Appendix A

GIS Data Sources

Appendix A

GIS Data Sources

This appendix lists the spatial data sets (GIS, or Geographic Information System data) used during the development of the Preliminary Findings and Recommendations Report, along with the sources for these data.

Feature	Data Set	Source
Hydrography	1:24,000 scale hydrography for Hiwassee River Basin	NCCGIA (BasinPro 3.1)*
Land Cover	NC Land Cover Data Base	NCCGIA, via NCEEP
Roads	NC Primary Roads, Cherokee and Clay County Secondary Roads	NCDOT
TIP Project Locations	TIP Roads, 2004-2010	NCDOT, via NCEEP
Ecoregions	NC Level IV Ecoregions	NCDENR, via NCEEP
Geological Formations	NC Geology, 1:250,000 scale	NCDENR
5 Ft. Contour Intervals	Contours from 2005 LIDAR data	NCDOT
National Forest Boundaries	Managed Areas	NCNHP
Rare, Threatened and Endangered Species	Natural Heritage Element Occurrences	NCNHP
Terrestrial Habitat Data (Vegetation Types)	NCGAP Data Base	NC Gap Analysis Program, via NCEEP
Significant Natural Areas	Significant Natural Heritage Areas	NCNHP
Wetlands	National Wetlands Inventory	US FWS, via NCDENR
Population	2000 Census Block Group Data	US Census Bureau
Water Supply Watersheds	Water Supply Watersheds	NCCGIA (BasinPro 3.1)
Sewered Areas	Sanitary Sewer Systems-Type A Service Areas	NCCGIA (BasinPro 3.1)
Municipal Boundaries	Municipal Boundaries	NCCGIA (BasinPro 3.1)
County Boundaries	County Boundaries	NCCGIA (BasinPro 3.1)
USGS Gage Stations	USGS Gage Stations	NCCGIA (BasinPro 3.1)
100 Ft. Riparian Zone	100 Ft. Riparian Zone	Equinox
Project Area Boundary	Project Area Boundary	Equinox
Sub-watershed Boundary	Sub-watershed Boundary	Equinox
Windshield Survey Site Locations	Windshield Survey Site Locations	Equinox
TVA Water Quality Monitoring Sites	TVA Water Quality Monitoring Sites	Tennessee Valley Authority
NCDWQ Water Quality Mon. Sites	NCDWQ Water Quality Monitoring Sites	Equinox
Groundwater Contamination Sites	Groundwater Contamination Sites	Equinox
NPDES Permits	NPDES Permits	Equinox
1998 Color Infrared Aerial Photography	1998 Color Infrared Aerial Photography	DENR
2004 Color Aerial Photography	2004 Color Aerial Photography	Cherokee County, via NCEEP
Potential Stream Restoration Sites	Potential Stream Restoration Sites	Equinox

Table Notes:

*To correct inaccuracies in the stream network at a few locations, Equinox modified the location of several streams. Associated stream names were also edited, but other attributes were not altered.

NCCGIA = NC Center for Geographic Information and Analysis
NCDOT = NC Department of Transportation
NCEEP = NC Ecosystem Enhancement Program
NCDENR = NC Department of Environment and Natural Resources
NCNHP = NC Natural Heritage Program
NCDWQ = NC Division of Water Quality
USGS = US Geological Survey
USFWS = US Fish and Wildlife Service
TVA = Tennessee Valley Authority
NPDES = National Pollution Discharge Elimination System
BasinPro 3.1 is a set of custom data layers and ArcView tools developed by NCCGIA for the NC Clean Water Management Trust Fund.
'Equinox' indicates data set was created by Equinox Environmental Consultation and Design, Inc. for this project.

Appendix B

Windshield Survey Documentation

Appendix B

Windshield Survey Documentation

This appendix presents a brief synopsis of the Windshield Survey Stream Site Worksheet, and a summary of selected results.

Purpose and Worksheet Format

The purpose of the Phase 1 windshield stream site survey is to provide a general impression of stream and watershed conditions by observing selected sites in the project area. It is a rapid exercise designed to facilitate the early stages of watershed planning. Though the survey provides primarily subjective information, it is important that it be carried out in an organized fashion and that similar factors are observed at each site. The purpose of the worksheet is to insure that this occurs.

The worksheet was completed at pre-determined locations (primarily road crossings) selected to provide coverage of all parts of the planning area.

The worksheet includes four sections:

1. Site location information;
2. Tracking information (e.g. information on photos taken and GPS readings);
3. Water quality field parameters (specific conductance, dissolved oxygen, temperature) and observations; and
4. A description of site characteristics (impressions of land use, stream condition, etc).

Site characteristics assessed included: land use, riparian area condition, bank stability, and channel substrate/condition. All four of these factors were assessed separately for areas upstream and downstream of the bridge. The key *land uses* in the area surrounding the site were recorded. This was an overall impression of the surrounding, visible area (not limited to the riparian area, nor as expansive as the entire drainage). When assessing *riparian zone condition*, the primary focus was the zone within approximately 50 feet of each stream bank. Each bank was examined separately, and given a Good-Fair-Poor rating. The following distances were used as a general guide, with allowances being made for the existence of breaks and the type and maturity of woody vegetation: Good--forested width of at least 30-50 feet; Fair—forested width of 10-30 feet; Poor—forested width of less than 10 feet. *Bank stability* was noted for each bank. Good represents fairly natural, stable banks with minimal erosion. Poor represents substantial bank instability. For c*hannel substrate and condition,* the overall condition of the channel (physical condition and habitat) was rated as Good, Fair or Poor.

A copy of the Windshield Survey Stream Site Worksheet is included at the end of this Appendix.

Results

Thirty one sites were surveyed in August 2005. The location of these sites is shown in Table 1, along with survey results. A map showing site locations is included in Section 3 of the main text.

Notes for Table 1:
Ratings are designated as G (Good), F (Fair) or P (Poor).
Channel condition was assessed both upstream and downstream of each site. In the table, a slash (/) separates these two ratings. If only a single rating is given (e.g. G), the upstream and downstream ratings were identical. A single rating followed only by a slash (e.g. G/) indicates that one area

(upstream or downstream) received a rating, while the other was not rated, generally due to inability to see the channel because of vegetative growth.
Ratings for riparian condition and bank stability are presented in the same fashion, except that two ratings are presented on each side of the slash, one for each bank, separated by a dash (e.g. G-P/G-G).

Table 1. Summary of Phase 1 Windshield Survey Results, Peachtree-Martins Creek Local Watershed Planning Area

No.	WS	Stream Name	Site Location	Conductance (uS/cm)	Temp (C)	Oxygen (mg/L)	Condition	Stability	Condition
2	UPT	Peachtree Ck	SR 1539, near end of road	15.2	18.3	8.9	G-P	G-F	G
3	UPT	Peachtree Ck	Griffith Rd (SR 1655)	16.0	18.3	8.2	G-P/G-G	G/G	F/G
4	UPT	Moore Branch*	SR 1675	32.0	18.6	7.7	P	G/F	F/G
7	PBR	Pipes Br	SR 1540 (Lunsford Rd)	12.8	19.8	7.6	G-F/F	G/	G/
6	MPT	Peachtree Ck	Mission Rd, above Lizzie Elliott Branch	23.1	19.8	7.2	G-P/	G-F/G	G/
6	MPT	Peachtree Ck	Mission Rd, below Lizzie Elliott Branch	23.1	19.8	7.2			
8	MPT	Peachtree Ck	Upper Peachtree Rd (below Lunsford Rd)	20.1	20.0				
10	MPT	Lizzie Elliott Br	near Mission Rd, at mouth	38.6	21.4	6.7	G-F/	G-F/	F
9	MPT	Lamb Br	Upper Peachtree Rd	20.9	19.3				
13	MPT	Lizzie Elliott Br	Upper Peachtree Rd	21.3	19.4	6.6	F-P/P	F/P	P
11	MPT	Peachtree Ck	NC 141	55.8	22.0	6.9	G-F/P	G-F/G	G/P
15	SHW	Slow Ck	Canyon Rd (SR 1527)	NR			F/P	F/	P/
16	SHW	Slow Ck	Arrowhead Rd (SR 1528)	44.7	21.8	8.1	F/P	F/F	P
18	SBT	Slow Ck	Greenlawn Cemetary Rd (SR 1670)	68.1	21.3	7.2	P/F	G/F-P	P/F
19	MBR	Messer Br	Hendrix Rd (SR 1531)	32.6	21.0	6.6	P	F/F-P	P
22	GSB	Snead Br	Hendrix Rd (SR 1531)	29.9	20.0	7.0	G/P	G-F/F-P	F/P
24	PBT	Peachtree Ck	US 64	44.8	22.4	7.0	F/G-F	G	G
26	CMB	UT Hiwassee	Mission Dam Rd (Clay Co SR 1302)	314.6	22.4	6.6	G-P	G-P	P
27	CMB	Calhoun Br	Mission Rd (SR 1537)	89.2	21.8	6.1	F-P	G-F/G-G	F
29	CMB	Mission Br	Mission Rd (SR 1537)	30.3	20.3	7.1	F/G-F	G/	F/
30	MCB	McCombs Br	McCombs Rd (SR 1549)	31.2	20.6	6.0	G/F-P	G/G-F	G/F
33	FBR	Fall Br	Fall Branch Rd (SR 1550)	21.7	18.7	7.9	G-F/G	G-F/	F/
32	FBR	Fall Br	US 64	25.1	19.0	8.4	G-F/	G/	F/
35	SUT	UT Hiwassee 1	Harshaw Rd (SR 1558)	NR			G	G/G-F	F
39	HCK	Hampton Ck	Mulkey Rd (SR 1634)	NR			G-P/G-F	G	P/G
38	HCK	Hampton Ck	Harshaw Rd (SR 1558)	32.8	23.1	7.1	G-F/P	G-F/G-P	F/P
40	UMC	Martins Ck	Tobe Stalcup Rd (SR 1753)	25.6	20.9	7.3	G/P	G/G-F	G
43	MMC	Martins Ck	Martins Ck Rd (SR 1556)	40.5	21.5	6.4	F/G	G/	F
45	MMC	Martins Ck	Crisp Rd (SR 1576)	49.0	22.4	7.1	P/F	F-P/	P/F
42	MMC	UT Martins Ck	Crisp Rd (SR 1576)	28.1	27.7	5.9	P	G	P
46	LMC	Martins Ck	Martins Ck Rd (SR 1556)	45.1	22.0	6.3	G-F/F-P	F-P/F	F
47	LMC	Martins Ck	Harshaw Rd (SR 1558)	45.0	22.3	7.1	G/G-F	F/G-F	F/G

NR= site accessible but no measurements recorded because stream could not be easily reached due to fencing, slope or vegetation

Key for riparian-bank-channel ratings:
Slash (/) separates upstream from downstream rating. Rating on one side of slash indicates that only us or ds rating was made.
Single rating with no slash indicates that us and ds ratings were the same. Dash (eg F-P) indicates range of ratings for R vs L bank.

