Chapter 2
Cape Fear River Subbasin 03-06-02
Including: Haw River, Buffalo Creek, Reedy Fork Creek and Greensboro Reservoirs

2.1 Subbasin Overview

Subbasin 03-06-02 at a Glance

Land and Water Area

Total area:	562 mi²
Land area:	555 mi²
Water area:	7 mi²

Population Statistics

2000 Est. Pop.: 247,449 people
Pop. Density: 441 persons/mi²

Land Cover (percent)

Forest/Wetland:	58.9%
Surface Water:	2.5%
Urban:	8.5%
Cultivated Crop:	2.3%
Pasture/ Managed Herbaceous:	27.9%

Counties

Alamance, Caswell, Forsyth, Guilford and Orange

Municipalities

Burlington, Graham, Green Level, Greensboro, Haw River and Mebane

Subbasin 03-06-02 is an outer piedmont watershed characterized by highly erodible soils. Most of the watershed is forested or in agriculture, with increasing urban development that can have negative water quality impacts. Development is occurring along the I-85/40 corridor in Greensboro and Burlington. Population is expected to grow by 165,000 people in counties with portions or all of their areas in this subbasin by 2020.

There are 30 individual NPDES wastewater discharge permits in this subbasin with a permitted flow of 76.6 MGD (Figure 5). The largest are Burlington Eastside WWTP (12.0 MGD), Graham WWTP (3.5 MGD), Mebane WWTP (2.5 MGD), North Buffalo WWTP (16 MGD) and T.Z. Osborne WWTP (40 MGD). Refer to Appendix VI and Chapter 30 for more information on NPDES permit holders. Issues related to compliance with NPDES permit conditions are discussed below in Section 2.3 for Impaired waters.

In this subbasin, Burlington, Graham, Greensboro, Haw River and Mebane are required to develop stormwater programs (Chapter 31).

There is one registered swine operation, one registered cattle operation and five registered dairy operations in this subbasin. Issues related to agricultural activities are discussed below in Section 2.3 for Impaired waters.

There were 22 benthic macroinvertebrate community samples and 13 fish community samples (Figure 5 and Table 5) collected during this assessment period. Data were also collected from 34 ambient monitoring stations including four DWQ stations, nine UCFRBA (Appendix V) stations, four shared ambient stations, and 16 City of Greensboro (Appendix V) stations. Three DWQ bacterial special study stations were also sampled as well as six reservoirs. Refer to the *2003 Cape Fear River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html and Appendix IV for more information on monitoring.

