

D.C. DEPARTMENT OF HEALTH

Environmental Health Administration

Bureau of Environmental Quality

Water Quality Division

DISTRICT OF COLUMBIA

FINAL

TOTAL MAXIMUM DAILY LOAD

for

FECAL COLIFORM BACTERIA

in

KINGMAN LAKE

October 2003



Government of the
District of Columbia
Anthony A. Williams, Mayor

INTRODUCTION

Section 303(d)(1)(A) of the Federal Clean Water Act (CWA) states:

Each state shall identify those waters within its boundaries for which the effluent limitations required by section 301(b)(1)(A) and section 301(b)(1)(B) are not stringent enough to implement any water quality standards applicable to such waters. The State shall establish a priority ranking for such waters taking into account the severity of the pollution and the uses to be made of such waters.

Further section 303(d)(1)(C) states:

Each state shall establish for the waters identified in paragraph (1)(A) of this subsection, and in accordance with the priority ranking, the total maximum daily load, for those pollutants which the Administrator identifies under section 304(a)(2) as suitable for such calculations. Such load shall be established at a level necessary to implement the applicable water quality standards with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality.

In 1996, the District of Columbia (DC), developed a list of waters that do not or are not expected to meet water quality standards as required by section 303(d)(1)(A). The list was revised in 1998 and again in 2002. The list of water bodies contains a priority list of those waters which are the most polluted. This priority listing is used to determine which of those water bodies are in critical need of immediate attention. This list, submitted to the Environmental Protection Agency every two years, is known as the Section 303(d) list. For each of the listed waters, states are required to develop a Total Maximum Daily Load (TMDL) which calculates the maximum amount of a pollutant that can enter the water without violating water quality standards and allocates that load to all significant sources. Pollutants above the allocated loads must be eliminated.

The District of Columbia's section 303(d) list Kingman Lake for fecal coliform bacteria. The Kingman lake organics (toxics), metals, BOD, TSS, and oil and grease and the Anacostia River TMDLs for bacteria contain information relevant to Kingman Lake.

APPLICABLE WATER QUALITY STANDARDS

Kingman Lake is listed on DC's 303(d) lists for excessive counts of fecal Coliform bacteria. The District of Columbia Water Quality Standards (WQS), Title 21 of the District of Columbia Municipal Regulations (DCMR) Chapter 11 specifies the categories of beneficial uses as:

1. Class A- primary contact recreation,
2. Class B- secondary contact recreation,
3. Class C- protection and propagation of fish, shellfish, and wildlife,
4. Class D- protection of human health related to consumption of fish and shellfish, and;
5. Class E- navigation.

The waters are classified on the basis of current use and designated beneficial uses as follows:

Waterbody	Current Use	Designated Use
Anacostia River		
Tributaries (except as listed below)	B,C,D	A,B,C,D
Hickey Run	B,C,D	B,C,D
Watts Branch	B,C,D	B,C,D

Class A and Class B waters must achieve or exceed water quality standard for bacteria as measured by Fecal Coliform as an indicator organism. While fecal coliforms, which are microbes that live in the intestinal tracts of warm-blooded animals, are not harmful themselves, their presence indicates the potential for pathogens in the water. Water quality standards are derived from EPA recommendations based on risk levels associated with swimming.

The standard for Class A waters is a maximum 30-day geometric mean of 200 MPN/100 ml, where MPN is a statistically-derived estimate of the “Most Probably Number” of bacteria colonies in a 100 ml sample. This statistical estimate is often called a “count” although it is represented as a concentration. The geometric mean is based on no fewer than five samples within the 30-day period. The standard for Class B waters is a 30-day geometric mean of 1000 MPN/100 ml. However since Kingman Lake is designated as Class A water, which has a more restrictive bacteria standard, the 200 MPN/100ml for Class A designation is used as the not-to-exceed criterion in this TMDL.

