

2007 Lake Monitoring Report
Mecklenburg County Water Quality Program
SWIM Phase I Part 2-CO

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Final Report for FY2007-2008

PURPOSE AND BACKGROUND

The Mecklenburg County Water Quality Program (MCWQP) has an ongoing program to monitor the water quality in the three Catawba Lakes bordering the county: Lake Norman, Mountain Island Lake and Lake Wylie. Samples are also routinely collected at the two water bodies in the northern end of Mecklenburg County cut off from Lake Norman proper by I-77: Lake Cornelius and Lake Davidson. Data collected from all lake sites are used to screen for environmental problems using MCWQP Action and Watch levels for various pollutants and also to rate the overall water quality at sampling locations in the lakes using a water quality index. Additional objectives are to describe seasonal trends and address spatial variability in the data. This report presents the lake monitoring data for the calendar year 2007

ACTIVITIES AND METHODS

Regular monthly lake sampling was conducted at seven locations in Lake Norman and one location each on Lake Cornelius and Lake Davidson (Appendix A), ten locations in Mountain Island Lake (Appendix B) and eight sampling locations in Lake Wylie (Appendix C). In May 2007, the sampling program was changed in Lake Wylie to add several new cove monitoring sites. This resulted in an increase in regular sampling sites in Lake Wylie from eight to thirteen (Appendix D). Lakes Norman, Wylie and Mountain Island were sampled monthly from May through September and every other month during the rest of the year, i.e. January, March and November. During the summer months extra sites on these lakes were monitored for fecal coliform bacteria (Appendices A, B, C and D). Lakes Cornelius and Davidson were sampled monthly from May through September only. Lake Davidson was sampled from a dock and Lake Cornelius was sampled with the cooperation of the Lake Norman YMCA using their ski boat as it is problematic to launch the MCWQP boat in these two lakes. The MCWQP boat was completely out of commission for the November 2007 lake runs. These runs were conducted with the cooperation of the Charlotte-Mecklenburg Police Department for Lake Norman and the Mecklenburg County Parks and Recreation Department for Mountain Island Lake and Lake Wylie.

Field measurements were collected for all lake runs. Depth profiles of physical-chemical measurements (temperature, dissolved oxygen, pH and conductivity, turbidity and chlorophyll) were collected in the field during lake runs using a calibrated YSI 6600 multiprobe. Water transparency was measured in the field using a Secchi disk.

Water samples were collected using a Labline composite sampler to a depth of twice the Secchi depth. During the summer months (May through September) a discrete bottom sample was collected about 1.5 m off the bottom at forebay locations near the dams of all three lakes: LN1, MI1 and LW1 as well as LC2 in Lake Cornelius. Water samples collected for laboratory analysis were placed on ice and transported back to the Charlotte Mecklenburg Utilities (CMU) Hal Marshall Laboratory where they were analyzed by standard methods. Water chemistry samples collected at all sites were analyzed for the following parameters: nutrients (total phosphorus, orthophosphorus, TKN, NH₃, and NO₂-NO₃), chlorophyll *a*, total suspended solids, total solids, turbidity, alkalinity and fecal coliform bacteria. During the July sampling runs volatile organic

compound (VOC) samples were collected at selected sites in all lakes. Metals were collected at both surface and bottom samples at forebay locations from May through September and at all sites in July.

All lab data were extracted from CMU Laboratory Services LABWORKS database and reviewed by the designated Environmental Specialist for QA/QC purposes. The Lake Water Quality Index (Fusilier 1982) was calculated for each location and date using EPIC. Fusilier’s Lake Water Quality Index (LWQI) is an opinion-based index that uses scores from nine water quality parameters (temperature, dissolved oxygen, chlorophyll *a*, Secchi disk depth, nitrate, total alkalinity, pH, specific conductivity and total phosphorus) to calculate an overall score rated from Very Poor to Excellent. In addition, the North Carolina Trophic State Index (NCTSI) was calculated using total phosphorus, Secchi depth and organic nitrogen using a formula developed as part of North Carolina’s original Clean Lakes Classification Survey (NCDNRCD 1982). Lakewide means through the growing season (May through September) were used to produce the NCTSI score for each lake. Line graphs were generated using EXCEL spreadsheets and map figures were all done using ARCVIEW 3.2.

RESULTS AND DISCUSSION

North Carolina Trophic State Index

The North Carolina Trophic State Index (NCTSI) was calculated for each lake using a mean of relevant parameters during the growing season (May through September). The trophic state indicates the degree of eutrophication of the reservoirs. Eutrophication is the process of physical, chemical and biological changes associated with nutrient, organic matter and silt enrichment that cause a water body to age (Holdren, Jones and Taggart 2001). Lake Norman rated as oligotrophic in 2007 as it was in 2006. Mountain Island Lake rated as oligotrophic in 2007, a slight change from the mesotrophic / borderline oligotrophic rating in 2006. Lake Wylie rated in the eutrophic range in 2007 as it was rated in 2006. Lake Cornelius and Lake Davidson rated mesotrophic and oligotrophic, respectively, as in 2006.

Table 1. Mean summer NCTSI values by lake for 2007 and 2006.

