FINAL
Total Maximum Daily Load (TMDL)

For
Nutrient Impairment

Weiss Lake	AL03150105-1003-102
Weiss Lake	AL03150105-1001-102

Cherokee County, Alabama

Prepared by:
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October, 2008

In compliance with the provisions of the Federal Clean Water Act, 33 U.S.C §1251 et. seq., as amended by the Water Quality Act of 1987, P.L. 400-4, the U.S. Environmental Protection Agency is hereby establishing Total Maximum Daily Loads (TMDLs) for Nutrients for Weiss Lake (AL03150105-1003-102 and AL03150105-1001-102) Subsequent actions must be consistent with these TMDLs.

James D. Giattina
Director
Water Management Division

Date

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TMDL INFORMATION PAGE

Table i. Listing Information

Waterbody ID	Name	Impairment	Boundaries	Uses*
AL03150105-1003-102	Weiss Lake	Nutrients	Weiss Dam Powerhouse to Spring Creek	PWS, S, F&W
AL03150105-1001-102	Weiss Lake	Nutrients	Spring Creek to AL/GA state-line	S, F&W

*PWS-Public Water Supply S-Swimming F&W-Fish and Wildlife

Table ii. Applicable Alabama Water Quality Standards

Parameter	Water Quality Criteria
Chlorophyll _a_	Alabama's Water Quality Criteria Applicable to Specific Lakes (335-6-10-.11(2)(c)(1)) for Weiss Lake in the Coosa River Basin. Weiss Lake: those waters impounded by Weiss Dam on the Coosa River. The lake has a surface area of 30,200 acres at full pool. (i) Chlorophyll _a_ (corrected, as described in *Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998*): the mean of photic-zone composite chlorophyll _a_ samples collected monthly April through October shall not exceed 20 µg/L, as measured at the deepest point, main river channel, power dam forebay; or 20 µg/L, as measured at the deepest point, main river channel, immediately upstream of the causeway (Alabama Highway 9) at Cedar Bluff. If the mean of photic-zone composite chlorophyll _a_ samples collected monthly April through October is significantly less than 20 µg/L for a given year, the Department will re-evaluate the chlorophyll _a_ criteria, associated nutrient management strategies, and available data and information, and recommend changes, if appropriate, to maintain and protect existing uses.

Table iii. Nutrient (Total Phosphorus) TMDL Necessary to Meet WQS in Weiss Lake

ALABAMA			GEORGIA		TMDL
LA [1]	WLA		Aggregate allocation to GA at the State Border for loads from the Coosa River [4]	Aggregate allocation to GA at the state border for loads from the Chattooga River [5]	
	Major Point Sources (≥ 1 MGD) [2]	Minor Point Sources (< 1 MGD) [3]			
30% reduction (Q_1 * 0.37) #/day	1.0 mg/l	8.34 #/day maximum	30% reduction (Q_4 * 0.323) #/day	30% reduction (Q_5 * 0.862) #/day	30% reduction

1 The load allocation for Alabama is expressed as a function of flow (Q_1), where Q_1 represents the sum of flows (in terms of cubic feet per second as an annual average) of waters within Alabama that drain to Weiss Lake. The value of 0.37 represents an allowable growing season median concentration of 69 µg/L of total phosphorus multiplied by a units conversion factor.

2 The wasteload allocation requires that all Alabama major point sources (i.e., with a design flow equal or greater than 1 MGD) must each meet an end of pipe monthly average concentration of 1.0 mg/l (April through October only). Expressed as a daily load, the wasteload allocation for an individual major point source is Q_3 * 5.39 pounds per day, where Q_3 represents the effluent flow rate of the point source in terms of cubic feet per second. Future point sources may be allowed as long as such point sources comply with the wasteload allocation and water quality modeling analysis confirms that such dischargers will ensure protection of the applicable water quality standards.

3 The wasteload allocation requires that each Alabama minor point source (i.e., with a design flow less than 1 MGD) must not exceed 8.34 lbs/day, as a monthly average (April through October only). Future point sources may be allowed as long as such point sources comply with the wasteload allocation and water quality modeling analysis confirms that such dischargers will ensure protection of the applicable water quality standards.

4 The aggregate allocation for the Coosa River loads from Georgia at the state border is expressed as a function of flow (Q_4), where Q_4 represents the Coosa River flow (in terms of cubic feet per second as an annual average). The value of 0.323 represents an allowable growing season median concentration of 60 µg/L of total phosphorus multiplied by a units conversion factor.

5 The aggregate allocation for the Chattooga River loads from Georgia at the state border is expressed as a function of flow (Q_5), where Q_5 represents the Chattooga River flow (in terms of cubic feet per second as an annual average). The value of 0.862 represents an allowable growing season median concentration of 160 µg/L of total phosphorus multiplied by a units conversion factor.

EXECUTIVE SUMMARY

The State of Alabama originally placed Weiss Lake on the Alabama 1996 Section 303(d) List of Impaired Waterbodies due to priority organics, nutrients, pH and organic enrichment/dissolved oxygen (OE/DO). EPA approved delistings for OE/DO and pH with the 2000 and 2004 §303(d) lists, respectively, based on recent monitoring data that showed that the water quality standards for DO and pH were being attained in Weiss Lake. Total Maximum Daily Loads (TMDLs) were finalized for priority organics and nutrients in 2004. This TMDL is based on new and updated information and addresses impairment due to nutrients in Weiss Lake by providing an estimate of the total phosphorus concentrations allowable in the lake from the point sources and non-point sources in the watershed. This TMDL replaces the previous version established in 2004, and provided the most current information for input into the Coosa Lakes TMDLs.

