TOTAL MAXIMUM DAILY LOAD (TMDL)

For

Siltation and Habitat Alteration

In The

Little Tennessee River Watershed (HUC 06010204)

Blount, Loudon, and Monroe Counties, Tennessee

FINAL

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LIST OF ABBREVIATIONS

ADB	USEPA/TDEC Assessment Database
ARS	Agriculture Research Station
BMP	Best Management Practices
CFR	Code of Federal Regulations
DEM	Digital Elevation Model
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
NRCS	Natural Resource Conservation Service
NRI	National Resources Inventory
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
TDOT	Tennessee Department of Transportation
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids

LIST OF ABBREVIATIONS, Cont.

TVA	Tennessee Valley Authority
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

LITTLE TENNESSEE RIVER WATERSHED (HUC 06010204)

Total Maximum Daily Load for Siltation/Habitat Alteration in Waterbodies Identified on the State of Tennessee's *2006 303(d) List*

Impaired Waterbody Information:

State: Tennessee
Counties: Blount, Loudon, and Monroe
Watershed: Tennessee River (HUC 06010204)
Watershed Area: 780.5 mi^2
Constituent of Concern: Siltation/Habitat Alteration
Impaired Waterbody: *2006 303(d) List*

Waterbody ID	Impacted Waterbody	Miles/Acres Impaired
TN06010204002_1000	Fork Creek	19.30
TN06010204004_0200	Craighead Creek	8.50
TN06010204042_0100	Centenary Creek	3.25
TN06010204043_0300	Little Baker Creek	6.10
TN06010204043_1000	Baker Creek	18.22
TN06010204045_0100	North Fork Notchy Creek	12.80
TN06010204045_1000	Notchy Creek	11.20

Designated Uses: Fish & aquatic life, Irrigation, Livestock Watering & Wildlife, and Recreation. Some waterbodies in watershed also classified for Domestic Water Supply, Industrial Water Supply, Navigation, Trout Stream, and/or Naturally Reproducing Trout Stream (TDEC, 2004).

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 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.

TMDL Development

General Analysis Methodology:

- Analysis performed using the Watershed Characterization System Sediment Tool (based on Universal Soil Loss Equation (USLE)) 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 Waste Load Allocations (WLAs) for Ready Mixed Concrete Facilities (RMCFs) and regulated mining sites. Most loading from these sources is small compared to total loading. Since the Total Suspended Solids (TSS) component of Sewage Treatment Plant (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 National Pollution Discharge Elimination System (NPDES) regulated construction storm water discharges, and Load Allocations (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

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

HUC-12 Subwatershed (06010204___)	Waterbody ID	Waterbody	Level IV Ecoregion	TMDL (Required Overall Load Reduction)	Required Load Reduction	
					WLAs (Construction SW and MS4s)	LAs (Nonpoint Sources)
				[%]	[%]	[%]
0205	06010204042_0100	Centenary Creek	66e	81.8	82.7	82.7
0409	06010204045_0100	North Fork Notchy Creek	67i	35.3	38.6	38.6
	06010204045_1000	Notchy Creek				
0502	06010204043_0300	Little Baker Creek	67f	16.9	21.0	21.0
	06010204043_1000	Baker Creek				
0504	06010204004_0200	Craighead Creek	67i	56.1	58.3	58.3
0505	06010204002_1000	Fork Creek	67f	39.7	42.7	42.7

Note: Calculations were conducted for all HUC-12 subwatersheds containing waterbodies identified as impaired for siltation/habitat alteration.

WLAs for RMCFs and Mining Sites:

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

Ready Mixed Concrete Facilities Permitted to Discharge TSS and Located in an Impaired Subwatershed

HUC-12 Subwatershed (06010204___)	NPDES Permit No.	Name	TSS Daily Max Limit [mg/l]
0504	TNG110234	R&S Concrete	50

Mining Sites Permitted to Discharge TSS and Located in an Impaired Subwatershed

HUC-12 Subwatershed (06010204___)	NPDES Permit No.	Name	TSS Daily Max Limit [mg/l]
0505	TN0068969	Craighead Limestone Co. (Craighead Limestone Quarry)	40
	TN0072346	Vulcan Construction Materials (Madisonville Quarry)	

TOTAL MAXIMUM DAILY LOAD (TMDL)
FOR SILTATION/HABITAT ALTERATION
LITTLE TENNESSEE RIVER WATERSHED (HUC 06010204)

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 Little Tennessee River Watershed, Hydrologic Unit Code (HUC) 06010204, is located in North Carolina and Southeast Tennessee (ref.: Figure 1). The information (including figures and tables) presented hereafter in this document is for the Tennessee portion of the watershed only. The watershed includes parts of Blount, Loudon, and Monroe counties in Tennessee. The Little Tennessee River Watershed lies within two Level III ecoregions (Blue Ridge Mountains and Ridge and Valley and Southwestern Appalachians) and contains seven Level IV subecoregions as shown in Figure 2 (USEPA, 1997):

- The Southern Sedimentary Ridges (66e) in Tennessee include some of the westernmost foothill areas of the Blue Ridges 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.

- The Southern Metasedimentary Mountains (66g) are steep, dissected, biologically-diverse mountains that include Clingmans Dome (6,643 feet), the highest point in Tennessee. The Precambrian-age metamorphic and sedimentary geologic materials are generally older and more metamorphosed than the Southern Sedimentary Ridges (66e) to the west and north. The Appalachian oak forests and, at higher elevations, the northern hardwoods forests include a variety of oaks and pines, as well as silverbell, hemlock, yellow poplar, basswood, buckeye, yellow birch, and beech. Spruce-fir forests, found generally above 5,500 feet, have been affected greatly over the past twenty-five years by the balsam woolly aphid. The Copper Basin, in the southeast corner of Tennessee, was the site of copper mining and smelting from the 1850s to 1987, and once left more than fifty square miles of eroded earth.

