D.C. DEPARTMENT OF HEALTH
Environmental Health Administration
Bureau of Environmental Quality
Water Quality Division

DISTRICT OF COLUMBIA FINAL TOTAL MAXIMUM DAILY LOADS FOR ORGANICS AND METALS IN KINGMAN LAKE

SEPTEMBER 2003

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

DISTRICT OF COLUMBIA
FINAL
TOTAL MAXIMUM DAILY LOADS
FOR
ORGANICS AND METALS
IN
KINGMAN LAKE

DEPARTMENT OF HEALTH
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WATER QUALITY DIVISION
WATER QUALITY CONTROL BRANCH

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1. Introduction

1.1. TMDL Definition and Regulatory Information

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.*

Section 303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for waterbodies, which are exceeding water quality standards.

In 1996, the District of Columbia (DC), developed a list of impaired waters that did not or were not expected to meet water quality standards as required by Section 303(d)(1)(A). This list, submitted to the Environmental Protection Agency every two years, is known as the Section 303(d) list. This list of impaired waters was revised in 1998 based on additional water quality monitoring data. EPA, subsequently, approved each list. The Section 303(d) list of impaired waters contains a priority list of those waters that are the most polluted. This priority listing is used to determine which waterbodies are in critical need of immediate attention. For each of the listed waters, states are required to develop a Total Maximum Daily Load (TMDL), which establishes the maximum amount of a pollutant that a waterbody can receive without violating water quality standards and allocates that load to all significant sources. Pollutants above the allocated loads must be eliminated. By following the TMDL process, states can establish water-quality based controls to reduce pollution from both point and nonpoint sources to restore and maintain the quality of their water resources.

1.2. Impairment Listing

Kingman Lake was listed in the District of Columbia’s 1996 and 1998 Section 303 (d) list (Table 1-1) for impairments due to organics (toxics), metals, bacteria, biochemical oxygen demand, total suspended solids and oil and grease in the Anacostia River and Kingman Lake. This TMDL addresses impairments due to Organics and Metals. Figure 1-1 identifies the location of Kingman Lake.

Table 1-1: 1996 and 1998 Section 303(d) Listing Information

1996 Section 303(d) Listing					
S. No	Waterbody	Pollutant of Concern	Priority	Ranking	Action Needed
6.	Kingman Lake	F. Coliform, organics and toxics	High	6	Control CSO and nonpoint source (NPS) pollution
1998 Section 303(d) Listing					
S. No	Waterbody	Pollutant of Concern	Priority	Ranking	Action Needed
6.	Kingman Lake	BOD, Bacteria, organics, metals, total suspended solids, and oil& grease	High	6	Control CSO, point and nonpoint source (NPS) pollution

CSO – combined sewer outfall

1.3. Watershed Location

Kingman Lake is located in the southeast section of Washington, D.C. on the west side of the Anacostia River (which ultimately flows into the Potomac River and then to the Chesapeake Bay). It is not a true lake, but a 110-acre tidal freshwater impoundment created during the 1920s and 1930s to provide a recreational boating area for District of Columbia residents. The lake is connected to the tidal Anacostia River by two inlets located at the northern and southern ends of Kingman Island, a wooded 94-acre dredge/fill-created island that separates the lake from the river. The Hydrologic Unit Code (HUC) for Kingman Lake is 02070010.

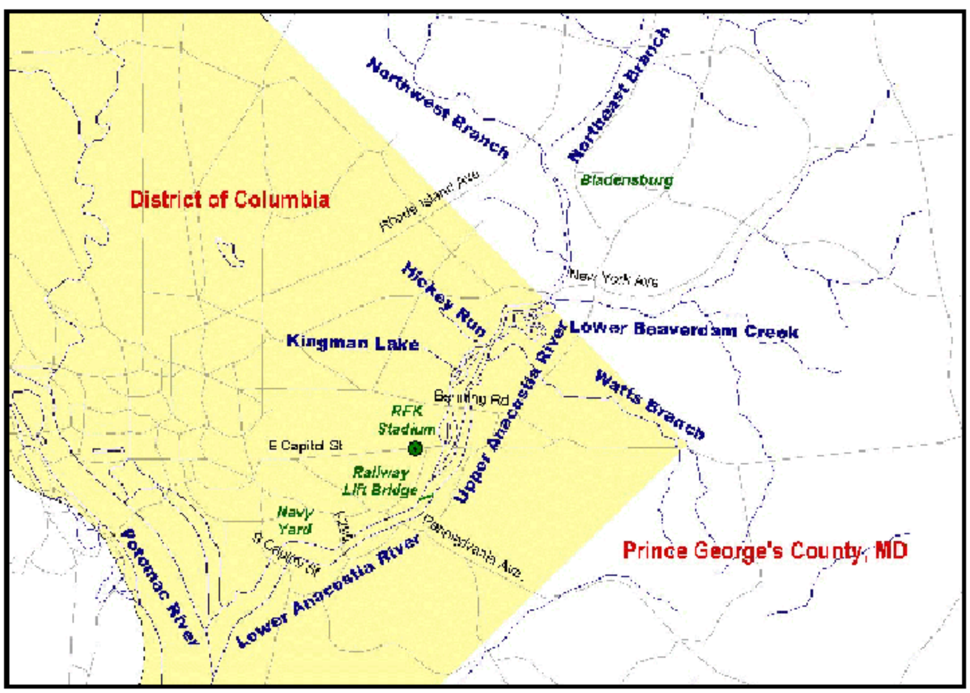

Figure 1-1: Kingman Lake

2. Chemical of Concern Beneficial Uses and Applicable Water Quality Standards

2.1. Chemicals of Concern

The list of organics and metals Chemicals of Concern for this TMDL were determined from data derived from fish tissue[1] and sediment[3] analysis. Fish tissue was harvested and analyzed for the list of suspected contaminants. The contaminants of concern that were discovered above the allowed concentration were identified and were included in this TMDL. Sediment samples were also collected and analyzed for the contaminants of concern. Those that indicated high levels of exceedance above the screening criteria were identified as contaminants of concern and included in the TMDL. Table 2-1 represents the results of this assessment.

