

**PROPOSED
TOTAL MAXIMUM DAILY LOADS (TMDLs)**

**For
Polychlorinated Biphenyls (PCBs)
And Chlordane
In
Melton Hill Reservoir**

Lower Clinch River Watershed (HUC 06010207)

Anderson, Knox, Loudon, and Roane Counties, Tennessee

FINAL

Prepared by:

Tennessee Department of Environment and Conservation
Division of Water Pollution Control
7th Floor L & C Annex
401 Church Street
Nashville, TN 37243-1534

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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
NPS	Non-point Source
NPDES	National Pollutant Discharge Elimination System
PCB	Polychlorinated Biphenyl
RM	River Mile
STP	Sewage Treatment Plant
SWPPP	Storm Water Pollution Prevention Plan
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
MELTON HILL RESERVOIR

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

Impaired Waterbody Information:

State: Tennessee

Counties: Anderson, Knox, Loudon, and Roane

Watershed: Lower Clinch River Watershed (HUC 06010207)

Constituents of Concern: Polychlorinated Biphenyls (PCBs) and Chlordane

Waterbody ID	Impaired Waterbody	Acres
TN06010207006_1000	Melton Hill Reservoir	5690

Designated Uses: Fish & aquatic life, irrigation, livestock watering & wildlife, and recreation.

Applicable Water Quality Standard Most stringent numerical criteria applicable to recreation use classification

(Chlordane): 0.0081 µg/L.

(PCBs): 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 and chlordane 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.
- Fish tissue monitoring data indicate that levels of chlordane are below the target criteria. Since only a limited amount of monitoring data was available for chlordane, TDEC recommends additional fish tissue monitoring. At this time, a TMDL has been provided for chlordane. If additional data confirms levels below the target, TDEC recommends de-listing of the Melton Hill Reservoir for chlordane.

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 Melton Hill Reservoir

Waterbody ID	Impaired Waterbody	Pollutant	TMDL	MOS	WLA	LA	<i>Required Overall Load Reduction*</i>
			[lb/day]	[lb/day]	[lb/day]	[lb/day]	[%]
TN06010207006_1000	Melton Hill Reservoir	PCBs	0.0174	0.0035	0.00	0.0139	96.1
		Chlordane	0.2175	0.0435	0.00	0.1740	NR

*Note: Load reduction required to achieve TMDL.

NR = No reduction required. Sample load is lower than target load.

**TOTAL MAXIMUM DAILY LOADS (TMDLs)
FOR PCBs and CHLORDANE
MELTON HILL 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

Melton Hill Reservoir is located in Anderson, Knox, Loudon, and Roane counties of northeastern Tennessee. Tennessee Valley Authority maintains the reservoir. Melton Hill Reservoir is located within the Lower Clinch River watershed. The Lower Clinch River Watershed, HUC 06010207, has approximately 854 miles of streams and drains approximately 628 square miles to the Tennessee River.

The Lower Clinch River watershed is located in eastern Tennessee (ref.: Figure 1) and includes parts of Anderson, Knox, Loudon, and Roane counties. The Lower Clinch River watershed is positioned within three Level III ecoregions (Ridge and Valley, Southwest Appalachians, and Central Appalachians). There are five Level IV subecoregions in the Lower Clinch River watershed (ref.: Figure 2) (USEPA, 1997).

Watershed land use distribution is based on the Multi-Resolution Land Characteristic (MRLC) databases derived from Landsat Thematic Mapper digital images from approximately 2001. Although changes in the land use of the Lower Clinch River 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 Lower Clinch River watershed, as shown in Figure 3.