* Shown on USGS maps as Fate Puett Cove Creek

Windshield Survey Stream Site Worksheet, Hiwassee Local Watershed Planning Area

Stream:_____ **Site ID:**_____ **Site Location** :_____
Subwatershed:_____ **Staff:**_____ **Date**_____

Tracking Information
Waypoint No. _____ Lat_____ Long_____ Photo number(s) and description_____ _____ _____ Potential restoration-enhancement-protection site (specify)?_____

Water Quality Field Parameters and Observed Conditions	
Field Params: Specific conductance _____µmhos/cm Temperature_____^{0}C DO _____mg/L	*Water Appearance*: ☐ turbid ☐ clear ☐ other (list) _____ *Flow Conditions*: ☐ high ☐ normal ☐ low *Last Rainfall* (if known)_____

> ***Site Characteristics*** <

Upstream	Downstream
Key Land Uses	**(check up to two, circle primary)**
☐ Forest ☐ Pasture ☐ Row crops ☐ Low density residential/rural residential ☐ Medium- high density residential ☐ Commercial, industrial, institutional ☐ Other_____	☐ Forest ☐ Pasture ☐ Row crops ☐ Low density residential/rural residential ☐ Medium- high density residential ☐ Commercial, industrial, institutional ☐ Other_____
Riparian Zone Condition	**(Wooded Width and Condition for Each Bank)**
☐ Good/Good ☐ Fair/Fair ☐ Good/Fair ☐ Fair/Poor ☐ Good/Poor ☐ Poor/Poor _____	☐ Good/Good ☐ Fair/Fair ☐ Good/Fair ☐ Fair/Poor ☐ Good/Poor ☐ Poor/Poor _____
Bank Stability	**(Rate Each Bank)**
☐ Good/Good ☐ Fair/Fair ☐ Good/Fair ☐ Fair/Poor ☐ Good/Poor ☐ Poor/Poor _____	☐ Good/Good ☐ Fair/Fair ☐ Good/Fair ☐ Fair/Poor ☐ Good/Poor ☐ Poor/Poor _____
Channel Substrate	**and Condition**
☐ Excessive sedimentation ☐ Good ☐ Recent dredging or straightening ☐ Fair ☐ Channel at least moderately incised ☐ Poor ☐ Natural sinuosity ☐ Large woody debris common _____	☐ Excessive sedimentation ☐ Good ☐ Recent dredging or straightening ☐ Fair ☐ Channel at least moderately incised ☐ Poor ☐ Natural sinuosity ☐ Large woody debris common _____

Potential	**Positive Features**
☐ Large tracts of mature forest ☐ Livestock fenced from stream ☐ Conservation tillage ☐ Other BMP_____ ☐ Important species present_____ ☐ Other_____	☐ Large tracts of mature forest ☐ Livestock fenced from stream ☐ Conservation tillage ☐ Other BMP_____ ☐ Important species present_____ ☐ Other_____
Potential	**Negative Features**
☐ Major bank failure ☐ Highly intensive use_____ ☐ Recent clearcutting ☐ Land clearing/construction_____ ☐ Eroding road banks ☐ Livestock in stream or obvious access trails ☐ Invasive exotic plant species common_____ ☐ Other_____ _____	☐ Major bank failure ☐ Highly intensive use _____ ☐ Recent clearcutting ☐ Land clearing/construction_____ ☐ Eroding road banks ☐ Livestock in stream or obvious access trails ☐ Invasive exotic plant species common_____ ☐ Other_____ _____
Notes:	

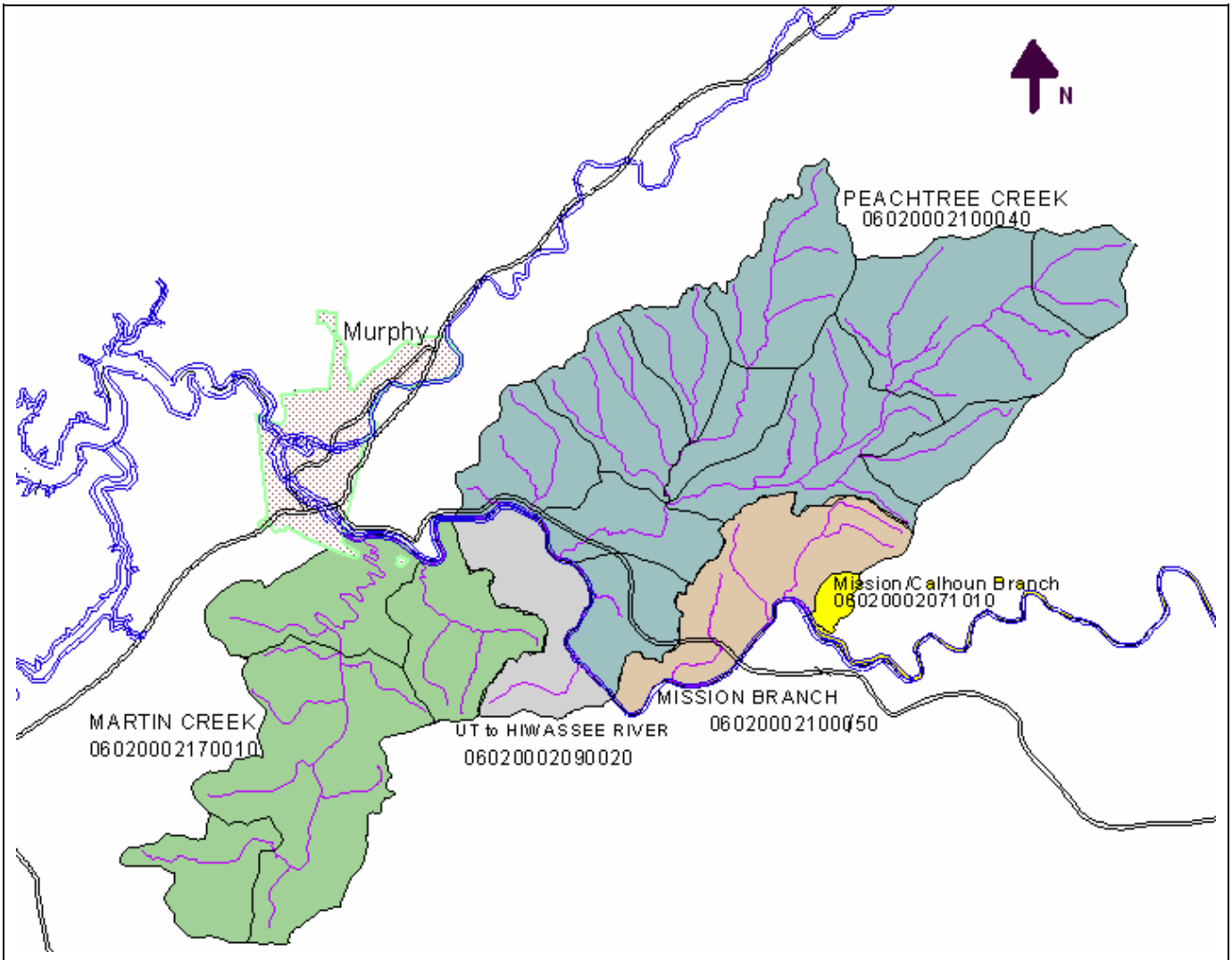
Appendix C

Summary of Existing Water Quality Data

Summary of Available Data

Hiwassee River Basin

Project NC Subbasin: 04-05-02 (Hiwassee 02); 04-05-01 (Hiwassee 01), in part
Project Cataloging Unit: 06020002
Project Hydrologic Units: -090020, -100040, -100050, -170010, -071010 (in part)



Proposed 14-digit hydrologic units for local watershed plan development

Prepared by
NC Division of Water Quality
Watershed Assessment Team
Raleigh and Swanannoa, NC
September 16, 2005

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Tables and figures

Basin overview

The Ecosystem Enhancement Program (EEP) has selected four contiguous subwatersheds within the Hiwassee River Basin for the development of an Local Watershed Plan (LWP). In support of this, the DWQ Watershed Assessment Team (WAT) has developed this summary of available water quality data for the area. The NC Division of Water Quality (DWQ), the Tennessee Valley Authority (TVA), and Hiwassee River Watershed Coalition (HRWC) have partnered in the past on restoration projects in the Brasstown Cr. and Valley R. watershed, located upstream and downstream (respectively) of the watershed, and there is continuing interest to identify further restoration opportunities.

The majority of the LWP watershed is located within Cherokee County and has a total area of 39 square miles. It includes Martins Cr.[1] (HU 06020002170010), Peachtree Cr. (HU 06020002100040), Mission Br. (HU 06020002100050), and an unnamed tributary (HU 06020002170020), all of which drain into the Hiwassee R. These subwatersheds are located mainly in NC subbasin Hiwassee 02 (04-05-02), with Mission Br. located in subbasin Hiwassee 01 (04-05-01). In addition to these, a small sub-watershed located just inside Clay County (HU 06020002071010), also in subbasin 04-05-01, was added into the LWP because of additional water quality concerns. This small tributary drains from a mining operation to the Mission Creek dam.

In comparison to other basins in the state, the Hiwassee River basin has shown few serious water quality concerns. It is one of only three major river basins in the state that do not currently have any impaired waters included on the latest NC 303(d) list. This area also contains rare and federally listed species and is a center of aquatic endemism. There are no NPDES-permitted facilities in the watershed chosen for LWP development. There is one facility covered under the General Permit NCG020000, which regulates its stormwater discharge, mine dewatering, and process water.

There do appear to be some threats to water quality in this watershed, and impacts are anticipated to increase as demand continues to rise for residences for retirement and vacation homes. Several transportation projects are also planned for this area. Monitoring data are already showing some recent impacts. In 2004, DWQ habitat assessments documented evidence of what may be recent destabilization of stream banks, with the erosion described as "severe" in one case, and increasing amounts of silt and sediment. Fecal coliform levels seem to be showing a recent upward trend, after consistently showing annual medians of <10 colonies/100mL throughout the 1990's. In assessing Hiwassee Lake, which is located just downstream of the watershed of interest, the TVA notes that there may be an upward trend in chlorophyll a, which could indicate higher nutrient inputs within the basin.

Within the study watershed, monitoring data are available from both DWQ and TVA for a total of eight locations on Peachtree Cr., Martins Cr., and the Hiwassee R. The DWQ performs benthic macroinvertebrate, fish community, habitat, chemical, physical, and microbiological monitoring. The TVA has provided benthic macroinvertebrate and fish community results. It should be noted that sampling and analysis methods between DWQ and the TVA are significantly different. The comparability of these data has not been fully assessed by the author and readers should use best professional judgment when making comparisons between results of the two programs.

[1] The stream is labeled as "Martin Creek" on USGS topographic maps, and this is also how it is listed in the USGS Geographic Names Information System (GNIS). However, it is referred to locally as "Martins Creek" and this is the name used throughout this document.

Use impairments

The latest available DWQ Basin Plan for the Hiwassee (2000) determined that 100% of the monitored stream segments are supporting all currently assessed uses (aquatic life, secondary recreation, primary recreation, fish consumption, and water supply). There are no waterbodies in the Hiwassee basin included in the 2004 Integrated 305(b) and 303(d) Report. In the past, six creeks within the basin have been listed as "Partially Supporting", but have since been de-listed. These include Davis Creek, Garrett Creek, North Shoal Creek, Valley River, Brasstown Creek, and Webb Creek, none of which are included in the LWP watershed. Previously listings were due to sedimentation, possible toxicity issues from a permitted WWTP, and impacted benthic communities. Listings were removed in response to WWTP improvements and subsequent benthic samplings indicating improvements in water quality.

