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

DISTRICT OF COLUMBIA

TOTAL MAXIMUM DAILY LOAD
FOR
ORGANICS, METALS AND BACTERIA
IN
OXON RUN

DECEMBER 2004

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

Table of Content

Executive Summary

This report details the development of total maximum daily loads in the Oxon Run watershed. Oxon Run is listed on the District of Columbia's 1998 through draft 2004 Section 303(d) Lists of Impaired Waters. The Section 303(d) lists indicate that fecal coliform bacteria, metals, and organics are the causes of impairment in Oxon Run. Oxon Run flows from its headwaters in Prince George's County, Maryland, into the southeast region of the District, then reenters Maryland before discharging into the Potomac River. Approximately 26 percent of the watershed is located in the District; the remainder of the Oxon Run watershed is located in Maryland.

The Oxon Run watershed is approximately 7,906 acres, or 12.4 square miles. Dominant land uses in the watershed are developed lands (67.9%) and forested lands (22.8%), which account for over 90% of the land area in the Oxon Run watershed. There are three general soil associations present in the Oxon Run watershed; the majority of the soils in the watershed have moderate to slow infiltration rates.

The DC Small Tributaries TMDL Model, developed by the Interstate Commission on the Potomac River Basin (ICPRB), was used to model fecal coliform, metals, and organics concentrations in Oxon Run. The Small Tributaries model is a simple mass balance model which predicts daily water column concentrations of each modeled constituent in Oxon Run. The Small Tributaries model treats each stream as a "bathtub" which, on each day of the simulation period, receives a volume of water representing storm water runoff and a volume of water representing base flow from groundwater from the stream's drainage area. Each of these volumes of water flowing into Oxon Run is assumed to contain a quantity of each of the modeled constituents, based on average concentrations measured in available storm water and base flow monitoring data.

D.C. TMDL For Organics, metals and Bacteria in the Oxon Run

TMDL allocations for Oxon Run were based on the following equation:

$$TMDL = WLA + LA + MOS$$

Where: TMDL= Total Maximum Daily Load

WLA = Wasteload Allocation

LA = Load Allocation

MOS = Margin of Safety

The wasteload allocation represents the total pollutant loading allocated to point sources. In Oxon Run, the wasteload is allocated only to the municipal separate storm sewer systems (MS4s). The load allocation represents the total pollutant loading allocated to nonpoint sources, i.e., pollutant loads carried with runoff from the land surface. An implicit or explicit margin of safety is a required TMDL element to account for uncertainties in TMDL development. An explicit margin of safety of 1% was used to develop the TMDLs for Oxon Run. Because the Oxon Run watershed drains areas in both the District and Maryland, loads were allocated based on the proportion of the drainage areas located in each of these jurisdictions.

Fecal coliform, metals, and organics TMDLs for Oxon Run are presented in Tables E-1 through E-6. A 90% reduction in fecal coliform is required to meet the applicable fecal coliform standard. A 68% reduction in arsenic, a 68% reduction in copper, a 78% reduction in lead, and a 0% reduction in zinc are required to achieve the metals TMDLs in Oxon Run. An 83% reduction in chlordane, a 97% reduction in DDT, a 79% reduction in dieldrin, an 85% reduction in heptachlor epoxide, 0%, 98%, and 98% reductions in the three modeled classes of polycyclic aromatic hydrocarbons (PAHs), and a 99.9% reduction in total polychlorinated biphenyls (PCBs) are required to achieve the organics TMDLs in Oxon Run.

D.C. TMDL For Organics, metals and Bacteria in the Oxon Run

Table E-1: District of Columbia Fecal Coliform Average Annual Existing Loads, TMDL, and Necessary Percent Reduction for Oxon Run (MPN/year)

Oxon Run DC Existing Load	TMDL	MOS (1%)	WLA	LA	Percent Reduction
1.10E+15	1.10E+14	1.10E+12	9.82E+13	1.03E+13	90.0%

Table E-2: Maryland Fecal Coliform Existing and Allocated Loads, and Necessary Percent Reduction for Oxon Run (MPN/year)

Oxon Run MD Existing Load	Oxon Run MD Allocated Load	MOS (1%)	Percent Reduction
7.87E+14	7.87E+13	7.87E+11	90.0%

Table E-3: District of Columbia Metals Average Annual Existing Loads and TMDLs for Oxon Run (lbs/year)

Metals Parameter	Oxon Run DC Existing Load	TMDL	MOS (1%)	WLA	LA	Percent Reduction
Arsenic (total)	6.3	2.0	0.02	1.8	0.2	68%
Copper (total)	237.4	76.0	0.8	67.8	7.4	68%
Lead (total)	115.4	25.4	0.3	22.7	2.4	78%
Zinc (total)	706.4	706.4	7.1	631.3	68.1	0%

Table E-4: Maryland Metals Existing and Allocated Loads and Necessary Percent Reductions for Oxon Run (lbs/year)

Metals Parameter	Oxon Run MD Existing Load	Oxon Run MD Allocated Load	MOS (1%)	Percent Reduction
Arsenic (total)	16.54	5.29	0.05	68%
Copper (total)	610.95	195.50	1.96	68%
Lead (total)	294.95	64.89	0.65	78%
Zinc (total)	1812.28	1812.28	18.12	0%

Table E-5: District of Columbia Organics Average Annual Existing Loads and TMDLs for Oxon Run (lbs/year)

Organics Parameter	Oxon Run DC Existing Load	TMDL	MOS (1%)	WLA	LA	Percent Reduction
Chlordane	4.26E-02	7.24E-03	7.24E-05	6.51E-03	7.30E-04	83%
DDT	1.89E-01	5.66E-03	5.66E-05	5.02E-03	6.40E-04	97%
Dieldrin	4.04E-03	8.48E-04	8.48E-06	7.29E-04	1.19E-04	79%
Heptachlor Epoxide	6.63E-03	9.94E-04	9.94E-06	8.73E-04	1.22E-04	85%
PAH1	3.91E+00	3.91E+00	3.91E-02	3.51E+00	4.01E-01	0%
PAH2	2.29E+01	3.89E-01	3.89E-03	3.51E-01	3.81E-02	98%
PAH3	1.45E+01	2.91E-01	2.91E-03	2.63E-01	2.82E-02	98%
TPCB[1]	3.65E-01	3.65E-04	3.65E-06	3.28E-04	3.78E-05	99.9%

1: TPCB Atmospheric Load: 2.81E-01 lbs/year (see Appendix for full calculation)

Table E-6: Maryland Organics Existing and Allocated Loads and Necessary Percent Reductions for Oxon Run (lbs/year)

Organics Parameter	Oxon Run MD Existing Load	Oxon Run MD Allocated Load	MOS (1%)	Percent Reduction
Chlordane	1.10E-01	1.87E-02	1.87E-04	83%
DDT	5.03E-01	1.51E-02	1.51E-04	97%
Dieldrin	1.15E-02	2.41E-03	2.41E-05	79%
Heptachlor Epoxide	1.81E-02	2.71E-03	2.71E-05	85%
PAH1	1.02E+01	1.02E+01	1.02E-01	0%
PAH2	5.88E+01	9.99E-01	9.99E-03	98%
PAH3	3.73E+01	7.46E-01	7.46E-03	98%
TPCB	9.52E-01	9.52E-04	9.52E-06	99.9%

There is reasonable assurance that the goals of these TMDLs can be met. The District sponsors several programs aimed at controlling stormwater runoff and nonpoint source pollution, and is an active participant in the Chesapeake Bay Agreement, which seeks to significantly reduce nonpoint pollutant loads to the Chesapeake Bay. Public participation is an important part of the Oxon Run TMDL development process. The publication of the Oxon Run draft TMDL report will be public noticed, and the public will have the opportunity to comment on the draft TMDL report.

