PROPOSED
TOTAL MAXIMUM DAILY LOADS (TMDLs)

For
Polychlorinated Biphenyls (PCBs)
In
Fort Loudoun Reservoir

Fort Loudoun Lake Watershed (HUC 06010201)

Blount, Knox, and Loudon Counties, Tennessee

FINAL

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LIST OF ABBREVIATIONS

ADB	Assessment Database
BCF	Bioconcentration Factor
BMP	Best Management Practices
CFR	Code of Federal Regulations
EFO	Environmental Field Office
GIS	Geographic Information System
HRT	Hydraulic Retention Time
HUC	Hydrologic Unit Code
LA	Load Allocation
MGD	Million Gallons per Day
MOS	Margin of Safety
MRLC	Multi-Resolution Land Characteristic
MS4	Municipal Separate Storm Sewer System
NED	National Elevation Dataset
NHD	National Hydrography Dataset
NPS	Non-point Source
NPDES	National Pollutant Discharge Elimination System
PCB	Polychlorinated Biphenyl
RM	River Mile
RMCF	Ready Mixed Concrete Facility
STP	Sewage Treatment Plant
STATSGO	State Soil and Geographic Database
SWPPP	Storm Water Pollution Prevention Plan
SSURGO	Soil Survey Geographic Database
TDA	Tennessee Department of Agriculture
TDEC	Tennessee Department of Environment & Conservation
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WLA	Waste Load Allocation
WWTF	Wastewater Treatment Facility

SUMMARY SHEET

FORT LOUDOUN RESERVOIR

Total Maximum Daily Load for Polychlorinated Biphenyls (PCBs) as Identified on the State of Tennessee's *2008 303(d) List*

Impaired Waterbody Information:

State: Tennessee
Counties: Blount, Knox and Loudon
Watersheds: Fort Loudoun Lake Watershed (HUC 06010201)
Constituents of Concern: Polychlorinated Biphenyls (PCBs)

Waterbody ID	Impaired Waterbody	Miles/Ac
TN06010201020_1000	Fort Loudoun Reservoir	14066 ac
TN06010201020_2000	Fort Loudoun Reservoir	534 ac

Designated Uses:	Domestic water supply, fish & aquatic life, industrial water supply, irrigation, livestock watering & wildlife, and recreation.
Applicable Water Quality Standard	Most stringent numerical criteria applicable to recreation use classification (0.00064 µg/L).
Toxic Substances	The waters shall not contain toxic substances, whether alone or in combination with other substances, that will render the waters unsafe or unsuitable for water contact activities including the capture and subsequent consumption of fish and shellfish, or will propose toxic conditions that will adversely affect man, animal, aquatic life, or wildlife. Human health criteria have been derived to protect the consumer from consumption of contaminated fish and water. The water and organisms criteria should only be applied to those waters classified for both recreation and domestic water.

TMDL Development

General Analysis Methodology:

- Composite fish tissue samples are collected and analyzed for constituents of concern. Existing loads of PCBs in the water column are estimated from the fish tissue concentrations using the Bioconcentration Factors defined by the U.S. Environmental Protection Agency.

- Maximum allowable loads are based on the product of the median winter pool volume and the water quality criteria established by the Tennessee Department of Environment and Conservation, Division of Water Pollution Control.

- TMDLs are established by dividing the maximum allowable loads by the hydraulic retention time.
- Waste Load Allocations (WLAs) are derived for point source dischargers of PCBs.
- Load Allocations are established for non-point sources using a mass-balance approach.

Critical Conditions: Methodology takes into account all flow conditions.

Seasonal Variation: Methodology addresses all seasons.

Margin of Safety (MOS): 20% (Explicit).

TMDLs and Allocations for Fort Loudoun Reservoir

Waterbody ID	Impaired Waterbody	TMDL	MOS	WLA	LA	*Required Overall Load Reduction**
		[lb/day]	[lb/day]	[lb/day]	[lb/day]	*[%]*
TN06010201020_1000	Fort Loudoun Reservoir	0.0330	0.0066	0.00	0.0264	*95.5*
TN06010201020_2000						

*Note: Load reduction required to achieve TMDL.

TOTAL MAXIMUM DAILY LOADS (TMDLs) FOR PCBs FORT LOUDOUN RESERVOIR

1.0 INTRODUCTION

Section 303(d) of the Clean Water Act requires each state to list those waters within its boundaries for which technology-based effluent limitations are not stringent enough to protect any water quality standard applicable to such waters. Impaired waters are prioritized with respect to designated use classifications and the severity of pollution. In accordance with this prioritization, states are required to develop Total Maximum Daily Loads (TMDLs) for those waterbodies that are not attaining water quality standards. State water quality standards consist of designated use(s) for individual waterbodies, appropriate numeric and narrative water quality criteria protective of the designated uses, and an antidegradation statement. The TMDL process establishes the maximum allowable loadings of pollutants for a waterbody that will allow the waterbody to maintain water quality standards. The TMDL may then be used to develop controls for reducing pollution from both point and non-point sources in order to restore and maintain the quality of water resources (USEPA, 1991).

2.0 WATERSHED DESCRIPTION

Fort Loudoun Reservoir is located in Blount, Knox, and Loudon counties of northeastern Tennessee. Tennessee Valley Authority maintains the reservoir.

The Fort Loudoun Lake Watershed, Hydrologic Unit Code (HUC) 06010201, is located in East Tennessee. (ref.: Figure 1). This watershed includes parts of Blount, Knox, Loudon, and Sevier counties. The Fort Loudoun Lake Watershed is positioned within two Level III ecoregions (Blue Ridge Mountains and Ridge and Valley). There are eight Level IV subecoregions in the Fort Loudoun Lake Watershed (ref.: Figure 2) (USEPA, 1997). The Fort Loudoun Lake Watershed has approximately 911 miles of streams and 14,600 reservoir/lake acres (based on the USEPA/TDEC Assessment Database (ADB)) and drains approximately 638 square miles to the Tennessee River.

Watershed land use distribution is based on the Multi-Resolution Land Characteristic (MRLC) databases derived from Landsat Thematic Mapper digital images from around 2001. Although changes in the land use of the Fort Loudoun Lake Watershed have occurred since 2001 as a result of rapid development, this is the most current land use data available. Table 1 summarizes land use for the Fort Loudoun Lake Watershed, as shown in Figure 3.