Table 2-1: Fish Tissue and Sediment Data Exceeding Screening Values

Organic/Metal Exceedance	Anacostia Fish tissue Data[1] (ppm)	EPA Screening Value[2] (ppm)	Anacostia Sediment Data (ppm dw)	Sediment Screening value (ppm dw)
Arsenic	0.026 N/A	0.026	N/A 4.5	N/A
Copper	N/A N/A	N/A	312.5 60.7	31.6
Lead	N/A N/A	N/A	586.54 97	35.8
Zinc	N/A N/A	N/A	1,457.290 296	121
Chlordane	0.338 .044	0.114	0.1699 ND	0.00324
DDT	0.375 0.0018	0.117	0.3194 ND	0.00528
Dieldrin	0.0315 U	0.0025	N/A ND	N/A
Heptachlor Epoxide	0.0080 0.0042	0.00439	NA ND	NA
Total PAHs	0.151 N/A	0.00547	97.878 9.271	1.61
Total PCBs	2.49 .0953	0.020	1.629 .189	0.0598

Notes:

1. U.S. FWS. 2001. Analysis of Contaminant Concentrations in Fish Tissue Collected from the Waters of the District of Columbia. Final Report. Publication number CBFO-C01-01, Chesapeake Bay Field Office, Annapolis, MD.
2. U.S. EPA 2000. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 1, Fish Sampling and Analysis, Third edition. EPA 823-B-00-007, Office of Water, Washington D.C.
3. Data Assessment Report Anacostia River Sediments Patrick Center for Environmental Research, The Academy of Natural Sciences of Philadelphia, KQS Report Number 134-01R01. Appendix II. September 2000.
4. MacDonald, D.D., C.G. Ingersoll and T.A. Berger. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. *Arch. Environ. Contam. Toxicol.* 29-31.

N/A Data not available.

2.2. Designated Beneficial Uses

Categories of DC surface water designated beneficial uses and water quality standards are contained in District of Columbia Water Quality Standards, Title 21 of the District of Columbia Municipal Regulations, Chapter 11 (DC WQS, Effective January 24, 2003). Section 1101.1 states:

> *For the purposes of water quality standards, the surface waters of the District shall be classified on the basis of their (i) current uses, and (ii) future uses to which the waters will be restored.*

Kingman Lake is identified as a tributary of the Anacostia River. The categories of designated beneficial uses for Kingman Lake are as follows:

Class A - primary contact recreation,
Class B - secondary contact recreation and aesthetic enjoyment,
Class C - protection and propagation of fish, shellfish, and wildlife, and
Class D - protection of human health related to consumption of fish and shellfish.

2.3. Applicable Water Quality Standards

2.3.1. Narrative Criteria

The District of Columbia's Water Quality Standards include narrative and numeric criteria that were written to protect existing and designated uses.

Section 1104.1 states several narrative criteria designed to protect the existing and designated uses:

> *The surface waters of the District shall be free from substances in amounts or combinations that do any one of the following:*
>
> 1. *Settle to form objectionable deposits;*
> 2. *Float as debris, scum, oil, or other matter to form nuisances;*
> 3. *Produce objectionable odor, color, taste, or turbidity;*
> 4. *Cause injury to, are toxic to or produce adverse physiological or behavioral changes in humans, plants, or animals;*
> 5. *Produce undesirable or nuisance aquatic life or result in the dominance of nuisance species; or*
> 6. *Impair the biological community which naturally occurs in the waters or depends on the waters for their survival and propagation.*

2.3.2. Numerical Criteria

2.3.2.1. Metals Numerical Criteria

Table 2-2: Dissolved Metals Table 2 Numerical Criteria

Constituent – Metals[1]	Criteria for Classes (ug/L)		
	C		D
	CCC[2] Four Day Average	CMC[2] One Hour Average	30 Day Average
Arsenic	150	340	0.14
Copper[3]	10.31	15.31	N/A
Lead[4]	2.23	57.15	N/A
Zinc[5]	95.04	104.08	N/A

Notes:

1. D.C. Water Quality Standards, Effective January 24, 2003, Table 2. The criteria for the hardness dependant constituents (Copper, Lead and Zinc) were calculated utilizing the applicable formulas in the Notes for Table 2. To calculate the dissolved criteria, the formula results were multiplied by their respective EPA Conversion Factor. The respective EPA Conversions Factors were derived in accordance with subsection 1105.10 from 60 Fed. Ref. 22,231 (1995), and are included at the end of the formulas below.
2. The Class C Criteria Maximum Concentration (CMC) and Criteria Continuous Concentration (CCC) standards were computed from the published District of Columbia standards Section 104.7 Table 2 Note 4 (listed below under note 3, 4, and 5) at a hardness of 89.4 mg/L as $CaCO_3$, the mean hardness computed from (1989) DC DOH monitoring data for the Anacostia River.
3. Copper is expressed as a function of hardness calculated using the following formula: $CCC = e^{(0.8545[\ln(hardness)]-1.465)} \times 0.96$; $CMC = e^{(0.9422[\ln(hardness)]-1.464)} \times 0.96$
4. Lead is expressed as a function of hardness calculated using the following formula: $CCC = [e^{(1.2730[\ln(hardness)]-4.705)}] \times [1.46203-[(\ln(hardness)(0.145712)]]$; and $CMC =[e^{(1.2730[\ln(hardness)]-1.460)}] \times [1.46203-[(\ln(hardness)(0.145712)]]$
5. Zinc is expressed as a function of hardness calculated using the following formula: $CCC = [e^{(0.8473[\ln(hardness)]+0.7614)}] \times 0.986$; $CMC = [e^{(0.8473[\ln(hardness)]+0.8604)}] \times 0.978$