Alabama has established a numeric chlorophyll *a* criterion of 20 µg/L for Weiss Lake. The criterion has been established at two specific locations in Weiss Lake and is applied as a growing season average defined as the period from April 1st through October 31st. The TMDL is represented by the growing season median total phosphorus loads, shown in Table 1, that are allowable so that Weiss Lake achieves an average growing season (April-October) chlorophyll *a* concentration of 20 µg/L at those specific compliance points (See Table ii). This target will allow for sufficient productivity in the reservoir to maintain the fisheries, while also reducing the risk of nuisance blooms of algae and reduce the hypolimnetic oxygen deficit, thereby improving fish habitat.

Table 1: Nutrient (Total Phosphorus) TMDL Necessary to Meet WQS in Weiss Lake

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1.0 INTRODUCTION

1.1 Background

The identification of waterbodies not meeting their designated use and the development of Total Maximum Daily Loads (TMDLs) for those waterbodies are required by 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). The TMDL process is designed to restore and maintain the quality of those impaired waterbodies through the establishment of pollutant specific allowable loads.

Weiss Lake, comprising 30,200 acres, was originally identified by the State of Alabama as being impaired due to nutrients in the 1996 §303(d) list of impaired waters and remained on the 1998 through 2004 lists. In 2004, EPA established a nutrient TMDL for Weiss Lake. In 2006, the waterbody was removed from the 303(d) list and placed in category 4a due to the nutrients TMDL being established. As of October 2008, the waterbody remains in category 4a. This TMDL is being revised as part of an effort by EPA, ADEM and Georgia Environmental Protection Division (GAEPD) to ensure all portions of the Coosa River will achieve water quality standards. Necessary load allocations are determined by linking compatible water quality models of multiple segments of the Coosa River system.

1.2 Applicable Waterbody Segment Use and Standard

The designated beneficial uses of Weiss Lake are Public Water Supply (Weiss Dam Powerhouse to Spring Creek only), Swimming, and Fish and Wildlife. The water use classifications are established by the State of Alabama in the Code of Alabama rule and regulations Chapter 335-6-11 Water Use Classifications for Interstate and Intrastate Waters.

The chlorophyll-a criteria, based on Alabama's Water Quality Criteria Applicable to Specific Lakes (335-6-10-.11(2)(c)(1)) for Weiss Lake in the Coosa River Basin, are as follows:

> Weiss Lake: those waters impounded by Weiss Dam on the Coosa River. The lake has a surface area of 30,200 acres at full pool.
>
> (i)Chlorophyll a (corrected, as described in *Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998*): the mean of photic-zone composite chlorophyll a samples collected monthly April through October shall not exceed 20 µg/L, as measured at the deepest point, main river channel, power dam forebay; or 20 µg/L, as measured at the deepest point, main river channel, immediately upstream of the causeway (Alabama Highway 9) at Cedar Bluff. If the mean of photic-zone composite chlorophyll a samples collected monthly April through October is significantly less than 20 µg/L for a given year, the Department will re-evaluate the chlorophyll a criteria, associated nutrient management strategies, and available data and information, and recommend changes, if appropriate, to maintain and protect existing uses.

1.3 Nutrient Target Development

Phosphorus has commonly been considered the primary limiting nutrient governing algal growth in most freshwater stream systems in North America, particularly in freshwater lakes, in contrast with nitrogen-limited estuarine ecosystems (e.g., Correll, 1998). Case studies cited in EPA guidance demonstrated that control of nutrient concentrations can limit the growth of filamentous algae (USEPA, 2000; Sosiak, 2002). Recent evidence suggests that nutrient limitation by nitrogen or phosphorus may be seasonal and that nitrogen limitation has been observed in some streams (Dodds et al., 2000). Based on analysis of the readily available data and information, EPA has determined that reductions in phosphorus, without concurrent reductions in nitrogen, are expected to result in the attainment of the Weiss Lake chlorophyll a criteria. Although total nitrogen loads were considered in the modeling analysis, reductions to the existing nitrogen loads are not necessary to address the nutrient impairment within Weiss Lake.

Potential impacts of nitrogen downstream from Weiss Lake were also considered as part of the TMDL analysis. Four reservoirs in the Coosa River basin downstream from Weiss Lake (i.e., Lake Neely Henry, Lake Logan Martin, Lay Lake, and Lake Mitchell) are identified as impaired by nutrients on Alabama's CWA section 303(d) list. TMDLs to address the nutrient impairment for these reservoirs are contained in a separate report for public review and comment. The nutrient TMDLs for these reservoirs are based on a system of hydrodynamic and water quality models which are linked to the Weiss Lake model that represents the hydrodynamic and water quality conditions of Weiss Lake. Based on the modeling analysis, reductions in total phosphorus alone (i.e., without concurrent reductions in nitrogen) are appropriate to address the nutrient impairment in those downstream reservoirs.

Alabama has established numeric chlorophyll *a* criteria of 20 μg/L for Weiss Lake. More specifically, the established criteria shall not exceed 20 μg/L as measured for compliance at two specific locations within Weiss Lake, namely at the Weiss power dam forebay and immediately upstream of AL Hwy 9 causeway, as indicated in Table 2. The chlorophyll *a* criteria are applicable as a growing season average of monthly samples collected during the period of April through October. The TMDL is represented by the median total phosphorus loads that are allowable so that Weiss Lake achieves an average growing season chlorophyll *a* concentration of 20 μg/L at those specific compliance points. This target will allow for sufficient productivity in the reservoir to maintain the fisheries, while also reducing the risk of nuisance blooms of algae and reduce the hypolimnetic oxygen deficit, thereby improving fish habitat.

