TOTAL MAXIMUM DAILY LOAD (TMDL)

For

Siltation and/or Habitat Alteration

In The

Watauga River Watershed (HUC 06010103)

Carter, Johnson, Sullivan, Unicoi, and Washington Counties, Tennessee

FINAL

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LIST OF ABBREVIATIONS

ARS	Agricultural Research Station
BMP	Best Management Practices
CFR	Code of Federal Regulations
DEM	Digital Elevation Model
EFO	Environmental Field Office
GIS	Geographic Information System
HUC	Hydrologic Unit Code
LA	Load Allocation
MGD	Million Gallons per Day
MOS	Margin of Safety
MRLC	Multi-Resolution Land Characteristic
MS4	Municipal Separate Storm Sewer System
NED	National Elevation Dataset
NHD	National Hydrography Dataset
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
NSL	National Sediment Laboratory
RM	River Mile
RMCF	Ready Mixed Concrete Facility
SSURGO	Soil Survey Geographic Database
STATSGO	State Soil and Geographic Database
STP	Sewage Treatment Plant
SWMP	Storm Water Management Plan
SWPPP	Storm Water Pollution Prevention Plan
TDA	Tennessee Department of Agriculture
TDEC	Tennessee Department of Environment & Conservation
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
USLE	Universal Soil Loss Equation
WCS	Watershed Characterization System
WLA	Waste Load Allocation
WWTF	Wastewater Treatment Facility

SUMMARY SHEET

WATAUGA RIVER WATERSHED (HUC 06010103)

Total Maximum Daily Load for Siltation/Habitat Alteration in Waterbodies Identified on the State of Tennessee's *2004 303(d) List*

Impaired Waterbody Information:

State: Tennessee
Counties: Carter, Johnson, Sullivan, Unicoi, and Washington
Watershed: Watauga River (HUC 06010103)
Watershed Area: 664.9 mi^2
Constituent of Concern: Siltation/Habitat Alteration
Impaired Waterbodies: *2004 303(d) List*

Waterbody ID	Impaired Waterbody	RM
06010103006_0100	Carroll Creek	4.3
06010103006_1000	Boones Creek	19.31
06010103008_0200	Campbell Branch	3.0
06010103008_0400	Davis Branch	5.9
06010103008_0800	Gap Branch	15.93
06010103009_1000	Brush Creek	20.3
06010103013_0300	Hampton Creek	6.2
06010103020T_0200	Sink Creek	2.0
06010103034_0300	Town Creek	3.0
06010103034_0310	Goose Creek	15.4
06010103034_0320	Furnace Creek	15.51
06010103034_1000	Roan Creek	6.8
06010103034_2000	Roan Creek	6.0
06010103061_1000	Reedy Creek	10.7
06010103635_0100	Cash Hollow Creek	3.48
06010103635_0200	Cobb Creek	4.5
06010103635_1000	Knob Creek	12.13

Designated Uses:	Fish & aquatic life, irrigation, livestock watering & wildlife, and recreation. Some waterbodies in watershed also classified for domestic and/or industrial water supply.
Applicable Water Quality Standard:	Most stringent narrative criteria applicable to fish & aquatic life use classification.
Biological Integrity:	The waters shall not be modified through the addition of pollutants or through physical alteration to the extent that the diversity and/or productivity of aquatic biota within the receiving waters are substantially decreased or adversely affected, except as allowed under 1200-4-3-.06.

Interpretation of this provision for any stream which (a) has at least 80% of the upstream catchment area contained within a single bioregion, (b) is of the appropriate stream order specified for the bioregion, and (c) contains the habitat (riffle or rooted bank) specified for the bioregion, may be made using the most current revision of the Department's Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys and/or other scientifically defensible methods.

Interpretation of this provision for all other streams, plus large rivers, reservoirs, and wetlands, may be made using Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers (EPA/841-B-99-002) and/or other scientifically defensible methods. Effects to biological populations will be measured by comparisons to upstream conditions or to appropriately selected reference sites in the same bioregion if upstream conditions are determined to be degraded.

Habitat: The quality of instream habitat shall provide for the development of a diverse aquatic community that meets regionally based biological integrity goals. The instream habitat within each subecoregion shall be generally similar to that found at reference streams. However, streams shall not be assessed as impacted by habitat loss if it has been demonstrated that the biological integrity goal has been met.

TMDL Development

General Analysis Methodology:

- Analysis performed using the Watershed Characterization System Sediment Tool (based on Universal Soil Loss Equation) applied to impaired HUC-12 subwatershed areas to calculate existing sediment loads.
- Target sediment loads (lbs/acre/year) are based on the average annual sediment load from biologically healthy watersheds (Level IV Ecoregion reference sites).
- TMDLs are expressed as the percent reduction in average annual sediment load required for a subwatershed containing impaired waterbodies relative to the appropriate target load.
- 5% of subwatershed target loads are reserved to account for WLAs for RMCFs and regulated mining sites. Most loading from these sources is small compared to total loading.

- Since the TSS component of STP discharges is generally composed of primarily organic material and is considered to be different in nature than the sediments produced from erosional processes, TSS discharges from STPs were not considered in the TMDL analysis (ref.: Sections 3.0 and 6.0).

- WLAs for Municipal Separate Storm Sewer Systems (MS4s), WLAs for NPDES regulated construction storm water discharges, and LAs for nonpoint sources are expressed as the percent reduction in average annual sediment load required for a subwatershed containing impaired waterbodies relative to the appropriate reduced target load (target load minus 5% reserved WLAs for RMCFs and mining sites).

Critical Conditions: Methodology takes into account all flow conditions.

Seasonal Variation: Methodology addresses all seasons.

Margin of Safety (MOS): Implicit (conservative modeling assumptions).

TMDL/Allocations

TMDLs, WLAs for MS4s and Construction Storm Water Sites, and LAs for Nonpoint Sources:

HUC-12 Subwatershed (06010103___)	Waterbody ID	Waterbody	Level IV Ecoregion	TMDL (Required Overall Load Reduction)	Required Load Reduction	
					WLA (MS4s and Construction SW)	LA (Nonpoint Sources)
				[%]	[%]	[%]
0101	06010103034_2000	Roan Creek	66d	94.5	94.8	94.8
0102	06010103034_0310	Goose Creek	66e	87.6	88.3	88.3
	06010103034_0320	Furnace Creek				
0103	06010103034_1000	Roan Creek		82.4	83.3	83.3
	06010103034_2000	Roan Creek				
0206	06010103020T_0200	Sink Creek		50.4	52.9	52.9
0402	06010103013_0300	Hampton Creek	66d	79.7	80.7	80.7
0501	06010103008_0200	Campbell Branch	66e	79.2	80.2	80.2
	06010103008_0400	Davis Branch				
	06010103008_0800	Gap Branch				
0505	06010103009_1000	Brush Creek	67f	63.2	65.0	65.0
0506	06010103006_0100	Carroll Creek		18.0	22.1	22.1
	06010103061_1000	Reedy Creek				
0507	06010103635_0100	Cash Hollow Creek		90.7	91.2	91.2
	06010103635_0200	Cobb Creek				
	06010103635_1000	Knob Creek				
0508	06010103006_1000	Boones Creek		30.6	34.1	34.1

Note: Calculations were conducted for all HUC-12 subwatersheds containing waterbodies identified as impaired for siltation/habitat alteration. Some impaired waterbodies extend across more than one HUC-12 subwatershed.

WLAs for Mining Sites and RMCFs:

WLAs for NPDES regulated mining sites and RMCFs located in impaired subwatersheds are equal to existing permit limits for total suspended solids (TSS).

RMCFs Permitted to Discharge TSS and Located in Impaired Subwatersheds

HUC-12 Subwatershed (06010103___)	NPDES Permit No.	Facility Name	TSS Daily Max Limit	TSS Cut-off Conc. (SW Discharge)
			[mg/l]	[mg/l]
0101	TNG110197	Chandler Concrete	50	200
0505	TNG110162	Summers Taylor Concrete		
	TNG110163	Transit-Mix Concrete		
0506	TNG110298	Boones Creek Concrete		

Mining Sites Permitted to Discharge TSS and Located in Impaired Subwatersheds

HUC-12 Subwatershed (06010103___)	NPDES Permit No.	Name	TSS Daily Max Limit
			[mg/l]
0101	TN0066192	Maymead, Inc.	40
	TN0066206	Maymead, Inc.	
0102	TN0071463	Mountain City Stone, Inc.	
0103	TN0071315	S & S Paving & Material, Inc.	
	TN0072672	Appalachian Aggregates, Inc.	
0501	TN0001775	American Limestone Company, Inc.	
	TN0068977	American Limestone Company, Inc.	
0505	TN0066401	General Shale Products, LLC	
	TN0071404	General Shale Products, LLC	
	TN0071412	General Shale Products, LLC	
0507	TN0071471	General Shale Products, LLC	

TOTAL MAXIMUM DAILY LOAD (TMDL) FOR SILTATION/HABITAT ALTERATION WATAUGA RIVER WATERSHED (HUC 06010103)

1.0 INTRODUCTION

Section 303(d) of the Clean Water Act requires each state to list those waters within its boundaries for which technology based effluent limitations are not stringent enough to protect any water quality standard applicable to such waters. Listed waters are prioritized with respect to designated use classifications and the severity of pollution. In accordance with this prioritization, states are required to develop Total Maximum Daily Loads (TMDLs) for those water bodies that are not attaining water quality standards. State water quality standards consist of designated use(s) for individual waterbodies, appropriate numeric and narrative water quality criteria protective of the designated uses and an antidegradation statement. The TMDL process establishes the maximum allowable loadings of pollutants for a waterbody that will allow the waterbody to maintain water quality standards. The TMDL may then be used to develop controls for reducing pollution from both point and nonpoint sources in order to restore and maintain the quality of water resources (USEPA, 1991).

2.0 WATERSHED DESCRIPTION

The Watauga River Watershed (HUC 06010103) is located in North Carolina and East Tennessee (ref.: Figure 1). The Tennessee portion includes parts of Carter, Johnson, Sullivan, Unicoi, and Washington Counties. The Watauga River Watershed lies within two Level III ecoregions (Blue Ridge Mountains and Ridge and Valley) and contains five Level IV subecoregions as shown in Figure 2 (USEPA, 1997):

- Southern Igneous Ridges and Mountains (66d) occur in Tennessee's northeastern Blue Ridge near the North Carolina border, primarily on Precambrian-age igneous and high-grade metamorphic rocks. The typical crystalline rock types include granite, gneiss, schist, and metavolcanics, covered by well-drained, acidic brown loamy soils. Elevations of this rough, dissected region range from 2,000-6,200 feet, with Roan Mountain reaching 6,286 feet. Although there are a few small areas of pasture and apple orchards, the region is mostly forested; Appalachian oak and northern hardwood forests predominate.

- Southern Sedimentary Ridges (66e) include some of the westernmost foothill areas of the Blue Ridge Mountains ecoregion, such as the Bean, Starr, Chilhowee, English, Stone, Bald, and Iron Mountain areas. Slopes are steep, and elevations are generally 1,000-4,500 feet. The rocks are primarily Cambrian-age sedimentary (shale, sandstone, siltstone, quartzite, conglomerate), although some lower stream reaches occur on limestone. Soils are predominantly friable loams and fine sandy loams with variable amounts of sandstone rock fragments, and support mostly mixed oak and oak-pine forests.

- Limestone Valleys and Coves (66f) are small but distinct lowland areas of the Blue Ridge, with elevations mostly between 1,500 and 2,500 feet. About 450 million years ago, older Blue Ridge rocks to the east were forced up and over younger rocks to the west. In places, the Precambrian rocks have eroded through to Cambrian or Ordovician-age limestones, as seen especially in isolated, deep cove areas that are surrounded by steep mountains. The main areas of limestone include the Mountain City lowland area and Shady Valley in the north; and

Wear Cove, Tuckaleechee Cove, and Cades Cove of the Great Smoky Mountains in the south. Hay and pasture, with some tobacco patches on small farms, are typical land uses.

- Southern Limestone/Dolomite Valleys and Low Rolling Hills (67f) form a heterogeneous region composed predominantly of limestone and cherty dolomite. Landforms are mostly low rolling ridges and valleys, and the soils vary in their productivity. Landcover includes intensive agriculture, urban and industrial, or areas of thick forest. White oak forests, bottomland oak forest, and sycamore-ash-elm riparian forest are the common forest types, and grassland barrens intermixed with cedar-pine glades also occur here.

- Southern Shale Valleys (67g) consist of lowlands, rolling valleys, and slopes and hilly areas that are dominated by shale materials. The northern areas are associated with Ordovician-age calcareous shale, and the well-drained soils are often slightly acid to neutral. In the south, the shale valleys are associated with Cambrian-age shales that contain some narrow bands of limestone, but the soils tend to be strongly acid. Small farms and rural residences subdivide the land. The steeper slopes are used for pasture or have reverted to brush and forested land, while small fields of hay, corn, tobacco, and garden crops are grown on the foot slopes and bottom land.

Figure 1 Location of the Watauga River Watershed

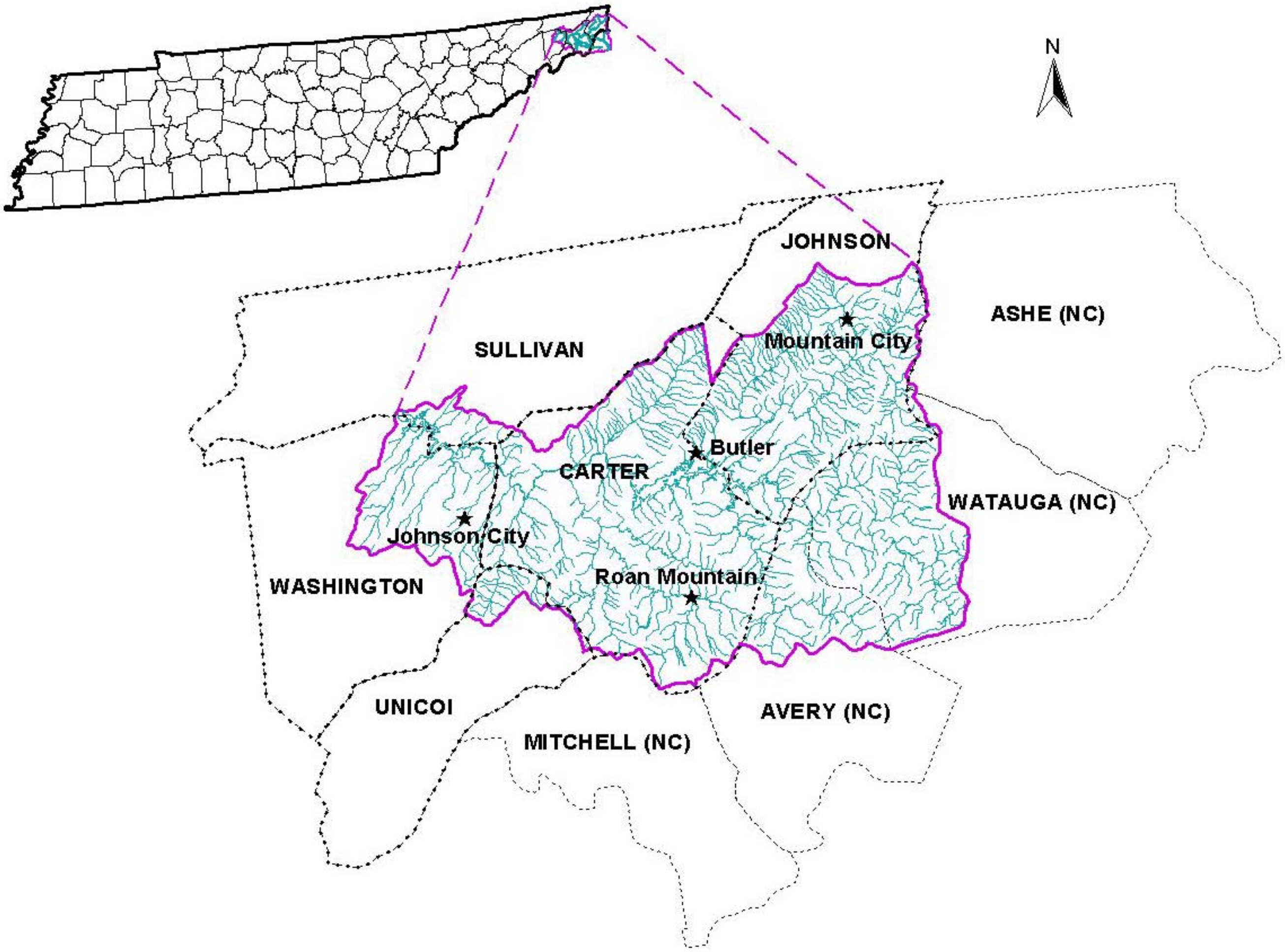
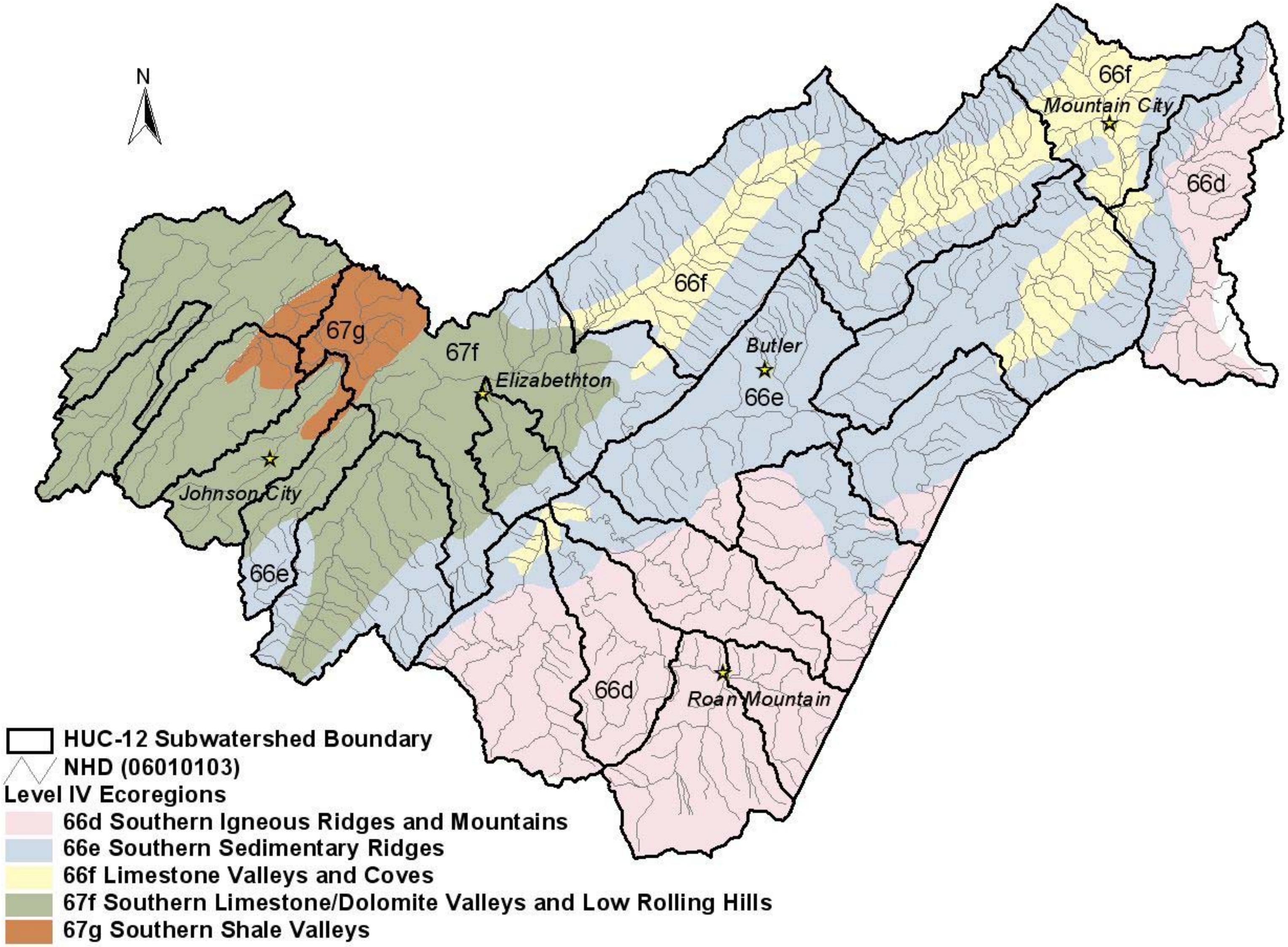