Permitted facilities

There are no active individual NPDES permits for facilities in the watershed. There is one facility that is covered by the NPDES Mining General Permit NCG020000, which relates to stormwater discharge, mine dewatering, and process wastewater. The facility name is Mission Quarry (permit # NCG020606), located on Mission Dam Rd. (approximate latitude 35.071, longitude –83.930). The facility is located on an unnamed tributary that flows south to feed into the Hiwassee R. near the Mission Dam.

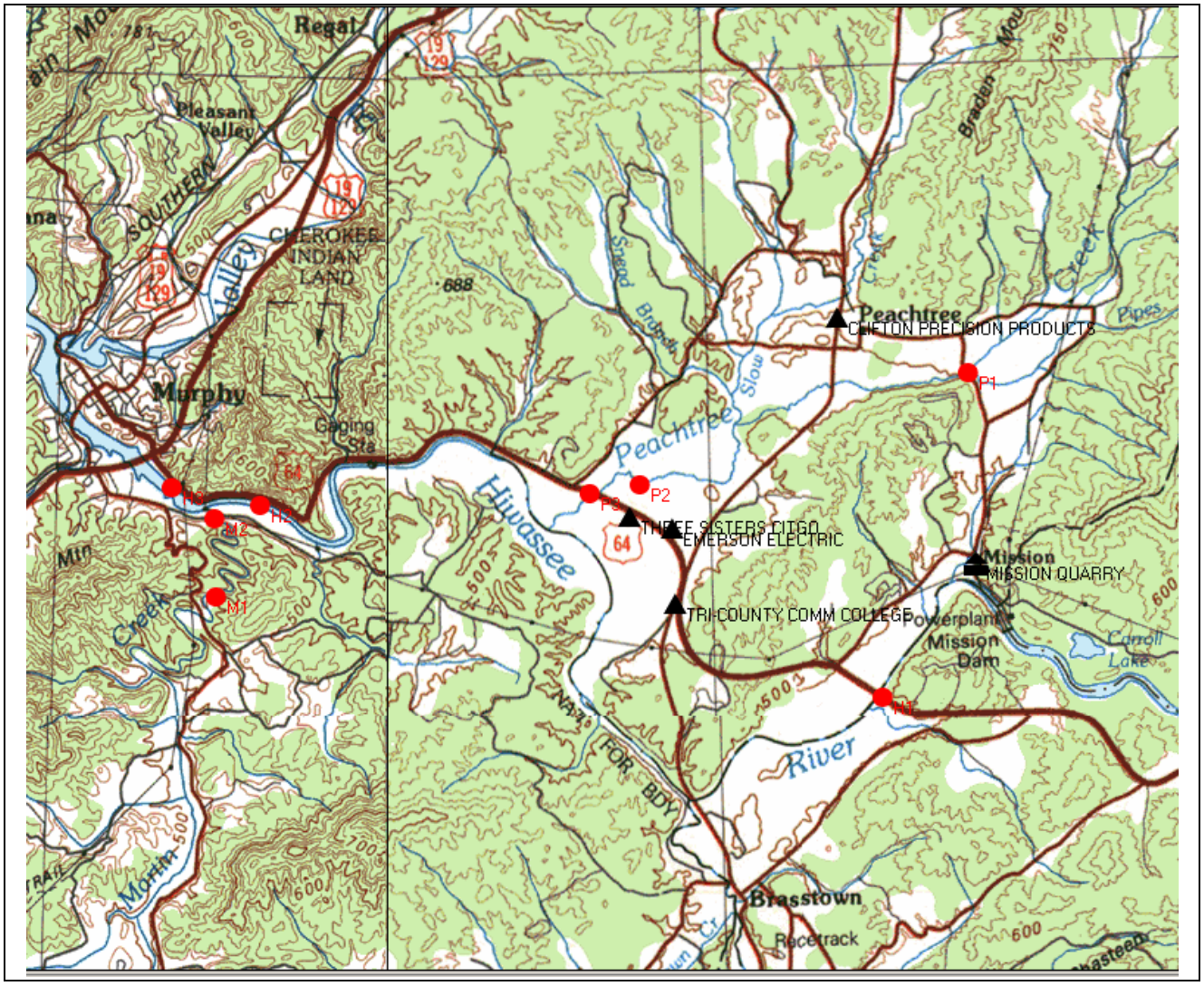
Monitoring locations

Data have been collected at eight locations within the watershed by the NC Division of Water Quality (DWQ) and the Tennessee Valley Authority (TVA). Station locations and types of monitoring data available for each agency are shown in Table 1 and Figure 1.

Table 1: DWQ and TVA monitoring station locations

Summary site number	Location	HU	NC Stream Index	NC Stream Class	Latitude (dec. deg.)	Longitude (dec deg.)	DWQ Benthos	DWQ Fish comm.	DWQ Habitat	DWQ Chemistry	TVA Benthos	TVA Fish comm..
H1	Hiwassee R at US 64 near Brasstown	-100050	1-(16.5)	WS-IV	35.0580	-83.9420				X	X	
H2	Hiwassee R off US 64 UPS of Martins Cr.	-170010	1-(43.7)	WS-V	35.0766	-84.0148					X	X
H3	Hiwassee R at US 64 above Murphy	-170010	1-(43.7)	WS-V	35.0788	-84.0254	X		X	X		
P1	Peachtree Cr at SR 1537	-100040	1-44	C	35.0895	-83.9308	X		X			
P2	Peachtree Cr UPS of US 64	-100040	1-44	C	35.0787	-83.9697						X
P3	Peachtree Cr at US 64	-100040	1-44	C	35.0774	-83.9746		X	X			
M1	Martins Cr DNS of SR 6247	-170010	1-49	C	35.0676	-84.0201					X	
M2	Martins Cr at SR 1558	-170010	1-49	C	35.0750	-84.0208	X	X	X			

Figure 1: Monitoring stations, facilities, and groundwater incident locations (1:100K)



Fish community

Historically, the DWQ NC Index of Biological Integrity (NCIBI) criteria that are used to rate streams based on fish community were not applicable to streams in the Hiwassee basin. However, by 2004 tentative criteria had been developed, allowing sites in the basin to be rated for the first time, establishing critical baseline data. As indicated in the 2005 Basin Assessment Report (BAR) prepared by the Environmental Sciences Section, these ratings should be considered tentative, as more data will be required to verify that

Table 2: NCIBI scores and classes for Hiwassee River basin

NCIBI score	Integrity Class
58 or 60	Excellent
48, 50, 52, 56	Good
40, 44, 46	Good-Fair
34, 36, or 38	Fair
≤ 32	Poor

the metrics are appropriate for this basin.

NCIBI scores are based on a number of metrics. Each metric can receive a score of 1, 3, or 5, which results in an even-numbered total score. In the Hiwassee and other Western and Northern Mountain basins, the NCIBI relies on ten metrics. This contrasts with the rest of the state, where a total of twelve metrics are used. In order to have a maximum score of 60 regardless of the region, Western/Northern Mountain total raw scores are multiplied by 1.2 (12/10). This final NCIBI score is then compared to the Integrity Class scale (Table 2) to assign a water quality rating. (Note that due to multiplying by 1.2, the total scores of 30, 42, and 54 are non-existent.) For more information on sampling methods, metrics, and ratings, refer to the Fish Community Sampling SOP (ND DWQ, 2001).

Two locations were sampled by the DWQ Biological Assessment Unit (BAU) within the LWP watershed in 2004: Peachtree Cr. at US 64 (P3) and Martins Cr. at SR 1558 (M2). The raw values and corresponding NCIBI scores for each of the ten metrics measured are shown in Table 3. Raw data are provided in Appendix 1.

Table 3: 2004 DWQ Fish Community metric scores

			Metrics											
Station #	**Location**	**Result type**	**N Species**	**N Individuals**	**N Darter species**	**N RST species [1]**	**N Cyprinid species**	**N Intolerant species**	**% Tolerant species**	**% Omni + herb**	**% Insectivores**	**% Multiple ages**	**Total raw score**	**NCIBI score**
P3	Peachtree Cr at US 64	raw data	22	535	4	2	8	3	2	11	85	64	--	--
		score	5	5	5	5	5	5	5	5	5	3	48	58
M2	Martins Cr at SR 1558	raw data	19	288	4	1	7	3	4	7	91	63	--	--
		score	5	3	5	3	3	5	3	1	1	3	32	38

[1] *RST = rockbass, smallmouth bass, trout*

Peachtree Cr. received an Excellent rating, despite a low habitat score (see "Habitat Assessment" discussion below). It received the maximum score for 9 out of 10 metrics. In particular, there were a high number of species at this site, including wild rainbow trout. However, the raw data for the metrics that reflect trophic function (i.e., feeding groups: % omnivores + herbivores, % insectivores) were borderline. If the % Omnivore + Herbivore had been 9% instead of 11%, or % Insectivores had been 86% instead of 85%, these metrics would have received a score of 1 instead of 5.

Based on abiotic characteristics, Martins Cr. qualifies as a regional reference site for DWQ's Fish Community Monitoring Program, but rated Fair by the NCIBI. Main impacts on the total score were trophic group metrics: % Omnivores + Herbivores was low, and % Insectivores was high. Both of these received the lowest possible score of 1. Maximum possible scores were given for number or darter species, total number of species, and number of intolerant species. The highland shiner (*Notropis micropteryx*), an intolerant species, was found at this site. The BAR indicates that a specific impact on the fish community is not clear, though lack of habitat diversity may certainly be a contributor.

In discussions with BAU biologists, they believe that Martins Creek should have scored and rated higher with the NCIBI. In fact, during BAR preparation they spent a significant amount of time discussing this particular site because a rating of Fair did not seem to fit. As stated in the BAR, they think that low habitat diversity was the problem. Specifically, critical pool habitats were lacking in this section of

Martins Cr., probably because snags and downed logs were rare and the entire 600 foot reach was one uniform depth. Without logs, snags and rocks of various sizes in clear streams, fish of certain trophic levels simply don't have appropriate habitat. With slightly higher habitat diversity it would be expected that there would have been a more species diversity, and consequently several of the NCIBI metrics would have likely bumped the rating up to Good-Fair. As it stands, the score of 38 that was given to Martins Cr. is at the very top of the Fair rating. BAU biologists also note that the following metrics would have improved the rating:

- Metric 2: 31 additional fish of any species;
- Metric 4: the presence of 1 additional RST species (rockbass, smallmouth bass, trout);
- Metric 5: the presence of 1 additional Cyprinid species (both the creek chub and the longnose dace were common in Hiwassee subbasins 01 and 02, but not captured here. Rosyside dace and whitetail shiners were also missing).

BAU biologists also suggested that EEP request further sampling on Martins Cr., not only at this location but also at the next upstream road crossing where more varied habitat may be present.

The TVA has performed fish community sampling in the LWP watershed at three sites. A summary of these results is shown in Table 4. Please note that TVA uses different sampling methods and does not use the NCIBI used by DWQ. A full assessment of comparability of the ratings from the two organizations has not been performed for this summary and readers should realize that there may be limitations in regards to comparing the two data sets.