Table 2: Alabama's Water Quality Criteria Applicable to Weiss Lake

Parameter	Water Quality Criteria
Chlorophyll _a_	Alabama's Water Quality Criteria Applicable to Specific Lakes (335-6-10-.11(2)(c)(1)) for Weiss Lake in the Coosa River Basin. Weiss Lake: those waters impounded by Weiss Dam on the Coosa River. The lake has a surface area of 30,200 acres at full pool. (i) Chlorophyll _a_ (corrected, as described in *Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998*): the mean of photic-zone composite chlorophyll _a_ samples collected monthly April through October shall not exceed 20 µg/L, as measured at the deepest point, main river channel, power dam forebay; or 20 µg/L, as measured at the deepest point, main river channel, immediately upstream of the causeway (Alabama Highway 9) at Cedar Bluff. If the mean of photic-zone composite chlorophyll _a_ samples collected monthly April through October is significantly less than 20 µg/L for a given year, the Department will re-evaluate the chlorophyll _a_ criteria, associated nutrient management strategies, and available data and information, and recommend changes, if appropriate, to maintain and protect existing uses.

As outlined in Alabama's Nutrient Criteria Plan, ADEM is currently working on the development of numeric nutrient criteria, which may include parameters other than chlorophyll _a_ and, as they are developed, they will be adopted in State water quality standards. The targets derived for this TMDL may not necessarily represent the final determination of the necessary parameters and protective values that may be applied to these waters, with respect to nutrient criteria. As the knowledge supporting the development of nutrient targets and/or adopted criteria continues to improve, EPA encourages the State to consider subsequent nutrient information in development of any future new or revised water quality standards for nutrients, following completion of this TMDL, and any subsequent modeling efforts that result from the Coosa River Lakes TMDLs.

2.0 WATERBODY ASSESSMENT

2.1 Watershed Description

Weiss Lake lies in the Upper Coosa Watershed in northeastern Alabama (**Figure 1**). The watershed, which has a drainage area of approximately 5,273 square miles, extends into Georgia and southern Tennessee. Weiss Lake is the upper most in a chain of lakes located on the Coosa River. The Coosa River flows through Weiss Lake, discharging through the Weiss Dam. The Dam is located approximately 226 miles upstream from the confluence of the Coosa and Tallapoosa Rivers. These two rivers merge together to form the Alabama River.

Weiss Lake extends approximately 52 miles upstream from the Weiss Dam. Weiss Dam was built in 1961 by Alabama Power Company for hydroelectric power generation and is a gravity concrete and earth-fill structure that is approximately 86 feet tall. The lake has a surface area of 30,200 acres at the normal water surface elevation of 564 feet MSL. The lake has 447 miles of shoreline and a maximum depth of 62 feet at the dam and an average depth of 10.2 feet. The storage capacity of Weiss Lake at the normal pool elevation is 306,331 acre-feet. Operation of the project is licensed by the Federal Energy Regulatory Commission (FERC).

The lake is used primarily for hydroelectric generation; however, its other uses include: flood control, public water supply, maintenance of downstream water quality, irrigation, swimming and other recreation. The lake also serves as an excellent habitat for fish and wildlife. Although Weiss Lake is used for flood control, there is a limited amount of storage that is available in the lake; therefore, the operation of the lake is coordinated with the other lakes in the Coosa River chain to minimize flooding.

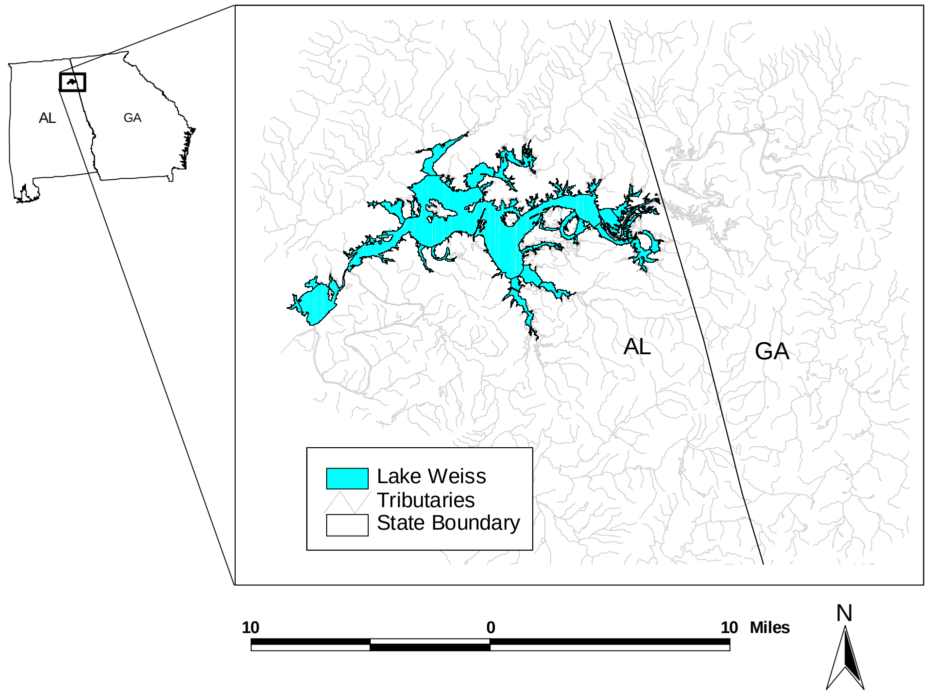

Figure 1: Location of Weiss Lake

2.2 Assessment of Point Sources

An important step in assessing pollutant sources in the Coosa River Watershed and Weiss Lake is locating the NPDES permitted sources. There are eighteen significant facilities permitted to discharge into the Upper Coosa River and Weiss Lake watersheds, all of these dischargers are included in the water quality model for Weiss Lake. Details on these facilities are included in the lake Weiss Water Quality and Watershed modeling reports. (Tetra Tech, Inc., 2007)