Figure 1 Location of the Little Tennessee River Watershed

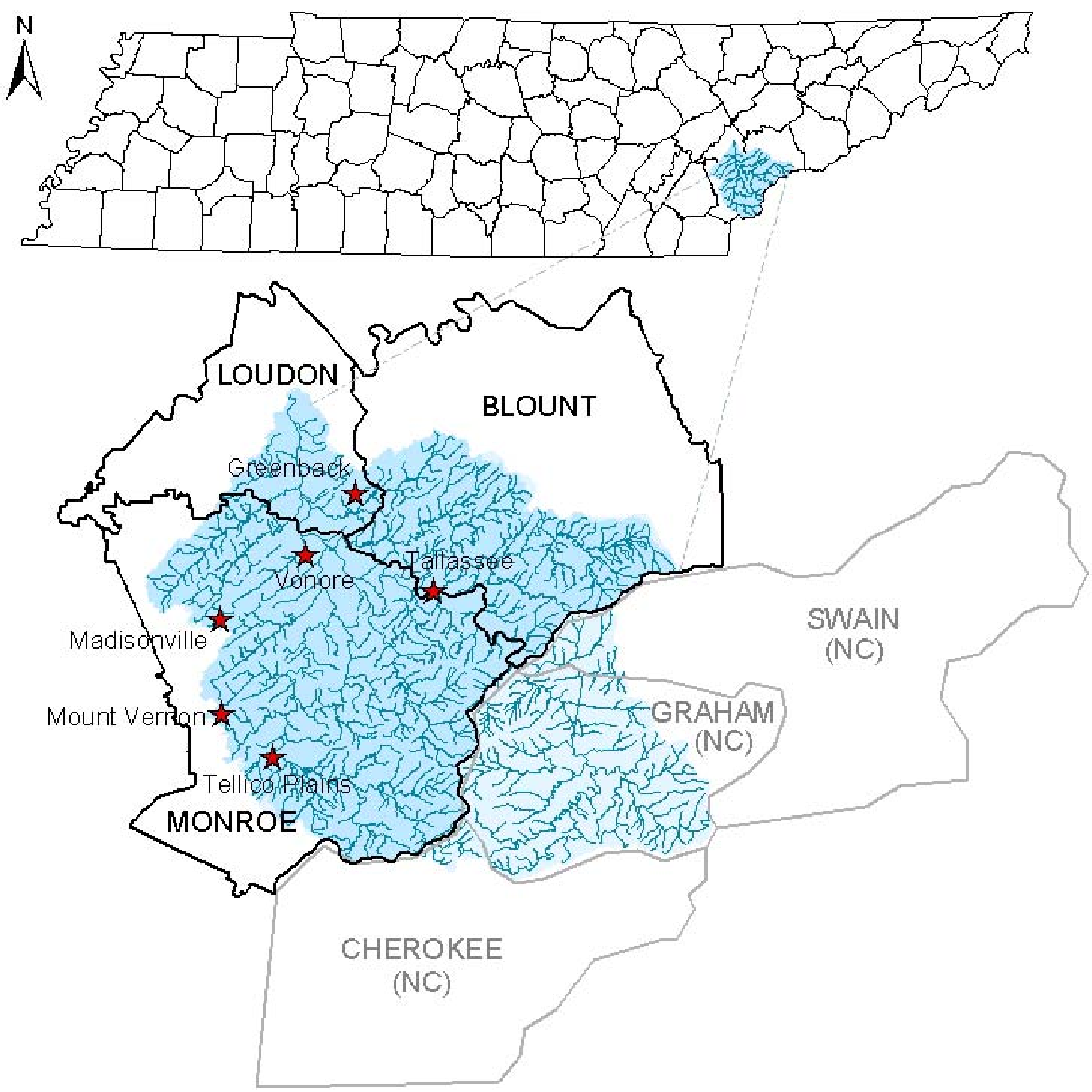
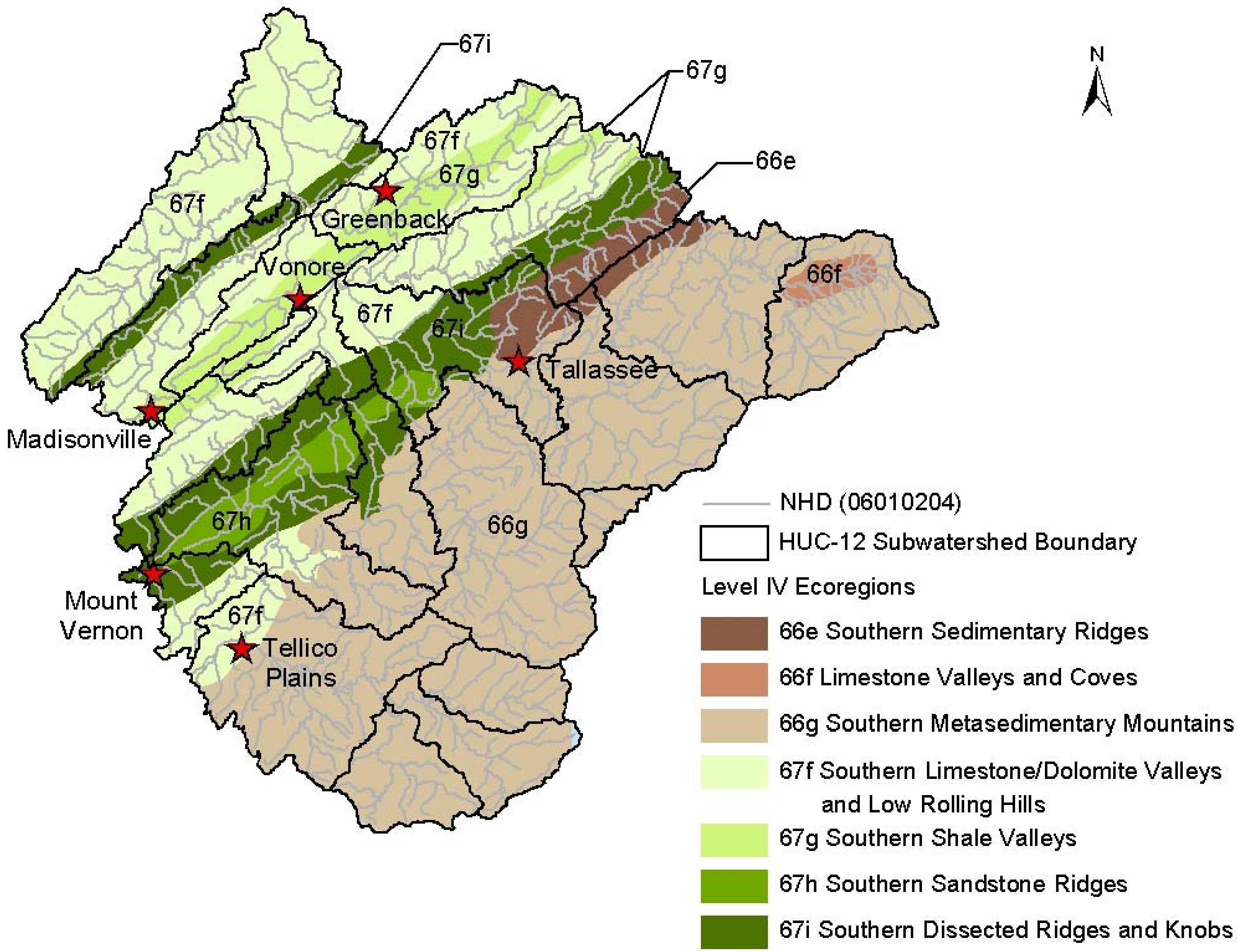


Figure 2 Level IV Ecoregions in the Little Tennessee River Watershed



- 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 uses, as well as areas of thick forest. White oak forest, bottomland oak forest, and sycamore-ash-elm riparian forests are the common forest types. Grassland barrens intermixed with cedar-pine glades also occur here.

- Southern Shale Valleys (67g) consist of lowlands, rolling valleys, 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.

- The Southern Sandstone Ridges (67h) ecoregion encompasses the major sandstone ridges, but these ridges also have areas of shale and siltstone. The steep, forested chemistry of streams flowing down the ridges can vary greatly depending on the geologic material. The higher elevation ridges are in the north, including Wallen Ridge, Powell Mountain, Clinch Mountain, and Bays Mountain. White Oak Mountain in the south has some sandstone on the west side, but abundant shale and limestone as well. Grindstone Mountain, capped by the Gizzard Group sandstone, is the only remnant of Pennsylvanian-age strata in the Ridge and Valley of Tennessee.

- Southern Dissected Ridges and Knobs (67i) contain crenulated, broken, or hummocky ridges. The ridges on the east side of Tennessee's Ridge and Valley tend to be associated with the Ordovician Sevier shale, Athens shale, and Holston and Lenoir limestones. These can include calcareous shale, limestone, siltstone, sandstone, and conglomerate. In the central and western part the shale ridges are associated with the Cambrian-age Rome Formation: shale and siltstone with beds of sandstone. Chestnut oak forests and pine forests are typical for the higher elevations of the ridges, with white oak, mixed mesophytic forest, and tulip poplar on the lower slopes, knobs, and draws.

The Tennessee portion of the Little Tennessee River Watershed (HUC 06010204) has approximately 1,075.6 miles of streams and 29.5 square miles of reservoir (based on the USEPA/TDEC Assessment Database (ADB)) and drains approximately 780.5 square miles (ref.: Table 1) to the Tennessee River. 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 Little Tennessee River Watershed is summarized in Table 1 and shown in Figure 3.