Figure 5 Cape Fear River Subbasin 03-06-02

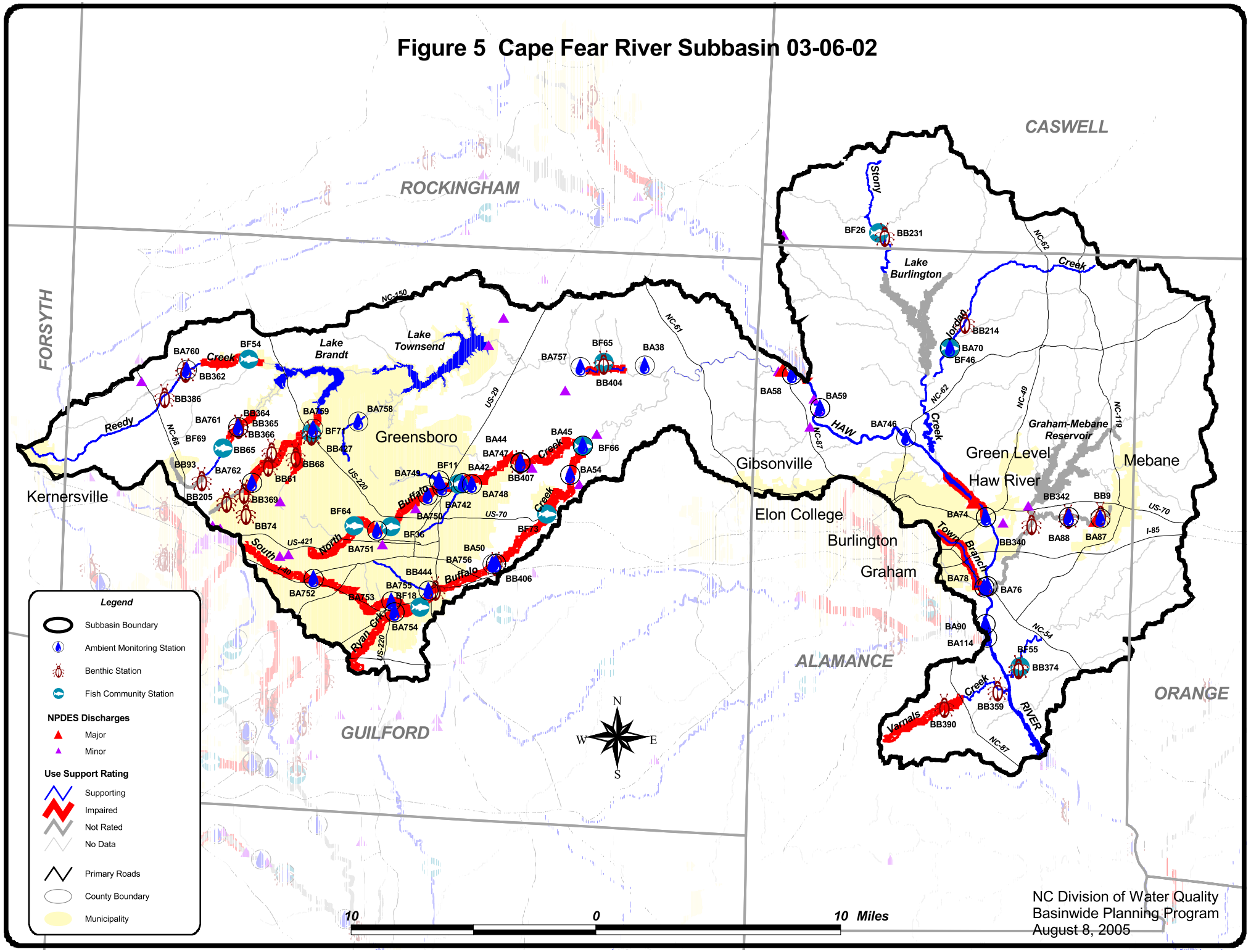

Table 5 CAPE FEAR Subbasin 03-06-02

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment: AL Rating	Station	Result	Year/ Parameter	% Exc	Recreation Assessment: REC Rating	Station	Result	Stressors	Sources
Back Creek												
16-18-(6)	C NSW	6.2 FW Miles	**NR**					ND				
From dam at Graham-Mebane Reservoir to Haw River				BB340	NR	'1999						
Back Creek (Graham-Mebane Reservoir)												
16-18-(1.5)	WS-II HQ	693.3 FW Acres	**NR**	BL7	NCE	Chlor a	33	ND			Chlorophyll a	Unknown
From .3 mile upstream of NC Hwy 119 to dam at Graham-Mebane Res												
Blackwood Creek												
16-11-14-2-4	C NSW	5.6 FW Miles	**S**	BA755	NCE			**NR***	BA755	NCE	Fecal Coliform Bacteria	MS4 NPDES
From source to Buffalo Creek												
Brush Creek												
16-11-4-(1)a1	WS-III NS	2.4 FW Miles	**NR**					ND				
From source to UT at SR 2085				BB93	NR	'2003						
16-11-4-(1)a2	WS-III NS	1.8 FW Miles	**S**					ND				
From UT at SR 2085 to UT 0.3 miles downstream fo SR 3820				BF69	G	'1999						
16-11-4-(1)a3	WS-III NS	1.6 FW Miles	**I**	BA761	NCE	Turbidity	10	**NR***	BA761	NCE	Fecal Coliform Bacteria	MS4 NPDES
From UT 0.3 miles downstream of SR 3820 to a point 0.5 mile downstream of Guilford County SR 2190				BB364	F	'2003					Habitat Degradation	MS4 NPDES
											Turbidity	MS4 NPDES
Brush Creek(Lake Higgins)												
16-11-4-(2)	WS-III NS	79.2 FW Acres	**S**	BL4	NCE			ND				
From a point 0.5 mile downstream of Guilford SR 2190 to Lake Brandt, Reedy Fork												
Haw Creek												
16-20-(4)	C NSW	3.8 FW Miles	**S**					ND				
From N.C. Hwy. 54 to Haw River				BB374	GF	'2003						
				BB374	NR	'1999						
				BF55	G	'2003						

Table 5 CAPE FEAR Subbasin 03-06-02

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment						Recreation Assessment				
			AL Rating	Station	Result	Year/ Parameter	% Exc		REC Rating	Station	Result	Stressors	Sources
HAW RIVER													
16-(1)d2	C NSW	10.1 FW Miles	**S**	BA59	NCE	Turbidity	9.8		**S**	BA59	NCE	Turbidity	Impervious Surfac
										BA59	NCE	Turbidity	MS4 NPDES
										BA746	NCE	Turbidity	Agriculture
From Subbasin 01/02 boundary to Service Creek													
16-(1)d3	C NSW	2.1 FW Miles	**S**	BA74	NCE	Turbidity	9.6		**I**	BA74	CE	Fecal Coliform Bacteria	Unknown
										BA74	NCE	Turbidity	Unknown
From Service Creek to a NC 49													
16-(1)e	C NSW	18.5 FW Miles	**S**	BA117	NCE				**NR***	BA118	NCE	Fecal Coliform Bacteria	Unknown
				BA118	NCE					BA76	NCE	Turbidity	Unknown
				BA76	NCE	Turbidity	9.8			BA90	NCE		
				BA90	NCE	Turbidity	7.3						
From NC 49 to a point 0.4 mile downstream of Cane Creek (South side of Haw River)				BB220	GF	2002							
				BB220	GF	1998							
Horsepen Creek													
16-11-5-(0.5)a	WS-III NS	1.8 FW Miles	**NR**						ND			Habitat Degradation	MS4 NPDES
From source to Ballinger Road				BB205	NR	2001							
				BB205	NR	2000							
				BB369	NR	2001							
				BB369	NR	2000							
16-11-5-(0.5)b	WS-III NS	3.2 FW Miles	**I**						**NR***	BA762	NCE	Fecal Coliform Bacteria	Unknown
From Ballinger Road to U.S. Hwy 220				BB61	P	2000						Habitat Degradation	MS4 NPDES
16-11-5-(2)	WS-III NS	1.8 FW Miles	**I**						**NR***	BA759	NCE	Fecal Coliform Bacteria	Unknown
From U.S. Hwy 220 to Lake Brandt, Reedy Fork				BB427	P	2003						Habitat Degradation	MS4 NPDES
				BB427	NR	2001							
				BB427	F	2000							
				BF71	GF	1999							

