Chapter 3 Lakes and Reservoirs

3.1 Lake Water Quality Assessment

3.1.1 Background

Section 314 (a) (2) of the Clean Water Act, as amended by the Water Quality Act of 1987, requires states to conduct assessments of publicly-owned lake water quality and report the findings as part of the biennial §305(b) Water Quality Report to Congress. The assessment process is conducted through the use of federal and matching funding, including that available pursuant to Sections 106 and 319 of the Act.

The Department has defined publicly-owned lakes/reservoirs as those that are of a multiple-use nature, publicly accessible, and exhibit physical/chemical characteristics typical of impounded waters. Lakes designated strictly for public water supply, privately owned lakes, or lakes managed by the Alabama Department of Conservation and Natural Resources (ADCNR) strictly for fish production are not included in this definition. Lakes currently meeting the above definition are included in the tables that follow.

In 1985, the need for information on the trophic state of Alabama's publicly-owned lakes led to the initial survey, conducted by the ADEM with the assistance of the U.S. Environmental Protection Agency Region IV. During the survey, limited baseline data was collected and used to rank the lakes according to trophic condition.

In 1989, Clean Lakes Program funds enabled the ADEM to conduct required water quality assessments of thirty-four (34) publicly-owned lakes in the State and submit collected information as part of the 1990 Water Quality Report to Congress. Trophic state index (TSI) values calculated from data gathered for the water quality assessments indicated potentially significant increases when compared to the TSI values derived from the study conducted in 1985.

In 1990, the Reservoir Water Quality Monitoring (RWQM) Program was initiated by the Field Operations Division of ADEM. Objectives of the program are as follows:

a) to develop an adequate water quality database for all publicly-owned lakes in the State;
b) to establish trends in lake trophic status that can only be established through long-term monitoring efforts; and,
c) to satisfy the requirement of Section 314(a)(1) of the Water Quality Act of 1987 that states conduct assessments of the water quality of publicly-owned lakes and report the findings as part of their biennial "Water Quality Report to Congress".

Acquiring this information enables the ADEM to determine lake water quality and identify lakes in which water quality may be deteriorating. Should deterioration in water quality be indicated by collected data, more intensive study of the lake can be instituted to establish the causes and extent of the deterioration.

From 1990-1992, thirty-one publicly-owned lakes in the State were monitored at least once. Lakes indicated to be use-threatened or impaired from previously collected data were monitored annually. Additional funding received in 1991 through the Clean Lakes Program allowed the expansion of the Program to include all of the thirty-two (32) publicly-owned lakes in the State, with the exception of those in the Tennessee River system. These reservoirs are monitored through the TVA Reservoir Vital Signs Program.

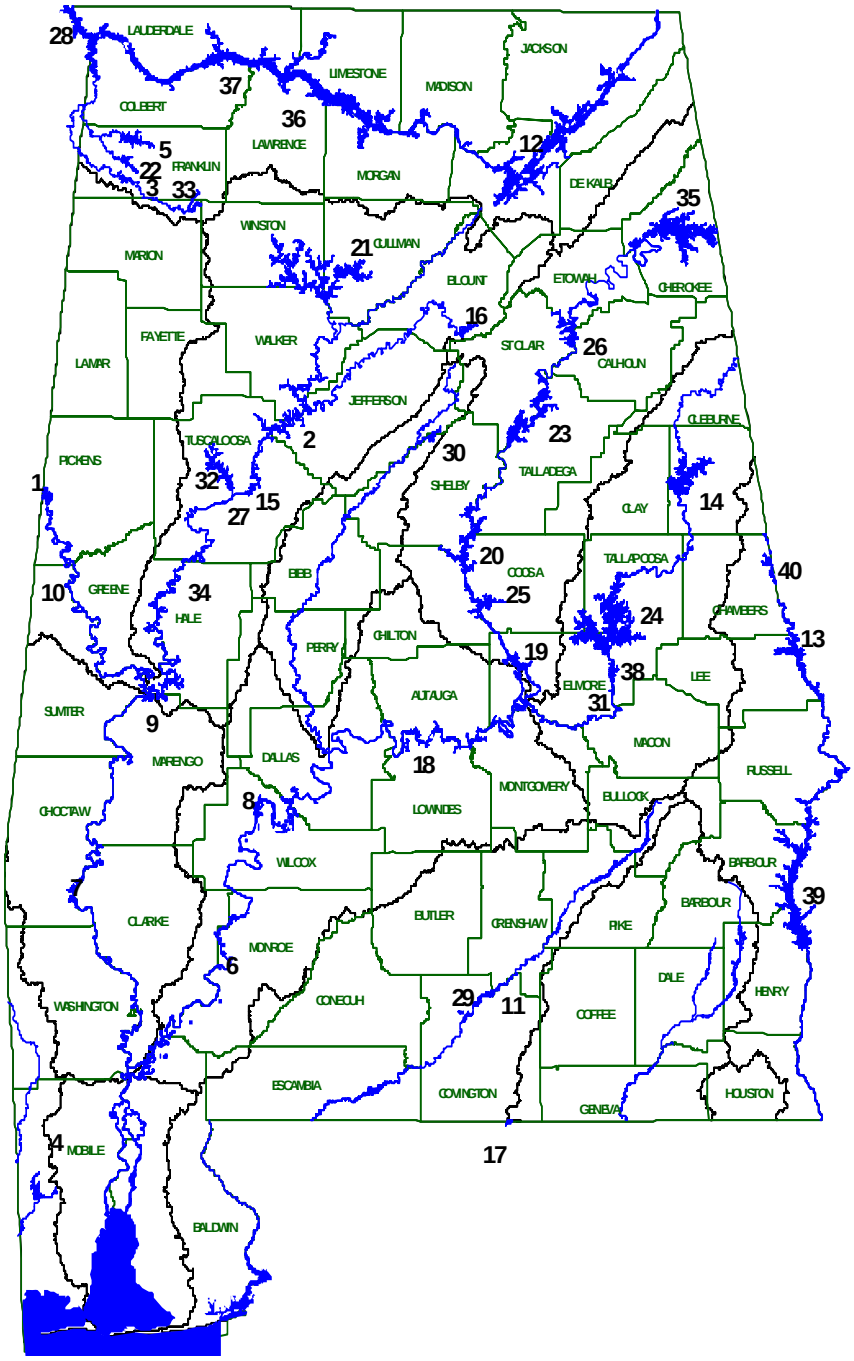
Beginning in 1994, the frequency of reservoir monitoring in the RWQM Program was increased to a minimum of once every two years so that the water quality database and trends in trophic status could be more rapidly developed. Lakes indicated to be use-threatened or impaired continued to be monitored annually. Realignment of the reservoir sampling schedule was also initiated in 1994 so that reservoir sampling by basin could be instituted.

In 1997, intensive monitoring of reservoirs by basin was initiated, with spring season sampling for the RWQM Program discontinued to allow allocation of resources toward this effort. Intensive monitoring consists of monthly sampling of multiple mainstem and tributary embayment stations in each reservoir from April-October. Reservoirs intensively monitored to date are as follows:

a) Coosa and Tallapoosa River Basin reservoirs, 1997;
b) Black Warrior River Basin reservoirs, 1998;
c) Chattahoochee and Conecuh River Basin reservoirs, 1999;
d) Coosa, Tallapoosa, and Alabama River Basin reservoirs, 2000;
e) Tombigbee and Escatawpa reservoirs, 2001;
f) Black Warrior River Basin reservoirs, 2002;
g) Tennessee River Basin tributary embayments, 2003;
h) Chattahoochee, Perdido-Escambia, and Choctawhatchee River Basins, 2004; and,
i) Coosa, Tallapoosa, and Alabama River Basin reservoirs, 2005.
j) Tombigbee and Escatawpa reservoirs, 2006
k) Black Warrior River Basin reservoirs, 2007

Initiated in 1989, water quality monitoring of lakes of the Tennessee River system continues through the Tennessee Valley Authority (TVA) Reservoir Vital Signs Monitoring Program. The Program provides results of its monitoring activities to the ADEM on an annual basis through Program reports. Activities of the Program are based on the examination of appropriate physical, chemical, and biological indicators in the forebay, mid-region, and headwater areas of each lake. Objectives of the Program are to provide basic information on the “health” or integrity of the aquatic ecosystem in each TVA lake and to provide screening level information describing how well each reservoir meets the “fishable” and “swimmable” goals of the Clean Water Act. Figure 3-1 shows Publicly Accessible Reservoirs of Alabama.

Figure 3-1 Publicly Accessible Reservoirs of Alabama



1) Aliceville
2) Bankhead
3) Bear Creek
4) Big Creek
5) Cedar Creek
6) Claiborne
7) Coffeeville
8) Dannelly
9) Demopolis
10) Gainesville
11) Gantt
12) Guntersville
13) Harding
14) Harris
15) Holt
16) Inland
17) Jackson
18) Jones Bluff
19) Jordan
20) Lay
21) Lewis Smith
22) Little Bear Creek
23) Logan-Martin
24) Martin
25) Mitchell
26) Neely Henry
27) Oliver
28) Pickwick
29) Point A
30) Purdy
31) Thurlow
32) Tuscaloosa
33) Upper Bear Creek
34) Warrior
35) Weiss
36) Wheeler
37) Wilson
38) Yates
39) W. F. George
40) West Point

For more information about Lakes and Reservoirs, contact Ms. Gina LoGiudice in ADEM's Montgomery Office at (334) 260-2783 or glogiudice@adem.state.al.us.

3.2 Trophic Status

In the RWQM Program, the ADEM uses Carlson's trophic state index (TSI) for determination of the trophic state of Alabama lakes. Carlson suggests the use of chlorophyll a concentrations in calculations of the trophic state of lakes during the summer months. Using chlorophyll a concentrations to determine trophic state is considered to give the best estimate of the biotic response of lakes to nutrient enrichment when phytoplankton is the dominant plant community.

Carlson's TSI provides the limnologist and the public with a single number that serves as an indicator of trophic status of a lake but does not necessarily define it. Lakes with a TSI of seventy (70) or greater are generally considered to be hypereutrophic and in need of regulatory action appropriate for protection and restoration. A TSI of fifty (50) to seventy (70) indicates eutrophic conditions in a lake. Trophic state index values from forty (40) to fifty (50) indicate mesotrophic conditions. Oligotrophic conditions are indicated by TSI values less than forty (40).

The number and surface area of lakes for each trophic classification appear in Table 3-1, which was developed using current monitoring data.