Figure 1 Location of Melton Hill Reservoir

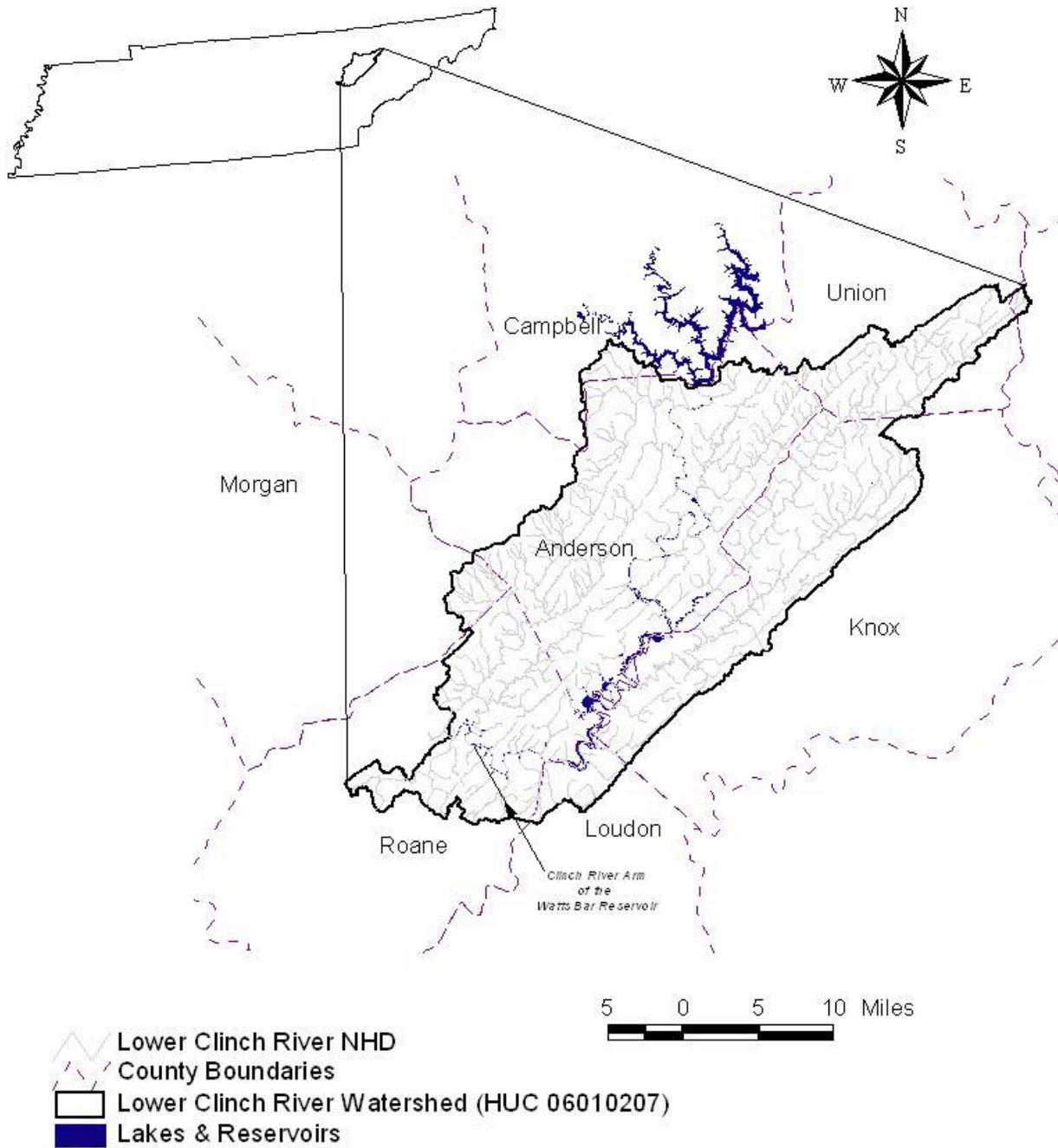


Figure 2 Level IV Ecoregions in the Lower Clinch River Watershed