Table 5 CAPE FEAR Subbasin 03-06-02

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment					Recreation Assessment				
			AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
Jordan Creek												
16-14-6-(0.5)	Ws-II HQW	10.6 FW Miles	**S**	BA70	NCE			**S**	BA70	NCE		
From source to a point 0.7 mile upstream of mouth				BB214	GF	'2003						
				BF46	GF	'2003						
Moadams Creek (Latham Lake)												
16-18-7	C NSW	4.6 FW Miles	**NR**	BA87	NCE			**NR***	BA87	NCE		
				BA88	NCE				BA88	NCE		
From source to Back Creek				BB342	NR	'1999						
				BB9	NR	'1999						
Muddy Creek												
16-11-14-1-3	C NSW	3.7 FW Miles	**S**	BA748	NCE			**NR***	BA748	NCE	Fecal Coliform Bacteria	Unknown
From source to North Buffalo Creek												
North Buffalo Creek												
16-11-14-1a1	C NSW	7.5 FW Miles	**I**					**NR***	BA750	NCE	Habitat Degradation	Unknown
									BA751	NCE		
From source to Philadelphia Lake				BF36	P	'1999						
				BF64	P	'1999						
16-11-14-1a2	C NSW	1.6 FW Miles	**S**					**I**	BA42	NCE	Fecal Coliform Bacteria	MS4 NPDES
									BA742	CE		
From Philadelphia Lake to North Buffalo Creek WWTP				BF11	P	'1999						
				BF11	GF	'2003						
16-11-14-1b	C NSW	8.1 FW Miles	**I**	BA44	NCE	Turbidity	7.4	**NR***	BA44	NCE	Habitat Degradation	MS4 NPDES
				BA45	NCE				BA45	NCE	Fecal Coliform Bacteria	MS4 NPDES
									BA747	NCE	Turbidity	MS4 NPDES
From North Buffalo Creek WWTP to Buffalo Creek				BB407	P	'2003						
Philadelphia Lake (Buffalo lake, and White Oak Lake)												
16-11-14-1-2b	C NSW	18.0 FW Acres	**S**	BA749	NCE	Turbidity	10	**NR***	BA749	NCE	Fecal Coliform Bacteria	MS4 NPDES
White Oak Lake											Turbidity	MS4 NPDES

Table 5 CAPE FEAR Subbasin 03-06-02

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment: AL Rating	Station	Result	Year/ Parameter	% Exc	Recreation Assessment: REC Rating	Station	Result	Stressors	Sources
Reedy Creek												
16-11-(1)a	WS-III NS	8.1 FW Miles	**S**	BA760	NCE			**S**	BA760	NCE	Habitat Degradation	Impervious Surfac
From source to UT 0.7 miles downstream of SR 2128				BB362	GF	2003						
				BB362	G	2001						
				BB386	GF	2003						
16-11-(1)b	WS-III NS	4.2 FW Miles	**I**					ND			Habitat Degradation	Impervious Surfac
From SR 2128 to a point 0.4 mile downstream of Moores Creek				BF54	F	1999						
Reedy Fork (Hardys Mill Pond)												
16-11-(9)a1	C NSW	6.7 FW Miles	**S**	BA757	NCE			**S**	BA757	NCE		
From Lake Townsend Dam to UT at SR 2782												
16-11-(9)a2	C NSW	2.2 FW Miles	**I**					ND				
From UT at SR 2782 to UT at SR 2778				BB404	F	2003						
				BF65	G	2003						
16-11-(9)a3	C NSW	3.0 FW Miles	**S**	BA38	NCE			**S**	BA38	NCE		
From Ut at SR 2778 to Buffalo Creek												
16-11-(9)b	C NSW	8.6 FW Miles	**S**	BA58	NCE			**I**	BA58	CE	Fecal Coliform Bacteria	Unknown
									BA58	NCE		
From Buffalo Creek to Haw River												
Reedy Fork(including Lake Brandt and Lake Townsend below nor												
16-11-(3.5)a	WS-III NS	760.0 FW Acres	**S**	BL2	NCE			ND				
Lake Brandt												
16-11-(3.5)b	WS-III NS	1,404.7 FW Acres	**S**	BL3	NCE			ND				
Lake Townsend												
Richland Creek (Richland Lake)												
16-11-7-(1)a	WS-III NS	3.1 FW Miles	**S**	BA758	NCE			**NR***	BA758	NCE	Fecal Coliform Bacteria	Unknown
From source to backwaters of Richland Lake												
Ryan Creek												
16-11-14-2-3	C NSW	4.2 FW Miles	**I**	BA754	CE	Turbidity	14	**NR***	BA754	NCE	Fecal Coliform Bacteria	MS4 NPDES
From source to South Buffalo Creek											Turbidity	MS4 NPDES

Table 5 CAPE FEAR Subbasin 03-06-02

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
South Buffalo Creek													
16-11-14-2a	C NSW	15.4 FW Miles	From source to McConnell Rd	I	BA50 BA752 BA756 BB406	NCE CE NCE P	Turbidity Turbidity 2003	7.3 14	NR*	BA50 BA752 BA753	NCE NCE NCE	Habitat Degradation Fecal Coliform Bacteria Turbidity	MS4 NPDES MS4 NPDES MS4 NPDES
16-11-14-2b	C NSW	4.7 FW Miles	From McConnell Rd to US 70	I	BF73	P	2003		ND			Habitat Degradation	MS4 NPDES
16-11-14-2c	C NSW	4.8 FW Miles	From US 70 to Buffalo Creek	I	BA54	CE	Turbidity	10.5	ND	BA54	NCE	Turbidity	MS4 NPDES
Stony Creek (Lake Burlington)													
16-14-(1)a	Ws-II HQW	4.3 FW Miles	From source to Benton Branch	S	BF26	GF	2003		ND			Habitat Degradation	
16-14-(1)b	Ws-II HQW	2.7 FW Miles	From Benton Branch to backwaters of Lake Burlington	S	BB231	GF	2003		ND			Habitat Degradation	
16-14-(1)c	Ws-II HQW	738.0 FW Acres	Lake Burlington	NR	BL5	NCE	Chlor a	33	ND			Chlorophyll a	Agriculture
Stony Creek (Stony Creek Reservoir)													
16-14-(5.5)	WS-II HQ	118.0 FW Acres	From Buttermilk Creek to dam at Stony Creek Reservoir	S	BL6	NCE			ND				
Town Branch													
16-17	C NSW	4.2 FW Miles	From source to Haw River	S	BA78	NCE			I	BA78 BA78	NCE CE	Fecal Coliform Bacteria	MS4 NPDES
Unnamed Tributary at Guilford College													
16-11-5-1-(2)	WS-III NS	1.3 FW Miles	From dam at Guilford College bathing lake to Horsepen Creek	I	BB68	P	2001		ND				

