview of the services, resources, finances, and community activities of WASA.
- “Rooftop Trees”, Washington Post, 12/11/1999: A letter to the editor encouraging rooftop greening projects for the District
- “Leaders Seek Cleanup of Anacoatia”, Washington Times, December 4, 2001

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- Journal Articles
  - “District of Columbia has Big Plan to Limit Combined Sewer Discharge”, Engineering News Record, July 9, 2001.

10.3 RELEASE OF DRAFT LTCP

10.3.1 Distribution of Information

The Draft LTCP was officially released at a press conference on June 29, 2001 at the Main and O Street Pumping Stations. The public was invited and the television and print media covered the event.

The Draft LTCP and summaries of the plan were extensively distributed to the public for comments. This included the following:

- Distribution of Draft LTCP - In early July 2001, more than 150 copies of the complete Draft LTCP were distributed to individuals associated with local government agencies, regulatory agencies, environmental interest groups, citizens groups, WASA, and consultants.

- Public Information Depositories - Two copies of the complete Draft LTCP were placed on reserve in each of nine public libraries in the District that served as Public Information Depositories for the program. These copies were made available to the general public in the reference section of each library.

- Web Site - An electronic version of the complete Draft LTCP and the Executive Summary were placed on WASA’s web site for download and viewing.

- *Washington Post* Insert – A four-page insert was placed in the Sunday Washington Post on August 19, 2001. Over 292,000 copies were distributed. Spanish language versions were also distributed to Spanish speaking households by the Post. The insert described the Draft LTCP and provided information on opportunities for comment.

- Abbreviated Summaries for the Public – abbreviated summaries of the Draft LTCP were prepared and made available. These were titled "Control Plan Highlights" and "WASA's Recommended Combined Sewer System Draft Long Term Control Plan - Executive Summary".

10.3.2 Media Publicity

After the Draft LTCP was released, considerable coverage occurred in local media. The following is a list of the coverage:

- "$1 Billion Remedy For Sewer Spills", *The Washington Post*, June 25, 2001.
- "D.C. Region: City to Propose $1B Plan to Fix Sewer System", *Environment and Energy Publishing, LLC*, June 26, 2001.
- "News Conference- DC Water and Sewer Authority", *Federal News Service, Inc*., June 29, 2001.
- "News Conference", *Federal Information and News Dispatch, Inc*. June 29, 2001.
- "District of Columbia Water and Sewer Authority Releases Recommended $1.05 billion Draft Combined Sewer System Long Term Control Plan", *PR Newswire Association, Inc*. June 29, 2001.
- "D.C. Agency to Ask Congress to Fund Billion-Dollar Sewer Project", *The Bond Buyer, Inc.*, July 2, 2001.
- 'District of Columbia Has Big Plan to Limit Combined Sewer Discharge", *Engineering News-Record*, July 9, 2001.
- "Community Members, D.C. Council Member Call for an End to Dumping of Raw Sewage Into D.C.'s Rivers", *U.S. Newswire, Inc*., July 20, 2001.
- "Groups, Citizens, D.C. Council Member Call for End to Raw Sewage Discharge in DC Rivers", *U.S. Newswire, Inc*., July 24, 2001.
- Mendelson, Environmentalists say WASA's Sewer Solution Falls Short", *Common Denominator*, July 30, 2001.
- "Reviving the Forgotten River", *Environmental Citizenship*, www.envirocitizen.org, August 24, 2001.

10.4 OPPORTUNITIES FOR PUBLIC COMMENT ON DRAFT LTCP

Many forums and opportunities were made available for public comment. An overview of the major opportunities is summarized below:

- Public Meetings - Three public meetings were held prior to release of the Draft LTCP. Public Meeting No. 4 was held on July 24, 2001 after release of the Draft LTCP. The purpose of the meeting was to explain the Draft LTCP and to begin the process of obtaining public comments.

- Stakeholder Advisory Panel Meetings - Ten Stakeholder Advisory Panel meetings were held prior to release of the Draft LTCP. Two meetings were held after release of the Draft LTCP.

- Neighborhood Meetings - Neighborhood Meetings were held in each of the eight wards of the District to explain the Draft LTCP and to provide an opportunity for comment. Questionnaires were distributed at these Neighborhood Meetings. The purpose of the questionnaires was to poll citizens on what degree of CSO control they would be willing to pay for through water/sewer bill rate increase, and to gauge support for wet weather provisions for water quality standards. In addition, citizens were encouraged to write other comments or concerns on the questionnaires as well. Neighborhood Meetings are summarized in Table 10-4 below.

Table 10-4
Neighborhood Meeting Summary

Ward	No. of Attendees[1]	*Date*	*Location*
1	17 (6)	Tues., August 7, 2001	Mt. Pleasant Library 3160 16th Street, NW
2	23 (7)	Wed., August 22, 2001	Georgetown Library 3260 R Street NW
3	21 (5)	Tues., August 28, 2001	Tenley-Friendship Library 4450 Wisconsin Ave, NW
4	18 (6)	Wed., August 15, 2001	Shepard Park Library 7420 Georgia Avenue, NW
5	12 (5)	Wed., August 1, 2001	Gallaudet University 800 Florida Ave, NE
6	13 (6)	Thurs., August 9, 2001	Southeast Library 403 7th Street, SE
6	26 (5)	Tues., August 14, 2001	Anacostia Branch Library 1800 Good Hope Road, SE
7	16 (4)	Wed., August 29, 2001	Capitol View Library 5001 Central Ave, SE
8	9 (6)	Thurs., August 23, 2001	Washington Highlands Library 115 Atlantic Street SW

[1]Number in parentheses indicate number of staff associated with development of LTCP (WASA, Greeley and Hansen LLP and subconsultants, and in some cases, MWCOG employees)

- D.C. Council Public Hearing - The Council of the District of Columbia Committee on Public Works and the Environment held a public hearing on October 4, 2001. Due to time constraints, the hearing was continued on October 22, 2001. Public testimony was received a record of the hearing was made.

- Briefing at National Building Museum - On October 16, 2001, WASA made a presentation and participated in a panel discussion on the LTCP at the National Building Museum. The forum was titled "the Anacostia River Cleanup" and was part of the Museum's ongoing "DC Builds" series.

- WASA Public Hearing - WASA held a public hearing on October 22, 2001. The public was invited in advertisements to sign up in advance for oral testimony time during the hearing. Oral testimony received from the public was included as part of the official written transcript for the public hearing. In addition, written comments from the public were accepted until November 21, 2001.

- Citizens Forum - On November 7, 2001, a community forum to review the Draft LTCP was held at the Sumner School in the District. The forum was sponsored by the D.C. Federation of Civic Associations, the D.C. Citizens Association, and the Consumer Utility Board.

  WASA made a presentation on the Draft LTCP and five invited panel members made brief oral statements. The audience then made comments and directed questions to selected panel members.

- Letters, Faxes and E-mail - Letters, faxes and e-mail comments were received throughout the process.

10.5 PUBLIC COMMENTS ON DRAFT LTCP

10.5.1 Number and Types of Comments

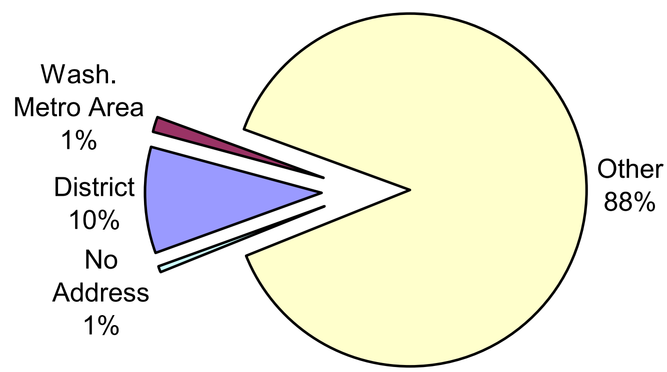
WASA received two types of comments: form letters and unique comments. The number of commenters is summarized in Table 10-5 and described below.

Table 10-5
Number of Commenters

Comment Type	*Number of Commenters*
Form Letter #1	216
Form Letter #2	2,017
Other Comments	132
Total	2,365

- Form Letters
  Two types of form letters were received. The majority of commenters were not from the District or the greater Washington Metropolitan area. Some of the commenters were from Canada. Figure 10-1 illustrates the origins of the form letters.

Figure 10-1: Origins of Form Letter Comments



- Other Comments
  More than 130 other commenters provided over 430 comments on the Draft LTCP. Comments were received from a variety of sources including the following:

  - Regulatory Agencies – Comments from EPA and the D.C. Department of Health.

  - Others, such as the following
    - Citizens
    - DC Office of Planning
    - Washington Suburban Sanitary Commission
    - Prince George's County
    - Environmental groups
    - U.S. Fish & Wildlife Service
    - U.S. Geological Survey
    - Others

Copies of these comments are included in separate report titled *"Comments on Draft Long Term Control Plan"*.

10.5.2 Approach to Addressing Comments

An extremely large number of comments were received. In addition, there are significant degrees of overlap and common themes in many of the comments. As a result, comments were grouped by type and subject matter and addressed together in a commentary type response. The goal of this approach is to produce a commentary that is both readable and comprehensive. The comments were grouped as being related to the following topics:

- Nine Minimum Controls
- Alternatives Evaluation
- Separation
- Low Impact Development Source Control, Pollution Prevention
- Blue Plains Wastewater Treatment Plant
- CSO Location
- Flooding
- Implementability
- Tunneling
- Regulatory Compliance
- Public Participation
- Financial Capability
- Schedule
- Water Quality Standards Revisions
- Miscellaneous Comments

Appendix F provides a response to each type of comment received.

10.6 FUTURE PUBLIC PARTICIPATION

WASA is committed to active public participation and consultation during the planning, design and construction of CSO control projects. Future public participation will be designed to educate the public about the status of the program; progress in implementing the program; to inform neighborhood residents before, during and after construction; and to report on progress in reducing CSOs and improving water quality as a result of the program.

Section 11
Selection of Final LTCP

11.1 INTRODUCTION

Based on the comments received, the new TMDL for TSS for the Anacostia River and on additional CSO Policy considerations, WASA developed additional CSO control alternatives for selection of a Final LTCP. This section describes the development of the alternatives and the selection of the Final LTCP.

11.2 BASES FOR EVALUATIONS

11.2.1 Design Storms

The selection of the Draft LTCP was made based on average year conditions as required by the CSO Policy. Several commenters requested additional evaluations of the quantity of CSO overflow and the performance of various control plans for design storms such as the 1-year, 2-year, 5-year, 10-year, 15-year, 25-year and 50-year return frequency storms. Several sources of data were reviewed to develop design storm characteristics. They are:

- USDA Approach – These are synthetic storms developed based on rainfall data collected throughout the US by the National Weather Service (NWS). Maps of regional rainfall for various design storms are presented in Technical Paper No. 40 (Hershfield, 1961). This rainfall is then apportioned in time using a distribution created by the USDA (1986). This distribution is appropriate for design storms over small areas less than 10 square miles.

- Huff Approach – These are also synthetic storms developed based on design storms presented in NWS Technical Paper No. 40. The approach differs from the USDA method when apportioning the rainfall over time. The Huff Approach was developed for large drainage areas, ranging from 50 to 400 square miles (Huff, 1990).

- National Airport Data – hourly rainfall data is available at National Airport from 1949 to the present. This data was used to calculate return frequencies based on actual data.

The procedure for determining design storms is to first select a storm duration. Common durations are 6-hour, 12-hour and 24-hour storms. Longer storms produce larger rainfall volumes. For each duration, storms are ranked from largest to smallest based on total rainfall volume. Note that when using actual rainfall data, intensities may or may not increase with rainfall volume. For example, it is possible to have a 25-year storm where it rained steadily for the entire 24 hours thereby producing a lot of rain but having a low intensity. Similarly, a lower return frequency storm such as a 10-year storm may have rained intensely for a short period of time and then drizzled for the remainder of the 24 hours. These are the types of complexities encountered when dealing with natural phenomena.

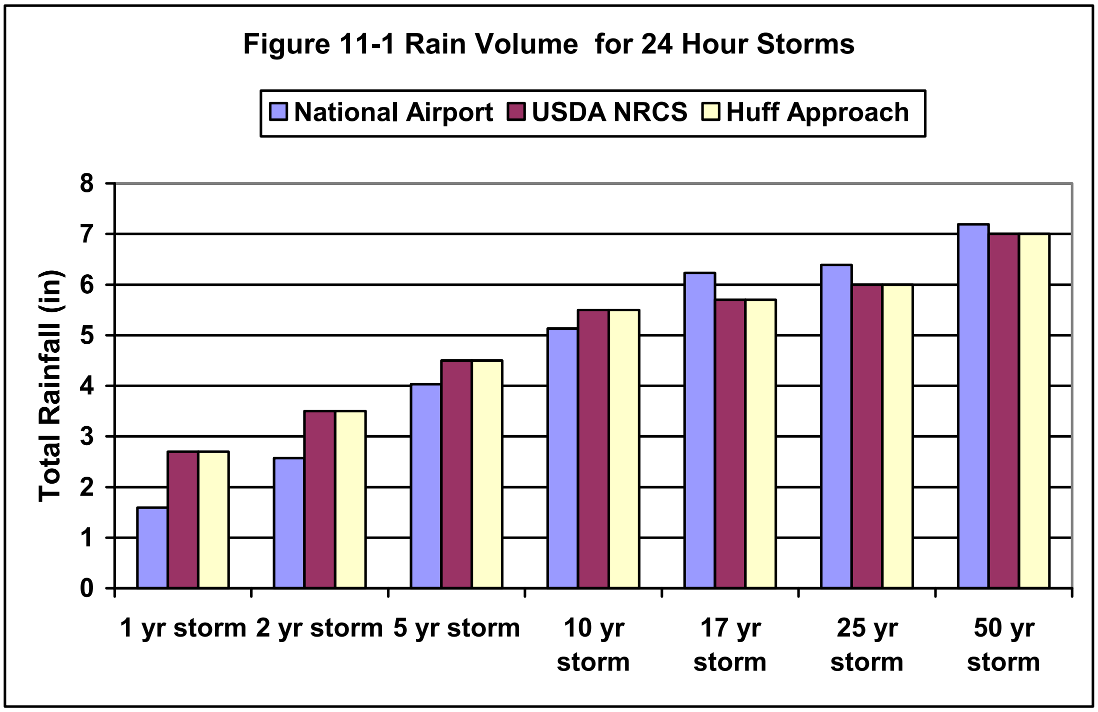
Table 11-1 summarizes the characteristics of the design storms for the three approaches and three durations evaluated. The 15-year design storm developed as part of the 1983 O'Brien & Gere CSO study is also shown (O'Brien & Gere, 1983). Figures 11-1 and 11-2 compare the total rainfall volumes and maximum hourly intensities, respectively, for the 24-hour designs storms.

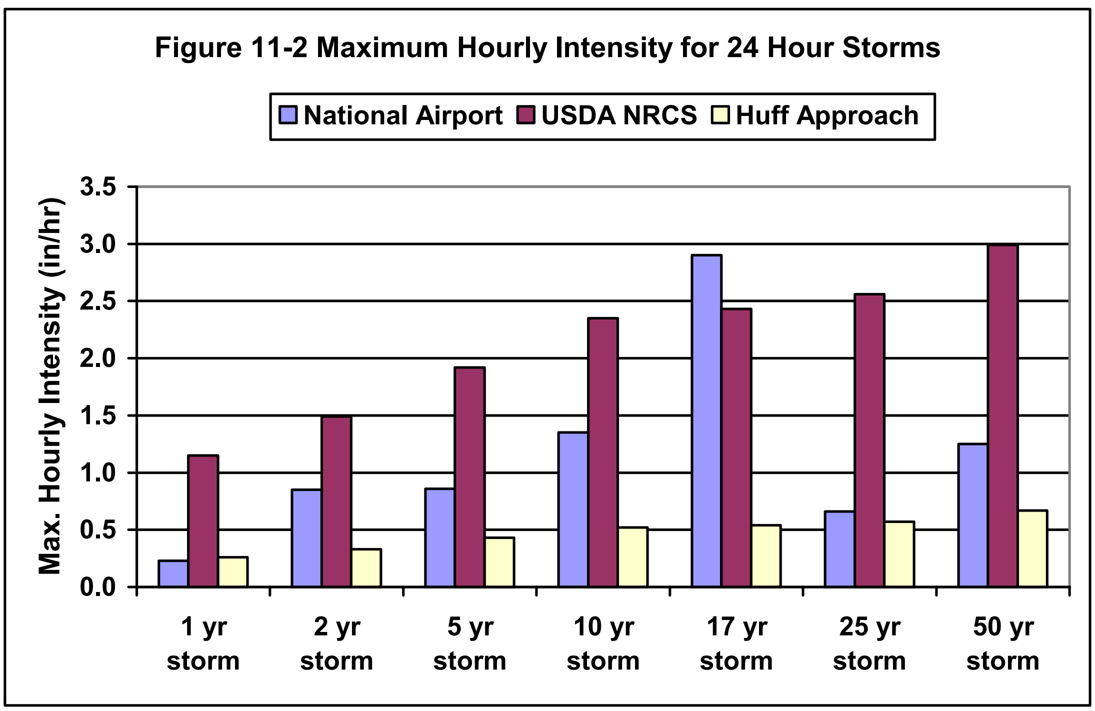
Table 11-1
Summary of Design Storms

	National Airport		*USDA NRCS*		*Huff Approach*		*O'Brien & Gere 1983 CSO Study*	
	Rainfall (in)	*Max Hourly Intensity (in/hr)*	*Rainfall (in)*	*Max Hourly Intensity (in/hr)*	*Rainfall (in)*	*Max Hourly Intensity (in/hr)*	*Rainfall (in)*	*Max Hourly Intensity (in/hr)*
24 Hr Storm								
1 yr storm	1.59	0.23	2.70	1.15	2.70	0.26		
2 yr storm	2.57	0.85	3.50	1.49	3.50	0.33		
5 yr storm	4.03	0.86	4.50	1.92	4.50	0.43		
10 yr storm	5.13	1.35	5.50	2.35	5.50	0.52		
17 yr storm	6.23	2.90	5.70	2.43	5.70	0.54		
25 yr storm	6.39	0.66	6.00	2.56	6.00	0.57		
50 yr storm	7.19	1.25	7.00	2.99	7.00	0.67		
12 Hr Storm								
1 yr storm	1.25	0.40	2.40	1.16	2.40	0.46		
2 yr storm	2.43	1.29	3.00	1.45	3.00	0.57		
5 yr storm	3.65	0.86	3.80	1.83	3.80	0.72		
10 yr storm	4.16	1.45	4.50	2.17	4.50	0.86		
17 yr storm	4.69	1.44	4.70	2.27	4.70	0.89		
25 yr storm	4.87	0.66	5.10	2.46	5.10	0.97		
50 yr storm	6.22	1.25	6.00	2.89	6.00	1.14		
6 Hr Storm								
1 yr storm	1.00	0.81	2.10	1.14	2.10	0.82		
2 yr storm	2.14	0.65	2.60	1.41	2.60	1.01		
5 yr storm	2.84	0.79	3.20	1.74	3.20	1.25		
10 yr storm	3.74	1.51	3.80	2.06	3.80	1.48		
17 yr storm	3.97	1.23	4.00	2.17	4.00	1.56	3.14 (5 hrs)	2.90
25 yr storm	4.35	3.29	4.30	2.33	4.30	1.68		
50 yr storm	5.18	1.23	5.00	2.72	5.00	1.95		

As indicated in the table, the total rainfall volumes for the three different approaches (National Airport, USDA, and Huff approach) are similar for most of the storms. At the 1-year and 2-year storms, the National Airport volumes are about 1" less than the synthetic curves.

In addition, the intensities for the Huff approach are extremely low, while those of the USDA approach are very high. This is not unexpected in that the Huff approach was developed for large watersheds where the overall watershed-wide intensity will typically be much less than the intensity predicted for smaller drainage areas based on the USDA approach. The intensities for National airport generally fall between the two.





Design storms developed using National Airport data were selected as the basis for the LTCP evaluations. This is because it provides site-specific information, particularly at the lower level storms and because the intensities generally fall between the two synthetic approaches. Testing of the model indicated that the largest overflow volumes were produced by 24 hour storms. These were thus selected as the basis for this analysis.

The combined sewer system model was run to predict overflows associated with each of the 24-hour design storms. The results are summarized in Table 11-2.

Table 11-2
Predicted CSO Overflow Volumes for 24-Hour Design Storms
(National Airport Data)

	CSO Overflow Volume (mg)			
Event	*Anacostia*	*Potomac*	*Rock Creek*	*Total*
No Phase I Controls (Scenario B1)				
1-yr storm	176	106	10	292
2-r storm	272	209	39	519
5-yr storm	558	334	71	963
10-yr storm	656	328	87	1,071
17-yr storm	960	389	235	1,584
25-yr storm	920	509	70	1,499
50-yr storm	1,229	605	312	2,145
Phase I Controls and Pump Station Rehabilitation (Scenario C3)				
1-yr storm	127	57	10	194
2-yr storm	219	146	39	404
5-yr storm	500	246	72	818
10-yr storm	564	252	88	904
17-yr storm	894	323	236	1,453
25-yr storm	827	377	72	1,276
50-yr storm	1,160	489	313	1,962
Draft LTCP (Scenario D70A)				
1-yr storm	0	15	5	20
2-yr storm	106	142	28	275
5-yr storm	385	261	60	706
10-yr storm	438	271	66	775
17-yr storm	777	303	200	1,281
25-yr storm	726	490	50	1,266
50-yr storm	1,047	589	299	1,934

Note that there is a limit to the capacity of any sewer system. Typically, storm and combined sewer systems in the United States are designed to accommodate the 5, 10 or 15-year storms. Systems are not usually designed to accommodate larger storms. This is an acknowledgment of the great cost associated with conveying these larger storms and their low frequency of occurrence.

The subsequent section will address developing alternatives designed to control specified design storms.

11.2.2 Targeted Separation

Several commenters indicated that targeted separation should be given further consideration. The commenters recommended considering areas to be separated based on capital cost, water quality impacts, unit costs, and other factors.

A review of the drainage areas was conducted to determine which might be most suitable for targeted separation. The drainage areas were evaluated with preference given to drainage areas with the following:

- Proximity to public use areas
- Low total capital cost
- Favorable cost per impervious area removed
- Favorable cost per gallon of CSO overflow volume removed
- Areas with a high percentage of drainage area already separated or with a high degree of orphaned storm sewers

Table 11-3 summarizes the results of the analysis.

Table 11-3
Evaluation of Targeted Separation Options

No.	*CSO NPDES No.*	*Description*	*Overflow Volume (mg/yr)*	*Drainage Area (ac)*	*Imperv. Area (ac)*	*% Area Already Separated*	*Capital Cost ($M)*	*$/Imp Acre (x $1000)*	*$/mg overflow ($M)*	*By Cap Cost?*	*By $/Imp Area?*	*By $/ OF Vol?*	*Near Public Use Area?*	*Consider for Targeted Separation?*
1	005	Fort Stanton	16.54	65.51	29.0	28%	$ 12.5	$431	$ 0.8		Y	Y		Y
2	006	Fort Stanton	0.11	13.56	6.6		$ 3.2	$ 488	$ 29.5	Y	Y			Y
3	007	Fort Stanton	36.97	188.13	68.0	28%	$ 33.4	$ 492	$ 0.9			Y		Y
4	013	Canal Street Sewer	9.78	20.10	1.1		$ 5.3	$ 4,978	$ 0.5	Y				Y
5	014	Navy Yard/M St: 6th St - 7th St	38.98	128.06	41.8		$ 31.5	$ 754,935	$ 0.8			Y	Y	Y
6	015	Navy Yard/M St: 9th St. - M St	0.72	30.82	4.1		$ 8.2	$ 2,008	$ 11.4	Y			Y	Y
7	016	Navy Yard/M St: 12th St. - 9th St.	13.3	152.58	75.1		$ 38.9	$ 518	$ 2.9		Y		Y	Y
8	017	Navy Yard/M St: 14th St. - Penn Ave.	20.05	259.91	114.5		$ 69.6	$ 608	$ 3.5				Y	Y
9	018	Barney Circle	4.7	48.93	20.1		$ 10.7	$ 532	$ 2.3	Y	Y		Y	Y
10	023, 024	West Rock Creek Diversion Sewer: K St.- Wisconsin Ave	16.23	41.66	16.1		$ 8.2	$ 512	$ 0.5	Y	Y		Y	Y
11	025	31st & K St NW	0.16	9.89	6.0		$ 2.6	$ 437	$ 16.3	Y	Y		Y	Y
12	026	Water St District (WRC)	0	13.88	4.3		$ 2.8	$ 666	N/A	Y			Y	Y
13	028	37th St- Georgetown	0.49	21.06	6.4		$ 5.6	$ 871	$ 11.4	Y			Y	Y
14	031	Penn Ave - Middle E. Rock Creek	0.22	1.11	0.3		$ 0.28	$ 906	$ 1.3	Y		Y		Y

No.	CSO NPDES No.	Description	Overflow Volume (mg/yr)	Drainage Area (ac)	Imperv. Area (ac)	% Area Already Separated	Capital Cost ($M)	$/Imp Acre (x $1000)	$/mg overflow ($M)	By Cap Cost?	By $/Imp Area?	By $/ OF Vol?	Near Public Use Area?	Consider for Targeted Separation?
15	032	26th - M St - Middle E. Rock Creek	0	10.83	6.8		$ 4.6	$ 678	N/A	Y				Y
16	033	N St. - 25th St - Middle E. Rock Crk.	4.48	13.08	6.5		$ 5.1	$ 793	$ 1.1	Y		Y		Y
17	037	Kalorama Circle West - E. Rock Crk.	0.05	16.61	3.7		$ 2.6	$ 687	$ 51.4	Y				Y
18	038	Kalorama Circle East - E. Rock Crk.	0	9.54	2.1		$ 1.5	$ 690	N/A	Y				Y
19	040	Biltmore St - East Rock Creek	0.03	24.52	10.5		$ 6.3	$ 605	$ 211.2	Y	Y			Y
20	041	Ontario Rd - Upper E. Rock Crk.	0	27.17	7.1		$ 6.7	$ 936	N/A	Y			Y	Y
21	042	Quarry Rd - Upper E. Rock Crk.	0	36.22	10.9		$ 9.3	$ 854	N/A	Y			Y	Y
22	044	Kenyon St. - Upper E. Rock Crk.	0	17.07	7.1		$ 4.5	$ 631	N/A	Y				Y
23	045	Lamont St. - Upper E. Rock Creek	0.03	17.17	7.4		$ 4.6	$ 620	$ 152.6	Y				Y
24	046	Park Road - Upper E. Rock Creek	0.01	17.38	7.1		$ 4.5	$ 634	$ 452.9	Y				Y
25	047	Ingleside Terr. - Upper E. Rock Crk.	0.25	18.16	7.2		$ 4.9	$ 694	$ 19.9	Y				Y
26	048	Oak St-Mt Pleasant Upper E Rock C.	0.08	26.06	9.6		$ 7.0	$ 733	$ 87.6	Y				Y
27	050	M St -27th St - West Rock Creek	0	36.41	16.0		$ 8.3	$ 516	N/A	Y	Y			Y
28	051	Olive - 29th St. - West Rock Creek	0	11.87	5.2		$ 3.2	$ 614	N/A	Y				Y
29	053	Q St - West Rock Creek	0	5.50	0.4		$ 0.9	$ 1,934	N/A	Y				Y
30	058	Connecticut Ave.	0	5.24	1.6		$ 0.9	$ 595	N/A	Y	Y			Y
		Subtotal		**1,288**			**$325**							
31	009	B St./N.J. Ave	16.84	41.27	23.6		$ 17.1	$ 723	$ 1.0			Y		
32	010, 011, 011a	B St./N.J. Ave - O St. pumped	247.21	732.72	175.2		$ 198.9	$ 1,135	$ 0.8					
33	012	Tiber Creek	21.74	1,153.83	459.0	6%	$ 414.6	$ 903	$ 19.1					
34	019	Northeast Boundary	854.81	4,242.39	1,565.8		$ 1,224.1	$ 782	$ 1.4					
35	020	Easby Point	54.81	573.14	343.2	10%	$ 215.9	$ 629	$ 3.9					
36	022	I St. - 22nd St, NW	30.04	125.23	36.0		$ 46.9	$ 1,300	$ 1.6					
37	027	Georgetown	52.5	179.38	77.8		$ 47.3	$ 608	$ 0.9			Y		
38	029	College Pond	26	300.79	90.4	11%	$ 77.2	$ 854	$ 2.9					
39	034, 021	Slash Run Trunk Sewer	458.43	473.78	252.7	23%	$ 134.8	$ 534	$ 0.3					
40	035	Northwest Boundary	0	546.69	193.5		$ 154.2	$ 797	N/A					
41	036	Mass Ave & 24th - E. Rock Crk.	1.64	69.76	19.8		$ 12.3	$ 621	$ 7.5					
42	039	Belmont Rd - East Rock Creek	0	54.25	13.1		$ 12.8	$ 981	N/A					

No.	CSO NPDES No.	Description	Overflow Volume (mg/yr)	Drainage Area (ac)	Imperv. Area (ac)	% Area Already Separated	Capital Cost ($M)	$/Imp Acre (x $1000)	$/mg overflow ($M)	By Cap Cost?	By $/Imp Area?	By $/ OF Vol?	Near Public Use Area?	Consider for Targeted Separation?
43	043	Irving St. - Upper E. Rock Crk	0.15	70.31	28.7		$ 18.6	$ 649	$ 124.1					
44	049	Piney Branch	39.73	2,433.20	675.3	4%	$ 437.2	$ 647	$ 11.0					
45	052	O St.-31st St, NW	0	108.50	47.4		$ 28.5	$ 601	N/A		Y			
46	057	Cleveland - 28th St & Conn. Ave	2.33	84.50	16.6		$ 19.4	$ 1,175	$ 8.3					

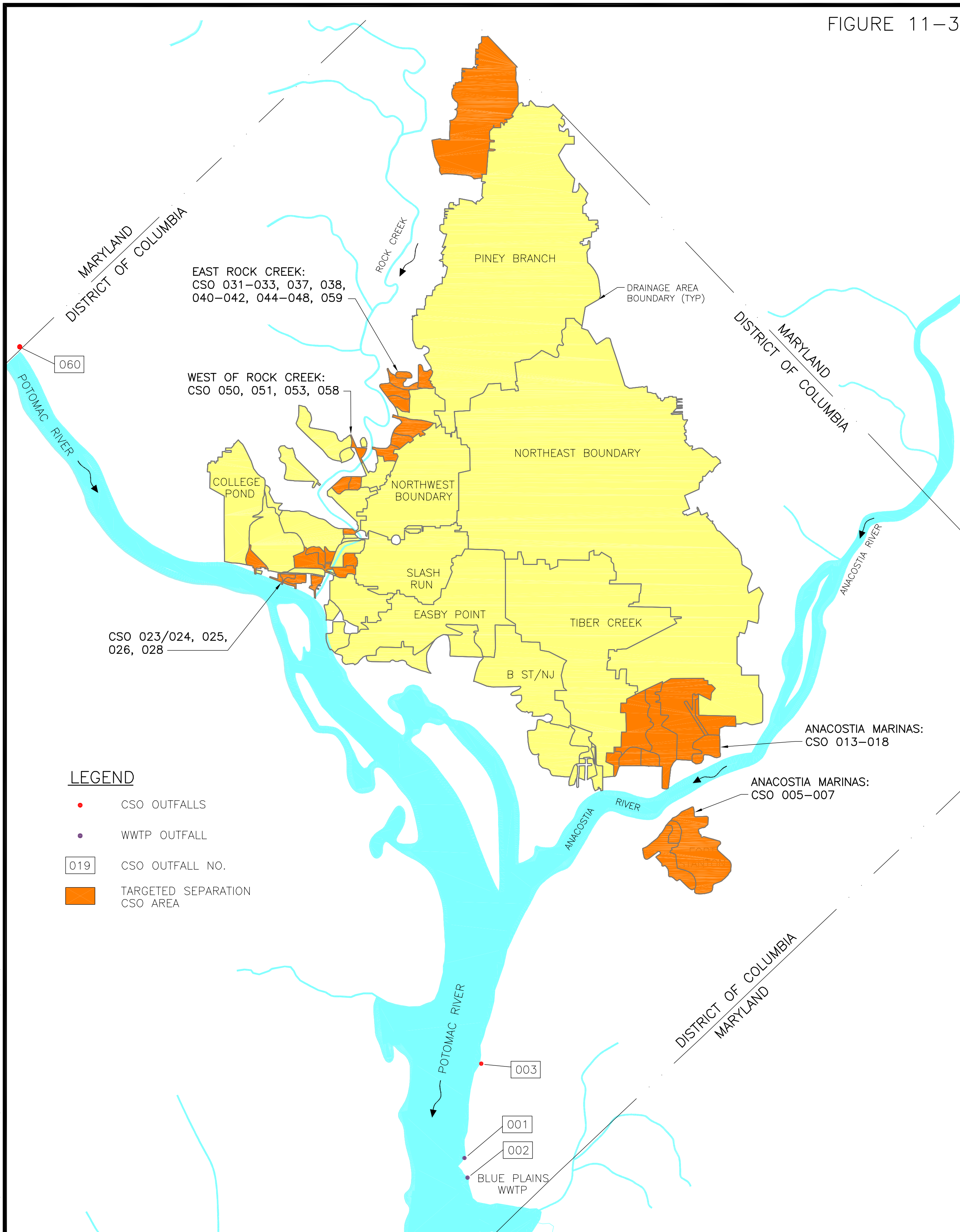
Based on this analysis, the top 30 outfalls in the table above were considered for targeted separation. They comprise a drainage area of 1,288 acres and the capital cost of separation is estimated to be $325 million. Figure 11-3 shows the locations of the targeted separation areas. The results of the further assessment of targeted separation are discussed later in this chapter.

11.2.3 Outfall Consolidation

Reducing the number of outfalls has been a concern to WASA. A number of commenters also expressed interest in this matter. Consolidation refers to eliminating outfalls by routing the discharge so that it is joined with one or more other outfalls. While consolidation does not reduce the overflow, it allows it to occur at a place that may cause less of an impact. In addition to targeted separation, commenters requested that consideration be given to eliminating outfalls via consolidation. Commenters suggested that emphasis be placed on outfalls near public access areas such as the Anacostia Marinas and the boathouses along the Georgetown waterfront.

An evaluation of the feasibility of consolidation was conducted. The premise of consolidation was that the existing outfalls would be conveyed to the tunnel. Flow beyond the capacity of the tunnel would be conveyed through the tunnel to a discharge point. The tunnel must be in place before the outfalls can be consolidated since its carrying capacity is necessary to prevent upstream flooding. Outfalls in the Georgetown waterfront and in the Anacostia Marinas areas were determined to be feasible for consolidation. These outfalls are summarized in Table 11-4 and are shown on Figure 11-4. The peak flow rates from these drainage areas that must be conveyed through the tunnel system to the discharge points are also shown.

FIGURE 11-3



TARGETED SEPARATION CSO AREAS

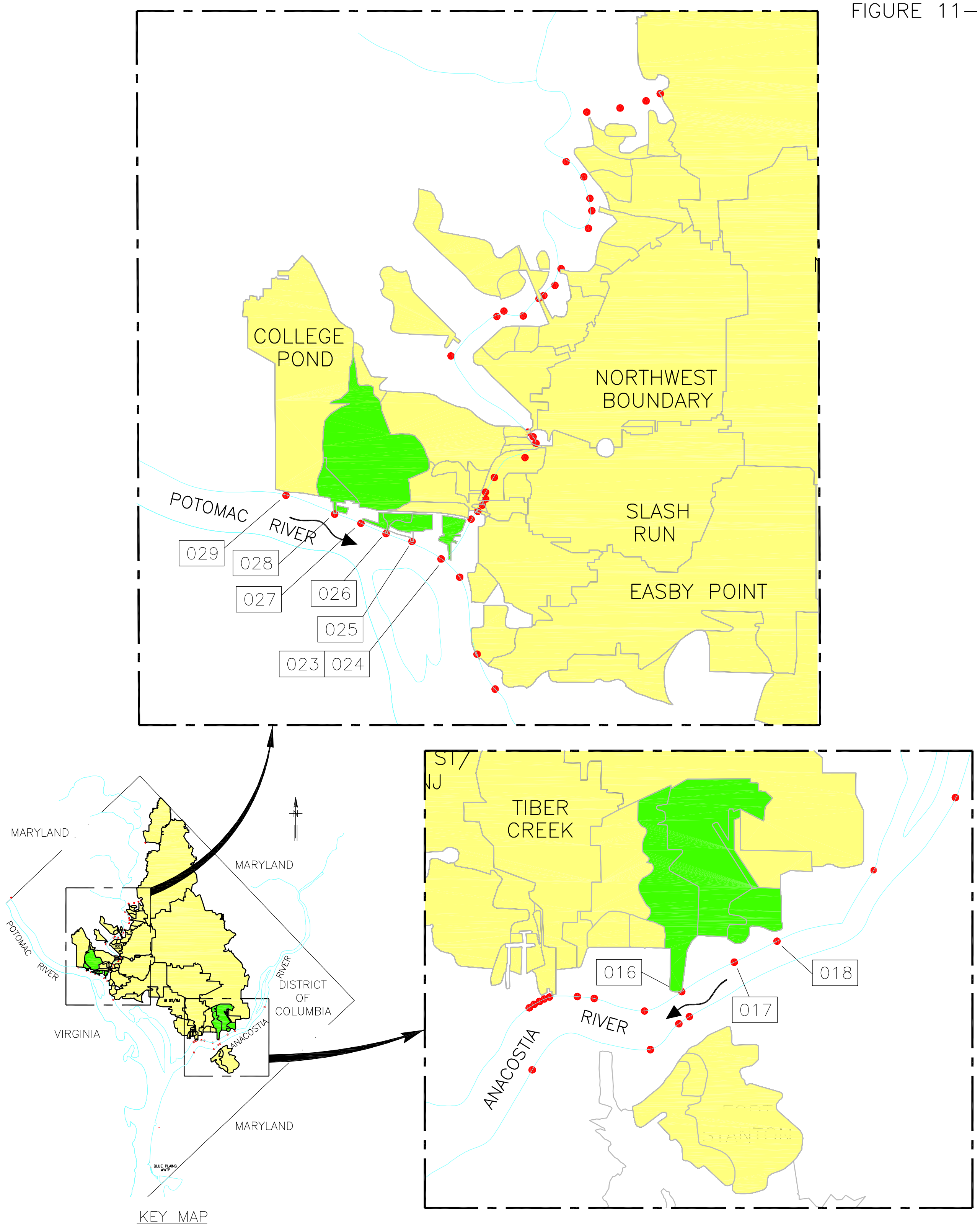
NOT TO SCALE

EPMC–III
GREELEY AND HANSEN LLC

D.C. WATER AND SEWER AUTHORITY
CSS LONG TERM CONTROL PLAN

FILE: J:\1160\DWGS\LTCP\FINAL-LTCP\FINF11-3 1:1 07/01/02 10:04 GH-G

FIGURE 11-4



LEGEND

- CSO OUTFALLS
- 019 CSO OUTFALL NO.
- OUTFALLS FOR CONSOLIDATION

OUTFALLS FOR CONSOLIDATION

NOT TO SCALE

EPMC-III
GREELEY AND HANSEN LLC

D.C. WATER AND SEWER AUTHORITY
CSS LONG TERM CONTROL PLAN

Table 11-4
Outfalls Feasible for Consolidation

CSO Outfall	*Peak Flow Rate to be Diverted to New Location (mgd)*
Anacostia CSOs	
CSO 016	497
CSO 017	588
CSO 018	575
Potomac CSOs	
CSO 023/024	470
CSO 025	24
CSO 026	30
CSO 027	360
CSO 028	70

Conceptually, the relief for the consolidated Anacostia CSOs was envisioned to occur at Main and O Street Pumping Stations. Similarly, the relief for the consolidated Potomac CSOs was envisioned to occur near the Memorial Bridge at CSO 021.

11.2.4 Low Impact Development-Retrofit

General

In the draft LTCP, LID–R was assumed to be applied over 15% of the impervious areas in the entire District (not just the CSS area). Many comments were received indicating that a higher degree of LID-R could be applied, that LID-R should focus on the combined sewer area, and that LID-R was more effective and less costly than indicated in the draft LTCP. In response to these comments, a range of LID-R application rates was analyzed and the costs and benefits were reassessed.

Modeling Approach

The overall goal of LID is to mimic the natural environment and the infiltration that occurs in natural surfaces. Natural surfaces are limited in how fast they can take water (i.e. max infiltration rate) and in how much water they can absorb before saturation. A modeling technique was thus sought that would reflect these complexities.

In addition, there are many LID-R technologies and each has a different applicability, effectiveness and cost. Since the LTCP must assess CSO control benefits on a CSO outfall and city-wide basis, it was not possible to identify which technology would be applied on each street, alley or lot. Instead, a more general modeling approach was needed.

Given these factors, LID-R was modeled by converting impervious area in the model to pervious area. Converting impervious area to pervious area has the benefits of decreasing runoff as would occur with LID-R, and increasing the overall travel time of runoff to reduce flow peaks. A range of conversions of existing impervious area to pervious areas was modeled as follows: 0% (existing conditions), 10%, 50%, and 100%. The 100% conversion is the fairly unrealistic condition where all impervious area is converted to pervious.

There is a practical interpretation of this modeling approach. To achieve the performance of the 10% conversion scenario, enough LID-R would need to be installed such that 10% of the impervious area acts like pervious area. It would not be necessary to eliminate 10% of the impervious area. Instead, enough LID-R measures could be installed so that 10% of the impervious area drains to the LID-R measures and the measures are sized large enough to act like pervious areas. The same applies for the higher degrees of impervious area conversion.

The results of the CSS model indicated that about 20% of the rain in an average year runs off from pervious areas, whereas 80% runs off from impervious areas. To determine the number of LID-R facilities required to achieve a specified reduction in effective imperviousness, this relationship was used. To mimic pervious conditions, the quantity and sizing of LID facilities was determined by using enough of them and sizing them large enough to capture all but 20% of the runoff in the average year. By reviewing all storms in the 1988-1990 average year evaluation period selected for the LTCP (1988-1990), it was determined that if the first 1.25” of rain could be captured, then 80% of the runoff would be captured and 20% would be runoff. This was used as the basis for determining the number and sizes of LID-R measures.

Type and Cost of LID-R Facilities Required

Based on a literature review, the performance and cost of more than 20 LID-R technologies were determined. The costs were converted to a dollars per impervious acre treated at 1.25” of rain for comparison purposes. In addition, layouts and sizing were performed for technologies which appear to have good potential for applicability in built-up urban areas: infiltrating curbs, street tree filters and infiltrating catch basins. Detailed information on the literature review and cost estimation is included in Appendix E.

Some of the most economical technologies in the literature such as detention basins and filter strips were based on excavating earthen basins in undeveloped areas. These types of facilities are not applicable to built-up areas like the District and were not included in the analysis.

A mix of LID technologies was selected to generate a unit cost per acre for LID-R. The mix was selected as identified in Table 11-5.

Table 11-5
Unit Costs for LID Application

LID-R Technology	*$/Imp Ac*	*% Applied*	*Base Construction Cost*	*Construction Cost with 30% Contingency*	*Capital Cost*
Bioretention	$ 26,000	25%	$ 6,500	$ 8,450	$ 9,100
Sand Filters	$ 55,000	15%	$ 8,250	$ 10,725	$ 11,550
Porous Pavement on Sidewalks	$ 90,000	15%	$ 13,500	$ 17,550	$ 18,900
Infiltrating catch basins	$370,000	15%	$ 55,500	$ 72,150	$ 77,700
Infiltrating curbs	$ 77,000	20%	$ 15,400	$ 20,020	$ 21,560
Street Tree Filters	$423,000	10%	$ 42,300	$ 54,990	$ 59,220
Total $/Imp ac(rounded)		100%	$142,000	$ 184,000	$ 198,000
Total $/acre @ 25% Impervious (rounded)			$ 35,363	$ 46,000	$ 50,000
Total $/acre @ 65% Impervious (rounded)			$ 92,000	$ 120,000	$ 129,000

Results

The CSS model was used to predict the effect on CSO overflow volumes of converting impervious area to pervious through the application of LID-R. The model was run for two scenarios: Phase I Controls and Pump Station Rehabilitations and the Draft LTCP. The results are summarized in Table 11-6. The results show that CSO overflows can be reduced substantially by the application of high levels of LID-R. In addition, the analyses suggest that runoff from pervious areas can cause some CSOs, particularly during the most extreme events.

Table 11-6
Effect of LID-R on CSO Overflow Volumes- Summary

	% Impervious Area Converted to Pervious			
Parameter	*0% (Exist.)*	*10%*	*50%*	*100%*
Drainage Area Characteristics				
Total Drainage Area (ac)[1]	12,477	12,477	12,477	12,477
Acres of Impervious Area in CSO Area (ac)	5,070	4,563	2,535	0
Acres of Impervious Area in CSO Area Treated by LID-R (ac)	0	507	2,535	5,070
Total Runoff from CSS (mg/yr)	7,839	7,353	5,397	2,929
% of Rain Appearing as Runoff (%)	56%	53%	39%	21%
CSO Overflow Volume (mg/average yr)				
Phase I Controls and Pump Station Rehabilitation (Scenario C3)	1,969	1,814	1,305	810
Draft LTCP (Scenario D70A)	259	217	102	In progress
Added Capital Cost for LID-R ($ Millions)	$0	$129	$646	$1,292

Notes:

1. Excluding CSO 059, Luzon Valley. This CSO has been separated.

The effect of varying levels of LID on an outfall by outfall basis is shown in Table 11-7.

Table 11-7

Effect of LID-R on CSO Overflow Volumes- By Outfall

		% Impervious Land Converted to Pervious Land							
		0%		*10%*		*50%*		*100%*	
NPDES No.	*Description*	*# of Overflows*	*CSO Overflow Volume (mg/yr)*	*# of Overflows*	*CSO Overflow Volume (mg/yr)*	*# of Overflows*	*CSO Overflow Volume (mg/yr)*	*# of Overflows*	*CSO Overflow Volume (mg/yr)*
	Anacostia CSOs								
004	Poplar Pt. Bypass	0	0.00	0	0.00	0	0.00	0	0.00
005	Fort Stanton	73	16.54	71	15.08	55	9.96	23	6.34
006	Fort Stanton	5	0.11	4	0.10	3	0.07	2	0.04
007	Fort Stanton	64	36.97	63	34.07	45	23.96	23	16.18
008	AMI	0	0.00	0	0.00	0	0.00	0	0.00
009	B St./N.J. Ave	54	16.84	51	15.55	39	11.02	25	7.01
010	B St./N.J. Ave - O St. pumped	18	247.21	16	229.33	13	170.06	10	87.47
011	B St./N.J. Ave - Main pumped	0	0.00	0	0.00	0	0.00	0	0.00
011a	B St./N.J. Ave - Main gravity	0	0.00	0	0.00	0	0.00	0	0.00
012	Tiber Creek	6	21.74	6	15.87	4	12.51	4	5.42
013	Canal Street Sewer	28	9.78	27	9.04	24	6.58	20	3.93
014	Navy Yard	49	38.98	46	36.18	33	26.05	28	16.83
015	Navy Yard	12	0.72	11	0.69	11	0.58	9	0.47
016	Navy Yard	24	13.30	24	12.59	21	9.97	17	7.40
017	Navy Yard	32	20.05	30	18.37	20	12.76	13	7.99
018	Navy Yard	35	4.70	32	4.20	14	2.61	11	1.43
019	Northeast Bound. - Swirl Effluent	36	645.64	33	587.48	25	392.09	15	235.38
019	Northeast Bound. - Swirl Bypass	13	209.17	13	189.14	11	133.47	8	73.06
	Anacostia Subtotal	**75**	**1,282**	**74**	**1,168**	**56**	**812**	**29**	**469**
	Potomac CSOs								
003	Bolling AFB	0	0.00	0	0.00	0	0.00	0	0.00
020	Easby Point	21	54.81	21	53.02	19	45.88	18	36.46
021	Slash Run	30	458.43	29	432.45	25	335.93	23	235.40
022	I St. - 22nd St, NW	30	30.04	29	28.03	26	21.06	22	14.13
023/024	West Rock Creek Diversion Sewer	17	16.23	16	14.73	14	10.21	9	5.80
025	31st & K St NW	14	0.16	12	0.15	9	0.09	5	0.05
026	Water St District (WRC)	0	0.00	0	0.00	0	0.00	0	0.00
027	Georgetown	72	52.50	71	46.85	57	26.37	21	11.27
028	37th St- Georgetown	13	0.49	12	0.45	8	0.31	5	0.19
029	College Pond	56	26.00	53	23.98	38	17.03	24	11.13
030	Abandoned	--	--	--	--	--	--	--	--
060	Little Falls Branch Emerg. Bypass	0	0.00	0	0.00	0	0.00	0	0.00
	Potomac Subtotal	**74**	**639**	**72**	**600**	**58**	**457**	**26**	**314**
	Rock Creek CSOs								
031	Penn Ave - Middle E. Rock Creek	9	0.22	9	0.20	8	0.16	6	0.11
032	26th - M St - Middle E. Rock Creek	0	0.00	0	0.00	0	0.00	0	0.00
033	N St. - 25th St - Middle E. Rock Crk.	6	4.48	6	4.16	5	2.99	3	1.89
034	Slash Run Trunk Sewer	0	0.00	0	0.00	0	0.00	0	0.00
035	Northwest Boundary	0	0.00	0	0.00	0	0.00	0	0.00
036	Mass Ave & 24th - E. Rock Crk.	29	1.64	28	1.55	25	1.23	22	0.87
037	Kalorama Circle West - E. Rock Crk.	3	0.05	3	0.05	3	0.04	3	0.03
038	Kalorama Circle East - E. Rock Crk.	0	0.00	0	0.00	0	0.00	0	0.00
039	Belmont Rd - East Rock Creek	0	0.00	0	0.00	0	0.00	0	0.00
040	Biltmore St - East Rock Creek	1	0.03	1	0.03	1	0.02	1	0.01
041	Ontario Rd - Upper E. Rock Crk.	0	0.00	0	0.00	0	0.00	0	0.00
042	Quarry Rd - Upper E. Rock Crk.	0	0.00	0	0.00	0	0.00	0	0.00
043	Irving St. - Upper E. Rock Crk	1	0.15	1	0.13	1	0.06	1	0.01
044	Kenyon St. - Upper E. Rock Crk.	0	0.00	0	0.00	0	0.00	0	0.00
045	Lamont St. - Upper E. Rock Creek	2	0.03	2	0.03	2	0.02	2	0.01

NPDES No.	Description	0% # of Overflows	0% CSO Overflow Volume (mg/yr)	10% # of Overflows	10% CSO Overflow Volume (mg/yr)	50% # of Overflows	50% CSO Overflow Volume (mg/yr)	100% # of Overflows	100% CSO Overflow Volume (mg/yr)
		% Impervious Land Converted to Pervious Land							
046	Park Road - Upper E. Rock Creek	2	0.01	2	0.01	1	0.00	1	0.00
047	Ingleside Terr. - Upper E. Rock Crk.	3	0.25	3	0.23	1	0.16	1	0.10
048	Oak St-Mt Pleasant Upper E Rock C.	2	0.08	2	0.07	2	0.05	2	0.03
049	Piney Branch	25	39.73	25	37.70	22	30.22	19	22.51
050	M St -27th St - West Rock Creek	0	0.00	0	0.00	0	0.00	0	0.00
051	Olive - 29th St. - West Rock Creek	0	0.00	0	0.00	0	0.00	0	0.00
052	O St.-31st St, NW	0	0.00	0	0.00	0	0.00	0	0.00
053	Q St - West Rock Creek	0	0.00	0	0.00	0	0.00	0	0.00
054	West Rock Creek Diversion Sewer	0	0.00	0	0.00	0	0.00	0	0.00
055	Aband (Mass Ave & Whitehaven)	0	0.00	0	0.00	0	0.00	0	0.00
056	Normanstone Dr.-relief for WRCDS	0	0.00	0	0.00	0	0.00	0	0.00
057	Cleveland - 28th St & Conn. Ave	15	2.33	14	2.13	11	1.46	7	0.90
058	Connecticut Ave.	0	0.00	0	0.00	0	0.00	0	0.00
	Rock Creek Subtotal	**30**	**49**	**30**	**46**	**27**	**36**	**24**	**26**
	TOTAL		**1,969**		**1,814**		**1,305**		**810**

Varying degrees of LID-R are combined with other CSO controls in subsequent sections to develop complete control plans.

11.2.5 Limits On Blue Plains

Blue Plains Wastewater Treatment Plant (BPWWTP) is rated for an annual average flow of 370 mgd. During wet weather events, flows up to 740 mgd can receive treatment for up to 4 hours. After the first 4 hours, the treatment capacity is reduced to 511 mgd to protect the biological process. Additional flows of up to 336 mgd that exceed the treatment capacity of the plant receive excess flow treatment, which consists of screening, grit removal, primary treatment and disinfection before discharge to the Potomac River. This results in an overall plant capacity of 1076 mgd for the first four hours and 847 mgd thereafter.

The current NPDES permit has no limit on how long the treatment plant must operate at 511 mgd during wet weather events. During back to back storms or during sustained hurricanes, the plant could be called upon to operate at 511 mgd for extended periods. Experience indicates that operation at 511 mgd indefinitely is not practical. Such operation would cause process washouts and failure of the nitrification/denitrification processes. In order to prevent such occurrences, the alternatives for the LTCP have been based upon treating up to 740 mgd for four hours and up to 511 mgd for the next 20 hours (total time of 4 hours +20 hours = 24 hours). After 24 hours, the maximum flow treated by the plant would be 450 mgd. The flow rate of 450 mgd is the maximum sustained rate that the plant can accommodate for an extended period of time.

11.2.6 Excess Flow Treatment at Blue Plains

The CSO Policy recognizes that treatment plants may have primary treatment capacity in excess of secondary treatment capacity and that maximizing the use of this capacity can be an effective approach to CSO control. The CSO Policy considers CSO flows that enter the headworks of a plant but that do not receive secondary treatment to be a bypass, and indicates that such CSO bypasses may be permitted provided that:

- Justification for the flow rate at which CSO will be diverted from secondary treatment is made.
- A cost-benefit analysis demonstrates that this approach is more beneficial than other CSO abatement alternatives such as storage and pump back for secondary treatment, sewer separation and satellite treatment.
- The treatment approach is recognized in the NPDES Permit.

At BPWWTP, excess flows up to 336 mgd receive excess flow treatment and are discharged at outfall 001. Excess flow treatment consists of screening, grit removal, primary clarification, disinfection and dechlorination. This subsection provides justification that outfall 001 is a CSO and that it meets the requirements of the CSO policy as specified above.

Blue Plains was originally designed and constructed in the 1930s to provide only primary treatment. The discharge from the original plant was through the outfall now designated as 001. The plant was upgraded many times and the outfall now designated as 002 was added in the 1970s for the discharge of flow receiving advanced treatment. Two outfalls were needed because the secondary and new advanced treatment facilities were not designed with sufficient capacity to treat total peak wet weather flows for which the primary treatment facilities were designed.

These two separate outfalls were incorporated into the first NPDES permit issued for Blue Plains in the 1970s. At that time, the original primary treatment outfall was designated outfall 001 for excess flow and the secondary outfall was designated as outfall 002 for complete treatment. This "two-outfall" concept has been retained since then through several plant upgrades and expansions as well as successive permit reissuances and amendments. Fact Sheets accompanying these permit reissuances and amendments have noted that outfall 001 is the excess flow conduit, used primarily to avoid hydraulic overloads at the plant.

The cut-off point for diversion of excess flow from secondary treatment is 740 mgd for the first four hrs, 511 mgd for the next 20 hours and 450 mgd thereafter. The selection of the 740/511 mgd rates was made after the Blue Plains Feasibility Study in 1984. The flow and time limits were developed to avoid washing out secondary biological processes. The 450 mgd limit was developed based on operating experience.

Cost-benefit analyses were made of other options for handling excess flows. The alternatives are described below:

- Alternative 1: Excess Flow System – maintain the current excess flow system, but improve its reliability by adding four additional primary clarifiers and making improvements to the excess flow control system
- Alternative 2: Add storage – abandon the existing excess flow treatment system, and increase the size of the proposed storage tunnels to provide the same degree of CSO control. Modeling indicates that 200 million gallons of additional storage would be required on top of the proposed 193 mg of storage in the LTCP, for a total of 393 million gallons. Because of the large storage volume required, BPWWTP would have inadequate capacity to dewater the tunnels before the next rain event (within 48-72 hours). As a result, this alternative includes a dedicated 200 mgd high rate treatment facility located at BPWWTP to dewater the tunnels.
- Alternative 3: Satellite Treatment – this involves constructing a remote high rate treatment facility. The facility has a capacity of 350 mgd (to replace the existing excess flow) and was sited for costing purposes on Federal property between Bolling Air Force Base and the Naval Air Station. Property would need to be acquired for this option. It may not be practical to obtain such property.
- Alternative 4: Replace Existing Excess Flow with High Rate Treatment – this involves replacing the existing excess flow system with a 350 mgd high rate treatment facility located at BPWWTP.
- Alternative 5 Separation – this alterative consists of separating approximately 60 % of the combined sewer area such that excess flow would no longer be required and CSO overflows would be reduced using the tunnels to the same degree of CSO control as proposed in the LTCP.
- Alternative 6 – Expand Secondary Treatment capacity of BPWWTP – this alternative consists of expanding the capacity of BPWWTP downstream of the primary facilies by 336 mgd. Given the lack of land at the site and the large increase in capacity required compared to the capacity of the existing plant (336 mgd vs. 370 mgd average), this option has been deleted from further consideration.

The alternatives are summarized in Table 11-8.

Table 11-8
Comparison of Alternatives to Excess Flow

Alternative	*Sizing*	*Capital Cost ($millions, ENR = 6383)*	*% Above Lowest Cost*
1. Excess Flow System	336 mgd, modifications to improve reliability	$22	0 %
2. Add Storage	Add 200 mg tunnel storage,	$784	3,464 %

Alternative	*Sizing*	*Capital Cost ($millions, ENR = 6383)*	*% Above Lowest Cost*
	and 200 mgd high rate treatment to dewater tunnel		
3. Satellite Treatment	350 mgd high rate treatment	$363	1,550 %
4. Replace Existing Excess Flow with High Rate Treatment	Add 350 mgd High Rate Treatment	$279	1,168 %
5. Separation	Separate 60% of CSO area	$2,125	8,400 %
6. Expansion of BPWWTP	Not feasible	Not feasible	--

Alternatives 2 through 5 are an order of magnitude more expensive than retaining the excess flow system with improvements.

The water quality benefits of Alternatives 2 through 5 were estimated using the Potomac receiving water model. The results are shown in Table 11-9. The results indicate that even with the existing storm water and upstream loads present, the Potomac River is predicted to meet the Class A fecal coliform standard every month in the average year. Given the high cost of the alternatives to excess flow and the lack of substantive water quality benefit, the recommended approach is to retain the excess flow treatment system, with modifications to improve its reliability.

Table 11-9
Water Quality Benefits of Alternatives to Excess Flow

Alternative	*No. of Months/avg year Fecal Coliform Geometric Mean >200/100ml*	
	All Loads Present	CSO Loads Only (no upstream or storm water loads)
1. Excess Flow System	0	0
2. Eliminate Excess flow or provide High Rate Treatment (Alternatives 2 through 5)	0	0

11.2.7 Effect of B Street/ New Jersey Avenue Sewer

The Rock Creek Main Interceptor starts in upper Rock Creek and conveys flows south to the Potomac area sewers. Near lower Rock Creek, the Rock Creek Main Interceptor turns into the B Street/New Jersey Avenue sewer, which conveys flows through the Potomac area to the Main Pumping Station along the bank of the Anacostia River. The B Street/New Jersey Avenue sewer acts to transfer flows from the Rock Creek and Potomac areas to the Anacostia River.

Modeling was performed to determine the effect of terminating this connection in an attempt to reduce CSO to the Anacostia River. The results are summarized in Table 11-10.

Table 11-10
Effect of Shutting off Inter-basin Transfer at B St/ New Jersey Ave Combined Sewer (Average Year 1988-1990)

Item	*Anacostia River*	*Potomac River*	*Rock Creek*	*Total System*
CSO Overflow Volume (mg/yr)				
Phase I Controls & Pump Station Rehabilitation	1,282	639	49	1,969
As above with B St/ NJ Ave connection shut off	1,142	664	50	1,857
% Change	**-11 %**	**+ 4%**	**+ 2%**	**-6%**
Number of Overflows/yr				
Phase I Controls and Pump Station Rehabilitation	75	74	30	-
As above with B St/ NJ Ave connection shut off	75	74	29	-
% Change	**0%**	**0%**	**3%**	-

Preventing the transfer of flow from the Potomac area to the Anacostia has the effect of decreasing Anacostia CSOs, but increasing Potomac and Rock Creek CSOs. This is consistent with the operation of the sewer. During extreme storm events, the inter-basin transfer would need to be maintained to prevent flooding in upstream areas. As a result, some type of automatically operated gate would likely be required. Such a system would be difficult to operate and maintain give the constant flows in the interceptor.

Due to the detrimental effect on the Potomac River and since Potomac controls are proposed to be constructed later in the schedule, terminating eth inter-basin transfer is not proposed as part of the LTCP.

11.3 DESCRIPTION OF ALTERNATIVES

11.3.1 General

In response to comments and upon further evaluation of the Draft plan, additional CSO control alternatives were developed and evaluated. Alternatives that combined multiple technologies such as tunnel storage, targeted separation, LID-R and other features were also developed. Some alternatives were developed to provide higher degrees of control than the Draft LTCP, while others were developed to provide equivalent performance though the use of alternative technologies. As an example, alternatives were developed where targeted separation and LID-R were included and the tunnels proposed in the Draft LTCP were downsized to provide performance equivalent to the Draft LTCP. Equivalent performance has been defined as providing the same number of overflows in the average year, not necessarily the same overflow volume. This is because some alternatives such as LID-R fundamentally change the relationship between overflow volume and number of overflows. The number of overflows was selected as an indicator of equivalent performance because it related to the number of times the use of the waterway may be affected by CSO discharges.

When considering the alternatives, it was useful to group them into categories based on the amount of CSO storage volume required. The required storage volume can be changed by the application of LID-R or separation, but the description of plans based on this criteria provides a comparison of the relative magnitude of control. The required storage volumes are summarized in Table 11-11, and the alternatives are summarized below.

Table 11-11
Range of CSO Storage Volumes Required for Alternatives

Alternative	*Required CSO Storage Volume (mg)*
Based on Draft LTCP	~150 mg
1-Year Storm and DOH Plan	~200-250 mg
2-Year Storm and Zero Overflows in 1988-1990	~430 mg
5 Year Storm	775+ mg

Except for the Draft LTCP, all alternatives include consolidation of CSOs 016, 017, and 018 on the Anacostia and CSO 023/024, 025, 026, 027, and 028 on the Potomac. Except for the Draft LTCP, all alternatives also include either one of the following:

- Targeted separation of the 30 CSO outfalls identified earlier in this section or
- Limited separation of the following outfalls:
  - CSO 006 on the Anacostia
  - CSOs 031, 037, 053, and 058 on Rock Creek

Limited separation was included as another option because of the high cost of the targeted separation outfalls.

11.3.2 Alternatives Based on Draft LTCP

One group of alternatives was based on the Draft LTCP with variations in targeted separation, LID-R, sanitary flow rates, wet weather peaking factors, and facility sizes. The alternatives can be grouped in the following categories:

- Addition of LID-R and Targeted Separation – these alternatives consist of the program outlined in the Draft LTCP with the addition of LID-R, targeted separation, and changes in the size of the tunnels to achieve different levels of control.

- Changes in District and Suburban Dry Weather Flow- Comments were received suggesting that WASA should reduce the base sanitary flow in the District by water conservation, infiltration control and other measures. In the Draft LTCP, the dry weather flow in the District was set at 158 mgd, equal to the IMA allowance. In 2002, The Metropolitan

Washington Council of Governments (MWCOG) completed wastewater flow projections for the BPWWTP, with a planning horizon of about 25 years. MWCOG uses the Regional Wastewater Flow Forecast Model (RWFFM) to project flows. The RWFFM is a computer model that links a GIS sewer shed layer with population projections to compute wastewater flows. The RWFFM develops a base year flow based on regression analysis of historical data. This is done to dampen the effects of short-term flow fluctuations. From the base year flow, the model then projects future flows based on population changes, infiltration and inflow allowances, and changes in wastewater management such as flow diversions to other treatment facilities.

MWCOG indicates that the year 2000 wastewater flow to the District was 160 mgd. The population in the District is projected to increase from about 518,000 in 2000 to about 648,000 in 2025. The unadjusted year 2025 wastewater flow from the District is projected to average 180 mgd. The term ‘unadjusted’ means it does not account for other changes in the sewer system. WASA plans a Wastewater Flow Reduction Program, a Water Conservation Program, and a Sewer System Assessment Program that are expected to achieve a total 20 mgd reduction in District Wastewater Flows. Considering these adjustments, MWCOG projects the flow from the District in 2025 to be 160 mgd. The year 2025 wastewater flow of 160 mgd is extremely close to the 158 mgd used in draft LTCP. As a result, the Draft LTCP does allow for substantial population growth in the District without an increase in overflows.

In order to demonstrate the impact of changes in sanitary flow on overflows, the following two alternatives were developed:

- Alternative D70F- Draft LTCP with District dry weather flow reduced to 138 mgd
- Alternative D70G - Draft LTCP with District DWF increased to 180 mgd

- Changes in Suburban Peaking Factors – Comments were received indicating that the wet weather peaking factors of the large suburban jurisdictions should be reduced as a form of CSO control. This was modeled by setting the peaking factors equal to 1 for the following large suburban flows: Potomac Interceptor, Rock Creek and WSSC Anacostia Pumping Stations which have IMA average flows of 54.6 mgd, 33.5 mgd, and 83.2 mgd, respectively. The total IMA average flow from these sources is 171.3 mgd or 81 % of the total flow of 212 mgd allocated to the suburbs. The large flows were selected because control of them would have a greater impact on CSOs and because they might be more cost effective to control than many small flows. For costing purposes, it was assumed that flow equalization basins would be constructed near the District Boundary to reduce the peaking factors.

11.3.3 Alternatives Based on 1-Year 24-Hour Storm

An alternative was developed that was sized to accommodate the 1-year storm. This alternative was then run for the 3-year evaluation period to determine its CSO performance in the average year. The analyses indicated that a CSO storage volume of 193 mg was required to control to the 1-year 24-hour storm. The tunnels in the Draft LTCP can be upsized to accommodate this requirement.

With BPWWTP operating at 450 mgd and with average flows of 370 mgd, it would take about 58 hours to dewater the tunnels if they were full. This is longer than the goal of 48 hours for dewatering. However, an evaluation of the frequency of the large events that would produce enough overflow to fill the tunnel was made. The analyses indicated that there are relatively few events in the year that will fill the tunnel to capacity. Given the low frequency with which this occurs, BPWWTP can accommodate the infrequent need to dewater the tunnels longer than 48 hours.

11.3.4 Alternatives Based on D.C. Department of Health Proposal

The D.C. Department of Health (DOH) proposed that the CSO controls for the Anacostia and Rock Creek be sized for no overflows in the dry and average year with 1 to 2 overflows in the wet year. DOH indicated the level of control proposed in the Draft LTCP was acceptable for the Potomac (9 overflows per year). In the three year analysis period, 1988 was the dry year with 31.74" of rain, 1990 was the average year with 40.94" of rain, and 1989 was the wet year with 50.32 " of rain.

The analyses indicated that the Anacostia and Rock Creek tunnel volumes would need to be increased and that the tunnels proposed in the Draft LTCP could be upsized to accommodate this increase. The total CSO storage volume required was determined to be slightly larger than that required for the the1-year storm 24-hour storm.

Figure 11-5 presents the major components of plans based on the Draft LTCP, the 1-year 24-hour storm and the DOH Plan.

11.3.5 Expanded Plan

An alternative was developed that provided the following level of CSO control:

- No overflows in the dry and average years, and 1 overflow in the wet year in the Anacostia and Rock Creek
- 4 overflows per year on the Potomac

The plan includes the tunnels proposed in the Draft LTCP upsized to accommodate the higher degree of control. Due to the large storage volume, BPWWTP has an inadequate capacity to dewater the tunnels in a reasonable amount of time. As a result, alternate means of treating the tunnel contents were required. This was accomplished by constructing a 350 mgd high rate physical chemical (High

Rate) treatment facility at BPWWTP. A dedicated force main would be constructed from the proposed tunnel dewatering pumping station at Poplar Point to the high rate facility. The tunnel contents would be dewatered through the high rate facility, disinfected, dechlorinated and discharged. During wet weather events, it was envisioned that the new high rate facility would be used in place of the existing excess flow treatment system at BPWWTP, and would treat up to 350 mgd of excess flow during rain events. This would provide a higher quality effluent than the existing excess flow treatment system. Figure 11-6 presents the major components of the expanded plan.

11.3.6 Alternatives Based on Zero Overflows in the Period 1988-1990

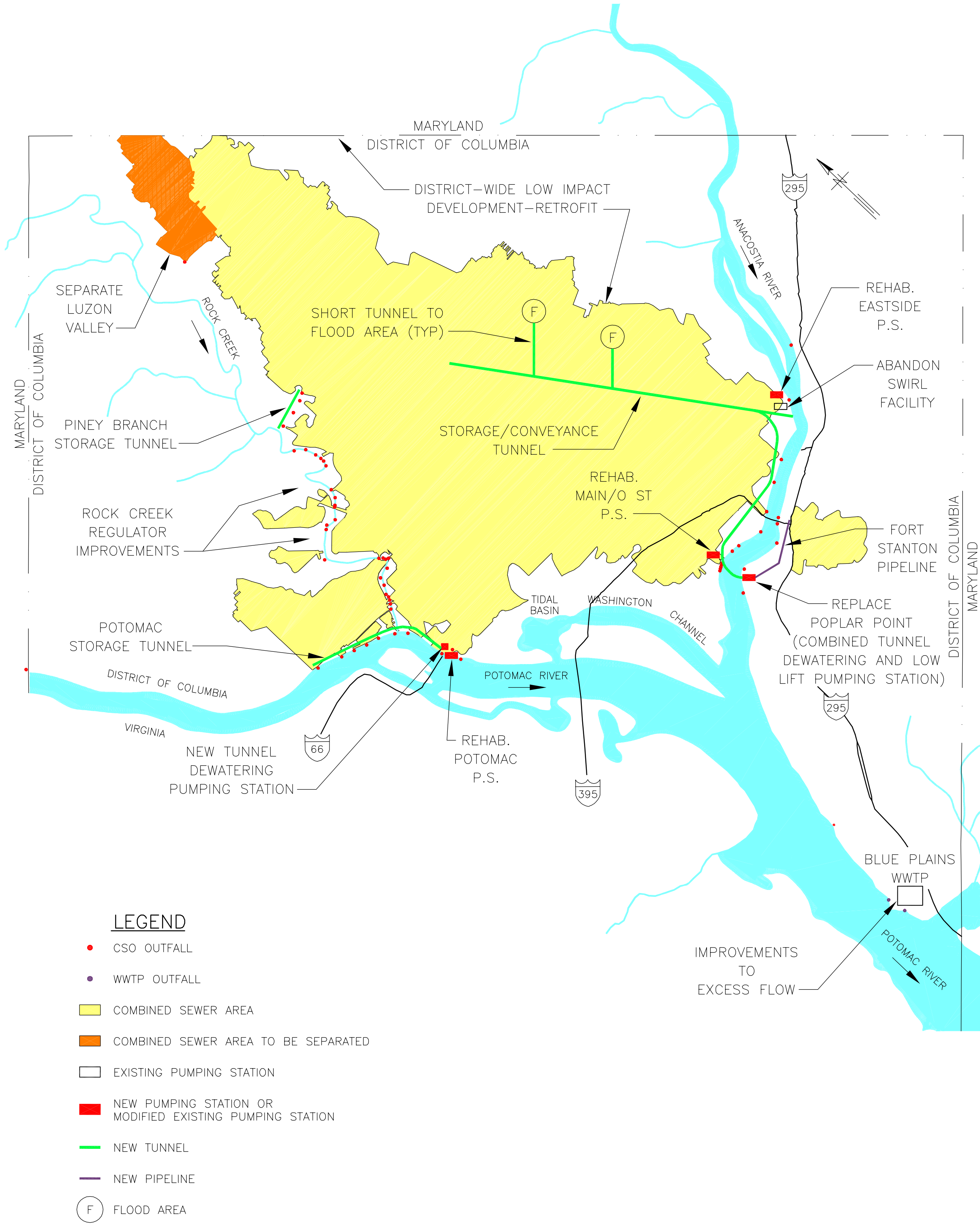
An alternative was developed to provide zero overflows in each of the three analysis years. Due to the large CSO storage volumes required, it was not feasible to simply increase the diameter of the tunnels proposed in the Draft LTCP. Instead, it was necessary to extend the tunnels as follows:

- Anacostia – extend the Anacostia tunnel from Poplar Point to BPWWTP
- Potomac – Extend the Potomac tunnel from the Potomac Pumping Station to connect with the Anacostia Tunnel near Main and O Street Pumping Stations
- Piney Branch- Delete the Piney Branch storage tunnel proposed in the Draft LTCP. Instead, extend the Anacostia tunnel along Florida Avenue up to Piney Branch to capture this overflow.
- Blue Plains – construct a 350 mgd high rate treatment facility and a central tunnel dewatering pump station at the plant. Dewater the tunnels through the high rate facility.

11.3.7 Alternatives Sized for 5-Year 24-Hour Storm

This alternative was sized for the 5-year 24-hour storm. The tunnels were configured as above for the zero overflow in three years option. Due to the large storage volume required, it was not feasible to capture all of the CSO in the tunnel. Instead, the first 773 mg is captured in the tunnel and the remainder is conveyed by the tunnel to Blue Plains where it treated by a 1,725 mgd sedimentation/ disinfection facility.

Figure 11-7 presents the major components of plans based on zero overflows in 1988-1990 and based on the 5-year 24-hour storm. A summary of the alternatives is included in Table 11-12.

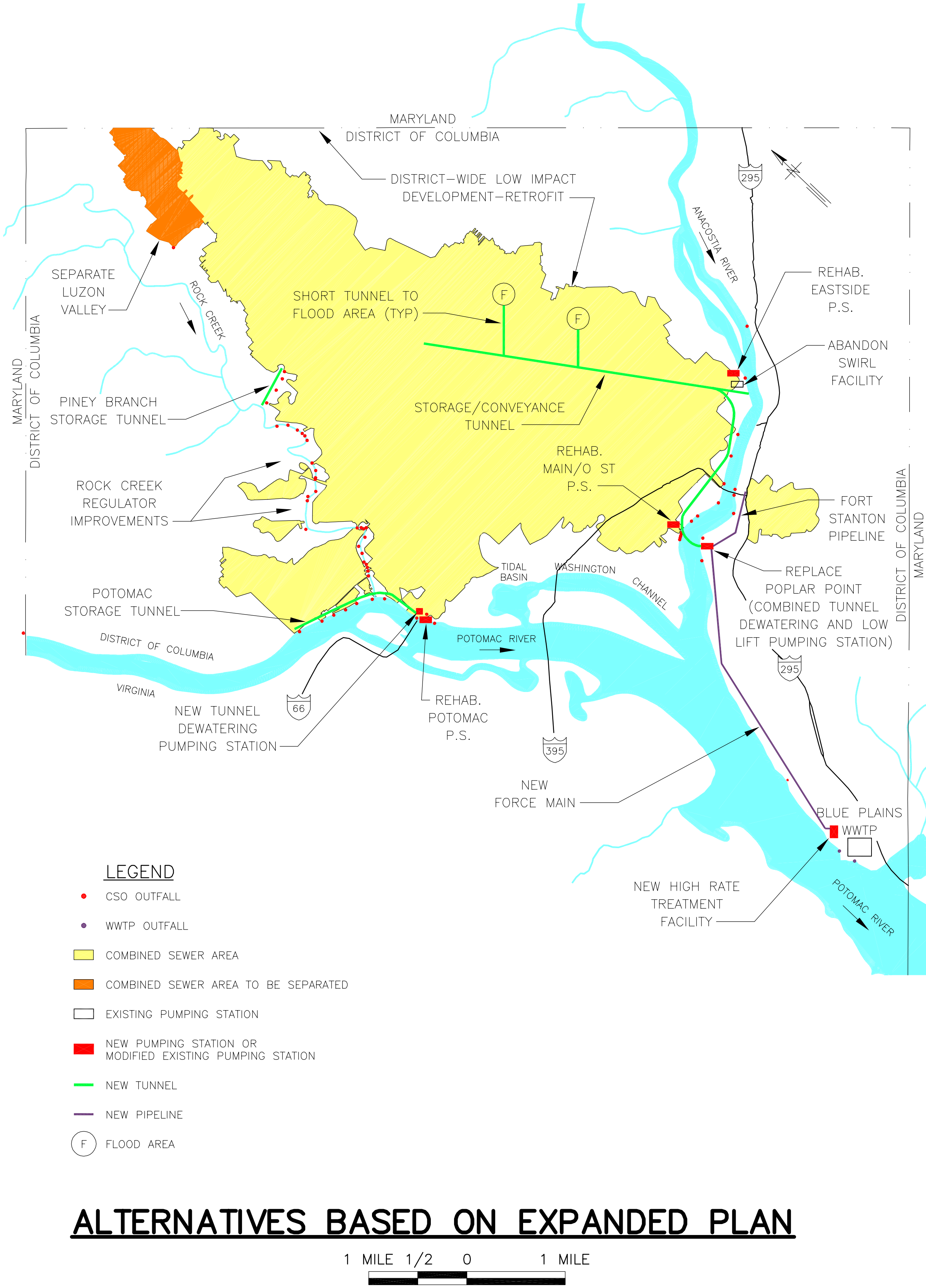


ALTERNATIVES BASED ON DRAFT LTCP, 1-YEAR 24-HOUR STORM AND DOH PLAN

1 MILE 1/2 0 1 MILE

EPMC-III
GREELEY AND HANSEN LLC

D.C. WATER AND SEWER AUTHORITY
CSS LONG TERM CONTROL PLAN



ALTERNATIVES BASED ON EXPANDED PLAN

EPMC-III
GREELEY AND HANSEN LLC

D.C. WATER AND SEWER AUTHORITY
CSS LONG TERM CONTROL PLAN

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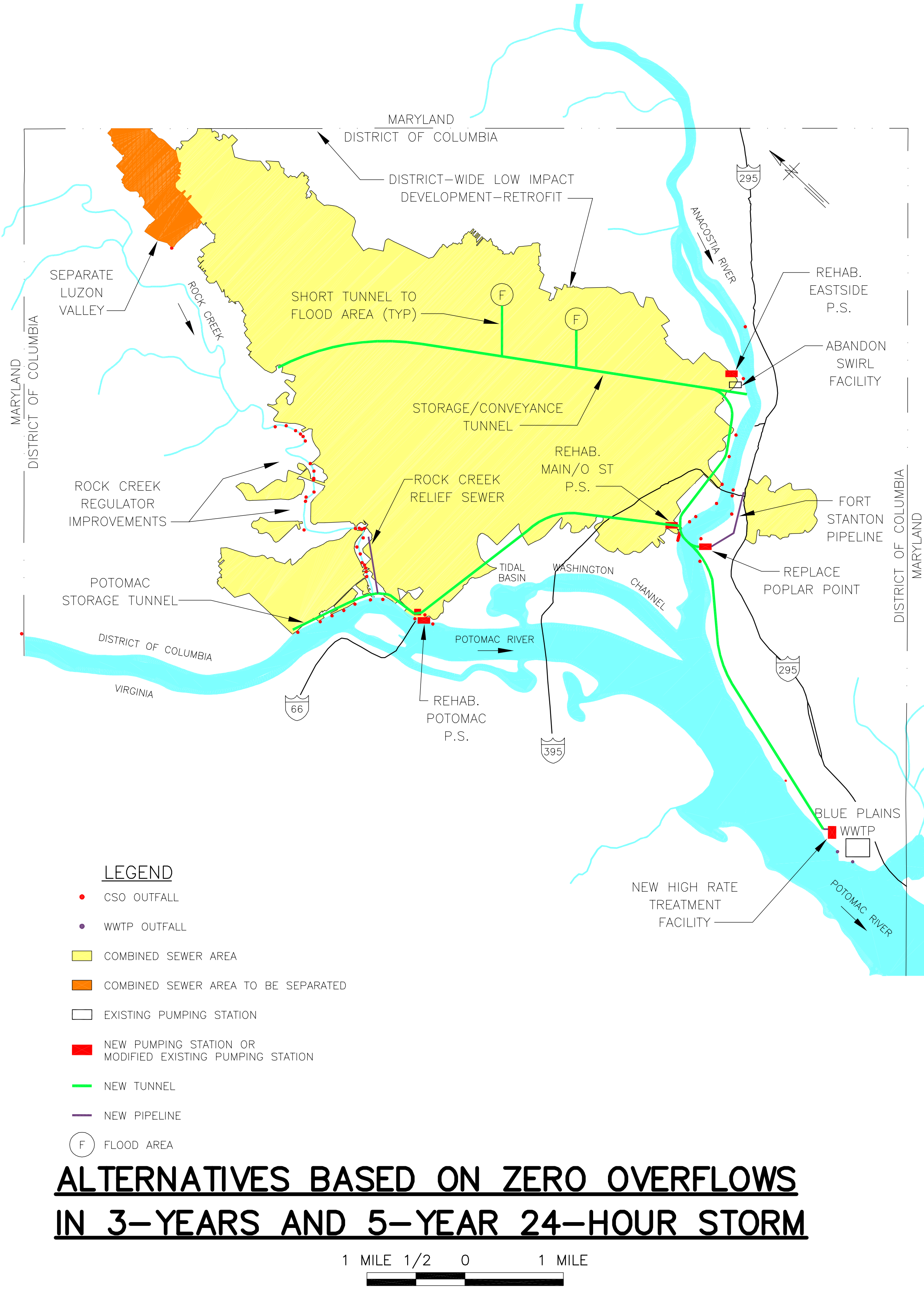

ALTERNATIVES BASED ON ZERO OVERFLOWS IN 3-YEARS AND 5-YEAR 24-HOUR STORM

EPMC-III
GREELEY AND HANSEN LLC

D.C. WATER AND SEWER AUTHORITY
CSS LONG TERM CONTROL PLAN

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Table 11-12

Description of Alternatives

Alternative	*LID @ WASA Facilities?*	*Other LID?*	*Target Separation?*	*Limited Separation?*	*Consolidation?*	*Notes*	*Alternative No.*
Based on Draft LTCP							
Draft LTCP	Yes	--	--	--	--		D70A
Draft LTCP + 10% LID-R	Yes	10%	--	Yes	Yes		D70B
Draft LTCP + 50% LID-R	Yes	50%	--	Yes	Yes		D70C
Draft LTCP + 10% LID-R (Equal Performance)	Yes	10%	--	Yes	Yes	Tunnels downsized to provide performance equivalent to Draft LTCP	D70J
Draft LTCP + 50% LID-R (Equal Performance)	Yes	50%	--	Yes	Yes	Tunnels downsized to provide performance equivalent to Draft LTCP	D70M
Draft LTCP + Target Separation (Equal Performance)	Yes	--	Yes	--	Yes	Tunnels downsized to provide performance equivalent to Draft LTCP	D70K
Draft LTCP + 10% LID-R + Targeted Separation	Yes	10%	Yes	--	Yes		D70D
Draft LTCP + 50% LID-R + Targeted Separation	Yes	50%	Yes	--	Yes		D70E
Draft LTCP + 10% LID-R + Targeted Separation (Equal Performance)	Yes	10%	Yes	--	Yes	Tunnels downsized to provide performance equivalent to Draft LTCP	D70I
Draft LTCP + No Peaking Factors for Large suburbs	Yes	--	--	Yes	Yes	Wet weather peaking factors for the following suburban flows reduced to 1.0 (i.e. no wet weather peak): Potomac Interceptor, Rock Creek, WSSC Anacostia Pumping Stations	D70F
Draft LTCP with District DWF Reduced to 138 mgd	Yes	--	--	Yes	Yes	District dry weather flow reduced from 158 mgd to 138 mgd	D70G
Draft LTCP with District DWF Increased to 180 mgd	Yes	--	--	Yes	Yes	District dry weather flow increased from 158 mgd to 180 mgd	D70L
1-Year Storm							
1 Year Storm	Yes	--	--	Yes	Yes		D70P
DOH Plan							
DOH Plan	Yes	--	--	Yes	Yes		D71A
DOH Plan+10% LID + Targeted Separation	Yes	10%	Yes	--	Yes		D71D
DOH Plan+10% LID + Targeted Separation (Equal Performance)	Yes	10%	Yes	--	Yes	Tunnels downsized to provide performance equivalent to Draft LTCP	D71F
Enhanced LTCP							
Enhanced LTCP	Yes	--	--	Yes	Yes		D75A

Alternative	*LID @ WASA Facilities?*	*Other LID?*	*Target Separation?*	*Limited Separation?*	*Consolidation?*	*Notes*	*Alternative No.*
Enhanced LTCP +10% LID (Equal Performance)	Yes	10%	--	Yes	Yes	Tunnels downsized to provide performance equivalent to Draft LTCP	D75J
Enhanced LTCP +10% LID + Targeted Separation (Equal Performance)	Yes	10%	Yes	--	Yes	Tunnels downsized to provide performance equivalent to Enhanced LTCP	D75I
Zero Overflows in 3 Years (~2-Year storm)							
Zero Overflows in 3 Years (~2-Year storm)	Yes	--	--	Yes	Yes		D72A
5-Year Storm							
Base Plan	Yes	--	--	Yes	Yes		D73C-5yr
Base Plan + 10% LID + Targeted Separation (Equal Performance)	Yes	10%	Yes	--	Yes	Tunnels downsized to provide performance equivalent to base Plan	D73E

11.4 EVALUATION OF ALTERNATIVES

Alternative control plans were evaluated against many criteria and were assembled into a matrix for comparison. The criteria were as follows:

- CSO Control Performance – the number of overflows and overflow volume in the average year was tabulated based on the combined sewer system model for each alternative.
- Cost - the capital cost, operation and maintenance cost and the 20-year net present worth was estimated for each plan.
- Water quality performance – using the receiving water models, the number of days in the calendar year when the fecal coliform concentration was predicted to exceed 200 per 100 ml was predicted. The prediction was made with background loads (storm water and upstream loads) at their existing levels, and with background loads set to zero. The scenarios with background loads set to zero accentuates the impact of CSOs and makes it possible to distinguish between alternative control plans. It also indicates the number of days per average year that CSOs will have an impact on the receiving waters.
- Impact on Blue Plains – The method of dewatering the storage and the handling of excess flows at Blue Plains was considered for each alternative.
- Impact on IMA Flows – increasing the amount of CSO captured and treated at Blue Plains will increase the annual average flows attributed to the District under the IMA. The relative impact of each of the alternatives was calculated using the scenario of No Phase I Controls (no inflatable dams or swirl facility) as a baseline.

The alternatives are tabulated in Table 11-13.

Table 11-13
Final Alternatives Comparison (ENR= 6383)

Parameter	***Existing*** B1 No Phase I Controls	***Phase I + P.S. Rehab*** C3 Phase I Controls & P.S. Rehab	***Draft LTCP*** D70A Draft LTCP	D70B + 10% LID	D70C + 50% LID	D70J + 10% LID (Equal Performance)	D70M + 50% LID (Equal Performance)
Tunnel Storage Volume (mg)							
Anacostia	0	0	108	108	108	99	71
Potomac	0	0	35	35	35	30	24
Rock Creek	0	0	4	4	4	3	2.5
Total	0	0	147	147	147	132	98
No. Overflow/Avg. Yr.							
Anacostia	82	75	4	3	1	4	4
Potomac	74	74	9	7	4	9	9
Rock Creek (Piney Branch/Others)	30	30	4 / 4	3 / 4	2 / 3	4 / 4	4 / 4
CSO Overflow Vol. (mg/avg yr.)							
Anacostia	2,142	1,282	93	71	16	102	110
Potomac	1,063	639	153	134	78	162	149
Rock Creek	49	49	13	12	8	12	10
Total	3,254	1,970	259	217	102	276	269
Capital Cost ($M)							
LID-R	$0	$0	$3	$129	$646	$129	$646
Anacostia	$0	$115	$856	$886	$886	$873	$834
Potomac	$0	$12	$189	$209	$209	$199	$190
Rock Creek	$0	$0	$38	$42	$42	$42	$41
Blue Plains	$0	$0	$22	$22	$22	$22	$220
Total	$0	$127	$1,108	$1,288	$1,805	$1,265	$1,931
Operation & Maintenance ($M/yr)	$0	$0	$12	$16	$35	$16	$35
20 Yr. Net Present Worth	$0	$0	$1,275	$1,524	$2,311	$1,498	$2,430
% Above Draft LTCP	-	-	0	20%	81%	17%	91%
$M/day gained compared to Draft LTCP	-	-	-	$45	$44	>$100	>$100
Water Quality Performance (Avg. Yr.)							
# days FC>200 (CSO Only)							
Anacostia @ Navy Yard	212	120	11	9	2	12	13
Potomac @ Memorial Bridge	57	44	10	9	5	10	11
Rock Creek @ Zoo	22	22	4	3	2	4	4
# days FC>200 (All Loads)							
Anacostia @ Navy Yard	239	200	183	183	182	183	183
Potomac @ Memorial Bridge	142	133	107	107	107	108	108
Rock Creek @ Zoo	294	294	294	294	294	294	294
Blue Plains							
Excess Flow	Existing	Existing	Existing	Existing	Existing	Existing	Existing
Tunnel Dewatering	-	-	BP 002	BP 002	BP 002	BP 002	BP 002
BP002 Dewatering Rate (mgd)	-	-	450	450	450	450	450
Dewatering Time (hrs)	-	-	44	44	44	40	29
IMA Impacts - Increase in Avg. Flow (mgd)	Baseline	+3.5	+8.2	+6.5	+0.1	+6.3	-0.4

Table 11-13 (continued)

Final Alternatives Comparison (ENR= 6383)

Parameter	*Draft LTCP*						
	D70K	*D70D*	*D70E*	*D70I*	*D70F*	*D70G*	*D70L*
	+ Target Separation (Equal Perf.)	*+ 10% LID + Target Separation*	*+ 50% LID + Target Separation*	*+ 10% LID + Target Separation (Equal Perf)*	*+ No Peak Factor for Large Suburbs*	*+District DWF=138 mgd*	*+District DWF=180 mgd (Equal Perf)*
Tunnel Storage Volume (mg)							
Anacostia	93	108	108	84	108	108	115
Potomac	25	35	35	21	35	35	35
Rock Creek	3	4	4	3	4	4	4
Total	121	147	147	108	147	147	154
No. Overflow/Avg. Yr.							
Anacostia	4	2	1	4	4	3	4
Potomac	9	5	3	9	7	7	9
Rock Creek (Piney Branch/Others)	4 / 4	3 / 3	2 / 2	4 / 4	4 / 4	4 / 4	4 / 4
CSO Overflow Vol. (mg/avg yr.)							
Anacostia	71	25	7	86	78	78	88
Potomac	137	76	49	150	129	132	171
Rock Creek	10	10	7	11	12	12	12
Total	218	111	63	247	219	222	271
Capital Cost ($M)							
LID-R	$3	$129	$646	$129	$3	$3	$3
Anacostia	$1,026	$1,046	$1,046	$1,011	$975	$1,007	$897
Potomac	$195	$211	211	$189	$280	$330	$209
Rock Creek	$110	$110	110	$110	$59	$163	$42
Blue Plains	$22	$22	22	$22	$22	$22	$22
Total	$1,356	$1,518	$2,035	$1,461	$1,339	$1,526	$1,173
Operation & Maintenance ($M/yr)	$13	$18	$36	$17	$15	$12	$12
20 Yr. Net Present Worth	$1,535	$1,768	$2,554	$1,704	$1,549	$1,700	$1,345
% Above Draft LTCP	20%	39%	100%	34%	21%	33%	5%
$M/day gained compared to Draft LTCP	$248	$32	$55	>$100	$231	$139	$3
Water Quality Performance (Avg. Yr.)							
# days FC>200 (CSO Only)							
Anacostia @ Navy Yard	10	4	2	12	11	10	11
Potomac @ Memorial Bridge	10	5	4	11	9	9	9
Rock Creek @ Zoo	4	3	2	4	4	3	4
# days FC>200 (All Loads)							
Anacostia @ Navy Yard	147	190	190	147	183	183	183
Potomac @ Memorial Bridge	110	118	117	110	107	107	107
Rock Creek @ Zoo	293	299	299	293	294	294	294
Blue Plains							
Excess Flow	Existing	Existing	Existing	Existing	Existing	Existing	Existing
Tunnel Dewatering	BP 002	BP 002	BP 002	BP 002	BP 002	BP 002	BP 002
BP002 Dewatering Rate (mgd)	450	450	450	450	450	450	450
Dewatering Time (hrs)	36	44	44	32	44	44	46
IMA Impacts - Increase in Avg. Flow (mgd)	+5.6	+3.9	-1.8	+3.5	+8.3	+8.3	+8.3

Table 11-13 (continued)

Final Alternatives Comparison (ENR= 6383)

Parameter	***1-Year Storm***	***DOH Plan***		
	D70P	*D71A*	*D71D*	*D71F*
	1-Year, 24-Hour Storm	*Base Plan*	*+10% LID +Target Separation*	*+10% LID +Target Separation (Equal Perf.)*
Tunnel Storage Volume (mg)				
Anacostia	126	160	160	119
Potomac	58	35	35	25
Rock Creek	9.1	9.4	9.4	7
Total	193	204	204	151
No. Overflow/Avg. Yr.				
Anacostia	2	0.33	0.33	2
Potomac	4	8	4	8
Rock Creek (Piney Branch/Others)	1 / 4	0.33 / 3	0.33 / 3	2 / 4
CSO Overflow Vol. (mg/avg yr.)				
Anacostia	54	15	3	33
Potomac	79	152	47	139
Rock Creek	5	5	3	4
Total	138	172	53	176
Capital Cost ($M)				
LID-R	$3	$3	$129	$129
Anacostia	$940	$985	$1,169	$1,107
Potomac	$250	$224	$246	$194
Rock Creek	$50	$74	$141	$104
Blue Plains	$22	$22	$22	$22
Total	$1,265	$1,308	$1,707	$1,556
Operation & Maintenance ($M/yr)	$13	$13	$19	$18
20 Yr. Net Present Worth	$1,456	$1,501	$1,973	$1,808
% Above Draft LTCP	14%	18%	55%	42%
$M/day gained compared to Draft LTCP	$12	$15	$32	$37
Water Quality Performance (Avg. Yr.)				
# days FC>200 (CSO Only)				
Anacostia @ Navy Yard	7	1	1	2
Potomac @ Memorial Bridge	4	10	5	9
Rock Creek @ Zoo	1	1	0	2
# days FC>200 (All Loads)				
Anacostia @ Navy Yard	182	182	190	142
Potomac @ Memorial Bridge	106	107	118	110
Rock Creek @ Zoo	294	294	299	293
Blue Plains				
Excess Flow	Existing	Existing	Existing	Existing
Tunnel Dewatering	BP 002	BP 002	BP 002	BP 002
BP002 Dewatering Rate (mgd)	450	450	450	450
Dewatering Time (hrs)	58	61	61	45
IMA Impacts - Increase in Avg. Flow (mgd)	+8.5	+8.5	+6.9	+6.6

Table 11-13 (continued)

Final Alternatives Comparison (ENR= 6383)

Parameter	*Expanded LTCP*			*No Overflows in 3 Years*	*5 Year Storm*
	D75A	*D75J*	*D75I*	*D72A*	*D73C*
	Base Plan	*+10% LID (Equal Perf.)*	*+10% LID + target Separation (Equal Perf.)*	*Base Plan*	*Base Plan*
Tunnel Storage Volume (mg)					
Anacostia	160	148	127	Integrated Tunnel System	Integrated Tunnel System
Potomac	53	47	36		
Rock Creek	9.7	9.4	8.5		
Total	223	204	172	433	773
No. Overflow/Avg. Yr.					
Anacostia	0.33	0.33	0.33	0	0
Potomac	4	4	4	0	0
Rock Creek (Piney Branch/Others)	0.33 / 3	0.33 / 3	0.33 / 3	0 / 3	0 / 3
CSO Overflow Vol. (mg/avg yr.)					
Anacostia	15	15	14	0	0
Potomac	94	85	72	0	0
Rock Creek	5	4	3	2	2
Total	114	104	89	2	2
Capital Cost ($M)					
LID-R	$3	$129	$129	$3	$3
Anacostia	$985	$963	$1,122	$929	$1,067
Potomac	$261	$184	$184	$473	$601
Rock Creek	$74	$73	$141	$162	$298
Blue Plains	$359	$359	$359	$677	$1,161
Total	$1,682	$1,708	$1,935	$2,244	$3,130
Operation & Maintenance ($M/yr)	$21	$25	$25	$25	$39
20 Yr. Net Present Worth	$1,976	$2,059	$2,296	$2,600	$3,684
% Above Draft LTCP	55%	61%	80%	104%	189%
$M/day gained compared to Draft LTCP	$34	$35	$44	$45	$81
Water Quality Performance (Avg. Yr.)					
# days FC>200 (CSO Only)					
Anacostia @ Navy Yard	1	1	1	0	0
Potomac @ Memorial Bridge	6	6	4	0	0
Rock Creek @ Zoo	1	1	1	0	0
# days FC>200 (All Loads)					
Anacostia @ Navy Yard	182	182	182	182	182
Potomac @ Memorial Bridge	107	107	107	107	107
Rock Creek @ Zoo	294	294	294	94	94
Blue Plains					
Excess Flow	350 MGD High Rate	350 MGD High Rate	350 MGD High Rate	350 MGD High Rate	350 MGD High Rate
Tunnel Dewatering	BP 002 & High Rate	BP 002 & High Rate	BP 002 & High Rate	High Rate	High Rate
BP002 Dewatering Rate (mgd)	450	450	450	None	None
Dewatering Time (hrs)	19	17	13	None	None
IMA Impacts - Increase in Avg. Flow (mgd)	+8.6	+6.8	+6.8	+8.9	+8.9

11.5 ABILITY TO MEET NUMERIC WATER QUALITY STANDARDS

In the Anacostia River, both bacteria and dissolved oxygen are of concern. In the Potomac and Rock Creek, dissolved oxygen is predicted to meet standards and bacteria is the parameter of concern.

For the Anacostia River, the analyses in Section 9 demonstrated that once CSOs are controlled to 8 overflows per average year or less, increased levels of CSO control have minimal effect on dissolved oxygen. In summary, meeting the bacteria standard is the driving factor in terms of CSO control.

In addition to the analyses presented previously, evaluation of the ability of various levels of CSO control to meet the current bacteria water quality standard were performed. The current standard is a fecal coliform 30-day geometric mean of 200/100 ml. Without any other loads present, all CSO plans with controls equal to or grater than the Draft LTCP will meet the geometric mean standard. With upstream and storm water loads at existing levels, the geomean standard will not be met much of the time. As a result, analyses were conducted to determine how much of a reduction in other loads would be required for the geomean standard to be met in the District. These were conducted for various levels of CSO control to determine if increased levels of control provided a significant benefit. The analyses were conducted for three conditions:

- Average year, monthly basis – the model generates a daily prediction for fecal coliform concentration. Using each day in the month, a geometric mean is calculated for the month. Other sources were reduced enough so that the standard was not exceeded in any month for the average year
- 1988, 1989, 1990; monthly basis – Geometric means were calculated on a monthly basis as above. However, other loads were reduced such that the standard would be met each month in the entire three-year period. This is a more restrictive condition than in the average year and typically requires more control.
- 1988, 1989, 1990; rolling 30-day geometric means – 30-day rolling geometric means were calculated for the entire three-year period. Other loads were reduced such that the standard would be met for all of the calculated geometric means in the three-year period. This is the most restrictive condition.

The results are summarized in Table 11-14.

Table 11-14
Reduction in Other Loads Required to Meet Fecal Coliform Geometric Mean Standard[1]

CSO Control by Receiving Water	*CSO Overflows/ Avg. Yr*	*Based on Monthly Geometric Means*		*Based on Rolling 30 Day Geometric Means*
		Average Year	*1988, 1989, 1990*	*1988, 1989, 1990*
Anacostia River				
Draft LTCP	4	85%	90%	90%
1-Year 24-Hour Storm	2	85%	90%	90%
DOH Plan	0.33	85%	90%	90%
Potomac River				
Draft LTCP	9	20%	35%	50%
1-Year 24-Hour Storm	4	20%	35%	50%
Rock Creek (Including Piney Branch Stream)				
Draft LTCP	4	95%	95%	99%
1-Year 24-Hour Storm	1	95%	95%	99%
DOH Plan	0.33	95%	95%	99%
Rock Creek (Excluding Piney Branch Stream)				
Draft LTCP	4	85%	90%	91%
1-Year 24-Hour Storm	1	85%	90%	91%
DOH Plan	0.33	85%	90%	91%

Notes:

1. Uniform percent reduction in District storm water and upstream loads required for fecal coliform geometric mean to be less than 200 MPN/100 ml

As indicated in the table, high levels of load reduction in the Anacostia and Rock Creek are required to meet the geometric mean standard. Note that increasing levels of CSO control do not change the amount of reduction in other loads necessary to meet the standard. This suggests that the controls included in the Draft LTCP reduce CSOs enough so that they have minimal effect on the geometric mean. Additional control beyond the Draft LTCP does not have a significant benefit on meeting the geometric mean standard.

For Rock Creek, the calculation was performed both including and excluding Piney Branch Stream. During dry weather conditions, Piney Branch has minimal flow in it. During wet weather, the flow in Piney Branch is almost entirely urban storm water and some amount of CSO from whatever discharges that are occurring. The bacteria concentrations in Piney Branch Stream are thus almost equal to the concentration in urban storm water. Extremely high reductions are thus required. This suggests that the stream has been so fundamentally altered by development that it may not be possible to achieve the current bacteria standard.

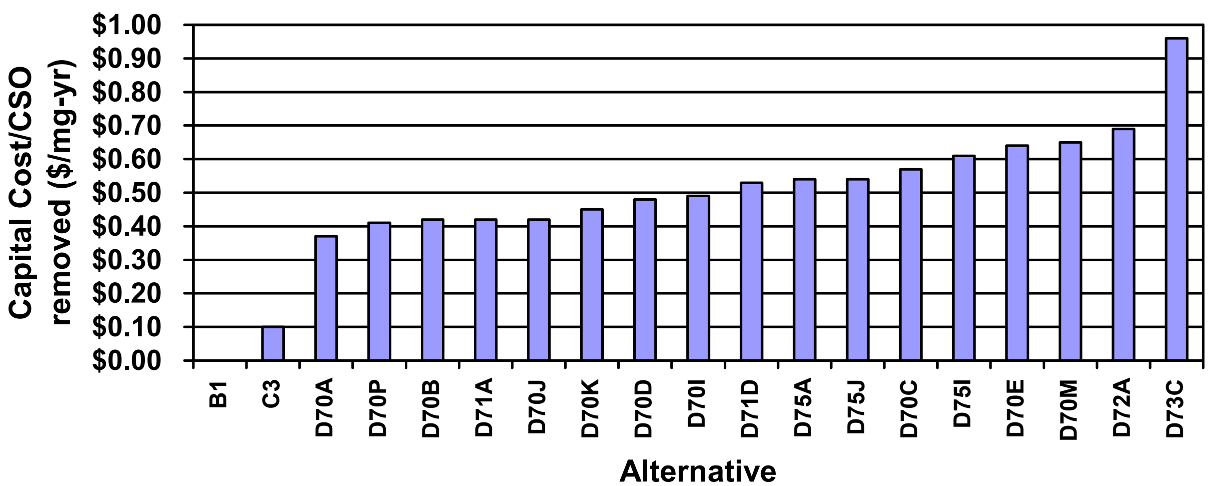
11.6 SELECTION OF FINAL LTCP

The following observations are made based on the alternatives evaluation:

- All plans meet the BOD TMDL for the Anacostia River.
- Plans with CSO controls greater than or equal to the 1-year 24-hour storm meet the Anacostia TSS TMDL.
- Large-scale separation and LID-R are less cost effective than increasing the size of the capital facilities. However, separation and LID-R have flow reduction benefits in that they can assist the District in meeting its IMA limit.
- Large scale separation produces worse water quality than higher degrees of CSO control due to untreated storm water.
- Based on the affordability analysis in the following section, the zero overflow per year and the 5-year 24-hour storm alternatives are not affordable.
- All the plans can be cost-effectively expanded to zero overflow per year and the 5 year storm plans.
- All plans will meet the fecal coliform geometric means standard with commensurate storm water and upstream controls.
- The 1 year –24 hr storm plan brings CSOs in all receiving waters to high levels of controls at or above the presumptive approach outlined in the CSO Policy of 4 overflows per average year.

The overall cost effectiveness of the alternatives is compared in Figure 11-8. For each alternative, the total capital cost divided by the million gallons of CSO removed in an average year compared to No Phase I Controls (Alternative B1) is plotted.

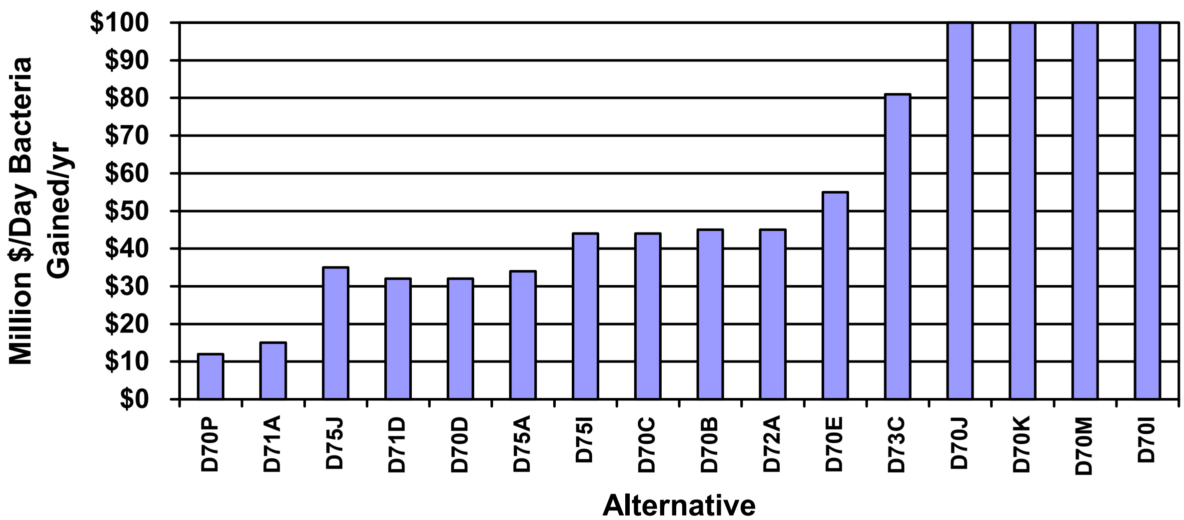
Figure 11-8
Cost Effectiveness of Alternatives Based on CSO Volume Reduction



Pump Station Rehabilitation (C3) and the Draft LTCP (D70A) are the most cost effective. For plans with more control than the Draft LTCP, the plan sized for the 1-year 24-hour storm (D70P) is the next most cost effective.

Among other factors, alternatives were evaluated based on the number of days per year that CSOs alone would cause the fecal coliform concentration to exceed 200/100 ml. The cost per day to reduce the number of days from that provided by the Draft LTCP is plotted on Figure 11-9. The most cost effective plan is the 1-year 24-hour storm alternative (D70P).

Figure 11-9
Cost Effectiveness of Alternatives Based on Bacteria Reduction



Based on the affordability analysis in the following section, the expanded plan alternatives (D75A, D75J, D75I), the zero overflow per year alternative (D72A), and the 5-year 24-hour storm alternative (D73C) are not affordable and have thus been eliminated from further consideration.

Alternatives that include a large amount of targeted separation result in worse water quality in the receiving waters and are more costly than the other options. In addition to the costs presented, alternatives involving a large amount of targeted separation will require District residents to pay additional funds to address the resulting storm water, making these options even more expensive. The following alternatives have thus been eliminated: D70K, D70D, D70E, D70I, D71D and D71F.

The three alternatives that involve reducing the dry weather flow in the District or the peaking factors for the suburbs do not significantly reduce CSO overflow volumes below that in the Draft LTCP and have thus been deleted (D70F, D70G, D70L).

Alternatives based on the Draft LTCP and those that provide equal performance to the Draft LTCP will not meet the TSS TMDL for the Anacostia River. The following alternatives have thus been deleted: D70A, D70J and D70M.

Alternative D70B and D70D include the capital facilities in the Draft LTCP and 10% and 50% application of LID-R, respectively. Since WASA does not control development in the District and cannot rely on others to meet its permit conditions, these alternatives have been deleted from further consideration. WASA hopes that extensive LID-R will occur in the District. Any degree of LID-R will assist in reducing CSO overflow volumes.