2.3.2.2. Organics Numerical Criteria

Table 2-3: WQS Section 1104.7 Table 3 Organics Numerical Criteria

Constituent – Organics[1]	Criteria for Classes (ug/L)		
	C		D
	CCC Four Day Average	CMC One Hour Average	30-Day Average
Chlordane	0.004	2.4	0.00059
DDE	0.001	1.1	0.00059
DDD	0.001	1.1	0.00059
DDT	0.001	1.1	0.00059
Dieldrin	0.0019	2.5	0.00014
Heptachlor Epoxide	0.0038	0.52	0.00011
PAH 1[2]	50	N/A	14000
PAH 2[3]	400	N/A	0.031
PAH 3[4]	N/A	N/A	0.031
Total PCBs	0.014	N/A	0.000045

Notes:

1. WQS for PAH1, 2 and 3 were based on a conservative assumption that applicable water quality standards are the most stringent standard for a single PAH in the group. For example, the Class D water quality standard for fluoranthene, pyrene, benz[a]anthracene, and chrysene are 370, 11000, 0.031, and 0.031 ug/l, respectively. Therefore the most stringent of the individual standards, 0.031 ug/l is given in Table X-X as the Class D standard for PAH2.
2. PAH1, is the sum of six 2 and 3-ring PAHs, naphthalene, 2-methyl napthalene, acenapthylene, acenapthene, fluorene, and phenanthrene.
3. PAH2, consists of the four 4-ring PAHs, fluoranthene, pyrene, benz[a]anthracene, and chrysene.
4. PAH3, consists of the six 5 and 6-ring PAHS, benzo[k]fluoranthene, benzo[a]pyrene, perylene, indeno[1,2,3-c,d]pyrene, benzo[g,h,i]perylene, and dibenz[a,h+ac]anthracene.

2.4. TMDL Endpoint

Section 1104.2 states:

> *For the waters of the District with multiple designated uses, the most stringent standards or criteria shall govern.*

Therefore, for each of the above organics or metals the lowest numerical criteria was used to establish their respective TMDL allocations to protect the District of Columbia waters and designated uses.

3. Watershed Characterization

3.1. 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 mid-1900s the Army Corps of Engineers dredged the Anacostia River wetlands in the vicinity of the present day RFK Stadium for improved vessel navigation and filled in what were then considered useless and undesirable freshwater tidal wetlands. In the process they created Kingman and Heritage Islands. As part of a flood control measure, the Anacostia River was straightened and a bend of the river was left as an oxbow lake. This was named Kingman Lake.

The District of Columbia, as many cities in the 19^{th} and early 20^{th} centuries, developed a combined sewer system, which transported both rainfall and sanitary sewage away from the developed areas and discharged it into the rivers. The two major combined sewage outfalls were at the present location of the “O” Street Pump Station and at the Northeast Boundary Sewer just below Kingman Lake. In the 1930s, Blue Plains Wastewater Treatment Plant (WWTP) was constructed and dry weather sewage flows were transported across the Anacostia River to Blue Plains. However, the wet weather flows were and are often greater than the transmission capacity of the pump stations and piping system and resulted in overflows. Later, sewer system construction techniques utilized two pipes so that the storm water could be kept separate from the sanitary sewage. Storm water is transported to the nearest stream channel and discharged while the sanitary sewage is transported to Blue Plains WWTP for treatment.

3.2. Land Use

The predominate land use in the tidal portion of the Anacostia River basin is intensive urban activities, including residential, commercial, and industrial development and associated infrastructure. Kingman Lake lies adjacent to the Anacostia River's western edge near the Robert F. Kennedy (RFK) Memorial Stadium and associated parking lots. The 110 acre lake is separated from the river by the 94 acre Kingman Island and is bisected into northern and southern connected parts at the box culvert at Benning Road. Lansgton Golf Course surrounds the upper cell of the lake while the lower is bounded by RFK parking lots on the western shore and on the east by Kingman Island. Excluding the Langston Golf Course, which is located just upstream, the majority of the surrounding area is heavily developed, with large areas of impervious surfaces.

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 are chiefly drainage from a golf course, a high school and about two blocks of residential area (100,000 ft^2). The portion below Benning Road on the northwestern shore is predominately developed as residential and a stadium and parking while the southeastern shore is parkland. The stadium parking has a green space buffer along the lake shore.

3.3. Hydraulic Characteristics

Kingman Lake is hydrologically connected to the Anacostia River by two inlets located at the northern and southern ends of the lake, approximately 135 feet and 100 feet wide, respectively. The upper section of the lake is characterized by a dendritic tidal canal system, and during a low tide is primarily barren mudflats and areas with shallow water. The lower section of the lake has as average depth of 3 feet at low tide, with fewer mudflats and no tidal canal system. During a rising tide, water enters the lake through the inlets. The range between mean low and mean high tide is approximately 2.9 feet. Mean high tide elevation is 2.09 feet National Geodetic Vertical Datum (NGVD). The majority sources of water entering the lake include tidal flow, sheet flow from periods of heavy rain, and stormwater outfalls. Tidal cycles influence the river and lake twice daily. In general, the upper section of the lake has low water velocities and increased sedimentation and the lower portion of the lake is predominately influenced by the tidal bore of the Anacostia River and is characterized by deeper water.

4. Source Assessment

4.1. 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, which discharges about 750 feet below the lower entrance to Kingman Lake. 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. U.S. EPA has issued a storm water permit to DC that regulates storm sewer discharges as point sources and this flow is rainfall driven and contains both organic and inorganic suspended solids.

4.2. Non-Point Sources

In the upper two thirds of the District of Columbia'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.

The annual average storm water entering Kingman Lake was estimated from the storm water flow to the Anacostia River. A subset (segment 15 to 19) of the storm water flow in 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, the golf course and some parts of the RFK stadium parking lot.

5. Technical Approach

The first section describes the modeling framework for simulating pollutant loadings, hydrology, and water quality responses. The second and third sections present the modeling results in terms of a TMDL, and allocate the TMDL between point sources and nonpoint sources. The fourth section explains the rationale for the margin of safety and a remaining future allocation.