Table 1 Land Use Distribution - Little Tennessee River Watershed

Land use	Area		
	[acres]	[mi^2]	[% of watershed]
Bare Rock/Sand/Clay	4	0.0	0.0
Deciduous Forest	150,805	235.6	30.2
Emergent Herbaceous Wetlands	26	0.0	0.0
Evergreen Forest	136,228	212.9	27.3
High Intensity Commercial/Industrial/Transportation	1,235	1.9	0.2
High Intensity Residential	107	0.2	0.0
Low Intensity Residential	1,914	3.0	0.4
Mixed Forest	107,254	167.6	21.5
Open Water	16,047	25.1	3.2
Other Grasses (Urban/Recreational)	1,134	1.8	0.2
Pasture/Hay	64,772	101.2	13.0
Row Crops	17,366	27.1	3.5
Transitional	2,383	3.7	0.5
Woody Wetlands	270	0.4	0.1
Total	**499,546**	**780.5**	**100.0**

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

3.0 PROBLEM DEFINITION

The State of Tennessee's *2006 303(d) List* (TDEC, 2006) identified a number of waterbodies in the Little Tennessee 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. Designated use classifications for streams can be found in *Rules of Tennessee Department of Environment and Conservation, Tennessee Water Quality Control Board, Division of Water Pollution Control, Chapter 1200-4-4 Use Classification for Surface Waters, January, 2004* (TDEC, 2004). The designated use classifications for the Little Tennessee River include Fish & Aquatic Life, Irrigation, Livestock Watering & Wildlife, and Recreation. Some waterbodies in the watershed are also classified for Domestic Water Supply, Industrial Water Supply, Navigation, Trout Stream, and/or Naturally Reproducing Trout Stream.

A description of the stream assessment process in Tennessee can be found in *2006 305(b) Report, The Status of Water Quality in Tennessee* (TDEC, 2006a). 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 ADB and is referenced to the waterbody IDs in Table 2. Assessment Database information may be accessed at:

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

An example of a typical stream assessment (Fork Creek) is shown in Appendix A.

Figure 3 MRLC Land Use in the Little Tennessee River Watershed

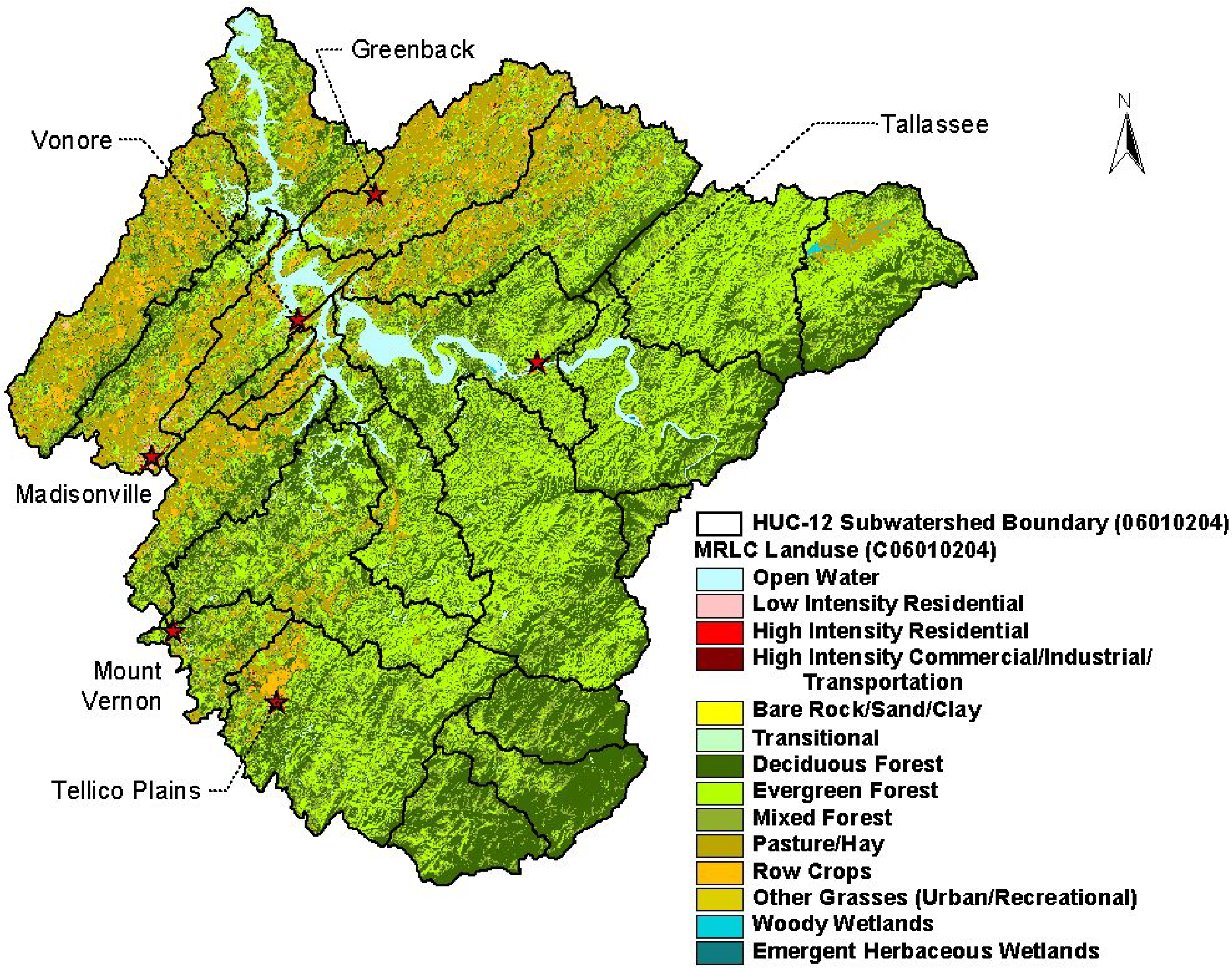


Table 2 *2006 303(d) List* **- Stream Impairment Due to Siltation/Habitat Alteration in the Little Tennessee River Watershed**

Waterbody ID	Impacted Waterbody	Miles/Acres Impaired	CAUSE / TMDL Priority	Pollutant Source
06010204002_1000	Fork Creek	19.30	Nitrate/Loss of biological integrity due to siltation/Escherichia coli	Pasture Grazing
06010204004_0200	Craighead Creek	8.50	Alteration in stream-side or littoral vegetative cover Loss of biological integrity due to siltation	Pasture Grazing
06010204042_0100	Centenary Creek	3.25	Alteration in stream-side or littoral vegetative cover Loss of biological integrity due to siltation	Pasture Grazing
06010204043_0300	Little Baker Creek	6.10	Alteration in stream-side or littoral vegetative cover Loss of biological integrity due to siltation	Pasture Grazing
06010204043_1000	Baker Creek	18.22	Alteration in stream-side or littoral vegetative cover/Escherichia coli	Pasture Grazing
06010204045_0100	North Fork Notchy Creek	12.80	Alteration in stream-side or littoral vegetative cover Loss of biological integrity due to siltation	Pasture Grazing
06010204045_1000	Notchy Creek	11.20	Alteration in stream-side or littoral vegetative cover/Loss of biological integrity due to siltation/Escherichia coli	Pasture Grazing

Figure 4 Waterbodies Impaired Due to Siltation/Habitat Alteration (Documented on the *2006 303(d) List*)