A trophic state ranking of Alabama lakes appears in Table 3-2. TSI graphs or Alabama reservoirs are found in Figures 3-2 thru 3-32.

Table 3-1 Trophic Status of Significant Publicly Owned Lakes

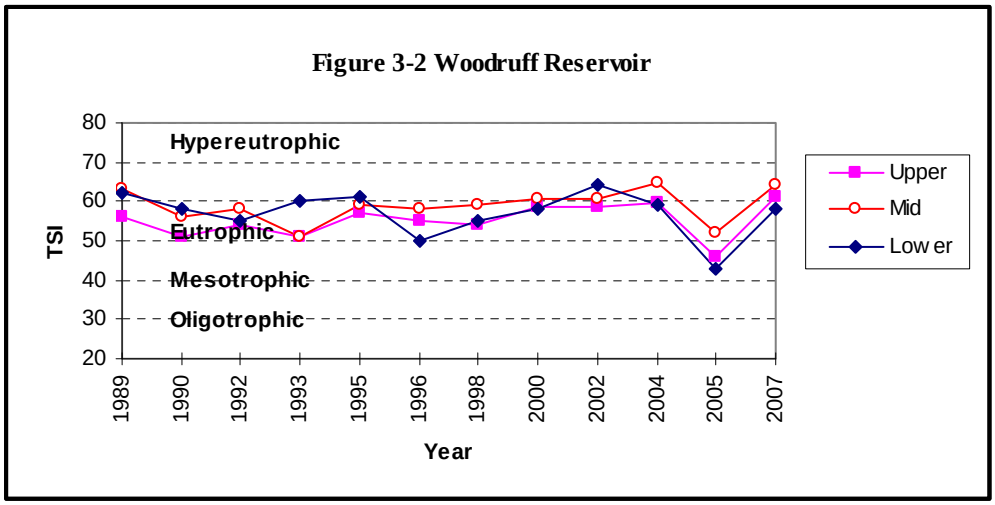
	Number of Lakes	Acreage of Lakes
Total	40	420,277
Assessed	40	420,277
Oligotrophic	4	60,730
Mesotrophic	11	38,051
Eutrophic	25	321,496
Hypereutrophic	0	0
Dystrophic	0	0
Unknown	0	0

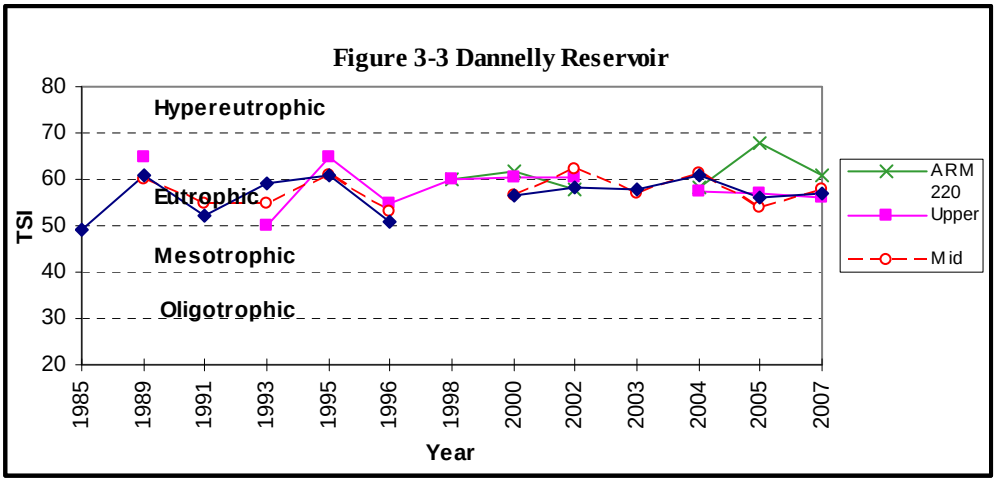
Table 3-2 Reservoir and Lake Trophic Status

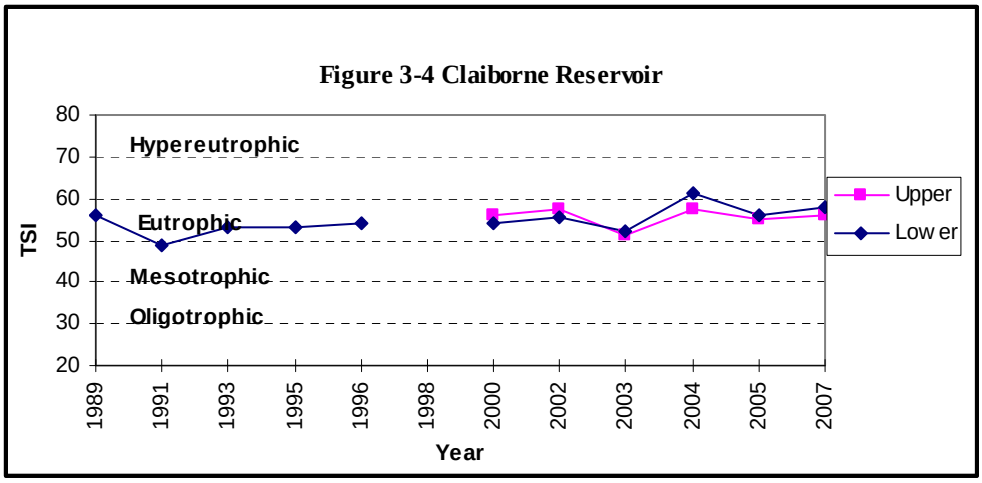
Trophic State Designation	Index	Reservoir	River Basin	*August TSI Value	August TSI Year	**Average TSI Value
Eutrophic	1	Neely Henry	Coosa	66	2007	64
	2	Weiss	Coosa	65	2007	63
	3	Lay	Coosa	64	2007	59
	4	Logan Martin	Coosa	63	2007	59
	5	Warrior	Warrior	63	2007	53
	6	Jordan	Coosa	62	2007	56
	7	Mitchell	Coosa	62	2007	58
	8	Wilson	Tennessee	62	2007	59
	9	Wheeler	Tennessee	61	2007	60
	10	West Point	Chattahoochee	60	2007	54
	11	Claiborne	Alabama	58	2007	55
	12	Pickwick	Tennessee	58	2007	57
	13	Upper Bear	Tennessee	58	2007	60
	14	Woodruff	Alabama	58	2007	57
	15	W.F. George	Chattahoochee	58	2007	55
	16	Bear	Tennessee	57	2007	58
	17	Dannelly	Alabama	57	2007	57
	18	Aliceville	Tombigbee	56	2006	57
	19	Guntersville	Tennessee	56	2007	55
	20	Gainesville	Tombigbee	54	2006	53
	21	Holt	Warrior	54	2007	52
	22	Oliver	Warrior	54	2007	53
	23	Coffeeville	Tombigbee	52	2006	52
	24	Gantt	Perdido Escambia	52	2007	47
	25	Purdy	Cahaba	51	2007	58
Mesotrophic	26	Harding	Chattahoochee	49	2007	52
	27	Yates	Tallapoosa	49	2007	44
	28	Demopolis	Tombigbee	48	2006	51
	29	Thurlow	Tallapoosa	48	2007	37
	30	Big Creek	Escatawpa	47	2006	50
	31	Harris	Tallapoosa	47	2007	48
	32	Jackson	Perdido Escambia	46	2007	44
	33	Tuscaloosa	Warrior	45	2007	42
	34	Point A	Perdido Escambia	42	2007	47
	35	Cedar	Tennessee	41	2007	43
	36	Little Bear	Tennessee	41	2007	46
Oligotrophic	37	Smith	Warrior	35	2007	42
	38	Inland	Warrior	31	2007	37
	39	Bankhead	Warrior	24	2007	49
	40	Martin	Tallapoosa	24	2007	40

*Analytical holding times for chlorophyll a (used in calculating TSI) in 2005 were exceeded, therefore the reported values are estimated
**Average values (1985-present) from dam forebay stations during August/September.
***Average values may not reflect a lake's current trophic state.
Oligotrophic < 40; Mesotrophic 40-49; Eutrophic 50-69; Hypereutrophic > 69