Figure 1 Location of Fort Loudoun Lake Watershed

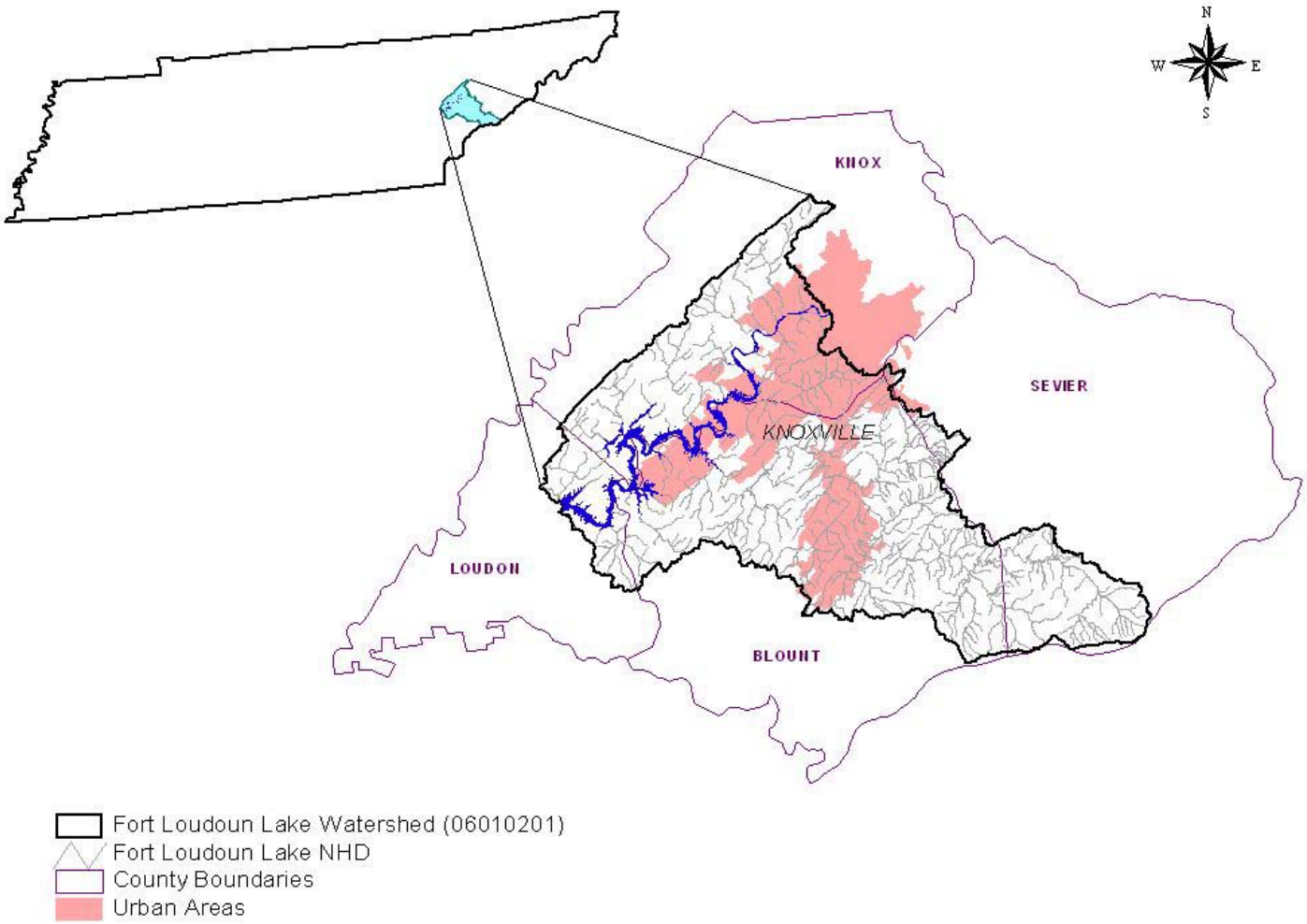


Figure 2 Level IV Ecoregions in the Fort Loudoun Lake Watershed

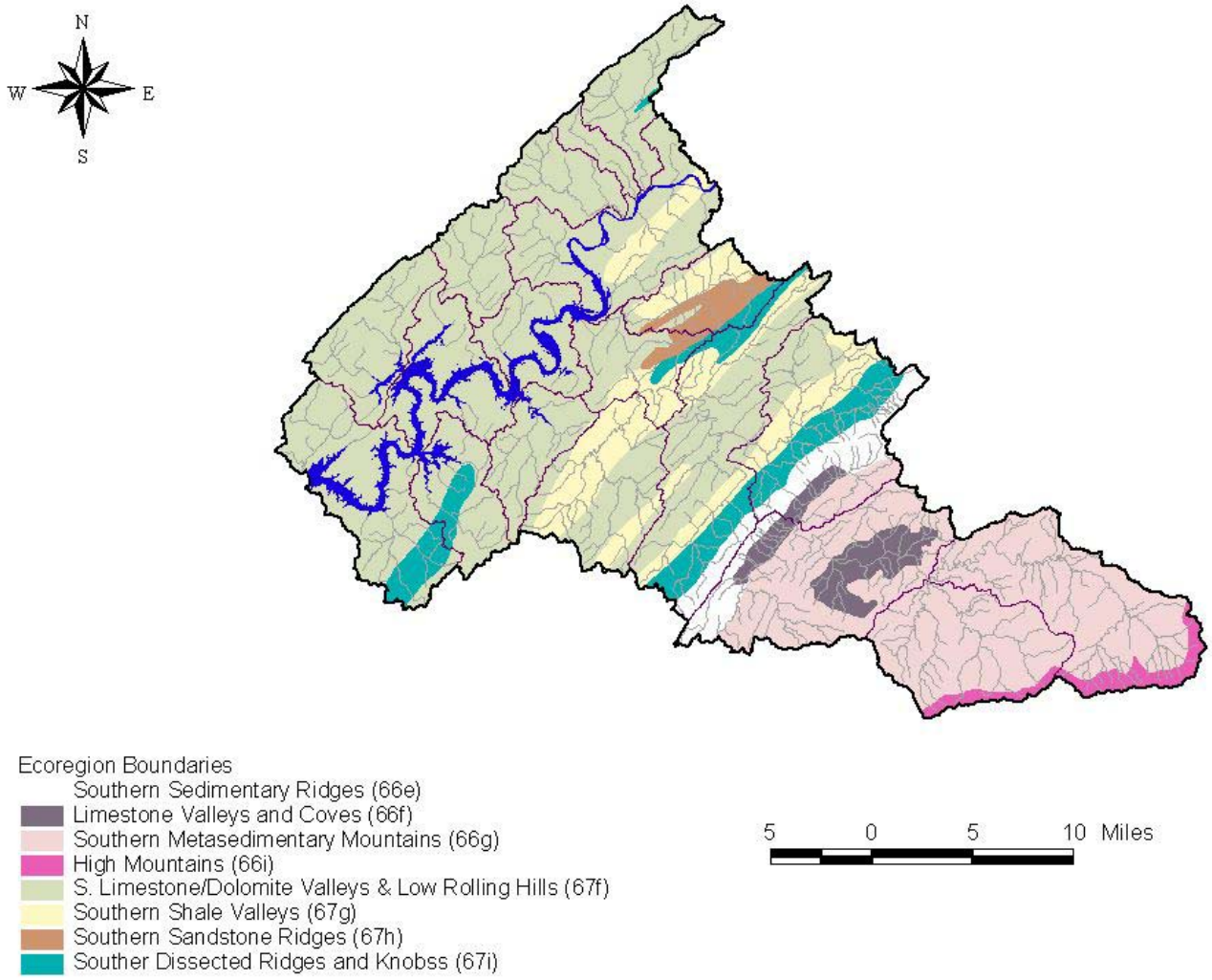


Figure 3 Land Use in the Fort Loudoun Lake Watershed

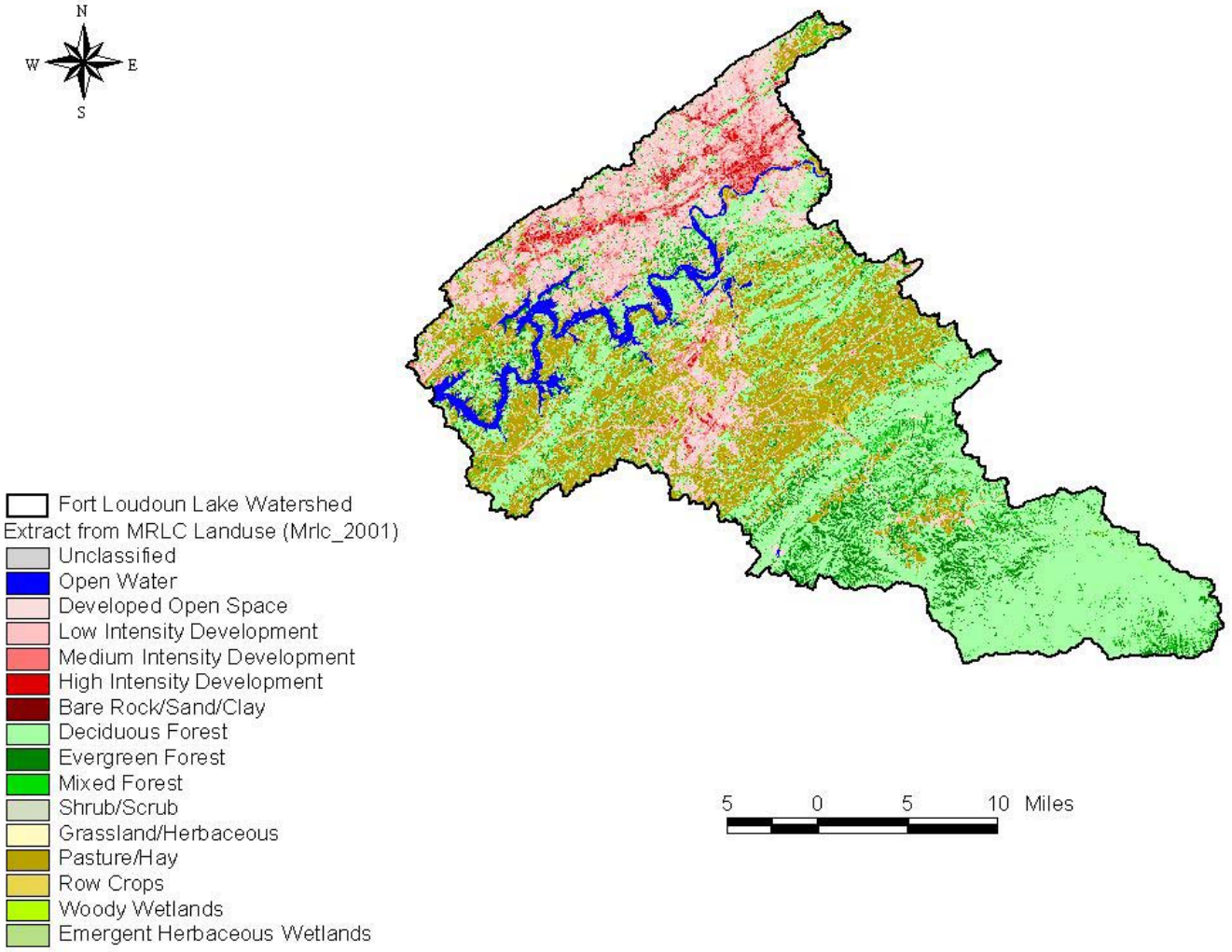


Table 1 2001 MRLC Land Use Distribution – Fort Loudoun Lake Watershed

Land Use	Area	
	[acres]	[%]
Unclassified	0	0.00
Open Water	13,434	3.29
Developed Open Spaces	48,794	11.95
Low Intensity Residential	33,074	8.10
Medium Intensity Residential	13,434	3.29
High Intensity Residential	4,614	1.13
Bare Rock/Sand/Clay	368	0.09
Deciduous Forest	162,552	39.81
Evergreen Forest	27,031	6.62
Mixed Forest	15,353	3.76
Shrub/Scrub	2,246	0.55
Grasslands/Herbaceous	3,552	0.87
Pasture/Hay	77,581	19.00
Row Crops	4,410	1.08
Woody Wetlands	1,878	0.46
Emergent Herbaceous Wetlands	0	0.00
Total	**408,320**	**100.00**

Note: A spreadsheet was used for this calculation and values are approximate due to rounding.