The following sections of the District of Columbia Water Quality Standards have some bearing on this TMDL:

- 1104.3 Class A waters shall be free of discharges of untreated sewage, litter and unmarked, submerged or partially submerged, man-made structures which would constitute a hazard to the users. Dry weather discharges of untreated sewage are prohibited.
- 1104.4 The aesthetic qualities of Class B waters shall be maintained. Construction, placement or mooring of facilities not primarily and directly water oriented is prohibited in, on, or over Class B waters unless:
- (a) The facility is for the general public benefit and service, and
 - (b) Land based alternatives are not available.
- 1105.7 Mixing zones may be allowed for point source discharges of pollutants on a case by case basis, where it is demonstrated that allowing a small area impact will not adversely affect the waterbody as a whole. The following conditions shall apply:

- (e) The positioning of mixing zones shall be done in a manner that provides the greatest protection to aquatic life and for the designated uses of the water;
- (f) Within the estuary, the maximum cross-sectional area occupied by a mixing zone shall not exceed ten percent (10%) of the numerical value of the cross-sectional area of the waterway, and the width of the mixing zone shall not occupy more than one third (1/3) of the width of the waterway;

Current use - the use which is generally and usually met in the waterbody at the present time in spite of the numeric criteria for that use not being met sometimes.

Designated use - the use specified for the waterbody in the water quality standards whether or not it is being attained.

Existing use - the use actually attained in the waterbody on or after November 28, 1975.

Mixing zone - a limited area or a volume of water where initial dilution of a discharge takes place; and where numerical water quality criteria can be exceeded but acute toxic conditions are prevented from occurring.

Primary contact recreation - those water contact sports or activities which result in frequent whole body immersion and/or involve significant risks of ingestion of the water.

Secondary contact recreation - those water contact sports or activities which seldom result in whole body immersion and/or do not involve significant risks of ingestion of the water.

Class A and B are not existing uses for Kingman Lake. Class B is listed as a current use. Class A and B are designated uses for Kingman Lake. The mixing zone concept implies that even though some area of a water body does not attain the numerical criteria that the use is still attained or protected the water body. The definitions of Class A primary contact Recreation and Class B secondary contact recreation make clear there is a risk level associated with recreational activities. The EPA criteria document estimated that at a geometric mean of 200 organisms per 100ml that there would be about 8 illnesses out of 1,000 swimmers at a recreation swimming beach. The use of a geometric mean recognizes that there will be occasions where individual samples will be higher than 200 organisms/100ml. Obviously, different types of Class A activities carry different risks, with swimming involving the highest risk. Activities such as windsurfing where the person spends most of the time out of the water but spends significant amounts of time in the water or being splashed with water runs a lesser risk. While in the case of scuba diving, because of increased pressure of the water at depths, may cause a higher prevalence of ear infections than other types of activities. Certain Class A activities maybe limited by factors other than disease risk. Issues such as current velocity, floods, clarity of the water and competing uses such as navigation or fishing may restrict these activities to certain areas at certain times and most certainly winter temperatures and heavy ice create limitations. The District of Columbia water quality standards do not guarantee risk free primary contact recreation nor do they guarantee that it can occur everywhere all of the time.

BACKGROUND

Around 1800, the Anacostia River was a major thoroughfare for trade in the area now known as the District of Columbia, particularly for Bladensburg, a deep water port in Maryland. By 1850, however, the Anacostia River had developed sedimentation problems due to deforestation and

improper farming techniques related to tobacco farms and settlements. Channel volumes were greatly decreased and stream flow patterns were altered. Due to the continuation of the urbanization process, the river was never able to flush out the excessive amount of sediment and nutrients. In the 1940's the Corp of Engineers re-configured the Anacostia River with a massive dredging project. As part of a flood control measure the River was straightened and a bend of the river was left as an oxbow lake (Figure 1). This was named Kingman Lake.