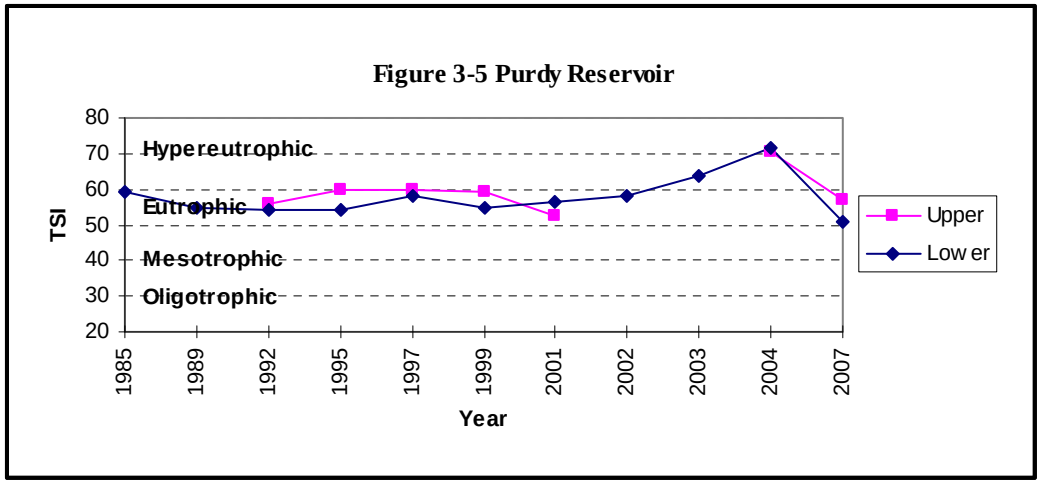
Alabama River Basin



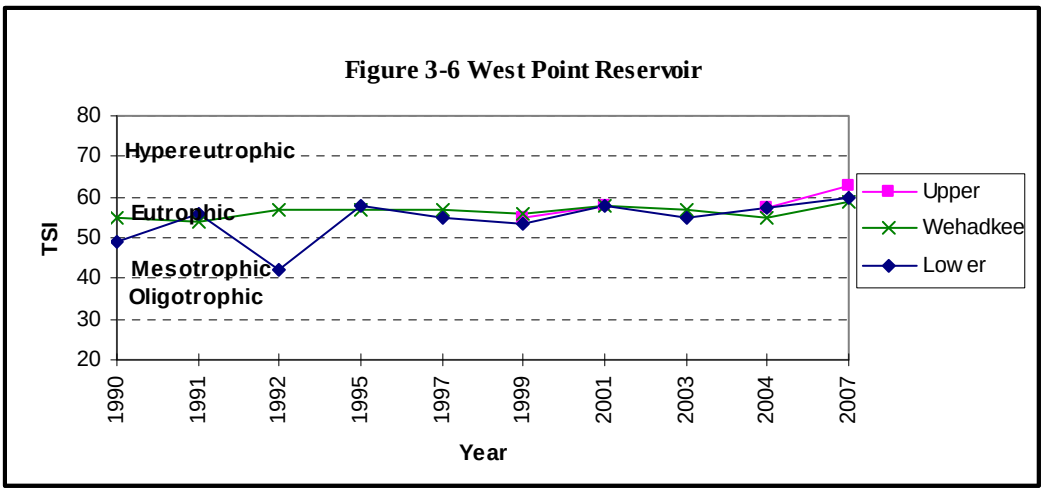


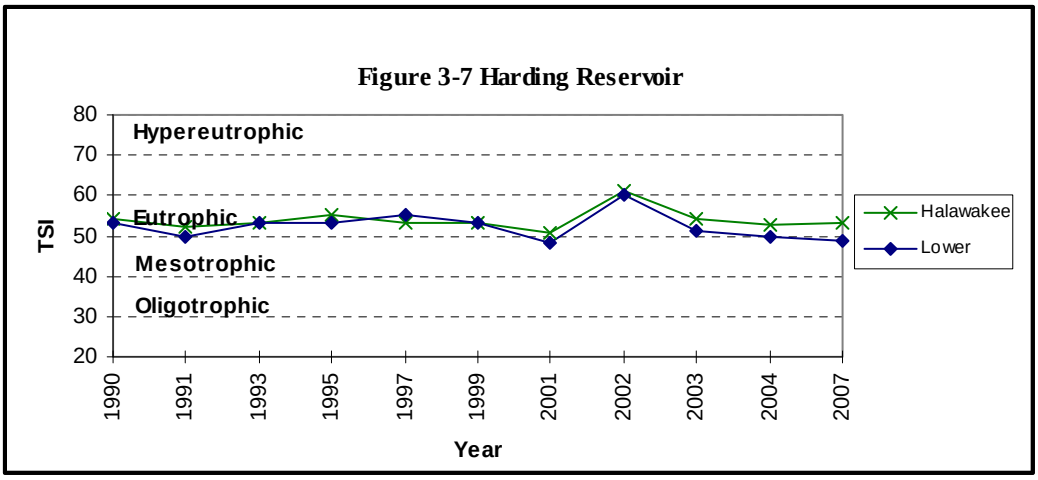


Cahaba River Basin

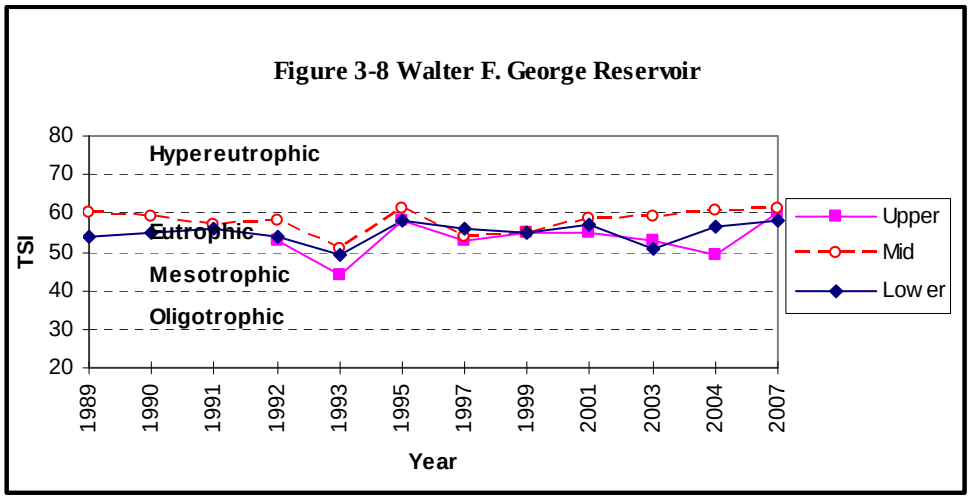


Chattahoochee River Basin

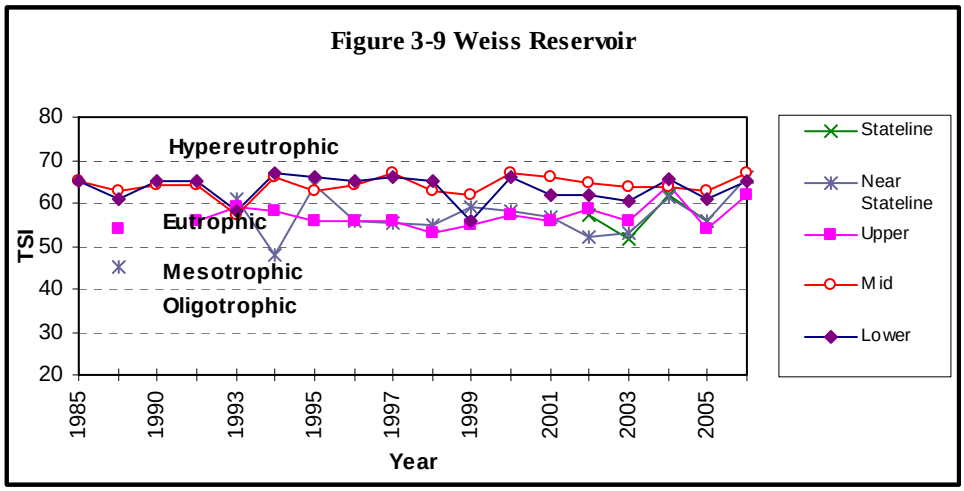


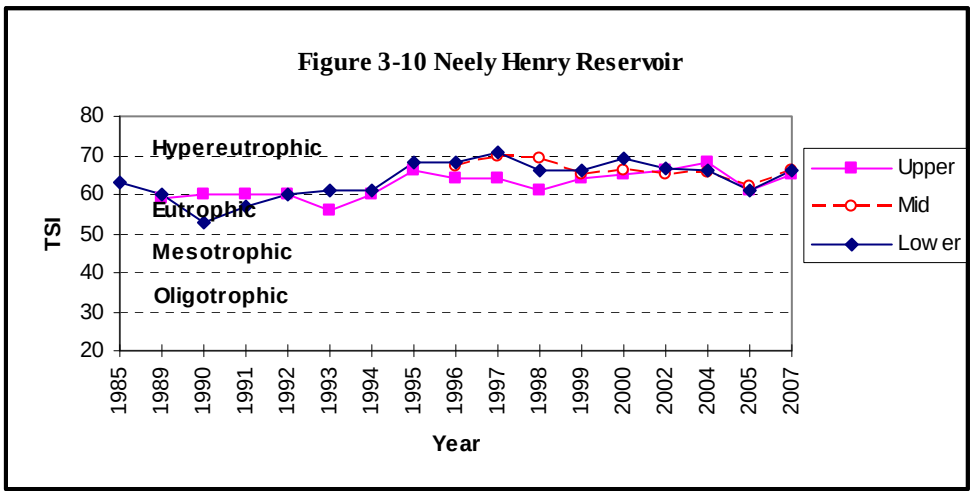


Chattahoochee River Basin



Coosa River Basin





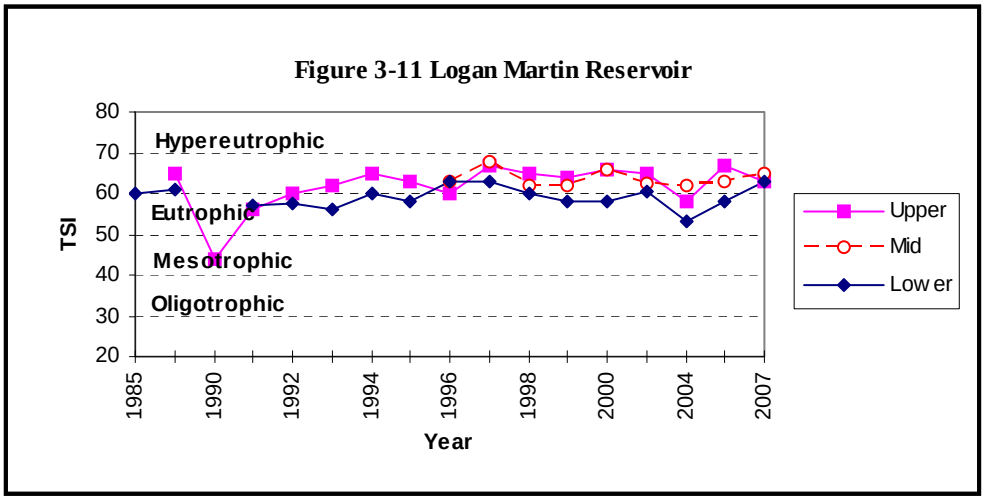


Figure 3-11 Logan Martin Reservoir
80
70
60
50
40
30
20
TSI
Hypereutrophic
Eutrophic
Mesotrophic
Oligotrophic
1985
1990
1992
1994
1996
1998
2000
2004
2007
Year
Upper
Mid
Low er

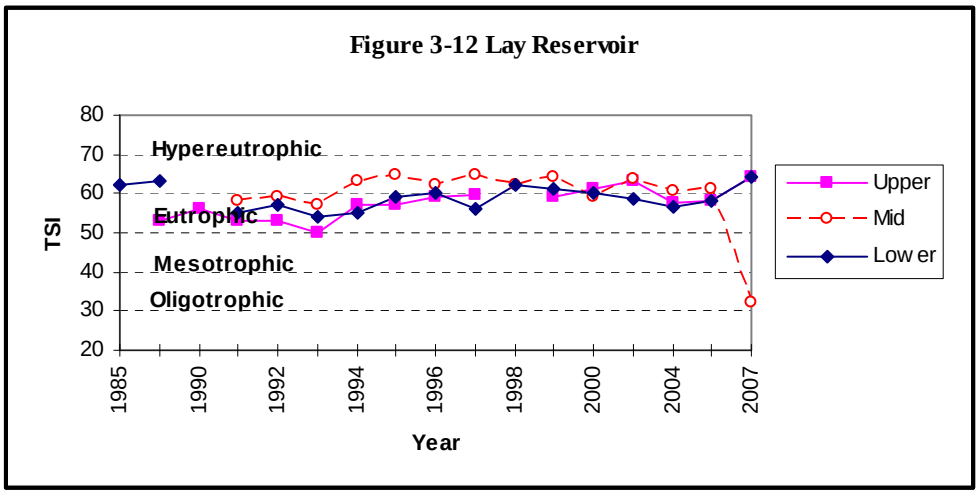


Figure 3-12 Lay Reservoir
80
70
60
50
40
30
20
TSI
Hypereutrophic
Eutrophic
Mesotrophic
Oligotrophic
1985
1990
1992
1994
1996
1998
2000
2004
2007
Year
Upper
Mid
Low er