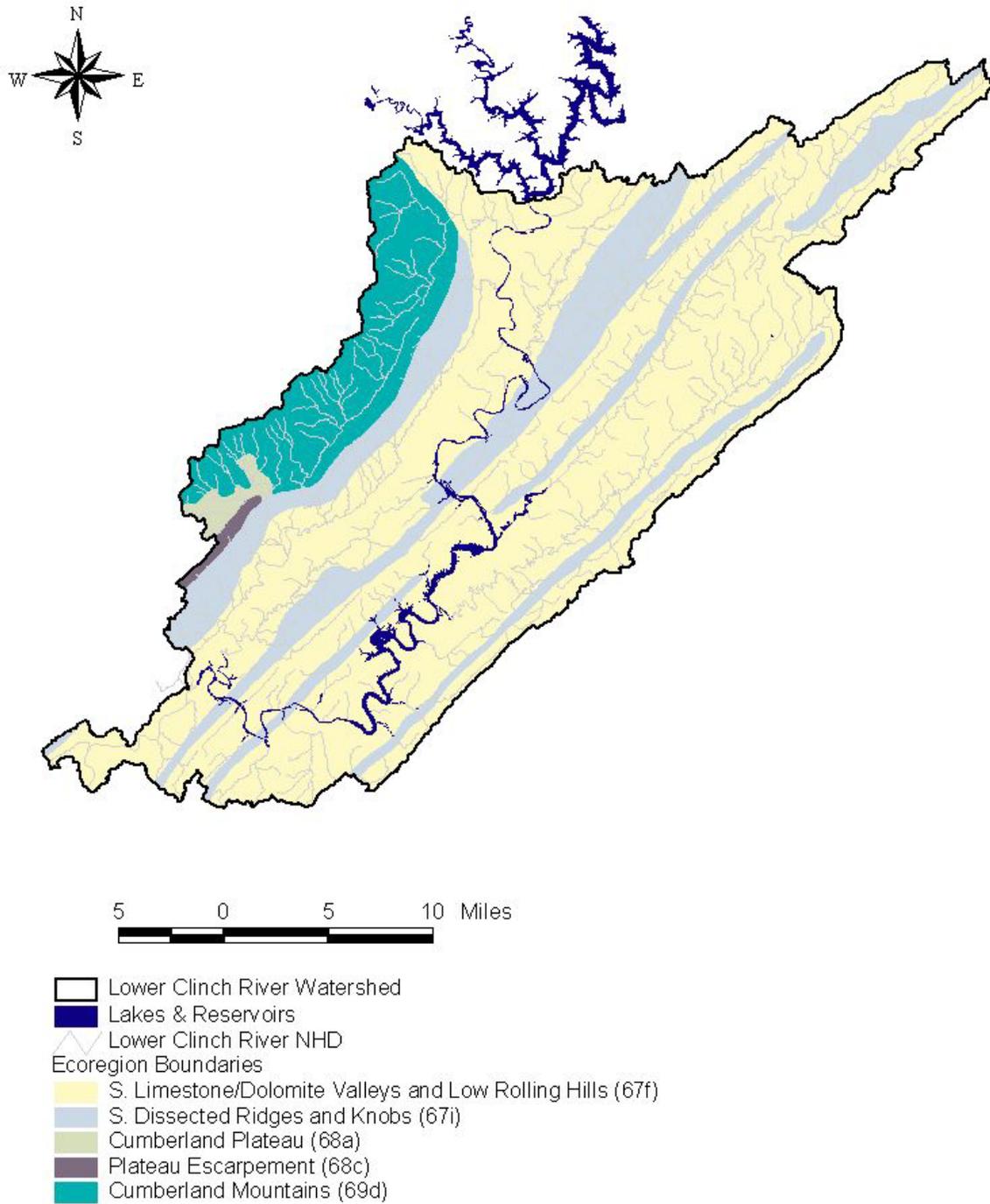
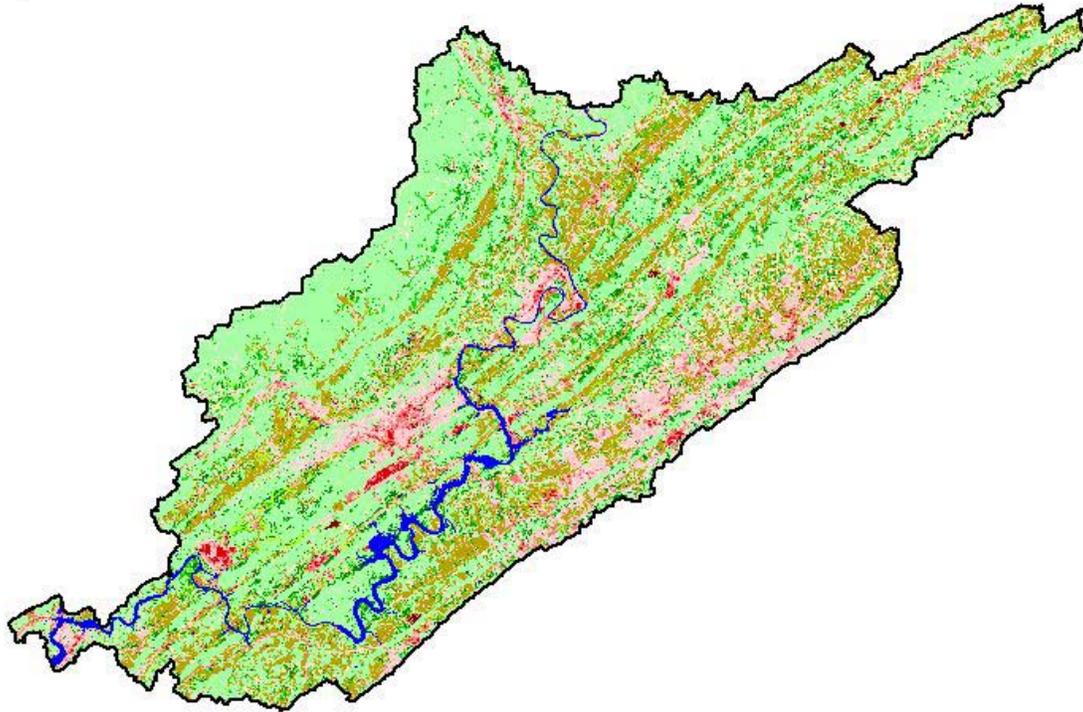
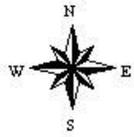