Lake	No. Sites	2007		No. Sites	2006	
		NCTSI Score	Trophic Classification		NCTSI Score	Trophic Classification
<i>Major Reservoirs</i>						
Norman	7	-3.744	Oligotrophic	7	-3.706	Oligotrophic
Mt. Island	10	-2.068	Oligotrophic	8	-1.996	Mesotrophic
Wylie	13	0.447	Eutrophic	8	0.162	Eutrophic
<i>Small Northern Lakes</i>						
Cornelius	1	-1.143	Mesotrophic	1	-0.550	Mesotrophic
Davidson	1	-2.962	Oligotrophic	1	-3.105	Oligotrophic

Interpretation of North Carolina Trophic State Index (NCTSI)

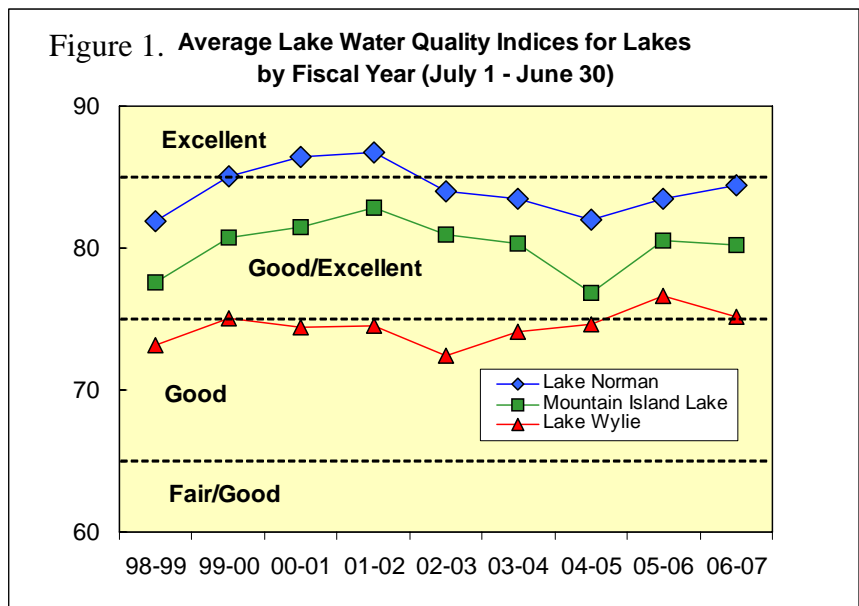
NCTSI	Classification
<-2.0	Oligotrophic
-2.0 to 0	Mesotrophic
0 to 5.0	Eutrophic
> 5.0	Hypereutrophic

Lake Water Quality Index

Historical Trends

Average annual LWQI values were calculated by fiscal year (July 1 through June 30) from 1998 through 2007 (Figure 1). Average LWQI values for Lake Norman and Mountain Island Lake showed an increase from FY98-99 through FY01-02 when they peaked and then exhibited a gradual decline to FY04-05 before increasing again through FY06-07. Average LWQI values for Lake Wylie did not show a discernable historic trend, although values have increased for the past four years.

Spatially, LWQI values in 2007 followed the usual pattern of rating the highest in Lake Norman, followed by Mountain Island Lake with lower values observed in Lake Wylie. This pattern has been consistent over the nine years plotted on the graph. The LWQIs for Lake Wylie and to a lesser extent Mountain Island Lake are at times negatively influenced by sediment and nutrients from tributary inflows.



LWQI Ranking

Fusilier's LWQIs for each site were averaged for 2007, ranked from highest to lowest and compared with the ranking from 2006 (Table 2). The general pattern of decreasing LWQI values from Lake Norman through Mountain Island Lake to Lake Wylie can be seen in the rankings by site which are color coded by lake. Eight of the top nine sites were in Lake Norman and eleven of the bottom twelve rated sites were in Lake Wylie.

The top rated site for 2007 was MI4 in Mountain Island Lake just below Cowans Ford Dam. Withers Cove (LW10), a new site added in May 2007, became the lowest ranked site for the year. Browns Cove (BC1) improved 5.9 points in 2007 over 2006 although the 2007 average only included samples collected in January and March. The LWQI in McDowell Creek Cove (MI3) declined 5.2 points in 2007 compared with 2006 and Crowders Creek Cove declined 5.3 points for the same period. The bottom ten rated

sites are all located in coves or arms of the lakes directly impacted by tributary inflows from the surrounding watersheds. Overall, average LWQIs declined 1.43 points in 2007 over 2006.