Table 5 CAPE FEAR Subbasin 03-06-02

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment				
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
Varnals Creek													
16-21a	C NSW	4.6 FW Miles		I					ND				
	From source to Rock Creek				BB390	F	2000						
16-21b	C NSW	2.8 FW Miles		S					ND				
	From Rock Creek to Haw River				BB359	G	2000						

AL - Aquatic Life	BF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	BB - Benthic Community Survey	G - Good	NR - Not Rated
	BA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	BL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
	S- DEH RECMON	P - Poor	**Results**
		NI - Not Impaired	CE-Criteria Exceeded > 10% and more than 10 samples
	Miles/Acres	S- Severe Stress	NCE-No Criteria Exceeded
	FW- Fresh Water	M-Moderate Stress	
	S- Salt Water	N- Natural	

Aquatic Life Rating Summary

S	m	101.3	FW Miles
NR	m	15.0	FW Miles
I	m	63.5	FW Miles
S	m	2,379.9	FW Acres
NR	m	1,431.3	FW Acres
ND		213.4	FW Miles
ND		498.0	FW Acres

Recreation Rating Summary

S	m	38.5	FW Miles
NR*	m	77.2	FW Miles
I	m	16.5	FW Miles
NR*	m	18.0	FW Acres
ND		261.0	FW Miles
ND		4,291.2	FW Acres

Fish Consumption Rating Summary

I	e	393.2	FW Miles
I	e	4,309.2	FW Acres

Waters in the following sections are identified by assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, 303(d) Impaired waters list and the various tables in this basin plan. The assessment unit number is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the assessment unit and the DWQ index segment are the same.

2.2 Use Support Assessment Summary

Use support ratings were assigned for waters in subbasin 03-06-02 in the aquatic life, recreation, fish consumption and water supply categories. All waters are Impaired on an evaluated basis in the fish consumption category because of fish consumption advice that applies to the entire basin. In the water supply category, all WS classified waters (4,201.1 acres and 182.3 miles) are Supporting on an evaluated basis based on reports from DEH regional water treatment plant consultants. Refer to Appendix X for a complete list of monitored waters and more information on Supporting monitored waters.

There were 179.8 stream miles (45.7 percent) and 3,811.2 freshwater acres (88.4 percent) monitored during this assessment period in the aquatic life category. There were 63.5 miles (16.2 percent) of Impaired waters in this category. There were also 16.5 stream miles (4.2 percent) Impaired for recreation in this subbasin.

2.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2000) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2006 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Refer to the overview for more information on AUs. Information regarding 303(d) listing and reporting methodology is presented in Appendix VII.

2.3.1 Brush Creek [AU# 16-11-4-(1)a1, a2 and a3]

2000 Recommendations
The 2000 basin plan recommended that Brush Creek be resampled and that DWQ work with the City of Greensboro to improve water quality where possible.

Current Status
Brush Creek [16-11-4-(1)a1] from source to SR 2085 (2.4 miles) is Not Rated for aquatic life because a benthic community rating could not be assigned at site BB93 because of the small size of the stream.

Brush Creek [16-11-4-(1)a2] from SR 2085 to 0.3 miles downstream of SR 3820 (1.8 miles) is Supporting aquatic life because of a Good fish community rating at site BF69.

Brush Creek [16-11-4-(1)a3] from SR 3820 to 0.5 miles downstream of SR 2190 (1.6 miles) is Impaired for aquatic life because of a Fair benthic community rating at site BB364. Turbidity also exceeded the water quality standard in 10 percent of samples at site BA761. This segment is Not Rated for recreation because fecal coliform bacteria screening criteria were exceeded at site BA761.

The Brush Creek watershed drains large impervious areas from the Piedmont Triad International Airport as well as residential areas west of the airport. Road construction along the I-85 corridor has also impacted water quality in Brush Creek. DWQ staff noted several storm sewers draining directly into the creek and evidence of very high storm flows. There is no riparian area on Brush Creek as it flows through a golf course. A stressor survey conducted in 2003 found habitat degradation caused by modified watershed hydrology resulting in streambank erosion and sedimentation continues to stress the benthic community in Brush Creek.

2005 Recommendations
DWQ will continue to monitor water quality in the Brush Creek watershed. DWQ recommends that the City of Greensboro (Appendix V) continue to monitor water quality at site BA761 and submit these data to DWQ. Construction of the FEDEX project should use and maintain BMPs to minimize further disturbance to the Brush Creek watershed. DWQ will determine if intensive sampling is needed to assess the fecal coliform bacteria standard in this creek (Appendix X). Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

Segments 16-11-4-(1)a1 and a3 will remain on the 303(d) list of Impaired waters. Segment 16-11-4-(1)a2 will be removed from the 303(d) list because of the Good fish community rating. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

2.3.2 Haw River [AU# 16-(1)d2, d3 and e]

2000 Recommendations
The 2000 basin plan recommended that a TMDL be developed for turbidity and fecal coliform bacteria in this segment of the Haw River. The plan also noted that improvements to the Buffalo/Reedy Fork watersheds were also needed.

Current Status
The Haw River [16-(1)d2] from the subbasin boundary to Service Creek (10.1 miles) is Supporting aquatic life because no criteria were exceeded at sites BA59 and BA746, although turbidity exceeded the standard in 9.8 percent of samples collected at site BA59. The fecal coliform bacteria screening criteria were exceeded during the assessment period, but bacteria levels were below the standard during resamples the following summer at sites BA59 and BA746. This segment is Supporting recreation.