1 Introduction

1.1 Regulatory Guidance

Section 303(d) of the Clean Water Act and the Environmental Protection Agency's (EPA) Water Quality Planning and Management Regulations (40 CFR Part 130) require states and the District of Columbia to develop Total Maximum Daily Loads (TMDLs) for waterbodies that are identified on the Section 303(d) List of Impaired Waters as not meeting their designated use(s). TMDLs represent the total pollutant loading from point, non-point, and natural background sources, including a margin of safety, which a waterbody can receive without violating water quality standards. The TMDL process establishes the allowable pollutant loadings for a waterbody based on the relationship between pollutant sources and instream water quality conditions. By following the TMDL process, water quality based controls can be established to reduce pollution from both point and non-point sources to restore and maintain water quality (EPA, 2001).

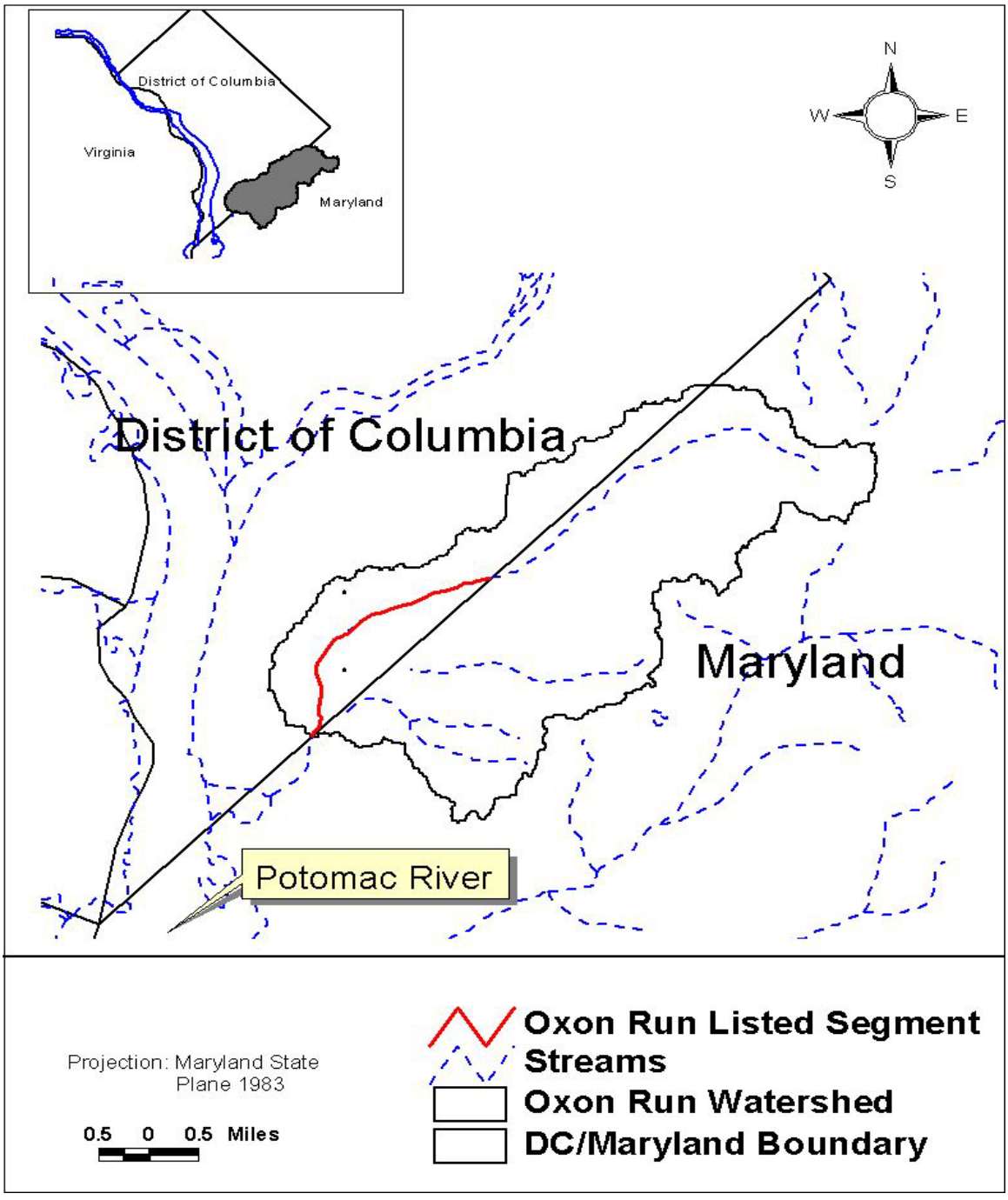
The regulatory agency for the District of Columbia is the Department of Health (DOH). As required by the Clean Water Act, DOH develops and maintains the Section 303(d) List of Impaired Waters in the District that details the pollutant(s) exceeding water quality standards and the potential source(s) of each pollutant. As part of the settlement of a TMDL lawsuit in the District, EPA agreed to develop or approve TMDLs for waters included on the District's 1998 Section 303(d) List of Impaired Waters under a specified timeframe. The TMDLs in this report were developed in partial fulfillment of that lawsuit and address one segment on the District's 1998 Section 303(d) list, Oxon Run. Under the terms of the TMDL lawsuit settlement, EPA must approve the Oxon Run TMDLs by December 2004.

1.2 Impairment Listing

Oxon Run is listed on the District's 1998 through draft 2004 Section 303(d) Lists of Impaired Waters. The Section 303(d) lists indicate that fecal coliform bacteria, metals, and organics are the causes of impairment in Oxon Run. Oxon Run flows from its headwaters in Prince George's County, Maryland, into the southeast region of the District and then flows back into Maryland before discharging into the Potomac River (Figure 1-

1). Based on EPA's Most Current Section 303(d) Listed Waters GIS coverage (EPA, 2002), the impaired segment is 2.9 miles long and is located entirely within the District of Columbia. The impairment begins near the intersection of Mississippi and Southern Avenues where Oxon Run flows from Maryland into the District and continues downstream to the District-Maryland line just south of South Capitol Street.

Figure 1-1: Location of the Oxon Run Watershed



1.2.1 Pollutants of Concern

Due to the limited availability of metals and organics data in Oxon Run, the metals and organics pollutants of concern for the Oxon Run TMDL development were determined from fish tissue and sediment data collected in the Anacostia River. Because of the relatively homogenous distribution of urban lands located throughout the District, it is reasonable to assume that pollutant loadings to Oxon Run are similar to pollutants loadings in other streams in the District, because land use exerts a large influence on pollutant loading (Novotny and Olem, 1994). This approach of establishing the pollutants of concern in Oxon Run was based on the assumption that the pollutants in Oxon Run were similar to those occurring in the Anacostia River and other streams in the District from which data were available (Section 3.0; ICPRB, 2003).

Fecal coliform data were collected in Oxon Run from 1990 to 2002 as part of the DOH monitoring program. Metals and organics pollutants of concern in Oxon Run were determined from fish tissue and sediment samples collected in the Anacostia River and analyzed for metals and organics concentrations. Observed concentrations that exceeded established criteria were identified and cited as pollutants of concern. Arsenic, copper, lead, and zinc were identified as metals of concern (Academy of Natural Sciences, 2000). Chlordane, DDT, dieldrin, heptachlor epoxide, total polycyclic aromatic hydrocarbons (PAHs) and total polychlorinated biphenyls (PCBs) were identified as organic pollutants of concern (U.S. Fish and Wildlife Service, 2001). Given the limited metals and organics data, the pollutants presented above were considered adequate to address the metals and organics impairments in Oxon Run. Additional information on the observed fish tissue and sediment sample results used to establish pollutants of concern can be found in the U.S. Fish and Wildlife Service report on contaminant fish tissue concentrations in the District's surface waters (U.S. Fish & Wildlife Service, 2001) and the sediment data assessment report conducted on the Acacostia River by the Academy of Natural Sciences in Philadelphia (Academy of Natural Sciences, 2000).

1.3 Applicable Water Quality Standards

EPA regulations require that TMDLs be based on the applicable water quality standards. Water quality standards consist of designated uses for a waterbody and water quality criteria necessary to support those designated uses, as well as an antidegradation section. According to the District's Water Quality Standards (DOH, 2003a), "the surface waters of the District should be classified on the basis of their (i) current uses, and (ii) future uses to which the waters will be restored." Designated use classifications are described below.