Table 2. Annual Rank of Lake Water Quality Indices by Site for 2007

Rank 2007	Site	Location Description	Average LWQI		Difference
			2007	2006	
1	MI4	Headwaters MI Lake	85.22	82.23	3.0
2	LN3	Reed's Creek Arm	84.78	84.32	0.5
3	LN6	Knox Cove	84.70	83.78	0.9
4	LN1	Cowans Ford Dam	84.65	84.68	0.0
5	LN4	Main Channel Lake Norman	84.56	84.64	-0.1
6	LN7	Davidson Creek Arm	84.27	83.86	0.4
7	LN2	Ramsey Creek Arm	83.90	83.41	0.5
8	LN5	North Meck Water Intake	83.47	83.57	-0.1
9	LD5	Lake Davidson	83.47	81.76	1.7
10	MI7	Highway 16 Bridge	82.41	NS	
11	MI1	Mt. Island Dam	82.23	83.86	-1.6
12	LW6A	Headwaters Lake Wylie	82.09	82.37	-0.3
13	MI2B	Upstream Water Intake	81.84	82.08	-0.2
14	LC2	Lake Cornelius	81.73	80.30	1.4
15	MI5	Nance Cove	81.14	81.46	-0.3
16	MI2A	Downstream Water Intake	80.37	82.16	-1.8
17	MI2	Gar Creek Cove	80.09	81.89	-1.8
18	LW1	Lake Wylie Dam (SC)	79.40	79.78	-0.4
19	LW2	Allison Creek Cove (SC)	78.15	78.14	0.0
20	MI6A	Upper Gar Creek Cove	77.68	79.65	-2.0
21	LW225	Buster Boyd Bridge	76.17	NS	
22	PALC1	Palisades, Boyds Cove	75.71	NS	
23	PALC10	Palisades, Snug Harbor Cove	74.44	NS	
24	BC2	Browns Cove (Middle)	72.42	NS	
25	BC1	Browns Cove	72.06	66.18	5.9
26	LW5	Dutchman's Creek	71.88	70.32	1.6
27	LW7	Crowders Creek Cove	70.95	76.43	-5.5
28	LW4	Paw Creek Cove	70.62	75.03	-4.4
29	LW3	South Fork Catawba River	67.82	71.12	-3.3
30	MI3	McDowell Creek Cove	65.79	70.98	-5.2
31	LW10	Withers Cove	64.28	NS	
Average			78.33	79.76	-1.43