Table 4: TVA Fish community results

Station #	Stream name	Sampling date	IBI score	IBI rating
H2	Hiwassee R off US 64 UPS of Martins Cr	7/2002	54	Good/Excellent
		7/1997	54	Good/Excellent
		5/1994	52	Good
P2	Peachtree Cr UPS of US 64	4/1994	46	Fair/Good
M1	Martins Cr DNS of SR 6247	4/1994	48	Good

Benthic macroinvertebrates

Benthos data are reported by the DWQ in terms of community diversity (i.e., taxa richness, or S) and a metric termed the NC biotic index (BI), which is calculated based on relative abundance of taxa in the sample and the sensitivity of each taxon to pollution. Each of these measures can be reported for all taxa, or by using only the so-called EPT taxa, which refers to the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). Taxa in these orders are generally much more sensitive to stressors and better indicators of water quality.

Three sites in the LWP watershed have been sampled by the DWQ Biological Assessment Unit (BAU) for benthic macroinvertebrates: Hiwassee R near Murphy (H3), Peachtree Cr at SR 1537 (P1), and Martins Cr at SR 1558 (M1). A summary of results are shown in Table 5. More detailed results are included in Appendix 2.

Martins Cr. at SR 1558 (M2) was first sampled in 2004, receiving a Good rating. This creek appears to be more impacted than others in this subbasin, which is to be expected given the higher level of residential development in this watershed.

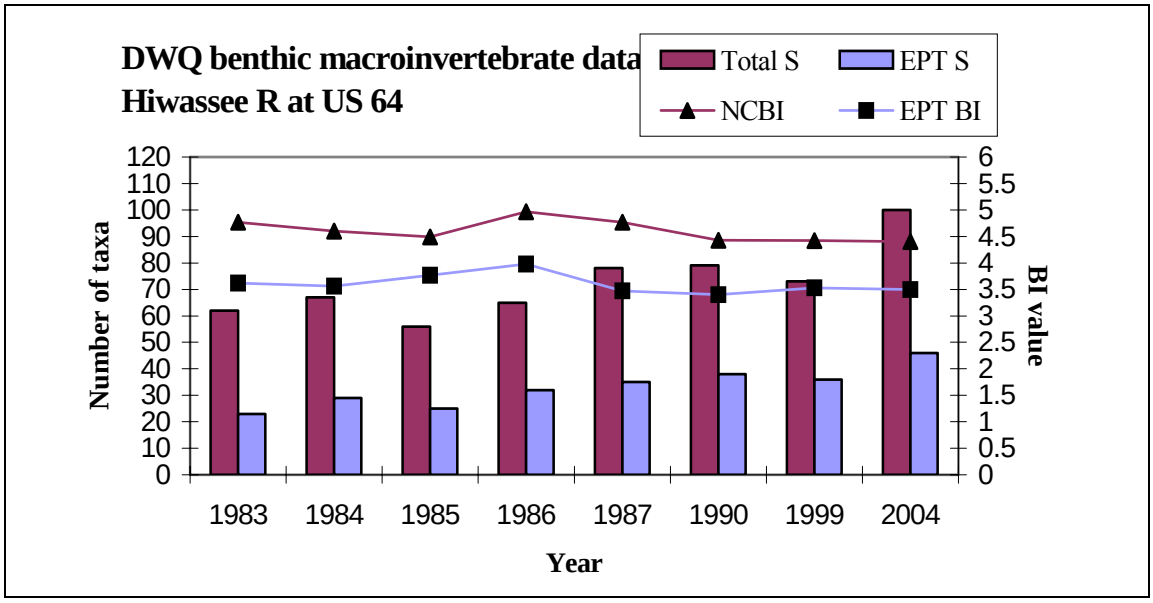
Peachtree Cr at SR 1537 (P1) was sampled in 1994, 1999, and 2004 and has consistently been rated Excellent. The site has shown a steadily increasing number of EPT taxa. The NC EPT Biotic Index (BI) ratings have been consistently well below the mountain ecoregion criteria of <4.05 that is required to be rated as Excellent.

There is a much more substantial data set available for the Hiwassee R. at US 64 near Murphy (H3). It has been sampled eight times between 1983 and 2004. It has shown a generally improving trend in water quality, based on BI ratings (both total and for EPT taxa only) as well as the total number of taxa found (S), as shown in Figure 2. It has been rated Good or Good-Fair, until the most recent sampling in 2004 when it was rated Excellent.

Table 5: DWQ benthic macroinvertebrate results

Station #	Location	Date	Total S	EPT S	BI	EPT BI	Bioclass-ification
M2	Martins Cr. at SR 1558	8/2004	--	30	--	3.1	Good
P1	Peachtree Cr. at SR 1537	8/2004	--	49	--	2.5	Excellent
		8/1999	--	38	--	2.9	Excellent
		7/1994	--	37	--	2.42	Excellent
H3	Hiwassee R at US 64 near Murphy	8/2004	100	46	4.4	3.5	Excellent
		8/1999	73	36	4.4	3.5	Good
		8/1990	79	38	4.43	3.40	Good
		8/1987	78	35	4.77	3.47	Good
		7/1986	65	32	4.97	3.98	Good-Fair
		8/1985	56	25	4.49	3.77	Good
		8/1984	67	29	4.60	3.56	Good
		8/1983	62	23	4.77	3.62	Good-Fair

Figure 2: DWQ benthos data for Hiwassee R near Murphy (H3)



The TVA has also performed benthic macroinvertebrate sampling at four locations in the watershed. Scores for EPT taxa only have been provided. The available data are shown in Table 6. As with fish community sampling, the TVA and DWQ use very different sampling and analysis methods. The comparability of the ratings produced by the two data sets have not been assessed for this summary and readers should realize there may be limitations to comparing the two data sets.

Table 6: TVA benthic macroinvertebrate data

Station #	Location	Sampling date	EPT score	EPT rating
H1	Hiwassee River at US 64 near Brasstown	8/1997	15	Good
H2	Hiwassee River off US 64 UPS of Martins Cr	7/2002	23	Good
		7/1997	18	Good
		5/1994	10	Fair
M1	Martins Creek DNS of SR 6247	4/1994	6	Poor/Fair

Habitat assessment

The DWQ benthic macroinvertebrate and fish community monitoring programs include habitat assessments as part of their standard protocols. With the exception of Martins Cr., which has a more developed catchment, habitat scores from 2004 sampling events were surprisingly low for streams in this ecoregion. Recent bank erosion problems due to high flows in the spring of 2004 have been cited as a possible cause for the low scores. A summary of individual habitat scores is shown in Table 7. Maximum possible scores for each category are shown in italics for reference.

The Hiwassee R near Murphy (H3) received a score of 61 in 2004, with the BAR citing a lack of instream habitat diversity, lack of riffles, and moderate bank erosion as major causes of the unexpectedly low score. It was also noted that the riparian area was no longer intact, as was reported during the 1999 sampling.

For Peachtree Cr., habitat assessments are available at two sites, located several miles apart. In 1999 the

Table 7: DWQ habitat assessment scores by category

Station #	Location	Year (B = benthos, F = fish)	Channel	Instream habitat	Substrate	Pool variety	Riffles	Bank stability	Shade	Riparian	Total
		Max scores	*5*	*20*	*15*	*10*	*16*	*14*	*10*	*10*	*100*
H3	Hiwassee at US 64 near Murphy	2004 (B)	4	12	8	6	6	12	7	6	61
		1999 (B)	4	19	11	10	3	12	2	6	67
P1	Peachtree Cr at SR 1537	2004 (B)	5	13	11	8	16	4	7	3	67
		1999 (B)	5	20	11	6	16	14	10	6	88
P3	Peachtree Cr at US 64	2004 (F)	5	12	8	6	10	4	9	4	58
M2	Martins Cr at SR 1558	2004 (F)	5	16	11	7	5	10	10	10	74
		2004 (B)	4	13	13	4	8	12	9	10	73

upstream site at SR 1537 (P1) had a score of 88, receiving maximum scores in five different categories and noted an intact riparian area. In 2004, the total score dropped dramatically to 67. The largest decreases were seen for instream habitat and bank stability, and it was noted that the riparian area was no longer intact.

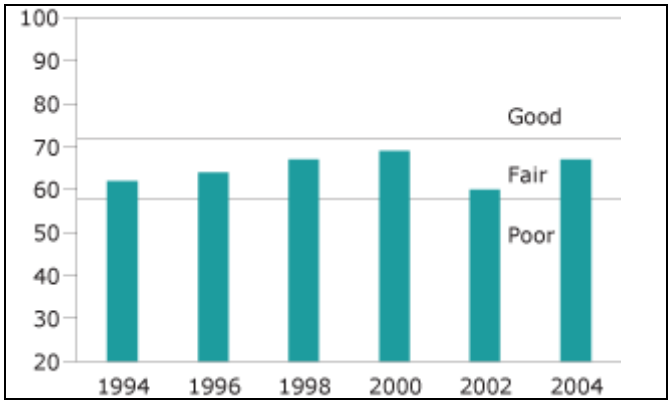
The 2004 habitat score of 58 at Peachtree Cr. at US 64 (P3) indicates a decrease in habitat quality from the upstream site. Severe bank erosion and instability seems to be a significant problem cited at both locations, and the most recent BAR indicates that this may be a very new problem in response to high flows in Spring 2004. The riparian area is not intact at either site and in the lower reach is described as "quite poor", being given a score of 4 out of a possible 10.

Martins Cr. drains one of the more developed catchments in the basin, primarily residential areas associated with the town of Murphy. However, it received the highest habitat assessment scores of the four sites in the LWP watershed. The benthos and fish monitoring programs scored this site as 73 and 74, respectively. As discussed earlier, the NCIBI rated this site lower than expected, and BAU biologists mainly attribute that to low habitat diversity. Additionally, the station is located just upstream of the confluence with the Hiwassee, and has a very low gradient which causes poorly developed pools and riffles, which is reflected in the scores for these categories. It is also noted the stream has a very uniform depth and a high percentage of silt and sand. Riparian zones were intact (scoring 10 of 10), greater than 18 meters in width, and bank stability received a moderate score (10 of 14).

Lake monitoring- DWQ and TVA

No lakes are present in the proposed LWP watershed. However, Hiwassee Lake begins just downstream of the Martins Cr. and Hiwassee R. confluence, and data collected at the lake may be of use for assessing nutrient inputs from the upstream watershed. The lake is monitored by DWQ on a five-year cycle and the TVA samples it every other year. Though ratings from DWQ and TVA cannot be considered equivalent, they do seem to provide conflicting information in terms of nutrient enrichment response (i.e., chlorophyll).

Figure 3: TVA Ecological Health Ratings for Hiwassee Lake, 1994-2004



Hiwassee Lake has consistently received an "Ecological Health Rating" of Fair (on a scale of poor, fair, and good) by the TVA (Figure 3). In 2004, the slightly depressed TVA rating was mainly attributed to Poor ratings for both chlorophyll-*a* and bottom life categories (Table 8). The TVA has noted that chlorophyll-*a* seems to be on a continuing upward trend, which would indicate that nutrient inputs are most likely on the rise as well. See http://www.tva.gov/environment/ecohealth/hiwassee.htm for more information on the TVA program.

Table 8: TVA 2004 Hiwassee Lake Ecological Health Ratings by Indicator

Location	DO	Chlorophyll-*a*	Fish	Bottom life	Sediment
Forebay	Fair	Poor	Good	Fair	Good
Mid-reservoir	Good	Poor	Good	Poor	Good

The DWQ Ambient Lake Monitoring System has consistently rated Hiwassee Lake as oligotrophic since it was first monitored in 1981, implying low primary productivity. Chlorophyll-*a* data collected by the DWQ do not confirm the upward trend seen by the TVA. Though high values were seen in 1999, results from 1994 and 2004 were fairly low (Table 9). No samples from these dates exceeded the NC water quality standard of 40ug/L. However, the DWQ only samples lakes during one summer of each five-year basin cycle so trends may be difficult to identify using this data set.