1.3.1 Designated Uses

The District's Water Quality Standards (§ 1101 of the District of Columbia Municipal Regulations) define five categories of designated water uses which shall be protected, and upon which the development of water quality criteria shall be based. The five designated use categories, and the corresponding classes defined by the District, are presented in Table 1-1. These include the protection primary and secondary contact recreation, as well as aesthetic enjoyment. The maintenance and propagation of aquatic life and the protection of human health related to fish and shellfish consumption are also protected as designated uses of the District's waters. The District's Water Quality Standards also serve to designate waters in the municipality for navigation.

Section 1101.2 of the DC Municipal Regulations classifies Oxon Run under four of the five possible designated use classes (A, B, C, and D). Current uses of Oxon Run are specified as designated use classes B, C, and D. The District's 2004 305(b) report indicates that fecal coliform concentrations in Oxon Run exceeded the primary contact recreation fecal coliform standard 92.3% of the time, and exceeded the secondary contact recreation fecal coliform standard 69.2% of the time (DOH, 2004a). Additionally, the District's 2004 305(b) report states that a bioassessment conducted in 2002 showed that Oxon Run is not supporting its aquatic life use designation, and suggested "possible toxic degradation to the streams' inhabitants" (DOH, 2004a). Therefore, Oxon Run is not currently meeting its designated uses.

Table 1-1: Designated Use Categories for District of Columbia Waters

Designated Use Categories for District of Columbia Waters	Designated Use Classes
Primary contact recreation	A
Secondary contact recreation and aesthetic enjoyment	B
Protection and propagation of fish, shellfish, and wildlife	C
Protection of human health related to consumption of fish and shellfish	D
Navigation	E

1.3.2 Water Quality Criteria

Water quality criteria for bacteria, metals, and organics established by the District of Columbia and Maryland are presented below. The applicable water quality criteria for the Oxon Run TMDLs are the District's standards for fecal coliform, metals, and organics. However, Oxon Run must also meet Maryland water quality standards at the downstream District/Maryland boundary, where Oxon Run flows back into Maryland from the District (Figure 1-1).

1.3.2.1 Fecal Coliform Criteria

The fecal coliform standards defined in the District's Water Quality Standards (§ 1104 of the DC Municipal Regulations) provides separate criteria for the maximum fecal coliform concentrations allowable in waterbodies designated for primary contact recreation (class A) and secondary contact recreation and aesthetic enjoyment (class B; DOH, 2003a). The standards specify the maximum allowable 30-day geometric mean fecal coliform concentration for class A waters as 200 MPN/100mL, where MPN/100mL is defined as the "most probable number" of bacteria colonies in a 100mL sample. The standards also specify the maximum allowable 30-day geometric mean fecal coliform concentration for class B waters to be 1,000 MPN/100mL. Because both primary and secondary contact recreation are specified as designated uses of Oxon Run, the more stringent class A fecal coliform standard of 200 MPN/100mL is the applicable fecal coliform target for the Oxon Run TMDL development.

Maryland expresses its bacteria water quality standards in terms of E. coli rather than fecal coliform bacteria. The Maryland steady state geometric mean standard for E. coli in

all areas is specified as 126 counts/100mL (MDE, 1988). Maryland also specifies single sample maximum allowable density E. coli criteria as 235 counts/100mL for waters with frequent full body contact recreation, 298 counts/100mL for waters with moderately frequent full body contact recreation, 410 counts/100mL for waters with occasional full body contact recreation, and 576 counts/100mL for waters with infrequent full body contact recreation (MDE, 1988).

Evaluation of Oxon Run's primary and secondary contact recreation uses was based on surface water quality data collected and compiled for a five-year span ending in 2003 (DOH, 2004a). Results showed that Oxon Run was not in compliance for its primary contact recreation use 92.3% of the time, and was not in compliance for its secondary contact recreation use 69.2% of the time.

1.3.2.2 Metals Criteria

Metals were also identified on the District's Section 303(d) Lists of Impaired Waters as contributing to the impairment in Oxon Run. Metals criteria are specified in § 1104 of the DC Municipal Regulations (DOH, 2003a). The District's metals criteria for the protection and propagation of fish, shellfish, and wildlife (designated use class C) are expressed in terms of both four-day average criteria and one-hour average criteria. The District's metals criteria for the protection of human health (designated use class D) are expressed as 30-day average criteria. Maryland metals criteria for freshwater systems are also defined for both aquatic life and human health (MDE, 1988). Metals criteria for the pollutants of concern (Section 1.2.1) are presented in Table 1-2. The District's metals criteria for copper, lead and zinc are expressed as a function of hardness. In these instances an average hardness value was computed from all available data points and used to calculate the applicable metals water quality criteria for Oxon Run. Hardness data used to calculate the average hardness value were collected from 1989 to 1997.

Table 1-2: Applicable Metals Water Quality Criteria for Pollutants of Concern

Metals Parameter	District Class C		District Class D	MD Freshwater Aquatic Life		MD Human Health
	4-Day Ave. Criteria (µg/L)	1-Hour Ave. Criteria (µg/L)	30-Day Ave. Criteria (µg/L)	Acute (µg/L)	Chronic (µg/L)	Drinking Water + Organism (µg/L)
Zinc[1]	113.3	124.1	NA	120	120	7400
Lead[1]	2.8	71.6	NA	65	2.5	NA
Copper[1]	12.3	18.6	NA	13	9	1300
Arsenic	150	340	0.14	340	150	10

NA: No applicable criteria available
1: Zinc, lead, and copper concentrations calculated using water quality criteria equations published by the District, using an average observed hardness concentration of 110 mg/L as CaCO3 for the period from 1989 to 1997

1.3.2.3 Organics Criteria

Oxon Run was also identified on the Section 303(d) lists as being impaired due to organics. The District's Water Quality Criteria for organic compounds are specified under Section 1104 of the District of Columbia Municipal Regulations. Organics criteria for the protection and propagation of fish, shellfish, and wildlife (designated use class C) are expressed in terms of both four-day average criteria and one-hour average criteria. Organics criteria for the protection of human health (designated use class D) are expressed as 30-day average criteria. Maryland metals criteria for freshwater systems are also expressed for both aquatic life and human health (MDE, 1988). Organics criteria for the pollutants of concern (Section 1.2.1) are presented in Table 1-3. Note that polycyclic aromatic hydrocarbons are divided into three classes: PAH1 represents the sum of six two- and three-ring PAHs, PAH2 represents the sum of four four-ring PAHs, and PAH3 represents the sum of six five- and six-ring PAHs (ICPRB, 2003). Also, because District water quality standards for PCBs apply to total PCBs only, all PCB congeners were summed into a single class, total PCBs.

Table 1-3: Applicable Organics Water Quality Criteria for Pollutants of Concern

Organic Chemical Parameter	District Class C		District Class D	MD Freshwater Aquatic Life		MD Human Health
	4-Day Ave. Criteria (µg/L)	1-Hour Ave. Criteria (µg/L)	30-Day Ave. Criteria (µg/L)	Acute (µg/L)	Chronic (µg/L)	Drinking Water + Organism (µg/L)
Total Chlordane	0.004	2.4	0.00059	2.40	0.056	0.0080
DDT	0.001	1.1	0.00059	1.10	0.001	0.0022
Dieldrin	0.0019	2.5	0.00014	0.24	0.056	0.00052
Heptachlor Epoxide	0.0038	0.52	0.00011	0.52	0.0038	0.00039
PAH1[a]	50	NA	14000	NA	NA	d
PAH2[b]	400	NA	0.031	NA	NA	0.038[e]
PAH3[c]	NA	NA	0.031	NA	NA	d
Total PCBs	0.014	NA	0.000045	NA	0.014	0.00064

NA: no applicable criteria available
a: sum of six two and three-ring PAH's: naphthalene, 2-methyl naphthalene, acenapthylene, acenapthene, fluorene, phenanthrene (ICPRB, 2003).
b: sum of four four-ring PAH's: fluoranthene, pyrene, benz[a]anthracene, chrysene (ICPRB, 2003).
c: sum of six five and six-ring PAH's: benzo[k]fluoranthene, benzo[a]pyrene, perylene, indeno[1,2,3-c,d]pyrene, benzo[g,h,i]perylene, dibenz[a,h+ac]anthracene (ICPRB, 2003).
d: Maryland human health criteria not specified for all summed parameters. Human health criteria for some specific parameters presented in Maryland Water Quality Standards (MDE, 1988).
e: criteria calculated as the most stringent standard for fluoranthene, pyrene, benz[a]anthracene, and chrysene (ICPRB, 2003).