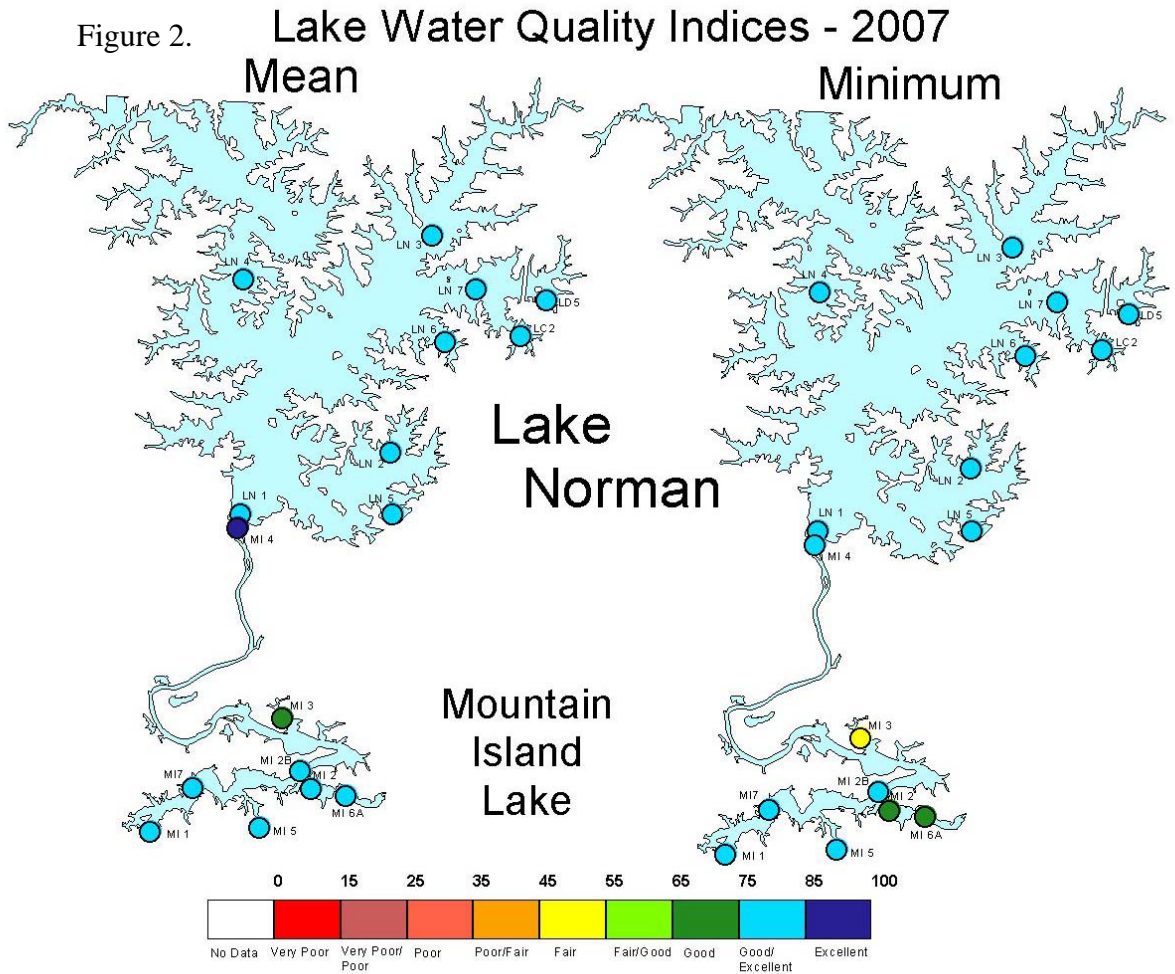
NS = Not Sampled

KEY Lake Norman Mt. Island Lake Lake Wylie Lake Cornelius/Davidson



Spatial Distribution of LWQIs

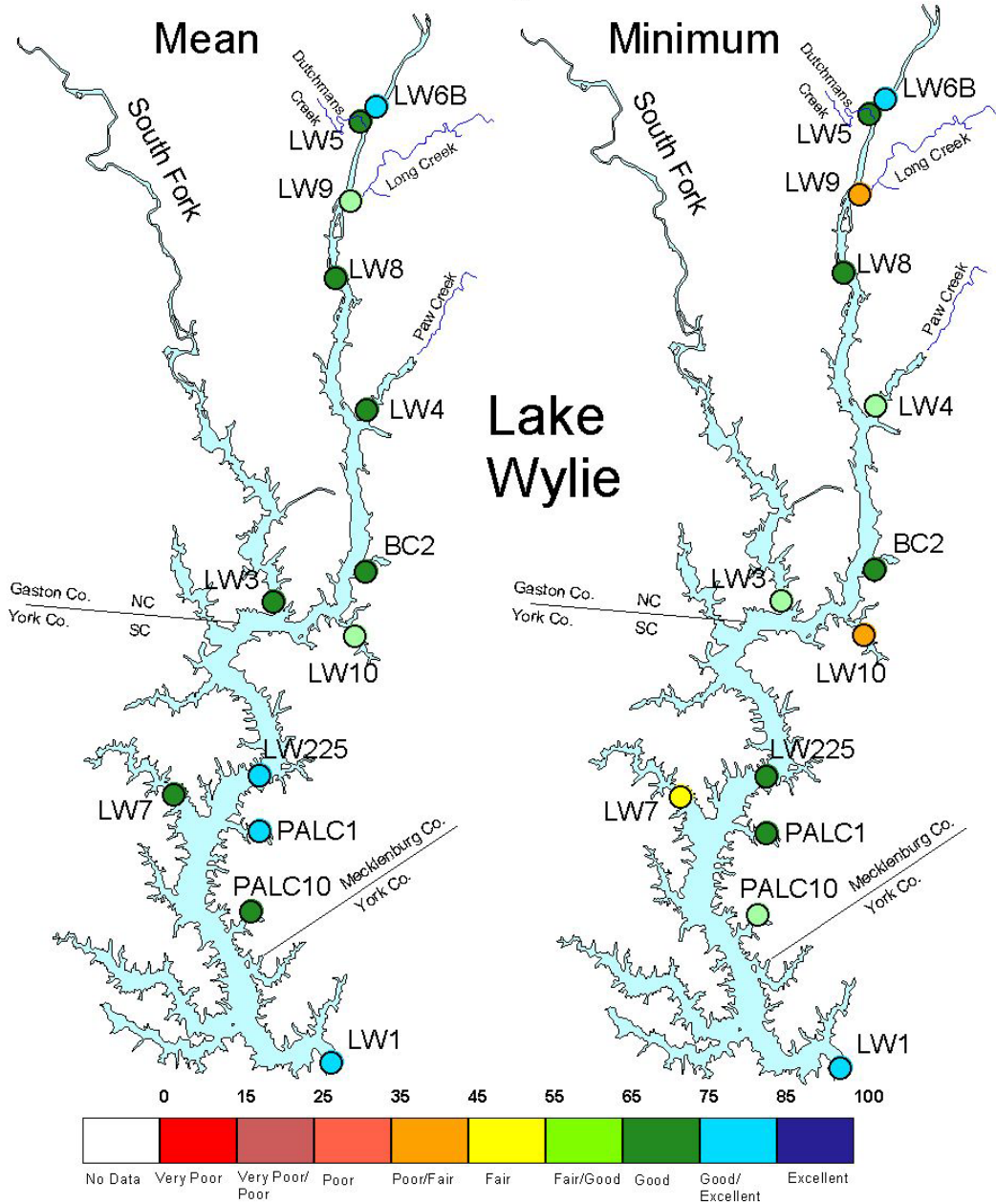
The average and minimum LWQI by site were plotted on maps to show their spatial distribution. (Figure 2). The average and minimum annual LWQIs for Lake Norman in 2007 were all in the Good/Excellent range as has been observed since 2004. The annual average LWQIs for Mountain Island Lake were also in the Good/Excellent range at all sites except McDowell Creek Cove (MI3). McDowell Creek Cove had a minimum value in the Fair range in 2007 and locations MI2 and MI6A in Gar Creek Cove had minimum ratings in the Good range. The site below Cowans Ford Dam (MI4) was the only site sampled in 2007 that averaged in the Excellent range for the calendar year. Both the average and minimum summer LWQIs for Lakes Cornelius and Davidson rated in the Good/Excellent range for 2007.



As was observed in 2006, the average annual LWQIs for Lake Wylie for 2007 rated in the Good/Excellent range in upper Lake Wylie below the Mountain Island Lake Dam and in the lower lake near the Lake Wylie Dam. The average annual LWQI for two new sites added in 2007, midlake near the Buster Boyd Bridge (LW225) and in Boyds Cove (PALC1), also rated as Good/Excellent. The lowest rated average LWQIs in 2007 were observed at other new sampling sites: Withers Cove (LW10) and Long Creek (LW9). These low values were primarily driven by high chlorophyll *a* and total phosphorus levels.

Figure 3.

Lake Water Quality Indices - 2007



Exceedances of Water Quality Standards

Water quality values collected from all regular lake sampling sites in 2007 were compared with NC state water quality standards for chlorophyll a (40 ug/l), dissolved oxygen (5.0 ppm), pH (<6.0 or >9.0) and turbidity (25 NTU) and MCWQP Action Levels for total phosphorus (0.04 ppm), nitrate (0.65 ppm) and fecal coliform bacteria (200 col./100 ml). Results are listed in Table 3.