5.1. Tidal Anacostia Model

The TAM/WASP Toxics Screening Level Model simulates the loading, fate, and transport of toxic chemical contaminants in the tidal portion of the Anacostia River, and can predict the changes over time of concentrations of these contaminants in both the river's water and in the surficial bed sediment. The toxics model is based on ICPRB's TAM/WASP modeling framework, which was first used to construct a eutrophication/sediment oxygen demand model for the District's dissolved oxygen TMDL (Mandel and Schultz, 2000). The sediment transport capabilities of the model were then further developed, resulting in TAM/WASP Version 2.1 (Schultz, 2003), which was used by the District to develop its suspended solids TMDL. The TAM/WASP Toxics Screening Level Model, TAM/WASP Version 2.3, uses, with only minor changes, the hydrodynamic model and the sediment transport model components of Version 2.1.

The TAM/WASP Toxics Screening Level Model includes three primary components:

1. A hydrodynamic component, based on the Tidal Anacostia Model (TAM), originally developed at MWCOG in the 1980's (Sullivan and Brown, 1988). This component simulates the changes in water level and water flow velocities throughout the river due the influence of tides and due to the various flow inputs entering the river. The original 15 segment hydrodynamic model has been upgraded by ICPRB to a 36-segment model with side embayments (Schultz, 2003).

2. A load estimation component, constructed by ICPRB using Microsoft ACCESS. Water containing sediment and chemicals flows into the river every day from a variety of sources, including the upstream tributaries (the Northeast and Northwest Branches), tidal basin tributaries (Lower Beaverdam Creek, Watts Branch and others), the combined sewer system overflows (CSOs), the DC separate storm (SS) sewer system, and ground water. The ICPRB load estimation component estimates daily water flows into the river based on USGS gage data for the Northwest and Northeast Branches and National Airport daily precipitation data for flows from other sources. It also estimates daily sediment chemical loads into the river, based on available monitoring data.

3. A water quality component, based on the EPA's Water Quality Analysis Simulation Program, Version 5 (WASP-TOXI5) for sediments and toxic contaminants (Ambrose al., 1993). This component simulates the physical and chemical processes that transport and transform chemical contaminants that have entered the river. The WASP sediment/toxics transport module has been enhanced by ICPRB to more realistically simulate sediment erosion and deposition processes based on hydrodynamic conditions (see Schultz, 2003).

TAM/WASP is a one-dimensional (1-D) model, that is, it simulates processes in the river by idealizing the river as a long channel where conditions may vary along the length of the channel but are assumed to be uniform throughout any channel transect (i.e. from left bank to right bank). Approximating the river as a one-dimensional system is reasonable given the results of the summer 2000 SPAWAR study (Katz et al., 2001), which concluded that throughout a channel transect, the water in the river was generally well-mixed, and current velocities were relatively homogenous and primarily directed along the axis of the channel. It is also supported by model simulations carried out subsequent to a dye study conducted in 2000 by LimnoTech, Inc. (LTI) (LTI, 2000). These results showed that a 35 segment 1-D model was capable of simulating fairly well the time evolution of dye concentrations in the tidal river (DC WASA, 2001; Schultz, 2003)

In ICPRB's TAM/WASP Version 2, the main channel is divided along its length into 35 model water column segments, extending from the Bladensburg Road Bridge in Prince Georges County, MD, to the Anacostia's confluence with the Potomac in Washington, DC (see Figure 1-1). Additionally, WASP model segment 36, representing Kingman Lake, adjoins segment 19 (see Figure 5-1). (Kingman Lake is represented as a tidal embayment to segment 19 in ICPRB's upgraded version of the TAM hydrodynamic model.) Each of these 36 water column segments is underlain by a surficial sediment segment (segments 37 to 72), and each surficial sediment segment is underlain by a segment of the lower sediment layer (segments 73 to 108). Surficial sediment segment 72 and lower sediment segment 108 underlie water column segment 36, representing Kingman Lake, and are not represented in Figure 1-3. In all but the PCB sub-model, the surficial bed sediment layer is 1 centimeter (cm) in thickness and the lower bed sediment layer is 5 cm in thickness. Unlike the other TAM/WASP sub-models, the PCB sub-model has four bed sediment layers instead of two.