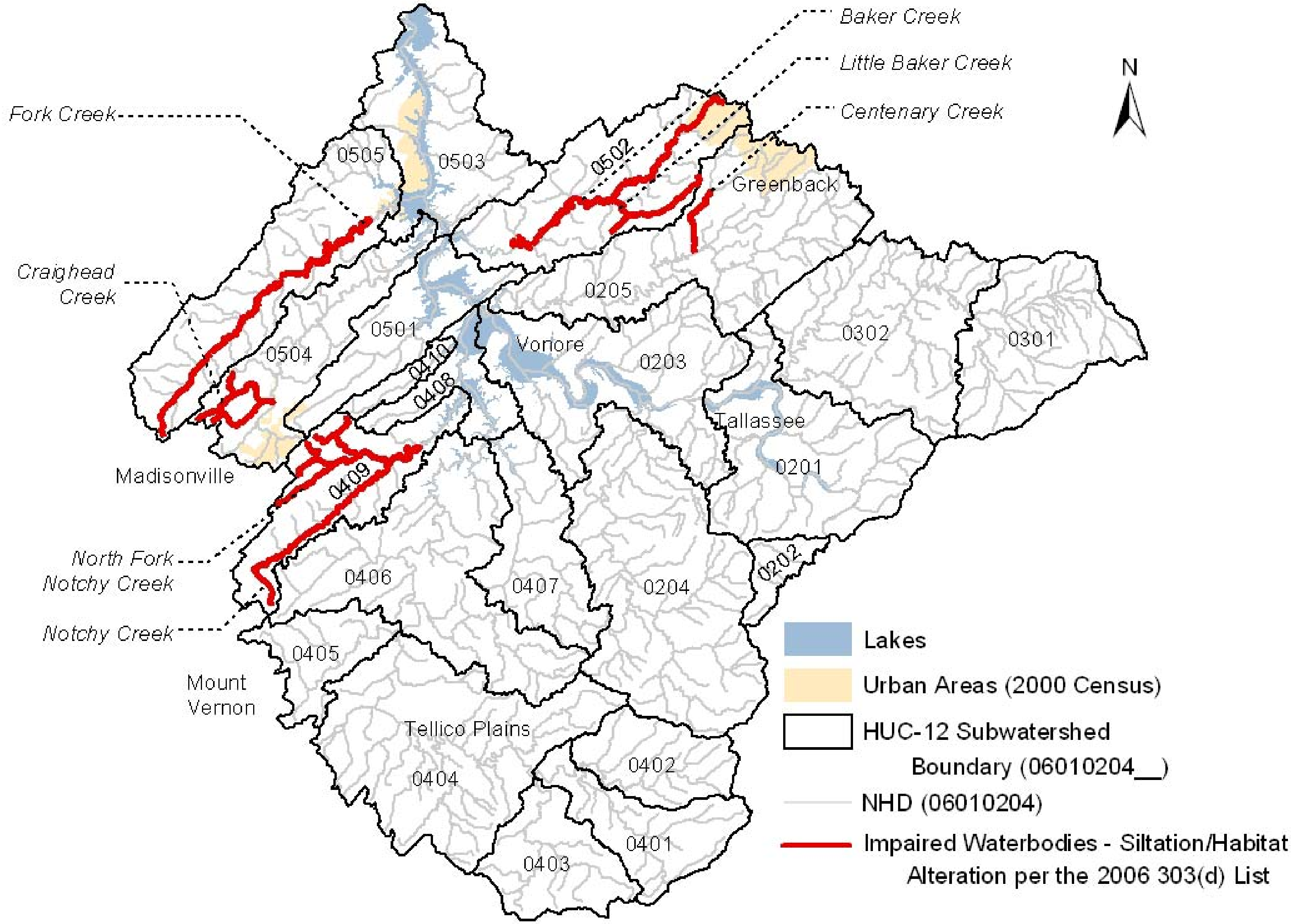


Table 3 Water Quality Assessment of Waterbodies Impaired Due to Siltation/Habitat Alteration

Waterbody ID	Impacted Waterbody	Comments
06010204002_1000	Fork Creek (from Tellico Reservoir to headwaters)	2003 TDEC chemical stations at mile 6.5 (Eve Mill Road) and at mile 14.8 (Hwy 322). At mile 6.5: 10 out of 10 E.coli observations above 941. At mile 14.8: 2 out of 10 E.coli observations over 941. 2003 LAB RBPIII at mile 6.5 and 15.8. At mile 6.5: 5 EPT genera, 32 total genera. Index score = 32. Habitat score = 109. At mile 15.8: 4 EPT genera, 30 total genera. Index score = 26. Habitat score = 116. 1999 TDEC monitoring station at mile 4.6 (Harrison Road). 10 EPT genera, 2 intolerant, 33 total genera. Index score = 9. High NCBI = 6.17. Habitat score = 156. 1997 TVA biological survey at mile 6.5 (Eve Mills). 6 EPT families, 23 total families.
06010204004_0200	Craighead Creek (from Bat Creek to headwaters)	2003 LAB biorecon at mile 1.2 (u/s Dyer Road). 2 EPT genera, zero intolerant, 17 total genera. Biorecon score = 5. Habitat score = 86.
06010204042_0100	Centenary Creek (from Ninemile Creek to headwaters)	2003 TDEC chemical station at mile 0.3 (Indian Warpath Road)). Zero out of 10 E.coli observations were above 941. 2003 LAB RBPIII survey at mile 0.3. 4 EPT genera, 41 total genera. Index score = 28. Habitat score = 101. 1999 TDEC monitoring station at mile 0.3 (Indian Warpath Road). 17 EPT genera, 8 intolerant, 46 total genera. Biorecon score = 13. NCBI = 4.12. Habitat score = 104.
06010204043_0300	Little Baker Creek (from Baker Creek to headwaters)	2003 LAB biorecon at mile 0.5. 4 EPT genera, 1 intolerant, 18 total genera. Biorecon score = 5. Habitat score = 105.

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

Waterbody ID	Impacted Waterbody	Comments
06010204043_1000	Baker Creek (from Tellico Reservoir to headwaters)	2003 chemical station at mile 8.9 (Hwy 95) and at mile 17.5 (Springview Road). At mile 8.9: zero out of 10 E.coli observations above 941. At mile 17.5: 1 out of 10 E.coli observations above 941. 2003 LAB RBPIII at mile 8.9. 8 EPT genera, 25 total genera. Index score = 36. Habitat score = 95. 2003 LAB RBPIII at mile 17.5. 5 EPT genera, 38 total genera. Index score = 22. Habitat score = 79. 1999 TDEC monitoring station at mile 8.9 (Hwy 95). 10 EPT genera, 2 intolerant, 29 total genera. Biorecon score = 7. NCBI = 4.45. Habitat score = 123. TVA fish IBI = 32. E. coli g.m. = 512. 1999 TVA biological survey. 9 EPT families, 20 total families.
06010204045_0100	North Fork Notchy Creek (from Notchy Creek to headwaters)	2003 LAB biorecon at mile 1.2. 3 EPT genera, 2 intolerant, 12 total genera. Biorecon score = 3. Habitat score = 108. Are these data representative?
06010204045_1000	Notchy Creek (from Tellico Reservoir to headwaters)	2003 TDEC chemical station at mile 2.5 (Griffith Branch Road). 3 out of 10 E.coli observations above 941. 2003 LAB RBPIII at mile 2.5. 4 EPT genera, 31 total genera. Index score = 28. Habitat score = 104. 1999 TDEC monitoring station at mile 2.5 (Griffith Branch Road). 12 EPT genera, 2 intolerant, 30 total genera. Biorecon score = 7. NCBI = 5.14. Habitat score = 138. TVA fish IBI = 30. E. coli g.m. = 848. 1997 TVA biological survey at mile 9.6. 8 EPT families, 19 total.