Figure 2 Level IV Ecoregions in the Watauga River Watershed



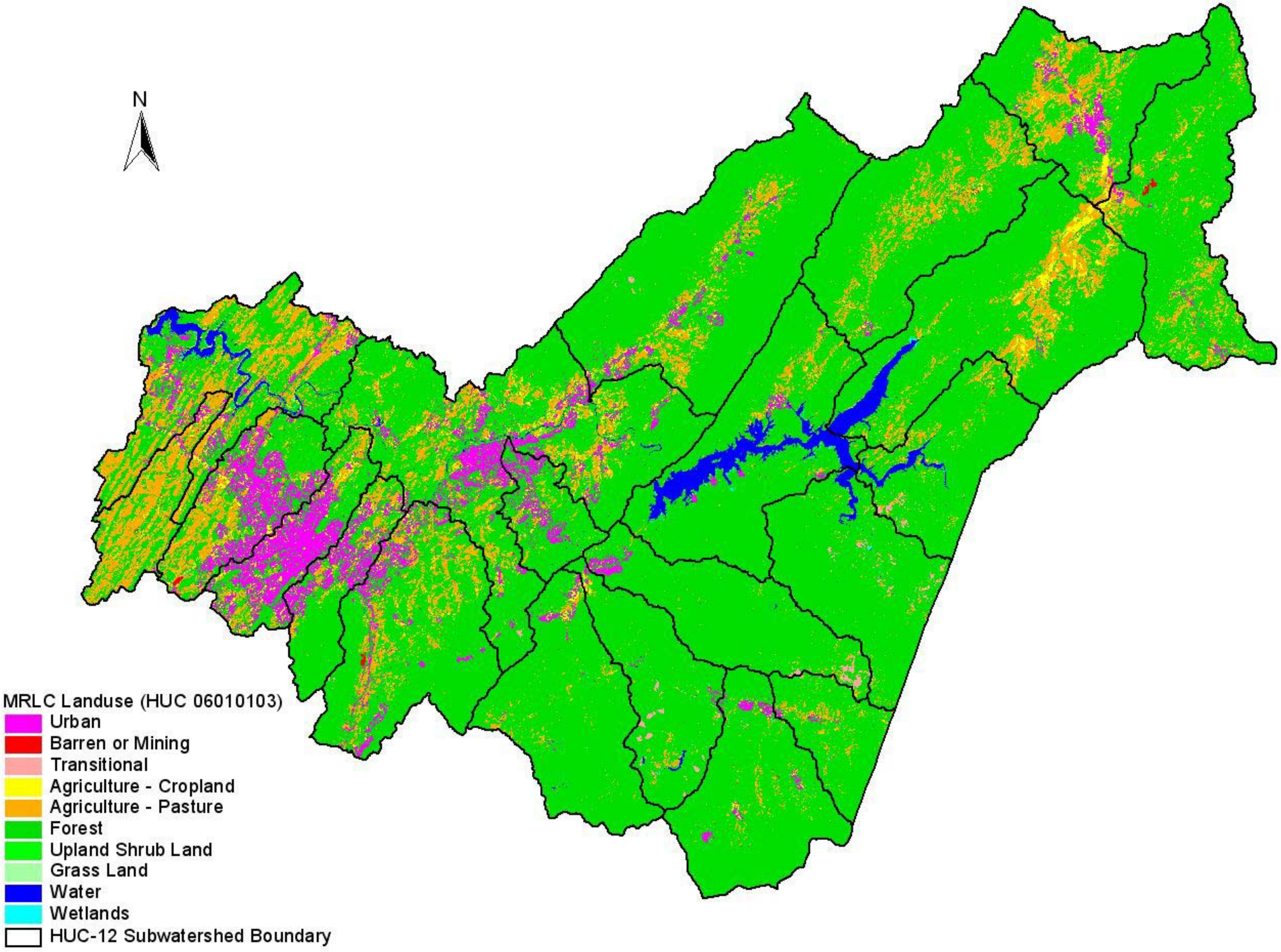
The Watauga River Watershed, designated the Hydrologic Unit Code (HUC) 06010103 by the USGS, drains approximately 816 square miles, of which 665 square miles are in Tennessee and drains to Boone Reservoir. Watershed land use distribution is based on the 1992 Multi-Resolution Land Characteristic (MRLC) satellite imagery databases derived from Landsat Thematic Mapper digital images from the period 1990-1993. Land use for the Watauga River Watershed is summarized in Table 1 and shown in Figure 3.

Table 1 Land Use Distribution - Watauga River Watershed

Land use	Area		
	[acres]	[mi^2]	[% of watershed]
Bare Rock/Sand/Clay	597	0.93	0.1
Deciduous Forest	182,644	285.38	42.9
Emergent Herbaceous Wetlands	137	0.21	0.0
Evergreen Forest	63,358	99.00	14.9
High Intensity Commercial/Industrial/Transportation	4,829	7.55	1.1
High Intensity Residential	2,074	3.24	0.5
Low Intensity Residential	15,063	23.54	3.5
Mixed Forest	94,773	148.08	22.3
Open Water	7,734	12.08	1.8
Other Grasses (Urban/Recreational)	2,755	4.30	0.6
Pasture/Hay	41,562	64.94	9.8
Quarries/Strip Mines/Gravel Pits	141	0.22	0.0
Row Crops	8,144	12.73	1.9
Transitional	1,255	1.96	0.3
Woody Wetlands	483	0.75	0.1
Total	**425,555**	**664.93**	**100.0**

Note: A spreadsheet was used for this calculation and values are approximate due to rounding.

Figure 3 MRLC Land Use in the Watauga River Watershed



3.0 PROBLEM DEFINITION

The State of Tennessee's *2004 303(d) List* (TDEC, 2005) identified a number of waterbodies in the Watauga River watershed as not fully supporting designated use classifications due, in part, to siltation and/or habitat alteration associated with agriculture, urban runoff, land development, and bank modification. These waterbodies are summarized in Table 2 and shown in Figure 4. The designated use classifications for the Watauga River and its tributaries include fish & aquatic life, irrigation, livestock watering & wildlife, and recreation. Some waterbodies in the watershed are also classified for industrial water supply and/or domestic water supply.

A description of the stream assessment process in Tennessee can be found in *2004 305(b) Report, The Status of Water Quality in Tennessee* (TDEC, 2004a). This document states that "biological surveys using macroinvertebrates as the indicator organisms are the preferred method for assessing support of the fish & aquatic life designated use." The waterbody segments listed in Table 2 were assessed as impaired based primarily on biological surveys. The results of these assessment surveys are summarized in Table 3. The assessment information presented is excerpted from the EPA/TDEC Assessment Database (ADB) and is referenced to the waterbody IDs in Table 2. Assessment Database information may be accessed at:

http://gwidc.memphis.edu/website/dwpc/

A typical example of a stream assessment (Campbell Branch at RM 0.6) is shown in Appendix A.

Siltation is the process by which sediments are transported by moving water and deposited on the bottom of stream, river, and lakebeds. Sediment is created by the weathering of host rock and delivered to stream channels through various erosional processes, including sheetwash, gully and rill erosion, wind, landslides, dry gravel, and human excavation. In addition, sediments are often produced as a result of stream channel and bank erosion and channel disturbance. Movement of eroded sediments downslope from their points of origin into stream channels and through stream systems is influenced by multiple interacting factors (USEPA, 1999).

Siltation (sedimentation) is the most frequently cited cause of waterbody impairment in Tennessee, impacting over 5,743 miles of streams and rivers (TDEC, 2004a). Unlike many chemical pollutants, sediments are typically present in waterbodies in natural or background amounts and are essential to normal ecological function. Excessive sediment loading, however, is a major ecosystem stressor that can adversely impact biota, either directly or through changes to physical habitat.

Excessive sediment loading has a number of adverse effects on fish & aquatic life in surface waters. As stated in excerpts from *Developing Water Quality Criteria for Suspended and Bedded Sediments (SABS) – Draft* (USEPA, 2003):

> In streams and rivers, fine inorganic sediments, especially silts and clays, affect the habitat for macroinvertebrates and fish spawning, as well as fish rearing and feeding behavior. Larger sands and gravels can scour diatoms and cause burying of invertebrates, whereas suspended sediment affects the light available for photosynthesis by plants and visual capacity of animals.

Table 2 ***2004 303(d) List*** **- Stream Impairment Due to Siltation/Habitat Alteration in the Watauga River Watershed**

Waterbody ID	Waterbody	Miles/ Acres	Cause (Pollutant)	Source (Pollutant)
06010103006_0100	Carroll Creek	4.3	Nitrates/Loss of biological integrity due to siltation/Habitat loss due to alteration in stream-side or littoral vegetative cover	Discharges from MS4 area Pasture Grazing
06010103006_1000	Boones Creek	19.31	Nitrates/Loss of biological integrity due to siltation/Habitat loss due to alteration in stream-side or littoral vegetative cover Escherichia coli	Discharges from MS4 area Pasture Grazing Land Development
06010103008_0200	Campbell Branch	3.0	Nitrates/Loss of biological integrity due to siltation/Habitat loss due to alteration in stream-side or littoral vegetative cover Escherichia coli	Discharges from MS4 area
06010103008_0400	Davis Branch	5.9	Habitat loss due to stream flow alteration Habitat loss due to alteration in stream-side or littoral vegetative cover	Discharges from MS4 area Upstream Impoundment
06010103008_0800	Gap Branch	15.93	Habitat loss due to alteration in stream-side or littoral vegetative cover	Discharges from MS4 area Streambank Modification
06010103009_1000	Brush Creek	20.3	Nutrients/Loss of biological integrity due to siltation/ Other Anthropogenic Habitat Alterations	Discharges from MS4 area
06010103013_0300	Hampton Creek	6.2	Physical Substrate Habitat Alterations	Channelization
06010103020T_0200	Sink Creek	2.0	Habitat loss due to alteration in stream-side or littoral vegetative cover/Nitrates Escherichia coli	Pasture Grazing
06010103034_0310	Goose Creek	15.4	Habitat loss due to alteration in stream-side or littoral vegetative cover	Land Development
06010103034_0320	Furnace Creek	15.51	Habitat loss due to alteration in stream-side or littoral vegetative cover	Channelization
06010103034_1000	Roan Creek	6.8	Loss of biological integrity due to siltation	Pasture Grazing

Table 2 (Cont.) ***2004 303(d) List*** **- Stream Impairment Due to Siltation/Habitat Alteration in the Watauga River Watershed**

Waterbody ID	Waterbody	Miles/ Acres	Cause (Pollutant)	Source (Pollutant)
06010103034_2000	Roan Creek	6.0	Nitrates/Loss of biological integrity due to siltation/Escherichia coli	Municipal Point Source Discharge/Pasture Grazing
06010103061_1000	Reedy Creek	10.7	Nitrates/Physical Substrate Habitat Alterations/Loss of biological integrity due to siltation	Discharges from MS4 area Pasture Grazing Channelization
06010103635_0100	Cash Hollow Creek	3.48	Habitat loss due to alteration in stream-side or littoral vegetative cover Escherichia coli	Discharges from MS4 area
06010103635_0200	Cobb Creek	4.5	Habitat loss due to alteration in stream-side or littoral vegetative cover Loss of biological integrity due to siltation	Discharges from MS4 area
06010103635_1000	Knob Creek	12.13	Habitat loss due to alteration in stream-side or littoral vegetative cover Nitrates/Loss of biological integrity due to siltation/Escherichia coli	Discharges from MS4 area Pasture Grazing

Figure 4 **Waterbodies Impaired Due to Siltation/Habitat Alteration (Documented on the *2004 303(d) List***

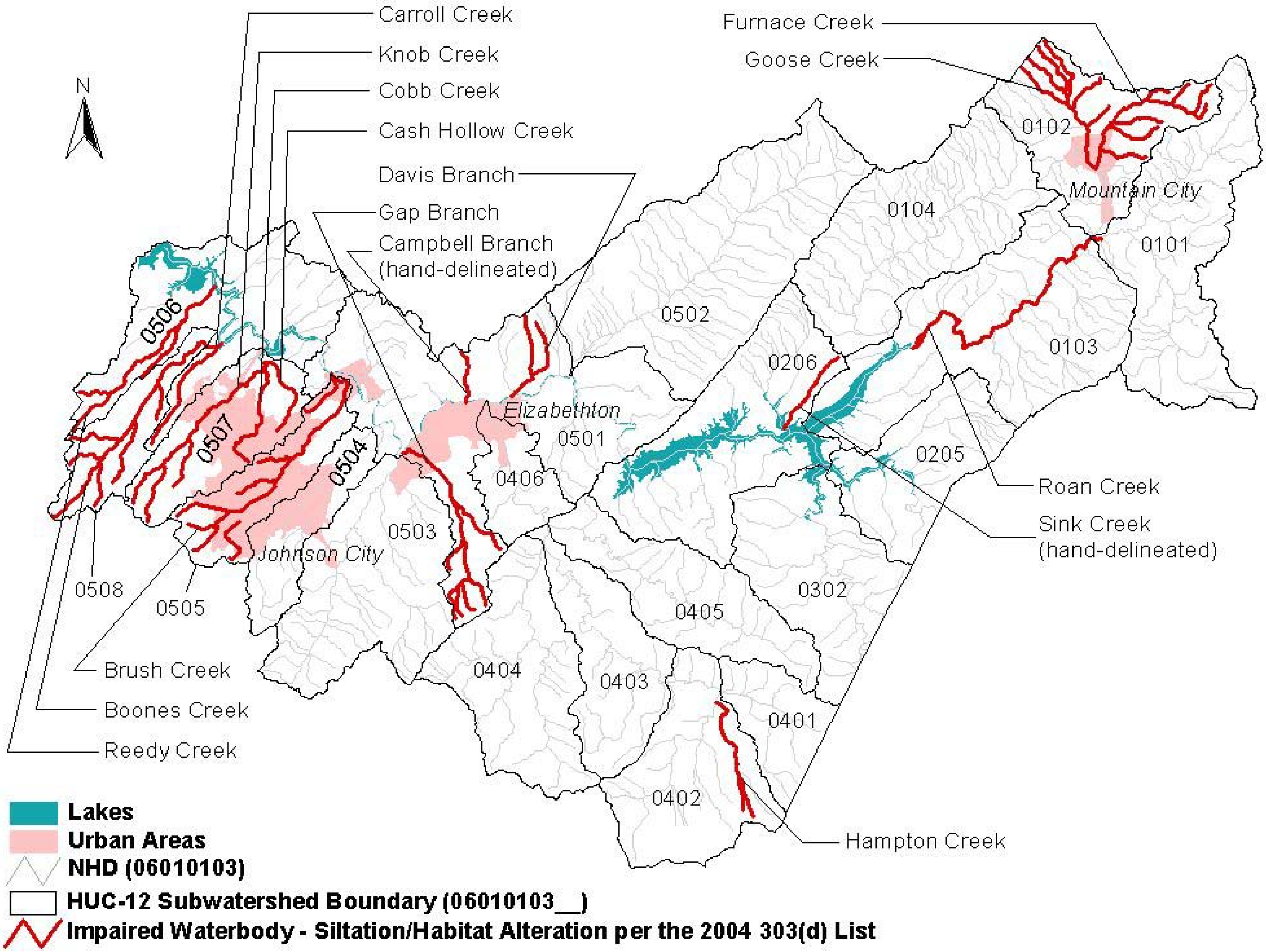


Table 3 Water Quality Assessment of Waterbodies Impaired Due to Siltation/Habitat Alteration

Waterbody ID	Waterbody	Comments
06010103006_0100	Carroll Creek (from Boones Creek to headwaters)	2001 TDEC chemical station and biorecon at mile 0.6 (Carroll Creek Road). 8 EPT genera, 5 intolerant, 21 total genera. BR score = 7. Habitat score = 118.
06010103006_1000	Boones Creek (from Boones Reservoir to headwaters)	2002 TDEC chemical stations at mile 1.7 (Bentley Condiminiums), at mile 3.7 (Christians Church Road), and at mile 7.6 (Bugaboo Springs Road). E. coli and nitrate-nitrite elevated. 2001 TDEC RBPIII survey at mile 1.7 and 3.7. At mile 1.7, 5 EPT genera, 30 total genera. Index score = 28. Fails biocriteria. Habitat score = 130. 2001 TDEC RBPIII survey at mile 3.7. 5 EPT genera, 23 total genera. Index score = 30. Fails biocriteria. Habitat score = 124. 1996? TDEC biological survey at mile 2.8 (Christians Bend Road). 4 EPT families, 24+ total families. Habitat score = 102. 1995 TVA biological survey at mile 0.7 (Flourville). 10 EPT families.
06010103008_0200	Campbell Branch (from Watauga River to headwaters)	2001 TDEC RBPIII survey and chemical station at mile 0.3 (near Biltmore). 1 EPT genera, 15 total genera. Index score = 6. Fails biocriteria. Habitat score = 108. Fecal and nitrate-nitrite elevated.
06010103008_0400	Davis Branch (from Watauga River to headwaters)	001 TDEC RBPIII survey and chemical station at mile 1.2 (SR 91). 6 EPT genera, 21 total genera. Index score = 20. Fails biocriteria. Habitat score = 126.
06010103008_0800	Gap Branch (from Watauga River to headwaters)	2002 TDEC biorecon and chemical station at mile 0.4 (SR 67, Old Elizabethton Hwy). 6 EPT genera, 2 intolerant, 9 total genera. BR score = 28. Habitat score = 115. 2001 TVA survey at Gap Creek Road. 8 EPT families, 1 intolerant, 21 total families. BR score = 9. 1995 TDEC biological survey at Southside Drive. 7 EPT families. Habitat score = 152.

Table 3 (Cont.) Water Quality Assessment of Waterbodies Impaired Due to Siltation/Habitat Alteration

Waterbody ID	Waterbody	Comments
06010103009_1000	Brush Creek (from Watauga Reservoir to headwaters)	2001 TDEC RBPIII and chemical station at mile 0.7 (SR 400). Also 2001 TDEC chemical stations at mile 4.1 (Railroad Street) and mile 7.9 (McKindley Road). 5 EPT genera, 18 total genera. Index score = 30. Fails biocriteria. Habitat score = 136. 2001 TVA survey at the airport. 4 EPT families, 1 intolerant, 22 total families. Failed biorecon criteria. 1993 TVA biological survey at mile 0.8. 1 EPT family.
06010103013_0300	Hampton Creek (from Buck Creek to headwaters)	1994 TVA biological survey at mile 0.7 (Flourville). 14 EPT families. This section channelized in 1998.
06010103020T_0200	Sink Creek (from Watauga Reservoir to headwaters)	2002 TDEC chemical station and biorecon at mile 0.7 (Sink Valley Road). 8 EPT genera, 9 intolerant, 33 total genera. BR score = 7. Habitat score = 90. Appearance of impacts may be due to low flows.
06010103034_0310	Goose Creek (from Town Creek to headwaters)	2003 TDEC RBPIII and chemical station at mile 0.3 (behind Visitors Center). 6 EPT genera, 21 total genera. Index score = 16. Failed biocriteria. Habitat score = 114. 2001 TDEC RBPIII at mile 1.3 (near subdivision). 5 EPT genera, 28 total genera. Index score = 24. Failed biocriteria. Habitat score = 101.
06010103034_0320	Furnace Creek (from Town Creek to headwaters)	2001 TDEC RBPIII and chemical station at mile 0.3 (Visitors Center). 11 EPT genera, 30 total genera. Index score = 28. Failed biocriteria. Habitat score = 120. 2001 TDEC RBPIII at mile 1.7 (SR 91). 10 EPT genera, 25 total genera. Index score = 28. Failed biocriteria. Habitat score = 115.
06010103034_1000	Roan Creek (from Watauga Reservoir to confluence of Mill Creek)	2001 TDEC chemical station at mile 7.5 (SR 167). 2001 TDEC chemical station at mile 11.6 (Big Dry Run Road). 2002 TDEC RBPIII at mile 7.5 (SR 167). 7 EPT genera, 24 total genera. Index score = 14.
06010103034_2000	Roan Creek (from Mill Creek to Lumpkin Branch)	Mountain City bypassing and permit violations into Town Creek and Roan Creek. 2001 TDEC RBPIII and chemical station at mile 16.4 (at Maymead Farms). 11 EPT genera, 28 total genera. Index score = 28. Failed biocriteria. 2001 TDEC chemical station and RBPIII at mile 17.9 (at church). 13 EPT genera, 35 total genera. Index score = 30. Passed biocriteria.