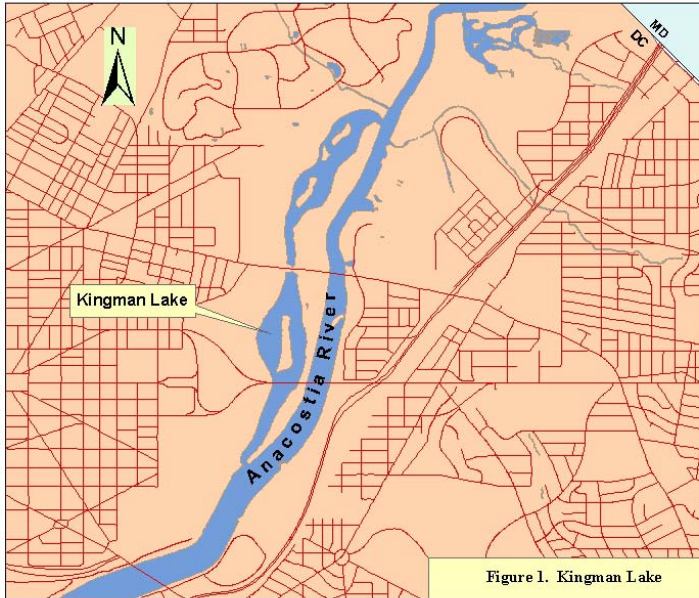
CURRENT LAND USE

Kingman Lake direct drainage is about 16,000,000 square feet, composed of about 50 percent parkland/golf course, 25 percent residential and 25 RFK stadium and parking lot. The portions of the lake above the Benning Road bridge is chiefly drainage from a golf course, a high school and about two blocks of residential area (100,000sqft). The portion below Benning Road on the northwestern shore is predominately developed as residential, and stadium and parking while the southeastern shore is parkland. The stadium parking has a green space buffer along the lake shore.

HYDRAULIC CHARACTERISTICS

Kingman Lake is tidal with an opening at each end. Tidal amplitude is about 3 feet. The lake was originally about 94 acres. After creation of 44 acres of wetlands there were 50 acres of open lake left. Final design of the wetlands was to create an inundation depth of 0.0 to 2.0 feet at high tide. About 25 acres would have an inundation depth of one foot at high tide. 50 acres (2,187,000 square feet and a volume of 5,744,000ft³) would have an exchange volume of 3 feet and 25 acres would have an exchange volume of 1 foot.

There are no tributaries that empty directly to Kingman Lake. Storm water runoff from the DC separate sewer system discharges to the Lake.



WATER QUALITY STANDARDS

Class A waters have an associated maximum 30-day geometric mean for fecal Coliform of 200 MPN/100 ml based on a minimum of 5 measurements. The MPN is the statistical estimate of the number of Coliform colonies likely to be found in a 100 ml sample. These measurements are often referred to as 'counts'. The purpose of this TMDL is to determine the limit to which fecal Coliform counts must be reduced to achieve and maintain the WQS for bacteria. The criteria must be achieved for all flow conditions. Since fecal Coliform are not measured in traditional concentrations (mass/volume), the TMDL is not a true maximum load, but rather a statistical estimate of the most probable number of Coliform colonies that can be assimilated into the receiving waters without violating the WQS. Computationally, however, this parameter can be represented like a traditional pollutant and so for this TMDL it will be referred as a fecal Coliform load.

SOURCE ASSESSMENT

Point Sources

Within the District of Columbia, there are three different networks for conveying waste water. Originally, a combined sewer system was installed which collected sanitary waste and storm water and transported the sanitary flow to the waste water treatment plant. When storm water caused the combined flow to exceed the pipe capacity leading to the treatment plant, the excess flow was discharged, untreated, through the combined sewer overflow to the rivers. There are no sewer overflow outfalls to Kingman Lake. A possible impact from combined sewer overflow sources to Kingman Lake may be due to the Northeast Boundary combined sewer overflow into the Anacostia River about 750 feet below the lower entrance to Kingman Lake.