2.3 Landuse in Weiss Lake Watershed

Weiss Lake receives flow from four upstream watersheds that lie across the Alabama state line into northwestern Georgia. These watersheds, shown in **Figure 2**, include the Conasauga (HUC# 03150101), Coosawattee (HUC# 03150102), Oostanaula (HUC# 03150103), and Etowah (HUC# 03150104). The drainage area of the Coosa River Watershed and Weiss Lake is approximately 240,514 acres. The watersheds contain many different landuse types including: urban, forest, cropland, pasture, water, and wetlands. The land use information for the watershed is based on the 1999 National Land Cover Dataset (NLCD) and is summarized in **Table 3**. The landuse categories were grouped into the land uses of urban, forest, cropland, pasture, disturbed, wetlands, and water.

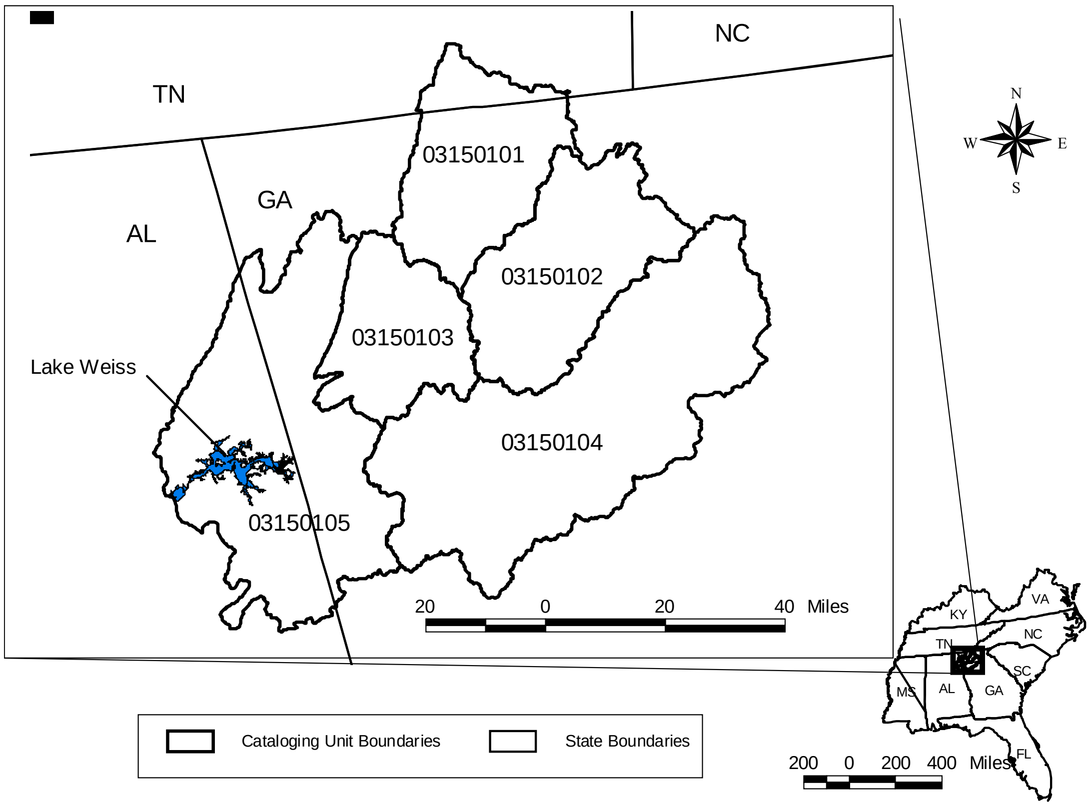

Figure 2: Watersheds Draining to Weiss Lake

Table 3: Landuse in Coosa River and Weiss Lake Watersheds

Landuse (acres)	Barren	Cropland	Forest	Pasture	Urban Impervious	Urban Pervious	Wetlands
Upper Coosa River Watersheds							
Coosawattee	656	82,94	424,965	74,370	8,951	26,741	1,761
Oostanuala	568	11,005	239,067	69,572	11,852	21,169	2,310
Conasauga	1,207	12,307	300,962	92,290	19,757	33,620	4,222
Etowah	7806	15757	777455	178274	68084	118214	7756
Headwater Total	*10,237*	*47,363*	*1,742,449*	*414,506*	*108,643*	*199,744*	*16,049*
Coosa River and Weiss Lake							
Beech, King and Cabin Creeks	7,806	1,189,103	777,455	178,274	68,084	118,214	714
Cedar Creek	310	3,067	88,626	30,437	4,390	9,227	1,040
Chattooga River	283	8,149	164,574	55,972	6,599	15,535	1,657
Little River	178	5,468	119,363	33,908	1,559	5,006	838
Cowan Creek	131	6,498	32,276	14,963	840	2,381	661
South of Lake Watershed 534	566	9,878	45,419	12,850	1,155	2,734	2,174
Middle Weiss Lake Watershed	0	8,073	62,096	13,025	2,509	4,482	1,938
Lower Weiss Lake Watershed	28	2,180	12,770	7,630	390	1,125	100
Weiss Lake Watershed Total	*9,302*	*1,232,416*	*1,302,579*	*347,059*	*85,526*	*158,704*	*9,122*
Grand Total	*19,539*	*1,279,779*	*3,045,028*	*761,565*	*194,170*	*358,448*	*25,171*
Percent	*0.34 %*	*22.52 %*	*53.57 %*	*13.40 %*	*3.42 %*	*6.31 %*	*0.44 %*

2.4 Assessment of Non-Point Sources

The two primary nutrients of concern are nitrogen and phosphorus. Total Nitrogen (TN) is a combination of many forms of nitrogen found in the environment. Inorganic nitrogen can be transported in particulate and dissolved phases in surface runoff. Dissolved inorganic nitrogen can be transported in groundwater and may enter a stream from groundwater infiltration.