Figure 3 Land Use in the Lower Clinch River Watershed



Lower Clinch River Watershed (06010207)

MRLC 2001

- | | |
|------------------------------|------------------------------|
| Unclassified | Evergreen Forest |
| Open Water | Mixed Forest |
| Developed Open Space | Shrub/Scrub |
| Low Intensity Development | Grassland/Herbaceous |
| Medium Intensity Development | Pasture/Hay |
| High Intensity Development | Row Crops |
| Bare Rock/Sand/Clay | Woody Wetlands |
| Deciduous Forest | Emergent Herbaceous Wetlands |

Table 1 2001 MRLC Land Use Distribution – Lower Clinch River Watershed

Land Use	[acres]	[%]
Unclassified	0	0.00
Open Water	9,365	2.33
Developed Open Spaces	39,227	9.76
Low Intensity Residential	24,075	5.99
Medium Intensity Residential	8,440	2.10
High Intensity Residential	2,452	0.61
Bare Rock/Sand/Clay	1,407	0.35
Deciduous Forest	186,370	46.37
Evergreen Forest	15,996	3.98
Mixed Forest	21,463	5.34
Shrub/Scrub	322	0.08
Grasslands/Herbaceous	19,131	4.76
Pasture/Hay	66,839	16.63
Row Crops	884	0.22
Woody Wetlands	5,948	1.48
Emergent Herbaceous Wetlands	0	0.00
Total	401,920	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 Melton Hill Reservoir include fish & aquatic life, irrigation, livestock watering & wildlife, and recreation. The State of Tennessee's 2008 303(d) List (TDEC, 2008) identified portions of Melton Hill Reservoir as not fully supporting designated use classifications due, in part, to elevated levels of polychlorinated biphenyls (PCBs) and chlordane 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/>

3.1 Polychlorinated Biphenyls (PCBs)

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).

3.2 Chlordane

Chlordane is a synthetic, chlorinated organic compound with broad applications as an insecticide. Pure chlordane is a mixture of stereoisomers primarily in the cis (alpha) and trans (gamma) forms. Technical grade chlordane, on the other hand, is a formulary of various chlorinated hydrocarbons (e.g. heptachlor, chlordene, and nonachlor) in addition to the cis and trans isomers. Chlordane was widely used in the United States for termite control and as an insecticide for agricultural crops, home lawns, and gardens. Due to rising concerns over the product's safety, however, the U.S. Environmental Protection Agency began to restrict the use of chlordane on food crops, lawns, and gardens as early as 1978.

Chlordane is an environmentally persistent and bioaccumulative substance, which has been classified as a probable human carcinogen. Although it can still be manufactured in the United States, the Environmental Protection Agency canceled commercial use of chlordane in 1988. Large amounts of chlordane were already widely distributed throughout the environment by the time its usage ended. According to *Toxicological Review of Chlordane* (USEPA, 1997a), “[Chlordane] residues still exist in soils and sediments and chlordane bioaccumulates in fatty tissue of fish and humans; this bioaccumulation is a source of current concern.”