Given the discussions above, two alternatives are left: the DOH Plan (D71A) and the 1-year 24-hour plan (D70P). Both have similar costs and storage capacities. However, the DOH plan provides more control for the Anacostia and Rock Creek but no additional control for the Potomac River. The 1-year 24-hour plan is responsive to the requirements of the CSO Policy, existing and prospective TMDLs, and public comments, regulatory agency concerns that called for increasing levels of control in all receiving waters. In addition, the 1-year 24-hour storm plan meets the levels of control in the presumptive approach in the CSO Policy for all receiving waters. Based on the cost effectiveness evaluation, and the above analyses, the plan sized for the 1-year 24-hour storm is the recommended Final LTCP.

After implementation of the recommended Final LTCP, the remaining overflows predicted for the average year are summarized in Table 11-15.

Table 11-15

Remaining Overflows after Implementation of Recommended Final LTCP(Average Year)

CSO NPDES No.	*Descrption*	*No. Events (No./yr)*	*Overflow Volume (mg/yr)*	*Notes*
Anacostia				
004	Poplar Point P.S. Emergency Bypass	-	-	
005	Ft. Stanton	-	-	
006	Ft. Stanton	-	-	Separated
007	Ft. Stanton	-	-	
008	AMI Relief	-	-	
009	B St /NJ Ave at Main & ‘O’ Street	-	-	
010	B St /NJ Ave at Main & ‘O’ Street	1	21	
011	B St /NJ Ave at Main & ‘O’ Street	-	-	
011a	B St /NJ Ave at Main & ‘O’ Street	-	-	
012	Tiber Creek at Main & O Street	-	-	
013	Canal St. Sewer	-	-	
014	Navy Yard/ M St	-	-	
015	Navy Yard/ M St	-	-	
016	Navy Yard/ M St	-	-	Consolidated

CSO NPDES No.	*Descrption*	*No. Events (No./yr)*	*Overflow Volume (mg/yr)*	*Notes*
017	Navy Yard/ M St	-		Consolidated
018	Barney Circle	-	-	Consolidated
019	Northeast Boundary	2	33	
	Anacostia Subtotal		**54**	
Potomac				
003	Bolling Air Force Base	2	9.8	
020	Easby Point	3	20.7	
021	Potomac P.S. – Slash Run	3	19.3	
022	I St-22nd St NW	3	28.5	
023/024	West Rock Creek Diversion Sewer at Georgetown	-	-	Consolidated
025	Georgetown	-	-	Consolidated
026	Georgetown	-	-	Consolidated
027	Georgetown	-	-	Consolidated
028	Georgetown	-	-	Consolidated
029	Georgetown	1	1.0	
030	Abandoned	-	-	
060	Little Falls Branch	-	-	
	Potomac Subtotal		**79**	
Rock Creek				
031	Penn Ave	-	-	Separated
032	26th St- M St.	-	-	
033	N St.-25th	3	1.18	
034	Slash Run	-	-	
035	Northwest Boundary	-	-	
036	Mass Ave & 24th ST.	3	0.29	
037	Kalorama Circle West	-	-	Separate
038	Kalorama Circle East	-	-	
039	Belmont Rd	1	0.02	
040	Biltmore St	1	0.05	
041	Ontario Rd	-	-	
042	Quarry Rd	-	-	
043	Irving St.	1	0.26	
044	Kenyon St.	1	0.01	
045	LamontSt.	4	0.76	
046	Park Road	2	0.01	
047	Ingleside Terrace	1	0.01	
048	Oak St-Mt. Pleasant	2	0.14	
049	Piney Branch	1	1.41	
050	M St. – 27th St.	-	-	
051	Olive – 29th St.	-	-	
052	O St.-31st St.	-	-	
053	Q St.	-	-	Separated
054	West Rock Creek Diversion Sewer	-	-	
055	(Abandoned)	-	-	
056	Normanstone Drive	-	-	
057	Cleveland – 28th St. & Conn. Ave.	2	0.38	

CSO NPDES No.	*Descrption*	*No. Events (No./yr)*	*Overflow Volume (mg/yr)*	*Notes*
058	Connecticut Avenue	**-**	**-**	Separated
059	Luzon Valley	**-**	**-**	Separated
	Rock Creek Subtotal		**5**	
	Grand Total		**138**	

Section 12
Financial Capability

12.1 INTRODUCTION

Financing CSO programs in a fair and equitable manner without placing an unreasonable burden on ratepayers is one of the most challenging aspects facing CSO communities. CSO control costs can be one of the largest single expenditures made on a public works project for many communities. No dedicated grant programs currently exist to fund CSO control programs. As a result, a detailed affordability analysis is necessary to assess the impact of CSO control costs on the fiscal health of a community. A procedure for assessing financial capability is described in EPA's Guidance Document, *Guidance for Financial Capability Assessment and Schedule Development* (EPA, 1997). This procedure was used to perform the financial capability assessment for WASA.

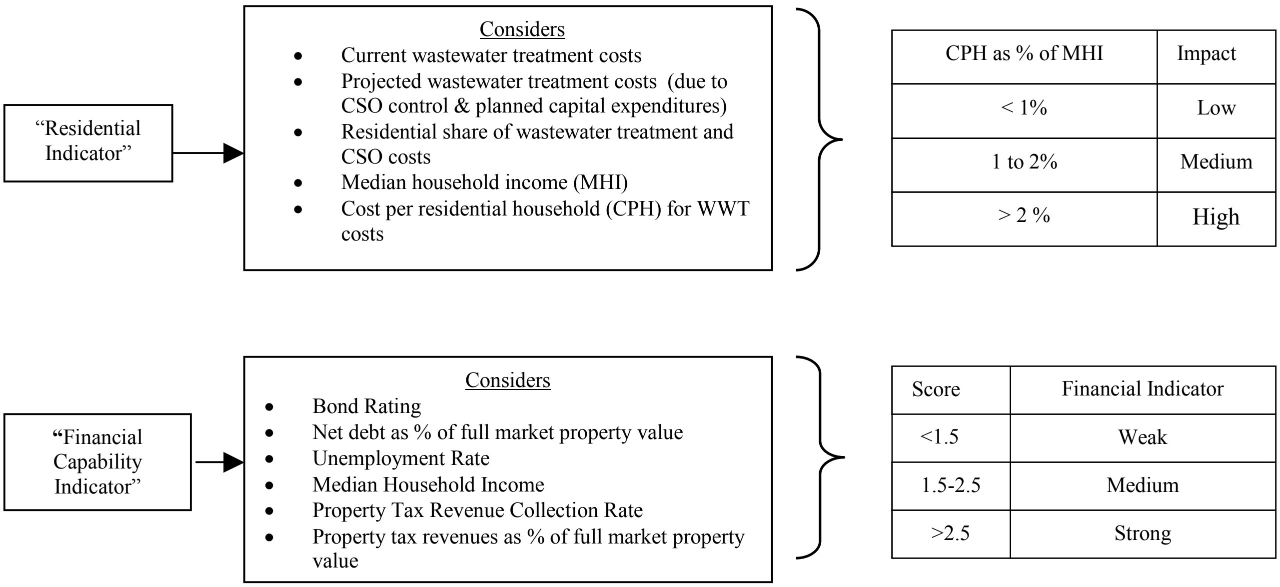
Regulatory agencies are allowed to consider other factors that will have an impact on the ability of a community to finance CSO controls. As a result, this evaluation also considers the District's income distribution, the ability of the District to remain competitive in the greater Washington area, and the effect of WASA's existing capital improvement program on the ability to finance CSO controls.

12.2 METHODOLOGY

In EPA's guidance document, assessment of financial capability entails a two-phase approach. The first phase consists of the calculation of a "Residential Indicator", which measures the financial impact of current and proposed CSO controls on residential users. The residential indicator is calculated by estimating the cost per household (CPH) for current and proposed wastewater treatment and CSO control costs. The CPH is used in conjunction with the median household income (MHI) to estimate residential impacts. Residential impacts are considered by EPA to be 'low' if the CPH is less than 1% of the MHI, 'medium' if the CPH is between 1% and 2% of the MHI, and 'high' if the CPH is greater than 2% of the MHI. Note that the CPH is not strictly equivalent to a monthly or annual sewer user fee. The CPH does not take into account all factors that are included when developing a sewer bill such as project scheduling, industrial vs. residential rates and other factors.

The second phase of the assessment involves calculation of a "Financial Capability Indicator", which assesses the overall financial health of the community. This indicator examines bond rating, debt burden, unemployment rate, property tax collection rates, MHI and other factors to develop a numerical score. The financial capability is considered by EPA to be low if the score is less than 1.5, medium if the score is between 1.5 and 2.5, and strong if the score is greater than 2.5. Figure 12-1 summarizes the development and scoring of the residential and financial capability indicators.

Figure 12-1
EPA's Residential and Financial Capability Indicators



Once the residential and financial capability indicators are calculated, they are combined into a financial capability matrix. The matrix provides EPA's assessment of the overall burden associated with funding CSO controls. This is summarized in Table 12-1.

Table 12-1
EPA's Financial Capability Matrix

Financial Capability Indicator	Residential Indicator (Cost per Household as % of Median Household Income)		
	Low (Below 1.0%)	Medium (Between 1.0% and 2.0%)	High (Above 2.0%)
Weak (Below 1.5)	Medium Burden	High Burden	High Burden
Medium (Between 1.5 and 2.5)	Low Burden	Medium Burden	High Burden
Strong (Above 2.5)	Low Burden	Low Burden	Medium Burden

12.3 RESIDENTIAL INDICATOR

12.3.1 Median Incomes

The CPH for wastewater treatment (WWT) and CSO controls was developed using a three-step process. First, WASA's total WWT and CSO costs were calculated by adding current costs for existing wastewater treatment operations and projected costs for proposed WWT facilities and CSO controls. Next, the residential share of total WWT and CSO costs was calculated. The final step consists of calculating the CPH by dividing the residential share of total WWT and CSO costs by the number of households in the District.

Current WWT costs consist of current annual wastewater operating and maintenance (O & M) expenses, plus current annual debt service (principal and interest). Planned WWT capital costs were obtained from WASA's ten year Capital Improvement Program (CIP) (WASA, 2000b). The CIP amounts to $1.6 billion for the ten-year period FY2000 through FY2009, of which about $564 million are attributable to wastewater treatment for WASA customers within the District. The remainder of the CIP is attributable to water system improvements or to expenditures to be borne by others such as the surrounding counties whose wastewater is treated at Blue Plains.

The affordability analysis was conducted for a range of CSO control plan capital costs between $100 million and $2 billion in year 2001 dollars. Five cost levels were selected to compute the CPH: $0 million, $100 million; $500 million; $1 billion; and $2 billion. Each of the foregoing CSO control cost levels was assumed to occur in FY2001 to establish a common implementation year for all assumed CSO control cost scenarios as a benchmark for their comparison.

WASA's Board of Directors has adopted financial policies that require maintenance of 140 percent debt service coverage, and maintenance of cash reserves of 180 days O&M expenses, currently approximately $91 million. The present analysis factored in WASA's debt service coverage requirement. CSO control O&M costs will add substantially to the reserve requirement. An interest rate of 7% and a term of 30 years were used in the analysis to determine the capital recovery factor, which are consistent with WASA's assumptions for debt issuance for the CIP (WASA, 2002a). An interest rate of 2.6% was used as a present value adjustment factor based on the past 5 year average annual increase in the Consumer Price Index (CPI) from the Bureau of Labor Statistics (U.S. Bureau of Labor, 2000).

The residential share of total annual WWT and CSO costs is computed by multiplying the percent of total wastewater flow attributable to residential users by the total costs. For FY 1999, the residential share of wastewater flow within the District boundaries was 50% (WASA, 2000c).

The latest median household income (MHI) for the District estimated by the Census Bureau for 2000 is $38,752 (U.S. Census Bureau, 2002). This was adjusted upward to year 2001 using an inflation adjustment factor resulting in an adjusted MHI of $39,760. Dividing this amount by total annual WWT and CSO control costs per household (CPH) yields the Residential Indicator and the financial impact on residential customers.

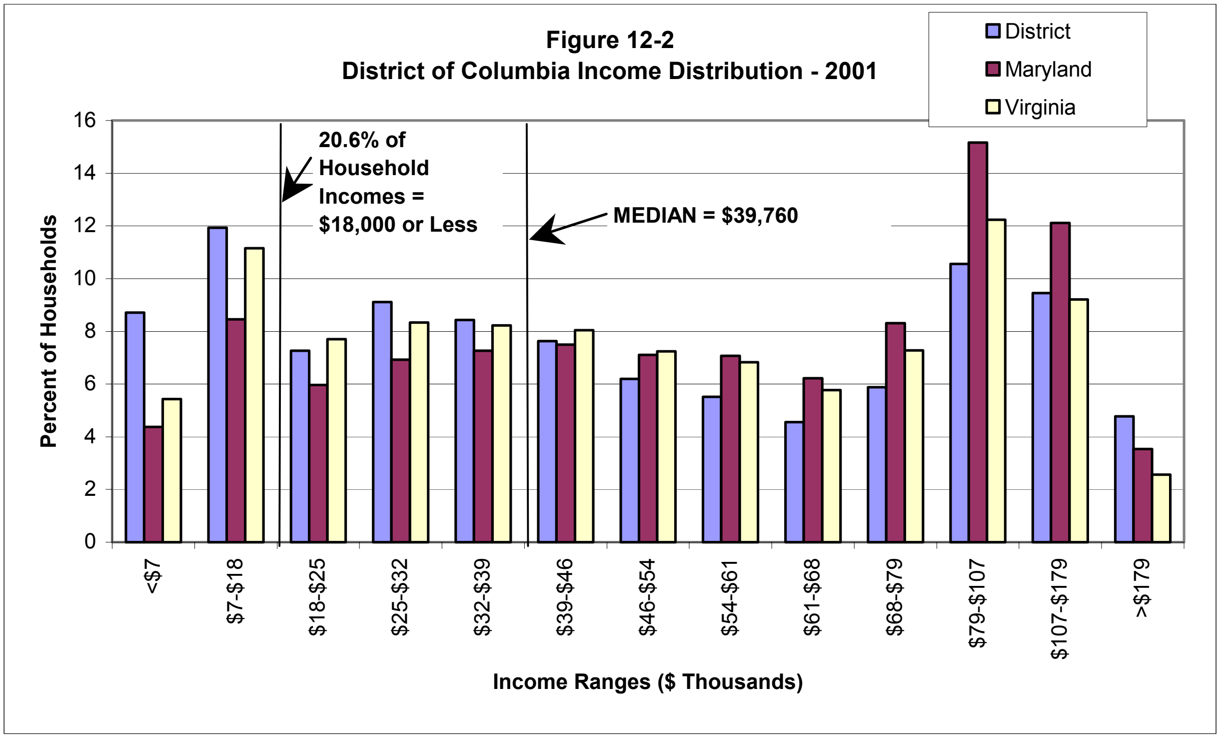
The annual cost per household and the residential indicator are summarized in Table 12-2.

Table 12-2
Projected Cost Per Household and Residential Indicator
Median Income Households

Category	*CSO Control Costs in Year 2001 (ENR=6383)*					*Line No. from EPA Worksheet*
	$0	*$100 Million*	*$500 Million*	*$1,000 Million*	*$2,000 Million*	
Current WWT Costs:						
Annual O&M Expenses	$88,059,582	$88,059,582	$88,059,582	$88,059,582	$88,059,582	100
Annual Debt Service (P&I)	$17,111,944	$17,111,944	$17,111,944	$17,111,944	$17,111,944	101
Subtotal (Line 100 + Line 101)	$105,171,526	$105,171,526	$105,171,526	$105,171,526	$105,171,526	102
Projected WWT Costs: Annual O & M Expense	$0	$0	$0	$0	$0	103a
Projected CSO Costs: Annual O & M Expense	$0	$1,500,000	$7,500,000	$15,000,000	$30,000,000	103b
Projected WWT & CSO Costs: Annual Debt Service (P&I)	$58,110,933	$69,107,129	$113,091,910	$168,072,887	$278,034,842	104
Subtotal (Lines 103a + 103b+ 104)	$58,110,933	$70,607,129	$120,591,910	$183,072,887	$308,034,842	105
Total Current & Projected WWT & CSO Costs (Line 102 + Line 105):	$163,282,459	$175,778,655	$225,763,436	$288,244,413	$413,206,368	106
Residential Share of Total WWT & CSO Costs:	$81,641,230	$87,889,327	$112,881,718	$144,122,207	$206,603,184	107
Total No. of Households in District:	248,338	248,338	248,338	248,338	248,338	108
Annual Cost per Household (Line 107 / Line 108):	**$329**	**$354**	**$455**	**$580**	**$832**	**109**
Median Household Income (MHI) for Census Year 2000	$38,752	$38,752	$38,752	$38,752	$38,752	201
MHI Adjustment to Year 2001	1.026	1.026	1.026	1.026	1.026	202
Adjusted MHI (Line 201 x Line 202)	$39,760	$39,760	$39,760	$39,760	$39,760	203
Annual WWT & CSO Control Costs per Household (CPH) (Line 109)	$329	$354	$455	$580	$832	204
Residential Indicator: CPH as % MHI) (Line 204 / Line 203 x 100)	**0.83%**	**0.89%**	**1.14%**	**1.46%**	**2.09%**	**205**
Financial Impact:	**Low**	**Low**	**Mid-Range**	**Mid-Range**	**High**	

12.3.2 Lower Incomes

The financial impact of wastewater treatment and CSO control costs on residential customers in the District is not fully measured by the foregoing method. Because of the demographics of the District, income does not follow a normal statistical distribution, or bell curve, among households across the full range of incomes. In the District, there is a distinct clustering of household incomes at the lower and upper extremes of the income spectrum. This creates a 'u' shaped or upside down income distribution which is shown on Figure 11-2.



Because of the disproportionate number of low income households in the District, the impact of wastewater treatment and CSO control costs on the most well off households in the lowest 20% of income distribution in the District was calculated. The most well off households in this category have incomes of approximately $18,000 per year. The results are presented in Table 12-3, which shows a high impact on this segment of the population for all assumed levels of CSO control costs.

Table 12-3
Projected Cost Per Household and Residential Indicator
Lower 20% of Household Incomes

Category	*CSO Control Costs Year 2001 (ENR=6383)*					*Line No. from EPA Worksheet*
	$0	*$100 Million*	*$500 Million*	*$1,000 Million*	*$2,000 Million*	
Highest Household Income of Lower 20% of Income Range:	$18,000	$18,000	$18,000	$18,000	$18,000	201a
Annual WWT & CSO Control Costs per Household (CPH) (Line 109)	$329	$354	$455	$580	$832	204
Residential Indicator: CPH as % MHI) (Line 204 / Line 203 x 100)	**1.83%**	**1.97%**	**2.53%**	**3.22%**	**4.62%**	**205a**
Financial Impact:	**Mid-Range**	**Mid-Range**	**High**	**High**	**High**	

12.4 FINANCIAL CAPABILITY INDICATORS

12.4.1 General

The permittee's financial indicator score was determined by evaluation of selected factors that portray WASA's and the District's debt burden, socioeconomic conditions, and financial operations. WASA's current debt burden was assessed as well as its ability to issue new debt to finance CSO controls by determining bond ratings and overall debt as a percentage of full market property value in the District. Socioeconomic conditions in the District were evaluated by assessing its unemployment rate and median household income (MHI). The District's ability to manage financial operations were evaluated by determining the property tax collection rate and property tax revenues as a percentage of full market property value. A value range for each of these indicators characterizes whether WASA's residential users are in a "Weak", "Mid-Range" or "Strong" position to bear WASA's WWT and CSO control costs relative to national benchmarks according to the EPA guidance document.

12.4.2 Bond Ratings

Ratings of WASA's Public Utility Revenue Bonds, Series 1998, have been upgraded since their issuance by Moody's, Standard & Poors and Fitch IBCA to A1, A, and A+, respectively. Continued compliance with the Board of Directors' 140 percent debt service coverage and 180 day O&M expense cash reserves policies has been critical to these bond rating upgrades. This will ultimately result in lower interest rates on future WASA debt issuance.

When WASA was first created in 1996, it was an unrated utility. WASA started operations with the negative cash position left by its predecessor agency, the Water and Sewer Utility Administration (WASUA). In barely two years WASA reached its 180 day O & M cash reserve goal, 11 months ahead of schedule. Without strong cash reserves and debt service coverage policies, WASA's bond ratings would be significantly lower and its cost of capital significantly higher. WASA has worked hard to implement these policies and achieve their goals. They must be maintained in order to ensure WASA's long-term financial viability and not be compromised by unaffordable new projects.

According to criteria in the guidance document, the rating of the most recent bonds to be issued either by the District or WASA is to be used to determine a bond rating indicator for WASA. Consequently, a rating of Baa1 for the District's General Obligation Bonds (Series 1999A) and General Obligation Bonds (Series 1999B) by Moody's Investor Service has been used, corresponding to a "Mid-Range" indicator rating (WASA 2002a).

12.4.3 Summary of Financial Capability Indicators

An average score for the indicators determined in this phase of the financial capability assessment was calculated. The indicators are compared to national benchmarks to form an overall assessment of the financial capability and its effect on implementation schedules in the long-term CSO control plan. Each indicator is scored using the following rating scale:

Indicator Ratings	Score
Weak	1
Mid-Range	2
Strong	3

The average score for the indicators was calculated by dividing the sum of the scores by the number of entries. The average score is given on line 907 of Table 12-4 and the overall financial capability rating is given at the bottom of the table. According to this procedure, WASA's overall financial capability corresponds to a "Mid-Range" rating. However, because of the disproportionate number of lower income households in the District previously described, an alternative score is presented using the income of the most well off households in the lowest 20% of income distribution in the District instead of the MHI. This score results in a "Low" overall financial capability rating.

Table 12-4
Financial Capability Indicators

Indicator(Line No. from EPA Worksheet)	*Value*	*Indicator Rating*	*Score Using Median Household Incomes*	*Score Using Lower 24% of Household Incomes*	*Line No. from EPA Worksheet*
Bond Rating (Line 303):	Baa1	Mid-Range	2	2	901
Overall Net Debt as a Percent of Full Market Property Value (Line 405):	7.30%	Weak	1	1	902
Unemployment Rate (Line 501):	5.1	Weak	1	1	903
Median Household Income (Line 601):	$39,760	Mid-Range	2	0	904
Highest Household Income of Lower 20% of Income Range (Line 601a):	$18,000	Weak	0	1	904a
Property Tax Revenues as a Percent of Full Market Property Value (Line 703):	1.31%	Strong	3	3	905
Property Tax Revenue Collection Rate (Line 803):	86.89%	Weak	1	1	906
Permittee Indicators Score (Sum of Scores/ Number of Entries):			1.67	1.50	907
Financial Capability:			**Mid-Range**	**Low**	

12.5 COMBINED RESIDENTIAL AND FINANCIAL INDICATORS

The Residential Indicator and the Financial Capability Indicators were combined in the Financial Capability Matrix to evaluate the level of financial burden that CSO controls might impose on WASA. The Residential Indicator score is given on line 1001 and the Financial Capability Indicator score is given on line 1002 of Table 12-5.

Table 12-5
Financial Capability Matrix Overall Score

	CSO Control Costs in Year 2001 (ENR-6383)					*Line No. from EPA Worksheet*
	$0	*$100 Million*	*$500 Million*	*$1,000 Million*	*$2,000 Million*	
For Median Incomes						
Residential Indicator Score (Line 205):	0.83%	0.89%	1.14%	1.46%	2.09%	1001
Financial Capability Indicators Score (Line 907 Column B):	1.67	1.67	1.67	1.67	1.67	1002
Financial Capability Matrix Category:	**Low Burden**	**Low Burden**	**Medium Burden**	**Medium Burden**	**High Burden**	**1003**
Lower 20% of Household Incomes						
Residential Indicator Score (Line 205a):	1.83%	1.97%	2.53%	3.22%	4.62%	1001a
Financial Capability Indicators Score (Line 907 Column C):	1.50	1.50	1.50	1.50	1.50	1002a
Financial Capability Matrix Category:	**Medium Burden**	**Medium Burden**	**High Burden**	**High Burden**	**High Burden**	**1003a**

Based on EPA’s approach, it would appear that CSO control programs costing between $500 million and $1 billion would impose a “Medium Burden” and a CSO control program costing $2 billion would impose a “High Burden” on WASA and its residential customers.

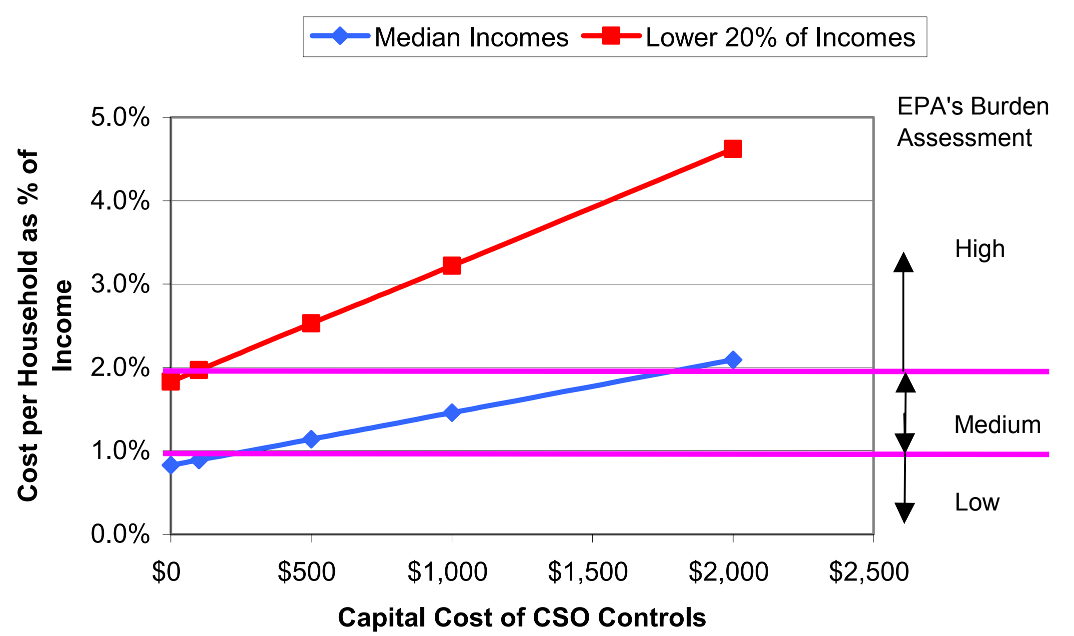
This method of determining a Financial Capability Matrix category for WASA understates the impact of CSO controls on the disproportionately large number of low income households in the District. Therefore, the Financial Capability Matrix Score was also calculated for the most well off households in the lowest 20% of income distribution. This score presents a very different picture of the impact of CSO control costs, indicating that any program above approximately $100 million would impose a “High Burden” on this segment of the population.

Additional analyses were performed to determine the CSO control cost levels that would trigger each of the financial burden categories established by EPA. The results suggest that for median income households, the threshold CSO capital cost for rising into EPA’s ‘high’ burden level is about $1.85 billion. For the upper end of the lower 20% income range, this threshold is only $125 million. These results are summarized in Table 12-6 and on Figure 12-3.

Table 12-6
Summary of CSO Control Cost Impacts on Residential Customers
(Year 2001 Dollars)

EPA's Burden Assessment	*Median Income Households*			*Low Income Households (Income of 18,000)*		
	CPH as a % of MHI	*Wastewater & CSO CPH*	*CSO Control Plan Cost*	*CPH as a % of Income*	*Wastewater & CSO CPH*	*CSO Control Plan Cost*
No Additional CSO Controls (Baseline Condition)	0.83%	$329	$0	1.83%	$329	$0
Medium Burden Threshold	1.0%	$399	$280 million	1.0%	$180	$0
High Burden Threshold	2.0%	$794	$1.85 billion	2.0%	$360	$125 million

Figure 12-3
Impact of CSO Controls on Cost Per Household



12.6 OTHER FACTORS

12.6.1 Baseline Rate Impacts Facing WASA's Rate Payers

The financial assessment and affordability analysis presented in the previous sections uses EPA's standard methodology to assess the financial capability of the Authority and its customers relative to the proposed LTCP. The assessment using EPA's approach results in a finding of an overall "medium impact" on the Authority and its customers; the impact is high when applied to the over 51,000 households that have incomes of less than $18,000. These households approach the medium impact with WASA's existing capital program and financial plan; including CSO costs, their wastewater costs will fall in the very high range. A more accurate and complete picture of the financial capability of the Authority and its customers to fund the proposed LTCP must take into consideration the total cost of wastewater treatment and CSO controls, the rising cost of drinking water services, and, as pointed out earlier, the disparate impact on low income residents of the District of Columbia.

This analysis reflects several important analytical conventions that differ from the analysis presented in earlier sections.

- This rate impact analysis focuses on a typical residential customer with metered water consumption of 100 ccf per year. The EPA approach documented in earlier sections uses the number of households and cost per household (CPH) to evaluate financial capability. Note the two methods are not strictly equivalent. The CPH does not take into account all factors that are included in retail rate making such as project scheduling, varying consumption levels, etc.

- The EPA approach uses cost estimates in current dollars. The plan reflects 2001 values for all cost estimates. This analysis of rate impacts uses "year-of-expenditure" values which reflect the inflationary impact of time on costs and rates.

In January 2002, the Authority adopted a 10-year financial plan that provides for operations, maintenance and capital expenditures for the period of FY 2001 to FY 2010. This 10-year plan continues the Authority's current $1.6 billion water and wastewater capital improvement program (CIP).

Approximately 24 percent of the CIP is for mandated improvements that will enable the Authority to meet its current regulatory requirements. The balance of the program reflects the age and condition of the system and historical disinvestment in the system's infrastructure by predecessor agencies.

- Over half of WASA's pumping stations were constructed before 1940 and are not operating at optimal capacity.
- Half of WASA's pipes were built prior to 1930.
- Preventive maintenance expenditures were extremely low from 1980 to 1996.
- Virtually no technology existed in the Authority's operations prior to 1997.
- Prior to WASA's creation in 1997, annual capital spending averaged less than $40 million per year on total plant in service of over $1.3 billion.

Between FY 2003 and FY 2007, in the peak years of this capital program, WASA's annual capital investments in water and wastewater infrastructure (before consideration of the LTCP) exceed $200 million, a fivefold increase from the average investment only five years ago.

Even with significant capital funding from wholesale customers and grants – about 13% of the CIP's funding will come from EPA grants and 28% from wholesale customers – WASA will need to issue approximately $775 million in new debt between FY 2001 and FY 2010 to finance 47% percent of the program. As a result debt service costs will increase by more than $50 million per year by 2010 over current levels. This rising trend is equivalent to average annual increases of 11% in annual debt service costs.

The majority of the burden of this capital investment falls on the District's retail rate payers. Annual increases in retail rates of approximately 6.5% to 7.0% through FY 2008 followed by 6% annual increases from FY 2009 through FY 2012 will be required to finance the Authority's existing capital program. This projection is consistent with the policy adopted by WASA's Board of Directors to use steady rate increases as a way to mitigate the impacts of rising and mandated costs to customers. The Board established this policy after implementing a critically-needed 42% rate increase in 1997.

Over the long-term, the Authority is projecting that future necessary infrastructure investment will continue to require steady rate increases of at least 5% per year. This longer-term outlook is consistent with national infrastructure studies that document the need for doubling of rates over 20 years for infrastructure investment (see Clean and Safe Water for the 21st Century, Water Infrastructure Network, Washington, D.C.).

Under this "baseline" scenario, in which customer rates are affected by the water and wastewater capital program and routine inflationary increases in the cost of doing business, the annual cost for water and wastewater costs for a typical residential customer with metered consumption of 100 CCF per year prior to consideration of the CSO LTCP will increase from $290 to $617, a 113% increase, in fifteen years.

12.6.2 Substantial Rate Increases Required to Fund LTCP

Implementation of the LTCP will result in substantial additional rate increases and higher costs to the Authority's customers over and above the increases needed to fund the baseline capital program. Through analysis of a range of LTCP implementation schedules WASA has determined that the only rates impacts that are feasible (without substantial outside funding) are those associated with the longest possible implementation schedules. Shorter implementation schedules create too high a burden on the Authority's rate payers in terms of rapid escalation of the cost of wastewater services.

If WASA implemented the proposed LTCP over a 40-year period, a typical residential customer with annual metered water consumption of 100 CCF will see their annual wastewater costs rise from $290 to $722 in 15-years; an increase of 150%. This figure is $105 per year more than the annual bill in the baseline case without any CSO program.

Any shortening of the implementation schedule to less than 40 years will significantly increase the impacts on WASA's rate payers of the CSO controls. A fifteen-year LTCP implementation schedule would result in a more than tripling of wastewater bills to $1002 in fifteen years, and would require multiple peak increases within the next 5 to 10 years exceeding 15%, as described further below. A twenty-year program also has similar peaking impacts during the first 10 years.

Table 12-7 displays the impacts for a 100 CCF customer over 15 years for the baseline and for several LTCP implementation schedules.

Table 12-7
Summary of Rate Impacts of the CSO LTCP on 100 CCF Residential Customer

	FY 2003 Annual Bill	*Annual Bill in 15 Years*	*Average Annual Rate Increases Over 15 Years*
Baseline – No LTCP	$290	$617	6.0%
Baseline Plus LTCP – 40 Years	$290	$722	7.2%
Baseline Plus LTCP – 30 Years	$290	$795	8.0%
Baseline Plus LTCP – 20 Years	$290	$942	9.4%
Baseline Plus LTCP – 15 Years	$290	$1,002	9.9%

12.6.3 True Affordability Measure -- Impacts on Annual Household Budgets

A key indicator of the affordability of the proposed LTCP is the impact on the annual household budgets for District ratepayers as measured by the timing and extent of the required annual rate increases.

The 15 and 20-year LTCP implementation schedules would require a large number of consecutive "double-digit" rate increases when the costs of those programs are added to the demands imposed by the baseline investment in water and wastewater infrastructure. The 15-year program is projected to require 8 consecutive increases over 10% per year. Such rate increases would outpace expected growth in household incomes by two to three times, therefore eroding household resources for other items .

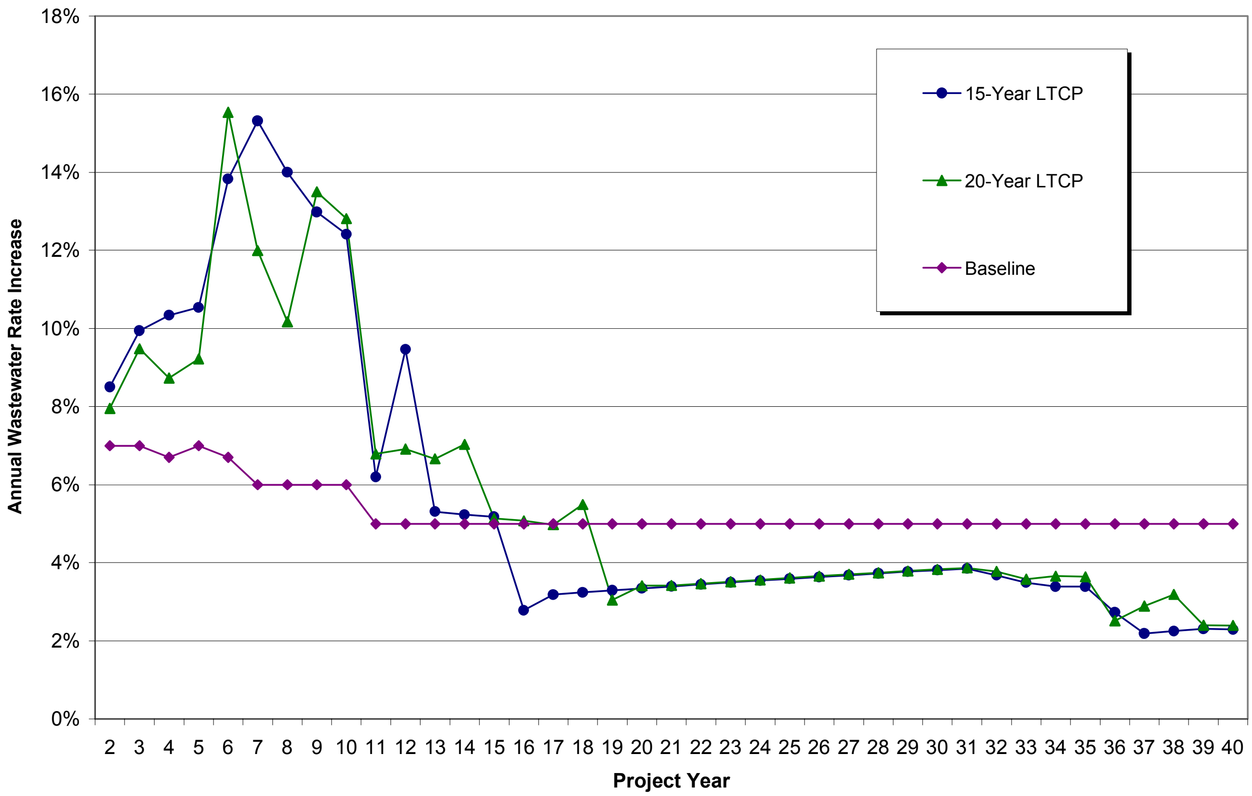
In addition to the extreme peaking of rate increases, the disparity between the rising costs that would be borne by District of Columbia residents and national experience is illustrated by the difference between 9.9% average annual increases associated with the 15-year program and the 3.6% annual rate of growth in consumer expenditures for water and sewer maintenance reported by the Bureau of Labor Statistics (BLS from January 1992 to January 2002.

These burdens will make it increasingly difficult for the District to remain competitive on a "cost of living" or "cost of doing business basis" compared to neighboring jurisdictions or other major cities that are not faced with the same capital investment burden. Currently the Authority's rates are generally competitive with the wastewater rates paid in neighboring jurisdictions in Maryland and Virginia but none of these jurisdictions is faced with the burden of an expensive CSO LTCP. The impact of this program will reduce the ability of the District to attract and retain residents and businesses relative to other locations in the area.

Nationally, a survey conducted by Memphis Gas, Light and Water Division of residential wastewater bills for rates in effect in 2001 found the monthly wastewater bills for residential customers in the District were the sixth highest out of 28 cities surveyed. All of the future rate increases associated with the baseline infrastructure investment needs and the CSO will likely further reduce the District's competitiveness on a cost of living and cost of doing business basis relative to other major cities that do not have the same burdens.

Figure 12-4 shows the annual increase in wastewater rates required for the 15 and 20-year programs as well as the baseline case.

Figure 12–4
Annual Rate Increases Required for 15 and 20-Year LTCP Plans



Another important measure is the total increase in revenue requirement added in each fiscal year, as shown in Figure 12-5. This measure demonstrates the intense peaking requirements of the CSO program as well. A 15-year program would require approximately $20 million of annual rate increases solely for CSO in five out of six years at the height of the program. The highest annual increase in revenue requirement would be approximately $33 million when the total needs of the baseline infrastructure program and the CSO are taken together.

Longer implementation schedules that range from 30 to 40 years greatly minimize peak rate increases: the 15-year schedule required eight consecutive annual increases in excess of 10 percent, while a 40 year schedule will only require one increase that is greater than 10 percent. Fewer peak increases under longer-term implementation schedules minimize the near-term impact on customers, particularly the 51,000 households with incomes less than $18,000 per year, allowing them to plan for more gradual rate increases that are in line with projected salary and other income increases. Figure 12-6 displays the annual rate increases required for 30- and 40-year implementation programs.

Figure 12-5
Annual Increase in Revenue Requirement for 15-Year LTCP and Baseline Needs

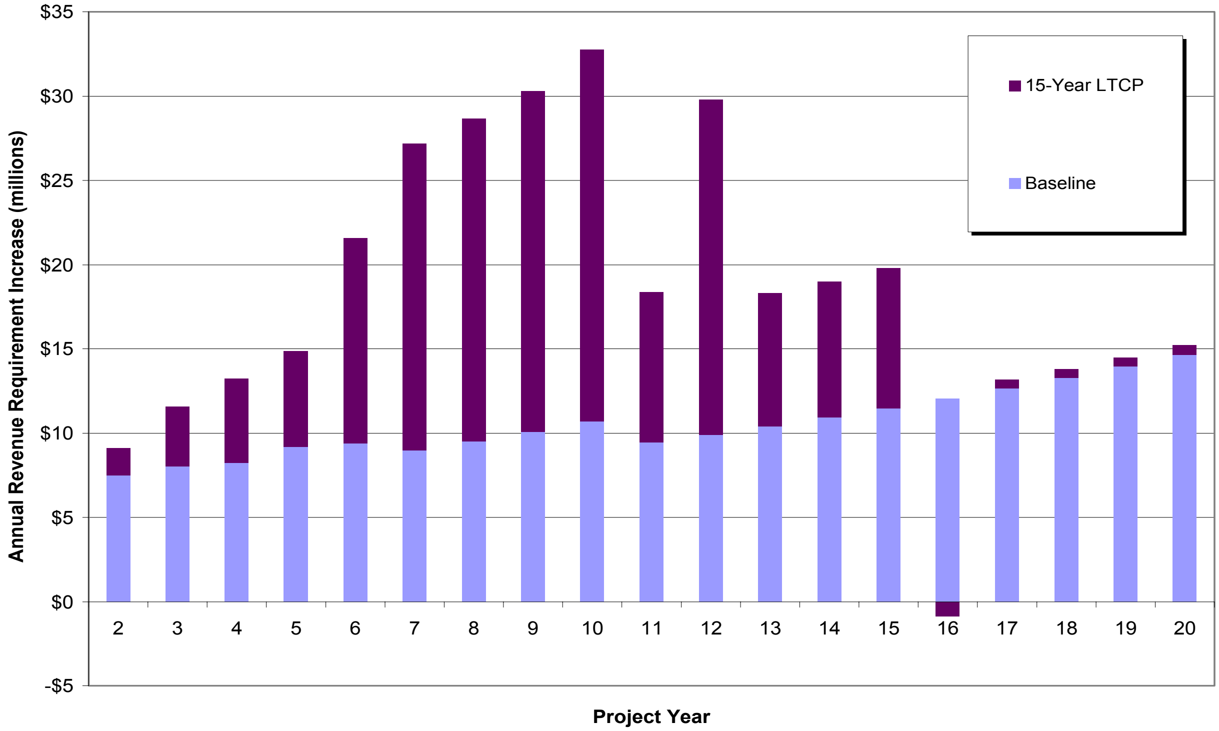
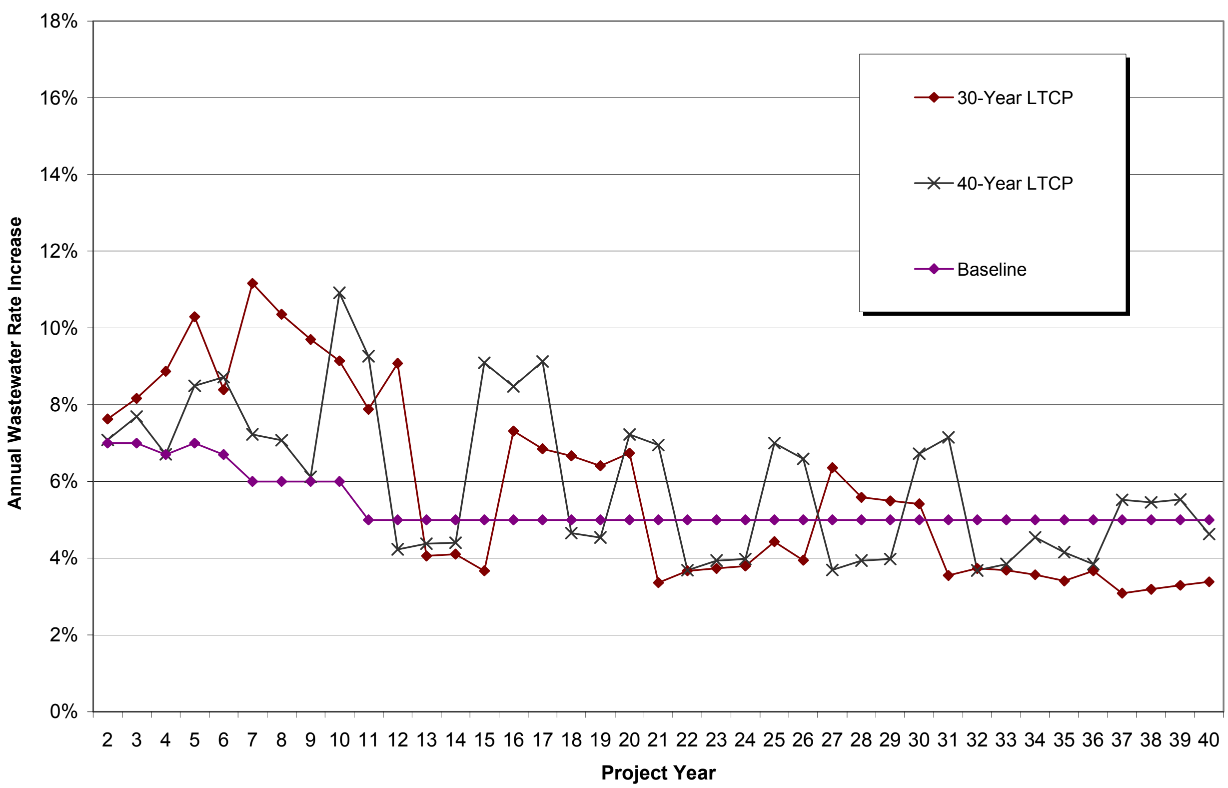
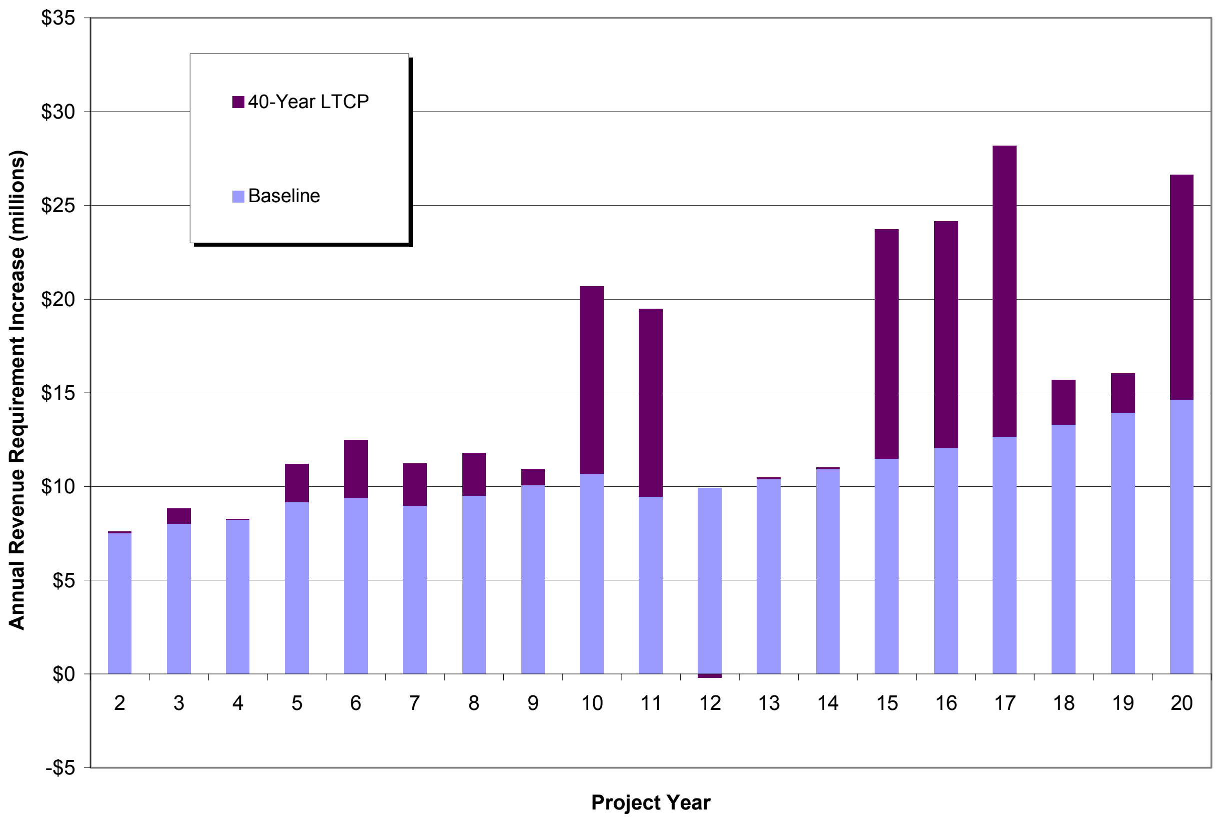


Figure 12-6
Annual Rate Increases Required for 30 and 40-Year LTCP Plans



Although there are still burdensome peaks, in general the 40-year program requires less annual increases in rate revenues for CSO. As shown in Figure 12-5, a 15-year program will require annual rate revenue increases in excess of $20 million for five out of fifteen years. Figure 12-7 shows that a 40-year schedule will require only one increase in excess of $20 million during the first fifteen years of implementation. This illustrates the minimizing effect of a longer term program on WASA's customers, particularly low income customers.

Figure 12-7
Annual Increases in Revenue Requirements for 40-Year Program



12.6.4 High Degree of Uncertainty in Rate Impacts Should Be Considered

In formulating its rate impact analysis WASA focused on a "most probable" approach to key assumptions that represent the economic and demographic conditions during the foreseeable future in a manner appropriate for this planning document. Nevertheless, the economic and demographic conditions that actually materialize on a year-to-year basis may differ from those associated with the forecast. Some of these considerations are described below:

- <u>Water Consumption</u> - The analysis of rate impacts has assumed that metered water consumption is maintained at current levels over the long-term. Water consumption has declined over the past 2 decades due to technological improvements and shifts in consumer behavior. Although WASA has taken steps to maintain a high level of meter accuracy and to reduce unbilled water, it is possible that water consumption will continue to decrease over the long-term, particularly in response to increasing rates. It is not unreasonable to expect that the 150% increase in rates over 15 years associated with the 40-year LTCP program will result in some level of reduced consumption. Any reduction in consumption will result in higher impacts have to be offset with further rate increases on the balance of the water sold by the Authority. There exists the potential to initiate a vicious cycle that would be particularly hard on low income households.

- Cost Estimates -The rate impact analysis reflects the cost estimates prepared for this planning document. These costs estimates have a level of confidence of minus-15% to plus-40%. It would be equally likely that the final cost estimates in today's dollars are 40% greater or 15% less than the cost estimates included in this plan. These estimates reflect the level of planning and engineering completed to date on each alternative which is only a portion of the work needed to complete the project. It is very likely that the costs will be higher due to the complexity of the project and the unique risks involved with a mega-project. In recent months many high-profile mega-projects of this type have seen bid amounts far exceed preliminary estimates. Several examples within the Washington region are the Woodrow Wilson Bridge replacement and the I-495/I-395 interchange (the "Mixing Bowl") project. Unlike those projects however, any cost increases or contract overruns would be borne by a relatively small population of wastewater rate payers in the District of Columbia. These are very real risks that should be considered as part of the financial capability assessment.

- Interest Rates - This rate impact analysis assumes that the Authority will be able to borrow for future CSO costs at the same interest rates as it currently pays for its utility revenue debt. Any increase in interest rates due to market conditions will need to be absorbed by WASA's retail customers and will increase the financial burden of all LTCP schedule options. The Authority's future credit rating and the structure of future bond issues could also have negative impacts on the revenue requirements. These risks should also be considered in the financial capability analysis.

- Future Regulatory Requirements - The rates impact analysis reflects the current regulatory horizon that the Authority has used to develop its current capital improvement program and the LTCP for its combined sewer system. The analysis does not provide for additional costs that may be mandated to cover future regulations such as Total Maximum Daily Loads (TMDLs) or additional nitrogen removal requirements at Blue Plains. While the baseline analysis provides substantial capital funding for future reinvestment in infrastructure, any extraordinary capital costs related to future regulation (e.g., disinfection by-products) or critical infrastructure replacement needs would further increase rates for the Authority's rate payers.

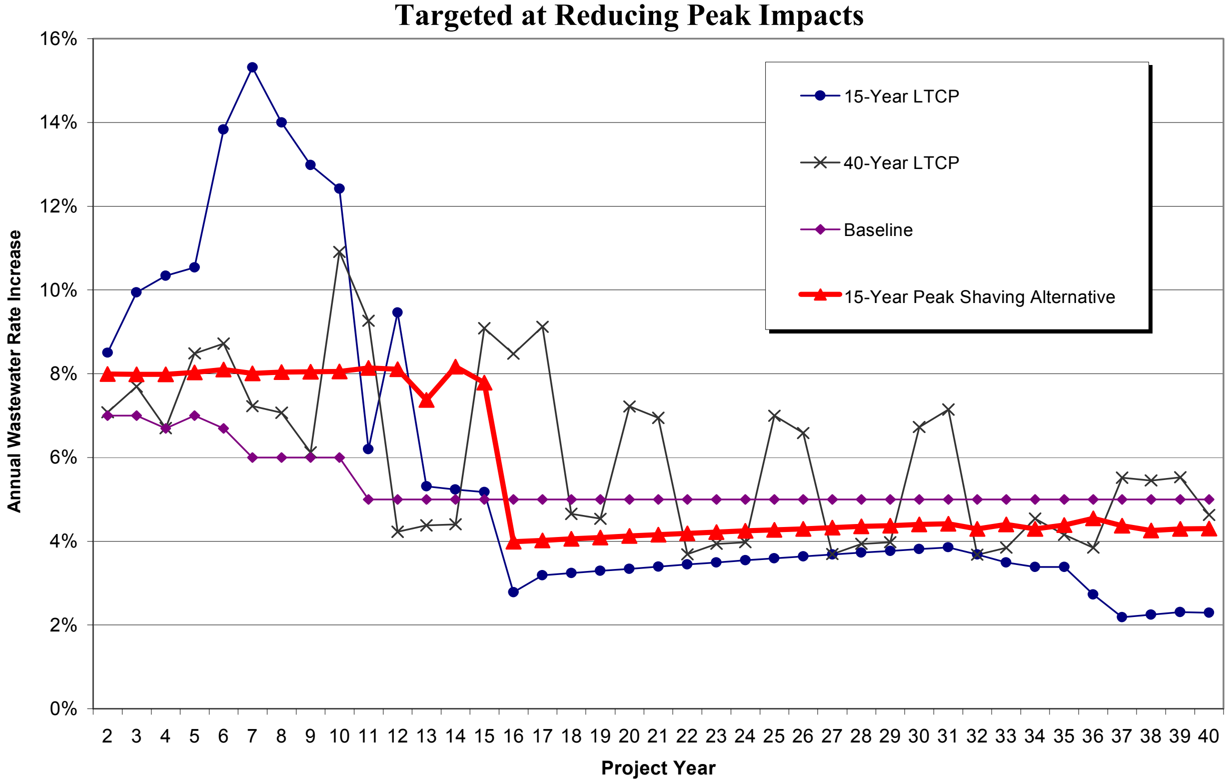
12.6.5 Effect of Federal Funding on Rate Increases

There are two ways to reduce the rate impacts of a shorter LTCP implementation schedule, external funding assistance and deferral of other water and wastewater capital expenditures.

External assistance targeted at limiting peak rate increases can reduce the severe impacts of high annual rate increases associated with the shorter programs. External assistance of 62% of the capital cost of the program could keep rate increases to 8% per year as shown in the following chart. The additional annual revenue required would gradually increase to $11.2 million by year 15.

Total external capital assistance under this scenario would be $960 million over 15 years. The external assistance in this case is targeted at the peaking impacts on wastewater rates and varies from year to year as necessary to limit rate increases to 8% or less. In any case, it is important for external assistance to reflect year-of-expenditure values or the actual "cost to complete" the project. If external assistance is determined on current dollars or on an amount per year, the cost to complete and inflation risks are shifted to ratepayers.

Figure 12-8
Rate Increases for a 15-Year LTCP Plan with External Assistance Targeted at Reducing Peak Impacts



Section 13
Recommended Control Plan

13.1 INTRODUCTION

This section describes the long-term control plan that WASA has selected. The purpose of the recommended plan is to improve water quality and it has been selected based on existing and new regulatory requirements, the alternatives evaluation, public input and consultation, and the financial capability analyses described in prior sections. In order to select the recommended plan, WASA considered the ability to meet water quality standards, cost effectiveness, and non-monetary factors such as reliability and ease of operation and maintenance. This section describes the recommended plan, the proposed implementation schedule, proposed revisions to water quality standards, and compliance monitoring.

13.2 RECOMMENDED CONTROL PROGRAM

WASA is committed to improving the quality of the Anacostia River, Rock Creek, and the Potomac River. The recommended LTCP has been selected to provide a significant improvement in the quality of each receiving water while balancing the affordability to ratepayers. The recommended LTCP consists of many elements and program components. Table 13-1 lists the components by receiving water. Figure 13-1 shows the location of the principal elements.

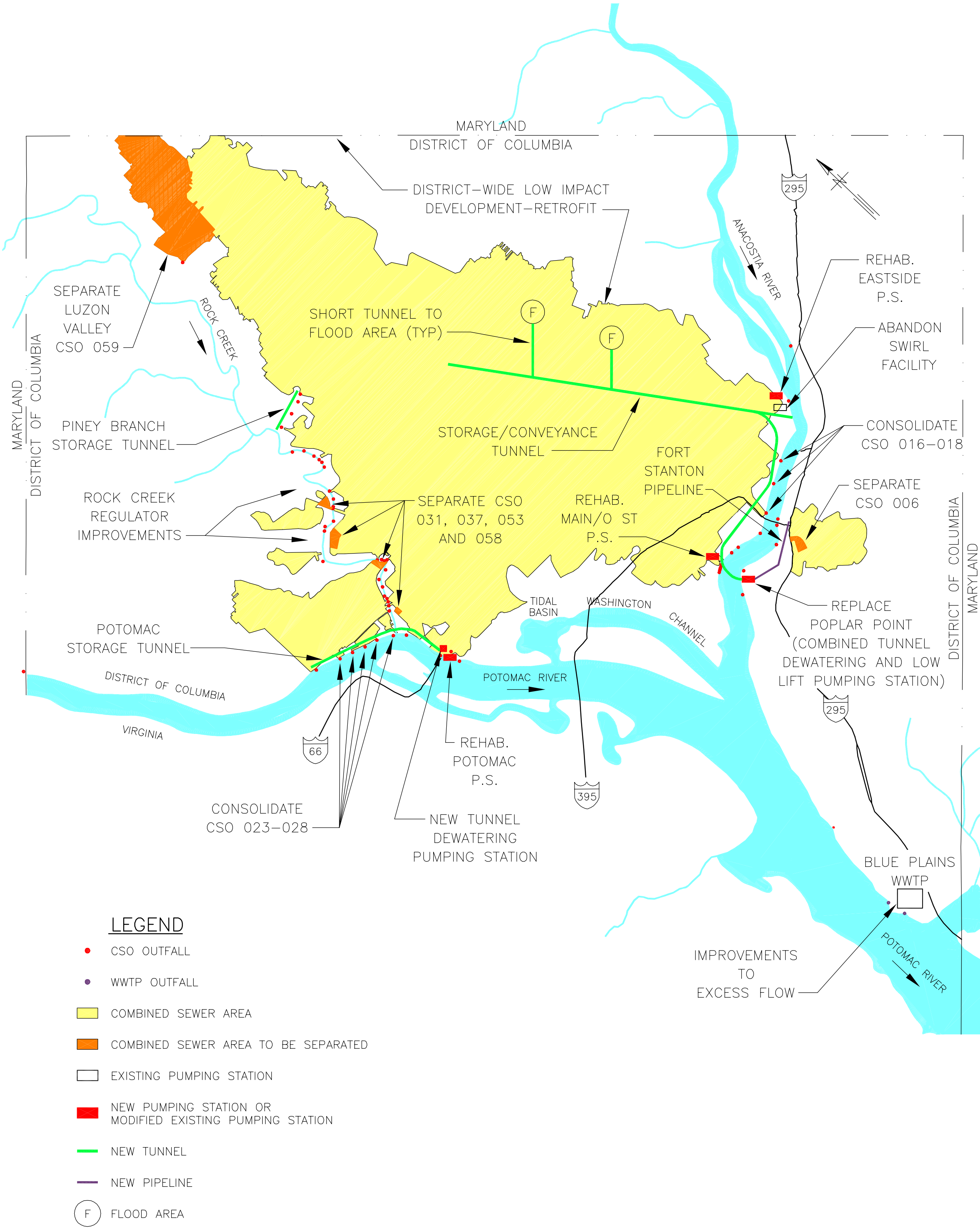
Table 13-1
Recommended Control Program Elements and Estimated Costs

Component	*Capital Cost Opinion (Millions, ENR=6383)*	*Annual Operation and Maintenance (Millions, ENR=6383)*
System Wide		
Low Impact Development – Retrofit (LID-R)– Advocate implementation of LID-R throughout entire District. Provide technical and regulatory assistance to District Government. Implement LID-R projects on WASA facilities where feasible.	$3	$0.11
Anacostia River		
Rehabilitate Pumping Stations – Rehabilitate existing pumping stations as follows: • Interim improvements at Main and 'O' Street Pumping Stations necessary for reliable operation until rehabilitation of stations is performed. • Rehabilitate Main Pumping Station to 240 mgd firm sanitary capacity. Screening facilities for firm sanitary pumping capacity only. • Rehabilitate Eastside and 'O' Street Pumping stations to 45 mgd firm sanitary capacity • Interim improvements at existing Poplar Point Pumping Station necessary for reliable operation until replacement pumping station is constructed as part of storage tunnel	$115	$0[1]

Component	Capital Cost Opinion (Millions, ENR=6383)	Annual Operation and Maintenance (Millions, ENR=6383)
Storage Tunnel from Poplar Point to Northeast Boundary Outfall – 49 million gallon storage tunnel between Poplar Point and Northeast Boundary. Tunnel will intercept CSOs 009 through 019 on the west side of the Anacostia. Project includes new tunnel dewatering pump station and low lift pumping station at Poplar Point.	$332	$7.98
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. Abandon Northeast Boundary Swirl Facility upon completion of main tunnel.	$452	
Outfall Consolidation – Consolidate the following CSOs in the Anacostia Marina area: CSO 016, 017 and 018	$27	$0[1]
Separate CSO 006 – Separate this CSO in the Fort Stanton Drainage Area	$3	$0.01
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.	$11	$0.04
Anacostia Subtotal	**$940**	**$8.03**
Rock Creek		
Separate Luzon Valley – Completed in 2002.	Completed	$0
Separation – Separate CSOs 031, 037, 053, and 058.	$5	$0.02
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	$3	$0.01
Storage Tunnel for Piney Branch (CSO 049) – 9.5 million gallon storage tunnel	$42	$0.60
Rock Creek Subtotal	**$50**	**$0.63**
Potomac River		
Rehabilitate Potomac Pumping Station – Rehabilitate station to firm 460 mgd pumping capacity	$12	$0[1]
Outfall Consolidation – Consolidate CSOs 023 through 028 in the Georgetown Waterfront Area.	$20	$0[1]
Potomac Storage Tunnel – 58 million gallon storage tunnel from Georgetown to Potomac Pumping Station. Includes tunnel dewatering pumping station.	$218	$2.78
Potomac River Subtotal	**$250**	**$2.78**
Blue Plains Wastewater Treatment Plant		
Excess Flow Treatment Improvements – Four new primary clarifiers, improvements to excess flow treatment control and operations	$22	$1.81
Grand Total	**$1,265**	**$13.36**

Notes:
1. No significant change from existing.

FIGURE 13-1



RECOMMENDED CONTROL PROGRAM

1 MILE 1/2 0 1 MILE

EPMC-III
GREELEY AND HANSEN LLC

D.C. WATER AND SEWER AUTHORITY
CSS LONG TERM CONTROL PLAN

13.2.1 System Wide Controls: Low Impact Development - Retrofit

The objective of low impact development (LID) is to mimic predevelopment site hydrology by using site design techniques that store, infiltrate, evaporate and detain runoff from rainfall events. Examples of such facilities include biofilters, tree planting, rain gardens, sand filters, porous pavement, storm water detention, rooftop greening and others. LID has the potential to reduce CSOs by diverting runoff into LID facilities and thereby preventing that runoff from reaching surface waters. Also, certain LID facilities (e.g. biofilters) can provide some treatment to runoff and reduce the pollutant load in discharges to surface waters.

Low Impact Development Retrofit (LID-R) is the application of LID to the modification of an existing site. Since most of the District is developed, LID-R appears to offer the practicable approach for implementation of LID in the District. Public comments indicated a strong preference for LID-R, and this section describes the LID-R measures that have been included in the LTCP.

Benefits of LID-R

The analyses conducted as part of the LTCP indicate that LID-R can reduce the magnitude and frequency of CSOs. Generally, CSO reduction benefits of LID-R are in proportion to the quantity of storm water that would be diverted from the receiving waters (e.g. Anacostia River) by the LID-R measures. In order to achieve a high degree of CSO control, a large application rate for LID-R is required.

In order to meet the requirements of the CSO Policy, the degree of CSO control proposed in the LTCP is extremely high in that the controls are sized for large and intense storms. As a result, the analyses indicate that application of LID-R by itself cannot be expected to provide the degree of CSO control proposed in the LTCP. However, LID-R can be coupled with structural controls to reduce CSOs or to reduce the size of capital facilities required for the degree of control proposed in the LTCP.

In addition to CSO control, LID-R can provide other ancillary benefits. These include beautification and aesthetic improvements, reduced cooling costs and reduction in pollutants from the separate storm water system. Because LID diverts storm water from the collection system, it also has the potential to reduce the total amount of flow treated by the BPWWTP. This would potentially provide capacity to handle additional dry weather flow or increase treatment performance without constructing additional facilities at the plant.

Challenges to Implementation

There are several challenges associated with the implementation of LID-R. These have been divided into technical, institutional and regulatory issues below:

- Technical Issues - In the past, LID has been primarily applied in new developments. Little data are available on the application of LID in urban retrofit conditions on a mass scale the size of the District. The lack of data makes it difficult to predict the implementability, performance, cost and CSO reduction benefits of such measures. As a result, there is uncertainty as to the practicability of implementation of LID-R in heavily developed urban areas and its benefits and cost effectiveness.

  LID-R would typically be applied on a small scale, on a street by street and lot by lot approach. Models to predict the effectiveness of LID-R measures on a micro-scale are being developed but are not available for use in this study. In addition, CSO planning requires prediction of system wide CSO performance over an extended period of time. Even if such micro-scale models were available, they would most likely not be practical to apply over the entire District and for extended simulations necessary to develop a LTCP under the CSO Policy. Given these challenges, there is uncertainty as to the CSO performance of LID-R measures in the urban setting.

  If the degree of CSO control to be obtained by LID were to match the storage approach included in the LTCP, an LID-R program equivalent to complete separation might be required.

  Prediction of the benefits of LID-R can involve many complex phenomena and require site-specific information that is not available at a planning level study. As an example, LID-R measures that infiltrate runoff into the ground may inadvertedly increase infiltration in adjacent combined sewers. This may negate some of the effectiveness of the LID-R measures. This is an example of the complexities that can be encountered when evaluating LID-R.

  Various efforts are underway to measure the effectiveness of LID-R and to improve LID-R technology. These may help make LID-R more practical, effective and attractive to citizens in the long run.

- Institutional Issues – LID-R would need to be applied in streets, sidewalks, parking lots and in public and private property in the District. One difficulty is that WASA does not control and cannot regulate development or redevelopment in the District. As a result, WASA is not able to mandate application of LID-R. Laws and building codes in the District would need to be changed in order for this to occur. WASA can, however, serve as an advocate for LID-R and recommend these types of changes to the District and provide technical assistance in their development. This is discussed further below.

- Regulatory Issues - The most practical and cost-effective way to implement LID-R would be in conjunction with redevelopment and reconstruction within the District. It would be much more costly to implement LID-R separate from reconstruction that was already planned. As a result, the implementation time associated with LID-R would be a function of the rate and magnitude of redevelopment. This may make the implementation time for LID-R very long and the benefits of LID-R may not be measurable for several decades.

  After the LTCP is implemented, WASA's discharge permit will require a specified degree of performance for the CSO controls. Violations of the permit are subject to penalties by law. If LID-R is relied on to provide all or part of the control specified in the permit, this could place WASA in the situation of having to meet a permit condition without the means to control LID-R, which is relied upon to meet the permit.

Incorporating LID-R in the LTCP

The following are findings regarding the application of LID-R for CSO control in the District:

- Since application of LID-R on a mass scale for CSO control is unproven, LID-R demonstration projects geared toward CSO reduction are recommended.

- The storage tunnels on the Potomac and Rock Creek are scheduled to be constructed after the Anacostia projects. The sizes of these facilities will be re-evaluated based on the results of the demonstration projects and the actual degree of implementation of LID-R at the time of design. This allows the possibility of reducing the size of the capital facilities required based on the application of LID-R.

- Application of LID-R in the low–density Rock Creek drainage areas may be the most beneficial. The piping system in Rock Creek generally conveys wet weather flow out of Rock Creek to the Potomac River. At the Potomac, the flow is either pumped to the BPWWTP or overflows to the Potomac River. Some of this flow is also transferred to the Anacostia system. Reducing wet weather flows in Rock Creek not only reduces CSOs in Rock Creek, but also reduces CSOs in the Potomac River and offloads flow from the Anacostia. LID-R in Rock Creek may thus have a synergistic effect on the system as a whole. The relatively low density residential areas in Rock Creek are also more likely to allow cost effective implementation of LID-R than more densely developed areas.

- The consensus of the public and regulatory agencies is that CSO controls for the Anacostia River should be implemented first. This does not allow for development and evaluation of demonstration projects prior to design and construction. As a result, the CSO facilities on the Anacostia have been sized without taking credit for the potential benefits provided by LID-R.

If LID-R is significantly implemented, CSO control will improve beyond that provided by the Anacostia control facilities.

- Institutional changes are required to allow and encourage application of LID-R

The LID-R measures presented in Table 13-2 have been selected to be part of the LTCP implemented by WASA to support the findings identified above.

Table 13-2
LID-R Measures in LTCP – By WASA

Description	Opinion of Capital Cost (Millions, ENR = 6383)
1. LID-R at WASA Facilities – Incorporate LID-R techniques into new construction or reconstruction on WASA facilities, where applicable	$3
2. Re-Evaluate the Sizes of the Potomac and Rock Creek Storage Tunnels – Based on the results of WASA demonstration projects, other current LID information, and on the actual application of LID-R in the District at the time, re-evaluate the sizing of the Rock Creek and Potomac Storage Tunnels. Modify the LTCP as appropriate.	--
3. Advocate for LID-R – As storm water administrator, be an advocate for the implementation for LID-R and provide technical and management guidance where feasible.	--
TOTAL	$3

Suggestions for institutional changes and programs to foster LID-R are presented in Table 13-3. The suggested agency for implementing each program is also included.

Table 13-3
Recommendations for Institutional Change to Foster LID-R

Description	Applicable Agencies
Public Education	
1. Develop a public education program to encourage the use of LID-R in the District.	District, Federal Government
Change Development/Redevelopment Regulations	
2. Adopt building code provisions that allow and encourage LID-R.	District
3. Consider requiring LID-R for land disturbing activities greater than a threshold dollar amount for redevelopmnet. The LID–R requirement would be to reduce storm water runoff to levels that approach the natural environment prior to human development. This is more stringent than the requirement of no net increase in storm water.	District

Description	Applicable Agencies
4. Consider encouraging LID-R on a voluntary basis by associating it with the building permit process. To obtain a permit, the permittee would need to comply with the LID-R requirements adopted. A financial incentive could be provided in terms of a reduced building permit fee, tax incentives or a reduced storm water fee. Literature and approaches could be provided to permittees with the building permit application material handed out to each permittee.	District
Change Government Practices	
5. Consider revising Department of Public Works standard details to include LID-R measures as part of transportation construction.	District
6. Develop government construction guidelines used in redevelopment and new projects that incorporate LID-R. For example, some cities have policies requiring that 'open' designs be implemented to reduce the presence of hidden, out of the way places where crime is more likely. Others have development guidelines requiring historically correct façades on new buildings in historic neighborhoods. Similar voluntary guidelines incorporating LID-R could be adopted by the District government, federal government, military facilities and institutions.	District, Federal Government
Provide Financial Incentives	
7. Consider a partial credit in the storm water fee to individuals/groups implementing LID-R.	District
8. Consider a tax rebate to individuals/groups implementing LID-R.	District, Federal Government
9. Consider a revolving loan fund for LID-R implementation.	District, Federal Government

In 2001, the D.C. Council proposed the "Urban Forest Preservation Act of 2001". The bill requires that mature trees removed or damaged during construction be replaced on the same property or at another location in the community. It also provides for establishment of a Tree Fund, paid for by those undertaking construction. The fund would be used to improve management of existing trees in the District. This type of legislation is consistent with LID-R measures and could help to reduce CSO in the long term.

In addition to these, WASA looks forward to participating in a partnership with others to investigate the feasibility of apply LID-R in an urban setting. Possible goals of the partnership would be to demonstrate and evaluate LID-R effectiveness on a sewershed basis, establish design, construction and performance standards, assess capital, operating and maintenance costs, and determine practicality. Such a program might consist of demonstrating LID-R on approximately three sewer sheds with drainage areas in the five to ten acre range. The first year of the program might include monitoring of the baseline situation without LID-R. After that, LID facilities would be constructed and an additional phase of monitoring for approximately one year would be conducted to assess benefits. Given time for finding suitable sites, design, construction and monitoring, the overall duration of the program might be in the range of three to five years. Given the Federal Government's role in the District and its interest is identifying techniques that could be applied elsewhere, a significant Federal participation in such a partnership would be appropriate.

WASA would also be willing to participate in a watershed forum or planning group, with a Federal presence, to address pollution in the watershed. The LTCP has identified that storm water is one of the major pollution sources for all of the urban watersheds. Storm water pollution is a common concern of the District, Virginia and Maryland. This could serve as a catalyst to create the forum and to strive for solutions.

13.2.2 Anacostia River Components

The control measures selected for the Anacostia River are predicted to limit overflows to 2 events per average year. During the three year analysis period (1988-1990), the frequency of overflow ranged from one per year to three per year for dry and wet years, respectively. The controls were selected to make maximum use of existing facilities and to provide supplemental storage via a tunnel to control overflows. The controls include the following:

- Rehabilitating existing Pumping Stations – Main, 'O' Street and Eastside pumping stations will be rehabilitated to firm pumping capacities of 240 mgd, 45 mgd, and 45 mgd, respectively.
- Storage/Conveyance Tunnel – A storage/conveyance tunnel will be constructed from Poplar Point to Northeast Boundary. The tunnel will intercept the CSOs from the Main and O Street Pumping Station site, the CSOs along the Navy Yard and M Street, and the Northeast Boundary CSO. An additional leg of the tunnel will be constructed parallel to the Northeast Boundary Sewer and to several low lying areas to provide additional storage for CSO and to relieve street and basement flooding in the Northeast Boundary area.
- The existing Poplar Point Pumping station will be replaced. A tunnel dewatering pump station will be incorporated into the new facility, enabling this one facility to serve two functions. In the interim, improvements will be made at the facility to assure reliable operation until the new pumping station is completed. Construction of a new Poplar Point Pumping Station could be coordinated with other improvements envisioned as part of the Anacostia Waterfront Initiative, such as construction of a new South Capitol Street Bridge over the Anacostia. WASA will continue to meet with the D.C. Office of Planning to coordinate these improvements.
- Once the tunnel is completed, the Northeast Boundary Swirl Facility will be abandoned.
- Separate CSO 006 – Separate this CSO on the east side of the Anacostia River, eliminating it as a CSO outfall.
- Outfall Consolidation – consolidate outfalls 016, 107 and 018 in the Anacostia Marina area by connecting them to the tunnel. This will eliminate these outfalls from the system and remove these outfalls from the marina area.

13.2.3 Rock Creek Components

The control measures selected for Rock Creek are predicted to limit Piney Branch overflows to one per average year. At Piney Branch, the frequency of overflow ranged from zero per year to two per year for dry and wet years, respectively, during the three-year analysis period. The remaining overflows in Rock Creek will be controlled to 4 events per average year. For these overflows, the frequency of overflow ranged from one per year to six per year for dry and wet years, respectively, during the three year analysis period. The principal control measures are:

- Separate Luzon Valley (CSO 059) – Separation of this area was completed in early 2002.
- Separate CSOs 031, 037, 053, and 058 – separation of these four drainage areas comprising a total drainage area of about 28 acres. This will allow the elimination of these CSOs.
- Monitoring at CSOs 033, 036, 047, and 057- These CSOs are predicted to overflow relatively infrequently and in very small amounts. Monitoring will be conducted to confirm that overflows are indeed occurring. If the monitoring confirms the predictions of the model, then regulator improvements will be implemented on each of the CSOs and relief of the Rock Creek Main Interceptor will be provided by connecting the interceptor to the proposed Potomac Storage Tunnel. If the monitoring indicates that surcharge in the Rock Creek Main Interceptor is worse than predicted by the model, then a relief interceptor parallel to the Rock Creek Main Interceptor may be required. The capital cost of the relief interceptor is estimated to be about $17 million. This cost is not included in the recommended LTCP.
- Piney Branch Storage Tunnel – The largest CSO in Rock Creek is Piney Branch. A storage tunnel would be constructed to control overflows from this largest CSO. The tunnel would dewater by gravity, avoiding the need for a pumping station.

13.2.4 Potomac River Components

The control measures selected for the Potomac River are predicted to limit overflows to 4 events per average year. During the three-year analysis period, the frequency of overflow ranged from zero per year to five per year for dry and wet years, respectively. The principal control measures are:

- Rehabilitation of Potomac Pumping Station – rehabilitation of Potomac Pumping Station will enable more flow to be pumped to BPWWTP for treatment. The rehabilitation of the station is predicted to reduce CSOs in the Georgetown area by one half.
- Potomac Storage Tunnel – a storage tunnel would be constructed from west of the Key Bridge, parallel to Georgetown, and terminating at Potomac Pumping Station. The tunnel will intercept the Georgetown CSOs and the large CSOs downstream of Rock Creek. A new pumping station would be constructed at the Potomac Pump Station to dewater the tunnel.
- Outfall Consolidation – consolidate outfalls 023/024, 025, 026, 027 and 028 in the Georgetown waterfront area by connecting them to the tunnel. This would eliminate these

five outfalls from the system and remove these outfalls from the most used portion of the waterfront.

13.2.5 Blue Plains Wastewater Treatment Plant Components

The recommended LTCP reflects that the Blue Plains Wastewater Treatment Plant (BPWWTP) will operate at its current permit limits. The facility is currently rated for 370 mgd on an annual average basis. During wet weather events, flows up to 740 mgd can receive treatment for up to 4 hours. After the first 4 hours, the treatment capacity is reduced to 511 mgd to protect the biological process. Additional flows of up to 336 mgd that exceed the treatment capacity of the plant receive excess flow treatment, which consists of screening, grit removal, primary treatment and disinfection before discharge to the Potomac River. For the first four hours, the combined treatment and excess flow capacity is 1076 mgd (740 + 336) and thereafter 847 mgd (511 + 336).

In 1999, a review of the excess flow control strategy was conducted, and recommendations were developed in order to improve the reliability and performance of that treatment train. These improvements are needed as part of the LTCP and major elements are summarized below:

- Construct four additional primary clarifiers (or their equivalent) on the east side of the plant ("J House" primary tanks). These tanks will decrease the loading on the existing tanks and will improve reliability by providing redundancy.
- Lengthen the weir on the Excess Flow Chlorine Contact Tank and replace influent sluice gates with motor operated butterfly valves to reduce headloss through the system and improve control.
- Incorporate a control system and possibly variable speed drives into the rehabilitation of Raw Wastewater Pump Station No. 2 to improve control of wet well levels at the facility.
- Improve record keeping, time keeping and communications during excess flow events and provide automated controls to facilitate these functions.

The BPWWTP was designed for nitrification, and these facilities were placed in operation in 1980. The plant was not originally designed to remove nitrogen (i.e. to denitrify). In 1987, the District of Columbia signed the Chesapeake Bay Agreement, which calls for voluntary reductions in nutrients to the Bay by 40 percent by 2000 using 1985 as a base year. In 1996, a Denitrification Demonstration Facility was constructed at BPWWTP. The facility uses the existing nitrification reactors and other nitrification capacity to conduct both nitrification and denitrification. Nitrification capacity was reduced to the first four stages of the reactor, to accommodate denitrification in the last stage. Full scale denitrification using this approach was later incorporated at the plant.

This approach to denitrification utilizes one facility for two processes. There are difficulties in conducting denitrification under all conditions of flow, load and temperature. This was shown to be the case when implementation of nitrogen removal was negotiated with regulatory agencies. Experience with the full scale facility has shown that denitrification process produces poorly settling solids which contribute to solids washouts and blinding of the effluent filters at high flow rates. This is due to attempting to treat high flows during storm events simultaneously with nitrification-denitrification using the same tankage, particularly during cold weather. Based on this experience, it appears that BPWWTP will not be able to reliable denitrify under high flow conditions.

The frequency of this occurrence depends on rainfall conditions and water temperature. A preliminary estimate of the time denitrification might not be feasible is on the order of 100 days per average year. This will need to be refined when higher flows begin to be received at the plant after the pump station rehabilitations.

Because the Chesapeake Bay Program is considering revised nitrogen limits for the Bay, future NPDES permits may require nitrogen removal at Blue Plains to an effluent concentration as low as 3 mg/L. Chesapeake Bay Program Goals may thus dictate nitrogen removal requirements at the plant, and further measures should be based on the final outcome of the Bay Program. No costs for nitrogen removal are included in the LTCP.

13.2.6 Permits and Land Requirements

Permits and approvals from a myriad of agencies will be required to construct the recommended LTCP. Without performing detailed facility plans for each control measure, it is not possible to ascertain all of the required permits and approvals. It is, however, likely that permits may be required from the District Government including D.C. Department of Health, National Park Service, the U.S. Army Corps of Engineers, EPA and possibly easements from some private land owners. Because many of the CSO facilities cross National Park Service land to reach the receiving waters, extensive permitting and coordination with this agency will be required.

Actual land and permitting requirements will depend on the alignment and configuration selected for the control facilities. Effort will be made to select alignments to minimize the need for easements and right of ways. Based on the preliminary concepts in the recommended plan, significant land and permitting requirements are summarized in Table 13-4.

Table 13-4
Preliminary Assessment of Significant Land and Permitting Requirements

Land/Permitting Activity	*Probable Permitting Agency*
Anacostia Components	
Site for new Poplar Point Pumping Station	Depends on location, probably the National Park Service
Site for replacement East Side Pumping Station	National Park Service
Easements/right of way for tunnel, pipelines and appurtenant facilities	National Park Service, various private property owners and government agencies, depending on selected alignment

Land/Permitting Activity	*Probable Permitting Agency*
Right of way or easements for Fort Stanton Interceptor and appurtenant facilities	National Park Service, depending on alignment
Potomac Components	
Easements/right of way for tunnel, pipelines and appurtenant facilities	National Park Service, various private property owners and government agencies, depending on selected alignment
Rock Creek Components	
Easements/right of way for Piney Branch Storage Tunnel, shafts and appurtenant facilities	National Park Service
Easements/right of way for Rock Creek Regulator Improvements	National Park Service

13.2.7 Expandability

The CSO Policy requires that control plans be expandable such that higher levels of control can be implemented if required in the future. The recommended plan can be expanded to a plan that would provide zero overflows in the three analysis years or to a plan that would provide zero overflows during a 5-year 24-hour design storm. There are many ways to do this including:

- Separate portions of the CSO area
- Implement additional LID in the District
- High Rate Treatment
- Expanding the tunnel system:
  - Anacostia System – extend the proposed tunnel which terminates at Poplar Point to BPWWTP, greatly increasing the storage volume.
  - Potomac System – extend the Potomac tunnel to join with the Anacostia Tunnel in the vicinity of the Main and O Street Pumping Stations.
  - Piney Branch – Extend the Anacostia Tunnel from Florida Avenue to intercept Piney Branch. The Piney Branch tunnel proposed in the LTCP would remain. Once the Piney Branch tunnel filled, it would overflow to the extension of the Anacostia Tunnel.
  - Blue Plains – Construct a tunnel dewatering pump station to empty the contents of the entire tunnel system. Construct a high rate treatment facility to treat the contents of the tunnel. This would be required since BPWWTP does not have adequate capacity to treat the large volume of stored CSO in a reasonable amount of time.
- Emergence of new technologies
- Combinations of the above

The selection of a method of expansion would depend on the desired goal. This would need to be determined on a case by case basis.

13.2.8 Other Activities Benefiting CSO Control

Activities by other governmental and private organizations could improve the degree of CSO control provided by the recommended plan. These activities are typically aimed at reducing storm water runoff, but include other flow reduction measures. They would reduce the load on the combined sewer system by reducing flows in the sewers and thereby reduce overflows.

The recommended LTCP does not take credit for these activities being in place. This is because WASA may not control the activities or because there is no firm information as to when or to what degree the activities will be implemented or effective. As a result, any degree of implementation or effectiveness would serve to improve the level of CSO control provided by the recommended LTCP. The activities are described below:

- Trees in the District – trees can reduce runoff and slow down flow into the combined sewer system. :In a letter to WASA regarding the storm water retained by trees during storm events, James Urban, FASLA indicated that during a rain event the "above ground structure of the tree (leaves, branches and trunk) becomes coated with water held by surface tension and not released. Most of this water evaporates after the rain event. Additional water attaches to the tree and the surface friction of the tree slows its downward flow into the storm water system." Mr. Urban has examined the literature and found two sources to calculate the amount of water held in the tree: (1) "Urban Hydrology for Small Watersheds TR-55" published by the USDA Natural Resources Conservation Service in June 1986, while not specifically addressing the water held in canopy, is designed to look at large storm events and indicates an approximately 10% decrease in runoff resulting from the addition of tree canopy (derived by comparing runoff from forested and grazed pasture in poor soils). (2) A more recent study conducted at the Center for Urban Forest Research, USDA Forest Service, University of California, Davis [xiao@cstars.ucdavis.edu], indicates that trees hold between 0.05 to 0.17 inches of water per square foot of canopy area, retaining about 10% of a one-inch rain event when in full leaf (and less in winter). Consequently, Mr. Urban concludes: "Trees, even when they are growing in environments that are mostly paved, have a significant impact on storm water flow rates and time of concentration. New technologies in the design for trees in urban areas allow us to grow significant tree canopies in areas that are mostly paved." (Urban, 2001)

  Some of the activities related to trees are summarized below

  - District's Urban Forestry Administration – The Mayor and D.C. Council have improved the District's street tree maintenance and planting programs under the Urban Forestry Administration in the Department of Transportation.

  - Urban Forestry Preservation Act - In 2001, the D.C. Council proposed the "Urban Forest Preservation Act of 2001". The bill requires that mature trees removed or damaged during construction be replaced on the same property or at another location in the community. It also provides for establishment of a Tree Fund, paid for by those undertaking construction. The fund would be used to improve management of existing trees in the District.

  - Casey Trees Foundation – In 2001, Ms. Betty Brown Casey of the Eugene B. Casey Foundation gave $50 million to the Garden Club of America for the creation of a permanent endowment to restore the tree canopy of Washington, DC. The Casey trees Foundation was thus created to restore and enhance the District's trees. In the summer of 2002, the foundation is performing an inventory of public and privately owned trees. More information is available at www.caseytrees.org.

- Building Code Changes – WASA participates on the Building Code Advisory Committee, which reviews and advises on code changes. As part of this committee, WASA advocates for practical changes that encourage and allow low impact development and other measures aimed at decreasing runoff. The committee recently proposed a series of changes that could reduce flow to the combined sewer system. The changes now await action by the Director of the D.C. Department of Consumer and Regulatory Affairs and submittal to and approval by the D.C. Council. The proposed changes relevant to runoff reduction are as follows:
  - Changes to Section 1101 of Plumbing Code to allow storm water discharge to vegetated areas and any other approved place of disposal
  - New Section 708 of Plumbing Code that requires owners to disconnect storm drainage systems from sewer systems if physically possible and when the property improvements exceed 50% of fair market value
  - Changes to definition of "Cisterns" in the Plumbing code to allow cisterns in any land use

- Zoning Changes – The Zoning Commission has asked the Mayor's Office of Planning to review regulations that encourage or require more rather than less impervious cover in land use. WASA proposes to make the agencies aware of the issues and seek appropriate reform.

- D.C. Extension Service – the Land Grant Extension Service, based at the University of the District of Columbia (UDC), has expressed an interest in playing a role in LID programs. WASA has offered to work with UDC and the Extension Service.

- Suburban Jurisdictions – The suburban jurisdictions send separate sanitary wastewater flow to Blue Plains for treatment. Monitoring data indicates that this flow increases during wet weather, most likely due to infiltration and inflow. While wet weather flows from the suburbs are within the peak flow limits allowed by the Intermunicipal Agreement (IMA), the suburbs do have ongoing infiltration and inflow reduction programs. For example, WSSC has a program to assess wet weather flow in particular drainage basins and prioritize them for remedial action as is cost effective and appropriate. Such reductions in wet weather flows from the suburbs could help in the reduction in CSOs in the District.

- Other WASA programs, other than the LTCP - WASA has other programs that are or will be underway that may have additional CSO reduction benefits. These are:

    - Water Conservation and Wastewater Flow Reduction Programs - these programs will reduce dry weather flow, thereby allowing the system to accommodate more CSO. The purpose of the programs is to reduce the District's annual average flow from the current 1606mgd to meet the District's IMA allocation of 148 mgd. The LTCP was prepared with the District's dry weather flow at 148 mgd. Any additional reductions in flow due to these programs below the IMA allowance would provide additional CSO reduction benefit.

    - Sewer System Assessment – WASA is beginning a system-wide sewer system assessment program. The purpose of the program is to assess the condition and capacity of the sewer system and to develop a program for rehabilitation and upgrade of the system where needed. This program may make recommendations for downspout disconnection, some selective separation and projects to reduce inflow and infiltration. Particular attention will be given to separating areas where investments in separation have already been made such as College Pond and portions of downtown near the Capitol and White House.

    - Tide Gate Replacement – WASA is in the process of replacing tide gates at selected CSO outfalls. Replacement of tide gates can reduce the amount of water that enters the system from the receiving waters, thereby freeing ups space for CSO and reducing overflows.

13.3 BENEFITS OF RECOMMENDED CONTROL PROGRAM

The selected CSO control program is expected to provide significant benefits to the citizens of the District and to all who use and enjoy the Anacostia River, Rock Creek and the Potomac River.

13.3.1 CSO Overflow Reduction

The frequency and volume of CSO overflows will be greatly reduced as a result of the recommended LTCP. Table 13-5 illustrates the reduction of overflows.

Table 13-5
CSO Overflow Reduction of Recommended CSO Plan (Average Year)

Item	*Anacostia River*	*Potomac River*	*Rock Creek*	*Total System*	*% Capture of Combined Sewage per CSO Policy*
CSO Overflow Volume (mg/yr)					
No Phase I Controls	2,142	1,063	49	3,254	76%
With Phase I Controls	1,485	953	52	2,490	82%
Recommended Plan	*54*	*79*	*5*	*138*	*99%*
% Reduction from No Phase I Controls	97.5%	92.5%	89.8%	95.8%	-
Number of Overflows/yr					
No Phase I Controls	82	74	30	-	-
With Phase I Controls	75	74	30	-	-
Recommended Plan	*2*	*4*	*1 / 4*[1]	-	-

Notes:
1. One at Piney Branch, four at the other Rock Creek CSOs

The Phase I CSO controls consisted of the inflatable dams for in-system storage and the Northeast Boundary Swirl Facility for treatment of CSO overflows. These controls were completed in 1991. Prior to the Phase I Controls, the predicted annual CSO overflow volume to all receiving waters was about 3,254 million gallons. The Phase I Controls reduced this to an estimated 2,490 million gallons. The recommended CSO plan is predicted to reduce this to 138 million gallons or by about 95.8% on a system-wide basis compared to no Phase I Controls.

In the Anacostia the number of overflows are predicted to decrease from about 82 per average year to 2 per average year. Similarly, the number of overflows in the Potomac River and Rock Creek are predicted to decrease from 74 and 30 to 4 and 1 per average year, respectively.

In addition to demonstrating reductions in overflows from current levels, EPA's CSO Policy calls for calculating the percentage of combined sewage that is captured for treatment in the combined sewer system. The percentage of capture without the Phase I CSO controls was already very high at 76%, primarily due to the ability of BPWWTP to treat high flows during wet weather events. With implementation of the recommended LTCP, the CSO capture rate is predicted to be 99% on a system wide, annual average basis. This is extremely high when compared to EPA's guideline of 85% capture under the presumptive approach as described in Section 2.

13.3.2 Outfall Elimination

The recommended plan will eliminate 14 CSO outfalls by separation and consolidation. For CSOs eliminated by separation, a storm water outfall will be present for each of the drainage areas separated. The eliminated outfalls are summarized in Table 13-6.

Table 13-6
Outfalls Eliminated by Consolidation and Separation

Receiving Water	*Outfall Eliminated*	*Drainage Area*	*Method of Elimination*
Anacostia	CSO 006	Fort Stanton	Separation
Anacostia	CSO 016	Navy Yard/M St.: 12th St.– 9th St.	Consolidation
Anacostia	CSO 017	Navy Yard/M St.: 14th to Penn Ave.	Consolidation
Anacostia	CSO 018	Barney Circle	Consolidation
Potomac	CSO 023/024	West of Rock Creek Diversion Sewer – K St.To Wisconsin Ave.	Consolidation
Potomac	CSO 025	31st & K St NW	Consolidation
Potomac	CSO 026	Water St District (WRC)	Consolidation
Potomac	CSO 027	Georgetown	Consolidation
Potomac	CSO 028	37th St-Georgetown	Consolidation
Rock Creek	CSO 031	Penn Ave-Middle East Rock Creek	Separation
Rock Creek	CSO 037	Kalorama Circle West – E. Rock Creek	Separation
Rock Creek	CSO 053	Q St. – West Rock Creek	Separation
Rock Creek	CSO 058	Connecticut Avenue	Separation
Rock Creek	CSO 059	Luzon Valley	Separation Complete
Total Number	**14**		

Note that the tunnels must be completed before consolidation can take place because the tunnel capacity is used to move the flow from the consolidated outfalls downstream. Separation can proceed independently of the tunnels.

13.3.3 Water Quality

Bacteria and dissolved oxygen are the two common performance measures used to assess water quality and the benefits provided by CSO control.

Bacteria

The analyses conducted as part of the LTCP demonstrated that other sources of bacteria will prevent meeting the Class A water quality standard for fecal coliform in the Anacostia River and Rock Creek, even if CSOs were eliminated. However, the recommended LTCP will dramatically reduce the impact of CSOs. By themselves, CSOs will meet the fecal coliform geometric mean standard in each receiving water as shown in Table 13-7.

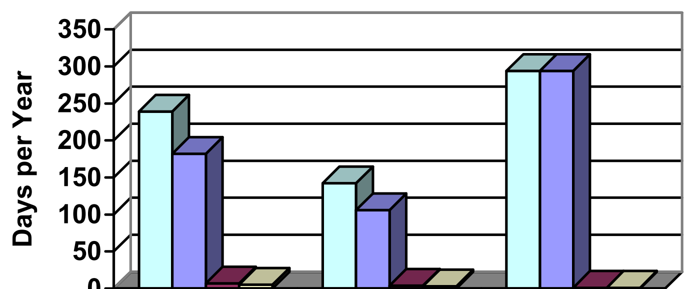
Table 13-7

CSOs Will Meet Bacteria Geometric Mean Standard

Receiving Water	*No. of Months per Average Year Class A Fecal Coliform Standard of 200/100 ml Exceeded*
Anacostia River	0
Potomac River	0
Rock Creek	0

Figure 13-2 shows the number of days where the predicted fecal coliform concentration is greater that 200/100 ml.

Figure 13-2
Number of Days Fecal Coliforms Exceeding 200/100 ml



	Anacostia River (Navy Yard)	Potomac River (at Memorial Bridge)	Rock Creek (at Zoo)
No Phase I Controls	239	142	294
Recommended Plan - All Loads	182	106	294
Recommended Plan-CSO's Only, Calendar Year (1)	7	4	1
Recommended Plan-CSO's Only, May-Sept (1)	5	3	1

Note: (1) Days due to CSOs are number of days concentration exceeds 200/100 ml if there were no other sources of bacteria.

In the Anacostia River, implementation of the recommended LTCP will reduce the number of days where the predicted concentration is above 200/100 ml from approximately 239 days to 182 days. Figure 13-2 shows the predicted days the concentration in the receiving waters would exceed 200 due to CSOs if there were no other sources of bacteria in the river. Of the 182 days predicted to exceed 200/100ml, 7 days in the year would be caused by CSOs. Of those 7 days, 5 are in the period May through September, the period of most likely primary contact recreation. A similar pattern is observed for the Potomac River and Rock Creek.

While other sources of pollution will prevent meeting water quality standards that allow full body contact recreation, CSO controls will significantly reduce the concentrations of bacteria in the receiving waters. As an example, the fecal coliform concentrations in May in the Anacostia at the Navy Yard are predicted to decrease from about 3,300 organisms/100ml (no Phase I Controls) to about 800 organisms/100ml (2 overflows per year).

Dissolved Oxygen

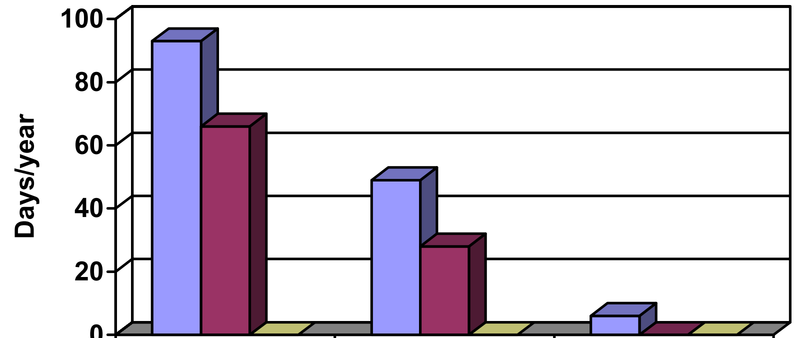
Dissolved oxygen is not a significant concern in Rock Creek or the Potomac River because existing water quality standards are met the majority of the time. The reduction of CSO overflows to these receiving waters will reduce the quantity of pollutants which contribute to oxygen deficiencies.

In the Anacostia River, dissolved oxygen is a significant concern. Low dissolved oxygen levels typically occur in the summer months of June to August and typically follow a significant local or upstream wet weather event. The low dissolved oxygen is driven by the naturally low saturation level of oxygen in the water due to the high water temperature, the influx of pollutant loads from wet weather events, and the demand exerted by polluted sediments in the river bottom. Dissolved oxygen levels below 2.0 mg/L can occur several times per summer month, with each episode lasting 1 to 2 days. Fish kills have been observed in the past. Figure 13-3 shows the projected benefits provided by the recommended LTCP at South Capitol Street.

In addition to the number of days less than 5 mg/L, the figure also shows the number of days less than 4 mg/L and 2 mg/L. Below 4 mg/L, certain fish begin to experience stress, while dissolved oxygen levels below 2 mg/L cause a risk of fish kill.

It is predicted that the recommended LTCP will reduce the number of days less than 5 mg/L from approximately 93 to 66. A similar reduction is observed for the 4 mg/L threshold. At South Capitol Street, the selected plan is predicted to eliminate the number of days less than 2 mg/L, the fish kill threshold. It is important to note that dissolved oxygen levels below 2.0 mg/L are still predicted to occur at other locations in the river such as at the Navy Yard and RFK Stadium, primarily due to the impact of sources such as upstream loads, storm water discharges and the sediments in the river.

Figure 13-3
Number of Days Per Year Dissolved Oxygen is Less Than Indicated Value at South Capitol Street in Anacostia River



	Days < 5 mg/L	Days <4 mg/L	Days <2 mg/L
No Phase I Controls	93	49	6
Recommended LTCP-All Loads	66	28	0
Recommended LTCP-CSO's Only	0	0	0

While it is possible for CSO control alone to prevent the dissolved oxygen level from dropping below 2 mg/L at locations approaching the Potomac River (such as at South Capitol Street), control of other sources, coupled with CSO control, is required to meet this criteria at all locations along the river.

Anacostia River Total Maximum Daily Loads (TMDLs)

There are two existing TMDLs for the Anacostia River. One TMDL is for dissolved oxygen and it has been expressed in terms of biochemical oxygen demand (BOD). The second TMDL is for water clarity, and it has been expressed in terms of total suspended solids (TSS). Presuming the TMDLs are expressed appropriately in regulatory documents such as permits (such as on an annual average basis), the LTCP will meet both TMDLs. A comparison of the loads allocated to CSO and the predicted loads after implementation of the LTCP are presented in Table 13-8. Note that the BOD TMDL did not allocate any load to CSO in the upper Anacostia River. It is presumed that this is an oversight since the largest Anacostia CSO is located in the Upper Anacostia as defined by EPA. It is assumed this can be corrected by regulatory agencies.

Table 13-8
LTCP Meets Anacostia River TMDLs

Location	BOD TMDL (lb BOD/avg yr)		TSS TMDL (tons TSS/April-Oct 1989)	
	TMDL Allocation to CSO	Projected CSO Load for LTCP	TMDL Allocation to CSO	Projected CSO Load for LTCP
Upper Anacostia	0	8,901	58	56
Lower Anacostia	152,906	9,490	45.4	22
Total	**152,906**	**18,391**	**103.4**	**78**

Preliminary discussions with DOH indicate that the LTCP will comply with the future fecal coliform TMDL for the Anacostia, Potomac and Rock Creek.

Chesapeake Bay Program

In 1983 and 1987, Virginia, Maryland, Pennsylvania, the District of Columbia, the Chesapeake Bay Commission and EPA signed agreements establishing the Chesapeake Bay Program to protect and restore the Chesapeake Bay. In 2000, *Chesapeake 2000* was signed which reaffirmed the commitments. The Agreement calls for many measures to improve the ecosystem such as habitat restoration, water quality protection and improvement, nutrient reduction, land conservation and other factors. The receiving waters in the District are tributary to the Chesapeake Bay and affect its water quality. The reduction in CSO overflow of 96 % due to the proposed CSO controls will benefit the Bay and will contribute to meeting the goals of the Bay Program.

13.3.4 Solids and Floatables Control

Solids and floatables on the receiving waters come from the following sources:

- Combined sewer overflows
- Storm water outfalls
- Littering and dumping directly into or along the receiving waters
- Upstream sources

Implementation of the recommended control plan will virtually eliminate solids and floatables from combined sewer system discharges because the majority of CSOs will be captured and treated. For storms which are beyond the capacity of the proposed control system, the first flush of CSO which contains the vast majority of solids and floatables will be captured and treated. Overflows from the proposed control system will typically occur near the end of extreme storm events after most of the solids and floatables have been washed from the streets and captured by the control facilities. In addition, the following control measures will be implemented:

- WASA will incorporate floatables control for overflows which exceed the capacity of the recommended control plan into the design of new CSO diversion structures/facilities which will be constructed as part of the recommended plan, where practical. One method that might be used is a combination baffle/bar rack arrangement in new CSO regulators. This method has been used successfully in Richmond, Virginia and Boston, Massachusetts. As was discovered in those communities, there may be some outfalls where incorporation of floatables control into new facilities is not practical due to hydraulics, site constraints or other factors. This will be evaluated on a case by case basis during the design phase.
- WASA will continue to operate the Anacostia River Floatable Debris Removal Program, which consists of skimmer boats that remove solids and floatables from the Anacostia and Potomac Rivers. Note that this program removes materials from the rivers from all sources, not just from CSOs.
- The storm water pumps at the Main and O Street Pumping Stations incorporate trash racks on the influent side of the pumps that remove floatables before discharge to the Anacostia River.

After implementation of the recommended plan, a large amount of trash may still be present due to sources other than CSO. Control of these other sources in a watershed-based approach is recommended.

13.4 COMPARISON OF FINAL LTCP TO DRAFT LTCP

The Final LTCP described in this report represents a major increase in CSO control over the Draft LTCP that was released in June 2001. In developing the Final LTCP, consideration was given to public and regulatory agency comments, the CSO Policy, the need to meet D.C. water quality standards, and existing and prospective TMDLs for the receiving waters. Particular attention was paid to separation, outfall elimination, low impact development and increasing the level of CSO control. Major advances in each of these categories have been made. The Final LTCP is compared to the Draft in Table 13-9.

Table 13-9
Comparison of Final and Draft LTCPs

Item	*Draft LTCP*	*Final LTCP*
No. CSO Overflows/Avg. Year		
Anacostia	4	2
Potomac	12	4
Rock Creek at Piney Branch	4	1
Rock Creek – other outfalls	4	4
CSO Overflow Volume (mg/avg yr)		
Anacostia	93	54
Potomac	153	79
Rock Creek	13	5
Total	259	138
% Reduction From Existing	92%	96%

Item	*Draft LTCP*	*Final LTCP*
% Reduction on Anacostia	96%	98%
System Characteristics		
CSO Storage Volume (mg)	147	193
No of CSO Outfalls	60	46
Water Quality Criteria		
Meets Oxygen and Bacteria Water Quality Standard for Design Condition?	Yes	Yes
Meets Anacostia BOD and TSS TMDLs?	BOD - Yes TSS - Yes	Yes
Cost		
Capital Cost (Year 2001)	$1.05 Billion	$1.265 Billion
Cost Increase over Draft LTCP	-	20%

13.5 FINANCIAL IMPACTS

A detailed affordability analysis was prepared to assess the impact of the recommended LTCP on rate payers. The following two methods were used:

- Long-term rate impact analyses using the Authority's financial planning and rates model, and
- Affordability analysis using procedures developed by EPA.

A key indicator of the affordability of the proposed LTCP is the impact on the annual household budgets for District ratepayers as measured by the timing and extent of the required annual rate increases. To document the actual impact on household budgets and to supplement the EPA approach, WASA conducted an analysis of the impacts of the CSO program on wastewater rates.

To finance its current $1.6 billion capital program, annual increases in retail rates of approximately 6.5% to 7.0% through FY 2008 followed by 6% annual increases from FY 2009 through FY 2012 will be required. Over the long-term, WASA is projecting that future necessary infrastructure re-investment will continue to require steady rate increases of about 5% per year. This longer-term outlook is consistent with national infrastructure studies that document the need for doubling of rates over 20 years for infrastructure investment. Under this "baseline" scenario, the annual cost for water and wastewater for a typical residential customer with metered consumption of 100 CCF per year will increase 113% (from $290 to $617) in fifteen years.

Implementation of the LTCP will result in additional rate increases and higher costs to the Authority's customers over and above the increases needed to fund the baseline capital program. Through analysis of a range of LTCP implementation schedules WASA has determined that the only rates impacts that are feasible are those associated with the longest implementation schedules. Table 13-10 displays the impacts for a 100 CCF customer over 15 years for the baseline and for several LTCP implementation schedules.

Table 13-10
Rate Impacts of the CSO LTCP on 100 CCF Residential Customer

	FY 2003 Annual Bill	*Annual Bill in 15 Years*	*Annual Rate Increases Over 15 Years*
Baseline – No LTCP	$290	$617	6.0%
Baseline Plus LTCP – 40 Years	$290	$722	7.2%
Baseline Plus LTCP – 30 Years	$290	$795	8.0%
Baseline Plus LTCP – 20 Years	$290	$942	9.4%
Baseline Plus LTCP – 15 Years	$290	$1,002	9.9%

If WASA implemented the proposed LTCP over a 40-year period, a typical residential customer with annual metered water consumption of 100 CCF will see their annual wastewater costs rise from $290 to $722 in 15-years; a 150% increase.

Shorter LTCP implementation schedules create too high a burden on the Authority's rate payers in terms of rapid escalation of the cost of wastewater services. The 15 and 20-year LTCP implementation schedules would require a large number of consecutive "double-digit" rate increases when the costs of those programs are added to the demands imposed by the baseline investment in water and wastewater infrastructure. As shown in Figure 13-4, the 15-year program is projected to require 8 consecutive increases over 10% per year. Such rate increases would outpace expected growth in household incomes by two to three times, thereby eroding household resources for other items. As shown in Figure 13-5, longer implementation schedules require lower peak rate increases and reduce the number of increases over 10% from 8 consecutive increases to fund the 15-year schedule to a single increase exceeding 10% in the case of the 40-year schedule.

There are two ways to reduce the rate impacts of a shorter LTCP implementation schedule, external funding assistance and deferral of other water and wastewater capital expenditures. External assistance targeted at limiting peak rate increases can reduce the severe impacts of high annual rate increases associated with the shorter programs. External assistance of approximately 62% of the capital cost of the program can keep rate increases to 8% per year as shown in the following chart. Total external capital assistance under this scenario would be $960 million. It is important for any external assistance to reflect year-of-expenditure values or the actual "cost to complete" the project. If external assistance is determined on current dollars or on an amount per year, the cost to complete and inflation risks are shifted to ratepayers.