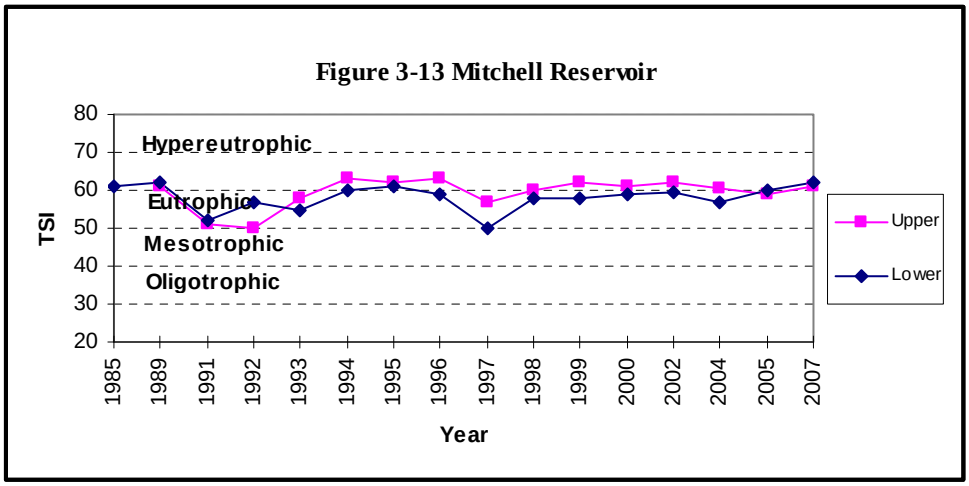
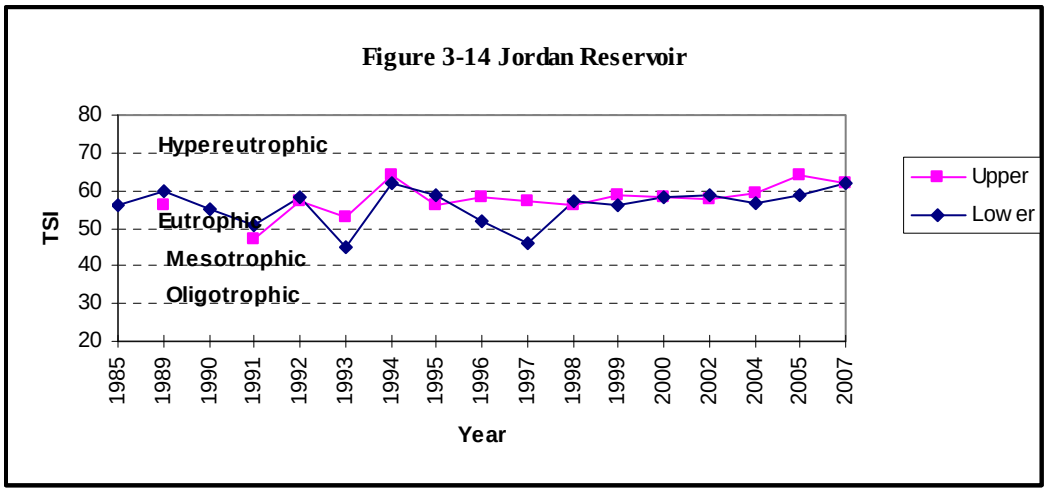
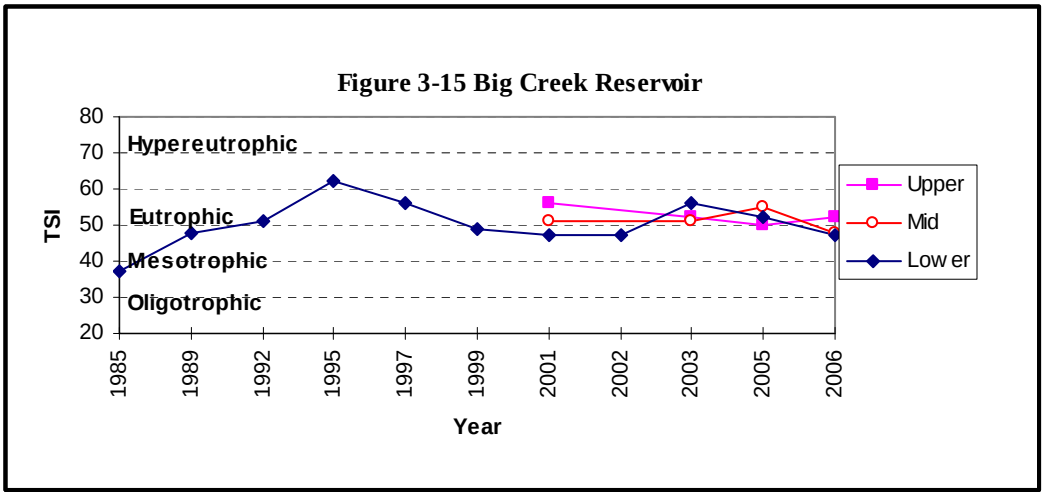


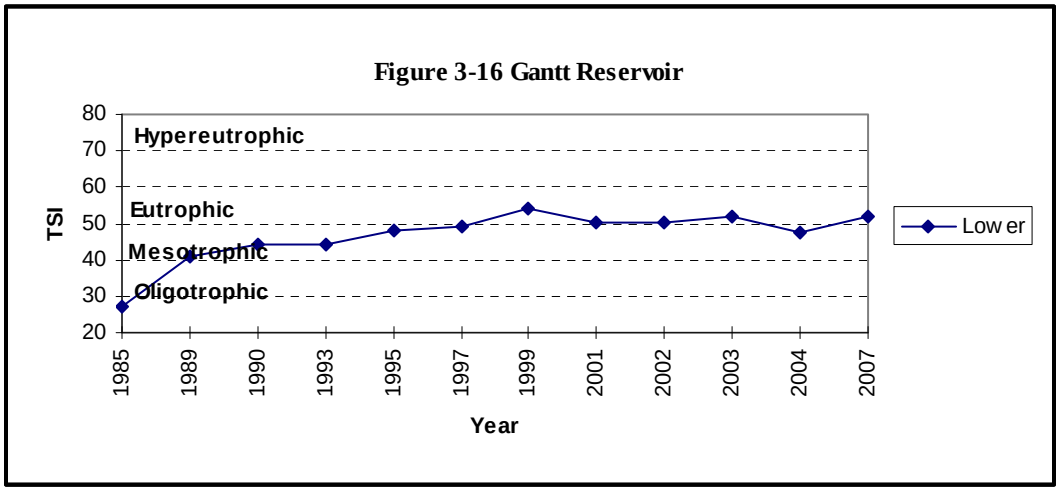
Figure 3-13 Mitchell Reservoir
80
70
60
50
40
30
20
TSI
Hypereutrophic
Eutrophic
Mesotrophic
Oligotrophic
1985
1989
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2002
2004
2005
2007
Year
Upper
Lower