The Haw River [16-(1)d3] from Service Creek to NC 49 (2.1 miles) is Impaired for recreation because the fecal coliform bacteria standard was violated at site BA74. Although this segment is Supporting aquatic life, the turbidity standard was exceeded in 10 percent of samples collected at site BA74. Turbidity violated the standard in two storm events monitored by DWQ.

A TMDL, completed in 2004 and approved in January 2005, recommended a 61 percent reduction in Total Suspended Solids and a 77 percent reduction in fecal coliform bacteria from both point and nonpoint sources to meet the turbidity and fecal coliform bacteria standards in these two segments of the Haw River (Chapter 35).

The Haw River [16-(1)e] from NC 49 to Cane Creek (18.5 miles) is Supporting aquatic life because of a Good-Fair benthic community rating at site BB220; however, the turbidity standard was exceeded in 7 and 10 percent of samples collected at site BA76 and BA90. This segment is Not Rated for recreation because the fecal coliform bacteria screening criteria were exceeded at sites BA76, BA90 and BA118.

2005 Recommendations

DWQ will work with nonpoint source agencies and local governments to identify funding sources and BMP opportunities to implement reductions in TSS and fecal coliform bacteria as recommended in the TMDL. DWQ will continue to monitor the Haw River.

Segment 16-(1)d2 will be removed from the 303(d) list of Impaired waters because the fecal coliform bacteria and turbidity standards were not violated. Segment 16-(1)d3 will remain on the 303(d) until water quality standards for fecal coliform bacteria are met, although turbidity will be removed as a cause of impairment based on data from site BA74. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

Water Quality Initiatives

The Ag Sediment initiative estimates that $650,000 is needed to install field agriculture BMPs and livestock exclusion to reduce agriculture loading of turbidity and fecal coliform bacteria to this segment of the Haw River. The survey also noted urban development, impervious surfaces, and streambank erosion in addition to agriculture as sources of sediment.

In 1999, Graham received a $20,000 CWMTF (Chapter 34) grant to study the feasibility of a greenway between I-85 and NC 54 along the Haw River [16-(1)e]. In 2001, Graham received a $140,000 CWMTF grant to purchase 22 acres along the Haw River as part of the greenway system. In 2001, Piedmont Triad COG (Chapter 34) received a $65,000 CWMTF grant to develop a riparian corridor plan targeting 214 parcels along the Haw River.

2.3.3 Horsepen Creek [AU# 16-11-5-(0.5)a and b and 16-11-5-(2)] and Unnamed Tributary at Guilford College [AU#16-11-5-1-(2)]

2000 Recommendations

The 2000 basinwide plan recommended that Horsepen Creek be resampled and that DWQ work with the City of Greensboro to improve water quality where possible. DWQ, with the CWMTF, conducted a detailed study of the watershed as part of WARP project to identify stressors and recommend solutions to water quality problems.

Current Status

Horsepen Creek [16-11-5-(0.5)a] from source to Ballinger Road (1.8 miles) is Not Rated for aquatic life because benthic community ratings could not be assigned at sites BB369 and BB205. Amoco Greensboro Terminal (NC0003671) had significant violations of phenolics permit limits

during the last two years of the assessment period. The problem has been remedied and there were no violations in 2004.

The unnamed tributary [16-11-5-1-(2)] from dam at Guilford College Bathing Lake to Horsepen Creek (1.3 miles) is Impaired for aquatic life because of a Poor benthic community rating at site BB68.

Horsepen Creek [16-11-5-(0.5)b] from Ballinger Road to US 220 (3.2 miles) is currently Impaired for aquatic life because of a Poor benthic community rating at site BB61. This segment is Not Rated for recreation because fecal coliform bacteria screening criteria were exceeded at site BA762.

Horsepen Creek [16-11-5-(2)] from US 220 to Lake Brandt (1.8 miles) is currently Impaired for aquatic life because of Poor and Fair benthic community ratings at site BB427. This segment is Not Rated for recreation because fecal coliform bacteria screening criteria were exceeded at site BA759.

A WARP study was completed in December 2002 in the Horsepen Creek watershed. The study identified potential toxicity, organic enrichment and habitat degradation from scour, channel modification, culverting and impervious surface runoff as stressors to the benthic community. To view the entire report and recommendations to restore water quality in the Horsepen Creek watershed visit http://h2o.enr.state.nc.us/swpu/.

2005 Recommendations

DWQ will work with nonpoint source agencies and the City of Greensboro Stormwater Program to identify funding sources for restoration projects and BMP implementation recommended in the WARP study. DWQ recommends that the City of Greensboro (Appendix V) continue to monitor water quality at sites BA762 and BA759 on Horsepen Creek and submit these data to DWQ. DWQ will determine if intensive sampling is needed to assess the fecal coliform bacteria standard in this creek (Appendix X). Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

All three segments of Horsepen Creek will remain on the 303(d) list of Impaired waters and the Unnamed Tributary at Guilford College Bathing Lake will be added to the 303(d) list. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

Water Quality Initiatives

In 2000, Greensboro received a $6,000 Section 319 grant (Chapter 34) to convert two retention ponds to bioretention BMPs as part of an urban BMP demonstration project. The bioretention BMPs are located on Downwind Road and Terrault Drive. The NCEEP completed 1.77 acres of riverine restoration in this watershed (Chapter 34).

2.3.4 North Buffalo Creek [AU# 16-11-14-1a1, a2 and 1b]

2000 Recommendations
The 2000 basin plan recommended that North Buffalo Creek be resampled and that TMDLs be developed for identified stressors. DWQ also recommended that no new discharges be permitted to North Buffalo Creek and that Cone Mills connect to the Greensboro Metro WWTP as soon as possible.

Current Status
North Buffalo Creek [16-11-14-1a1] from source to Philadelphia Lake (7.5 miles) is Impaired for aquatic life because of Poor fish community ratings at sites BF36 and BF64. This segment is Not Rated for recreation because fecal coliform bacteria screening criteria were exceeded at sites BA751 and BA750.