Unlike nitrogen, phosphorus is primarily transported in surface runoff when it has been absorbed by eroding sediment. Phosphorus may also be associated with fine-grained particulate matter in the atmosphere and can enter streams as a result of dry fallout and rainfall (USEPA, 1999). However, phosphorus is typically not readily available from the atmosphere or the natural water supply (Davis and Cornwell, 1998). As a result, phosphorus may be a limiting nutrient in non-point source dominated rivers and streams.

For Weiss Lake, based on data and modeling analyses, phosphorus was determined to be the limiting nutrient and this TMDL will evaluate the reduction of total phosphorus to meet the Weiss Lake chlorophyll a criteria of 20 µg/L expressed as a growing season average.

3.0 ANALYTICAL APPROACH

3.1 Introduction

Weiss Lake was listed as impaired by nutrients, presumed at that time to be indicated by excess chlorophyll-a. For the purposes of this TMDL, the existing impaired condition of Weiss Lake was compared to the subsequently adopted Alabama chlorophyll a criteria of 20 µg/L growing season average, as measured at specific locations within the lake. TMDL allocations were determined by analyzing the effects of TP loads on in-lake response variables of algal biomass required to meet the applicable water quality standards. The EPA Water Quality Analysis Simulation Program, Version 7 (WASP7.2) was applied as the in-stream water quality model (Wool, et. al., 2001). WASP7.2 contains an eutrophication component that simulates complex nutrient transport and cycling in the streams, as well as models any dissolved oxygen sag resulting from point source discharges. The purpose of the modeling exercise was to determine the level of reductions in nutrient loads that would have to occur in order to protect the designated use and achieve water quality standards in Weiss Lake.

3.2 Estimating Non-point Source Loads

The Loading Simulation Program in C++ (LSPC) was also used to represent the watershed runoff to Weiss Lake downstream of USGS flow gage 02397000. The model was also used to represent the accumulation and washoff of nutrients within the entire Weiss Lake drainage area. The model was developed for total nitrogen and total phosphorus using observed 2005 concentration data from four tributary stations discharging to Weiss Lake: Cedar, Kings, Cabin and Beech Creeks; and three larger river water quality stations: Chattooga River at Mills Creek, Little River and Coosa River. The watershed model was run for the entire simulation period (January 1, 1991 – December 31, 2005) to generate a time series of water quality concentrations for the watersheds. LSPC provided concentrations of total nitrogen and total phosphorus for input to the WASP water quality model. The total nutrients were broken down into their respective components based on the sampling data. Total nitrogen was broken down into three components: organic nitrogen, nitrate-nitrite and ammonia nitrogen; total phosphorus was broken down into ortho-phosphorus and organic phosphorus.

Modifications to the original LSPC model (Tetra Tech, Inc., 2007) included: revising the kinetic decay rates, modeling just total nitrogen and phosphorus, and inclusion of point source contributions for all the modeled parameters, not just the parameters monitored by the point sources.

3.3 WASP Model

The WASP model helps users interpret and predict water quality responses to natural phenomena and man-made pollution for various pollution management decisions. WASP is a dynamic compartment-modeling program for aquatic systems, including both the water column and the underlying benthos. The time-varying processes of advection, dispersion, point and diffuse mass loading and boundary exchange are represented in the basic program. This analysis used the conventional pollutant (eutrophication) module. The conventional pollutant module represents the reaction kinetics for nutrients (nitrogen, phosphorus), carbon sources (detritus, algae, and three CBOD groups), algal growth and dissolved oxygen. The WASP model was used to provide an estimate for the existing growing season in-lake chlorophyll a concentrations based on least disturbed landuse conditions.

The EFDC hydrodynamic model provided the flow, velocity and temperature transport mechanism and was incorporated into the WASP water quality model through the hydrodynamic linkage file. The EFDC model provided the following information to WASP:

- Flows from the upstream boundary, point sources and watersheds
- Temperatures from the upstream boundary, point sources and watersheds
- Three dimensional model cell structure and volumes
- Cell volumes and transport

The WASP model for Weiss Lake was setup using the following state variables:

- Ammonia (NH_3)
- Nitrate+Nitrite (NO_2+NO_3)
- Organic Nitrogen
- Orthophosphate (PO_4)
- Organic Phosphorus
- Chlorophyll-a (Chl a)
- Dissolved Oxygen (DO)
- Carbonaceous Biochemical Oxygen Demand (CBOD)

Calibration details for both the EFDC and WASP models are provided in the "Hydrodynamic and Water Quality Modeling Report for Weiss Lake, Alabama" (Tetra Tech, Inc., 2007).

EPA updated the Weiss Lake EFDC and WASP models. EPA revised the EFDC Model for Weiss Lake by updating the Georgia Power Plant Hammond heat load and modified Upper Coosa River depths to represent the actual cross section, as measured by the Army Corps of Engineers by using the GAEPD RIV1 hydraulic cross section information. EPA revised the WASP Model for Weiss Lake to incorporate the updated watershed loads, include the city of Rome WTF in the main model and adjusted kinetic parameters to achieve a calibrated model to the Chlorophyll a growing season (April thru October) averages.