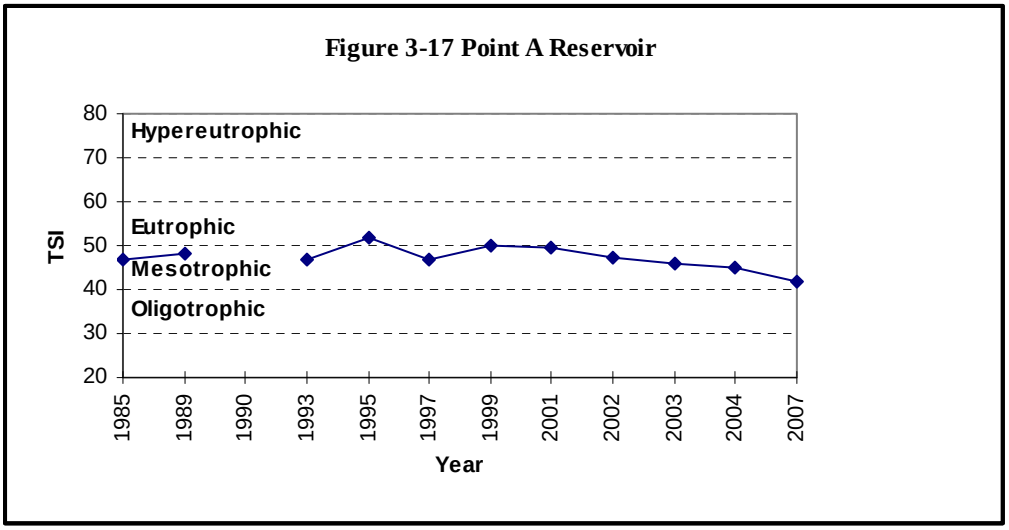
Escatawpa River Basin

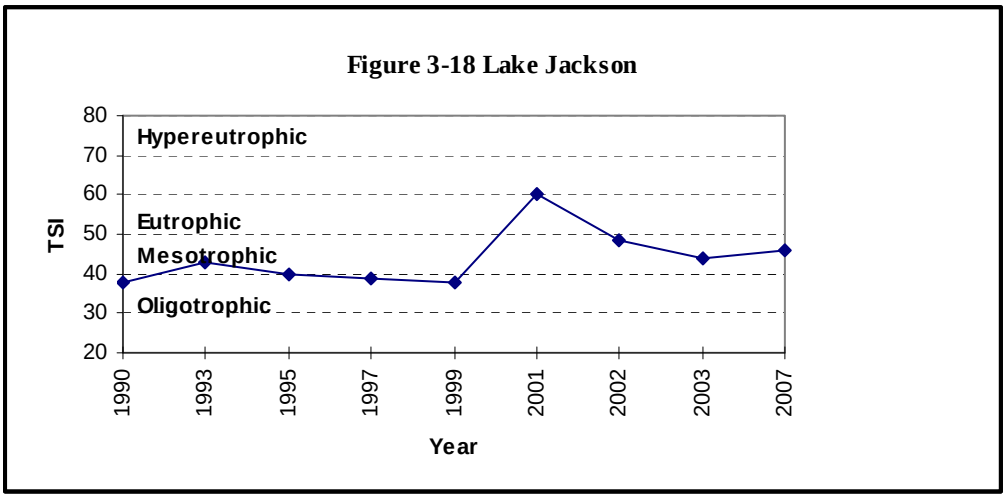


Perdido Escambia River Basin

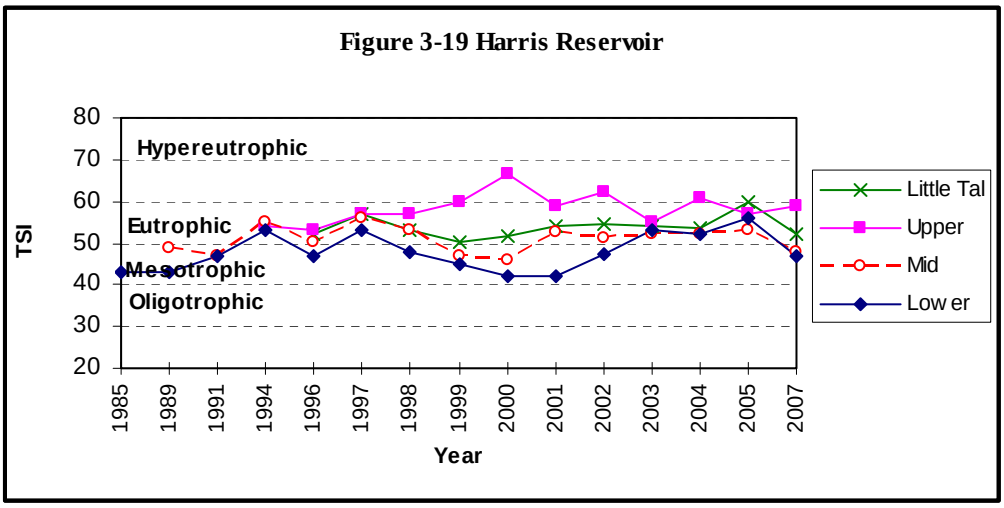


Perdido Escambia River Basin

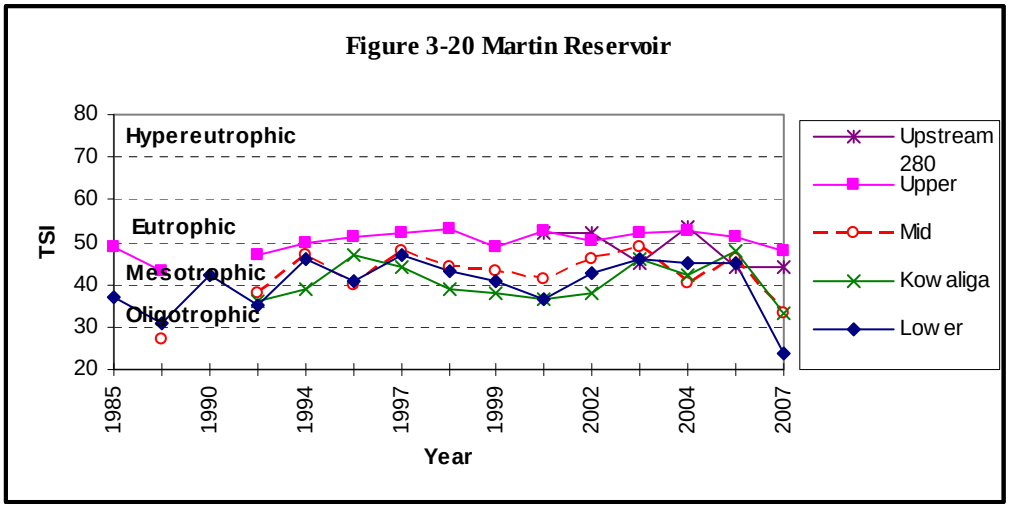


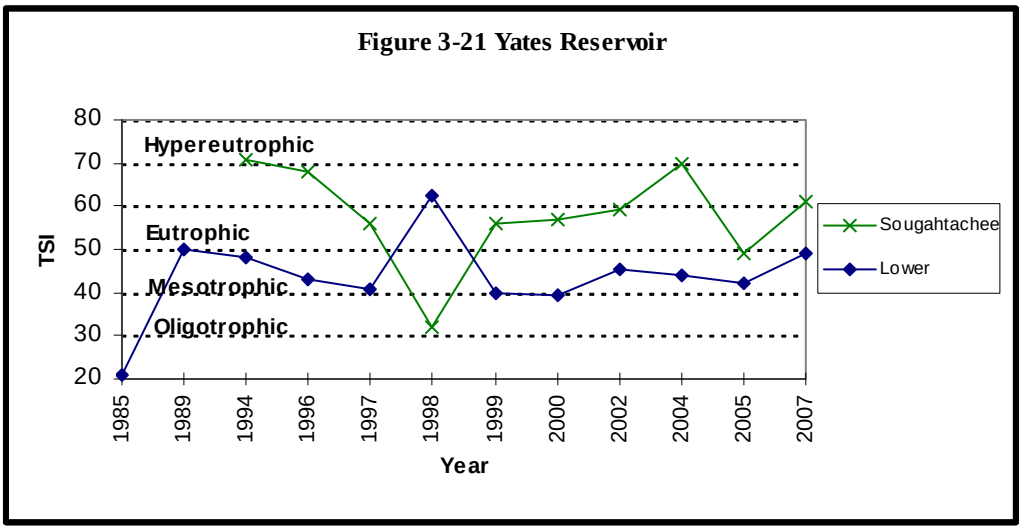


Tallapoosa River Basin

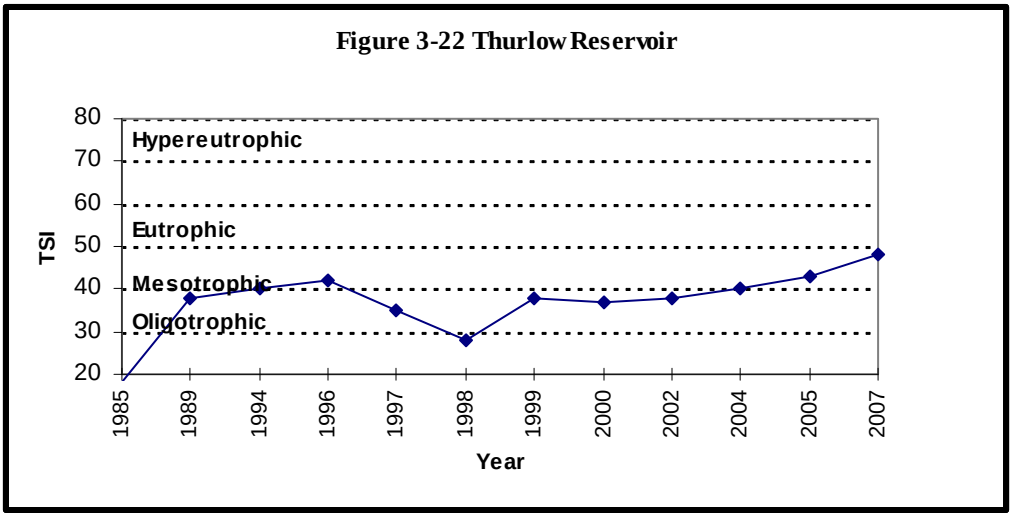


Tallapoosa River Basin

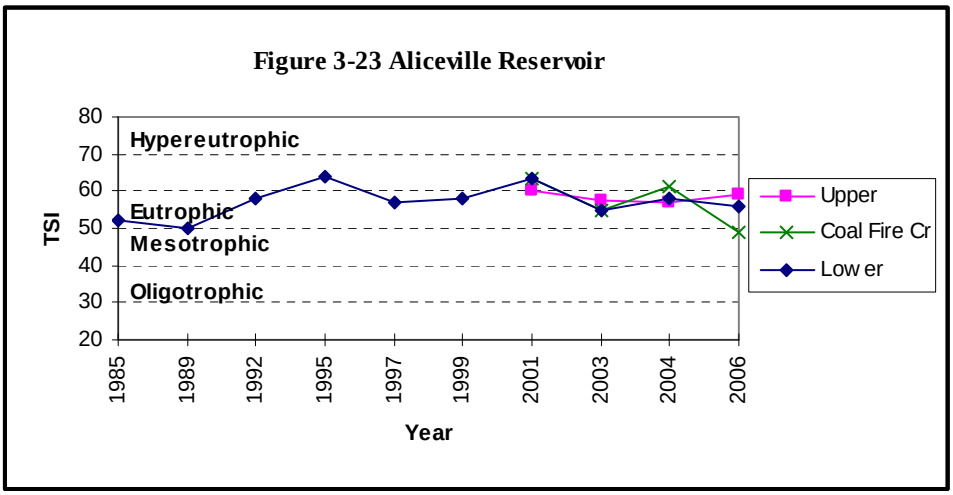


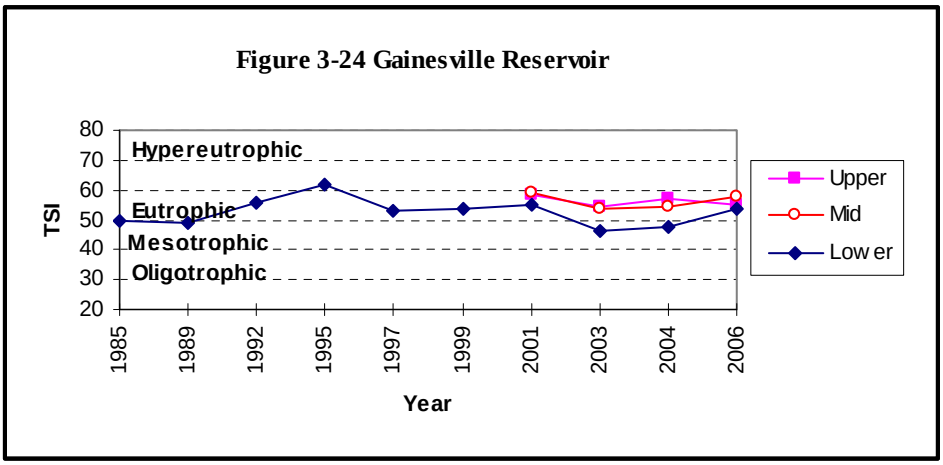


Tombigbee River Basin

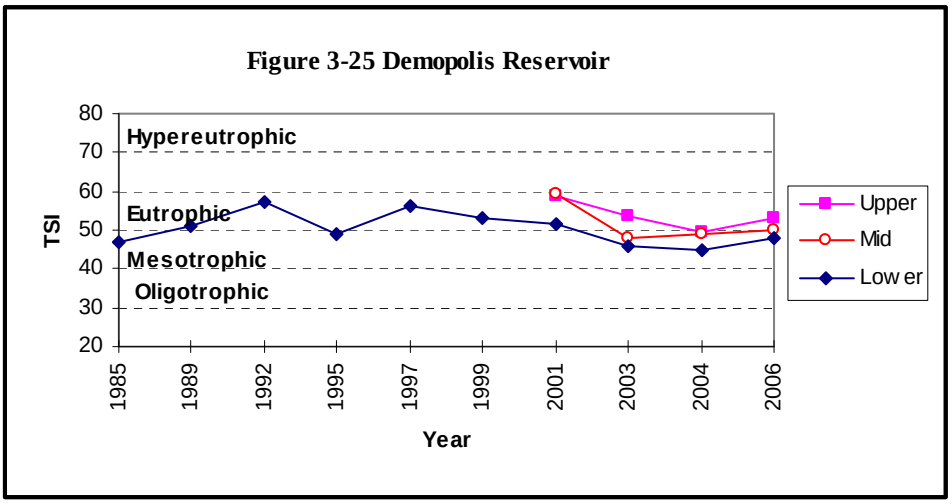


Tombigbee River Basin

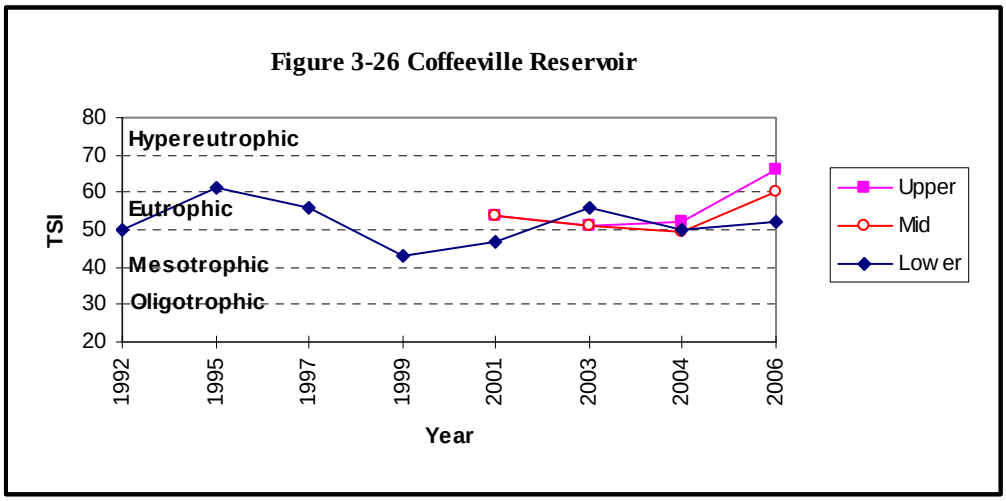




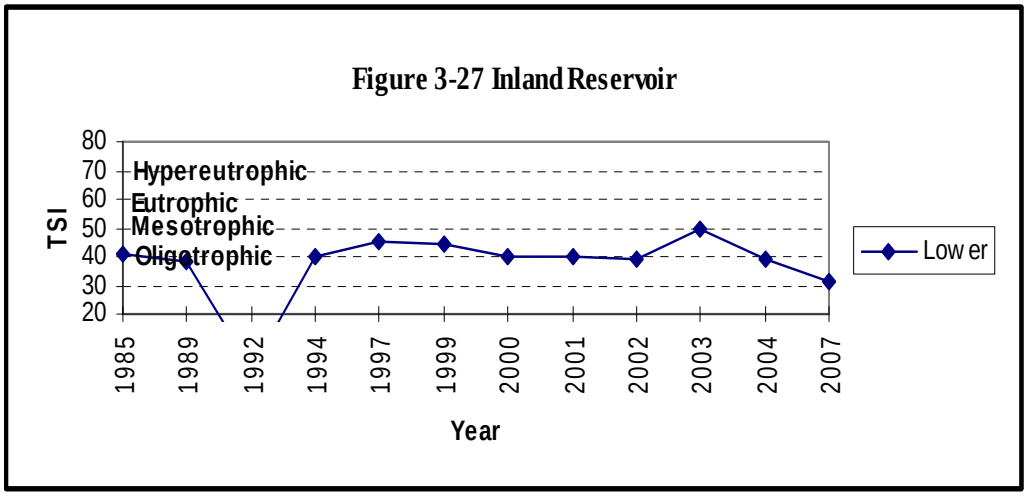
Tombigbee River Basin

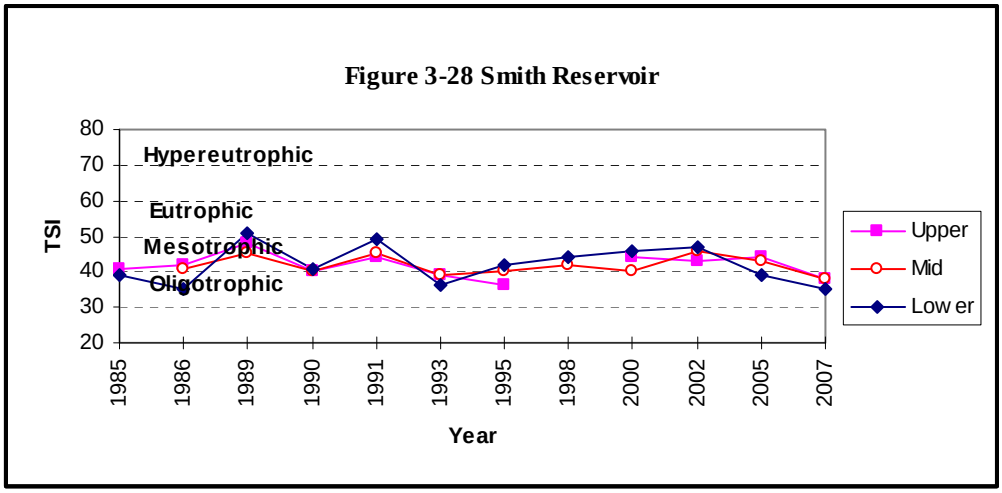


Tombigbee River Basin

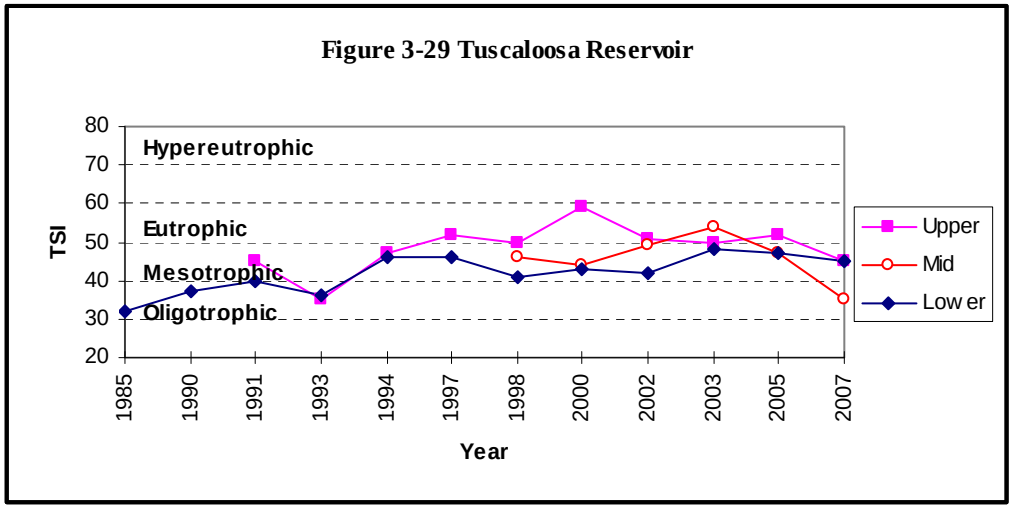


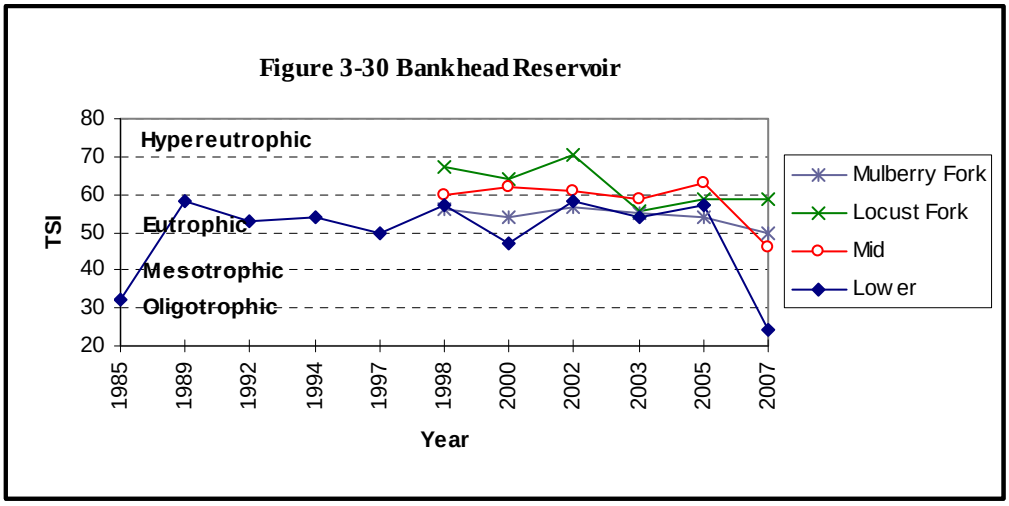
Warrior River Basin

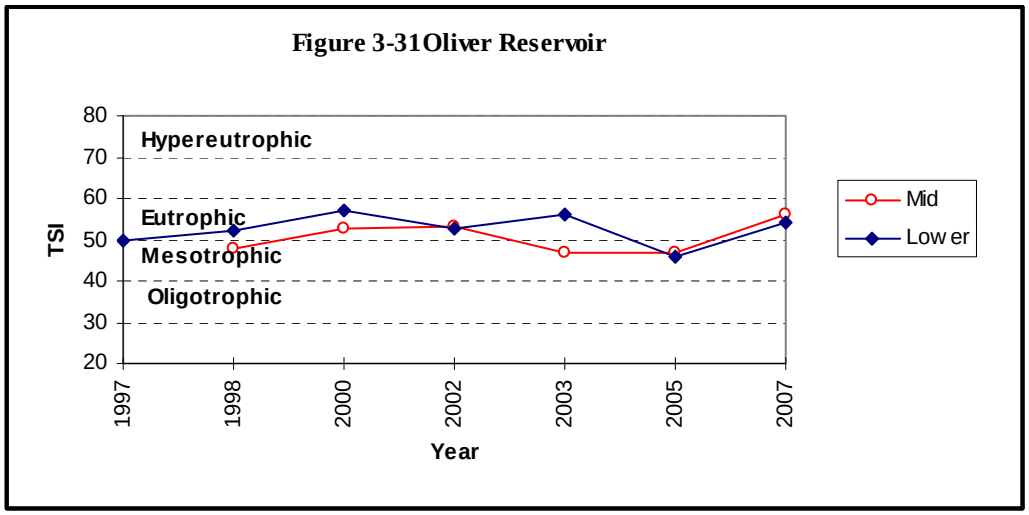




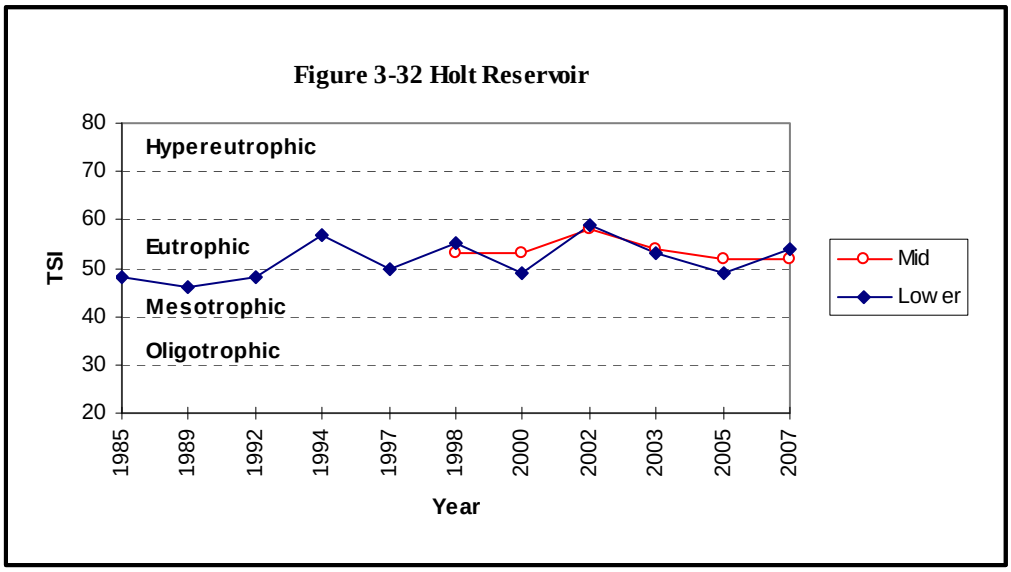
Warrior River Basin

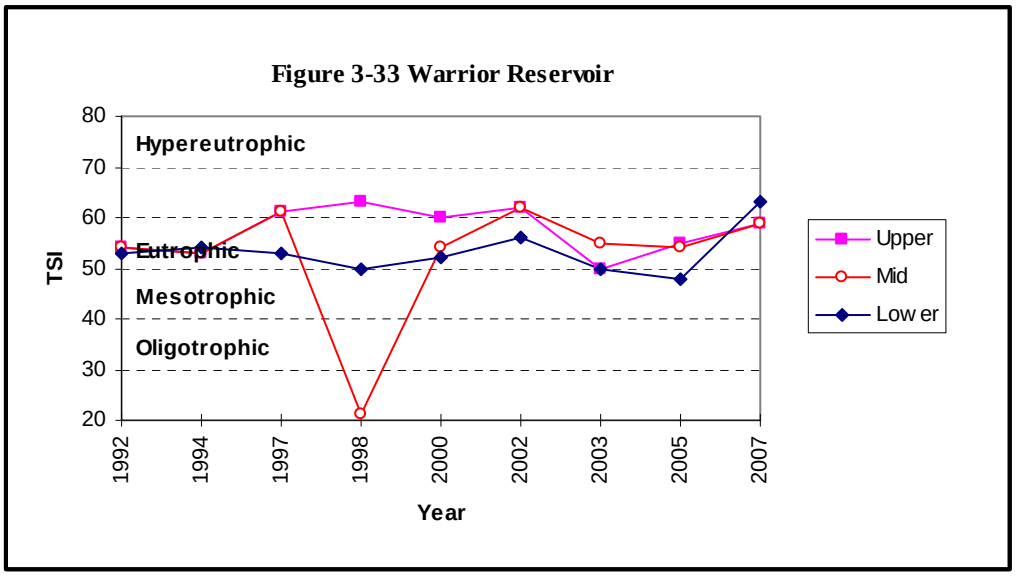






Warrior River Basin





3.3 Control Methods

The ADEM has not defined control methods specifically for lakes. Instead, the pollution controls of ADEM's Point Source Program (NPDES permitting) and the Nonpoint Source Program are applicable for all of the State's surface waters.

3.4. Restoration Efforts

Water quality data collected by the RWQM Program enabled the ADEM to determine lakes in need of Clean Lakes Program Phase I Diagnostic/Feasibility Studies. All Clean Lakes Program Phase I Diagnostic/Feasibility Studies were conducted through cooperative agreements between ADEM and Auburn University. A list of the Clean Lakes Program Projects of Alabama appears in Table 3-3. Table 3-4 shows State Owned and Operated Public Fishing Lakes.

Table 3-3 List of Clean Lakes Program Projects

Name of Project	Type of Project	Federal Funding ($)	Problems Addressed	Management Measures Proposed or Undertaken
West Point Reservoir	Phase I	100,000	Diagnostic/ Feasibility	See Report
W.F. George Reservoir	Phase I	70,000	Diagnostic/ Feasibility	See Report
Neely Henry Reservoir	Phase I	92,000	Diagnostic/ Feasibility	See Report
Weiss Reservoir	Phase I	142,583	Diagnostic/ Feasibility	See Report