North Buffalo Creek [16-11-14-1a2] from Philadelphia Lake to North Buffalo WWTP (1.6 miles) is Supporting for aquatic life because of a Good-Fair fish community rating at site BF11. The fish community rating improved after the Cone Mills discharge was removed and connected to the Metro WWTP on South Buffalo Creek in January 2001. This segment is Impaired for recreation because the fecal coliform bacteria standard was violated at site BA742. Fecal coliform bacteria screening criteria were also exceeded at site BA42.

North Buffalo Creek [16-11-14-1b] from North Buffalo WWTP to Buffalo Creek (8.1 miles) is Impaired for aquatic life because of a Poor fish community rating at sites BF66 and a Poor benthic community rating at site BB407. Prolific algal growths were noted at site BB407. Turbidity also exceeded the water quality standard in 7 percent of samples collected at site BA44. The North Buffalo Creek WWTP (NC0024325) had significant violations of the cyanide permit limits and three whole effluent toxicity test failures during the last two years of the assessment period. The facility is conducting a cyanide study to determine the source of the violations. The smell of treated effluent has been noted at site BF66, 8.5 miles downstream of the WWTP. There have been odor problems reported and sanitary sewer overflows in the watershed as well. This segment is Not Rated for recreation because fecal coliform screening criteria were exceeded at sites BA747, BA44 and BA45.

A fecal coliform bacteria TMDL was completed for North Buffalo Creek in 2004. The Piedmont-Triad COG and partners completed a fecal coliform bacteria source-tracking project to assist in TMDL development. The TMDL recommended reductions of 60 to 100 percent depending on the source and climatic conditions. Exfiltrating sewers, sanitary sewer overflows, pets and illicit discharges were identified as sources of fecal coliform bacteria.

2005 Recommendations
DWQ recommends that the reductions called for in the TMDL be implemented by the various sources to reduce fecal coliform bacteria loading to North Buffalo Creek. The NPDES compliance process will be used to address the significant permit violations noted above. DWQ recommends that the City of Greensboro (Appendix V) continue to monitor water quality at sites on North Buffalo Creek and submit these data to DWQ. These data will be helpful in measuring the success of TMDL implementation. DWQ will continue to monitor North Buffalo Creek to identify stressors to the biological community. Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

Segments 16-11-14-1a1 and 1b will remain on the 303(d) list of Impaired waters. Segment 16-11-14-1a2 may be removed from the list, although any restoration efforts or TMDLs for stressors to the biological community will target the entire watershed. This segment will remain on the 303(d) list for the recreation impairment. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

Water Quality Initiatives
The City of Greensboro is pursuing funding to rehabilitate the wastewater collection system to reduce exfiltration and sanitary sewer overflows.

2.3.5 Reedy Creek [AU# 16-11-(1)a and b]

Current Status
Reedy Creek was Fully Supporting in the 2000 basin plan and no recommendations were made. Reedy Creek [16-11-(1)b] from SR 2128 to 0.4 miles downstream of Moores Creek (4.2 miles) is Impaired for aquatic life because of a Fair fish community rating at site BF54. Habitat degradation was noted by eroding streambanks and few pools and riffles.

2005 Recommendations
DWQ will continue to monitor this segment of Reedy Creek to identify stressors to the fish community. This portion of the watershed could experience growth in the next few years. Every effort should be made to minimize impacts to Reedy Creek. Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

This segment of Reedy Creek will be added to the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

2.3.6 Reedy Fork (Hardys Mill Pond) [AU# 16-11-(9)a1, a2, a3 and b]

2000 Recommendations
The 2000 basin plan recommended that DWQ work with Greensboro to reduce impacts to Reedy Fork. Reedy Fork [16-11-(9)b] was Partially Supporting in the 2000 plan.

Current Status
Reedy Fork [16-11-(9)a1] from Lake Townsend Dam to UT at SR 2782 (6.7 miles) is Supporting recreation because no criteria were exceeded at site BA757. Although Autumn Forest Manufactured Homes (NC0022691) had significant violations of fecal coliform bacteria permit limits during the last two years of the assessment period, the facility had no violations of bacteria limits in 2004. This segment is Supporting aquatic life because no criteria were exceeded at site BA757, although Lake Townsend WTP (NC0081617) had significant violations of solids permit limits.

Reedy Fork [16-11-(9)a2] from the UT at SR 2782 to SR 2778 (2.2 miles) is Impaired for aquatic life because of a Fair benthic community rating at site BB404. The benthic community may have been adversely impacted by low dissolved oxygen releases from Lake Townsend dam during drought conditions. Northeast Middle and Senior High School (NC0038156) discharges into an unnamed tributary in this segment and had significant violations of ammonia permit

limits during the last two years of the assessment period as well. The schools are under a special order of consent (SOC# S91039) that expires in June 2005. The schools are expected to be connected to the City of Greensboro collection system and cease discharging by March 2005. Segment 16-11-(9)a3 is Supporting aquatic life because no criteria were exceeded at site BA38.

Reedy Fork [16-11-(9)b] from Buffalo Creek to the Haw River (8.6 miles) is Impaired for recreation because the fecal coliform bacteria standard was violated at site BA58. This segment is Supporting aquatic life because no criteria were exceeded at site BA58.

2005 Recommendations
DWQ will continue to monitor this segment of Reedy Fork to identify stressors to the fish community. This portion of the watershed could experience growth in the next few years. Every effort should be made to minimize impacts to Reedy Fork. Flow conditions should be maintained below Lake Townsend to minimize adverse impacts to the downstream benthic community (Chapter 32). DWQ recommends that the City of Greensboro (Appendix V) continue to monitor water quality at sites on Reedy Fork. The NPDES compliance process will be used to address the significant permit violations noted above. Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

Segments 16-11-(9)a2 will be added to the 303(d) list of Impaired waters and 16-11-(9)b will remain on the list because of the recreation impairment and because of past biological impairment. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

2.3.7 Ryan Creek [AU # 16-11-14-2-3]

Current Status
Ryan Creek was Not Rated in the 2000 basin plan; however, Ryan Creek [16-11-14-2-3] from source to South Buffalo Creek (4.2 miles) is currently Impaired for aquatic life because the turbidity standard was violated at site BA754 in 14 percent of samples. Ryan Creek is Not Rated for recreation because fecal coliform bacteria screening criteria were exceeded at site BA754.