Table 3 (Cont.) Water Quality Assessment of Waterbodies Impaired Due to Siltation/Habitat Alteration

Waterbody ID	Waterbody	Comments
06010103061_1000	Reedy Creek (from Boone Reservoir to headwaters)	2003 TDEC chemical station and biorecon at mile 1.8 (White Street). 8 EPT genera, 5 intolerant, 22 total genera. BR score = 7. Habitat score = 110.
06010103635_0100	Cash Hollow Creek (from Knob Creek to headwaters)	Water contact advisory.
06010103635_0200	Cobb Creek (from Knob Creek to headwaters)	2001 TDEC chemical station and biorecon at mile 0.3 (Austin Springs Road). 8 EPT genera, 2 intolerant, 26 total genera. BR score = 7. Habitat score = 140.
06010103635_1000	Knob Creek (from Boones Reservoir to headwaters)	2002 TDEC chemical station and RBPIII at mile 1.0 (Wastewater Plant Road). 5 EPT genera, 16 total genera. Index score = 26. Failed biocriteria. Habitat score = 153. Also TDEC chemical stations at 3.7 (SR 36) and 5.8 (Knob Creek Road). Pathogens and nutrients elevated. In 2002, TDEC also assessed (RBPIII) an unnamed trib to Knob Creek (near Claude Simmons Road). At mile 0.3: 6 EPT genera, 25 total genera. Index score = 28. Failed biocriteria. Habitat score = 131. At mile 1.1 (Ranko Ridge Apts.). 6 EPT genera, 38 total genera. Index score = 24. Failed biocriteria. Habitat score = 82. At mile 1.5 (Claude Simmons Road u/s mini-storage units): 6 EPT genera, 34 total genera. Index score = 24. Failed biocriteria. Habitat score = 64.

> Sedimentation alters the structure of the invertebrate community by causing a shift in proportions from one functional group to another. Sedimentation can lead to embeddedness, which blocks critical macroinvertebrate habitat by filling in the interstices of the cobble and other hard substrate on the stream bottom. As deposited sediment increases, changes in invertebrate community structure and diversity occur.
>
> Invertebrate drift is directly affected by increased suspended sediment load in freshwater streams. These changes generally involve a shift in dominance from ephemeroptera, plecoptera and trichoptera (EPT) taxa to other less pollution-sensitive species that can cope with sedimentation. Increases in sediment deposition that affect the growth, abundance, or species composition of the periphytic (attached) algal community will also have an effect on the macroinvertebrate grazers that feed predominantly on periphyton. ……. Effects on aquatic individuals, populations, and communities are expressed through alterations in local food webs and habitat. When sedimentation exceeds certain thresholds, ensuing effects will likely involve decline of the existing aquatic invertebrate community and subsequent colonization by pioneer species.

Historically, waterbodies in Tennessee have been assessed as not fully supporting designated uses due to siltation when the impairment was determined to be the result of excess loading of the inorganic sediment produced by erosional processes. In cases where impairment was determined to be caused by excess loading of the primarily organic particulate material found in sewage treatment plant (STP) effluent, the cause of pollution was listed as total suspended solids (TSS) or organic enrichment. In consideration of this practice, this document presents the details of TMDL development for waterbodies in the Watauga River watershed listed as impaired due to siltation (excess inorganic sediment produced by erosional processes) and/or appropriate cases of habitat alteration. The TSS in STP effluent is considered to be a distinctly different pollutant and, therefore, is excluded in sediment loading calculations.

4.0 TARGET IDENTIFICATION

Several narrative criteria, applicable to siltation/habitat alteration, are established in *Rules of Tennessee Department of Environment and Conservation, Tennessee Water Quality Control Board, Division of Water Pollution Control, Chapter 1200-4-3 General Water Quality Criteria, January, 2004* (TDEC, 2004):

> Applicable to all use classifications (Fish & Aquatic Life shown):
>
> > Solids, Floating Materials, and Deposits – There shall be no distinctly visible solids, scum, foam, oily slick, or the formation of slimes, bottom deposits or sludge banks of such size and character that may be detrimental to fish & aquatic life.
> >
> > Other Pollutants – The waters shall not contain other pollutants that will be detrimental to fish or aquatic life.
>
> Applicable to the Domestic Water Supply, Industrial Water Supply, Fish & Aquatic Life, and Recreation use classifications (Fish & Aquatic Life shown):
>
> > Turbidity or Color – There shall be no turbidity or color in such amounts or of such character that will materially affect fish & aquatic life.

Applicable to the Fish & Aquatic Life use classification:

> Biological Integrity - The waters shall not be modified through the addition of pollutants or through physical alteration to the extent that the diversity and/or productivity of aquatic biota within the receiving waters are substantially decreased or adversely affected, except as allowed under 1200-4-3-.06.
>
> Interpretation of this provision for any stream which (a) has at least 80% of the upstream catchment area contained within a single bioregion and (b) is of the appropriate stream order specified for the bioregion, and (c) contains the habitat (riffle or rooted bank) specified for the bioregion, may be made using the most current revision of the Department's Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys and/or other scientifically defensible methods.
>
> Interpretation of this provision for all other streams, plus large rivers, reservoirs, and wetlands, may be made using Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers (EPA/841-B-99-002) and/or other scientifically defensible methods. Effects to biological populations will be measured by comparisons to upstream conditions or to appropriately selected reference sites in the same bioregion if upstream conditions are determined to be degraded.
>
> Habitat - The quality of instream habitat shall provide for the development of a diverse aquatic community that meets regionally based biological integrity goals. The instream habitat within each subecoregion shall be generally similar to that found at reference streams. However, streams shall not be assessed as impacted by habitat loss if it has been demonstrated that the biological integrity goal has been met.

These TMDLs are being established to attain full support of the fish & aquatic life designated use classification. TMDLs established to protect fish & aquatic life will protect all other use classifications for the identified waterbodies from adverse alteration due to sediment loading.

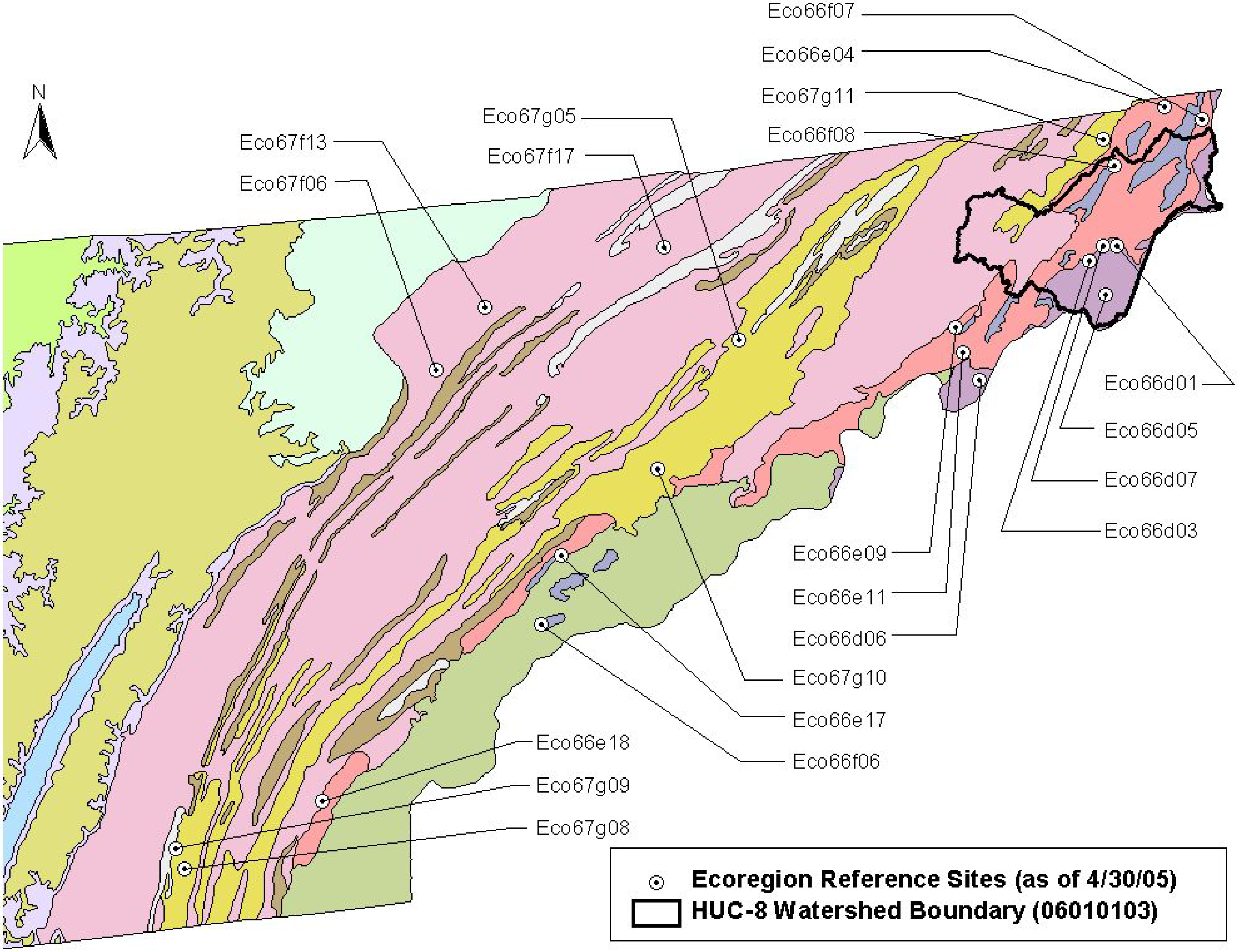
In order for a TMDL to be established, a numeric "target" protective of the uses of the water must be identified to serve as the basis for the TMDL. Where State regulation provides a numeric water quality criteria for the pollutant, the criteria is the basis for the TMDL. Where State regulation does not provide a numeric water quality criteria, as in the case of siltation/habitat alteration, a numeric interpretation of the narrative water quality standard must be determined. For the purpose of these TMDLs, the average annual sediment loading in lbs/acre/yr, from a biologically healthy watershed, located within the same Level IV ecoregion as the impaired watershed, is determined to be the appropriate numeric interpretation of the narrative water quality standard for protection of fish & aquatic life. Biologically healthy watersheds were identified from the State's ecoregion reference sites. These ecoregion reference sites have similar characteristics and conditions as the majority of streams within that ecoregion. Detailed information regarding Tennessee ecoregion reference sites can be found in *Tennessee Ecoregion Project, 1994-1999* (TDEC, 2000). In general, land use in ecoregion reference watersheds contain less pasture, cropland, and urban areas and more forested areas compared to the impaired watersheds. The biologically healthy (reference) watersheds are considered the "least impacted" in an ecoregion and, as such, sediment loading from these watersheds may serve as an appropriate target for the TMDL.

Using the methodology described in Appendix B, the Watershed Characterization System (WCS) Sediment Tool was used to calculate the average annual sediment load for each of the biologically healthy (reference) watersheds in Level IV ecoregions 66d, 66e, 66f, 67f, and 67g. The geometric mean of the average annual sediment loads of the reference watersheds in each Level IV ecoregion was selected as the most appropriate target for that ecoregion. Since the impairment of biological integrity due to sediment build-up is generally a long-term process, using an average annual load is considered appropriate. The average annual sediment loads for reference sites and corresponding TMDL target values for Level IV ecoregions 66d, 66e, 66f, 67f, and 67g are summarized in Table 4. Reference site locations are shown in Figure 5.

Table 4 Average Annual Sediment Loads of Level IV Ecoregion Reference Sites

Level 4 Ecoregion	Reference Site	Stream	Drainage Area (acres)	Average Annual Sediment Load [lbs/acre/year]
66d	Eco66d01	Black Branch	757	250.3
	Eco66d03	Laurel Fork Creek	11,164	260.4
	Eco66d05	Doe River	593	31.5
	Eco66d06	Tumbling Creek	644	19.6
	Eco66d07	Little Stony Creek	1,538	272.7
		Geometric Mean (Target Load)		**101.9**
66e	Eco66e04	Gentry Creek	2,699	151.9
	Eco66e09	Clark Creek	5,886	69.3
	Eco66e11	Lower Higgins Creek	2,189	90.0
	Eco66e17	Double Branch	1,878	135.2
	Eco66e18	Gee Creek	2,728	221.0
		Geometric Mean (Target Load)		**123.1**
66f	Eco66f06	Abrams Creek	13,857	143.8
	Eco66f07	Beaverdam Creek	29,262	265.9
	Eco66f08	Stony Creek	2,471	118.9
		Geometric Mean (Target Load)		**165.6**
67f	Eco67f06	Clear Creek	1,975	400.9
	Eco67f13	White Creek	1,724	272.4
	Eco67f17	Big War Creek	30,062	585.1
		Geometric Mean (Target Load)		**399.8**
67g	Eco67g05	Bent Creek	21,058	904.9
	Eco67g08	Brymer Creek	4,237	605.0
	Eco67g09	Harris Creek	3,054	724.5
	Eco67g10	Flat Creek	13,236	651.8
	Eco67g11	N Prong Fishdam Creek	1,019	853.2
		Geometric Mean (Target Load)		**739.1**

Figure 5 Reference Sites in Level IV Ecoregions 66d, 66e, 66f, 67f, and 67g



5.0 WATER QUALITY ASSESSMENT AND DEVIATION FROM TARGET

Using the methodology described in Appendix B, the WCS Sediment Tool was used to determine the average annual sediment load, due to precipitation-based sources, for all HUC-12 subwatersheds in the Watauga River Watershed (ref.: Figure 4). Existing precipitation-based sediment loads for subwatersheds with waterbodies identified on the *2004 303(d) List* as impaired for siltation/habitat alteration are summarized in Table 5.

Table 5 Existing Sediment Loads in Subwatersheds With Impaired Waterbodies

HUC-12 Subwatershed (06010103____)	Level IV Ecoregion	Existing Sediment Load
		[lbs/ac/yr]
0101	66d	1,857
0102	66e	997
0103		700
0206		248
0402	66d	503
0501	66e	592
0505	67f	1,086
0506		488
0507		4,294
0508		576

6.0 SOURCE ASSESSMENT

An important part of the TMDL analysis is the identification of individual sources, source categories, or source subcategories of siltation in the watershed and the amount of pollutant loading contributed by each of these sources. Under the Clean Water Act, sources are broadly classified as either point or nonpoint sources. Under 40 CFR 122.2, a point source is defined as a discernable, confined and discrete conveyance from which pollutants are or may be discharged to surface waters. The National Pollutant Discharge Elimination System (NPDES) program regulates point source discharges. Regulated point sources include: 1) municipal and industrial wastewater treatment facilities (WWTFs); 2) storm water discharges associated with industrial activity (which includes construction activities); and 3) certain discharges from Municipal Separate Storm Sewer Systems (MS4s). A TMDL must provide Waste Load Allocations (WLAs) for all NPDES regulated point sources. For the purposes of these TMDLs, all sources of sediment loading not regulated by NPDES are considered nonpoint sources. The TMDL must provide a Load Allocation (LA) for these sources.

6.1 Point Sources

6.1.1 NPDES Regulated Wastewater Treatment Facilities

As stated in Section 3.0, the TSS component of STP discharges is generally composed of primarily organic material and is considered to be different in nature than the sediments produced from erosional processes. Therefore, TSS discharges from STPs are <u>not</u> included in the TMDLs developed for this document.

6.1.2 NPDES Regulated Ready Mixed Concrete Facilities

Discharges from regulated Ready Mixed Concrete Facilities (RMCFs) may contribute sediment to surface waters as TSS discharges (TSS discharged from RMCFs is composed of primarily inorganic material and is therefore included as a source for TMDL development). Most of these facilities obtain coverage under NPDES Permit No. TNG110000, *General NPDES Permit for Discharges of Storm Water Runoff and Process Wastewater Associated With Ready Mixed Concrete Facilities* (TDEC, 2003). This permit establishes a daily maximum TSS concentration limit of 50 mg/l on process wastewater effluent and specifies monitoring procedures for storm water discharges. Facilities are also required to develop and implement storm water pollution prevention plans (SWPPPs). Discharges from RMCFs are generally intermittent, and contribute a small portion of total sediment loading to HUC-12 subwatersheds (ref.: Appendix D). In some cases, for discharges into impaired waters as documented on the *2004 303(d) List*, sites may be required to obtain coverage under an individual NPDES permit. There are four permitted RMCFs in the Watauga River Watershed as of November 8, 2005 and they are all located in impaired subwatersheds. These facilities are listed in Table 6 and shown in Figure 6.

6.1.3 NPDES Regulated Mining Sites

Discharges from regulated mining activities may contribute sediment to surface waters as TSS (TSS discharged from mining sites is composed of primarily inorganic material and is therefore included as a source for TMDL development). Discharges from active mines may result from dewatering operations and/or in response to storm events, whereas discharges from permitted inactive mines are only in response to storm events. Inactive sites with successful surface reclamation contribute relatively little solids loading. Of the fourteen permitted mining sites in the Watauga River Watershed (as of November 8, 2005), eleven are located in impaired subwatersheds. These are listed in Table 7 and shown in Figure 7. Sediment loads (as TSS) to waterbodies from mining site discharges are very small in relation to total sediment loading (ref.: Appendix D).

6.1.4 NPDES Regulated Construction Activities

Discharges from NPDES regulated construction activities are considered point sources of sediment loading to surface waters and occur in response to storm events. Currently, discharges of storm water from construction activities disturbing an area of one acre or more must be authorized by an NPDES permit. Most of these construction sites obtain coverage under NPDES Permit No. TNR10-0000, *General NPDES Permit for Storm Water Discharges Associated With Construction Activity* (TDEC, 2005a). Since construction activities at a site are of a temporary, relatively short-term nature, the number of construction sites covered by the general permit at any instant of time varies. Of the 185 permitted active construction sites in the Watauga River Watershed on November 8, 2005, 162 were in impaired subwatersheds (ref.: Figure 8).

Table 6 NPDES Regulated Ready Mixed Concrete Facilities Located in Impaired Subwatersheds (as of November 8, 2005)

HUC-12 Subwatershed (0610103__)	NPDES Permit No.	Facility Name	TSS Daily Maximum Limit	TSS Cut-off Conc.
			[mg/l]	[mg/l]
0101	TNG110197	Chandler Concrete	50	200
0505	TNG110162	Summers Taylor Concrete		
	TNG110163	Transit-Mix Concrete		
0506	TNG110298	Boones Creek Concrete		

Table 7 NPDES Regulated Mining Sites Permitted to Discharge TSS and Located in Impaired Subwatersheds (as of November 8, 2005)

HUC-12 Subwatershed (06010103__)	NPDES Permit No.	Name	TSS Daily Max Limit
			[mg/l]
0101	TN0066192	Maymead, Inc.	40
	TN0066206	Maymead, Inc.	
0102	TN0071463	Mountain City Stone, Inc.	
0103	TN0071315	S & S Paving & Material, Inc.	
	TN0072672	Appalachian Aggregates, Inc.	
0501	TN0001775	American Limestone Company, Inc.	
	TN0068977	American Limestone Company, Inc.	
0505	TN0066401	General Shale Products, LLC	
	TN0071404	General Shale Products, LLC	
	TN0071412	General Shale Products, LLC	
0507	TN0071471	General Shale Products, LLC	