3.0 PROBLEM DEFINITION

The designated use classifications for Fort Loudoun Reservoir include domestic water supply, fish & aquatic life, industrial water supply, irrigation, livestock watering & wildlife, and recreation. The State of Tennessee's *2008 303(d) List* (TDEC, 2008) identified Fort Loudoun Reservoir (TN06010201020_1000 and TN06010201020_2000) in the Fort Loudoun Lake Watershed as not fully supporting designated use classifications due, in part, to elevated levels of polychlorinated biphenyls (PCBs) in fish tissue samples. An excerpt from the 2008 303(d) list is presented in Table 2 and the impaired segments are shown in Figure 4. Assessment information excerpted from the Assessment Database (ADB) is also listed in Table 2. ADB information may be accessed at:

http://tnmap.tn.gov/wpc/

There are approximately 209 congeners of polychlorinated biphenyls (PCBs). These 209 synthetic organic compounds vary not only in their physical and chemical properties, but also in toxicity (USEPA, 1999). PCBs were sold as a mixture that was based upon the percentage of chlorination. Aroclor 1248, 1254, and 1260 indicate the relative percentages of 48, 54, and 60 respectively of chlorination contained in each of these mixtures.

PCBs were manufactured in the United States from the 1920s until 1979 when they were banned by the U.S. Environmental Protection Agency. Prior to this ban, PCBs were commonly used as coolants and lubricants in transformers, capacitors, and other electrical equipment. The manufacturing ban on PCBs did not require all PCB-containing materials to be removed from use. Therefore, some PCBs may still be utilized commercially. So, although the production of PCBs has ceased, these chemicals are widely distributed throughout the environment (USEPA, 1999a). Some other products made before 1977 that may contain PCBs include old fluorescent lighting fixtures and electrical devices containing PCB capacitors and old microscope and hydraulic oils (ATSDR, 2001).

As stated in *Fact Sheet: Polychlorinated Biphenyls Update: Impact on Fish Advisories* (USEPA, 1999):

> Currently, the major source of PCBs is environmental reservoirs from past releases. PCBs have been detected in soil, surface water, air, sediment, plants, and animal tissue in all regions of the earth. PCBs are highly persistent in the environment with reported half-lives in soil and sediment ranging from months to years.

Once in the sediment, PCBs can enter the aquatic food chain. PCBs are fat-soluble chemicals with the potential to concentrate in fish tissue. As a result, humans may be exposed to PCBs through the consumption of contaminated foods, primarily contaminated fish. Studies have demonstrated adverse health effects resulting from PCB exposure. PCBs are classified by EPA as Group B2 (probable carcinogen). PCBs have also been shown to be toxic to the immune system, the reproductive system, the nervous system, and the endocrine system (USEPA, 1999a).

Figure 4 Location of Fort Loudoun Reservoir PCB Impairments (Documented on the *2008 303(d) List*)

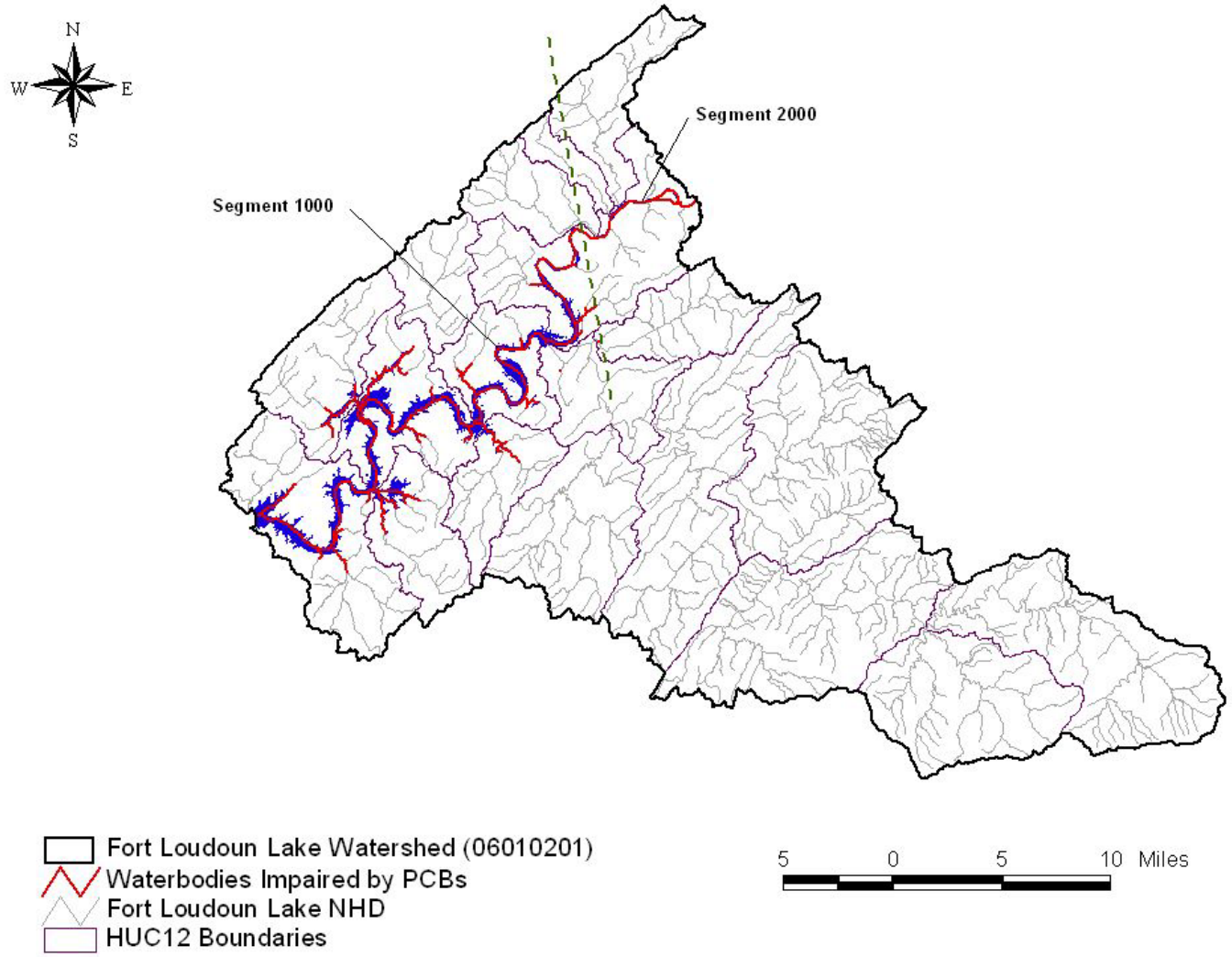


Table 2 *2008 303(d) List* - Stream Impairment Due to PCBs

Waterbody ID	Waterbody	Miles/ Acres	Cause (Pollutant)	Source (Pollutant)	Assessment Comments
TN06010201020_1000	Fort Loudoun Reservoir	14066 ac	PCBs	Contaminated Sediment	TDEC and TVA fish tissue monitoring. TDEC fish sampling station at mile 643.3 (Marine Base). TVA fish sampling station at mile 604.0 (forebay) and at mile 624.6 (d/s Lackey Creek near Lakeview). Fishing advisory for largemouth bass and catfish.
TN06010201020_2000	Fort Loudoun Reservoir	534 ac	Mercury PCBs	Contaminated Sediment	TVA fish tissue monitoring. TVA sampling station at mile 652.0 (d/s confluence of French Broad and Holston). Fishing advisory for largemouth bass and catfish.