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 is 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 5,800 miles of streams and rivers (TDEC, 2006a). Unlike many chemical pollutants, sediments are typically present in waterbodies in natural or background amounts and are essential to normal ecological function. <u>Excessive sediment loading, however, is a major ecosystem stressor that can adversely impact biota, either directly or through changes to physical habitat.</u>

Excessive sediment loading has a number of adverse effects on Fish & Aquatic Life in surface waters. As stated in excerpts from *Framework For Developing Suspended And Bedded Sediments (SABS) Water Quality Criteri*a (USEPA, 2006):

> Excessive suspended sediment in aquatic systems decrease light penetration, directly impacting productivity that is especially important in estuarine and marine habitats, where trophic interrelationships tend to be more complex and marginal when compared to freshwater aquatic systems. Decreased water clarity impairs visibility and associated behaviors such as prey capture and predator avoidance, recognition of reproductive cues, and other behaviors that alter reproduction and survival. At very high levels, suspended sediments can cause physical abrasion and clogging of filtration and respiratory organs.
>
> In flowing waters, bedded sediments are likely to have a more significant impact on habitat and biota than suspended sediments; while most organisms can tolerate episodic occurrences of increased levels of suspended sediments, impacts can become chronic once the sediment is settled. When sediments are deposited or shift longitudinally along the streambed, infaunal or epibenthic organisms and demersal eggs are vulnerable to smothering and entrapment. In smaller amounts, excess fine sediments can fill in gaps between larger substrate particles, embedding the larger particles, and eliminating interstitial spaces that could otherwise be used as habitat for reproduction, feeding, and cover for invertebrates and fish. A noteworthy example of effects of bedded sediments in streams and rivers is the loss of spawning habitat for salmonid fishes due to increased embeddedness. Increased sedimentation can limit the amount of oxygen in the spawning beds, which can reduce hatching success, trap the fry in the sediment after hatching, or reduce the area of habitat suitable for development.

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 Little Tennessee 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, 2004a):

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.

This TMDL is being established to attain full support of the fish & aquatic life designated use classification. A TMDL established to protect fish & aquatic life will protect all other use classifications for the identified waterbody from adverse alteration due to sediment loading.

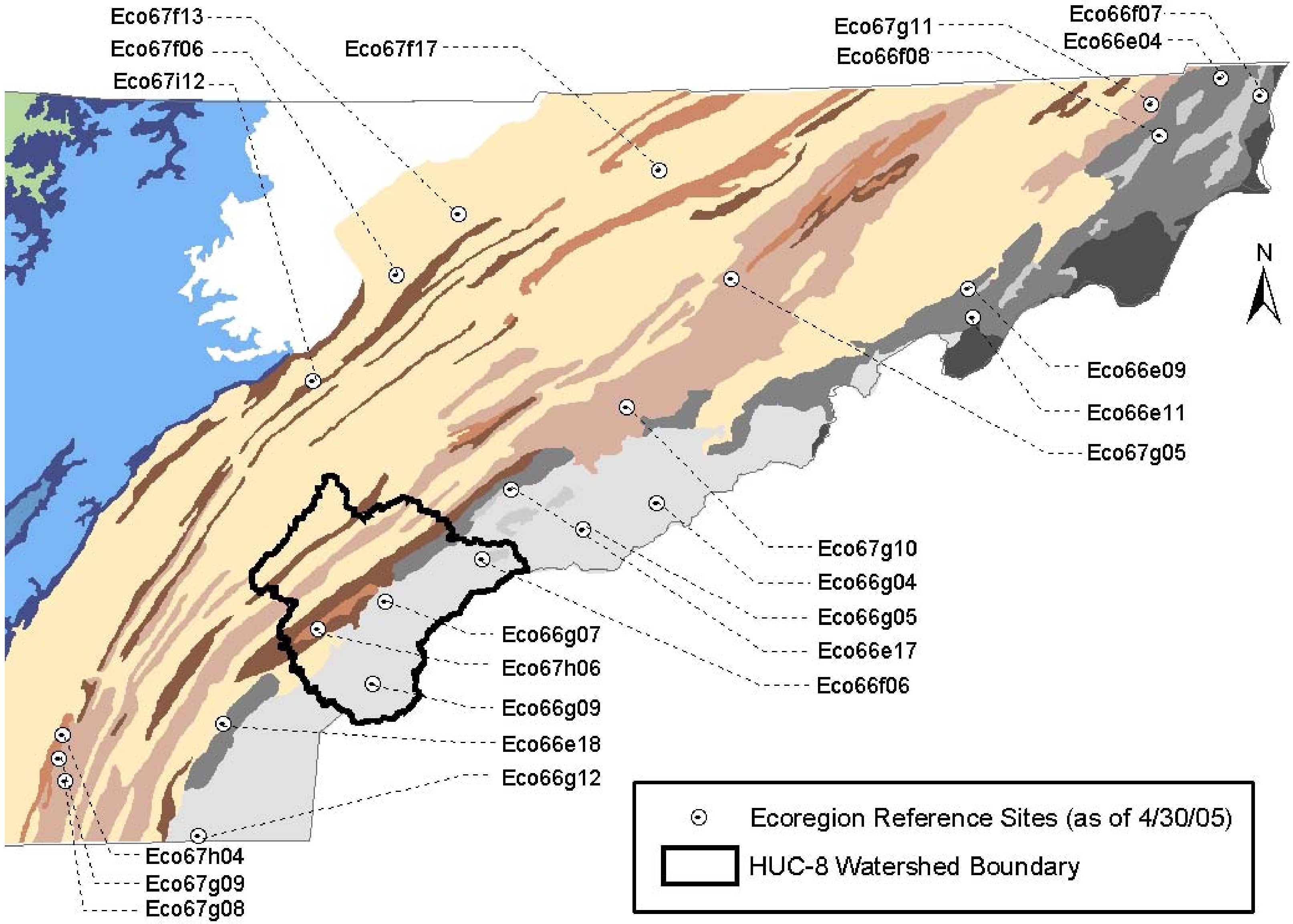
In order for a TMDL to be established, a numeric "target" protective of the uses of the water must be identified to serve as the basis for the TMDL. Where State regulation provides a numeric water quality criteria for the pollutant, the criteria is the basis for the TMDL. Where State regulation does 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 this TMDL, 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 consist of 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 66e, 66f, 66g, 67f, 67g, 67h, and 67i. 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 66e, 66f, 66g, 67f, 67g, 67h, and 67i 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/yr]
66e	Eco66e04	Gentry Creek	2,699	127.6
	Eco66e09	Clark Creek	5,886	83.5
	Eco66e11	Lower Higgins Creek	2,189	64.1
	Eco66e17	Double Branch	1,878	85.1
	Eco66e18	Gee Creek	2,728	222.7
			Geometric Mean (Target Load)	**105.3**
66f	Eco66f06	Abrams Creek	13,857	128.9
	Eco66f07	Beaverdam Creek	29,262	246.7
	Eco66f08	Stony Creek	2,474	363.3
			Geometric Mean (Target Load)	**226.1**
66g	Eco66g04	Middle Prong Little Pigeon River	12,376	85.3
	Eco66g05	Little River	19,999	58.8
	Eco66g07	Citico Creek	1,556	96.7
	Eco66g09	North River	7,470	362.3
	Eco66g12	Sheeds Creek	3,568	93.2
			Geometric Mean (Target Load)	**110.4**
67f	Eco67f06	Clear Creek	1,963	513.0
	Eco67f13	White Creek	1,724	366.4
	Eco67f17	Big War Creek	30,062	543.8
			Geometric Mean (Target Load)	**467.6**
67g	Eco67g05	Bent Creek	21,058	524.0
	Eco67g08	Brymer Creek	4,237	552.0
	Eco67g09	Harris Creek	3,054	571.1
	Eco67g10	Flat Creek	13,236	578.8
	Eco67g11	N Prong Fishdam Creek	1,019	766.8
			Geometric Mean (Target Load)	**593.0**
67h	Eco67h04	Blackburn Creek	653	497.9
	Eco67h06	Laurel Creek	1,793	512.3
			Geometric Mean (Target Load)	**505.0**
67i	Eco67i12	Mill Branch	681	284.3
			(Target Load)	**284.3**

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



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 Little Tennessee River Watershed (ref.: Figure 4). Existing precipitation-based sediment loads for subwatersheds with waterbodies listed on the *2006 303(d) List* as impaired for siltation/habitat alteration are summarized in Table 5.