Figure 13-4

Annual Rate Increases Required for 15 and 20-year LTCP Plans

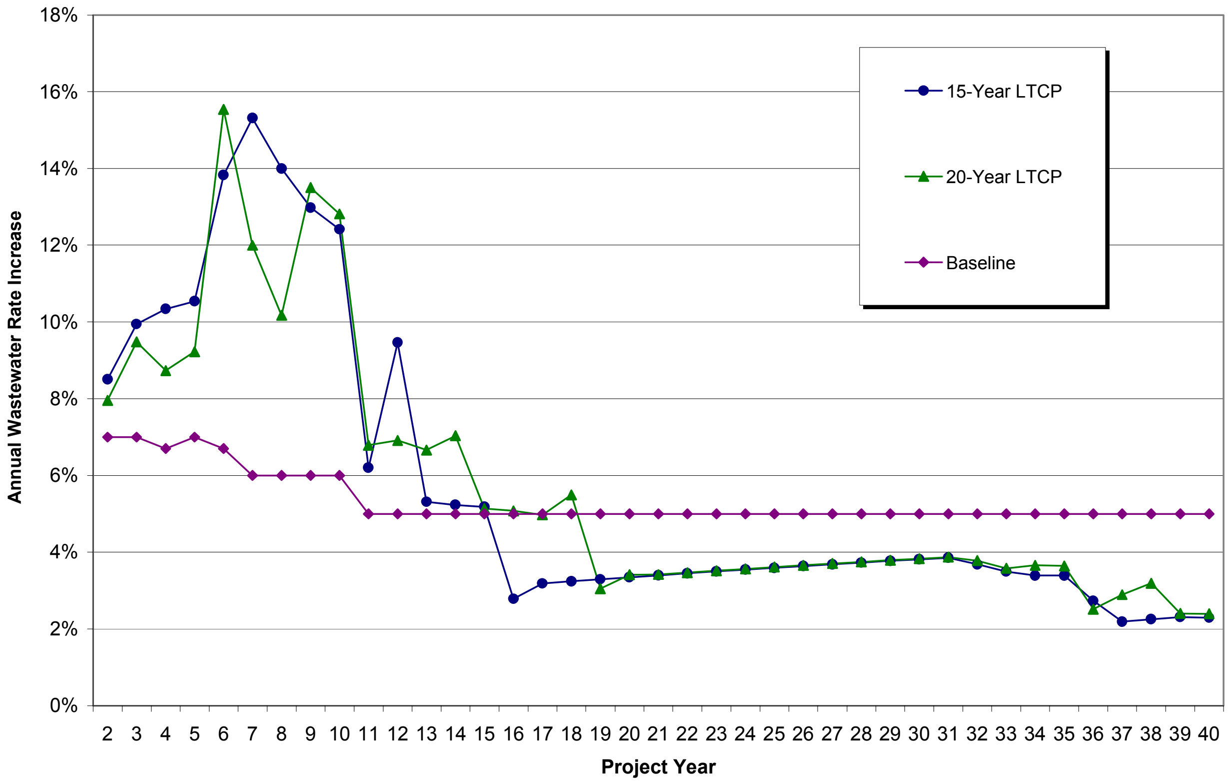
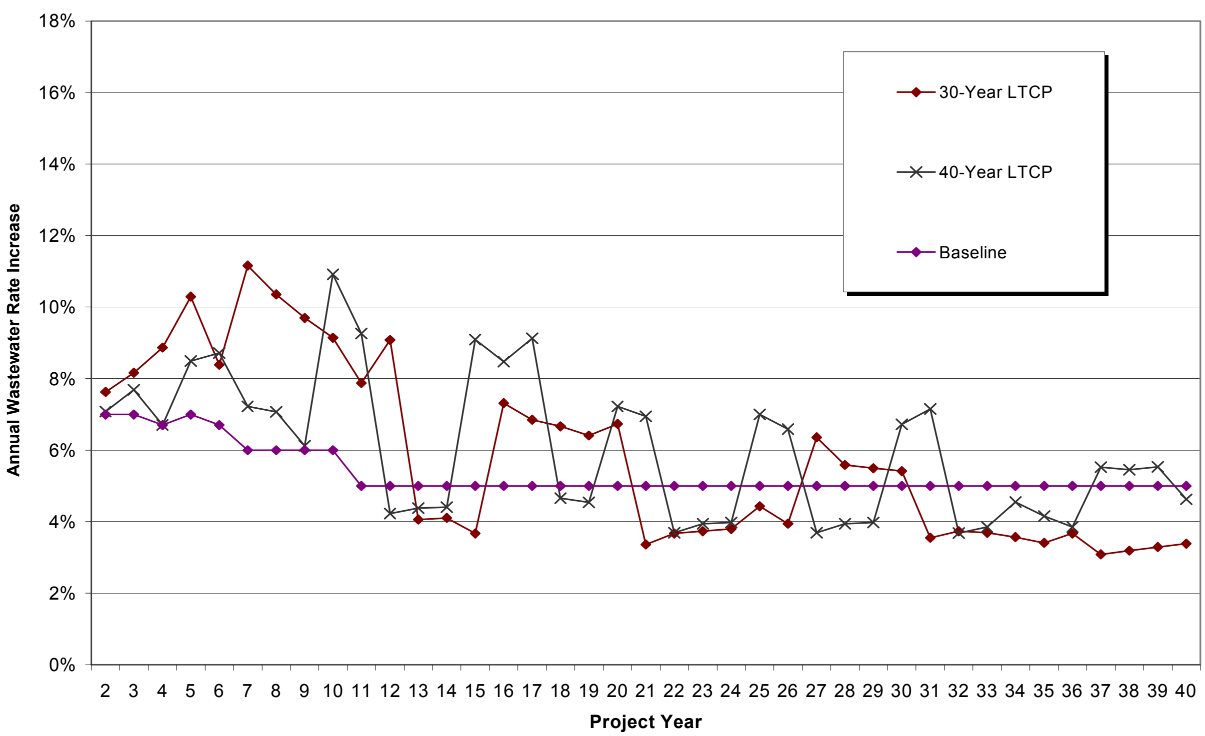


Figure 13-5

Annual Rate Increases Required for 30 and 40-year LTCP Plans



The EPA's approach involves calculating the cost per household (CPH) for residential customers for current and proposed wastewater treatment and CSO control costs. The CPH is used in conjunction with the median household income (MHI), estimated at $39,760 per year in 2001, to estimate residential impacts. Residential impacts are considered by EPA to be 'low' if the CPH is less than 1% of the MHI, 'medium' if the CPH is between 1% and 2% of the MHI, and 'high' if the CPH is greater than 2% of the MHI. The CPH is combined with other factors such as unemployment rate, property tax collection rates and other factors to develop an overall assessment of financial burden.

In the District, incomes do not follow a conventional statistical distribution. Instead, there is a distinct clustering of household incomes at the lower and upper extremes of the income spectrum. Because of the disproportionate number of low-income households in the District, the impact of wastewater treatment and CSO control costs on the lowest 20% of income distribution in the District was calculated. The analysis was performed for the maximum income in this category, which is $18,000 per year.

Table 13-11 summarizes the results of the analysis. For all median incomes, wastewater treatment costs including the proposed CSO controls are projected to impose a medium burden according to EPA guidelines. Current wastewater treatment costs alone impose a medium burden on lower income households. Addition of CSO controls to low income households increases the burden level to EPA's highest level, reaching nearly 3.5% of household income alone for wastewater costs. Various levels of Federal assistance are listed showing the degree to which they reduce the CPH as a percent of median income.

Table 13-11
Cost Impacts on Residential Customers (Year 2001 Dollars)

Scenario	*Cost Per Household for Wastewater Treatment ($/yr)*	*Cost Per Household as % of Income*	
		Median Incomes	*Upper end of Lower 24% of Incomes ($18,000/yr Income)*
Current Residential Bill (April 2001)	$271	0.8%	1.5 %
After Completion of Current Capital Improvement Program, but no additional CSO controls[1]	$329	0.83%	1.83%
Current Capital Improvement Program Plus Additional Recommended CSO Controls:			
0% Assistance	$602	1.51%	3.35%
25% Assistance	$539	1.36%	3.00%
75% Assistance	$413	1.04%	2.30%

Notes: 1. Includes cost of rehabilitation of Main, 'O' Street, Eastside and Poplar Point Pumping Stations.

13.6 SCHEDULE

A schedule for implementing the selected control plan was developed using the following priorities:

- In accordance with public and regulatory agency comments, Anacostia River projects should be given priority.
- Those projects which could be implemented quickly should be moved ahead in the schedule.
- Those projects which provide the greatest environmental benefit should be a priority.
- Those projects that would benefit sensitive areas should be a priority.
- Practical construction considerations, such as the need to construct downstream facilities prior to upstream facilities.

Based on these considerations, a sequencing of projects was developed. An implementation schedule was then developed for each project. The implementation schedule typically included the following steps:

- Facility Planning – This step comprises the next activity following approval of the LTCP and includes developing additional definition of the project necessary for preliminary design. Examples would include performing planning level geotechnical investigations and developing proposed alignments for the tunnels, setting bases for design, establishing system hydraulics, siting shafts, regulators and pumping stations, and other elements needed to define the function and interaction of the system.
- Design – This step consists of performing preliminary designs and preparing contract documents (plans and specifications) to obtain bids for construction.
- Permitting, Approvals, Land Acquisitions – this step entails obtaining the necessary permits and approvals required for construction. It also includes acquiring land or obtaining easements necessary for construction.
- Notice to Proceed – After obtaining bids and awarding a construction contract, a notice to proceed is issued to the construction contractor indicating that work can begin.
- Construction - this includes the building of the facility.
- Place in Operation – at this milestone, the facility is operational and is performing the function for which it is intended. Construction may extend beyond this milestone for such items as landscaping, final cleanup, punch list items or to address claims arising during construction.

The projects in the LTCP can be divided into two categories: those in the existing Capital Improvement Program (CIP) and those not currently in the CIP. Projects in the CIP have been budgeted and scheduled and these projects will move forward without approval of the LTCP. The schedule for these projects is shown on Figure 13-6.

For projects not currently in the CIP, an implementation schedule has been developed based on years after approval of the LTCP. Based on the financial capability assessment and in order to mitigate the annual rate increases that would be required to fund the full LTCP, 40-year implementation time is required for the entire recommended plan if no outside financial assistance is received. This schedule is shown on Figure 13-7.

If significant outside financial assistance is obtained, it is technically feasible to accelerate the schedule to a 15-year implementation time frame. Significant outside assistance on the order of 62% would be required to achieve this schedule. A 15-year schedule is shown on Figure 13-8.

13.7 BASES FOR LTCP DEVELOPMENT AND IMPLEMENTATION SCHEDULE

The LTCP has been developed at this stage to a conceptual level. Basic capacities have been established for the facilities, general locations have been selected and appurtenant and support facilities identified. Also, the general hydraulic operation of the system has been formulated, interfaces with existing facilities considered and potential construction sequencing reviewed.

The overall probable time requirements for implementing the complete LTCP range from fifteen to forty years. These time requirements are dictated principally by the availability of funds. There are, however, a wide-array of institutional, legal and technical factors which also control time requirements for implementation of the LTCP. This plan will be one of the largest single public works projects in the District and experience shows that it is neither feasible nor practicable to establish final time requirements for the various elements that make up a project of this magnitude and complexity in a highly urbanized environment.

Time requirements in the implementation schedule have been based on information compiled during the planning process, experience with similar projects and estimates of future and field conditions. There are a number of uncertainties associated with the time requirements included in the implementation plan and schedules. As the implementation process moves forward, it will be necessary to identify and resolve such uncertainties and to adjust time requirements. Additionally, changes in laws, requirements or regulations could occur during implementation of the LTCP and requires different time requirements than anticipated. The principal criteria, standards, regulations, laws, guidelines and assumptions upon which the elements of the LTCP and schedule are based include but may not be limited to those listed below. Changes to any of the following may require modification of the LTCP and the implementation schedule:

1. The Clean Water Act, 1994 CSO Policy and EPA guidance for CSOs and for performing water quality standard reviews and revisions.
2. District of Columbia Water Quality Standards.

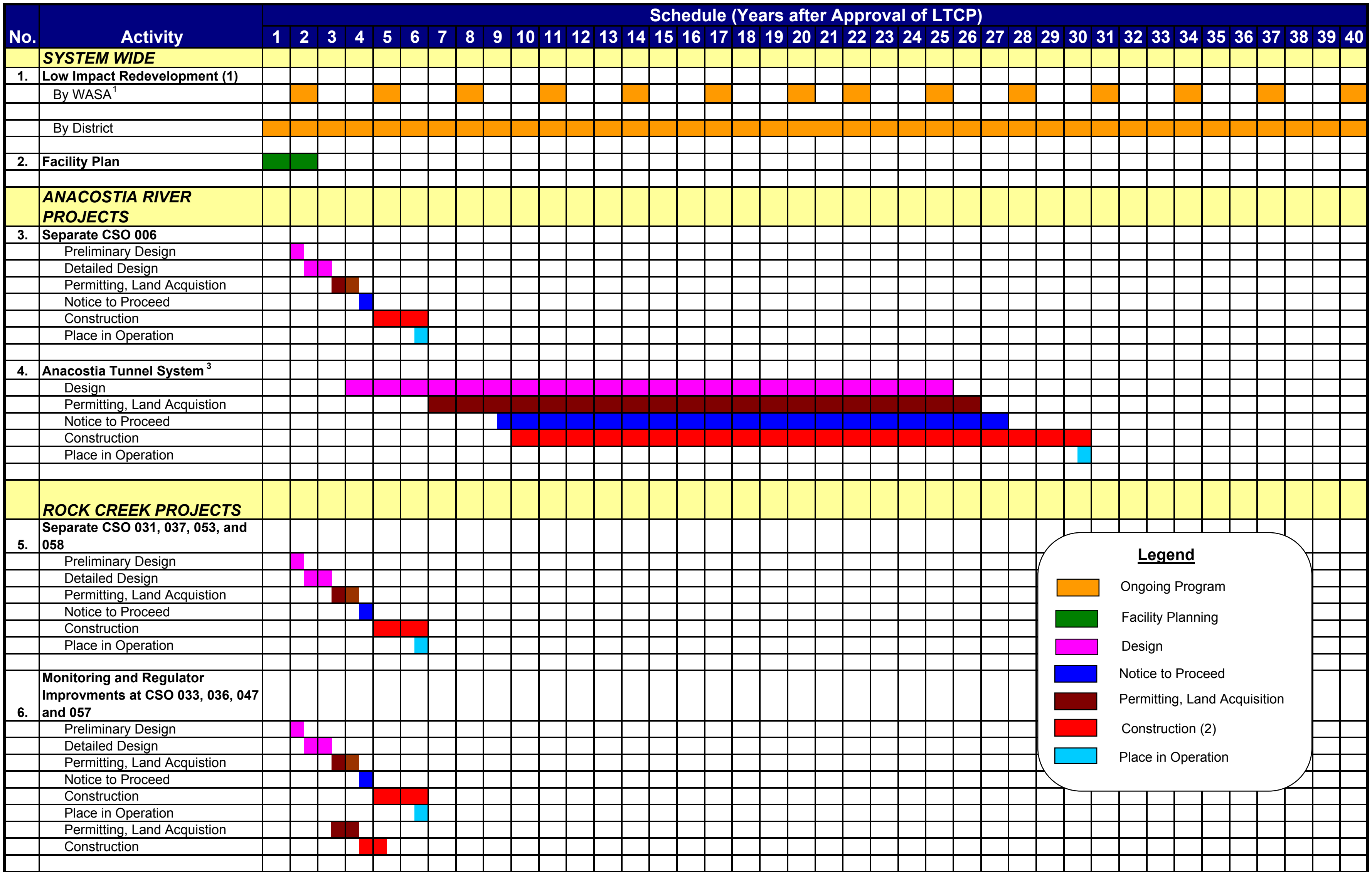
Figure 13-6
Implementation Schedule for Projects in Capital Improvement Program (CIP)

No.	Activity	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
	SYSTEM WIDE										
1.	**Low Impact Redevelopment**										
	By WASA[1]										
	ANACOSTIA RIVER PROJECTS										
2.	**Rehabilitate Main and 'O' Street Pumping Stations**										
	Retain Program Manager and Designer										
	Design										
	Permitting										
	Construction										
	Place in Operation										
3.	**Rehabilitate Eastside Pumping Station**										
	Retain Program Manager and Designer										
	Design										
	Permitting, Land Acquistion										
	Construction										
	Place in Operation										
4.	**Rehabilitate Poplar Point Pumping Station**										
	Retain Program Manager and Designer										
	Design										
	Permitting										
	Construction										
	Place in Operation										
	POTOMAC RIVER PROJECTS										
5.	**Rehabilitate Potomac Pumping Station**										
	Retain Program Manager and Designer										
	Design										
	Permitting										
	Construction										
	Place in Operation										

Legend
- Ongoing Program
- Procurement
- Design (2)
- Approvals (3)
- Construction (4)
- Facility Planning

Notes:
1. Incorporate into new construction or reconstruction at WASA facilities where appropriate.
2. Includes submitting documents for requried approvals.
3. Includes approvals from agencies having jurisdiction and obtaining necessary permits, advertisement for bids and award of
4. Construction may extend beyond placing facilities in operation.

Figure 13-7
40-Year Implementation Schedule for Projects Not in Capital Improvement Program (CIP)



District Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

Figure 13-7
40-Year Implementation Schedule for Projects Not in Capital Improvement Program (CIP)

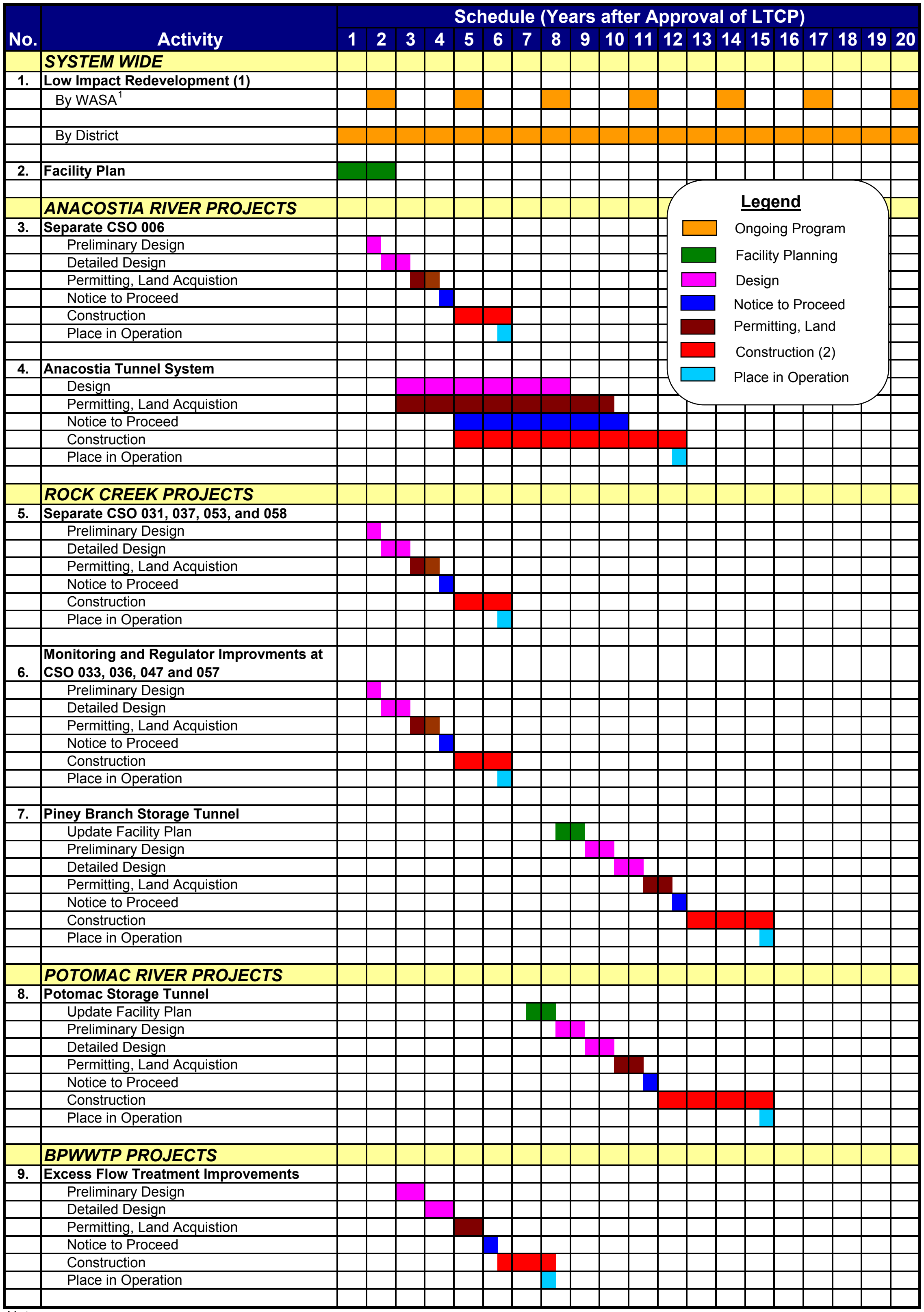
No.	Activity	Schedule (Years after Approval of LTCP)																																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
7.	**Piney Branch Storage Tunnel**																																								
	Update Facility Plan																																								
	Preliminary Design																																								
	Detailed Design																																								
	Permitting, Land Acquistion																																								
	Notice to Proceed																																								
	Construction																																								
	Place in Operation																																								
	POTOMAC RIVER PROJECTS																																								
8.	**Potomac Storage Tunnel**																																								
	Update Facility Plan																																								
	Preliminary Design																																								
	Detailed Design																																								
	Permitting, Land Acquistion																																								
	Notice to Proceed																																								
	Construction																																								
	Place in Operation																																								
	BPWWTP PROJECTS																																								
9.	**Excess Flow Treatment Improvements**																																								
	Preliminary Design																																								
	Detailed Design																																								
	Permitting, Land Acquistion																																								
	Notice to Proceed																																								
	Construction																																								
	Place in Operation																																								

Notes:

\\Gh-wash\ENG 1160\LTCP\LTCP Final\[LTCP_13_Schedule.xls]15 yr

1. Incorporate into new construction or reconstruction at WASA facilities where appropriate.
2. Construction may extend beyond placing facilities in operation.
3. Activities may be phased in accordance with financial, technical, legal, and institutional conditions that affect the program.

Figure 13-8
15-Year Implementation Schedule for Projects Not in Capital Improvement Program (CIP)



Notes: \\Gh-wash\ENG 1160\LTCP\LTCP Final\[LTCP_13_Schedule.xls]15 yr

1. Incorporate into new construction or reconstruction at WASA facilities where appropriate.
2. Construction may extend beyond placing facilities in operation.

3. The BOD and TSS TMDLs for the Anacostia River as they existed in June 2002. No other TMDLs exist for District waters affected by CSOs.
4. WASA's NPDES Permit.
5. Future judicial or administrative orders.
6. The requirements of the 1985 Intermunicipal Agreement.
7. The financial capability of WASA and the District remains equal to or better than that indicated in the financial capability assessment in the LTCP.
8. WASA bond's rating is not lower than that indicated in the financial capability assessment in the LTCP and the interest rate for bonding is not higher than that indicated in the financial capability assessment.
9. All approvals, permits and land acquisitions can be obtained in the time frames shown in the implementation schedule.
10. Facility Plan – at this stage, the LTCP is a concept plan. Tunnel alignments have not been selected, easements have not been obtained, facilities have not been finally sited, etc. The purpose of the facility plan is to collect additional information (such as soil borings) and to perform additional engineering (such as hydraulic design, functional design, system operational design, interaction and interface studies, configuration design, geotechnical investigations and right-of-way investigations) necessary to develop the LTCP projects in more detail so phasing and preliminary designs can be prepared. Based on the results of the investigations, and studies, the facility plan findings may require revision to time requirements and the project schedule. Subsequent changes in the findings of the Facility Plan may require additional modifications of the schedule. These are fundamental assumptions upon which the LTCP and schedule are based.
11. Land is acquired or easements or rights to use the land are obtained from landowners, including the National Park Service, without unreasonable restrictions, for the following facilities:
    a. Anacostia River
        i. Alignment for the Fort Stanton Interceptor generally along the Anacostia Park road between CSO 007 and Poplar Point.
        ii. Site for a new Poplar Point and Tunnel Dewatering Pumping Station in the general vicinity of the existing Poplar Point Pumping Station.
        iii. Site for tunnel drop shaft and ancillary facilities near the existing Northeast Boundary Sewer Outfall.
        iv. Rights to cross under National Park Service land with the Anacostia Tunnel between:
            1. Northeast Boundary outfall CSO 019 and CSO 018.
            2. Main and O Street Pumping Station and the new Poplar Point Tunnel Dewatering Pumping Station.

b. Potomac River
    i. Site for drop shaft, access shaft and tunnel in Chesapeake and Ohio Canal to intercept CSO 029.
    ii. Rights to cross under National Park Service land with the Potomac Tunnel in Cheaspeake and Ohio Canal Park, Rock Creek, Rock Creek Park and West Potomac Park between CSO 020 and 029
    iii. Rights to connect CSO 020 (Easby Point) to the Potomac Tunnel via a surface pipeline.

c. Rock Creek
    i. Piney Branch Tunnel in the slope of land north of Piney Branch stream such that gravity dewatering of the tunnel is possible.
    ii. Rock Creek regulator improvements as indicated in the LTCP.
    iii. Outfall/pipeline to Rock Creek required for separation of the CSOs specified in the LTCP to be separated.

d. Other facilities as necessary to complete the LTCP

12. The National Park Service and other landowners allow temporary construction access, without unreasonable restriction, to perform investigations, surveys, and to construct the facilities at locations as identified above.
13. The technical bases related to construction conditions and technology for construction of the control facilities.
14. Plans of the District or Federal governments that impact the siting, operation or other functional requirements of the control facilities.
15. The actual costs of CSO control projects (based on construction bids or conditions encountered during construction which change costs) that change the financial capability bases.
16. Technical, legal and institutional conditions which require more time than anticipated or planned.

13.8 CSO REDUCTION VERSUS TIME

It will not be necessary to wait until the completion of the entire program to realize the benefits of the LTCP. CSO reduction will occur regularly throughout implementation of the program as facilities are brought on line. Significant reductions in CSO will occur early in the program with replacement of the inflatable dams and rehabilitation of the pumping stations. Major reductions in CSO will occur when tunnel segments are made operational. Figure 13-9 shows how reductions in CSO would occur for the 40 year and 15 year implementation time frames.

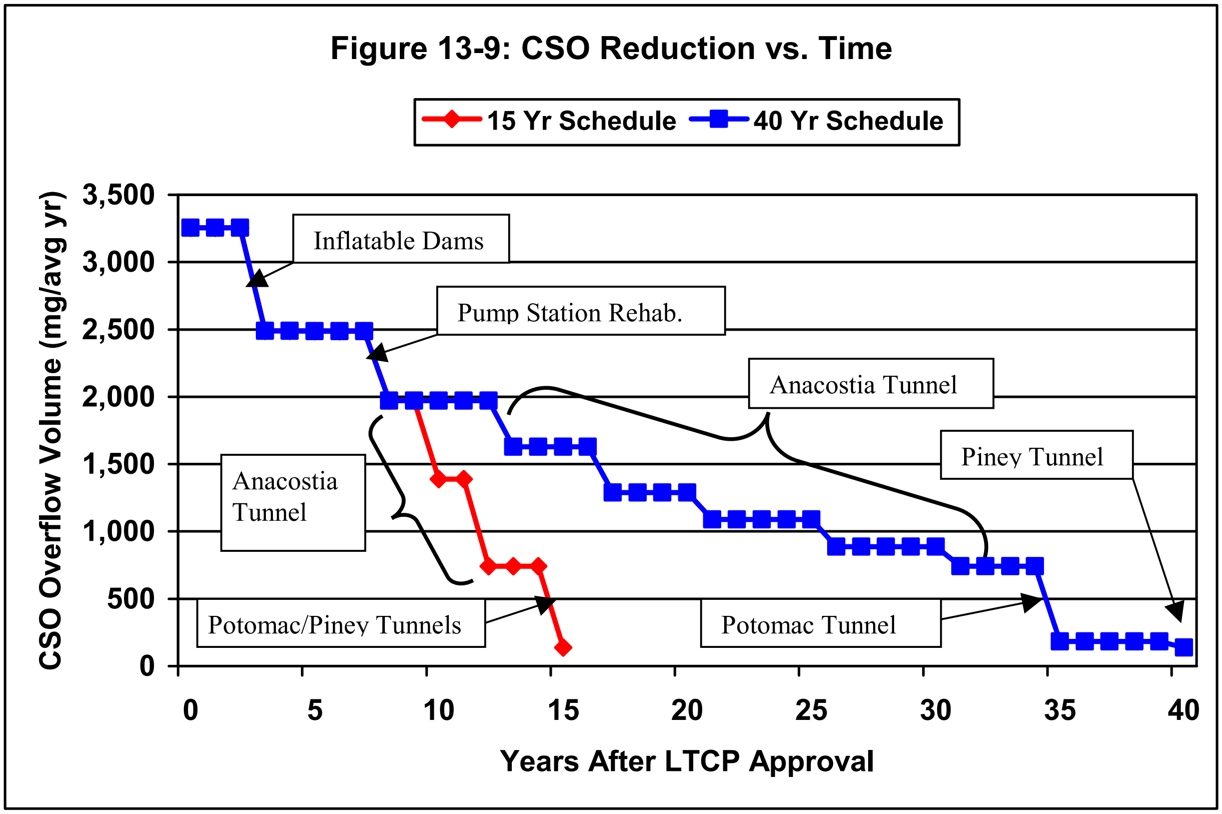


Figure 13-9: CSO Reduction vs. Time
15 Yr Schedule
40 Yr Schedule
3,500
3,000
2,500
2,000
1,500
1,000
500
0
CSO Overflow Volume (mg/avg yr)
0
5
10
15
20
25
30
35
40
Years After LTCP Approval
Inflatable Dams
Pump Station Rehab.
Anacostia Tunnel
Piney Tunnel
Anacostia Tunnel
Potomac/Piney Tunnels
Potomac Tunnel

Section 14
Water Quality Standards Review

14.1 INTRODUCTION

USEPA policy and guidance state that the selected LTCP should provide for compliance with existing water quality standards. This same policy and guidance also provide, however, that if the preferred option in the LTCP will not result in compliance with existing water quality standards when fully implemented, and chemical, physical or economic factors appear to preclude attainment of the standards, then the data collected during LTCP development may be used to support revisions to water quality standards, "including adoption of uses that better reflect the water quality that can be achieved with an affordable level of CSO control." [See, EPA Guidance on Implementing the Water Quality-Based Provisions in the CSO Control Policy (Draft – December 20, 2000).]

The recommended LTCP does not result in compliance with existing District of Columbia Water quality standards under all wet weather situations because physical and economic factors appear to preclude their attainment. Therefore, as provided in Section 402 (q) of the Clean Water Act and USEPA's CSO Control Policy, a review has been conducted to evaluate and assess the draft LTCP discharges against the District of Columbia Water Quality Standards and selected water quality conditions to support revisions to the water quality standards to better reflect water quality that can be achieved with an affordable level of CSO control.

14.2 NATIONAL REGULATORY BACKGROUND

In 1994, the USEPA published its CSO Control Policy (Policy). Subsequently, enactment of the Wet Weather Water Quality Act in December 2000 resulted in the CSO Control Policy being made law by incorporating the Policy into the Clean Water Act at Section 402 (q).

A key principle in the Policy is the "review and revision, as appropriate, of water quality standards and their implementation procedures when developing CSO control plans to reflect site-specific impacts of CSOs". Additionally, pursuant to subsection 402 (q) (2) of the Clean Water Act, the USEPA is developing guidance to facilitate the conduct of water quality and designated use reviews for municipal combined sewer overflow receiving waters. The guidance is still in draft form, but the information included in the working draft can be applied to the evaluation of LTCPs for control of CSO discharges.

14.3 DISTRICT OF COLUMBIA WATER QUALITY STANDARDS (DCWQS)

Although greatly reduced under the recommended LTCP, combined sewer overflows will be discharged to the Anacostia River, Potomac River, Rock Creek and tributaries, under certain storm conditions.

Water Quality Standards Review

These District waters have been classified on the basis of current uses and future designated uses to which the waters will be restored. The classifications are as follows:

Surface Water	Use Classes: Current Use	Use Classes: Designated Use
Anacostia River	B, C, D, E	A, B, C, D, E
Potomac River	B, C, D, E	A, B, C, D, E
Rock Creek	B, C, D, E	A, B, C, D, E

Categories of uses for the surface waters listed are as follows:

Surface Water	Categories of Uses Which Determine Water Quality Standards
A	Primary contact recreation
B	Secondary contact recreation and aquatic enjoyment
C	Protection and propagation of fish, shellfish and wildlife
D	Protection of human health related to consumption of fish & shellfish
E	Navigation

Principal DCWQS, which may be applicable to the evaluation of CSO discharges under the LTCP, are summarized as follows:

- *The Director may remove a designated use, establish a partial use, or establish sub-categories of a use for a particular surface water segment or body if a use attainability analysis can demonstrate that attaining the designated use is not feasible because:*
  - *Naturally occurring pollutant concentrations prevent the attainments of the use;*
  - *Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges without violating the District's water conservation requirements to enable uses to be met;*
  - *Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place;*
  - *Dams, diversions or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original condition or, to operate such modification in a way that would result in the attainment of the use;*
  - *Physical conditions related to the natural features of the water body, such as the lack of proper substrate, cover, flow, depth, pools, riffles, and the like unrelated to water quality, preclude attainment of aquatic life protection uses; or*

 * *Controls more stringent than those required by sections 310(b) and 306 of the Federal Clean Water Act would result in substantial and widespread economic and social impact.*
- *A designated use specified in section 1101 may not be removed and a partial use, that involves the removal of the designated use, may not be established if:*
  * *The use is actually attained in the surface water segment or body on or after November 28, 1975, unless a use requiring more stringent criteria is added, or*
  * *Such uses will be attained by implementing effluent limits required under sections 301(b) and 306 of the Federal Clean Water Act and by implementing cost-effective and reasonable best management practices for nonpoint source control.*
- *If a permittee requests the Director to conduct a use attainability analysis and provides a reasonable basis for the need, the Director shall:*
  * *Conduct a public meeting in the watershed of the affected segment or water body to inform the public of the nature of the use change requested and the basis of the request and solicit the opinions and views of the public prior to determining whether to conduct a use attainability analysis;*
  * *Inform the permittee and the public of the decision;*
  * *Inform the permittee of the approximate costs of the analysis and the schedule and the permittee shall provide payment as specified by the Director for the analysis;*
  * *Not allow the permittee to perform the analysis;*
  * *Form an advisory group of citizens and affected parties who will meet periodically during the course of the study;*
  * *Hold a public hearing concerning the preliminary finding of the use attainability analysis prior to concluding the study;*
  * *Submit the analysis to the Environmental Protection Agency for review and approval, if it is determined that a modification or change in the uses of the segment or water body is justified; and*
  * *Modify or remove the use in accordance with federal and District procedures for revising water quality standards upon receipt of approval by the Environmental Protection Agency.*
- *Numeric criteria include the following:*

Constituent	Criteria for Classes A	B	C
Bacteriological (No./100mL)			
Fecal Coliform	*200*	*1,000*	
(Maximum 30 day geometric mean for 5 samples)			
Physical			
Dissolved oxygen (mg/L)			
Minimum daily average			*5.0*
(3 samples per 24 hours once per 8 hour)			
One hour minimum			
March through June			*5.0*
July through February			*4.0*

- *The surface waters of the District shall be free from substances attributable to point or nonpoint sources discharged in amounts that do any of the following:*
  - *Settle to form objectionable deposits;*
  - *Float as debris, scum, oil or other matter to form nuisances;*
  - *Produce objectionable odor, color, taste or turbidity;*
  - *Cause injury to, are toxic to or produce adverse physiological or behavioral changes in human, plants or animals;*
  - *Produce undesirable aquatic life or result in the dominance of nuisance species; or*
  - *Impair the biological community, which naturally occurs in the waters or depends on the waters for their survival and propagation.*
- *For the waters of the District with multiple designated uses, the most stringent standards or criteria shall govern.*
- *Class A waters shall be free of discharge of untreated sewage, litter and unmarked, submerged or partially submerged, man-made structures which would constitute a hazard to users.*
- *The aesthetic qualities of Class B waters shall be maintained. Construction, placement or moving of facilities not primarily and directly water oriented is prohibited in, on or over Class B waters unless:*
  - *The facility is for the general public benefit and service, and*
  - *Land based alternatives are not available.*
- *Class E waters shall be free of unmarked submerged or partially submerged man-made objects which pose a hazard to users of these waters* (DC Register, 2000).

Overall, the DCWQS define the designated use of the receiving waters as “fishable-swimmable”. The D.C. uses and water quality standards have been considered with regard to the performance and compliance aspects of the LTCP.

14.4 SELECTED WATER QUALITY CONDITIONS

Water quality standards are, in general, designed for drought or low flow conditions in receiving waters under steady state and short term conditions. Combined sewer overflows are wet weather events and are, therefore, episodic in nature and will occur over a wide range of receiving water flow conditions.

The existing numeric water quality standards for dissolved oxygen and bacteria (fecal coliform) do not effectively describe the effects associated with combined sewer overflows. Other values have, therefore, been employed to evaluate CSO discharges. The existing numeric criteria and other values developed for evaluation of CSO discharges are summarized in Table 14-1:

Table 14-1
Evaluation Criteria for CSO Discharges

Item	*Existing WQS*	*CSO Evaluation Criteria*
Dissolved Oxygen-mg/l Minimum Daily Average	5.0	5.0
One hour minimum		
• March-June	5.0	5.0
• July-February	4.0	4.0
• Minimum Day	-	2.0
Fecal Coliform- #/100ml		
• Maximum 30 day Geometric Mean	200	-
• Daily Average Level	-	200 (1)

(1) This criterion is more stringent than a 200 count geometric mean

14.5 CSO CONTROL – GENERAL

Extensive mathematical modeling together with economic and water quality benefit comparisons have been conducted as part of development of the LTCP. These studies show that elimination (by complete separation) of combined sewer discharges to the receiving waters is not economically feasible for the District and has numerous technical and environmental drawbacks. One of the drawbacks of complete separation is the extensive disruption associated with the construction of essentially a new sewer system in the central one-third of the District. Additionally, the water quality conditions predicted for complete separation have been shown to be less beneficial as compared to control programs based on significant reductions and treatment of combined sewer overflows.

Since complete separation was found to be not cost effective and technically difficult with lower water quality benefits, the studies focused on long term controls that would reduce overflows and strike a balance between costs and benefits. The LTCP was selected as a plan that offers an effective combination of costs, benefits and environmental protection. However, although greatly reduced, CSO discharges will exist under the LTCP and water quality provisions will need to be adopted that accommodate wet weather discharges from the combined sewer system.

14.6 LTCP WET WEATHER WATER QUALITY CONDITIONS

Water quality conditions predicted in the receiving waters for the LTCP are summarized in Table 14-2 and Table 14-3.

Table 14-2
Predicted Conditions for Average Year In Receiving Waters

	After Completion- LTCP	*Predicted Condition for Average Year In Receiving Waters*		
		Anacostia River	*Potomac River*	*Rock Creek*
1.	Location	Navy Yard	Memorial Bridge	At Zoo
2.	Annual Overflow Volume	All Outfalls	All Outfalls	All Outfalls
	• Percent Reduction	97.5%	92.5%	89.8%
3.	Fecal Coliform-Percent Time (Days) Less than 200/100ml, CSO Load Only			
	• Year Around	98.1%	98.9%	99.7%
	• May thru Sept.	96.7%	99%	99.3%
4.	Dissolved Oxygen-Number Days Less Than (CSO Load Only):			
	• 5.0 mg/l	0	0	(1)
	• 4.0 mg/l	0	0	(1)
	• 2.0 mg/l	0	0	(1)
5.	Dissolved Oxygen-Minimum Day Concentration-mg/l (CSO Load Only)	6.9	7.4	(1)

(1) Water quality standards met

Table 14-3
LTCP Wet Weather Water Quality Conditions

	Item	*Predicted Condition for Average Year In Receiving Waters*		
		Anacostia River	*Potomac River*	*Rock Creek*
A.	Number of Annual Overflow Events			
	1. Location	Navy Yard	Mem Bridge	At Zoo
	2. No Phase I Controls	82	74	30
	3. After Completion, LTCP	2	4	4
B.	Annual Overflow Volume (mg/yr)			
	1. Location	All Outfalls	All Outfalls	All Outfalls
	2. No Phase 1 Controls	2,142	1,063	49
	3. After Completion LTCP	54	79	5
	4. Percent Reduction	97.5%	92.5%	89.8%

Item		Predicted Condition for Average Year In Receiving Waters: Anacostia River	Potomac River	Rock Creek
C.	Bacteria (As Fecal Coliform, No./ 100 ml)			
	1. Location	Navy Yard	Mem Bridge	At Zoo
	2. No. Mos. Class A Geo. Mean (200/100 ml) exceeded			
	• All Loads (CSO, Upstream, D.C. Storm Water)			
	* No Phase I Controls	11	3	12
	* After Completion, LTCP	5	0	12
	* Percent Reduction	55%	100%	0%
	• CSO Loads Only			
	* No Phase I Controls	9	0	0
	* After Completion, LTCP	0	0	0
	3. No. Days 200/100 ml exceeded (Year Round)			
	• All Loads			
	* No Phase I Controls	239	142	294
	* After Completion, LTCP	182	106	294
	• CSO Loads Only			
	* No Phase I Controls	212	57	22
	* After Completion, LTCP	7	4	1
	4. No. Days 200/100 ml Exceeded (May thru Sep)			
	• All Loads			
	* No Phase I Controls	91	64	136
	* After Completion, LTCP	61	43	119
	• CSO Loads Only			
	* No Phase I Controls	84	33	14
	* After Completion, LTCP	5	3	1
	5. Percent Time (Days) Bacteria Less than 200/100 ml			
	• All Loads			
	* No Phase I Controls	34.5%	61.1%	19.4%
	* After Completion, LTCP	50.1%	70.9%	19.4%
	• CSO Loads Only			
	* No Phase I Controls	41.9%	84.4%	93.9%
	* After Completion, LTCP	98.6%	98.9%	99.7%
D.	Dissolved Oxygen			
	1. Location	Navy Yard	Mem.Bridge	At Zoo
	2. No. Days Less Than 5.0 mg/L			
	• All Loads			
	* No Phase I Controls	93	0	N/A[1]
	* After Completion, LTCP	72	0	N/A
	• CSO Loads Only			
	* No Phase I Controls	0	0	N/A
	* After Completion, LTCP	0	0	N/A
	3. No. Days Less Than 4.0 mg/L			
	• All Loads			
	* No Phase I Controls	57	0	N/A
	* After Completion, LTCP	35	0	N/A

Item		Predicted Condition for Average Year In Receiving Waters		
		Anacostia River	Potomac River	Rock Creek
	• CSO Loads Only			
	* No Phase I Controls	0	0	N/A
	* After Completion, LTCP	0	0	N/A
	4. No. Days Less Than 2.0 mg/L			
	• All Loads			
	* No Phase I Controls	10	0	N/A
	* After Completion, LTCP	3	0	N/A
	• CSO Loads Only			
	* No Phase I Controls	0	0	N/A
	* After Completion, LTCP	0	0	N/A
	5. Min. Day Concentration-mg/L[2]			
	• All Loads			
	* No Phase I Controls	0.5	5.6	N/A
	* After Completion, LTCP	2.5	5.6	N/A
	• CSO Loads Only			
	* No Phase I Controls	4.9	7.3	N/A
	* After Completion, LTCP	6.9	7.4	N/A

Notes:

1. Dissolved oxygen was not modeled for Rock Creek. Because of its free flowing nature, there is no evidence of dissolved oxygen problems.
2. Minimum day concentration in entire three-year period (1988-1990) as predicted by the model for the hydraulic conditions occurring in those three years.

Additional evaluations were made for the fecal coliform condition for the May through September period and are summarized in Table 14-4.

Table 14-4

Predicted Average Year LTCP Performance: Fecal Coliform – CSO Load Only

Receiving Water	LTCP Performance-CSO Load Only						
	Number of Days Fecal Coliform Count is Predicted to Exceed 200/100 ml						Percent of Time Fecal ColiformCount Less Than 200/100 ml
	May	June	July	August	September	Total	
Anacostia River at Navy Yard	1	1	2	1	0	5	96.7%
Potomac River at Memorial Bridge	0	0	1	1	1	3	98.0%
Rock Creek at Zoo	1	0	0	0	0	1	99.3%

Because fecal coliform levels are the principal concern for Class A use of the receiving waters, evaluations have been made for conditions beyond the average year. These evaluations have been made for the actual 51-year period of record for the years 1948 through 1998. The evaluations have been based on those rainfall events that are predicted to exceed the capacity of the Final LTCP and result in the occurrence of an overflow from the combined sewer system. The data have been summarized for the impacts from CSO loads only in Table 14-5.

Table 14-5
Predictions for 51-Year Period of Record (1948-1998)

	Predicted Condition in Receiving Water For 51-Year Record		
Item	*Anacostia River*	*Potomac River*	*Rock Creek (Piney Branch only)*
Total Number of Rainfall Events Resulting in a CSO	118	188	75
Average Number of CSOs per Year	2.31	3.69	1.47
Percent of Time Waters are Free From:			
• A CSO Occurrence	99.4 %	99.0 %	99.6 %
• A Fecal Coliform Level Greater Than 200/100ml [1]	98.1 %	98.0 %	99.6 %

Notes:

1. Based on CSOs causing fecal coliform levels to exceed 200/100 ml the following number of days on average for each occurrence: Anacostia –3 days, Potomac – 2 days, Rock Creek – 1 day.

The findings from the foregoing analyses of water quality conditions in the receiving waters for the LTCP have been summarized as follows:

- For CSO loads only in the average year and in accordance with the CSO Policy, the remaining overflows after implementation of the Final LTCP will meet the D.C. numerical water quality standards in all receiving waters.
- The D.C. standards at 1104.3 prohibit "discharges of untreated sewage". CSOs that remain after implementation of the LTCP will all have received some degree of treatment prior to discharge to the receiving waters. Generally, the treatment will be in the form of solid and floatables control. Under these conditions, the remaining CSOs would not be untreated and therefore, should meet the narrative D.C. water quality standards in all receiving waters.
- After implementation of the Final LTCP, all receiving waters are predicted to be free from average daily levels of fecal coliform (due to CSOs) greater than 200/100 ml between 98 and 99 percent of the time.
- Other pollution sources in the watersheds will have to be reduced to produce the same water quality improvements provided by the Final LTCP.

The findings show that the Final LTCP can meet the D.C water quality standards in accordance with the CSO Policy. The findings also show that on average, and based on the 51 year record of rainfall events, the LTCP would be protective of the beneficial uses of the receiving waters. Because fecal coliform levels due to CSOs are predicted to be greater than 200/100 ml about 1 to two percent of the time, there would be minimal disruption from CSOs to public use of the waters for full body contact.

Additionally, the findings show that pollution sources other than discharges from the combined sewer system cause impairment to the receiving waters. The other pollution sources in the watershed include separate storm water systems and nonpoint source discharges. These watershed-wide sources would have to be substantially reduced to reach the equivalent degree of protection that can be achieved by WASA's LTCP. The sources of the contaminants that comprise the other pollution sources have not been completely identified or documented.

Cost effective and reliable technical programs to effectively reduce the impact of the other pollution sources may not be available for the foreseeable future. Besides the technical uncertainties of reduction of the other pollution sources, a significant component of these sources originate in political jurisdictions outside the District. Given the history and experience of dealing with diverse pollution sources and other political jurisdictions, the results of future efforts to control these sources cannot be predicted with any degree of certainty. The CSO studies have shown that the benefits of the Final LTCP are reliable and implementable. As WASA and the District develop provisions to implement the LTCP, consideration should be given to formation of a watershed based forum to reduce the other pollution sources.

In view of the complex and technically difficult situation regarding control of diverse and undocumented pollution sources, consistent "fishable and swimmable" water quality conditions for District waters receiving CSO discharges may not be achievable, particularly during wet weather. Certainly, the studies show that the LTCP will be a fundamental component to an eventual watershed solution. As a component of an ultimate watershed solution, the LTCP will control CSO discharges in the three receiving waters for the average year to:

- Reduce the annual volume of uncontrolled CSO discharges by approximately 96 percent,
- Meet the D.C. narrative and numeric water quality standards; and
- Reduce the exceedance of a 200 per 100ml fecal coliform count to no more than about 3% of the time during the recreational season (May thru September) due to CSOs alone, if no other loads were present,

Under the conditions that are predicted for the LTCP, the District's use of "fishable-swimmable" for its waters should not need to be revised. As with many public use waters (beaches, streams), there are situations which render such waters unavailable to the public at certain times and locations. Such situations may include:

- Unsafe high surf at an ocean beach
- Storms or temperature conditions
- Low flow or exposed rocks
- High flow (raging waters) conditions
- Nuisance aquatic life

Based on examination of the 51-year record, some of the natural conditions such as stormy weather would be expected to occur at the same time as CSOs. Overall, therefore, CSOs would not always add to those situations when waters might not be available for full body contact.

In any case, the LTCP would provide the foundation to work towards "fishable-swimmable" conditions. To such an end, the LTCP would accomplish the following:

- A situation whereby the "fishable" component of the "fishable-swimmable" use designation would be achieved. In this regard, fishing could be practiced whether or not a CSO discharge was occurring.
- A situation wherein full body contact might not be available at all times. However, there would be few occurrences throughout the warm weather recreational period when the public might occasionally be precluded from full body contact by CSO discharges.

WASA has developed a comprehensive CSO Control LTCP that can serve as a foundation for "fishable-swimmable" conditions in District waters which minimize the periods when full body contact should be avoided without inconveniencing the public use. Controls for other pollution sources would also be needed to support the protection that can be achieved under the LTCP.

14.7 WET WEATHER DISCHARGE CONDITIONS

WASA has developed a LTCP that supports public use of District waters receiving CSO discharges. Substantial financial commitments will be required by District ratepayers and by those providing financial assistance in support of LTCP implementation.

Wet weather discharge provisions need to be provided to accommodate LTCP implementation. The wet weather discharge provisions need to recognize that there will be CSOs when the capacity of the LTCP control facilities is exceeded.

WASA has been in discussions with the D.C. Department of Health and EPA regarding the nature of such provisions. The discussions have not been finalized and alternative approaches are still being considered. Under some approaches, the LTCP would be accommodated without changing the water quality standards. These approaches may involve the interpretation by regulatory agencies that the proposed LTCP meets the current water quality standards. Such an interpretation could be made in the regulatory agencies' approval of the LTCP.

Other approaches under consideration involve incorporating provisions in the water quality standards to accommodate the remaining discharges after the capacity of the LTCP is exceeded. Such approaches may require a use attainability analysis (UAA) and/or modification or additions to the uses in the water quality standards. If revision of the standards is required, the following elements or conditions should be considered for incorporation into the water quality standards:

- The capacity of the LTCP facilities has been developed based on a specific storm in the period of record that has its own unique total precipitation, duration, intensity and spatial distribution.
- The capacity of facilities that transfer flow from the combined sewers to storage or treatment, the storage facilities and treatment facilities have all been based on this storm and its characteristics. The WQS need to recognize that because of the variability of climate condition, an overflow could occur because the capacity of one or a combination of the elements of the control facilities has been exceeded.
- The WQS now have a low stream flow limit for application of the criteria. It would be appropriate for the wet weather provisions to establish an upper limit for application of the criteria.
- The upper limit for application of the criteria should be the capacity of the LTCP based on the flow rates derived from the storm used to establish the capacity of the various elements of the plan (e.g. transfer or conveyance, storage, and treatment).

Because there is a great deal of natural variability in climate conditions that can cause the capacity of one or a combination of elements of the LTCP to be exceeded, it does not appear feasible to fix an upper limit for application of the WQS to a single flow condition (e.g. the seven day ten year low flow, 7Q10 used as the low stream flow limit for application of the standards). For the combined sewer system, the LTCP describes the upper limit because it is the document that translates the storm condition to flow conditions that would limit the application of the WQS. In view of these unique circumstances, the practicable approach would be to incorporate the LTCP into the WQS.

A potential approach for modifying the District's WQS for the LTCP based on the foregoing would be as follows:

District WQS at subsection 1105.6, Delete, and replace with the following:

1105.6 The narrative and numeric criteria at 1104 shall not apply to CSO overflows occurring consistent with a Long Term Control Plan approved for implementation by EPA and the Director.

District WQS at subsection 1199.1, (Definitions) add

> LTCP or Long Term Control Plan. *A plan for control of combined sewer overflows prepared pursuant to the CSO Control Policy at Section 402 (q) of the Federal Clean Water Act and approved for implementation by the Director and EPA.*

The foregoing may be a departure from the traditional approach for identifying flow conditions applicable to criteria. It does, however, deal with the climatic variabilities and flow complexities inherent in CSO control and would establish straightforward methods for measuring performance. Such methods have been developed and are described in Section 15.

Other states (California, Massachusetts) have adopted approaches for incorporating control plans as part of standards applications and the above suggestion for the District's standards would not be inconsistent with those approaches. Additionally, the suggested provisions provide a basis for future modifications that may be needed based on review of plan performance or the promulgation of new criteria.

Section 15
Post Construction Monitoring

15.1 INTRODUCTION

This section describes the post construction monitoring program that would be used to monitor the effectiveness of the long-term CSO controls and establishes NPDES permit conditions for measuring compliance. The CSO Policy requires that a post construction water quality monitoring program be developed to ascertain the effectiveness of CSO controls and to verify compliance with water quality standards and protection of designated uses. The monitoring program described in this section will utilize existing monitoring programs and will supplement these to determine the performance of the selected CSO controls and their effects on water quality.

15.2 OVERVIEW OF APPROACH

The LTCP has demonstrated that, under existing conditions, bacteria water quality standards will not be achieved most of the time in each receiving water, even if CSOs did not exist. This is due to upstream and storm water pollutant loads. Unless there are dramatic changes in the other pollutant loads, the post construction monitoring program will not be able to demonstrate that water quality standards will be met after the LTCP is in place. For example, the models predict that with the CSO controls in place, the fecal coliform count will exceed 200 MPN/100ml more than 180 days per year in the Anacostia due to other pollutant loads. Instead, the post construction monitoring will be able to demonstrate that CSOs are reduced to the levels predicted for the recommended LTCP. This reduction in the occurrence of CSOs is the most tangible measure of system performance. In terms of water quality, the post construction monitoring will be able to demonstrate that concentrations of bacteria are greatly reduced.

It is important to note that assessing compliance can be difficult. In accordance with the CSO Policy, the LTCP was developed based on “average year” conditions. Rainfall varies substantially from year to year and from storm to storm. It may be difficult to compare one year’s rainfall conditions to the average year to assess performance. The same is true for receiving water monitoring where the variables include other pollutant sources that are also driven by wet weather conditions. For these reasons, considerable judgment must be employed when assessing results.

In addition to field monitoring, the combined sewer system and receiving water models will continue to be used to analyze results. This will be useful in relating measured conditions to the average year performance levels predicted in the LTCP.

In the LTCP, there are two milestones where there will be significant reduction in CSO to the receiving waters. The first is the completion of the replacement of the inflatable dams and the rehabilitation of the pumping stations. These activities are projected to reduce CSO overflow volume by about 40% on a system-wide basis. The next major milestone is the completion of the storage tunnels, which will provide the largest reduction in CSO overflow volumes. The post construction monitoring program has thus been divided into phases to allow assessment of the benefits of each milestone.

The various phases are described in the following subsections and summarized as follows:

- Phase 1 Monitoring – After Inflatable Dams and Pumping Station Rehabilitation. This program will be conducted for a period of one year after rehabilitation projects are placed in operation in each receiving water (Anacostia and Potomac Rivers).

- Phase 2 Monitoring – After Tunnel Construction. This program will be conducted for a period of one year after tunnels are placed in operation in each receiving water (Anacostia, and Potomac Rivers and Rock Creek).

- Phase 3 Monitoring – This program will be conducted once every 5 years for each receiving water (Anacostia and Potomac Rivers and Rock Creek) after all control facilities have been placed in operation.

- NPDES Permit Compliance Monitoring – This program would be part of permit conditions for measuring compliance of the LTCP.

15.3 EXISTING DATA SOURCES

Several ongoing receiving water quality monitoring programs can provide data to assess compliance. The agencies that support monitoring are as follows:

- Metropolitan Washington Council of Governments
- D.C. Department of Health, Environmental Health Administration, Water Quality Division
- Maryland Department of Natural Resources
- National Park Service

The monitoring conducted by these agencies is described below.

- *Metropolitan Washington Council of Governments (MWCOG)* - MWCOG supports a Regional Monitoring Subcommittee (RMS) that coordinates the local monitoring efforts of federal, state, and local government agencies in Maryland, Virginia, and the District of Columbia. MWCOG maintains a centralized database and performs processing, analysis, and disbursement of ambient monitoring data. MWCOG also conducts two monitoring efforts that provide data that will be important to assessing compliance. These are as follows:

- Monitors at Benning Road and Seafarer's Marina stations on the Anacostia River that record dissolved oxygen, temperature, conductivity, alkalinity, pH, date, and time at 30 minute intervals.
- Fall Line monitoring at Chain Bridge on the Potomac River, which has been supported by MWCOG since the early 1980s. Because the bridge is located approximately at the fall line and head of tide, the measurements are indicative of the quality and quantity of upstream inputs into the estuary. Grab samples are taken on a weekly basis and more often during storm events. The automated sampler measures river stage. When the river level is high, the samples are taken at timed intervals until the water level recedes. This wet-weather sampling is done to characterize the loads when they are expected to be the highest. Samples from the Chain Bridge Station are tested for many parameters, including: temperature, DO, pH, conductivity, TSS, turbidity, dissolved organic carbon, TKN, ammonia, alkalinity, BOD, fecal coliform, total coliform, chlorophyll, alkalinity, and hardness.

- *DC Department of Health* **-** The DC Department of Health (DOH), Water Quality Monitoring Branch (WQMB) monitors a total of 80 surface water stations. Of these, 29 stations are on the Anacostia River; 28 stations are on the Potomac River; and the remaining 23 stations are on Rock Creek, the C&O Canal, the Washington Ship Channel, the Tidal Basin, Kingman Lake, and other small streams and surface waters throughout the District. The physical parameters measured at all stations are temperature, DO, pH, and conductivity. Chemical analysis is performed on samples from 26 of the stations (7 on the Potomac, 10 on the Anacostia, 3 on Watts Branch, 2 on Rock Creek, 2 on the C&O Canal, and 2 on Kingman Lake). The water chemistry parameters include TSS, turbidity, dissolved organic carbon, TKN, ammonia, nitrate, nitrite, total and soluble phosphorus, orthophosphorus, silica, alkalinity, BOD-5, fecal coliform, chlorophyll, alkalinity, and hardness. Metals tests include arsenic, cadmium, chromium, copper, iron, mercury, lead, selenium, and zinc.

  Sampling is typically conducted once per month. Four samples per year at water chemistry stations are tested for heavy metals. The regular sampling program is supplemented by rapid bioassessments, fish tissue samples, and sediment surveys.

  DOH also installed a continuous DO monitor in the Anacostia River on the CONRAIL Bridge in 1997.

- *Maryland Department of Natural Resources (MDNR)* - The MDNR conducts monitoring on the Anacostia near Bladensburg, MD at the head of tide on a monthly basis. MDNR also conducts biological sampling in the Anacostia once every three years.

- *National Park Service (NPS)* **-** The NPS conducts routine monitoring and special surveys on the Anacostia and Potomac Rivers. In the Anacostia River the NPS monitoring includes stations in and adjacent to Kenilworth Marsh and Kingman Lake, a backwater of the tidal Anacostia River.

Since compliance monitoring under an NPDES permit may occur many years after approval of the LTCP, the availability and scope of existing monitoring sources will be ascertained prior implementation of the actual monitoring program.

15.4 PHASE 1 MONITORING – AFTER INFLATABLE DAMS AND PUMPING STATION REHABILITATION

The goal of the Phase 1 monitoring is to confirm the reduction in CSO due to the replacement of the inflatable dams and the pumping station rehabilitations. The proposed monitoring program will consist of rainfall monitoring, CSO overflow monitoring and sampling. Receiving water monitoring performed by the D.C. Department of Health will be used to assess water quality benefits. The proposed system monitoring is summarized in Table 15-1. No monitoring is proposed in Rock Creek because the inflatable dams and pumping station rehabilitation are not predicted to have a measurable effect on these CSOs.

Table 15-1
Phase 1 Monitoring

Monitoring Type	*Anacostia River*	*Potomac River*	*Rock Creek*	*Frequency*
Rain Fall Monitoring	• 1 gage in Northeast Boundary • 1 gage in Tiber Creek	• 1 gage in Slash Run	--	• Continuous
CSO Overflow Monitoring (Flow and Volume)	• Northeast Boundary CSO 019 • B ST/ NJ Ave Pumped Overflow CSO 010	• Potomac Pumping Station CSO 021 • West Rock Creek Diversion Sewer CSO 023/024	--	• Continuous
CSO Overflow Sampling	• 1 sampling station at Northeast Boundary	--	--	• 4 storms per year • Approx 1 hour sample interval for each storm
Receiving water Monitoring- Dissolved Oxygen	• D.O. monitors operated by DOH	• D.O. monitors operated by DOH	--	• Approx 30 minute intervals
Receiving Water Monitoring- Bacteria, Field Parameters	• Use data from other existing programs	• Use data from other existing programs	--	• Frequency of existing programs

Rainfall and flow monitoring will be conducted for 12 months. The sampling at Northeast Boundary will be conducted at the influent to the Northeast Boundary Swirl Facility. Sampling data will be collected up to a maximum of 4 storms, with samples collected at approximately 1 hour intervals during each storm. The sampling will be tailored to capture the first flush of the discharge. CSO samples will be analyzed for fecal coliform, enterococci, CBOD5 and TSS.

15.5 PHASE 2 MONITORING – AFTER TUNNEL CONSTRUCTION

Phase 2 monitoring will be conducted after tunnel construction. The monitoring program would comprise elements as follows:

- Rainfall monitoring
- Flow monitoring:
    - At representative CSO overflows on each receiving water system.
    - At representative facilities that transfer flow from CSO outfalls to storage.
- Periodic sampling at representative CSO overflows
- A system to measure the degree to which storage facilities are filled.
- A receiving water monitoring program to obtain information on water quality. This program would be structured similar to that employed to obtain information for the LTCP.

Table 15-2 summarizes proposed monitoring locations and frequencies.

Table 15-2
Phase 2 Monitoring

Monitoring Type	*Anacostia River*	*Potomac River*	*Rock Creek*	*Frequency*
Rain Fall Monitoring	• 1 gage in Northeast Boundary • 1 gage in Tiber Creek	• 1 gage in Slash Run • 1 gage in College Pond	• 1 gage in Piney Branch	• Continuous
CSO Overflow Monitoring and Diversion to Storage Monitoring	• Northeast Boundary CSO 019 • Fort Stanton CSO 007 • B ST/ NJ Ave Pumped Overflow CSO 010	• Potomac Pumping Station CSO 021 • College Pond CSO 029	• Piney Branch CSO 049	• Continuous
Tunnel Storage Level Monitoring	• 1 sensor in Tunnel	• 1 sensor in Tunnel	• 1 sensor in Tunnel	• Continuous
CSO Overflow Sampling	• 1 sampling station at Northeast Boundary	• 1 sampling station at CSO 021	--	• 4 storms per year • Approx 1 hour sample interval for each storm
Receiving water Monitoring- Dissolved Oxygen	• Continuous D.O. monitors operated by others	• Continuous D.O. monitors operated by others	--	• Approx 30 minute intervals
Receiving Water Monitoring- Bacteria, Field Parameters	• Approx. 6 locations	• Approx. 3 locations	• Approx. 7 locations	• Once per week

CSO overflow samples will be collected up to a maximum of 4 storms per year, with samples collected at approximately 1 hour intervals during each storm. The sampling will be tailored to capture the first flush of the discharge. CSO samples will be analyzed for fecal coliform, enterococci, CBOD5 and TSS.

In order to assess performance, the CSO sampling and the receiving water monitoring are proposed to be conducted for 12 months. Depending on the results, periodic CSO sampling and receiving water monitoring may be recommended to confirm performance. The Phase 2 monitoring may be conducted at different times on each receiving water to coincide with the phased implementation of controls in each receiving water.

After the Phase 2 assessment, long term compliance monitoring would consist of flow monitoring representative CSO overflows and CSO diversion rates to storage, and measuring storage levels in the tunnel. It is anticipated that these monitoring provisions would become part of NPDES permit conditions, which are described in the following section.

15.6 PHASE 3 MONITORING

After the control facilities are in operation and after the Phase 2 performance evaluation has been conducted, Phase 3 monitoring will be conducted every 5 years. The purpose of the monitoring will be to identify any changes in control system performance, any changes in the nature of CSO discharges and in receiving water conditions and impacts.

As part of the NPDES compliance monitoring described below, CSO overflow volume, CSO diversion rates into the tunnel and tunnel level will be regularly monitored. Phase 3 monitoring will supplement this with the collection of samples of CSO overflow at representative overflows, and assessment of water quality impacts in the receiving water. Receiving water monitoring data collected by others such as the Department of Health will be used in conjunction with the models to assess receiving water conditions. Table 15-3 summarizes the monitoring.

Table 15-3
Phase 3 Monitoring

Monitoring Type	*Anacostia River*	*Potomac River*	*Rock Creek*	*Frequency*
Rain Fall Monitoring	• 1 gage in Northeast Boundary • 1 gage in Tiber Creek	• 1 gage in Slash Run • 1 gage in College Pond	• 1 gage in Piney Branch	• Continuous
CSO Overflow Monitoring and Diversion to Storage Monitoring	• Northeast Boundary CSO 019 • Fort Stanton CSO 007 • B ST/ NJ Ave Pumped Overflow CSO 010	• Potomac Pumping Station CSO 021 • College Pond CSO 029	• Piney Branch CSO 049	• Continuous
Tunnel Storage Level Monitoring	• 1 sensor in Tunnel	• 1 sensor in Tunnel	• 1 sensor in Tunnel	• Continuous
CSO Overflow Sampling	• 1 sampling station at Northeast Boundary	• 1 sampling station at CSO 021	--	• 4 storms per year • Approx 1 hour sample interval for each storm
Receiving water Monitoring- Dissolved Oxygen	• D.O. monitors operated by DOH	• D.O. monitors operated by DOH	--	• Approx 30 minute intervals
Receiving Water Monitoring- Bacteria, Field Parameters	• Use data from other existing programs	• Use data from other existing programs	--	• Frequency of existing programs

Phase 3 monitoring will be conducted for 12 months.

15.7 NPDES PERMIT CONDITIONS

Because the operation of the District's combined sewer system is addressed in NPDES Permit No. DC0021199, permit conditions will need to be developed to monitor and measure compliance based on operation of the LTCP. A potential framework for defining an acceptable level of performance and permit compliance would contain the requirements such that the CSO control system would be in compliance when:

- Transfer facilities from CSO outfalls to storage are conveying flow up to prescribed rates.
- An outfall is not discharging when its associated storage facility is not filled to capacity and the transfer facility is conveying flow up to prescribed rates.
- The BPWWTP is operating at prescribed treatment rates and capacities.

An outline of permit conditions is as follows:

- Discharges from permitted individual combined sewer system outfalls are prohibited except during wet weather events when:
    - The associated combined sewer overflow storage facilities are filled to capacity:

- o Combined sewer flow is being transferred from the individual outfall to the appropriate storage facility at prescribed rates; and
- o The associated wastewater pumping stations are operating at their maximum practical capacity; and
- o The Blue Plains Wastewater Treatment Plant (BPWWTP) is providing treatment for flows conveyed to the plant as specified below.

- Combined sewer overflow storage capacity shall be not less than the following:
  - o Anacostia River System – 126 million gallons.
  - o Potomac River System – 58 million gallons.
  - o Piney Branch Storage Tunnel – 9.5 million gallons
- Transfer rates from combined sewer outfalls to storage facilities shall be not less than the rates listed in Table 15-4

Table 15-4
Minimum Diversion Capacities to Storage for Recommended LTCP

CSO Outfall	*Drainage Area*	*Minimum Diversion Capacity Required for CSO Control(mgd)*
Anacostia CSOs		
005	Fort Stanton	37
006	Fort Stanton	Proposed to be separated
007	Fort Stanton	111
009	Canal Street	36
010	B St./N.J. Ave	690
011	B St./N.J. Ave	460
012	Tiber Creek	471
013	Canal Street Sewer	18
014	Navy Yard/M St.: 6th St – 7th St	92
015	Navy Yard/9th St-M St.	11
016[1]	Navy Yard/M St.: 12th St.– 9th St.	86
017[1]	Navy Yard/M St.: 14th to Penn Ave.	65
018[1]	Barney Circle	57
019	Northeast Boundary	1,460
Potomac CSOs		
020	Easby Point	297
021	Slash Run	530
022	I St.- 22nd St., NW	333
023/24[1]	West of Rock Creek Diversion Sewer	66
025[1]	31st & K St NW	3
026[1]	Water St District (WRC)	0
027[1]	Georgetown	92
028[1]	37th St-Georgetown	9

CSO Outfall	*Drainage Area*	*Minimum Diversion Capacity Required for CSO Control(mgd)*
029	College Pond	133
Rock Creek CSOs		
049	Piney Branch	468

Note:
1. These outfalls are proposed to be consolidated. The diversion capacity indicated is that required for CSO control. For consolidation, the full capacity of the outfall and/or drainage area must be conveyed to and relieved from the tunnel to prevent flooding. This diversion rate will be confirmed during the detailed design stage.

- Excess flow treatment at the BPWWTP means treatment of plant influent flows comprising screening, grit removal, primary clarification in the east primary facilities, followed by chlorination and dechlorination with discharge from outfall 001. The maximum capacity of excess flow treatment is 336 mgd.
- Complete treatment means passage of plant influent and recycle flows through any combination of conveyance and treatment facilities downstream of primary sedimentation that ultimately discharges effluent from Outfall 002.
- During wet weather conditions the BPWWTP shall treat at rates not less than those indicated below:
    - First four hours: Up to 1,076 mgd, with the first 740 mgd receiving complete treatment and up to 336 mgd receiving excess flow treatment.
    - Next 20 hours: Up to 847 mgd, with the first 511 mgd receiving complete treatment, and up to 336 mgd receiving excess flow treatment.
    - Thereafter: Up to 786 mgd, with the first 450 mgd receiving complete treatment, and up to 336 mgd receiving excess flow treatment.
- All combined sewer storage on the Anacostia River, Potomac River and Rock Creek systems shall be emptied within 59 hours following the cessation of a wet weather event. If a wet weather event occurs within 59 hours of the end of one event, the cessation period shall start from the end of the last event. All flow stored in the storage systems shall receive treatment at the BPWWTP.

An schematic of the monitoring system is shown on Figure 15-1.

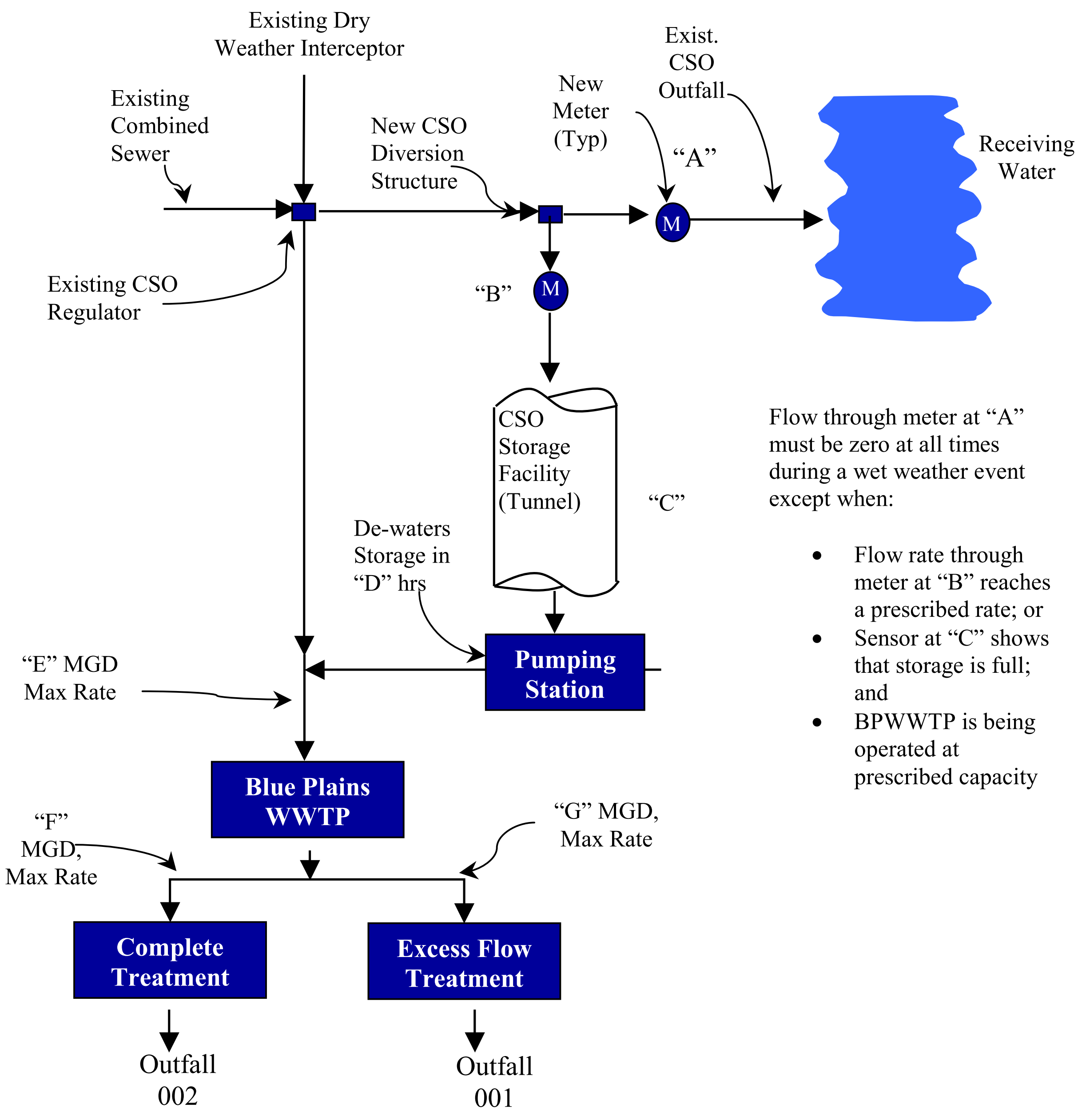


Figure 15-1
LTCP Monitoring Approach

15.8 PUBLIC NOTIFICATION

In order to advise the affected public of overflows, a visual notification system will be installed at three or four locations on each receiving water at public access locations. This system would serve to notify the public of the occurrence of overflows based on the flow monitoring at the representative

CSO outfalls. The system would comprise a series of colored lights, flags or pendents that would operate as follows:

- Color A would be displayed as long as flow is being detected as flowing out from the representative outfall.
- Other colors would be displayed based on the overflow volume from the representative outfall. There would be two levels of notification; one for a normal event and another for a major event.
- For a normal volume (probable impact not more than 24 hours), Color B would be displayed for 24 hours after flow has ceased flowing out from the representative outfall.
- For a significant volume (probable impact greater than 24 hours but less than 72 hours), Color C would be displayed for 72 hours after flow has ceased flowing out from the representative outfall.
- The visual notification system would be described and explained on WASA's web site.

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Glossary

A

Activated Sludge: Product that results when primary effluent is mixed with bacteria-laden sludge and then agitated and aerated to promote biological treatment, speeding the breakdown of organic matter in raw sewage undergoing secondary waste treatment.
Advanced Treatment: A level of wastewater treatment more stringent than secondary treatment; requires an 85-percent reduction in conventional pollutant concentration or a significant reduction in non-conventional pollutants. Sometimes called tertiary treatment.
Advanced Wastewater Treatment: Any treatment of sewage that goes beyond the secondary or biological water treatment stage and includes the removal of nutrients such as phosphorus and nitrogen and a high percentage of suspended solids. (See primary, secondary treatment.)
Aeration: A process that promotes biological degradation of organic matter in water. The process may be passive (as when waste is exposed to air), or active (as when a mixing or bubbling device introduces the air).
Algae: Simple rootless plants that grow in sunlit waters in proportion to the amount of available nutrients. They can affect water quality adversely by lowering the dissolved oxygen in the water. They are food for fish and small aquatic animals.
Algal Blooms: Sudden spurts of algal growth, which can affect water quality adversely and indicate potentially hazardous changes in local water chemistry.
Assimilation: The ability of a body of water to purify itself of pollutants.
Assimilative Capacity: The capacity of a natural body of water to receive wastewaters or toxic materials without deleterious efforts and without damage to aquatic life or humans who consume the water.
Authority: District of Columbia Water and Sewer Authority

B

Bacteria: (Singular: bacterium) Microscopic living organisms that can aid in pollution control by metabolizing organic matter in sewage, oil spills or other pollutants. However, some types of bacteria in soil, water or air can also cause human, animal and plant health problems. Measured in number of bacteria organisms per 100 milliliters of sample (No./ml or #/100 ml).
Best Management Practice (BMP): Methods that have been determined to be the most effective, practical means of preventing or reducing pollution from non-point sources.
Biochemical Oxygen Demand (BOD): A measure of the amount of oxygen consumed in the biological processes that break down organic matter in water. The greater the BOD, the greater the degree of pollution.
Biotic Community: A naturally occurring assemblage of plants and animals that live in the same environment and are mutually sustaining and interdependent.
BPWWTP: Blue Plains Wastewater Treatment Plant

Glossary

C

CFR: Code of Federal Regulation
Capture: The total volume of flow collected in the combined sewer system during precipitation events on a system-wide, annual average basis (not percent of volume being discharged).
CBOD5: Carbonaceous Biochemical Oxygen Demand
Chlorination: The application of chlorine to drinking water, sewage, or industrial waste to disinfect or to oxidize undesirable compounds.
CIP: Capital Improvement Program
COD: Chemical Oxygen Demand
Collection System: Pipes used to collect and carry wastewater from individual sources to an interceptor sewer that will carry it to a treatment facility.
Combined Sewer Overflow (CSO): Discharge of a mixture of storm water and domestic waste when the flow capacity of a sewer system is exceeded during rainstorms.
Combined Sewer System (CSS): A sewer system that carries both sewage and storm-water runoff. Normally, its entire flow goes to a waste treatment plant, but during a heavy storm, the volume of water may be so great as to cause overflows of untreated mixtures of storm water and sewage into receiving waters. Storm-water runoff may also carry toxic chemicals from industrial areas or streets into the sewer system.
Conc. Concentration
Cost-Benefit Analysis: A quantitative evaluation of the costs, which would be incurred by implementing an alternative versus the overall benefits to society of the proposed alternative.
Cr+6: Chrome +6
CSO: Combined Sewer Overflow (See above)
CWA: Clean Water Act – Federal law stipulating actions to be carried out to improve water quality in U.S. waters.

D

Design Capacity: The average daily flow that a treatment plant or other facility is designed to accommodate.
Designated Uses: Those water uses identified in state water quality standards that must be achieved and maintained as required under the Clean Water Act. Uses can include cold-water fisheries, public water supply, and irrigation.
DETS: WASA's Department of Engineering and Technical Services
Discharge: Flow of surface water in a stream or canal or the outflow of ground water from a flowing artesian well, ditch, or spring. Can also apply to discharge of liquid effluent from a facility or to chemical emissions into the air through designated venting mechanisms.
Disinfectant: A chemical or physical process that kills disease-causing organisms in water, air, or on surfaces. Chlorine is often used to disinfect sewage treatment effluent, water supplies, wells, and swimming pools.
Dissolved Oxygen (DO): The oxygen freely available in water, vital to fish and other aquatic life and for the prevention of odors. DO levels are considered a most important indicator of a water body's ability to support desirable aquatic life. Secondary and advanced waste treatments are generally designed to ensure adequate DO in waste-receiving waters.
DCSW: District of Columbia Storm Water
DMS: WASA's Department of Maintenance Services
DOC: Dissolved Organic Carbon

DOH: District of Columbia Department of Health, the environmental regulatory agency for the District
DOT: District of Columbia Division of Transportation
DPW: District of Columbia Department of Public Works
DSS: WASA's Department of Sewer Services

E

Effluent Guidelines: Technical EPA documents which set effluent limitations for given industries and pollutants.
Effluent Limitation: Restrictions established by a state or EPA on quantities, rates, and concentrations in wastewater discharges.
Effluent Standard: (See effluent limitation.)
Effluent: Wastewater—treated or untreated—that flows out of a treatment plan, sewer, or industrial outfall. Generally refers to wastes discharged into surface waters.
EHRC: Enhanced High Rate Clarification
EMCs: Event Mean Concentration
EPA: United States Environmental Protection Agency
EPMC: Engineering Program Management Consultant

F

Floatables: Large floating material sometimes characteristic of sanitary wastewater and storm runoff, which includes litter and trash.
Food Chain: A sequence of organisms, each of which uses the next, lower member of the sequence as a food source.

G

GIS: Geographical Information System
GPD: Gallons per Day

H

Holding Pond: A pond or reservoir, usually made of earth, built to store polluted runoff.
HRT: High Rate Treatment
Hypoxia/Hypoxic Waters: Waters with dissolved oxygen concentrations of less than 2 ppm, the level generally accepted as the minimum required for most marine life to survive and reproduce.

I

I/I: Inflow/Infiltration (See definitions of Inflow and Infiltration below)
IBI: Indices of Biological Integrity
ICPRB: Interstate Commission on Potomac River Basin
in: Inches
Infiltration: The penetration of water from the soil into sewer or other pipes through defective joints, connections, or manhole walls.
Inflow: Entry of extraneous rainwater into a sewer system from sources other than infiltration, such as basement drains, manholes, storm drains, and street washing.

Influent: Water, wastewater, or other liquid flowing into a reservoir, basin, or treatment plant.
Interceptor Sewers: Large sewer lines that, in a combined system, control the flow of sewage to the treatment plant. During some storm events, their capacity is exceeded and regulator structures relieve excess flow to receiving waters to prevent flooding basements, businesses and streets.

K

Knee-off-the-curve: The point where the incremental change in the cost of the control alternative per change in performance of the control alternative changes most rapidly.

L

Long Term Control Plan (LTCP): A document developed by CSO communities to describe existing waterway conditions and various CSO abatement technologies that will be used to control overflows.
LID: Low Impact Development
LID-R: Low Impact Development - Retrofit

M

Macro-invertebrate: Invertebrate (no spinal column) organism that is too large to pass through a No. 40 Screen (0.417mm).
mf/l: Million fibers per liter – A measure of concentration.
mg: Million Gallons – A measure of volume.
mgd: Million Gallons Per Day – A measure of the rate of water flow.
mg/l: Milligrams Per Liter – A measure of concentration.
MHI: Median Household Income
MOUSE: Computer model developed by the Danish Hydraulic Institute used to model the combined sewer system.
Municipal Sewage: Wastes (mostly liquid) originating from a community; may be composed of domestic wastewater and/or industrial discharges.
MWCOG: Metropolitan Washington Council of Governments

N

National Pollutant Discharge Elimination System (NPDES): A provision of the Clean Water Act which prohibits discharge of pollutants into water of the United States unless a special permit is issued by EPA, a state, or, where delegated, a tribal government on an Indian reservation.
NH_3: Ammonia – A nutrient pollutant of concern in the Chesapeake Region.
No./ml (or #/ml): number of bacteria organisms per milliliter – measure of concentration
Non-Point Source (NPS): Diffused pollution sources (i.e., without a single point of origin or not introduced into a receiving stream from a specific outlet). The pollutants are generally carried off the land by storm water. Common non-point sources are agriculture, forestry, urban, mining, construction, dams, channels, land disposal, saltwater intrusion, and city streets.
Nutrient: Any substance assimilated by living things that promotes growth. The term is generally applied to nitrogen and phosphorus in wastewater, but is also applied to other essential and trace elements.

O

Operation and Maintenance (O&M): Actions taken after construction to ensure that facilities constructed will be properly operated and maintained to achieve normative efficiency levels and prescribed effluent eliminations in an optimum manner.
Organic: (1) Referring to other derived from living organisms. (2) In chemistry, any compound containing carbon.
Organic Chemicals/Compounds: Naturally occurring (animal or plant-produced or synthetic) substances containing mainly carbon, hydrogen, nitrogen, and oxygen.
Organic Matter: Carbonaceous waste contained in plant or animal matter and originating from domestic or industrial sources.
Ortho P: Ortho Phosphorus

P

pH: An expression of the intensity of the basic or acid condition of a liquid; may range from 0 to 14, where 0 is the most acid and 7 is neutral. Natural waters usually have a pH between 6.5 and 8.5
PCBs: Polychlorinated biphenyls
PE: Primary Effluent
Point Source: A stationary location or fixed facility from which pollutants are discharged; any single identifiable source of pollution; e.g., a pipe, ditch, ship, ore pit, factory smokestack.
Pretreatment: Processes used to reduce, eliminate, or alter the nature of wastewater pollutants from non-domestic sources before they are discharged into Publicly Owned Treatment Works (POTWs).
Priority Pollutants: A list of 129 toxic pollutants including metals developed by the EPA as a basis for defining toxics and is commonly refered to as "priority pollutants".
Primary Waste Treatment: First steps in wastewater treatment; screens and sedimentation tanks are used to remove most materials that float or will settle. Primary treatment removes about 30 percent of carbonaceous biochemical oxygen demand from domestic sewage.
PS: Pump Station

R

Raw Sewage: Untreated wastewater and its contents.
Riparian Habitat: Areas adjacent to rivers and streams with a differing density, diversity, and productivity of plant and animal species relative to nearby uplands.
R.L: Reporting Limit
Run-Off: That part of precipitation, snowmelt, or irrigation water that runs off the land into streams or other surface-water. It can carry pollutants from the air and land into receiving waters.
RTC: Real-Time Control – A system of data gathering instrumentation used in conjunction with control components such as dams, gates and pumps to maximize storage in the existing sewer system.

S

Sanitary Sewers: Underground pipes that carry off any domestic or industrial waste, not storm water.
SCADA: Supervisory Control and Data Acquisition, system for controlling and collecting and recording data on certain elements of WASA combined sewer system.

Glossary

Secondary Treatment: The second step in most publicly owned waste treatment systems in which bacteria consume the organic parts of the waste. It is accomplished by bringing together waste, bacteria, and oxygen in trickling filters or in the activated sludge process. This treatment removes floating and settleable solids and about 90 percent of the oxygen-demanding substances and suspended solids. Disinfection is the final stage of secondary treatment. (See: primary, tertiary treatment.)
Sedimentation: Letting solids settle out of wastewater by gravity during treatment.
Sediments: Soil, sand, and minerals washed from land into water, usually after rain. They pile up in reservoirs, rivers and harbors, destroying fish and wildlife habitat, and clouding the water so that sunlight cannot reach aquatic plants. Careless farming, mining, and building activities will expose sediment materials, allowing them to wash off the land after rainfall.
SF: Square foot
Sediment Oxygen Demand (SOD): A measure of the amount of oxygen consumed in the biological process that breaks down organic matter in the sediment.
Settleable Solids: Material heavy enough to sink to the bottom of a wastewater treatment tank.
Settling Tank: A holding area for wastewater, where heavier particles sink to the bottom for removal and disposal.
Sewer Sludge: Sludge produced at a Publicly Owned Treatment Works (POTW), the disposal of which is regulated under the Clean Water Act.
Sewage: The waste and wastewater produced by residential and commercial sources and discharged into sewers.
Sewer: A channel or conduit that carries wastewater and storm-water runoff from the source to a treatment plant or receiving stream. "Sanitary" sewers carry household, industrial, and commercial waste. "Storm" sewers carry runoff from rain or snow. "Combined" sewers handle both.
Sewerage: The entire system of sewage collection, treatment, and disposal.
SSWS: Separate Storm Water System – A system of catch basin, pipes, and other components that carry only surface run off to receiving waters.
Storage: Treatment holding of waste pending treatment or disposal, as in containers, tanks, waste piles, and surface impoundments.
Storm Sewer: A system of pipes (separate from sanitary sewers) that carries waste runoff from buildings and land surfaces.
Surcharge Flow: Flow in which the water level is above the crown of the pipe causing pressurized flow in pipe segments.
Surface Runoff: Precipitation, snow melt, or irrigation water in excess of what can infiltrate the soil surface and be stored in small surface depressions; a major transporter of non-point source pollutants in rivers, streams, and lakes.
Surface Water: All water naturally open to the atmosphere (rivers, lakes, reservoirs, ponds, streams, impoundments, seas, estuaries, etc.)
Suspended Loads: Specific sediment particles maintained in the water column by turbulence and carried with the flow of water.
Suspended Solids: Small particles of solid pollutants that float on the surface of, or are suspended in, sewage or other liquids. They resist removal by conventional means.
SWMP: Storm Water Management Plan

T

TDS: Total Dissolved Solids
Tertiary Treatment: Advanced cleaning of wastewater that goes beyond the secondary or biological stage, removing nutrients such as phosphorus, nitrogen, and most BOD and suspended solids.
TKN: Total Kjeldahl Nitrogen, the sum of organic nitrogen and ammonia nitrogen.
TMDL: Total Maximum Daily Loads
TOC: Total Organic Carbon
Total P: Total Phosphorus
Total Suspended Solids (TSS): A measure of the suspended solids in wastewater, effluent, or water bodies, determined by tests for "total suspended non-filterable solids." (See: suspended solids.)
Toxic Pollutants: Materials that cause death, disease, or birth defects in organisms that ingests or absorbs them. The quantities and exposures necessary to cause these effects can vary widely.
Treated Wastewater: Wastewater that has been subjected to one or more physical, chemical, and biological processes to reduce its potential of being a health hazard.
Treatment: (1) Any method, technique, or process designed to remove solids and/or pollutants from solid waste, waste-streams, effluents, and air emissions. (2) Methods used to change the biological character or composition of any regulated medical waste so as to substantially reduce or eliminate its potential for causing disease.
Treatment Plan: A structure built to treat wastewater before discharging it into the environment.
TSS: Total Suspended Solids

U

UAA: Use Attainability Analysis**,** an evaluation that provides the scientific and economic basis for a determination that the designated use of a water body is not attainable based on one or more factors proscribed in federal regulations.
ug/l: Microgram per liter – A measure of concentration
Urban Runoff: Storm water from city streets and adjacent domestic or commercial properties that carries pollutants of various kinds into the sewer systems and receiving waters.
USEPA: United States Environmental Protection Agency
USGS: United States Geological Survey
UV: Ultraviolet

V

VSS: Total Volatile Suspended Solids

W

WASA: District of Columbia Water and Sewer Authority
Waste Water Treatment Plant (WWTP): A facility containing a series of tanks, screens, filters and other processes by which pollutants are removed from water.
Wastewater: The spent or used water from a home, community, farm, or industry that contains dissolved or suspended matter.
Water Pollution: The presence in water of enough harmful or objectionable material to damage the water's quality.

Glossary

Water Quality Criteria: Levels of water quality expected to render a body of water suitable for its designated use. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, fish production, or industrial processes.
Water Quality Standards (WQS): State-adopted and EPA-approved ambient standards for water bodies. The standards prescribe the use of the water body and establish the water quality criteria that must be met to protect designated uses.
Watershed: The land area that drains into a stream; the watershed for a major river may encompass a number of smaller watersheds that ultimately combined at a common point.
Watershed Approach: A coordinated framework for environmental management that focuses public and private efforts on the highest priority problems within hydrologically-defined geographic area taking into consideration both ground and surface water flow.
Weir: (1) A wall or plate placed in an open channel to measure the flow of water. (2) A wall or obstruction used to control flow from settling tanks and clarifiers to ensure a uniform flow rate and avoid short-circuiting.

District of Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

APPENDIX A

List of Program Documents

District of Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

List of Program Documents

The following documents were prepared as part of the Long Term Control Plan development process:

1. Long Term Control Plan Program Plan
2. Study Memorandum LTCP-1-1: Study area
3. Study Memorandum LTCP-1-2: Dry Weather Flow
4. Study Memorandum LTCP-1-3: Existing CSO Controls and Programs
5. Study Memorandum LTCP-1-4: CSO Case Histories
6. Study Memorandum LTCP-2-1: Public Participation Program
7. Study Memorandum LTCP-3-1: Watersheds – General
8. Study Memorandum LTCP-3-2: Rainfall Conditions
9. Study Memorandum LTCP-3-3: Regulatory Requirements
10. Study Memorandum LTCP-3-4: Sensitive Areas
11. Study Memorandum LTCP-4-2: CSS - Update Structure Book
12. Study Memorandum LTCP-4-3: CSS – CSO Overflow and Diversion Structure Inspections
13. Study Memorandum LTCP-4-4: CSS - Sewer System Characteristics Report
14. Study Memorandum LTCP-4-6: SSWS - Exist. Info – Sewer System Characteristics Report
15. Study Memorandum LTCP-5-1: Monitoring Plan for Sewer Systems and Receiving Waters
16. Quality Assurance Project Plan: Monitoring for Combined Sewer System Long Term Control Plan
17. Study Memorandum LTCP-5-2: Outfall Survey Report
18. Study Memorandum LTCP-5-3: CSS - Model Justification and Selection
19. Study Memorandum LTCP-5-4: CSS - Model Documentation
20. Study Memorandum LTCP-5-5a: CSS and SSWS Monitoring Results: Aug. 1999-Feb 2000
21. Study Memorandum LTCP-5-5b: CSS and SSWS Monitoring Results: Mar. 2000-June 2000
22. Study Memorandum LTCP-5-5c: CSS and SSWS Monitoring Results: July 2000-Nov. 2000
23. Study Memorandum LTCP-5-5d: CSS and SSWS Monitoring Results: Dec. 2000
24. Data Validation Report for WASA CSO Monitoring Project (Sewer Systems) – Sept. 2000
25. Data Validation Report for WASA CSO Monitoring Project (Receiving Waters)-Feb. 2000
26. Data Validation Report for WASA CSO Monitoring Project (Receiving Waters)-June 2000
27. Data Validation Report for WASA CSO Monitoring Project (Receiving Waters)-Oct. 2000
28. Data Validation Report for WASA CSO Monitoring Project (Receiving Waters)-Jan. 2001
29. Anacostia River Wet Weather Receiving Water Monitoring Survey Events 1-3, July 2000
30. Study Memorandum LTCP-5-6: SSWS - Model Justification and Selection
31. Study Memorandum LTCP-5-7: SSWS - Model Documentation
32. Study Memorandum LTCP-5-8: CSS and SSWS Event Mean Concentrations
33. Study Memorandum LTCP-5-9: Toxics Monitoring and Analysis
34. Study Memorandum LTCP-6-1: Existing Information – Receiving Waters
35. Study Memorandum LTCP-6-2: Receiving Waters – Report on Results of Mon. (Interim)
36. Study Memorandum LTCP-6-3: Receiving Waters – Model Selection
37. Study Memorandum LTCP-6-4: Anacostia River Model Documentation
38. Study Memorandum LTCP-6-5: Potomac River Model Documentation
39. Study Memorandum LTCP-6-6: Rock Creek Model Documentation
40. Study Memorandum LTCP-7-1: Watershed - Sources of Pollution

41. Study Memorandum LTCP-8-5: Financial Capability Assessment
42. Feasibility Assessment – EquiFlow Combined Sewer Overflow Storage System
43. Stakeholder Advisory Panel Meeting Summaries – Meetings No. 1 through 10
44. Public Meeting Responsiveness Summaries – Meetings No. 1 through 3
45. Nine Minimum Controls Summary Report
46. Nine Minimum Controls Action Plan
47. Review of BMPs for Solids and Floatables Control
48. Catch Basin Program Evaluation
49. Northeast Boundary Sewer Performance Evaluation Plan
50. Northeast Boundary Sewer Performance Evaluation Quality Assurance Project Plan
51. Northeast Boundary Sewer Local Flooding Report
52. Memorandum – Documentation of Installation of CSO Outfall Signs
53. Draft Long Term Control Plan
54. Comments on Draft Long Term Control Plan

District of Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

APPENDIX B

Effect of CSO Controls on Water Quality
Anacostia River

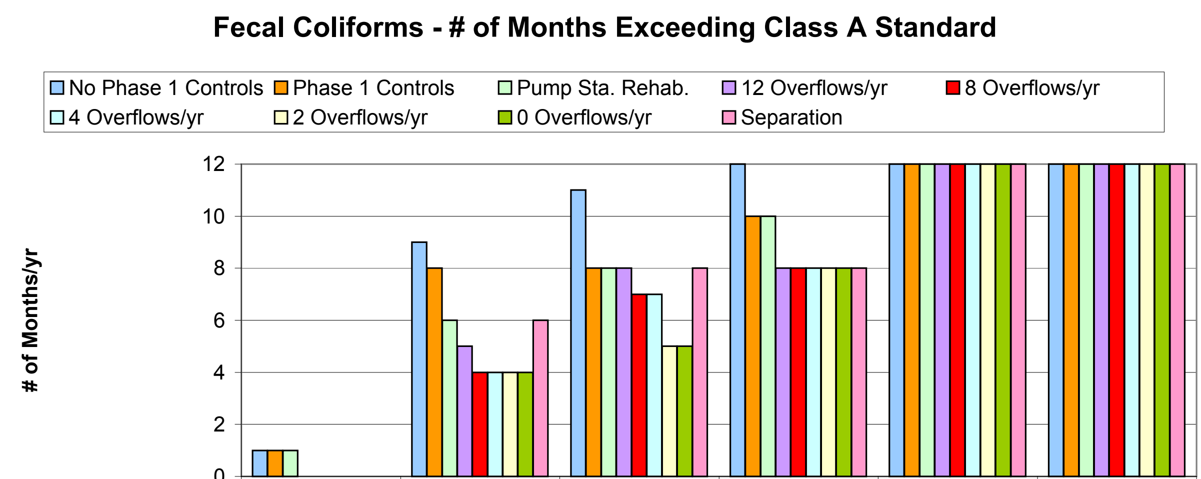
District of Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

Table of Contents
Appendix B – Effect of CSO Controls on Water Quality in Anacostia River

District of Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

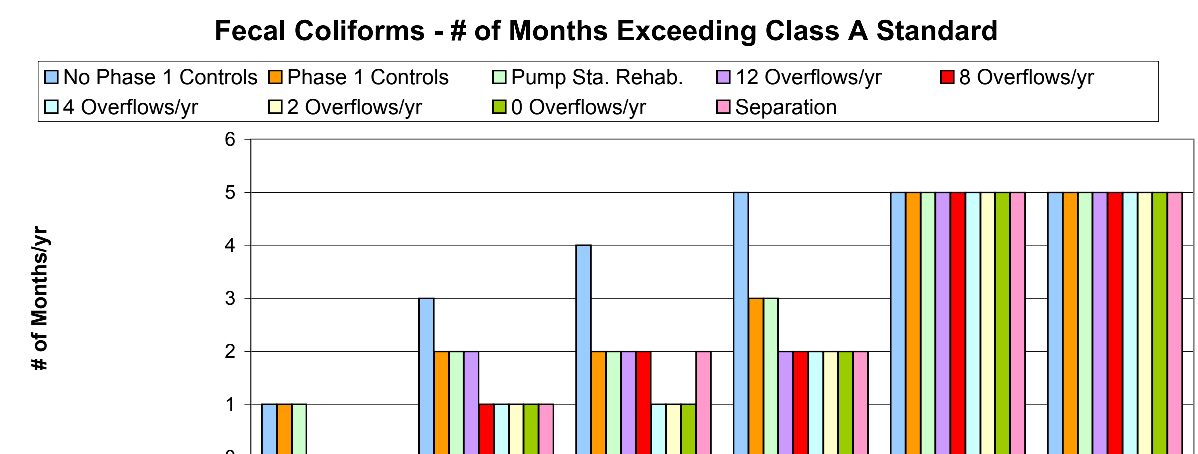
Figure B-1
Anacostia River: Effect of CSO Control on Fecal Coliform Concentrations
(No Change in Upstream or Stormwater Loads)

ENTIRE CALENDAR YEAR



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	1	9	11	12	12	12
Phase 1 Controls	1	8	8	10	12	12
Pump Sta. Rehab.	1	6	8	10	12	12
12 Overflows/yr	0	5	8	8	12	12
8 Overflows/yr	0	4	7	8	12	12
4 Overflows/yr	0	4	7	8	12	12
2 Overflows/yr	0	4	5	8	12	12
0 Overflows/yr	0	4	5	8	12	12
Separation	0	6	8	8	12	12

MAY THROUGH SEPTEMBER



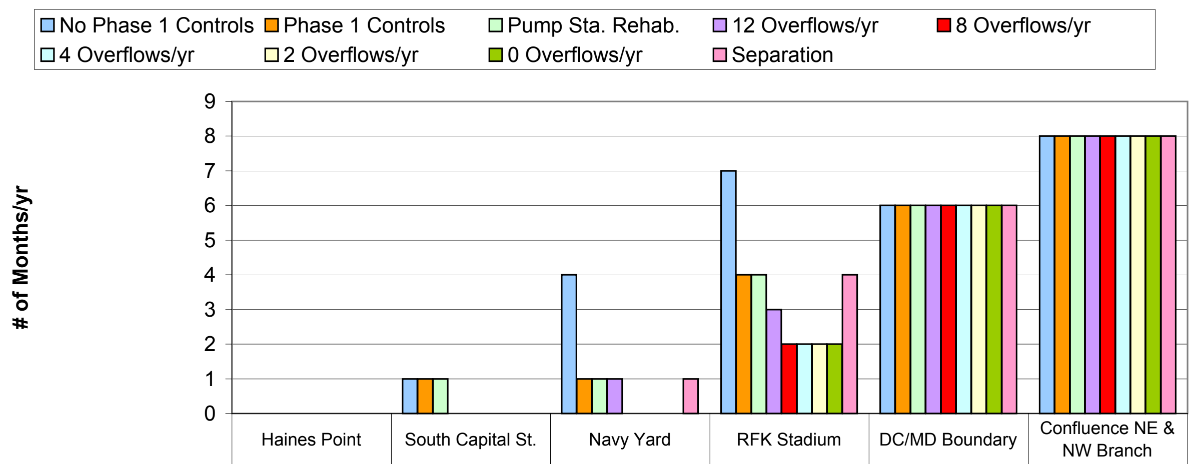
	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	1	3	4	5	5	5
Phase 1 Controls	1	2	2	3	5	5
Pump Sta. Rehab.	1	2	2	3	5	5
12 Overflows/yr	0	2	2	2	5	5
8 Overflows/yr	0	1	2	2	5	5
4 Overflows/yr	0	1	1	2	5	5
2 Overflows/yr	0	1	1	2	5	5
0 Overflows/yr	0	1	1	2	5	5
Separation	0	1	2	2	5	5

District of Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

Figure B-2
Anacostia River: Effect of CSO Control on Fecal Coliform Concentrations
(No Change in Upstream or Stormwater Loads)

ENTIRE CALENDAR YEAR

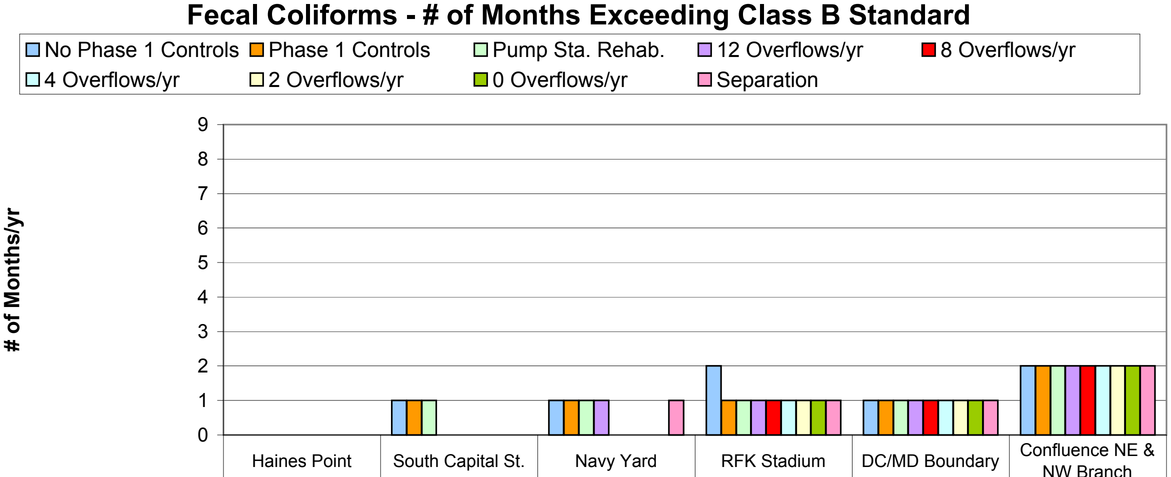
Fecal Coliforms - # of Months Exceeding Class B Standard



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	0	1	4	7	6	8
Phase 1 Controls	0	1	1	4	6	8
Pump Sta. Rehab.	0	1	1	4	6	8
12 Overflows/yr	0	0	1	3	6	8
8 Overflows/yr	0	0	0	2	6	8
4 Overflows/yr	0	0	0	2	6	8
2 Overflows/yr	0	0	0	2	6	8
0 Overflows/yr	0	0	0	2	6	8
Separation	0	0	1	4	6	8

MAY THROUGH SEPTEMBER

Fecal Coliforms - # of Months Exceeding Class B Standard



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	0	1	1	2	1	2
Phase 1 Controls	0	1	1	1	1	2
Pump Sta. Rehab.	0	1	1	1	1	2
12 Overflows/yr	0	0	1	1	1	2
8 Overflows/yr	0	0	0	1	1	2
4 Overflows/yr	0	0	0	1	1	2
2 Overflows/yr	0	0	0	1	1	2
0 Overflows/yr	0	0	0	1	1	2
Separation	0	0	1	1	1	2

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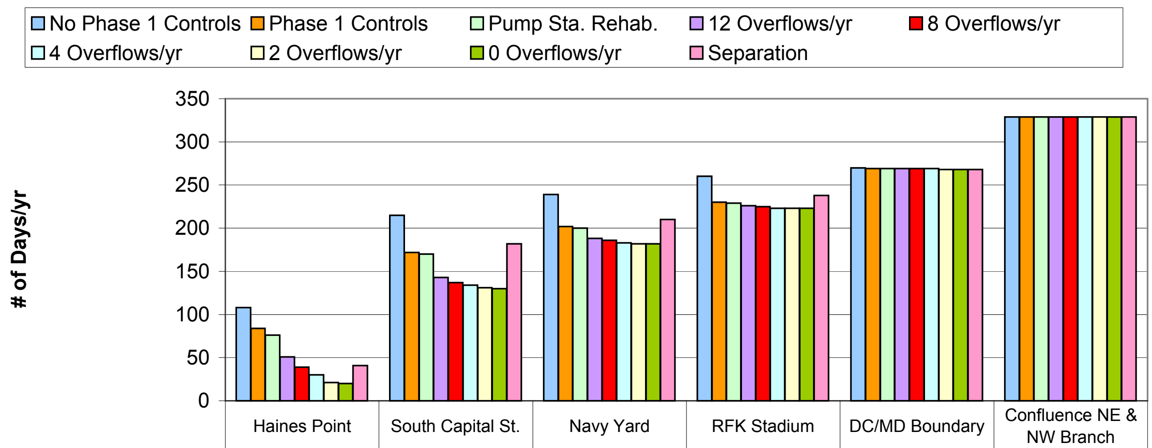
Figure B-3
Anacostia River: Effect of CSO Control on Fecal Coliform Concentrations
(No Change in Upstream or Stormwater Loads)