**Figure 4 Location of Melton Hill Reservoir PCB and Chlordane Impairments
(Documented on the 2008 303(d) List)**

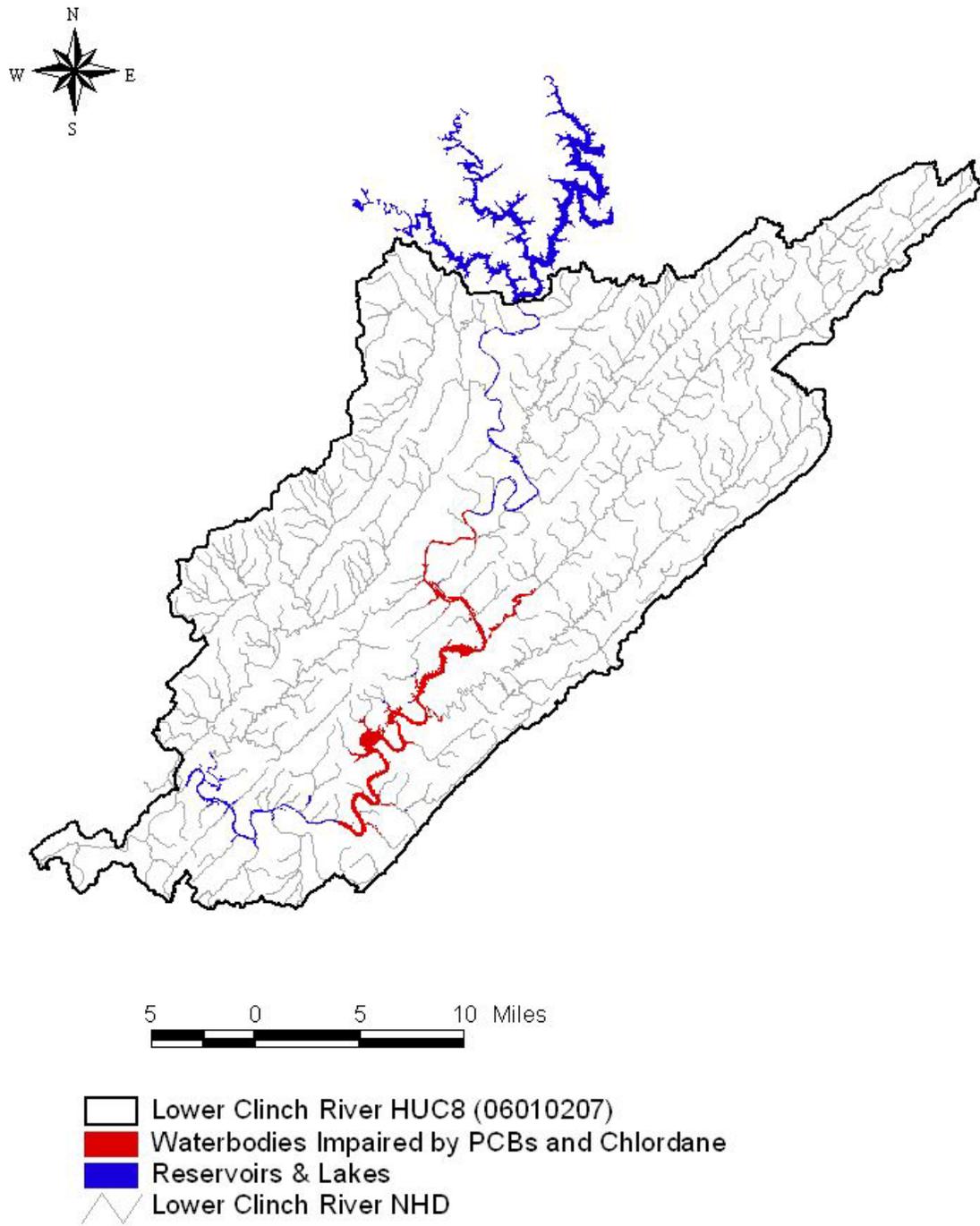


Table 2 2008 303(d) List - Stream Impairment Due to PCBs and Chlordane

Waterbody ID	Waterbody	Miles/ Acres	Cause (Pollutant)	Source (Pollutant)	Assessment Comments
TN06010207006_1000	Melton Hill Reservoir	5690 ac	PCBs Chlordane	Contaminated Sediment	Fishing advisory due to PCBs. TVA and ORNL have a fish tissue station at mile 24.5 (dam forebay) and at mile 43.5 (Highway 62, Solway Bridge).

4.0 TARGET IDENTIFICATION

These TMDLs are being proposed for Melton Hill Reservoir, which is impaired because PCBs and chlordane 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 and chlordane, 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.

4.1 PCB Target

The recreation designated use classification will provide the basis for this PCB TMDL. While numeric criteria exist under the fish & aquatic life designated use, the fish tissue concentrations calculated from the water column criteria for the recreation designated use classification are more stringent than the fish tissue concentrations calculated from the water column criteria established for the fish and aquatic life use classification. The Tennessee water quality criteria for total PCBs is 0.00064 µg/L under the recreation designated use classification. Therefore, 0.00064 µg/L will serve as the appropriate target for the TMDL.

4.2 Chlordane Target

The recreation designated use classification will provide the basis for the chlordane TMDL. While numeric criteria also exist under the fish & aquatic life designated use, the fish tissue concentrations calculated from the water column criteria for the recreation designated use classification are more stringent than the fish tissue concentrations calculated from the water column criteria established for the fish and aquatic life use classification. (See Appendix A.) Under the recreation designated use classification, the Tennessee water quality criterion for chlordane is 0.0081 µg/L for organisms only.

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. According to the methodology outlined in Section 7.1, the water column concentrations and the existing loads of chlordane and PCBs in the water column were calculated from composite fish tissue data.

5.1 PCBs Water Quality Assessment and Deviation

The existing concentration of PCBs in the water column was estimated 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 geometric mean of PCB concentrations, the existing water column concentration was calculated to be 0.0163 µg/L, which is greater than the 0.00064 µg/L target value.