Non point Sources

In the upper two thirds of the city's drainage area, a separate sanitary sewer system and a storm sewer system were constructed. In this area, the separate sanitary sewer line has no storm water inlets to the system and it flows directly to the waste water treatment facility. Storm water pipes collect storm water from the streets and parking lots and are discharged to the rivers. There are four storm water outfalls which discharge to Kingman Lake. The annual average storm water entering Kingman Lake was estimated from the storm water flow to part of the Anacostia River. A subset (segment 15 to 19) of the storm water flow data for the Anacostia River bacteria TMDL modeling was used to estimate the average annual storm water flow to Kingman Lake.

Hickey Run enters the Anacostia River about 300 feet above the upper entrance to Kingman Lake and the flow may be carried into the lake. Storm water runoff comes from Kingman and Heritage Island, a golf course and some parts of the Robert F. Kennedy stadium parking lot.

In recent years significant progress has been made towards the restoration of the freshwater tidal waters of the Kingman Lake area. The restoration efforts have resulted in providing habitat for additional waterfowl in the area.

TOTAL MAXIMUM DAILY LOADS AND ALLOCATION

Existing Load

The existing load is computed

Existing Fecal Coliform Load (MPN) - Storm Water			
	Dry Year	Wet Year	Average Year
Jan	2.12E+11	1.41E+11	1.71E+11
Feb	1.51E+11	1.69E+11	4.97E+10
Mar	1.27E+11	2.56E+11	1.23E+11
Apr	1.05E+11	1.77E+11	2.35E+11
May	2.70E+11	5.70E+11	2.92E+11
Jun	4.23E+10	3.17E+11	2.43E+11
Jul	1.94E+11	2.65E+11	1.66E+11
Aug	1.03E+11	5.28E+10	4.13E+11
Sep	8.06E+10	6.31E+11	1.87E+10
Oct	8.27E+10	4.25E+11	2.15E+11
Nov	3.80E+11	1.53E+11	1.47E+11
Dec	5.99E+10	1.40E+11	3.14E+11

Storm water

ALLOCATIONS, REDUCTIONS, MARGIN OF SAFETY, AND THE TMDL

Analysis Framework

The analysis is conducted with the underlying assumptions of the Anacostia River Bacterial TMDL. It is assumed that the Anacostia River water that enters Kingman Lake meets the conditions described under the final allocations, which accordingly meets water quality standards. Therefore, only the contribution of storm water source to Kingman Lake is considered for this TMDL.

The storm water flow estimation is based on the Tidal Anacostia Model (TAM), originally developed by the Metropolitan Washington Council of Governments (MWCOG) in the 1980's (Sullivan and Brown, 1988), and recently modified by the Interstate Commission on the Potomac River Basin (ICPRB). The hydrodynamic component simulates the changes in water level and water flow velocities throughout the river due to the influence of tides and due to the various flow inputs entering the Anacostia River. Kingman Lake is modeled as an embayment to the

Anacostia River (Schultz, 2003). The storm flow is estimated from flow records of three consecutive years, 1988, 1989, and 1990. These years are representative of a dry, wet and average rainfall year on record.

To estimate the load, the volume of storm water flow and a representative fecal coliform concentration in storm water flows were used.