ENTIRE CALENDAR YEAR

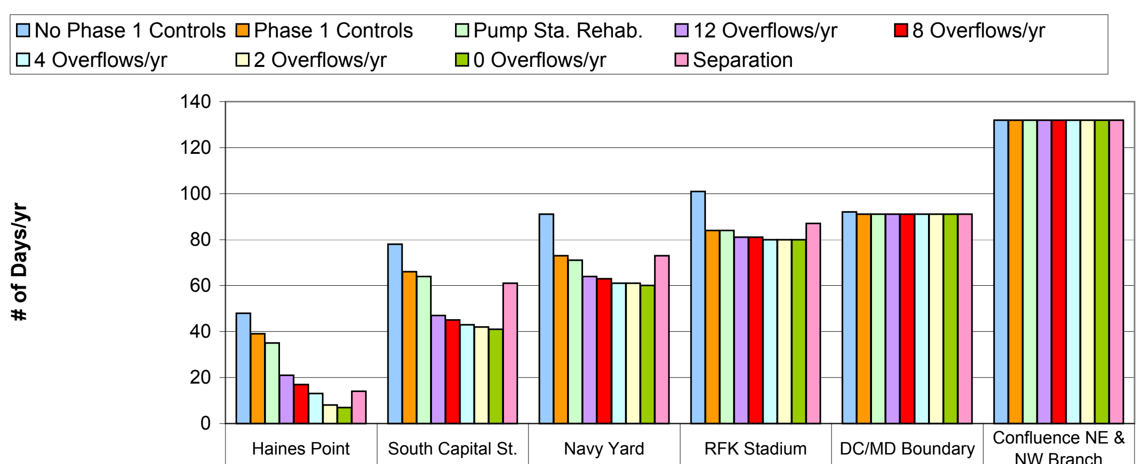
Fecal Coliforms - # of Days >200/100ml



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	108	215	239	260	270	329
Phase 1 Controls	84	172	202	230	269	329
Pump Sta. Rehab.	76	170	200	229	269	329
12 Overflows/yr	51	143	188	226	269	329
8 Overflows/yr	39	137	186	225	269	329
4 Overflows/yr	30	134	183	223	269	329
2 Overflows/yr	21	131	182	223	268	329
0 Overflows/yr	20	130	182	223	268	329
Separation	41	182	210	238	268	329

MAY THROUGH SEPTEMBER

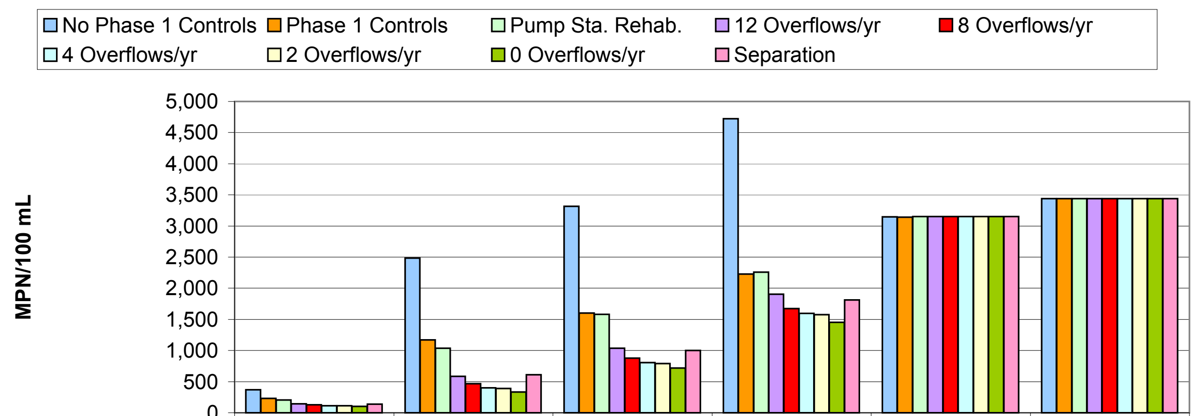
Fecal Coliforms - # of Days >200/100ml



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	48	78	91	101	92	132
Phase 1 Controls	39	66	73	84	91	132
Pump Sta. Rehab.	35	64	71	84	91	132
12 Overflows/yr	21	47	64	81	91	132
8 Overflows/yr	17	45	63	81	91	132
4 Overflows/yr	13	43	61	80	91	132
2 Overflows/yr	8	42	61	80	91	132
0 Overflows/yr	7	41	60	80	91	132
Separation	14	61	73	87	91	132

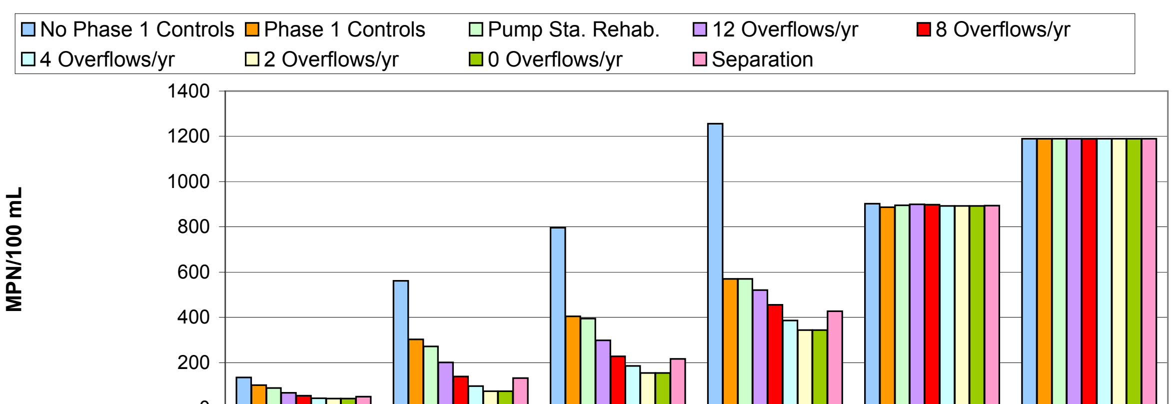
Figure B-4
Anacostia River: Effect of CSO Control on Fecal Coliform Concentrations
(No Change in Upstream or Stormwater Loads)

Fecal Coliforms - May Geometric Means



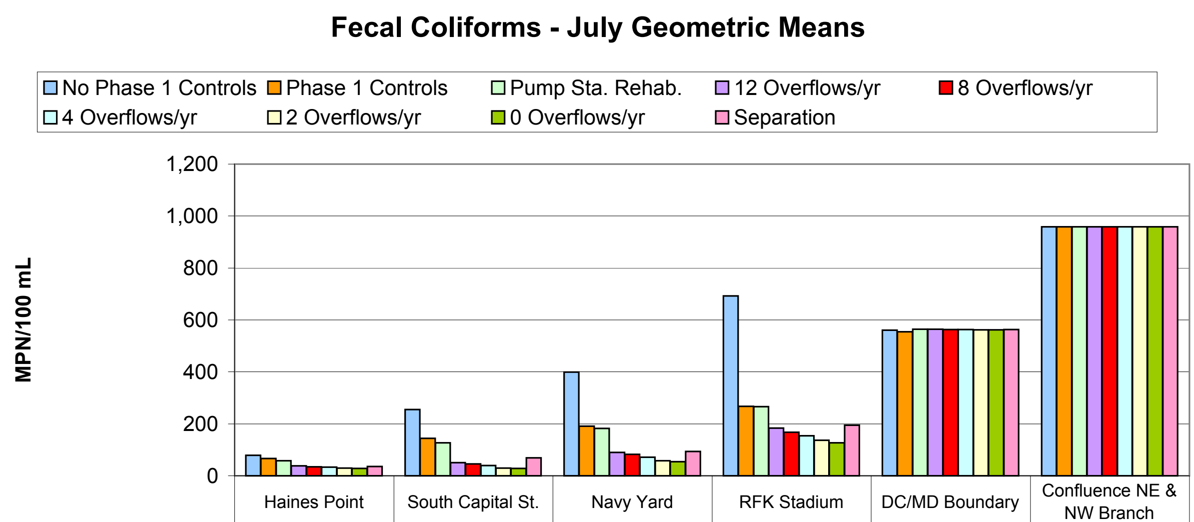
	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	368	2,485	3,316	4,721	3,146	3,438
Phase 1 Controls	231	1,172	1,602	2,227	3,140	3,438
Pump Sta. Rehab.	205	1,039	1,582	2,259	3,154	3,438
12 Overflows/yr	146	583	1,039	1,902	3,152	3,438
8 Overflows/yr	130	468	879	1,673	3,152	3,438
4 Overflows/yr	115	398	806	1,595	3,152	3,438
2 Overflows/yr	113	389	789	1,576	3,152	3,438
0 Overflows/yr	103	333	718	1,452	3,152	3,438
Separation	140	611	1,002	1,814	3,153	3,438

Fecal Coliforms - June Geometric Means

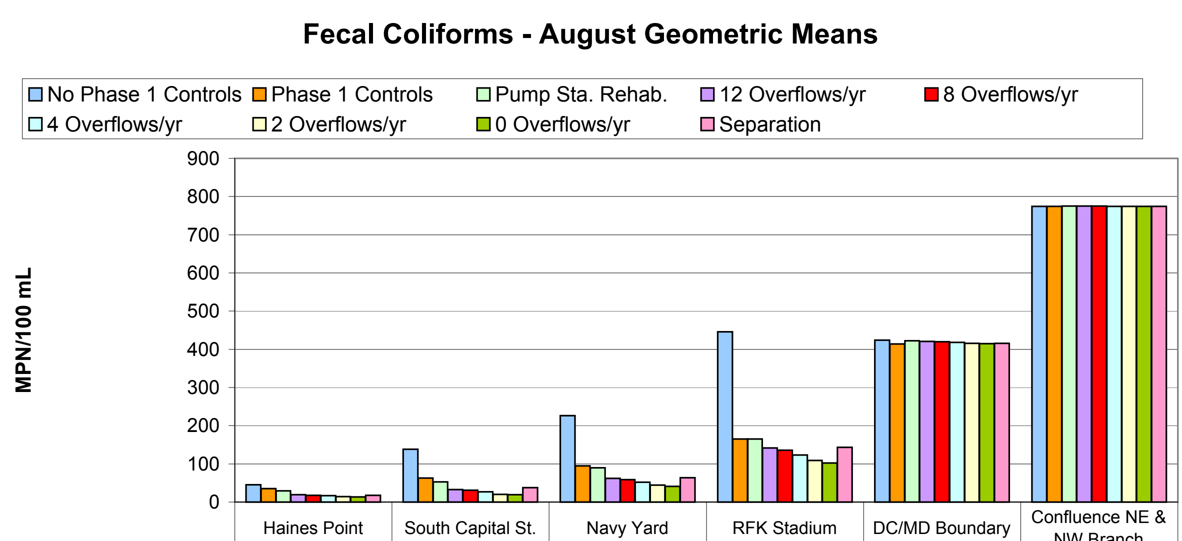


	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	135	561	796	1256	902	1190
Phase 1 Controls	101	302	405	570	887	1190
Pump Sta. Rehab.	88	271	394	570	895	1190
12 Overflows/yr	67	201	298	520	900	1190
8 Overflows/yr	54	138	227	456	898	1190
4 Overflows/yr	43	96	185	386	892	1190
2 Overflows/yr	41	74	154	343	892	1190
0 Overflows/yr	41	74	154	343	892	1,190
Separation	50	131	216	427	894	1190

Figure B-5
Anacostia River: Effect of CSO Control on Fecal Coliform Concentrations
(No Change in Upstream or Stormwater Loads)

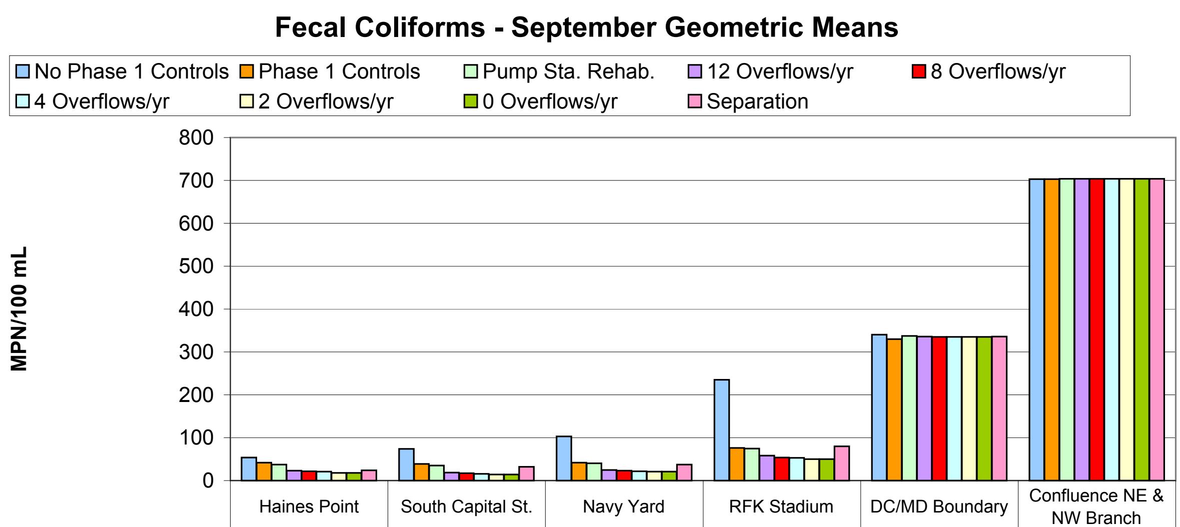


	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	79	255	399	692	560	958
Phase 1 Controls	66	144	191	267	554	958
Pump Sta. Rehab.	58	127	182	266	564	959
12 Overflows/yr	38	51	90	183	564	959
8 Overflows/yr	35	46	82	168	563	959
4 Overflows/yr	33	40	71	154	563	959
2 Overflows/yr	29	30	58	137	562	959
0 Overflows/yr	28	28	54	127	562	959
Separation	36	69	94	195	563	959



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	45	138	226	446	424	774
Phase 1 Controls	35	63	95	165	414	774
Pump Sta. Rehab.	29	53	90	165	422	775
12 Overflows/yr	19	33	62	142	421	775
8 Overflows/yr	18	31	59	136	420	775
4 Overflows/yr	17	27	52	123	418	774
2 Overflows/yr	14	20	44	109	416	774
0 Overflows/yr	13	19	41	102	415	774
Separation	18	38	64	143	416	774

Figure B-6
Anacostia River: Effect of CSO Control on Fecal Coliform Concentrations
(No Change in Upstream or Stormwater Loads)

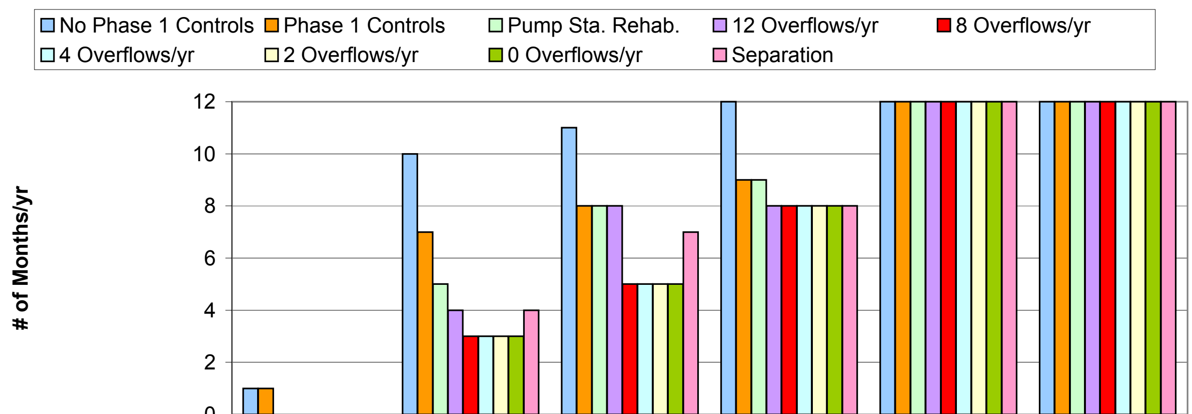


	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	54	74	103	235	340	703
Phase 1 Controls	42	39	42	76	330	703
Pump Sta. Rehab.	37	35	40	75	337	704
12 Overflows/yr	23	19	25	58	336	704
8 Overflows/yr	22	17	23	54	335	704
4 Overflows/yr	21	16	22	53	335	704
2 Overflows/yr	18	14	21	50	335	704
0 Overflows/yr	18	14	21	50	335	704
Separation	24	32	37	80	336	704

Figure B-7
Anacostia River: Effect of CSO Control on Fecal Coliform Concentrations
(No Change in Upstream or Stormwater Loads)

ENTIRE CALENDAR YEAR

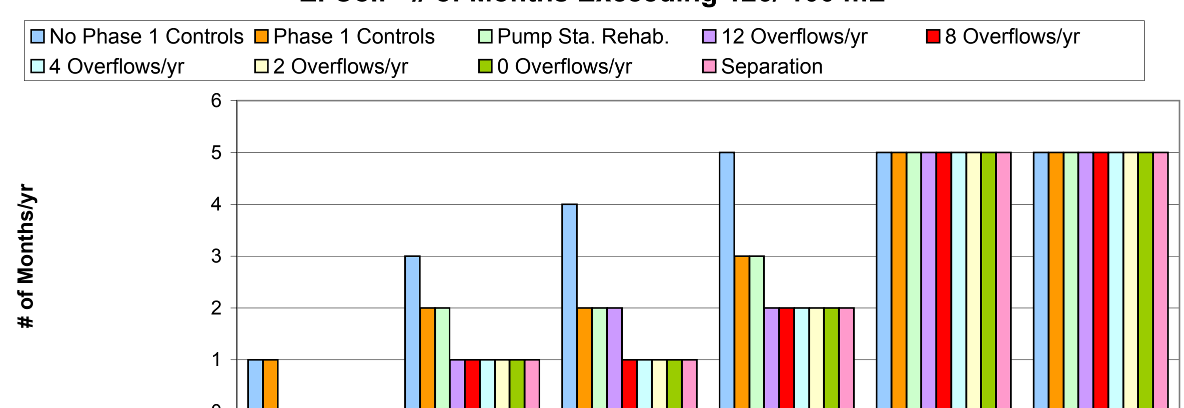
E. Coli - # of Months Exceeding 126/ 100 mL



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	1	10	11	12	12	12
Phase 1 Controls	1	7	8	9	12	12
Pump Sta. Rehab.	0	5	8	9	12	12
12 Overflows/yr	0	4	8	8	12	12
8 Overflows/yr	0	3	5	8	12	12
4 Overflows/yr	0	3	5	8	12	12
2 Overflows/yr	0	3	5	8	12	12
0 Overflows/yr	0	3	5	8	12	12
Separation	0	4	7	8	12	12

MAY THROUGH SEPTEMBER

E. Coli - # of Months Exceeding 126/ 100 mL



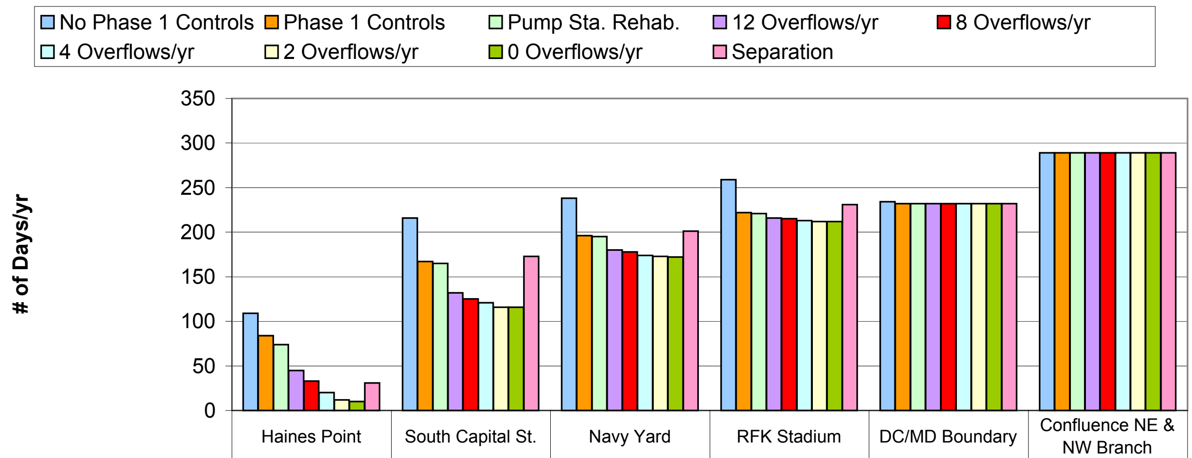
	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	1	3	4	5	5	5
Phase 1 Controls	1	2	2	3	5	5
Pump Sta. Rehab.	0	2	2	3	5	5
12 Overflows/yr	0	1	2	2	5	5
8 Overflows/yr	0	1	1	2	5	5
4 Overflows/yr	0	1	1	2	5	5
2 Overflows/yr	0	1	1	2	5	5
0 Overflows/yr	0	1	1	2	5	5
Separation	0	1	1	2	5	5

District of Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

Figure B-8
Anacostia River: Effect of CSO Control on Fecal Coliform Concentrations
(No Change in Upstream or Stormwater Loads)

ENTIRE CALENDAR YEAR

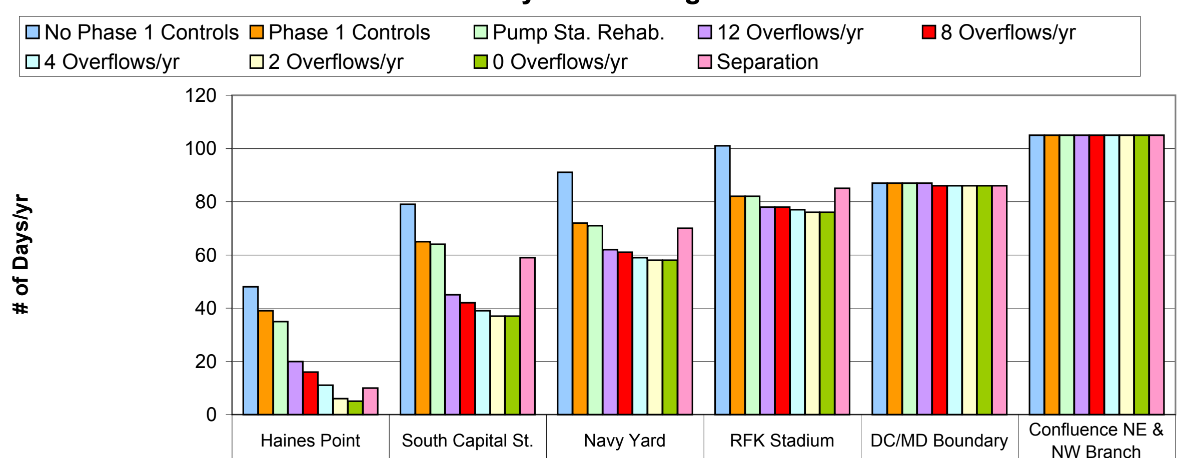
E. Coli - # of Days Exceeding 126/100 mL



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	109	216	238	259	234	289
Phase 1 Controls	84	167	196	222	232	289
Pump Sta. Rehab.	74	165	195	221	232	289
12 Overflows/yr	45	132	180	216	232	289
8 Overflows/yr	33	125	178	215	232	289
4 Overflows/yr	20	121	174	213	232	289
2 Overflows/yr	12	116	173	212	232	289
0 Overflows/yr	10	116	172	212	232	289
Separation	31	173	201	231	232	289

MAY THROUGH SEPTEMBER

E. Coli - # of Days Exceeding 126/100 mL



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	48	79	91	101	87	105
Phase 1 Controls	39	65	72	82	87	105
Pump Sta. Rehab.	35	64	71	82	87	105
12 Overflows/yr	20	45	62	78	87	105
8 Overflows/yr	16	42	61	78	86	105
4 Overflows/yr	11	39	59	77	86	105
2 Overflows/yr	6	37	58	76	86	105
0 Overflows/yr	5	37	58	76	86	105
Separation	10	59	70	85	86	105

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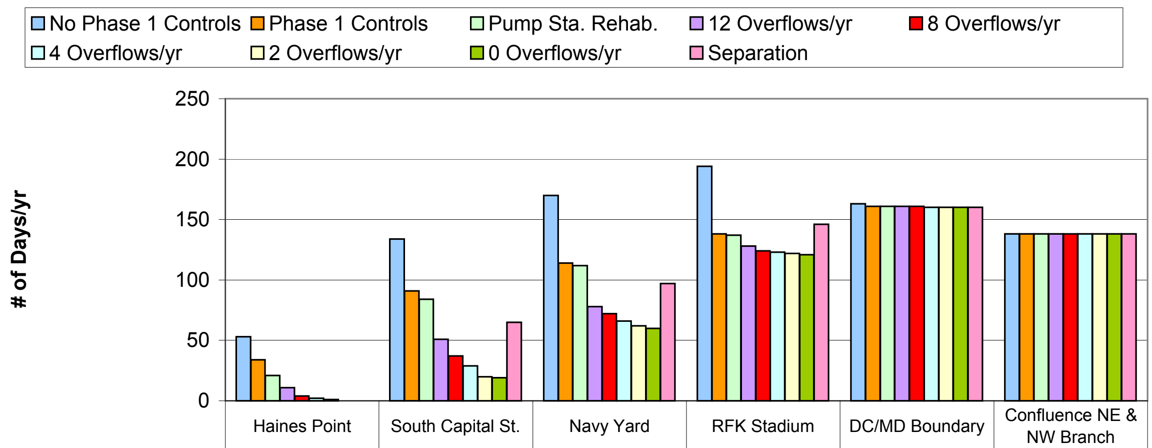
Figure B-9
Anacostia River: Effect of CSO Control on Fecal Coliform Concentrations
(No Change in Upstream or Stormwater Loads)

ENTIRE CALENDAR YEAR

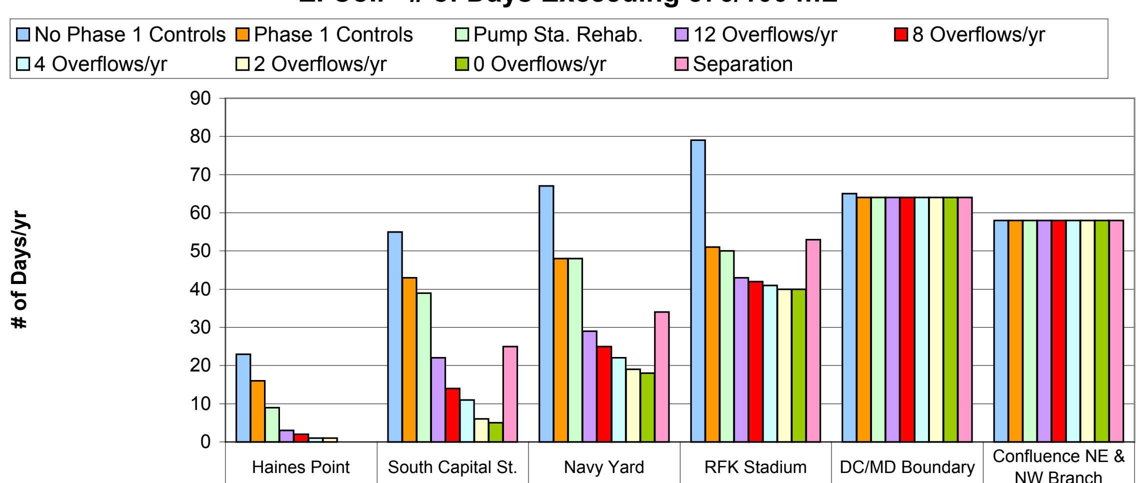
E. Coli - # of Days Exceeding 576/100 mL



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	53	134	170	194	163	138
Phase 1 Controls	34	91	114	138	161	138
Pump Sta. Rehab.	21	84	112	137	161	138
12 Overflows/yr	11	51	78	128	161	138
8 Overflows/yr	4	37	72	124	161	138
4 Overflows/yr	2	29	66	123	160	138
2 Overflows/yr	1	20	62	122	160	138
0 Overflows/yr	0	19	60	121	160	138
Separation	0	65	97	146	160	138

MAY THROUGH SEPTEMBER

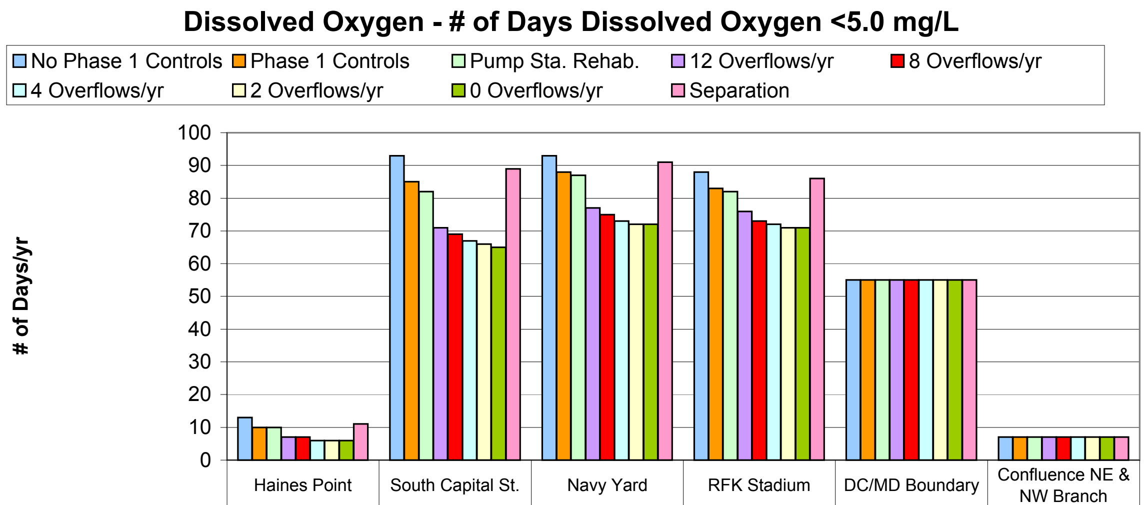
E. Coli - # of Days Exceeding 576/100 mL



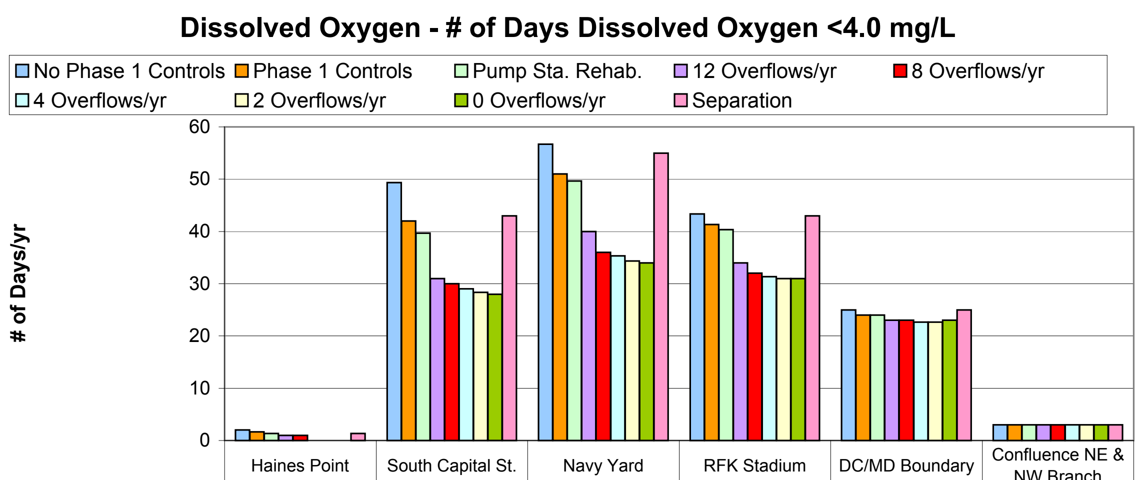
	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	23	55	67	79	65	58
Phase 1 Controls	16	43	48	51	64	58
Pump Sta. Rehab.	9	39	48	50	64	58
12 Overflows/yr	3	22	29	43	64	58
8 Overflows/yr	2	14	25	42	64	58
4 Overflows/yr	1	11	22	41	64	58
2 Overflows/yr	1	6	19	40	64	58
0 Overflows/yr	0	5	18	40	64	58
Separation	0	25	34	53	64	58

District of Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

Figure B-10
Anacostia River: Effect of CSO Control on Dissolved Oxygen Concentration
(No Change in Upstream or Stormwater Loads)



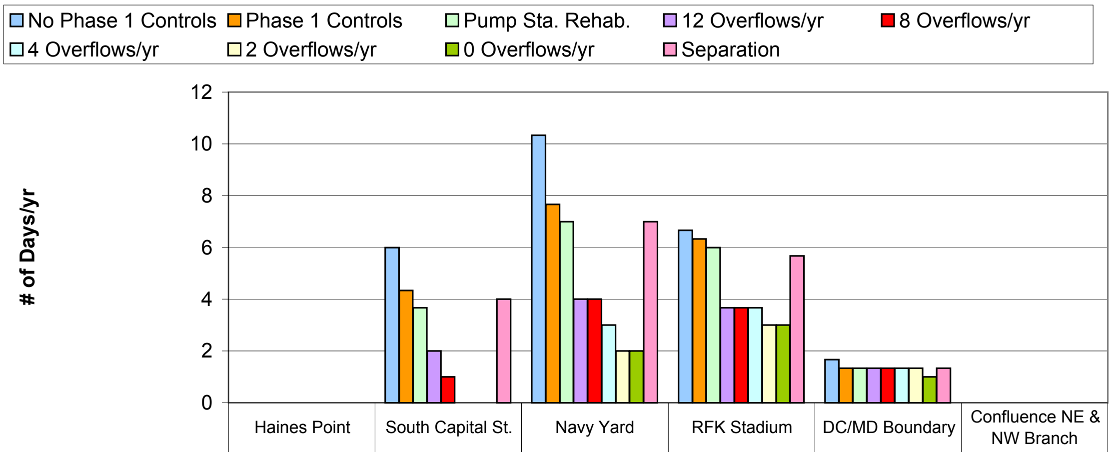
	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	13	93	93	88	55	7
Phase 1 Controls	10	85	88	83	55	7
Pump Sta. Rehab.	10	82	87	82	55	7
12 Overflows/yr	7	71	77	76	55	7
8 Overflows/yr	7	69	75	73	55	7
4 Overflows/yr	6	67	73	72	55	7
2 Overflows/yr	6	66	72	71	55	7
0 Overflows/yr	6	65	72	71	55	7
Separation	11	89	91	86	55	7



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	2	49	57	43	25	3
Phase 1 Controls	2	42	51	41	24	3
Pump Sta. Rehab.	1	40	50	40	24	3
12 Overflows/yr	1	31	40	34	23	3
8 Overflows/yr	1	30	36	32	23	3
4 Overflows/yr	0	29	35	31	23	3
2 Overflows/yr	0	28	34	31	23	3
0 Overflows/yr	0	28	34	31	23	3
Separation	1	43	55	43	25	3

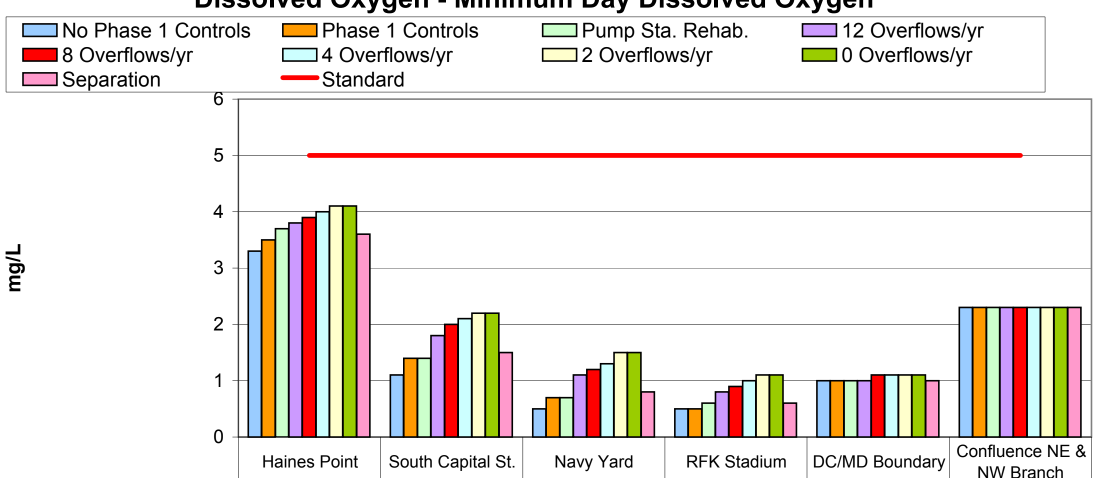
Figure B-11
Anacostia River: Effect of CSO Control on Dissolved Oxygen Concentration
(No Change in Upstream or Stormwater Loads)

Dissolved Oxygen - # of Days Dissolved Oxygen <2.0 mg/L



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	0	6	10	7	2	0
Phase 1 Controls	0	4	8	6	1	0
Pump Sta. Rehab.	0	4	7	6	1	0
12 Overflows/yr	0	2	4	4	1	0
8 Overflows/yr	0	1	4	4	1	0
4 Overflows/yr	0	0	3	4	1	0
2 Overflows/yr	0	0	2	3	1	0
0 Overflows/yr	0	0	2	3	1	0
Separation	0	4	7	6	1	0

Dissolved Oxygen - Minimum Day Dissolved Oxygen[1]



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	3.3	1.1	0.5	0.5	1	2.3
Phase 1 Controls	3.5	1.4	0.7	0.5	1	2.3
Pump Sta. Rehab.	3.7	1.4	0.7	0.6	1.0	2.3
12 Overflows/yr	3.8	1.8	1.1	0.8	1.0	2.3
8 Overflows/yr	3.9	2.0	1.2	0.9	1.1	2.3
4 Overflows/yr	4.0	2.1	1.3	1.0	1.1	2.3
2 Overflows/yr	4.1	2.2	1.5	1.1	1.1	2.3
0 Overflows/yr	4.1	2.2	1.5	1.1	1.1	2.3
Separation	3.6	1.5	0.8	0.6	1.0	2.3
Standard	5.0	5.0	5.0	5.0	5.0	5.0

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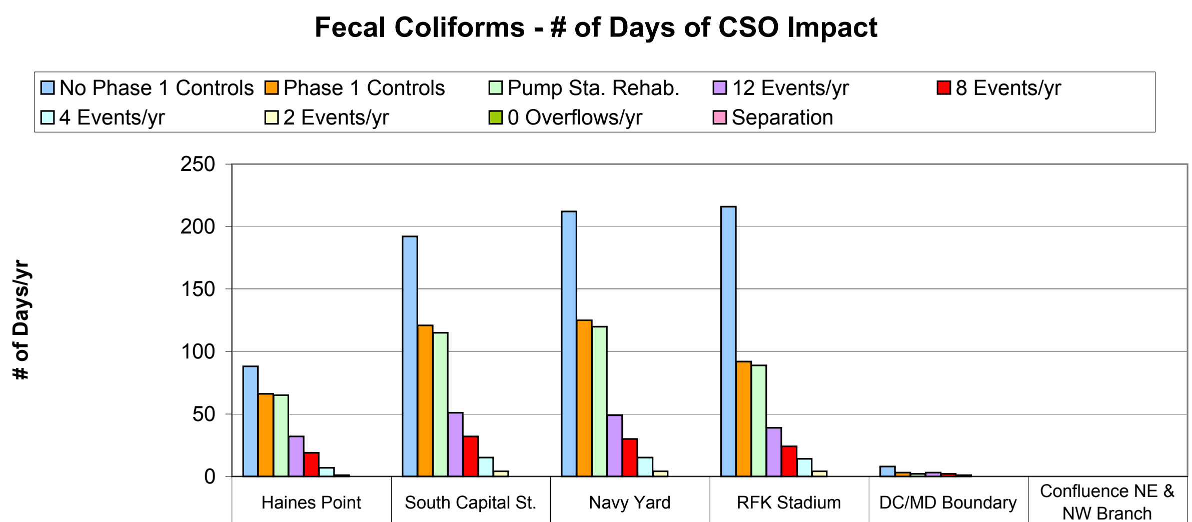
[1] Minimum dissolved oxygen for entire 3 year period (1988-1990).

District of Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

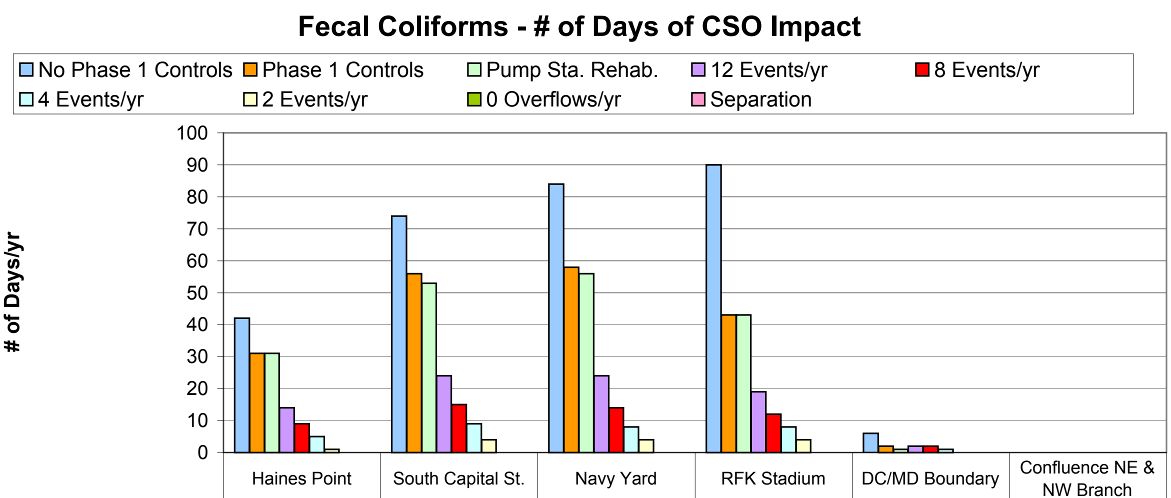
Figure B-12
Anacostia River: Effect of CSO Control on Fecal Coliform Concentrations
(CSO Loads Only - no other loads present)

ENTIRE CALENDAR YEAR



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	88	192	212	216	8	0
Phase 1 Controls	66	121	125	92	3	0
Pump Sta. Rehab.	65	115	120	89	2	0
12 Events/yr	32	51	49	39	3	0
8 Events/yr	19	32	30	24	2	0
4 Events/yr	7	15	15	14	1	0
2 Events/yr	1	4	4	4	0	0
0 Overflows/yr	0	0	0	0	0	0
Separation	0	0	0	0	0	0

MAY THROUGH SEPTEMBER



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	42	74	84	90	6	0
Phase 1 Controls	31	56	58	43	2	0
Pump Sta. Rehab.	31	53	56	43	1	0
12 Events/yr	14	24	24	19	2	0
8 Events/yr	9	15	14	12	2	0
4 Events/yr	5	9	8	8	1	0
2 Events/yr	1	4	4	4	0	0
0 Overflows/yr	0	0	0	0	0	0
Separation	0	0	0	0	0	0

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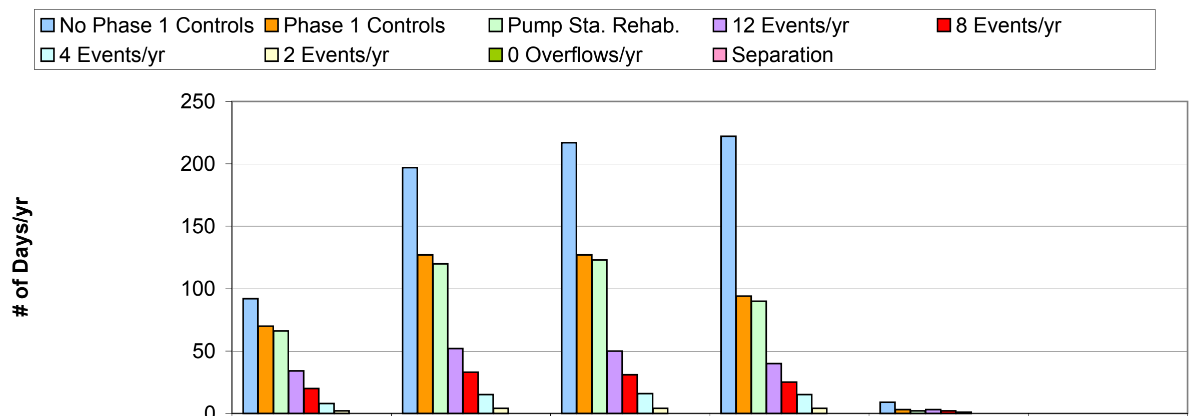
Figure B-13
Anacostia River: Effect of CSO Control on Fecal Coliform Concentrations
(CSO Loads Only - no other loads present)

ENTIRE CALENDAR YEAR

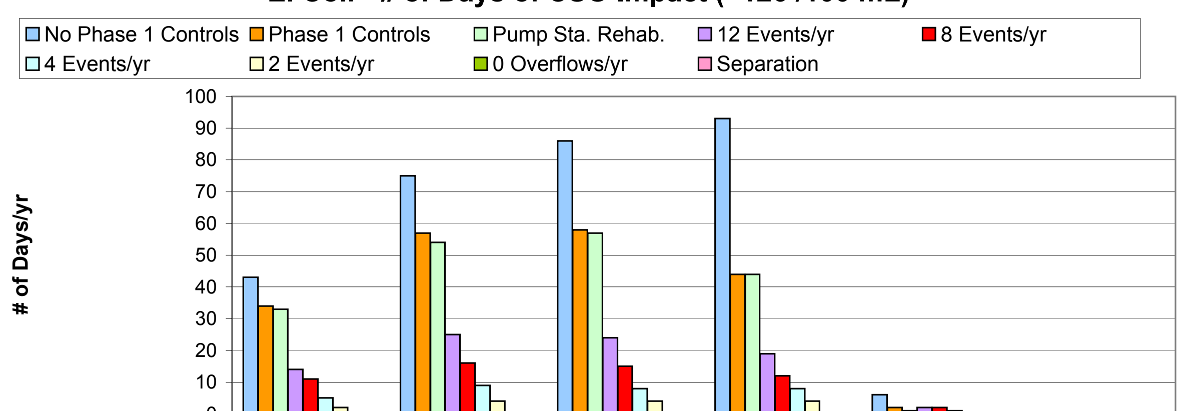
E. Coli - # of Days of CSO Impact (>126 /100 mL)



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	92	197	217	222	9	0
Phase 1 Controls	70	127	127	94	3	0
Pump Sta. Rehab.	66	120	123	90	2	0
12 Events/yr	34	52	50	40	3	0
8 Events/yr	20	33	31	25	2	0
4 Events/yr	8	15	16	15	1	0
2 Events/yr	2	4	4	4	0	0
0 Overflows/yr	0	0	0	0	0	0
Separation	0	0	0	0	0	0

MAY THROUGH SEPTEMBER

E. Coli - # of Days of CSO Impact (>126 /100 mL)



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	43	75	86	93	6	0
Phase 1 Controls	34	57	58	44	2	0
Pump Sta. Rehab.	33	54	57	44	1	0
12 Events/yr	14	25	24	19	2	0
8 Events/yr	11	16	15	12	2	0
4 Events/yr	5	9	8	8	1	0
2 Events/yr	2	4	4	4	0	0
0 Overflows/yr	0	0	0	0	0	0
Separation	0	0	0	0	0	0

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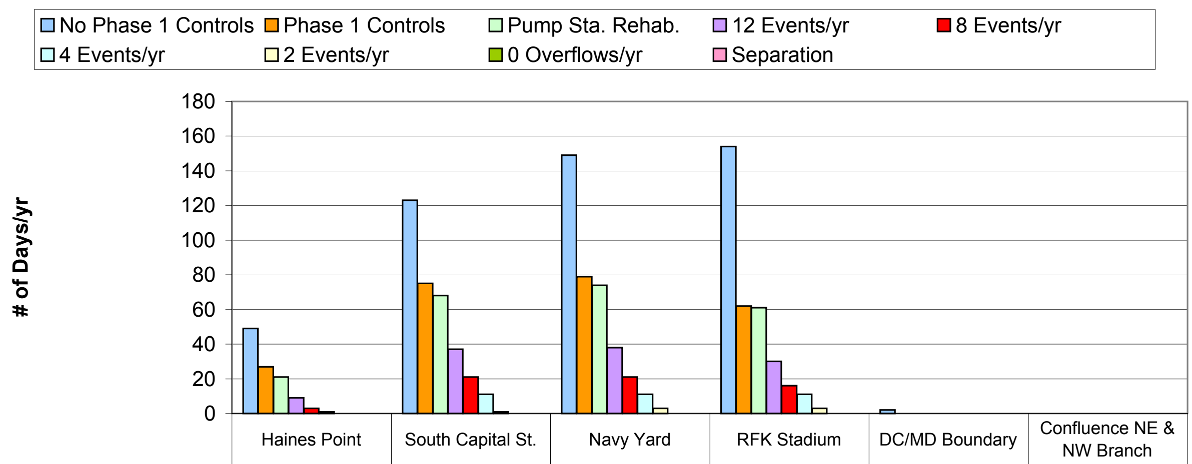
Figure B-14
Anacostia River: Effect of CSO Control on Fecal Coliform Concentrations
(CSO Loads Only - no other loads present)

ENTIRE CALENDAR YEAR

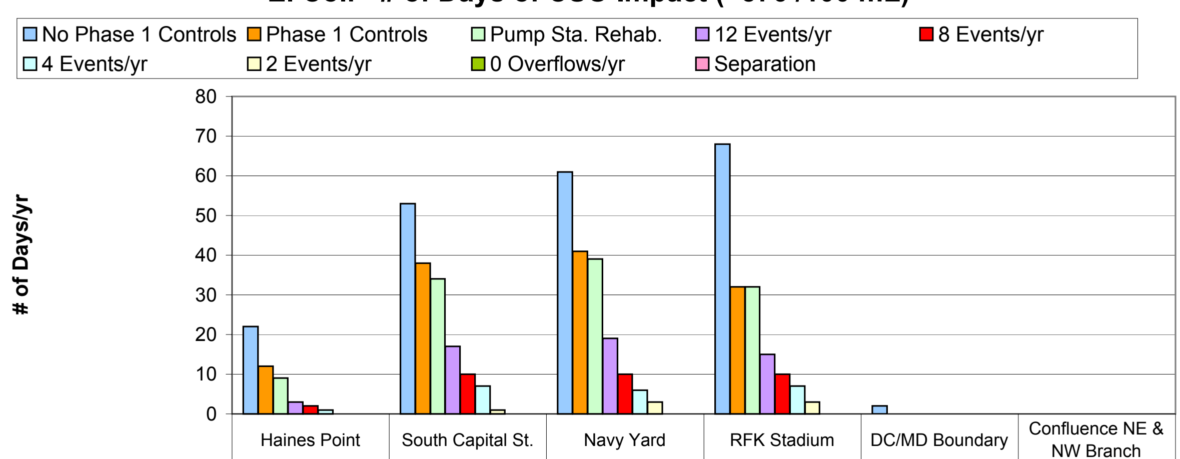
E. Coli - # of Days of CSO Impact (>576 /100 mL)



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	49	123	149	154	2	0
Phase 1 Controls	27	75	79	62	0	0
Pump Sta. Rehab.	21	68	74	61	0	0
12 Events/yr	9	37	38	30	0	0
8 Events/yr	3	21	21	16	0	0
4 Events/yr	1	11	11	11	0	0
2 Events/yr	0	1	3	3	0	0
0 Overflows/yr	0	0	0	0	0	0
Separation	0	0	0	0	0	0

MAY THROUGH SEPTEMBER

E. Coli - # of Days of CSO Impact (>576 /100 mL)

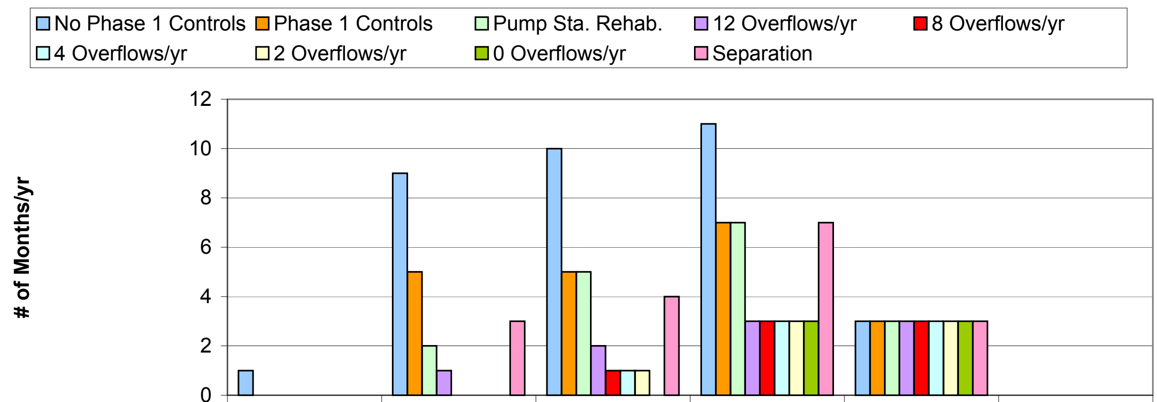


	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	22	53	61	68	2	0
Phase 1 Controls	12	38	41	32	0	0
Pump Sta. Rehab.	9	34	39	32	0	0
12 Events/yr	3	17	19	15	0	0
8 Events/yr	2	10	10	10	0	0
4 Events/yr	1	7	6	7	0	0
2 Events/yr	0	1	3	3	0	0
0 Overflows/yr	0	0	0	0	0	0
Separation	0	0	0	0	0	0

Figure B-15
Anacostia River: Effect of CSO Control on Fecal Coliform Concentrations
(Upstream and Stormwater Load Reduction[1])

ENTIRE CALENDAR YEAR

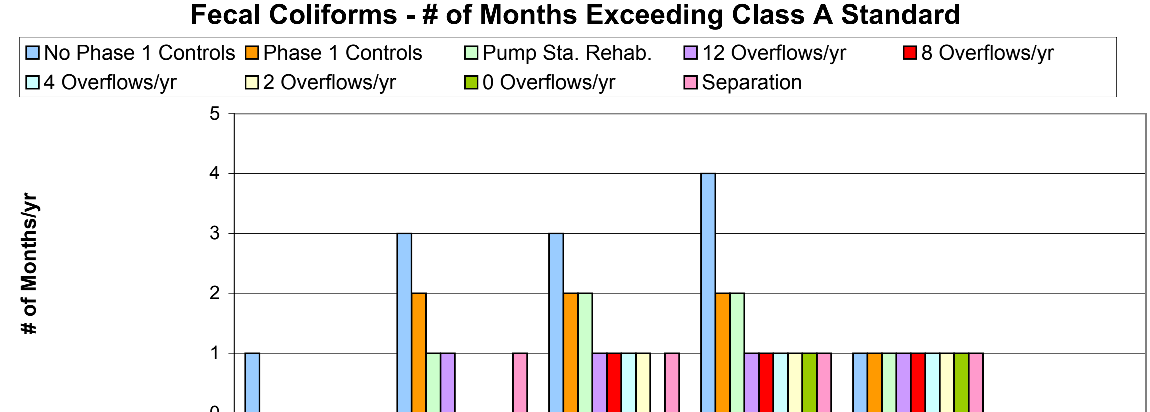
Fecal Coliforms - # of Months Exceeding Class A Standard



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	1	9	10	11	3	0
Phase 1 Controls	0	5	5	7	3	0
Pump Sta. Rehab.	0	2	5	7	3	0
12 Overflows/yr	0	1	2	3	3	0
8 Overflows/yr	0	0	1	3	3	0
4 Overflows/yr	0	0	1	3	3	0
2 Overflows/yr	0	0	1	3	3	0
0 Overflows/yr	0	0	0	3	3	0
Separation	0	3	4	7	3	0

MAY THROUGH SEPTEMBER

Fecal Coliforms - # of Months Exceeding Class A Standard



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	1	3	3	4	1	0
Phase 1 Controls	0	2	2	2	1	0
Pump Sta. Rehab.	0	1	2	2	1	0
12 Overflows/yr	0	1	1	1	1	0
8 Overflows/yr	0	0	1	1	1	0
4 Overflows/yr	0	0	1	1	1	0
2 Overflows/yr	0	0	1	1	1	0
0 Overflows/yr	0	0	0	1	1	0
Separation	0	1	1	1	1	0

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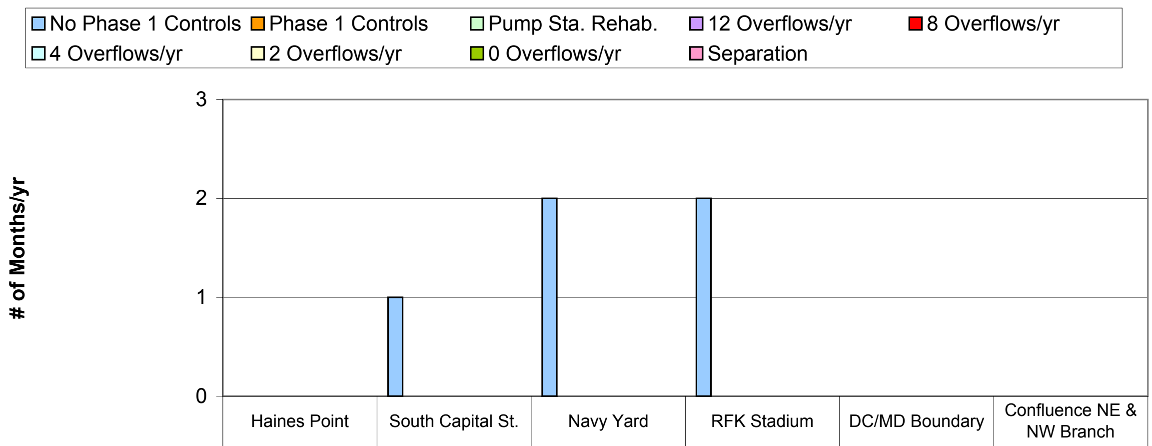
[1] Storm water: 40% reduction in loads, Upstream: 40% reduction in nutrients
Fecal coliforms at 80% of water quality standard (concentration = 160/100 ml)

Figure B-16
Anacostia River: Effect of CSO Control on Fecal Coliform Concentrations
(Upstream and Stormwater Load Reduction[1])

ENTIRE CALENDAR YEAR

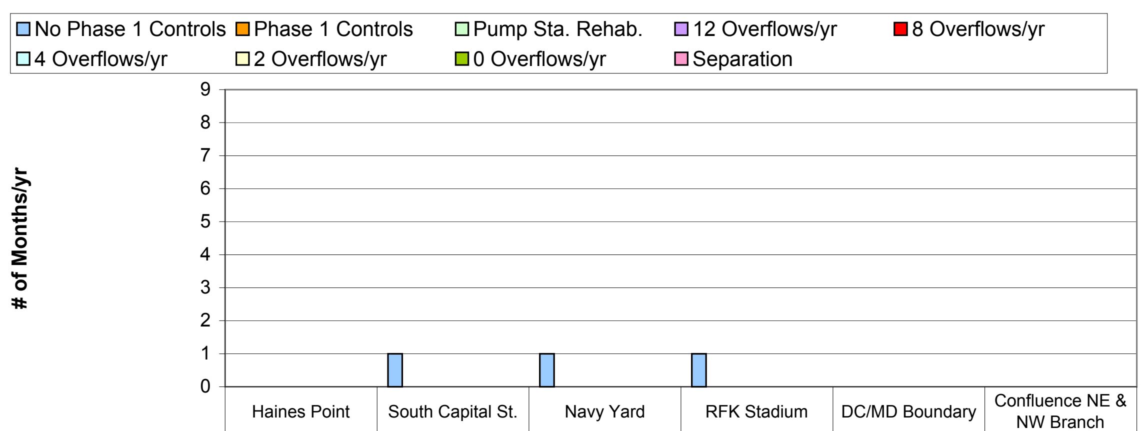
Fecal Coliforms - # of Months Exceeding Class B Standard



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	0	1	2	2	0	0
Phase 1 Controls	0	0	0	0	0	0
Pump Sta. Rehab.	0	0	0	0	0	0
12 Overflows/yr	0	0	0	0	0	0
8 Overflows/yr	0	0	0	0	0	0
4 Overflows/yr	0	0	0	0	0	0
2 Overflows/yr	0	0	0	0	0	0
0 Overflows/yr	0	0	0	0	0	0
Separation	0	0	0	0	0	0

MAY THROUGH SEPTEMBER

Fecal Coliforms - # of Months Exceeding Class B Standard



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	0	1	1	1	0	0
Phase 1 Controls	0	0	0	0	0	0
Pump Sta. Rehab.	0	0	0	0	0	0
12 Overflows/yr	0	0	0	0	0	0
8 Overflows/yr	0	0	0	0	0	0
4 Overflows/yr	0	0	0	0	0	0
2 Overflows/yr	0	0	0	0	0	0
0 Overflows/yr	0	0	0	0	0	0
Separation	0	0	0	0	0	0

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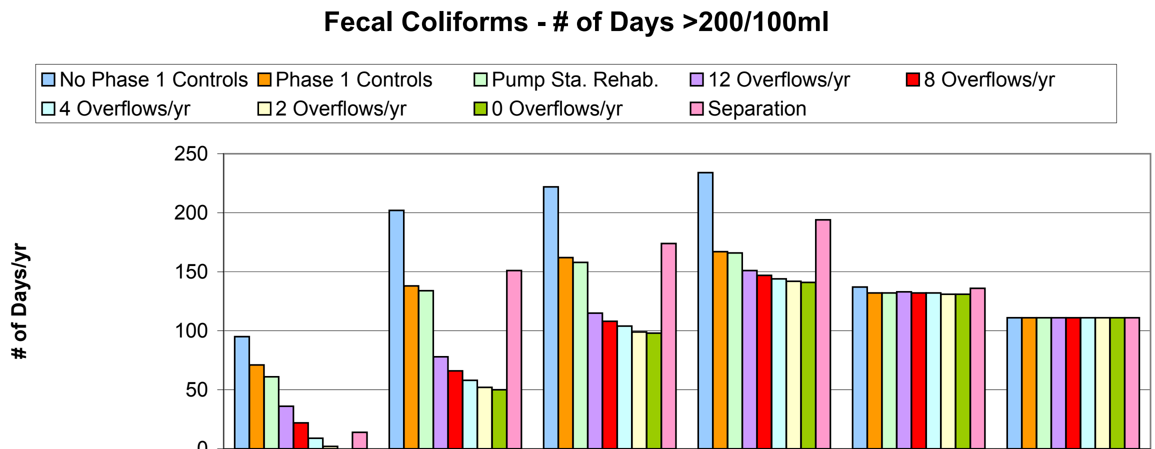
[1] Storm water: 40% reduction in loads, Upstream: 40% reduction in nutrients
Fecal coliforms at 80% of water quality standard (concentration = 160/100 ml)

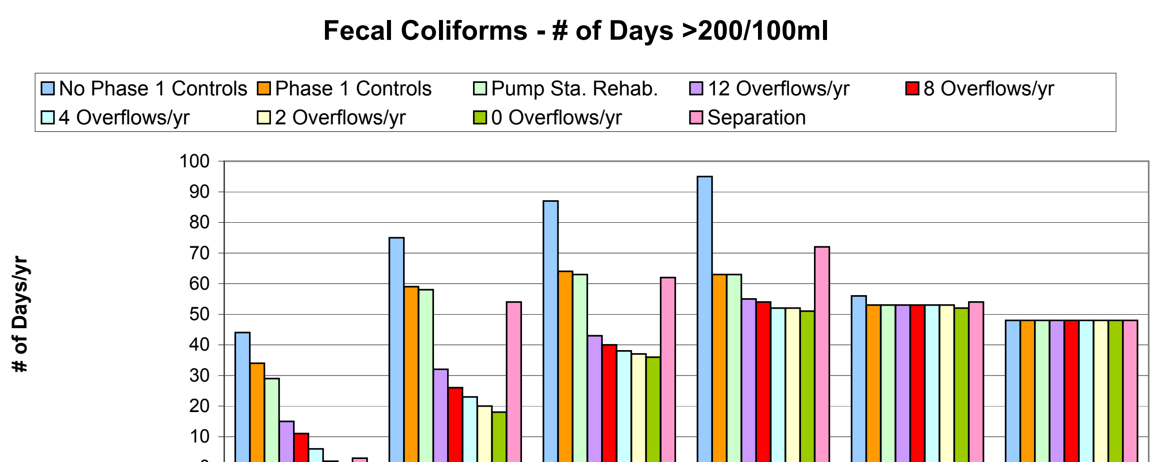
Figure B-17
Anacostia River: Effect of CSO Control on Fecal Coliform Concentrations
(Upstream and Stormwater Load Reduction[1])

ENTIRE CALENDAR YEAR



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	95	202	222	234	137	111
Phase 1 Controls	71	138	162	167	132	111
Pump Sta. Rehab.	61	134	158	166	132	111
12 Overflows/yr	36	78	115	151	133	111
8 Overflows/yr	22	66	108	147	132	111
4 Overflows/yr	9	58	104	144	132	111
2 Overflows/yr	2	52	99	142	131	111
0 Overflows/yr	0	50	98	141	131	111
Separation	14	151	174	194	136	111

MAY THROUGH SEPTEMBER



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	44	75	87	95	56	48
Phase 1 Controls	34	59	64	63	53	48
Pump Sta. Rehab.	29	58	63	63	53	48
12 Overflows/yr	15	32	43	55	53	48
8 Overflows/yr	11	26	40	54	53	48
4 Overflows/yr	6	23	38	52	53	48
2 Overflows/yr	2	20	37	52	53	48
0 Overflows/yr	0	18	36	51	52	48
Separation	3	54	62	72	54	48

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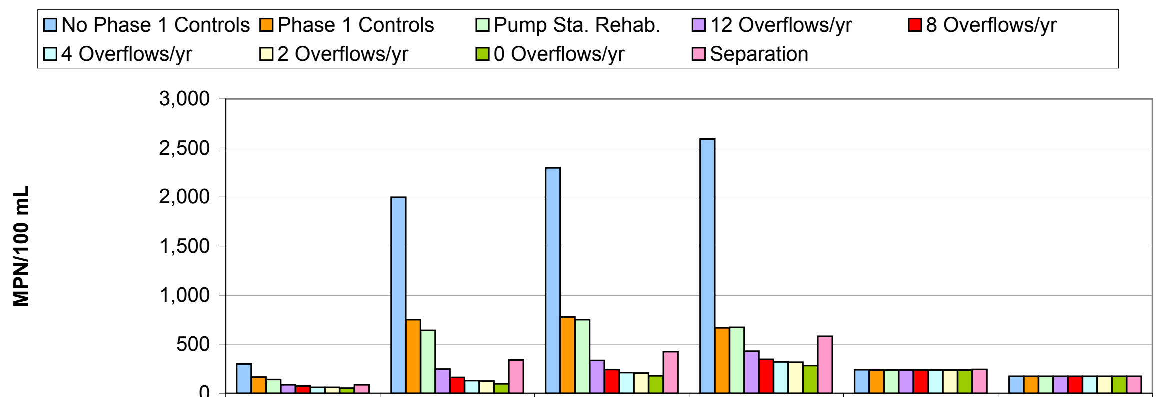
[1] Storm water: 40% reduction in loads, Upstream: 40% reduction in nutrients
Fecal coliforms at 80% of water quality standard (concentration = 160/100 ml)

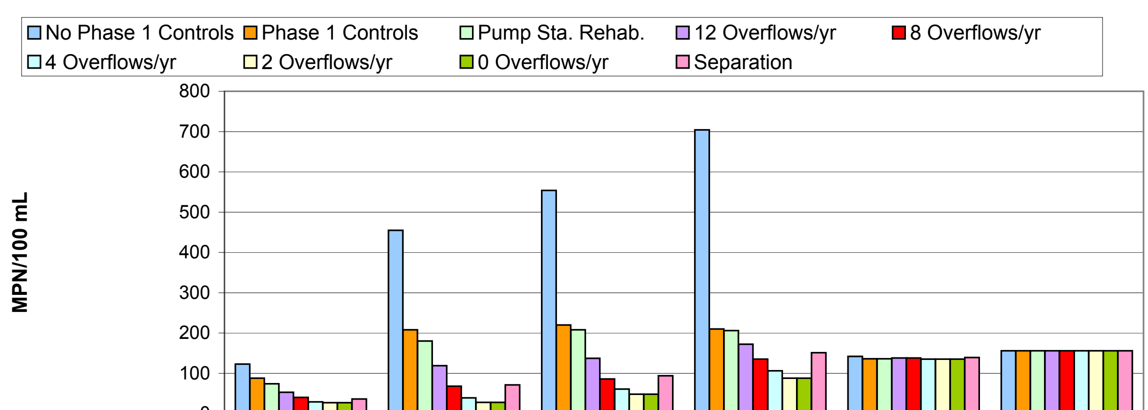
Figure B-18
Anacostia River: Effect of CSO Control on Fecal Coliform Concentrations
(Upstream and Stormwater Load Reduction[1])

Fecal Coliforms - May Geometric Means



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	299	1,998	2,298	2,591	240	173
Phase 1 Controls	165	750	777	667	237	173
Pump Sta. Rehab.	140	641	750	672	237	173
12 Overflows/yr	87	247	335	428	236	173
8 Overflows/yr	74	162	241	345	236	173
4 Overflows/yr	61	129	211	320	236	173
2 Overflows/yr	60	124	206	316	236	173
0 Overflows/yr	52	97	178	282	236	173
Separation	86	339	424	580	243	173

Fecal Coliforms - June Geometric Means



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	123	455	554	704	142	156
Phase 1 Controls	88	208	220	210	136	156
Pump Sta. Rehab.	74	180	208	206	136	156
12 Overflows/yr	53	119	137	172	138	156
8 Overflows/yr	40	68	86	135	138	156
4 Overflows/yr	29	39	61	106	135	156
2 Overflows/yr	27	28	48	88	135	156
0 Overflows/yr	27	28	48	88	135	156
Separation	36	71	94	151	139	156

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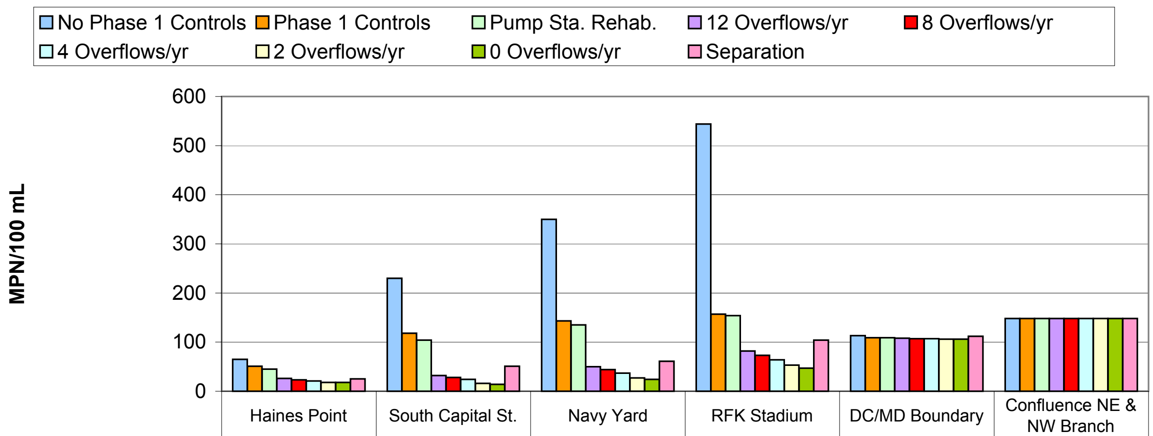
[1] Storm water: 40% reduction in loads, Upstream: 40% reduction in nutrients
Fecal coliforms at 80% of water quality standard (concentration = 160/100 ml)

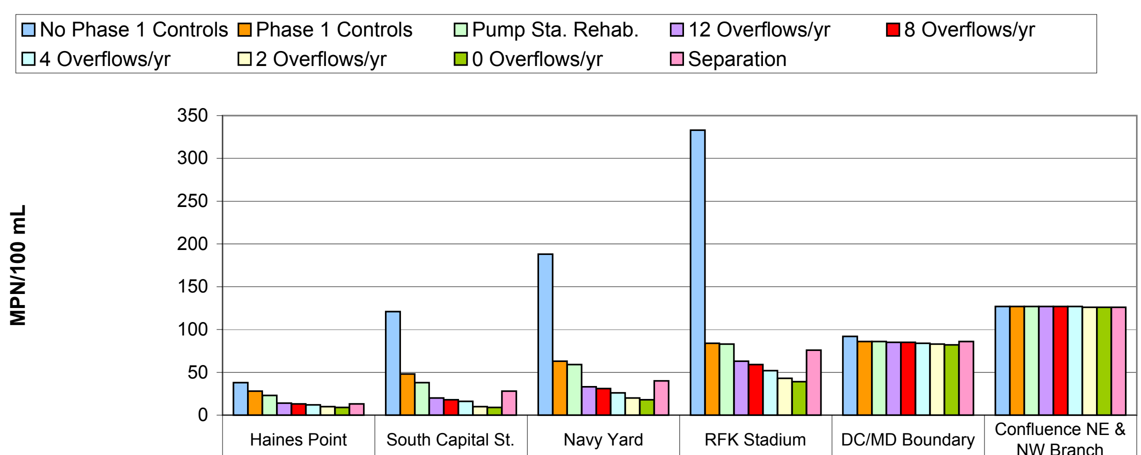
Figure B-19
Anacostia River: Effect of CSO Control on Fecal Coliform Concentrations
(Upstream and Stormwater Load Reduction[1])

Fecal Coliforms - July Fecal Coliforms



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	65	230	350	544	113	148
Phase 1 Controls	51	118	143	157	109	148
Pump Sta. Rehab.	45	104	135	154	109	148
12 Overflows/yr	26	32	50	82	108	148
8 Overflows/yr	23	28	44	73	107	148
4 Overflows/yr	21	24	37	64	107	148
2 Overflows/yr	18	16	27	53	106	148
0 Overflows/yr	18	14	24	47	106	148
Separation	25	51	61	104	112	148

Fecal Coliforms - August Fecal Coliforms



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	38	121	188	333	92	127
Phase 1 Controls	28	48	63	84	86	127
Pump Sta. Rehab.	23	38	59	83	86	127
12 Overflows/yr	14	20	33	63	85	127
8 Overflows/yr	13	18	31	59	85	127
4 Overflows/yr	12	16	26	52	84	127
2 Overflows/yr	10	10	20	43	83	126
0 Overflows/yr	9	9	18	39	82	126
Separation	13	28	40	76	86	126

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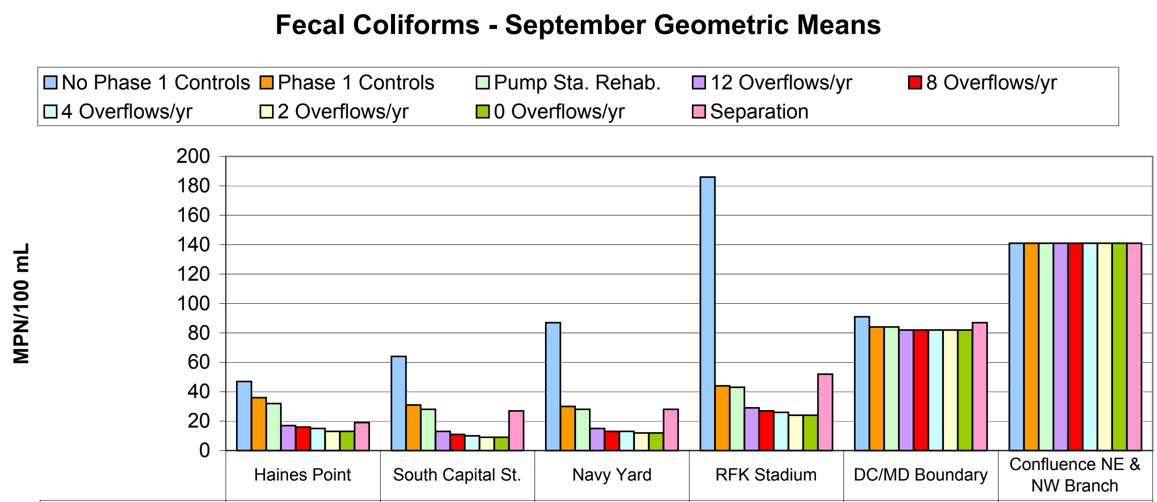
[1] Storm water: 40% reduction in loads, Upstream: 40% reduction in nutrients
Fecal coliforms at 80% of water quality standard (concentration = 160/100 ml)

Figure B-20
Anacostia River: Effect of CSO Control on Fecal Coliform Concentrations
(Upstream and Stormwater Load Reduction[1])



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	47	64	87	186	91	141
Phase 1 Controls	36	31	30	44	84	141
Pump Sta. Rehab.	32	28	28	43	84	141
12 Overflows/yr	17	13	15	29	82	141
8 Overflows/yr	16	11	13	27	82	141
4 Overflows/yr	15	10	13	26	82	141
2 Overflows/yr	13	9	12	24	82	141
0 Overflows/yr	13	9	12	24	82	141
Separation	19	27	28	52	87	141

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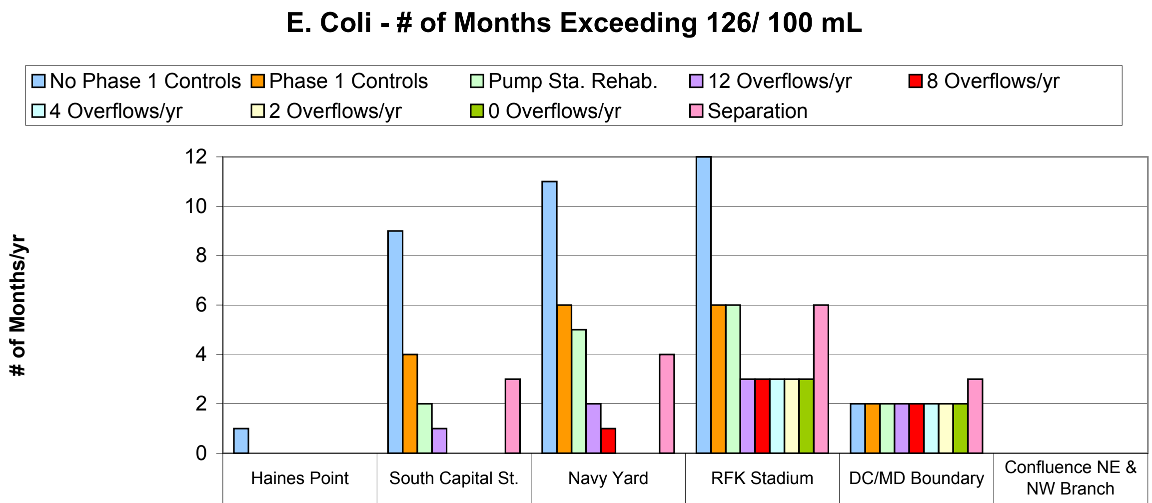
[1] Storm water: 40% reduction in loads, Upstream: 40% reduction in nutrients
Fecal coliforms at 80% of water quality standard (concentration = 160/100 ml)

District of Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

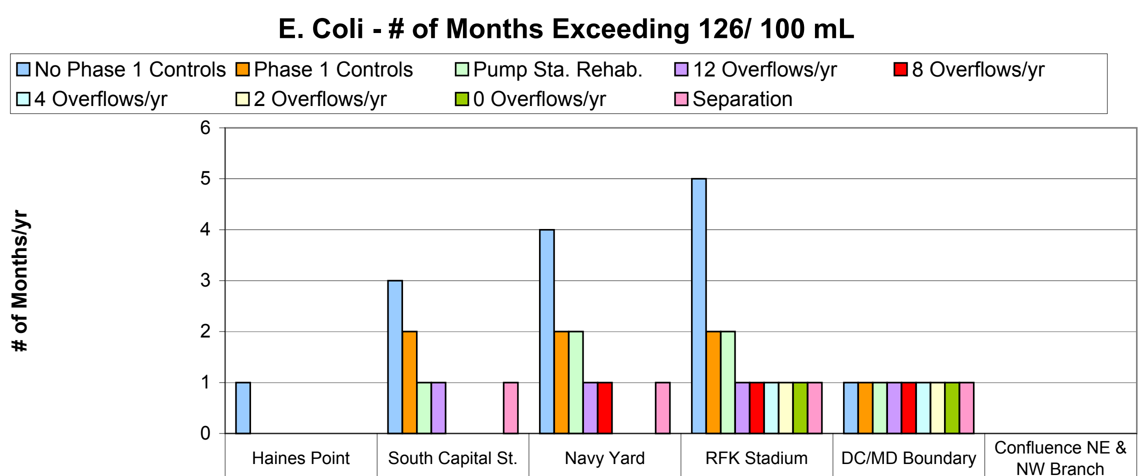
Figure B-21
Anacostia River: Effect of CSO Control on Fecal Coliform Concentrations
(Upstream and Stormwater Load Reduction[1])

ENTIRE CALENDAR YEAR



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	1	9	11	12	2	0
Phase 1 Controls	0	4	6	6	2	0
Pump Sta. Rehab.	0	2	5	6	2	0
12 Overflows/yr	0	1	2	3	2	0
8 Overflows/yr	0	0	1	3	2	0
4 Overflows/yr	0	0	0	3	2	0
2 Overflows/yr	0	0	0	3	2	0
0 Overflows/yr	0	0	0	3	2	0
Separation	0	3	4	6	3	0

MAY THROUGH SEPTEMBER



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	1	3	4	5	1	0
Phase 1 Controls	0	2	2	2	1	0
Pump Sta. Rehab.	0	1	2	2	1	0
12 Overflows/yr	0	1	1	1	1	0
8 Overflows/yr	0	0	1	1	1	0
4 Overflows/yr	0	0	0	1	1	0
2 Overflows/yr	0	0	0	1	1	0
0 Overflows/yr	0	0	0	1	1	0
Separation	0	1	1	1	1	0

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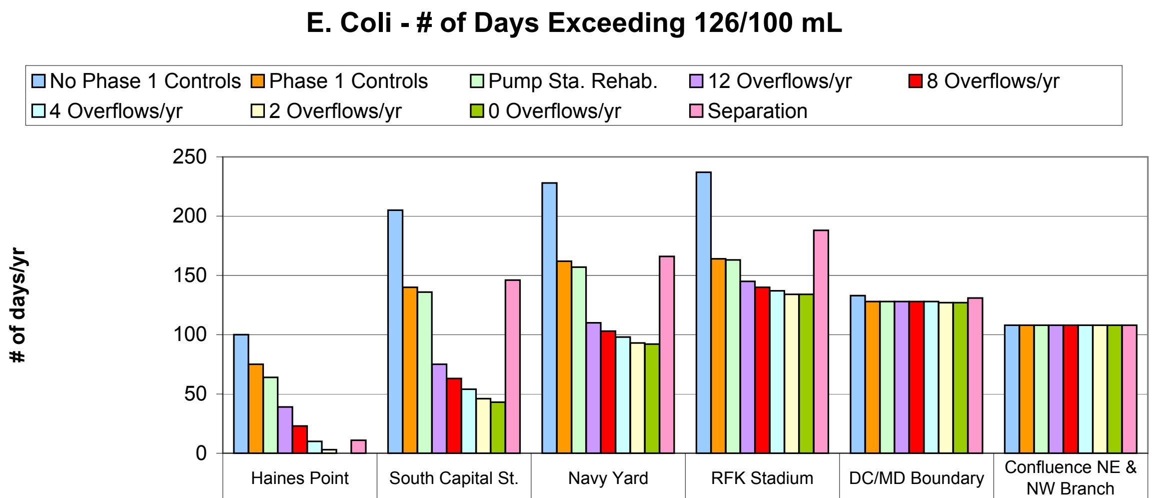
[1] Storm water: 40% reduction in loads, Upstream: 40% reduction in nutrients
Fecal coliforms at 80% of water quality standard (concentration = 160/100 ml)

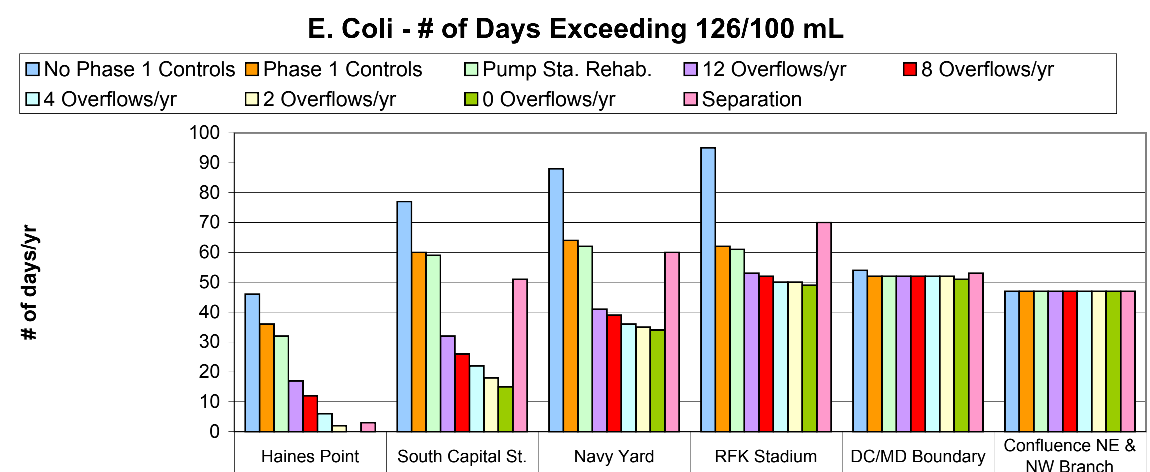
Figure B-22
Anacostia River: Effect of CSO Control on Fecal Coliform Concentrations
(Upstream and Stormwater Load Reduction[1])

ENTIRE CALENDAR YEAR



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	100	205	228	237	133	108
Phase 1 Controls	75	140	162	164	128	108
Pump Sta. Rehab.	64	136	157	163	128	108
12 Overflows/yr	39	75	110	145	128	108
8 Overflows/yr	23	63	103	140	128	108
4 Overflows/yr	10	54	98	137	128	108
2 Overflows/yr	3	46	93	134	127	108
0 Overflows/yr	0	43	92	134	127	108
Separation	11	146	166	188	131	108

MAY THROUGH SEPTEMBER



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	46	77	88	95	54	47
Phase 1 Controls	36	60	64	62	52	47
Pump Sta. Rehab.	32	59	62	61	52	47
12 Overflows/yr	17	32	41	53	52	47
8 Overflows/yr	12	26	39	52	52	47
4 Overflows/yr	6	22	36	50	52	47
2 Overflows/yr	2	18	35	50	52	47
0 Overflows/yr	0	15	34	49	51	47
Separation	3	51	60	70	53	47

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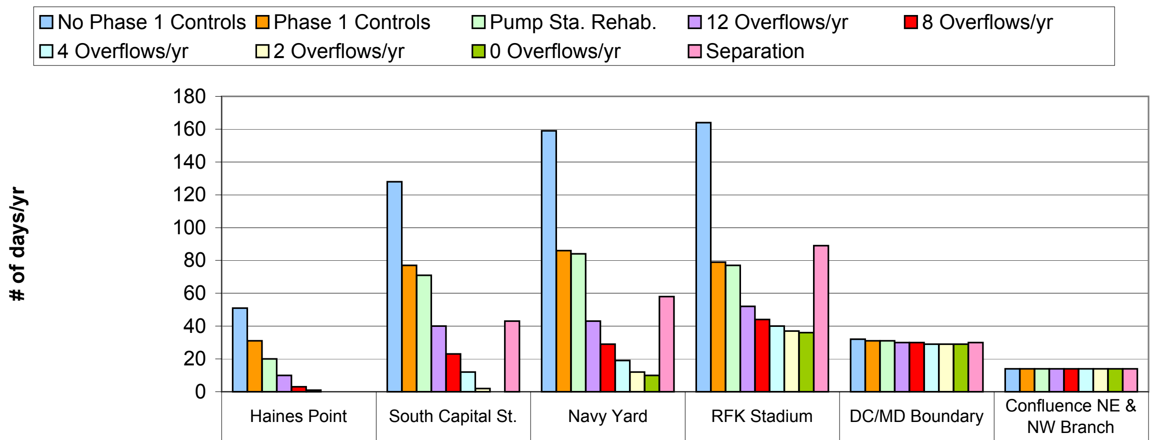
[1] Storm water: 40% reduction in loads, Upstream: 40% reduction in nutrients
Fecal coliforms at 80% of water quality standard (concentration = 160/100 ml)

Figure B-23
Anacostia River: Effect of CSO Control on Fecal Coliform Concentrations
(Upstream and Stormwater Load Reduction[1])

ENTIRE CALENDAR YEAR

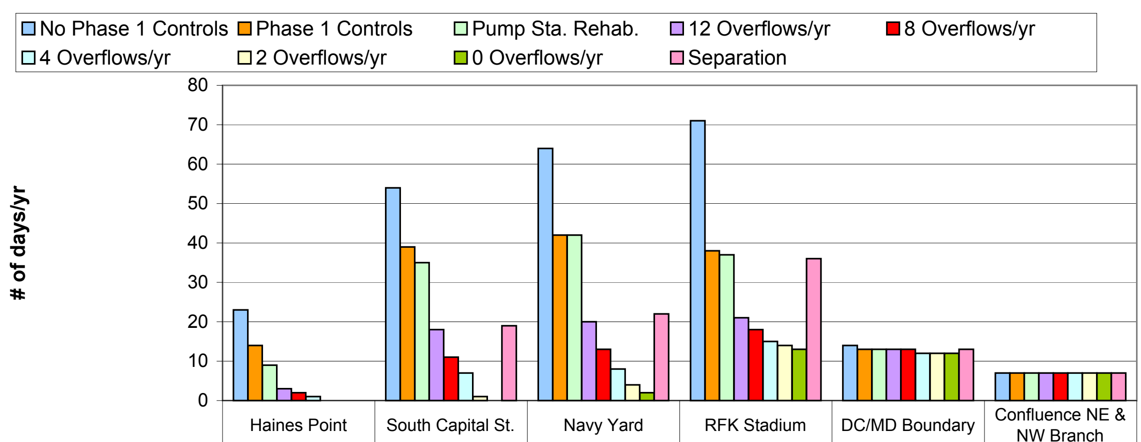
E. Coli - # of Days Exceeding 576/100 mL



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	51	128	159	164	32	14
Phase 1 Controls	31	77	86	79	31	14
Pump Sta. Rehab.	20	71	84	77	31	14
12 Overflows/yr	10	40	43	52	30	14
8 Overflows/yr	3	23	29	44	30	14
4 Overflows/yr	1	12	19	40	29	14
2 Overflows/yr	0	2	12	37	29	14
0 Overflows/yr	0	0	10	36	29	14
Separation	0	43	58	89	30	14

MAY THROUGH SEPTEMBER

E. Coli - # of Days Exceeding 576/100 mL



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	23	54	64	71	14	7
Phase 1 Controls	14	39	42	38	13	7
Pump Sta. Rehab.	9	35	42	37	13	7
12 Overflows/yr	3	18	20	21	13	7
8 Overflows/yr	2	11	13	18	13	7
4 Overflows/yr	1	7	8	15	12	7
2 Overflows/yr	0	1	4	14	12	7
0 Overflows/yr	0	0	2	13	12	7
Separation	0	19	22	36	13	7

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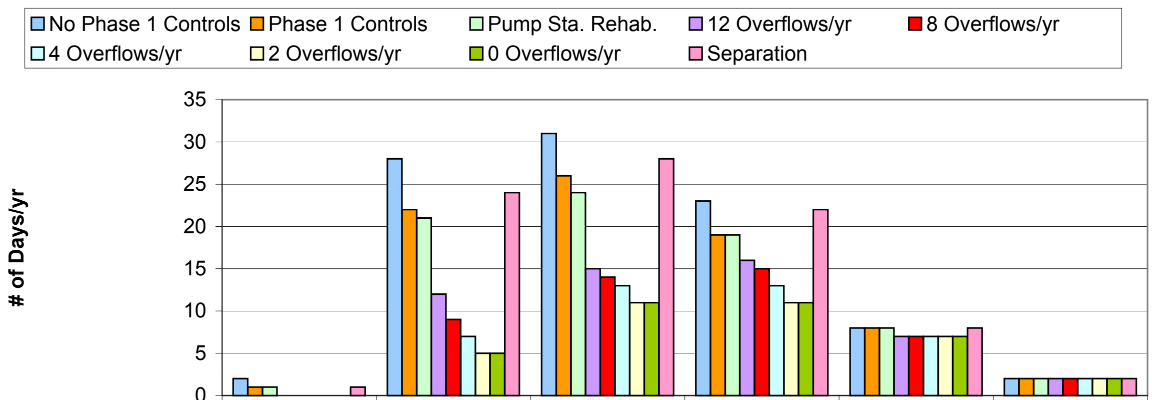
[1] Storm water: 40% reduction in loads, Upstream: 40% reduction in nutrients
Fecal coliforms at 80% of water quality standard (concentration = 160/100 ml)

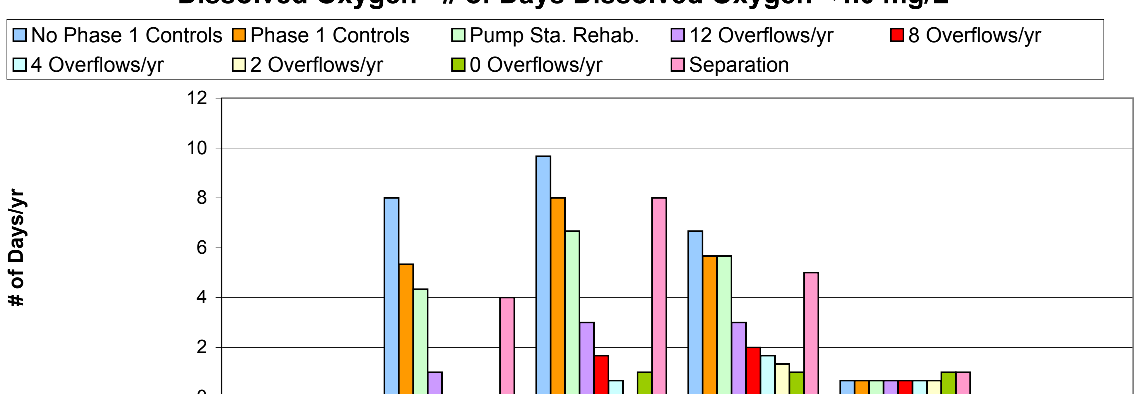
Figure B-24
Anacostia River: Effect of CSO Control on Dissolved Oxygen Concentration
(Upstream and Stormwater Load Reduction[1])

Dissolved Oxygen - # of Days Dissolved Oxygen <5.0 mg/L



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	2	28	31	23	8	2
Phase 1 Controls	1	22	26	19	8	2
Pump Sta. Rehab.	1	21	24	19	8	2
12 Overflows/yr	0	12	15	16	7	2
8 Overflows/yr	0	9	14	15	7	2
4 Overflows/yr	0	7	13	13	7	2
2 Overflows/yr	0	5	11	11	7	2
0 Overflows/yr	0	5	11	11	7	2
Separation	1	24	28	22	8	2

Dissolved Oxygen - # of Days Dissolved Oxygen <4.0 mg/L



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	0	8	10	7	1	0
Phase 1 Controls	0	5	8	6	1	0
Pump Sta. Rehab.	0	4	7	6	1	0
12 Overflows/yr	0	1	3	3	1	0
8 Overflows/yr	0	0	2	2	1	0
4 Overflows/yr	0	0	1	2	1	0
2 Overflows/yr	0	0	0	1	1	0
0 Overflows/yr	0	0	1	1	1	0
Separation	0	4	8	5	1	0

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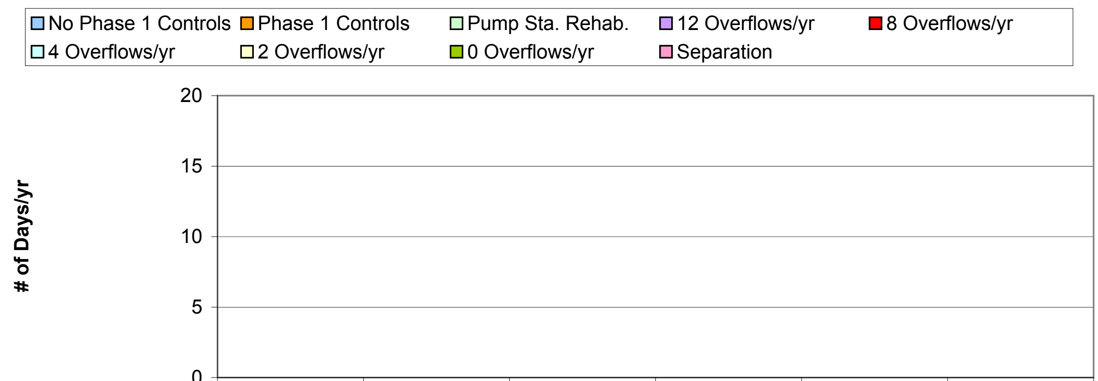
[1] Storm water: 40% reduction in loads, Upstream: 40% reduction in nutrients
Fecal coliforms at 80% of water quality standard (concentration = 160/100 ml)

District of Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

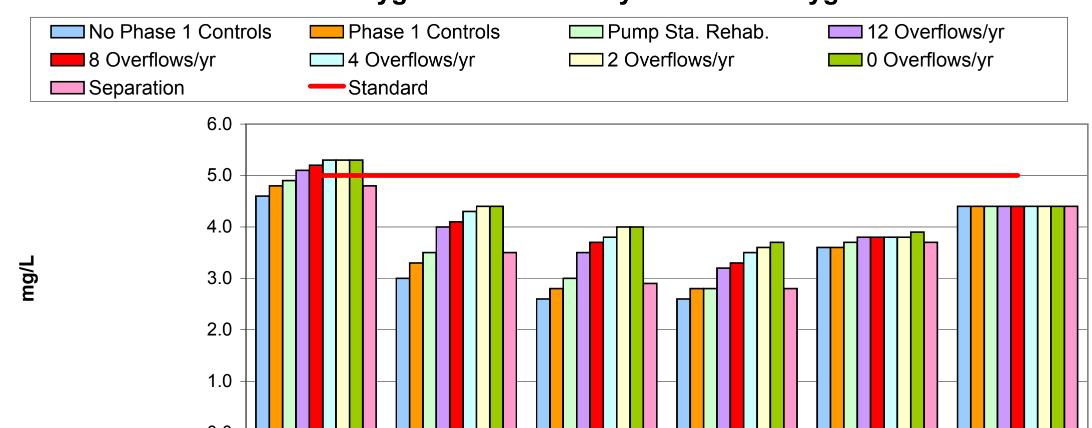
Figure B-25
Anacostia River: Effect of CSO Control on Dissolved Oxygen Concentration
(Upstream and Stormwater Load Reduction[1])

Dissolved Oxygen - # of Days Dissolved Oxygen <2.0 mg/L



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	0	0	0	0	0	0
Phase 1 Controls	0	0	0	0	0	0
Pump Sta. Rehab.	0	0	0	0	0	0
12 Overflows/yr	0	0	0	0	0	0
8 Overflows/yr	0	0	0	0	0	0
4 Overflows/yr	0	0	0	0	0	0
2 Overflows/yr	0	0	0	0	0	0
0 Overflows/yr	0	0	0	0	0	0
Separation	0	0	0	0	0	0

Dissolved Oxygen - Minimum Day Dissolved Oxygen[2]



	Haines Point	South Capital St.	Navy Yard	RFK Stadium	DC/MD Boundary	Confluence NE & NW Branch
No Phase 1 Controls	4.6	3.0	2.6	2.6	3.6	4.4
Phase 1 Controls	4.8	3.3	2.8	2.8	3.6	4.4
Pump Sta. Rehab.	4.9	3.5	3.0	2.8	3.7	4.4
12 Overflows/yr	5.1	4.0	3.5	3.2	3.8	4.4
8 Overflows/yr	5.2	4.1	3.7	3.3	3.8	4.4
4 Overflows/yr	5.3	4.3	3.8	3.5	3.8	4.4
2 Overflows/yr	5.3	4.4	4.0	3.6	3.8	4.4
0 Overflows/yr	5.3	4.4	4.0	3.7	3.9	4.4
Separation	4.8	3.5	2.9	2.8	3.7	4.4
Standard	5.0	5.0	5.0	5.0	5.0	5.0

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[1] Storm water: 40% reduction in loads, Upstream: 40% reduction in nutrients
Fecal coliforms at 80% of water quality standard (concentration = 160/100 ml)
[2] Minimum dissolved oxygen for entire three year period (1988-1990).