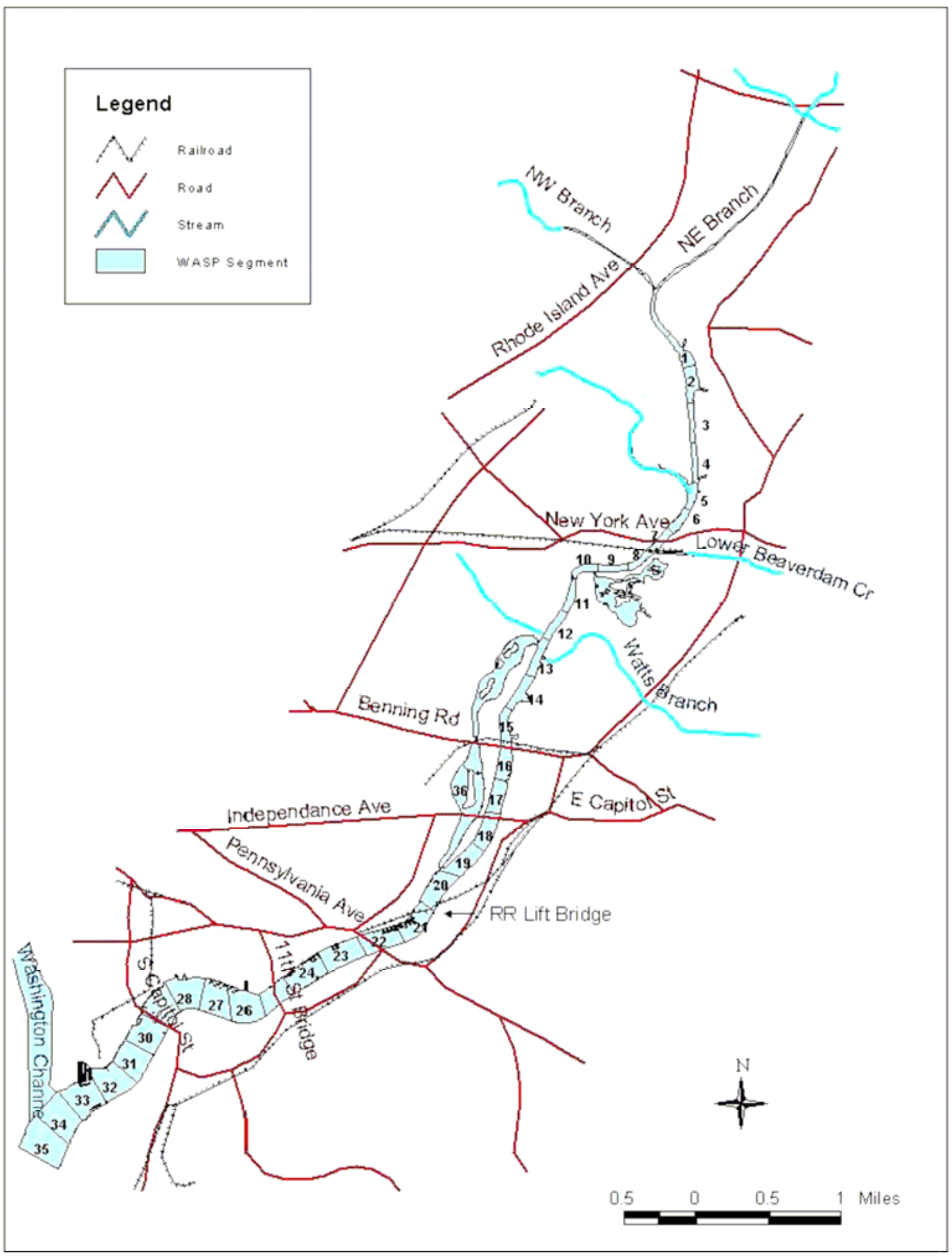

Figure 5-1: Anacostia River Model Segment Geometry, segment 36 represents Kingman Lake

The model was calibrated to meteorological, flow, and water quality data for the calendar years 1988, 1989, and 1990. This series of years is a reasonable set of conditions to examine load reduction scenarios because 1988 was a low flow year, followed by 1989 a high flow year, and 1990 an "average" flow year.

Additional information on this model may be found in the Final TAM/WASP Toxics Screening Level Model for Anacostia River, prepared by ICPRB.

5.2. Scenarios and Model Runs

The Kingman's Lake is considered in the WASP/TAM model as segment 36 to the Anacostia River. The lake is taken as a side embayment in the hydrodynamic model and as an adjoining segment to segment 19 in the WASP model simulation. All model runs for the toxic and metal constituents considered the lake as part of the river system since it is principally affected by the flow conditions in the river than acting as an independent lake system.

The inflows into the Kingman's lake are generally from two sources, the tidal Anacostia flow and the flows from separate storm water, MS4, which are accounted for in the TAM/WASP simulation. Therefore, the corresponding load reduction values adopted in the process of determination of Organic and Metal TMDL values for the Anacostia River hold true for Kingman's Lake.

Calculation of the TMDL values for Kingman's Lake are done by first calculating the existing loads entering the Kingman's Lake from the MS4s, then the existing loads were subjected to corresponding reduction factors that were used in the determination of Organic and Metal TMDL values for the Anacostia River. For more information on the scenarios and runs necessary to achieve compliance for the Organic and Metal TMDL for the Anacostia River, please see that document.

6. Loads TMDL Allocations and Margins of Safety

6.1. Total Loads Reductions and TMDL for Organics and Metals Excluding PCB

For the District of Columbia Stormwater Runoff sources, the following tables show the Loads and allowable TMDL for Kingman Lake Organics and Metals that met the applicable WQS with a margin of safety of one percent. The table includes the percent reduction necessary to meet the WQS critical criteria.

The total allowable loads are shown below.

Constituent	Total Load	Critical Criteria	% Reduction	Total SS Allocation	1% MOS	Total Allocable Stormwater
Arsenic	4.34E-01	Class-D	85%	6.51E-02	6.51E-04	6.44E-02
Copper	1.64E+01	Class-C	0%	1.64E+01	1.64E+00	1.62E+01
Lead	7.99E+00	Class-C	0%	7.99E+00	7.99E-01	7.91E+00
Zinc	4.88E+01	Class-C	0%	4.88E+01	4.88E+00	4.83E+01
Chlordane	2.92E-03	Class-D	90%	2.92E-04	2.92E-06	2.89E-04
DDD	2.13E-03	Class-D	70%	2.133E-04	2.13E-06	2.11E-04
DDE	4.71E-03	Class-D	70%	4.710E-04	4.71E-06	1.27E-05
DDT	1.27E-02	Class-D	70%	1.273E-03	4.66E-04	1.26E-03
Dieldrin	2.62E-04	Class-D	30%	1.83E-04	1.83E-06	1.82E-04
Heptachlor Epoxide	4.42E-04	Class-D	80%	8.84E-05	8.84E-07	8.75E-05
PAH1	2.01E-01	Class-C	98%	1.97E-01	1.97E-03	1.95E-01
PAH2	1.18E+00	Class-D	98%	1.16E+00	1.16E-02	1.15E+00
PAH3	7.53E-01	Class-D	98%	7.38E-01	7.38E-03	7.31E-01

6.1.1. Allocations Excluding PCB

Waste Load Allocation

There are no combined sewer outfalls (CSO) that discharge directly 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. Load reductions for this source have been allocated in the TMDL for Organics and Metals for the Anacostia River and its Tributaries. Therefore, no specific reduction is provided for in this TMDL.

Storm water discharges from storm sewers are point source discharges and are assigned the reductions noted above.

Load Allocation

The total allocation for point source and non-point source storm water are listed above. Those storm water discharges, which are nonpoint sources are assigned the same reduction of loads that are necessary to achieve the total.