Storm Water Load Allocation

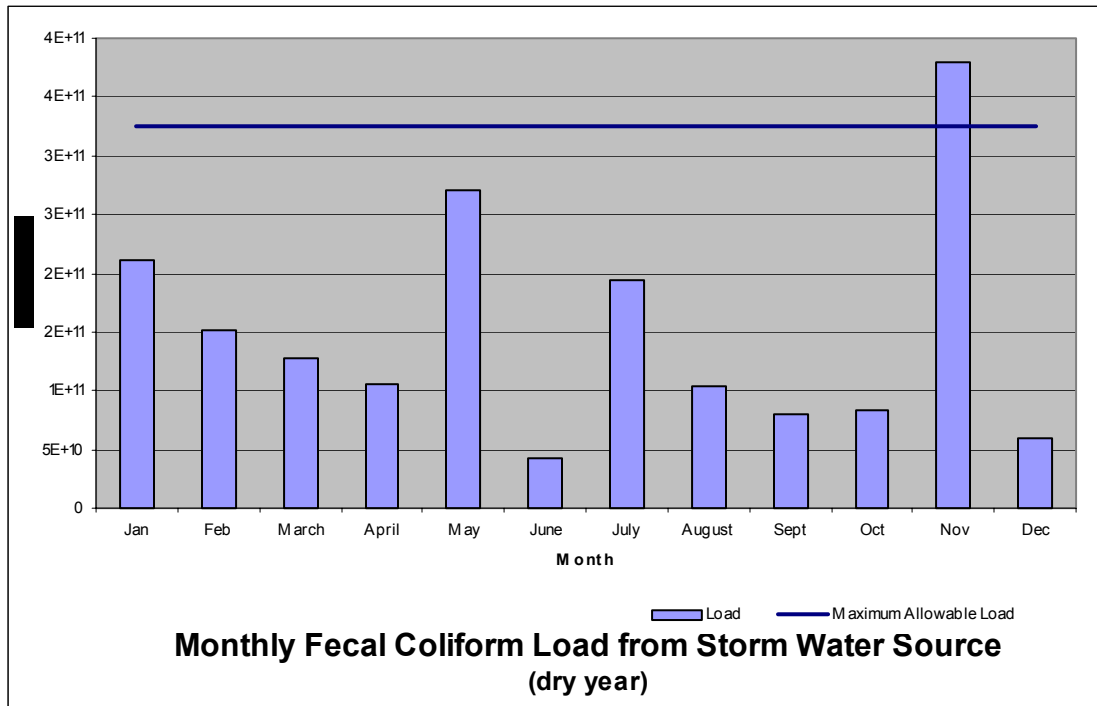
The only load allocation for fecal coliform to Kingman Lake is made to storm water source. The maximum allowable load, L_{max} can be computed as:

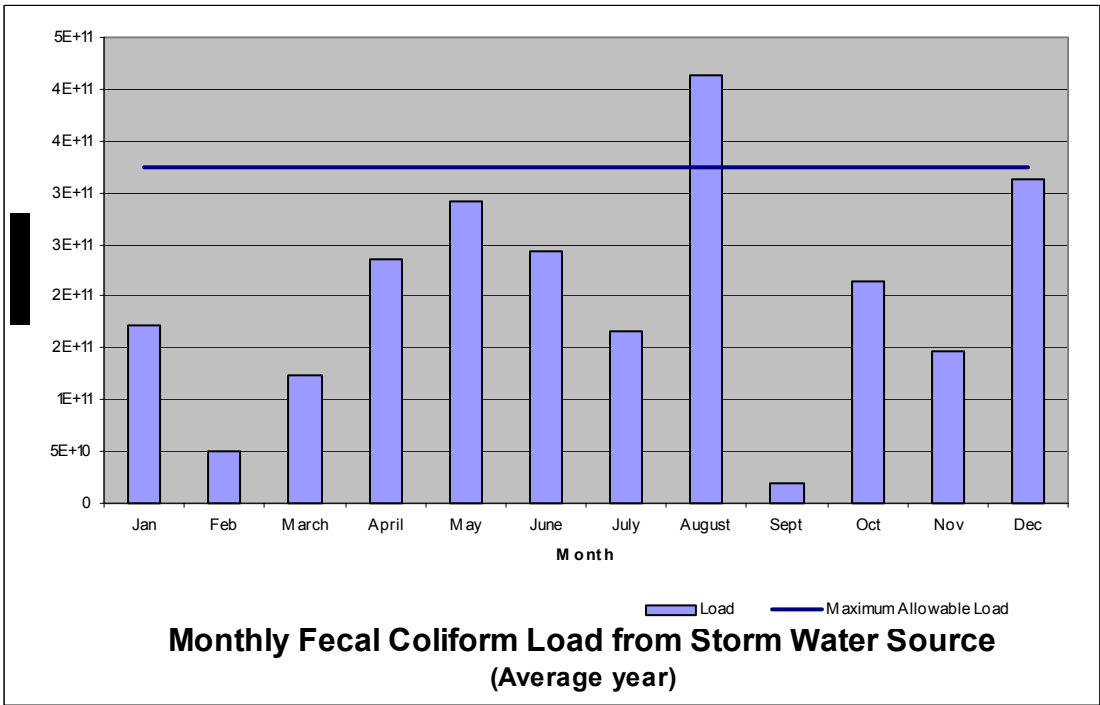
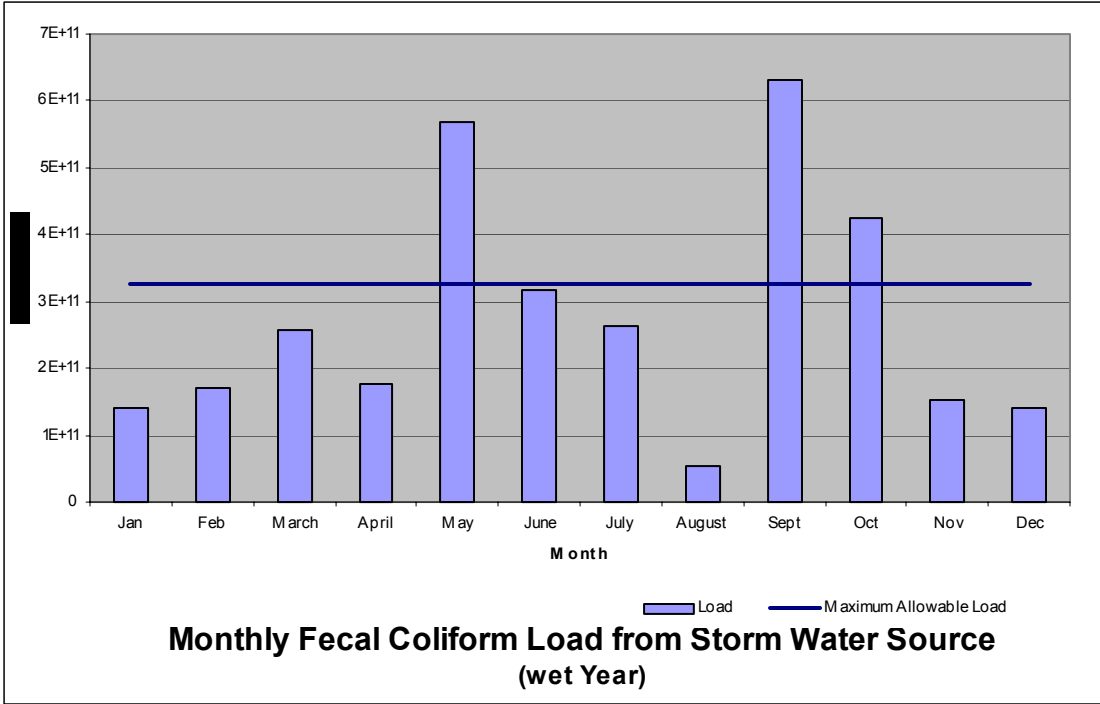
$$L_{max} = V_{kl} \times C_A$$

where V_{kl} is the volume of Kingman Lake, and C_A is the maximum allowed concentration for Class A. The values for both V_{kl} , and C_A are known.

$$L_{max} = 1.626 \times 10^{11} \text{ ml} \times 200 \text{ MPN}/100 \text{ ml} = 3.252 \times 10^{11} \text{ MPN}$$

The load due to storm water sources is presented below. The figures show the monthly mean load over the years of record.





Within the three years of record, the monthly load exceeds the allowable load once in a dry and average rainfall years, and three times in a wet year. The Water Quality Standard will be met by 15% and 50% load reductions on a dry and a wet year, respectively. A 50 % reduction across the board will satisfy the necessary reduction in any rainfall condition to meet the maximum allowable load.