Smith Reservoir	Phase I	93,000	Diagnostic/ Feasibility	See Report

Table 3-4 State Owned and Operated Public Fishing Lakes

County	County Fishing Lakes	Acres
Barbour	Barbour County Lake	75
Bibb	Bibb County Lake	100
Chambers	Chambers County Lake	183
Clay	Clay County Lakes	74
Coffee	Coffee County Lake	80
Crenshaw	Crenshaw County Lake	53
Dale	Dale County Lake	92
Dallas	Dallas County Lake	100
DeKalb	DeKalb County Lake	120
Escambia	Escambia County Lake	184
Fayette	Fayette County Lake	60
Geneva	Geneva County Lakes	65
Lamar	Lamar County Lake	68
Lee	Lee County Lake	130
Madison	Madison County Lake	105
Marion	Marion County Lake	37
Monroe	Monroe County Lake	94
Pike	Pike County Lake	45
Walker	Walker County Lake	163
Washington	Washington County Lake	84
Totals	20 State Fishing Lakes	1,061

3.5. Impaired Lakes

The Size of Rivers and Streams Impaired by Causes appears in Table 3-5. Size of Rivers and Streams Impaired by Sources appears in Table 3-6.

Water quality data collected by the RWQM Program, Clean Lakes Program Phase I Studies, TVA Reservoir Monitoring Program, and ADEM intensive reservoir surveys were used for determination of use support status. Available data from each reservoir was examined for repeated violations of specific water quality criteria established by the ADEM and evaluated with adherence to the Guidelines For Preparation of the State Water Quality Assessments (305 (b) Reports). Waters affected by health advisories related to fish consumption were determined to be either partially supporting or not supporting. This determination was dependent upon whether advisories specified limited consumption or no consumption of a particular species as directed in the guidelines mentioned above.

Table 3-5 Size of Rivers and Streams Impaired by Causes

Reservoirs and Lakes	Size of Water Impaired
Metals (Hg)	73,331 acres
Nutrients	49,919 acres
Organic Enrichment/DO	45,826 acres
Pesticides (DDT)	85 acres
pH	12,702 acres
Priority Organics (PCBs)	32,196 acres
Total	214,059 acres

Table 3-6 Size of Rivers and Streams Impaired by Sources

Reservoirs and Lakes	Size of Impaired Waters
Atmospheric Deposition	6,592 acres