Other Sources and Reserve

The allocation of the above listed Organics and Metals to boats, ships, houseboats, and floating residences is zero. The allocation to reserve is zero.

Additional Considerations

Load reductions of the sources to Kingman Lake should continue in order to improve water quality in Kingman Lake**.**

6.1.2. Margin of Safety

The final load allocations and targets include a 1% margin of safety (see Total Allowable Load table above) from the total load allocations.

6.2. Total PCBs: PCB1, PCB2, and PCB3

Polychlorinated biphenyls are one of the most recognizable man made contaminants. PCBs are mixtures of synthetic organic chemicals. Due to their non-flammability, chemical stability and electrical insulation properties, PCBs were used in hundreds of industrial and commercial applications especially in capacitors, transformers and other electrical equipment. Because of the evidence that PCBs persist in the environment and cause harmful effects their manufacture was significantly curtailed in 1977. Their presence in landfills and industrial spills continues to be a significant concern. PCBs are highly soluble in lipids and are absorbed by fish and other animals and tend to accumulate. The rates of metabolism and elimination are slow and vary by species and by congener. Bioaccumulation through food chain leads to concentrate higher chlorine congeners and appear to be more toxic than commercial PCBs. The acute toxicity of PCBs appears to be relatively low, but results from chronic toxicity tests indicate that toxicity is directly related to the duration of exposure. (U.S. EPA, 2000)

PCBs are wide spread in the environment and humans are exposed through multiple pathways. PCBs are carcinogenic and can cause melanoma, stomach and liver cancer. Animal studies link PCBs to problems with pregnancy including stillbirths and spontaneous abortions. Contaminated fish and shell fish are potential sources of human exposure to PCBs. PCBs also have significant ecological and human health effects other than cancer, including neurotoxicity, reproductive and developmental toxicity, immune system suppression, liver damage, skin irritation and endocrine disruption. Toxic effects have been observed from acute and chronic exposures to PCB mixtures with varying chlorine content. The levels in air, water, soil and sediment vary over several orders of magnitude, often depending on proximity to a source of release into the environment. The toxic mechanisms in humans and cancer studies are in progress. (U.S. EPA, 2000)

As discussed above, the modeling for PCBs was divided into three groups PCB1, PCB2, and PCB3. PCB1 includes Dichlorobiphenyl and Trichlorobiphenyl; PCB2 includes Tetrachlorobiphenyl, Pentachlorobiphenyl and Hexachlorobiphenyl; and PCB3 includes Heptachlorobiphenyl, Octachlorobiphenyl, and Nonachlorobiphenyl. The representative water quality standard for each group was based on the constituent with the most stringent water quality standard.

6.2.1. PCB1, PCB2 and PCB3 Loads

PCB1, PCB2 and PCB3 existing concentrations are affected by all of the previously mentioned sources. Two additional sources were identified as contributors to the PCB Loads: 1) Watershed Atmospheric Deposition and 2) Sediment Flux and Resuspension. The average annual loads for the three year period 1988, 1989, and 1990, in pounds, are calculated below for Maryland, CSO, and DC storm water.

Existing PCB1, PCB2 and PCB3 Average Loads in pounds/year

Constituent	Load
PCB1	1.50E-02
PCB2	3.10E-02
PCB3	8.99E-03
Total PCB	5.50E-02

6.2.2. PCB TMDL

6.2.3.

Watershed Atmospheric Deposition of Total PCB was calculated (see Appendix A for calculations) based on Average Annual Atmospheric Deposition Fluxes provided by Chesapeake Bay Program data, 1999, (CPB 1999) yielding a Total Atmospheric Load of 0.053 pounds/year of Total PCB. This value was adjusted by the Runoff Coefficient values provided by the D.C Strom Water Management Report, 2002, resulting in a Total Available Atmospheric Load of 0.025 pounds per year. This load represents the source of the Stormwater Loads to Kingman Lake.

Atmospheric loads impact all stormwater and represent 46.55 % of the total loads. Therefore a 46.55 % load has been allocated to Atmospheric Deposition.

Constituent	Remaining Loads
PCB1	6.97E-03
PCB2	1.45E-02
PCB3	4.19E-03
Total PCB	2.56E-02

The above data inputs were run through the TAM/WASP PCB sub-model for seven consecutive years (21 years) at 46.55 % load reduction as allocated to Atmospheric Deposition and 100 % load reduction to all other remaining sources. However, the final model output concentrations continued to violate the water quality standards, Class D criteria of $4.5x10^{-5}$ ug/l. Sediment flux and resuspension due to existing levels of PCB sediment contamination was identified as the primary barrier to water quality attainment.