Table 5 Existing Sediment Load in Subwatersheds With an Impaired Waterbody

HUC-12 Subwatershed (06010204____)	Level IV Ecoregion	Existing Sediment Load
		[lbs/ac/yr]
0205	66e	578
0409	67i	440
0502	67f	562
0504	67i	648
0505	67f	776

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 this TMDL, 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 TMDL 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, sites may be required to obtain coverage under an individual NPDES permit. Of the two permitted RMCFs in the Little Tennessee River Watershed as of October 10, 2006, one is in an impaired subwatershed. It is listed in Table 6 and shown in Figure 6.

Table 6 NPDES Regulated RMCFs Permitted to Discharge TSS and Located in an Impaired Subwatershed (as of October 10, 2006)

HUC-12 Subwatershed (06010204___)	NPDES Permit No.	Name	TSS Daily Max Limit [mg/l]
0504	TNG110234	R&S Concrete	50

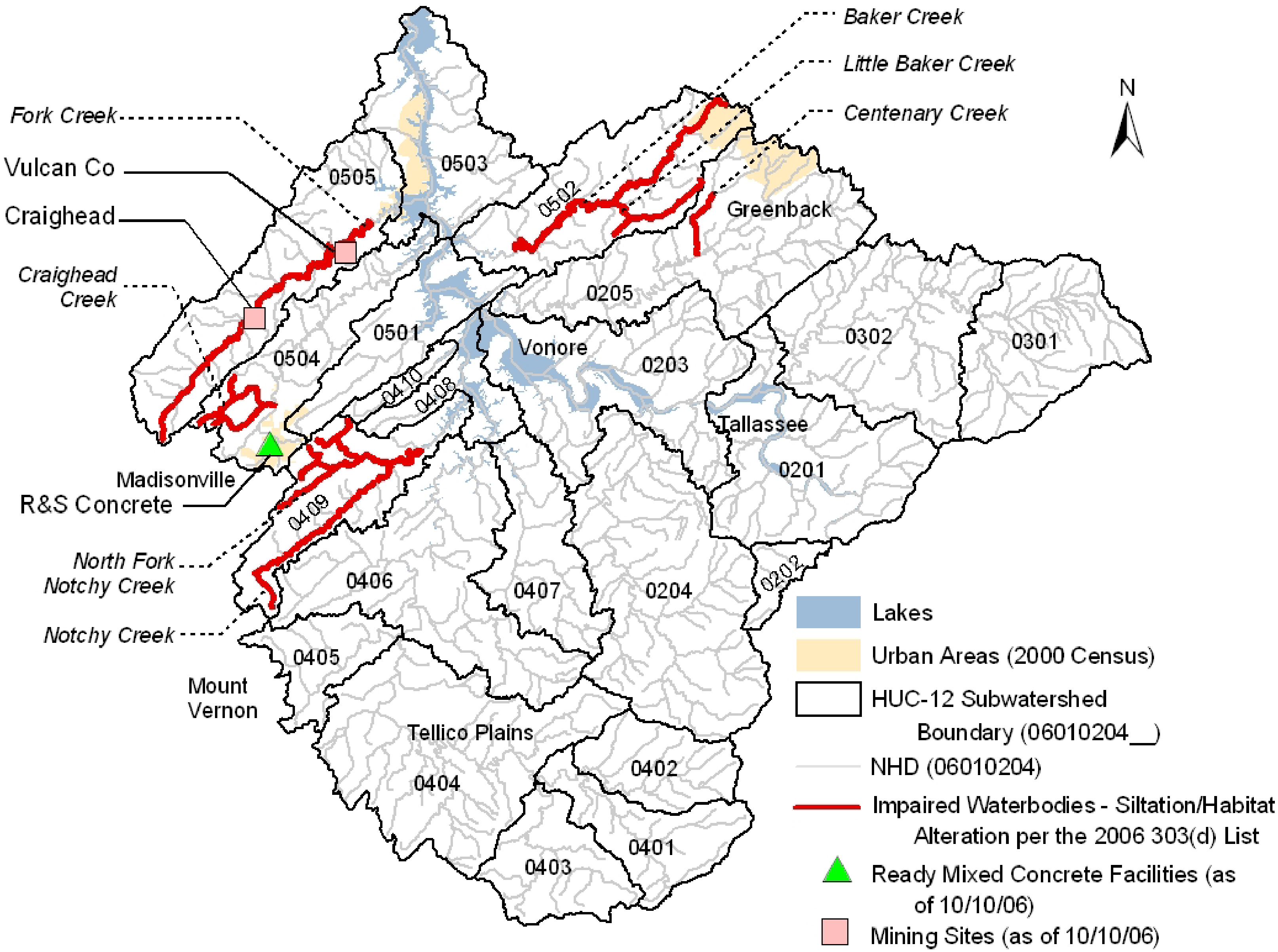
6.1.3 NPDES Regulated Mining Sites

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 three permitted mining sites in the Little Tennessee River Watershed as of October 10, 2006, two are located in an impaired subwatershed. They are listed in Table 7 and shown in Figure 6. Sediment loads (as TSS) to waterbodies from mining site discharges are very small in relation to total sediment loading (ref.: Appendix D).

Table 7 NPDES Regulated Mining Sites Permitted to Discharge TSS and Located in an Impaired Subwatershed (as of October 10, 2006)

HUC-12 Subwatershed (06010204___)	NPDES Permit No.	Name	TSS Daily Max Limit [mg/l]
0505	TN0068969	Craighead Limestone Co. (Craighead Limestone Quarry)	40
	TN0072346	Vulcan Construction Materials (Madisonville Quarry)	

Figure 6 NPDES Regulated RMCFs and Mining Sites Located in Impaired Subwatersheds



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, 2005). 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 39 permitted active construction storm water sites in the Little Tennessee River Watershed on October 10, 2006, 17 were in impaired subwatersheds (ref.: Figure 7).

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. Phase I of the EPA storm water program requires large and medium MS4s to obtain NPDES storm water permits. Large and medium MS4s are those located in incorporated places or counties serving populations greater than 100,000 people. At present, there are no Phase I MS4s in the Little Tennessee River Watershed.