Table 3. Exceedances of Selected NC Water Quality Standards and MCWQP Action Levels - 2007

Site ID		NC Water Quality Standards				MCWQP Action Levels			
		Chl a > 40 ug/l	Turbid. > 25 ntu	D. O. < 5.0 ppm	pH <6.0 or > 9.0	Total No. NC Stand. Exceed.	Tot P > 0.04 ppm	NOX > 0.65 ppm	Fecal col > 200 col. /100ml
Lake Norman									
LN1	Cowans Ford Dam	0	0	0	0	0	0	0	0
LN2	Ramsey Creek Arm	0	0	0	0	0	0	0	0
LN3	Reed's Creek Arm	0	0	0	0	0	0	0	0
LN4	Main Channel Lake Norman	0	0	0	0	0	0	0	0
LN5	North Meck Water Intake	0	0	0	0	0	0	0	0
LN6	Knox Cove	0	0	0	0	0	0	0	0
LN7	Davidson Creek Arm	0	0	0	0	0	0	0	0
Lake Corn. & David.									
LC2	Lake Cornelius	0	0	0	0	0	0	0	0
LD5	Lake Davidson	0	0	0	0	0	0	0	0
Mt. Island Lake									
MI1	Mt. Island Dam	0	0	0	0	0	0	0	0
MI2	Gar Creek Cove	0	0	0	0	0	1	0	0
MI2A	Downstream Water Intake	0	0	0	0	0	0	0	0
MI2B	Upstream Water Intake	0	0	0	0	0	0	0	0
MI3	McDowell Creek Cove	0	0	0	0	0	6	3	0
MI4	Headwaters MI Lake	0	0	0	0	0	0	0	0
MI5	Nance Cove	0	0	0	0	0	0	0	0
MI6A	Upper Gar Creek Cove	0	0	0	0	0	1	0	0
Lake Wylie									
LW1	Lake Wylie Dam (SC)	0	0	0	0	0	0	0	0
LW2*	Allison Creek Cove (SC)	0	0	0	0	0	1	0	1
LW3	South Fork Catawba River	0	1	0	0	1	8	1	0
LW4	Paw Creek Cove	1	1	0	0	2	5	0	0
LW5	Dutchman's Creek	0	2	0	0	2	5	1	4
LW6A*	Headwaters Lake Wylie	0	0	0	0	0	1	0	0
LW6B	Headwaters above Dutchmans	0	0	0	0	0	0	0	0
LW7	Crowders Creek Cove	1	1	0	0	2	1	0	1
LW8	I-85 Bridge	0	0	0	0	0	2	0	0
LW9	Long Creek	1	0	0	0	1	2	0	0
LW10	Withers Cove	2	0	0	0	2	3	0	0
LW225	Buster Boyd Bridge	0	0	0	0	0	0	0	0
BC1	Browns Cove	0	1	0	0	1	2	0	0
BC2	Browns Cove - Middle	0	0	0	0	0	3	0	1
PALC1	Boyds Cove	0	0	0	0	0	0	0	0
PALC10	Snug Harbor Cove	0	0	0	0	0	0	0	0
* Sites discontinued in May 2007									
Total	Lake Norman	0	0	0	0	0	0	0	0
Total	Lake Cornelius & Davidson	0	0	0	0	0	0	0	0
Total	Mt. Island Lake	0	0	0	0	0	8	3	0
Total	Lake Wylie	5	6	0	0	11	33	2	7

No exceedances of any water quality standards or MCWQP Action Levels were observed at any sites in Lake Norman for 2007. In Mountain Island Lake, no exceedances of any NC state standards were observed as well, although nine exceedances of nutrient MCWQP action levels were observed in McDowell Creek Cove and two exceedances of the total phosphorus MCWQP action level were observed at Gar Creek Cove locations (MI2 and MI6A). Lake Wylie had 11 exceedances of NC state water quality standards: 5 for chlorophyll *a* and 6 for turbidity. Exceedances of the chlorophyll *a* standard were observed at Paw Creek Cove, Crowders Creek Cove, Withers Cove and Long Creek. Exceedances of the turbidity standard in Lake Wylie were observed at Paw Creek Cove, Dutchmans Creek, South Fork, Crowders Creek and Browns Cove in 2007. The elevated turbidity levels were all observed at cove locations that are more subject to impacts from storm events in the watershed. The fecal coliform MCWQP Action Level was exceeded seven times at regular sampling sites in 2007: four times at LW5 in Dutchmans Creek and one time each at LW2 (Allison Creek), LW7 (Crowders Creek) and BC2 (Browns Cove, Middle).