3.3.1 Weiss Lake Model Segmentation

The lake was segmented into curvilinear orthogonal computational grid cells representing horizontal dimensions for the hydrodynamic model. The hydrodynamic model utilizes the generalized vertical coordinate system that allows for a variable number of layers in the vertical direction. The waterbody was segmented into 207 horizontal grid cells (**Figure 3**).

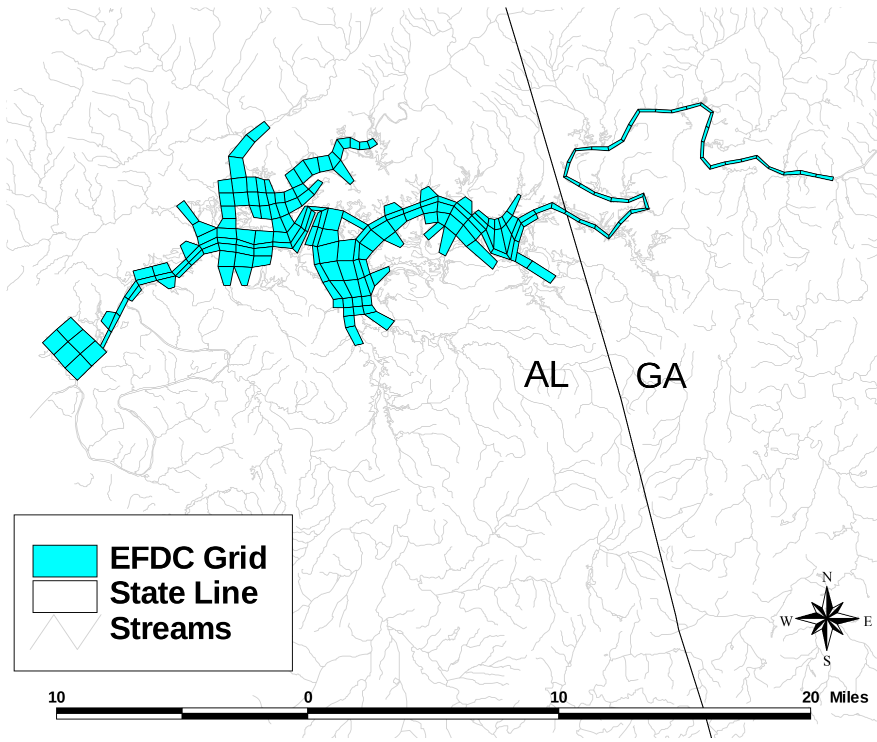

Figure 3: Grid Cells for Weiss Lake EFDC Model

The grid on the Coosa River effectively reaches the USGS station 02397000 near Rome, Georgia. In order to define the domain coverage, a GIS polygon coverage of the pool boundary of Weiss Lake, provided by Alabama Power, was used. Also, a GIS coverage of the Coosa River was used to define the channel in the lake. The grid was first developed to follow the original river channel, where the main flow occurs, and then was built to cover the rest of the reservoir area. The bottom elevation of each grid cell was defined based on the available data from Alabama Power and GAEPD, taking into account the total pool area and volume of the reservoir provided by Alabama Power.

3.3.2 Weiss Lake Model Simulation Period

The simulation period for the calibration of the water quality model was from January 1, 2001 through December 31, 2005, concentrating on 2005 when additional water quality data were available. The 2005 period was selected because, during that growing season, GAEPD and

ADEM performed extensive data collection efforts on Weiss Lake. ADEM also collected water quality data on Weiss Lake during the 2000 to 2004 growing seasons. Water quality data for the upstream boundary was collected at the USGS station 02397000. Chlorophyll a data at the upstream boundary were collected daily from March 12 through December 23, 2005. All other parameters were collected approximately weekly from mid-April through mid-October.

3.4 Model Results for Existing Conditions

The watershed model was run from 1991 thru 2005. The growing season median TP load for this period is 3,210 kg/day, of which 2,280 kg/day are nonpoint source (NPS) loads and 930 kg/day are wastewater treatment (WTF) effluent discharges. The model was also run under natural landuse conditions (90 percent forest and 10 percent wetlands). **Table 4** provides the annual loads broken down by state for existing and natural conditions. These loads vary by year, dependent on the flow of the rivers and the pollutant washoff due to rainfall. **Table 5** illustrates how the annual TP loads vary by year for the years 2001 thru 2005 and shows the associated growing season average chlorophyll a predicted for each year at the most critical Alabama Weiss Lake compliance site, Weiss Station 2, based on model runs.

Table 4: Growing Season Median TP Loads by State

Scenario	Georgia TP (kg/day) Growing Season Median Loads	Alabama TP (kg/day) Growing Season Median Loads
Existing Conditions	2,930	280
Existing with no WTF discharges	2,005	196
Natural Conditions	800	135

Table 5: Growing Season Median TP Loads and predicted Chl a 2001 – 2005

Year	Weiss Lake Growing Season Median TP Loads (kg/day)	Compliance Point – Station Weiss 2* Chl a (µg/L)
2001	2,740	33
2002	2,150	25
2003	4,290	24
2004	2,415	27
2005	2,110	28

* See Hydrodynamic and Water Quality Modeling Report for Weiss Lake, Alabama, Tetra Tech, Inc., 2007 for station location

Years 2001, 2004 and 2005 are the critical time periods for high chlorophyll a concentrations. Since 2005 has a better data set and, therefore, better modeling inputs that reflect the actual conditions, this year was selected as the critical year and was used for TMDL development.

4.0 DEVELOPMENT OF THE TMDL

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody and still meet the water quality standard, 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. TMDLs are comprised of the sum of individual wasteload allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. Conceptually, this definition is denoted by the equation:

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

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 WQS achieved. 40 CFR 130.2 (i) states that TMDLs are expressed in terms of mass per time (e.g. pounds per day), toxicity, or other appropriate measures.