	Fecal Coliform Load (MPN) Reduction - Storm Water					
	reduction		% reduction		%reduction	
	Dry Year	Dry year	Wet Year	Wet year	Average Year	Avg. year
Jan	2.12E+11		1.41E+11		1.71E+11	
Feb	1.51E+11		1.69E+11		4.97E+10	
Mar	1.27E+11		2.56E+11		1.23E+11	
Apr	1.05E+11		1.77E+11		2.35E+11	
May	2.70E+11		5.70E+11	42.9	2.92E+11	
Jun	4.23E+10		3.17E+11		2.43E+11	
Jul	1.94E+11		2.65E+11		1.66E+11	
Aug	1.03E+11		5.28E+10		4.13E+11	21.2
Sep	8.06E+10		6.31E+11	48.5	1.87E+10	
Oct	8.27E+10		4.25E+11	23.4	2.15E+11	
Nov	3.80E+11	14.5	1.53E+11		1.47E+11	
Dec	5.99E+10		1.40E+11		3.14E+11	

Load Allocation

Current nonpoint sources are included in the storm water load allocation. No other quantifiable nonpoint sources are known.

Margin of Safety

A margin of safety of 10% is recommended here. It is to be noted that the Anacostia River TMDL calls for a ninety percent fecal coliform load reduction from storm water sources. This shows that the water in Kingman Lake is of better quality than the Anacostia River mainstem waters.

Implementation

On May 10, 1999, Mayor Williams signed a new Anacostia Watershed Restoration Agreement with Maryland, Prince George’s County, Montgomery County, and U.S. EPA to increase efforts to improve water quality. The Agreement has six major goals. The first one pertains to this TMDL:

Goal #1: dramatically reduce pollutant loads, such as sediment, toxics, CSOs, other nonpoint inputs and trash, delivered to the tidal river and its tributaries to meet water quality standards and goals.

On June 28, 2000, Mayor Williams, Governor Glendening, U.S. EPA and others signed the new Chesapeake Bay Agreement which states:

By 2010, the District of Columbia, working with its watershed partners, will reduce pollution loads to the Anacostia River in order to eliminate public health concerns and achieve the living resources, water quality, and habitat goals of this and past agreements.

Thus, an agreement is in place, which clearly demonstrates a commitment to the restoration of the river by the year 2010. This establishes a completion date for implementation of those activities necessary to achieve the load reductions allocated in this TMDL.

Storm Water Load Reductions

Significant steps are being taken to reduce nonpoint source pollution in the District of Columbia. Major currently operating programs in DC which reduce loads are as follows:

2. Requirements for storm water treatment on all new development and earth disturbing activities such as road construction. The BMP and removal efficiencies that have been installed in the Anacostia drainage area in accordance with DC Law 5-188 , The Water Pollution Control Act of 1985 are included in the appendix.
3. Regulatory programs restricting illegal discharges to storm sewers and enforcing the erosion control laws.
4. Kingman Lake -The goal of this project is to restore over 40 acres of freshwater tidal wetlands in the Kingman Lake area in order to increase plant and animal diversity. These wetlands will also improve water quality by reducing the amount of sediment in the water by an estimated 1,600,000 pounds per growing season. This project was completed in 2000. Monitoring efforts are continuing in connection with other wetlands that have been restored in Kenilworth Park. Funding for this project was cost shared by the USACE, Maryland and USEPA. The DC Department of Health has issued the Nonpoint Source Management Plan II.
5. River Fringe Wetlands -The goal of this project is to restore 15 acres of tidal wetlands along the shores of the Anacostia River above Kingman Island. As with the Kingman Lake wetlands, these wetlands will increase the number of beneficial plants and fish in the river and will reduce the amount of sediment in the water an estimated 369,000 pounds per growing season. The USACE has completed the design for this project. Construction is scheduled for Spring 02. Funding for this project was cost shared with the USACE and USEPA.
6. Kingman Island- The goal of this project is to restore the southern half of the island as a natural park recreational area. This project is being closely coordinated with Office of Planning and Department of Parks Recreation. The USACE has completed preliminary sampling for