SUMMARY AND CONCLUSIONS

1. North Carolina Trophic State Index values for 2007 rated Lake Norman and Mountain Island Lake as oligotrophic and Lake Wylie as eutrophic. Lake Davidson was rated as oligotrophic and Lake Cornelius rated as mesotrophic.
2. Lake Water Quality Indices (LWQI) were generally higher in Lake Norman and Mountain Island Lake and lower in Lake Wylie in 2007 as has been seen in the past.
3. The highest ranked sampling location for 2007 using the LWQI was in upper Mountain Island Lake just below the Cowans Ford Dam (MI4). The lowest ranked sampling location was in Withers Cove in Lake Wylie (LW10).
4. No exceedances of the NC state water quality standards for dissolved oxygen or pH were observed at any surface water (0.2 m depth) sampling location.
5. No exceedances of the NC state standard for chlorophyll *a* or turbidity were observed at any MCWQP sampling sites in Lake Norman or Mountain Island Lake for 2007.
6. Five exceedances of the NC state standard for chlorophyll *a* and six exceedances of the NC state standard for turbidity were observed at sampling sites in Lake Wylie in 2007.
7. No exceedances of the MCWQP Action level for fecal coliform bacteria were observed in Lake Norman or Mt. Island Lake during 2007.
8. Seven exceedances of the MCWQP Action level for fecal coliform bacteria were observed at sampling sites in Lake Wylie for 2007.

REFERENCES

Fusilier, W. E. 1982. An opinion derived nine parameter unweighted multiplicative lake water quality index: the LWQI. PhD Dissertation. Univ.of Mich. Ann Arbor, MI. 75 pp.

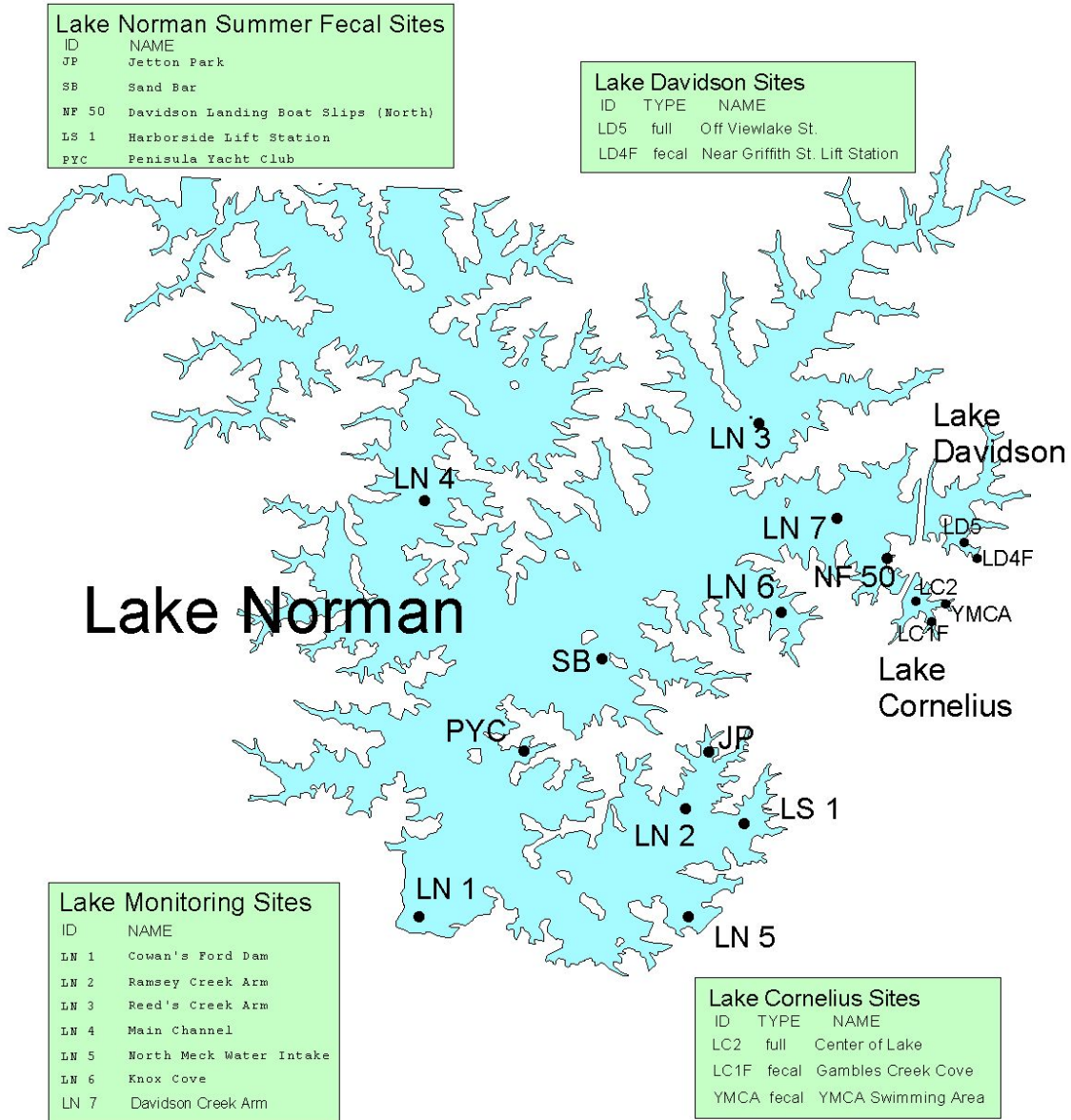
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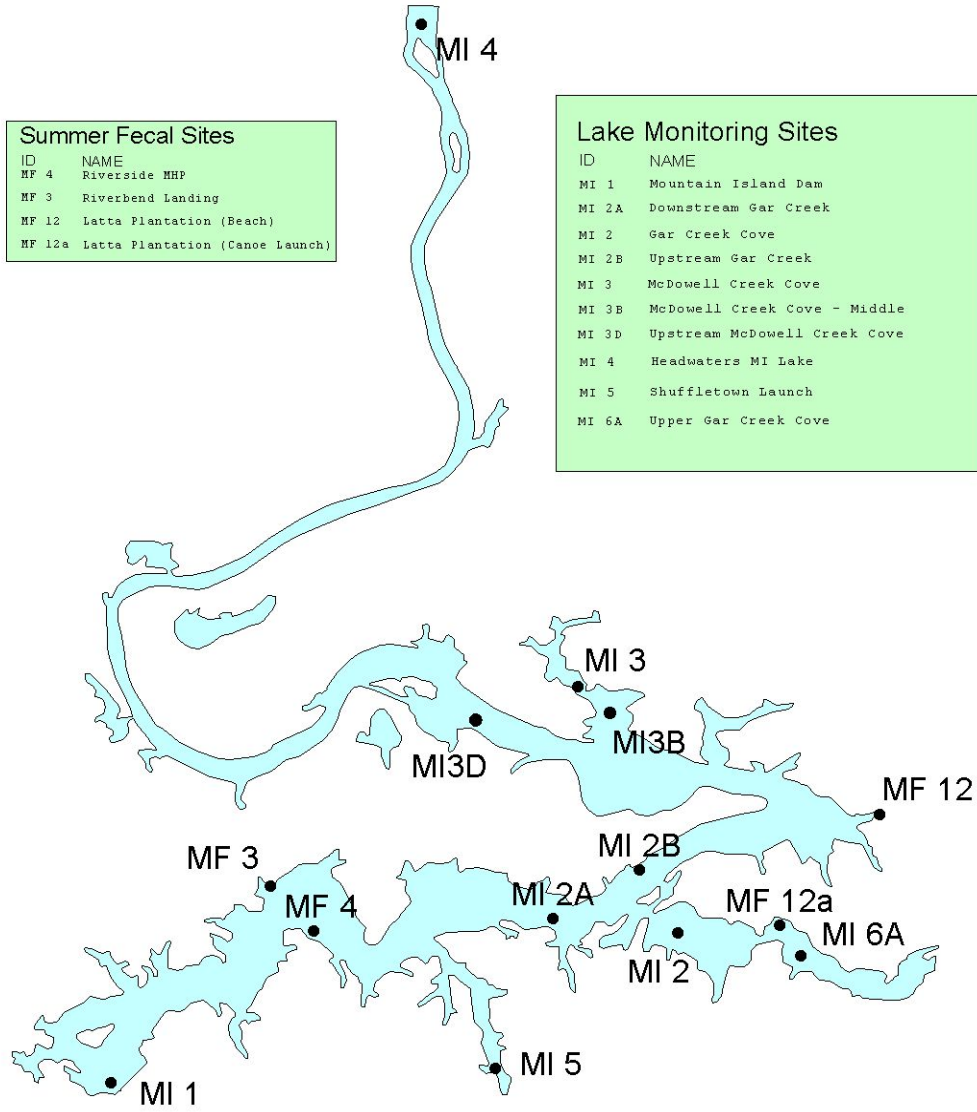
Appendix A