4.0 TARGET IDENTIFICATION

These TMDLs are being proposed for Fort Loudoun Reservoir, which is impaired because PCBs in fish tissue samples were detected at levels that exceed the applicable water quality criteria. In order for a TMDL to be established, a numeric "target" protective of the uses of the water must be identified to serve as the basis for the TMDL. Numerical criteria, applicable for PCBs have been established in the *State of Tennessee Water Quality Standards, Chapter 1200-4-3, General Water Quality Criteria, October 2007* (TDEC, 2007) to preserve the various use classifications.

The recreation designated use classification will provide the basis for this PCB TMDL. While numeric criteria exist under the fish & aquatic life designated use, TMDLs developed to protect recreation will protect all other use classifications for the identified waterbodies from adverse effects due to PCB loading. The Tennessee water quality criteria for individual PCB Aroclors and total PCBs are both 0.00064 µg/L under the recreation designated use classification. This value is the same both for organism only and for water & organism consumption. Therefore, 0.00064 µg/L will serve as the appropriate target for the TMDL.

5.0 WATER QUALITY ASSESSMENT AND DEVIATION FROM TARGET

Fish tissue samples were collected and analyzed as defined in *The Results of Fish Tissue Monitoring in Tennessee 1992-1997* (TDEC). Fish tissue data were available from the sites shown in Figure 5. Data were available from both individual and composite fish tissue samples. Only data from composite fish tissue samples were included in the analysis for this TMDL.

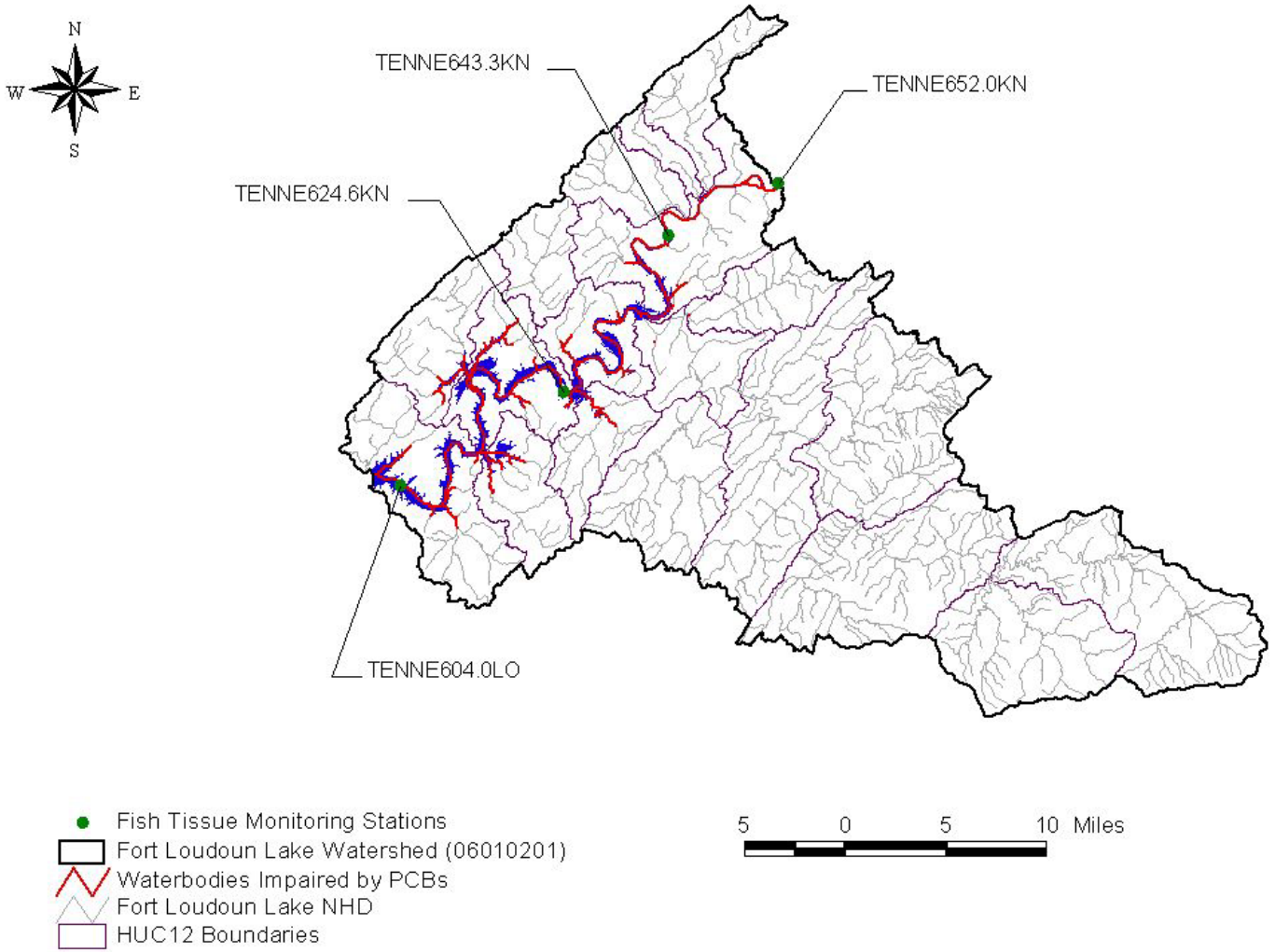
According to the methodology outlined in Section 7.1, the existing concentration of PCBs in the water column was estimated from the fish tissue concentration by using the Bioconcentration Factor defined by the U.S. Environmental Protection Agency (ref.: Appendix A). This data is presented in Table 3. According to the fish species with the highest geometric mean of PCB concentrations, the existing water column concentration was calculated to be 0.0144 µg/L, which is greater than the 0.00064 µg/L target value.