contaminants on both Heritage and Kingman Island and is currently completing a feasibility study of the islands. The USACE is also assisting the District in meeting the National Environmental Policy Act, a legal requirement when the land was transferred back to the District. The USACE Aquatic Restoration program is designing the habitat component of this project. Design and implementation is cost shared: 65% federal, 35% District. Habitat restoration efforts on Heritage Island are scheduled for implementation by the USACE in FY02. EHA also funded and facilitated the reconstruction of the pedestrian bridges by the US Navy (completed 04/01).

7. Approximately two thirds of the RFK parking lot drainage is now routed to storm water BMPs installed in 2002 by the Sports and Entertainment Commission.
8. The golf course has planted buffer strips of trees along Kingman Lake.
9. Environmental education and citizen outreach programs to reduce pollution causing activities.

Federal lands encompass approximately 18 percent of the land inside DC that contribute flow to storm water to the Anacostia River. Consequently, load reductions are assigned to the federal government to achieve. The Washington Navy Yard, GSA-Southeast Federal Center, and Anacostia Naval Air Station have or will have storm water permits issued by U.S. EPA and certified by DC DOH. Under these permits, the federal facilities are required to have storm water management plans to control storm water runoff. The remaining federal facilities such as the National Park Service and National Arboretum will need to develop storm water management plans to reduce their loads and implement those plans.

The District of Columbia Water Pollution Control Act (DC Law 5-188) authorizes the establishment of the District's Water Quality Standards (21 DCMR, Chapter 10) and the control of sources of pollution such as storm water management (21 DCMR, Chapter 5). The storm water management regulations require the hydraulic control of the once in 15 years storm and the water quality treatment of the first one half inch of rainfall.

Monitoring

Kingman Lake watershed is an urban sanctuary for a wide range of wildlife, particularly birds, in the District of Columbia. Direct deposition from the birds introduces an unknown amount of bacteria to the waterbody. Monitoring data will be used to support model calibration and allocation to sources.

There are two existing ambient water quality monitoring stations located within Kingman Lake sponsored by the District of Columbia Department of Health. These stations are used to monitor for fecal coliform bacteria. The current fecal coliform measurement methods do not allow for the delineation of the contribution of fecal bacteria from human, wildlife, and pets and will assist in establishing the "natural" conditions for Kingman Lake.

For a period of at least 15 months, the District will collect a minimum of 15 samples, extending the project's duration if necessary to satisfy minimum sampling requirements. Collection will

begin by June 2005 and no later than September 2005. The following monitoring stations along Kingman Lake will be used:

Station ID	Descriptor	Frequency	Analysis
KNG01	Kingman Lake upstream of the East Capital St. Bridge along the west bank	TBD	Fecal/BST ¹
KNG01	Kingman Lake upstream of the Benning Rd. Bridge along the west bank	TBD	Fecal/BST

¹Bacterial Source Tracking

TBD – to be determined

The Department of Health will employ an accepted methodology, including Bacterial Source Tracking, to estimate the percentage of fecal bacteria contributions of bacteria from humans, wildlife, and pets, to the Kingman Lake. Individual stations may be substituted, as appropriate, based on best professional judgment and accessibility. All monitoring, sampling, and analysis is to be conducted in accordance with the District of Columbia Municipal Regulations, Title 21, Chapter 19 – Water Quality Monitoring Regulations. Specifically, Sections 1901 and 1902 of this Chapter provide for a Quality Assurance Project Plan and Quality Assurance Manual for water quality monitoring.

This monitoring plan may be amended by mutual consent of EPA and DC DOH. However, subsequent agreements between EPA and DC DOH must maintain the intent and purposes of the plan.