The TMDL for Weiss Lake is expressed as the allowable loadings of TP that are expected to achieve the chlorophyll *a* criteria. The sources of TP originate in two states, Alabama and Georgia. This TMDL is composed of three categories of allocations: 1) a wasteload allocation for the point sources in Alabama; 2) a load allocation for the nonpoint sources in Alabama; and 3) and aggregate allowable pollutant load, which includes both the point and nonpoint contributions from Georgia sources at the state border. The target chlorophyll *a* concentration is 20 µg/L, expressed as a growing season average (April through October). Consistent with the applicable water quality standards for the TMDL, the allocations are applicable from April through October. As previously stated, 2005 was selected as the critical year for TMDL development.

4.1 Wasteload Allocation (WLA)

Facilities regulated by the NPDES program in Alabama are assigned a WLA. The WLAs are expressed separately for major point sources (i.e., facilities with a discharge capacity greater than or equal to 1.0 million gallons per day (MGD)) and minor point sources (i.e., facilities with a discharge capacity less than 1.0 MGD).

For this TMDL, the WLA for the point sources in Alabama require reductions of TP to achieve the chlorophyll *a* criteria established for Weiss Lake. The WLA call for reductions of TP effluent concentrations from the major point sources to achieve TP = 1 mg/L as a monthly average. These reductions are consistent with the GaEPD nutrient reduction procedure for nutrient impaired waterbodies. For minor point sources in Alabama, the WLA requires that effluent loads shall not exceed 8.34 pound per day.

4.2 Load Allocation (LA)

The LA for this TMDL addresses nonpoint source TP loads originating in Alabama. The primary mode for transport of nutrients to streams is during a storm event. Modification of the land surface from a pervious land cover to an impervious surface results in higher peak flow rates that wash nutrient enriched water into the stream. The LA calls for a 30 percent overall reduction in growing season median TP loadings from non-point sources throughout the portion of the watershed within Alabama. Note, these reductions can be targeted at watersheds with higher nonpoint source TP concentration as long as the over all reduction of 30% is achieved.

4.3 Determination of TMDL

In addition to the WLA and LA for point sources and nonpoint sources in Alabama identified above, this TMDL provided an aggregate allocation to Georgia at the state border for the TP loads originating from the Coosa and Chattooga Rivers. The aggregate allocations require a 30% reduction of TP loads from Georgia. Based on the results of EPA's modeling analysis, the reductions required by the WLA, LA, and aggregate allocation to Georgia will result in the attainment of the applicable water quality standards.

These results, illustrated in **Figure 4** and **Table 6Table 6: Existing Conditions and TMDL Chl *a* Results**, show a predicted growing season chlorophyll *a* average concentration at the compliance point of 19 µg/L, which does not exceed the targeted water quality criteria for chlorophyll *a* of 20 ug/L at that point. The resultant annual and daily loads for 2005 are provided in **Table 7**. Note, these annual and daily maximum loads are specific to low flow critical years only, but the allocations provided in Table 7 below will provide protection for both wet and dry years.

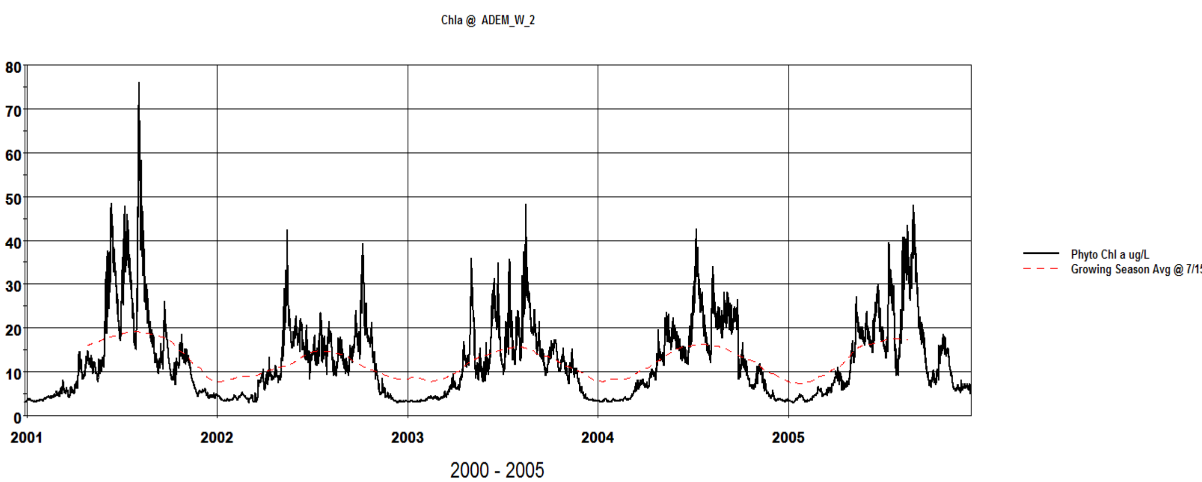

Figure 4: Predicted Chl *a* at Alabama Weiss Station 2 – Critical Segment Station

Table 6: Existing Conditions and TMDL Chl *a* Results

Year	Weiss 2		Weiss 1	
	Actual	TMDL	Actual	TMDL
2001	33	19	23	10
2002	25	15	17	7
2003	24	16	22	10
2004	27	17	20	5
2005	28	18	22	6

Table 7: Nutrient (Total Phosphorus) TMDL Necessary to Meet WQS in Weiss Lake

ALABAMA			GEORGIA		TMDL
LA [1]	WLA		Aggregate allocation to GA at the State Border for loads from the Coosa River [4]	Aggregate allocation to GA at the state border for loads from the Chattooga River [5]	
	Major Point Sources (≥ 1 MGD) [2]	Minor Point Sources (< 1 MGD) [3]			
30% reduction (Q_1 * 0.37) #/day)	1.0 mg/l	8.34 #/day maximum	30% reduction (Q_4 * 0.323) #/day	30% reduction (Q_5 * 0.862) #/day	30% reduction

1 The load allocation for Alabama is expressed as a function of flow (Q_1), where Q_1 represents the sum of flows (in terms of cubic feet per second as an annual average) of waters within Alabama that drain to Weiss Lake. The value of 0.37 represents an allowable growing season median concentration of 69 µg/L of total phosphorus multiplied by a units conversion factor.