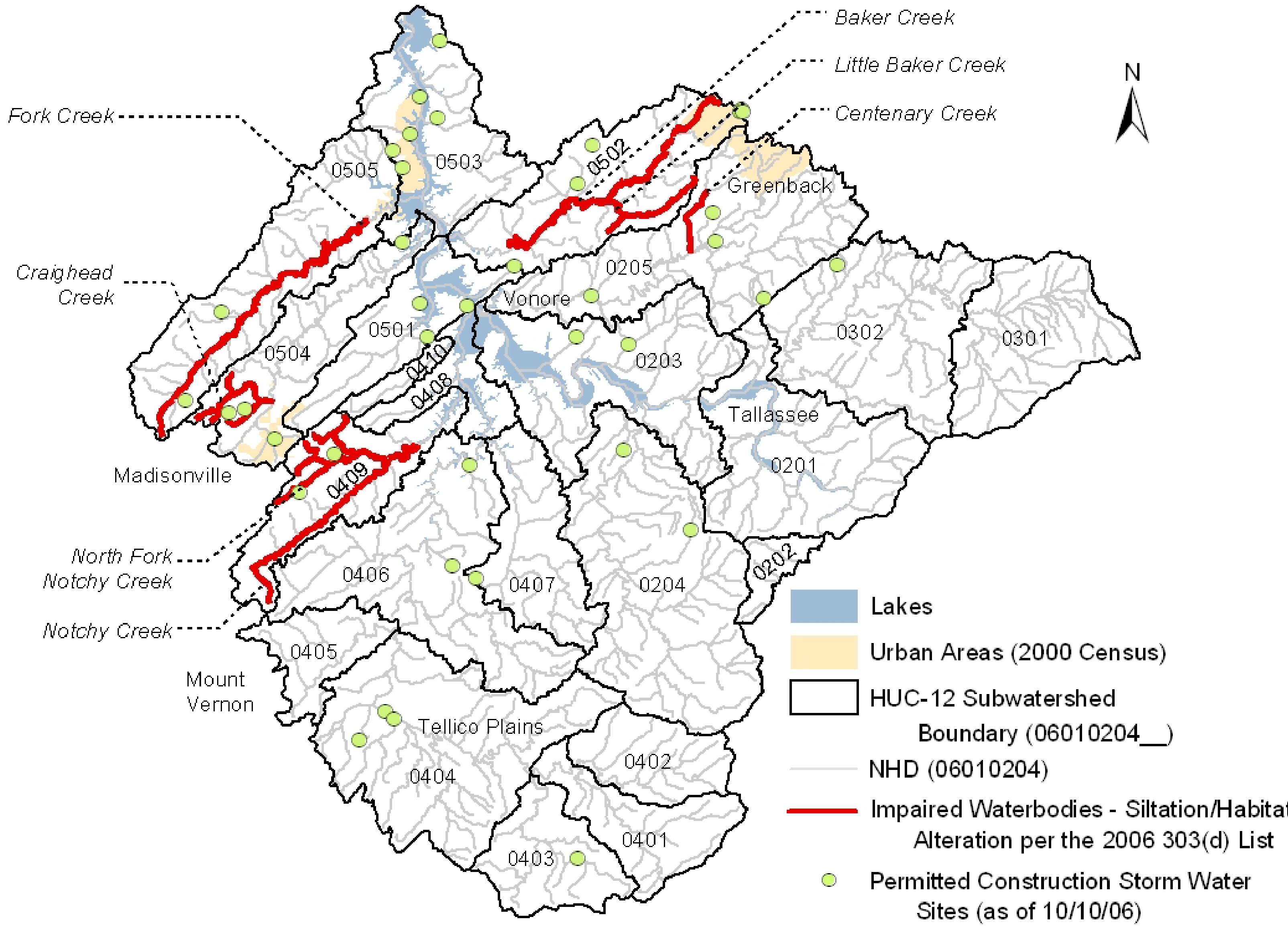
As of March 2003, regulated small MS4s in Tennessee must also obtain NPDES permits in accordance with the Phase II storm water program. A small MS4 is designated as *regulated* if: a) it is located within the boundaries of a defined urbanized area that has a residential population of at least 50,000 people and an overall population density of 1,000 people per square mile; b) it is located outside of an urbanized area but within a jurisdiction with a population of at least 10,000 people, a population density of 1,000 people per square mile, and has the potential to cause an adverse impact on water quality; or c) it is located outside of an urbanized area but contributes substantially to the pollutant loadings of a physically interconnected MS4 regulated by the NPDES storm water program. Most regulated small MS4s in Tennessee obtain coverage under the *NPDES General Permit for Discharges from Small Municipal Separate Storm Sewer Systems* (TDEC, 2003a). There are three permitted Phase II MS4s in the Little Tennessee River Watershed as follows:

NPDES Permit Number	Permittee Name
TNS075116	Blount County
TNS075591	Loudon County

The Tennessee Department of Transportation (TDOT) has been issued an individual MS4 permit (TNS077585) that authorizes discharges of storm water runoff from State road and interstate highway right-of-ways that TDOT owns or maintains, discharges of storm water runoff from TDOT owned or operated facilities, and certain specified non-storm water discharges. This permit covers all eligible TDOT discharges statewide, including those located outside of urbanized areas.

Information regarding storm water permitting in Tennessee may be obtained from the TDEC website http://www.state.tn.us/environment/wpc/stormh2o/.

Figure 7 Location of NPDES Permitted Construction Storm Water Sites in the Little Tennessee River Watershed



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 the impaired waterbodies within the Little Tennessee River Watershed, the primary source of nonpoint sediment loads is agriculture (pasture grazing). The watershed land use distribution based on the 1992 MRLC satellite imagery databases is shown in Appendix C for the impaired HUC-12 subwatershed.

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 code (HUC-12) area basis for subwatersheds containing waterbodies identified as impaired due to siltation and/or habitat alteration on the *2006 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 the sediment TMDL in the Little Tennessee River Watershed.

Sediment loading analysis for the waterbodies impaired due to siltation/habitat alteration in the Little Tennessee 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 Little Tennessee River Watershed sediment TMDL.

- 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 *2006 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 RMCFs and mining sites. 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.

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

- TMDLs, WLAs for construction storm water sites and MS4s, and LAs are expressed as a percent reduction in average annual sediment loading. WLAs for RMCFs and mining sites are equal to loads authorized by their existing permits. Since sediment loading from RMCFs and mining sites is 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 expected 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

The sediment TMDLs for the subwatersheds containing the 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

Of the two Ready Mixed Concrete Facilities (RMCFs) in the Little Tennessee River Watershed with NPDES permits, one is located in an impaired subwatershed (ref. Table 6 and Figure 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 sites.

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

HUC-12 Subwatershed (06010204___)	Waterbody ID	Waterbody Impaired by Siltation/ Habitat Alteration	Level IV Ecoregion	Existing Sediment Load	Target Load	TMDL (overall required load reduction)
				[lbs/ac/yr]	[lbs/ac/yr]	[%]
0205	06010204042_0100	Centenary Creek	66e	578	105.3	81.8
0409	06010204045_0100	North Fork Notchy Creek	67i	440	284.3	35.3
	06010204045_1000	Notchy Creek				
0502	06010204043_0300	Little Baker Creek	67f	562	467.6	16.9
	06010204043_1000	Baker Creek				
0504	06010204004_0200	Craighead Creek	67i	648	284.3	56.1
0505	06010204002_1000	Fork Creek	67f	776	467.6	39.7

7.3.2 Waste Load Allocations for NPDES Regulated Mining Activities

Of the three mining sites in the Little Tennessee River Watershed with NPDES permits, two are located in an impaired subwatershed (ref.: Table 7 and Figure 6). 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 requirements for these sites.

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 *2006 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 impaired subwatersheds, 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, 2005). WLAs should <u>not</u> be construed as numeric permit limits.