Figure 6 NPDES Regulated RMCFs Located in Impaired Subwatersheds

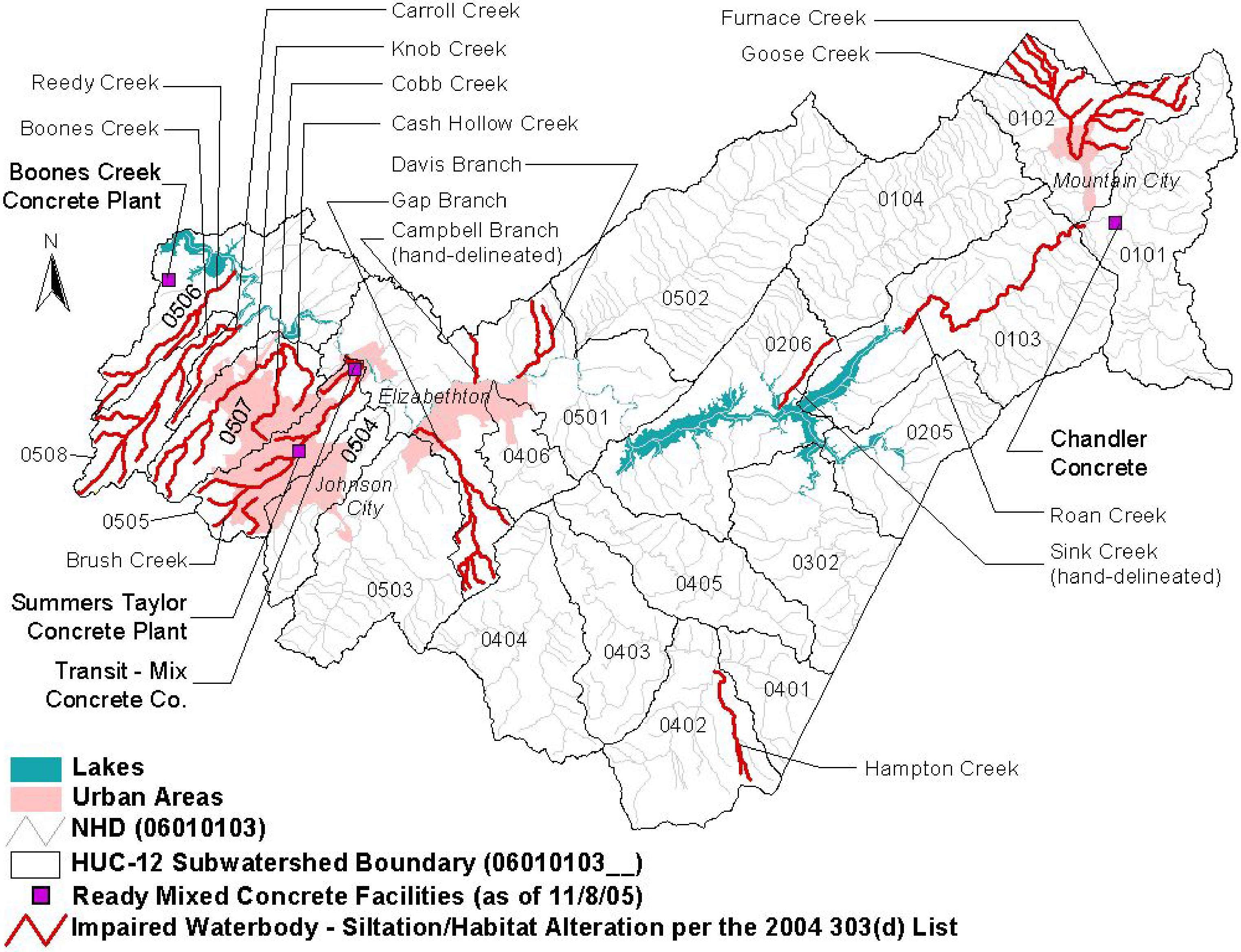


Figure 7 NPDES Regulated Mining Sites Permitted to Discharge TSS and Located in Impaired Subwatersheds

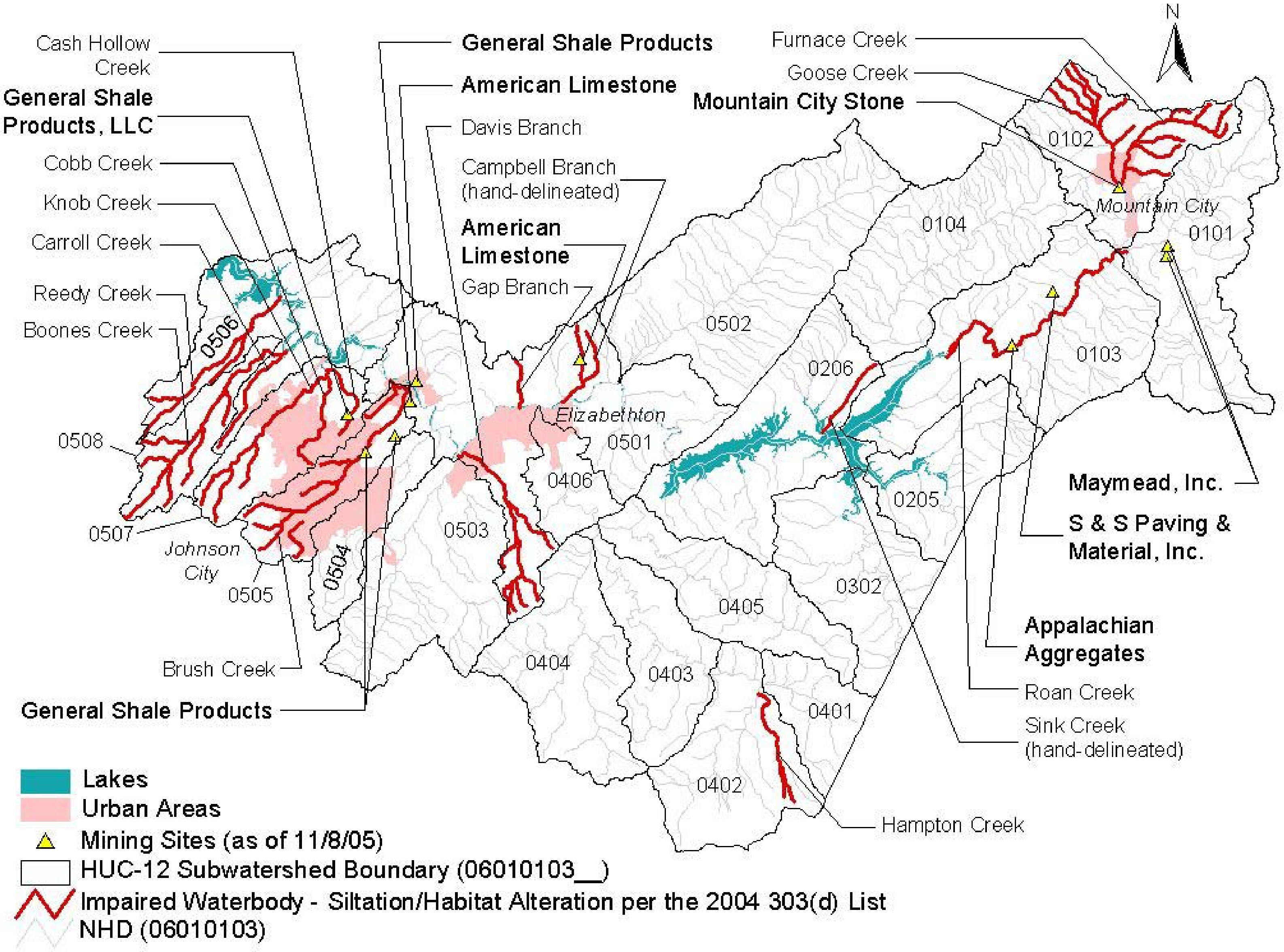
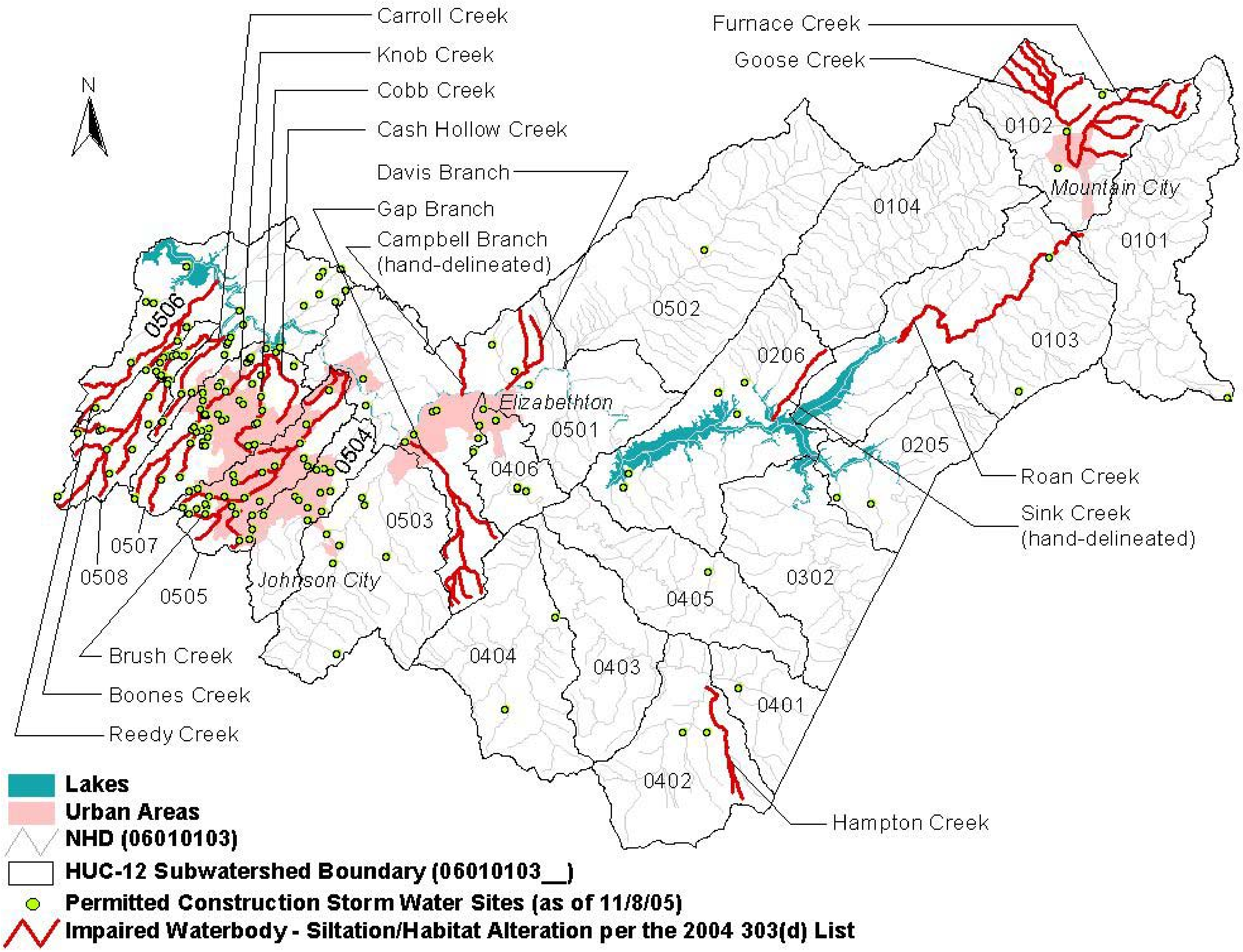


Figure 8 Location of NPDES Permitted Construction Storm Water Sites in the Watauga River Watershed



6.1.5 NPDES Regulated Municipal Separate Storm Sewer Systems (MS4s)

MS4s may discharge sediment to waterbodies in response to storm events through road drainage systems, curb and gutter systems, ditches, and storm drains. These systems convey urban runoff from surfaces such as bare soil and wash-off of accumulated street dust and litter from impervious surfaces during rain events. Large and medium MS4s serving populations greater than 100,000 people are required to obtain NPDES storm water permits. At present, there are no MS4s of this size in the Watauga River Watershed. As of March 2003, small MS4s serving urbanized areas, or having the potential to exceed instream water quality standards, are required to obtain a permit under the *NPDES General Permit for Discharges from Small Municipal Separate Storm Sewer Systems* (TDEC, 2003a). An urbanized area is defined as an entity with a residential population of at least 50,000 people and an overall population density of 1,000 people per square mile. The six permitted MS4s in the Watauga River Watershed are as follows:

NPDES Permit Number	Phase	Permittee Name
TNS075124	II	Carter County
TNS075281	II	City of Elizabethton
TNS075370	II	City of Johnson City
TNS075671	II	Sullivan County
TNS075728	II	City of Jonesborough
TNS075787	II	Washington County

The Tennessee Department of Transportation (TDOT) is also being issued an MS4 permit (TNS077585) for State roads in urban areas. Information regarding storm water permitting in Tennessee may be obtained from the TDEC website at http://www.state.tn.us/environment/wpc/stormh2o/.

6.2 Nonpoint Sources

Nonpoint sources account for the vast majority of sediment loading to surface waters. These sources include:

- Natural erosion occurring from the weathering of soils, rocks, and uncultivated land; geological abrasion; and other natural phenomena.

- Erosion from agricultural activities can be a major source of sedimentation due to the large land area involved and the land-disturbing effects of cultivation. Grazing livestock can leave areas of ground with little vegetative cover. Unconfined animals with direct access to streams can cause streambank damage.

- Urban erosion from bare soil areas under construction and washoff of accumulated street dust and litter from impervious surfaces.

- Erosion from unpaved roadways can be a significant source of sediment to rivers and streams. It occurs when soil particles are loosened and carried away from the roadway, ditch, or road bank by water, wind, or traffic. The actual road construction (including erosive road-fill soil types, shape and size of coarse surface aggregate, poor subsurface and/or surface drainage, poor road bed construction, roadway shape, and inadequate runoff discharge outlets or "turn-outs" from the roadway) may aggravate roadway erosion. In addition, external factors such as roadway shading and light exposure, traffic patterns, and road maintenance may also affect roadway erosion. Exposed soils, high runoff velocities and volumes and poor road compaction all increase the potential for erosion.

- Runoff from abandoned mines may be significant sources of solids loading. Mining activities typically involve removal of vegetation, displacement of soils, and other significant land disturbing activities.

- Soil erosion from forested land that occurs during timber harvesting and reforestation activities. Timber harvesting includes the layout of access roads, log decks, and skid trails; the construction and stabilization of these areas; and the cutting of trees. Established forest areas produce very little soil erosion.

For impaired waterbodies within the Watauga River Watershed, the primary sources of nonpoint sediment loads come from agriculture, roadways, and urban sources. The watershed land use distribution based on the 1992 MRLC satellite imagery databases is shown in Appendix C for impaired HUC-12 subwatersheds.

7.0 DEVELOPMENT OF TOTAL MAXIMUM DAILY LOAD

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and recommends regulatory or other actions to be taken to achieve compliance with applicable water quality standards based on the relationship between pollution sources and in-stream water quality conditions. A TMDL can be expressed as the sum of all point source loads (Waste Load Allocations), non-point source loads (Load Allocations) and an appropriate margin of safety (MOS) which takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$\text{TMDL} = \Sigma\ \text{WLAs} + \Sigma\ \text{LAs} + \text{MOS}$$

The objective of a TMDL is to allocate loads among all of the known pollutant sources throughout a watershed so that appropriate control measures can be implemented and water quality standards achieved. 40 CFR §130.2 (i) states that TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measure.

TMDL analyses are performed on a 12-digit hydrologic unit area (HUC-12) basis for subwatersheds containing waterbodies identified as impaired due to siltation and/or habitat alteration on the *2004 303(d) List*. HUC-12 subwatershed boundaries are shown in Figure 4.

7.1 Analysis Methodology

Sediment analysis for watersheds can be conducted using methods ranging from simple, gross estimates to complex dynamic loading and receiving water models. The choice of methodology is dependent on a number of factors that include watershed size, type of impairment, type and quantity of data available, resources available, time, and cost. In consideration of these factors, the following approach was selected as the most appropriate for first phase sediment TMDLs in the Watauga River Watershed.

Sediment loading analysis for waterbodies impaired due to siltation/habitat alteration in the Watauga River Watershed was accomplished using the Watershed Characterization System (WCS) Sediment Tool. This ArcView geographic information system (GIS) based model is described in Appendix B and was utilized according to the following procedure:

- The Watershed Characterization System (WCS) Sediment Tool was used to determine sediment loading to Level IV ecoregion reference site watersheds. These are considered to be biologically healthy watersheds. The average annual sediment loads in lbs/acre/yr of these reference watersheds serve as target values for the Watauga River Watershed sediment TMDLs.

- The Sediment Tool was also used to determine the existing average annual sediment loads of impaired watersheds located in the same Level IV ecoregion. Impaired watersheds are defined as 12-digit HUCs containing one or more waterbodies identified as impaired due to siltation/habitat alteration on the State's *2004 303(d) List* (ref: Figure 4).

- The existing average annual sediment load of each impaired HUC-12 subwatershed was compared to the average annual load of the appropriate reference (biologically healthy) watershed and an <u>overall</u> required percent reduction in loading calculated. For each impaired HUC-12 subwatershed, the TMDL is equal to this <u>overall</u> required reduction:

  $$\text{TMDL} = \frac{(\text{Existing Load}) - (\text{Target Load})}{(\text{Existing Load})} \times 100$$

  Although the Sediment Tool uses the best road, elevation, and land use GIS coverages available, the resulting average annual sediment loads should not be interpreted as an absolute value. The calculated loading reductions, however, are considered to be valid since they are based on the relative comparison of loads calculated using the same methodology.

- In each impaired subwatershed, 5% of the ecoregion-based target load was reserved to account for WLAs for NPDES permitted mining sites and RMCFs. The existing loads from these facilities are less than the five percent reserved in each impaired HUC-12 subwatershed. Any difference between these existing loads and the 5% reserved load provide for future growth and additional MOS (ref.: Appendix D).

- For each impaired HUC-12 subwatershed, WLAs for construction storm water sites, WLAs for MS4s, and LAs for nonpoint sources were considered to be the percent load reduction required to decrease the existing annual average sediment load to a level equal to 95% of the target value.

$$\text{WLA}_{\text{Const. SW}} = \text{WLA}_{\text{MS4}} = \text{LA} = \frac{(\text{Existing Load}) - [(.95)\ (\text{Target Load})]}{(\text{Existing Load})} \times 100$$

- TMDLs, WLAs for construction storm water sites and MS4s, and LAs are expressed as a percent reduction in average annual sediment loading. WLAs for mining sites and RMCFs are equal to loads authorized by their existing permits. Since sediment loading from mining sites and RMCFs are small with respect to storm water induced sediment loading for all subwatersheds, further reductions from these facilities were not considered warranted (ref.: Appendix D).

It is considered that the reduction of sediment loading as specified by WLAs and LAs in impaired watersheds will result in the attainment of fully supporting status for all designated use classifications, with respect to siltation/habitat alteration. According to 40 CFR §130.2 (i), TMDLs can be expressed in terms of mass per time, toxicity or other appropriate measure.

Details of the analysis methodology are more fully described in Appendix B. This approach is recognized as an acceptable alternative to a maximum allowable mass load per day in the *Protocol for Developing Sediment TMDLs* (USEPA, 1999).

7.2 TMDLs for Impaired Subwatersheds

Sediment TMDLs for subwatersheds containing waterbodies identified as impaired for siltation/habitat alteration are summarized in Table 8.

7.3 Waste Load Allocations

7.3.1 Waste Load Allocations for NPDES Regulated Ready Mixed Concrete Facilities

There are four Ready Mixed Concrete Facilities (RMCFs) in the Watauga River Watershed with NPDES permits and they are all located in impaired subwatersheds (ref.: Table 6). Since sediment loading from RMCFs located in impaired subwatersheds is small (ref.: Appendix D) compared to the total loading for impaired subwatersheds, the WLAs are considered to be equal to the existing permit requirements for these facilities.

7.3.2 Waste Load Allocations for NPDES Regulated Mining Activities

Of the fourteen mining sites in the Watauga River Watershed with NPDES permits, eleven are located in impaired subwatersheds (ref.: Table 7). Since sediment loading from mining sites located in impaired subwatersheds is small (ref.: Appendix D) compared to the total loading for impaired subwatersheds, the WLAs are considered to be equal to the existing permit requirement for these sites.

Table 8 Sediment TMDLs for Subwatersheds with Waterbodies Impaired for Siltation/Habitat Alteration

HUC-12 Subwatershed (06010103___)	Waterbody ID	Waterbody Impaired by Siltation/ Habitat Alteration	Level IV Ecoregion	Existing Sediment Load	Target Load	TMDL (required load reduction)
				[lbs/ac/yr]	[lbs/ac/yr]	[%]
0101	06010103034_2000	Roan Creek	66d	1857	101.9	94.5
0102	06010103034_0310	Goose Creek	66e	997	123.1	87.6
	06010103034_0320	Furnace Creek				
0103	06010103034_1000	Roan Creek		700		82.4
	06010103034_2000	Roan Creek				
0206	06010103020T_0200	Sink Creek		248		50.4
0402	06010103013_0300	Hampton Creek	66d	503	101.9	79.7
0501	06010103008_0200	Campbell Branch	66e	592	123.1	79.2
	06010103008_0400	Davis Branch				
	06010103008_0800	Gap Branch				
0505	06010103009_1000	Brush Creek	67f	1086	399.8	63.2
0506	06010103006_0100	Carroll Creek		488		18.0
	06010103061_1000	Reedy Creek				
0507	06010103635_0100	Cash Hollow Creek		4294		90.7
	06010103635_0200	Cobb Creek				
	06010103635_1000	Knob Creek				
0508	06010103006_1000	Boones Creek		576		30.6

Note: Calculations were conducted for all HUC-12 subwatersheds containing waterbodies identified as impaired for siltation/habitat alteration. Some impaired waterbodies extend across more than one HUC-12 subwatershed.