Table 3 Existing Concentrations of PCBs in Fort Loudoun Reservoir Calculated from Composite Fish Tissue Samples

Fish Species	Sample Year	Sampling Site Location	PCBs in Fish Sample (ppm)	Calculated Water Column Concentration (µg/L)
Carp	1991	Tennessee RM 643.3	0.178	0.0057
	1998	Tennessee RM 643.3	0.110	0.0035
		Geomean	**0.1399**	**0.0045**
Blue Catfish	1998	Tennessee RM 643.3	0.090	0.0029
		Geomean	**0.0900**	**0.0029**
Channel Catfish	1991	Tennessee RM 643.3	0.274	0.0088
	2002	Tennessee RM 604.0	0.700	0.0224
		Tennessee RM 624.6	0.600	0.0192
		Tennessee RM 652.0	0.400	0.0128
	2004	Tennessee RM 604.0	0.600	0.0192
		Tennessee RM 652.0	0.300	0.0096
		Geomean	**0.4498**	**0.0144**
LM Bass	1991	Tennessee RM 643.3	0.091	0.0029
	1998	Tennessee RM 643.3	0.0701	0.0022
	2004	Tennessee RM 624.6	0.300	0.0096
		Tennessee RM 604.0	0.200	0.0064
		Tennessee RM 652.0	0.100	0.0032
		Geomean	**0.1308**	**0.0042**

Note: Data presented is representative of PCB Aroclor 1260 – other Aroclors may have been below detection limits.

Figure 5 Fish Tissue Monitoring Sites in Fort Loudoun Reservoir along the Tennessee River



6.0 SOURCE ASSESSMENT

An important part of the TMDL analysis is the identification of individual sources, source categories, or source subcategories of pollutants in the watershed and the amount of pollutant loading contributed by each of these sources. According to the Clean Water Act, sources are broadly classified as either point or non-point sources. Under 40 CFR §122.2, a point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. The National Pollutant Discharge Elimination System (NPDES) program regulates point source discharges. Regulated point sources include: 1) municipal and industrial wastewater treatment facilities (WWTFs); 2) storm water discharges associated with industrial activity (which includes construction activities); and 3) certain discharges from Municipal Separate Storm Sewer Systems (MS4s). For the purposes of these TMDLs, all sources of pollutant loading not regulated by NPDES are considered non-point sources.

6.1 Point Sources

There are numerous permitted dischargers in the Fort Loudoun Lake Watershed. However, there are currently no permitted point source dischargers with existing allocations for PCBs in the Fort Loudoun Lake Watershed.

6.2 Non-point Sources

Assessments have determined that contaminated sediment is the source of PCB impairments in Fort Loudoun Reservoir. According to the U.S. Environmental Protection Agency, “Because PCBs have very low solubility in water and low volatility, most PCBs are contained in sediments that serve as environmental reservoirs from which PCBs may continue to be released over a long period of time. PCBs may be mobilized from sediments if disturbed (e.g., flooding, dredging)” (USEPA, 1999).

Historical data contains very little information regarding point or non-point sources of PCBs. Therefore, until site-specific data proves otherwise, these TMDLs will consider contaminated sediment in the reservoir bed as the primary source of PCB contamination in Fort Loudoun Reservoir.

7.0 DEVELOPMENT OF TOTAL MAXIMUM DAILY LOADS

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and recommends regulatory or other actions to be taken to achieve compliance with applicable water quality standards based on the relationship between pollution sources and in-stream water quality conditions. A TMDL can be expressed as the sum of all point source loads (Waste Load Allocations), non-point source loads (Load Allocations) and an appropriate margin of safety (MOS), which takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$TMDL = \Sigma WLAs + \Sigma LAs + MOS$$

The objective of a TMDL is to allocate loads among all of the known pollutant sources throughout a watershed so that appropriate control measures can be implemented and water

quality standards achieved. 40 CFR §130.2 (i) states that TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measure.

7.1 Analysis Methodology

TMDL analyses were performed at various sites to evaluate waterbodies identified as impaired on the *2008 303(d) List* due to elevated levels of PCBs in fish tissue samples. The TMDL for PCBs in the water column, and the corresponding required load reduction, were calculated according to the following procedure:

- Fish tissue samples were collected and analyzed as defined in *The Results of Fish Tissue Monitoring in Tennessee 1992-1997* (TDEC).

- The geometric mean of the concentrations of PCBs in the fish tissue samples was calculated. If several species were analyzed from the same waterbody, the fish species with the highest geometric mean (ref.: Table 3) was used to estimate the concentration of PCBs in the water column:

$$C_{water} = \frac{C_{fish}}{BCF} \times 1{,}000$$

Where C_{fish}= Fish tissue concentration (mg/kg)
C_{water} = Water column concentration (µg/L)
BCF = Bioconcentration factor (31,200 L/kg)
1,000 = Conversion factor (µg/mg)

- Assuming uniform distribution, the existing total PCB load of the reservoir was computed as the product of the median winter pool volume and the calculated water column concentration (ref.: Section 5.0):

Existing Load = C_{water} x Winter Pool Volume x Unit Conversion Factor

- The maximum allowable amount of PCBs in the reservoir at any time, was determined by the product of the water quality target concentration (ref.: Section 4.0) and the median winter pool volume:

Maximum Allowable Load = C_{target} x Winter Pool Volume x Unit Conversion Factor

- The TMDL was calculated by dividing the maximum allowable load of PCBs in the reservoir at any time by the hydraulic retention time (HRT).

$$TMDL = \frac{\text{Maximum Allowable Load}}{HRT}$$

- A percent reduction, corresponding to the TMDL, was computed based on the existing load and the maximum allowable load:

$$\% \text{ Reduction} = \frac{(\text{Existing Load}) - (\text{Maximum Allowable Load})}{(\text{Existing Load})} \times 100\%$$

- A 20% explicit margin of safety was incorporated into the TMDL.

- Waste load and load allocations were calculated using the TMDL value.

7.2 Margin of Safety

There are two methods for incorporating a Margin of Safety (MOS) into TMDL analysis: a) implicitly incorporate the MOS using conservative model assumptions to develop allocations; or b) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. In these TMDLs, a 20% explicit margin of safety was utilized to account for uncertainties.

7.3 Critical Conditions and Seasonal Variation

Critical conditions were incorporated into the TMDL analysis by using the entire period of record (1991-2004) for the fish tissue monitoring data. Fish tissue data were collected during a variety of seasons. PCB concentrations are not expected to fluctuate very much due to the fact that these pollutants are contained mainly in the sediment.