1.4 Oxon Run TMDL Endpoints

The fecal coliform, metals, and organics criteria established by the District and presented in Section 1.3.2 were used as the numeric TMDL endpoints for Oxon Run. As stated above, PAHs were divided into three classes; to determine the TMDL endpoints for these classes, the conservative assumption was made that the applicable water quality standard was the most stringent standard for a single PAH in each group (ICPRB, 2003). The District specifies water quality criteria for PCBs in terms of total PCBs, so this standard was used as the PCB TMDL endpoint.

2 Watershed Description and Source Assessments

2.1 Watershed Description and Identification

2.1.1 Watershed Boundaries

Oxon Run is a tributary to the Potomac River. The Oxon Run watershed is approximately 7,906 acres, or 12.4 square miles. The watershed is located within Prince George's County, Maryland, and the District of Columbia. The headwaters of Oxon Run originate in Prince George's County, Maryland. Oxon Run then flows into the southeastern section of the District before crossing back over the Maryland state line, then discharging into the Potomac River. For the purposes of the Oxon Run TMDL development, the watershed outlet was delineated at the point Oxon Run leaves the District boundaries and flows back into Maryland. Approximately 26 percent of the watershed is located in the District; the remainder of the Oxon Run watershed is located in Maryland. The location and watershed boundary of Oxon Run was presented in Figure 1-1.

2.1.2 Streams

As stated above, Oxon Run is a tributary of the Potomac River, and flows from Prince George's County, Maryland, into the southeastern section of the District, before flowing back into Maryland and discharging into the Potomac River. Stream data for Oxon Run was obtained from the Reach File version 3 (RF3) database available in BASINS. The Oxon Run Section 303(d) listed segment was obtained from the EPA Most Current Section 303(d) Listed Waters GIS coverage (EPA, 2002). It should be noted that although the EPA Section 303(d) coverage was published in 2002, it has been updated after the publication date to reflect new information. Measurements taken using GIS tools indicate that the length of the mainstem of Oxon Run is approximately 6.8 miles from its headwaters in Prince George's County to the downstream end of the listed segment at the District/Maryland boundary, and that the length of the impaired segment, defined as the segment of Oxon Run located in the District, is approximately 2.9 miles.

Most of the Oxon Run segment located in the District is a concrete-lined trapezoidal channel approximately 50 feet wide and 112 feet deep-with the exception of two reaches

in which the natural streambed has remained intact. Most of its tributaries are piped into the mainstem (DOH, 2004a). Stormwater pipes discharge to Oxon Run at numerous locations along the impaired segment, and several sewer lines cross and parallel the stream (DOH, 2004a).

Most of the Oxon Run segment located in the District has been canalized, and most of its tributaries are piped into the mainstem (DOH, 2004a). The streambed has also been lined with concrete for most of the reach, with the exception of two reaches in which the natural streambed has remained intact. Stormwater pipes discharge to Oxon Run at numerous locations along the impaired segment, and several sewer lines cross and parallel the stream (DOH, 2004a).

2.1.3 Topography

A digital elevation model (DEM) and USGS 7.5 minute quadrangle maps were used to characterize the topography in the watershed. DEM data were obtained from BASINS. Elevation in the watershed ranged from 15 to 609 feet above mean sea level.

2.1.4 Soils

The Oxon Run watershed soil characterization was based on the State Soil Geographic (STATSGO) database obtained from BASINS. There are three general soil associations present in the Oxon Run watershed: Beltsville-Croom-Sassafras, Beltsville-Croom-Leonardtown, and Sunnyside-Christiana-Muirkirk. The majority of the watershed is comprised of Beltsville-Croom-Sassafras and Beltsville-Croom-Leonardtown soils. Beltsville-Croom-Sassafras soils are typically level to strongly sloping, moderately well-drained to well-drained silty and loamy upland soils that may have a fragipan or compact gravelly subsoil. Beltsville-Croom-Leonardtown soils are characterized by a perched water table, slow permeability, and impeded drainage. Sunnyside-Christiana-Muirkirk soils are moderately well-drained soils with moderate to slow infiltration rates, and have the potential to be highly erosive. The distribution of soils in the Oxon Run watershed is presented in Table 2-1.

Table 2-1: Soil Types and Characteristics in the Oxon Run Watershed

Map Unit ID	Soil Association	Percent	Hydrologic Soil Group
MD001	Beltsville-Croom-Sassafras	48.6	B/C/D
MD002	Beltsville-Croom-Leonardtown	43.4	C/B/D
MD007	Sunnyside-Christiana-Muirkirk	7.9	B/C

Source: BASINS (STATSGO)

2.1.5 Land Use

Land use characterization was based on National Land Cover Data (NLCD), developed by USGS. The distribution of land uses in Oxon Run, by land area and percentage, is presented in Table 2-2. Dominant land uses in the watershed are developed lands (67.3%) and forested lands (23.9%), which account for over 91% of the land area in the Oxon Run watershed. Figure 2-1 depicts the land use distribution within the watershed. The percentages of the land use types in the District and Maryland sections of the Oxon Run watershed are presented in Table 2-3. The land use distributions are similar in the District and Maryland sections of Oxon Run, and are dominated by developed lands. The distributions of forested lands are also similar throughout the watersheds. The percent imperviousness in the Oxon Run watershed was calculated using percent imperviousness data for each land use type (ICPRB, 2003). Based on this analysis, it was determined that approximately 1,838 acres (22%) of the Oxon Run watershed is comprised of impervious surfaces.