Table 9 Summary of WLAs for MS4s and Construction Storm Water Sites and LAs for Nonpoint Sources

HUC-12 Subwatershed (06010103__)	Level IV Ecoregion	Percent Reduction – Average Annual Sediment Load	
		WLAs (Construction SW and MS4s)	LAs (Nonpoint Sources)
		[%]	[%]
0101	66d	94.8	94.8
0102	66e	88.3	88.3
0103		83.3	83.3
0206		52.9	52.9
0402	66d	80.7	80.7
0501	66e	80.2	80.2
0505	67f	65.0	65.0
0506		22.1	22.1
0507		91.2	91.2
0508		34.1	34.1

7.3.3 Waste Load Allocations for NPDES Regulated Construction Activities

Point source discharges of storm water from construction activities (including clearing, grading, filling, excavating, or similar activities) that result in the disturbance of one acre or more of total land area must be authorized by an NPDES permit. Since these discharges have the potential to transport sediment to surface waters, WLAs are provided for this category of activities. WLAs are established for each subwatershed containing a waterbody identified on the *2004 303(d) List* as impaired due to siltation and/or habitat alteration (ref.: Table 2). WLAs are expressed as the required percent reduction in the estimated average annual sediment loading for the impaired subwatershed, relative to the estimated average annual sediment loading (minus 5%) of a biologically healthy (reference) subwatershed located in the same Level IV ecoregion (ref.: Table 9). WLAs provided to NPDES regulated construction activities will be implemented as Best Management Practices (BMPs), as specified in NPDES Permit No. TNR10-0000, *General NPDES Permit for Storm Water Discharges Associated With Construction Activit*y (TDEC, 2005a). WLAs should not be construed as numeric permit limits.

7.3.4 Waste Load Allocations for NPDES Regulated Municipal Separate Storm Sewer Systems (MS4s)

Municipal separate storm sewer systems (MS4s) are regulated by the State's NPDES program (ref.: Section 6.1.5). Since MS4s have the potential to discharge TSS to surface waters, WLAs are specified for these systems. WLAs are established for each HUC-12 subwatershed containing a waterbody identified on the *2004 303(d) List* as impaired due to siltation and/or habitat alteration (ref.: Table 2). WLAs are expressed as the required percent reduction in the estimated average annual sediment loading for an impaired subwatershed, relative to the estimated average annual sediment loading (minus the 5% allocated to RMCFs and regulated mining sites) of a biologically healthy (reference) subwatershed located in the same Level IV ecoregion (ref.: Table 9). WLAs provided to NPDES regulated MS4s will be implemented as Best Management Practices (BMPs) as specified in Phase I and II MS4 permits. WLAs should not be construed as numeric limits.

7.4 Load Allocations for Nonpoint Sources

All sources of sediment loading to surface waters not covered by the NPDES program are provided a Load Allocation (LA) in these TMDLs. LAs are established for each HUC-12 subwatershed containing a waterbody identified on the *2004 303(d) List* as impaired due to siltation and/or habitat alteration (ref. Table 2). LAs are expressed as the required percent reduction in the estimated average annual sediment loading for the impaired subwatershed, relative to the estimated average annual sediment loading (minus 5%) of a biologically healthy (reference) subwatershed located in the same Level IV ecoregion (ref.: Table 9).

7.5 Margin of Safety

There are two methods for incorporating a Margin of Safety (MOS) in the analysis: a) implicitly incorporate the MOS using conservative model assumptions to develop allocations; or b) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. In these TMDLs, an implicit MOS was incorporated through the use of conservative modeling assumptions. These include:

- Target values based on Level IV ecoregion reference sites. These sites represent the least impacted streams in the ecoregion.

- The use of the sediment delivery process that results in the most sediment transport to surface waters (Method 2 in Appendix B).

In most presently impaired subwatersheds, some amount of explicit MOS is realized due to the WLAs specified for NPDES permitted mining sites and RMCFs being less than the 5% of the target load reserved for these facilities.

7.6 Seasonal Variation

Sediment loading is expected to fluctuate according to the amount and distribution of rainfall. The determination of sediment loads on an average annual basis accounts for these differences through the rainfall erosivity index in the USLE (ref.: Appendix B). This is a statistic calculated from the annual summation of rainfall energy in every storm and its maximum 30-minute intensity.

8.0 IMPLEMENTATION PLAN

8.1 Point Sources

8.1.1 NPDES Regulated Ready Mixed Concrete Facilities

All four of the NPDES regulated RMCFs are located in impaired subwatersheds (ref.: Table 6). WLAs will be implemented through NPDES Permit No. TNG110000, *General NPDES Permit for Discharges of Storm Water Runoff and Process Wastewater Associated With Ready Mixed Concrete Facilities* (TDEC, 2003).

8.1.2 NPDES Regulated Mining Sites

Eleven of the fourteen NPDES regulated mining sites in the Watauga River watershed are located in impaired subwatersheds (ref.: Table 7). WLAs will be implemented through the existing permit requirements for these sites.

8.1.3 NPDES Regulated Construction Storm Water

The WLAs provided to existing and future NPDES regulated construction activities will be implemented through Best Management Practices (BMPs) as specified in NPDES Permit No. TNR10-0000, *General NPDES Permit for Storm Water Discharges Associated With Construction Activit*y (TDEC, 2005a). The permit requires the development and implementation of a site-specific Storm Water Pollution Prevention Plan (SWPPP) prior to the commencement of construction activities. The SWPPP must be prepared in accordance with good engineering practices and the latest edition of the *Tennessee Erosion and Sediment Control Handbook* (TDEC, 2002) and must identify potential sources of pollution at a construction site that would affect the quality of storm water discharges and describe practices to be used to reduce pollutants in those discharges. At a minimum, the SWPPP must include the following elements:

- Site description
- Description of storm water runoff controls
- Erosion prevention and sediment controls
- Storm water management
- Description of items needing control
- Approved local government sediment and erosion control requirements
- Maintenance
- Inspections
- Pollution prevention measures for non-storm water discharges
- Documentation of permit eligibility related to TMDLs

The SWPPP must include documentation supporting a determination of permit eligibility with regard to waters that have an approved TMDL for a pollutant of concern, including:

- identification of whether the discharge is identified, either specifically or generally, in an approved TMDL and any associated allocations, requirements, and assumptions identified for the discharge;

- summaries of consultation with the division on consistency of SWPPP conditions with the approved TMDL; and

- measures taken to ensure that the discharge of pollutants from the site is consistent with the assumptions and requirements of the approved TMDL, including any specific wasteload allocation that has been established that would apply to the discharge.

The permit does not authorize discharges that would result in a violation of a State water quality standard. In addition, a number of special requirements are specified for discharges entering high quality waters or waters identified as impaired due to siltation. These additional requirements include:

- The SWPPP must certify that erosion and sediment controls are designed to control runoff from a 5-year, 24-hour storm event.
- More frequent (twice weekly) inspections of erosion and sediment controls.
- If a discharger is complying with the SWPPP, but is contributing to the impairment of a stream, the SWPPP must be revised and implemented to eliminate further impairment to the stream. If these changes are not implemented within 7 days of receipt of notification, coverage under the general permit will be terminated and continued discharges covered under an individual permit. The construction project must be stabilized until the revised SWPPP is implemented or an individual permit issued. No earth disturbing activities, except for stabilization, are authorized until the individual permit is issued.
- For an outfall in a drainage area of a total of 5 or more acres, a temporary (or permanent) sediment basin that provides storage for a calculated volume of runoff from a 5-year, 24-hour storm and runoff from each acre drained, or equivalent control measures, shall be provided until final stabilization of the site.
- A 60-foot natural riparian buffer zone adjacent to a receiving stream designated as impaired or high quality waters must be preserved, to the maximum extent practicable, during construction activities at the site.

Strict compliance with the provisions of the *General NPDES Permit for Storm Water Discharges Associated With Construction Activit*y (TDEC, 2005a) can reasonably be expected to achieve reduced sediment loads to streams. The primary challenge for the reduction of sediment loading from construction sites to meet TMDL WLAs is in the effective compliance monitoring of all requirements specified in the permit and timely enforcement against construction sites not found to be in compliance with the permit.

8.1.4 NPDES Regulated Municipal Separate Storm Sewer Systems (MS4s)

For existing and future regulated discharges from municipal separate storm sewer systems (MS4s), WLAs will be implemented through Phase I and II MS4 permits. These permits will require the development and implementation of a Storm Water Management Plan (SWMP) that will reduce the discharge of pollutants to the "maximum extent practicable" and not cause or contribute to violations of State water quality standards. The NPDES General Permit for Discharges from Small Municipal Separate Storm Sewer Systems (TDEC, 2003a) was issued on February 27, 2003 and requires SWMPs to include the following minimum control measures:

- Public education and outreach on storm water impacts
- Public involvement/participation
- Illicit discharge detection and elimination
- Construction site storm water runoff control

- Post-construction storm water management in new development and re-development
- Pollution prevention/good housekeeping for municipal operations

For discharges into impaired waters, the Small MS4 General Permit (ref: http://www.state.tn.us/environment/wpc/stormh2o/MS4II.php) requires that SWMPs include a section describing how discharges of pollutants of concern will be controlled to ensure that they do not cause or contribute to instream exceedances of water quality standards. Specific measures and BMPs to control pollutants of concern must also be identified. In addition, MS4s must implement the WLA provisions of an applicable TMDL and describe methods to evaluate whether storm water controls are adequate to meet the WLA.

In order to evaluate SWMP effectiveness and demonstrate compliance with specified WLAs, MS4s must develop and implement appropriate monitoring programs. Instream monitoring, at locations selected to best represent the effectiveness of BMPs, must include analytical monitoring of pollutants of concern as well as stream surveys to evaluate biological integrity. A detailed plan describing the monitoring program must be submitted to the appropriate Environmental Field Office (EFO) of the Division of Water Pollution Control within 12 months of the approval date of this TMDL. The appropriate EFO can be determined based on the county (ref.: http://tennessee.gov/environment/eac/index.php).

Implementation of the monitoring program must commence within 6 months of plan approval by the EFO. The monitoring program shall comply with the monitoring, recordkeeping, and reporting requirements of *NPDES General Permit for Discharges from Small Municipal Separate Storm Sewer Systems* (TDEC, 2003a).

8.2 Nonpoint Sources

The Tennessee Department of Environment & Conservation (TDEC) has no direct regulatory authority over most nonpoint source discharges. Reductions of sediment loading from nonpoint sources (NPS) will be achieved using a phased approach. Voluntary, incentive-based mechanisms will be used to implement NPS management measures in order to assure that measurable reductions in pollutant loadings can be achieved for the targeted impaired waters. Cooperation and active participation by the general public and various industry, business, and environmental groups is critical to successful implementation of TMDLs. Local citizen-led and implemented management measures offer the most efficient and comprehensive avenue for reduction of loading rates from nonpoint sources. There are links to a number of publications and information resources on EPA's Nonpoint Source Pollution website (http://www.epa.gov/owow/nps/pubs.html) relating to the implementation and evaluation of nonpoint source pollution control measures.

TMDL implementation activities will be accomplished within the framework of Tennessee's Watershed Approach (ref: http://www.state.tn.us/environment/wpc/watershed/). The Watershed Approach is based on a five-year cycle and encompasses planning, monitoring, assessment, TMDLs, WLAs/LAs, and permit issuance. It relies on participation at the federal, state, local and nongovernmental levels to be successful.

The actions of local government agencies and watershed stakeholders should be directed to accomplish the goal of a reduction of sediment loading in the watershed. There are a number of measures that are particularly well-suited to action by local stakeholder groups. These measures include, but are not limited to:

- Detailed surveys of impaired subwatersheds to identify additional sources of sediment loading.
- Advocacy of local area ordinances and zoning that will minimize sediment loading to waterbodies, including establishment of buffer strips along streambanks, reduction of activities within riparian areas, and minimization of road and bridge construction impacts.
- Educating the public as to the detrimental effects of sediment loading to waterbodies and measures to minimize this loading.
- Advocacy of agricultural BMPs (e.g., riparian buffer, animal waste management systems, waste utilization, stream stabilization, fencing, heavy use area treatment protection, livestock exclusion, etc.) and practices to minimize erosion and sediment transport to streams. The Tennessee Department of Agriculture (TDA) keeps a database of BMPs implemented in Tennessee. Of the 147 BMPs in the Watauga River Watershed as of September 2, 2005, 56 are in sediment-impaired subwatersheds (see Figure 9).

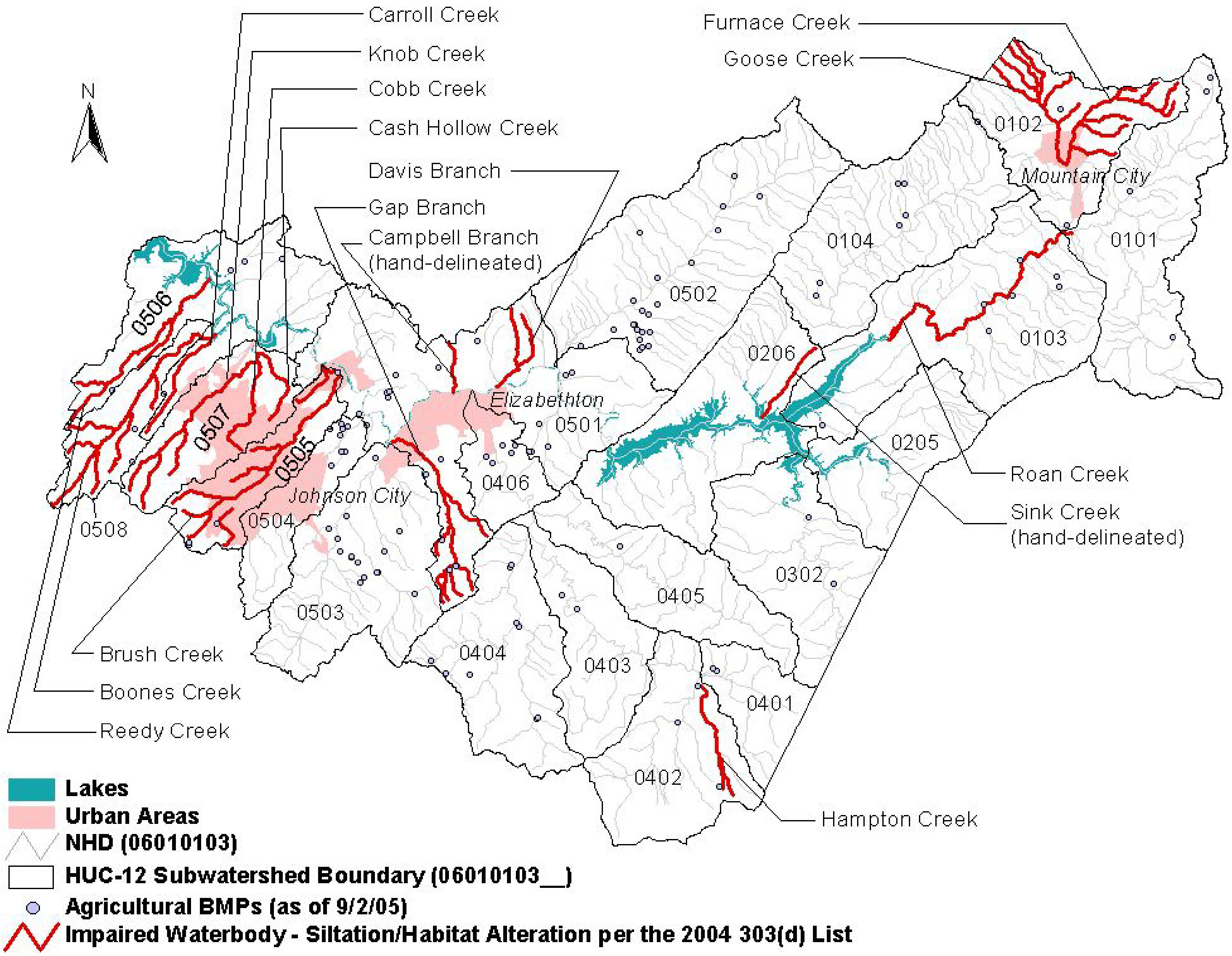
An excellent example of stakeholder involvement and action for the implementation of the nonpoint source load allocations (LAs) specified in an approved TMDL is described in *Guidance for Development of a Total Maximum Daily Load Implementation Plan for Fecal Coliform Reduction* (SCWA, 2004), prepared by the Sinking Creek Watershed Alliance. This document details the cooperative effort of a number of stakeholders and governmental entities to develop an implementation plan for the restoration of water quality in Sinking Creek, near Johnson City, Tennessee. Plan development was funded, in part, through a TDEC 604(b) grant and a Tennessee Department of Agriculture (TDA) Nonpoint source Program 319 grant. The plan is based on land use and pollutant source identification surveys and considers public education & participation, funding resources, in-stream monitoring, best management practices (BMPs), and stakeholder responsibilities. Recommendations for future activities include verification of chemical/biological findings through Bacteria Source Tracking (BST) research, implementation of appropriate BMPs, post implementation monitoring to verify reduction of pollutant loading.

Another stakeholder project underway is the 604(b) Planning Grant that TDEC awarded to First Tennessee Development District (FTDD) in November 2005. The planning grant will enable FTDD to conduct three local focus meetings and five watershed-wide meetings in the Watauga River Watershed. The goal of the grant is to develop a sustainable Watauga River Watershed Association.

8.3 Evaluation of TMDL Effectiveness

The effectiveness of the TMDL will be assessed within the context of the State’s rotating watershed management approach. Watershed monitoring and assessment activities will provide information by which the effectiveness of sediment loading reduction measures can be evaluated. Monitoring data, ground-truthing, and source identification actions will enable implementation of particular types of BMPs to be directed to specific areas in the subwatersheds. These TMDLs will be reevaluated during subsequent watershed cycles and revised as required to assure attainment of applicable water quality standards.

Figure 9 Location of Agricultural Best Management Plans in the Watauga River Watershed



9.0 PUBLIC PARTICIPATION

In accordance with 40 CFR §130.7, the proposed sediment TMDLs for the Watauga River Watershed was placed on Public Notice for a 35-day period and comments were solicited. Steps that were taken in this regard included:

1) Notice of the proposed TMDLs was posted on the Tennessee Department of Environment and Conservation website. The notice invited public and stakeholder comments and provided a link to a downloadable version of the TMDL document.

2) Notice of the availability of the proposed TMDLs (similar to the website announcement) was included in the January 9, 2006 NPDES permit Public Notice mailing, which was sent to approximately 90 interested persons or groups who had requested this information.