Table 9: DWQ ALMS Hiwassee Lake chlorophyll-*a* data summary

Year	N	Min	Median	Max
2004	15	2	5	10
1999	5	5	22	31
1994	5	1	2	3

DWQ Ambient Monitoring System (AMS)

The DWQ Ambient Monitoring System has conducted monitoring of chemical, physical, and microbiological water quality indicators for several decades all across North Carolina. Within the watershed of interest, there are two stations with a significant data set, both located on the Hiwassee R. mainstem. The upstream site at US 64 near Brasstown (H1) was active from 1973-1981. The downstream site at US 64 near Murphy (H3) was also initially established in 1973, but it is still actively monitored. A summary of types of data available for each station is attached as Appendix 3.

Given that the most recent data from the upstream site (H1) are over twenty years old, review and analysis of data for this summary was focused on the downstream site near Murphy (H3). The distributions of major parameters of interest for station H3 are shown in Table 10. Applicable NC water quality standards and action levels are included in a column labeled "EL" ("evaluation level") for comparison.[2]

The only parameters that exceeded standards in the last basin assessment period (1999-2004) are turbidity (2% of samples exceed the standard of 50 NTU), iron (9% of samples exceed the standard of 1000 ug/L), and fecal coliform (4% of samples > 400 col/100mL). When the data from the entire period of record were graphed, most parameters seem to be fairly stable over time. One exception is fecal coliform, which appears to be increasing in recent years, as shown in Figure 4. Though still well below the NC water quality standard of 200 col/100mL, annual medians have generally been rising over the last ten years (Figure 5), particularly since the end of the last drought in 2002. Even before the drought began in 1998, median coliform levels were ≤10 col/100mL. Total suspended residue (aka, total suspended solids or TSS) seems to be declining (Figure 6), though turbidity may be showing a slight increase (Figure 7).

Nutrients were also reviewed. No apparent trends were visible with any nitrogen species. Total phosphorus (TP) results were examined fairly closely. Given that the TVA postulates that chlorophyll-*a*

[2] USGS has calculated ecoregional "reference levels" for certain parameters, such as the National Water-Quality Assessment (NAWQA) Program Retrospective Database for Nutrients in Ground Water and Surface Water. However, these often rely heavily on data retrieved from the EPA STORET database, which did not, at the time of retrieval by USGS, contain any of the substantial data record collected by NC DWQ/DEM. Without inclusion of NC data in development of these reference levels, and the additional concern of the bias inherent in station locations for these historic data, the author felt that these values were not appropriate for use in this case.

is on the rise in Hiwassee Lake just downstream, a look at the levels of this limiting nutrient was warranted. There are several complications with performing this review:

- TP levels are generally very low in this region of the state, as compared to piedmont or coastal plain streams. However, it would be ideal to identify possible small increases to allow proactive measures to be taken to prevent more substantial enrichment.
- The DWQ Laboratory Section's reporting limit for TP has fluctuated widely over the last ten years. In the early 1980's, non-detects were reported as <0.05. From approximately 1984 through 2000, the reporting limit dropped to 0.01. During a QA/QC overhaul of the laboratory in 2001, the reporting limit temporarily jumped to 0.5, then dropped to 0.1, and finally to 0.02, the current reporting limit. Note that this current reporting limit is twice what it was in the 1980's-1990's. Performing trend analysis on these data, especially given a significant number of non-detects, is not reasonable. As can be seen in Figure 8, these changes in reporting limits can certainly muddle the graphical representation of the data.

Benthic macroinvertebrate communities will often respond to small increases in nutrient input. Due to the increase in primary productivity of a system, this will often result in what appears to be an improvement in water quality as determined by the common metrics used by DWQ. The benthos community at this site has shown recent improvements (see above). BAU staff are currently reviewing raw data from the station at Hiwassee at US 64 near Murphy (H3), but preliminary findings do not confirm the hypothesis that this system is experiencing nutrient enrichment. One indicator used is an increase in chironomid and oligochaete taxa with a corresponding decrease in EPT taxa, which data do not show. Additionally, it is very difficult to identify these changes in a river the size of the Hiwassee. It is much more likely to see a community response indicating nutrient enrichment in smaller, lower-order streams.

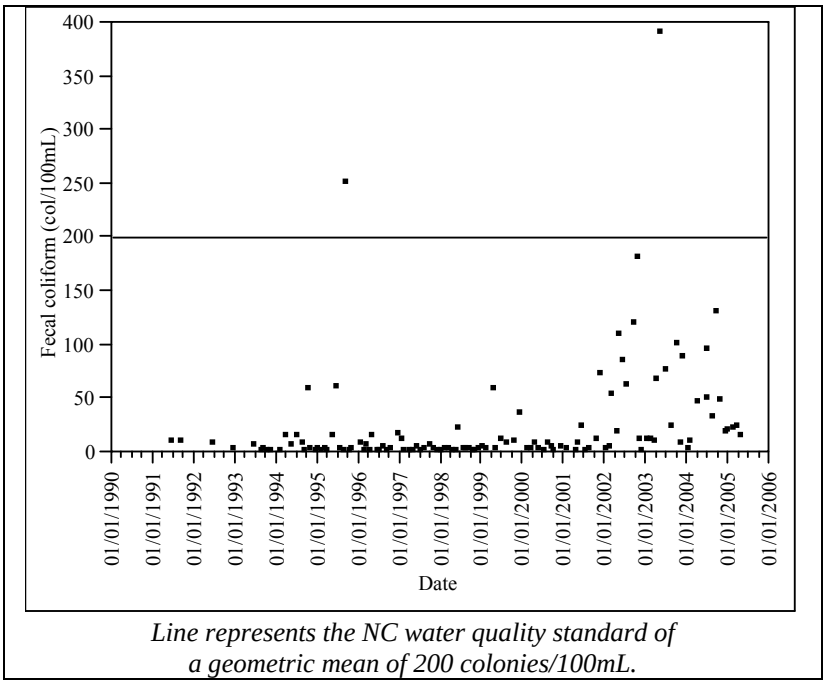
Table 10: Distributions of AMS data collected at Hiwassee R. near Murphy (stream class WS-V)

Parameter	EL	N	Min	10th	25th	50th	75th	90th	Max
Alkalinity total as CaCO3 (mg/L)	--	78	1	7	8	9	9	11	14
Alkalinity total field as CaCO3 (mg/L)	--	91	5	6	7	8	10	13	21
Aluminum Al - Total (ug/L)	--	103	50	62.2	100	150	280	532	6800
Ammonia nitrogen (mg/L)	--	130	0.01	0.01	0.02	0.02	0.05	0.07	0.5
Arsenic As total (ug/L)	10	138	5	10	10	10	10	10	10
BOD 5 day (mg/L)	--	78	0.2	0.3	0.5	0.7	0.8	1.5	3.2
COD (mg/L)	--	19	5	5	5	8.5	10	10	10
Cadmium Cd total (ug/L)	2	138	2	2	2	2	2	20	50
Chloride Total (mg/L)	230 [a]	62	1	1	1	2	2	3	4
Chromium Cr total (ug/L)	50	138	25	25	25	25	25	50	100
Conductivity field (umho/cm at 25°C)	--	202	7	23	25	27	31.3	36.7	54
Copper Cu total (ug/L)	7 [a]	138	2	2	2	2	10	20	40
Dissolved oxygen (mg/L)	5.0	218	7.8	8.8	9.3	10.2	11.1	11.8	14.7
Dissolved oxygen saturation- calculated (%)	--	135	78	87	91	94.4	99	103.4	115.6
Fecal coliform MF (colonies/100mL)	200/400 [b]	203	1	1	3	21	150	456	12000
Hardness CaCO3 total (mg/L)	--	118	1	4	6.8	8	10	12.1	83
Iron Fe total (ug/L)	1000 [a]	93	120	160	210	320	435	802	6500
Lead Pb total (ug/L)	25	138	10	10	10	10	10	100	100
Manganese Mn (ug/L)	200	26	14	16.1	21	28.5	52.5	74.4	91
Mercury Hg total (ug/L)	0.012	138	0.2	0.2	0.2	0.2	0.2	0.2	9
Nickel Ni total (ug/L)	25	137	10	10	10	10	10	100	100
Nitrate/nitrite NO2 + NO3 as nitrogen (mg/L)	10	130	0.02	0.07	0.12	0.15	0.19	0.25	5.9
pH field (SU)	6.0-9.0	214	6.1	6.6	6.8	7	7.2	7.5	9
pH lab (SU)	--	80	6.3	6.61	6.7	6.9	7	7.1	7.5
Phosphorus in total orthophosphate as P (mg/L)	--	28	0.01	0.01	0.01	0.01	0.01	0.05	0.05
Phosphorus total as P (mg/L)	--	131	0.01	0.01	0.01	0.02	0.03	0.05	0.5
Residue total (mg/L)	--	157	10	23	29	39	50	64.2	360
Residue total nonfilterable (TSS) (mg/L)	--	178	1	1	2.6	5	8	17.1	300
Total coliform LES (colonies/100mL)	--	77	4	22	40	100	245	530	8400
Total Kjeldahl nitrogen TKN as N (mg/L)	--	129	0.1	0.1	0.1	0.2	0.2	0.3	1
Turbidity lab (NTU)	50	174	1.3	2.2	3	4.5	6.8	10.5	150
Water temperature (°C)	--	219	1	7	10	15	19	21	25
Zinc Zn total (ug/L)	50 [a]	138	10	10	10	10	20	50	340

a: Value shown is an action level

b: Fecal coliform standard has two parts, both based on five samples taken over 30 days. These samples should not exceed a geomean of 200 and no more than 20% exceed a single sample maximum of 400. See full text of standards for details.

Figure 4: Fecal coliform results for Hiwassee R. near Murphy (H3)



Line represents the NC water quality standard of a geometric mean of 200 colonies/100mL.