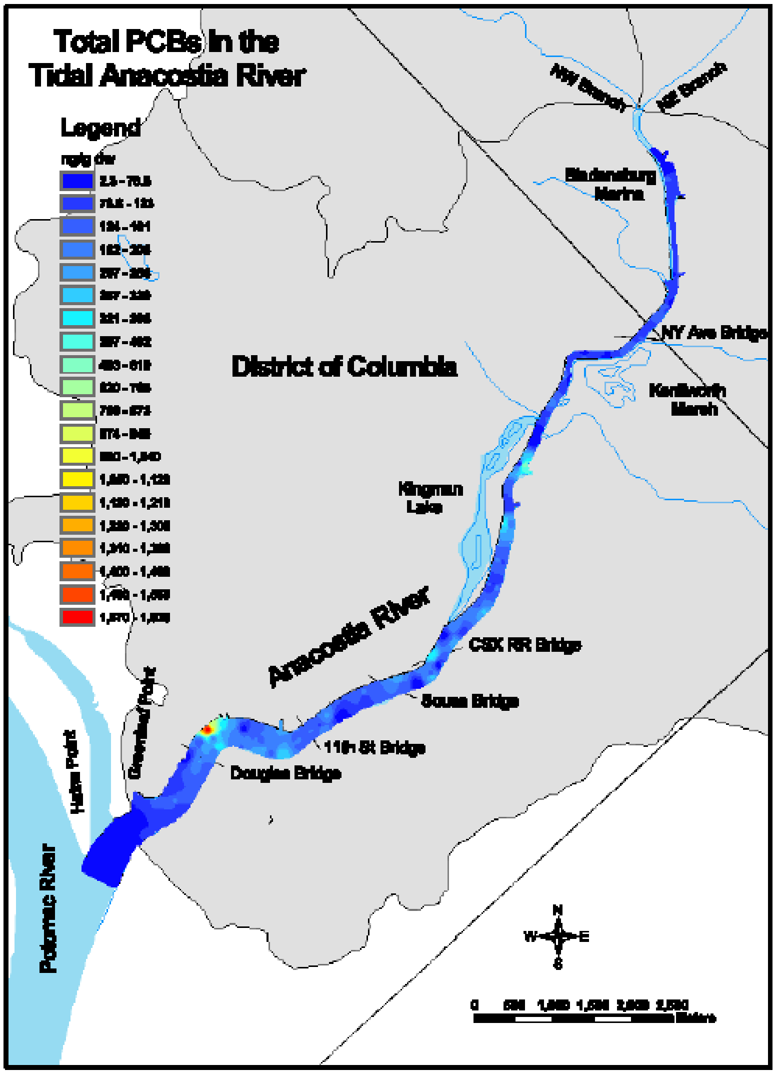

Figure 6-1: Spatial Distribution of Total PCB Sediment Contamination

6.2.4. PCB Allocations

Kingman Lake is located in a watershed in which the PCB impairment is predominately due to atmospheric deposition 100% and historic spills, landfill releases, land applications, *e.g.,* dust suppression, and sediment contamination. Consequently, 47 % of the PCB loads have been allocated to Atmospheric Deposition. Atmospheric Deposition is expected to decrease since the production and use of PCBs was banned in the 1970's, the load from atmospheric deposition will decrease over time. The releases from unidentified land sources are accounted for in the model by the CSO and storm water loads from the MS4 storm sewers. Implementation of this TMDL may require identification of potential PCB sources, *e.g.,* rail yards, and refinements of local air deposition fluxes.

In 1997, Total PCB Load in the lower tidal Anacostia River was estimated at 4.7 MT (metric tons) or 4,700 kg. Further, data obtained through the sediment analysis study performed by Velinsky et.al., (1999) demonstrates the spatial extent and degree of the historic sediment contamination. Their Total PCB sediment concentration results in the tidal river ranged from .0023 to 1.630 ppm dw with an average concentration of 0.162 ppm dw compared to the sediment screening value of 0.0598 ppm dw. (MacDonald, et.al. 2000). Figure 6-1 shows the spatial distribution of Total PCB. Finally, the sediment analysis study performed by U.S. Army Corps of Engineers, *Data Report Kingman Lake Wetland Restoration Project Washington D.C.,* February 2000, further demonstrated the impact of PCB sediment contamination on Kingman Lake. Their results from a composite of eight samples estimated Total PCB at 189.1 ug/kg (estimated as twice the total detected congeners).

As proposed by CPB 1999, only 5% of a tributaries PCB load is transported to the Potomac, the remaining 95% are trapped because the "dilution by downstream transport is not an effective cleansing mechanism for tributaries." Consequently, the flux and resuspension of the contaminated sediment load creates a continuous source to the water column, inhibiting attainment of the water quality standards. To effectively achieve attainment of the water quality standards, a sediment management plan must be developed and implemented. Without implementing a sediment management plan, the sediment contamination will remain a continuous source of PCBs impairing the ability to attain the water quality standards. Therefore, no further reductions to stormwater loads will be imposed at this time.

7. Reasonable Assurance

The District of Columbia has several programs in place to control the effects of storm water runoff and promote nonpoint source pollution prevention and control. Because nonpoint source pollution problems are best addressed on a watershed-wide basis, the District also has joined with the State of Maryland, Prince George's and Montgomery Counties, the Army Corps of Engineers, and other federal agencies to form the Anacostia Watershed Restoration Committee, whose goal is to coordinate efforts to improve water quality in the Anacostia Watershed. The District is also a signatory to the Chesapeake Bay Agreement, pledging to reduce nutrient loads to the Bay by 40 percent or more by the year 2010.

7.1. Agreements

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.

7.2. Source Control Plan

7.2.1. Upstream Target Load Reductions for Maryland

Based upon the best available information, load reductions for the above organics and metals were selected to achieve DC WQS at the DC/MD line. DOH estimates that the controls needed to achieve the allocated reductions will concomitantly achieve at least an 80% reduction of the TSS loads.

7.2.2. CSO Load Reductions

WASA is currently engaged in the following CSO reduction programs.

1. Nine Minimum Controls Plan.
2. Development of the Long-Term Control plan for CSOs which meets the requirements of this TMDL. The completion of the LTCP is contingent upon approval from U.S. EPA and DC DOH.
3. East side interceptor cleaning to remove sedimentation and restore transmission capacity.
4. Pump station rehabilitation to increase transmission capacity to the treatment plant.
5. Inflatable dam rehabilitation to restore the dam's ability to hold sewage inside the pipe, hence reduce overflows.
6. Swirl concentrator rehabilitation and performance enhancements to improve treatment.

7.2.3. Storm Water Load Reductions

The DC Department of Health issued the Nonpoint Source Management Plan II in June, 2000. The plan contains descriptions of the current programs and activities that are performed by DC Government to reduce nonpoint source pollution.

Under the U.S. EPA issued Municipal Separate Storm Sewer Permit there are a number of requirements. The most pertinent of these is the requirement to develop a storm water management plan by April 2002. DC submitted an updated Storm Water Management Plan, dated October 19. 2002. This plan provides additional mechanisms for achieving the load reductions needed.