3) A letter was sent to following point source facilities in the Watauga River Watershed that are permitted to discharge treated total suspended solids (TSS) and are located in impaired subwatersheds advising them of the proposed sediment TMDLs and their availability on the TDEC website. The letter also stated that a written copy of the draft TMDL document would be provided on request. Letters were sent to the following facilities:

TNG110197	Chandler Concrete
TNG110162	Summers Taylor Concrete
TNG110163	Transit-Mix Concrete
TNG110298	Boones Creek Concrete
TN0066192	Maymead, Inc.
TN0066206	Maymead, Inc.
TN0071463	Mountain City Stone, Inc.
TN0071315	S & S Paving & Material, Inc.
TN0072672	Appalachian Aggregates, Inc.
TN0001775	American Limestone Company, Inc.
TN0068977	American Limestone Company, Inc.
TN0066401	General Shale Products, LLC
TN0071404	General Shale Products, LLC
TN0071412	General Shale Products, LLC
TN0071471	General Shale Products, LLC

4) A letter was sent to identified water quality partners in the Watauga River Watershed advising them of the proposed sediment TMDLs and their availability on the TDEC website and invited comments. These partners include:

   Natural Resources Conservation Service
   Tennessee Department of Agriculture
   Tennessee Valley Authority
   Tennessee Wildlife Resources Agency
   USDA - Forest Service
   USGS Water Resource Programs
   Boone Watershed Partnership (BWP)
   North Carolina's Basinwide Planning Program
   The Nature Conservancy

5) A draft copy of the proposed sediment TMDLs was sent to the following MS4s:

TNS075124	Carter County
TNS075281	City of Elizabethton
TNS075370	City of Johnson City
TNS075671	Sullivan County
TNS075728	City of Jonesborough
TNS075787	Washington County
TNS077585	Tennessee Department of Transportation (TDOT)

10.0 FURTHER INFORMATION

Further information concerning Tennessee's TMDL program can be found on the Internet at the Tennessee Department of Environment and Conservation website:

http://www.state.tn.us/environment/wpc/tmdl/

Technical questions regarding these TMDLs should be directed to the following members of the Division of Water Pollution Control staff:

Mary L. Wyatt, Watershed Management Section
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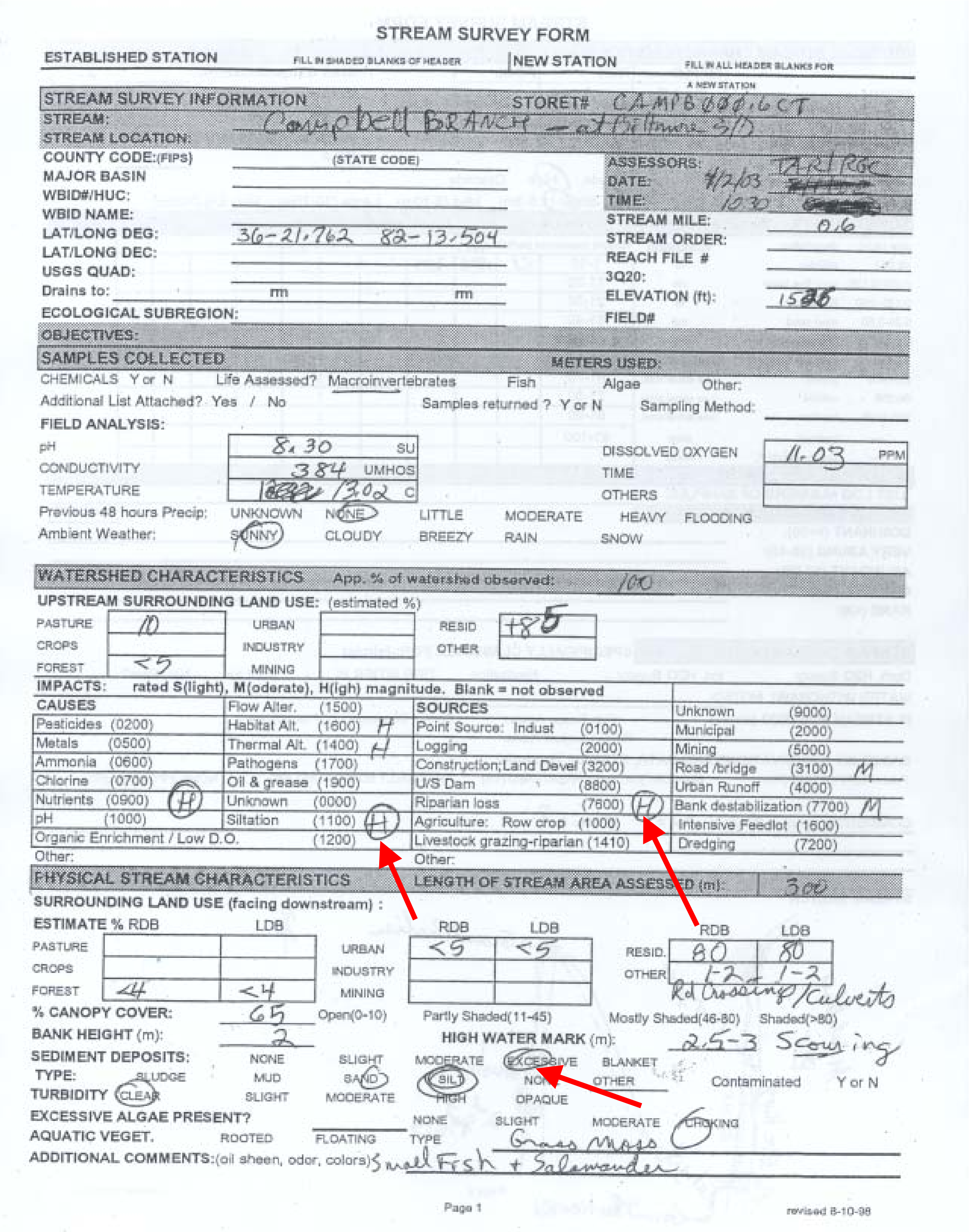
APPENDIX A

Example of Stream Assessment (Campbell Branch at RM 0.6)

Figure A-1 Campbell Branch Stream Survey, p. 1 (Field Sheet) – April 2, 2003



STREAM SURVEY FORM

ESTABLISHED STATION FILL IN SHADED BLANKS OF HEADER | NEW STATION FILL IN ALL HEADER BLANKS FOR A NEW STATION

STREAM SURVEY INFORMATION STORET# CAMPB000.6CT
STREAM: Campbell BRANCH – at Biltmore S/D
STREAM LOCATION:
COUNTY CODE:(FIPS) (STATE CODE)
MAJOR BASIN
WBID#/HUC:
WBID NAME:
LAT/LONG DEG: 36-21.762 82-13.504
LAT/LONG DEC:
USGS QUAD:
Drains to: m m
ECOLOGICAL SUBREGION:
ASSESSORS: TAR/RGC
DATE: 4/2/03
TIME: 10:30
STREAM MILE: 0.6
STREAM ORDER:
REACH FILE #
3Q20:
ELEVATION (ft): 1536
FIELD#
OBJECTIVES:

SAMPLES COLLECTED METERS USED:
CHEMICALS Y or N Life Assessed? Macroinvertebrates Fish Algae Other:
Additional List Attached? Yes / No Samples returned ? Y or N Sampling Method:

FIELD ANALYSIS:
pH 8.30 SU
CONDUCTIVITY 384 UMHOS
TEMPERATURE 13.02 C
DISSOLVED OXYGEN 11.03 PPM
TIME
OTHERS
Previous 48 hours Precip: UNKNOWN [✓ NONE] LITTLE MODERATE HEAVY FLOODING
Ambient Weather: [✓ SUNNY] CLOUDY BREEZY RAIN SNOW

WATERSHED CHARACTERISTICS App. % of watershed observed: 100
UPSTREAM SURROUNDING LAND USE: (estimated %)
PASTURE 10
CROPS
FOREST <5
URBAN
INDUSTRY
MINING
RESID +85
OTHER

IMPACTS: rated S(light), M(oderate), H(igh) magnitude. Blank = not observed

CAUSES	Flow Alter. (1500)	SOURCES	Unknown (9000)
Pesticides (0200)	Habitat Alt. (1600) H	Point Source: Indust (0100)	Municipal (2000)
Metals (0500)	Thermal Alt. (1400) H	Logging (2000)	Mining (5000)
Ammonia (0600)	Pathogens (1700)	Construction;Land Devel (3200)	Road /bridge (3100) M
Chlorine (0700)	Oil & grease (1900)	U/S Dam (8800)	Urban Runoff (4000)
Nutrients (0900) H	Unknown (0000)	Riparian loss (7600) H	Bank destabilization (7700) M
pH (1000)	Siltation (1100) H	Agriculture: Row crop (1000)	Intensive Feedlot (1600)
Organic Enrichment / Low D.O. (1200)		Livestock grazing-riparian (1410)	Dredging (7200)
Other:		Other:	

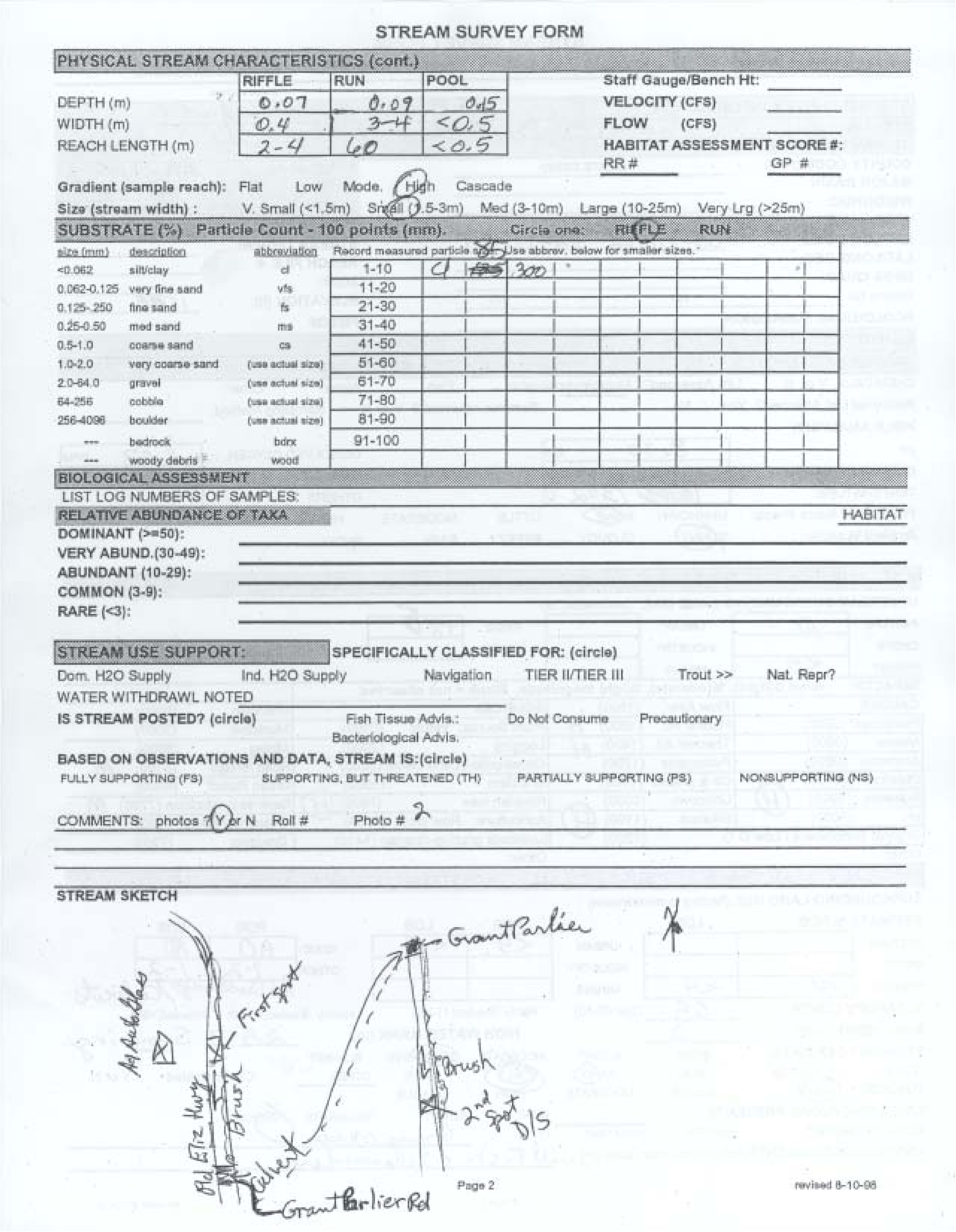
PHYSICAL STREAM CHARACTERISTICS LENGTH OF STREAM AREA ASSESSED (m): 300
SURROUNDING LAND USE (facing downstream) :

ESTIMATE %	RDB	LDB		RDB	LDB		RDB	LDB
PASTURE			URBAN	<5	<5	RESID.	80	80
CROPS			INDUSTRY			OTHER	1-2	1-2
FOREST	<4	<4	MINING					

Rd Crossing/Culverts
% CANOPY COVER: 65 Open(0-10) Partly Shaded(11-45) Mostly Shaded(46-80) Shaded(>80)
BANK HEIGHT (m): 2 HIGH WATER MARK (m): 2.5-3 Scouring
SEDIMENT DEPOSITS: NONE SLIGHT MODERATE [✓ EXCESSIVE] BLANKET
TYPE: SLUDGE MUD [✓ SAND] [✓ SILT] NONE OTHER Contaminated Y or N
TURBIDITY [✓ CLEAR] SLIGHT MODERATE HIGH OPAQUE
EXCESSIVE ALGAE PRESENT? NONE SLIGHT MODERATE [✓ CHOKING]
AQUATIC VEGET. ROOTED FLOATING TYPE Grass Moss
ADDITIONAL COMMENTS:(oil sheen, odor, colors) Small Fish + Salamander

Page 1 revised 8-10-98

Figure A-2 Campbell Branch Stream Survey, p. 2 (Field Sheet) – April 2, 2003



STREAM SURVEY FORM

PHYSICAL STREAM CHARACTERISTICS (cont.)

	RIFFLE	RUN	POOL
DEPTH (m)	0.07	0.09	0.15
WIDTH (m)	0.4	3-4	<0.5
REACH LENGTH (m)	2-4	60	<0.5

Staff Gauge/Bench Ht: ________
VELOCITY (CFS) ________
FLOW (CFS) ________
HABITAT ASSESSMENT SCORE #:
RR # ________ GP # ________

Gradient (sample reach): Flat Low Mode. [✓ High] Cascade
Size (stream width) : V. Small (<1.5m) [✓ Small (1.5-3m)] Med (3-10m) Large (10-25m) Very Lrg (>25m)

SUBSTRATE (%) Particle Count - 100 points (mm). Circle one: [✓ RIFFLE] RUN

size (mm)	description	abbreviation	Record measured particle size.* Use abbrev. below for smaller sizes.*										
<0.062	silt/clay	cl	1-10	cl	~~85~~ 85	300							
0.062-0.125	very fine sand	vfs	11-20										
0.125-.250	fine sand	fs	21-30										
0.25-0.50	med sand	ms	31-40										
0.5-1.0	coarse sand	cs	41-50										
1.0-2.0	very coarse sand	(use actual size)	51-60										
2.0-64.0	gravel	(use actual size)	61-70										
64-256	cobble	(use actual size)	71-80										
256-4096	boulder	(use actual size)	81-90										
---	bedrock	bdrx	91-100										
---	woody debris*	wood											

BIOLOGICAL ASSESSMENT

LIST LOG NUMBERS OF SAMPLES:

RELATIVE ABUNDANCE OF TAXA HABITAT

DOMINANT (>=50): ________
VERY ABUND.(30-49): ________
ABUNDANT (10-29): ________
COMMON (3-9): ________
RARE (<3): ________

STREAM USE SUPPORT: **SPECIFICALLY CLASSIFIED FOR: (circle)**

Dom. H2O Supply Ind. H2O Supply Navigation TIER II/TIER III Trout >> Nat. Repr?

WATER WITHDRAWL NOTED ________

IS STREAM POSTED? (circle) Fish Tissue Advis.: Do Not Consume Precautionary
Bacteriological Advis.

BASED ON OBSERVATIONS AND DATA, STREAM IS:(circle)

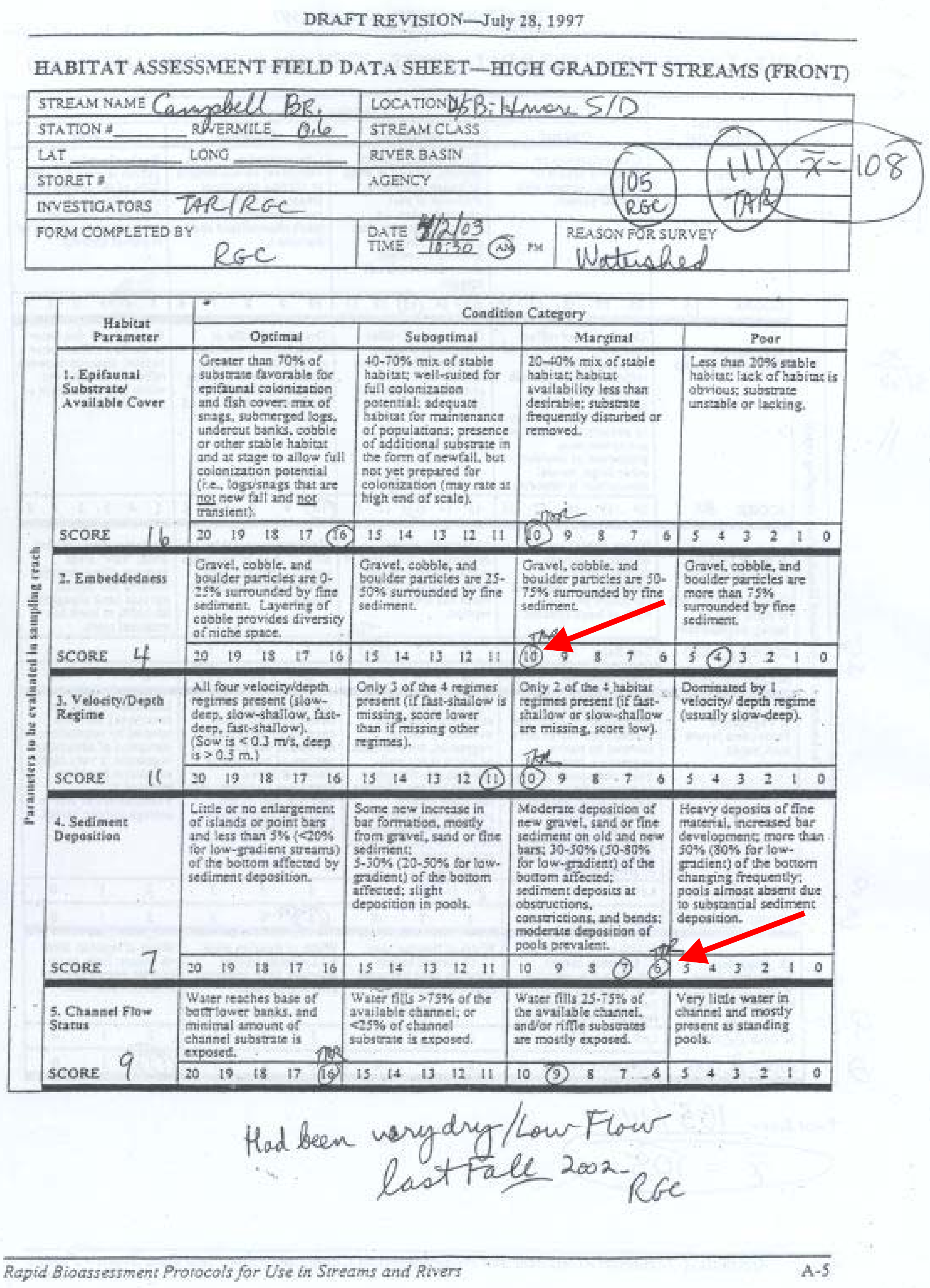
FULLY SUPPORTING (FS) SUPPORTING, BUT THREATENED (TH) PARTIALLY SUPPORTING (PS) NONSUPPORTING (NS)

COMMENTS: photos ? [✓ Y] or N Roll # Photo # 2

STREAM SKETCH

Page 2 revised 8-10-98

Figure A-3 Campbell Branch - Habitat Assessment Field Data Sheet, front – April 2, 2003



DRAFT REVISION—July 28, 1997

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Campbell Br.
LOCATION D/S B: Hmore S/D
STATION # ________ RIVERMILE 0.6
STREAM CLASS
LAT ________ LONG ________
RIVER BASIN
STORET #
AGENCY
INVESTIGATORS TAR/RGC
FORM COMPLETED BY RGC
DATE 4/2/03
TIME 10:30 [✓ AM] PM
REASON FOR SURVEY Watershed

105 RGC
111 TAR
x̄ ~ 108

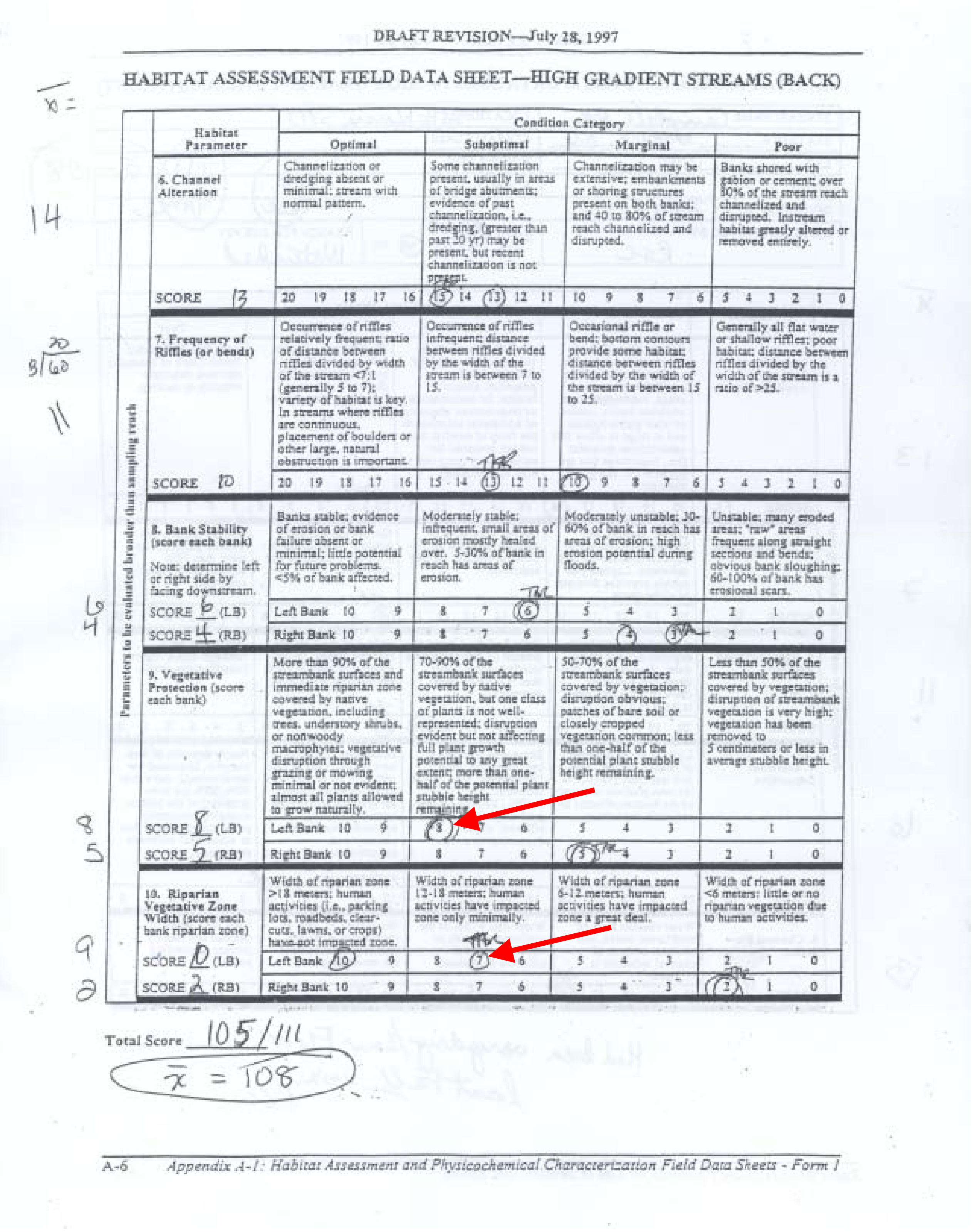
Parameters to be evaluated in sampling reach