Contaminated sediments	32,694 acres
Flow regulation/modification	57,790 acres
Industrial	13,198 acres
Municipal	12,276 acres
Non-irrigated crop production	4,200 acres
Pasture grazing	2,300 acres
Upstream sources	53,570 acres
Urban runoff/storm sewers	22,499 acres
Total	205,119 acres

3.6. Toxic Effects on Lakes

Lake-specific monitoring information for toxic pollutants is limited. Point source control efforts are directed at the source of toxic pollutants through NPDES permitting programs. Total lake acres affected by toxicants appear in Table 3-7. Lake acreage monitored for toxicants consists of lakes for which fish have been collected and analyzed through the ADEM Fish Tissue Monitoring Program and the TVA Reservoir Program. Lake acreage with elevated levels of toxicants consists of lake areas upon which health advisories have been instituted that relate to consumption of fish contaminated with certain priority pollutants.

Fish will continue to be collected from major lakes, rivers, and certain waterbodies of concern and analyzed for toxic pollutants as part of the ADEM Fish Tissue Monitoring Program. Fish tissue sampling results are contained in the Fish Tissue Monitoring section of Part V Public Health Information.

3.7 Acid Effects on Lakes

The number and acreage of lakes affected by acidity appear in Table 3-8. The number and acreage of lakes affected by sources of high acidity appear in Table 3-9. No reservoirs monitored by the ADEM have been determined to be impacted by high acidity based on data collected through the RWQM Program. However, the following reservoirs are considered vulnerable to acidity based on low alkalinities and pH values observed in monitoring data that were near limits of specific ADEM water quality criteria: Big Creek; Inland; Jackson; Point A; Smith; and Tuscaloosa. Low pH values measured in Big Creek, Jackson, and Point A Reservoirs are determined to be of natural origin and are considered unlikely to cause adverse impacts. In the case of both Smith and Tuscaloosa Reservoirs, mining activities in the watershed were also considered in determining the vulnerability of the reservoirs to acid effects.