PCBs can persist in the environment for many years and since there are no known sources of additional PCBs loading, the mass of PCBs contained in the reservoir bed is assumed to be constant over short periods of time. So the concentration of PCBs should be inversely proportional to the volume of water in the reservoir. Determination of PCB loads using the median winter pool volume (when reservoir levels generally are lowest) accounts for periods when the PCB concentrations would theoretically be the greatest. Therefore, the TMDLs will provide year-round protection of water quality standards.

7.4 TMDLs for the Impaired Waterbody

For Fort Loudoun Reservoir the median winter pool volume between 1972 and 1999 was 363,000 ac-ft. The hydraulic retention time is 15 days. (Montgomery, 2008) TMDLs were derived according to the methodology described in Section 7.1.

Maximum Allowable Load = 0.00064 µg/L x 282,000 ac-ft x (1.23×10^{6}) L/ac-ft x (2.205×10^{-9}) lb/µg

Maximum Allowable Load = 0.49 lb

TMDL = 0.49 lb / 15 days = 0.033 lb/day

Using the estimated water column concentration specified in Section 5.0, the existing load was calculated:

Existing Load = 0.0144 µg/L x 282,000 ac-ft x (1.23×10^{6}) L/ac-ft x (2.205×10^{-9}) lb/µg = 11.01 lb

The percent reduction corresponding to the TMDL was computed from the existing load and maximum allowable load:

$$\% \text{ Reduction} = \frac{(11.01 \text{ lb}) - (0.49 \text{ lb})}{(11.01 \text{ lb})} \times 100\% = 95.5\%$$

The TMDL values represent the maximum allowable daily loading of PCBs. Furthermore, these values assume that the pollutants will be uniformly distributed throughout the waterbody. Such conditions may or may not exist, and in either case the localized concentration of either pollutant in Fort Loudoun Reservoir should not exceed water quality target values. The TMDLs and percent reductions are summarized in Table 4.

7.5 Development of Waste Load Allocations and Load Allocations

7.5.1 Waste Load Allocations

There are currently no permitted point source dischargers with existing allocations for PCBs. Zero waste load allocations are being provided.

7.5.2 Load Allocations

The load allocation requires the contribution from non-point sources to be less than or equal to the TMDL target value. In the absence of point sources,

$$LA = TMDL - MOS$$

Incorporating the 20% MOS into the TMDL restricts the PCB loading in Fort Loudoun Reservoir to 0.0264 lb/day. The allocations for Fort Loudoun Reservoir are also provided in Table 4.

Table 4 TMDLs and Allocations for Fort Loudoun Reservoir

Waterbody ID	Impaired Waterbody	TMDL	MOS	WLA	LA	*Required Overall Load Reduction**
		[lb/day]	[lb/day]	[lb/day]	[lb/day]	*[%]*
TN06010201020_1000	Fort Loudoun Reservoir	0.0330	0.0066	0.00	0.0264	*95.5*
TN06010201020_2000						

*Note: Load reduction required to achieve TMDL.

8.0 IMPLEMENTATION PLAN

8.1 Non-point Sources

The Tennessee Department of Environment & Conservation (TDEC) has no direct regulatory authority over most non-point source discharges. Voluntary, incentive-based mechanisms will be used to implement non-point source management measures in order to assure that measurable reductions in pollutant loadings can be achieved for the impaired waterbody.

Fort Loudoun Reservoir was listed as impaired on the *2008 303(d) List* because it was not fully supporting designated use classifications due, in part, to elevated levels of PCBs. Contaminated sediments were listed as the likely source for the contamination in the Fort Loudoun Reservoir.

There are generally two options to prevent PCBs contained in the sediment from being released to the reservoir: 1) avoid disturbing the sediment or 2) remediate contaminated sites. TDEC recommends using option one whenever possible. If the sediment must be disturbed, remediation efforts will be necessary to control the load of PCBs in the reservoir so that the water quality criteria are not exceeded. Strategies to identify sites with elevated levels of PCBs may be helpful for implementing controls to prevent the contaminants from being released into the reservoir.

8.2 Evaluation of TMDL Effectiveness

The effectiveness of these TMDLs will be assessed as data becomes available. As less of the contaminants become biologically available, the concentrations of PCBs measured in fish tissue samples should theoretically decline. Watershed monitoring and assessment activities will provide information by which the effectiveness of PCB load allocations can be evaluated. Continued fish tissue sampling will be necessary to monitor the efficacy of the proposed TMDLs. These results will be reevaluated during subsequent water quality assessment cycles as required by the Clean Water Act.

9.0 PUBLIC PARTICIPATION

In accordance with 40 CFR §130.7, the proposed TMDLs for PCBs in Fort Loudoun Reservoir was placed on Public Notice for a 35-day period and comments solicited. Steps that were taken in this regard included:

1) Notice of the proposed TMDLs was posted on the Tennessee Department of Environment and Conservation website. The announcement invited public and stakeholder comment and provided a link to a downloadable version of the TMDL document.

2) Notice of the availability of the proposed TMDLs (similar to the website announcement) was included in one of the NPDES permit Public Notice mailings, which is sent to interested persons or groups who have requested this information.

3) A letter was sent to identified water quality partners in the Fort Loudoun Lake Watershed advising them of the proposed PCB TMDLs, stating the document's availability on the TDEC website, and inviting comments. These partners included:

Blount County Planning Commission
Little River Watershed Association
Tennessee Izaak Walton League
Natural Resources Conservation Service
Tennessee Department of Agriculture
Tennessee Valley Authority
Tennessee Wildlife Resources Agency
The Nature Conservancy
United States Army Corps of Engineers
United States Fish and Wildlife Service
United States Forest Service
United States Geological Survey

No comments were received during the public notice period.

10.0 FURTHER INFORMATION

Further information concerning Tennessee's TMDL program can be found on the Internet at the Tennessee Department of Environment and Conservation website:

http://www.state.tn.us/environment/wpc/tmdl/

Technical questions regarding these TMDLs should be directed to the following members of the Division of Water Pollution Control staff:

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APPENDIX A

Development of Fish Tissue Concentrations Equivalent to Water Quality Criteria for PCBs

In the State of Tennessee, assessment of waterbody segments for impairment due to PCBs is based on fish tissue concentrations. Public fishing advisories are also based upon fish tissue concentrations. Therefore, for the purpose of this TMDL, PCB concentrations from fish tissue samples will be converted to their equivalent water column concentrations.