		Condition Category			
x̄	Habitat Parameter	Optimal	Suboptimal	Marginal	Poor
13	**1. Epifaunal Substrate/ Available Cover**	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	SCORE 16	20 19 18 17 [✓ 16]	15 14 13 12 11	[✓ 10] 9 8 7 6	5 4 3 2 1 0
7	**2. Embeddedness**	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
	SCORE 4	20 19 18 17 16	15 14 13 12 11	[✓ 10] 9 8 7 6	5 [✓ 4] 3 2 1 0
11	**3. Velocity/Depth Regime**	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.3 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
	SCORE 11	20 19 18 17 16	15 14 13 12 [✓ 11]	[✓ 10] 9 8 7 6	5 4 3 2 1 0
6	**4. Sediment Deposition**	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	SCORE 7	20 19 18 17 16	15 14 13 12 11	10 9 8 [✓ 7] [✓ 6]	5 4 3 2 1 0
13	**5. Channel Flow Status**	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	SCORE 9	20 19 18 17 [✓ 16]	15 14 13 12 11	10 [✓ 9] 8 7 6	5 4 3 2 1 0

Had been very dry/Low Flow
last Fall 2002 -
RGC

Rapid Bioassessment Protocols for Use in Streams and Rivers A-5

Figure A-4 Campbell Branch - Habitat Assessment Field Data Sheet, back – April 2, 2003



HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

$\overline{x}$ =

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 13	20 19 18 17 16	[✓ 15] 14 [✓ 13] 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 10	20 19 18 17 16	15 14 [✓ 13] 12 11	[✓ 10] 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 6 (LB)	Left Bank 10 9	8 7 [✓ 6]	5 4 3	2 1 0
SCORE 4 (RB)	Right Bank 10 9	8 7 6	5 [✓ 4] [✓ 3]	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 8 (LB)	Left Bank 10 9	[✓ 8] 7 6	5 4 3	2 1 0
SCORE 5 (RB)	Right Bank 10 9	8 7 6	[✓ 5] 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 10 (LB)	Left Bank [✓ 10] 9	8 [✓ 7] 6	5 4 3	2 1 0
SCORE 2 (RB)	Right Bank 10 9	8 7 6	5 4 3	[✓ 2] 1 0

14

$\frac{20}{3\overline{)60}}$

11

6
4

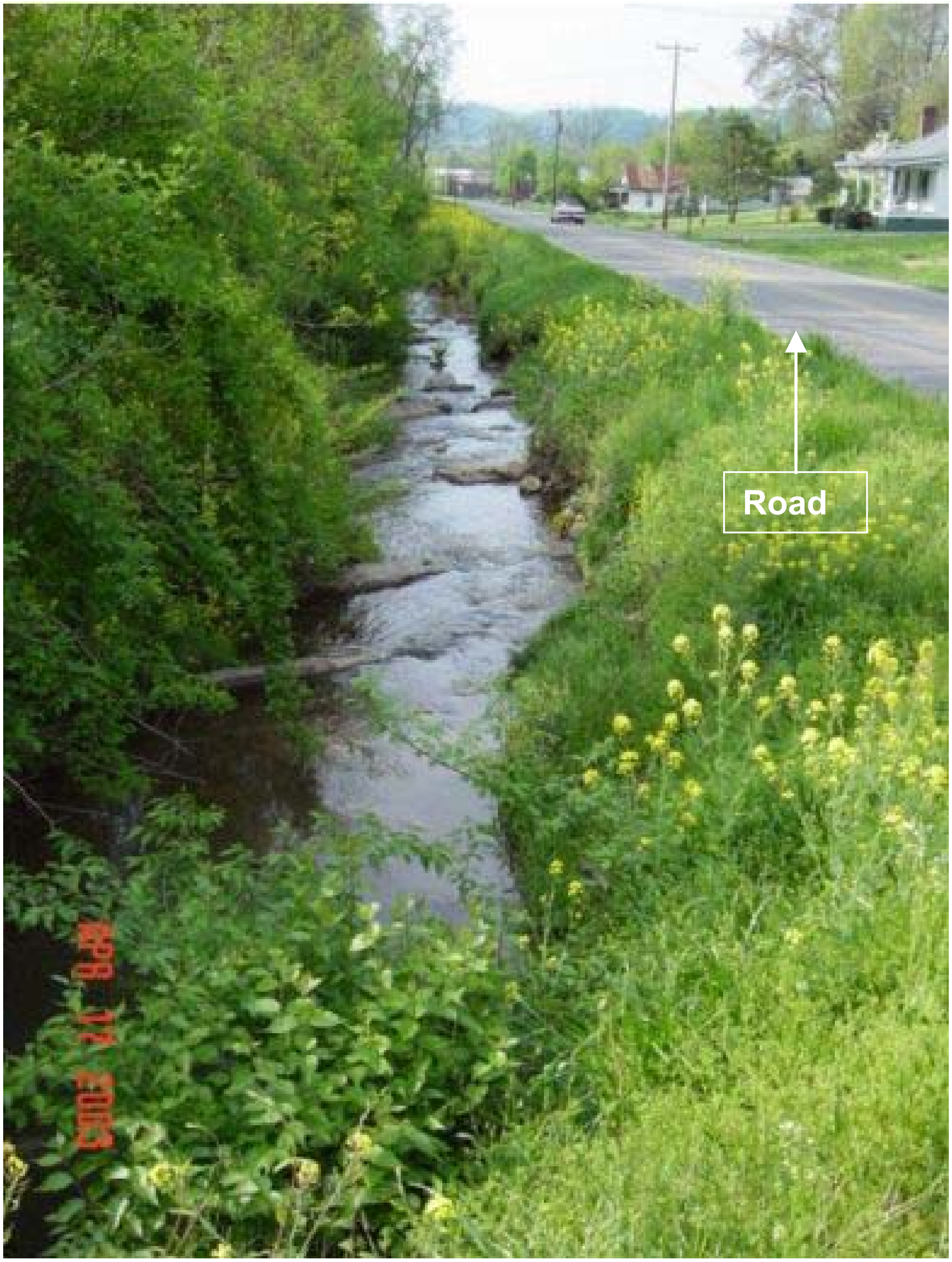
8
5

9
2

Total Score 105/111

$\overline{x}$ = 108

Figure A-5 Photo of Campbell Branch at RM 0.6



Note: This photo highlights the poor riparian vegetative zone, as indicated in the stream assessment above. The stream is adjacent to a roadway, with poor canopy.

APPENDIX B

Watershed Sediment Loading Model

WATERSHED SEDIMENT LOADING MODEL

Determination of target average annual sediment loading values for reference watersheds and the sediment loading analysis of waterbodies impaired for siltation/habitat alteration was accomplished utilizing the Watershed Characterization System (WCS) Sediment Tool (v.2.6). WCS is an ArcView geographic information system (GIS) based program developed by USEPA Region IV to facilitate watershed characterization and TMDL development. WCS consists of an initial set of spatial and tabular watershed data, stored in a database, and allows the incorporation of additional data when available. It provides a number of reporting tools and data management utilities to allow users to analyze and summarize data. Program extensions, such as the sediment tool, expand the functionality of WCS to include modeling and other more rigorous forms of data analysis (USEPA, 2001).

Sediment Analysis

The Sediment Tool is an extension of WCS that utilizes available GIS coverages (land use, soils, elevations, roads, etc), the Universal Soil Loss Equation (USLE) to calculate potential erosion, and sediment delivery equations to calculate sediment delivery to the stream network. The following tasks can be performed:

- Estimate extent and distribution of potential soil erosion in the watershed.
- Estimate potential sediment delivery to receiving waterbodies.
- Evaluate effects of land use, BMPs, and road network on erosion and sediment delivery.

The Sediment Tool can also be used to evaluate different scenarios, such as the effects of changing land uses and implementation of BMPs, by the adjustment of certain input parameters. Parameters that may be adjusted include:

- Conservation management and erosion control practices
- Changes in land use
- Implementation of Best Management Practices (BMPs)
- Addition/Deletion of roads

Sediment analyses can be performed for single or multiple watersheds.

Universal Soil Loss Equation

Erosion potential is based on the Universal Soil Loss Equation (USLE), developed by Agriculture Research Station (ARS) scientists W. Wischmeier and D. Smith. It has been the most widely accepted and utilized soil loss equation for over 30 years. The USLE is a method to predict the average annual soil loss on a field slope based on rainfall pattern, soil type, topography, crop system and management practices. The USLE only predicts the amount of soil loss resulting from sheet or rill erosion on a single slope and does not account for soil losses that might occur from gully, wind, or tillage erosion. Designed as a model for use with certain cropping and management systems, it is also applicable to non-agricultural situations (OMAFRA, 2000). While the USLE can be used to estimate long-term average annual soil loss, it cannot be applied to a specific year or a specific storm. Based on its long history of use and wide acceptance by the forestry and agricultural communities, the USLE was considered to be an adequate tool for estimating the relative long-term average annual soil erosion of watersheds and evaluating the effects of land use changes and implementation of BMP measures.

Soil loss from sheet and rill erosion is primarily due to detachment of soil particles during rain events. It is the cause of the majority of soil loss for lands associated with crop production, grazing areas, construction sites, mine sites, logging areas and unpaved roads. In the USLE, five major factors are used to calculate the soil loss for a given area. Each factor is the numerical estimate of a specific condition that affects the severity of soil erosion in that area. The USLE for estimating average annual soil erosion is expressed as:

$$A = R \text{ x } K \text{ x } LS \text{ x } C \text{ x } P$$

where:

A = average annual soil loss in tons per acre
R = rainfall erosivity index
K = soil erodibility factor
LS = topographic factor - L is for slope length and S is for slope
C = crop/vegetation and management factor
P = conservation practice factor

Evaluating the factors in USLE:

R - Rainfall Erosivity Index

The rainfall erosivity index describes the kinetic energy generated by the frequency and intensity of the rainfall. It is statistically calculated from the annual summation of rainfall energy in every storm, which correlates to the raindrop size, times its maximum 30-minute intensity. This index varies with geography.

K - Soil Erodibility Factor

This factor quantifies the cohesive or bonding character of the soil and its ability to resist detachment and transport during a rainfall event. The soil erodibility factor is a function of soil type.

LS - Topographic Factor

The topographic factor represents the effect of slope length and slope steepness on erosion. Steeper slopes produce higher overland flow velocities. Longer slopes accumulate runoff from larger areas and also result in higher flow velocities. For convenience L and S are frequently lumped into a single term.

C - Crop/Vegetation and Management Factor

The crop/vegetation and management factor represents the effect that ground cover conditions, soil conditions and general management practices have on soil erosion. It is the most computationally complicated of USLE factors and incorporates the effects of: tillage management, crop type, cropping history (rotation), and crop yield.

P - Conservation Practice Factor

The conservation practice factor represents the effects on erosion of Best Management Practices (BMPs) such as contour farming, strip cropping and terracing.

Estimates of the USLE parameters, and thus the soil erosion as computed from the USLE, are provided by the Natural Resources Conservation Service's (NRCS) National Resources Inventory (NRI) 1994. The NRI database contains information of the status, condition, and trend of soil, water and related resources collected from approximately 800,000 sampling points across the country. The soil losses from the erosion processes described above are localized losses and not the total amount of sediment that reaches the stream. The fraction of the soil lost in the field that is eventually delivered to the stream depends on several factors. These include, the distance of the source area from the stream, the size of the drainage area, and the intensity and frequency of rainfall. Soil losses along the riparian areas will be delivered into the stream with runoff-producing rainfall.

Sediment Modeling Methodology

Using WCS and the Sediment Tool, average annual sediment loading to surface waters was modeled according to the following procedures:

1. A WCS project was setup for the watershed that is the subject of these TMDLs. Additional data layers required for sediment analysis were generated or imported into the project. These included:

    DEM (grid) - The Digital Elevation Model (DEM) layers that come with the basic WCS distribution system are shapefiles of coarse resolution (300x300m). A higher resolution DEM grid layer (30x30m) is required. The National Elevation Dataset (NED) is available from the USGS website and the coverage for the watershed (8-digit HUC) was imported into the project.

    Road - A road layer is needed as a shape file and requires additional attributes such as road type, road practice, and presence of side ditches. If these attributes are not provided, the Sediment Tool automatically assigns default values: road type - secondary paved roads, side ditches present and no road practices. This data layer was obtained from ESRI for areas in the watershed.

    Soil - The SSURGO (1:24k) soil data may be imported into the WCS project if higher-resolution soil data is required for the estimation of potential erosion. If the SSURGO soil database is not available, the system uses the STATSGO Soil data (1:250k) by default.

    MRLC Land Use - The Multi-Resolution Land Characteristic (MRLC) data set for the watershed is provided with the WCS package, but must be imported into the project.

2. Using WCS, the entire watershed was delineated into subwatersheds corresponding to USGS 12-digit Hydrologic Unit Codes (HUCs). These delineations are shown in Figure 6. Land use distribution for these delineations is summarized in Appendix C. All of the sediment analyses were performed on the basis of these drainage areas.

The following steps are accomplished using the WCS Sediment Tool:

3. For a selected watershed or subwatershed, a sediment project is set up in a new view that contains the data layers that will be subsequently used to calculate erosion and sediment delivery.

4. A stream grid for each delineated subwatershed was created by etching a stream coverage, based on National Hydrology Dataset (NHD), to the DEM grid.

5. For each 30 by 30 meter grid cell within the subwatershed, the Sediment Tool calculates the potential erosion using the USLE based on the specific cell characteristics. The model then calculates the potential sediment delivery to the stream grid network. Sediment delivery can be calculated using one of the four available sediment delivery equations:

    - Distance-based equation (Sun and McNulty, 1998)
      $Mad = M * (1-0.97 * D/L)$
      where: Mad = mass moved (tons/acre/yr)
      M = sediment mass eroded (ton)
      D = least cost distance from a cell to the nearest stream grid (ft)
      L = maximum distance the sediment may travel (ft)

    - Distance Slope-based equation (Yagow et al., 1998)
      $DR = \exp(-0.4233 * L * So)$
      $So = \exp(-16.1 * r/L + 0.057)) - 0.6$
      where: DR = sediment delivery ration
      L = distance to the stream (m)
      r = relief to the stream (m)

    - Area-based equation (USDASCS, 1983)
      $DR = 0.417762 * A^{(-0.134958)} - 1.27097, \quad DR <= 1.0$
      where: DR = sediment delivery ratio
      A = area (sq miles)

    - WEEP-based regression equation (Swift, 2000)
      $Z = 0.9004 - 0.1341 * X^2 + X^3 - 0.0399 * Y + 0.0144 * Y^2 + 0.00308 * Y^3$
      where: Z = percent of source sediment passing to the next grid cell
      X = cumulative distance down slope (X > 0)
      Y = percent slope in the grid cell (Y > 0)

    The distance slope based equation (Yagow et al., 1998) was selected to simulate sediment delivery in the Watauga River Watershed.

6. The total sediment delivered upstream of each subwatershed "pour point" is calculated. The sediment analysis provides the calculations for six new parameters:

    - Source Erosion - estimated erosion from each grid cell due to the land cover
    - Road Erosion - estimated erosion from each grid cell representing a road
    - Composite Erosion - composite of the source and road erosion layers

- Source Sediment - estimated fraction of the soil erosion from each grid cell that reaches the stream (sediment delivery)
- Road Sediment - estimated fraction of the road erosion from each grid cell that reaches the stream
- Composite Sediment - composite of the source and erosion sediment layers

The sediment delivery can be calculated based on the composite sediment, road sediment or source sediment layer. The sources of sediment by each land use type is determined showing the types of land use, the acres of each type of land use and the tons of sediment estimated to be generated from each land use.

7. For each subwatershed of interest, the resultant sediment load calculation is expressed as a long-term average annual soil loss expressed in pounds per year calculated for the rainfall erosivity index (R). This statistic is calculated from the annual summation of rainfall energy in every storm (correlates with raindrop size) times its maximum 30-minute intensity.

   Calculated erosion, sediment loads delivered to surface waters and unit loads (per unit area) for subwatersheds that contain waters on the *2004 303(d) List* as impaired for siltation and/or habitat alteration are summarized in Tables B-1, B-2, and B-3, respectively.