Figure 5: Median fecal coliform values by year for Hiwassee R. near Murphy (H3)

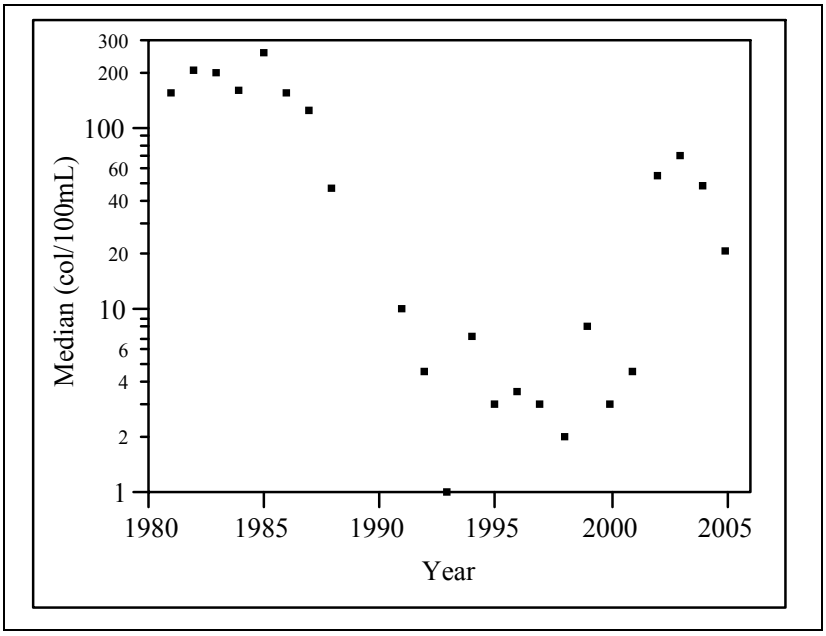


Figure 6: TSS results from Hiwassee R. near Murphy (H3)

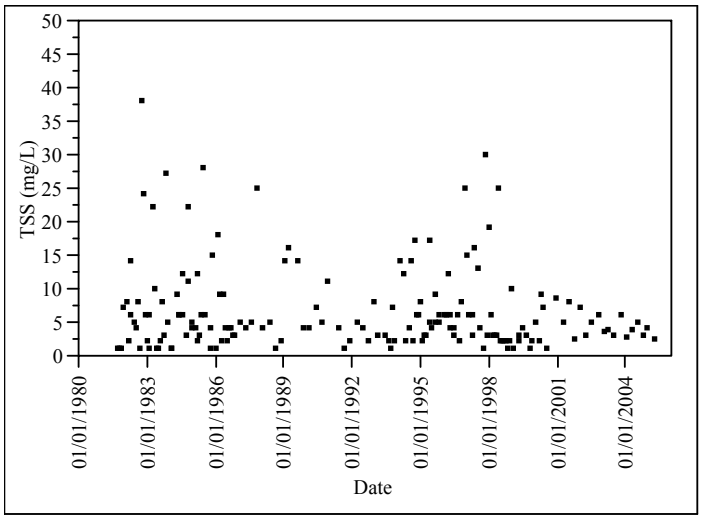


Figure 7: Turbidity results from Hiwassee R. near Murphy (H3)

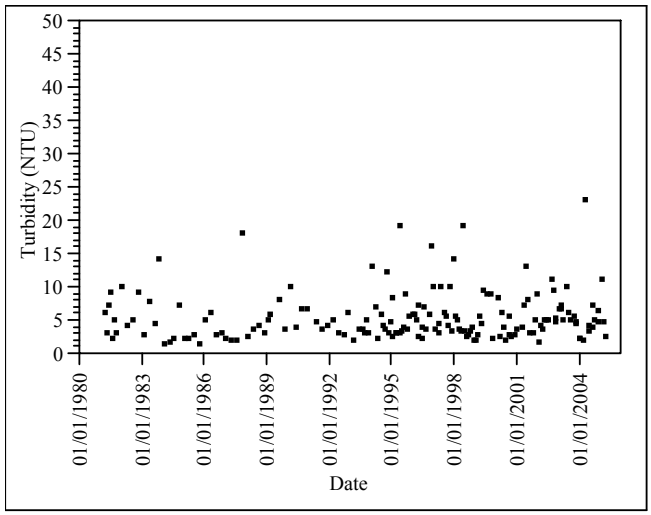
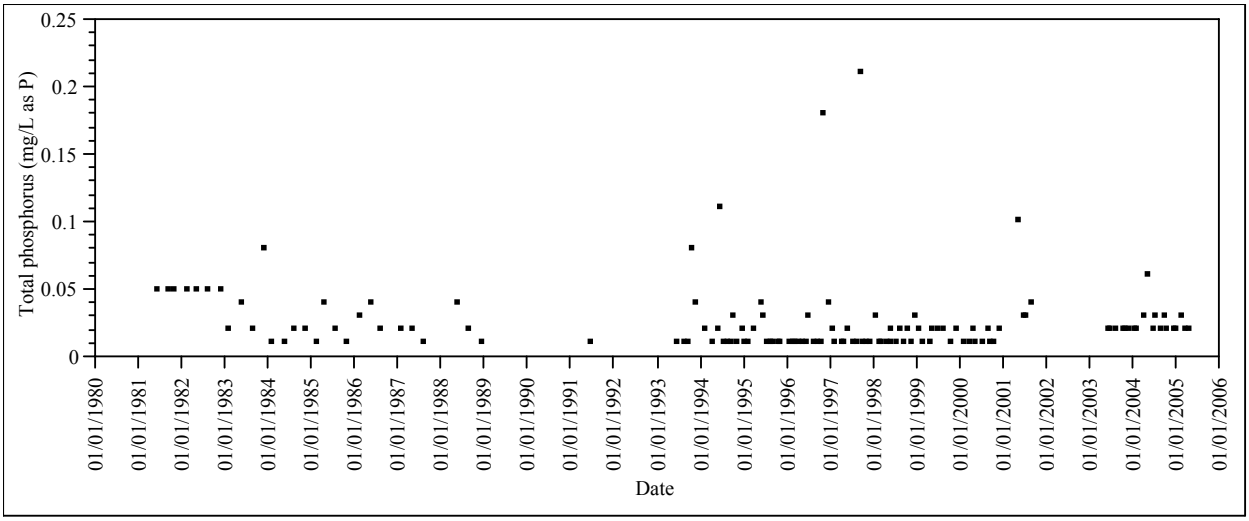


Figure 8: Total phosphorus results from Hiwassee R. near Murphy (H3)



USGS flow data

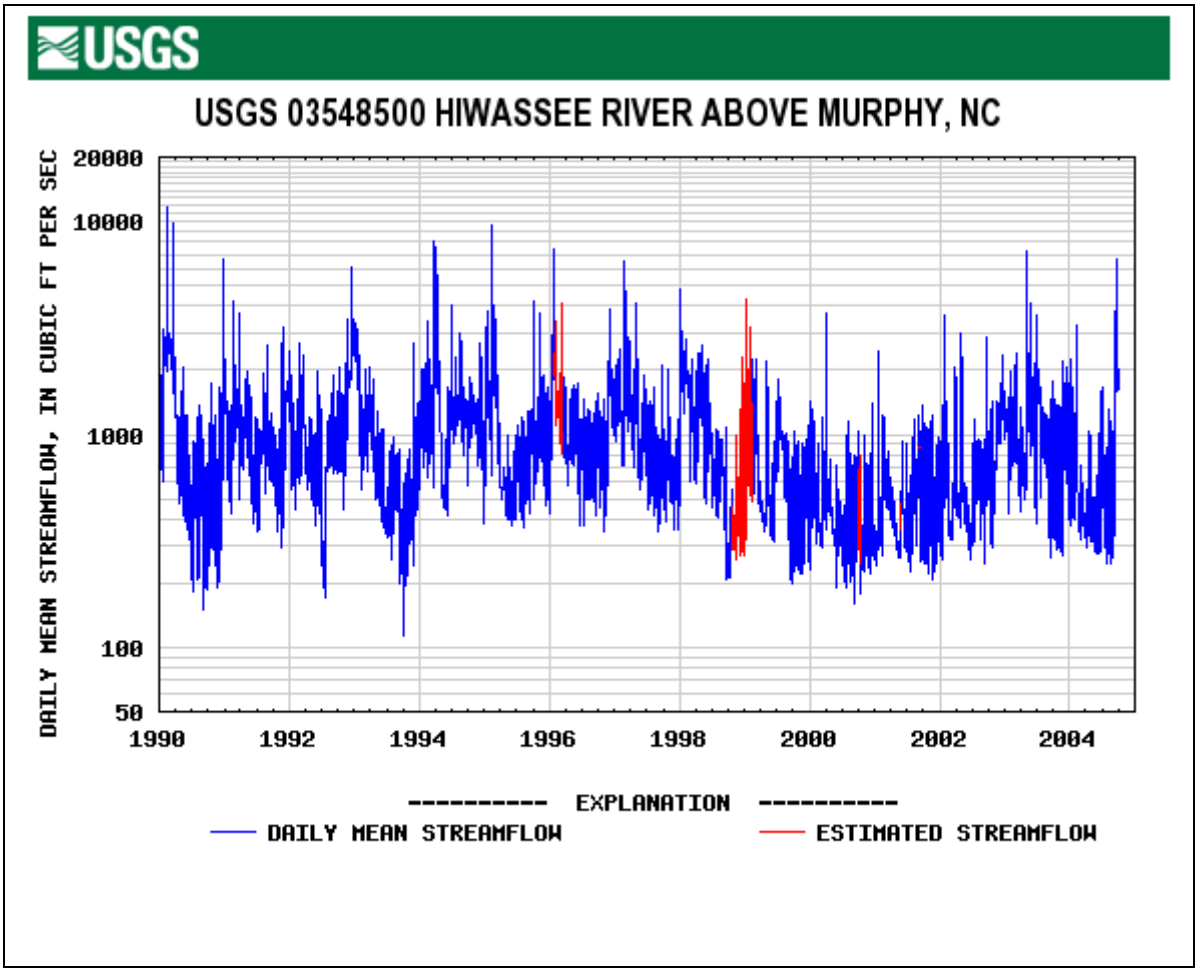
A summary of USGS gage locations is shown in Table 11. The USGS does not have any currently active gage sites within the LWP watershed; one gage was located on the Hiwassee near Murphy, but was discontinued in 2004. A graph of the last fifteen years' worth of daily streamflow from the Hiwassee R above Murphy is shown in Figure 9. There are still two active sites within the Cataloging Unit (06020002), located on Brasstown Cr. and the Valley R.

Table 11: USGS gage sites

USGS site number	Description	Latitude (dec deg)	Longitude (dec deg)	Start date	N daily streamflow records
03548330	Brasstown Cr at Brasstown	35.0400	-83.9592	10/2000	1,461
03550000	Valley R at Tomotla	35.1389	-83.9806	07/1904	34,576
03548500	Hiwassee R above Murphy[1]	35.0814	-84.0028	10/1897	39,081

[1] *Discontinued in 2004*

Figure 9: Daily mean streamflow at USGS Station #03548500, 1990-2004



Hiwassee River Watershed Coalition

The Hiwassee River Watershed Coalition, part of the Volunteer Water Information Network (VWIN), has approximately 22 current monitoring sites in the Hiwassee basin. The HRWC is also a partner with the EEP on developing the current LWP. Their ongoing monitoring program relies on citizen volunteers, who measure basic field parameters and take samples for nutrients, turbidity, total solids, and select metals on a monthly basis. However, the program's sites are located in the Lake Nottely and Lake Chatuge watershed; no data are collected in the watershed of concern for this project. Information from the program may be useful as supporting anecdotal information.

In addition to volunteer monitoring efforts, the HRWC has been awarded grants by the Clean Water Management Trust Fund for two restoration projects in the basin, located in Brasstown Creek and the Valley River watershed. The Valley River project involved benthos and fish community collections throughout the basin by both DWQ and TVA. These data are summarized in a 2004 report, available online at http://www.hrwc.net/valley_combined_2002data.pdf. Though these sampling sites are not within the LWP watershed they may a good reference for regional reference conditions or as supporting anecdotal evidence of trends within the Hiwassee basin.

Aquatic toxicity

Since there are no individual NPDES-permitted facilities in the watershed under study, no whole effluent toxicity (WET) data are available.

DWQ Groundwater Incidents

According to the DWQ Aquifer Protection Section, there have been several documented incidents that have impacted groundwater in the LWP watershed, involving four different facilitites. Information was obtained from the Groundwater Incident database (http://gw.ehnr.state.nc.us/), and is included in Appendix 4.