District of Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

APPENDIX C

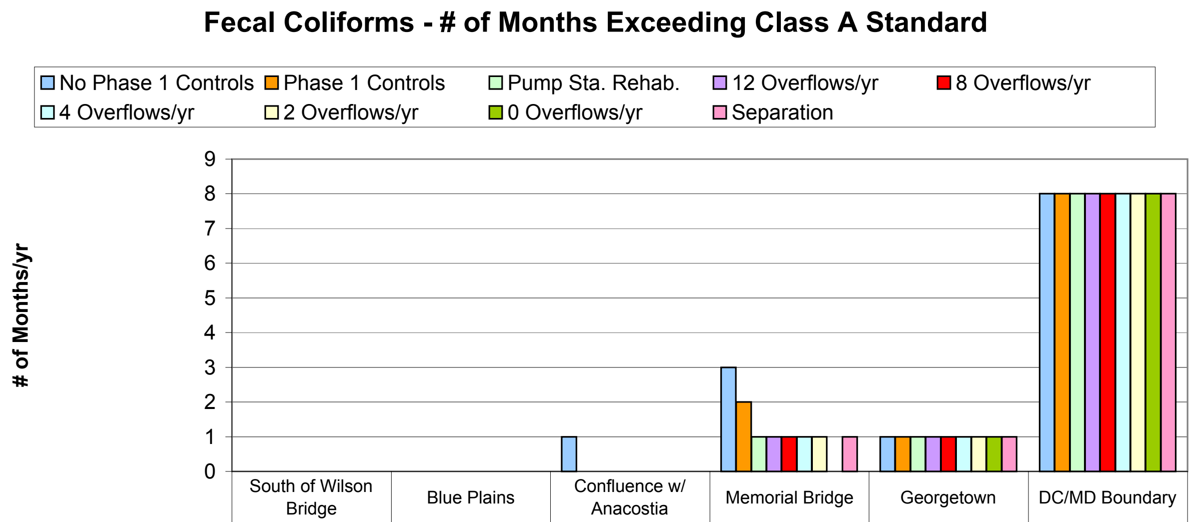
Effect of CSO Controls on Water Quality Potomac River

District of Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

Table of Contents
Appendix C – Effect of CSO Controls on Water Quality in Potomac River

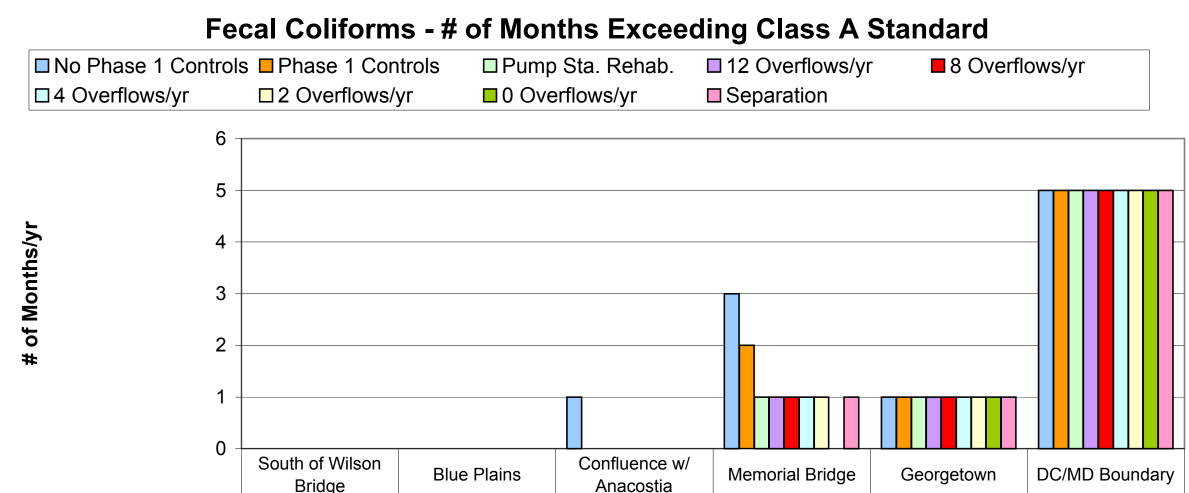
Figure C-1
Potomac River: Effect of CSO Control on Fecal Coliform Concentrations
(No Change in Upstream or Stormwater Loads)

ENTIRE CALENDAR YEAR



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	0	0	1	3	1	8
Phase 1 Controls	0	0	0	2	1	8
Pump Sta. Rehab.	0	0	0	1	1	8
12 Overflows/yr	0	0	0	1	1	8
8 Overflows/yr	0	0	0	1	1	8
4 Overflows/yr	0	0	0	1	1	8
2 Overflows/yr	0	0	0	1	1	8
0 Overflows/yr	0	0	0	0	1	8
Separation	0	0	0	1	1	8

MAY THROUGH SEPTEMBER

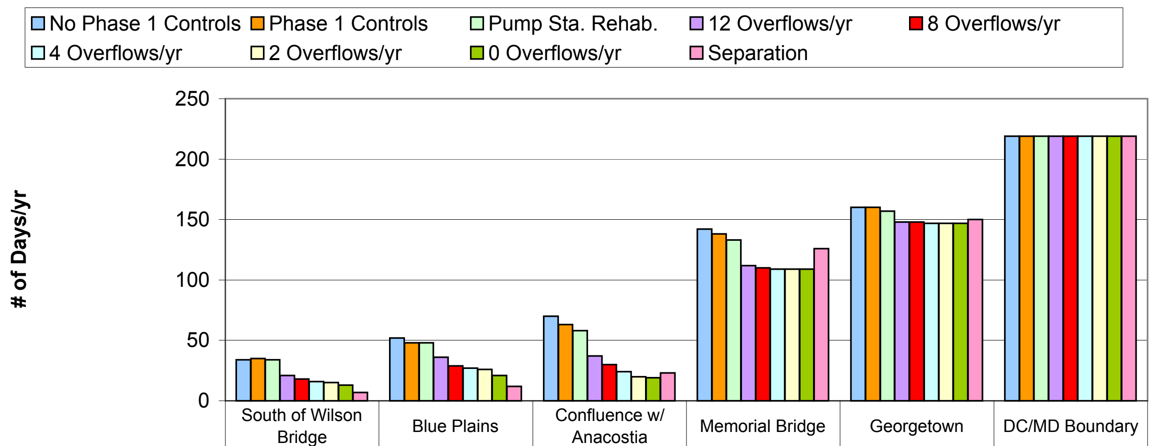


	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	0	0	1	3	1	5
Phase 1 Controls	0	0	0	2	1	5
Pump Sta. Rehab.	0	0	0	1	1	5
12 Overflows/yr	0	0	0	1	1	5
8 Overflows/yr	0	0	0	1	1	5
4 Overflows/yr	0	0	0	1	1	5
2 Overflows/yr	0	0	0	1	1	5
0 Overflows/yr	0	0	0	0	1	5
Separation	0	0	0	1	1	5

Figure C-2
Potomac River: Effect of CSO Control on Fecal Coliform Concentrations
(No Change in Upstream or Stormwater Loads)

ENTIRE CALENDAR YEAR

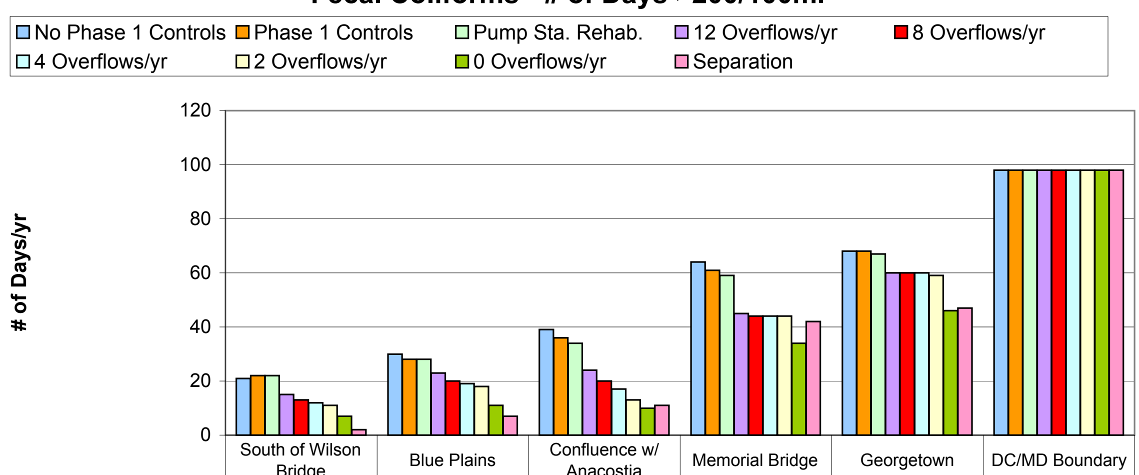
Fecal Coliforms - # of Days >200/100ml



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	34	52	70	142	160	219
Phase 1 Controls	35	48	63	138	160	219
Pump Sta. Rehab.	34	48	58	133	157	219
12 Overflows/yr	21	36	37	112	148	219
8 Overflows/yr	18	29	30	110	148	219
4 Overflows/yr	16	27	24	109	147	219
2 Overflows/yr	15	26	20	109	147	219
0 Overflows/yr	13	21	19	109	147	219
Separation	7	12	23	126	150	219

MAY THROUGH SEPTEMBER

Fecal Coliforms - # of Days >200/100ml

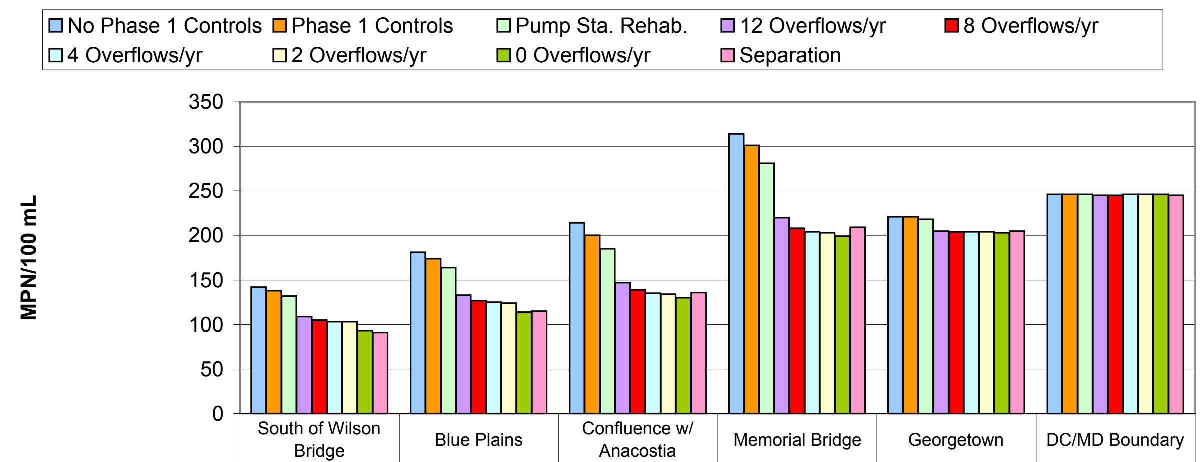


	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	21	30	39	64	68	98
Phase 1 Controls	22	28	36	61	68	98
Pump Sta. Rehab.	22	28	34	59	67	98
12 Overflows/yr	15	23	24	45	60	98
8 Overflows/yr	13	20	20	44	60	98
4 Overflows/yr	12	19	17	44	60	98
2 Overflows/yr	11	18	13	44	59	98
0 Overflows/yr	7	11	10	34	46	98
Separation	2	7	11	42	47	98

District of Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

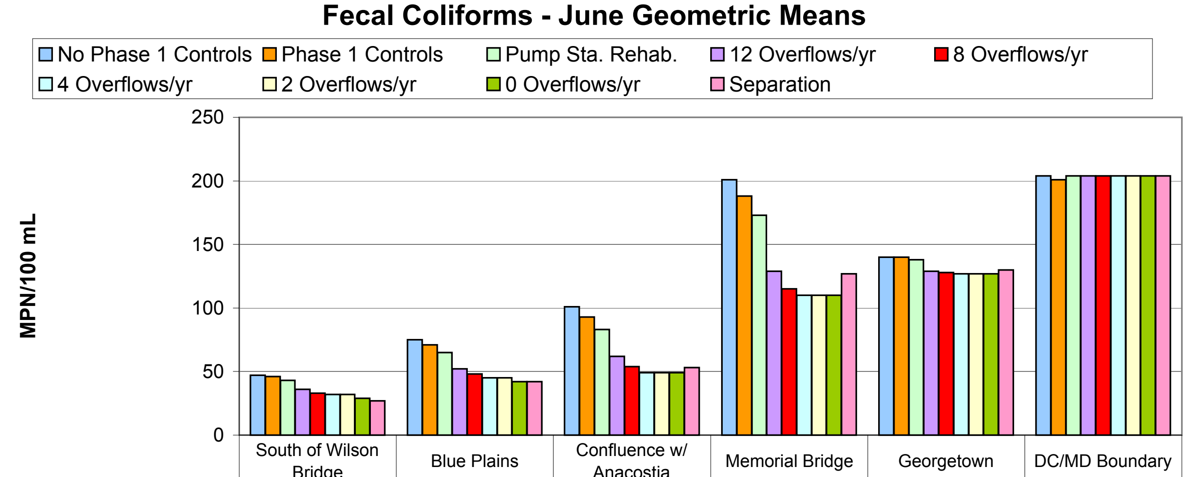
Figure C-3
Potomac River: Effect of CSO Control on Fecal Coliform Concentrations
(No Change in Upstream or Stormwater Loads)

Fecal Coliforms - May Geometric Means



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	142	181	214	314	221	246
Phase 1 Controls	138	174	200	301	221	246
Pump Sta. Rehab.	132	164	185	281	218	246
12 Overflows/yr	109	133	147	220	205	245
8 Overflows/yr	105	127	139	208	204	245
4 Overflows/yr	103	125	135	204	204	246
2 Overflows/yr	103	124	134	203	204	246
0 Overflows/yr	93	114	130	199	203	246
Separation	91	115	136	209	205	245

Fecal Coliforms - June Geometric Means



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	47	75	101	201	140	204
Phase 1 Controls	46	71	93	188	140	201
Pump Sta. Rehab.	43	65	83	173	138	204
12 Overflows/yr	36	52	62	129	129	204
8 Overflows/yr	33	48	54	115	128	204
4 Overflows/yr	32	45	49	110	127	204
2 Overflows/yr	32	45	49	110	127	204
0 Overflows/yr	29	42	49	110	127	204
Separation	27	42	53	127	130	204

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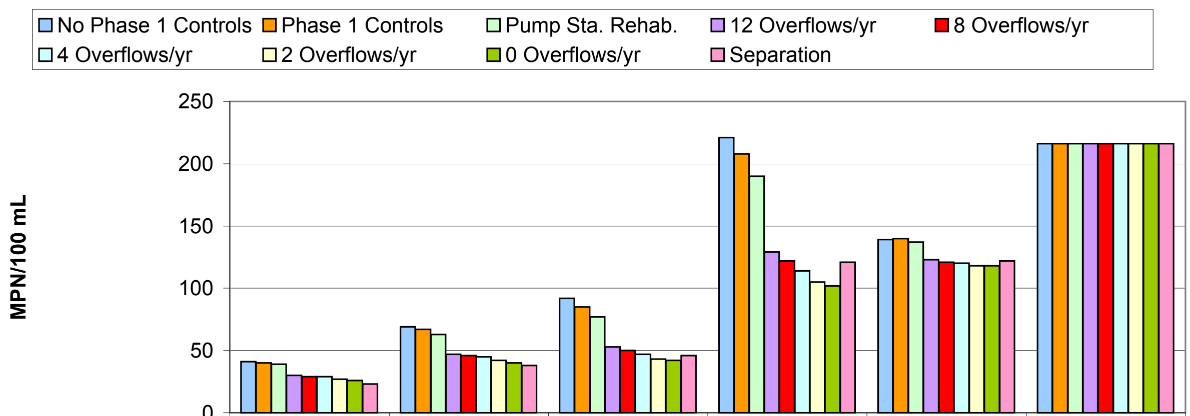
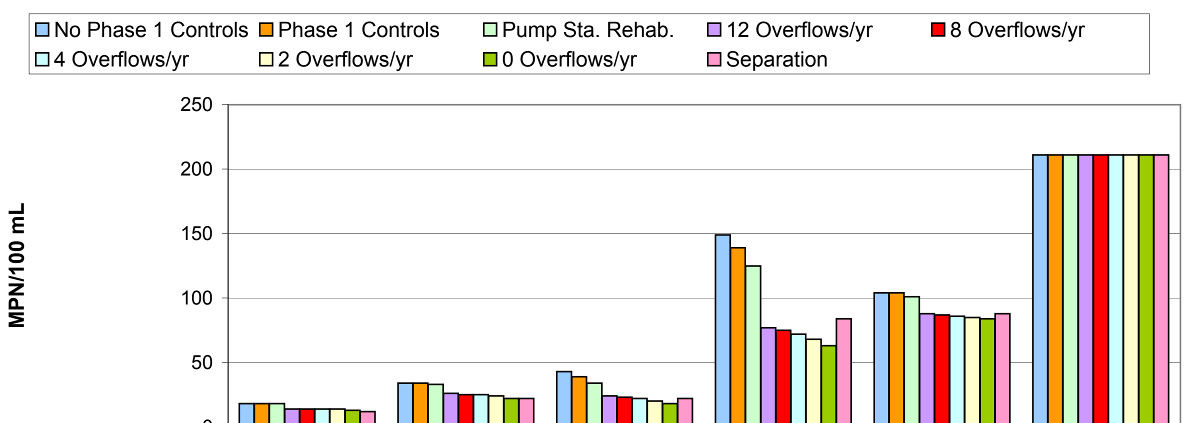
Figure C-4
Potomac River: Effect of CSO Control on Fecal Coliform Concentrations
(No Change in Upstream or Stormwater Loads)

Fecal Coliforms - July Geometric Means



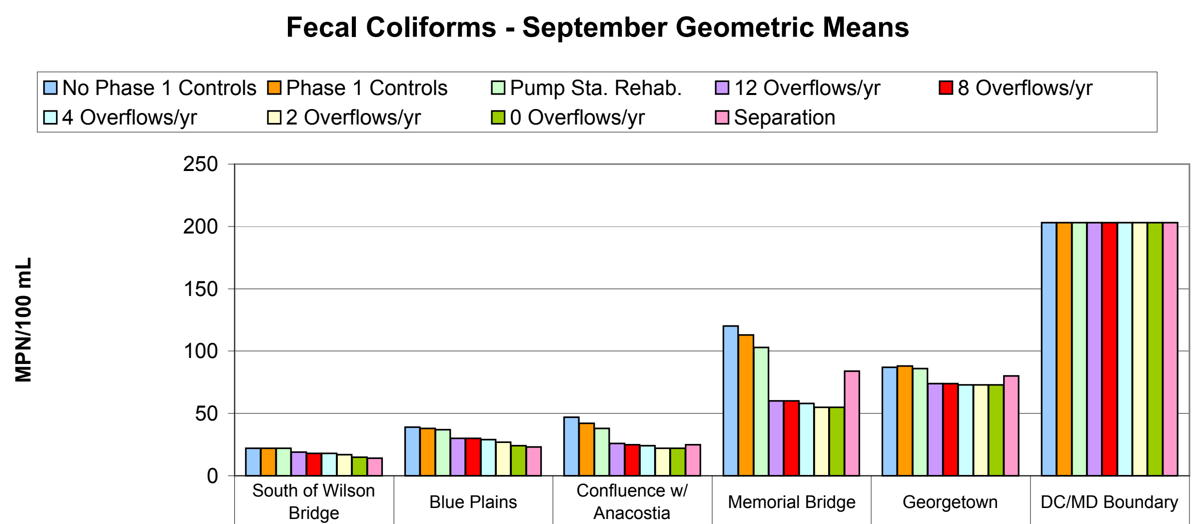
	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	41	69	92	221	139	216
Phase 1 Controls	40	67	85	208	140	216
Pump Sta. Rehab.	39	63	77	190	137	216
12 Overflows/yr	30	47	53	129	123	216
8 Overflows/yr	29	46	50	122	121	216
4 Overflows/yr	29	45	47	114	120	216
2 Overflows/yr	27	42	43	105	118	216
0 Overflows/yr	26	40	42	102	118	216
Separation	23	38	46	121	122	216

Fecal Coliforms - August Geometric Means



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	18	34	43	149	104	211
Phase 1 Controls	18	34	39	139	104	211
Pump Sta. Rehab.	18	33	34	125	101	211
12 Overflows/yr	14	26	24	77	88	211
8 Overflows/yr	14	25	23	75	87	211
4 Overflows/yr	14	25	22	72	86	211
2 Overflows/yr	14	24	20	68	85	211
0 Overflows/yr	13	22	18	63	84	211
Separation	12	22	22	84	88	211

Figure C-5
Potomac River: Effect of CSO Control on Fecal Coliform Concentrations
(No Change in Upstream or Stormwater Loads)

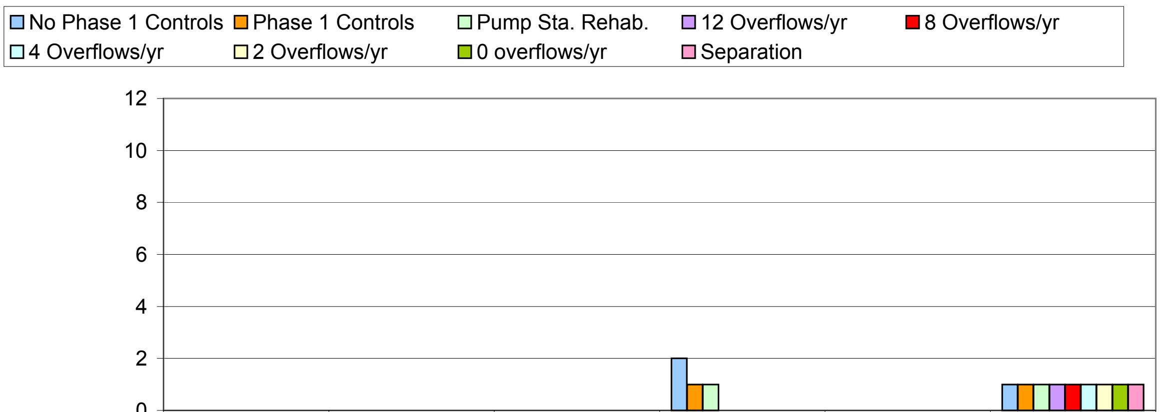


	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	22	39	47	120	87	203
Phase 1 Controls	22	38	42	113	88	203
Pump Sta. Rehab.	22	37	38	103	86	203
12 Overflows/yr	19	30	26	60	74	203
8 Overflows/yr	18	30	25	60	74	203
4 Overflows/yr	18	29	24	58	73	203
2 Overflows/yr	17	27	22	55	73	203
0 Overflows/yr	15	24	22	55	73	203
Separation	14	23	25	84	80	203

Figure C-6
Potomac River: Effect of CSO Control on Fecal Coliform Concentrations
(No Change in Upstream or Stormwater Loads)

ENTIRE CALENDAR YEAR

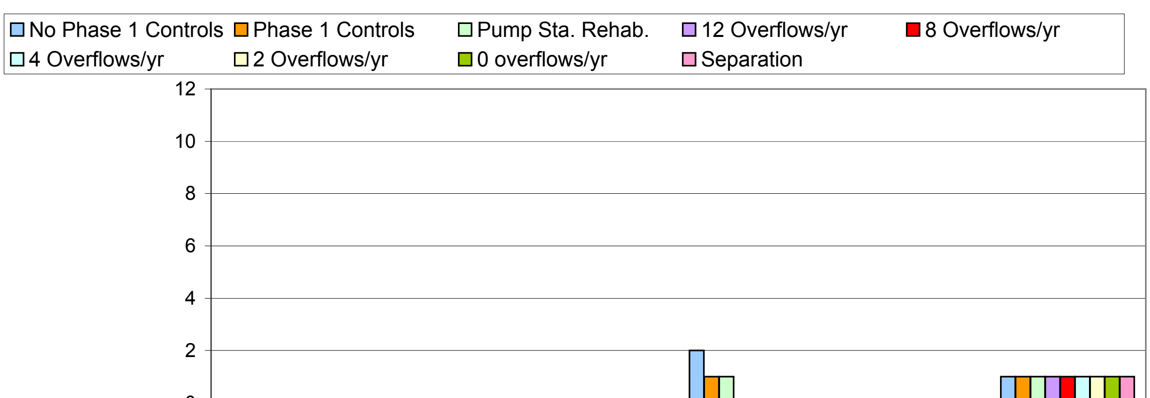
E. Coli - # of Months Exceeding 126/ 100 mL



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	0	0	0	2	0	1
Phase 1 Controls	0	0	0	1	0	1
Pump Sta. Rehab.	0	0	0	1	0	1
12 Overflows/yr	0	0	0	0	0	1
8 Overflows/yr	0	0	0	0	0	1
4 Overflows/yr	0	0	0	0	0	1
2 Overflows/yr	0	0	0	0	0	1
0 overflows/yr	0	0	0	0	0	1
Separation	0	0	0	0	0	1

MAY THROUGH SEPTEMBER

E. Coli - # of Months Exceeding 126/ 100 mL

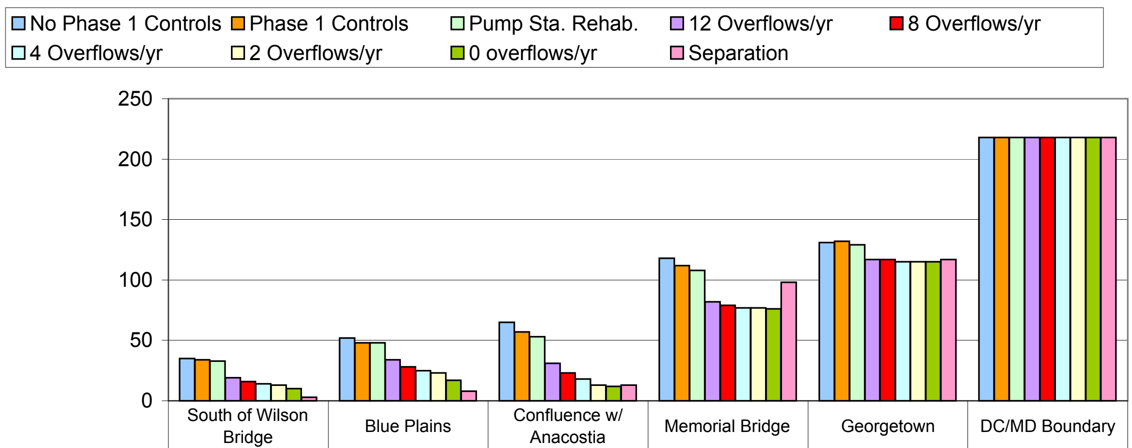


	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	0	0	0	2	0	1
Phase 1 Controls	0	0	0	1	0	1
Pump Sta. Rehab.	0	0	0	1	0	1
12 Overflows/yr	0	0	0	0	0	1
8 Overflows/yr	0	0	0	0	0	1
4 Overflows/yr	0	0	0	0	0	1
2 Overflows/yr	0	0	0	0	0	1
0 overflows/yr	0	0	0	0	0	1
Separation	0	0	0	0	0	1

Figure C-7
Potomac River: Effect of CSO Control on Fecal Coliform Concentrations
(No Change in Upstream or Stormwater Loads)

ENTIRE CALENDAR YEAR

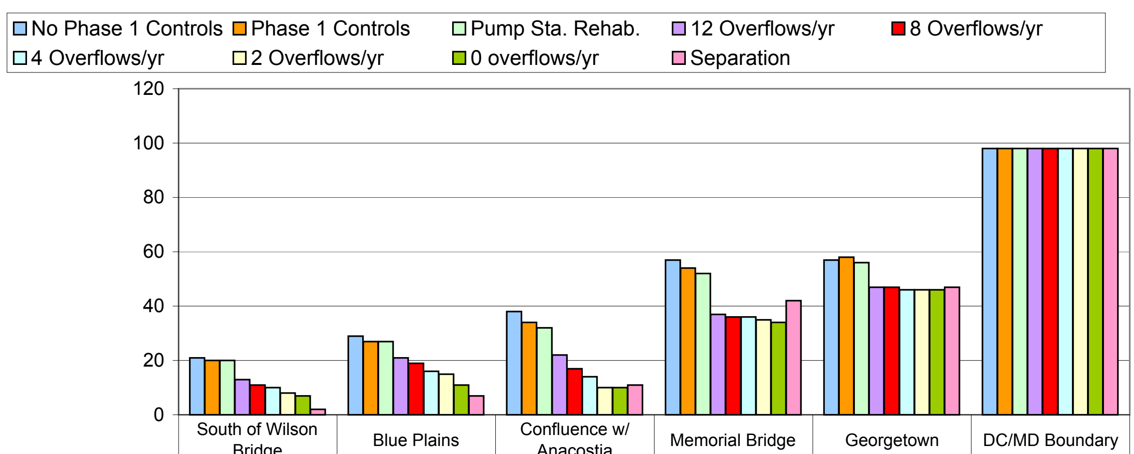
E. Coli - # of Days Exceeding 126/100 mL



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	35	52	65	118	131	218
Phase 1 Controls	34	48	57	112	132	218
Pump Sta. Rehab.	33	48	53	108	129	218
12 Overflows/yr	19	34	31	82	117	218
8 Overflows/yr	16	28	23	79	117	218
4 Overflows/yr	14	25	18	77	115	218
2 Overflows/yr	13	23	13	77	115	218
0 overflows/yr	10	17	12	76	115	218
Separation	3	8	13	98	117	218

MAY THROUGH SEPTEMBER

E. Coli - # of Days Exceeding 126/100 mL



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	21	29	38	57	57	98
Phase 1 Controls	20	27	34	54	58	98
Pump Sta. Rehab.	20	27	32	52	56	98
12 Overflows/yr	13	21	22	37	47	98
8 Overflows/yr	11	19	17	36	47	98
4 Overflows/yr	10	16	14	36	46	98
2 Overflows/yr	8	15	10	35	46	98
0 overflows/yr	7	11	10	34	46	98
Separation	2	7	11	42	47	98

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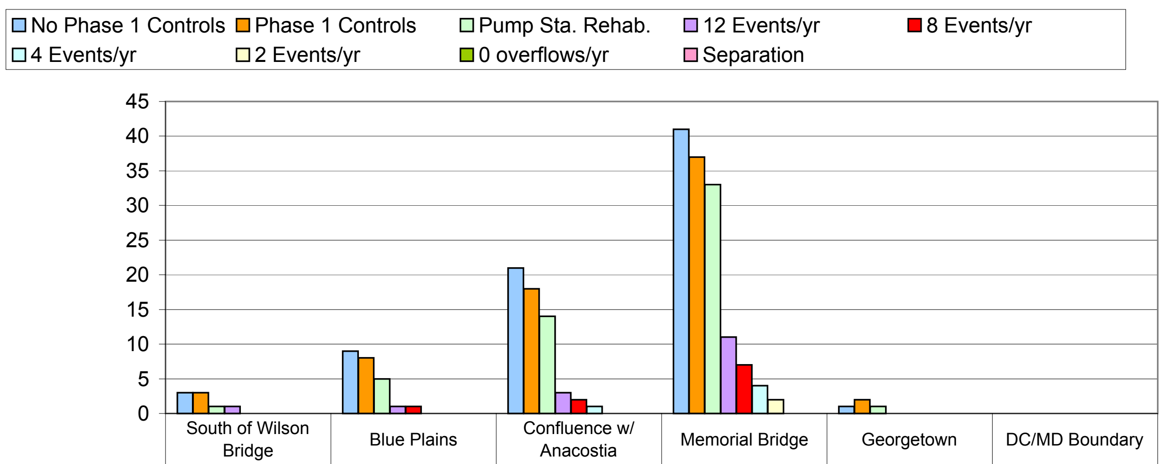
Figure C-8
Potomac River: Effect of CSO Control on Fecal Coliform Concentrations
(No Change in Upstream or Stormwater Loads)

ENTIRE CALENDAR YEAR

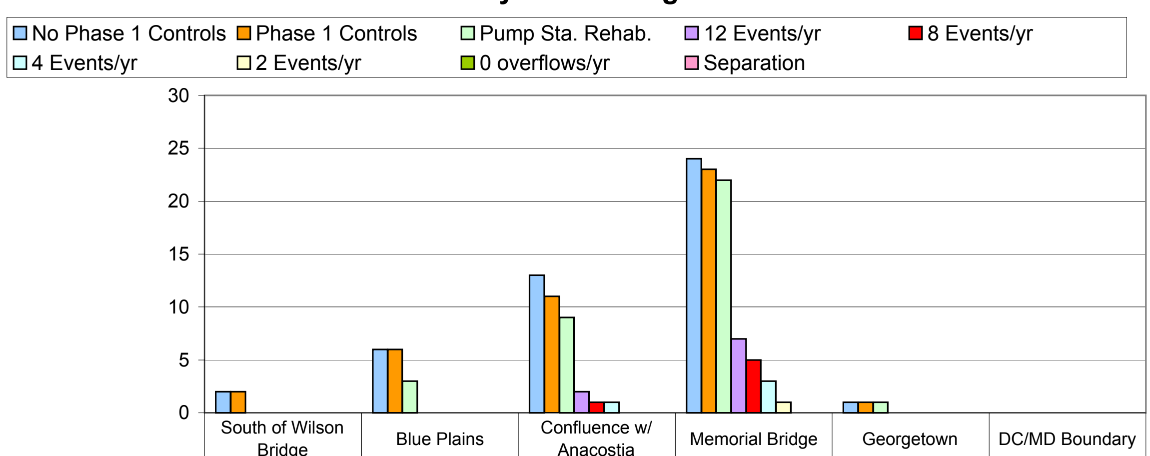
E. Coli - # of Days Exceeding 576/100 mL



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	3	9	21	41	1	0
Phase 1 Controls	3	8	18	37	2	0
Pump Sta. Rehab.	1	5	14	33	1	0
12 Events/yr	1	1	3	11	0	0
8 Events/yr	0	1	2	7	0	0
4 Events/yr	0	0	1	4	0	0
2 Events/yr	0	0	0	2	0	0
0 overflows/yr	0	0	0	0	0	0
Separation	0	0	0	0	0	0

MAY THROUGH SEPTEMBER

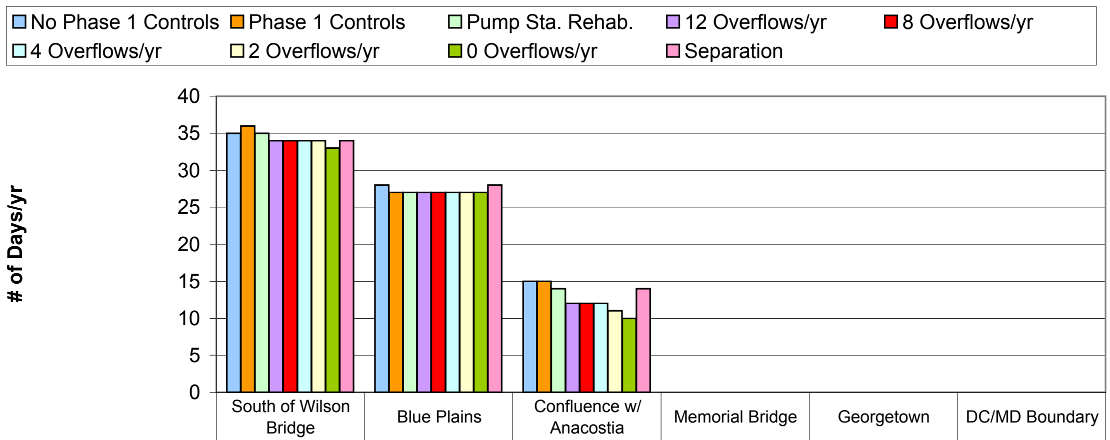
E. Coli - # of Days Exceeding 576/100 mL



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	2	6	13	24	1	0
Phase 1 Controls	2	6	11	23	1	0
Pump Sta. Rehab.	0	3	9	22	1	0
12 Events/yr	0	0	2	7	0	0
8 Events/yr	0	0	1	5	0	0
4 Events/yr	0	0	1	3	0	0
2 Events/yr	0	0	0	1	0	0
0 overflows/yr	0	0	0	0	0	0
Separation	0	0	0	0	0	0

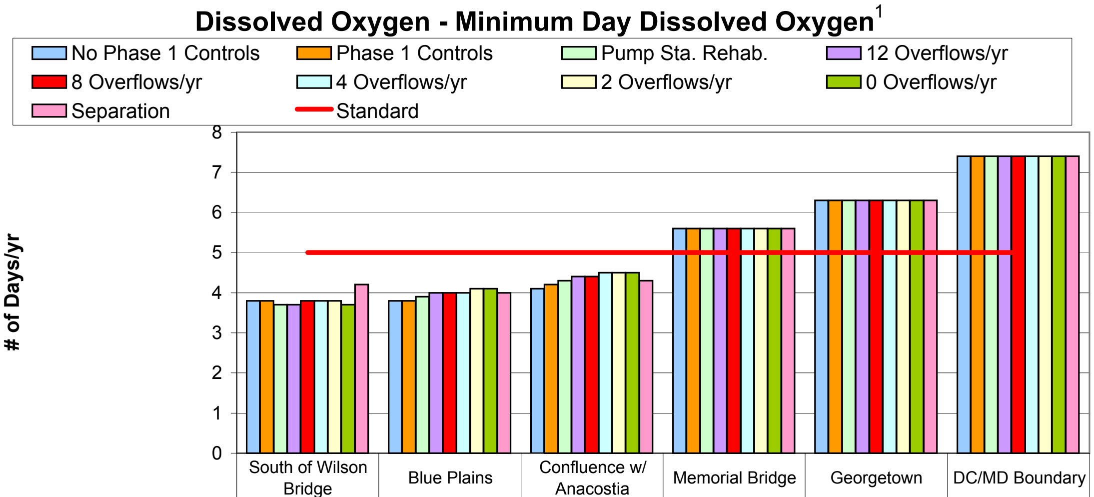
Figure C-9
Potomac River: Effect of CSO Control on Fecal Coliform Concentrations
(No Change in Upstream or Stormwater Loads)

Dissolved Oxygen - # of Days Dissolved Oxygen <5.0 mg/L



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	35	28	15	0	0	0
Phase 1 Controls	36	27	15	0	0	0
Pump Sta. Rehab.	35	27	14	0	0	0
12 Overflows/yr	34	27	12	0	0	0
8 Overflows/yr	34	27	12	0	0	0
4 Overflows/yr	34	27	12	0	0	0
2 Overflows/yr	34	27	11	0	0	0
0 Overflows/yr	33	27	10	0	0	0
Separation	34	28	14	0	0	0

Dissolved Oxygen - Minimum Day Dissolved Oxygen[1]



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	3.8	3.8	4.1	5.6	6.3	7.4
Phase 1 Controls	3.8	3.8	4.2	5.6	6.3	7.4
Pump Sta. Rehab.	3.7	3.9	4.3	5.6	6.3	7.4
12 Overflows/yr	3.7	4	4.4	5.6	6.3	7.4
8 Overflows/yr	3.8	4	4.4	5.6	6.3	7.4
4 Overflows/yr	3.8	4	4.5	5.6	6.3	7.4
2 Overflows/yr	3.8	4.1	4.5	5.6	6.3	7.4
0 Overflows/yr	3.7	4.1	4.5	5.6	6.3	7.4
Separation	4.2	4	4.3	5.6	6.3	7.4

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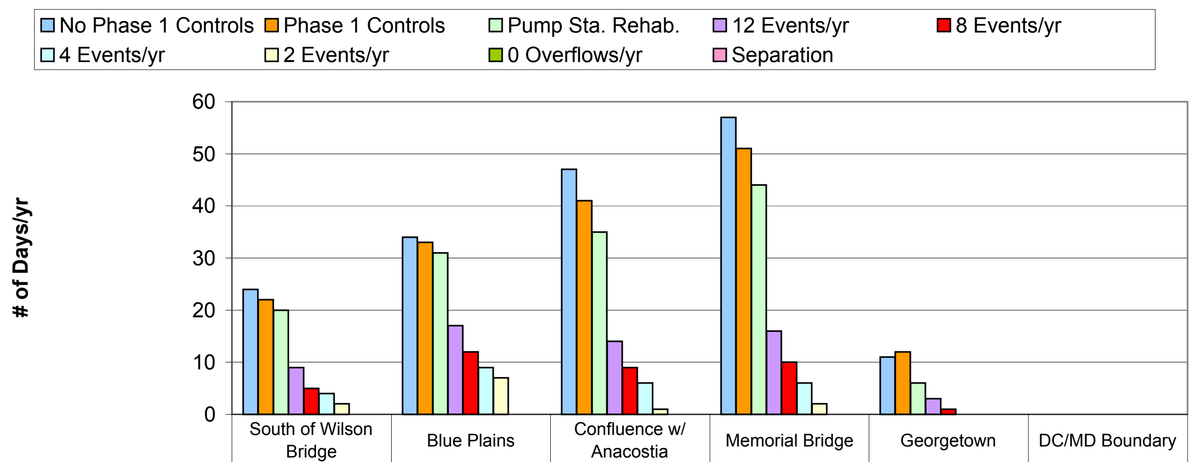
[1] Minimum dissolved oxygen for entire 3 year period (1988-1990).

Figure C-10
Potomac River: Effect of CSO Control on Fecal Coliform Concentrations
(CSO Loads Only - no other loads present)

ENTIRE CALENDAR YEAR

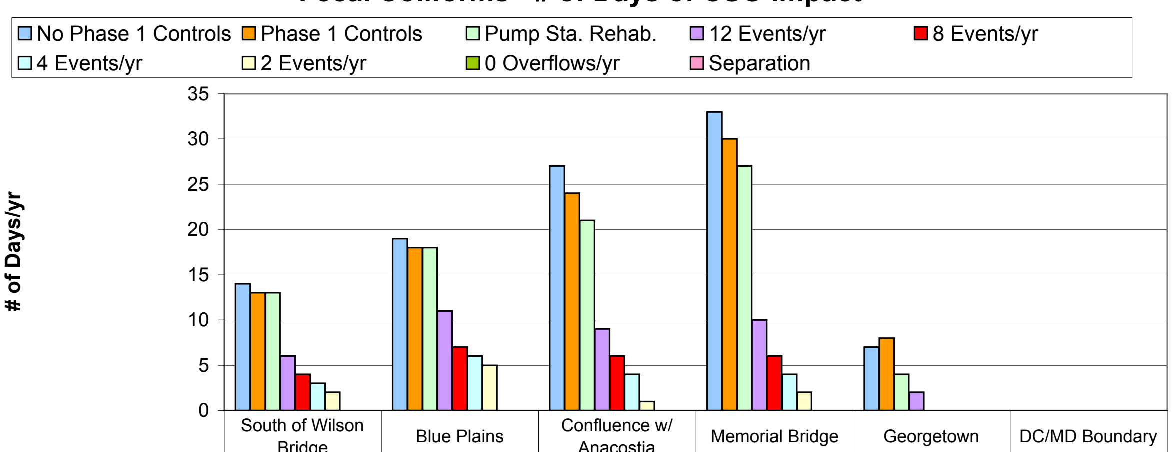
Fecal Coliforms - # of Days of CSO Impact



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	24	34	47	57	11	0
Phase 1 Controls	22	33	41	51	12	0
Pump Sta. Rehab.	20	31	35	44	6	0
12 Events/yr	9	17	14	16	3	0
8 Events/yr	5	12	9	10	1	0
4 Events/yr	4	9	6	6	0	0
2 Events/yr	2	7	1	2	0	0
0 Overflows/yr	0	0	0	0	0	0
Separation	0	0	0	0	0	0

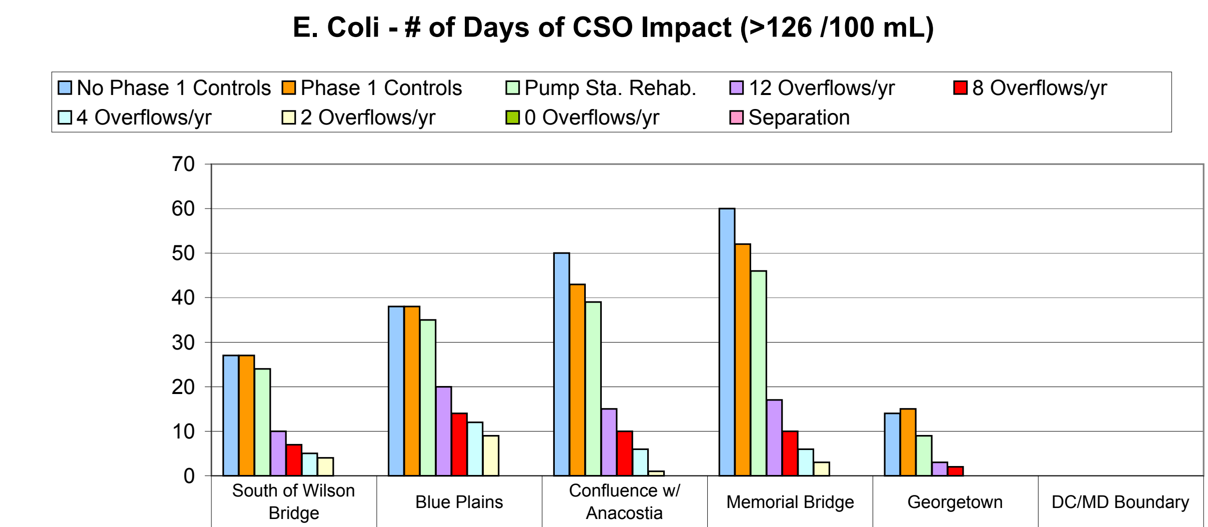
MAY THROUGH SEPTEMBER

Fecal Coliforms - # of Days of CSO Impact

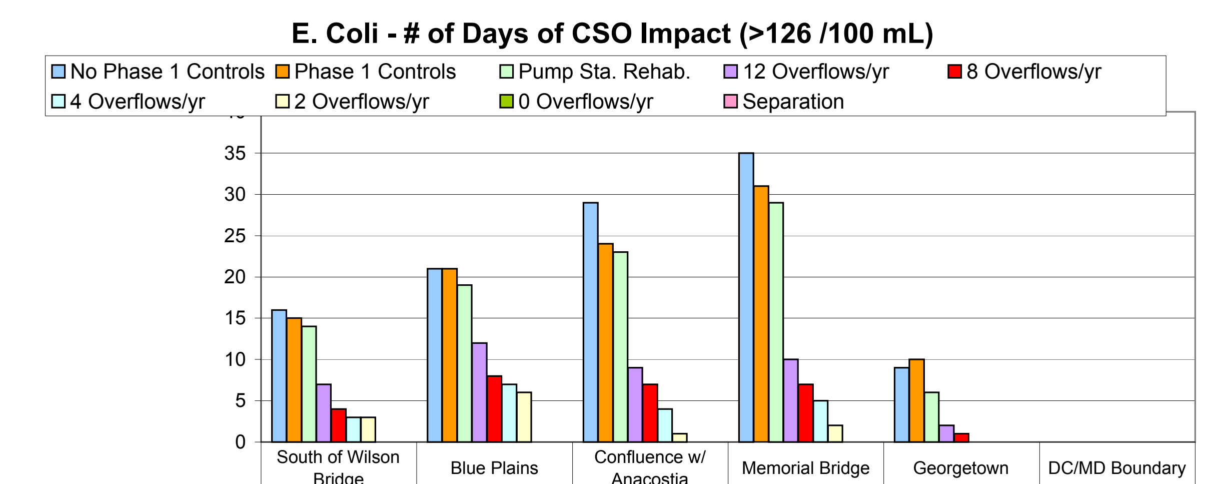


	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	14	19	27	33	7	0
Phase 1 Controls	13	18	24	30	8	0
Pump Sta. Rehab.	13	18	21	27	4	0
12 Events/yr	6	11	9	10	2	0
8 Events/yr	4	7	6	6	0	0
4 Events/yr	3	6	4	4	0	0
2 Events/yr	2	5	1	2	0	0
0 Overflows/yr	0	0	0	0	0	0
Separation	0	0	0	0	0	0

Figure C-11
Potomac River: Effect of CSO Control on Fecal Coliform Concentrations
(CSO Loads Only - no other loads present)

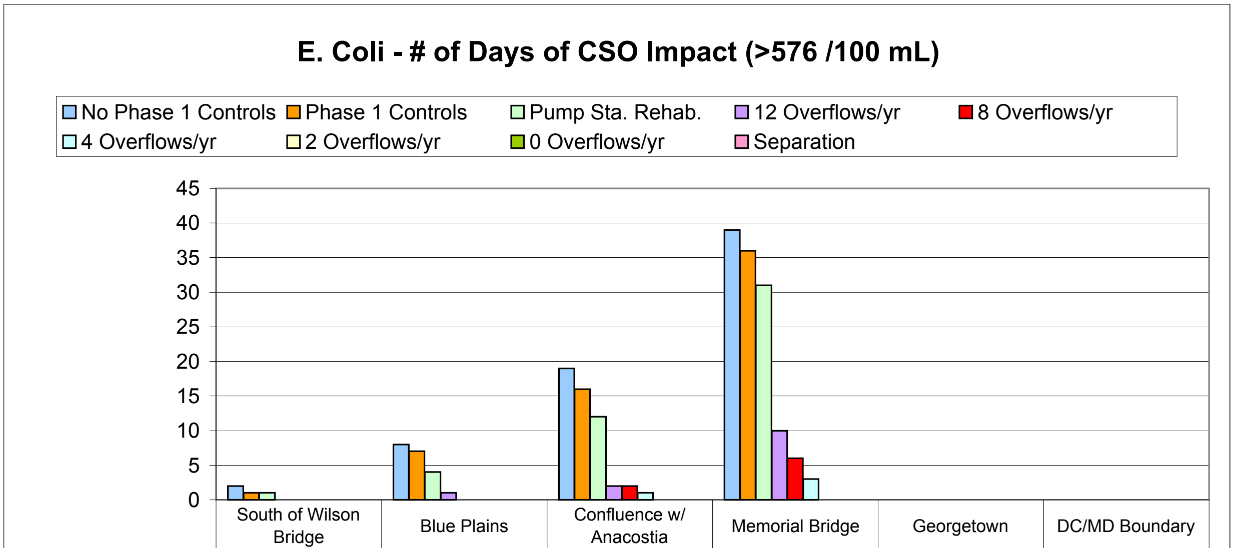


	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	27	38	50	60	14	0
Phase 1 Controls	27	38	43	52	15	0
Pump Sta. Rehab.	24	35	39	46	9	0
12 Overflows/yr	10	20	15	17	3	0
8 Overflows/yr	7	14	10	10	2	0
4 Overflows/yr	5	12	6	6	0	0
2 Overflows/yr	4	9	1	3	0	0
0 Overflows/yr	0	0	0	0	0	0
Separation	0	0	0	0	0	0

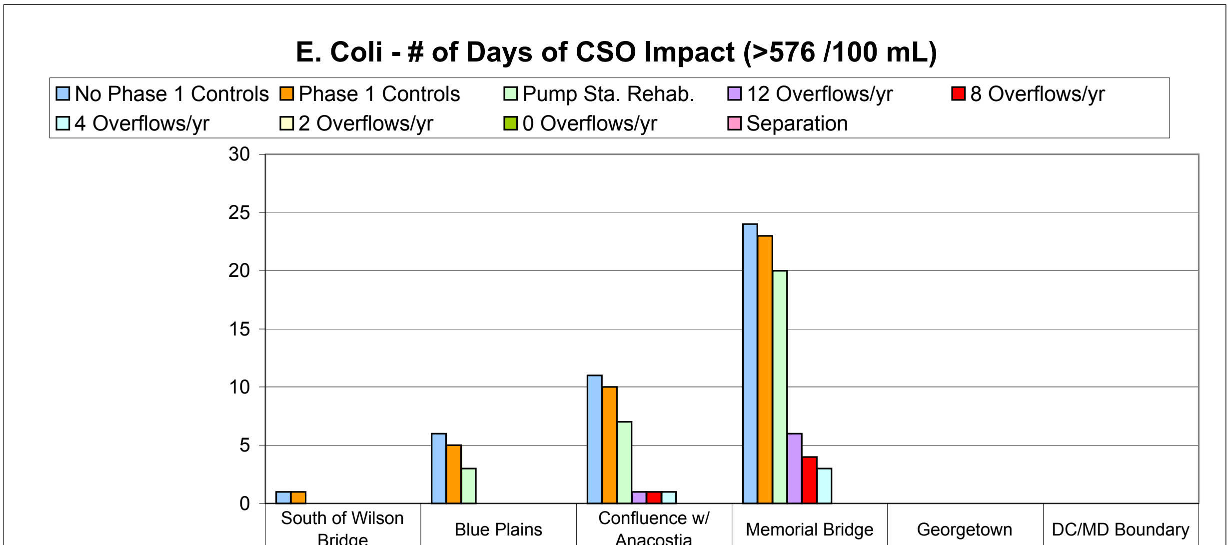


	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	16	21	29	35	9	0
Phase 1 Controls	15	21	24	31	10	0
Pump Sta. Rehab.	14	19	23	29	6	0
12 Overflows/yr	7	12	9	10	2	0
8 Overflows/yr	4	8	7	7	1	0
4 Overflows/yr	3	7	4	5	0	0
2 Overflows/yr	3	6	1	2	0	0
0 Overflows/yr	0	0	0	0	0	0
Separation	0	0	0	0	0	0

Figure C-12
Potomac River: Effect of CSO Control on Fecal Coliform Concentrations
(CSO Loads Only - no other loads present)



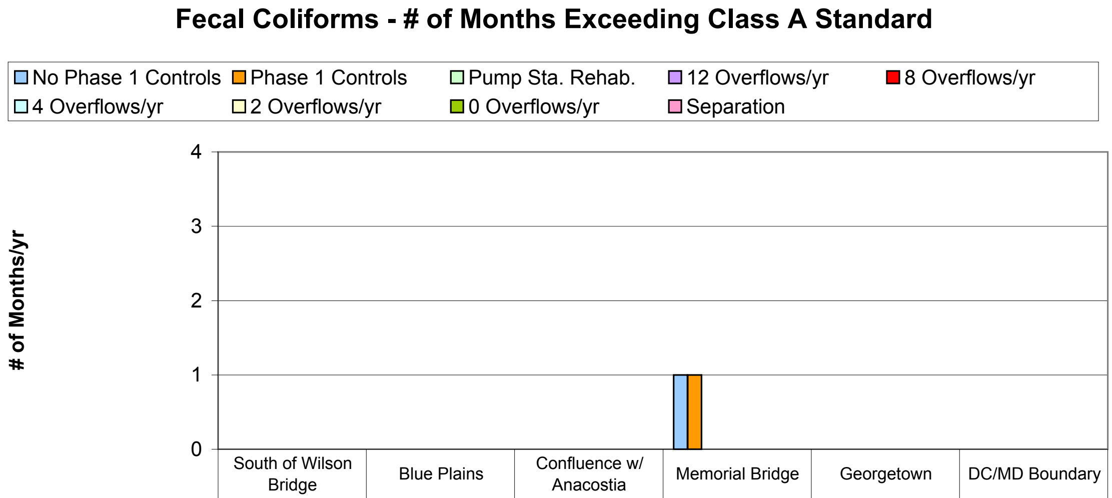
	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	2	8	19	39	0	0
Phase 1 Controls	1	7	16	36	0	0
Pump Sta. Rehab.	1	4	12	31	0	0
12 Overflows/yr	0	1	2	10	0	0
8 Overflows/yr	0	0	2	6	0	0
4 Overflows/yr	0	0	1	3	0	0
2 Overflows/yr	0	0	0	0	0	0
0 Overflows/yr	0	0	0	0	0	0
Separation	0	0	0	0	0	0



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	1	6	11	24	0	0
Phase 1 Controls	1	5	10	23	0	0
Pump Sta. Rehab.	0	3	7	20	0	0
12 Overflows/yr	0	0	1	6	0	0
8 Overflows/yr	0	0	1	4	0	0
4 Overflows/yr	0	0	1	3	0	0
2 Overflows/yr	0	0	0	0	0	0
0 Overflows/yr	0	0	0	0	0	0
Separation	0	0	0	0	0	0

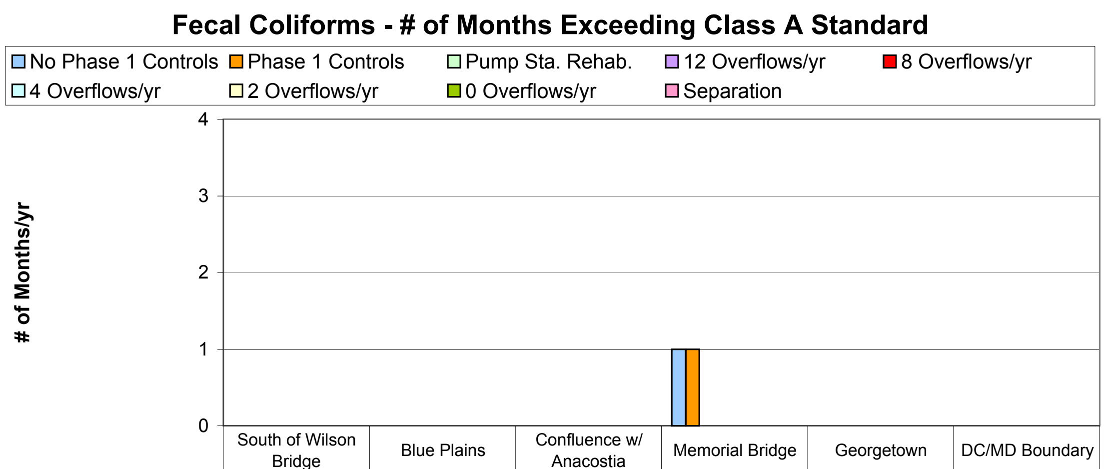
Figure C-13
Potomac River: Effect of CSO Control on Fecal Coliform Concentrations
(Upstream and Stormwater Load Reduction[1])

ENTIRE CALENDAR YEAR



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	0	0	0	1	0	0
Phase 1 Controls	0	0	0	1	0	0
Pump Sta. Rehab.	0	0	0	0	0	0
12 Overflows/yr	0	0	0	0	0	0
8 Overflows/yr	0	0	0	0	0	0
4 Overflows/yr	0	0	0	0	0	0
2 Overflows/yr	0	0	0	0	0	0
0 Overflows/yr	0	0	0	0	0	0
Separation	0	0	0	0	0	0

MAY THROUGH SEPTEMBER



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	0	0	0	1	0	0
Phase 1 Controls	0	0	0	1	0	0
Pump Sta. Rehab.	0	0	0	0	0	0
12 Overflows/yr	0	0	0	0	0	0
8 Overflows/yr	0	0	0	0	0	0
4 Overflows/yr	0	0	0	0	0	0
2 Overflows/yr	0	0	0	0	0	0
0 Overflows/yr	0	0	0	0	0	0
Separation	0	0	0	0	0	0

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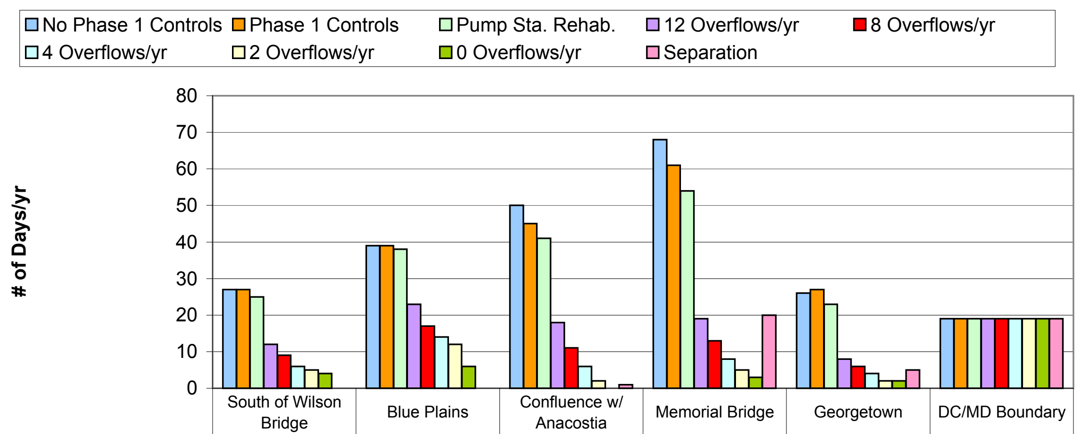
[1] Storm water: 40% reduction in loads, Upstream: 40% reduction in nutrients
Fecal coliforms at 80% of water quality standard (concentration = 160/100 ml)

Figure C-14
Potomac River: Effect of CSO Control on Fecal Coliform Concentrations
(Upstream and Stormwater Load Reduction[1])

ENTIRE CALENDAR YEAR

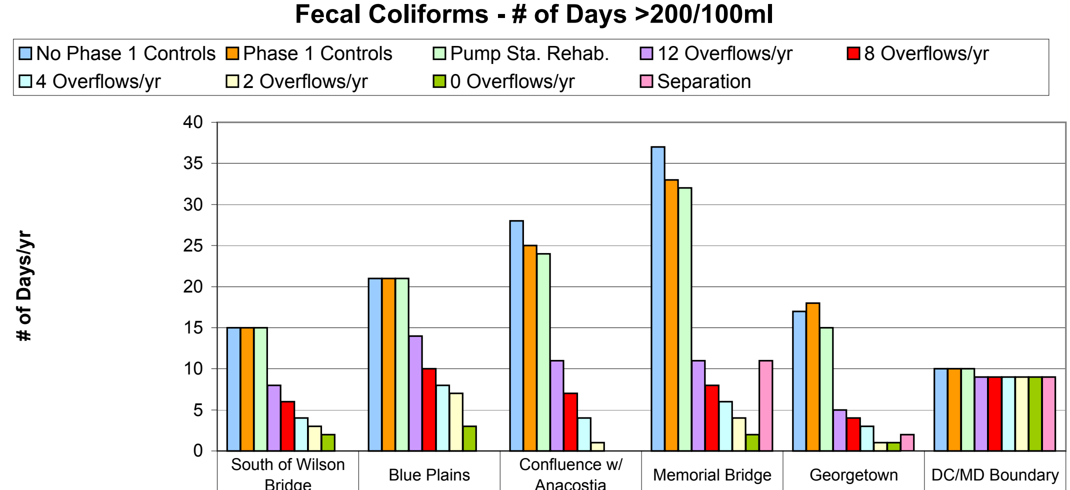
Fecal Coliforms - # of Days >200/100ml



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	27	39	50	68	26	19
Phase 1 Controls	27	39	45	61	27	19
Pump Sta. Rehab.	25	38	41	54	23	19
12 Overflows/yr	12	23	18	19	8	19
8 Overflows/yr	9	17	11	13	6	19
4 Overflows/yr	6	14	6	8	4	19
2 Overflows/yr	5	12	2	5	2	19
0 Overflows/yr	4	6	0	3	2	19
Separation	0	0	1	20	5	19

MAY THROUGH SEPTEMBER

Fecal Coliforms - # of Days >200/100ml



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	15	21	28	37	17	10
Phase 1 Controls	15	21	25	33	18	10
Pump Sta. Rehab.	15	21	24	32	15	10
12 Overflows/yr	8	14	11	11	5	9
8 Overflows/yr	6	10	7	8	4	9
4 Overflows/yr	4	8	4	6	3	9
2 Overflows/yr	3	7	1	4	1	9
0 Overflows/yr	2	3	0	2	1	9
Separation	0	0	0	11	2	9

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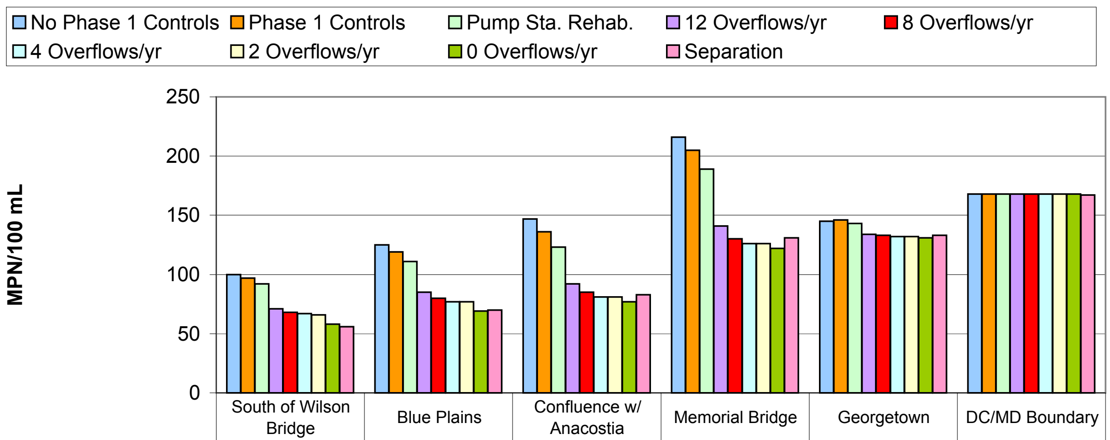
[1] Storm water: 40% reduction in loads, Upstream: 40% reduction in nutrients
Fecal coliforms at 80% of water quality standard (concentration = 160/100 ml)

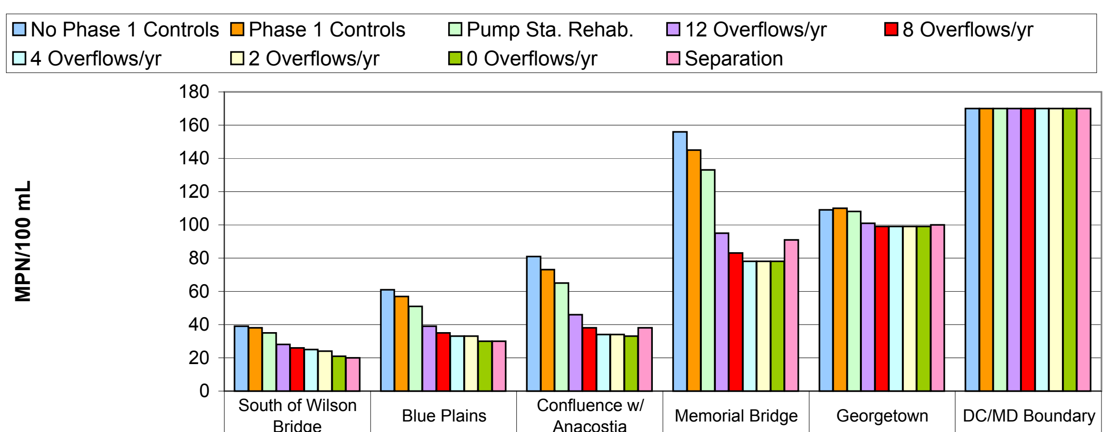
Figure C-15
Potomac River: Effect of CSO Control on Fecal Coliform Concentrations
(Upstream and Stormwater Load Reduction[1])

Fecal Coliforms - May Geometric Means



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	100	125	147	216	145	168
Phase 1 Controls	97	119	136	205	146	168
Pump Sta. Rehab.	92	111	123	189	143	168
12 Overflows/yr	71	85	92	141	134	168
8 Overflows/yr	68	80	85	130	133	168
4 Overflows/yr	67	77	81	126	132	168
2 Overflows/yr	66	77	81	126	132	168
0 Overflows/yr	58	69	77	122	131	168
Separation	56	70	83	131	133	167

Fecal Coliforms - June Geometric Means



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	39	61	81	156	109	170
Phase 1 Controls	38	57	73	145	110	170
Pump Sta. Rehab.	35	51	65	133	108	170
12 Overflows/yr	28	39	46	95	101	170
8 Overflows/yr	26	35	38	83	99	170
4 Overflows/yr	25	33	34	78	99	170
2 Overflows/yr	24	33	34	78	99	170
0 Overflows/yr	21	30	33	78	99	170
Separation	20	30	38	91	100	170

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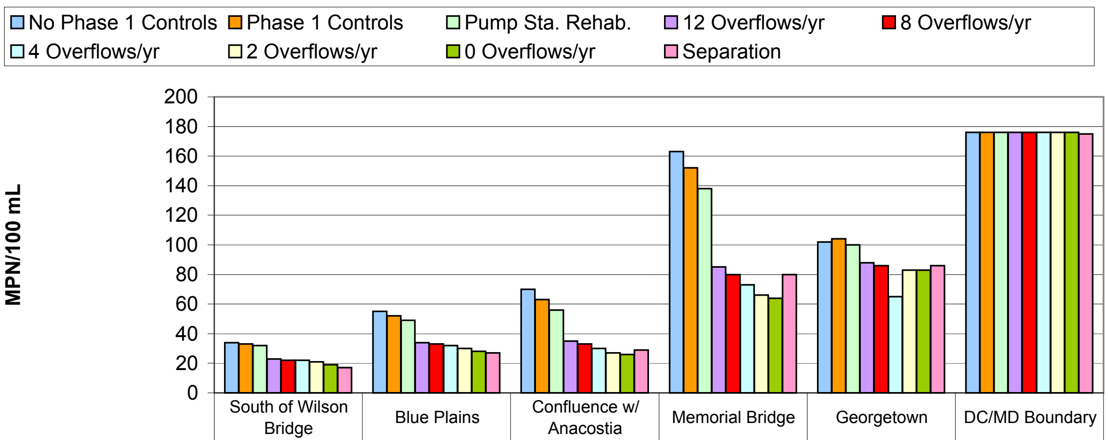
[1] Storm water: 40% reduction in loads, Upstream: 40% reduction in nutrients
Fecal coliforms at 80% of water quality standard (concentration = 160/100 ml)

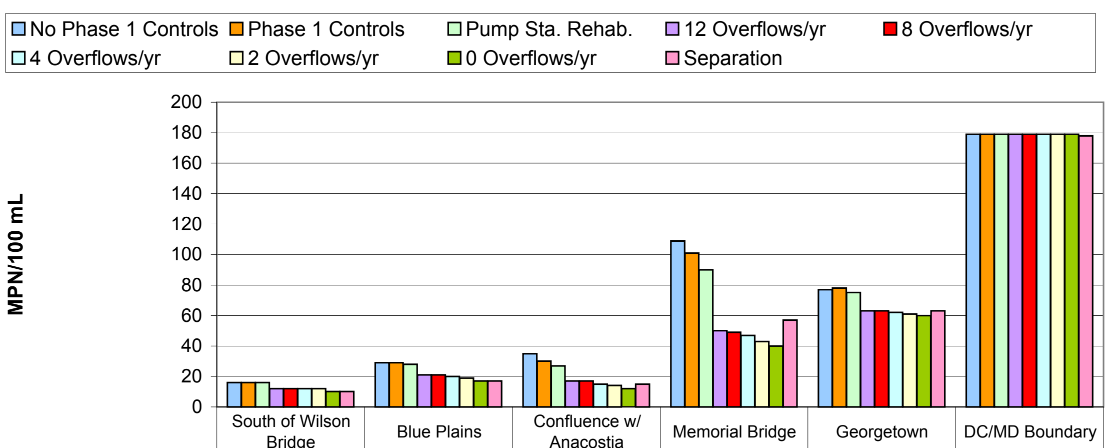
Figure C-16
Potomac River: Effect of CSO Control on Fecal Coliform Concentrations
(Upstream and Stormwater Load Reduction[1])

Fecal Coliforms - July Geometric Means



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	34	55	70	163	102	176
Phase 1 Controls	33	52	63	152	104	176
Pump Sta. Rehab.	32	49	56	138	100	176
12 Overflows/yr	23	34	35	85	88	176
8 Overflows/yr	22	33	33	80	86	176
4 Overflows/yr	22	32	30	73	65	176
2 Overflows/yr	21	30	27	66	83	176
0 Overflows/yr	19	28	26	64	83	176
Separation	17	27	29	80	86	175

Fecal Coliforms - August Geometric Means



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	16	29	35	109	77	179
Phase 1 Controls	16	29	30	101	78	179
Pump Sta. Rehab.	16	28	27	90	75	179
12 Overflows/yr	12	21	17	50	63	179
8 Overflows/yr	12	21	17	49	63	179
4 Overflows/yr	12	20	15	47	62	179
2 Overflows/yr	12	19	14	43	61	179
0 Overflows/yr	10	17	12	40	60	179
Separation	10	17	15	57	63	178

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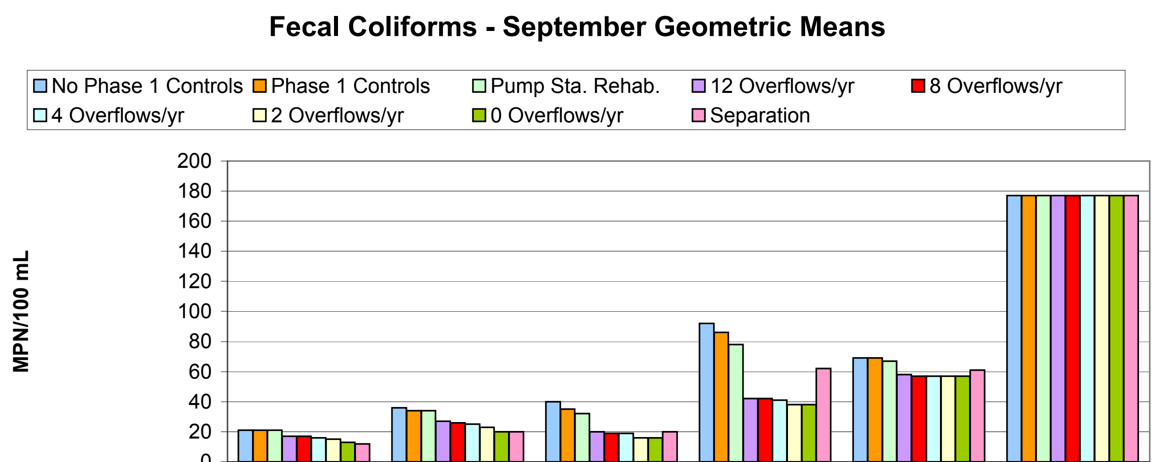
[1] Storm water: 40% reduction in loads, Upstream: 40% reduction in nutrients
Fecal coliforms at 80% of water quality standard (concentration = 160/100 ml)

Figure C-17
Potomac River: Effect of CSO Control on Fecal Coliform Concentrations
(Upstream and Stormwater Load Reduction[1])



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	21	36	40	92	69	177
Phase 1 Controls	21	34	35	86	69	177
Pump Sta. Rehab.	21	34	32	78	67	177
12 Overflows/yr	17	27	20	42	58	177
8 Overflows/yr	17	26	19	42	57	177
4 Overflows/yr	16	25	19	41	57	177
2 Overflows/yr	15	23	16	38	57	177
0 Overflows/yr	13	20	16	38	57	177
Separation	12	20	20	62	61	177

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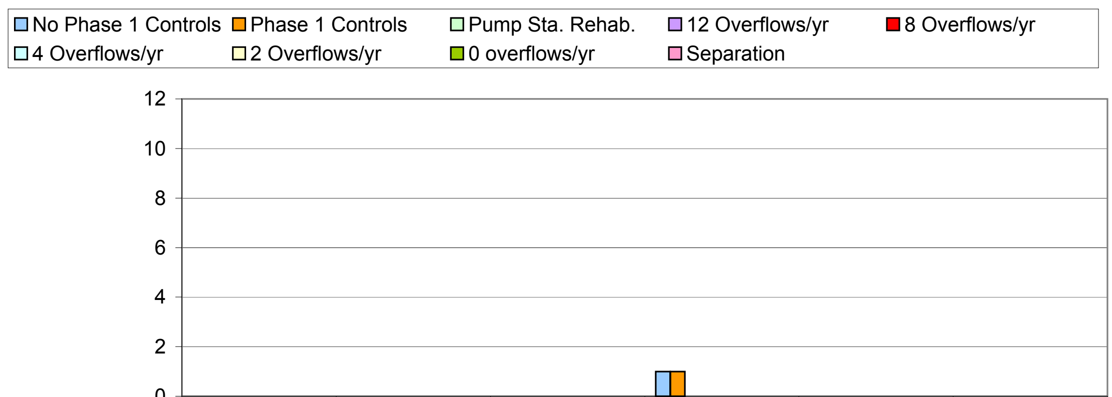
[1] Storm water: 40% reduction in loads, Upstream: 40% reduction in nutrients
Fecal coliforms at 80% of water quality standard (concentration = 160/100 ml)

Figure C-18
Potomac River: Effect of CSO Control on Fecal Coliform Concentrations
(Upstream and Stormwater Load Reduction[1])

ENTIRE CALENDAR YEAR

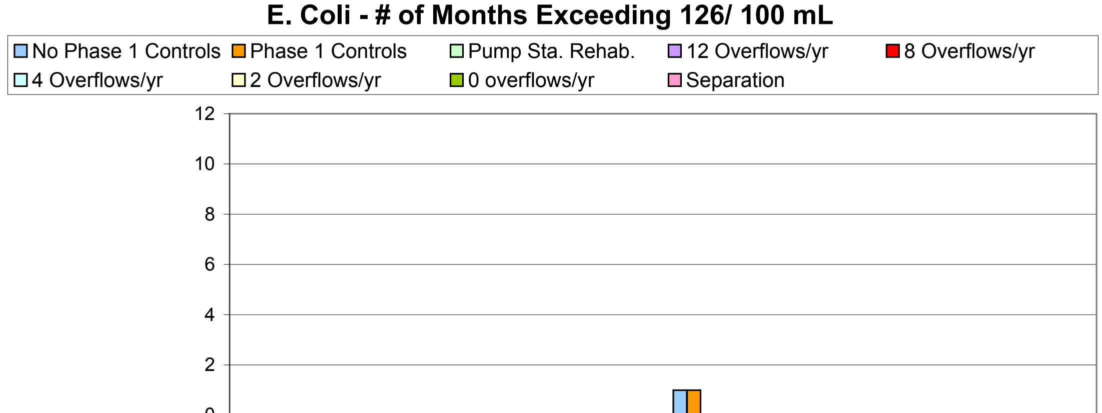
E. Coli - # of Months Exceeding 126/ 100 mL



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	0	0	0	1	0	0
Phase 1 Controls	0	0	0	1	0	0
Pump Sta. Rehab.	0	0	0	0	0	0
12 Overflows/yr	0	0	0	0	0	0
8 Overflows/yr	0	0	0	0	0	0
4 Overflows/yr	0	0	0	0	0	0
2 Overflows/yr	0	0	0	0	0	0
0 overflows/yr	0	0	0	0	0	0
Separation	0	0	0	0	0	0

MAY THROUGH SEPTEMBER

E. Coli - # of Months Exceeding 126/ 100 mL



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	0	0	0	1	0	0
Phase 1 Controls	0	0	0	1	0	0
Pump Sta. Rehab.	0	0	0	0	0	0
12 Overflows/yr	0	0	0	0	0	0
8 Overflows/yr	0	0	0	0	0	0
4 Overflows/yr	0	0	0	0	0	0
2 Overflows/yr	0	0	0	0	0	0
0 overflows/yr	0	0	0	0	0	0
Separation	0	0	0	0	0	0

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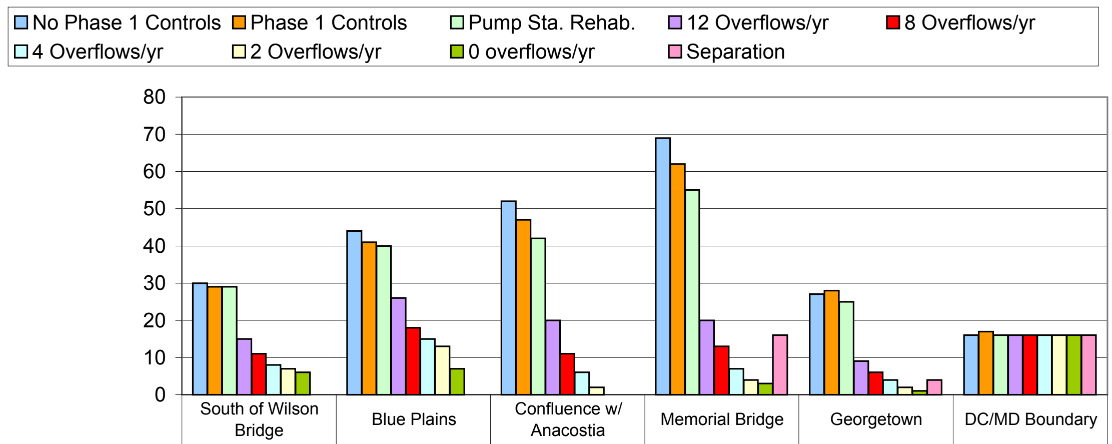
[1] Storm water: 40% reduction in loads, Upstream: 40% reduction in nutrients
Fecal coliforms at 80% of water quality standard (concentration = 160/100 ml)

Figure C-19
Potomac River: Effect of CSO Control on Fecal Coliform Concentrations
(Upstream and Stormwater Load Reduction[1])

ENTIRE CALENDAR YEAR

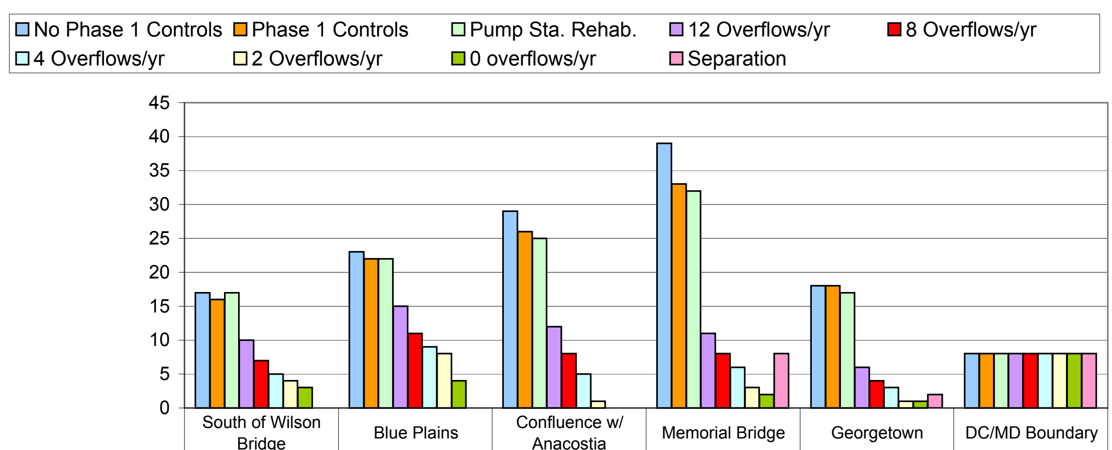
E. Coli - # of Days Exceeding 126/100 mL



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	30	44	52	69	27	16
Phase 1 Controls	29	41	47	62	28	17
Pump Sta. Rehab.	29	40	42	55	25	16
12 Overflows/yr	15	26	20	20	9	16
8 Overflows/yr	11	18	11	13	6	16
4 Overflows/yr	8	15	6	7	4	16
2 Overflows/yr	7	13	2	4	2	16
0 overflows/yr	6	7	0	3	1	16
Separation	0	0	0	16	4	16

MAY THROUGH SEPTEMBER

E. Coli - # of Days Exceeding 126/100 mL



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	17	23	29	39	18	8
Phase 1 Controls	16	22	26	33	18	8
Pump Sta. Rehab.	17	22	25	32	17	8
12 Overflows/yr	10	15	12	11	6	8
8 Overflows/yr	7	11	8	8	4	8
4 Overflows/yr	5	9	5	6	3	8
2 Overflows/yr	4	8	1	3	1	8
0 overflows/yr	3	4	0	2	1	8
Separation	0	0	0	8	2	8

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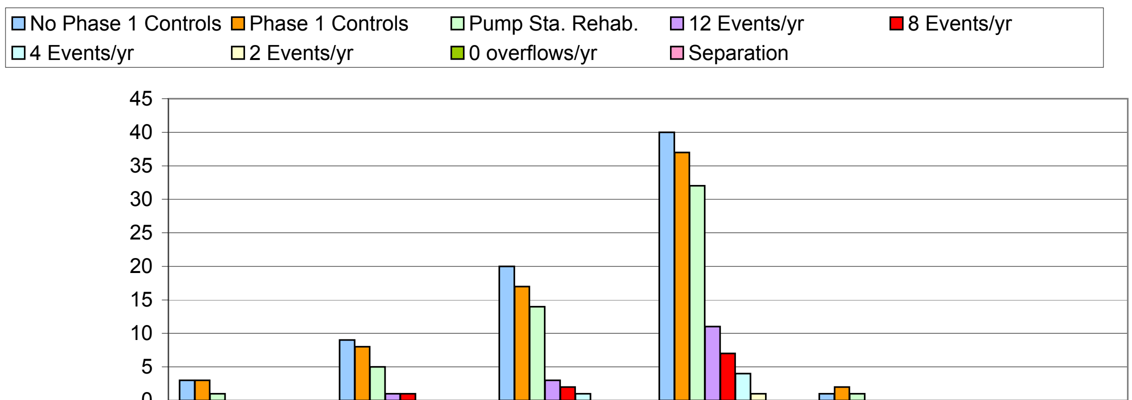
[1] Storm water: 40% reduction in loads, Upstream: 40% reduction in nutrients
Fecal coliforms at 80% of water quality standard (concentration = 160/100 ml)

District of Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

Figure C-20
Potomac River: Effect of CSO Control on Fecal Coliform Concentrations
(Upstream and Stormwater Load Reduction[1])

ENTIRE CALENDAR YEAR

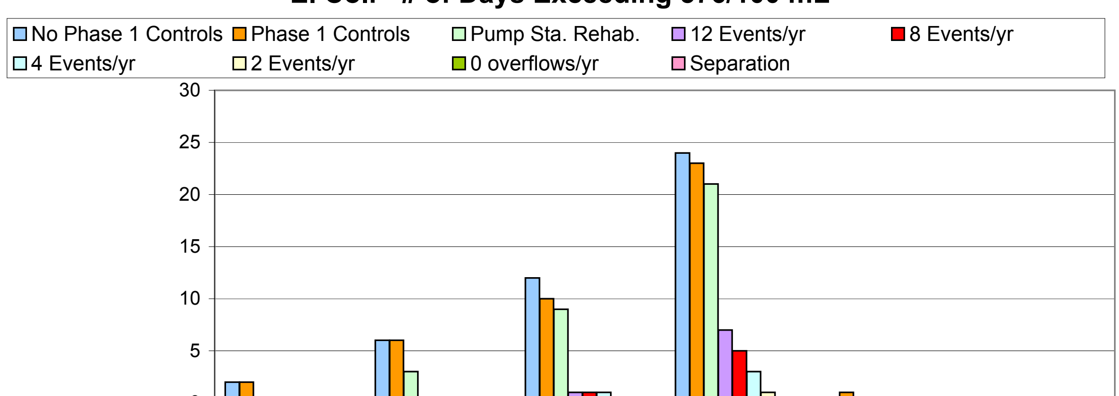
E. Coli - # of Days Exceeding 576/100 mL



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	3	9	20	40	1	0
Phase 1 Controls	3	8	17	37	2	0
Pump Sta. Rehab.	1	5	14	32	1	0
12 Events/yr	0	1	3	11	0	0
8 Events/yr	0	1	2	7	0	0
4 Events/yr	0	0	1	4	0	0
2 Events/yr	0	0	0	1	0	0
0 overflows/yr	0	0	0	0	0	0
Separation	0	0	0	0	0	0

MAY THROUGH SEPTEMBER

E. Coli - # of Days Exceeding 576/100 mL



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	2	6	12	24	0	0
Phase 1 Controls	2	6	10	23	1	0
Pump Sta. Rehab.	0	3	9	21	0	0
12 Events/yr	0	0	1	7	0	0
8 Events/yr	0	0	1	5	0	0
4 Events/yr	0	0	1	3	0	0
2 Events/yr	0	0	0	1	0	0
0 overflows/yr	0	0	0	0	0	0
Separation	0	0	0	0	0	0

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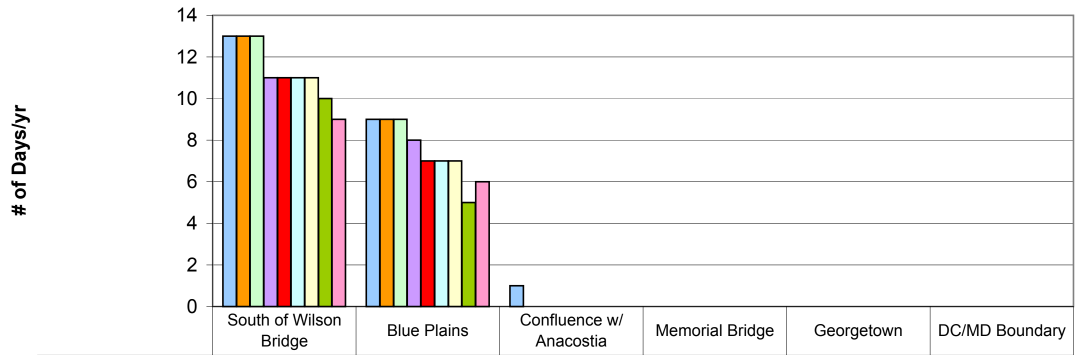
[1] Storm water: 40% reduction in loads, Upstream: 40% reduction in nutrients
Fecal coliforms at 80% of water quality standard (concentration = 160/100 ml)

Figure C-21
Potomac River: Effect of CSO Control on Fecal Coliform Concentrations
(Upstream and Stormwater Load Reduction[1])

Dissolved Oxygen - # of Days Dissolved Oxygen <5.0 mg/L

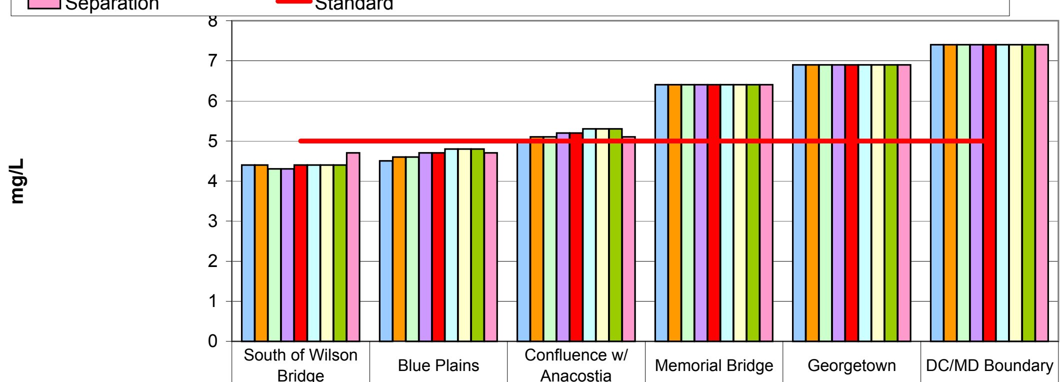
No Phase 1 Controls, Phase 1 Controls, Pump Sta. Rehab., 12 Overflows/yr, 8 Overflows/yr, 4 Overflows/yr, 2 Overflows/yr, 0 Overflows/yr, Separation



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	13	9	1	0	0	0
Phase 1 Controls	13	9	0	0	0	0
Pump Sta. Rehab.	13	9	0	0	0	0
12 Overflows/yr	11	8	0	0	0	0
8 Overflows/yr	11	7	0	0	0	0
4 Overflows/yr	11	7	0	0	0	0
2 Overflows/yr	11	7	0	0	0	0
0 Overflows/yr	10	5	0	0	0	0
Separation	9	6	0	0	0	0

Dissolved Oxygen - Minimum Day Dissolved Oxygen[2]

No Phase 1 Controls, Phase 1 Controls, Pump Sta. Rehab., 12 Overflows/yr, 8 Overflows/yr, 4 Overflows/yr, 2 Overflows/yr, 0 Overflows/yr, Separation, Standard



	South of Wilson Bridge	Blue Plains	Confluence w/ Anacostia	Memorial Bridge	Georgetown	DC/MD Boundary
No Phase 1 Controls	4.4	4.5	5	6.4	6.9	7.4
Phase 1 Controls	4.4	4.6	5.1	6.4	6.9	7.4
Pump Sta. Rehab.	4.3	4.6	5.1	6.4	6.9	7.4
12 Overflows/yr	4.3	4.7	5.2	6.4	6.9	7.4
8 Overflows/yr	4.4	4.7	5.2	6.4	6.9	7.4
4 Overflows/yr	4.4	4.8	5.3	6.4	6.9	7.4
2 Overflows/yr	4.4	4.8	5.3	6.4	6.9	7.4
0 Overflows/yr	4.4	4.8	5.3	6.4	6.9	7.4
Separation	4.7	4.7	5.1	6.4	6.9	7.4
Standard	5.0	5.0	5.0	5.0	5.0	5.0

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[1] Storm water: 40% reduction in loads, Upstream: 40% reduction in nutrients
Fecal coliforms at 80% of water quality standard (concentration = 160/100 ml)
[2] Minimum dissolved oxygen for entire 3 year period (1988-1990)

District of Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

APPENDIX D

Effect of CSO Controls on Water Quality
Rock Creek

District of Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

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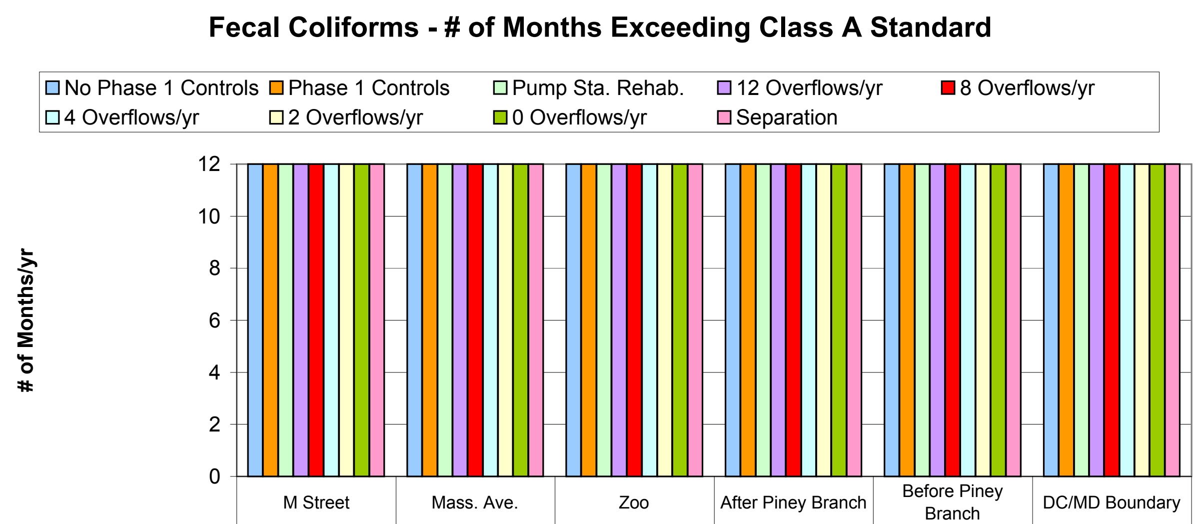
Appendix D – Effect of CSO Controls on Water Quality in Rock Creek

District of Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

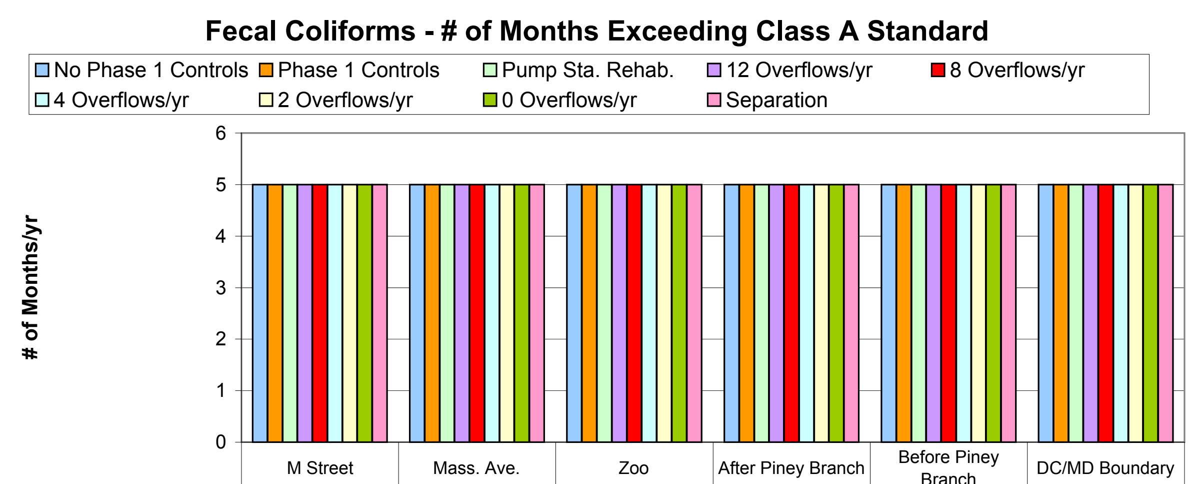
Figure D-1
Rock Creek: Effect of CSO Control on Fecal Coliform Concentrations
(No Change in Upstream or Stormwater Loads)

ENTIRE CALENDAR YEAR



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	12	12	12	12	12	12
Phase 1 Controls	12	12	12	12	12	12
Pump Sta. Rehab.	12	12	12	12	12	12
12 Overflows/yr	12	12	12	12	12	12
8 Overflows/yr	12	12	12	12	12	12
4 Overflows/yr	12	12	12	12	12	12
2 Overflows/yr	12	12	12	12	12	12
0 Overflows/yr	12	12	12	12	12	12
Separation	12	12	12	12	12	12

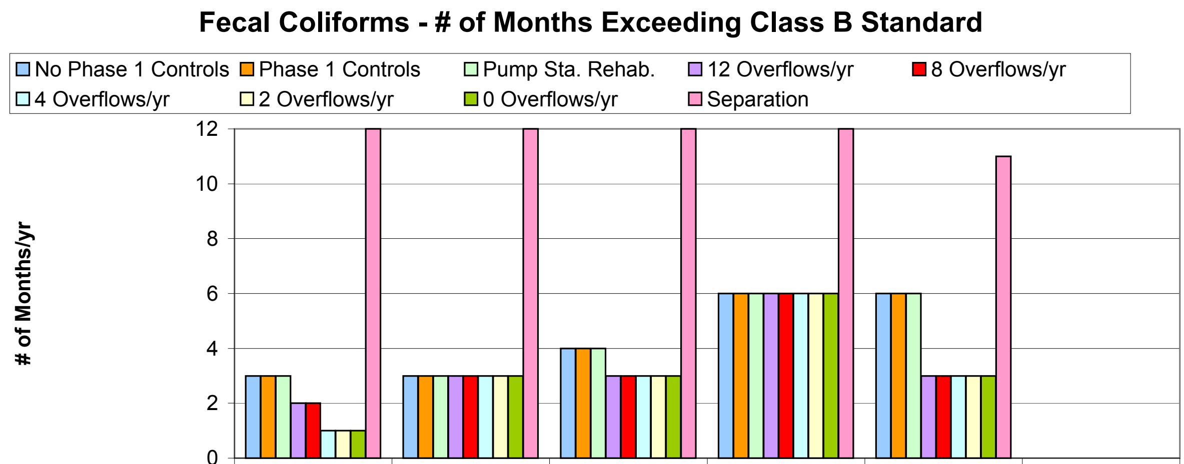
MAY THROUGH SEPTEMBER



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	5	5	5	5	5	5
Phase 1 Controls	5	5	5	5	5	5
Pump Sta. Rehab.	5	5	5	5	5	5
12 Overflows/yr	5	5	5	5	5	5
8 Overflows/yr	5	5	5	5	5	5
4 Overflows/yr	5	5	5	5	5	5
2 Overflows/yr	5	5	5	5	5	5
0 Overflows/yr	5	5	5	5	5	5
Separation	5	5	5	5	5	5

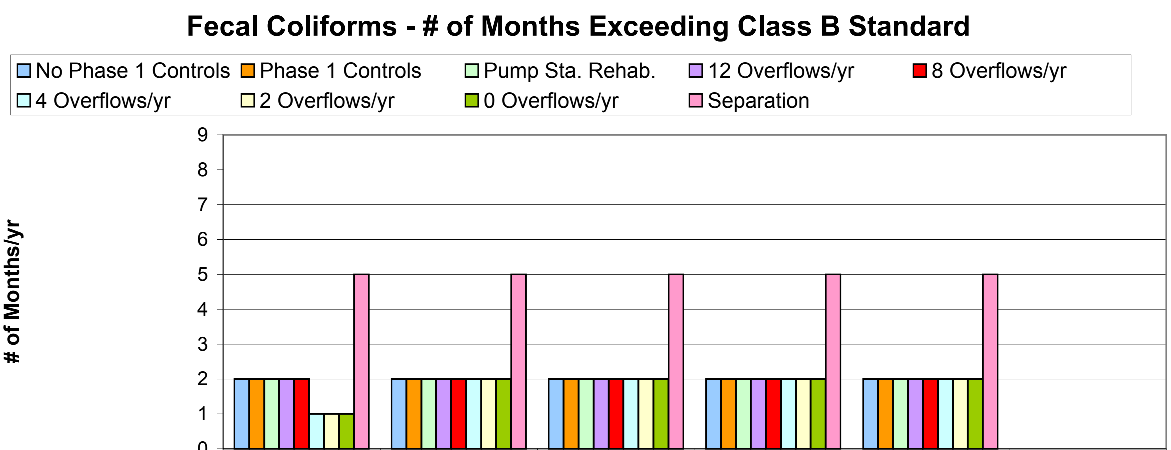
Figure D-2
Rock Creek: Effect of CSO Control on Fecal Coliform Concentrations
(No Change in Upstream or Stormwater Loads)

ENTIRE CALENDAR YEAR



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	3	3	4	6	6	0
Phase 1 Controls	3	3	4	6	6	0
Pump Sta. Rehab.	3	3	4	6	6	0
12 Overflows/yr	2	3	3	6	3	0
8 Overflows/yr	2	3	3	6	3	0
4 Overflows/yr	1	3	3	6	3	0
2 Overflows/yr	1	3	3	6	3	0
0 Overflows/yr	1	3	3	6	3	0
Separation	12	12	12	12	11	0

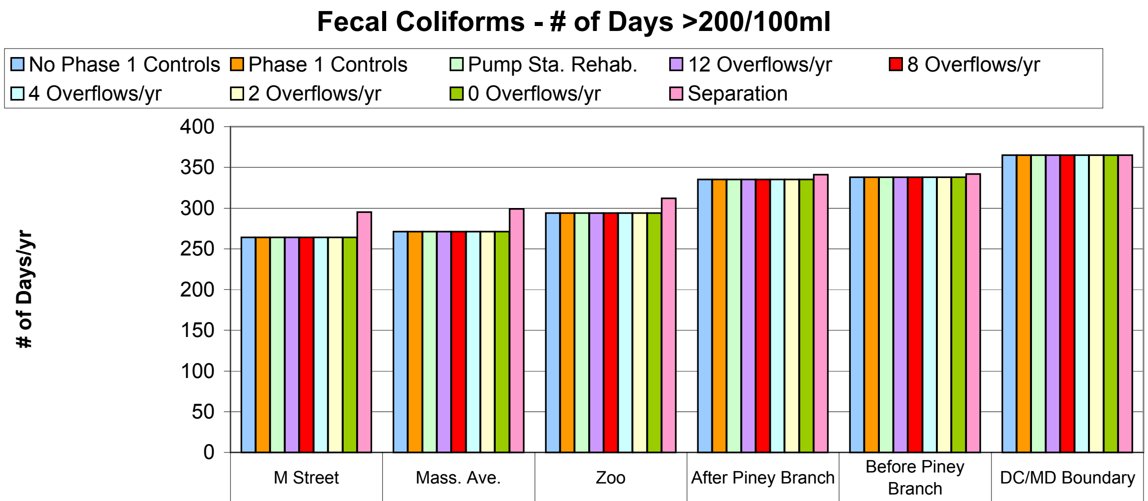
MAY THROUGH SEPTEMBER



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	2	2	2	2	2	0
Phase 1 Controls	2	2	2	2	2	0
Pump Sta. Rehab.	2	2	2	2	2	0
12 Overflows/yr	2	2	2	2	2	0
8 Overflows/yr	2	2	2	2	2	0
4 Overflows/yr	1	2	2	2	2	0
2 Overflows/yr	1	2	2	2	2	0
0 Overflows/yr	1	2	2	2	2	0
Separation	5	5	5	5	5	0

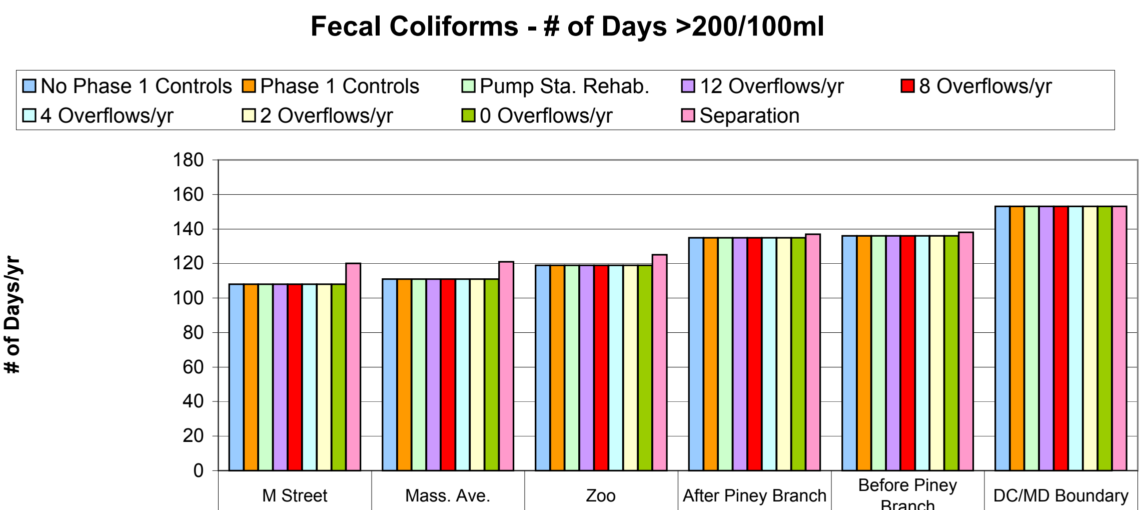
Figure D-3
Rock Creek: Effect of CSO Control on Fecal Coliform Concentrations
(No Change in Upstream or Stormwater Loads)

ENTIRE CALENDAR YEAR



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	264	271	294	335	338	365
Phase 1 Controls	264	271	294	335	338	365
Pump Sta. Rehab.	264	271	294	335	338	365
12 Overflows/yr	264	271	294	335	338	365
8 Overflows/yr	264	271	294	335	338	365
4 Overflows/yr	264	271	294	335	338	365
2 Overflows/yr	264	271	294	335	338	365
0 Overflows/yr	264	271	294	335	338	365
Separation	295	299	312	341	342	365

MAY THROUGH SEPTEMBER



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	108	111	119	135	136	153
Phase 1 Controls	108	111	119	135	136	153
Pump Sta. Rehab.	108	111	119	135	136	153
12 Overflows/yr	108	111	119	135	136	153
8 Overflows/yr	108	111	119	135	136	153
4 Overflows/yr	108	111	119	135	136	153
2 Overflows/yr	108	111	119	135	136	153
0 Overflows/yr	108	111	119	135	136	153
Separation	120	121	125	137	138	153

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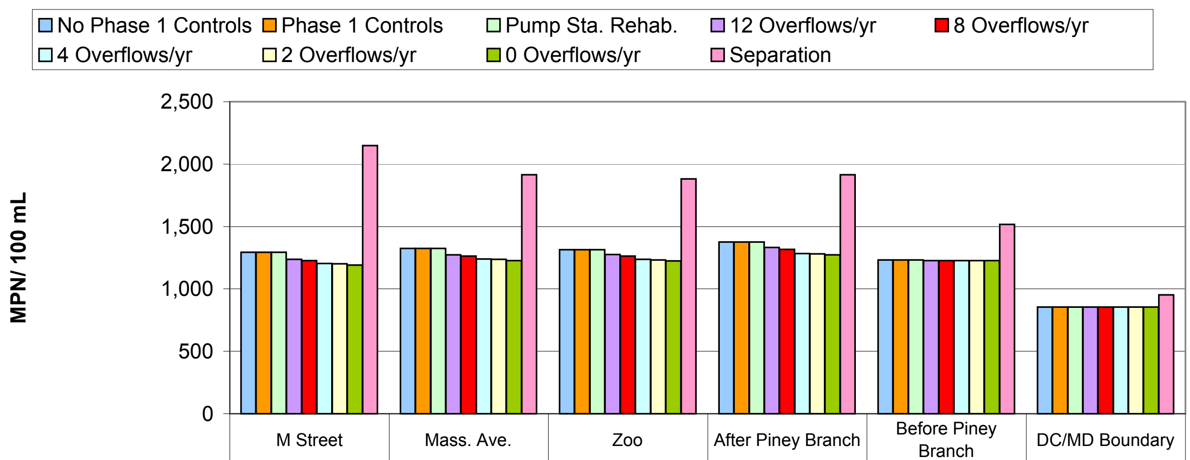
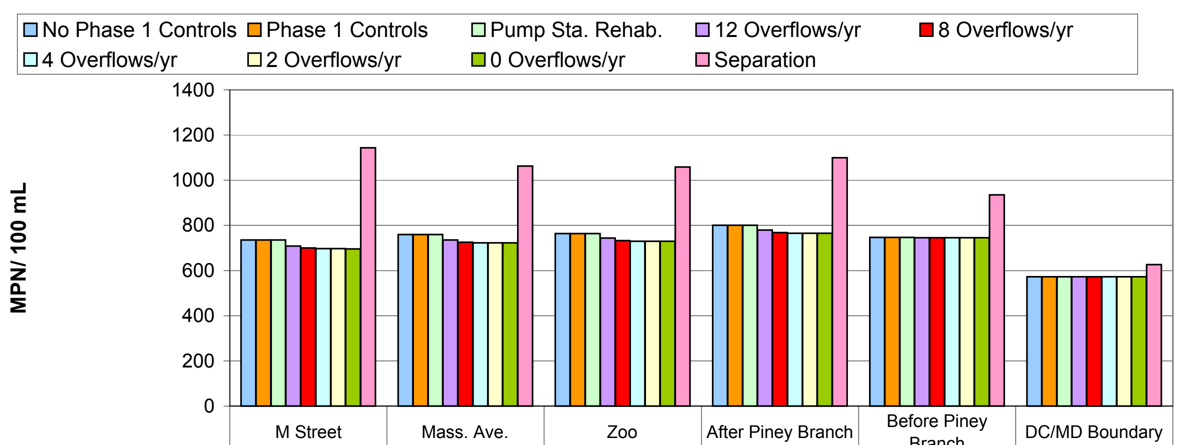
Figure D-4
Rock Creek: Effect of CSO Control on Fecal Coliform Concentrations
(No Change in Upstream or Stormwater Loads)

Fecal Coliforms - May Geometric Means



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	1,293	1,325	1,313	1,377	1,233	855
Phase 1 Controls	1,293	1,325	1,313	1,377	1,233	855
Pump Sta. Rehab.	1,293	1,325	1,313	1,377	1,233	855
12 Overflows/yr	1,237	1,274	1,276	1,332	1,228	855
8 Overflows/yr	1,227	1,263	1,264	1,317	1,228	855
4 Overflows/yr	1,205	1,239	1,236	1,284	1,228	855
2 Overflows/yr	1,202	1,237	1,233	1,281	1,228	855
0 Overflows/yr	1,192	1,228	1,224	1,272	1,228	855
Separation	2,149	1,916	1,882	1,916	1,516	952

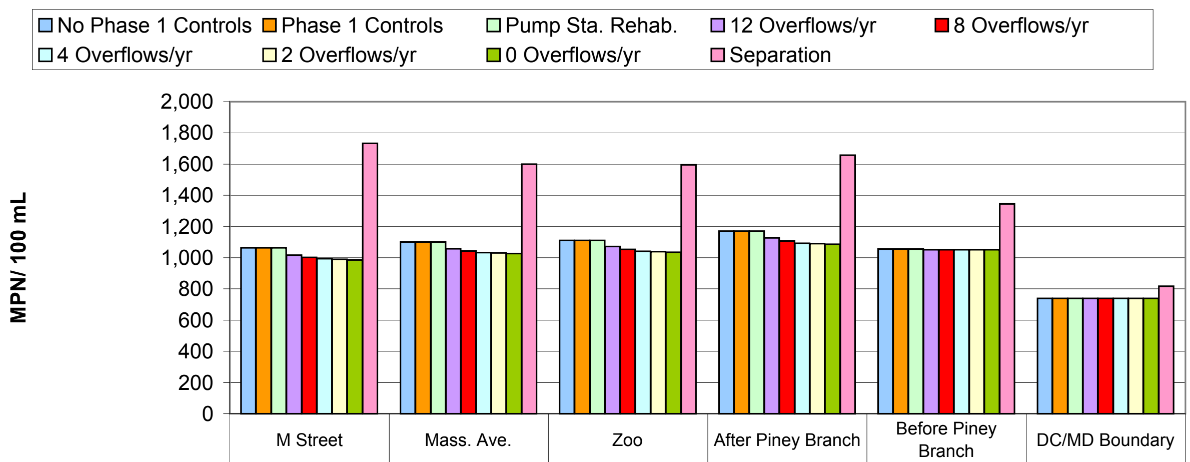
Fecal Coliforms - June Geometric Means



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	735	760	764	801	747	573
Phase 1 Controls	735	760	764	801	747	573
Pump Sta. Rehab.	735	760	764	801	747	573
12 Overflows/yr	709	735	744	780	746	573
8 Overflows/yr	700	726	733	768	746	573
4 Overflows/yr	697	723	730	765	746	573
2 Overflows/yr	697	723	730	765	746	573
0 Overflows/yr	696	722	730	765	746	573
Separation	1143	1063	1059	1099	935	627

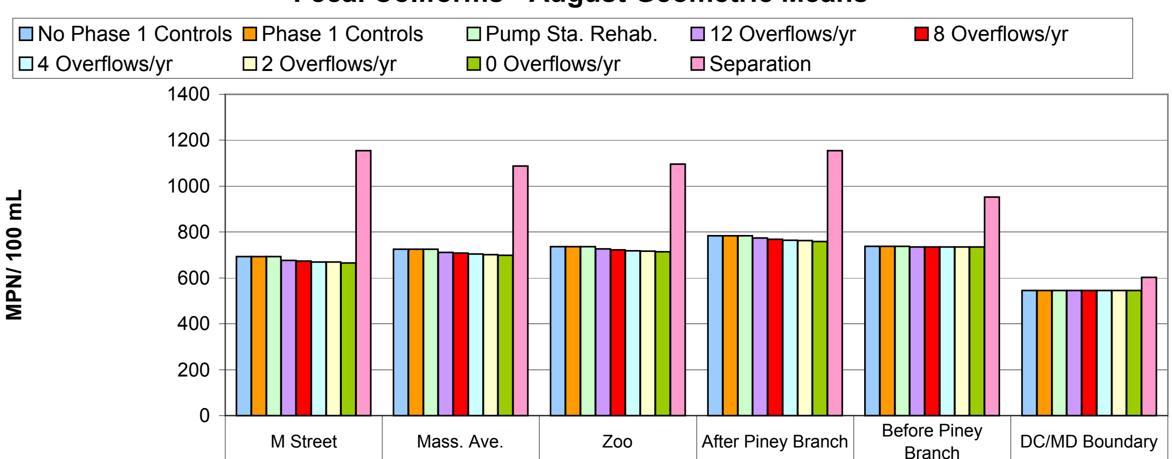
Figure D-5
Rock Creek: Effect of CSO Control on Fecal Coliform Concentrations
(No Change in Upstream or Stormwater Loads)

Fecal Coliforms - July Geometric Means



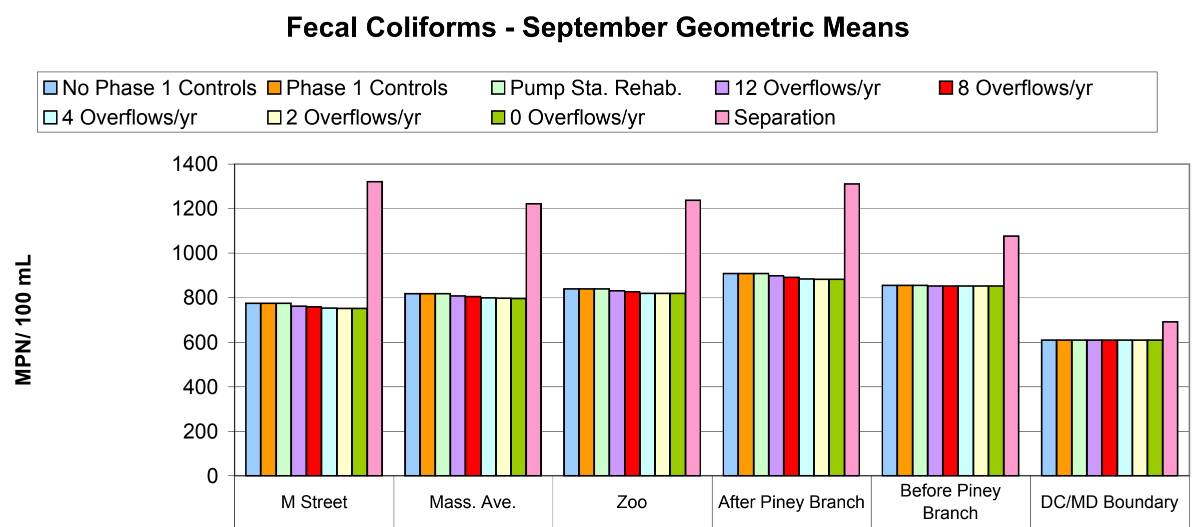
	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	1,064	1,100	1,110	1,170	1,055	739
Phase 1 Controls	1,064	1,100	1,110	1,170	1,055	739
Pump Sta. Rehab.	1,064	1,100	1,110	1,170	1,055	739
12 Overflows/yr	1,017	1,058	1,071	1,127	1,051	739
8 Overflows/yr	1,003	1,043	1,053	1,106	1,051	739
4 Overflows/yr	993	1,032	1,041	1,093	1,051	739
2 Overflows/yr	990	1,030	1,039	1,090	1,051	739
0 Overflows/yr	986	1,026	1,035	1,087	1,051	739
Separation	1,734	1,599	1,596	1,657	1,345	817