2005 Recommendations
DWQ recommends that the City of Greensboro (Appendix V) continue to monitor water quality in Ryan Creek and submit these data to DWQ. DWQ will determine if intensive sampling is needed to assess the fecal coliform bacteria standard in this creek (Appendix X). Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

Ryan Creek will be added to the 303(d) list of Impaired waters because of the turbidity violations. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

2.3.8 South Buffalo Creek [AU# 16-11-14-2a, b and c]

2000 Recommendations
The 2000 basin plan recommended that South Buffalo Creek be resampled and that TMDLs be developed for identified stressors, and that the City of Greensboro stormwater program work to improve water quality in this creek.

Current Status
South Buffalo Creek [all segments] from source to Buffalo Creek (24.9 miles) is Impaired for aquatic life because the turbidity standard was violated in 14 and 11 percent of samples at sites BA752 and BA54, Fair and Poor benthic community ratings at sites BB444 and BB406, and Fair and Poor fish community ratings at sites BF18 and BF73. The stream is filled with debris and has undercut banks. Periphyton covered rocks at the site below the Metro WWTP. The Metro WWTP (NC0047384) also had significant violations of cyanide permit limits, which could have adversely impacted aquatic life in the creek. The facility is conducting a cyanide study to determine the source of the violations. South Buffalo Creek is Not Rated for recreation because fecal coliform bacteria screening criteria were exceeded at sites BA50, BA752 and BA753.

2005 Recommendations
DWQ recommends that the City of Greensboro (Appendix V) continue to monitor water quality on South Buffalo Creek and submit these data to DWQ. DWQ will continue to work with the City of Greensboro to identify measures that can be used to reduce stormwater impacts to the creek. The NPDES compliance process will be used to address the significant permit violations noted above. DWQ will determine if intensive sampling is needed to assess the fecal coliform bacteria standard in this creek (Appendix X). Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

All three segments will remain on the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

Water Quality Initiatives
In 1997, Greensboro received a $800,000 CWMTF (Chapter 34) grant to acquire 40 acres to construct a stormwater wetland along South Buffalo Creek. In 2002, Greensboro received a $570,000 CWMTF grant to construct a 20-acre stormwater wetland along South Buffalo Creek treating runoff from 13 square miles of urban land.

NCEEP has completed 1,752 linear feet of stream restoration in Benbow Park, 2,748 linear feet in Brown Park, 5,963 linear feet in Hillsdale Park and 1,776 linear feet in Price Park. Also completed were 5,963 linear feet of stream restoration and 1,200 linear feet of stream enhancement at Gillespie Golf Course (Chapter 34).

2.3.9 Town Branch [AU# 16-17]

2000 Recommendations
Town Branch was Impaired in the 1996 basin plan, but limited sampling resulted in a Not Rated status in the 2000 basin plan. The 2000 plan recommended that Town Branch be resampled.

Current Status
Town Branch from source to the Haw River (4.2 miles) is Impaired for recreation because the fecal coliform bacteria standard was violated at site BA78. The stream is Supporting aquatic life because no criteria were exceeded at site BA78.

A TMDL for fecal coliform bacteria was approved for Town Branch in September 2002. The TMDL called for 70 percent reduction in bacteria loading from urban areas in Burlington and Graham. The TMDL also indicated leaking sewer systems, sanitary sewer overflows and failing septic systems in the lower portion of the watershed as a source of bacteria.

2005 Recommendations
DWQ will continue to monitor Town Branch. DWQ recommends that Burlington and Graham reduce fecal coliform bacteria loading as called for in the TMDL. It is also recommended that Graham annex homes in the lower portion of the watershed and connect them to municipal sewer system. The towns should also pursue funding to upgrade the wastewater collection system to reduce leaking lines and sanitary sewer overflows. DWQ will determine if intensive sampling is needed to assess the fecal coliform bacteria standard in this creek (Appendix X). Further recommendations to protect streams in urbanizing areas and to restore streams in existing urban areas are discussed in Chapter 31.

This segment will remain on the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors other than fecal coliform bacteria within 8-13 years of listing.

2.3.10 Varnals Creek [AU#16-21a and b]

Current Status
Varnals Creek was Fully Supporting in the 2000 basin plan; however, Varnals Creek [16-21a] from source to Rock Creek (4.6 miles) is currently Impaired for aquatic life because of a Fair benthic community rating at site BB390. Varnals Creek was studied in 2000 to determine if it would qualify for a supplemental HQW classification. Because of the Impaired benthic community, the creek did not qualify for the HQW classification.

Varnals Creek [16-21b] from Rock Creek to the Haw River (2.8 miles) is Supporting based on a Good benthic community rating at site BB359.

2005 Recommendations
DWQ will continue to monitor Varnals Creek to identify stressors to the biological community in the upper watershed. This watershed is predominately agriculture and DWQ will work with DSWC staff to further implement BMPs to reduce the impacts of agriculture in this watershed.

This segment will be added to the 303(d) list of Impaired waters. TMDLs (Chapter 35) will be developed for identified stressors within 8-13 years of listing.

2.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns have been documented for some waters based on this assessment. While

these waters are not Impaired, attention and resources should be focused on these waters to prevent additional degradation or facilitate water quality improvement. Waters in the following section are identified by assessment unit number (AU#). See overview for more information on AU#s.