The Three Sisters Citgo site seems to have had numerous incidents over the years involving gasoline spills. No current action is being taken at this site other than normal monitoring activities.

The other three sites within the Peachtree Creek subwatershed are the result of a 1987 investigation. At that time, trichloroethene (or trichloroethylene, TCE) was detected in a Tri-County Community College drinking water well. TCE levels at the Community College well were measured at 300 ug/L, which is well above the NC groundwater standard for TCE is 2.8 ug/L (Table 12). Low levels of chlorinated solvents and TCE were detected in other wells within the Peachtree community (Atwood 1987). These sites included Litton-Clifton Precision Products (currently known as Moog), Tri-County Community College and Emerson Electric Company.

Litton-Clifton Precision Products/Moog is still an active Federal CERCLA/RCRA site and under an EPA order for corrective action/remediation for both groundwater and surface water impacts by chlorinated solvents and other organics. Moog is currently

Table 12: Summary of NC water quality standards for trichloroethylene (TCE)

	TCE standard
Groundwater (class GA)	2.8 ug/L
Surface water- all waters	92.4 ug/L
Surface water- WS classes	3.08 ug/L

pumping groundwater coupled with soil vapor extraction. Moog's consultants are in the process of developing a RFI Work Plan Addendum to investigate possible off-site contamination resulting from local geology – fractured bedrock under the site.

Moog has monitoring sites on Slow Cr. and for groundwater. Some of the organics found within these samples include: 1,4-dioxane, 1,1-DCA, DCE, chloroform, cis-1,2 DCE, and PCE. A pond constructed on adjacent property to the north of the site was found to contain TCE in two samples at 5.4 ug/L and 5.6ug/L. As of February 2005, TCE levels in Slow Creek were found to be lower (4.3 ug/L) than previous samples taken within the past two-year period (18 ug/L and 9 ug/L). The NC water quality standard for TCE in class C surface waters, which would include Slow Cr. and the pond, is 92.4 ug/L.

Tri-County Community College groundwater was found to have high levels of TCE primarily near a domestic wastewater septic system with a sandfilter bed. The leachate was discharged to McComb Branch. The Community College was a Federal CERCLA site and has a current designation of "no further remedial action plan". This CERCLA file has been archived. A 2005 monitoring report was submitted to the NC DENR Asheville Regional Office indicating TCE is still being found in three monitoring wells (2.8 ug/L) and one PW well (11 ug/L). In addition, cis-1,2-dichloroethene (10 ug/L) was found in one of these monitoring wells, though below the groundwater standard of 70 ug/L. Current levels in McComb Branch, which has a NC stream classification of WS-IV, are unknown.

Emerson Electric Company had requested closure of their groundwater remediation system in March 1993. They had been issued a SOC to remediate any contamination attributable to activities conducted on site. This was to be continued until concentrations of organics were below applicable MACLs. They are currently designated: no further remedial action plan. This file has been archived per NC DENR superfund personnel.

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NC Environmental Management Commission. 2004. Classifications and Water Quality Standards Applicable to Surface Waters and Wetlands of NC. 15A NC Administrative Code Section 2H .0100.

Appendix 1: DWQ Fish community raw data

Basin	Sub	Waterbody	Station	County	Latitude	Longitude	Date	Collection No.	Scientific Name	Number
HIW	2	Martin Cr	SR 1558	Cherokee	350431	840115	06/17/04	2004-92	Hypentelium nigricans	8
HIW	2	Martin Cr	SR 1558	Cherokee	350431	840115	06/17/04	2004-92	Cottus bairdii	157
HIW	2	Martin Cr	SR 1558	Cherokee	350431	840115	06/17/04	2004-92	Campostoma anomalum	10
HIW	2	Martin Cr	SR 1558	Cherokee	350431	840115	06/17/04	2004-92	Hybopsis amblops	1
HIW	2	Martin Cr	SR 1558	Cherokee	350431	840115	06/17/04	2004-92	Lepomis macrochirus	27
HIW	2	Martin Cr	SR 1558	Cherokee	350431	840115	06/17/04	2004-92	Moxostoma duquesnei	1
HIW	2	Martin Cr	SR 1558	Cherokee	350431	840115	06/17/04	2004-92	Lepomis cyanellus	11
HIW	2	Martin Cr	SR 1558	Cherokee	350431	840115	06/17/04	2004-92	Perca flavescens	1
HIW	2	Martin Cr	SR 1558	Cherokee	350431	840115	06/17/04	2004-92	Etheostoma zonale	1
HIW	2	Martin Cr	SR 1558	Cherokee	350431	840115	06/17/04	2004-92	Nocomis micropogon	10
HIW	2	Martin Cr	SR 1558	Cherokee	350431	840115	06/17/04	2004-92	Etheostoma blennioides	6
HIW	2	Martin Cr	SR 1558	Cherokee	350431	840115	06/17/04	2004-92	Etheostoma rufilineatum	6
HIW	2	Martin Cr	SR 1558	Cherokee	350431	840115	06/17/04	2004-92	Percina evides	3
HIW	2	Martin Cr	SR 1558	Cherokee	350431	840115	06/17/04	2004-92	Luxilus coccogenis	10
HIW	2	Martin Cr	SR 1558	Cherokee	350431	840115	06/17/04	2004-92	Micropterus dolomieu	1
HIW	2	Martin Cr	SR 1558	Cherokee	350431	840115	06/17/04	2004-92	Notropis spectrunculus	1
HIW	2	Martin Cr	SR 1558	Cherokee	350431	840115	06/17/04	2004-92	Ichthyomyzon greeleyi	3
HIW	2	Martin Cr	SR 1558	Cherokee	350431	840115	06/17/04	2004-92	Notropis leuciodus	5
HIW	2	Martin Cr	SR 1558	Cherokee	350431	840115	06/17/04	2004-92	Notropis micropteryx	26
HIW	2	Peachtree Cr	US 64	Cherokee	350439	835828	06/15/04	2004-85	Nocomis micropogon	16
HIW	2	Peachtree Cr	US 64	Cherokee	350439	835828	06/15/04	2004-85	Cottus bairdii	197
HIW	2	Peachtree Cr	US 64	Cherokee	350439	835828	06/15/04	2004-85	Ambloplites rupestris	11
HIW	2	Peachtree Cr	US 64	Cherokee	350439	835828	06/15/04	2004-85	Luxilus coccogenis	67
HIW	2	Peachtree Cr	US 64	Cherokee	350439	835828	06/15/04	2004-85	Notropis spectrunculus	21
HIW	2	Peachtree Cr	US 64	Cherokee	350439	835828	06/15/04	2004-85	Hypentelium nigricans	21
HIW	2	Peachtree Cr	US 64	Cherokee	350439	835828	06/15/04	2004-85	Moxostoma duquesnei	1
HIW	2	Peachtree Cr	US 64	Cherokee	350439	835828	06/15/04	2004-85	Lepomis auritus	1
HIW	2	Peachtree Cr	US 64	Cherokee	350439	835828	06/15/04	2004-85	Oncorhynchus mykiss	2
HIW	2	Peachtree Cr	US 64	Cherokee	350439	835828	06/15/04	2004-85	Lepomis cyanellus	3
HIW	2	Peachtree Cr	US 64	Cherokee	350439	835828	06/15/04	2004-85	Lepomis macrochirus	13
HIW	2	Peachtree Cr	US 64	Cherokee	350439	835828	06/15/04	2004-85	Semotilus atromaculatus	6
HIW	2	Peachtree Cr	US 64	Cherokee	350439	835828	06/15/04	2004-85	Cyprinella galactura	4
HIW	2	Peachtree Cr	US 64	Cherokee	350439	835828	06/15/04	2004-85	Campostoma anomalum	45
HIW	2	Peachtree Cr	US 64	Cherokee	350439	835828	06/15/04	2004-85	Etheostoma rufilineatum	27
HIW	2	Peachtree Cr	US 64	Cherokee	350439	835828	06/15/04	2004-85	Hybopsis amblops	4
HIW	2	Peachtree Cr	US 64	Cherokee	350439	835828	06/15/04	2004-85	Notropis leuciodus	77
HIW	2	Peachtree Cr	US 64	Cherokee	350439	835828	06/15/04	2004-85	Moxostoma erythrurum	1
HIW	2	Peachtree Cr	US 64	Cherokee	350439	835828	06/15/04	2004-85	Etheostoma zonale	4
HIW	2	Peachtree Cr	US 64	Cherokee	350439	835828	06/15/04	2004-85	Percina evides	2
HIW	2	Peachtree Cr	US 64	Cherokee	350439	835828	06/15/04	2004-85	Etheostoma blennioides	3
HIW	2	Peachtree Cr	US 64	Cherokee	350439	835828	06/15/04	2004-85	Ichthyomyzon greeleyi	9

Appendix 2: DWQ Benthic macroinvertebrate raw data

Waterbody	Location	Date	Sample Type	Width	Depth	Total Taxa	Tot Intol Taxa	Intol Tax Abundance	Bioclass	BioticIndex	Boulder	Rubble	Gravel	Sand	Silt	Canopy
HIWASSEE R	US 64	8/10/1999	Full Scale	50	0.6	73	36	227	Good	4.4236	60	20	10	10	0	0
HIWASSEE R	US 64	8/8/1990	Full Scale	50	1.1	79	38	188	Good	4.4334	60	20	10	10	0	1
HIWASSEE R	US 64	8/6/1987	Full Scale	60	0.6	78	35	145	Good	4.7702	45	15	15	25	0	1
HIWASSEE R	US 64	7/22/1986	Full Scale	50	2	65	32	134	Good-Fair	4.9719	50	10	0	40	0	2
HIWASSEE R	US 64	8/7/1985	Full Scale	30	1	56	25	133	Good	4.4902	40	10	10	40	0	3
HIWASSEE R	US 64	8/20/1984	Full Scale	30	1	67	29	128	Good	4.6071	20	20	20	40	0	5
HIWASSEE R	US 64	8/15/1983	Full Scale	30	1	62	23	139	Good-Fair	4.7718	40	20	10	30	0	1
MARTIN CR	SR 1558	8/18/2004	EPT	6	0.4	30	30	161	Good	3.1489	20	30	20	10	20	90
PEACHTREE CR	SR 1537	8/10/1999	EPT	5	0.2	38	38	172	Excellent	2.9148	20	40	20	20	0	0
PEACHTREE CR	SR 1537	7/12/1994	EPT	5	0.3	37	37	146	Excellent	2.4202	20	30	20	30	0	0