Major currently operating programs in DC which reduce loads are as follows:

1. Street sweeping programs by the Department of Public Works.

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 –This project restored over 40 acres of freshwater tidal wetlands in the Kingman Lake area in order to increase plant and animal diversity. These wetlands will 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.
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 2002. Funding for this project was cost shared with the USACE and USEPA.
6. Kenilworth Marsh Restoration- This project was constructed in a cooperative effort by the Department of Health, USACE and USNPS. The project involved the restoration of 33 acres of wetlands and it is estimated that they remove 2,720,000 pounds of sediment per growing season.
7. 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).
8. River Terrace & RFK BMPs - The goal of this project is to install storm water management facilities at the end of two storm water outfalls. The outfalls are located along the RFK Stadium parking lot and the River Terrace community. The purpose of these facilities will be to filter pollutants from the storm water before the water is discharged into the Anacostia River. Currently, the USACE is conducted a feasibility study to determine different design options. Cost sharing and funding is provided by the USACE and USEPA for these projects.
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 Lansgton Golf Course has or will have storm water permits issued by U.S. EPA and certified by DC DOH. Under this permit, the federal facility are required to have storm water management plans to control storm water runoff. Any 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 11) 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.

7.2.4. NPDES Permits

Additional requirements, as necessary, will be added to all permits that are issued, reissued or modified by U.S. EPA and certified by DC DOH after the approval of this TMDL. Permits, as an EPA policy, are not reopened to incorporate TMDL requirements. However, in rare cases, a permit would be reopened, upon approval of a TMDL to incorporate necessary requirements of the TMDL, when egregious impacts to the environment are observed or if the permittee is determined to be a significant contributor and there is obvious environmental impact that needs immediate attention. Per EPA guidance, the requirements that will be incorporated into storm water permits are in most cases, BMPs and not numeric effluent limits.

Each source/permit holder in a category will not be required to make the same reductions. Reductions will be determined on a facility-by-facility basis and, in most cases for storm water permit holders, reductions are required in the form of BMPs. EPA will give credit to facilities that are implementing BMPs at the time of permit Reissuance. BMPs will be required to be checked for effectiveness and if additional controls are needed, additional BMPs would be required upon permit reissuance.

Point source facilities that currently have no monitoring for certain TMDL parameters will not necessarily be considered to be a source. However, this will be determined as follows:

First, the facility may be asked to volunteer to monitor for that particular constituent in order to determine whether or not they are a source. Second, the permit may be modified upon reissuance to require monitoring for the constituent with no limit placed. Third the permit may be modified upon reissuance to require monitoring with a clause that if the parameter is detected at levels above the TMDL WLA then the facility must take measures to determine the particular source of the constituent and enact controls to reduce. Then if levels are not reduced the next permit may have limits. A fourth option, if a permittee refuses to take a voluntary sample, EPA can require sampling by issuing a 308 order.

7.2.5. Boat Discharges

The Kingman Lake has been allocated a Zero Discharge from watercraft in this document. In the Chesapeake Bay 2000 Agreement, which was signed by the signatory states, the District of

Columbia, and US EPA, has a provision that by 2003 there will be no discharge of human waste from any boats. Further, DOH has funded pump out stations at every marina in the Anacostia River.

7.3. Monitoring

The Department of Health maintains an ambient monitoring network, which includes the Anacostia River and tributaries.

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APPENDIX A

PCB Atmospheric Deposition

The following are the calculations that were performed to determine the Total Available Atmospheric Load of Total PCB to the Kingman Lake Watershed.

Average Annual Atmospheric Deposition Flux to Chesapeake Bay for Anacostia was assumed as the same for the waterbodies adjoining the Anacostia River. Therefore, the Average Annual Atmospheric Deposition Flux to Anacostia River from Kingman Lake is:

8.3 ug/m2-year Wet Urban Deposition; 8.0 ug/m2-year Dry Urban Deposition

Total Wet-Dry Deposition = 16.3 ug/m^2-year

The calculated deposition flux to the Kingman Lake Watershed was calculated by multiplying the flux rate by the watershed area to generate an average annual loading directly to the waterbody from stormwater.

Kingman Lake Drainage Area = 16,000,000 square feet = 1,486,448.64 square meter

Total Wet-Dry Deposition/Year = 24.22 g/year = 0.053 lbs/year

Total PCB Atmospheric Load = 5.3E-02 lbs/yr

Total PCB Loads = 5.50E-02 lbs/yr

The Total Available Atmospheric Load was calculated by multiplying the Total Atmospheric Load by the Average Weighted Runoff Coefficient for the Kingman Lake Watershed. An average of the weighted average runoff coefficients was used to take into consideration the differences in imperviousness and land within the watershed. The Kingman Lake watershed includes three types of land use: Residential, RFK Stadium and Park, representing 25%, 25% and 50% or the total area respectively. Their corresponding percentage of imperviousness are 72.5 %, 100 %, and 10%, respectively. The average runoff coefficient for each land use was estimated using Equation 3 on page 5-16 of the "*Guidance Manual for the Preparation of the NPDES Permit Applications for Discharges from Municipal Storm Sewer Systems"*, 1992 as follows:

Ci = 0.05 + 0.009 * I
Where Ci = Runoff Coefficient
I = Percent Imperviousness

The weighted average runoff coefficient for the entire watershed was determined using Equation 2 on page 5-16 of the *Guidance Manual for the Preparation of the NPDES Permit Applications for Discharges from Municipal Storm Sewer Systems"*, 1992, as follows:

$$Ciw = (\sum Ai*Ci)/ \sum Ai$$

The results of these calculations are shown below.

Land Use	Area Ai (ft^2)	% Area	% Impervious	Avg Runoff Coefficient, Ci	Ai*Ci	Weighted Average, Ciw
Residential	4000000	25.00	72.5	0.7025	2810000	
RFK Stadium	4000000	25.00	100	0.95	3800000	
Park & Golf Course	8000000	50.00	10	0.14	1120000	
Totals	16000000				7730000	0.483125

Weighted Average Runoff Coefficient = 0.483125

Total Available Atmospheric Load to Kingman Lake = 0.025 lbs/yr