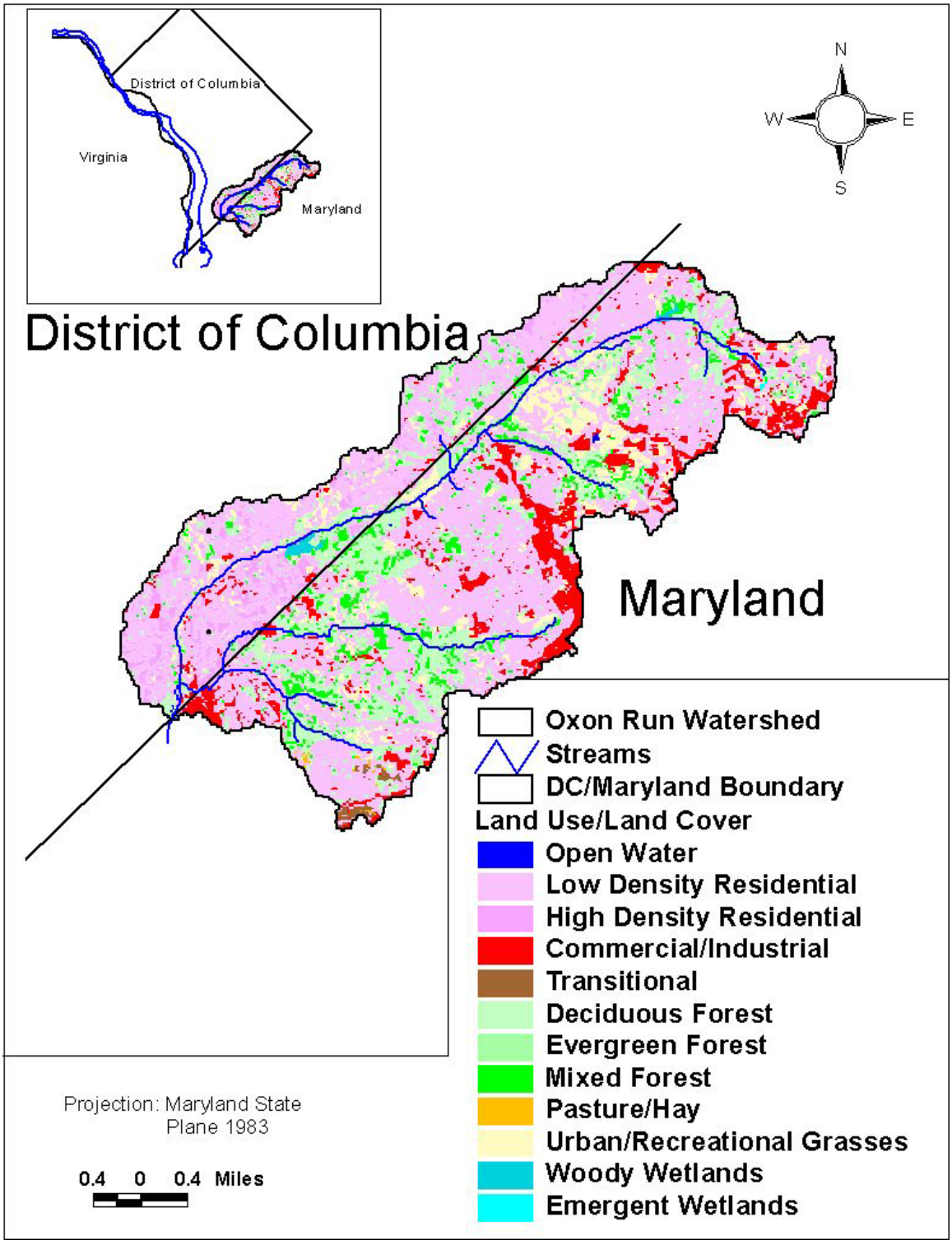
Table 2-2: Land Use Distribution in the Oxon Run Watershed

Land Use Category	Land Use Type	Acres	Percent of Watershed's Land Area
Water/Wetlands	Open Water	6.8	0.1
	Woody Wetlands	26.5	0.3
	Emergent Herbaceous Wetlands	2.7	0.0
Developed	Low Intensity Residential	4,381.1	55.4
	High Intensity Residential	238.9	3.0
	Commercial/Industrial/Transportation	750.7	9.5
Agriculture	Pasture/Hay	7.9	0.1
Forest	Deciduous Forest	1,328.9	16.8
	Evergreen Forest	80.9	1.0
	Mixed Forest	396.4	5.0
Other	Urban/Recreational Grasses	657.0	8.3
	Transitional	28.4	0.4
Total		**7,906**	**100**

Table 2-3: Percent of Land Use Types in the District of Columbia and Maryland Sections of Oxon Run

Land Use Category	Land Use Type	Percent Land Use in DC	Percent Land Use in MD
Water/Wetlands	Open Water	0.1	0.1
	Woody Wetlands	0.9	0.1
	Emergent Herbaceous Wetlands	0.0	0.0
Developed	Low Intensity Residential	65.3	51.9
	High Intensity Residential	11.4	0.0
	Commercial/Industrial/Transportation	2.5	12.0
Agriculture	Pasture/Hay	Not Present	0.1
Forest	Deciduous Forest	11.7	18.7
	Evergreen Forest	0.5	1.2
	Mixed Forest	2.6	5.9
Other	Urban/Recreational Grasses	5.1	9.5
	Transitional	Not Present	0.5
Total		**100**	**100**

Figure 2-1: Land Use in the Oxon Run Watershed



2.1.6 Permitted Facilities

There are two NPDES permitted discharges in the Oxon Run watershed. The first is the Washington Metropolitan Area Transit Authority (NPDES permit # DC0000337), which monitors flow, as well as suspended solids, pH, and oil and grease in its effluent. However, the Washington Metropolitan Area Transit Authority is not required to monitor effluent fecal coliform, metals, or organics concentrations, and is not considered a significant source of these pollutants. The second permitted discharge is the District of Columbia's Municipal Separate Storm Sewer System (MS4, NPDES permit # DC0000221). MS4 permits are different from traditional discharge permits because they do not have a discreet point of discharge but rather cover an area that generates stormwater runoff and the structures that deliver that runoff to streams and rivers. Based on available GIS data for the District, approximately 1,766 acres, or 85%, of the portion of the Oxon Run watershed located in the District are storm sewer areas (Figure 2-2).

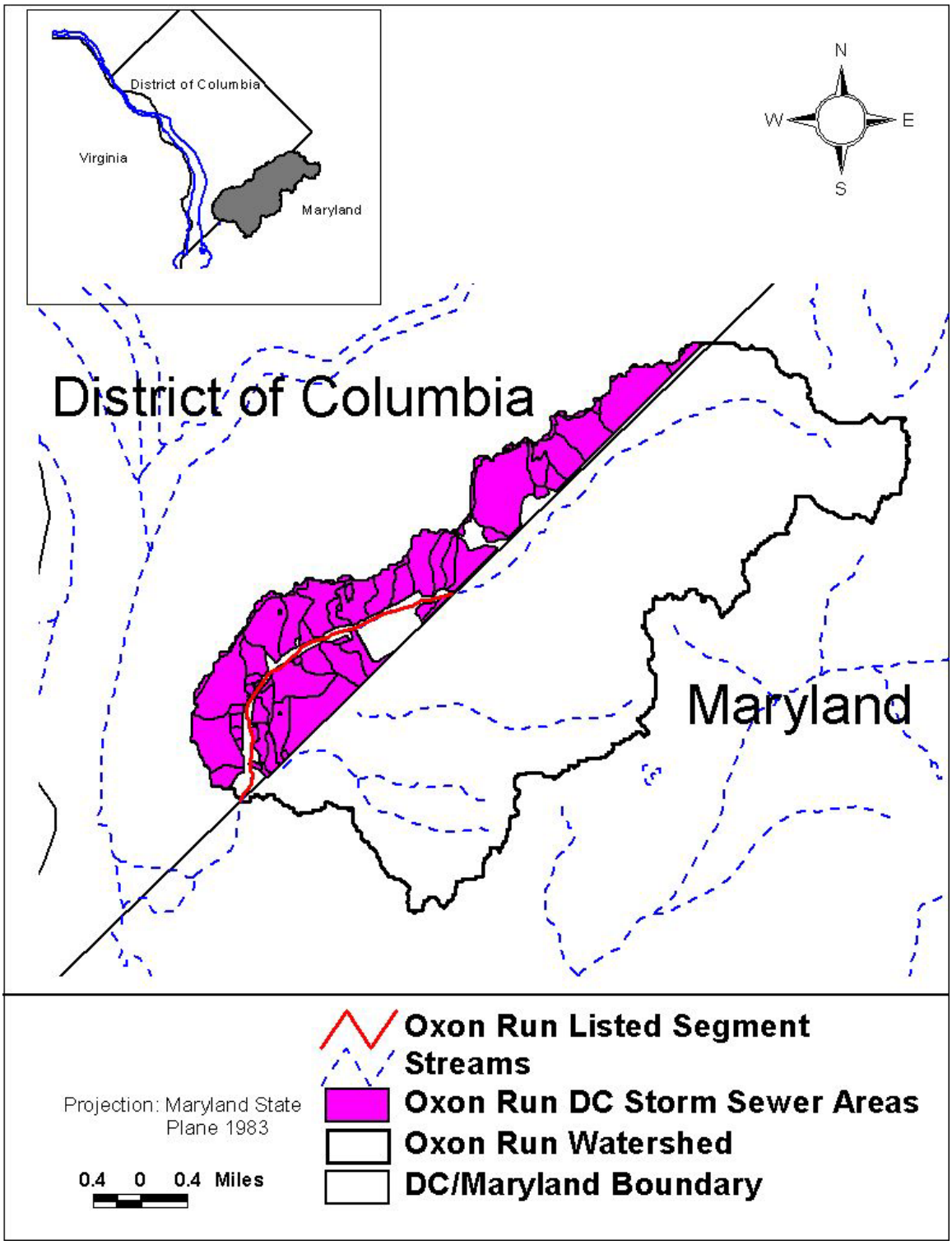
2.2 Sources Assessment

Fecal coliform bacteria can enter surface waters from several sources via several different pathways. During precipitation events, fecal coliform deposited on land by wildlife (i.e., geese, raccoons) or pets can be washed into the stream via storm sewers and overland flow. These animals can also deposit fecal coliform directly into the surface water in instances where they have direct access to the stream.