5.2 Chlordane Water Quality Assessment and Deviation

Using fish tissues samples from the sites in the reservoir, the concentration of chlordane in the water column was estimated using the Bioconcentration Factor defined by the U.S. Environmental Protection Agency (ref.: Appendix A). This data is presented in Table 4. According to the geometric mean of chlordane concentrations, the existing water column concentration was calculated to be 0.00385 µg/L, which is less than the 0.0081 µg/L target value. Since only a limited amount of monitoring data was available for chlordane, TDEC recommends additional fish tissue monitoring. At this time, a TMDL has been provided for chlordane. If additional data confirms concentrations below the target level, TDEC recommends de-listing of the Melton Hill Reservoir for chlordane.

**Table 3 Existing Concentrations of PCBs in Melton Hill 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)
Channel Catfish	2002	Clinch RM 24.0	0.60	
		Clinch RM 45.0	1.0	
	2003	Clinch RM 24.0	0.40	
		Clinch RM 24.0	0.30	
	2004	Clinch RM 24.0	1.20	
		Clinch RM 45.0	0.20	
		Geomean	0.508	0.0163

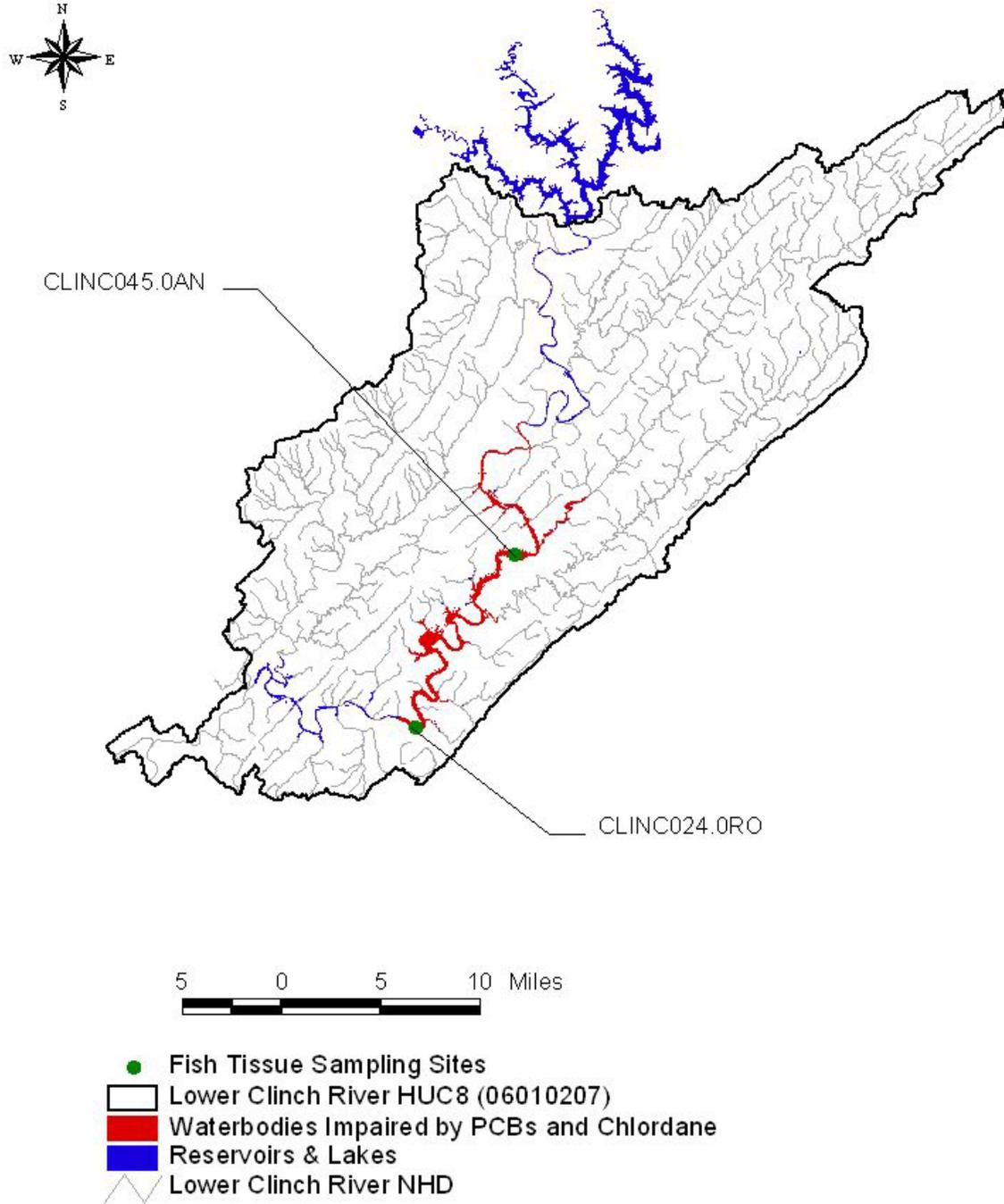
Note: Data presented is for PCB Aroclor 1260 – all other Aroclors were below detection limits.