2.4.1 Back Creek (Graham-Mebane Reservoir) [AU# 16-18-(1.5)]

Current Status and 2005 Recommendations
Graham Mebane Reservoir (693.3 acres) is Not Rated for aquatic life because 33 percent of chlorophyll *a* samples exceeded the water quality criterion; however, not enough samples were collected to assign a use support rating. Nutrient levels in the reservoir were higher than in previous years and nuisance algal blooms were present in summer months. DWQ will determine if increased monitoring efforts in this lake are warranted to better assess water quality.

2.4.2 Blackwood Creek [AU# 16-11-14-2-4]

Current Status and 2005 Recommendations
Blackwood Creek from source to Buffalo Creek (5.6 miles) is Not Rated for recreation because the fecal coliform bacteria screening criteria were exceeded at site BA755. DWQ recommends that the City of Greensboro (Appendix V) continue to monitor water quality at sites in Blackwood Creek. DWQ will determine if intensive sampling is needed to assess the fecal coliform bacteria standard in this creek (Appendix X).

2.4.3 MoAdams Creek (Latham Lake) [AU# 16-18-7]

Current Status and 2005 Recommendations
MoAdams Creek from source to Back Creek (4.6 miles) is Not Rated for recreation because the fecal coliform bacteria screening criteria were exceeded at sites BA87 and BA88. DWQ will determine if intensive sampling is needed to assess the fecal coliform bacteria standard in this creek (Appendix X).

2.4.4 Muddy Creek [AU# 16-11-14-1-3]

Current Status and 2005 Recommendations
Muddy Creek from source to North Buffalo Creek (3.7 miles) is Not Rated for recreation because the fecal coliform bacteria screening criteria were exceeded at sites BA748. DWQ recommends that the City of Greensboro (Appendix V) continue to monitor water quality at sites in Muddy Creek. DWQ will determine if intensive sampling is needed to assess the fecal coliform bacteria standard in this creek (Appendix methods).

2.4.5 Philadelphia Lake (Buffalo Lake and White Oak Lake) [AU# 16-11-14-1-2b]

Current Status and 2005 Recommendations
Philadelphia Lake (18 acres) is Not Rated for recreation because the fecal coliform bacteria screening criteria were exceeded at site BA749. Turbidity also exceeded the standard in 10 percent of samples at site BA749. DWQ recommends that the City of Greensboro (Appendix V) continue to monitor water quality at sites in Philadelphia Lake. DWQ will determine if intensive sampling is needed to assess the fecal coliform bacteria standard in this lake (Appendix X).

2.4.6 Richland Creek [AU# 16-11-7-(1)a]

Current Status and 2005 Recommendations
Richland Creek from source to Richland Lake (3.1 miles) is Not Rated for recreation because the fecal coliform bacteria screening criteria were exceeded at sites BA758. DWQ recommends that the City of Greensboro (Appendix V) continue to monitor water quality at sites in Philadelphia Lake. DWQ will determine if intensive sampling is needed to assess the fecal coliform bacteria standard in this lake (Appendix X).

2.4.7 Stony Creek (Lake Burlington) [AU# 16-14-(1)a, b and c]

Current Status and 2005 Recommendations
Stony Creek [16-14-(1)a] from source to Benton Branch (4.3 miles) is Supporting aquatic life because of a Good-Fair fish community rating at site BF26; however, this is a lower rating than the Excellent rating from 1994. There was evidence of past streambank erosion at the site.

Stony Creek [16-14-(1)b] from Benton Branch to backwaters of Lake Burlington (2.7 miles) is Not Rated because a benthic community rating could not be assigned at site BB231 due to small size stream. There were indications of increased sedimentation, and only one small riffle area was found. Drought conditions in 2001 and 2002 likely have had impacts on these communities. DWQ will continue to monitor water quality in this watershed and contact DSWC staff to determine if noted habitat impacts are from agricultural activities or from development in the area.

Lake Burlington [16-14-(1)c] (738 acres) is Not Rated for aquatic life because 33 percent of chlorophyll *a* samples exceeded the water quality standard; however, not enough samples were collected to assign a use support rating. Nutrient levels in the reservoir were higher than in previous years and nuisance algal blooms that can cause taste and odor problems in treated drinking water were present. DWQ will determine if increased monitoring efforts in this lake are warranted to better assess water quality.

2.5 Additional Water Quality Issues within Subbasin 03-06-02

The following section discusses issues that may threaten water quality in the subbasin that are not specific to particular streams, lakes or reservoirs. The issues discussed may be related to waters near certain land use activities or within proximity to different pollution sources.

2.5.1 Jordan Haw River Watershed Nutrient Sensitive Waters Strategy

All land uses and discharges of wastewater and stormwater in subbasin 03-06-02 potentially contribute nutrients to Jordan Reservoir in subbasins 03-06-04 and 03-06-05. The reservoir is Impaired for aquatic life because chlorophyll *a* violated the standard in all segments of the reservoir. Refer to Chapter 36 for more information on this strategy.

2.5.2 Greensboro Collection System SOC

The City of Greensboro collection system (WQCS00006) is currently under a special order of consent (SOC) because the North Buffalo WWTP is hydraulically overloaded, causing sanitary sewer overflows (SSOs) in the WWTP service area that includes the North Buffalo Creek watershed and portions of the Reedy Fork watershed. The SOC (WQS04012) was issued because Greensboro was unable to comply with collection system permit conditions which prohibit SSOs. The SOC contains dates by which specific actions must be accomplished. The SSOs are occurring most often from Hill Street to the WWTP. Greensboro will be building new pump stations to divert wastewater out of the North Buffalo Creek watershed and enlarging the primary outfall. Greensboro must build one of the new pump stations in the Reedy Fork watershed by March 2005. The SOC also provides for payment of penalties for any SSOs between Hill Street and the WWTP during anything less than a 10-year 24-hour storm event. DWQ will continue to work with Greensboro or ensure timely compliance with the conditions in the SOC.