Metals and organic compounds may wash off from various sources in urban areas, including rooftops, streets, parking lots, and residential lawns. Loading of metals and organics from urban areas typically occurs during precipitation or high surface runoff events. Additionally, some pollutants, such as PCBs, can enter surface waters via atmospheric deposition. There are no permitted point sources discharging metals or organics directly into Oxon Run.

Storm sewers also discharge into Oxon Run, and can potentially be a significant source of pollutant loading to the stream. Although illegal cross connections between sanitary and storm sewers can occur and may exist in the watershed, the District of Columbia Water and Sewer Authority (WASA) has an active program to find and remove such connections. Thus, illegal connections will not be considered further in this TMDL report.

Figure 2-2: District of Columbia Storm Sewer Areas in the Oxon Run Watershed



3 Technical Approach

The DC Small Tributaries TMDL model, developed by the Interstate Commission on the Potomac River Basin (ICPRB), was modified and used to model fecal coliform, metals, and organics concentrations in Oxon Run. The Small Tributaries model was developed to assist DOH in developing TMDLs for waters in the District, and has been previously used to develop TMDLs for small tributaries to the Anacostia and Potomac Rivers (DOH, 2003b; DOH, 2004b).

3.1 Model Description

The DC Small Tributaries TMDL model is a simple mass balance model which predicts daily water column concentrations of each modeled constituent in Oxon Run. The Small Tributaries model is composed of three submodels: an organic chemicals submodel, an inorganic chemicals submodel, and a bacteria submodel. The organic chemicals submodel is capable of modeling several pesticides, including chlordane, dieldrin, heptachlor epoxide, and dichloro-diphenyl-trichloroethane (DDT), as well as polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs). The inorganic chemicals submodel is capable of modeling arsenic, lead, zinc, and copper. The bacteria submodel simulates fecal coliform bacteria concentrations.

The Small Tributaries model treats each stream as a "bathtub" which, on each day of the simulation period, receives a volume of water representing stormwater runoff and a volume of water representing base flow from groundwater inflow through the stream banks. Each of these volumes of water flowing into Oxon Run is assumed to contain a quantity of each of the modeled constituents, based on average concentrations measured in available stormwater and base flow monitoring data. The storm and base flow water volume for each day are assumed to be completely mixed within each tributary, with no simulation of additional instream processes. The DC Small Tributaries model has been used previously to produce estimates of pollutant loadings in streams for which there were little data available (ICPRB, 2003).

3.1.1 Flow Estimates

The DC Small Tributaries model simulates pollutant loadings using data to estimate base flow and storm flow constituent concentrations, and uses the Watts Branch Hydrologic Simulation Program – FORTRAN (HSPF) model developed by ICPRB to estimate storm and base flow input volumes. The HSPF model uses land use, soils, and hourly precipitation data as inputs to simulate the components of the hydrologic cycle including instream flow. Additional information on the Watts Branch HSPF model is presented in Mandel and Schultz (2000).

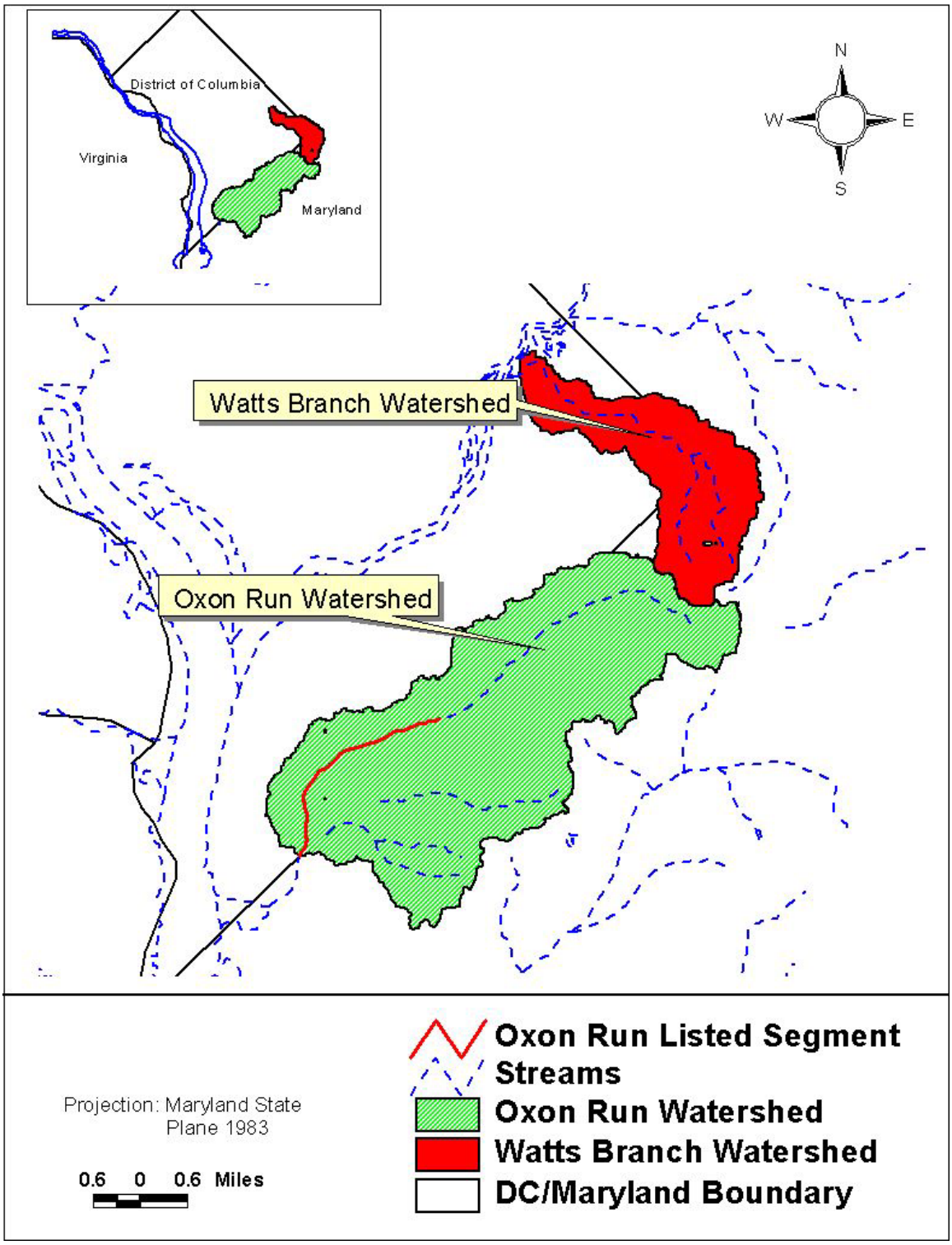
The Watts Branch HSPF model flow estimates were used to develop the Oxon Run TMDLs because the two watersheds are hydrologically very similar. The Watts Branch watershed is directly to the north and adjacent to the Oxon Run watershed (Figure 3-1). The Watts Branch and Oxon Run watersheds are primarily developed, with similar land use distributions and soil characteristics (Table 3-1). Because Oxon Run and Watts Branch have similar hydrologic properties, the unit flow estimates generated by the Watts Branch HSPF model can be used to calculate the flows in the Oxon Run watershed.

The Watts Branch HSPF model was run for a three-year period (1988-1990) that is representative of the range of weather conditions (i.e., dry weather, wet weather, and average precipitation) in the region.