Fecal Coliforms - August Geometric Means



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	693	725	736	784	738	545
Phase 1 Controls	693	725	736	784	738	545
Pump Sta. Rehab.	693	725	736	784	738	545
12 Overflows/yr	676	711	727	774	735	545
8 Overflows/yr	673	708	723	769	735	545
4 Overflows/yr	670	704	718	764	735	545
2 Overflows/yr	669	702	717	763	735	545
0 Overflows/yr	665	699	714	759	735	545
Separation	1155	1087	1096	1154	953	603

Figure D-6
Rock Creek: Effect of CSO Control on Fecal Coliform Concentrations
(No Change in Upstream or Stormwater Loads)



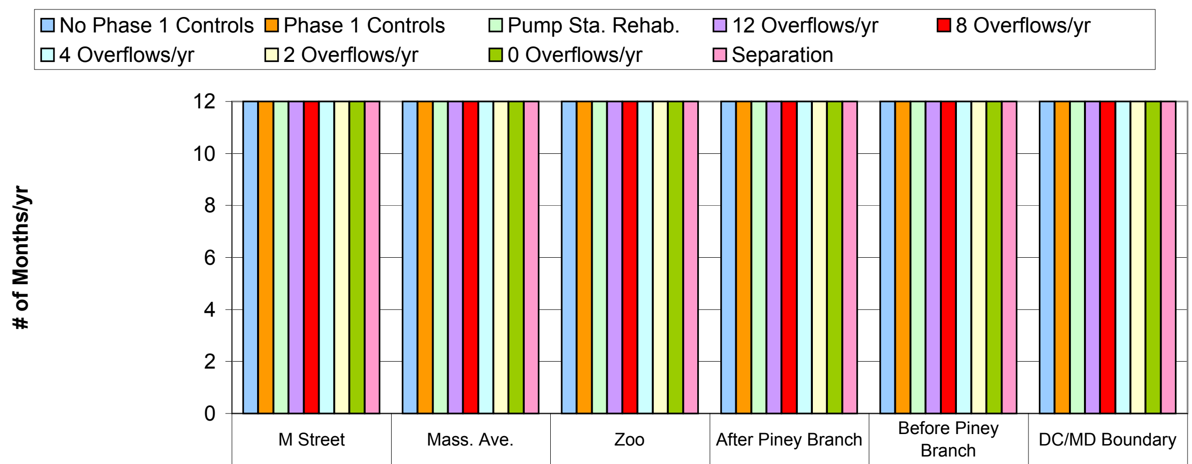
	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	775	818	840	908	855	609
Phase 1 Controls	775	818	840	908	855	609
Pump Sta. Rehab.	775	818	840	908	855	609
12 Overflows/yr	762	808	831	898	853	609
8 Overflows/yr	759	805	827	891	853	609
4 Overflows/yr	753	799	820	884	853	609
2 Overflows/yr	752	798	819	883	853	609
0 Overflows/yr	752	797	819	882	853	609
Separation	1321	1222	1237	1311	1076	691

District of Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

Figure D-7
Rock Creek: Effect of CSO Control on Fecal Coliform Concentrations
(No Change in Upstream or Stormwater Loads)

ENTIRE CALENDAR YEAR

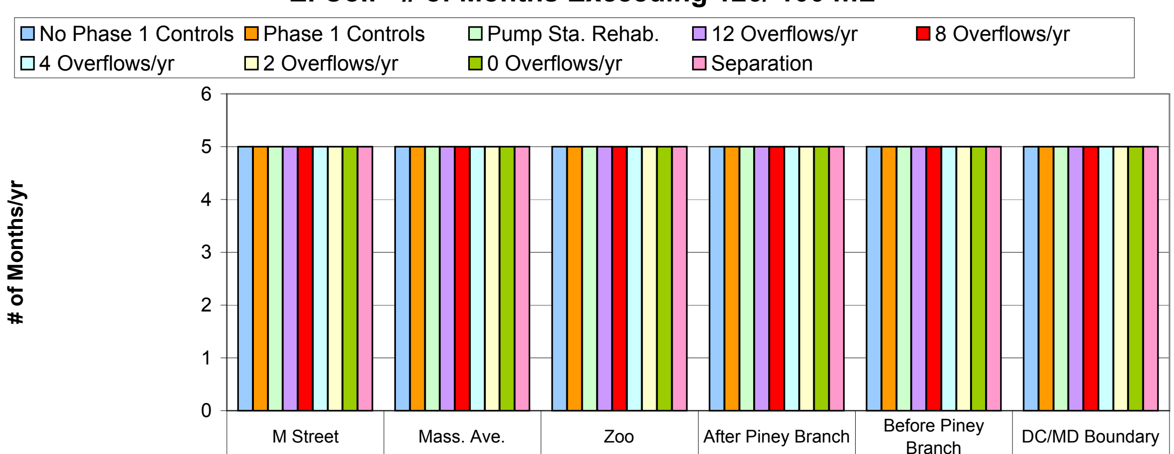
E. Coli - # of Months Exceeding 126/ 100 mL



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	12	12	12	12	12	12
Phase 1 Controls	12	12	12	12	12	12
Pump Sta. Rehab.	12	12	12	12	12	12
12 Overflows/yr	12	12	12	12	12	12
8 Overflows/yr	12	12	12	12	12	12
4 Overflows/yr	12	12	12	12	12	12
2 Overflows/yr	12	12	12	12	12	12
0 Overflows/yr	12	12	12	12	12	12
Separation	12	12	12	12	12	12

MAY THROUGH SEPTEMBER

E. Coli - # of Months Exceeding 126/ 100 mL

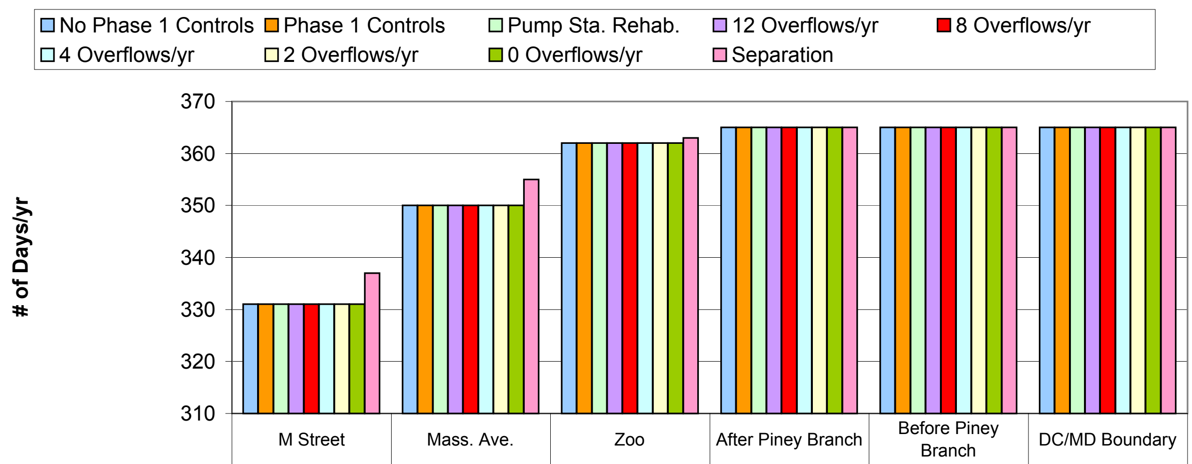


	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	5	5	5	5	5	5
Phase 1 Controls	5	5	5	5	5	5
Pump Sta. Rehab.	5	5	5	5	5	5
12 Overflows/yr	5	5	5	5	5	5
8 Overflows/yr	5	5	5	5	5	5
4 Overflows/yr	5	5	5	5	5	5
2 Overflows/yr	5	5	5	5	5	5
0 Overflows/yr	5	5	5	5	5	5
Separation	5	5	5	5	5	5

Figure D-8
Rock Creek: Effect of CSO Control on Fecal Coliform Concentrations
(No Change in Upstream or Stormwater Loads)

ENTIRE CALENDAR YEAR

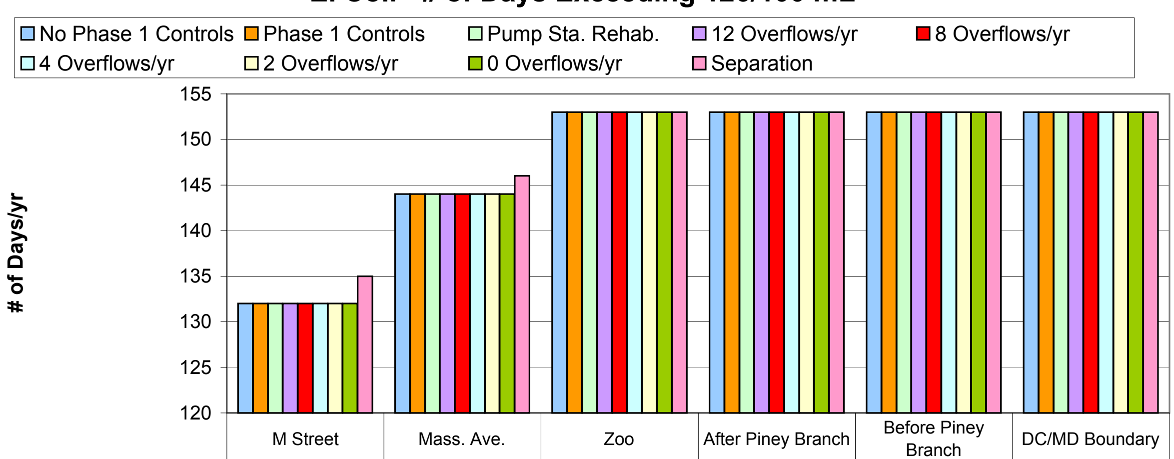
E. Coli - # of Days Exceeding 126/100 mL



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	331	350	362	365	365	365
Phase 1 Controls	331	350	362	365	365	365
Pump Sta. Rehab.	331	350	362	365	365	365
12 Overflows/yr	331	350	362	365	365	365
8 Overflows/yr	331	350	362	365	365	365
4 Overflows/yr	331	350	362	365	365	365
2 Overflows/yr	331	350	362	365	365	365
0 Overflows/yr	331	350	362	365	365	365
Separation	337	355	363	365	365	365

MAY THROUGH SEPTEMBER

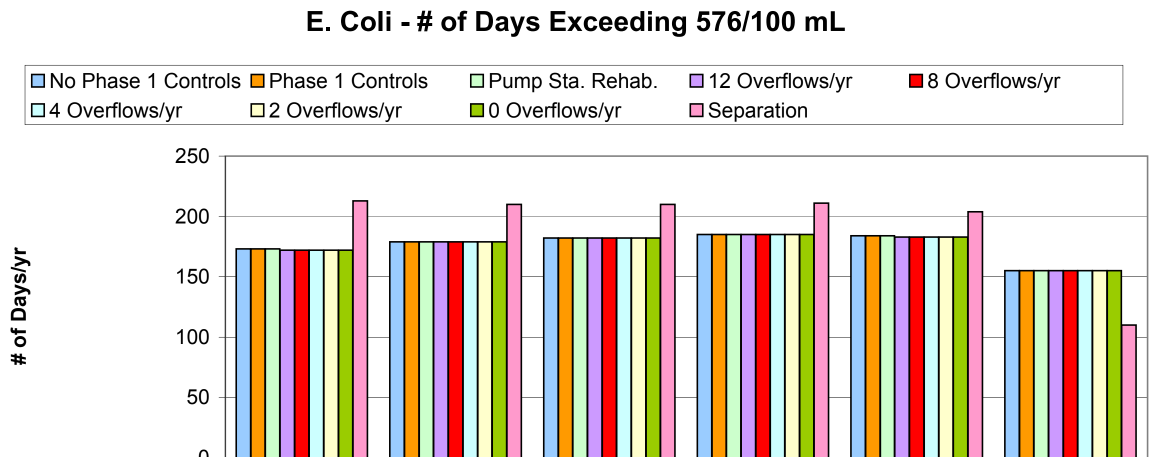
E. Coli - # of Days Exceeding 126/100 mL



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	132	144	153	153	153	153
Phase 1 Controls	132	144	153	153	153	153
Pump Sta. Rehab.	132	144	153	153	153	153
12 Overflows/yr	132	144	153	153	153	153
8 Overflows/yr	132	144	153	153	153	153
4 Overflows/yr	132	144	153	153	153	153
2 Overflows/yr	132	144	153	153	153	153
0 Overflows/yr	132	144	153	153	153	153
Separation	135	146	153	153	153	153

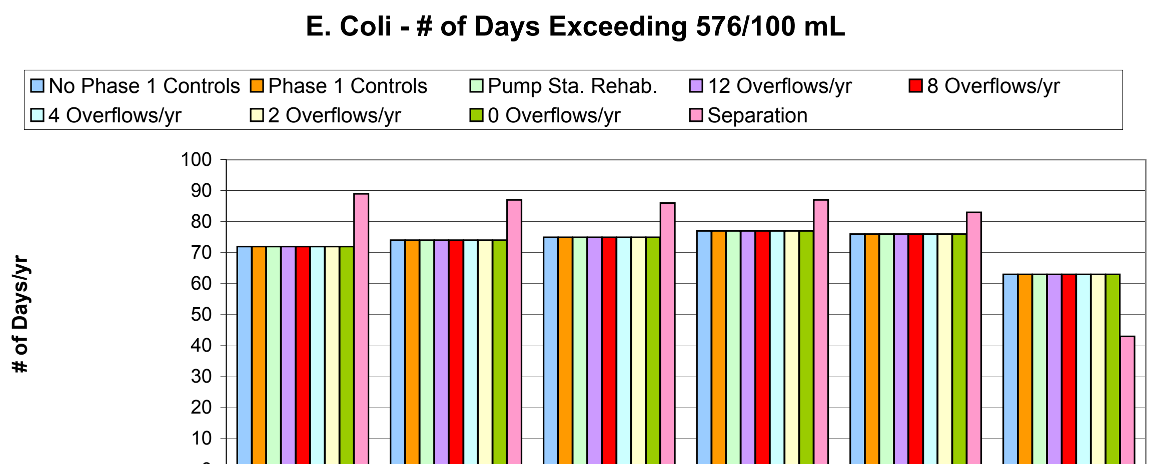
Figure D-9
Rock Creek: Effect of CSO Control on Fecal Coliform Concentrations
(No Change in Upstream or Stormwater Loads)

ENTIRE CALENDAR YEAR



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	173	179	182	185	184	155
Phase 1 Controls	173	179	182	185	184	155
Pump Sta. Rehab.	173	179	182	185	184	155
12 Overflows/yr	172	179	182	185	183	155
8 Overflows/yr	172	179	182	185	183	155
4 Overflows/yr	172	179	182	185	183	155
2 Overflows/yr	172	179	182	185	183	155
0 Overflows/yr	172	179	182	185	183	155
Separation	213	210	210	211	204	110

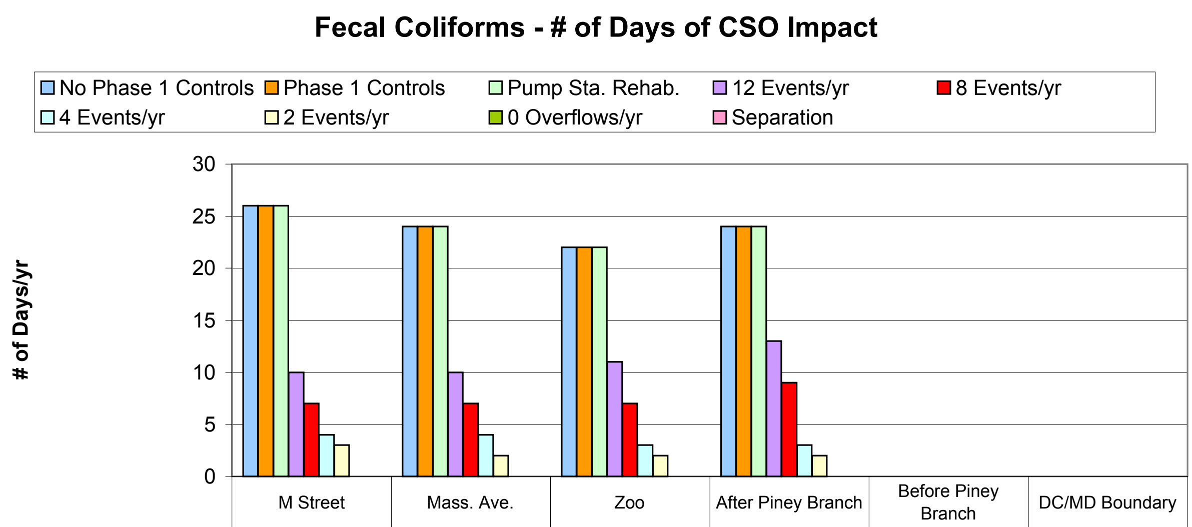
MAY THROUGH SEPTEMBER



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	72	74	75	77	76	63
Phase 1 Controls	72	74	75	77	76	63
Pump Sta. Rehab.	72	74	75	77	76	63
12 Overflows/yr	72	74	75	77	76	63
8 Overflows/yr	72	74	75	77	76	63
4 Overflows/yr	72	74	75	77	76	63
2 Overflows/yr	72	74	75	77	76	63
0 Overflows/yr	72	74	75	77	76	63
Separation	89	87	86	87	83	43

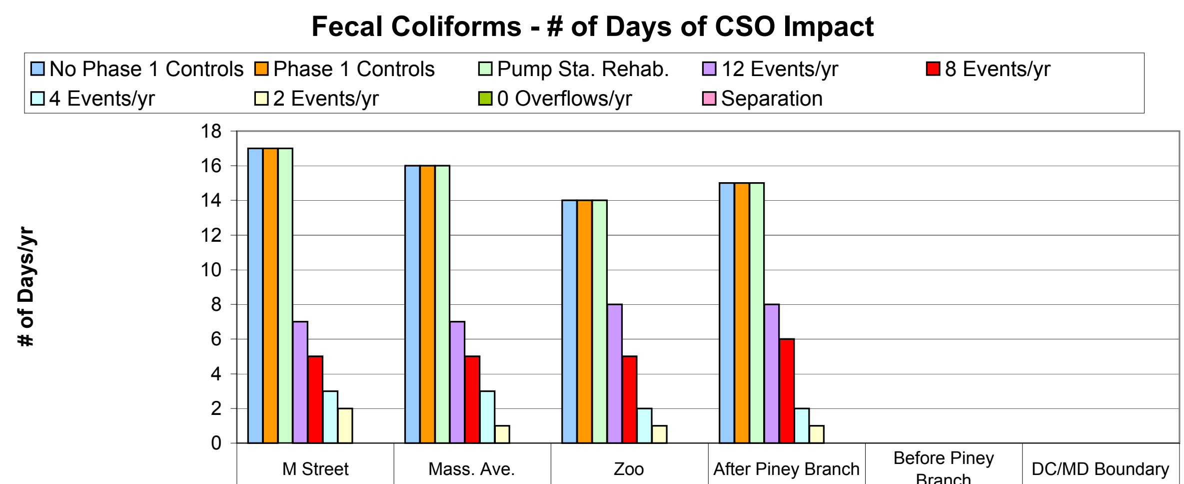
Figure D-10
Rock Creek: Effect of CSO Control on Fecal Coliform Concentrations
(CSO Loads Only - no other loads present)

ENTIRE CALENDAR YEAR



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	26	24	22	24	0	0
Phase 1 Controls	26	24	22	24	0	0
Pump Sta. Rehab.	26	24	22	24	0	0
12 Events/yr	10	10	11	13	0	0
8 Events/yr	7	7	7	9	0	0
4 Events/yr	4	4	3	3	0	0
2 Events/yr	3	2	2	2	0	0
0 Overflows/yr	0	0	0	0	0	0
Separation	0	0	0	0	0	0

MAY THROUGH SEPTEMBER



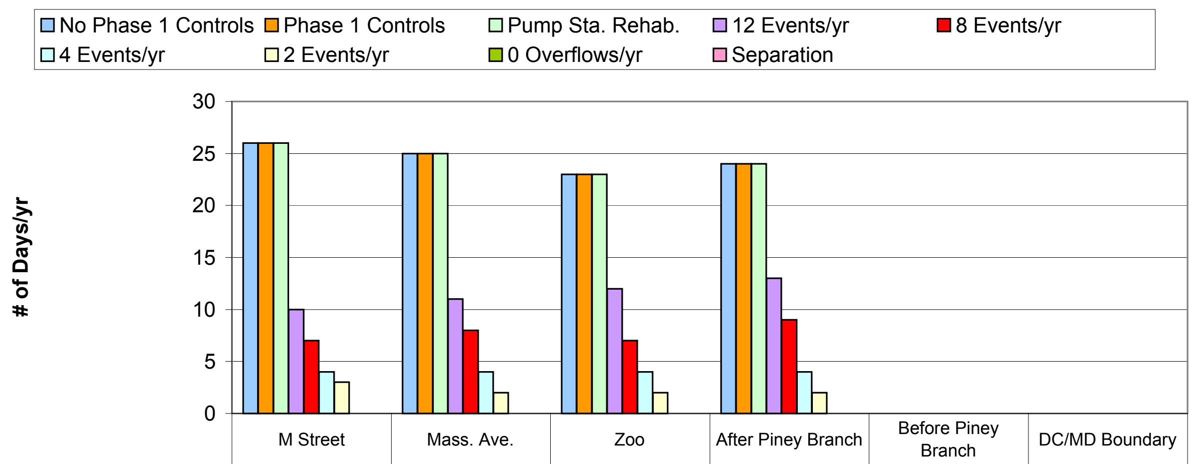
	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	17	16	14	15	0	0
Phase 1 Controls	17	16	14	15	0	0
Pump Sta. Rehab.	17	16	14	15	0	0
12 Events/yr	7	7	8	8	0	0
8 Events/yr	5	5	5	6	0	0
4 Events/yr	3	3	2	2	0	0
2 Events/yr	2	1	1	1	0	0
0 Overflows/yr	0	0	0	0	0	0
Separation	0	0	0	0	0	0

District of Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

Figure D-11
Rock Creek: Effect of CSO Control on Fecal Coliform Concentrations
(CSO Loads Only - no other loads present)

ENTIRE CALENDAR YEAR

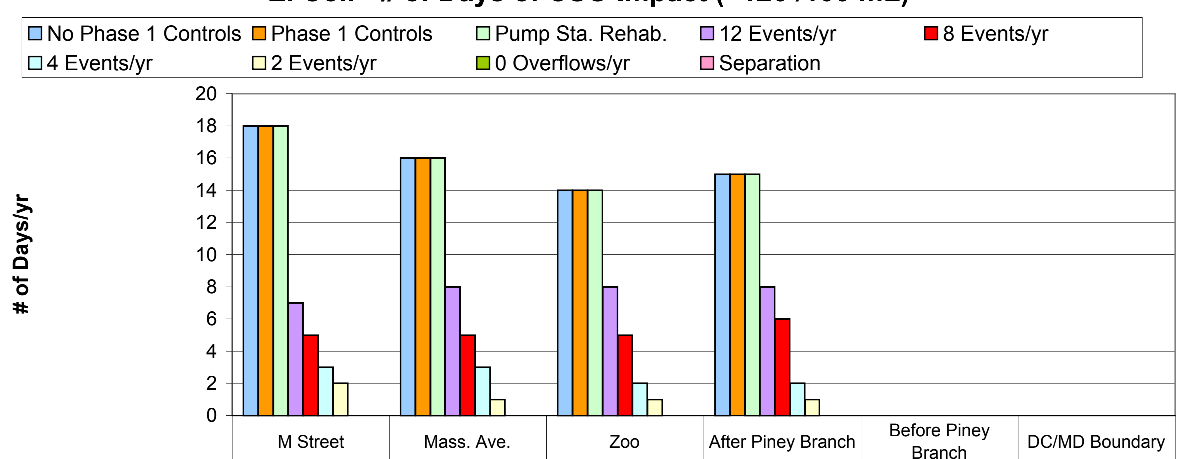
E. Coli - # of Days of CSO Impact (>126 /100 mL)



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	26	25	23	24	0	0
Phase 1 Controls	26	25	23	24	0	0
Pump Sta. Rehab.	26	25	23	24	0	0
12 Events/yr	10	11	12	13	0	0
8 Events/yr	7	8	7	9	0	0
4 Events/yr	4	4	4	4	0	0
2 Events/yr	3	2	2	2	0	0
0 Overflows/yr	0	0	0	0	0	0
Separation	0	0	0	0	0	0

MAY THROUGH SEPTEMBER

E. Coli - # of Days of CSO Impact (>126 /100 mL)



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	18	16	14	15	0	0
Phase 1 Controls	18	16	14	15	0	0
Pump Sta. Rehab.	18	16	14	15	0	0
12 Events/yr	7	8	8	8	0	0
8 Events/yr	5	5	5	6	0	0
4 Events/yr	3	3	2	2	0	0
2 Events/yr	2	1	1	1	0	0
0 Overflows/yr	0	0	0	0	0	0
Separation	0	0	0	0	0	0

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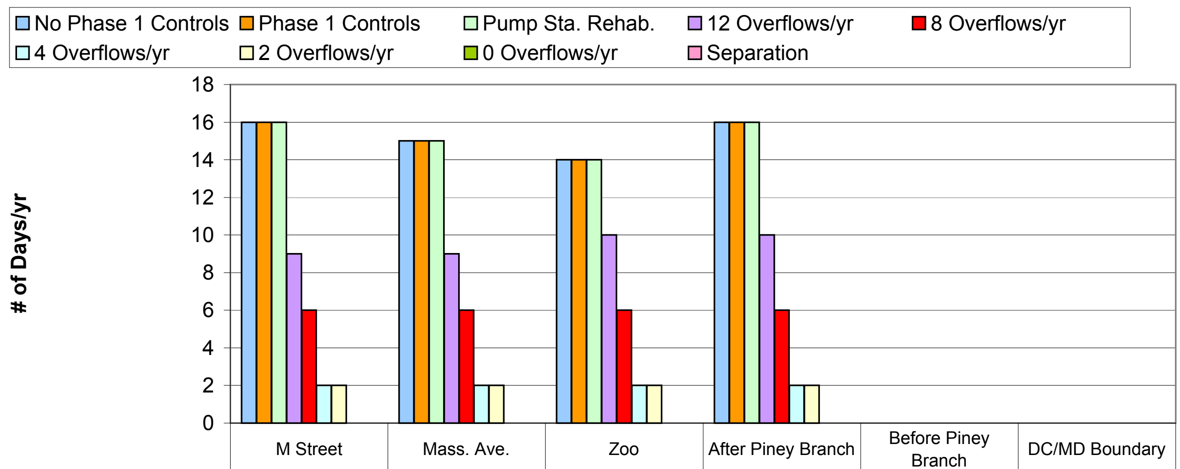
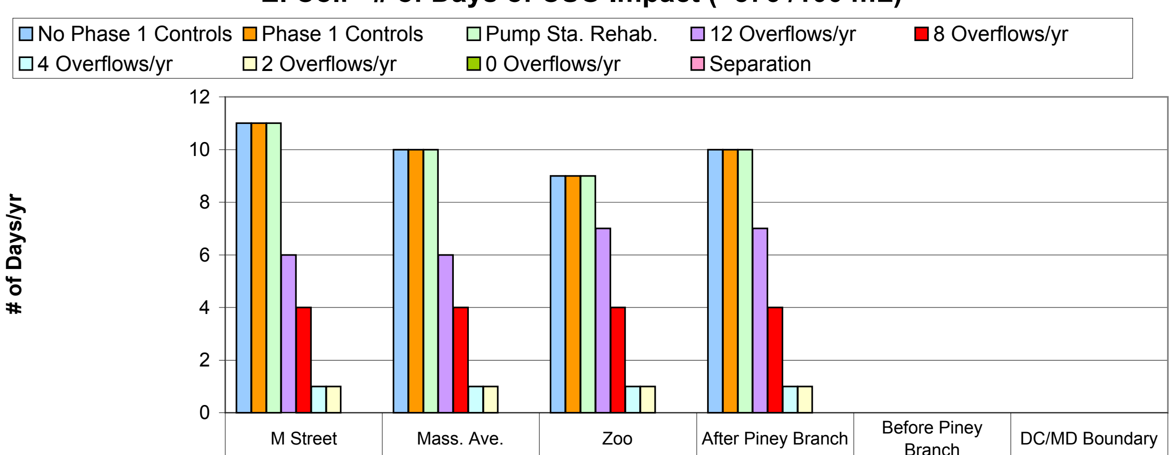
Figure D-12
Rock Creek: Effect of CSO Control on Fecal Coliform Concentrations
(CSO Loads Only - no other loads present)

E. Coli - # of Days of CSO Impact (>576 /100 mL)



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	16	15	14	16	0	0
Phase 1 Controls	16	15	14	16	0	0
Pump Sta. Rehab.	16	15	14	16	0	0
12 Overflows/yr	9	9	10	10	0	0
8 Overflows/yr	6	6	6	6	0	0
4 Overflows/yr	2	2	2	2	0	0
2 Overflows/yr	2	2	2	2	0	0
0 Overflows/yr	0	0	0	0	0	0
Separation	0	0	0	0	0	0

E. Coli - # of Days of CSO Impact (>576 /100 mL)



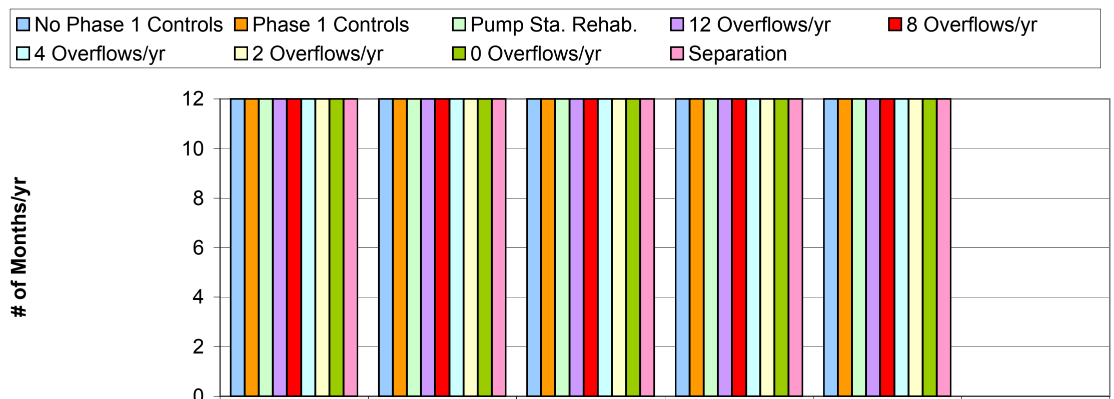
	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	11	10	9	10	0	0
Phase 1 Controls	11	10	9	10	0	0
Pump Sta. Rehab.	11	10	9	10	0	0
12 Overflows/yr	6	6	7	7	0	0
8 Overflows/yr	4	4	4	4	0	0
4 Overflows/yr	1	1	1	1	0	0
2 Overflows/yr	1	1	1	1	0	0
0 Overflows/yr	0	0	0	0	0	0
Separation	0	0	0	0	0	0

District of Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

Figure D-13
Rock Creek: Effect of CSO Control on Fecal Coliform Concentrations
(Upstream and Stormwater Load Reduction[1])

ENTIRE CALENDAR YEAR

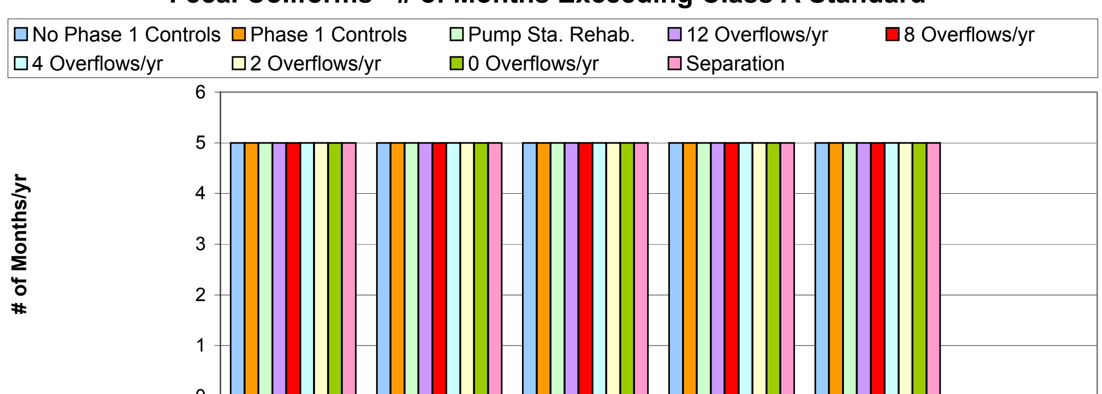
Fecal Coliforms - # of Months Exceeding Class A Standard



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	12	12	12	12	12	0
Phase 1 Controls	12	12	12	12	12	0
Pump Sta. Rehab.	12	12	12	12	12	0
12 Overflows/yr	12	12	12	12	12	0
8 Overflows/yr	12	12	12	12	12	0
4 Overflows/yr	12	12	12	12	12	0
2 Overflows/yr	12	12	12	12	12	0
0 Overflows/yr	12	12	12	12	12	0
Separation	12	12	12	12	12	0

MAY THROUGH SEPTEMBER

Fecal Coliforms - # of Months Exceeding Class A Standard



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	5	5	5	5	5	0
Phase 1 Controls	5	5	5	5	5	0
Pump Sta. Rehab.	5	5	5	5	5	0
12 Overflows/yr	5	5	5	5	5	0
8 Overflows/yr	5	5	5	5	5	0
4 Overflows/yr	5	5	5	5	5	0
2 Overflows/yr	5	5	5	5	5	0
0 Overflows/yr	5	5	5	5	5	0
Separation	5	5	5	5	5	0

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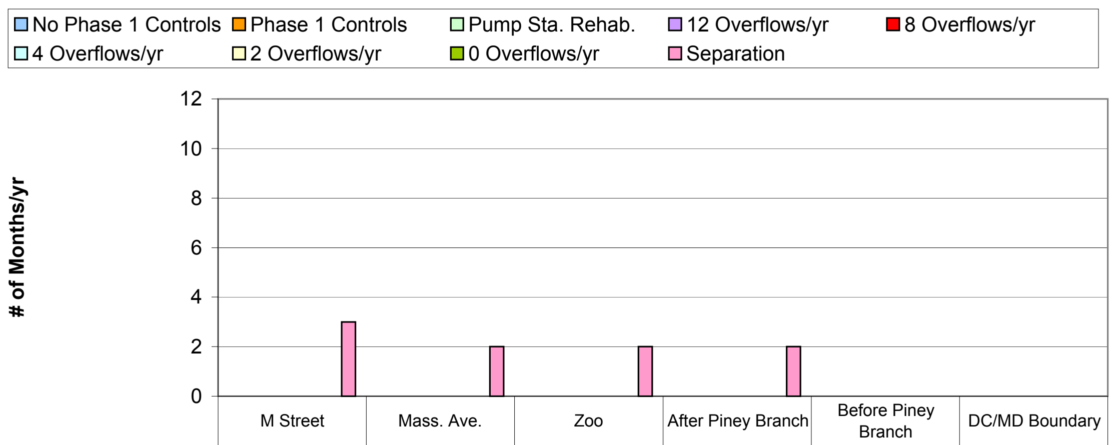
[1] Storm water: 40% reduction in loads, Upstream: 40% reduction in nutrients
Fecal coliforms at 80% of water quality standard (concentration = 160/100 ml)

District of Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

Figure D-14
Rock Creek: Effect of CSO Control on Fecal Coliform Concentrations
(Upstream and Stormwater Load Reduction[1])

ENTIRE CALENDAR YEAR

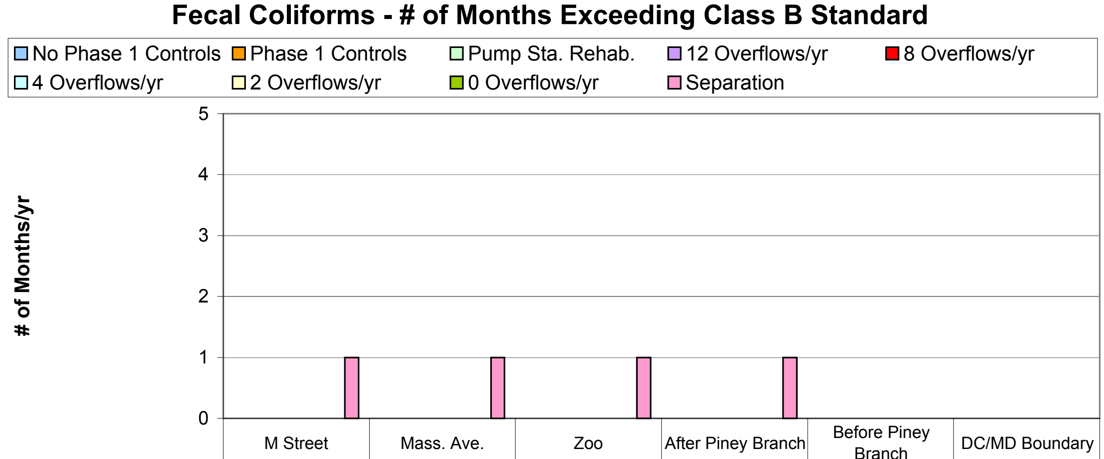
Fecal Coliforms - # of Months Exceeding Class B Standard



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	0	0	0	0	0	0
Phase 1 Controls	0	0	0	0	0	0
Pump Sta. Rehab.	0	0	0	0	0	0
12 Overflows/yr	0	0	0	0	0	0
8 Overflows/yr	0	0	0	0	0	0
4 Overflows/yr	0	0	0	0	0	0
2 Overflows/yr	0	0	0	0	0	0
0 Overflows/yr	0	0	0	0	0	0
Separation	3	2	2	2	0	0

MAY THROUGH SEPTEMBER

Fecal Coliforms - # of Months Exceeding Class B Standard



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	0	0	0	0	0	0
Phase 1 Controls	0	0	0	0	0	0
Pump Sta. Rehab.	0	0	0	0	0	0
12 Overflows/yr	0	0	0	0	0	0
8 Overflows/yr	0	0	0	0	0	0
4 Overflows/yr	0	0	0	0	0	0
2 Overflows/yr	0	0	0	0	0	0
0 Overflows/yr	0	0	0	0	0	0
Separation	1	1	1	1	0	0

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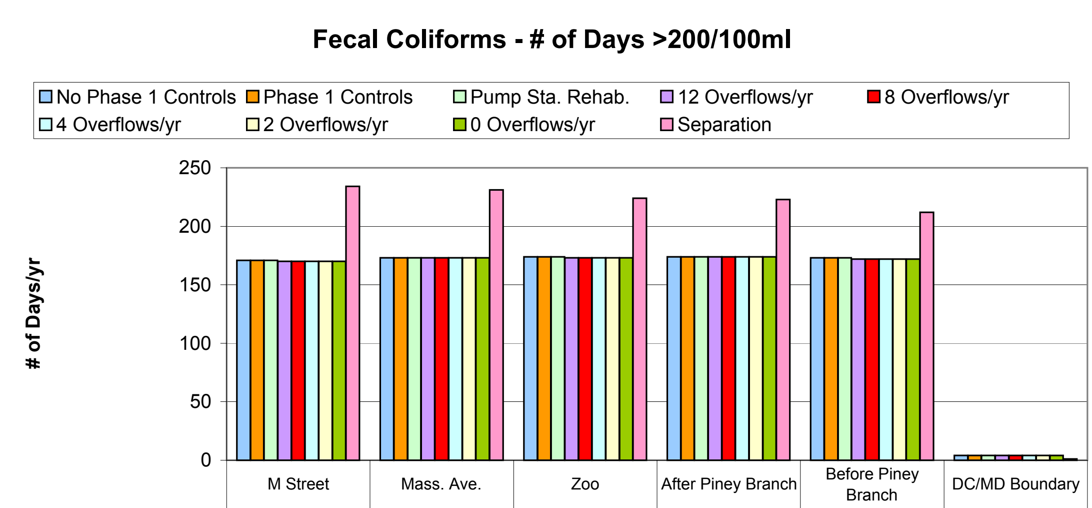
[1] Storm water: 40% reduction in loads, Upstream: 40% reduction in nutrients
Fecal coliforms at 80% of water quality standard (concentration = 160/100 ml)

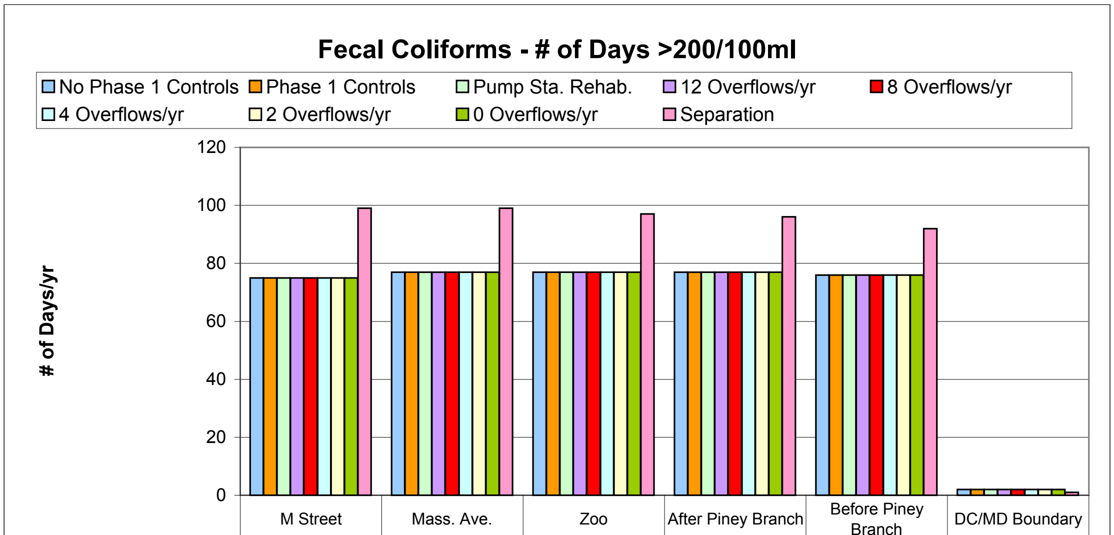
Figure D-15
Rock Creek: Effect of CSO Control on Fecal Coliform Concentrations
(Upstream and Stormwater Load Reduction[1])

ENTIRE CALENDAR YEAR



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	171	173	174	174	173	4
Phase 1 Controls	171	173	174	174	173	4
Pump Sta. Rehab.	171	173	174	174	173	4
12 Overflows/yr	170	173	173	174	172	4
8 Overflows/yr	170	173	173	174	172	4
4 Overflows/yr	170	173	173	174	172	4
2 Overflows/yr	170	173	173	174	172	4
0 Overflows/yr	170	173	173	174	172	4
Separation	234	231	224	223	212	1

MAY THROUGH SEPTEMBER



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	75	77	77	77	76	2
Phase 1 Controls	75	77	77	77	76	2
Pump Sta. Rehab.	75	77	77	77	76	2
12 Overflows/yr	75	77	77	77	76	2
8 Overflows/yr	75	77	77	77	76	2
4 Overflows/yr	75	77	77	77	76	2
2 Overflows/yr	75	77	77	77	76	2
0 Overflows/yr	75	77	77	77	76	2
Separation	99	99	97	96	92	1

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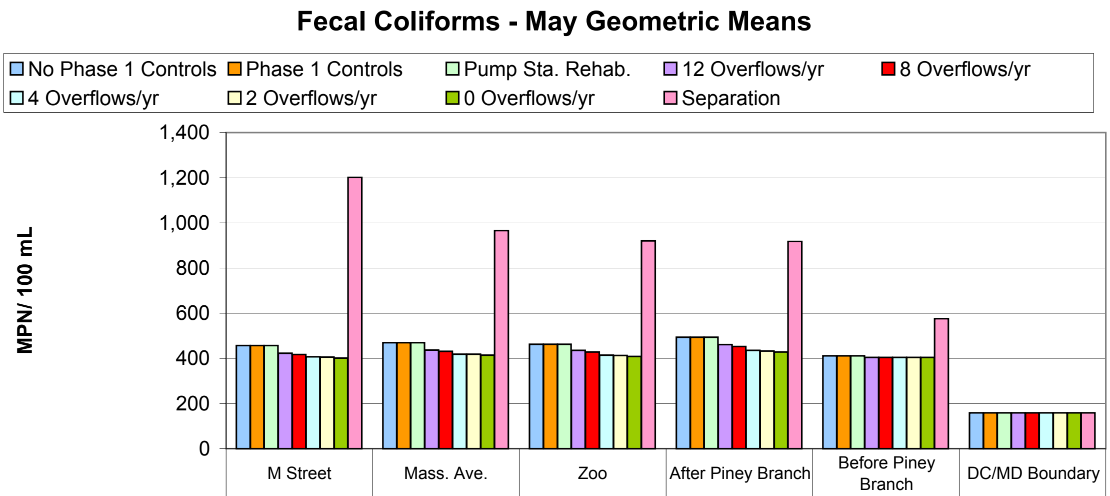
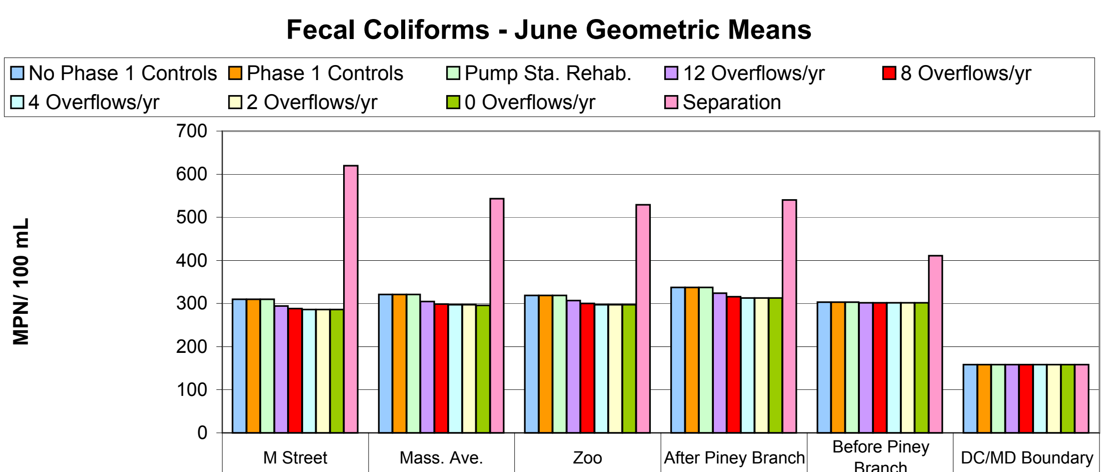
[1] Storm water: 40% reduction in loads, Upstream: 40% reduction in nutrients
Fecal coliforms at 80% of water quality standard (concentration = 160/100 ml)

Figure D-16
Rock Creek: Effect of CSO Control on Fecal Coliform Concentrations
(Upstream and Stormwater Load Reduction[1])



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	457	470	462	493	411	159
Phase 1 Controls	457	470	462	493	411	159
Pump Sta. Rehab.	457	470	462	493	411	159
12 Overflows/yr	423	437	435	461	404	159
8 Overflows/yr	417	431	428	452	404	159
4 Overflows/yr	407	419	414	435	404	159
2 Overflows/yr	405	418	413	433	404	159
0 Overflows/yr	401	414	409	429	404	159
Separation	1,202	966	921	918	576	159



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	310	321	319	337	303	158
Phase 1 Controls	310	321	319	337	303	158
Pump Sta. Rehab.	310	321	319	337	303	158
12 Overflows/yr	294	305	307	324	302	158
8 Overflows/yr	288	299	300	316	302	158
4 Overflows/yr	286	297	297	313	302	158
2 Overflows/yr	286	297	297	313	302	158
0 Overflows/yr	286	296	297	313	302	158
Separation	620	543	529	540	411	158

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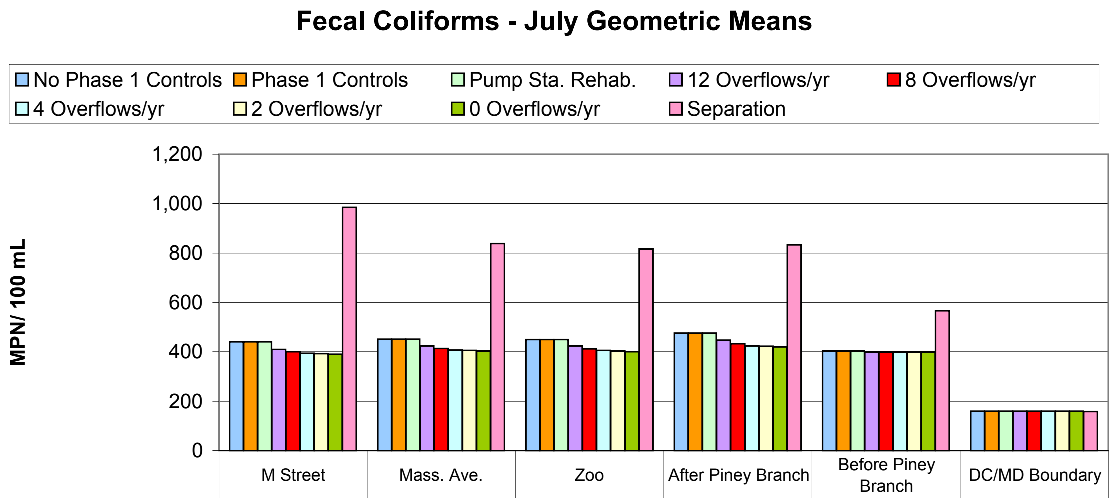
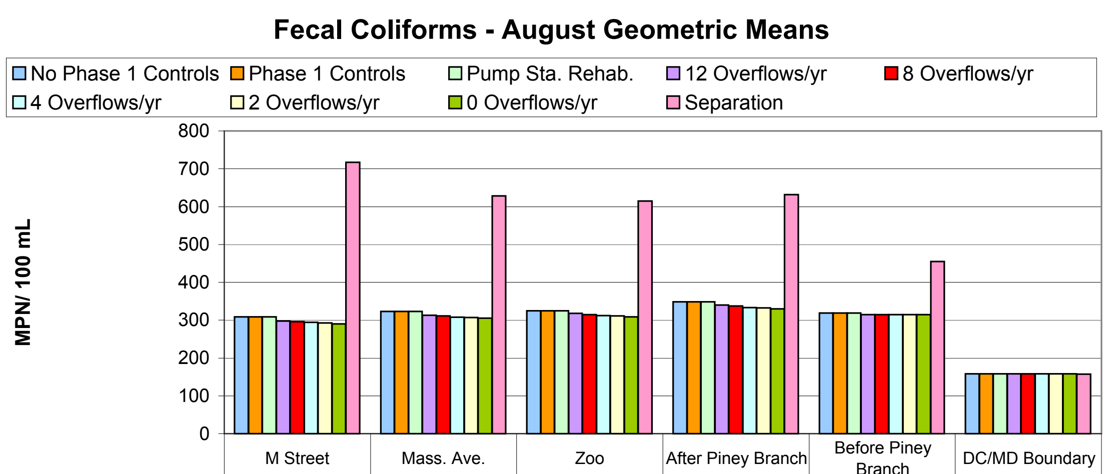
[1] Storm water: 40% reduction in loads, Upstream: 40% reduction in nutrients
Fecal coliforms at 80% of water quality standard (concentration = 160/100 ml)

Figure D-17
Rock Creek: Effect of CSO Control on Fecal Coliform Concentrations
(Upstream and Stormwater Load Reduction[1])



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	440	451	450	475	403	159
Phase 1 Controls	440	451	450	475	403	159
Pump Sta. Rehab.	440	451	450	475	403	159
12 Overflows/yr	410	424	424	447	399	159
8 Overflows/yr	401	414	412	433	399	159
4 Overflows/yr	394	407	405	424	399	159
2 Overflows/yr	393	406	403	423	399	159
0 Overflows/yr	390	403	401	420	399	159
Separation	985	838	817	833	566	158

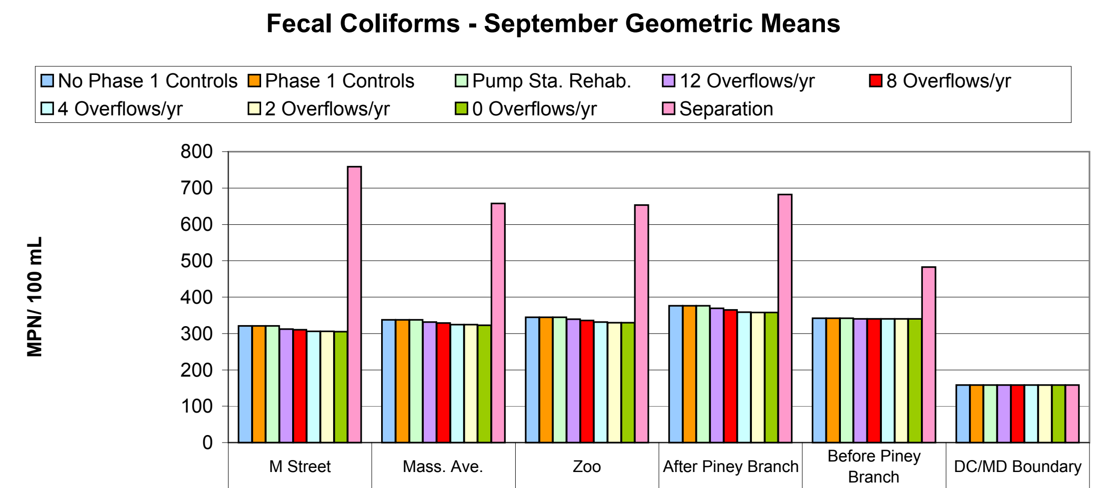


	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	309	323	325	348	319	158
Phase 1 Controls	309	323	325	348	319	158
Pump Sta. Rehab.	309	323	325	348	319	158
12 Overflows/yr	298	313	318	340	315	158
8 Overflows/yr	296	311	315	337	315	158
4 Overflows/yr	294	308	312	333	315	158
2 Overflows/yr	293	307	311	332	315	158
0 Overflows/yr	290	305	309	330	315	158
Separation	717	628	615	632	455	157

\\Gh-wash\ENG 1160\LTCP\LTCP Final Draft #2 (Board)\App D-RC WQ\[LTCP_App D_RC7.xls]21

[1] Storm water: 40% reduction in loads, Upstream: 40% reduction in nutrients
Fecal coliforms at 80% of water quality standard (concentration = 160/100 ml)

Figure D-18
Rock Creek: Effect of CSO Control on Fecal Coliform Concentrations
(Upstream and Stormwater Load Reduction[1])



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	321	338	345	376	342	158
Phase 1 Controls	321	338	345	376	342	158
Pump Sta. Rehab.	321	338	345	376	342	158
12 Overflows/yr	312	331	339	369	340	158
8 Overflows/yr	310	329	336	365	340	158
4 Overflows/yr	306	324	331	359	340	158
2 Overflows/yr	306	324	330	358	340	158
0 Overflows/yr	305	323	330	358	340	158
Separation	759	658	653	682	483	158

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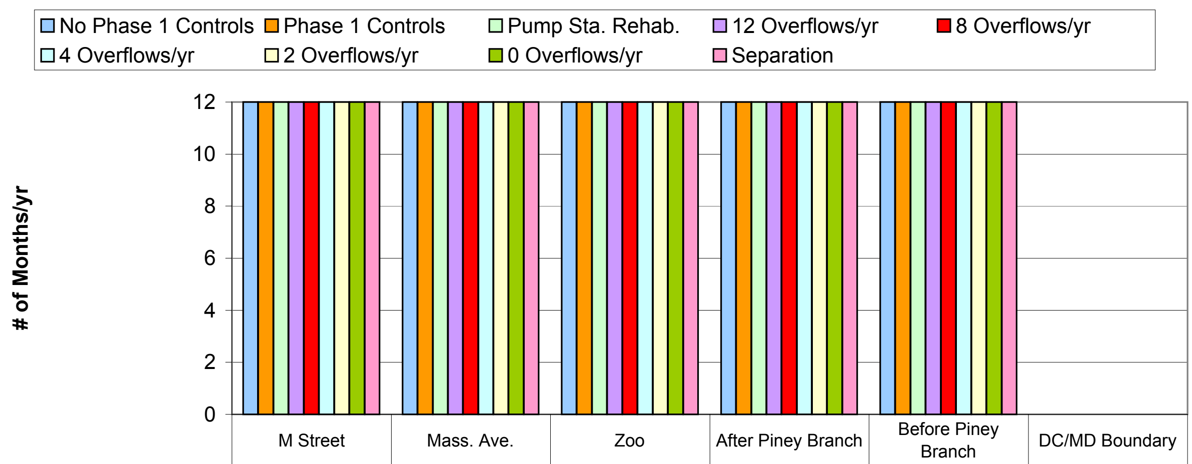
[1] Storm water: 40% reduction in loads, Upstream: 40% reduction in nutrients
Fecal coliforms at 80% of water quality standard (concentration = 160/100 ml)

Figure D-19
Rock Creek: Effect of CSO Control on Fecal Coliform Concentrations
(Upstream and Stormwater Load Reduction[1])

ENTIRE CALENDAR YEAR

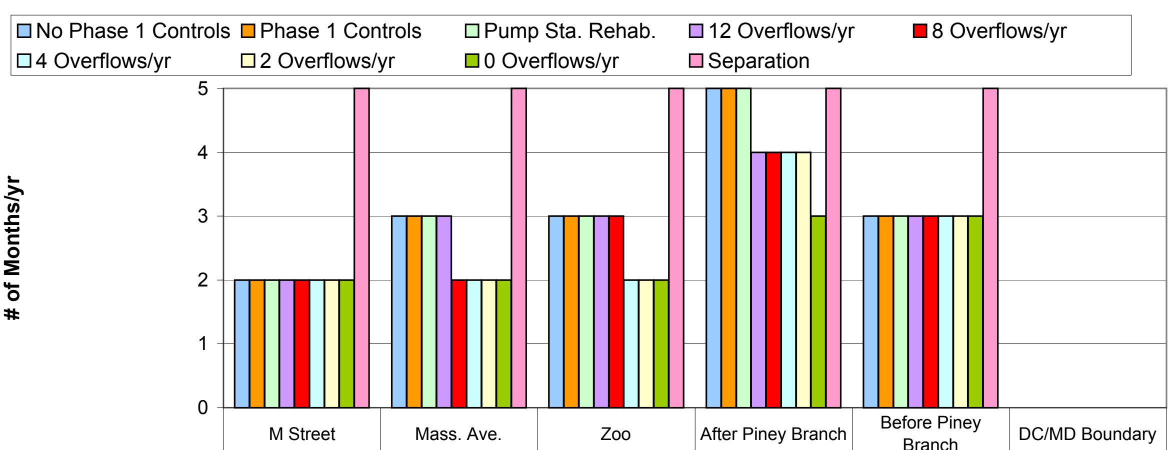
E. Coli - # of Months Exceeding 126/ 100 mL



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	12	12	12	12	12	0
Phase 1 Controls	12	12	12	12	12	0
Pump Sta. Rehab.	12	12	12	12	12	0
12 Overflows/yr	12	12	12	12	12	0
8 Overflows/yr	12	12	12	12	12	0
4 Overflows/yr	12	12	12	12	12	0
2 Overflows/yr	12	12	12	12	12	0
0 Overflows/yr	12	12	12	12	12	0
Separation	12	12	12	12	12	0

MAY THROUGH SEPTEMBER

E. Coli - # of Months Exceeding 126/ 100 mL

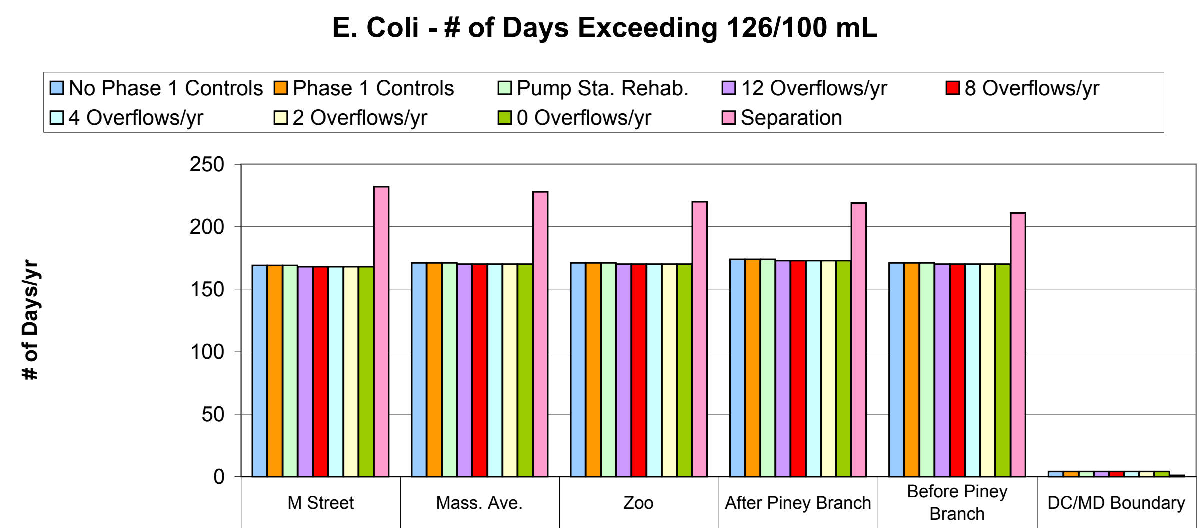


	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	2	3	3	5	3	0
Phase 1 Controls	2	3	3	5	3	0
Pump Sta. Rehab.	2	3	3	5	3	0
12 Overflows/yr	2	3	3	4	3	0
8 Overflows/yr	2	2	3	4	3	0
4 Overflows/yr	2	2	2	4	3	0
2 Overflows/yr	2	2	2	4	3	0
0 Overflows/yr	2	2	2	3	3	0
Separation	5	5	5	5	5	0

\\Gh-wash\ENG 1160\LTCP\LTCP Final Draft #2 (Board)\App D-RC WQ\[LTCP_App D_RC7.xls]21

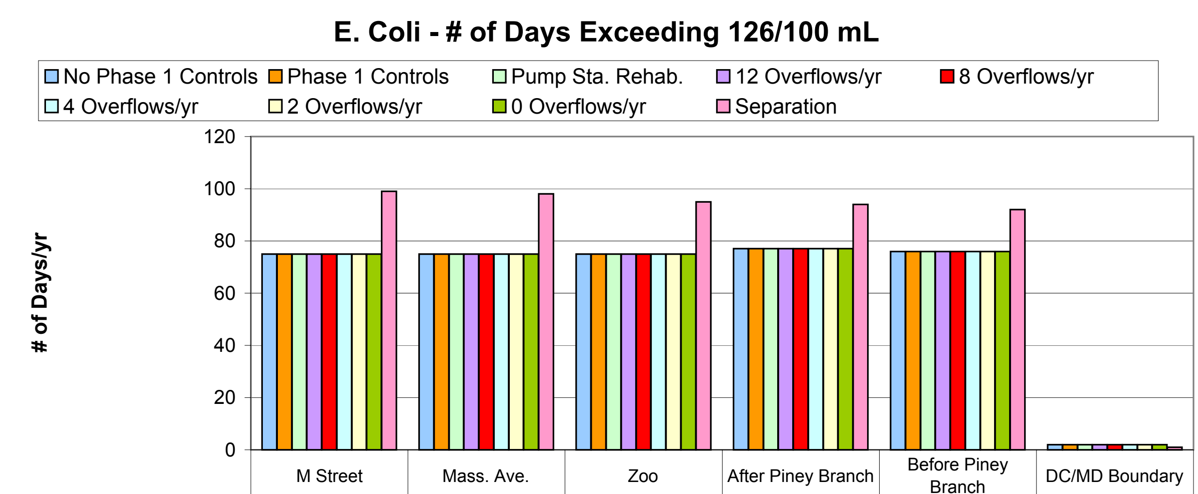
Figure D-20
Rock Creek: Effect of CSO Control on Fecal Coliform Concentrations
(Upstream and Stormwater Load Reduction[1])

ENTIRE CALENDAR YEAR



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	169	171	171	174	171	4
Phase 1 Controls	169	171	171	174	171	4
Pump Sta. Rehab.	169	171	171	174	171	4
12 Overflows/yr	168	170	170	173	170	4
8 Overflows/yr	168	170	170	173	170	4
4 Overflows/yr	168	170	170	173	170	4
2 Overflows/yr	168	170	170	173	170	4
0 Overflows/yr	168	170	170	173	170	4
Separation	232	228	220	219	211	1

MAY THROUGH SEPTEMBER

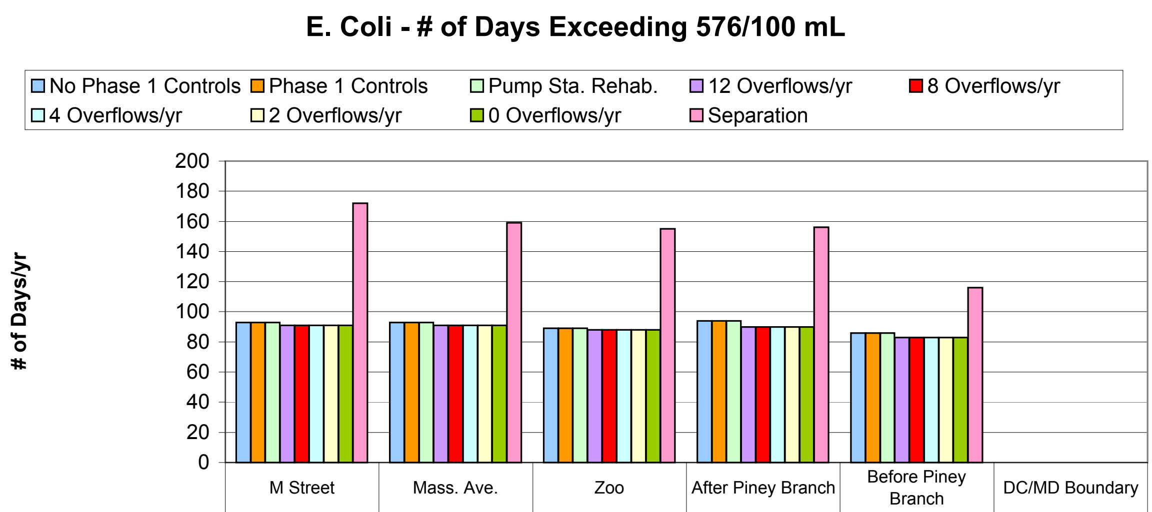


	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	75	75	75	77	76	2
Phase 1 Controls	75	75	75	77	76	2
Pump Sta. Rehab.	75	75	75	77	76	2
12 Overflows/yr	75	75	75	77	76	2
8 Overflows/yr	75	75	75	77	76	2
4 Overflows/yr	75	75	75	77	76	2
2 Overflows/yr	75	75	75	77	76	2
0 Overflows/yr	75	75	75	77	76	2
Separation	99	98	95	94	92	1

\\Gh-wash\ENG 1160\LTCP\LTCP Final Draft #2 (Board)\App D-RC WQ\[LTCP_App D_RC7.xls]21

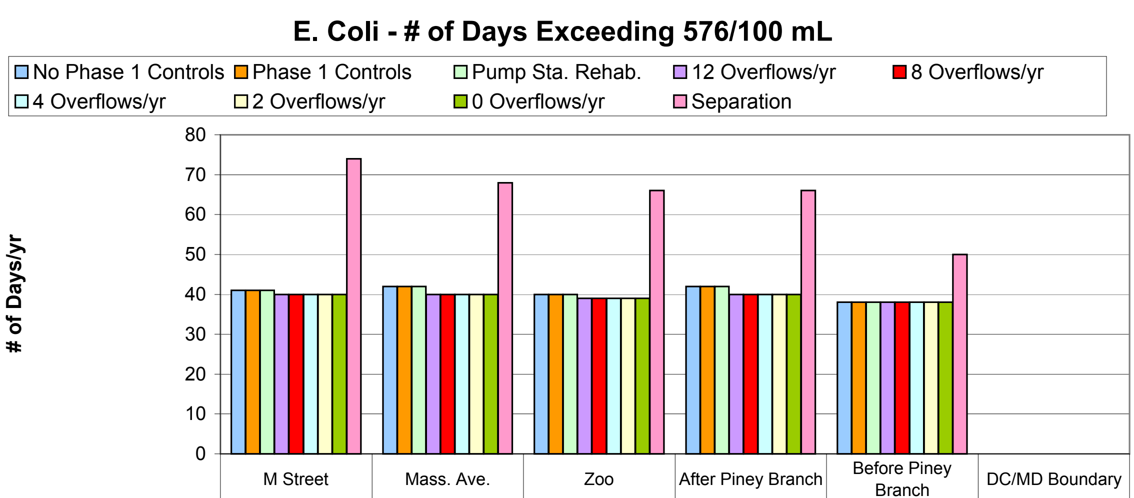
Figure D-21
Rock Creek: Effect of CSO Control on Fecal Coliform Concentrations
(Upstream and Stormwater Load Reduction[1])

ENTIRE CALENDAR YEAR



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	93	93	89	94	86	0
Phase 1 Controls	93	93	89	94	86	0
Pump Sta. Rehab.	93	93	89	94	86	0
12 Overflows/yr	91	91	88	90	83	0
8 Overflows/yr	91	91	88	90	83	0
4 Overflows/yr	91	91	88	90	83	0
2 Overflows/yr	91	91	88	90	83	0
0 Overflows/yr	91	91	88	90	83	0
Separation	172	159	155	156	116	0

MAY THROUGH SEPTEMBER



	M Street	Mass. Ave.	Zoo	After Piney Branch	Before Piney Branch	DC/MD Boundary
No Phase 1 Controls	41	42	40	42	38	0
Phase 1 Controls	41	42	40	42	38	0
Pump Sta. Rehab.	41	42	40	42	38	0
12 Overflows/yr	40	40	39	40	38	0
8 Overflows/yr	40	40	39	40	38	0
4 Overflows/yr	40	40	39	40	38	0
2 Overflows/yr	40	40	39	40	38	0
0 Overflows/yr	40	40	39	40	38	0
Separation	74	68	66	66	50	0

District of Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

APPENDIX E

Basis for Cost Opinions

Appendix E
Basis For Cost Opinions

1. GENERAL

In order to compare the alternatives, cost opinions including construction, capital, and operating and maintenance costs were prepared for each alternative carried forward. This appendix provides the bases for cost opinions.

In accordance with the Association for the Advancement of Cost Engineering definitions (AACE, 1997), cost opinions included in this document are considered to be concept screening level estimates, with an expected accuracy of +40%, -15%. Cost opinions are of this accuracy because alternatives have been prepared with a minimum of detailed design data for the purposes of relative comparison. This type of analysis is appropriate for comparisons between control programs.

2. CONSTRUCTION COSTS

2.1 Methodology

The following cost bases were used for the preparation of construction cost opinions:

- Construction Cost Index - The annual average Engineering News Record (ENR) Construction Cost Index (CCI) for year 2000 was 6221, with a monthly value of 6283 for December 2000. During the previous five years, the CCI has increased an average of 2.6% per year. This percentage was used to estimate an annual average CCI of 6383 for year 2001, which has been used as the basis for all costs prepared herein.

- Approach to Estimating Construction Costs- costs have been prepared using the following resources:
  - Generic facility and treatment plant cost curves such as:
    - *Construction Costs for Municipal Wastewater Treatment Plants: 1973-1982* (EPA, 1978)
    - *Manual - Combined Sewer Overflow Control*, (EPA 1993a)
    - *Cost Estimating Manual – Combined Sewer Overflow Storage and Teratment* (EPA, 1976)
    - *Pumping Station Design* (Sanks, 1998).
  - Unit costs in dollars per gallon or cost per linear foot obtained from other projects. Costs have been adjusted for relative characteristics such as complexity or location using engineering judgement.
  - Cost data from similar facilities:
    - Costs from other studies
    - Engineer's estimates of construction cost

        - Bid tabulations from similar projects. Where bid tabulations were available, the second and third bidder's unit prices were considered in addition to the low bidders unit prices.
    - Where facilities are unique or customized and cost curve type data does not exist was not applicable, conceptual layouts of facilities were prepared and costs were estimated by performing takeoffs to estimate quantities.

- Calculation Procedure - the following calculation procedure was used for construction costs:

Table 1
Calculation Procedure For Construction Cost Opinions

Line Number	*Description*	*Calculation Procedure*
1	Subtotal of Construction Line Items	--
2	Construction Contingencies	30% x Line 1
3	**Total Construction Cost**	Sum of Lines 1 and 2

2.2 Sewer Separation

Data used to estimate separation costs in the District was obtained from the following sources, as shown in Table 2:

- Data from other Cities – Many cities have evaluated separation as part of the preparation of LTCPs. Either estimated or bid costs of separation were available.
- District Estimates – Estimates of the cost of separation of select drainage areas within the District have been calculated in other reports. In addition, in 1957, the Board of Engineers completed a cost estimate to completely separate the combined sewer area in the District.

The cost of separating the combined sewer area in the District was estimated as follows:

- A GIS coverage land use map of the District was obtained from MWCOG. This land use map classified the entire area of the District by development type (commercial, industrial, residential, institutional, government, or open area), density, and percent imperviousness. For the purposes of calculating separation costs, each land use classification was assigned a category of low, medium, or high density, as shown in Table 3.
- Based on the land use map, the percentages of each combined sewershed according to category were calculated.
- The total cost of separation for each combined sewershed was calculated by multiplying the acreage of each category by the unit cost per acre for each ($240,000 for high, $150,000 for medium, and $85,000 for low). These costs were estimated based on review of the existing data.

Table 2

Sewer Separation Construction Cost Data

City	*CSO Drainage Area*	*Estimated Construction Cost (ENR=6383)*	*Unit Construction Cost($/acre, ENR=6383)*	*Type of Data*
Other Municipalities				
Alexandria, VA	885	$30,567,703	$34,540	Estimate
Chicago, IL	240,000	$18,030,662,872	$75,128	Estimate
San Francisco, CA	24,995	$9,765,513,443	$390,699	Estimate
Peoria, IL	61.3	$2,913,813	$47,534	Estimate
Richmond, VA	11,000	$2,278,815,025	$207,165	Estimate
Minneapolis, MN	4,000	$82,576,260	$20,644	Estimate
Columbus, OH	22	$974,610	$44,300	Bid
S. Dorchester Bay, Boston, MA	786	$91,522,842	$116,441	Bid
Stony Brook, Boston, MA	608	$48,223,919	$79,316	Estimate
Cambridge, Boston, MA	250	$70,000,000	$280,000	Estimate
Garden City, MI	1,180	$33,294,117	$28,215	Bid
Livonia, MI	103	$1,200,124	$11,652	Bid
Plymouth Township, MI	138	$1,044,489	$7,569	Bid
Wayne, MI	288	$7,405,272	$25,713	Bid
Westland, MI	409	$9,518,952	$23,274	Bid
Bloomfield Hills, MI	86	$1,831,426	$21,296	Bid
District				
Board of Engineers, 1957	11,741	$1,886,687,845	$160,692	Estimate
Anacostia River, (OB&G, 1983)	240	$17,264,076	$71,933	Estimate
College Pond (Massey, 1962)	231	$42,401,248	$183,555	Estimate
Southwest DC, (Gan. Flem., 1958)	890	$120,701,773	$135,620	Estimate
Slash Run, (RK&K, 1961)	593	$43,148,031	$72,762	Estimate

Table 3

Sewer Separation Land Use Density Data

Land Use	*Description*	*Density Used for Cost of Sewer Separation*
C1	Low density commercial	low
C2	Moderate density commercial	medium
C3	Medium Density commercial	medium
C4	Medium-high density commercial	high
C5	High density commercial	high
I1	Industrial	medium
M1	Moderate commercial and Moderate Residential	medium
M2	Low Commercial and Low residential	low
M3	Federal and Local Public	high
M4	High commercial and Low residential	medium
M5	Medium commercial & moderate residential	medium
M6	Moderate commercial & medium residential	medium
M7	Low commercial and moderate residential	medium
M8	Low commercial and high residential	high
M10	Moderate commercial and industrial	medium
M11	Federal and Medium Commercial	high
M13	Institutional and medium residential	medium

Land Use	*Description*	*Density Used for Cost of Sewer Separation*
M14	Medium-high commercial and industrial, high residential	high
M15	Moderate commercial and industrial, medium residential	medium
M16	Moderate commercial, moderate residential, park	medium
M17	Medium-high commercial, industrial	high
M18	Moderate commercial, institutional, moderate residential	medium
M19	Low commercial and moderate residential	medium
M20	Medium commercial and high residential	high
M21	Medium commercial and medium residential	medium
M22	Moderate commercial + Local government	medium
M23	Medium-high commercial and high institutional	high
P1	Federal	medium
P2	Local public facilities	High
P3 (C4)	Institutional	high
P4	Parks	low
R1	Low density residential	low
R2	Moderate density residential	medium
R3	Medium density residential	medium
R4	High density residential	high
W1	Water	low
Z1	Mixed Use	medium

2.3 Regulator Structures

Regulator structures control the diversion of CSO flow from outfall sewers to downstream facilities such as interceptors, retention facilities and treatment facilities. Construction cost data from recent (1996-2000) regulators constructed for the City of Richmond, Virginia are summarized in Table 4 and are plotted on Figure 1. The equation for construction cost as a function of flow rate in million gallons per day (mgd) was determined to be:

$$\text{Cost} = 6075.3(\text{mgd}) + 180{,}000$$

Table 4
Existing Wet Weather Regulator Cost Data

City of Richmond Regulator	*Design Diversion Capacity (mgd)*	*Construction Cost (ENR=6383)*	*Construction Cost/mgd (ENR=6383)*
Byrd Street	11.6	$238,335	$20,546
7th Street	32	$359,859	$11,352
Park Hydro	38	$417,094	$10,947
Reedy Creek	68	$432,774	$6,346
42nd Street	73	$358,124	$4,879
McCloy Street	81	$357,400	$4,423
Woodland Heights	83.5	$730,863	$8,753
Hampton Street	97	$445,000	$4,592
Gambles Hill	122	$1,612,351	$13,205
Canoe Run	239	$1,630,946	$6,824

2.4 Conveyance Pipelines

Costs for pipelines were developed using manufacturer's costs for pipes and unit costs in Means and other estimating references. Costs include manholes, sediment and erosion, and thrust restraint for force mains. A pipe depth of 20 feet in an urban congested area was assumed.

Table 5
Unit Construction Costs for Pipelines

Pipe Diameter	*Unit Cost ($/linear foot)*
Gravity Sewers	
18"	$423
24"	$482
30"	$548
36"	$619
42"	$697
48"	$772
54"	$854
60"	$948
66"	$1,027
72"	$1,112
78"	$1,202
84"	$1,318
90"	$1,432
96"	$1,551
102"	$1,769
108"	$1,923
114"	$2,143
120"	$2,192
126"	$2,432
132"	$2,533
138"	$2,800
144"	$2,852

Pipe Diameter	*Unit Cost ($/linear foot)*
Force Mains	
12”	$328
16”	$463
18”	$509
24”	$592
30”	$650
36”	$599
42”	$657
48”	$710
54”	$799
60”	$874
66”	$959
72”	$1,035
78”	$1,129
84”	$1,280
90”	$1,385
96”	$1,516

2.5 Pumping Stations

Cost data for pumping stations were obtained from actual facilities, EPA cost curves, and Sanks (see references). This construction cost data are plotted on Figure 2. A best-fit polynomial equation whose values were greater than or equal to most of the plotted values was developed. The equation for construction cost as a function of flow rate (MGD) was determined to be:

Up to 300 mgd: $\text{Cost} = 0.0307(\text{mgd})^3 - 125.76(\text{mgd})^2 + 213{,}533(\text{mgd}) + 279{,}183$

Over 300 mgd: $\text{Cost} = -3.2655(\text{mgd})^2 + 45481(\text{mgd}) + 40{,}000{,}000$

2.6 CSO Storage Facilities

Costs for CSO storage facilities were obtained from actual facilities and from EPA cost curves. Costs are summarized in Table 6 below.

Table 6
Existing Storage Facility Construction Cost Data

Location	*Storage Volume (mg)*	*Construction Cost (Millions, ENR=6383)*	*Unit Cost ($/gallon, ENR=6383)*
Mariposa - San Francisco, CA	0.7	$13.02	$18.60
Fitzhugh – Saginaw, MI	1.2	$6.42	$5.35
Seven Mile – Detroit MI	2	$16.44	$8.22
Union Park – Boston, MA	2.5	$38.16	$15.27
Eliza Howell – Detroit, MI	2.8	$19.94	$7.12
Salt/Frazer – Saginaw MI	2.8	$14.82	$5.29
Seneca WWTP	3	$3.62	$1.21
Chattanooga, TN	3.5	$6.4	$1.83
Webber – Saginaw, MI	3.6	$9.45	$2.63

Location	Storage Volume (mg)	Construction Cost (Millions, ENR=6383)	Unit Cost ($/gallon, ENR=6383)
Acacia Park , MI	4.5	$15.23	$3.38
Narragansett Bay , RI[1]	5	$29.19	$5.84
Emerson – Saginaw, MI	5	$21.12	$4.22
Birmingham, MI	5.5	$13.81	$2.51
WSSC – Rock Creek	6	$21.19	$3.53
Sunny Dale - San Francisco, CA	6.2	$25.47	$4.11
14th Street – Saginaw, MI	6.5	$16.65	$2.56
Weiss Street – Saginaw, MI	9.5	$28.65	$3.02
Bloomfield Village, MI	10.2	$31.67	$3.1
Edmund – Oakland, CA	11	$32.37	$2.94
Yosemite – San Francisco, CA	11.5	$26.5	$2.3
Tournament Club, Detroit	22	$59.19	$2.69
North Shore, San Francisco, CA	24	$106.35	$4.43
Market Ave. Retention Basin, Grand Rapids, MI	30.5	$38.41	$1.26
Shockoe basin – Richmond, VA	38	$52.11	$1.37

EPA has also produced a cost curve for offline storage as follows:

Storage Basin Cost = $3.627\ V^{0.826}$; with V = volume in gallons, ENR = 4800

EPA's cost curve and the construction cost data from actual facilities are plotted on Figure 3. As shown on the Figure, there is a broad range in actual facility costs. This is due to many factors, including site constraints, geology (e.g. piles or rock excavation required), unit processes included with the basin such as screening or disinfection, and the need to mitigate impacts to the surrounding neighborhood such as including odor control. As an example, the Mariposa facility in San Francisco and the Union Park Detention Center in Boston are two facilities with the highest cost per gallon stored ($18.60 and $15.27 respectively). In the case of Mariposa, the storage facility is an underground, custom-built storage transfer box with small volume (0.7 MG) and varying width (from 20 to 30 feet along its length) in a heavily urban setting. The Union Park Detention Center project included retrofits to an existing pumping station in addition to the construction of four underground storage tanks, fine screens, disinfection, and two sewer diversion structures with control gates. If retention basins were constructed in the District, they would be in a heavily urban setting and would likely be in the upper range of unit costs. Therefore, the "Value to Use" line for construction cost as a function of storage volume in million gallons (mg) as shown in Figure 3 will be used in cost opinions. This line's equation is:

$$\text{Cost} = 0.0307(mg)^3 - 125.76(mg)^2 + 213{,}533(mg) + 279{,}183$$

2.7 Tunnels and Drop Shafts

Cost data for tunnels were gathered from a variety of sources as follows:

- Previous studies concerning CSO control within the District:
  - *Report to District of Columbia Department of Sanitary Engineering on Improvements to Sewerage System* (Board of Engineers, 1957.)
  - *Combined Sewer Overflow Abatement Alternatives* (EPA 1970). This report was prepared by Roy F. Weston, Inc. for EPA.
  - *Reconnaissance Study of Combined Sewer Overflows and Storm Sewer Discharges*, Metcalf and Eddy, 1973 (Metcalf and Eddy 1973)
- An local engineering firm specializing in tunneling , Dr. G. Sauer Corporation, was retained to evaluate tunnel feasibility and prepare cost estimates for the LTCP (Dr. G. Sauer Corp, 2001).
- Actual cost data for tunnels built by the Washington Metropolitan Area Transit Authority (WMATA) for the District's "Metro" public transit system.
- Actual and estimated cost data for other tunnel obtained from other municipalities.

Tunnels in soils are significantly more expensive than those in rock and cost were thus developed separately for each of the tunneling media. This data is shown in Tables 7 and 8.

Table 7
Construction Cost Data for Tunnels in Rock

Source of Data	*Finished Diameter (ft)*	*Unit Cost ($/LF, ENR=6383)*
EPA (Weston) Cost Curve	10	$ 2,305
	15	$ 2,979
	20	$ 3,723
	25	$ 4,255
	30	$ 4,965
Board of Engineers Estimate	10	$ 3,100
	15	$ 5,471
Narragansett Bay, Rhode Island Estimate	10	$ 931
	20	$ 2,060
	30	$ 3,315
Dr. G. Sauer Corp. Full Face Tunnel Boring Machine, 5-10,000' long tunnel	10	$ 2,062
	15	$ 2,319
	20	$ 2,577
	25	$ 3,221
	30	$ 3,866
Dr. G. Sauer Corp. Full Face Tunnel Boring Machine, greater than 10,000' long tunnel	10	$ 1,964

Source of Data	*Finished Diameter (ft)*	*Unit Cost ($/LF, ENR=6383)*
	15	$ 2,210
	20	$ 2,455
	25	$ 3,069
	30	$ 3,683
Dr. G. Sauer Corp. Hand Mine, New Austrian Tunneling Method, 5-10,000' long tunnel	10	$ 2,937
	15	$ 3,304
	20	$ 3,671
	25	$ 4,589
	30	$ 5,507
Dr. G. Sauer Corp. Hand Mine, New Austrian Tunneling Method, >10,000' long tunnel	10	$ 2,863
	15	$ 3,221
	20	$ 3,579
	25	$ 4,474
	30	$ 5,369
Dr. G. Sauer Corp., Weathered Rock, Hand Mine, New Austrian Tunneling Method , <2500' long tunnel	10	$ 3,164
	15	$ 3,560
	20	$ 3,955
	25	$ 4,944
	30	$ 5,933
Richmond, Virginia CSO 4/5	14	$ 3,363
Rochester, NY CSO system		
Lyell Ave	12	$ 1,489
Saxton-Colvin/Jay-Arnett	10	$ 1,058
Saxton-Colvin/Jay-Arnett	8	$ 1,010
Lake Ave	14	$ 1,381
St. Paul (Siphon)	7	$ 840
Senaca/Norton	12	$ 1,620
Dewey-Eastman/Tiger Carlisle	14	$ 2,033
Lake Ave Extension	14	$ 2,608
State-Mt. Hope	14	$ 3,015
WMATA (by contract no)		
A-6	15	$ 2,607
A-9	15	$ 4,372
B-11a	15	$ 1,348

Table 8
Construction Cost Data for Tunnels in Soil

Source of Data	*Finished Diameter (ft)*	*Unit Cost ($/LF, ENR=6383)*
Board of Engineers Estimate	7	$ 3,647
	10	$ 5,927
	15	$ 9,848
M & E 1973 Estimate – Low / High	12	$ 2,128 / $ 5,319
	20	$ 5,319 / $ 8,865
	30	$ 10,461 / $ 15,958
New York City Estimate	20	$ 6,146
	25	$ 8,000
	30	$ 10,000
Other Cities		
Cleveland	20	$ 3,646
Birmingham, MI	11	$ 1,123
Chicago, IL	12	$ 1,618
Toledo, OH	13.5	$ 2,027
Toledo, OH	13.5	$ 2,659
PCI, MI	13.5	$ 3,605
Wyandotte, MI	13.5	$ 1,763
Washington, DC	21	$ 4,880
Dr. G. Sauer Corp, in Potomac Deposits, 5-10,000' long tunnel	10	$ 3,192
	15	$ 3,591
	20	$ 3,990
	25	$ 4,988
	30	$ 5,985
Dr. G. Sauer Corp, in Potomac Deposits, >10,000' long tunnel	10	$ 3,031
	15	$ 3,410
	20	$ 3,789
	25	$ 4,736
	30	$ 5,684
Dr. G. Sauer Corp, in Terrace Deposits, 5-10,000' long tunnel	10	$ 4,038
	15	$ 4,542
	20	$ 5,047
	25	$ 6,309
	30	$ 7,571
Dr. G. Sauer Corp, in Terrace Deposits, >10,000' long tunnel	10	$ 3,864
	15	$ 4,347
	20	$ 4,830
	25	$ 6,038
	30	$ 7,245

Source of Data	*Finished Diameter (ft)*	*Unit Cost ($/LF, ENR=6383)*
WMATA (by contract no)		
C-4	15	$ 2,913
D-9	15	$ 5,283
F-3c	15	$ 4,657
E4b	15	$ 3,182
E4b	15	$ 4,053

The aforementioned cost data per linear foot of tunnel were plotted against finished tunnel diameter, for excavation in both rock and soil, as shown in Figure 4. For both rock and soil tunnels, a best-fit polynomial equation whose values were greater than or equal to most of the plotted values was developed. The equations for both rock and soil tunnels as a function of finished tunnel diameter in feet are as follows:

$$\text{Cost} = 3(\text{dia})^2 + 35(\text{dia}) + 2{,}410 \qquad \text{(rock)}$$

$$\text{Cost} = 6.7143(\text{dia})^2 - 85.571(\text{dia}) + 5{,}000 \qquad \text{(soil)}$$

2.8 Tunnel Drop Shafts

Drop shafts will be required to convey flow from the elevation of the outfalls (near grade) down to tunnel level. Drop shafts were based on the vortex drop design based on pilot studies by Jain and Kennedy (Jain and Kennedy, 1983) for the Milwaukee CSO tunnel system. The drop shafts typically include:

- Tangential inlets – an approach channel designed to even out the flow streamlines and to force the flow into a spiral pattern.
- Drop shafts – vertical drop shafts where the CSO falls downward in a spiral pattern. The spiral pattern is designed to allow air to escape up the central core, preventing bulking of the flow. It also dissipates the energy gained by the flow when falling vertically.
- Deaeration chamber – chamber at the bottom of the drop shaft where air is allowed to escape before the CSO enters the main tunnel.

Drop shafts were assumed to be 130' deep. Preliminary layouts were prepared for 75, 200 and 1500 mgd facilities, and quantity takeoffs and cost estimates were prepared as shown in Table 9.

Table 9
Tangential Inlet, Drop Shaft and Deaeration Chamber Construction Costs

Flow Rate (mgd)	*Tangential Inlet*	*Drop Shaft*	*Deaeration Chamber*
75	$237,529	$1,014,659	$263,393
200	$315,345	$1,139,258	$498,640
1500	$961,961	$1,832,252	$2,330,315

The values in Table 9 were used to develop construction cost curves as a function of flow rate in mgd (Figure 5). The derived equations are as follows:

Cost = 503.89(mgd) + 206,813 (tangential inlets)

Cost = 4.2855(mgd) + 7,685.3 (drop shafts)

Cost = 1,433.5(mgd) + 182,624 (deaeration chambers)

2.9 Reductions in Dry Weather Flow

WASA's Wastewater Flow Reduction and Water Conservation Programs have developed preliminary cost estimates for various types of programs designed to base dry weather flow. These programs are summarized in Table 10, and are compared to conservation and flow reduction programs from New York City and Chicago. The unit cost of these programs covers a wide range, from $1 million/mgd to over $60 million/mgd. An average of $10 million/MGD of dry weather flow reduction will be used for the LTCP.

Table 10
Dry Weather Flow Reduction

Item	*Reduction in Flow (mgd)*	*Updated Construction Cost ($M) (ENR=6383*	*$Million dollars/mgd removed*	*Source*
I/I removal[1]	4.1	$3.7	$0.9	WASA Wastewater Flow Reduction Plan (Peer, 1999a)
Storm Sewer Separation[1]	3.5	$50	$14	WASA Wastewater Flow Reduction Plan (Peer, 1999a)
Sanitary Sewer Separation[1]	6.5	$406	$62	WASA Wastewater Flow Reduction Plan (Peer, 1999a)
Ground Water Diversion[1]	8.6	$43	$5	WASA Wastewater Flow Reduction (Peer, 1999a)
Water Conservation Measures	6.4	$14	$2.2	WASA Water Conservation Plan (Peer, 1999b)
New York City Toilet Rebate Program	70-90	$290	$3.6	New York City Water Conservation Programs (NYC, 1999)

Chicago[2]	1	\$10-\$20	\$10-\$20	Chicago Sewer Condition Assessment (Greeley and Hansen, 1995)

Notes:

1. Capital costs in study were converted to Construction costs and updated to 2001 dollars (ENR=6383)
2. Cost were calculated by assuming an existing infiltration rate of 5,000 gpd/inch-mile was reduced to 400 gpd/inch-mile for representative 24" diameter and 72" diameter sewers. The 24" sewer was assumed to be rehabilitated by cured in place lining, while the 72" pipe was rehabilitated by cast in place concrete lining.

2.10 High Rate Physical Chemical Treatment

Costs for high rate treatment facilities were obtained from estimates on proposed facilities and from the manufacturer's information, as shown in Table 11 below. As the application of this technology to CSO treatment is relatively new, none of the facilities under construction in the US have been completed. As a high rate treatment process must be integrated with existing wastewater plant infrastructure, there are many site specific construction requirements which may not be represented by the bid tabs of other projects. Note that the total cost of high rate treatment and ancillary facilities may include upgrades to existing facilities that are unrelated to the high rate treatment installation. The values in Table 11 were used to develop a construction cost curve as a function of flow rate in mgd (Figure 5). The developed equation is:

$$\text{Cost} = -0.0002(\text{mgd})^2 + 0.4426(\text{mgd}) + 7.5562$$

Table 11
Construction Cost of High Rate Treatment Facilities

Location	*Flow Rate (MGD)*	*Cost for High Rate only (\$M, ENR=6383)*	*Cost, High Rate and Ancillary Facilities (\$M, ENR=6383)*	*Unit Cost (\$k/mgd, ENR=6383)*
St. Bernard, LA (bid tab)	10	\$0.6	\$8.5	\$850
Bremerton, WA	20	-	\$4.1	\$205
Lawrence, KS	40	\$10	\$37.5	\$938
Jefferson County, LA (proposed)	60	\$6	-	-
Dallas, TX	110	-	\$30.0	\$273
Onondaga County, NY	126	-	\$91.0	\$722
Paerdegat Basin, the Bronx, NY (proposed)	500 750	\$27.5 \$41.1	\$165.0 \$216.0	\$330 \$288

2.11 Low Impact Development-Retrofit (LID-R)

Based on a literature review, the design parameters and costs of more than 20 LID-R technologies were determined as shown in Table 12 below. The technologies were divided into those that have a high probability of being applicable to the District, and those that appear to have a low probability. For example, earthen retention/detention basins unlikely to be widely applicable to built-up areas like the District.

Table 12

LID Facility Data

	Base Year Costs in Literature						Escalated Costs (ENR = 6383)				
Technology	Year	ENR CCI	Units	Cost Type	Low End Cost	High End Cost	Low End Cost	High End Cost	Notes	Convert to $/Imp acre	Source
High Probability of Applicability											
Infiltration Trench	1997	5825	ft^3	Constr.	-	$ 4.00	-	$ 4.38	Typical for a 100' trench.	$ 19,889	1
	1997	5826	ft^3	Constr.	$ 2.00	$ 4.00	$ 2.19	$ 4.38		$ 19,886	3
	1991	4835	ft^3	Constr.	$ 1.73	$ 3.67	$ 2.29	$ 4.84	Low end for a 100x10x6 (LxWxH) trench,High end for a 100x4x3 (LxWxH) trench. Unit cost per volume based on treatment volume, assuming 32% porosity.	$ 21,965	3
Infiltration Basin	1997	5825	ft^3	Constr.	-	$ 1.30	-	$ 1.42	Typical for a 0.25 acre infiltration basin.	$ 6,464	1
	1991	4835	ft^3	Constr.	-	$ 0.80	-	$ 1.06	For a 1.0 acre basin.	$ 4,792	3
Porous Pavement	1991	4835	acres	Constr.	-	$ 50,000	-	$ 66,008		$ 66,008	3
	1987	4398	acres	Constr.	-	$ 80,000	-	$ 116,107		$ 116,107	3
	2001	6383	acres	Constr.	-	$ 87,120	-	$ 87,120		$ 87,120	5
	1991	4835	acres	Constr.	$ 43,560	$ 87,120	$ 57,506	$ 115,013	Incremental cost over the cost of conventional asphalt.	$ 115,013	7
Concrete Grid Pavement	1981	3533	acres	Constr.	$ 43,560	$ 87,120	$ 78,699	$ 157,398	Incremental cost over the cost of conventional asphalt.	$ 157,398	7
Sand Filter	1997	5825	ft^3	Constr.	$ 3.00	$ 6.00	$ 3.29	$ 6.57	Perimeter sand filters are medium cost, surface and underground are most expensive.	$ 29,833	1
	1994	5410	Imp Ac	Constr.	$ 3,400	$ 50,000	$ 4,011	$ 58,993		$ 58,993	8
Sand Filter/Filtration Basin	1990	4728	ft^3	Constr.	$ 1.00	$ 11.00	$ 1.35	$ 14.85		$ 67,385	7
Bioretention	1997	5825	ft^3	Constr.	-	$ 5.30	-	$ 5.81	Usually designed as a constant fraction of the total drainage area, and therefore is relatively constant in cost.	$ 26,353	1
Filter Strip	1997	5825	ft^3	Constr.	$ -	$ 1.30	$ -	$ 1.42	Based on cost per square foot, and assuming 6 inches of storage in the filter strip. Loewst cost assumes buffer uses existing vegetation, and highest cost assumes that sods was used to establish the filter strip.	$ 6,464	1
Roof Drain Redirection	1999	6060	ea	Constr.	$ 45	$ 75	$ 47	$ 79			4
Basement Sump Pump Redirection	1999	6060	ea	Constr.	$ 300	$ 500	$ 316	$ 527			4
Flow Restriction for c.b.'s	1999	6060	ea	Constr.	$ 500	$ 1,200	$ 527	$ 1,264			4
Streets	2001	6383	lf	Constr.	-	$ 121	-	$ 121	Street width of 16' paved surface, 8' of parking on grasscrete underlain with 36" of gravel and a sidewalk on one side.	$ 219,615	5
Soil Amendments	2001	6383	sf	Constr.	-	$ 0.36	-	$ 0.36	A layer of soil and compost mixture under swales and bioretention cells.	$ 15,682	5
Rooftop Rainwater collection system	2001	6383	ea	Constr.	-	$ 8,000	-	$ 8,000	Per household		5
Water Quality Inlet	1991	4835	ea	Constr.	$ 1,100	$ 3,000	$ 1,452	$ 3,960			7
Water Quality Inlet with Sand Filters	1991	4835	acres	Constr.	-	$ 10,000	-	$ 13,202			7
Oil/Grit Separator	1987	4398	acres	Constr.	$ 15,000	$ 20,000	$ 21,770	$ 29,027			7

Technology	Base Year Costs in Literature						Escalated Costs (ENR = 6383)		Notes	Convert to $/Imp acre	Source
	Year	ENR CCI	Units	Cost Type	Low End Cost	High End Cost	Low End Cost	High End Cost			
Green Roofs (thin)	2001	6383	sf	Constr.	$ 15	$ 20	$ 15	$ 20		$ 871,200	9
Low Probability of Applicability											
Green Roofs (walkable)	2001	6383	sf	Constr.		$ 75	$ -	$ 75		$3,267,000	10
Retention and Detention Basins	1997	5825	ft^3	Constr.	$ 0.50	$ 1.00	$ 0.55	$ 1.10	Low unit cost for 150,000 ft3, high unit cost for 15,000 ft3	$ 4,972	1
	1991	4835	ft^3	Constr.	-	$ 1.06	-	$ 1.40	For 0.25 acre, 23,300 ft3 basin (moderate cost for this size)	$ 6,350	2
	1991	4835	ft^3	Constr.	-	$ 0.43	-	$ 0.57	For 1.0 acre, 148,000 ft3 basin (moderate cost for this size)	$ 2,576	2
	1991	4835	ft^3	Constr.	-	$ 0.33	-	$ 0.44	For 3.0 acre, 547,000 ft3 basin (moderate cost for this size)	$ 1,977	2
	1991	4835	ft^3	Constr.	-	$ 0.31	-	$ 0.41	For 5.0 acre, 952,000 ft3 basin (moderate cost for this size)	$ 1,857	2
Extended Detention Dry Pond	1991	4835	ft^3	Constr.	$ 0.05	$ 3.20	$ 0.07	$ 4.22	Average is $0.50/ cubic ft	$ 19,169	7
Wet Pond and Extended Detention Wet Pond	1991	4835	ft^3	Constr.	$ 0.05	$ 1.00	$ 0.07	$ 1.32	Storage Volume < 1,000,000 cubic ft, Average is $0.50/ cubic ft	$ 5,990	7
	1991	4835	ft^3	Constr.	$ 0.05	$ 0.50	$ 0.07	$ 0.66	Storage Volume > 1,000,000 cubic ft, Average is $0.25/ cubic ft	$ 2,995	7
Constructed Wetland	1997	5825	ft^3	Constr.	$ 0.60	$ 1.25	$ 0.66	$ 1.37	It was assumed Wetlands would be 25% more expensive than retention basins	$ 6,215	1
Grass Swale	1997	5825	ft^3	Constr.	-	$ 0.50	-	$ 0.55	Based on cost per square foot, assuming 6 inches of storage in filter.	$ 2,486	1
Swale	2001	6383	lf	Constr.	-	$ 8.00	-	$ 8.00	Includes fine grading and vegetation installation.	NA	5

Sources:
1. US EPA. Preliminary Data Summary of Urban Storm Water Best Management Practices. August 1999. Page 6-3.
2. US EPA. Preliminary Data Summary of Urban Storm Water Best Management Practices. August 1999. Page 6-7.
3. US EPA. Preliminary Data Summary of Urban Storm Water Best Management Practices. August 1999. Page 6-9.
4. US EPA. Combined Sewer Overflow Technology Fact Sheet: Inflow Reduction. September 1999. Table 1.
5. CH2M Hill. Pierce County Low Impact Development Study, Final Report. April 11, 2001. Sewer, water, electric infrastructure costs, and excavation/grading costs not included.
6. US EPA. Low Impact Development (LID): A Literature Review. October 2000.
7. US EPA. Guidance Specifying Management Measures For Sources of Nonpoint Pollution in Coast Water. January 1993. Table 4-8.
8. US EPA. Preliminary Data Summary of Urban Storm Water Best Management Practices. August 1999. Page 6-12.
9. Environmental Design + Construction Magazine, "Green Roofs: Stormwater Management from the Top Down" by Katrin Scholz-Barth, Jan-Feb 2001
10. New York Times, "Cooling Chicago, Starting with a Garden on the Roof of City Hall", John W Fountain

The costs were converted to a dollars ($) per impervious acre treated at 1.25” of rain for comparison purposes. In addition, layouts and sizing were performed for technologies that appeared to have good potential for applicability in built-up urban areas: infiltrating curbs, street tree filters and infiltrating catch basins.

A mix of LID technologies was selected to generate a unit cost per acre for LID-R. The mix was selected as identified in Table 13.

Table 13
Unit Costs for LID Application

LID-R Technology	*$/Imp Ac*	*% Applied*	*Base Construction Cost*	*Construction Cost with 30% Contingency*	*Capital Cost*
Bioretention	$ 26,000	25%	$ 6,500	$ 8,450	$ 9,100
Sand Filters	$ 55,000	15%	$ 8,250	$ 10,725	$ 11,550
Porous Pavement on Sidewalks	$ 90,000	15%	$ 13,500	$ 17,550	$ 18,900
Infiltrating catch basins	$370,000	15%	$ 55,500	$ 72,150	$ 77,700
Infiltrating curbs	$ 77,000	20%	$ 15,400	$ 20,020	$ 21,560
Street Tree Filters	$423,000	10%	$ 42,300	$ 54,990	$ 59,220
Total $/Imp ac(rounded)		100%	$142,000	$ 184,000	$ 198,000
Total $/acre @ 25% Impervious (rounded)			$ 35,363	$ 46,000	$ 50,000
Total $/acre @ 65% Impervious (rounded)			$ 92,000	$ 120,000	$ 129,000

3. CAPITAL COSTS

Engineering, construction management, construction inspection and administrative costs were calculated as a percentage of the construction cost to obtain the total opinion of capital cost. Percentages for these items were obtained from WASA based on current construction projects at BPWWTP. Capitalized interest is the cost of funds to finance construction projects. Recent WASA bonds have been approximately 6.5% and this value was used in the capital cost calculation. The following percentages of construction cost were used to estimate capital costs:

Table 14
Capital Cost Percentages

Line Number	*Description*	*Calculation Procedure*	*Net Impact*
1	Total Construction Cost	--	
2	Program Management	5% x Line 1	
3	Design Engineering	9% x Line 1	
4	Construction Management	11% x Line 1	
5	Office Engineering During Construction	2% x Line 1	
6	O & M Services	2% x Line 1	
7	Startup	2% x Line 1	
8	**Subtotal**	Sum of Lines 1 through 7	
9	Capitalized Interest	6.5% x Line 8	
10	**Total Capital Cost**	Sum of Lines 8 and 9	*Equivalent to Capital Cost = 1.40 x Construction Cost*

4. OPERATION AND MAINTENANCE COSTS

Operation and maintenance (O & M) costs were estimated using the following bases:

- Labor – Labor costs and requirements for the various CSO alternatives were based on the average cost of maintaining a single operating post manned by one operator on a 24 hour, year round basis. According to WASA's FY 2001 operations budget, a total of 1,057 positions required $54,491,000 which included regular wages, benefits, and overtime. Thus the average cost of one position was approximately $50,000. Assuming an eight hour workday, with three shifts per day, the average cost for a Continuous Operating Post (COP) would be $150,000. The number of COPs required for each alternative was determined on a case by case basis.
- Maintenance costs for facilities were taken as a percentage of the construction cost. For very large facilities, the percentages were adjusted to account for economy of scale on a case by case basis.
- Power – electricity costs were based on the unit cost per kWH as currently paid by WASA.
- Chemicals – chemical requirements were determined for each CSO control alternative based on the particular design requirements of that facility. Unit chemical costs were estimated based on actual chemical expenses at Blue Plains and by quotes from chemical suppliers.

Table 15
Operation and Maintenance Cost Basis

Item	*Unit*	*Cost Basis (per year)*
Operation		
Conveyance pipelines	--	Included in maintenance cost, see below
Storage basins		
Up to 10 mg	COP	0.5
Over 10 mg	COP	1.0
Pump stations		
Up to 100 mgd	COP	0.5
Over 100 mgd	COP	2.0
High Rate Physical Chemical Treatment	COP	2.0
Tunnels	COP	2.0
Maintenance		
Conveyance pipelines	% of construction cost	0.5%
Storage basins	% of construction cost	1.5%
Pump stations	% of construction cost	3.0%
High Rate Physical Chemical Treatment	% of construction cost	3.0%
Tunnels (except Piney Branch)	% of construction cost	1.0%
Piney Branch Tunnel	% of construction cost	2.0%

Item	*Unit*	*Cost Basis (per year)*
LID	% of construction cost	5.0%
New Clarifiers	% of construction cost	3.0%
Treatment		
Complete treatment	MG	$615
Excess flow treatment	MG	$184.50
High rate treatment	MG	$273
Power	KW-Hr	$0.051
Chemicals		
Chlorine gas	Pound	$0.134
Sodium hypochlorite, 15% solution strength	Pound	$0.328
Sulfur dioxide gas, 1.3:1 $SO_2 : Cl_2$ treatment ratio	Pound	$0.124
Sodium bisulfite, 38% solution strength, 1.3:1 $SO_2 : Cl_2$ treatment ratio	Pound	$1.80
Alum	Pound	
Ferric chloride, 40% solution strength	Pound	$0.105
Liquid polymer, dry	Pound	$1.30
Liquid polymer, emulsion	Pound	$0.56
Liquid polymer, mannich	Pound	$0.05
Microsand, 3 mg/l dosage	Pound	$0.25

5. NET PRESENT WORTH ANALYSIS

All costs were compared on a net present worth (NPW) basis using the following methodology and assumptions:

Table 12

Net Present Worth Assumptions

Item	*Description*
Planning Period	20 years
Salvage Value of Capital Facilities	$0
Inflation Rate	3%
Interest Rate (i.e. cost of money)	6.5%

For comparison of alternatives, capital expenditures were assumed to occur at year zero. Annual O & M costs were inflated each year at the inflation rate throughout the planning period. The interest rate was then used to bring each year's operation and maintenance cost to year zero to calculate the NPW of O & M costs.