PCB Methodology

The formula for calculating the fish tissue concentration requiring a fish advisory is established by *State of Tennessee Water Quality Standards, Chapter 1200-4-3, General Water Quality Criteria, October 2007* (TDEC, 2007). Section 1200-4-3-.03 (4) (l) is summarized below:

$$R = q * E \quad \text{(Equation A-1)}$$

where:

R = Plausible-upper-limit risk of cancer associated with a chemical in a fish species; in Tennessee, a risk level of 10^{-5} is used when considering a fish advisory
q = Carcinogenic Potency Factor for the specific chemical (kg-day/mg)
E = Exposure dose of the specific chemical (mg/kg-day) from the fish species

E is calculated based on the following formula:

$$E = C * I * X / W \quad \text{(Equation A-2)}$$

where:

C = Concentration of the chemical (mg/kg) in the edible portion of the fish species
I = Ingestion rate (g/day) of the fish species; 17.5 g/day will be used (USEPA, 2002)
X = Relative absorption coefficient; assumed to be 1.0
W = Average human mass (kg); 70 kg will be used (USEPA, 2002)

Combining equations A-1 and A-2 and solving for fish tissue concentration (C) results in the following equation:

$$C = (R * CF1 * W) / (q * I * X) \quad \text{(Equation A-3)}$$

where:

CF1 = Conversion Factor (1000 g/kg)

Once the fish tissue target concentration has been determined using Equation A-3, the corresponding water column concentration can be determined using the following equation:

$$C_{water} = [C_{fish} * CF2] / BCF \quad \text{(Equation A-4)}$$

where:

CF2 = Conversion Factor (1000 μg /mg)
BCF = Bioconcentration Factor (L/kg)

Using Equations A-3 and A-4 and published values for q and BCF (USEPA, 2002), the equivalent fish tissue concentrations were calculated for the waterbodies not designated for domestic water supply, see Table A-1.

Table A-1 Equivalent Fish Tissue Concentrations for Waterbodies Not Designated for Domestic Water Supply

Pollutant	q	C_{fish}	BCF	C_{water}
	(kg-day/mg)	(mg/kg)	(L/kg)	(μg/L)
PCB	2.0	0.0200	31,200	0.00064

Since this waterbody was also designated for domestic water supply, the ingestion rate (I) must be adjusted to account for the combined intake of fish and water.

$$I2 = FI + WI \quad \text{(Equation A-5)}$$

Where:

FI = Fish Intake; 17.5 g/day will be used (USEPA, 2002)
WI = Water Intake, 2 L/day will be used (USEPA, 2002)

The water intake can be converted to an equivalent fish intake using information from Equation A-4:

$$WI = 2\ L/Day * CF1 / BCF \quad \text{(Equation A-6)}$$

Therefore:

$$I2 = 17.5 + (2 * CF1 / BCF) \quad \text{(Equation A-7)}$$

Using Equation A-3 and A-4, published values for q and BCF, and substituting I2 for I, the equivalent fish tissue concentrations for waterbodies designated for domestic water supply were calculated:

Table A-2 Equivalent Fish Tissue Concentrations for Waterbodies Designated for Domestic Water Supply

Pollutant	q	C_{fish}	BCF	C_{water}
	(kg-day/mg)	(mg/kg)	(L/kg)	(μg/L)
PCB	2.0	0.0198	31,200	0.000636

Comparison of the fish tissue concentrations in Tables A-1 and A-2 to the water quality criteria established in Section 1200-4-3-.03 (4) (j) for “Organisms Only” and “Water & Organisms” respectively confirms that the values are equivalent. The fish tissue concentrations in Tables A-1 and A-2 are also more stringent than the fish tissue concentrations calculated from the water column criteria established for the fish and aquatic life use classification. Therefore, the fish tissue concentrations in Tables A-1 and A-2 will be used as the target criteria for this TMDL.

APPENDIX B

Public Notice Announcement

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF WATER POLLUTION CONTROL

PUBLIC NOTICE OF AVAILABILITY OF PROPOSED TOTAL MAXIMUM DAILY LOAD (TMDLS) FOR POLYCHLORINATED BIPHENYLS FOR THE FORT LOUDOUN LAKE WATERSHED (HUC 06010201), TENNESSEE

Announcement is hereby given of the availability of Tennessee's proposed Total Maximum Daily Loads (TMDLs) for polychlorinated biphenyls (PCBs) for the Fort Loudoun Lake Watershed, located in eastern Tennessee. Section 303(d) of the Clean Water Act requires states to develop TMDLs for waters on their impaired waters list. TMDLs must determine the allowable pollutant load that the water can assimilate, allocate that load among the various point and nonpoint sources, include a margin of safety, and address seasonality.

Fort Loudoun Reservoir was identified on Tennessee's Final 2008 303(d) list as not supporting designated use classifications due to elevated levels of polychlorinated biphenyls (PCBs) in fish tissue samples. Contaminated sediments are the source of pollutant causes associated with these impairments. Using a mass-balance approach, the TMDLs utilize Tennessee's general water quality criteria, fish tissue sampling data collected from several locations in the Fort Loudoun Reservoir, fish advisory calculations, Bioconcentration Factors defined by the U.S. Environmental Protection Agency, and an appropriate Margin of Safety (MOS) to establish PCB loading levels which will result in lower fish tissue concentrations and the attainment of water quality standards.

The proposed PCB TMDLs may be downloaded from the Department of Environment and Conservation website:

http://www.state.tn.us/environment/wpc/tmdl/

Technical questions regarding this TMDL should be directed to the following members of the Division of Water Pollution Control staff:

Vicki S. Steed, P.E., Watershed Management Section
Telephone: 615-532-0707

Sherry H. Wang, Ph.D., Watershed Management Section
Telephone: 615-532-0656

Persons wishing to comment on the proposed TMDL are invited to submit their comments in writing no later than January 4, 2010 to:

Division of Water Pollution Control
Watershed Management Section
7th Floor, L & C Annex
401 Church Street
Nashville, TN 37243-1534

All comments received prior to that date will be considered when revising the TMDL for final submittal to the U.S. Environmental Protection Agency.

The TMDL and supporting information are on file at the Division of Water Pollution Control, 6th Floor, L & C Annex, 401 Church Street, Nashville, Tennessee. They may be inspected during normal office hours. Copies of the information on file are available on request.