**Table 4 Existing Concentrations of Chlordane in Melton Hill Reservoir
 Calculated from Composite Fish Tissue Samples**

Fish Species	Sample Year	Sampling Site Location	Chlordane in Fish Sample (ppm)	Calculated Water Column Concentration (µg/L)
Channel Catfish	2002	Clinch RM 24.0	0.05	
		Clinch RM 45.0	0.07	
	2003	Clinch RM 24.0	0.05	
		Clinch RM 24.0	0.03	
	2004	Clinch RM 24.0	0.09	
		Clinch RM 45.0	0.01U	
		Geomean	0.0543	0.00385

Note: Total chlordane was calculated as the sum of alpha chlordane, gamma chlordane, cis-nonachlor, trans-nonachlor, oxychlordane, and chlordene.

Figure 5 Fish Tissue Monitoring Sites in Melton Hill Reservoir



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 Lower Clinch River watershed. However, there are currently no permitted point source dischargers with existing allocations for PCBs or chlordane in the Lower Clinch River watershed.

6.2 Non-point Sources

The source of PCB and chlordane contamination is not known at this time. There are no superfund sites, either active or inactive, related to PCBs or chlordane in the Melton Hill Reservoir drainage area.

This TMDL will consider contaminated sediment in the reservoir bed as the primary source of PCB and chlordane contamination in Melton Hill Reservoir. According to the U.S. Environmental Protection Agency, these pollutants have a very low solubility in water and low volatility and they are contained in sediments that serve as reservoirs from which these pollutants may be released over a long period of time (USEPA 1999).

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:

$$\text{TMDL} = \sum \text{WLA}s + \sum \text{LA}s + \text{MOS}$$

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:

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

Where C_{fish} = Fish tissue concentration (mg/kg)

C_{water} = Water column concentration ($\mu\text{g/L}$)

BCF = Bioconcentration factor (31,200 L/kg)

1,000 = Conversion factor ($\mu\text{g/mg}$)

- 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 5.1):

$$\text{Existing Load} = C_{\text{water}} \times \text{Winter Pool Volume} \times \text{Unit Conversion Factor}$$

- 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:

$$\text{Maximum Allowable Load} = C_{\text{target}} \times \text{Winter Pool Volume} \times \text{Unit Conversion Factor}$$

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

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

- 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.

The TMDL for chlordane was calculated using the same methodology, but using the BCF for chlordane (14,100 L/kg).

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 majority of the fish tissue monitoring data. Additional fish tissue monitoring data was collected by TVA in 1984. This data was excluded due to potential changes in sampling methodology and detection limits associated with analytical methods. Fish tissue data were collected during a variety of seasons. PCB concentrations are not expected to fluctuate significantly 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 Melton Hill Reservoir, the median pool volume is 120,000 ac-ft and the hydraulic retention time is 12 days. TMDLs were derived according to the methodology described in Section 7.1.

$$\begin{aligned} \text{Maximum Allowable Load} &= 0.00064 \mu\text{g/L} \times 120,000 \text{ ac-ft} \times (1.23 \times 10^6) \text{ L/ac-ft} \times (2.205 \times 10^{-9}) \\ &\quad \text{lb}/\mu\text{g} \\ \text{Maximum Allowable Load} &= 0.208 \text{ lb} \end{aligned}$$

$$\text{TMDL} = 0.208 \text{ lb} / 12 \text{ days} = 0.0174 \text{ lb/day}$$

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

$$\text{Existing Load} = 0.0163 \mu\text{g/L} \times 120,000 \text{ ac-ft} \times (1.23 \times 10^6) \text{ L/ac-ft} \times (2.205 \times 10^{-9}) \text{ lb}/\mu\text{g} = 5.30 \text{ lb}$$

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

$$\% \text{ Reduction} = \frac{(5.30 \text{ lb}) - (0.208 \text{ lb})}{(5.30 \text{ lb})} \times 100\% = 96.1\%$$

The TMDL of 0.2175 lb/day for chlordane was calculated using the same methodology. The percent reduction for chlordane was not calculated because the existing water column concentration was less than the target value.