6. REFERENCES

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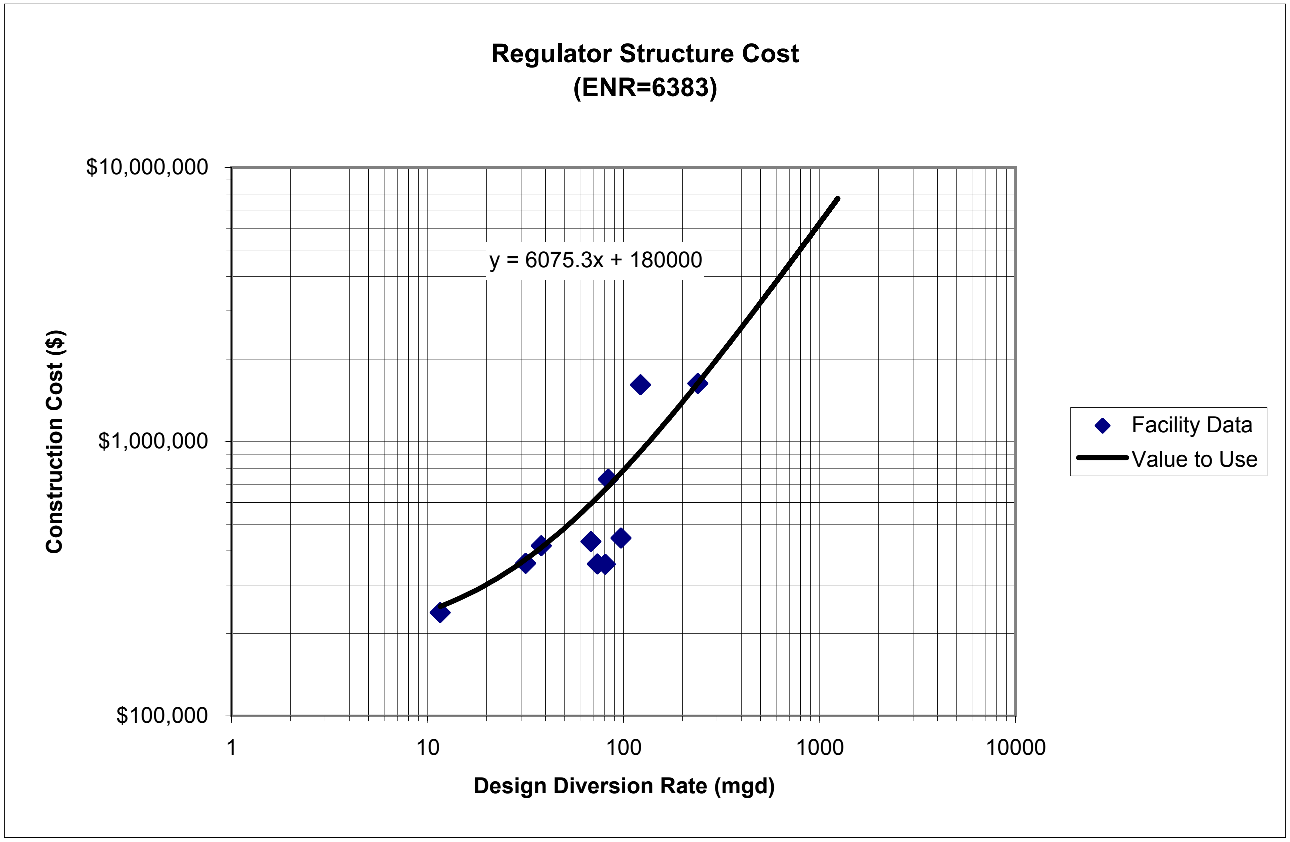
District of Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

Appendix E - Basis For Cost Opinions

Figure 1



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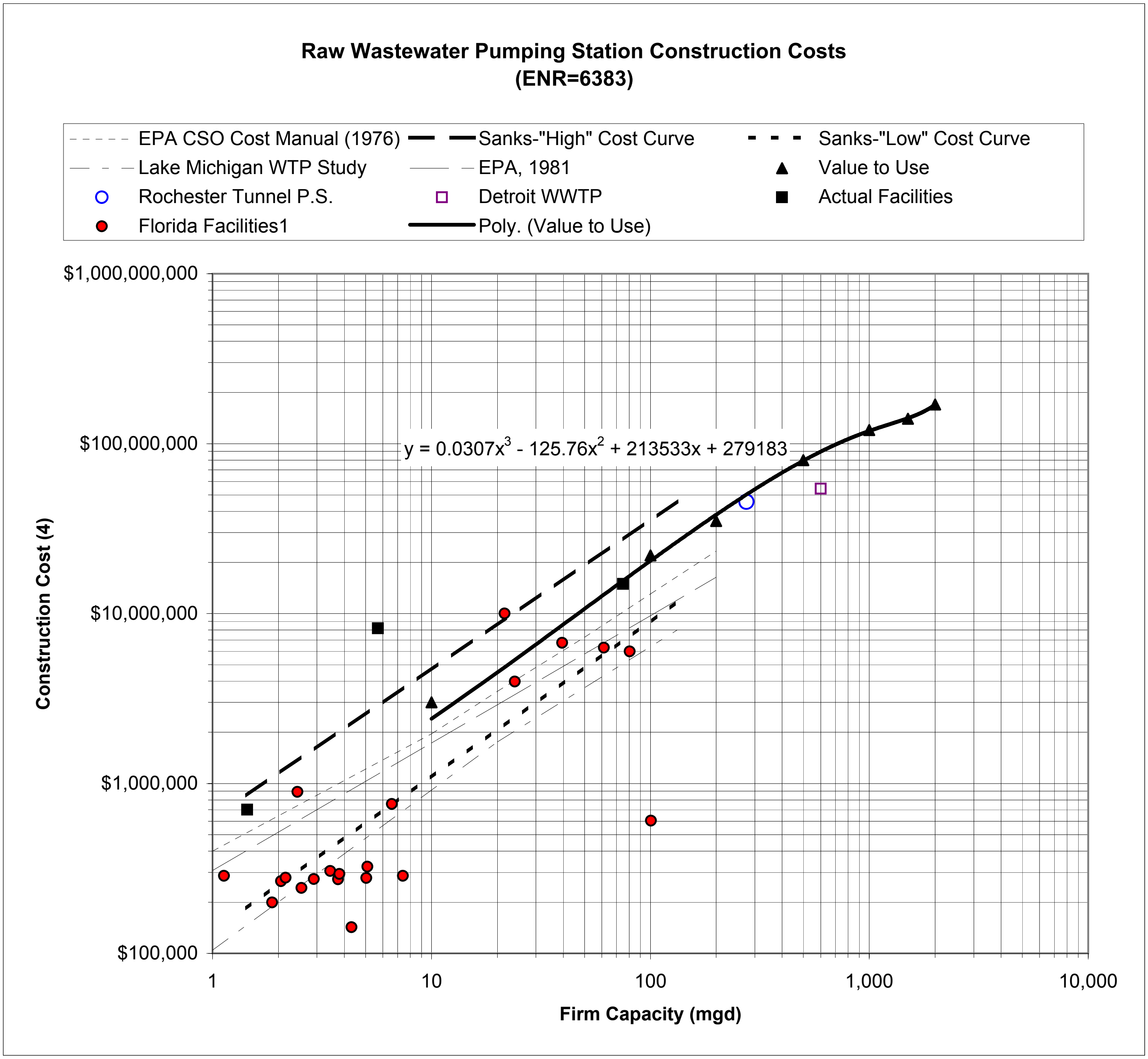
District of Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

Appendix E - Basis For Cost Opinions

Figure 2

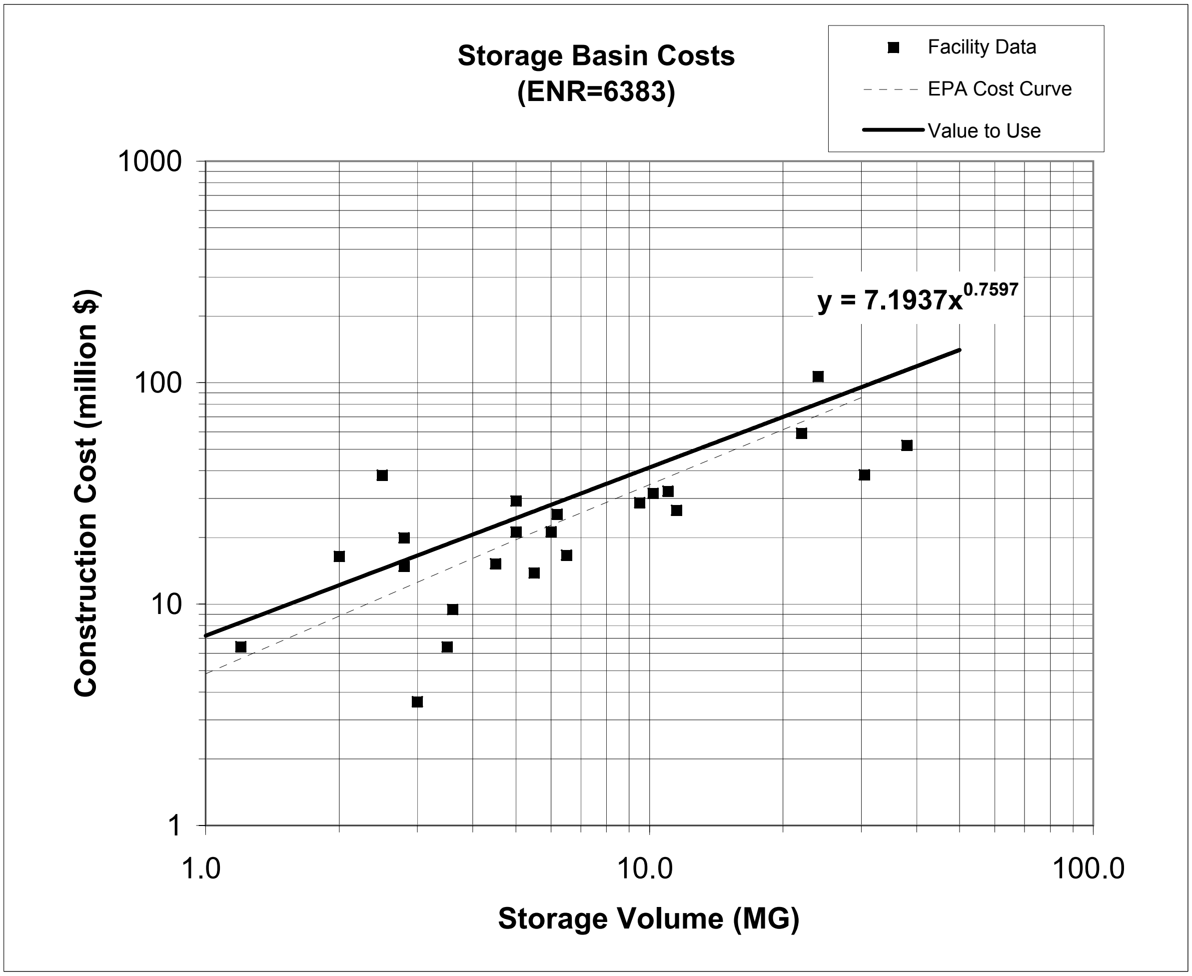


\\Gh-wash\ENG 1160\LTCP\LTCP Final\App E-Cost Basis\[Cost_P.S..xls]Report Fig

District of Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

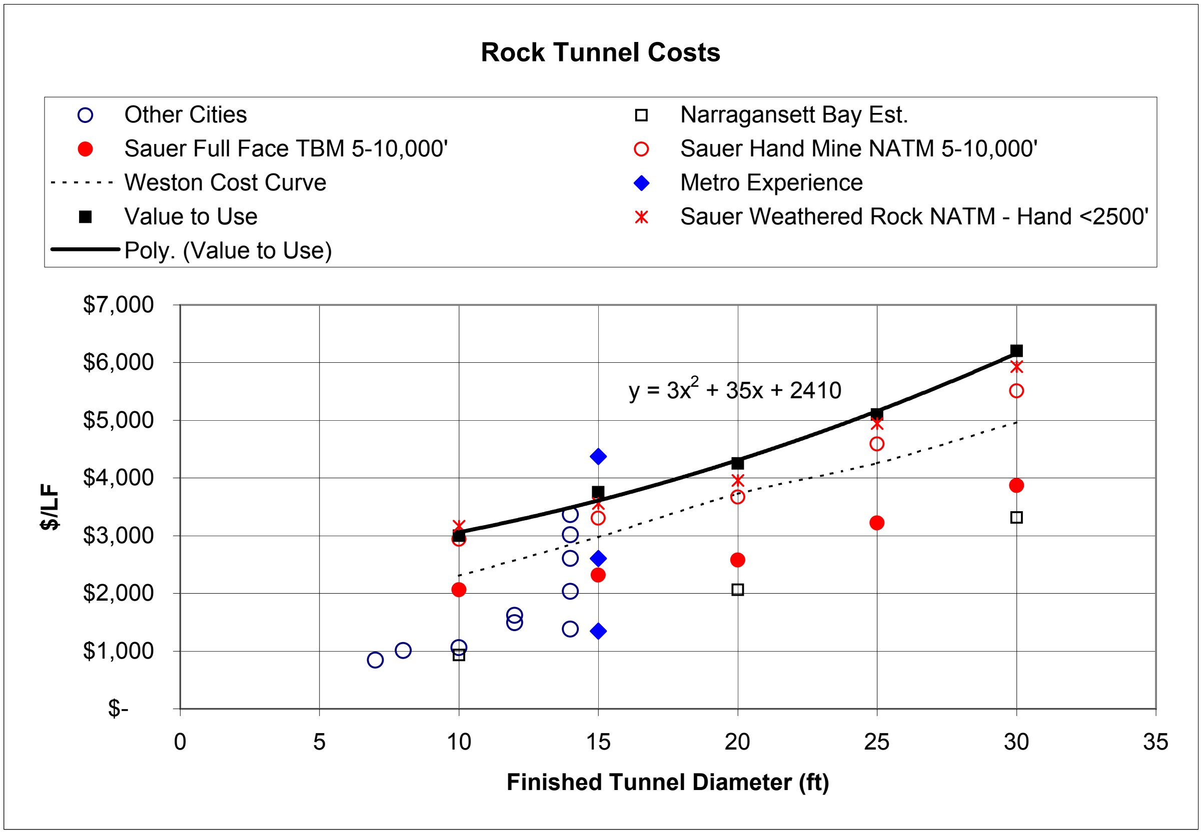
Appendix E - Basis For Cost Opinions

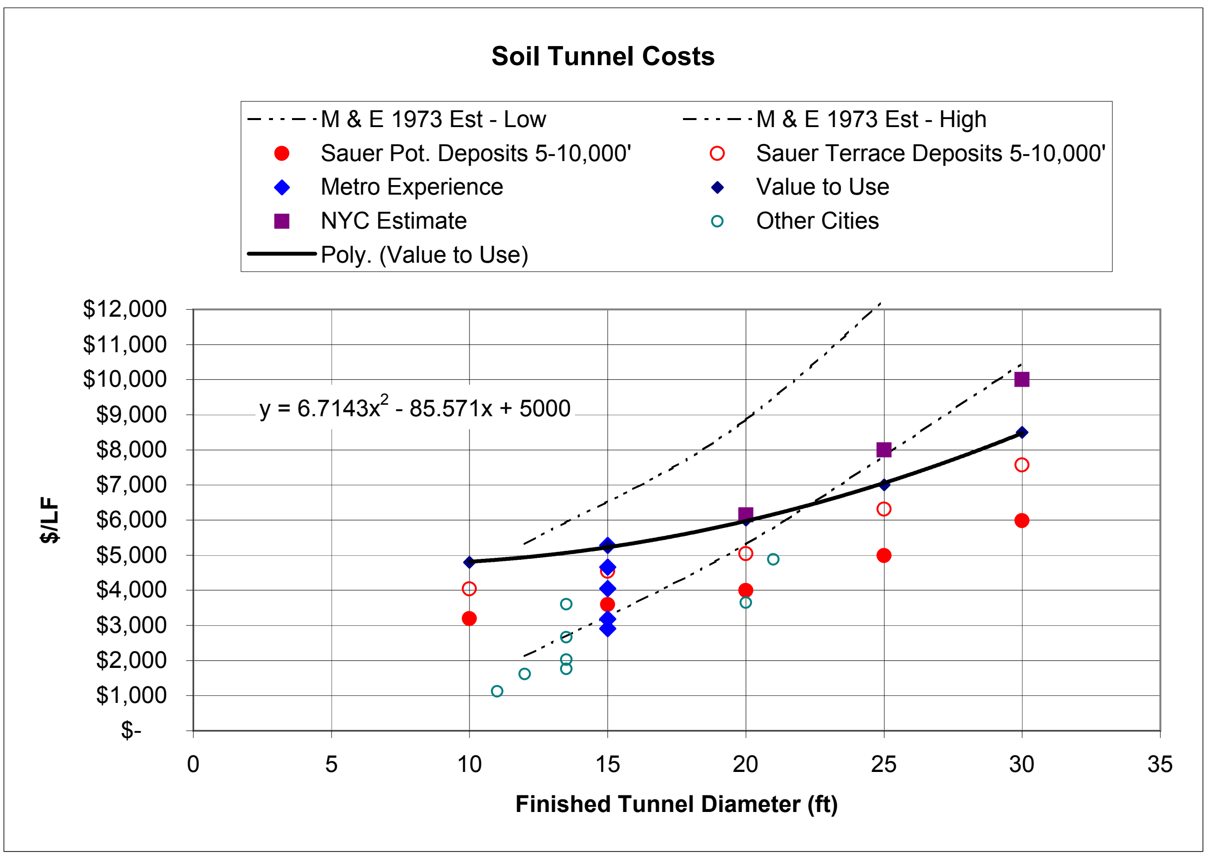
Figure 3



\\Gh-wash\ENG 1160\LTCP\LTCP Final\App E-Cost Basis\[Cost_Stor.xls]Figure 3

Figure 4

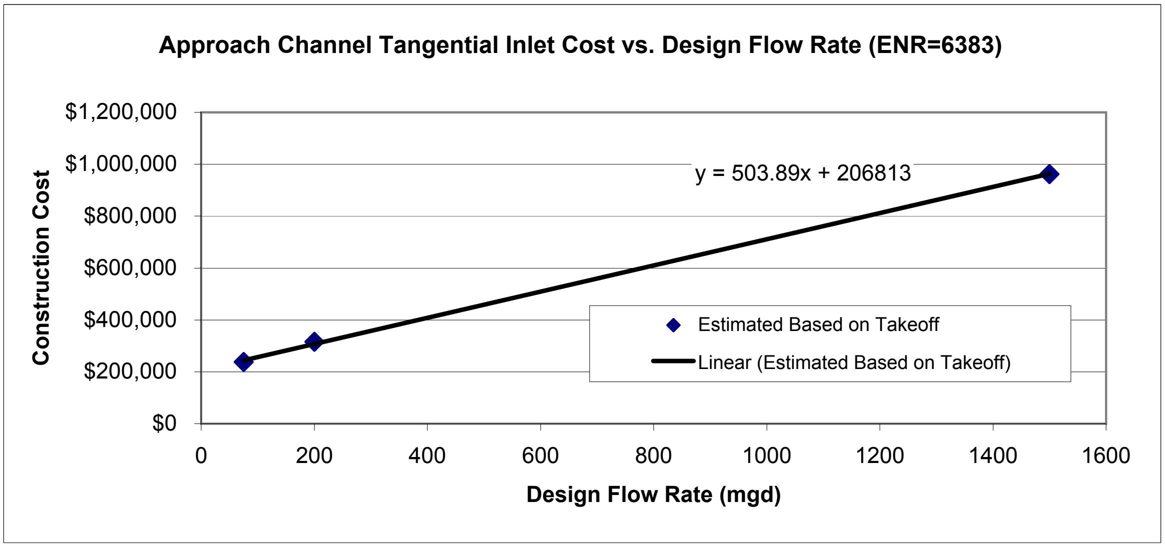

Rock Tunnel Costs
Other Cities
Sauer Full Face TBM 5-10,000'
Weston Cost Curve
Value to Use
Poly. (Value to Use)
Narragansett Bay Est.
Sauer Hand Mine NATM 5-10,000'
Metro Experience
Sauer Weathered Rock NATM - Hand <2500'
$7,000
$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$-
$/LF
y = 3x2 + 35x + 2410
0
5
10
15
20
25
30
35
Finished Tunnel Diameter (ft)

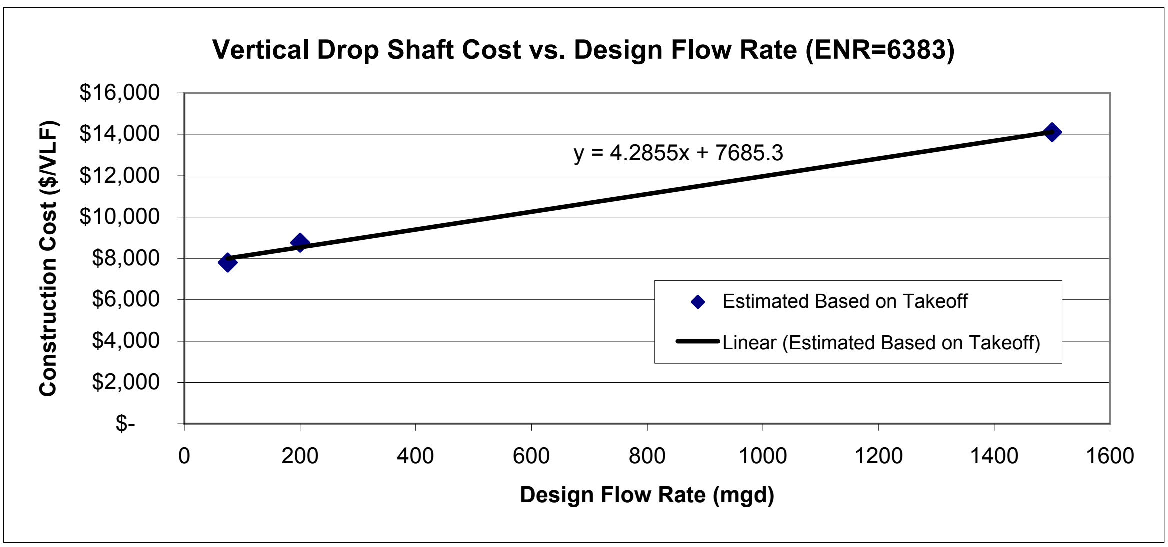

Soil Tunnel Costs
M & E 1973 Est - Low
Sauer Pot. Deposits 5-10,000'
Metro Experience
NYC Estimate
Poly. (Value to Use)
M & E 1973 Est - High
Sauer Terrace Deposits 5-10,000'
Value to Use
Other Cities
$12,000
$11,000
$10,000
$9,000
$8,000
$7,000
$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$-
$/LF
y = 6.7143x2 - 85.571x + 5000
0
5
10
15
20
25
30
35
Finished Tunnel Diameter (ft)

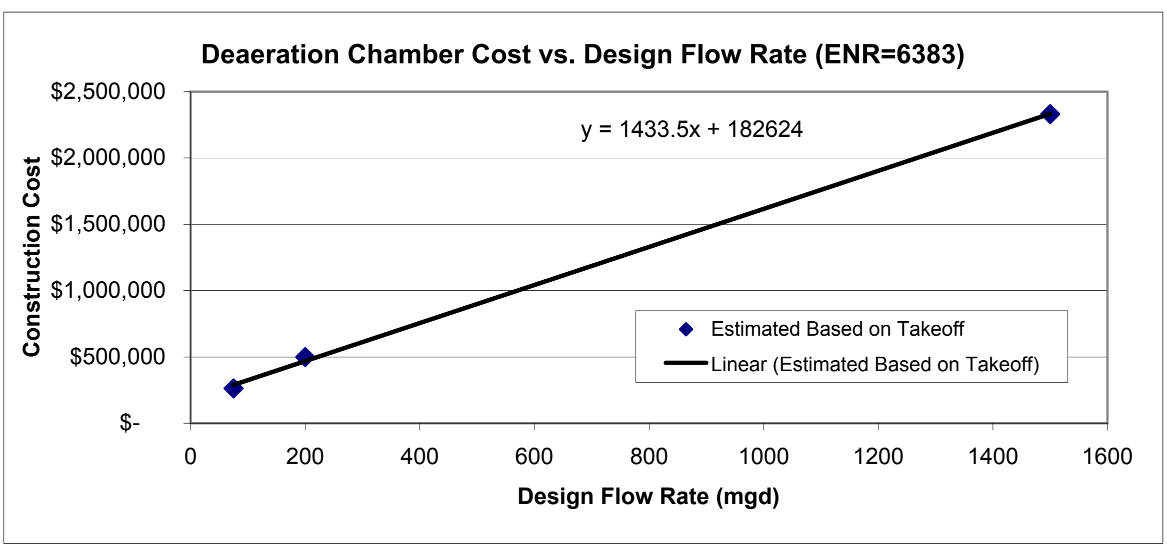
District of Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

Appendix E - Basis For Cost Opinions

Figure 5





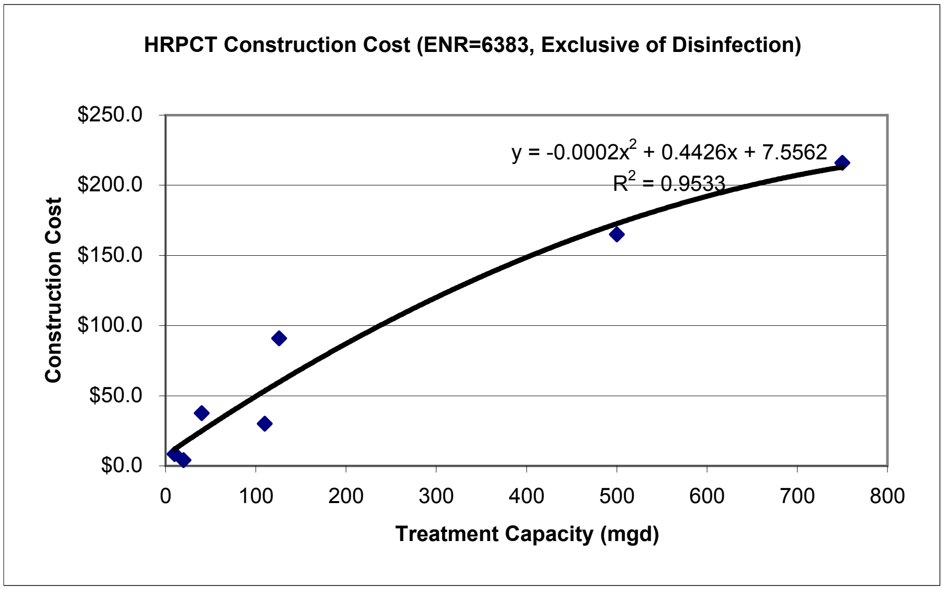


\\Gh-wash\ENG 1160\LTCP\LTCP Final\App E-Cost Basis\[Cost_dropshaft.xls]Cost Sum

District of Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

Appendix E - Basis For Cost Opinions

Figure 6



\\Gh-wash\ENG 1160\LTCP\LTCP Final\App E-Cost Basis\[Cost _High Rate.xls]Report Fig

District of Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

APPENDIX F

Responses to Comments

Appendix F
Responses to Comments

1. INTRODUCTION

This Appendix presents responses to comments received on the Draft Long Term Control Plan which was released in June 2001. An extremely large number of comments were received. In addition, there are significant degrees of overlap and common themes in many of the comments. As a result, comments were grouped by type and subject matter and addressed together in a commentary type response. The goal of this approach is to produce a commentary that is both readable and comprehensive. The comments were grouped as being related to the following topics:

- Nine Minimum Controls
- Alternatives Evaluation
- Separation
- Low Impact Development Source Control, Pollution Prevention
- Blue Plains Wastewater Treatment Plant
- CSO Location
- Flooding
- Implementability
- Tunneling
- Regulatory Compliance
- Public Participation
- Financial Capability
- Schedule
- Water Quality Standards Revisions
- Miscellaneous Comments

In the following text, each type of comments is described and a response is provided. The numbers after each comment refer to the comment number. Table 1 at the end of this section lists the commenters by comment number.

2. COMMENTS ON NINE MINIMUM CONTROLS

2.1 <u>Several commenters indicated that WASA should install a public notification system to advise people of the occurrence of CSOs. Commenters suggested that given the long time frame for LTCP implementation, a notification system was needed in the short term. One commenter suggested the system should be installed within 12 months and that a schedule should be included in the LTCP. EPA also asked what real-time enhancements</u>

to the overflow event warning system were planned to satisfy public notification requirements of the nine minimum controls (294, 295, 296, 297, 305).

The LTCP proposes a system of colored lights on each receiving water to notify the public. One color will be displayed when the overflow is occurring. Other colors would be displayed based on the overflow volume from a representative outfall in each receiving water. There would be two levels of notification; one for a normal event and another for a major event. For a normal volume, one color would be displayed for a specified time period. For a significant overflow volume, a second color would be displayed for a longer time period. The light display and durations following CSO events would be determined in consultation with The D.C. Department of Health and EPA.

2.2 One commenter indicated that WASA should fully implement the Nine Minimum Controls before embarking on a LTCP (306). EPA commented that the LTCP should more fully describe WASA's nine minimum control efforts to date, and plans to implement each of the NMCs. Since the overflow volume to be addressed by the LTCP can be reduced by maximizing NMC effectiveness, EPA indicated that it is important that current NMC information be reported. EPA asked if there were any near-term plans for trash and floatables control and if portions of the LTCP could be reduced in size or eliminated through full implementation of the Nine Minimum Controls. (305)

In 1996, WASA prepared a summary of its Nine Minimum Control (NMC) program. EPA made several comments on the report, which were ultimately addressed by WASA. Absent any documentation to the contrary, WASA thus considers its NMC adequate and in compliance with the CSO Policy.

In 1998, WASA participated in EPA's "Special Panel to Address Combined Sewer Overflows and Storm Water Issues in the District of Columbia". As a panel member, WASA was asked to review its NMC program and recommend improvements. This was documented in two reports: the *Nine Minimum Control Summary Report* (July 1999) and the *Nine Minimum Control Action Plan* (February 2000). No comments were received from EPA or the D.C. Department of Health on either of those reports. WASA continues to implement the enhancements to its NMC program as outlined in the reports.

It is important to note that the NMCs are best management practices. They are based on best professional judgement and are meant to be adapted to the site specific conditions of each system. The NMC program is also not a static program but is meant to be adjusted over time as appropriate. The enhancements that have been completed and those that are underway are in the spirit of making continuous improvements where feasible.

In the Draft LTCP, WASA has taken advantage of CSO reduction benefits of NMC-related measures. The two measures which have the most significant benefit are cleaning of the Eastside Interceptor and replacement of the inflatable dams. These components were assumed to be in place during the evaluation of alternatives. The benefits of these elements are shown on page 6-2 of the LTCP. Implementation of these measures has allowed for reduction in the size of capital facilities proposed in the Draft LTCP.

Regarding trash and floatables control, WASA will continue to:

- Operate the Anacostia River Floatable Debris Program on the Anacostia River. This is a skimmer boat program which removes floating debris on the river. Note that this program removes debris from storm water and upstream Maryland sources in addition to CSO sources.
- Continue to operate the end of pipe netting system on CSO 018 on the Anacostia River
- Continue the increased frequency of catch basin cleaning recommended in the NMC Summary Report.
- Operate the screening facility at the Northeast Boundary Sewer and the bar racks at the pumped overflows at the Main and 'O' Street Pumping Stations

Regarding a warning system to advise of overflows, WASA has proposed a warning light system to advise the public in the Final LTCP.

3. COMMENTS ON ALTERNATIVES EVALUATION

3.1 Some commenters suggested moving toward decentralized treatment systems such as composting toilets in lieu of centralized treatment systems (1,2). One commenter suggested constructing holding tanks for sanitary wastewater at individual properties such that wastewater could be held back during rain events so that overflows during rain events would not contain sanitary sewage (8).

There are two basic options for the management of decentralized treatment systems: operation by the utility such as WASA or operation by private individuals. Due to the large number of properties, operation by a utility would not be cost effective or practical. The large number required would be difficult to install, manage, maintain and operate. Operation by individual properties would not be reliable in that a significant percentage would likely be inoperable due to lack of maintenance. It is also unlikely that such a system would be accepted by the populace due to the space requirements of such systems, the need to enter private property to install them, and the disruption to private properties.

Note also that WASA's discharge permit will most likely require a specified degree of performance for the combined sewer system. Violations of the permit are subject to penalties by law. If decentralized systems were relied on to provide CSO control, there would need to be a permit system with individual properties in place to assure satisfactory performance to meet CSO control requirements. The numbers of properties and sites involved would make such a system expensive and unweildly.

In a concentrated urban environment, management of sanitary wastewater is a health issue in addition to being an aesthetic and environmental issue. The health issue could be of special concern in high rise buildings with many tenants. Given these difficulties, this type of system is not recommended for CSO control.

3.2 A commenter proposed the use of floodplains for controlling storm water to prevent its entry into the combined sewer system and thus to reduce overflows (3).

Floodplains are typically used adjacent to natural waterways to accommodate floodwaters in a natural area where damage to property and life is minimal. In the combined sewer system, the natural drainage system has been eliminated by the development of the city such that there is no natural outlet available. Typically, the only outlet available is the combined sewer. In these systems, it is not possible to effectively use floodplains without separating the system. An approach where facilities are constructed to allow storm water to infiltrate into the ground instead of into the combined sewer system is possible and is known as low impact development-retrofit (LID-R). This approach is addressed in subsequent comments.

3.3 One commenter suggested using used oil tankers for storage facilities for CSO overflows in lieu of the proposed tunnels. The tankers would be parked near outfalls and would be dewatered to the treatment plant after the rain subsided (7).

The CSO outfalls in the District are geographically dispersed along the waterways. It would be necessary to use many tankers or connect groups of outfalls to a tanker using a large diameter pipeline or tunnel. The draft LTCP uses the interconnecting tunnel as the storage facility. It is thus considered a more practical approach. Use of tankers would present the following additional difficulties:

- Tankers would take up considerable space in the water way, would present a hindrance to navigation and recreation and would detract aesthetically from the water way
- Solids in CSOs that settle in the tanker would be difficult to remove and would compromise CSO storage capacity.

- Separate pumping facilities would be needed at each tanker. This would be more expensive and difficult to operate and maintain than one or two consolidated facilities.
- In many locations, water depth an/or physical facilities nearby would not make tankers feasible

For these reasons, tankers for CSO storage are not recommended.

3.4 One commenter suggested using CSO as "grey water" to water lawns at golf courses and for other non-potable uses. (11)

Greywater typically refers to water which has received a level of treatment rendering it safe for use in non-potable applications such as watering lawns. CSO has relatively high levels of bacteria, solids, and trash/floatables which would make it unsuitable for use a greywater without treatment. Treatment of CSOs was evaluated in the draft LTCP and was found to be less practical than storage due to the extreme flow peaks that can occur, the lack of land available for treatment, and due to the intermittent and unpredictable nature of CSOs. A grey water system would require CSO to be collected, treated and then distributed to where grey water could be used. Such a system is not cost-effective compared to other technologies, particularly in the eastern United States where water is relatively plentiful.

3.5 One commenter indicated that the Draft LTCP was prepared allowing for growth in the suburbs but that it would not allow for growth in the District without increasing overflows. (18) Another commenter indicated that the Draft LTCP assumed the District flows met their IMA allowances when the District is currently exceeds its IMA allowance. (430).

BPWWTP has a rated annual average flow capacity of 370 mgd. The Blue Plains Intermunicipal Agreement of 1985 (IMA) allocates wastewater treatment capacity between the District and the surrounding jurisdictions. The surrounding jurisdictions are allocated an annual average capacity of 212 mgd. The District is allocated a capacity of 148 mgd with 10 mgd reserved to accommodate additional Potomac Interceptor flows for a total of 158 mgd. The Draft LTCP was prepared using the dry weather flows specified in the IMA: 158 mgd for the District, 212 mgd for the suburbs, or 370 mgd total.

The Metropolitan Washington Council of Governments (MWCOG) recently completed wastewater flow projections for the BPWWTP in 2002. MWCOG uses the Regional Wastewater Flow Forecast Model (RWFFM) to project flows. The RWFFM is a computer model that links GIS sewershed layer with population projections to compute wastewater flows. The RWFFM develops a base year flow based on regression analysis of historical data. This is done to dampen the effects of short-term flow fluctuations. From the base year flow, the model then projects future flows based on population changes, infiltration and inflow allowances, and changes in wastewater management such as flow diversions to other treatment facilities.

MWCOG indicates that the year 2000 wastewater flow to the District was 160 mgd. The population in the District is projected to increase from about 518,000 in 2000 to about 648,000 in 2025. The unadjusted year 2025 wastewater flow from the District is projected to average 180 mgd. The term 'unadjusted' means it does not account for other changes in the sewer sytem. WASA plans a Wastewater Flow Reduction Program, a Water Conservation Program, and a Sewer System Assessment Program that are expected to achieve a total 20 mgd reduction in District Wastewater Flows. Considering these adjustments, MWCOG projects the flow from the District in 2025 to be 160 mgd.

The year 2025 wastewater flow of 160 mgd is extremely close to the 158 mgs used in draft LTCP. As a result, the Draft LTCP does allow for substantial population growth in the District without an increase in overflows.

3.6 Several commenters indicated that the plan failed to address rehabilitation of the existing combined sewer system. A commenter suggested that it did not make sense to spend money on a new tunnel system if the existing combined sewer was in need of rehabilitation. (35, 36, 37, 38, 39, 40, 41, 42)

In the LTCP, WASA accounted for rehabilitation of the CSS in areas where there were known problems and where rehabilitation could have a measurable CSO benefit. These rehabilitations include:

- Cleaning of the Eastside Interceptor- the Eastside Interceptor is a sewer between the Northeast Boundary and Main Pumping station that was determined to have a large degree of siltation. WASA cleaned the sewer and accounted for the resulting CSO benefits in the draft LTCP.
- Replacement of the Inflatable Dams – the inflatable dams are air filled devices placed in several large sewers that provide in system storage capacity. Six of the twelve dams are not functioning and WASA is in the process of replacing them. Again, the CSO reduction benefits of replacing the dams were demonstrated and accounted for in the draft LTCP.
- Rehabilitation of Pumping Stations – WASA is in the process of rehabilitating the Potomac, Main, O Street, Eastside and Poplar Point Pumping Stations to restore pumping capacity and improve system reliability. The CSO reduction

benefits of the rehabilitations were demonstrated and accounted for in the draft LTCP.

WASA is also beginning a program of systematic evaluation of its combined and separate sewer system to identify and prioritize areas in need of rehabilitation and improvement. This will be an ongoing effort. It is unlikely that this program will results in significant CSO reduction on the order required by the CSO Policy and to meet water quality standards.

3.7 Several commenters indicated the plan did not address the following items:

- Alleged inadequate maintenance of catch basins, separate storm sewers and combined sewers (20,21)
- Pollution from the separate storm sewer system and sanitary sewer overflows (SSOs). (16)
- Cross connections between the water and sewer system (17)

The draft LTCP was prepared in accordance with WASA's NPDES Permit and EPA's CSO Policy, which is now part of the Clean Water Act. In accordance with these requirements, the purpose of the plan is to determine what CSO controls are required to meet water quality standards and other requirements specified in the Policy. Other programs are in place or under development to address other issues as follows:

- Catch Basin Cleaning and Maintenance of sewers – WASA has an approved Nine Minimum Control Program which includes catch basin cleaning and maintenance of sewers. The frequency of catch basin cleaning is approximately once per year, higher in trouble spots.
- Pollution from separate storm water system – pollution from the separate storm water system comes from both separate sewered areas in Maryland and in the District. In Maryland, The Maryland Department of the Environment (MDE) is the agency responsible for regulating state environmental issues. For waters that do not meet water quality standards, each state is responsible for developing a total maximum daily load (TMDL) for each pollution source designed to bring it into compliance with water quality standards. Maryland is in the process of developing several TMDLs. EPA is regulating this process. In the District, the separate storm water system is being addressed as part of the MS4 permit held by the District Government. WASA is the storm water administrator, and relies heavily on the Department of Public Works and Department of Health for many aspects of storm water control. In addition to District sources of storm water, the Federal Government owns many storm water outfalls.

- Sanitary Sewer Overflows (SSOs) - EPA is in the process of developing and promulgating its SSO policy. The nation as a whole is beginning to address these issues. WASA will be doing the same.
- Cross connections Between Potable Water and Sewer – WASA has identified cross connections in the system. As of March 2002, two separate contractors were working to address them.

3.8 Several commenters indicated that since flows from Maryland and Virginia take up capacity in the combined sewer system, they contribute to overflows. Commenters suggested that the suburbs should reduce their flows by water conservation, storm water controls or other unidentified measures. Another commenter suggested that the suburban flows should be carried around the combined sewer system so they do not affect the CSS and thus reduce overflows. EPA suggested that an alternative be developed to reduce the flow from the separated sewers from the suburbs and the District by storage, satellite treatment or conveyance past BPWWTP. (22, 23, 24, 29, 30, 44)

Flows to BPWWTP are governed by the Intermunicipal Agreement (IMA) of 1985. The IMA places annual average and peak flow limitations on the suburban jurisdictions. The suburbs are currently within their average and peak flow limitations and the LTCP was prepared by assuming the suburbs were discharging at these limits. WASA cannot require the suburban jurisdictions to reduce their flows without renegotiating the IMA. This would be a long and involved political process with an uncertain outcome.

An alternative wherein WASA would construct flow equalization basins in the District for the large suburban flows was evaluated. The purpose of the equalization basins was to reduce the suburban peaks during wet weather events. The modeling indicated that reducing the suburban peaks did not have a significant effect on CSOs in the District compared to the cost of the equalization basins. This is because the majority of the flow during wet weather is rainwater from the combined sewer system. It would also be difficult to obtain land and public acceptance to construct such facilities. This alternative was not considered attractive.

Conveying the suburban flows around the combined sewer area and directly to BPWWTP was also evaluated as a CSO control option. Construction of such facilities would be extremely expensive and disruptive. In addition, the overflow volume would not change significantly since the capacity of BPWWTP would still limit the amount of total flow treated.

3.9 Several commenters advocated for an integrated watershed approach that includes watershed protection and involves the counties. One suggested that WASA should allocate funding to these programs (26, 27, 28, 66, 67, 68)

The draft LTCP was prepared in accordance with WASA's NPDES Permit and EPA's CSO Policy, which is now part of the Clean Water Act. In accordance with these requirements, the purpose of the plan is to determine what CSO controls are required to meet water quality standards and other requirements specified in the Policy. While control of pollution sources in other parts of the watershed could improve water quality, they will not have any effect on CSO discharges. As a result, the draft LTCP was focused on controlling CSOs in the District.

The Draft LTCP indicated that control of CSOs alone will not allow the water quality standards to be met much of the time in the District. This is due to the other sources of pollution in the District and outside of the District. The analyses indicate that a watershed approach is necessary and that all major pollution sources must be controlled to achieve water quality standards.

WASA is active in larger watershed issues and is an advocate for control of other sources of pollution. WASA currently chairs the Anacostia Watershed Restoration Committee, which is a group established to bring together the major regulatory representatives and stakeholders in the watershed. WASA also has a role as the administrator for the District's separate storm water system permit issued by EPA. In this role, there are opportunities for reducing pollution from the storm water system. It is important to note that WASA shares responsibility for the storm water system with the Department of Public Works, the Department of Health and other agencies. However, WASA is not authorized to spend financial resources to control pollution that is the responsibility of other jurisdictions.

3.10 One commenter indicated that WASA's CSO modeling reports indicate that during the calibration, the combined system model predicted no overflows when overflows actually occurred during some calibration events. The commenter indicated that this raised concerns as to whether the model was capable of accurately predicting overflows. The commenter further suggested that WASA should account for this underprediction in some manner such as by increasing the size of the storage facilities. (31)

The model of the combined sewer system was calibrated to 9 months of monitoring data (October 1999-June 2000) representing a wide range of rainfall conditions. In general, the model calibration was excellent. In certain instances, the model predicted CSO overflows when none occurred, and other times did not predict overflows when some were measured. This was not a common occurrence and typically occurred at the smaller rainfall events that were near the threshold of overflowing. This is not atypical for CSO modeling and it represents the state of current predictive technology.

Overall, the model over predicted CSO overflow volumes by about 10-15% on an average year basis. This was intentionally done to provide conservatism and to account for the under prediction on certain occasions.

3.11 EPA commented that that the Real Time Control (RTC) alternative assumed the use of inflatable dams to provide in-system storage. Since the dams were susceptible to damage, the commenter suggested considering other technologies. (46)

The original inflatable dams in the District were an innovative and unproven technology at the time of installation. Some of the dams failed as a result of seam failure due to a manufacturing defect (not puncture). This also happened to other municipalities that installed dams from the same manufacturer. The manufacturer ultimately went bankrupt. The replacement dams that are being installed are from a reputable manufacturer with a proven track record at other municipalities. As a result, additional inflatable dams are a viable option for future installation.

Other options also exist such as sluice gates, butterfly gates, tipping weirs and movable weirs. The assessment of the practicality and cost effectiveness of additional RTC to supplement the existing dams would not be substantially affected by the selection of the technology employed.

3.12 EPA suggested that further consideration be given to satellite treatment of high volume CSOs where water quality impacts would be the greatest (47)

High rate physical chemical treatment (HRPCT) and disinfection were considered both in place of, and to supplement, the proposed storage facilities. These facilities were not considered preferred alternatives for the following reasons:

- Lack of land and difficulty in obtaining public acceptance for such facilities
- Intermittent operation would require continuous staffing or potentially unreliable automatic operation
- In order to have a reasonable number of treatment facilities, it is necessary to intercept and convey the various CSOs to one or more central sites for treatment. The size of these conveyance facilities becomes so large that it becomes more cost effective to increase their size to make them storage facilities
- Lack of cost effectiveness and practicality when compared to storage options

For these reasons, satellite treatment was not considered feasible or cost effective.

3.13 <u>The Draft LTCP indicated that solid and floatable control would be incorporated into the design of new regulators. EPA requested clarification regarding where regulators are to be replaced and how the evaluation regarding the applicability of solids and floatables control would be evaluated (65).</u>

New regulators would typically be provided for CSOs that will be controlled or captured by the tunnels. The regulators are used to divert CSO into the storage tunnels. Existing regulators cannot normally be used for this new function because the diversion rates required to achieve the specified degree of CSO control are much higher than the diversion rates of the existing regulators. The physical location of the regulators will depend on final location of the tunnels, the availability of land for construction and other factors. The siting of regulators is usually done at the design development stage.

The Draft LTCP indicates that WASA will incorporate floatables control for overflows which exceed the capacity of the recommended control plan into the design of new CSO diversion structures/facilities constructed as part of the LTCP. One method that might be used is a combination baffle/bar rack arrangement in new CSO regulators. This method has been used successfully in Richmond, Virginia and Boston, Massachusetts. As was discovered in those communities, there may be some outfalls where incorporation of floatables control into new facilities is not practical due to hydraulics, site constraints or other factors. As an example, there may be some outfalls where incorporation of solids/floatables control may cause added headloss such that flooding conditions may be created. It is not possible to make these types of assessments at this time. These evaluations are typically performed at the design stage when detailed information is available regarding facility location. WASA will make every effort to incorporate solids/floatables control where feasible.

3.14 <u>While acknowledging that the option of relocating the Main and O Street Pumping Facilities to the Poplar Point was costly and less desirable at the present time, a commenter supported retaining this option in the event circumstances or events changed. Examples include public/private development in Poplar Point changes in real estate values, etc. (421)</u>

Comment noted. The decision to relocate Main and O Street Pumping Stations is relatively independent of the selection of the LTCP. That is, nearly any LTCP can accommodate the relocation of Main and O Pumping Stations to Poplar Point. Deciding to relocate the facilities prior to completion of design of the new CSO facilities would be the most beneficial because it would allow joint design, construction and integration of the relocation in conjunction with other new facilities.

4. COMMENTS ON LEVEL OF CSO CONTROL

4.1 Ten commenters expressed support for the Draft LTCP (217, 218, 219, 220, 221, 222, 223, 224, 225, 226).

Comment noted.

4.2 One commenter indicated an opposition to any CSO control because the water quality benefits were not that great. (232). Two commenters opposed any degree of CSO control without other polluters such as Maryland, Virginia and the Federal Government doing their fair share. (25, 289)

Control of CSOs is required by the Clean Water Act and by WASA's National Pollutant Discharge Elimination System (NPDES) Permit. Other communities in the nation also are facing this issue. By controlling CSOs, WASA will lead by example and hopefully encourage the surrounding jurisdictions and the Federal Government to control their pollution sources.

4.3 EPA indicated it was unclear how benefits from LTCP implementation will translate to protection of designated and existing uses. We know the reduced number of overflows, and the reduction in CSO loading. What we do not know is how severe a storm will have to be to trigger overflows, and what the resultant water quality impacts will be (assuming of course that other point sources and NPS are controlled as envisioned in the BOD TMDL)(433).

4.3.1 What magnitude storm [5 (or whatever) year storm, defined as so many inches per hour, for a given amount of time, spread over a defined area] will cause overflows to the Anacostia (post implementation of the draft LTCP)? How severe would a storm have to be to result in sufficient overflows to exceed numeric water quality criteria? How much of a CSO load would it take to cause such an exceedance?

In accordance with the CSO Policy, CSO planning is based on average year conditions. WASA's LTCP (and most LTCPs around the country) propose that remaining overflows after implementation will be in the range of 1 to 4 per average year. This means that storms less severe than the 1 year storm will cause overflows.

Determining the return frequency of a storm that will cause overflows is complex and not directly translatable to actual conditions on the ground. In addition to rain volume and intensity, overflows can be caused by back-to-back small or moderate storms. These storms can fill the storage facility to capacity before there is time to dewater the facility. In this case, smaller storms that do not meet the "design storm" threshold can cause an overflow.

In addition to these complexities, design storms typically do not occur in the real world. Actual rainfall has a significant spacial and temporal variation that can dramatically affect overflows. Summer thunderstorms can cause intense rainfall in one drainage basin and little or no rainfall in an adjacent basin. Because of these complexities, it is difficult to translate design storms into real world actual conditions. As a result, and in accordance with the CSO Policy, average year conditions are used to gage system performance.

If upstream and storm water sources were controlled to levels required by the Anacostia TMDLs, the LTCP would meet the bacteria geometric mean standard in the Anacostia in the average year (the design condition per the CSO Policy). With other sources controlled, the same is true for the Potomac and Rock Creek.

4.3.2 <u>How many days of water body use, if any, do the models suggest would be lost in an average year to such exceedances (post implementation of the draft LTCP)?</u>

For the Draft LTCP in the average year, CSOs are projected to cause fecal coliform levels to rise above an average of 200MPN/100 ml for 11 days per year, 6 of which occur in the period of likely recreational use from May to September. Storm water and upstream sources are projected to cause exceedances of this criteria 183 days per year, a far greater number. Note that the 200 MPN/100 ml average daily concentration is a much more restrictive standard than the current water quality standards which specify a 30 day geometric mean.

4.3.3 <u>Please repeat the above for the LTCP scenario suggested by DOH, in which there would be no overflows to the Anacostia in an average year.</u>

The LTCP was evaluated based on a 3-year analysis period: 1988, 1989, and 1990. This included a wet year, dry year and average year. Average year conditions were defined as the arithmetic average of the results for the three years. The DOH plan called for no overflows in the dry or average year but allowed overflows in the wet year. For this plan, CSOs are projected to cause fecal coliform levels to rise above the 200MPN/100 ml daily average for 1 day per year. This day occurs in the period of likely recreational use from

May to September. Storm water and upstream sources are projected to cause exceedances of this criteria 182 days per year.

4.4 EPA questioned the extent to which increasing the diameters of the Anacostia tunnels increases the percent capture and decreases the number of overflow events without significantly adding to the overall cost of the project (229).

The cost versus CSO reduction curves and the associated analyses in the Draft LTCP are shown on page 9-30 for the Anacostia River. The knee-of-the-curve is the point where increasing tunnel sizes results in proportionately more costs than CSO reduction benefits. This starts to occur at the four overflows per average year level. The Draft LTCP was selected at the point where increasing tunnel sizes results in proportionately more costs than benefits. The Final LTCP increases the level of control to the point where increased level of control will provide few water quality benefits at great cost.

4.5 General Comments on Level of Control

4.5.1 Comments Applicable to All Receiving Waters

4.5.1.1. Many commenters advocated for a higher degree of control in general without specifying the degree of control (152, 163-199, 211, 230).

4.5.1.2. Several commenters recommended developing a plan that eliminates CSOs under all conditions. It was unclear from the comments whether the commenters advocated separation. (4, 161, 206, 207, 208, 209, 210,214).

4.5.1.3. A commenter advocated for some way to stop overflows under all conditions short of separation.(14).

4.5.1.4. One commenter recommended sizing facilities for zero discharges in the average year (215)

4.5.1.5. One commenter indicated support for the tunnels but that they should be sized for zero overflows in the wettest year of the three year evaluation period (213)

4.5.1.6. One commenter recommended the highest degree of control feasible without separation (212).

4.5.1.7. One commenter indicated that CSO controls were investments for the future and that cost was thus not the biggest consideration (228). Another commenter indicated that the decisions made now about CSO control would affect the District for the next 100 years and thus WASA should be visionary and bold in making the right decision. (231)

4.5.1.8. One commenter called for less pollution in general (160)

4.5.1.9. One commenter asked for a prediction of the magnitude of overflows expected for the 1, 5, 10, 15, and 25 year storms. (32)

4.5.2 Comments Specific to Anacostia River

4.5.2.1. The D.C. Department of Health suggested a CSO plan where the Anacostia tunnels would be sized for no overflows in the dry and average year with 1 to 2 overflows in the wet year. One commenter indicated support for DOH's plan. (216)

4.5.2.2. One commenter supported the tunnels as a good first step but indicated that more control was necessary (362)

4.5.2.3. One commenter endorsed the tunnels as laid out, but recommended they be sized to control the 25 year storm. The commenter further recommended that the pumping stations be upgraded, that LID be expanded and that water conservation be implemented in the Northeast Boundary. (156)

4.5.2.4. One commenter recommended that the goal in the Anacostia should be 0 overflows per year (157).

4.5.2.5. A commenter indicated that the Anacostia should receive priority because it is the most impacted river and that a higher degree of control should be provided for the Anacostia (158)

4.5.2.6. One commenter indicated the Anacostia River should receive a degree of control such that its water quality is the equal of the Potomac. (159)

4.5.3 Comments Specific to Potomac River:

4.5.3.1. In the Potomac, DOH concurred with the recommended plan which reduced overflows to 12 per average year (154)

4.5.3.2. One commenter indicated the Potomac tunnels should be sized for the wettest year in the three year evaluation period. (200)

4.5.3.3. Commenters indicated that the level of control proposed for the Potomac was too low compared to the other receiving waters. A commenter further indicated that the Potomac River is a highly used river for recreational purposes and that its use is expanding. The commenter indicated that there are opportunities for direct human contact with the water in the form of splashing from boat, boat upsets in the river, and dogs exercising in the river and then being handled by owners. The commenter recommended a higher degree of control for the Potomac River and suggested that the plan will have an adverse impact on users of the Potomac River. (201, 202, 203, 204, 205, 424)

This responds to all comments listed under item 4.5. The only CSO plan that will eliminate overflows under all weather conditions is separation. Separation has a cost almost triple that of the recommended LTCP, would cause massive disruption and hardships, and results in worse water quality than the recommended LTCP. For these and other reasons separation was not recommended. Given that separation is not feasible, there will be some remaining overflows for any CSO control plan. What remains to be decided is how big to make the facilities and how infrequent the CSO overflows will be. The higher the degree of CSO control, the higher the cost. The recommended plan was selected to provide an effective balance of overflow reduction, water quality improvement and cost. After implementation, it is predicted that CSOs will occur infrequently and that there will be very infrequent disruption of water quality due to CSO.

4.6 One commenter questioned the efficacy and rationale behind the Piney Branch tunnel in that it has very little water quality benefits. The commenter suggested implementing extensive LID and installation of a trash trap and disinfection facility in lieu of the tunnel at the Piney Branch Outfall. (33)

Due to the sensitive park setting, a trash trap and disinfection facility are unlikely to be acceptable to the National Park Service or the public. In fact, a screening facility was proposed for Piney Branch as a result of the 1983 CSO study. This was never constructed due, in part, to the impacts on Rock Creek.

4.7 One commenter suggested that there might be sewer leaks at sewers crossing Rock Creek at Military Road and the Dam upstream of Boulder Bridge. (44)

The receiving water monitoring in Rock Creek conducted as part of the LTCP did not suggest the presence of leaking sewers in the areas indicated. However, WASA will be conducting a City-wide assessment of the sewer system. Creek crossings will be one of the areas where particular attention will be focused.

4.8 One commenter suggested redesigning or closing regulators at Rock Creek where feasible. (45)

The LTCP proposes separation to eliminate four outfalls and associated regulators along Rock Creek. The plan also proposes monitoring and regulator improvements at four additional regulators in Rock Creek.

4.9 A commenter recommended setting enforceable milestones for reducing bacteria levels from Montgomery county to improve water quality in Rock Creek. The commenter indicated that WASA should mandate aggressive LID in the Rock Creek sewer shed in Montgomery county coupled with water conservation measures to reduce flows through the Rock Creek Interceptor. (253)

WASA does not have the authority to place requirements on surrounding jurisdictions.

4.10 EPA suggested that Rock Creek appeared to be a good candidate for selective separation or other remediation prior to construction of the Piney Branch tunnel. EPA asked about other alternatives to correct storm water and CSO overflows to Rock Creek (43).

In the combined sewer area tributary to Rock Creek, almost all of the storm water and sanitary sewage is captured by the combined sewer system. This is evident by the very low annual overflow volumes compared to the large drainage area. The analyses have indicated that large-scale separation in Rock Creek would make the water quality much worse. This is because of the very large volume of storm water which is captured by the combined sewer system that would otherwise discharge untreated to the Creek if separated. Large-scale separation is thus not beneficial.

Due to the low overflow volume in Rock Creek, CSOs do not have a significant effect on water quality. In the Draft LTCP, CSOs are projected to cause fecal coliform bacteria levels to be greater than 200 MPN/100 ml 4 days per average year, while storm water and upstream loads are projected to cause this level to be exceeded 294 days per year. The proposed CSO control will lower the concentrations of bacteria in the Creek, but will not result in the attainment of water quality standards. However, control of CSOs to zero overflows per year does not produce noticeably different water quality in Rock Creek when compared to the proposed levels of control.

The analyses demonstrate that the only way to meet water quality standards is to control urban storm water and upstream loads. This is the case for many urban streams in separate sewer areas.

4.11 One commenter indicated that WASA should consider not constructing the Potomac Tunnel and putting the money into Anacostia CSO control instead. (6)

CSOs can adversely affect the water quality in the Potomac. The CSO Policy thus requires this to be addressed. However, priority has been given in the schedule to the Anacostia.

4.12 EPA recommended that the Potomac and Rock Creek tunnels be re-evaluated when the Anacostia tunnel is completed, as part of the Anacostia post-construction monitoring plan (324).

Anacostia performance data will be used to re-evaluate the Potomac and Rock Creek programs where it is available.

4.13 One commenter indicated that the Draft LTCP "fails to reverse the old system of environmental injustice that has placed a disproportionate burden on the predominantly African-American communities on the East Side of DC". The commenter indicated that much has been spent on cleaning up the Potomac River, and that the proposed plan fails to do this for the Anacostia. (153,155)

The greatest CSO control benefit and the largest expenditures in both the Draft and Final LTCP are directed toward improving the Anacostia River. Of the $1.265 billion program, $940 million or about 74% are directed toward improving the water quality of the Anacostia River. The plan proposes to reduce overflows to the Anacostia such that both the frequency and volume of overflows are less than overflows to the Potomac. The LTCP is thus extremely responsive to the suggestion that the Anacostia be given priority.

4.14 One commenter advocated considering downstream beneficiaries in the cost benefit analysis and not just beneficiaries in the District. (162)

The LTCP identifies benefits to water quality in the District associated with CSO control. To some degree, these same benefits apply to downstream populations. Jurisdictions in close geographic proximity to the District would benefit the greatest. Jurisdictions farther from the District would benefit less so since the natural processes of dilution and assimilation of pollution mean that CSOs have less impact on waters farther from the District.

5. COMMENTS ON SEPARATION

5.1 EPA and several other commenters indicated that further consideration should be given to partial or targeted separation. Commenters suggested an evaluation considering such measures as cost, volume reduction, impacts on water quality, ability to alleviate flooding, potential to alleviate human health hazards from recreational contact, age and condition of existing infrastructure, impacts on wildlife and ability to be constructed in tandem with storm water management and LID measures. Some commenters recommended specifically considering separation in upper Rock Creek, the Federal area, and in the Ivy City/Trinidad neighborhoods subject to flooding to prevent human contact with wastewater. (10, 48, 49, 51, 52, 54, 57)

An evaluation of targeted separation based on feasibility, cost, CSO reduction and water quality benefits has been conducted. This evaluation is included in the Final LTCP. The studies show benefits for targeted separation and selected outfalls will be included for separation.

5.2 <u>Two commenters indicated that the cost estimates for separation were too high compared to the costs in EPA literature and the costs being used in Atlanta, Georgia (50, 58).</u>

The unit cost of separation ($/acre) was obtained from the literature, actual construction experience in other cities, and estimates performed by others. This data was obtained from cities such as San Francisco, Boston, Richmond, Chicago, Alexandria and others. The cost was found to range from about $24,000 acre (year 2001 dollars) for small communities without dense development to about $390,000/acre (year 2001 dollars) for ultra-dense urban areas. Most separation has taken place in small to medium size communities in low-density areas. Little actual construction data is available for large-scale separation of major metropolitan areas since most major cities have not selected this route. Different unit costs for separation were used as a function of land use in the District. High density areas were assigned a higher unit cost than low density areas. This reflects the increased expense associated with working around dense urban development in tight urban confines. The following unit costs were used:

- High density land uses: $240,000/acre
- Medium density land uses: $150,000/acre
- Low density land uses: $85,000/acre

These unit costs conservatively allow for potentially expensive contingencies such as working on or around private property, as well as difficulties encountered during actual construction.

5.3 <u>One commenter suggested looking at installing separate sewers inside of the existing combined sewers as a cost saving measure (53).</u>

Installation of small separate sewers inside larger combined sewers has not been widely applied or tested. The technique would be limited to sewers larger 3 feet to 4 feet in diameter. Some concerns include

- It will still be necessary to deal with the downspouts and connections on private property. This can be a significant portion of the cost.
- It will still be necessary to separate by conventional means the smaller diameter combined sewer
- There is the potential of taking up excessive amounts of the hydraulic capacity of the combined sewer and the resultant creation of flooding problems

In the draft LTCP, separation of combined sewers was shown to result in worse water quality than the draft LTCP. This is due to the large amount of storm water that is collected in the combined sewer system and treated prior to discharge. This same disadvantage would apply to separation by installing separate sewers inside of combined sewers. As a result the difficulties noted above, separation is not recommended.

5.4 Three commenters advocated for complete separation of the combined sewer system. The benefits of separation were reported to be elimination of flooding, reduction of odors and the ability to meet water quality standards (59-64). In addition several commenters indicated that since the infrastructure is old and must be replaced anyway, separation makes sense (55, 64).

Complete separation of the combined sewer system was evaluated in the draft LTCP. Issues associated with this alternative are as follows:

- Disruption – Separation essentially involves constructing a duplicate sewer system for the central one third of the District. Sewer construction would be necessary in every neighborhood and in the vast majority of streets in each neighborhood. Disruption associated with construction would be significant, widespread, and long lasting.

- Impacts to Private Property – the majority of buildings in the combined sewer area have roof drains and gutters discharging to the building sanitary system, which in turn discharges to the combined sewer system. Separation on private property would thus be required. Past separation experience in the District and in other cities has shown that obtaining access and permission from private property owners can be difficult, time consuming, and, in some cases, not achievable

- Technical Difficulty – Other cities such as Boston have discovered some separation projects to be much more difficult to construct that originally anticipated. In some cases, the efforts to separate sewer systems have been abandoned. Part of the reason for this is that there are many unknowns involved in working with sewer systems which have been constructed over a long period of time. Costs and difficulties of construction can be much greater than originally anticipated depending on what is actually discovered.

- Impact on Receiving Water Quality – the analyses conducted as part of the LTCP indicate that separation does not provide as good water quality as a high degree of CSO control. This is due to the large volume of separate storm water captured and treated by combined sewer system. Separation would eliminate CSOs and would thereby technically meet the water quality standards. However, the waterway would meet the water quality standards less frequently due to the increase in untreated storm water.

- Cost – complete separation is estimated to cost about $3.5 billion in year 2001 dollars. This is significantly more than the LTCP

- Flooding protection - Several commenters indicated that separation had the opportunity to eliminate flooding. In most cases, separation would be conducted by constructing a new sanitary sewer and converting the combined sewer to a separate storm sewer. The storm water conveyance capacity would then be provided by the existing combined sewer. The benefit to flood control would be very marginal since the existing sewer would be used. The only benefit would be that the combined sewer would no longer receive sanitary flow and would thus have some greater capacity for storm water.

- Reduction of odors – It is unlikely that separation will have a significant effect on odors.

- Need to Rehabilitate Collection System - Separation would involve constructing new separate sanitary sewers and converting the existing combined sewers to separate storm sewers. If the combined sewers need to be rehabilitated, that cost would need to be added on top of the cost to separate.

Given these reasons and other identified in the draft LTCP, complete separation of the combined sewer system is not recommended.

5.5 EPA commented that the report lacked a cost for separation of the Anacostia CSO areas (56).

The capital cost estimate for separating the Anacostia system is $2.1 billion in year 2001 dollars. The total estimated cost of separating the entire combined sewer system is $3.5 billion in year 2001 dollars. The LTCP has been amended to include this.

6. COMMENTS ON LOW IMPACT DEVELOPMENT, SOURCE CONTROL, POLLUTION PREVENTION

6.1 Many commenters advocated for more emphasis on non-engineered solutions aimed at reducing storm water such as Low Impact Development (LID) and Best Management Practices (BMPs) (10, 234, 236, 249, 254-274, 280). Commenters indicated that LID offers many side benefits such as beautification, reduction of heating/cooling costs, etc. (252). One commenter indicated that WASA should consider implementing LID instead of the tunnel system (235). Some commenters indicated that WASA should increase funding for LID (246-248). Others indicated that WASA's evaluation of LID was not reasonable in that is overstated the cost and understated the effectiveness (248, 251, 432). One commenter attached information indicating that LID can cost $20,000-60,000 per acre to install (248). EPA commented that a more thorough proposal for LID options should be included covering the following (233). One commenter indicated that increased tree cover could significantly reduce runoff. The commenter indicated that DC had experienced a 64% decrease in tree cover since 1973 and that this resulted in a 34% increase in storm water. (282-285):

- CSO reduction benefits and water quality impacts of LID throughout District and not just on WASA facilities.
- A more complete explanation of program objectives and methods including coordination with storm water management plans required by the MS-4 permit for the District.
- Specific mechanisms to implement LID District-wide
- Review a variety of levels of LID application and assess benefits

The analyses conducted as part of the LTCP indicate that LID-R can reduce the magnitude and frequency of CSOs. Generally, CSO reduction benefits of LID-R are in proportion to the quantity of storm water that would be diverted from the receiving waters (e.g. Anacostia River) by the LID-R measures. In order to achieve a high degree of CSO control, a large application rate for LID-R is required.

In order to meet the requirements of the CSO Policy, the degree of CSO control proposed in the LTCP is extremely high in that the controls are sized for large and intense storms. As a result, the analyses indicate that application of LID-R by itself cannot be expected to provide the degree of CSO control proposed in the LTCP and required to meet the CSO Policy and D.C. Water Quality Standards. However, LID-R can be coupled with structural controls to reduce CSOs or to reduce the size of capital facilities required for the degree of control proposed in the LTCP.

There are several challenges associated with the implementation of LID-R. These have been divided into technical, institutional and regulatory issues below:

- Technical Issues - In the past, LID has been primarily applied in new developments. Little data are available on the application of LID in retrofit conditions on a mass scale the size of the District. The lack of data makes it difficult to predict the implementability, performance, cost and CSO reduction benefits of such measures. As a result, there is uncertainty as to the practicability of implementation of LID-R in heavily developed urban areas and as to its benefits and cost effectiveness.

- Institutional Issues – LID-R would need to be applied in streets, sidewalks, parking lots and in public and private property in the District. One difficulty is that WASA does not control and cannot regulate development or redevelopment in the District. As a result, WASA is not able to mandate application of LID-R. Laws and building codes in the District would need to be changed in order for this to occur. WASA can, however, recommend these types of changes to the District and provide technical assistance in their development.

- Regulatory Issues - The most practical and cost-effective way to implement LID-R would be in conjunction with redevelopment and reconstruction within the District. It would be much more costly to implement LID-R separate from reconstruction that was already planned. As a result, the implementation time associated with LID-R would be a function of the rate and magnitude of redevelopment. This may make the implementation time for LID-R very long with an uncertain end. After the LTCP is implemented, WASA's discharge permit will require a specified degree of performance for the CSO controls. Violations of the permit are subject to penalties by law. If LID-R is relied on to provide all or part of the control specified in the permit, this could place WASA in the situation of having to meet a permit condition without the means to control LID-R, which is relied upon to meet the permit.

Since WASA does not control development or redevelopment in the District, WASA cannot mandate application of LID-R. WASA can, however, incorporate LID-R techniques into new construction or reconstruction on WASA facilities, where applicable. In addition, WASA recommends that the District Government develop and adopt the necessary laws and regulations to enable implementation of LID-R. In the Anacostia, LID-R can be viewed as additional control over and above that provided by the proposed tunnels. Detailed recommendations are included in the LTCP.

6.2 One commenter indicated that the DC Council should create incentives for LID (278).

The LTCP makes recommendations for governmental initiatives to foster LID in the District. The creation of incentives by the District and Federal Government is one of the initiatives.

6.3 Several commenters indicated a support for a variety of source control measures such as building code changes, public education, source reduction, water conservation, I/I reduction, roof leader disconnection, storm water reuse, green roofs, street sweeping, and other measures (9, 237, 250, 275, 279, 281).

WASA has a water conservation and wastewater flow reduction program to reduce flow in the system. Modeling indicates that these programs will not have a significant impact on CSO overflows because most of the water in the combined sewer system that causes overflows is from rain water (runoff). The combined sewer system is designed to convey rainwater to prevent flooding. WASA also has an approved Nine Minimum Control program which includes a public outreach and education measures. In addition, WASA is involved in building code review and updates and uses this forum to advocate for source control measures for storm water.

6.4 One commenter supported collaborative efforts between WASA and the Office of Planning in the areas of public education, daylighting orphaned storm sewers, storm water detention and low impact development (420).

WASA will seek opportunities to coordinate and collaborate with the Office of Planning throughout the implementation phase of the LTCP.

6.5 Several commenters indicated that groundwater pumpage from properties in the Federal Triangle and other areas were of concern. Commenters indicated that these properties should pay to discharge water to the system. EPA commented that the LTCP does not propose to remove the groundwater and asked if anything could be done to eliminate these flows from the system (238-242).

Prior studies have estimated groundwater flows to the combined sewer system to be approximately 8 mgd. Modeling has indicated that removal of this flow from the combined sewer system has minimal impact on CSO reduction because it is very small relative to wet weather flows. The cost of removal is extremely high because there is no separate storm sewer to the receiving water.

Assessment of the feasibility of extending orphaned storm sewers to the receiving waters is described in detail on page 8-13 of the Draft LTCP. A potential disadvantage of this option is the resulting polluted storm water that would be untreated and thus affect water quality.

Both of these options were considered as a form of CSO control. While feasible, they were determined to be much less cost effective than the proposed solution.

6.6 Several commenters indicated that I/I control and water conservation should be a significant part of the LTCP. One commenter indicated that WASA's owns studies suggest there may be up to 118 mgd of I/I in the system. Another commenter suggested incentives to reduce water use (243-245). A commenter recommended conducting detailed I/I studies on the existing Rock Creek Interceptor (253).

Modeling indicates that reduction in base flow via infiltration and inflow and water conservation will not have a significant impact on CSOs compared to the cost of control. This is because the vast majority of the water in the system when overflows occur is due to storm water runoff. WASA has a water conservation and wastewater flow reduction program that is currently being implemented. The program is projected to achieve a 20 mgd reduction in base flow. The reference to up to 118 mgd of I/I is taken out of context. The report in question indicated that the exact amount of I/I is unknown and that the 118 mgd probably overstates the amount. The magnitude and cost-effective opportunities to remove I/I will be addressed as part of a City-wide sewer system evaluation that will be conducted in the near future.

7. COMMENTS ON BLUE PLAINS WASTEWATER TREATMENT PLANT

7.1 EPA questioned the predicted frequency and duration that denitrification would not be achieved due to high flow conditions at BPWWTP. EPA asked what measures could be taken to optimize treatment at Blue Plains and assure maximum denitrification (71).

The BPWWTP was designed for nitrification, and these facilities were placed in operation in 1980. The plant was not originally designed to remove nitrogen (i.e. to denitrify). In 1987, the District of Columbia signed the Chesapeake Bay Agreement, which calls for voluntary reductions in nutrients to the Bay by 40 percent by 2000 using 1985 as a base year. In 1996, a Denitrification Demonstration Facility was constructed at BPWWTP. The facility uses the existing nitrification reactors and other nitrification capacity to conduct both nitrification and denitrification. Nitrification capacity was reduced to the first four stages of the reactor, to accommodate denitrification in the last stage. Full scale denitrification using this approach was later incorporated at the plant.

This approach to denitrification utilizes one facility for two processes. There are difficulties in conducting denitrification under all conditions of flow, load and temperature. This was shown to be the case when implementation of nitrogen removal was negotiated with regulatory agencies. Experience with the full scale facility has shown that denitrification process produces poorly settling solids which contribute to solids washouts and blinding of the effluent filters at high flow rates. This is due to attempting to treat high flows during storm events simultaneously with nitrification-denitrification using the same tankage, particularly during cold weather. Based on this experience, it appears that BPWWTP will not be able to reliable denitrify under high flow conditions.

The frequency of this occurrence depends on rainfall conditions and water temperature. A preliminary estimate of the time denitrification might not be feasible is on the order of 100 days per average year. This will need to be refined when higher flows begin to be received at the plant after the pump station rehabilitations.

Because the Chesapeake Bay Program is considering revised nitrogen limits for the Bay, future nitrogen removal at Blue Plains may include total nitrogen effluent concentration as low as 3 mg/L. Chesapeake Bay Program Goals may thus dictate nitrogen removal requirements at the plant, and further measures should be based on the final outcome of the Bay Program.

7.2 EPA indicated that outfall 001 at BPWWTP had been characterized as a CSO under the existing NPDES permit, but that it may be characterized as a bypass under the CSO Policy. Under the CSO Policy, approval of a CSO bypass requires that the LTCP provide justification for the cut-off point at which the flow will be diverted from the secondary treatment portion of the treatment plant and provide a cost-benefit analysis demonstrating that conveyance of wet weather flow to the POTW for primary treatment is more beneficial than other CSO abatement alternatives such as storage and pump back for secondary treatment, sewer separation, or satellite treatment. EPA indicated the LTCP should include a section addressing this (70).

This assessment is included in the Final LTCP.

7.3 One commenter asked what modifications, if any, were required to accommodate the increased flows expected at BPWWTP. The commenter further questioned whether the increased flows would be treated by the full process train or the excess flow treatment train. If the flows are to be treated by the full train, the commenter asked if WASA possesses sufficient unused capacity in the IMA to handle the additional flow. If not, the commenter asked how the District would acquire that capacity (69, 72, 75, 427).

Once the pumping stations in the system are rehabilitated, increased flows will be sent to BPWWTP during wet weather. These improvements consist of the addition of four new clarifiers and appurtenant weir and control system improvements. To accommodate this, improvements to the excess flow treatment train are recommended to improve performance and reliability. Stored CSO captured by the tunnels will be treated by the complete treatment train that discharges effluent at outfall 002. No improvements to the complete treatment train are proposed.

7.4 A commenter asked if the increased flow at BPWWTP due to the LTCP would cause operational impacts or affect the plants ability to meet permit limits (74, 429).

The plant is projected to be able to meet its permit limits with the LTCP in place.

7.5 A commenter asked if any new facilities would be considered joint-use or non-joint use facilities and asked about the cost of the modifications (72, 73). The commenter also asked if there would be any increase in Blue Plains operational costs and if the expense would be considered a WASA-only expense (76).

The cost apportionment of facilities and operation costs at BPWWTP have not been determined, but will be addressed once a Final LTCP is approved for implementation by regulatory agencies.

7.6 EPA asked what additional solids handling facilities would be included in the tunnel system and at Blue Plains to handle increased flows (367)

The tunnels will capture solids that will be pumped to BPWWTP for removal. Tunnels typically include screens to protect pumps and a sump at the end with clamshell for removal of material at pumping station. Tunnel slopes are also set to wash any solids to the pump station for removal. Additional solids handling facilities are not projected to be required at BPWWTP.

7.7 A commenter indicated that WSSC leases 95 mgd of capacity in the Anacostia System. The commenter asked if the lease could continue or if WSSC could acquire some additional capacity in the Anacostia system (77).

The LTCP contemplates that the District will utilize the capacity it is currently using in the 108" Anacostia Force Main via pumpage from the East Side Pumping Station. As a result, the LTCP does not anticipate any change from current conditions.

8. COMMENTS ON CSO LOCATION

8.1 Several commenters indicated that CSOs discharge to areas that are highly used and indicated that these CSOs should be moved, eliminated or given extra control. Concern was voiced for CSOs discharging near the Zoo in Rock Creek, Thompson's Boat House in the Potomac, and the marina's in the Anacostia. The commenter suggested that the outfalls near the entrance to Zoo be closed since it is in an area where wading might occur. EPA questioned whether some CSOs could be eliminated or consolidated (45, 78, 79, 80, 104).

The Final LTCP includes consolidation and separation of some outfalls. Those outfalls that are consolidated can be eliminated entirely. For those outfalls that are separated, a separate storm sewer outfall will remain.

9. COMMENTS ON FLOODING

9.1 Many commenters made general complaints about flooding in various sections of the District, some within the combined sewer area, others in the separate sewer area. Many of the complaints were general in nature and not specific to one area. Commenters indicated that while the Draft LTCP would address flooding in some areas, it would not address problems District-wide. Other commenters indicated that the LTCP should indicate whether the proposed improvements will prevent reoccurrence of the flooding that occurred on August 11, 2001. A commenter indicated that WASA was not responsive to the flooding of August 11, 2001. Specific complaints were issued about the following areas: (128, 129, 131-139, 141, 142, 143,145, 148)

- 31st and K Street NW in Georgetown
- West Virginia and Mt Olivet, NE
- Basement apartments in Dupont Circle area
- Bloomingdale and Trinidad neighborhoods

The purpose of the LTCP is to select CSO controls for the combined sewer system. Addressing the need for capacity/flooding relief is being addressed as part of a separate City-wide evaluation of the sewer system. However, while preparing the LTCP, an opportunity was identified to address long standing flooding problems in the Northeast Boundary drainage area. This includes the areas of West Virginia and Mt. Olivet, NE, the Bloomingdale and Trinidad neighborhoods, and Rhode Island and 4th Avenues NE. These areas were addressed due to the historical and well known nature of the chronic flooding occurring in these areas. Many of the areas that flooding on August 11, 2001were not previously known as susceptible top flooding. These areas will be addressed as part of the city-wide assessment of the sewer system.

9.2 EPA commented that the LTCP should describe in greater detail how and on what schedule the recommended plan will alleviate flooding in the Northeast Boundary area (130). EPA also commented on the new "relief outfall" into the Anacostia near the Northeast Boundary Swirl Facility and outfall 019 with the following questions: 1) What is the predicted frequency and duration of overflows for this outfall? 2) Is it included in Table 9-3? 3) Are the flows part of the receiving stream model for the Anacostia? 4) What are the impacts to water quality from the discharge? 5) What controls will be placed on the new outfall? 6) How is the new outfall to be permitted? (150)

Flooding in the Northeast Boundary is described on pages 8-26 and 8-27 of the LTCP. Three of the tunnels in the Draft LTCP address flooding in these areas as follows:

- Tunnel parallel to the Northeast Boundary Sewer
- Short tunnel from the Northeast Boundary Sewer to Rhode Island & 4th St NE
- Short tunnel from the Northeast Boundary Sewer to West Virginia & Mt. Olivet, NE

The flooding in these areas is predominantly caused by inadequate capacity of existing sewers, including the Northeast Boundary Sewer. When the existing sewers reach their capacity, the excess flow would be relieved to the new tunnels. Under certain rain events, the tunnels will be large enough to contain the entire volume of flow such that there is no CSO overflow. Under extreme rain events, the tunnels will fill and then act as conveyance pipes to move flow from the neighborhoods to the river to prevent flooding. After the storm stops, the tunnel contents will be dewatered to BPWWTP for treatment.

Flooding relief would be provided when all of these project components are completed. It is important to note that the tunnel parallel to the Northeast Boundary Sewer must be constructed prior to the short tunnels to the areas prone to flooding. This is because the Northeast Boundary Sewer has limited capacity. Construction of the short tunnels prior to the relieving the Northeast Boundary Sewer would exacerbate flooding downstream.

The proposed tunnels have been sized to convey up to the 15-year storm without flooding in accordance with WASA's design standards. There may be flooding for more extreme storms. In addition to the tunnels, some surface drainage improvements may be required to transport storm flows to the tunnel inlet structures.

The existing Northeast Boundary Sewer outfall does not have adequate capacity to convey extreme storm events to the river. In order to provide flooding relief, the existing outfall may need to be replaced or augmented for a short length. Depending on how the system is designed, is may be possible to reuse a short section of the existing outfall to eliminate the need for an entirely new outfall. Another approach would be to replace the existing outfall. The final approach will need to be worked out during detailed design.

The outfall replacement/augmentation does not affect the overflow volume, frequency, water quality, etc.; it only affects whether the overflow gets to the river in the existing pipe or in a new pipe. As a result, the overflow predictions, the data in Table 9-3 and the water quality models and predictions are all correct for replacement/augmentation of the Northeast Boundary outfall. The proposed tunnel will control the Northeast Boundary overflows. Permitting approaches will depend on the approach taken in final design.

The schedule for completion of these projects in the Draft LTCP is provided on pages 12-16 and 12-17.

9.3 <u>A commenter expressed concern about flooding in a basement caused by roots in a sewer lateral (140).</u>

WASA will clear blockages of sewer laterals in the public right of way. Contact Consumer services at 202-612-3400. Blockages of laterals on private property are the responsibility of the property owner. A licensed plumber should be contacted to address the problem.

9.4 One commenter stated that WASA indicated a large quantity of rain fell on August 11, 2001 but that National Airport reported a relatively small amount of rain (144).

The rainfall on August 11, 2001 was extremely regional in nature. National Airport reports that rainfall totaled 0.92" that day. In contrast, certain areas of the District such as near McMillan Reservoir, Dupont Circle and along MacArthur Boulevard, NW received more than 4" of rain on August 11, 2001. The rainfall was not uniform and rainfall quantities and intensities depended on geographic location.

9.5 Two commenters indicated that implementation of the LTCP was too long to wait for flooding relief in Northeast Boundary and that short term fixes should be implemented. (147, 149).

WASA has a program to provide temporary flooding relief in certain areas of the Northeast Boundary, primarily those off of Florida Avenue. These projects are being performed in conjunction with the Department of Public Works and involve regrading and the addition/revision of catch basins and inlets. These projects will provide a measure of flooding relief in certain areas until the tunnels are completed.

10. COMMENTS ON IMPLEMENTABILITY

10.1 EPA asked to what degree the "implementability" of the recommended control plan been evaluated. EPA asked what permits or approvals might be required from the National Park Service (NPS) and if discussions been undertaken with NPS or LTCP comments had been received from them (150).

Many alternatives were evaluated prior to selecting the Draft LTCP. These alternatives included surface storage facilities, treatment facilities or other measures that were determined unlikely to be implementable for a variety of reasons. These include lack of available land, public acceptance, need for permits and other operational and maintainability reasons. In contrast, the Draft LTCP was selected in part because it has a good likelihood of being implementable. Tunnels can be constructed with much less surface disruption and land requirements than many other alternatives and do not include the relatively complex operation and maintenance features of treatment and surface storage facilities.

On September 10, 2001, WASA briefed the National Park Service on the Draft LTCP. The response of the NPS was generally favorable in that the Draft LTCP would require significantly less construction in the park than other alternatives. Some comments have been received from the NPS. Comments from the staff level at the National Park Service Rock Creek Office expressed concern over the Piney Branch tunnel and issues associated with construction access, tunnel location, whether the tunnel was needed, and others. WASA hopes to be able to work through these during preliminary engineering and design.

10.2 EPA questioned if it would be necessary to obtain easements for the tunnels, who the affected property owners would be and if efforts had been made to reach agreement with them (151).

Actual land/easement requirements will depend on the final alignment and configuration selected for the control facilities. Efforts will be made to select alignments in public right-of-ways where possible to minimize the need for easements. No efforts have been made to reach agreements with landowners since the alignments of the proposed tunnels have not been selected and since the LTCP has not been finalized or approved. Easement/land acquisition will be part of the design phase. A preliminary assessment of the possible land requirements is in Section 13 of the LTCP.

11. COMMENTS ON TUNNELING

11.1 Several commenters indicated that Milwaukee CSO tunnels have experienced significant leakage which has compromised their capacity. Others indicated that Chicago's tunnels are undersized and have not performed as designed. Commenters indicated concern as to whether tunnels are a reliable and effective solution. Another commenter indicated that WASA should look at the lessons learned in other cities (345, 346, 347, 348, 15). EPA asked what degree of confidence WASA had that the tunnel sizing will be adequate to limit overflow events and avoid a situation such as that being experienced in Milwaukee where tunnels must be expanded due to continued CSO overflows and system backups. (369)

This comment goes to whether tunnels are a reliable technology for CSO control. Tunnels have been used successfully in many CSO cities including Rochester, Chicago, St. Louis and San Francisco. Tunnels are also proposed for other CSO cities such as Atlanta. WASA has surveyed these other municipalities regarding their experience and will take this into consideration during design.

Milwaukee's control program started in 1977 and its tunnels went into service in 1993. The cost of the system was about $2.8 billion. The program included approximately 17 miles of tunnels with diameters ranging from 12 to 32 feet, having a total storage volume of about 405 million gallons. In addition to CSOs, the tunnels were designed to control sanitary sewer overflows and to relieve the existing interceptors in the system. The design goals of the system were to reduce overflows from approximately 50 to 2 per average year. The tunnels were constructed in rock, with approximately 60% of the tunnel unlined.

The performance of the system as reported by Milwaukee is as follows:

Performance of Milwaukee CSO Tunnels

Year	*Rainfall*	*# of CSO Events*	*Notes*
1991	68”	66	
1992	46”	46	
1993	65”	64	
1994	27”	1	Tunnels in service
1995	31”	1	
1996	24”	1	
1997	33”	2	
1998	35”	2	
1999	38”	6	
2000	44”	5	
Long Term Average Rainfall = 31”			

The system is performing as designed. In dry years, the overflows were less than the average year and in wet years the number of overflows were more than the average year.

There have been reports of infiltration of groundwater into the tunnel and exfiltration of CSO out of the tunnel at levels above what was expected. Milwaukee is in the process of performing an inspection to quantify the degree of infiltration. One of contributing factors may be that 60% of the tunnels are unlined. Lining tunnels significantly improves the ability to control infiltration. In the District, it is likely that tunnels will need to be lined since the majority are expected to be soft ground tunnels. Other measures such as synthetic barriers in conjunction with concrete can also be employed to control infiltration.

Chicago is in the process of implementing the Tunnel and Reservoir Plan (TARP). It consists of 4 main tunnels and three reservoirs. Construction began in 1975 and is ongoing. The tunnels have been completed and hold approximately 2 billion gallons (bg) of CSO. The reservoirs are proposed to store in excess of 12 bg. Only one reservoir with a storage volume of 3.5 bg has been completed.

There is no indication that the Chicago system is not performing properly. The level of performance is reported to be in keeping with the degree of completion of the tunnels and without the reservoir components in place. Prior to implementation, overflows occurred about every 4 days (90 times per year) and they have decreased to about once per month (12 times per year). The performance is expected to improve with completion of the majority of the storage volume, which is in the reservoirs.

The technology of constructing tunnels has improved significantly since many of the earlier CSO tunnels were constructed. The District also has the advantage in that Metro has constructed many miles of subway tunnels. This experience will assist in the proper selection of construction methods to achieve reliable operating tunnels.

11.2 Commenters indicated concerns about odors from the tunnel particularly when filling and emptying (351, 357).

Tunnels are constructed very deep and there are limited points of access to the facilities. As a result, odors generated in the tunnels have a reduced potential for contact with the public when compared to a wastewater treatment plant or other above-ground wastewater facility. In addition, odor control facilities are sometimes employed to reduce the potential for odors. When they are being emptied, water is pumped out of the tunnels. In these conditions, air flows into the tunnels to replace the water that is being removed. This tends to minimize odors. During filling, air in the tunnels is displaced by the incoming CSO. The tunnel usually fill relatively quickly, reducing the time avalaibel for contact with odors. In addition, the tunnels fill during rain storms when there are few people about. Techniques to minimize odors include locating vents in areas where there is reduced opportunity for public contact, maintaining a slightly negative air pressure on the tunnels to prevent fugitive emissions, incorporating dampers or other controls to reduce fugitive emissions, and incorporating odor control. The specific techniques to apply to the proposed tunnels will depend on the alignment and configuration developed during detailed design.

11.3 A commenter indicated a concern about the tunnel leaking and contaminating the groundwater or collapsing. (352). EPA also asked what measures would be taken in tunnel design and construction to monitor and control infiltration and exfiltration in the tunnels (370)

Measures to control groundwater infiltration and exfiltration of tunnel contents will depend on the geology, groundwater chemistry, location and size of the tunnels. The exact measures to be employed will be selected during the detailed design phase when specific information is available for each tunnel section. It is possible that different measures will be employed along the length of the same tunnel as conditions change. Given that the tunnels are well below grade, are below the river level, and will be empty for much of the time, it is likely that groundwater infiltration will be the most significant concern. Measures to control both infiltration and exfiltration include lining the tunnel with concrete, incorporating a synthetic liner in conjunction with the concrete liner and grouting from inside the tunnel or from the surface to reduce the permeability of the ground immediately around the tunnel.

11.4 One commenter recommended that a ground water flow system analysis be performed prior to construction consisting of 1). Investigating and describing the hydrogeologic framework (geology) 2). Understanding the inflows and outflows of the groundwater flow system, 3). Describing the hydraulic properties of the geologic media and its ability to groundwater to the tunnels, 4). Determining the interaction of the groundwater with the major surface water bodies in the District and 5). Studying the groundwater quality conditions in the District to assess the potential impact of storage tunnels on groundwater and surface water quality (355, 356, 359, 361, 363, 364).

These types of evaluations are typically performed during the preliminary engineering phase where horizontal and vertical alignments for the tunnel are chosen. The impacts of the tunnel on groundwater and the selection of appropriate lining and waterproofing techniques for the tunnel are important elements of the design and will be performed in that phase of implementation.

11.5 Concern was expressed about the lack of specificity as to the alignment of the Potomac tunnel, the location of shafts, the locations for hauling tunnel spoil, the disruptions associated with hauling such as traffic (349, 350, 365). Some commenters expressed concern over the possibility of adversely affecting existing structures during tunnel construction due to excavation of the tunnel or the ancillary activities such as truck traffic. Particular concern was expressed over possible effects on the Potomac Boat Club, Key Bridge, Whitehurst Freeway, Metro Tunnel, and the C&O Canal Park. Reference was made to shifting soils during construction of unspecified Metro tunnels (354, 360). A commenter asked for more details regarding Piney Branch such as details on construction methods, access locations, construction impacts to the park, impact on groundwater, if other alignments were considered, if the tunnel could be eliminated by using LID, etc (425, 426).

The tunnel alignments presented in the draft LTCP are preliminary concepts. If approved, engineering studies would be performed to collect data necessary to site the tunnels and shafts. During this phase, data is collected on the location, depth and condition of existing structures. Consideration is also given to siting construction shafts where removal of excavated material is feasible and where access routes during construction will minimize nuisances to the public. WASA will select tunnel routes and/or construction methods to protect and preserve existing facilities and to minimize construction impacts such as traffic. The lessons learned by Metro will be valuable in assisting the successful construction of the proposed CSO tunnels.

11.6 One commenter expressed concern over the possible interruption of sewer service associated with construction of the plan (353).

The tunnels are proposed to be connected to the main interceptor sewers and outfalls in the system, typically well downstream of most residential and private sewer connections. As a result, it is unlikely there will be an interruption in sewer service for the vast majority of customers. In the unlikely event that an interruption in service is required, it would likely be of short duration and would affect a small number of customers.

11.7 One commenter expressed concern about WASA's ability to maintain the tunnels because of their depth and inaccessibility (358).

Many other municipalities have tunnels for CSO control and other purposes. Review of the experience of these municipalities indicate that it is important to design the facilities in a manner that will facilitate maintenance and access in the future. Examples might include providing openings/shafts to the tunnel large enough to accommodate cleaning equipment and providing facilities for proper ventilation.

11.8 EPA noted that the recommended plan for Rock Creek requires monitoring regulators for overflows. Connection of the Rock Creek Interceptor to the Potomac Tunnel may be required as a result. EPA asked if the Potomac Tunnel has been sized to accept the Rock Creek Interceptor flows initially (366)

The Potomac Tunnel has been sized to relieve the Rock Creek Main Interceptor.

11.9 EPA asked what cost estimation data was used to develop cost estimates for the proposed tunnels and asked for an assessment of WASA's level of confidence in the estimates (368).

WASA obtained construction cost data from Metro and from tunnels in other cities. WASA also retained a tunnel consultant to provide specific estimates for the tunnels as proposed. In addition, cost curves for tunnel projects in other municipalities were reviewed. Based on this data, cost curves were developed for tunnels in rock and tunnels in soft ground as a function of geology. The basis for the tunnel construction costs has been included in an appendix of the Final LTCP.

In accordance with the Association for the Advancement of Cost Engineering definitions, cost opinions developed for the LTCP are considered to be concept screening level estimates, with an expected accuracy of +40%, -15%. Cost opinions are of this accuracy because alternatives have been prepared with a minimum of detailed design data for the purposes of relative comparison. This type of analysis is appropriate for comparisons between control programs.

11.10 EPA inquired as to what preliminary geologic and hydrogeologic investigation had been done to determine feasibility and potential siting of underground storage tunnels (371).
Data on soil borings from other projects were collected and reviewed by geotechnical and tunneling experts. Some data was available on other tunnels in the District such as the B Street/New Jersey Avenue relief sewer which terminates at the Main and O Street site. The largest amount of data demonstrating the feasibility of tunneling is Metro's experience in constructing miles of tunnels in the DC area. Detailed site specific information will be collected as part of the facility planning investigations which will be conducted once the Final LTCP is approved.

12. COMMENTS ON REGULATORY COMPLAINCE

12.1 One commenter indicated that the recommended LTCP will still allow overflows every year and that such overflows will violate existing DC water quality standards. The commenter indicated that CSOs must comply with both the numerical and narrative portions of the standard. The commenter further indicated that the LTCP must demonstrate compliance the water quality standards under "all potential weather conditions", not just the average year (318).
The current District of Columbia water quality standards include both numeric and narrative components. The narrative components require, among other items, that discharges be "free of untreated sewage". Given the current standards, no alternative short of complete separation can completely eliminate overflows (and thereby comply with current standards) during all conditions. Separation has a cost almost triple that of the recommended LTCP, would cause massive disruption and hardships, and results in worse water quality than the recommended LTCP. For these and other reasons, separation was not recommended.

The CSO Policy requires development of controls based on average year conditions, not "all conditions". It is difficult to conceive of any plan that can accommodate "all condition" since this would include hurricanes, 100 year storms, and the intense August 11, 2001 rain event that occurred in the District.

Given that separation is not feasible, there will be some remaining overflows for any CSO control plan. What remains to be decided is how big to make the facilities and how infrequent the CSO overflows will be. The higher the degree of CSO control, the higher the cost. The recommended plan was selected to provide an effective balance of overflow reduction, water quality improvement and cost. After implementation, it is predicted that CSOs will occur infrequently and that there will be very infrequent disruption of water quality due to CSO. This is consistent with the CSO Policy (now part of the Clean Water Act), which calls for an evaluation of what water quality standards are actually achievable and for revision of standards, where appropriate.

12.2 A commenter indicated that the LTCP fails to comply with the CSO Policy because it does not address cost-effective expansion or retrofitting of the proposed system. EPA requested an explanation as to how cost effective expansion might be accomplished. (317, 317, 435)

The LTCP is expandable and a section describing this is included in Section 13 of the LTCP.

12.3 A commenter alleged that the draft LTCP violates the 2001 Anacostia Watershed Restoration Agreement and the Chesapeake Bay Agreement, which the District is a signatory (319).

In 1991, the District of Columbia, State of Maryland, Montgomery County and Prince George's County signed the Anacostia Watershed Restoration Agreement. The Agreement was reaffirmed in 1999 and again in 2001. The agreement has six main goals that call for improvement in water quality, ecological integrity, increased forest cover and public involvement. The attachment to the Agreement calls for initiation of long term CSO controls before 2010, a 95% reduction in CSO to the Anacostia with the LTCP determining the ultimate level of control and schedule for implementation. The LTCP is completely consistent with the agreement.

In 1983 and 1987, Virginia, Maryland, Pennsylvania, the District of Columbia, the Chesapeake Bay Commission and EPA signed agreements establishing the Chesapeake Bay Program to protect and restore the Chesapeake Bay. In 2000, *Chesapeake 2000* was signed which reaffirmed the commitments. The Agreement calls for many measures to improve the ecosystem such as habitat restoration, water quality protection and improvement, nutrient reduction, land conservation and other factors. The reductions in CSO overflow of more than 96 % for all receiving waters is a massive reduction in pollutants and is entirely consistent with the Chesapeake Bay Program Goals and Agreement.

12.4 A commenter indicated that the LTCP does not adequately meet the CSO Policy requirements for including a post-construction monitoring plan. The commenter indicated that the plan provides inadequate details regarding the how, when and where such monitoring will be conducted. (321). EPA also indicated that more detail on the

Post Construction monitoring plan should be included in the LTCP, including a schedule. (320).

A post–construction monitoring program has been included in the LTCP.

12.5 EPA indicated that a more detailed discussion of sensitive areas should be included for each of the three receiving waters. EPA indicated that the LTCP only addresses Rock Creek and does not explain how the Hay's Spring Amphipod will be protected by implementing CSO controls. EPA stated that a discussion of the actual impacts of CSOs and LTCP-related construction on each species (and mitigation efforts) is necessary. EPA noted that the Short Nosed Sturgeon was not been included in any discussion of sensitive areas for the Potomac. Since this endangered species has been known to reside in Potomac waters, EPA said it should be addressed in the plan along with the other threatened and/or endangered species (314). A second commenter indicated that the Anacostia and Potomac Rivers are waters with primary contact recreation as an existing use. The commenter attached photographs of people using the water body. The commenter indicated that this makes the Anacostia and Potomac Rivers sensitive areas as defined by the CSO Policy. The commenter indicated that the presence of the Hayes Spring Amphipod also makes this section of Rock Creek a sensitive area. The commenter indicated that the CSO Policy requires WASA to eliminate or relocate the outfalls on these water bodies unless it can demonstrate that it is not physically possible or economically achievable or that it would provide less environmental protection than additional treatment. The commenter further indicated that even if this determination could be made, the CSO Policy requires WASA to provide the level of treatment for remaining overflows necessary to protect existing and designated uses, which include primary contact recreation. (315)

An extensive assessment of sensitive areas for all receiving waters was made in *Study Memorandum 3-4: Sensitive Area.* An overview of the analyses was included in the Draft LTCP on page 2-13. In the Final LTCP, the complete analyses from the study memorandum have been included.

The analyses indicated that there were no sensitive areas in the Anacostia and the Potomac, and that the only potential sensitive areas were the occurrences of the Hayes Spring Amphipod in Rock Creek. In accordance with the CSO Policy, the analyses in Section 9 of the LTCP evaluate the feasibility of eliminating, relocating, or treating overflows to potential sensitive areas. The report concluded that these alternatives were not feasible and that the approach should be to provide the level of control necessary to protect designated uses and meet water quality standards. Actual construction activities will have no impact on the amphipod and the resulting water quality improvement will be of benefit to it.

Regarding the Short Nosed Sturgeon, correspondence with the U.S. Fish and Wildlife Service does not indicate that this fish is a federally listed species in the District. The only reference that we can find to it is in the District's MS4 Permit, which indicates that the fish may occur in the Potomac. In any case, the selected CSO controls will improve the water quality in the Potomac.

Note that in comments on the Draft LTCP, the U.S. Fish and Wildlife Service has indicated that the proposed LTCP will have no adverse impacts on threatened or endangered species and is likely to be beneficial to them.

Regarding primary contact recreation and existing uses, EPA defines an existing use as one which is actually attained in the water body on or after November 28, 1975. The waters of the District of Columbia do not have the water quality to support primary contact recreation in dry and wet weather most of the time. Indeed, the District instituted a ban on swimming 1971. This is also reflected in the District water quality standards which list primary contact recreation as a designed use, not an existing use. Thus, a water body does not attain the use of primary contact recreation just because some persons illegally elect to use the water body in that manner. Instead, the use of primary contact recreation is attained when the water quality that will allow safe swimming to occur is achieved and when the regulations allow it to occur. Primary contact recreation is thus not an existing use.

12.6 The U.S. Fish and Wildlife Service commented that implementation of the Draft LTCP will likely have no adverse effects on endangered species and may actually be beneficial to them. (423)

Comment noted.

13. COMMENTS ON PUBLIC PARTICIPATION

13.1 Several commenters called for more extensive public participation that involves more people and groups, and fosters public-private partnerships. One commenter indicated that there was inadequate citizen attendance at public meetings in that only about 50 citizens participated. (307-310).

WASA conducted an extensive public participation program designed to educate the affected public and to obtain their input and consultation in selecting the long term CSO controls. The public participation process included public meetings, establishment of a Stakeholder Advisory Panel, and an elaborate public information process. Four public meetings have been held to educate the public and to obtain feedback about CSO issues. At the request of the public during the first public meeting, a Stakeholder Advisory Panel was formed. The panel consisted of representatives from government agencies, regulatory agencies, citizens' groups, and environmental advocacy groups that are concerned about water quality issues within the District. Twelve Panel meetings were held during development of the LTCP.

In addition, the public outreach program included educational mailers in water and sewer bills, establishment of a CSO website, creation of a CSO mailing list, informational CSO newsletters, and establishment of public information depositories.

After release of the Draft LTCP, nine neighborhood meeting were held throughout the District to explain the program and obtain public comments. The D.C. Council and WASA held public hearings on the plan. Informational mailers, WASA's website and presentations to interested groups were also used to obtain input on plan. The Draft LTCP was well publicized and members of the public provided thoughtful comments. Over 2,300 comments were received on the Draft LTCP. This does not suggest a lack of public involvement.

13.2 <u>EPA indicated that the public participation section of the Draft LTCP (Section 10.7) should be expanded to include the preparation of a Public Responsiveness Document, its distribution, and information on how later versions of the LTCP will include additional information on the public participation process (311).</u>

The Final LTCP includes a description of the public participation efforts that have taken place after release of the Draft LTCP. This includes WASA's public hearing, the D.C. Council's public hearing, neighborhood civic association meetings, other efforts and preparation of the responsiveness summary. Once the LTCP is finalized and approved, no subsequent versions of the LTCP are currently planned. However, updates on implementation of the program or on modifications to the program will include descriptions of public participation as appropriate.

13.3 <u>EPA asked for information on what steps have been taken to ensure that public participation has effectively reached minority and low income populations (312).</u>

WASA has advertised public hearings and neighborhood meetings in newspapers which have an audience with a high proportion of minority and low income persons. Neighborhood meetings have also been held in every ward of the city, including those with a high proportion of minority and low income persons. Special effort was made to hold two neighborhood meetings in Ward 6, which spans the east and west sides of the Anacostia River. This was done to encourage minority and low-income participation. Public information depositories were also set up in libraries in these wards of the District. In addition, the informational mailer describing the Draft LTCP and requesting public comment was printed in both English and Spanish. Special mailings of the Spanish edition were made by the Washington Post to Spanish speaking households.

13.4 EPA asked for information on what steps have been taken to evaluate the potential for disproportionately high and adverse human health or environmental effects on minority and low-income populations (313).

Minority and low income populations make up a proportionally high share of the watershed of the Anacostia River in the District. The greatest CSO control benefit and the largest expenditures in the LTCP are directed toward improving the Anacostia River. Of the $1.265 billion program, $940 million or about 74% are directed toward improving the water quality of the Anacostia River. The LTCP is thus extremely responsive to those communities. Instead of having a negative impact, the LTCP will bring a much greater benefit to those communities.

14. COMMENTS ON FINANCIAL CAPABILITY ASSESSMENT

14.1 Several commenters opposed increasing rates to pay for CSO control. (82-85)

Control of CSOs is required by the Clean Water Act and by WASA's National Pollutant Discharge Elimination System (NPDES) Permit. Other communities in the nation also are facing this issue. One strategy that may mitigate rate increases is to seek financial assistance from the federal government.

14.2 Many commenters indicated that the Federal Government should pay a significant portion of the cost of CSO control. Some commenters asked for Federal participation in the 75-90% range. Commenters offered the following as reasons why federal involvement was justified: (86, 88, 89, 93, 94, 109-123)

- The ACOE and Federal Government built the CSS and turned it over to the District. The Fed Gov should pay for fixing the problem it created
- The special relationship between the Federal Government and the District Government
- The large number of federal properties in the District and government institutions such as embassies, etc. that are exempt from taxes
- CSO control is an unfounded mandate
- Financial burden on the District is too high
- Other Cities have received significant help with CSO costs (Boston, Chicago). There is precedent.

WASA is seeking financial assistance from the Federal Government for CSO control. In addition to paying water and sewer bills, the Federal Government bears a special responsibility to the District for the CSO system. This is because the Federal Government designed and constructed the combined sewer system and essentially left the

District with the liability for CSO control. In addition, the Federal Government has in the past and continues to govern the District in all matters. This situation places a special responsibility on the Federal Government to mitigate CSO costs to District ratepayers.

14.3 EPA questioned the method used to establish billings to the Federal Government and whether the current system properly allocates costs. EPA questioned whether changes should be made in the separate vs. combined sewer areas and if such changes would impact affordability (87).

The Federal Government and other large users pay water and sewer bills in proportion to metered potable water used. Combined sewer costs are proportional to runoff, and water consumption is not a good indicator of runoff. An example would be a parking lot with a large amount of runoff but only minimal water usage. As a result, WASA is evaluating alternate rate structures that give some consideration to impervious area. It is unlikely that alternate rate structures will substantially affect affordability.

In addition to water used and wastes/runoff generated, the Federal Government bears a special responsibility to the District for the CSO system. This is because the Federal Government designed and constructed the combined sewer system and essentially left the District with the liability for CSO control. In addition, the Federal Government has in the past and continues to govern the District in all matters. This situation places a special responsibility on the Federal Government to mitigate CSO costs to District ratepayers.

14.4 Several commenters indicated that since Maryland and Virginia send flow to the District for treatment, they contribute to CSOs and should pay a fair share toward CSO control. One commenter suggested that some form of commuter tax be employed (90-97).

In accordance with the Intermunicipal Agreement (IMA) of 1985, the surrounding jurisdictions pay WASA for the wastewater these jurisdictions sent to BPWWTP for treatment. The suburbs are currently within their average and peak flow limitations and the LTCP was prepared by assuming the suburbs were discharging at these limits. Under the current IMA, WASA cannot charge surrounding jurisdictions additional fees for CSO control since the suburbs are already paying for the wastewater they send to BPWWTP. Requiring the suburbs to pay an additional charge for CSO control would require justification and renegotiation of the IMA. This would be a long and involved political process with an uncertain outcome.

14.5 Several commenters indicated that consideration should be given to an alternate rate structure that incorporates impervious area since impervious surface is what contributes runoff and CSOs (101, 103, 105, 106). Several commenters indicated that the rate structure should be revised to include incentives for promoting the reduction of storm water. (276, 277).

WASA will give this consideration as the LTCP is implemented. However, changing the rate structure is unlikely to significantly affect affordability or the selection of the proposed CSO controls.

14.6 Several commenters suggested that a "lifeline" rate or other mechanism be developed to protect low income and the elderly form elevated rates, especially upon implementation of the LTCP (102, 104, 107, 108).

WASA will give this consideration as the LTCP is implemented.

14.7 One commenter suggested putting CSO costs in perspective by comparing them to school, road or other DC budgets (100).