2 The wasteload allocation requires that all Alabama major point sources (i.e., with a design flow equal or greater than 1 MGD) must each meet an end of pipe monthly average concentration of 1.0 mg/l (April through October only). Expressed as a daily load, the wasteload allocation for an individual major point source is Q_3 * 5.39 pounds per day, where Q_3 represents the effluent flow rate of the point source in terms of cubic feet per second. Future point sources may be allowed as long as such point sources comply with the wasteload allocation <u>and</u> water quality modeling analysis confirms that such dischargers will ensure protection of the applicable water quality standards.

3 The wasteload allocation requires that each Alabama minor point source (i.e., with a design flow less than 1 MGD) must not exceed 8.34 lbs/day, as a monthly average (April through October only). Future point sources may be allowed as long as such point sources comply with the wasteload allocation <u>and</u> water quality modeling analysis confirms that such dischargers will ensure protection of the applicable water quality standards.

4 The aggregate allocation for the Coosa River loads from Georgia at the state border is expressed as a function of flow (Q_4), where Q_4 represents the Coosa River flow (in terms of cubic feet per second as an annual average). The value of 0.323 represents an allowable growing season median concentration of 60 µg/L of total phosphorus multiplied by a units conversion factor.

5 The aggregate allocation for the Chattooga River loads from Georgia at the state border is expressed as a function of flow (Q_5), where Q_5 represents the Chattooga River flow (in terms of cubic feet per second as an annual average). The value of 0.862 represents an allowable growing season median concentration of 160 µg/L of total phosphorus multiplied by a units conversion factor.

The 30 percent overall reduction can be implemented in any number of ways, as long as the overall reduction equals 30 percent. Best management practices (BMPs) should be encouraged in the watershed to reduce potential TN and TP loads from non-point sources. The watershed with high monitored phosphorus concentrations should be considered a priority for riparian buffer zone restoration and other nutrient reduction BMPs.

4.4 Margin of Safety

TMDLs shall include a margin of safety (MOS) that takes into account any lack of knowledge about the pollutant loading and in-lake water quality. For this TMDL, the measured water quality was used directly to determine the reduction to meet the water quality standard. In this case, the lack of knowledge concerns the data and how well it represents the true water quality. There are two methods for incorporating a MOS in the analysis: 1) implicitly incorporate the MOS using conservative model assumptions to develop allocations; or 2) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. An implicit MOS was incorporated in the analyses through the years of data collection and a multiyear modeling exercise. Based on modeling predictions, the TMDL allocations result in a growing season average chlorophyll *a* concentration of 19 μg/L, which is less than the TMDL target and water quality criteria of 20 μg/L and provides and explicit margin of safety.

4.5 Critical Conditions and Seasonal Variation

The model scenario used a multi-year time period and accounts for numerous seasons and various meteorological conditions. Years 2001 and 2005 are the critical low flow growing seasons which result in the highest chlorophyll *a* values. By achieving the reduction for these growing seasons critical conditions, water quality standards will be achieved during all other times. Seasonal variation must also be considered to ensure that water quality standards will be met during all seasons of the year. Seasonal variation was considered by targeting the critical low flow growing seasons as this is when the nutrient loadings entering the system produce the greatest response in phytoplankton within the lake resulting in the highest chlorophyll *a* concentrations.

5.0 CONCLUSION

EPA has determined that the allocations described in this TMDL report will ensure protection of the applicable water quality standards in Weiss Lake. EPA solicited public review and comment on a proposed draft of this TMDL and also requested comment with respect to the allocation of the TMDL between the point sources and nonpoint sources. No comments were received during the public notice period; therefore, there is not a responsiveness summary included in the Administrative Record.

The State is strongly encouraged to continue monitoring and studying nutrients and nutrient-related parameters in Weiss Lake and considering this information consistent with ADEM's nutrient criteria plan. As part of this process, EPA recommends that the State consider conducting effluent discharge studies, for both nitrogen and phosphorus, in order to verify the targets in the TMDL. This TMDL assigns wasteload allocations to the NPDES facilities in the watershed. It is recommended that the Weiss Lake watershed be considered a priority for riparian buffer zone restoration and other nutrient reduction BMPs. The implementation of these BMP activities should reduce the nutrient load entering the system. This will provide improved water quality for the support of aquatic life in the water bodies and will result in the attainment of the applicable water quality standards.

6.0 PUBLIC PARTICIPATION

This draft TMDL was proposed for public review and comment for a 30-day period beginning August 29, 2008. EPA distributed information regarding the public notice of the TMDL by e-mail to members of the public who have requested that ADEM and GAEPPD include them on a TMDL mailing list. The TMDL was also made available for review and comment on EPA Region 4's website. The public was given an opportunity to review the TMDL and submit comments to EPA in writing. No comments were received during the public notice period; therefore, there is not a responsiveness summary included in the Administrative Record.

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