Table 3-1: Land Use Comparison between the Oxon Run and Watts Branch Watersheds

Physical Characteristic	Oxon Run	Watts Branch
Size (mi^2)	12.4	3.8
Land Use Category (%)		
Residential	58.4	64.5
Commercial/Industrial	9.5	8.8
Forest	22.8	18.2
Predominant Field Slope Range (%)	0-40	0-40
Predominant Soil Hydrologic Groups	C/B/D	C/D

Figure 3-1: Location of the Watts Branch and Oxon Run Watersheds



3.1.2 Pollutant Load Estimates

The entire Oxon Run watershed, from its headwaters in Prince George's County, Maryland, to the delineated watershed outlet at the downstream District/Maryland border, was modeled as one watershed, and flow and pollutant load estimates were divided between the District and Maryland based on the proportion of the drainage area located in each of the jurisdictions.

Land uses present in the Oxon Run watershed include residential land (low density and high density residential), commercial/industrial land, park land and forested land. These land use categories represent over 90% of the land use in the Oxon Run watershed (Table 2-2) and thus are reflective of the conditions in the watershed. For modeling purposes the land uses were reclassified into three major categories which include the following land uses; forest land (100% pervious), previous urban land, and impervious urban land.

In-stream pollutant daily concentrations and annual loads were estimated using the Small Tributaries Model and the unit flows generated by the Watts Branch HSPF model. To account for the load entering the stream from Maryland, and to distribute the pollutant loads between the sewered and unsewered areas of the watershed, the Small Tributaries Model was setup and run to calculate the following pollutant loadings:

- Total Existing Pollutant Load: based on the total Oxon Run watershed land area (7,906 acres) and the land use distribution in the watershed. The Total Existing Pollutant Load is comprised of:
    - Maryland Existing Pollutant Load: based on the watershed land area in Maryland and the corresponding land use distribution.
    - District Existing Pollutant Load: based on the watershed land area in the District and the corresponding land use distribution.
- Total Allocated Pollutant Load: based on the total Oxon Run watershed land area. The Total Allocated Pollutant Load is comprised of:
    - Maryland Allocated Pollutant Load: based on the Maryland portion of the watershed.

- District Sewered Allocated Pollutant Load: based on the sewered land area in the District portion of the watershed (1,776 acres) and represents the load carried to Oxon Run by the storm sewer network.
- District Unsewered Allocated Pollutant Load: based on the unsewered land area in the District portion of the watershed (313 acres) and represents the load carried to Oxon Run via overland flow.

3.2 Model Data Sources

Fecal coliform and dissolved metals data were collected in Oxon Run at a DOH water quality monitoring station located at the downstream end of the impaired Oxon Run segment. Total metals and organics data were not collected. The fecal coliform and dissolved metals data were collected from 1990 to 2002, and were used in the Oxon Run TMDL development. Data from previous studies were used to estimate loadings for metals and organic pollutants of concern. These datasets were incorporated into the Small Tributaries model by ICPRB, and are briefly summarized below.

3.2.1 ICPRB Study on the Anacostia River

In 1995-1996, ICPRB collected data on toxic chemicals in the Northeast and Northwest Branches of the Anacostia River as part of a special study (Gruessner et al., 1998). Monitoring was conducted on both tributaries during four storm events and six baseflow events at U.S. Geological Survey (USGS) stations 01649500 and 0165100, located on the Northeast and Northwest Branches of the Anacostia River, respectively. Data were collected for all modeled parameters with the exception of arsenic.

3.2.2 District Municipal Separate Storm Sewer System Monitoring

ICPRB incorporated data collected as part of the District's Municipal Separate Storm Sewer System (MS4) monitoring program into the Small Tributaries model. Data collected from June 2001 to June 2002 were incorporated into the model.

3.2.3 District Water and Sewer Authority Long Term Control Plan Monitoring

The District of Columbia Water and Sewer Authority (WASA) collected stormwater discharge data from combined sewer and separate storm sewer system outfalls, as well as

from tributaries in the District, in support of the District's Long Term Control Plan for combined sewer outfalls. Some samples were analyzed for metals and organic compounds, and these data were incorporated into the Small Tributaries model by ICPRB.

3.3 Consideration of Critical Conditions

Pollutant loadings presented in Section 4.0 are expressed as average annual loads; however, it is important to note that the average annual loads for Oxon Run are calculated based on daily model simulations run for a three-year period (1988-1990) under a range of weather conditions (i.e., dry weather, wet weather, average precipitation). The Oxon Run TMDLs meet water quality standards at all times during the three-year daily simulation, and thus account for seasonal and climatic variations that influence pollutant loadings. The available fecal coliform data collected in Oxon Run indicated that the primary contact recreation geometric mean fecal coliform standard was exceeded throughout the year. Thus, both wet weather and dry weather conditions were considered to be critical conditions for fecal coliform in Oxon Run. Although there were limited metals and organics data available in Oxon Run, metals and organics loadings are typically linked to precipitation and storm flow events in urban settings (Novotny and Olem, 1994). Therefore, the wet weather condition was considered to be the critical condition for metals and organic pollutants in Oxon Run.

4 TMDL Development and Allocation

The purpose of TMDL development and allocation is to quantify pollutant load reductions necessary for Oxon Run to achieve water quality standards. The TMDL endpoints are the numeric criteria for fecal coliform, metals, and organics established by the District and specified in Section 1.0 of this TMDL report.

4.1 Basis for TMDL Allocations

The TMDL is defined as the sum of the wasteload allocations (WLAs) plus the sum of the load allocations (LAs), which also considers the natural background condition, and the margin of safety (MOS). The TMDL is commonly expressed as the following equation:

$$TMDL = WLA + LA + MOS$$

Where:
TMDL= Total Maximum Daily Load
WLA = Wasteload Allocation
LA = Load Allocation
MOS = Margin of Safety

The wasteload allocation represents the total pollutant loading allocated to point sources. In Oxon Run, the wasteload is allocated only to the District's Municipal Separate Storm Sewer System (MS4). The load allocation represents the total pollutant loading allocated to nonpoint sources, i.e., pollutant loads carried with runoff from the land surface. An implicit or explicit margin of safety is a required TMDL element to account for uncertainties in TMDL development. An explicit margin of safety of 1% was used to develop the TMDLs for Oxon Run.

4.2 Total Maximum Daily Loads and Allocations

TMDLs for fecal coliform, metals, and organics were developed using the DC Small Tributaries model described in Section 3.0. To determine allocated loads, several scenarios were run for each parameter of interest before attaining the maximum allowable loading that would not violate the District's numeric water quality criteria. Because the Oxon Run watershed drains areas with similar land uses in both the District and Maryland, fecal coliform loads were allocated based on the proportion of the drainage areas located in each of these jurisdictions. Metals and organic pollutant loads were allocated to the Maryland portion of the watershed, and the sewered and unsewered areas of the District portion of the watershed. In the development of the Oxon Run TMDLs, pollutant loads allocated to sewered areas were considered to be the wasteload allocation (WLA), and pollutant loads allocated to unsewered areas were considered to be the load allocation (LA).

The average annual fecal coliform existing loads, TMDL, and necessary percent reductions for Oxon Run are presented in Tables 4-1 and 4-2. Average annual existing loads, TMDLs, and percent reductions for metals are presented in Tables 4-3 and 4-4. Average annual existing load calculations, TMDLs, and percent reductions for organics are presented in Tables 4-5 and 4-6.

Atmospheric deposition contributes to PCB contamination in the Potomac River Basin; therefore, an atmospheric PCB load was calculated in addition to the land-based load quantified using the Small Tributaries model. The atmospheric deposition PCB load for Oxon Run was based on average annual deposition flux data collected by the Chesapeake Bay Program and calculated using the methodology presented in the *Draft TMDL for Organics and Metals in Battle Kemble Creek, Foundry Branch, and Dalecarlia Tributary* report (DOH, 2004b). The PCB load originating from MS4s was calculated by subtracting the atmospheric load from the total existing load in Oxon Run. The PCB TMDL calculations for Oxon Run are presented in the Appendix.