Appendix 3: Summary of available AMS data by station

	H1 (Hiwassee nr Brasstown)			H3 (Hiwassee nr Murphy)		
Parameter	**N**	**Min date**	**Max date**	**N**	**Min date**	**Max date**
Acidity mineral (mg/L)	2	04/1976	05/1976	.	.	.
Acidity total as CaCO3 (mg/L)	2	04/1976	05/1976	.	.	.
Air temperature (°C)	.	.	.	210	05/1981	04/2005
Alkalinity phenolphthalein (mg/L)	54	11/1973	09/1980	5	06/1973	12/1988
Alkalinity total as CaCO3 (mg/L)	76	11/1973	03/1981	78	06/1973	06/1990
Alkalinity total as CaCO3- field (mg/L)	3	09/1980	03/1981	91	04/1981	10/1993
Aluminum Al - Total (ug/L)	.	.	.	103	09/1985	04/2005
Aluminum Al mud dry wt. (mg/kg)	.	.	.	1	08/1985	08/1985
Ammonia nitrogen (mg/L)	45	10/1974	03/1981	130	06/1981	04/2005
Arsenic As total (ug/L)	21	05/1974	12/1980	138	06/1981	04/2005
Arsenic sediment dry wt. (mg/kg)	.	.	.	2	11/1984	08/1985
Beryllium Be total (ug/L)	.	.	.	2	12/1989	03/1993
BOD 5 day (mg/L)	78	11/1973	03/1981	78	04/1981	06/1993
CALCIUM CA-TOT MG/L	4	01/1977	02/1978	1	12/1989	12/1989
CO3 ALK CACO3 MG/L	1	09/1980	09/1980	.	.	.
COD high level (mg/L)	74	02/1974	03/1981	1	04/1981	04/1981
COD low level (mg/L)	2	11/1973	12/1973	18	05/1981	11/1984
Cadmium Cd total (ug/L)	22	05/1974	03/1981	138	06/1981	04/2005
CD MUD DRY WGT MG/KG-CD	.	.	.	2	11/1984	08/1985
Chloride Total (mg/L)	.	.	.	62	04/1994	05/2000
Chromium Cr total (ug/L)	22	05/1974	03/1981	138	06/1981	04/2005
Chromium sediment (mg/kg dry wt.)	.	.	.	2	11/1984	08/1985
Cloud cover (%)	81	11/1973	03/1981	214	06/1973	04/2005
Cobalt Co total (ug/L)	22	05/1974	03/1981	4	06/1981	03/1993
Conductivity field (umho/cm at 25°C)	.	.	.	202	06/1981	04/2005
Conductivity lab (umho/cm at 25ºC)	44	05/1974	03/1981	7	02/1975	12/1989
Copper Cu total (ug/L)	22	05/1974	03/1981	138	06/1981	04/2005
Copper sediment (mg/kg dry wt.)	.	.	.	2	11/1984	08/1985
Dead fish severity	58	11/1973	03/1981	71	06/1973	11/1986
Detergent suds severity (scale 1-5)	58	11/1973	03/1981	74	06/1973	12/1997
Dissolved oxygen (mg/L)	80	11/1973	03/1981	218	06/1973	04/2005
Fecal coliform MF (colonies/100mL)	75	11/1973	03/1981	203	06/1973	04/2005
Floating debris severity	61	11/1973	03/1981	71	06/1973	11/1986
Floating sludge severity	58	11/1973	03/1981	71	06/1973	11/1986
Floating algal mat severity	.	.	.	66	05/1981	11/1986
Hardness CaCO3 total (mg/L)	.	.	.	118	02/1983	07/2001
Horizontal sampling location (% from right bank)	79	11/1973	03/1981	139	06/1973	06/1997
Iron Fe total (ug/L)	22	05/1974	03/1981	93	06/1981	04/2005
Lithium Li total (ug/L)	.	.	.	1	12/1989	12/1989
Lead Pb total (ug/L)	22	05/1974	03/1981	138	06/1981	04/2005
Lead sediment (mg/kg dry wt.)	.	.	.	2	11/1984	08/1985
Magnesium Mg total (mg/L)	2	01/1977	05/1977	1	12/1989	12/1989
Magnesium mud dry wt. (mg/kg-mg)	.	.	.	1	08/1985	08/1985
Manganese Mn (ug/L)	22	05/1974	03/1981	26	06/1981	04/2005

Appendix 3: Summary of available AMS data by station (continued)

	H1 (Hiwassee nr Brasstown)			H3 (Hiwassee nr Murphy)		
Parameter	**N**	**Min date**	**Max date**	**N**	**Min date**	**Max date**
Mean depth of stream (ft.)	.	.	.	69	02/1983	06/1997
Mercury Hg total (ug/L)	21	05/1974	03/1981	138	06/1981	04/2005
Mercury sediment mg/kg dry wt.	.	.	.	2	11/1984	08/1985
Nickel Ni total (ug/L)	4	01/1977	12/1980	137	06/1981	04/2005
Nickel sediment (mg/kg dry wt.)	.	.	.	2	11/1984	08/1985
Nitrate/nitrite NO2+NO3 as N (mg/L)	48	05/1974	03/1981	130	06/1981	04/2005
Odor severity	58	11/1973	03/1981	71	06/1973	11/1986
Oil-Grease severity	58	11/1973	03/1981	71	06/1973	11/1986
Orthophosphate total as P (mg/L)	28	01/1977	03/1981	28	06/1981	06/1991
Orthophosphate total as PO4 (mg/L)	2	01/1975	08/1975	.	.	.
pH field (SU)	67	11/1973	03/1981	214	06/1973	03/2005
pH lab (SU)	14	01/1980	03/1981	80	04/1981	07/1996
Phenols total (ug/L)	23	08/1978	02/1981	.	.	.
Phosphorus total as P (mg/L)	48	05/1974	03/1981	131	06/1981	04/2005
Precipitation previous 24 hrs. (in.)	80	11/1973	03/1981	208	06/1973	04/2005
Reference point reading (linear ft.)	23	10/1978	03/1981	.	.	.
Residue total (mg/L)	16	05/1977	03/1981	157	10/1981	05/2000
Residue total nonfilterable (mg/L)	16	05/1977	03/1981	178	10/1981	04/2005
Residue total fixed (mg/L)	.	.	.	1	02/1982	02/1982
Residue fixed nonfilterable (mg/L)	.	.	.	1	02/1982	02/1982
Residue total volatile (mg/L)	.	.	.	1	02/1982	02/1982
Residue volatile nonfilterable (mg/L)	.	.	.	1	02/1982	02/1982
SALINITYCNDUCTVY G/L	3	05/1974	02/1977	.	.	.
Sodium Na total (mg/L)	.	.	.	1	12/1989	12/1989
Stream flow, instantaneous (CFS)	31	10/1975	03/1981	92	04/1981	09/1993
Stream flow (CFS)	12	12/1973	04/1975	.	.	.
Stream stage (ft.)	45	12/1973	03/1981	96	06/1973	09/1993
Stream width (ft.)	.	.	.	64	02/1983	12/1996
Secchi Transparency (m)	1	07/1977	07/1977	.	.	.
Silver Ag total (ug/L)	.	.	.	1	12/1989	12/1989
Stream flow severity (scale of 1-4)	81	11/1973	03/1981	216	06/1973	03/2005
Total organic carbon as C (mg/L)	7	06/1979	12/1980	.	.	.
Total coliform LES (col/100mL)	.	.	.	77	04/1994	02/2002
Total Kjeldahl nitrogen as N (mg/L)	48	05/1974	03/1981	129	06/1981	04/2005
Turbidity lab (NTU)	50	11/1973	03/1981	174	04/1981	04/2005
Turbidity severity (scale of 1-4)	79	11/1973	03/1981	171	06/1973	10/2000
Water temperature (°C)	81	11/1973	03/1981	219	06/1973	04/2005
Wind Velocity (mph)	.	.	.	125	02/1987	03/2005
Wind direction from North (°)	65	11/1973	12/1980	109	06/1973	04/2005
Wind force (Beaufort scale)	79	11/1973	03/1981	70	06/1973	11/1986
Zinc Zn total (ug/L)	22	05/1974	03/1981	138	06/1981	04/2005
Zinc sediment (mg/kg dry wt.)	.	.	.	2	11/1984	08/1985

Appendix 4: Summary of groundwater incidences in LWP watershed

APS Incident #	Incident Location/ Name	Address	Latitude (DD)	Longitude (DD)	Submit Date	GW Contam.?	Wells Affected?	Current status[1]	Description of Incident
385	Litton-Clifton Precision Products (aka Moog)	P.O. Box 160, Murphy	35.0949	-83.9463	8/18/04	Y	Y	RE	Interim Cap Only With Remediation System Pnt Vapor Enhanced - CERCLA
3371	Tri-County Community College	US 64, Murphy	35.067	-83.9655	7/28/04	Y	Y	RE	Note: T103D,G,C,H The Source Of The TCE Contamination Appears To Be The Septic Tank Sand Filter System. Apparently TCE Had Been Disposed In The Lab & Bathroom Drains.
988	Emerson Electric	2004 US 64E	35.0743	-83.9658	7/28/04	NOD	Y	CO	
18234	Three Sisters Citgo	Hwy 64	35.0764	-83.9714	1/25/01	Y	N	FU	Above ground tanks

[1] Key to Incident Phase Codes: RE = Response; FU = Follow-up; UK = Unknown; CO = Closed out

Appendix F

Water Quality Monitoring Plan

Appendix F

Water Quality Monitoring Plan

The NC Division of Water Quality (NCDWQ) is currently developing a plan for additional water quality monitoring to be conducted in support of Phase 2 of the Peachtree-Martin's Creek Local Watershed Plan. A draft of this plan is not yet available. An initial proposal for site locations and the types of monitoring to be conducted is summarized in Table 1. The details of the plan will be finalized by NCDWQ in consultation with the NC Ecosystem Enhancement Program and Equinox Environmental.

Table 1. Proposed Monitoring Locations in the Peachtree-Martin's Creek Project Area

Stream	Crossing	Lat.	Long.	Parameter*			
				Benthos	Fish	Nutrients, Fecal Coliform	Metals, Organic Chemicals, Toxicity Bioassay
Martins Cr	Harshaw Rd (SR 1558)	35 04 31	84 01 14	X			
Martins Cr	Crisp Rd (SR 1576)	35 03 12	84 01 28	X	X	X	
UT Martins Cr	Crisp Rd (SR 1576)	35 02 51	84 01 52			X	
UT Hiwassee R	SR 1303 Clay Co	35 04 01	83 55 31				X
Calhoun Br	Mission Rd (SR 1537)	35 04 19	83 55 48	X		X	
Hampton Cr	SR 1560	35 03 52	84 00 21	X		X	
Mc Comb Br	McComb Rd (SR 1549)	35 04 05	83 58 14	X			X
Peachtree Cr	US 64	35 04 40	83 58 28	X			X
Peachtree Cr	NC 141	35 05 17	83 56 48			X	
Peachtree Cr	Mission Rd (SR 1537)	35 05 23	83 55 50		X		
Messer Br	Hendrix Rd (SR 1531)	35 06 05	83 57 12	X		X	
Slow Cr	Peachtree Rd	35 05 33	83 57 21	X	X	X	
Slow Cr	Arrowood Mill Rd	35 06 39	83 56 26	X			

* Field parameters (water temperature, dissolved oxygen, pH and specific conductance) will be measured during all sampling events. Aquatic habitat will be assessed as a part of fish and benthic community monitoring.

Benthic and fish community monitoring will be conducted using standard NCDWQ protocols (NCDWQ 2001 and 2003a). Water temperature, dissolved oxygen, pH and specific conductance will be measured *in situ* using appropriate field instrumentation. Samples for other parameters will be submitted to the DWQ Laboratory Section for analysis. Chemical/physical monitoring will be conducted according to the procedures described in the Intensive Survey Unit's Standard Operating Procedures (SOP) manual (NCDWQ 2003b) and the DWQ Laboratory Section's sample submission guidance (NCDWQ, 2002). Current sample preservation requirements are available on-line at http://www.esb.enr.state.nc.us/lab/qa/collpreswq.htm

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