Table 3-7 Total Reservoir Size Affected by Toxicants

Waterbody	Size Monitored for Toxicants	Size with Elevated Levels of Toxicants
Rivers (miles)	-	-
Lakes (acres)	339,406	66,832
Estuaries (sq. miles)	-	-
Coastal waters (miles)	-	-
Freshwater wetlands (acres)	-	-
Tidal wetlands (acres)	-	-

Table 3-8 Lakes Affected By Acidity

	Number of Lakes	Acreage of Lakes
Assessed for Acidity	41	481,757
Impacted by High Acidity	0	0
Vulnerable to Acidity	6	33,030

Table 3-9 Sources of High Acidity in Lakes and Reservoirs

Source	Number of Lakes Impacted	Acreage of Lakes Impacted
Acid Deposition	0	0
Acid Mine Drainage	0	0
Natural Sources	0	0
Other (list)	0	0

3.8. Trends

Status of Trends for Lakes and Reservoirs appears in Table 3-10. Trends were determined by reviewing three (3) or more years of water quality data from multiple sources, if available, for each reservoir during the period 1985 to 2003.

The reservoirs considered to be degrading were listed based on data collected through the RWQM Program.

Assignment of a particular reservoir to the "Stable" category does not necessarily indicate desirable water quality but only that the water quality appears stable.

Future data collection is critical in further establishing trends in water quality of reservoirs in the State.

Table 3-10 Status of Trends for Lakes and Reservoirs

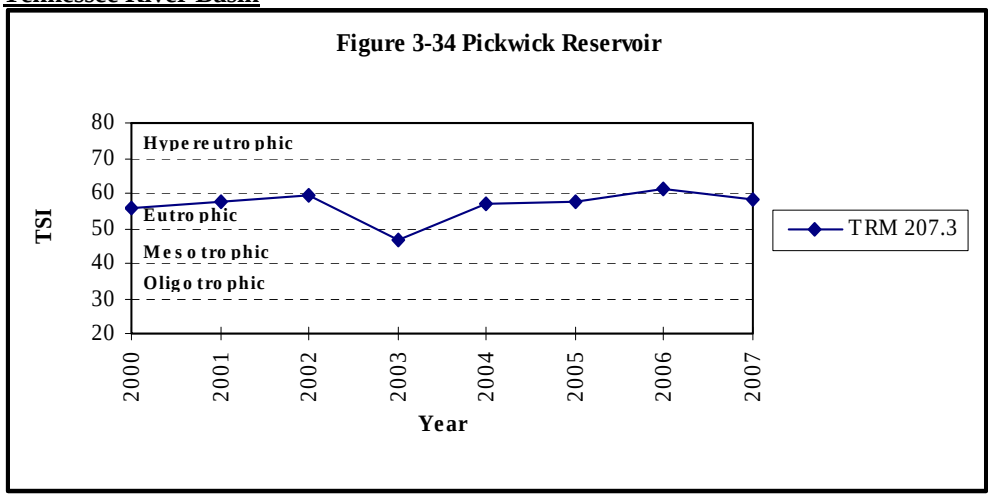
	Number of Lakes	Acreage of Lakes
Assessed for Trends	40	425,748
Improving	0	0
Stable	39	424,786
Degrading	1	962
Trend Unknown	0	0

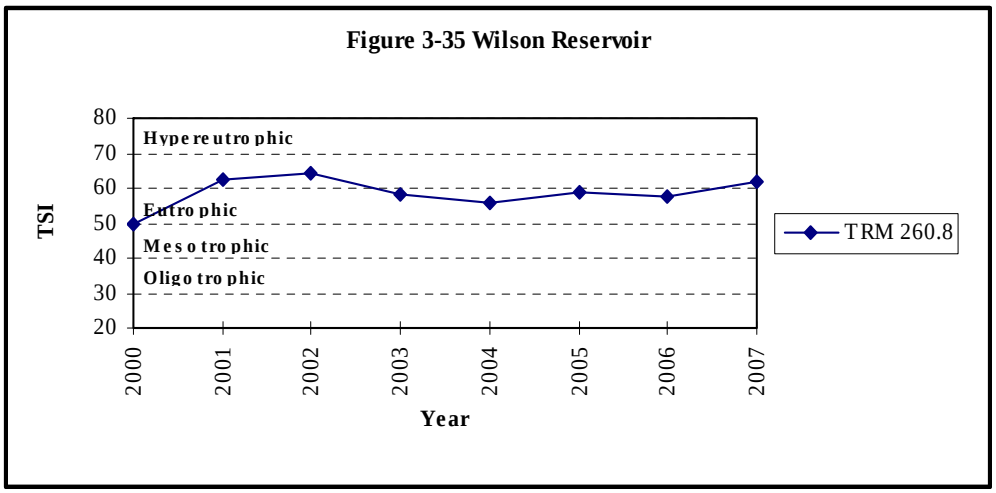
3.9 TVA Lakes

For certain lakes and reservoirs in Alabama there are waterbody-specific nutrient criteria. Nutrients may vary significantly lake-to-lake, and may vary from year to year depending on such factors as rainfall and hydraulic retention time. See Water Quality Criteria Applicable to Specific Lakes, ADEM Administrative code 335-6-10-.11. Tropic Status for TVA Reservoirs in Alabama appear in Figures 3-34 thru 3-40.

For more information about TVA Lakes, contact Mr. Johnathan Hall in ADEM's Montgomery Office at (334) 334-271-7835 or Jehall@adem.state.al.us.

Tennessee River Basin





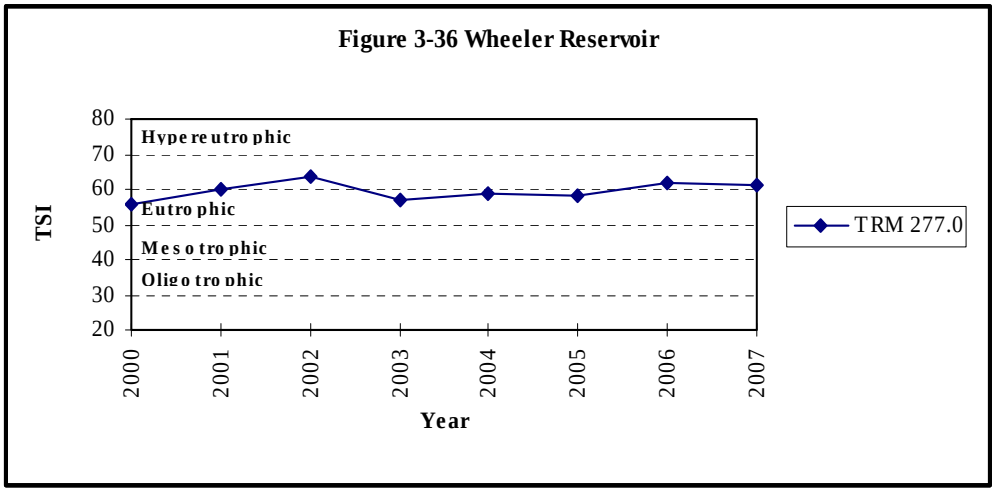


Figure 3-37 Guntersville Reservoir

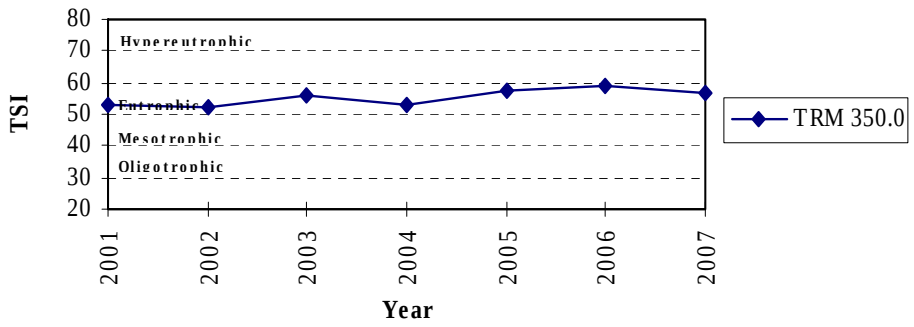


Figure 3-38 Cedar Creek Reservoir

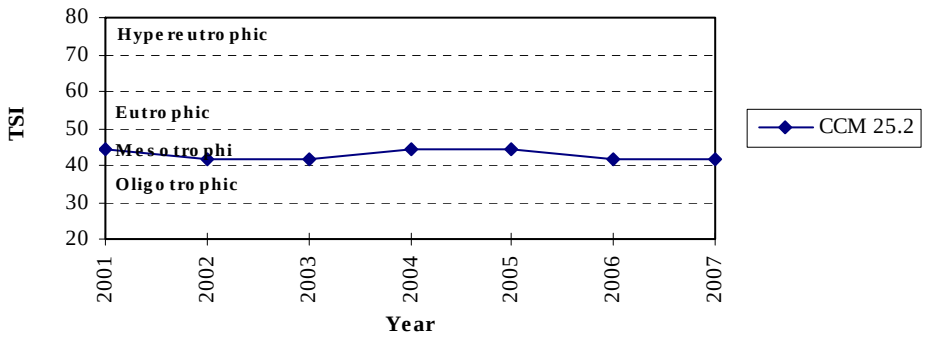
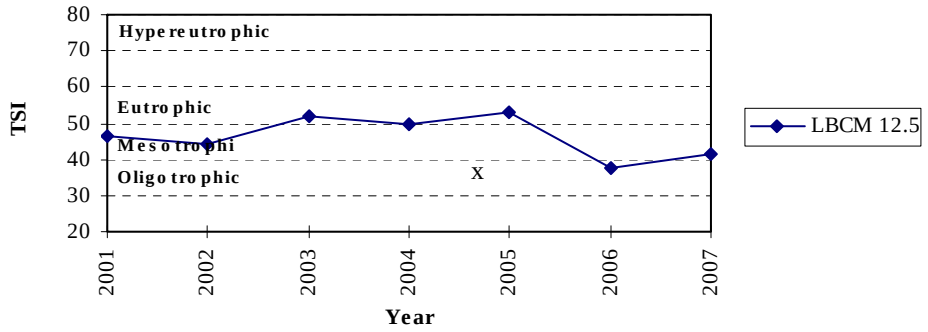



Figure 3-39 Little Bear Creek Reservoir