D.C. TMDL for Bacteria, Organics and Metals in the Oxon Run

Table 4-1: District of Columbia Fecal Coliform Average Annual Existing Loads, TMDL, and Necessary Percent Reduction for Oxon Run (MPN/year)

Oxon Run DC Existing Load	TMDL	MOS (1%)	WLA	LA	Percent Reduction
1.10E+15	1.10E+14	1.10E+12	9.82E+13	1.03E+13	90.0%

Table 4-2: Maryland Fecal Coliform Existing and Allocated Loads, and Necessary Percent Reduction for Oxon Run (MPN/year)

Oxon Run MD Existing Load	Oxon Run MD Allocated Load	MOS (1%)	Percent Reduction
7.87E+14	7.87E+13	7.87E+11	90.0%

Table 4-3: District of Columbia Metals Average Annual Existing Loads and TMDLs for Oxon Run (lbs/year)

Metals Parameter	Oxon Run DC Existing Load	TMDL	MOS (1%)	WLA	LA	Percent Reduction
Arsenic (total)	6.3	2.0	0.02	1.8	0.2	68%
Copper (total)	237.4	76.0	0.8	67.8	7.4	68%
Lead (total)	115.4	25.4	0.3	22.7	2.4	78%
Zinc (total)	706.4	706.4	7.1	631.3	68.1	0%

Table 4-4: Maryland Metals Existing and Allocated Loads and Necessary Percent Reductions for Oxon Run (lbs/year)

Metals Parameter	Oxon Run MD Existing Load	Oxon Run MD Allocated Load	MOS (1%)	Percent Reduction
Arsenic (total)	16.54	5.29	0.05	68%
Copper (total)	610.95	195.50	1.96	68%
Lead (total)	294.95	64.89	0.65	78%
Zinc (total)	1812.28	1812.28	18.12	0%

D.C. TMDL for Bacteria, Organics and Metals in the Oxon Run

Table 4-5: District of Columbia Organics Average Annual Existing Loads and TMDLs for Oxon Run (lbs/year)

Organics Parameter	Oxon Run DC Existing Load	TMDL	MOS (1%)	WLA	LA	Percent Reduction
Chlordane	4.26E-02	7.24E-03	7.24E-05	6.51E-03	7.30E-04	83%
DDT	1.89E-01	5.66E-03	5.66E-05	5.02E-03	6.40E-04	97%
Dieldrin	4.04E-03	8.48E-04	8.48E-06	7.29E-04	1.19E-04	79%
Heptachlor Epoxide	6.63E-03	9.94E-04	9.94E-06	8.73E-04	1.22E-04	85%
PAH1	3.91E+00	3.91E+00	3.91E-02	3.51E+00	4.01E-01	0%
PAH2	2.29E+01	3.89E-01	3.89E-03	3.51E-01	3.81E-02	98%
PAH3	1.45E+01	2.91E-01	2.91E-03	2.63E-01	2.82E-02	98%
TPCB[1]	3.65E-01	3.65E-04	3.65E-06	3.28E-04	3.78E-05	99.9%

1: TPCB Atmospheric Load: 2.81E-01 lbs/year (see Appendix for full calculation)

Table 4-6: Maryland Organics Existing and Allocated Loads and Necessary Percent Reductions for Oxon Run (lbs/year)

Organics Parameter	Oxon Run MD Existing Load	Oxon Run MD Allocated Load	MOS (1%)	Percent Reduction
Chlordane	1.10E-01	1.87E-02	1.87E-04	83%
DDT	5.03E-01	1.51E-02	1.51E-04	97%
Dieldrin	1.15E-02	2.41E-03	2.41E-05	79%
Heptachlor Epoxide	1.81E-02	2.71E-03	2.71E-05	85%
PAH1	1.02E+01	1.02E+01	1.02E-01	0%
PAH2	5.88E+01	9.99E-01	9.99E-03	98%
PAH3	3.73E+01	7.46E-01	7.46E-03	98%
TPCB	9.52E-01	9.52E-04	9.52E-06	99.9%

5 Reasonable Assurance

There is reasonable assurance that the goals of these TMDLs can be met. The District sponsors several programs aimed at controlling stormwater runoff and nonpoint source pollution. Additionally, the District is a signatory to the Chesapeake Bay Agreement and a partner in the Chesapeake Bay Program, which seek to significantly reduce nonpoint pollutant loads to the Chesapeake Bay (Chesapeake Bay Program, 2000).

5.1 Stormwater Load Reductions

The District has several ongoing programs and regulations the objective of which is to limit nonpoint source loading from stormwater runoff. These include the following:

- Street sweeping programs coordinated by the DC Department of Public Works
- Stormwater treatment regulations on all new development and other earth disturbing activities
- Regulatory programs that restrict illegal storm sewer discharges and enforce erosion control laws
- Environmental education and citizen outreach programs to reduce activities that cause pollution

In addition to these programs, the District also has a Nonpoint Source Management Plan to reduce nonpoint source pollution (DOH, 2002), as well as an MS4 permitting system that provides additional mechanisms for reducing nonpoint source pollutant loads from stormwater.

5.2 Chesapeake 2000 Agreement

On June 28, 2000, DC's Mayor Williams, along with the U.S. Environmental Protection Agency and the other Chesapeake Bay Program partners, signed the Chesapeake 2000 Agreement. The agreement sets ambitious goals for reducing nonpoint source loads entering the Chesapeake Bay, including the following:

"Achieve and maintain the water quality necessary to support the aquatic living resources of the Chesapeake Bay and its tributaries and to protect human health…"

and

"By 2010, correct the nutrient and sediment related problems in the Chesapeake Bay and its tidal tributaries sufficiently to remove the Bay and the tidal portions of its tributaries from the lists of impaired waters under the Clean Water Act."

The Chesapeake 2000 Agreement demonstrates a clear commitment to restore the Bay and includes the Potomac River Basin and all its tributaries, which encompasses Oxon Run, in that commitment. This provides assurance that the load reductions specified in the Oxon Run TMDL will be achieved.

5.3 Public Participation

Public participation is an important part of the Oxon Run TMDL development process. The publication of the Oxon Run draft TMDL report will be public noticed, and the public will have the opportunity to comment on the draft TMDL report.

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APPENDIX

Oxon Run PCB Atmospheric Deposition and Allocated Load

Allocated PCB Load = Existing Load – Available Atmospheric Deposition Load

Existing PCB load for the tributary was determined using the DC Small Tributaries Model. The calculations performed to determine the total available PCB atmospheric load to the Oxon Run watershed are described below.

The available atmospheric load was determined using average annual atmospheric deposition flux data collected in the Chesapeake Bay (Chesapeake Bay Program, 1999). The annual fluxes are:

Wet Urban Deposition = 8.3 $\mu g/m^2$-year;
Dry Urban Deposition = 8.0 $\mu g/m^2$-year; and
Total Wet-Dry Deposition = 16.3 $\mu g/m^2$-year

The PCB atmospheric load for the Oxon Run watershed was calculated by multiplying the total wet-dry flux rate by the watershed area to generate the total annual atmospheric deposition loading. This result was then multiplied by the watershed runoff coefficient to determine the atmospheric load delivered to the stream. Direct surface loading to Oxon Run or the water surface is negligible compared to the watershed-based loading, and hence, is not specifically considered. For the respective portions of the watershed in Maryland and the District of Columbia, available atmospheric loads were divided based on the area ratio.

The runoff coefficient was determined by using the following formula (ICPRB, 2003):
Runoff Coefficient = 0.05 + 0.009 * (percent imperviousness)

Percent imperviousness of the Oxon Run watershed is as follows:

Stream	Total Area (acres)	Impervious Area (acres)	Percent Imperviousness
Oxon Run	7,906	1,707	21.59

The PCB loadings for the Oxon Run watershed are as follows:

Stream	Drainage Area (mi^2)	Total Atmos. Load (lbs/yr)	Runoff Coefficient	Atmos. Load (lbs/yr)	Existing PCB Load	Land-Based Load	TMDL
Oxon Run	12.4	1.15	0.244	2.81E-01	1.32E+00	1.04E+00	1.04E-03