The TMDL values represent the maximum allowable daily loading of PCBs and chlordane. 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 Melton Hill Reservoir should not exceed water quality target values. The TMDLs and percent reductions are summarized in Table 5.

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 or chlordane. Waste load allocations of zero 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,

$$\text{LA} = \text{TMDL} - \text{MOS}$$

Incorporating the 20% MOS into the TMDL restricts the PCB loading in Melton Hill Reservoir to 0.0139 lb/day. The allocations for Melton Hill Reservoir are also provided in Table 5.

Table 5 TMDLs and Allocations for Melton Hill Reservoir

Waterbody ID	Impaired Waterbody	Pollutant	TMDL	MOS	WLA	LA	<i>Required Overall Load Reduction*</i>
			[lb/day]	[lb/day]	[lb/day]	[lb/day]	[%]
TN06010207006_1000	Melton Hill Reservoir	PCBs	0.0174	0.0035	0.00	0.0139	96.1
		Chlordane	0.2175	0.0435	0.00	0.1740	NR

*Note: Load reduction required to achieve TMDL.

NR = No reduction required. Sample load is lower than target load.

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.

Melton Hill 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 and chlordane. Contaminated sediments were listed as the likely source for the contamination in the Melton Hill Reservoir.

There are generally two options to prevent PCBs and chlordane 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 and chlordane in the reservoir so that the water quality criteria are not exceeded. Strategies to identify sites with elevated levels of PCBs and chlordane 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 and chlordane measured in fish tissue samples should theoretically decline. Watershed monitoring and assessment activities will provide information by which the effectiveness of PCB and chlordane 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 and chlordane in Melton Hill Reservoir were placed on Public Notice for a 35-day period and comments solicited. Steps that were taken in this regard include:

- 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 Melton Hill Reservoir watersheds advising them of the proposed PCB and chlordane TMDLs, stating the document's availability on the TDEC website, and inviting comments. These partners included:

Clinch River Chapter of Trout Unlimited
Natural Resources Conservation Service
Tennessee Citizens for Wilderness Planning
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:

Vicki S. Steed, Watershed Management Section
E-mail: Vicki.Steed@tn.gov

Bruce R. Evans, P.E., Watershed Management Section
Email: Bruce.Evans@tn.gov

Sherry H. Wang, Ph.D., Watershed Management Section
E-mail: Sherry.Wang@tn.gov

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APPENDIX A

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

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

PCB and Chlordane 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) (I) 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:

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

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
Chlordane	0.35	0.1142	14,100	0.0081

For waterbodies also designated for domestic water supply, the ingestion rate (I) must be adjusted to account for the combined intake of fish and water. Since Melton Hill Reservoir is not designated for domestic water supply, this calculation was not performed.

Comparison of the fish tissue concentrations in Table A-1 to the water quality criteria established in Section 1200-4-3-.03 (4) (j) for “Organisms Only” confirms that the values are equivalent.

The State of Tennessee has also established numeric criteria for the fish & aquatic life (FAL) designated use. For Total PCBs, the FAL criterion (0.014 µg/L) is greater than the recreation criterion. Therefore, the criterion for the recreation designated use will be applied for PCBs because it is more stringent. For chlordane, the FAL criterion is 0.0043 µg/L, which is lower than the recreation criterion (0.0081 µg/L). However, the equation for converting the water concentration to the fish tissue concentration for the FAL criterion is not the same as the equation used for the recreation criterion; it also takes into account the lipid concentration of the fish tissue. The calculated fish tissue concentration using the FAL criterion is 0.303 mg/kg, which is greater than the fish tissue concentration calculated from the recreation designated use criterion. Therefore, the criterion for the recreation designated use will be applied for chlordane because it is more stringent.

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
CHLORDANE and POLYCHLORINATED BIPHENYLS
FOR THE
MELTON HILL RESERVOIR
LOWER CLINCH RIVER WATERSHED (HUC 06010207), TENNESSEE

Announcement is hereby given of the availability of Tennessee's proposed Total Maximum Daily Loads (TMDLs) for chlordane and polychlorinated biphenyls (PCBs) for the Melton Hill Reservoir in the Lower Clinch River 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.

The Melton Hill Reservoir was identified on Tennessee's Final 2008 303(d) list as not supporting designated use classifications due to elevated levels of chlordane and 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 the Melton Hill Reservoir, fish advisory calculations, Bioconcentration Factors defined by the U.S. Environmental Protection Agency, and an appropriate Margin of Safety (MOS) to establish chlordane and PCB loading levels which will result in lower fish tissue concentrations and the attainment of water quality standards.

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

<http://www.tennessee.gov/environment/wpc/tmdl/proposed.shtml>

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 July 12, 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.