Table B-1 Calculated Erosion - Subwatersheds With Waterbodies Impaired Due to Siltation/Habitat Alteration (Documented on the *2004 303(d) List*)

HUC-12 Subwatershed (06010103__)	***EROSION***				
	Road [tons/yr]	**Source [tons/yr]**	**Total [tons/yr]**	**%Road**	**%Source**
0101	9,853	34,754	44,606	22.1	77.9
0102	6,450	9,949	16,399	39.3	60.7
0103	9,552	12,423	21,976	43.5	56.5
0206	7,227	2,837	10,064	71.8	28.2
0402	6,045	3,458	9,503	63.6	36.4
0501	18,631	15,125	33,756	55.2	44.8
0505	9,696	2,135	11,831	82.0	18.0
0506	7,836	7,525	15,361	51.0	49.0
0507	53,367	24,881	78,248	68.2	31.8
0508	2,544	2,978	5,522	46.1	53.9

Table B-2 Calculated Sediment Delivery to Surface Waters - Subwatersheds with Waterbodies Impaired Due to Siltation/Habitat Alteration (Documented on the *2004 303(d) List*)

HUC-12 Subwatershed (06010103__)	***SEDIMENT***				
	Road [tons/yr]	**Source [tons/yr]**	**Total [tons/yr]**	**%Road**	**%Source**
0101	7,163	16,794	23,957	29.9	70.1
0102	4,577	4,820	9,397	48.7	51.3
0103	5,605	6,608	12,213	45.9	54.1
0206	2,482	903	3,385	73.3	26.7
0402	3,513	1,366	4,878	72.0	28.0
0501	7,816	4,570	12,386	63.1	36.9
0505	4,806	863	5,669	84.8	15.2
0506	3,134	2,723	5,857	53.5	46.5
0507	19,277	9,900	29,176	66.1	33.9
0508	1,313	1,167	2,480	52.9	47.1

Table B-3 Unit Loads - Subwatersheds With Waterbodies Impaired Due to Siltation/Habitat Alteration (Documented on the *2004 303(d) List*)

HUC-12 Subwatershed (06010103__)	***UNIT LOADS***			
	Erosion		**Sediment**	
	[tons/ac/yr]	**[lbs/ac/yr]**	**[tons/ac/yr]**	**[lbs/ac/yr]**
0101	1.729	3,458	0.929	1,857
0102	0.870	1,739	0.498	997
0103	0.629	1,259	0.350	700
0206	0.369	738	0.124	248
0402	0.489	979	0.251	503
0501	0.806	1,612	0.296	592
0505	1.133	2,266	0.543	1,086
0506	0.639	1,279	0.244	488
0507	5.758	11,516	2.147	4,294
0508	0.641	1,282	0.288	576

APPENDIX C

MRLC Land Use of Impaired Subwatersheds and Ecoregion Reference Site Drainage Areas

Table C-1 Watauga River Watershed - Impaired Subwatershed Land Use Distribution

Land Use	Subwatershed (06010103___)							
	0101		0102		0103		0206	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand/Clay	11	0.0	15	0.1	19	0.1	0	0.0
Deciduous Forest	14,853	57.5	6,502	34.5	14,348	41.1	1,310	10.3
Emergent Herbaceous Wetlands	4	0.0	2	0.0	26	0.1	0	0.0
Evergreen Forest	2,936	11.4	3,465	18.4	5,099	14.6	2,033	16.1
High Intensity Commercial/Industrial/ Transportation	155	0.6	266	1.4	6	0.0	448	3.5
High Intensity Residential	2	0.0	90	0.5	0	0.0	28	0.2
Low Intensity Residential	69	0.3	562	3.0	38	0.1	378	3.0
Mixed Forest	4,597	17.8	3,967	21.0	8,819	25.3	2,262	17.9
Open Water	7	0.0	3	0.0	1,351	3.9	233	1.8
Other Grasses (Urban/Recreational)	26	0.1	166	0.9	0	0.0	1,251	9.9
Pasture/Hay	2,243	8.7	3,102	16.5	3,884	11.1	3,814	30.1
Quarries/Strip Mines/Gravel Pits	65	0.3	0	0.0	0	0.0	0	0.0
Row Crops	827	3.2	709	3.8	1,304	3.7	868	6.9
Transitional	0	0.0	0	0.0	0	0.0	32	0.3
Woody Wetlands	4	0.0	8	0.0	23	0.1	0	0.0
Total	**25,801**	**99.8**	**18,857**	**100.0**	**34,918**	**100.0**	**12,657**	**100.0**

Table C-1 (Cont.) Watauga River Watershed - Impaired Subwatershed Land Use Distribution

Land Use	Subwatershed (06010103___)							
	0402		0501		0505		0506	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand/Clay	7	0.0	78	0.2	40	0.4	124	0.5
Deciduous Forest	11,619	59.8	20,142	48.1	2,365	22.7	6,929	28.8
Emergent Herbaceous Wetlands	0	0.0	2	0.0	0	0.0	62	0.3
Evergreen Forest	2,918	15.0	4,856	11.6	1,084	10.4	3,154	13.1
High Intensity Commercial/Industrial/ Transportation	24	0.1	675	1.6	1,180	11.3	338	1.4
High Intensity Residential	15	0.1	242	0.6	799	7.7	57	0.2
Low Intensity Residential	322	1.7	2,636	6.3	2,473	23.7	1,077	4.5
Mixed Forest	3,941	20.3	6,503	15.5	848	8.1	2,997	12.5
Open Water	2	0.0	216	0.5	10	0.1	1,457	6.1
Other Grasses (Urban/Recreational)	60	0.3	361	0.9	433	4.2	367	1.5
Pasture/Hay	385	2.0	4,661	11.1	955	9.2	6,553	27.3
Quarries/Strip Mines/Gravel Pits	0	0.0	0	0.0	0	0.0	0	0.0
Row Crops	94	0.5	1,419	3.4	237	2.3	826	3.4
Transitional	15	0.1	24	0.1	0	0.0	0	0.0
Woody Wetlands	13	0.1	53	0.1	17	0.2	81	0.3
Total	**19,415**	**100.0**	**41,869**	**100.0**	**10,441**	**100.0**	**24,023**	**100.0**

Table C-1 (Cont.)   Watauga River Watershed - Impaired Subwatershed Land Use Distribution

Land Use	Subwatershed (06010103__)			
	0507		0508	
	[acres]	[%]	[acres]	[%]
Bare Rock/Sand/Clay	76	0.6	58	0.7
Deciduous Forest	3,198	23.5	1,540	17.9
Emergent Herbaceous Wetlands	0	0.0	0	0.0
Evergreen Forest	1,790	13.2	1,094	12.7
High Intensity Commercial/Industrial/ Transportation	1,015	7.5	57	0.7
High Intensity Residential	481	3.5	4	0.1
Low Intensity Residential	2,391	17.6	167	1.9
Mixed Forest	1,378	10.1	965	11.2
Open Water	20	0.1	80	0.9
Other Grasses (Urban/Recreational)	429	3.2	0	0.0
Pasture/Hay	2,435	17.9	4,322	50.2
Quarries/Strip Mines/Gravel Pits	39	0.3	0	0.0
Row Crops	308	2.3	307	3.6
Transitional	0	0.0	0	0.0
Woody Wetlands	29	0.2	18	0.2
Total	**13,589**	**100.0**	**8,612**	**100.0**

Table C-2 Level IV Ecoregion Reference Site Drainage Area Land Use Distribution

Land Use	Ecosite Subwatershed									
	Eco66d01		Eco66d03		Eco66d05		Eco66d06		Eco66d07	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Deciduous Forest	396	52.1	4,251	38.1	308	52.0	476	73.9	865	56.2
Emergent Herbaceous Wetlands	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Evergreen Forest	99	13.1	2,725	24.4	44	7.4	81	12.6	262	17.0
High Intensity Commercial/Industrial/ Transportation	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
High Intensity Residential	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Low Intensity Residential	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Mixed Forest	260	34.3	3,706	33.2	241	40.8	87	13.5	409	26.6
Open Water	0	0.1	6	0.1	0	0.0	0	0.0	0	0.0
Other Grasses (Urban/Recreational)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Pasture/Hay	0	0.1	133	1.2	0	0.0	0	0.0	1	0.0
Quarries/Strip Mines/Gravel Pits	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Row Crops	2	0.2	58	0.5	0	0.1	0	0.0	2	0.1
Transitional	0	0.0	283	2.5	0	0.0	0	0.0	0	0.0
Woody Wetlands	0	0.0	1	0.0	0	0.0	0	0.0	0	0.0
Total	**757**	**99.8**	**11,164**	**100.0**	**593**	**100.2**	**644**	**99.9**	**1,538**	**99.9**

Table C-2 (Cont.) Level IV Ecoregion Reference Site Drainage Area Land Use Distribution

Land Use	Ecosite Subwatershed									
	Eco66e04		Eco66e09		Eco66e11		Eco66e17		Eco66e18	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Deciduous Forest	2,021	74.5	3,144	53.4	1,226	56.1	470	25.0	977	35.8
Emergent Herbaceous Wetlands	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Evergreen Forest	210	7.8	1,157	19.7	386	17.6	695	37.0	884	32.4
High Intensity Commercial/Industrial/ Transportation	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
High Intensity Residential	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Low Intensity Residential	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Mixed Forest	449	16.5	1,569	26.7	567	25.9	696	37.0	843	30.9
Open Water	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Other Grasses (Urban/Recreational)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Pasture/Hay	0	0.0	14	0.2	4	0.2	16	0.9	0	0.0
Quarries/Strip Mines/Gravel Pits	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Row Crops	18	0.7	1	0.0	6	0.3	0	0.0	0	0.0
Transitional	0	0.0	0	0.0	0	0.0	0	0.0	23	0.8
Woody Wetlands	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total	**2,699**	**99.4**	**5,886**	**100.0**	**2,189**	**100.2**	**1,878**	**99.9**	**2,728**	**99.9**

Table C-2 (Cont.) Level IV Ecoregion Reference Site Drainage Area Land Use Distribution

Land Use	Ecosite Subwatershed									
	Eco66f06		Eco66f07		Eco66f08		Eco67f06		Eco67f13	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand	0	0.0	36	0.1	0	0.0	0	0.0	0	0.0
Deciduous Forest	4,352	31.4	11,868	40.6	1,476	59.7	1,686	85.4	1,505	87.2
Emergent Herbaceous Wetlands	1	0.0	15	0.1	0	0.0	0	0.0	0	0.0
Evergreen Forest	4,893	35.3	7,100	24.3	341	13.8	44	2.2	76	4.4
High Intensity Commercial/Industrial/ Transportation	2	0.0	28	0.1	0	0.0	1	0.0	0	0.0
High Intensity Residential	0	0.0	1	0.0	0	0.0	0	0.0	0	0.0
Low Intensity Residential	0	0.0	87	0.3	0	0.0	2	0.1	0	0.0
Mixed Forest	2,867	20.7	7,570	25.9	618	25.0	236	12.0	132	7.6
Open Water	1	0.0	4	0.0	0	0.0	0	0.0	0	0.0
Other Grasses (Urban/Recreational)	0	0.0	81	0.3	0	0.0	0	0.0	0	0.0
Pasture/Hay	1,567	11.3	2,077	7.1	25	1.0	6	0.3	10	0.6
Quarries/Strip Mines/Gravel Pits	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Row Crops	0	0.0	232	0.8	10	0.4	0	0.0	1	0.1
Transitional	0	0.0	118	0.4	0	0.0	0	0.0	0	0.0
Woody Wetlands	174	1.3	45	0.2	0	0.0	0	0.0	0	0.0
Total	**13,857**	**100.0**	**29,262**	**100.0**	**2,471**	**99.9**	**1,975**	**100.1**	**1,724**	**99.9**

Table C-2 (Cont.) Level IV Ecoregion Reference Site Drainage Area Land Use Distribution

Land Use	Ecosite Subwatershed							
	Eco67f17		Eco67g05		Eco67g08		Eco67g09	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand	0	0.0	1	0.0	0	0.0	0	0.0
Deciduous Forest	17,329	57.6	2,690	12.8	1,076	25.4	1,603	52.5
Emergent Herbaceous Wetlands	0	0.0	0	0.0	0	0.0	0	0.0
Evergreen Forest	2,869	9.5	2,154	10.2	721	17.0	696	22.8
High Intensity Commercial/Industrial/ Transportation	22	0.1	101	0.5	23	0.5	1	0.0
High Intensity Residential	0	0.0	24	0.1	1	0.0	2	0.1
Low Intensity Residential	16	0.1	114	0.5	64	1.5	48	1.6
Mixed Forest	4,178	13.9	3,787	18.0	1,087	25.7	497	16.3
Open Water	4	0.0	7	0.0	2	0.1	1	0.0
Other Grasses (Urban/Recreational)	10	0.0	193	0.9	46	1.1	10	0.3
Pasture/Hay	5,296	17.6	10,049	47.7	1,019	24.1	156	5.1
Quarries/Strip Mines/Gravel Pits	77	0.3	0	0.0	0	0.0	0	0.0
Row Crops	258	0.9	1,933	9.2	198	4.7	40	1.3
Transitional	4	0.0	0	0.0	0	0.0	0	0.0
Woody Wetlands	0	0.0	8	0.0	0	0.0	0	0.0
Total	**30,062**	**100.0**	**21,058**	**100.0**	**4,237**	**100.0**	**3,054**	**100.0**

Table C-2 (Cont.) Level IV Ecoregion Reference Site Drainage Area Land Use Distribution

Land Use	Ecosite Subwatershed			
	Eco67g10		Eco67g11	
	[acres]	[%]	[acres]	[%]
Bare Rock/Sand	0	0.0	0	0.0
Deciduous Forest	3,165	23.9	719	70.6
Emergent Herbaceous Wetlands	0	0.0	0	0.0
Evergreen Forest	2,669	20.2	162	15.9
High Intensity Commercial/Industrial/Transportation	17	0.1	0	0.0
High Intensity Residential	6	0.0	0	0.0
Low Intensity Residential	48	0.4	0	0.0
Mixed Forest	2,619	19.8	138	13.5
Open Water	4	0.0	0	0.0
Other Grasses (Urban/Recreational)	16	0.1	0	0.0
Pasture/Hay	4,420	33.4	0	0.0
Quarries/Strip Mines/Gravel Pits	0	0.0	0	0.0
Row Crops	272	2.1	0	0.0
Transitional	0	0.0	0	0.0
Woody Wetlands	0	0.0	0	0.0
Total	**13,236**	**100.0**	**1,019**	**100.0**

APPENDIX D

Estimate of Existing Point Source Loads for NPDES Permitted Mining Sites and Ready Mixed Concrete Facilities

Determination of Existing Point Source Sediment Loads

Existing point source sediment loads for mining sites and RMCFs located in impaired HUC-12 subwatersheds were estimated using the methodologies described below.

Mining Sites

Existing loads for permitted mining sites are based on an assumed runoff from the site drainage area, the daily maximum permit limit for TSS, and the area of the HUC-12 subwatershed in which the mining site is located (ref.: Table D-1). Site runoff was estimated by assuming that one half of the annual precipitation falling on the site area results in runoff. Annual precipitation for the Watauga River Watershed is approximately 50 in/yr (Midwest Plan Service, 1985).

$$AAL_{Mining} = \frac{(A_d)\ (DMax)\ (Precip.)\ (0.2266\ lb\text{-}l/ac\text{-}in\text{-}mg)\ (0.5)}{(A_{HUC\text{-}12})}$$

where: AAL_{Mining} = Average annual load [lb/yr]
A_d = Facility (site) drainage area [acres]
DMax = Daily maximum concentration limit for TSS [mg/l]
Precip. = Average annual precipitation for watershed [in/yr]
$A_{HUC\text{-}12}$ = Area of impaired HUC-12 subwatershed [acres]

Table D-1 Estimate of Existing Load – NPDES Permitted Mining Sites

HUC-12 Subwatershed (06010103___)	Subwatershed Area	NPDES Permit No.	Site Drainage Area	Daily Maximum TSS Limit	Annual Average Load
	[acres]		[acres]	[mg/l]	[lb/ac/yr]
0101	25,801	TN0066192	17	40	0.149
		TN0066206	233		2.046
0102	18,857	TN0071463	10		0.120
0103	34,918	TN0071315	10		0.065
		TN0072672	5		0.032
0501	41,869	TN0001775	166		0.898
		TN0068977	26		0.141
0505	10,441	TN0066401	39		0.846
		TN0071404	5		0.109
		TN0071412	10		0.217
0507	13,589	TN0071471	96		1.601

Ready Mixed Concrete Facilities (RMCFs)

Total loading from RMCFs is the sum of loading from process wastewater discharges and storm water runoff. Estimates of loading (ref.: Table D-2) from the RMCF located in an impaired subwatershed were determined as follows.

The existing loading from process wastewater discharge for RMCFs is based on facility design flow, the daily maximum permit limit for TSS, and the area of the HUC-12 subwatershed in which the facility is located. Loads are expressed as average annual loads per unit area and are summarized in Table D-2.

$$AAL_{RMCF} = \frac{(Q_d) \text{ x } (DMax)\ (8.34 \text{ lb-l/gal-mg})\ (365 \text{ days/yr})}{(A_{HUC\text{-}12})}$$

where: AAL_{RMCF} = Average annual load [lb/ac/yr]
Q_d = Facility design flow [MGD]
DMax = Daily maximum concentration limit for TSS [mg/l]
$A_{HUC\text{-}12}$ = Area of impaired HUC-12 subwatershed [acres]

The existing loading from storm water runoff for RMCFs is based on an assumed runoff from the site drainage area, the permit TSS cutoff concentration limit for storm water discharges, and the area of the HUC-12 subwatershed in which the facility is located (see Table D-2). Site runoff was estimated by assuming that one half of the annual precipitation falling on the site area results in runoff. Annual precipitation for the Watauga River watershed is approximately 50 in/yr (Midwest Plan Service, 1985).

$$AAL_{RMCF} = \frac{(A_d)\ (Cutoff)\ (Precip.)\ (0.2266 \text{ lb-l/ac-in-mg})\ (0.5)}{(A_{HUC\text{-}12})}$$

where: AAL_{RMCF} = Average annual load [lb/yr]
A_d = Facility (site) drainage area [acres]
Cutoff = Permit TSS cutoff concentration limit for storm water discharges [mg/l]
Precip. = Average annual precipitation for watershed [in/yr]
$A_{HUC\text{-}12}$ = Area of impaired HUC-12 subwatershed [acres]

Total Existing Point Source Loads for Impaired HUC-12 Subwatersheds

Estimated point source loads were summed for each impaired HUC-12 subwatershed and then compared to both existing and target subwatershed sediment loads (ref.: Table D-3).

Table D-2 Estimate of Existing Loads - Ready Mixed Concrete Facilities

HUC-12 Subwatershed (06010103__)	Subwatershed Area	NPDES Permit No.	Process Wastewater			Storm Water Runoff			Total Annual Average Load
			Estimated Flow	Daily Maximum TSS Limit	Annual Average Load	Site Drainage Area	TSS Cutoff Concentration	Annual Average Load	
			[MGD]	[mg/l]	[lb/ac/yr]	[acres]	[mg/l]	[lb/ac/yr]	[lb/ac/yr]
0101	25,801	TNG110197	0.0001	50	0.0006	2.00	200	0.0878	0.088
0505	10,441	TNG110162			0.0015	2.00		0.2170	0.218
		TNG110163			0.0015	1.99		0.2159	0.217
0506	24,023	TNG110298			0.0006	1.25		0.0590	0.060

Table D-3 Estimate of Existing Point Source Loads in Impaired HUC-12 Subwatersheds

HUC-12 Subwatershed (06010103__)	NPDES Permit No.	Facility Type	Average Annual Point Source Load	Existing Subwatershed Load	Point Source Percentage Of Existing Load	Subwatershed Target Load	Point Source Percentage of Target Load
			[lb/ac/yr]	[lb/ac/yr]	[%]	[lb/ac/yr]	[%]
0101	TNG110197	RMCF	0.088				
	TN0066192	Mining	0.149				
	TN0066206	Mining	2.046				
	Subwatershed 0101 Total		**2.284**	1,857	**0.12**	101.9	**2.24**
0102	TN0071463	Mining	**0.120**	997	**0.01**	123.1	**0.10**
0103	TN0071315	Mining	0.065				
	TN0072672	Mining	0.032				
	Subwatershed 0103 Total		**0.097**	700	**0.01**	123.1	**0.08**
0501	TN0001775	Mining	0.898				
	TN0068977	Mining	0.141				
	Subwatershed 0501 Total		**1.039**	592	**0.18**	123.1	**0.84**
0505	TNG110162	RMCF	0.218				
	TNG110163	RMCF	0.217				
	TN0066401	Mining	0.846				
	TN0071404	Mining	0.109				
	TN0071412	Mining	0.217				
	Subwatershed 0505 Total		**1.608**	1,086	**0.15**	399.8	**0.40**
0506	TNG110298	RMCF	**0.060**	488	**0.01**	399.8	**0.02**
0507	TN0071471	Mining	**1.601**	4,294	**0.04**	399.8	**0.40**

Note: A spreadsheet was used for this calculation and values are approximate due to rounding.

APPENDIX E

Public Notice Announcement

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF WATER POLLUTION CONTROL

PUBLIC NOTICE OF AVAILABILITY OF PROPOSED TOTAL MAXIMUM DAILY LOADS (TMDLs) FOR SILTATION & HABITAT ALTERATION IN THE WATAUGA RIVER WATERSHED (HUC 06010103), TENNESSEE

Announcement is hereby given of the availability of Tennessee's proposed Total Maximum Daily Loads (TMDLs) for siltation and habitat alteration in the Watauga River Watershed located in east Tennessee. Section 303(d) of the Clean Water Act requires states to develop TMDLs for waters on their impaired waters list. TMDLs must determine the allowable pollutant load that the water can assimilate, allocate that load among the various point and nonpoint sources, include a margin of safety, and address seasonality.

A number of waterbodies in the Watauga River watershed are listed on Tennessee's 2004 303(d) list as not supporting designated use classifications due, in part, to siltation and habitat alteration associated with land development, urban runoff, and agricultural sources. The TMDLs utilize Tennessee's general water quality criteria, ecoregion reference site data, land use data, digital elevation data, a sediment loading and delivery model, and an appropriate Margin of Safety (MOS) to establish reductions in sediment loading which will result in reduced in-stream concentrations and the attainment of water quality standards. The TMDLs require reductions in sediment loading of approximately 18% to 95% in the impaired waterbodies.

The proposed siltation/habitat alteration TMDLs may be downloaded from the Department of Environment and Conservation website:

http://www.state.tn.us/environment/wpc/tmdl/proposed.php

Technical questions regarding this TMDL should be directed to the following members of the Division of Water Pollution Control staff:

Mary Wyatt, Watershed Management Section
Telephone: 615-532-0714
e-mail: Mary.Wyatt@state.tn.us

Sherry H. Wang, Ph.D., Watershed Management Section
Telephone: 615-532-0656
e-mail: Sherry.Wang@state.tn.us

Persons wishing to comment on the TMDLs are invited to submit their comments in writing no later than February 13th, 2006 to:

Division of Water Pollution Control
Watershed Management Section
6th Floor, L & C Annex
401 Church Street
Nashville, TN 37243-1534

All comments received prior to that date will be considered when revising the TMDL for final submittal to the U.S. Environmental Protection Agency.

The TMDL and supporting information are on file at the Division of Water Pollution Control, 6th Floor, L & C Annex, 401 Church Street, Nashville, Tennessee. They may be inspected during normal office hours. Copies of the information on file are available on request.