Lake Norman Lake Cornelius and Davidson Monitoring Locations



Appendix B

Mt. Island Lake Monitoring Locations

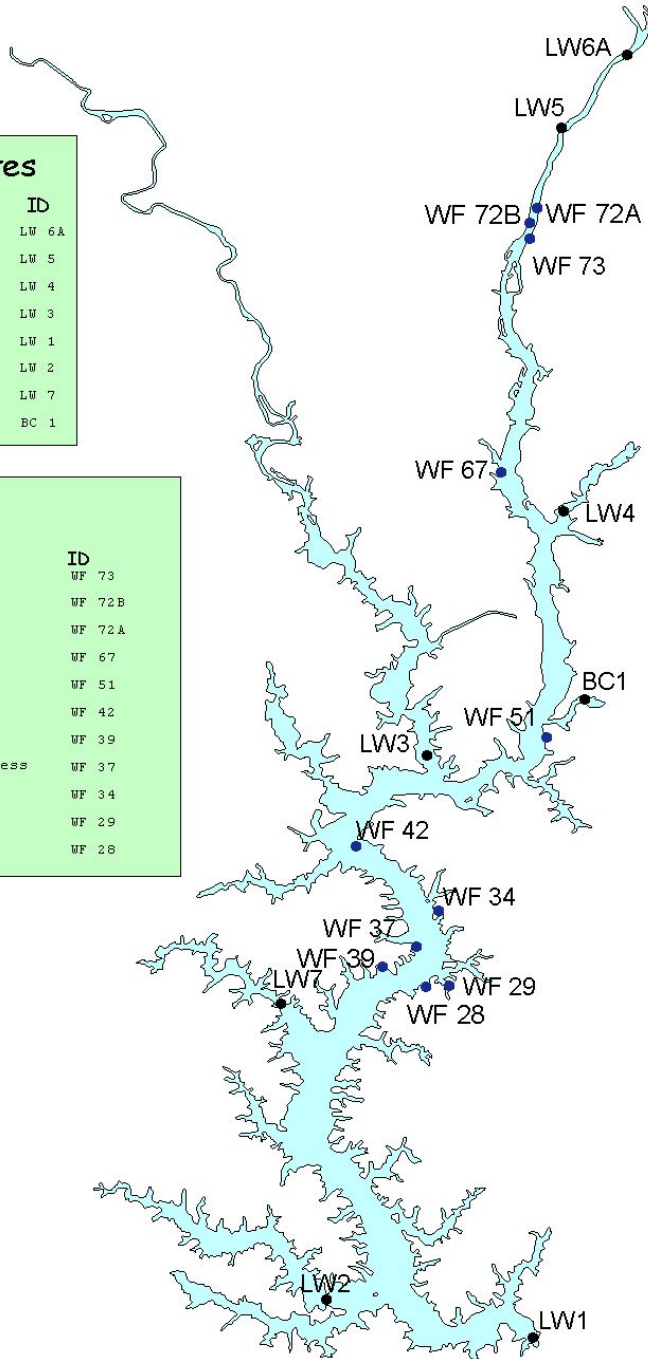


Appendix C

Lake Wylie Monitoring Locations

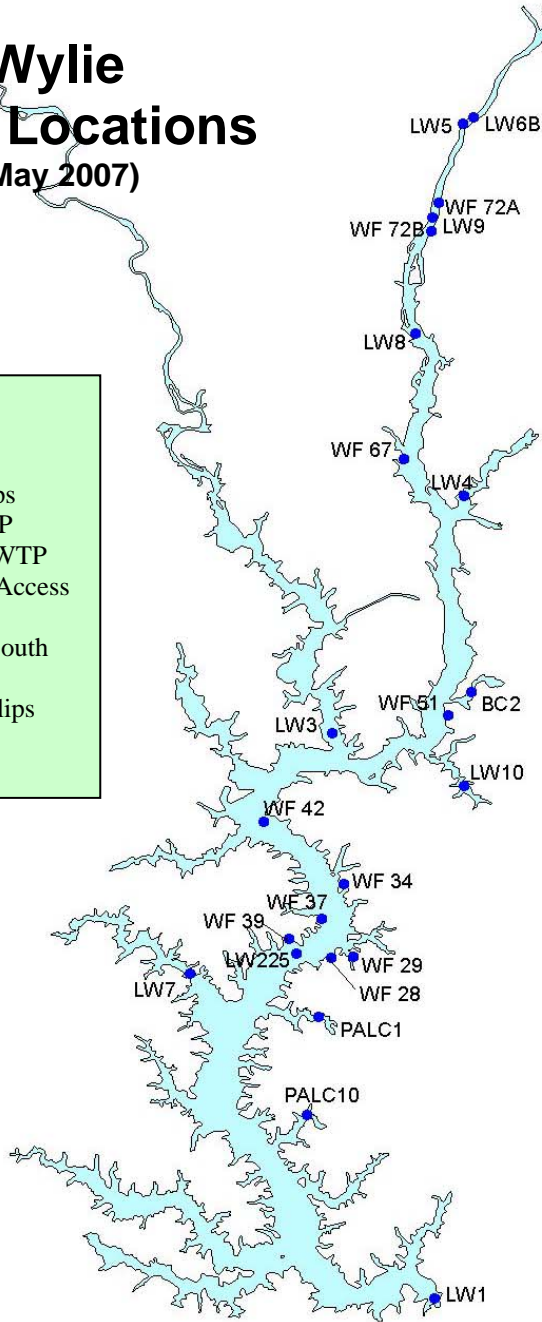
Lake Monitoring Sites	
NAME	ID
Headwaters at Mtn Island Dam	LW 6A
Dutchman's Creek	LW 5
Paw Creek Cove	LW 4
South Fork of the Catawba	LW 3
Near Lake Wylie Dam (SC)	LW 1
Allison Creek (SC)	LW 2
Crowders Creek	LW 7
Browns Cove	BC 1

Summer Fecal Sites	
NAME	ID
Long Creek	WF 73
Mt. Holly WWTP	WF 72B
Sandoz WWTP	WF 72A
Belmont WWTP	WF 67
Emerald Point WWTP & Boat Slips	WF 51
Sand Bar	WF 42
Camp Thunderbird	WF 39
Lake Wylie Marina, Buster Boyd Access	WF 37
Terry's Marina/Harbor Estates WWTP	WF 34
McDowell Park WWTP	WF 29
River Pointe WWTP & boat slips	WF 28



Appendix D

Lake Wylie Monitoring Locations (Effective May 2007)



Summer Fecal Sites

ID	Name
WF28	River Pointe WWTP and Boat Slips
WF29	McDowell Park Dock, near WWTP
WF34	Terry's Marina/Harbor Estates WWTP
WF37	Lake Wylie Marina, Buster Boyd Access
WF39	Camp Thunderbird
WF42	Sand Bar below confluence with South Fork
WF51	Emerald Point WWTP and Boat Slips
WF67	Belmont WWTP
WF72A	Sandoz WWTP

Lake Monitoring Sites

ID	Name
LW1	Near Lake Wylie Dam
LW3	South Fork of the Catawba
LW4	Paw Creek Cove
LW5	Dutchman's Creek
LW6B	Headwaters, Upstream of Dutchman's Creek
LW7	Crowder's Creek Arm
LW8	I-85 Bridge
LW9	Long Creek
LW10	Withers Cove
BC2	Browns Cove, Middle
PALC1	Boyd's Cove
PALC10	Snug Harbor Cove