Budgets for other programs might be considered large compared to the cost of CSO control. For example, the D.C. school budget for 2003 is reported to be about $5.7 billion. However, the impact on rates is a better indicator of the true cost to rate payers of CSO controls. Households in the District have a limited amount of disposable income. The proposed CSO controls will raise the cost of wastewater service to very high amounts.

14.8 Several commenters indicated that there was an overlap between the Draft LTCP and WASA's Capital Improvement Program (CIP). The pumping station rehabilitations are included in both the LTCP and the CIP. One commenter suggested that this overlap resulted in double counting of the pump station coats and overstatement of the effect on rates (98, 99).

The LTCP includes the following projects that are in the CIP: $127 million for pumping station rehabilitations and the $3 million for LID. Since these items are already budgeted, they were excluded from the cost of the LTCP for purposes of doing the financial analysis. Thus, these items are not "double counted" when evaluating the effect on rates.

14.9 One commenter indicated that the analysis in the Draft LCTP overstates the costs in the early years because it assumes the entire cost of the program is bonded from year one. Typically, bonds will be issued over time so the rate impacts are phased-in (127).

The affordability analysis in the LTCP was prepared according to the method proscribed by EPA. The analysis estimates the cost per household in terms of today's dollars near the peak in the program. It is a method of assessing what the relative cost of the program will be compared to income. It is true that in the early years of any program, rate increases are typically gradual to build up to the amount required to finance they program. However, the EPA methodology is a good indicator of what real costs will be compared to income.

14.10 One commenter indicated that a rate structure should be instituted so that non-profits such as the World Bank and Fannie Mae pay into the system. (81)

Non-profits and the Federal Government all pay water and sewer bills and thus contribute to the cost of the infrastructure including CSO control.

14.11 EPA commented that the Draft LTCP does not indicate when higher residential customer rates would be seen. EPA recommended that the projected phase-in of the rate increase be presented. (124)

The phase in of rate increases depends on many factors including:

- Implementation schedule
- Availability of grant funding
- Other capital improvements in the system
- Other regulatory requirements
- Approval date of LTCP

At this stage it is not possible to predict the actual rate increases necessary with a sufficient degree of accuracy. However, it is likely that rates increases will be small in the beginning, reach a peak near the middle of the program, and tail off near the end of the program.

14.12 EPA commented that that the report indicates the District has a disproportionate number of low income households, but does not provide census or other information to support the statement. (125)

The LTCP has been revised to compare the District's income distribution to that of Maryland and Virginia.

14.13 A commenter indicated that WASA needed a fall-back position if Federal Funding does not come through. (126)

If no federal funding is provided, the schedule for implementation may be extended to lessen the impact on ratepayers.

14.14 EPA indicated the LTCP should describe how much money will be needed to fund individual control plan elements based on the project schedule. They also requested that work be identified that has funding available. EPA also questions what was the significance that certain project elements were in the CIP (434).

The estimated capital and operation and maintenance costs for the items in the schedule are shown in Section 13 of the LTCP. Items in the capital improvement program (CIP) have also been identified in this section. These are significant in that they have a schedule and budget in the program.

14.15 A commenter indicated that WASA should consider opportunities for partnership with the Federal ISTEA program, EPA 319 grants and other federal programs. (431)

Comment noted.

15. COMMENTS ON SCHEDULE

15.1 Several commenters advocated for a shorter schedule (322, 330-339). One commenter incorrectly indicated that the LTCP will take 30 years to build. (326). Another commenter indicated that the 20-year implementation time is not adequately justified in the plan (328).

The projects in the LTCP can be divided into two categories: those in the existing Capital Improvement Program (CIP) and those not in the CIP. Projects in the CIP have been budgeted and scheduled and these projects will move forward without approval of the LTCP. These can generally be completed in about 6 years. For projects not in the CIP, an implementation schedule has been developed based on years after approval of the LTCP. Based on the financial capability assessment and the impact on rates, a 40-year implementation time is proposed for the entire recommended plan without any outside financial assistance. This is to mitigate the impact on rate payers of the large expenditures for CSO control. If significant outside financial assistance is obtained, it is technically feasible to accelerate the schedule to a 15-year implementation time frame. Significant outside assistance on the order of 75% would be required to achieve this schedule.

15.2 Some commenters indicated that there were things that could be done immediately (like trash control) and that these should be implemented early because 20 years is too long to wait for trash control (327, 342).

WASA has a nine minimum control program which includes the following measures to control solid and floatables control:

- Anacostia River Floatable Debris Program on the Anacostia River - this is a skimmer boat program which removes floating debris on the river. Note that this program removes debris from storm water and upstream Maryland sources in addition to CSO sources.
- End of pipe netting system on CSO 018 on the Anacostia River
- Catch basin cleaning

- Screening facility at the Northeast Boundary Sewer and the bar racks at the pumped overflows at the Main and 'O' Street Pumping Stations

Additional floatables control will be provided as LTCP elements come on line. These elements will come on line throughout the duration of implementation period. It will not be necessary to wait until the end of the implementation period.

15.3 One commenter indicated that the plan does not have fixed date schedules and thus does not comply with the CSO Policy (328).

It is unknown when the LTCP will be approved for implementation. The schedules in the LTCP were thus developed in years after the date of approval. The CSO Policy does not require fixed date schedule. The CSO Policy says: "*The permittee should include all pertinent information in the long term control plan necessary to develop the construction and financing schedule for implementation of CSO controls. Schedules for implementation of the CSO controls may be phased based on relative importance of adverse impacts on WQS and designated use, priority projects identified in the LTCP, and on the permittee's financial capability.*" The LTCP complies with these requirements.

15.4 One commenter indicated that the Potomac tunnel is pushed too far out in the schedule. The commenter advocated for earlier implementation. (329)

In accordance with the CSO Policy, the implementation schedule was developed giving consideration to public comments and to areas where water quality impacts due to CSOs were the greatest. The majority of the public and the regulatory agencies public indicated that the Anacostia River projects should be given priority. The Anacostia also receives the most CSO overflow volume and is the area where CSO impacts are the greatest. Given outside financial assistance, the Potomac CSO controls could be accelerated in the schedule.

15.5 EPA commented that the constraints that prevent nearer-term completion of each major project component should be described. (325)

This is included in Final LTCP.

15.6 EPA questioned whether the first 2 segments of the Anacostia tunnel project would be independently operational in terms of providing useable storage and transmission immediately upon completion of construction. (343)

There are three basic elements to the Anacostia system. They are listed from downstream to upstream as follows

- Tunnel from Poplar Point to Northeast Boundary Outfall
- Tunnel Parallel to Northeast Boundary Sewer
- Short tunnels from flood areas to Northeast Boundary Sewer

The downstream facilities must be completed before upstream tunnels come on line. However, the downstream tunnels can come on line before upstream tunnels are complete. This will enable achieving some CSO benefit earlier than otherwise expected.

15.7 A commenter and EPA suggested presenting year by year improvements in CSO reduction to demonstrate that CSO reduction is progressive and that the District will not have to wait 20 years to realize all the benefits of the plan (287, 341).
This is included in Final LTCP.

15.8 EPA commented that the draft plan identified early action items that are not dependent on LTCP approval. EPA indicated that a summary action plan should be prepared and submitted to implement the early action items (340).
The schedule in the LTCP includes elements that can proceed without approval of the plan.

15.9 One commenter indicated that WASA should be given more time to implement the LTCP if it includes more emphasis on non-engineered solutions (323).
Comment noted.

16. COMMENTS ON WATER QUALITY STANDARDS REVISIONS

16.1 Several commenters expressed support for modifying the water quality standards as proposed in the LTCP to acknowledge discharges that would remain after implementation of the Draft LTCP (411-416). Many commenters opposed changes to the water quality standards proposed in the Draft LTCP (373-407).
The current District of Columbia water quality standards include both numeric and narrative components. The narrative components require, among other items, that discharges be "free of untreated sewage". Given the current standards, no alternative short of complete separation can completely eliminate overflows (and thereby comply with current standards) during all conditions. Separation has a cost almost triple that of the recommended LTCP, would cause massive disruption and hardships, and results in worse water quality than the recommended LTCP. For these and other reasons, separation was not recommended. Given that separation is not feasible, there will be some remaining overflows for any CSO control plan under some weather conditions. Given the large investment in the LTCP, water quality standards provisions need to be adopted to provide for the remaining discharges that will occur. While the goal of

fishable and swimmable waterways should not be changed, there needs to be a recognition in the standards that there is an upper limit to the control provided by any CSO plan.

16.2 A commenter indicated that instead of seeking to change the water quality standards, WASA could seek a variance for CSO and thereby not need to change them. (417)

Variances are short-term modifications to the water quality standards that could be configured to allow CSOs. However, the District Standards and the CSO Policy indicate that variances are valid for 3 years and must be applied for and reviewed every 3 years. EPA guidance and practice indicate that variances are envisioned for short term application when some additional time is needed to ascertain a water quality impact or to develop a control approach. This is not the case for CSO controls, where implementation is expected to take 20 years and where there will be a lengthy period of evaluation of effectiveness after implementation. In addition, the renewal of a variance every 3 years is not guaranteed or certain. If the variance is not granted, the investment in the LTCP would be at risk and subject to lawsuits or regulatory action. It is not practical to risk the magnitude of the investment in the LTCP on the possibility of attaining many variances through the years.

16.3 EPA questioned how the implementation of the WQS currently proposed by DOH would affect the plan (408)

The District proposed revisions to the WQS in the October 12, 2001 D.C. Register. The revisions included several technical changes regarding light clarity and bacteriological standards, and a wet weather provision proposed to accommodate CSO. The District subsequently withdrew the proposed revisions and published an emergency rulemaking adopted on January 25, 2002. The emergency rule making included new numeric criteria for Secchi Depth, Chlorophyll a, Arsenic, and Ammonia, and made various other technical changes. The rule making did not propose any wet weather provisions or otherwise affect any portion of the standards pertaining to wet weather discharges.

As a result, the assessments made in the Draft LTCP regarding the impact of the current water quality standards on CSO remain accurate. WQS provisions are also addressed in the Final LTCP.

16.4 A commenter indicated that potable water was unsanitary and that higher water quality standards were needed to have safe drinking water (409). Another commenter indicated that CSOs affect our water supplies and that for this reason more CSO control is necessary. (302)

The District withdraws potable water from the Potomac well upstream of any CSO discharges. In addition, no potable water supplies withdraw water from the Potomac River downstream of the District CSO areas. This is due to the salinity in the Potomac River. As a result, the District's CSOs will not affect drinking water.

16.5 Commenters indicated that WASA worked backwards by proposing to change the WQS to fit the preferred LTCP instead of trying to develop a plan to meet the existing water quality standards. Commenters further stated that WASA did not start off with a goal of meeting the existing water quality standards.(418-419)

An evaluation was made of whether it was possible to meet the current water quality standards with any form of CSO control. The only plan that would meet the current standards is separation. In addition, separation provides worse real-world water quality than a high degree of CSO control. Due to the high cost, impracticality, and poor water quality performance of separation, an evaluation was made of other degrees of CSO control that provide an effective combination of performance, minimal disruption of the use of the water body, reasonable cost and practicality. This is in accordance with the approach described in EPA's CSO Policy which is now part of the Clean Water Act.

16.6 A commenter indicated that primary and secondary contact recreation are existing uses on each of the receiving waters and that the Clean Water Act legally prohibits changing the standards that would interfere with an existing use. (410)

Primary contact recreation is not an existing use. Reference the discussion in the comments related to Sensitive Areas. The District of Columbia Department of Health has established the existing use of the waterways as Class B or secondary contact recreation. The LTCP will meet the bacteria geometric mean standard for the design condition specified in the CSO Policy (average year) for Class B waters.

16.7 A commenter indicated that the net effect of changing the water quality standards as recommended in the LTCP would be to ban swimming in perpetuity. Without the existing water quality standards as a driving force, there would be no impetus to improve water quality and the people of the District deserve to be able to use the waters for recreation.

The recommended plan for CSO control will meet the geometric mean bacteria standard in all receiving waters. If other sources were controlled in conjunction the recommended plan, the bacteria standard could be met in all receiving waters. The CSO plan is thus protective of swimming and the current water quality standards.

After implementation, CSOs are projected to cause fecal coliform levels to rise above an average of 200MPN/100 ml for 7 days per year in the Anacostia, 5 of which occur in the period of likely recreational use from May to September. The LTCP is thus projected to be protective of swimming the remaining 358 days of the year or more than 98% of the time. The days when CSOs cause high bacteria levels will likely coincide with other natural conditions such as high water flows, severe thunder strorms, lightning and other conditions that would make use of the waterbody impractical or unsafe.

17. MISCELLANEOUS COMMENTS

17.1 A commenter indicated that WASA should consider the effects of global warming on long term rainfall patterns and determine if changes need to be made in the evaluation. (286).

A report entitled *Climate Change Impact on the United States* (National Assessment Synthesis Team. 2001) was reviewed to assess the possible impact of changes in precipitation on modeling future rain events for the recommended Long Term Control Plan. There are two major models, known as the Hadley Model and the Canadian Model that simulate and predict future precipitation in North America. Although both models predict an increase in the amount of precipitation in the Northeastern United States by the year 2100, the projected increase varies from 5% to 25%. Furthermore, additional studies offer conflicting results concerning the nature of precipitation in the future. Some studies predict more intense storms, while others predict less intense ones; some studies suggest an increase in the actual number of storms, while others suggest a decrease. There are also variations in the predicted tracks of storm events. Given the long time frame for a climate change and the lack of consistent and specific predictions regarding its effects, it impractical now to revise sizing of controls. If climate change does occur, the LTCP is expandable by techniques described in subsequent sections to accommodate any increased overflows.

17.2 A commenter suggested developing a system to track and respond to environmental complaints such as suspicious discharges to waterways, street and basement flooding incidences, and others. The commenter suggested incorporating some reporting mechanism so the public understands the complaint and knows what action was taken. (288)

WASA is responsible for the water and wastewater system in the District. The D.C. Department of Health and Police Department are responsible other discharges to waterways, illicit discharges, environmental crimes, and the like.

17.3 A commenter indicated that WASA should keep a record of notice of violations (292).

WASA submits discharge monitoring reports to EPA for Blue Plains and a quarterly report on the CSO system. These reports include information on permit violations. The CSO quarterly reports are available on WASA's web site at www.dcwasa.com.

17.4 Commenters indicated that continued CSOs present a health risk due to fish consumption and the potential for contact. The commenters indicated that the LTCP fails to adequately address this issue. (290,291)

The fish advisories in District waters are for PCBs in fish tissue. During the monitoring program prepared for this study, no PCBs were detected in CSO discharges. In addition, the proposed CSO controls will reduce CSOs by a large amount. See the response to comment 16.7 regarding primary contact with the receiving waters.

17.5 A commenter expressed a concern as to whether the LTCP would be competently and correctly implemented. (304)

Once approved, WASA is committed to professionally implementing the LTCP. WASA was created in 1996 and since that time has made major strides in improving operations, financial management, and the water and wastewater systems. WASA is currently managing a $1.6 billion capital improvement program separate from the LTCP. WASA capabilities have been proven by the major changes in operations and performance since its creation in 1996.

17.6 A commenter expressed concern that WASA was not forthcoming to the public and that WASA's statements were not reliable. (303)

WASA is committed to complete, truthful and timely responses to public inquiries and concerns. WASA's performance since 1996 is evidence of this and demonstrates WASA's commitment to these goals.

17.7 EPA commented that the statement in the LTCP reading "In March 2001 the DOH released its first TMDL for the impaired waterbody." is incorrect. The first TMDL was issued on January 12, 1999. The Anacostia BOD TMDL is the second (301).

The report will be corrected to reflect that the oil and grease TMDL for Hickey Run, a tributary to the Anacostia, was issued prior to the BOD TMDL.

17.8 EPA asked that the toxic pollution control benefits of the recommended plan be quantified, to the extent permitted by available information. EPA also asked for an estimate of the amount of toxics that will be captured and treated at Blue Plains WWTP that would otherwise be discharged if sewers were separated. (344)

The Draft LTCP is predicted to remove toxics (metals, organics, etc.) in proportion to the amount of CSO overflow volume reduced. The Draft LTCP proposed a system-wide 92% reduction in CSO overflow volume. The total discharge of toxics will be reduced proportionately. This is a conservative estimate since discharges that occur after implementation of the LTCP will typically occur well after the first flush when toxics concentrations are likely to be lower.

Separation would result in a significant increase in untreated discharges to the receiving waters. The Table below summarizes untreated discharged (i.e. excluding Blue Plains discharged) from the combined and separate storm water systems in the District.

Untreated Discharge Volumes in Average Year (Average of 1988-1990)

Scenario	CSO Overflow Volume (mg/yr)	Untreated Storm Water Discharges (mg/yr)	% Change From No Phase I Controls	% Change From Draft LTCP
No Phase I Controls	3,254	18,108	0%	
Draft LTCP	264	15,118	-17%	0%
Separation	0	22,491	24%	49%

The untreated discharges from the combined and separate storm water systems were found to have similar concentrations of toxics during the monitoring conducted as part of the LTCP. As a result, comparison of volumes alone is a good indicator of pollutants discharged. As indicated in the table, the Draft LTCP would result in a net 17% reduction in untreated volume discharged, while separation would result in an estimated 24% increase in untreated discharges. When compared to the Draft LTCP, separation would result in an estimated 49% increase in untreated discharges.

17.9 EPA asked if rehabilitation of the Potomac Pump Station would provide any additional screening of floatables (34).

Rehabilitation of Potomac Pumping Station will restore the capacity of the station to its design rating of 460 mgd. This will increase the amount of CSO captured and treated and will thereby increase the amount of floatables material captured.

17.10 A commenter recommended coordinating surface construction with the District Office of Planning for the possibility of integrating parks or other enhancements into the design. (422).

WASA will seek opportunities to coordinate and collaborate with the Office of Planning throughout the implementation phase of the LTCP.

17.11 One commenter requested the removal of references to upstream pollution sources being a significant source of water quality impairment (428).

WASA's NPDES permit requires the preparation of the LTCP in accordance with EPA CSO Policy which is now part of the Clean Water Act. The CSO Policy and EPA's guidance documents indicate that since pollution sources other than CSOs can affect receiving water quality and the ability to attain water quality standards, they should be considered and assessed in the LTCP. As result, discussion of upstream pollution sources and their effect on water quality is unavoidable.

Table 1 - Summary of Comments on Draft LTCP

No.	Last Name	First name	Affiliation	Address 1	Address 2	Forum	Comment	Category
1	Bobreski	Jim	Citizen			DC Council Pub Hearing	Consider decentralized treatment and tell people it has to be in their backyard	Alternatives
2	Schulman	Jim	Sustainable Community Initiatives	631 E St NE	Washington DC 20002	Questionnaire	Consider eliminating wastewater systems that use clean water- use grey water, composting toilets, natural filtration, etc.	Alternatives
3	Stiehler	Robert D.	Citizen	3234 Quesada St NW	Washington DC 20015	Questionnaire	Consider flood plains for storm water would reduce overflows	Alternatives
4			CItizen			Neigh Mtg#12	Consider innovative technologies to eliminate overflows entirely	Alternatives
5			Clean Water Campaign	NRDC 1200 New York Ave., NW	Washington DC 20005	Written Comments	Consider near term consolidation of CSOs & disinfection	Alternatives
6	Wentworth	Marchant	Sierra Club	1726 St NW, Suite 902	Washington DC 20036	DC Council Pub Hearing	Consider not doing Potomac Tunnel and putting money into Anacostia	Alternatives
7	Napier	Maurice, J.	The McCombie Napier Compant, Ltd		Scotland	Written Comments	Consider old ship tankers for CSO storage	Alternatives
8	Heinrich	Phil	Citizen			Written Comments	Consider on-site storage of sanitary wastes to "share" CSO system	Alternatives
9	Wells	Jeffrey R.	Citizen	3730 Windom Place, NW	Washington DC 20006	Written Comments	Consider pollution prevention	Alternatives
10	Not Provided	Not Provided	Citizen	Not Provided	Not Provided	Questionnaire	Consider storm water management incentives and targeted separation	Alternatives
11			CItizen			Neigh Mtg#3	Consider using CSO like greywater at golf courses	Alternatives
12							Number not used	
13							Number not used	
14	Forsberg	Ken	Citizen	1809 Monroe St, NW	Washington DC 20010	Questionnaire	Find some ways of stopping overflows other than separation	Alternatives
15	Sanders	Serita	Bloomingdale Civic Assoc	P.O. Box 92691	Washington, DC 20090	WASA Pub Hearing	Look at lessons learned in other cities	Alternatives
16	Fellows	Andrew, and Paul Schwartz	Clean Water Action	4455 Connecticut Ave, NW, A-300	Washington, DC 20008	WASA Pub Hearing	LTCP does not address SSOs and storm water pollution from separate sewer system	Alternatives
17	Fellows	Andrew, and Paul Schwartz	Clean Water Action	4455 Connecticut Ave, NW, A-300	Washington, DC 20008	WASA Pub Hearing	LTCP does not address water cross connections or water/sewer pipes crossing	Alternatives
18	Whitehead	Damon	Anacostia Riverkeeper	1st & Potomac Avenue, SE	Washington, DC 20003	WASA Pub Hearing	LTCP does not allow for any growth in District (IMA) whereas suburbs have growth	Alternatives
19	Chanay	Robin D	CItizen	503 S St NW	Washington DC 20001	Written Comments	LTCP will provide no WQ benefits	Alternatives
20			CItizen			Neigh Mtg#5	Maintenance: Concern that this plan does not address clogging in separate stsorm sewers/catch basin cleaning	Alternatives
21	Slowenski	Kent	Citizen	NA	NA	WASA Pub Hearing	Maintenance: Doesn't address maintenance of deteriorated sewer system	Alternatives
22	Wentworth	Marchant, and Robert Morris	Sierra Club	1726 St NW, Suite 902	Washington DC 20036	Written Comments	MD & VA should reduce their flows	Alternatives

No.	Last Name	First name	Affiliation	Address 1	Address 2	Forum	Comment	Category
23	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	MD/VA - An alternative should be developed and evaluated to temporarily reduce the input of flows from separated sewers during wet weather from Fairfax County, WSSC, and other currently separated portions of the District to the CSS. Options might include storage (in sewers or otherwise), satellite treatment, or conveyance past the combined system directly to Blue Plains	Alternatives
24			CItizen			Neigh Mtg#5	MD/VA - Concern that flows from MD/VA take up capacity in CSS, causing overflows	Alternatives
25	Glover	Joseph	Citizen	1215 33rd Palce SE	Washington DC	DC Council Pub Hearing	MD/VA - DC should not pay for pollution control without MD/VA doing their share	Alternatives
26	Blackwelder	Brent	Friends of the Earth	1025 Vermont Avenue, NW	Washington, DC 20005	WASA Pub Hearing	MD/VA - Fed Gov, Maryland and Virginia should stop polluting	Alternatives
27	Silverman	Larry and Robert Boone	Anacostia Watershed Society	4302 Baltimore Ave.	Bladensburg, MD 20710	WASA Pub Hearing	MD/VA - Push for watershed approach to storm water in MD and put some money toward it	Alternatives
28	Sesil	Joe	Citizen	3421 N St NW	Washington DC	Questionnaire	MD/VA - Recommends watershed protection program with counties	Alternatives
29	Baron	David	Earthjustice	1625 Mass. Ave, NW Suite 702	Washington DC 20036	Written Comments	MD/VA - Suburban flows should be carried around CSS or MD/VA should pay proportionate share of CSO cost	Alternatives
30	Wentworth	Marchant	Sierra Club	1726 St NW, Suite 902	Washington DC 20036	WASA Pub Hearing	MD/VA should conserve water/have storm water controls to reduce their peak flows	Alternatives
31	Baron	David	Earthjustice	1625 Mass. Ave, NW Suite 702	Washington DC 20036	Written Comments	Model underpredicts overflows in some cases - is model accurate? If so how will this be taken into account (i.e. increase storage)	Alternatives
32	Wentworth	Marchant, and Robert Morris	Sierra Club	1726 St NW, Suite 902	Washington DC 20036	Written Comments	Myth of avg year: correlate overflows to return frequencies (most intense, 1-yr, 5-yr, 10 yr etc)	Alternatives
33	Wentworth	Marchant, and Robert Morris	Sierra Club	1726 St NW, Suite 902	Washington DC 20036	Written Comments	Piney Branch: Consider trash trap & disinfection , they question WQ benefits of tunnel, consider intensive LID	Alternatives
34	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	Potomac - Will rehabilitation of the Potomac Pump Station provide any additional screening of floatables?	Alternatives
35	Whitehead	Damon	Anacostia Riverkeeper	1st & Potomac Avenue, SE	Washington, DC 20003	DC Council Pub Hearing	Rehab existing system	Alternatives
36	Sanders	Serita	Bloomingdale Civic Assoc	P.O. Box 92691	Washington, DC 20090	WASA Pub Hearing	Rehab existing system	Alternatives
37	Chanay	Robin D	CItizen	503 S St NW	Washington DC 20001	WASA Pub Hearing	Rehab existing system	Alternatives
38	Le Hall	Elizabeth	Citizen	6231 Piney Branch Road, NW	Washington DC 20011	Written Comments	Rehab existing system	Alternatives
39	Slowenski	Kent	Citizen	NA	NA	WASA Pub Hearing	Rehab existing system	Alternatives
40	Fellows	Andrew, and Paul Schwartz	Clean Water Action	4455 Connecticut Ave, NW, A-300	Washington, DC 20008	WASA Pub Hearing	Rehab existing system	Alternatives
41	Norouzi	Parisa	D.C. Environmental Network	1025 Vermont Avenue NW 3rd Flr	Washington DC 20005	DC Council Pub Hearing	Rehab existing system	Alternatives
42	New	Gregory R.	DC Federation of Civic Associations	P.O. Box 4549	Washington DC 20017	Written Comments	Rehab existing system: Is existing CSS in good enough shape?	Alternatives

No.	Last Name	First name	Affiliation	Address 1	Address 2	Forum	Comment	Category
43	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	Rock Creek - Data found in Chapter 3 shows sources of fecal coliform to Rock Creek to be 42% attributable to CSOs and 33% to DC storm water. Further, Rock Creek is expected to exceed the Class A standard for fecal coliform every month of the year (after implementation of CSO controls) and it is the habitat of an endangered species. This area appears to be a good candidate for selective separation or other remediation prior to installation of a deep tunnel that won't be implemented for fourteen years. What other alternatives can be developed to correct SW and CSS overflows in this area?	Alternatives
44	Wentworth	Marchant, and Robert Morris	Sierra Club	1726 St NW, Suite 902	Washington DC 20036	Written Comments	Rock Creek: Conduct detailed I/I studies in Rock Creek. Two places for possible sewer leaks are: Ford at Military Rd, Dam upstream of Boulder Bridge	Alternatives
45	Wentworth	Marchant, and Robert Morris	Sierra Club	1726 St NW, Suite 902	Washington DC 20036	Written Comments	Rock Creek: Redesign & close selected regulators: look at closing regulators at entrance to Zoo since it is area of most likely wading	Alternatives
46	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	RTC - An alternative for RTC presupposes use of additional inflatable dams; however, past experience has shown that inflatable dams are subject to puncture. What other alternatives are there that can be implemented for RTC?	Alternatives
47	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	Satellite Treatment - is eliminated from further consideration based upon location, staffing and sludge generation. However further consideration should be given to satellite treatment of the high volume CSOs (such as CSO 010,019,022 and 049) where WQ impacts are the greatest. What would the stream impacts be by providing satellite treatment at critical locations? Satellite treatment should be evaluated for short term to long term application.	Alternatives
48			CItizen			Neigh Mtg#4	Separation - areas other than luzon valley can and should be separated	Alternatives
49	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	Separation - Complete system separation is dismissed from further consideration due to cost, disruption, and increased loading to the SW system. Alternatives should be developed and evaluated for separation of discrete areas where combined flows are high, possibly in combination with constructing new storm sewers and satellite treatment systems or satellite storage. Areas tributary to the CSS that could most readily be separated should be identified. For each such area, identify the volume of SW flows that could be eliminated from the CSS during wet weather, where those flows would be discharged (if they were not to be discharged to the CSS), and the effect that such discharges would have on the receiving water body.	Alternatives
50	Chanay	Robin D	CItizen	503 S St NW	Washington DC 20001	Written Comments	Separation - cost is too high - EPA cost is $20-$60,000/ acre	Alternatives
51	Culp	David	Citizen	121 12th Street, SE #403	Washington, DC 20003	WASA Pub Hearing	Separation - look at partial separation in Federal area & make Fed Gov pay for it	Alternatives
52			CItizen			Neigh Mtg#3	Separation - look at separation in upper Rock Creek	Alternatives

No.	Last Name	First name	Affiliation	Address 1	Address 2	Forum	Comment	Category
53	Tibbetts	David, A.	Anacostia Watershed Society Treasurer	4302 Baltimore Ave.	Bladensburg, MD 20710	Written Comments	Separation - look at separation within existing combined sewers	Alternatives
54			Clean Water Campaign	NRDC 1200 New York Ave., NW	Washington DC 20005	Written Comments	Separation - look at targeted separation at Ivy City/Trinidad flood areas (to prevent human contact w/sewage)	Alternatives
55	Slowenski	Kent	Citizen	NA	NA	WASA Pub Hearing	Separation - Need to replace infra structure anyway, so why not just separate	Alternatives
56	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	Separation - Separation cost is included for Potomac & Rock Creek, but not Anacostia - correct.	Alternatives
57	Fitzpatrick	Neil	Audubon Naturalist Society	8940 Jones Mill Road	Chevy Chase, MD 20815	WASA Pub Hearing	Separation - supports targeted separation	Alternatives
58			Clean Water Campaign	NRDC 1200 New York Ave., NW	Washington DC 20005	Written Comments	Separation - WASA's separation costs are too high compared to Atlanta	Alternatives
59	Chanay	Robin D	CItizen	503 S St NW	Washington DC 20001	DC Council Pub Hearing	Separation is the answer	Alternatives
60	Chanay	Robin D	CItizen	503 S St NW	Washington DC 20001	WASA Pub Hearing	Separation is the answer	Alternatives
61	Chanay	Robin D	CItizen	503 S St NW	Washington DC 20001	Written Comments	Separation is the Answer	Alternatives
62	Glover	Joseph	Citizen	1215 33rd Palce SE	Washington DC	WASA Pub Hearing	Separation is the answer	Alternatives
63	Osted	Sarah	Citizen	4934 Eskridge Terrace, NW	Washington, DC	WASA Pub Hearing	Separation is the answer	Alternatives
64	Chanay	Robin D	CItizen	503 S St NW	Washington DC 20001	Written Comments	Separation will eliminate flooding, reduce odors, replace old infrastructure and will allow WQS to be met	Alternatives
65	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	The discussion of solids and floatables on page 12-12 alludes to new CSO regulators. Specifically, which regulators are to be replaced or modified under the LTCP? What is the process that will be used to evaluate individual regulator performance?	Alternatives
66	Fellows	Andrew, and Paul Schwartz	Clean Water Action	4455 Connecticut Ave, NW, A-300	Washington, DC 20008	WASA Pub Hearing	Watershed - Need holistic, integrated approach that involves entire watershed	Alternatives
67	Fitzpatrick	Neil	Audubon Naturalist Society	8940 Jones Mill Road	Chevy Chase, MD 20815	WASA Pub Hearing	Watershed approach - do something about it, don't just talk	Alternatives
68	Sesil	Joe	Citizen	3421 N St NW	Washington DC	Questionnaire	Watershed approach -Work with upstream counties to improve their water quality	Alternatives
69	Jones	Cy	Washington Suburban Sanitary Commission			Written Comments	If the full process train is to be used, does DCWASA possess sufficient unused treatment capacity within its IMA allocation to handle the additional flow? If not, how does the District intend to acquire the necessary additional capacity?	Blue Plains

No.	Last Name	First name	Affiliation	Address 1	Address 2	Forum	Comment	Category
70	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	Outfall 001 at BPWWTP has been characterized as a CSO under the existing NPDES permit, however, under the CSO policy it may be characterized as a bypass. Under the CSO Policy, approval of a CSO bypass requires that the LTCP, at a minimum, should provide justification for the cut-off point at which the flow will be diverted from the secondary treatment portion of the treatment plant and provide a cost-benefit analysis demonstrating that conveyance of wet weather flow to the POTW for primary treatment is more beneficial than other CSO abatement alternatives such as storage and pump back for secondary treatment, sewer separation, or satellite treatment. The LTCP should include a section to include this demonstration.	Blue Plains
71	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	What is the predicted frequency and duration that denitrification will not be achieved due to high flow conditions? With additional flows that will be sent to Blue Plains, what measures can be taken to optimize treatment at Blue Plains and assure maximum denitrification?	Blue Plains
72	Jones	Cy	Washington Suburban Sanitary Commission			Written Comments	What modifications to Blue Plains, if any, would be required? Would they be considered as joint-use or non-joint use projects?	Blue Plains
73	Jones	Cy	Washington Suburban Sanitary Commission			Written Comments	What would be the cost for the required modifications?	Blue Plains
74	Jones	Cy	Washington Suburban Sanitary Commission			Written Comments	Whichever train is used, what would be the operational impacts of the additional flow and the plants ability to meet its permit limits?	Blue Plains
75	Jones	Cy	Washington Suburban Sanitary Commission			Written Comments	Will the flow be treated by the full process train or the excess flow facility?	Blue Plains
76	Jones	Cy	Washington Suburban Sanitary Commission			Written Comments	Would there be any increase in Blue Plains operational costs? Would an increase be considered a DCWASA-only expense?	Blue Plains
77	Jones	Cy	Washington Suburban Sanitary Commission			Written Comments	WSSC leases 95 mgd in Anacostia System. Can lease continue or does WASA need it back. Can WSSC acquire soem additional capacity in Anacostia System?	Blue Plains
78	Cole	Cynthia	Potomac Boat Club	3530 Water Street NW	Washington DC 20002	Written Comments	Existing CSOs are located next to highly used areas of River	CSO Location
79	Wentworth	Marchant	Sierra Club	1726 St NW, Suite 902	Washington DC 20036	DC Council Pub Hearing	Take extra effort to controls CSOs at Thompson Boathouse & Anacostia Marinas (pub contact)	CSO Location
80	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	Will the recommended Plan eliminate (or consolidate) combined sewer outfalls to the point where they can be permanently sealed or the structures dismantled and removed from the receiving waterbody?	CSO Location

No.	Last Name	First name	Affiliation	Address 1	Address 2	Forum	Comment	Category
81	Caposi	John	Citizen	1619 G St SE	Washington DC	WASA Pub Hearing	Nonprofits should pay somehow (e.g. World bank, Fannie Mae)	Financial Impacts
82	Patrick-Jones	Peggy	Citizen	813 West Va. Ave, NE	Washington DC 20003	Written Comments	Don't raise rates	Financial Impacts
83	Wethered	Suzanne & J.V. Anil Kumar	Citizen	3726 Kanawha St, NW	Washington DC 20015	Written Comments	Don't raise rates	Financial Impacts
84			CItizen			Neigh Mtg#7	Don't raise rates	Financial Impacts
85	New	Gregory R.	DC Federation of Civic Associations	P.O. Box 4549	Washington DC 20017	Written Comments	Don't raise rates	Financial Impacts
86	Stiehler	Robert D.	Citizen	3234 Quesada St NW	Washington DC 20015	Questionnaire	Fed Gov - Costs need to be reduced unless federal government pays 80% of costs	Financial Impacts
87	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	Fed Gov - Describe the method used to establish billings to the Federal government (and potentially to other major flow contributors). Does the current system properly and fully allocate O&M and capital needs for sanitary flow (in separated areas) and both sanitary and storm flow (in combined areas)? What changes need to be made, by whom, and when? What should be the impact of such changes on the affordability of the proposed project to District residents? Can such changes make the project affordable to District residents without special appropriations?	Financial Impacts
88			CItizen			Neigh Mtg#8	Fed Gov - If ACOE/Fed built it, they should pay to fix it	Financial Impacts
89	New	Gregory R.	DC Federation of Civic Associations	P.O. Box 4549	Washington DC 20017	Written Comments	Federal Government should pay 80%	Financial Impacts
90	Baron	David	Earthjustice	1625 Mass. Ave, NW Suite 702	Washington DC 20036	DC Council Pub Hearing	MD & VA cause CSOs, so they should pay	Financial Impacts
91	Silverman	Larry and Robert Boone	Anacostia Watershed Society	4302 Baltimore Ave.	Bladensburg, MD 20710	WASA Pub Hearing	MD & VA should pay	Financial Impacts
92			CItizen			Neigh Mtg#4	MD and VA should pay	Financial Impacts
93			Clean Water Campaign	NRDC 1200 New York Ave., NW	Washington DC 20005	Written Comments	MD, VA & Fed gov should pay	Financial Impacts
94	Not Provided	Not Provided	Citizen	Not Provided	Not Provided	Questionnaire	MD/VA - Obtain commitments from MD, VA & Federal Government to pay	Financial Impacts
95			CItizen			Neigh Mtg#11	MD/VA - suburbs should pay	Financial Impacts
96	Caposi	John	Citizen	1619 G St SE	Washington DC	WASA Pub Hearing	MD/VA consider commuter tax	Financial Impacts
97			Clean Water Campaign	NRDC 1200 New York Ave., NW	Washington DC 20005	Written Comments	MD/VA should pay	Financial Impacts
98	Sanders	Serita	Bloomingdale Civic Assoc	P.O. Box 92691	Washington, DC 20090	WASA Pub Hearing	Overlap between LTCP and CIP	Financial Impacts
99			Clean Water Campaign	NRDC 1200 New York Ave., NW	Washington DC 20005	Written Comments	Overlap between LTCP and CIP - WASA double counted P.S. costs & overstated rate impacts	Financial Impacts
100	Forsberg	Ken	Citizen	1809 Monroe St, NW	Washington DC 20010	Questionnaire	Put CSO costs in perspective by comparing them to school, road or other DC budgets	Financial Impacts

No.	Last Name	First name	Affiliation	Address 1	Address 2	Forum	Comment	Category
101	Not Provided	Not Provided	Citizen	Not Provided	Not Provided	Questionnaire	Rate Structure - Consider cost based on impervious land and not water volume	Financial Impacts
102			CItizen			Neigh Mtg#3	Rate structure - consider giving senior citizens discounts in rates	Financial Impacts
103	Silverman	Larry and Robert Boone	Anacostia Watershed Society	4302 Baltimore Ave.	Bladensburg, MD 20710	WASA Pub Hearing	Rate structure - consider impervious area	Financial Impacts
104	Fellows	Andrew, and Paul Schwartz	Clean Water Action	4455 Connecticut Ave, NW, A-300	Washington, DC 20008	WASA Pub Hearing	Rate structure - implement a lifeline rate for low income households	Financial Impacts
105	Wentworth	Marchant, and Robert Morris	Sierra Club	1726 St NW, Suite 902	Washington DC 20036	Written Comments	Rate structure - look at alternate funding options such as tax on impervious surfaces	Financial Impacts
106			CItizen			Neigh Mtg#6	Rate structure - look at alternate rate structure taking into account impervious area	Financial Impacts
107	Wentworth	Marchant	Sierra Club	1726 St NW, Suite 902	Washington DC 20036	DC Council Pub Hearing	Rate structure - Protect lower income households	Financial Impacts
108	Schwartz	Paul	Clean Water Action	4455 Connecticut Ave, NW, A-300	Washington, DC 20008	DC Council Pub Hearing	Rate structure-need lifeline rate for low income customers like Philadelphia	Financial Impacts
109	Silverman	Larry and Robert Boone	Anacostia Watershed Society	4302 Baltimore Ave.	Bladensburg, MD 20710	WASA Pub Hearing	Secure Federal assistance	Financial Impacts
110	Sanders	Serita	Bloomingdale Civic Assoc	P.O. Box 92691	Washington, DC 20090	WASA Pub Hearing	Secure Federal assistance	Financial Impacts
111	Arner	Robert L.	Citizen	7209 Exfair Road	Bethesda MD 20815	Written Comments	Secure Federal assistance	Financial Impacts
112	Caposi	John	Citizen	1619 G St SE	Washington DC	WASA Pub Hearing	Secure Federal assistance	Financial Impacts
113	Glover	Joseph	Citizen	1215 33rd Palce SE	Washington DC	DC Council Pub Hearing	Secure Federal assistance	Financial Impacts
114	Glover	Joseph	Citizen	1215 33rd Palce SE	Washington DC	WASA Pub Hearing	Secure Federal assistance	Financial Impacts
115	Patrick-Jones	Peggy	Citizen	813 West Va. Ave, NE	Washington DC 20003	Written Comments	Secure Federal assistance	Financial Impacts
116	Pittman	Robert	Citizen			DC Council Pub Hearing	Secure Federal assistance	Financial Impacts
117	Reusga	Albert	Citizen	1727 P St NW, Apt D	Washington DC 20036	Written Comments	Secure Federal assistance	Financial Impacts
118	Wethered	Suzanne & J.V. Anil Kumar	Citizen	3726 Kanawha St, NW	Washington DC 20015	Written Comments	Secure Federal assistance	Financial Impacts
119			Clean Water Campaign	NRDC 1200 New York Ave., NW	Washington DC 20005	Written Comments	Secure Federal assistance	Financial Impacts
120	Blackwelder	Brent	Friends of the Earth	1025 Vermont Avenue, NW	Washington, DC 20005	WASA Pub Hearing	Secure Federal assistance	Financial Impacts
121	Wentworth	Marchant	Sierra Club	1727 St NW, Suite 902	Washington DC 20037	WASA Pub Hearing	Secure Federal assistance	Financial Impacts
122	Wentworth	Marchant, and Robert Morris	Sierra Club	1727 St NW, Suite 902	Washington DC 20037	Written Comments	Secure Federal assistance	Financial Impacts
123	Wrin	Bob	Citizen	5509 Chevy Chase Pkwy, NW	Washington DC	Questionnaire	Seek Federal assistance at 75%-80% level - this is an unfunded mandate	Financial Impacts

No.	Last Name	First name	Affiliation	Address 1	Address 2	Forum	Comment	Category
124	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	Table ES-4 analysis does not indicate when higher residential customer rates would be seen. What is the projected phase-in of the rate increase for customer rates?	Financial Impacts
125	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	The report suggest that the District has an disproportionate number of low income households, presumably relative to other large urban centers. It does not however provide census or other information to support the statement. Such data, if included in the report, would strengthen the argument for outside assistance.	Financial Impacts
126			CItizen			Neigh Mtg#5	WASA needs a fall-back position if Federal funding does not come through	Financial Impacts
127			Clean Water Campaign	NRDC 1200 New York Ave., NW	Washington DC 20005	Written Comments	WASA overstates costs in early years by financing all bonds now	Financial Impacts
128			CItizen			Neigh Mtg#6	Concern about flooding basement apartments and that the plan does not address these	Flooding
129			CItizen			Neigh Mtg#8	Concern that plan will not benefit flooding especially at 31st & K St in Georgetown	Flooding
130	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	Describe in greater detail how, and on what schedule, the recommended plan will alleviate flooding experienced in the NE boundary.	Flooding
131			CItizen			Neigh Mtg#1	Flooding at West Virginia & Mt. Olivette is a problem, when will it be fixed?	Flooding
132	Whitehead	Damon	Anacostia Riverkeeper	1st & Potomac Avenue, SE	Washington, DC 20003	WASA Pub Hearing	Flooding complaint	Flooding
133	Sanders	Serita	Bloomingdale Civic Assoc	P.O. Box 92692	Washington, DC 20091	DC Council Hearing	Flooding complaint	Flooding
134	Sanders	Serita	Bloomingdale Civic Assoc	P.O. Box 92691	Washington, DC 20090	WASA Pub Hearing	Flooding complaint	Flooding
135	Chanay	Robin D	CItizen	503 S St NW	Washington DC 20001	WASA Pub Hearing	Flooding complaint	Flooding
136	Mack	Geterrius	Citizen	1430 L St SE, #509	Washington DC 20003	Written Comments	Flooding complaint	Flooding
137			CItizen			Neigh Mtg#6	Flooding complaint	Flooding
138			Clean Water Campaign	NRDC 1200 New York Ave., NW	Washington DC 20005	Written Comments	Flooding complaint	Flooding
139	Strain	Sally	Pallisades Citizens Assoc.			Written Comments	Flooding complaint	Flooding
140	Le Hall	Elizabeth	Citizen	6231 Piney Branch Road, NW	Washington DC 20011	Written Comments	Flooding in basement caused by roots in sewer lateral	Flooding
141			Clean Water Campaign	NRDC 1200 New York Ave., NW	Washington DC 20005	Written Comments	LTCP does not explain how flooding will be alleviated in NEB, does not address flooding in other areas	Flooding
142	Whitehead	Damon	Anacostia Riverkeeper	1st & Potomac Avenue, SE	Washington, DC 20003	WASA Pub Hearing	LTCP does not protect City form flooding everywhere	Flooding
143			Clean Water Campaign	NRDC 1200 New York Ave., NW	Washington DC 20005	Written Comments	LTCP does not say if plan will fix the August 11, 2001 Flood	Flooding
144	Sanders	Serita	Bloomingdale Civic Assoc	P.O. Box 92691	Washington, DC 20090	WASA Pub Hearing	National Airport gages did not read alot of rain- WASA said it rained a lot on Aug 11	Flooding
145	Sanders	Serita	Bloomingdale Civic Assoc	P.O. Box 92691	Washington, DC 20090	WASA Pub Hearing	Plan should address lessons learned Aug 11	Flooding

No.	Last Name	First name	Affiliation	Address 1	Address 2	Forum	Comment	Category
146	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	The recommended plan shows a new "relief outfall" into the Anacostia near the current NE Boundary swirl facility and outfall 019. It is stated that this is necessary for flooding protection. 1) What is the predicted frequency and duration of overflows for this outfall? 2) Is it included in Table 9-3? 3) Are the flows part of the receiving stream model for the Anacostia? 4) What are the impacts to water quality from the discharge? 5) What controls will be placed on the new outfall? 6) How is the new outfall to be permitted?	Flooding
147			Clean Water Campaign	NRDC 1200 New York Ave., NW	Washington DC 20005	Written Comments	WASA must address immediate flooding problems	Flooding
148	Sanders	Serita	Bloomingdale Civic Assoc	P.O. Box 92691	Washington, DC 20090	DC Council Hearing	WASA was not responsive during flooding	Flooding
149	Sanders	Serita	Bloomingdale Civic Assoc	P.O. Box 92691	Washington, DC 20090	DC Council Hearing	What are short term fixes for flooding (Can't wait 20 yrs)	Flooding
150	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	To what degree has the "implementability" of the recommended control plan been evaluated? What permits or approvals are contemplated to be necessary from the National Park Service in order to implement the plan? Have discussions been undertaken with NPS or LTCP comments received from them?	Implementability
151	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	Will it be necessary to obtain easements from owners of property above the tunnels? If yes, who are the major property owners. What efforts have to be made to reach any needed agreements?	Implementability
152			CItizen			Neigh Mtg#2	Higher level of control - do not agree with cost/benefit	Level of Control
153	Eisenhardt	Julie	Sierra Club - Env. Justice Program	2568 Martin Luther King Jr. Ave, SE	Washington DC 20020	Written Comments	LTCP fails to reverse the old system of environmental injustice that has placed a disproportionate burden on the predominantly African-American communities on the East Side of DC. All DC waterways should achieve fishable/swimmable std	Level of Control
154	Collier	James R	DC Dept of Health	51 N St NE Suite 5010	Washington DC 20002	Written Comments	Anacostia & RC: 1 OF in wet year only; Potomac 12 OF/year is OK	Level of Control
155	Eisenhardt	Julie	Sierra Club - Env. Justice Program	2568 Martin Luther King Jr. Ave, SE	Washington DC 20020	Written Comments	Anacostia : should be as clean as Potomac	Level of Control
156	Wentworth	Marchant, and Robert Morris	Sierra Club	1726 St NW, Suite 902	Washington DC 20036	Written Comments	Anacostia: Endorse tunnels as laid out, Control to25 year storm, upgrade P.S., expand LID, water conservation in NEB	Level of Control
157	Connelly	Jim	Anacostia Watershed Society	4302 Baltimore Ave.	Bladensburg, MD 20710	DC Council Pub Hearing	Anacostia: Goal should be 0 overflows per year in Anacostia	Level of Control
158	Wentworth	Marchant	Sierra Club	1726 St NW, Suite 902	Washington DC 20036	DC Council Pub Hearing	Anacostia: Higher degree of control is recommended	Level of Control
159	Caposi	John	Citizen	1619 G St SE	Washington DC	WASA Pub Hearing	Anacostia: make Anacostia equal Potomac	Level of Control
160	Harris	Mitch	Citizen	828 Mountain Stream Lane	Lakemont GA 30552	Written Comments	Call for less pollution in general	Level of Control
161	New	Gregory R.	DC Federation of Civic Associations	P.O. Box 4549	Washington DC 20017	Written Comments	Come up with a plan that eliminates overflows	Level of Control
162	Dwyer	Stuart	Citizen	2113 N St NW #201	Washington DC 20037	Questionnaire	Consider downstream beneficiaries in cost/benefit analysis	Level of Control

No.	Last Name	First name	Affiliation	Address 1	Address 2	Forum	Comment	Category
163	Dwyer	Stuart	Citizen	2113 N St NW #201	Washington DC 20037	Questionnaire	Err on the side of more control	Level of Control
164	Whitehead	Damon	Anacostia Riverkeeper	1st & Potomac Avenue, SE	Washington, DC 20003	DC Council Pub Hearing	Higher level of control	Level of Control
165	Whitehead	Damon	Anacostia Riverkeeper	1st & Potomac Avenue, SE	Washington, DC 20003	WASA Pub Hearing	Higher level of control	Level of Control
166	Connelly	Jim	Anacostia Watershed Society	4302 Baltimore Ave.	Bladensburg, MD 20710	DC Council Pub Hearing	Higher level of control	Level of Control
167	Siglin	Douglas	Chesapeake Bay Foundation	717 E Street, NE	Washington, DC 20002	WASA Pub Hearing	Higher level of control	Level of Control
168	Armsby	Michelle	Citizen	#61 PO Box 18901	Rochester NY 14619	Written Comments	Higher level of control	Level of Control
169	Arner	Robert L.	Citizen	7209 Exfair Road	Bethesda MD 20815	Written Comments	Higher level of control	Level of Control
170	Bouri	S	Citizen			Written Comments	Higher level of control	Level of Control
171	Caposi	John	Citizen	1619 G St SE	Washington DC	WASA Pub Hearing	Higher level of control	Level of Control
172	Culp	David	CItizen	121 12th Street, SE #403	Washington, DC 20003	Neigh Mtg#3	Higher level of control	Level of Control
173	Culp	David	Citizen	121 12th Street, SE #403	Washington, DC 20003	WASA Pub Hearing	Higher level of control	Level of Control
174	Forsberg	Ken	Citizen	1809 Monroe St, NW	Washington DC 20010	Questionnaire	Higher level of control	Level of Control
175	Hamilton	Dawn, M.	Citizen	126 16th St SE	Washington DC	Written Comments	Higher level of control	Level of Control
176	Ho	Colisa	Citizen	7548 Clenmoor Lane	Winter Park, FL 32792	Written Comments	Higher level of control	Level of Control
177	Hurtt	Harold A	Citizen	640-B Croissant PL SE	Washington DC 20019	Questionnaire	Higher level of control	Level of Control
178	Lindley	George	Citizen	1444 Rhode Island Ave, NW, # 615	Washington DC 20007	Written Comments	Higher level of control	Level of Control
179	Mayock	Melanie	Citizen	501 Constitution Ave NE	Washington DC 20003	Written Comments	Higher level of control	Level of Control
180	McCuran	Elizabeth	Citizen	216 K St, NE	Washington DC 20003	Written Comments	Higher level of control	Level of Control
181	Mirsky	Jonathan, B.	Citizen	2321 Wisconsin Ave, NW #208	Washington DC 20008	Written Comments	Higher level of control	Level of Control
182	Mitchell	Jeanene	Citizen	3723 Winfield Lane NW	Washington DC 20007	Questionnaire	Higher level of control	Level of Control
183	Nagi	Suzanne	Citizen	4035 Highland Ct NW	Washington DC 20008	Written Comments	Higher level of control	Level of Control
184	Niswander	Ruth	Citizen	623 Barbera	Davis CA 95617	Written Comments	Higher level of control	Level of Control
185	Not Provided	Not Provided	Citizen	Not Provided	Not Provided	Questionnaire	Higher level of control	Level of Control
186	Robertson	Sean	Citizen	4540 MacArthur Blvd, NW Apt #81	Washington DC 20007	Written Comments	Higher level of control	Level of Control
187	Roepnack	Beth Rene	Citizen	213 Lansdowne Ave	Decatur, GA 30031	Written Comments	Higher level of control	Level of Control
188	Saidman	Amy	Citizen	1871 Engleside	Washington DC 20010	Written Comments	Higher level of control	Level of Control
189	Tyler	Joseph	Citizen	Georgetown University, Box 573145	Washington DC 20057	Written Comments	Higher level of control	Level of Control
190	Vogel	Mary	Citizen	3105 Crest Ave	Cheverly Md 20785	Questionnaire	Higher level of control	Level of Control

No.	Last Name	First name	Affiliation	Address 1	Address 2	Forum	Comment	Category
191	Wells	Jeffrey R.	Citizen	3730 Windom Place, NW	Washington DC 20006	Written Comments	Higher level of control	Level of Control
192			CItizen			Neigh Mtg#5	Higher level of control	Level of Control
193			Clean Water Campaign	NRDC 1200 New York Ave., NW	Washington DC 20005	Written Comments	Higher level of control	Level of Control
194	Norouzi	Parisa	D.C. Environmental Network	1025 Vermont Avenue NW 3rd Flr	Washington DC 20005	DC Council Pub Hearing	Higher level of control	Level of Control
195	Baron	David	Earthjustice	1625 Mass. Ave, NW Suite 702	Washington DC 20036	DC Council Pub Hearing	Higher level of control	Level of Control
196	Wentworth	Marchant	Sierra Club	1726 St NW, Suite 902	Washington DC 20036	WASA Pub Hearing	Higher level of control	Level of Control
197	Eisenhardt	Julie	Sierra Club - Env. Justice Program	2568 Martin Luther King Jr. Ave, SE	Washington DC 20020	Written Comments	Higher level of control	Level of Control
198	Niedzwieki	W.R. "Max"	Southeast Asia Resource Action Center	1628 16th St NW	Washington DC 20009	Written Comments	Higher level of control	Level of Control
199	Moore	K. Ruth Anderson	Citizen	4333 Yuma St NW	Washington DC 20016	Written Comments	Make things as clean as possible	Level of Control
200	Wentworth	Marchant, and Robert Morris	Sierra Club	1726 St NW, Suite 902	Washington DC 20036	Written Comments	Potomac - size Potomac Tunnels for the wettest year in 3-year period	Level of Control
201	Cole	Cynthia	Potomac Boat Club	3530 Water Street NW	Washington DC 20002	Written Comments	Potomac level of control is too low compared to Anacostia & Rock Creek	Level of Control
202	Webber	Elizabeth A.	Citizen	2320 Wisconsin Ave., NW, #201	Washington DC 20007	Written Comments	Potomac River is a recreational Resource and is used by many and its use is expanding,	Level of Control
203	Cole	Cynthia	Potomac Boat Club	3530 Water Street NW	Washington DC 20002	Written Comments	Potomac: Myth #1: Potomac is used only occassionally - it is highly used and its use is growing, examples cited	Level of Control
204	Cole	Cynthia	Potomac Boat Club	3530 Water Street NW	Washington DC 20002	Written Comments	Potomac: Myth #2:Existing uses do not entail direct contact between humans & water (describes spashing & risk of craft upset, Dogs exercise in River & pet owners touch dogs)	Level of Control
205	Cole	Cynthia	Potomac Boat Club	3530 Water Street NW	Washington DC 20002	Written Comments	Potomac: plan will have adverse impact on Potomac members?	Level of Control
206	Reusga	Albert	Citizen	1727 P St NW, Apt D	Washington DC 20036	Written Comments	Prefer to pay more, have a longer schedule and fix the problem entirely,	Level of Control
207	Niedzwieki	W.R. "Max"	Southeast Asia Resource Action Center	1628 16th St NW	Washington DC 20009	Written Comments	Prefer to pay more, have alonger schedule and fix the problem entirely	Level of Control
208	Amacker	Hilda	Citizen	1610 3rd St NW	Washington DC 20001	Written Comments	Recommendation - Advocates a permanent fix, no overflows	Level of Control
209	Lindley	George	Citizen	1444 Rhode Island Ave, NW, # 615	Washington DC 20005	Written Comments	Recommendation - Allow no overflows	Level of Control
210	Robertson	Sean	Citizen	4540 MacArthur Blvd, NW Apt #81	Washington DC 20007	Written Comments	Recommendation - Fix the problem completely, I am willing to pay more	Level of Control
211	Baron	David	Earthjustice	1625 Mass. Ave, NW Suite 702	Washington DC 20036	DC Council Pub Hearing	Recommendation - get closer to 0 overflows	Level of Control
212	Tyler	Joseph	Citizen	Georgetown University, Box 573145	Washington DC 20057	Written Comments	Recommendation - Highest degree of control possible without separation	Level of Control

No.	Last Name	First name	Affiliation	Address 1	Address 2	Forum	Comment	Category
213	Wentworth	Marchant	Sierra Club	1726 St NW, Suite 902	Washington DC 20036	WASA Pub Hearing	Recommendation - Support tunnels, but size for 0 overflows in wettest yr	Level of Control
214			CItizen			Neigh Mtg#4	Recommendation: Objection to continued CSO discharges under any conditions	Level of Control
215			CItizen			Neigh Mtg#4	Recommendation: zero discharges per average year	Level of Control
216	Siglin	Douglas	Chesapeake Bay Foundation	717 E Street, NE	Washington, DC 20002	WASA Pub Hearing	Support Collier's plan	Level of Control
217	Dwyer	Stuart	Citizen	2113 N St NW #201	Washington DC 20037	Questionnaire	Support LTCP as written	Level of Control
218	Gallucci	Jerry	Citizen	Westover PL, NW	Washington DC 20016	Written Comments	Support LTCP as written	Level of Control
219	Hackney	Lynn, & Kimberly Hoover	Citizen	1761 Church St NW	Washington DC 20036	Written Comments	Support LTCP as written	Level of Control
220	Not Provided	Not Provided	Citizen	Mt Pleasant	Washington DC	Questionnaire	Support LTCP as Written	Level of Control
221	Not Provided	Not Provided	Citizen	Not Provided	Not Provided	Questionnaire	Support LTCP as Written	Level of Control
222	Not Provided	Not Provided	Citizen	Not Provided	Not Provided	Questionnaire	Support LTCP as Written	Level of Control
223	Sesil	Joe	Citizen	3421 N St NW	Washington DC	Questionnaire	Support LTCP as written	Level of Control
224	Stiehler	Robert D.	Citizen	3234 Quesada St NW	Washington DC 20015	Questionnaire	Support LTCP as written	Level of Control
225	Wrin	Bob	Citizen	5509 Chevy Chase Pkwy, NW	Washington DC	Questionnaire	Support LTCP as written	Level of Control
226	Wrin	Bob	Citizen	5509 Chevy Chase Pkwy, NW	Washington DC	Questionnaire	Support LTCP as Written	Level of Control
227	Gallagher	Patricia, E.	National Capital Planning Commission	401 9th St NW, North Lobby, Suite 500	Washington DC 20576	Written Comments	Support LTCP as written	Level of Control
228	Baron	David	Earthjustice	1625 Mass. Ave, NW Suite 702	Washington DC 20036	DC Council Pub Hearing	This is an investment for the future, so cost is not the biggest consideration	Level of Control
229	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	To what extent can increasing the diameters of the Anacostia tunnels increase the percent capture and decrease the number of overflow events without significantly adding to the overall cost of the project?	Level of control
230	Mitchell	Jeanene	Citizen	3723 Winfield Lane NW	Washington DC 20007	Questionnaire	WASA should do all it can to reduce CSOs, even though it isn't the only polluter	Level of Control
231	Silverman	Larry and Robert Boone	Anacostia Watershed Society	4302 Baltimore Ave.	Bladensburg, MD 20710	WASA Pub Hearing	We are making decisions for 100yrs, so be bold and make it the right one	Level of Control
232			CItizen			Neigh Mtg#4	We should not spend all this money because we don't get a big WQ benefit	Level of Control

No.	Last Name	First name	Affiliation	Address 1	Address 2	Forum	Comment	Category
233	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	A more thorough proposal for LID options should be included in the LTCP. The plan should address the benefits and calculate reductions and water quality impacts for the application of LID throughout the entire District, not just the benefits related to WASA's facilities. A more complete explanation of program objectives and methods should be detailed, including coordination with stormwater management plans required by the MS-4 permit for the District. Specific mechanisms to implement District-wide LID should be identified (such as building codes, zoning ordinances, and permits) as well as institutional responsibilities. Also various levels of application for LID projects should be reviewed (such as new development, re-development, or retrofit of all development) to assess stormwater flow reduction.	LID/Source Control
234	Schwartz	Paul	Clean Water Action	4455 Connecticut Ave, NW, A-300	Washington, DC 20008	DC Council Pub Hearing	Bldg codes need to change to allow more LID	LID/Source Control
235			CItizen			Neigh Mtg#9	Build LID instead of tunnel	LID/Source Control
236	Schulman	Jim	Sustainable Community Initiatives	631 E St NE	Washington DC 20002	Written Comments	Do cost-benefit comparison of engineered to non-engineered solutions	LID/Source Control
237	Schulman	Jim	Sustainable Community Initiatives	631 E St NE	Washington DC 20002	Written Comments	Explore less capital intensive solutions like source reduction, bldg code improvements & public eductaion	LID/Source Control
238	Wentworth	Marchant, and Robert Morris	Sierra Club	1726 St NW, Suite 902	Washington DC 20036	Written Comments	Groundwater - Look at Federal groundwater pumpage	LID/Source Control
239			Clean Water Campaign	NRDC 1200 New York Ave., NW	Washington DC 20005	Written Comments	Groundwater - Reroute groundwater pumpage	LID/Source Control
240	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	Groundwater - Table 8-2 and 8-3 show significant groundwater flows from existing sources and orphan storm sewers, but does not propose to remove them from the system. What can be done to eliminate these flows from the system?	LID/Source Control
241	Hanrahan	Debra	DC Green Party	1505 Q Street, NW	Washington, DC	WASA Pub Hearing	Groundwater : Those pumping ground water should pay their fair share	LID/Source Control
242	Hanrahan	Debra	DC Green Party	1505 Q Street, NW	Washington, DC	WASA Pub Hearing	Groundwater: Groundwater pumpage is a concern	LID/Source Control
243	Baron	David	Earthjustice	1625 Mass. Ave, NW Suite 702	Washington DC 20036	Written Comments	I/I & Water Conservation - Inadequate I/I reduction program WASA's own studies show show there is 118 mgd of flow (WW flow reduction + Water Conservation)	LID/Source Control
244			CItizen			Neigh Mtg#4	I/I & Water Conservation - Incentives/water conservation should be a big part of program	LID/Source Control
245			Clean Water Campaign	NRDC 1200 New York Ave., NW	Washington DC 20005	Written Comments	I/I & Water Conservation - should be part of program	LID/Source Control
246	Deutsch	Barbara	Casey Trees	1800 K St NW, Suite 622	Washington DC 20002	WASA Pub Hearing	Increase funding for LID	LID/Source Control
247	Wentworth	Marchant, and Robert Morris	Sierra Club	1726 St NW, Suite 902	Washington DC 20036	Written Comments	Increase funding for LID	LID/Source Control

No.	Last Name	First name	Affiliation	Address 1	Address 2	Forum	Comment	Category
248			Clean Water Campaign	NRDC 1200 New York Ave., NW	Washington DC 20005	Written Comments	LID: overstates cost, understates effectiveness, $3 mill is inadequate	LID/Source Control
249			CItizen			Neigh Mtg#8	Look at more BMPs to treat storm water	LID/Source Control
250			Clean Water Campaign	NRDC 1200 New York Ave., NW	Washington DC 20005	Written Comments	Look at Water conservation, roof leader disconnection, storm water reuse, green roofs, urban forest	LID/Source Control
251	Not Provided	Not Provided	Citizen	Not Provided	Not Provided	Questionnaire	Low impact development alternatives have not been given a fair evaluation	LID/Source Control
252	Vogel	Mary	Citizen	3105 Crest Ave	Cheverly Md 20785	Questionnaire	Low impact development could achieve CSO reduction and beautify/ ecologically help City	LID/Source Control
253	Wentworth	Marchant, and Robert Morris	Sierra Club	1726 St NW, Suite 902	Washington DC 20036	Written Comments	Mandate LID/waterconservation in Rock Creek for Montgomery County, set enforceable bacteria milestones	LID/Source Control
254	Abrams	Alan	Citizen	808 Aspen St NW	Washington DC 20013	Written Comments	More emphasis on non-engineered solution	LID/Source Control
255	Armsby	Michelle	Citizen	#61 PO Box 18901	Rochester NY 14619	Written Comments	More emphasis on non-engineered solution	LID/Source Control
256	Chanay	Robin D	CItizen	503 S St NW	Washington DC 20001	WASA Pub Hearing	More emphasis on non-engineered solution	LID/Source Control
257	Chanay	Robin D	CItizen	503 S St NW	Washington DC 20001	Written Comments	More emphasis on non-engineered solution	LID/Source Control
258	Hamilton	Dawn, M.	Citizen	126 16th St SE	Washington DC	Written Comments	More emphasis on non-engineered solution	LID/Source Control
259	Ho	Colisa	Citizen	7548 Clenmoor Lane	Winter Park, FL 32792	Written Comments	More emphasis on non-engineered solution	LID/Source Control
260	Mayock	Melanie	Citizen	501 Constitution Ave NE	Washington DC 20003	Written Comments	More emphasis on non-engineered solution	LID/Source Control
261	McCuran	Elizabeth	Citizen	216 K St, NE	Washington DC 20003	Written Comments	More emphasis on non-engineered solution	LID/Source Control
262	Mirsky	Jonathan, B.	Citizen	2321 Wisconsin Ave, NW #208	Washington DC 20008	Written Comments	More emphasis on non-engineered solution	LID/Source Control
263	Nagi	Suzanne	Citizen	4035 Highland Ct NW	Washington DC 20008	Written Comments	More emphasis on non-engineered solution	LID/Source Control
264	Nagi	Suzanne	Citizen	4035 Highland Ct NW	Washington DC 20008	Written Comments	More emphasis on non-engineered solution	LID/Source Control
265	Niswander	Ruth	Citizen	623 Barbera	Davis CA 95617	Written Comments	More emphasis on non-engineered solution	LID/Source Control
266	Saidman	Amy	Citizen	1871 Engleside	Washington DC 20010	Written Comments	More emphasis on non-engineered solution	LID/Source Control
267	Fellows	Andrew, and Paul Schwartz	Clean Water Action	4455 Connecticut Ave, NW, A-300	Washington, DC 20008	WASA Pub Hearing	More emphasis on non-engineered solution	LID/Source Control
268	Woodworth	James	Clean Water Campaign	NRDC 1200 New York Ave., NW	Washington DC 20005	DC Council Pub Hearing	More emphasis on non-engineered solution	LID/Source Control
269			Clean Water Campaign	NRDC 1200 New York Ave., NW	Washington DC 20005	Written Comments	More emphasis on non-engineered solution	LID/Source Control
270	Norouzi	Parisa	D.C. Environmental Network	1025 Vermont Avenue NW 3rd Flr	Washington DC 20005	DC Council Pub Hearing	More emphasis on non-engineered solution	LID/Source Control
271	Blackwelder	Brent	Friends of the Earth	1025 Vermont Avenue, NW	Washington, DC 20005	WASA Pub Hearing	More emphasis on non-engineered solution	LID/Source Control
272	Wentworth	Marchant	Sierra Club	1727 St NW, Suite 902	Washington DC 20037	WASA Pub Hearing	More emphasis on non-engineered solution	LID/Source Control

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273	Siglin	Douglas	Chesapeake Bay Foundation	717 E Street, NE	Washington, DC 20002	WASA Pub Hearing	More LID	LID/Source Control
274	Morris	Bob	Sierra Club	413 5th Street, NE	Washington, DC 20002	WASA Pub Hearing	More LID	LID/Source Control
275			CItizen			Neigh Mtg#4	Public education should be part of program	LID/Source Control
276	Schulman	Jim	Sustainable Community Initiatives	631 E St NE	Washington DC 20002	Written Comments	Rate Structure - Consider fee-incentives such as property tax credits to promote source reduction of storm water	LID/Source Control
277			CItizen			Neigh Mtg#10	Rate Structure - Consider incentives in water/sewer rates to encourage LID	LID/Source Control
278	Connelly	Jim	Anacostia Watershed Society	4302 Baltimore Ave.	Bladensburg, MD 20710	DC Council Pub Hearing	Rate structure - Plan should creat incentives for LID (City Council should do it)	LID/Source Control
279	Fellows	Andrew, and Paul Schwartz	Clean Water Action	4455 Connecticut Ave, NW, A-300	Washington, DC 20008	WASA Pub Hearing	Support an integrated planning process e.g. street sweeping, eduction, water cons., grey water, etc	LID/Source Control
280	Hurtt	Harold A	Citizen	640-B Croissant PL SE	Washington DC 20019	Questionnaire	Supports LID	LID/Source Control
281	Blackwelder	Brent	Friends of the Earth	1025 Vermont Avenue, NW	Washington, DC 20005	WASA Pub Hearing	Supports source control (Wat. conserv., street sweeping, tree planting, LID, water reuse	LID/Source Control
282	Hogan	Sheila	Casey Trees	1800 K St NW, Suite 622	Washington DC 20002	Written Comments	Trees - DC has experienced a 64% decrease in tree cover since 1973 and a resulting 34% increase in storm water	LID/Source Control
283	Hogan	Sheila	Casey Trees	1800 K St NW, Suite 622	Washington DC 20002	Written Comments	Trees - If tree cover were restored to 1970 levels, could reduce storm water runoff by 826 mg/yr	LID/Source Control
284	Hogan	Sheila	Casey Trees	1800 K St NW, Suite 622	Washington DC 20002	Written Comments	Trees - LTCP has not adequately addressed tree loss & using it to control CSO	LID/Source Control
285	Deutsch	Barbara	Casey Trees	1800 K St NW, Suite 622	Washington DC 20002	WASA Pub Hearing	Trees - Make trees a critical component of LID	LID/Source Control
286	Forsberg	Ken	Citizen	1809 Monroe St, NW	Washington DC 20036	Written Comments	Consider effects of global warming on long term rain intensity/patterns	Misc
287	Silverman	Larry and Robert Boone	Anacostia Watershed Society	4302 Baltimore Ave.	Bladensburg, MD 20710	WASA Pub Hearing	Demonstrate year by year improvements	Misc
288	Wentworth	Marchant, and Robert Morris	Sierra Club	1726 St NW, Suite 902	Washington DC 20036	Written Comments	Devise system to track & respond to Environmental complaints	Misc
289	Reusga	Albert	Citizen	1727 P St NW, Apt D	Washington DC 20036	Written Comments	Do not do anything unless other polluters do their share	Misc
290	Fellows	Andrew, and Paul Schwartz	Clean Water Action	4455 Connecticut Ave, NW, A-300	Washington, DC 20008	WASA Pub Hearing	Health effects - Continued CSOs are a health risk due to fish consumption	Misc
291	Whitehead	Damon	Anacostia Riverkeeper	1st & Potomac Avenue, SE	Washington, DC 20003	DC Council Pub Hearing	Health Effects - fails to recognize health effects	Misc
292	Sesil	Joe	Citizen	3421 N St NW	Washington DC	Questionnaire	Keep recording notice of violations	Misc
293	DeGroot	Allison	Citizen		Washington, DC	WASA Pub Hearing	No comments	Misc
294	Wentworth	Marchant	Sierra Club	1726 St NW, Suite 902	Washington DC 20036	WASA Pub Hearing	Public notification - add system in short term	Misc
295	Wentworth	Marchant, and Robert Morris	Sierra Club	1726 St NW, Suite 902	Washington DC 20036	Written Comments	Public notification - Given long implementation time, take steps to advise people of CSOs (examples given)	Misc

No.	Last Name	First name	Affiliation	Address 1	Address 2	Forum	Comment	Category
296	Baron	David	Earthjustice	1625 Mass. Ave, NW Suite 702	Washington DC 20036	Written Comments	Public Notification - Visual notification system should have schedule in LTCP & be installed in 12 mos	Misc
297			Clean Water Campaign	NRDC 1200 New York Ave., NW	Washington DC 20005	Written Comments	Public notification - WASA must have immediate public notification system	Misc
298	Woodworth	James	Clean Water Campaign	NRDC 1200 New York Ave., NW	Washington DC 20005	WASA Pub Hearing	Same as written comments	Misc
299	Baron	David	Earthjustice	1625 Mass. Ave, NW Suite 702	Washington DC 20036	WASA Pub Hearing	Same as written comments	Misc
300	Schulman	Jim	Sustainable Community Initiatives	631 E St NE	Washington DC 20002	WASA Pub Hearing	Same as written testimony	Misc
301	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	The statement, "In March 2001 the DOH released its first TMDL for the impaired waterbody." is incorrect. The first TMDL was issued on January 12, 1999. The Anacostia BOD TMDL is the second.	Misc
302	Mack	Geterrius	Citizen	1430 L St SE, #509	Washington DC 20003	Written Comments	This affects our water supplies	Misc
303	Bobreski	Jim	Citizen			DC Council Pub Hearing	WASA is not forthcoming to public	Misc
304	Battle	C.A.	Citizen	5503 13th St NW	Washington DC 20011	Written Comments	Will the plan be implemented correctly	Misc
305	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	The LTCP should more fully describe WASA's efforts to date, and plans to implement each of the NMCs. Since the overflow volume to be addressed by the LTCP can be reduced by maximizing NMC effectiveness, it is important that current NMC information be reported. Although a NMC Summary Report was complete in July 1999 and NMC Action Plan Report in February 2000, the plan should include up-to-date NMC efforts and a current schedule for full implementation of NMCs. What near-term plans are there for trash and floatables control? Could any portions of the recommended Plan be reduced in size or eliminated through full implementation of the Nine Minimum Controls? Also what real-time enhancements to the overflow event warning system are planned to satisfy public notification requirements?	NMC
306			Clean Water Campaign	NRDC 1200 New York Ave., NW	Washington DC 20005	Written Comments	WASA must fully implement NMCs	NMC
307	Schulman	Jim	Sustainable Community Initiatives	631 E St NE	Washington DC 20002	Written Comments	Consider larger public involvement to bring in fresh perspectives & foster publci-private partnerships	Public Participation
308	Norouzi	Parisa	D.C. Environmental Network	1025 Vermont Avenue NW 3rd Flr	Washington DC 20005	DC Council Pub Hearing	Inadequate citizen attendance at public meetings (only 50)	Public Participation
309	Fellows	Andrew, and Paul Schwartz	Clean Water Action	4455 Connecticut Ave, NW, A-300	Washington, DC 20008	WASA Pub Hearing	Need better public involvement process that includes all the players	Public Participation
310	Sanders	Serita	Bloomingdale Civic Assoc	P.O. Box 92691	Washington, DC 20090	WASA Pub Hearing	Need better public participation	Public Participation

No.	Last Name	First name	Affiliation	Address 1	Address 2	Forum	Comment	Category
311	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	Section 10.7 should be expanded to include the process and preparation of Public Responsiveness Document and how it will be distributed through WASA's website and other means. Also explain how later versions of the LTCP will include additional information on the public participation process.	Public Participation
312	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	What steps have been taken to ensure that public participation has effectively reached minority and low income populations?	Public Participation
313	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	What steps have been taken to evaluate the potential for disproportionately high and adverse human health or environmental effects on minority and low-income populations? What steps have been taken to avoid any such impacts?	Public Participation
314	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	A more detailed discussion of sensitive areas to include each of the three receiving waterbodies is required. Presently, the LTCP only addresses the Rock Creek and does not explain how the Hay's Spring Amphipod will be protected by implementing CSO controls. A discussion of the actual impacts of CSOs and LTCP related construction on each species (and mitigation efforts) is necessary. The Short Nosed Sturgeon has not been included in any discussion of sensitive areas for the Potomac. Since this endangered species has been known to reside in Potomac waters, it should be addressed in the plan along with the other threatened and/or endangered species.	Regulatory
315	Baron	David	Earthjustice	1625 Mass. Ave, NW Suite 702	Washington DC 20036	Written Comments	Anacostia, Pot. & RC are all sensitive areas and must be treated as such per CSO Policy	Regulatory
316	Baron	David	Earthjustice	1625 Mass. Ave, NW Suite 702	Washington DC 20036	Written Comments	Expansion - CSO controls cannot be expanded as required by CSO Policy	Regulatory
317	Dwyer	Stuart	Citizen	2113 N St NW #201	Washington DC 20037	Questionnaire	Expansion - Make sure system can be upgraded in future	Regulatory
318	Baron	David	Earthjustice	1625 Mass. Ave, NW Suite 702	Washington DC 20036	Written Comments	LTCP should project water quality impacts of CSOs under "all potential weather conditions", not just average year.	Regulatory
319	Whitehead	Damon	Anacostia Riverkeeper	1st & Potomac Avenue, SE	Washington, DC 20003	WASA Pub Hearing	LTCP violates Chesapeake Bay Agreement and 2001 Watershed Restoration Agreement	Regulatory
320	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	Monitoring - More detail about the Post Construction monitoring plan development should be included in the LTCP along with a schedule for plan development. A monitoring program (to include Post Construction monitoring) is expected during and after LTCP implementation to determine the effectiveness of the overall program using monitoring conducted during LTCP development as a baseline.	Regulatory
321	Baron	David	Earthjustice	1625 Mass. Ave, NW Suite 702	Washington DC 20036	Written Comments	Monitoring - Post-construction monitoring program has inadequate detail and no schedule per CSO Policy	Regulatory
322			CItizen			Neigh Mtg#4	Can the plan be implemented faster?	Schedule
323	Schulman	Jim	Sustainable Community Initiatives	631 E St NE	Washington DC 20002	Questionnaire	DC should be given more time to develop less of a "middle of the pipe" solution	Schedule

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324	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	EPA notes that the project schedule identifies the start of design for the Rock Creek and Potomac tunnels in years 10 and 13. We agree that the initial emphasis should be on the Anacostia elements. We further suggest that the proposed Rock Creek and Potomac tunnels be re-evaluated when the Anacostia tunnel (Poplar Point to NE Boundary Outfall) is completed, as part of the Anacostia post-construction monitoring plan.	Schedule
325	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	For each major project component, describe implementation schedule constraints that prevent nearer-term completion.	Schedule
326	Cole	Cynthia	Potomac Boat Club	3530 Water Street NW	Washington DC 20002	Written Comments	Misconception that plan will take 30 years to build	Schedule
327	Connelly	Jim	Anacostia Watershed Society	4302 Baltimore Ave.	Bladensburg, MD 20710	DC Council Pub Hearing	Plan does not adequately address trash - too long to wait for tunnels	Schedule
328	Baron	David	Earthjustice	1625 Mass. Ave, NW Suite 702	Washington DC 20036	Written Comments	Plan does not have fixed date schedules per CSO Policy and 20-yr time frame is not justified	Schedule
329	Cole	Cynthia	Potomac Boat Club	3530 Water Street NW	Washington DC 20002	Written Comments	Potomac is pushed out too far in schedule	Schedule
330	Whitehead	Damon	Anacostia Riverkeeper	1st & Potomac Avenue, SE	Washington, DC 20003	DC Council Pub Hearing	Shorter schedule	Schedule
331	Whitehead	Damon	Anacostia Riverkeeper	1st & Potomac Avenue, SE	Washington, DC 20003	WASA Pub Hearing	Shorter schedule	Schedule
332	Connelly	Jim	Anacostia Watershed Society	4302 Baltimore Ave.	Bladensburg, MD 20710	DC Council Pub Hearing	Shorter schedule	Schedule
333	Arner	Robert L.	Citizen	7209 Exfair Road	Bethesda MD 20815	Written Comments	Shorter schedule	Schedule
334	Caposi	John	Citizen	1619 G St SE	Washington DC	WASA Pub Hearing	Shorter schedule	Schedule
335	Hamilton	Dawn, M.	Citizen	126 16th St SE	Washington DC	Written Comments	Shorter schedule	Schedule
336	Woodworth	James	Clean Water Campaign	NRDC 1200 New York Ave., NW	Washington DC 20005	DC Council Pub Hearing	Shorter schedule	Schedule
337			Clean Water Campaign	NRDC 1200 New York Ave., NW	Washington DC 20005	Written Comments	Shorter schedule	Schedule
338	Norouzi	Parisa	D.C. Environmental Network	1025 Vermont Avenue NW 3rd Flr	Washington DC 20005	DC Council Pub Hearing	Shorter schedule	Schedule
339	Blackwelder	Brent	Friends of the Earth	1025 Vermont Avenue, NW	Washington, DC 20005	WASA Pub Hearing	Shorter schedule	Schedule
340	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	The draft plan identifies early action items that are not dependent on LTCP approval. A summary action plan should be prepared and submitted to implement the early action items.	Schedule
341	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	The schedule should include a projection of the incremental progress in terms of increase in percent capture (1 or 2 year increments suggested) throughout the course of the proposed schedule.	Schedule
342	Woodworth	James	Clean Water Campaign	NRDC 1200 New York Ave., NW	Washington DC 20005	DC Council Pub Hearing	Things should be done immediately - trash control, better O & M, LID, wat conserv	Schedule
343	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	Will the first 2 segments of the Anacostia tunnel project be independently operational in terms of providing useable storage and transmission immediately upon completion of construction?	Schedule

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344	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	Quantify, to the extent that currently available information allows, the toxic pollution control benefits of the recommended plan. Provide an estimate of toxics that will be captured and treated at Blue Plains WWTP that would otherwise be discharged if sewers are separated.	Toxics
345	Chanay	Robin D	CItizen	503 S St NW	Washington DC 20001	Written Comments	Chicago & Milwaukee - Milwaukee tunnels leak, Chicago tunnels are undersized	Tunnel
346	Whitehead	Damon	Anacostia Riverkeeper	1st & Potomac Avenue, SE	Washington, DC 20003	WASA Pub Hearing	Chicago & Milwaukee - WASA did not look at other tunnels that failed (Chicago, Milwaukee)	Tunnel
347	Chanay	Robin D	CItizen	503 S St NW	Washington DC 20001	DC Council Pub Hearing	Chicago & Milwaukee have problems w/their tunnels	Tunnel
348	Chanay	Robin D	CItizen	503 S St NW	Washington DC 20001	WASA Pub Hearing	Chicago & Milwaukee have problems w/their tunnels	Tunnel
349			CItizen			Neigh Mtg#6	Concern about hauling tunnel spoil and traffic messes at Georgetown	Tunnel
350	Cole	Cynthia	Potomac Boat Club	3530 Water Street NW	Washington DC 20002	Written Comments	Concern about lack of details regarding tunnel (where will muck be removed, disturbance of existing structures,	Tunnel
351			CItizen			Neigh Mtg#6	Concern about odors in the tunnel	Tunnel
352			CItizen			Neigh Mtg#8	Concern about tunnel leaking, contaminating groundwater, collapsing	Tunnel
353			CItizen			Neigh Mtg#8	Concern regarding interruption of sewer service and disruption associated with Plan	Tunnel
354	Webber	Elizabeth A.	Citizen	2320 Wisconsin Ave., NW, #201	Washington DC 20007	Written Comments	Construction will adversely affect existing structures (Key Bridge, canal, etc due to shaking, etc	Tunnel
355	Gerhart	James M.	U.S. Geological Survey	8987 Yellow Brick Road	Baltimore MD 21237	Written Comments	Describe hydraulic properties of geologic media (ability to transmit groundwater to tunnels)	Tunnel
356	Gerhart	James M.	U.S. Geological Survey	8987 Yellow Brick Road	Baltimore MD 21237	Written Comments	Determine interaction of groundwater with surface waters	Tunnel
357	Slowenski	Kent	Citizen	NA	NA	WASA Pub Hearing	How will odors be controlled when tunnels fill and empty	Tunnel
358	Slowenski	Kent	Citizen	NA	NA	WASA Pub Hearing	How will WASA maintain tunnels	Tunnel
359	Gerhart	James M.	U.S. Geological Survey	8987 Yellow Brick Road	Baltimore MD 21237	Written Comments	Investigate & describe hydrogeologic framwork (geology)	Tunnel
360			CItizen			Neigh Mtg#2	Metro caused shifting soils. What are you going to do to prevent this	Tunnel
361	Gerhart	James M.	U.S. Geological Survey	8987 Yellow Brick Road	Baltimore MD 21237	Written Comments	Perform groundwater flow system analysis prior to designing tunnel	Tunnel
362	Connelly	Jim	Anacostia Watershed Society	4302 Baltimore Ave.	Bladensburg, MD 20710	DC Council Pub Hearing	Storage tunnels good first step	Tunnel
363	Gerhart	James M.	U.S. Geological Survey	8987 Yellow Brick Road	Baltimore MD 21237	Written Comments	Study groundwater quality conditions & evaluate effect of tuinnels on ground water and surface water quality	Tunnel
364	Gerhart	James M.	U.S. Geological Survey	8987 Yellow Brick Road	Baltimore MD 21237	Written Comments	Understand inflows & outflows of groundwater sysetm	Tunnel
365	Webber	Elizabeth A.	Citizen	2320 Wisconsin Ave., NW, #201	Washington DC 20007	Written Comments	Where will tunnel muck be removed, won't it cause a disruption?	Tunnel

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366	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	The recommended plan for the Rock Creek requires monitoring regulators for overflows. Connection of the Rock Creek Interceptor to the Potomac Tunnel may be required as a result. Is the Potomac Tunnel being sized to accept the RC Interceptor flows initially?	Tunnels
367	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	What additional solids handling facilities will be included in the tunnel system and at Blue Plains to handle increased flows?	Tunnels
368	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	What cost estimation data was used to develop cost estimates for installation of the proposed tunnels in DC? What is WASA's level of confidence in the cost estimates for the tunnels?	Tunnels
369	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	What degree of confidence does WASA have that the tunnel sizing will be adequate to limit overflow events and avoid a situation such as that being experienced in Milwaukee where tunnels must be expanded due to continued CSO overflows and system backups. Has WASA reviewed installation of tunnels in other cities and evaluated their problems and successes?	Tunnels
370	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	What measures will be taken in tunnel design & construction to monitor and control infiltration and exfiltration in the underground tunnels?	Tunnels
371	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	What preliminary geologic and hydrogeologic investigation has been done to determine feasibility and potential siting of underground storage tunnels?	Tunnels
372	Whitehead	Damon	Anacostia Riverkeeper	1st & Potomac Avenue, SE	Washington, DC 20003	WASA Pub Hearing	Changing WQS & the proposed LTCP would ban swimming in perpetuity	WQS
373	Cole	Cynthia	Potomac Boat Club	3530 Water Street NW	Washington DC 20002	Written Comments	Concern about changing WQS	WQS
374	Culp	David	CItizen	121 12th Street, SE #403	Washington, DC 20003	Neigh Mtg#3	Don't change WQS	WQS
375	Schulman	Jim	Sustainable Community Initiatives	631 E St NE	Washington DC 20002	Questionnaire	Don't change WQS	WQS
376	Whitehead	Damon	Anacostia Riverkeeper	1st & Potomac Avenue, SE	Washington, DC 20003	DC Council Pub Hearing	Don't change WQS	WQS
377	Whitehead	Damon	Anacostia Riverkeeper	1st & Potomac Avenue, SE	Washington, DC 20003	WASA Pub Hearing	Don't change WQS	WQS
378	Silverman	Larry and Robert Boone	Anacostia Watershed Society	4302 Baltimore Ave.	Bladensburg, MD 20710	WASA Pub Hearing	Don't change WQS	WQS
379	Tibbetts	David, A.	Anacostia Watershed Society Treasurer	4302 Baltimore Ave.	Bladensburg, MD 20710	Written Comments	Don't change WQS	WQS
380	Armsby	Michelle	Citizen	#61 PO Box 18900	Rochester NY 14618	Written Comments	Don't change WQS	WQS
381	Culp	David	Citizen	121 12th Street, SE #403	Washington, DC 20003	WASA Pub Hearing	Don't change WQS	WQS
382	Forsberg	Ken	Citizen	1809 Monroe St, NW	Washington DC 20010	Questionnaire	Don't change WQS	WQS
383	Ho	Colisa	Citizen	7548 Clenmoor Lane	Winter Park, FL 32792	Written Comments	Don't change WQS	WQS

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384	Hurtt	Harold A	Citizen	640-B Croissant PL SE	Washington DC 20019	Questionnaire	Don't change WQS	WQS
385	Mack	Geterrius	Citizen	1430 L St SE, #509	Washington DC 20003	Written Comments	Don't change WQS	WQS
386	Mayock	Melanie	Citizen	501 Constitution Ave NE	Washington DC 20003	Written Comments	Don't change WQS	WQS
387	McCuran	Elizabeth	Citizen	216 K St, NE	Washington DC 20003	Written Comments	Don't change WQS	WQS
388	Mitchell	Jeanene	Citizen	3723 Winfield Lane NW	Washington DC 20007	Questionnaire	Don't change WQS	WQS
389	Morgan	James	Citizen	4618 Bass Pl., SE	Washington DC	Questionnaire	Don't change WQS	WQS
390	Nagi	Suzanne	Citizen	4035 Highland Ct NW	Washington DC 20008	Written Comments	Don't change WQS	WQS
391	Niswander	Ruth	Citizen	623 Barbera	Davis CA 95617	Written Comments	Don't change WQS	WQS
392	Not Provided	Not Provided	Citizen	Not Provided	Not Provided	Questionnaire	Don't change WQS	WQS
393	Not Provided	Not Provided	Citizen	Not Provided	Not Provided	Questionnaire	Don't change WQS	WQS
394	Saidman	Amy	Citizen	1871 Engleside	Washington DC 20010	Written Comments	Don't change WQS	WQS
395	Sesil	Joe	Citizen	3421 N St NW	Washington DC	Questionnaire	Don't change WQS	WQS
396	Tyler	Joseph	Citizen	Georgetown University, Box 573145	Washington DC 20057	Written Comments	Don't change WQS	WQS
397	Vogel	Mary	Citizen	3105 Crest Ave	Cheverly Md 20785	Questionnaire	Don't change WQS	WQS
398	Wells	Jeffrey R.	Citizen	3730 Windom Place, NW	Washington DC 20006	Written Comments	Don't change WQS	WQS
399	Fellows	Andrew, and Paul Schwartz	Clean Water Action	4455 Connecticut Ave, NW, A-300	Washington, DC 20008	WASA Pub Hearing	Don't change WQS	WQS
400	Woodworth	James	Clean Water Campaign	NRDC 1200 New York Ave., NW	Washington DC 20005	DC Council Pub Hearing	Don't change WQS	WQS
401			Clean Water Campaign	NRDC 1200 New York Ave., NW	Washington DC 20005	Written Comments	Don't change WQS	WQS
402	Norouzi	Parisa	D.C. Environmental Network	1025 Vermont Avenue NW 3rd Flr	Washington DC 20005	DC Council Pub Hearing	Don't change WQS	WQS
403	New	Gregory R.	DC Federation of Civic Associations	P.O. Box 4549	Washington DC 20017	Written Comments	Don't change WQS	WQS
404	Baron	David	Earthjustice	1625 Mass. Ave, NW Suite 702	Washington DC 20036	DC Council Pub Hearing	Don't change WQS	WQS
405	Blackwelder	Brent	Friends of the Earth	1025 Vermont Avenue, NW	Washington, DC 20005	WASA Pub Hearing	Don't change WQS	WQS
406	Eisenhardt	Julie	Sierra Club - Env. Justice Program	2568 Martin Luther King Jr. Ave, SE	Washington DC 20020	Written Comments	Don't Change WQS	WQS
407	Schulman	Jim	Sustainable Community Initiatives	631 E St NE	Washington DC 20002	Written Comments	Don't Change WQS	WQS
408	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	How would implementation of the WQS currently proposed by DOH affect the plan?	WQS

No.	Last Name	First name	Affiliation	Address 1	Address 2	Forum	Comment	Category
409	Miller	Emily	Citizen	4109 12th St, NE	Washington DC 20017	Written Comments	Potable water is unsanitary, need higher WQS to have safe drinking water	WQS
410	Baron	David	Earthjustice	1625 Mass. Ave, NW Suite 702	Washington DC 20036	Written Comments	Primary contact & secondary contact are existing uses. WQS cannot legally be changed to interfere with existing uses.	WQS
411	Dwyer	Stuart	Citizen	2113 N St NW #201	Washington DC 20037	Questionnaire	Supports changing WQS	WQS
412	Not Provided	Not Provided	Citizen	Mt Pleasant	Washington DC	Questionnaire	Supports changing WQS	WQS
413	Not Provided	Not Provided	Citizen	Not Provided	Not Provided	Questionnaire	Supports changing WQS	WQS
414	Not Provided	Not Provided	Citizen	Not Provided	Not Provided	Questionnaire	Supports changing WQS	WQS
415	Wrin	Bob	Citizen	5509 Chevy Chase Pkwy, NW	Washington DC	Questionnaire	Supports changing WQS	WQS
416	Not Provided	Not Provided	Citizen	Not Provided	Not Provided	Questionnaire	Supports changing WQS - Some kind of recognition in water quality standards that allows a few overflows is OK	WQS
417	Whitehead	Damon	Anacostia Riverkeeper	1st & Potomac Avenue, SE	Washington, DC 20003	WASA Pub Hearing	WASA could seek a variance from the WQS - they don't need to change them	WQS
418	Fitzpatrick	Neil	Audubon Naturalist Society	8940 Jones Mill Road	Chevy Chase, MD 20815	WASA Pub Hearing	WASA worked backwards - adjusted WQS to fit plan and did not try to meet stds	WQS
419	Whitehead	Damon	Anacostia Riverkeeper	1st & Potomac Avenue, SE	Washington, DC 20003	WASA Pub Hearing	WASA worked backwards - WASA did not start off with a goal of achieving WQS	WQS
420	Altman	Andrew	Office of Planning	801 N. Capitol St, NE Ste 4000	Washington, DC 20002	Written Comments	Consider collaborative efforts in public education, orphaned storm sewers, stomr water retention, LID	Alternatives
421	Altman	Andrew	Office of Planning	801 N. Capitol St, NE Ste 4000	Washington, DC 20002	Written Comments	Support relocation of Main & O P.S., retain as option	Alternatives
422	Altman	Andrew	Office of Planning	801 N. Capitol St, NE Ste 4000	Washington, DC 20002	Written Comments	Coordinate surface construction with Office of Planning, possibly integrate parks into designs	Alternatives
423	Wolflin	John P.	U.S. Fish & Wildlife Service	177 Admiral Cochrane Drive	Annapolis MD 21401	Written Comments	Implementation of Draft LTCP will have no adverse effects on Endangered Speciaes and may be beneficial to them	Misc
424	Robinson	Carole	Arlington Boathouse Foundation, Inc.	177 Admiral Cochrane Drive	Annapolis MD 21401	Written Comments	Potomac level of control is too low - design plan to virtually eliminate risk of overflows	Level of Control
425	Curtis	Doug	National Park Service - Rock Creek Park	N/A	N/A	Written Comments	Piney Branch Tunnel - Want more details on construction methods, access locations, construction impacts to park, etc	Tunnel
426	Curtis	Doug	National Park Service - Rock Creek Park	N/A	N/A	Written Comments	Piney Branch Tunnel - Were other alignments considered?, what is impact on groundwater?, could LID decrease the size of proposed facilities	Tunnel
427	Wynkocp, Jr	Samuel E.	Prince George's County	Inglewood Center Three, 9400 Peppercorn Place	Largo MD 20774	Written Comments	Concern about LTCP taking up Blue Plains capacity	Blue Plains
428	Wynkocp, Jr	Samuel E.	Prince George's County	Inglewood Center Three, 9400 Peppercorn Place	Largo MD 20775	Written Comments	Remove references to upstream contributors being a significant source of watershed impairment	Misc

No.	Last Name	First name	Affiliation	Address 1	Address 2	Forum	Comment	Category
429	Wynkocp, Jr	Samuel E.	Prince George's County	Inglewood Center Three, 9400 Peppercorn Place	Largo MD 20776	Written Comments	What will be the effect of dewatering tunnels on Blue Plains, performance, O & M costs, etc	Blue Plains
430	Wynkocp, Jr	Samuel E.	Prince George's County	Inglewood Center Three, 9400 Peppercorn Place	Largo MD 20776	Written Comments	Questions use of IMA numbers for District given that District is above IMA allocation	Blue Plains
431	Wynkocp, Jr	Samuel E.	Prince George's County	Inglewood Center Three, 9400 Peppercorn Place	Largo MD 20776	Written Comments	Consider opportunities for partnership with Federal ISTEA program, EPA 319 grants and others	Misc
432	Wynkocp, Jr	Samuel E.	Prince George's County	Inglewood Center Three, 9400 Peppercorn Place	Largo MD 20776	Written Comments	LID 0.5" assumption wrong, costs too high, did not consider timing, funding of LID wrong, time too long, maintenance costs are lower, ecommends an LID demonstration project	LID/Source Control
433	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	It is unclear how benefits from LTCP implementation will translate to protection of designated and existing uses. How severe a storm will have to be to trigger overflows, and what the resultant water quality impacts will be (assuming of course that other point sources and NPS are controlled as envisioned in the BOD TMDL). 1. What magnitude storm [5 (or whatever) year storm, defined as so many inches per hour, for a given amount of time, spread over a defined area] will cause overflows to the Anacostia (post implementation of the draft LTCP)? How severe would a storm have to be to result in sufficient overflows to exceed numeric water quality criteria? How much of a CSO load would it take to cause such an exceedance? 2. How many days of water body use, if any, do the models suggest would be lost in an average year to such exceedances (post implementation of the draft LTCP)?3. Please repeat the above for the LTCP scenario suggested by DOH, in which there would be no overflows to the Anacostia in an average year.	Level of Control
434	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	The LTCP should describe how much money will be needed to fund individual control plan elements based on the project schedule (Figure 12-4). Identify work that already has funding available (especially for the "early action items"). Identify work on an approved CIP, and explain the significance of being included on the CIP (does that mean that funds are committed?).	Financial Impacts
435	Hanmer	Rebecca	EPA Reg 3	1650 Arch Street	Philadelphia, PA 19103	Written Comments	Demonstrate how the recommended LTCP can be cost effectively expanded in accordance with the CSO Policy	Regulatory

District of Columbia Water and Sewer Authority
Combined Sewer System Long Term Control Plan

APPENDIX G

Genera Manager's Letter to WASA Board

DCWASA
DISTRICT OF COLUMBIA WATER AND SEWER AUTHORITY
5000 OVERLOOK AVENUE, S.W., WASHINGTON, D.C. 20032
OFFICE OF THE GENERAL MANAGER
TEL: 202-787-2609
FAX: 202-787-2333

July 18, 2002

Glenn S. Gerstell
Chairman of the Board
D.C. Water and Sewer Authority
5000 Overlook Avenue, SW
Washington, DC 20032

Dear Chairman Gerstell and WASA Board Members:

It is with great pride today that I transmit to you the draft of the Final Combined Sewer System Long Term Control Plan (LTCP) for your review and approval. This document reflects several years of expert study and planning to comprehensively elevate this critical problem and brings a vital environmental solution and improvement in quality of life for residents of the District of Columbia.

Background
This plan was developed in accordance with EPA's 1994 CSO Policy, which was made part of the Clean Water Act by the Wet Weather Water Quality Act in December 2000. The LTCP was developed because of the long-standing effect of CSOs in the District of Columbia and because it is required by EPA's CSO Policy and WASA's NPDES permit.

The Draft LTCP was initially released to the public and regulatory agencies in June 2001. It proposed reducing overflows on the Anacostia, Potomac and Rock Creek to 4, 12 and 4 CSO events per average year respectively, at a cost of $1.05 billion dollars. The release of the Draft Plan was followed by an extensive public outreach program, including public meetings in every ward of the city. You may recall, that throughout the plan development process, WASA has held regular meetings with a group of active stakeholders. Other community and public meetings were also held. Since the release of the Draft Plan, over 2,300 comments were received on the plan, including comments from federal, DC, Montgomery and Prince George's county agencies. The commenters generally advocated for more CSO control, targeted separation, outfall elimination, and expressed concern about water quality standards issues.

Consistent with its commitment to environmental stewardship, WASA has continued to find ways to control more CSO in a cost effective way. WASA has also considered these comments carefully, and has developed a proposed LTCP that is both responsive to public comments and provides a balance of costs and benefits.

The time devoted to development of the plan by the public and environmental advocacy groups have resulted in a much better plan than could have otherwise been developed. Special gratitude is owed to the Stakeholder Advisory Panel, composed of a cross section of the community, who has devoted much time and effort in the development of the LTCP. Special thanks is also owed to the Mayor, the D.C. Department of Health and the EPA for the time they have spent in consulting and coordinating with the Authority on the plan. I wish to acknowledge Mr. C.C. Johnson's leadership, along with Board Chairman Gerstell, in establishing the CSO/Storm water Subcommittee and Mr. David J. Bardin's leadership in heading the subcommittee. Without these efforts, our progress would not be what it is today.

Proposed Final LTCP

The proposed Final LTCP is a vast improvement from the current situation and a major step forward from the Draft LTCP. The proposed plan consists of the following major elements:

- **Anacostia River Improvements** – Rehabilitation of the Main, O Street and Eastside Pumping Stations and replacement of the Poplar Point Pumping Station. The plan also includes construction of a CSO storage tunnel with segments along the Anacostia waterfront and the Northeast Boundary Sewer. The portion of the tunnel in the Northeast Boundary areas has the added benefit of providing flooding relief to the Trinidad, Bloomingdale and other neighborhoods where occasional street flooding has a been a problem for many years. These improvements are predicted to reduce CSO frequency from 82 to 2 events per average year. Additionally, the plan calls for the elimination of 4 of the 17 existing discharge points on the Anacostia River – 3 by consolidation and 1 through separation.

- **Potomac River Improvements** – Rehabilitation of the Potomac Pumping Station, construction of a storage tunnel along the Potomac River waterfront, and elimination of 5 CSO outfalls along the Georgetown waterfront by consolidation. These improvements are predicted to reduce CSO frequency from 74 to 4 events per average year.

- **Rock Creek Improvements** – Elimination of four CSO outfalls through separation, construction of a storage tunnel at Piney Branch and monitoring and regulator improvements to four CSO outfalls south of Rock Creek. These improvements are predicted to reduce CSO frequency from 30 to 1 event per year at Piney Branch and to 4 events per year at the other smaller CSO outfalls south of Piney Branch.

- **Blue Plains Wastewater Treatment Plant** – Improvement to the excess flow treatment train and the addition of four primary clarifiers.

- **System-wide improvements** - $3 million for LID at WASA facilities, advocacy for LID in the District, and participation in a newly-created, nationally based partnership with EPA and others, to research and evaluate LID approaches.

Overall the proposed plan will eliminate 13 of the 59 CSO outfalls in the system, 5 by separation and 8 by consolidation. Overflow volume will be reduced by 96 % from over 3 billion gallons per year to less than 150 million gallons per year. Priority has been given to the Anacostia where the largest reduction in overflow volume of 98% will occur.

Low Impact Development

As mentioned earlier, we have begun working with various environmental groups during this *entire* planning process, and just recently we received a letter from twelve groups commending WASA on its recent efforts to improve the Draft LTCP. Quoting from the letter, "...we would like to thank you for taking a second step in the right direction with the recent presentation of some improvements to the draft...LTCP..." The letter also stated that WASA's plan does not, "include adequate measures for aggressive implementation of source controls including low impact development..."

On this issue, WASA will continue pursue LID at its own facilities, and will work with various DC Government agencies to expand the use of LID to reduce wet-weather related pollution. WASA is also proposing to undertake collaborative research and investigation with EPA and other national partners to help fill the knowledge gap regarding the efficiency, effectiveness and appropriate use of LID.

It is envisioned that this research effort will generate a substantive body of data that could be used to establish specific standards for LID applications. With these standards, EPA could provide guidance for certain allowances for various types of LID applications. This would then let us look at and reevaluate the use of more LID with an understanding of its benefits and how they are measured and applied within our combined sewer system.

Affordability, Schedule and Federal Funding

The cost of the proposed plan is $1.265 billion in year 2001 dollars. Of this, $130 million is for Low Impact Development and the Pumping Station Rehabilitations and is part of the current Capital Improvement Program (CIP). Based on the financial capability assessment and in order to mitigate the annual rate increases that would be required to fund the LTCP, a 40-year implementation time is proposed for the entire recommended plan if no outside financial assistance is received. This is projected to limit sewer (check on this) rate increases to an approximate maximum of 8% per year, with 2% of that increase for the LTCP. The remainder of the increase is to fund the other projects currently planned in the CIP.

Public and EPA comments have advocated for a schedule shorter than 20 years for implementation of the LTCP. While technically viable, it is not financially feasible without substantial outside financial assistance. If approximately 62% of the program were federally funded, a 15-year schedule would have a similar financial impact on ratepayers as a 40-year schedule.

WASA will aggressively seek Federal assistance. There is ample precedent for this in other cities such as Boston, Chicago and Milwaukee CSO programs. The Federal government through the Mayor's office recently allocated $1.8 million for CSO control. This is a good start but much more significant assistance is needed.

Water Quality Standards
WASA has developed a LTCP that supports public use of District waters receiving CSO discharges. Substantial financial commitments will be required by District ratepayers and by those providing financial assistance in support of LTCP implementation. Wet weather discharge provisions need to be provided to accommodate LTCP implementation. It is necessary to recognize that due to uncertainties associated with precipitations, there will be CSOs when the capacity of the LTCP control facilities is exceeded.

WASA has been in discussions with the D.C. Department of Health and EPA regarding the nature of such provisions. The discussions have not been finalized and alternative approaches are still being considered. Under some approaches, the LTCP would be accommodated without changing the water quality standards. These approaches may involve the interpretation by regulatory agencies that the proposed LTCP meets the current water quality standards.

Other approaches under consideration involve incorporating provisions in the water quality standards to accommodate the remaining discharges after the capacity of the LTCP is exceeded. Such approaches will likely require a use attainability analysis (UAA) and/or modification or additions to the uses in the water quality standards. Discussions regarding the nature of the standards provisions for accommodating the LTCP are continuing and a final course of action has not been decided. However, it should be clearly understood that the USEPA cannot and will not approve a plan, which violates water quality standards. Thus, this matter must be addressed in a mutually agreeable manner prior to approval.

Possible Judicially Enforceable Document
In late 1999, various citizen plaintiffs filed a notice of intent to pursue civil action against the Authority. The suit alleged that WASA failed to adequately implement the nine minimum controls, required in the 1994 CSO policy and guidance, and failed to meet water quality standards as a result of discharges from the combined sewer system. Since that time, WASA has been attempting to resolve these issues with the parties, EPA and the Department of Justice.

Because implementation of the LTCP will take longer than a 5-year NPDES permit cycle, it is envisioned that implementation of the LTCP will be incorporated into some type of judicially enforceable document. It is unclear at this time whether acceptable terms can be agreed upon in a single document that both accommodates resolution of the civil action and implementation of the LTCP. It is possible that the civil action will be shown to be an inappropriate mechanism to ensure implementation of the LTCP. If this proves to be the case the Authority is prepared to pursue a separate judicially enforceable document that only addresses implementation of the LTCP. In any event, it is likely that implementation of the LTCP will be in some type of judicially enforceable document in the future.

CSO Control Will Move Ahead

While sorting through LTCP approval and implementation issues, WASA is proceeding with CSO control items that are in the current CIP. These include replacement of the inflatable dams and the pumping station rehabilitation. These improvements alone will result in significant reduction in CSO. The inflatable dam replacement project, a $7.5 million construction contract approved by the Board of Directors earlier this year, is now under construction. This project will reduce total overflow volume by 23%. Pumping station improvements valued at $127 million are under design (including the Potomac Pumping Station rehabilitation addressed by a proposed Board action today), and will further reduce overflow volume by 17%. This 40% overall reduction in overflow volume, to be achieved by 2010, constitutes a significant step forward. In implementing these projects, WASA will provide ratepayer-supported funding for over 98% of the construction costs while effectively and promptly utilizing the $1.8 million in Federal funding approved thus far.

In addition, WASA is working with the District Department of Transportation (DDOT) to improve street drainage and grading in the Bloomingdale area this summer to provide a degree of flooding relief prior to implementation of the LTCP.

Look Ahead

Mr. Chairman and members of the Board, with your approval, the Final LTCP would be forwarded to regulatory agencies at the end of July. Regulatory agencies have indicated that their intention is to approve the plan with approximately 3 months review time. It is expected that the outstanding issues such as water quality standard provisions and potential enforcement document issues may take longer to resolve.

I look forward to your approval to submit the LTCP for review and approval by EPA and the DC regulatory agency, and to the benefits it will provide the residents District of Columbia.

Sincerely,

Jerry N. Johnson
General Manager

DISTRICT OF COLUMBIA
WATER AND SEWER AUTHORITY
Serving the Public • Protecting the Environment

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