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

HUC-12 Subwatershed (06010204__)	Level IV Ecoregion	Percent Reduction – Average Annual Sediment Load	
		WLAs (Construction SW and MS4s) [%]	LAs (Nonpoint Sources) [%]
0205	66e	82.7	82.7
0409	67i	38.6	38.6
0502	67f	21.0	21.0
0504	67i	58.3	58.3
0505	67f	42.7	42.7

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 *2006 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 regulated RMCFs and mining sites) of a biologically healthy (reference) subwatershed located in the same Level IV ecoregion (ref.: Table 9). WLAs apply to MS4 discharges in the impaired subwatershed for which the WLAs were developed and 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 this TMDL. LAs are established for each HUC-12 subwatershed containing a waterbody identified on the *2006 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 impaired subwatersheds, 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 this TMDL, 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 the presently impaired subwatersheds, some amount of explicit MOS is realized due to the WLAs specified for NPDES permitted RMCFs and mining sites 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

One of the two NPDES regulated RMCFs in the Little Tennessee River Watershed is located in an impaired subwatershed (ref.: Table 6 and Figure 6). WLAs will be implemented through NPDES Permit No. TNG110000, *General NPDES Permit for Discharges of Storm Water Runoof and Process Wastewater Associated With Ready Mixed Concrete Facilities* (TDEC, 2003).

8.1.2 NPDES Regulated RMCFs and mining sites

Two of the three NPDES regulated mining sites in the Little Tennessee River Watershed are located in an impaired subwatershed (ref.: Table 7 and Figure 6). The 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 appropriate erosion prevention and sediment controls and 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, 2005). This 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. In addition, the permit specifies a number of special requirements for discharges entering high quality waters or waters identified as impaired due to siltation. The permit does <u>not</u> authorize discharges that would result in a violation of a State water quality standard.

Unless otherwise stated, full compliance with the requirements of the *General NPDES Permit for Storm Water Discharges Associated With Construction Activit*y is considered to be consistent with the WLAs specified in Section 7.3.3 of this TMDL document.

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. Both the *NPDES General Permit for Discharges from Small Municipal Separate Storm Sewer Systems* (TDEC, 2003a) and the TDOT individual MS4 permit (TNS077585) require SWMPs to include the following six minimum control measures:

1) Public education and outreach on storm water impacts;
2) Public involvement/participation;

3) Illicit discharge detection and elimination;
4) Construction site storm water runoff control;
5) Post-construction storm water management in new development and re-development;
6) Pollution prevention/good housekeeping for municipal (or TDOT) operations.

The permits also contain requirements regarding control of discharges of pollutants of concern into impaired waterbodies, implementation of provisions of approved TMDLs, and description of methods to evaluate whether storm water controls are adequate to meet the requirements of approved TMDLs.

In order to evaluate SWMP effectiveness and demonstrate compliance with specified WLAs, MS4s must develop and implement appropriate monitoring programs. An effective monitoring program could include:

- Effluent monitoring at selected outfalls that are representative of particular land uses or geographical areas that contribute to pollutant loading before and after implementation of pollutant control measures.
- Analytical monitoring of pollutants of concern in receiving waterbodies, both upstream and downstream of MS4 discharges, over an extended period of time.
- Instream biological monitoring at appropriate locations to demonstrate recovery of biological communities after implementation of storm water control measures.

The appropriate Environmental Field Office (ref.: http://tennessee.gov/environment/eac/) should be consulted for assistance in the determination of monitoring strategies, locations, frequency, and methods within 12 months after the approval date of this TMDL. Details of the monitoring plan and monitoring data should be included in the annual report required by the MS4 permit.

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 USEPA's Nonpoint Source Pollution website (ref.: 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:

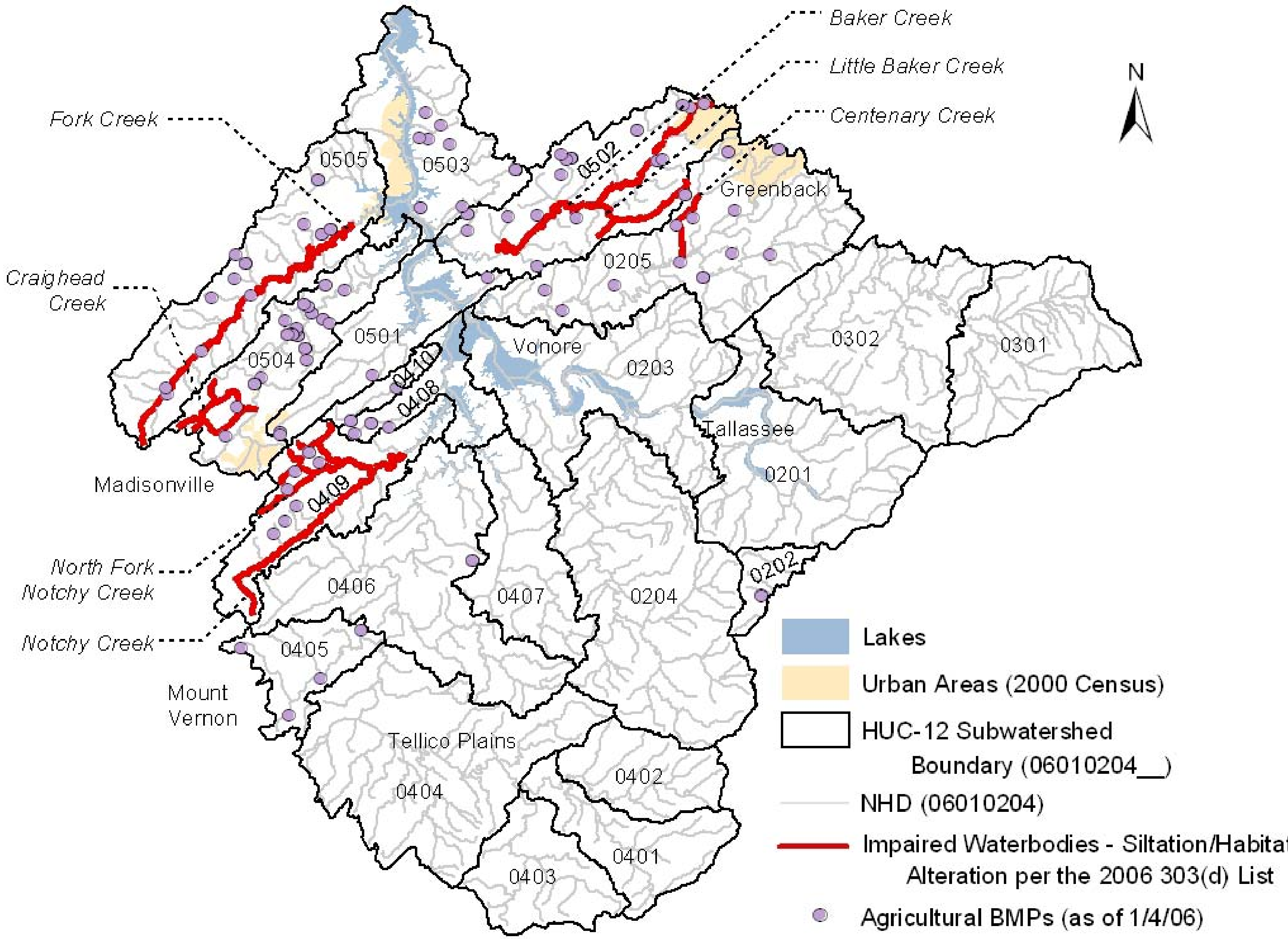
- Detailed surveys of impaired subwatersheds to identify additional sources of sediment loading.
- Advocacy of local area ordinances and zoning that will minimize sediment loading to waterbodies, including establishment of buffer strips along streambanks, reduction of activities within riparian areas, 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 160 BMPs in the Little Tennessee River Watershed as of January 4, 2006, 119 are in sediment-impaired subwatersheds (ref.: Figure 8).

An excellent example of stakeholder involvement and action is the Watershed Association of the Tellico Reservoir. The Watershed Association of the Tellico Reservoir (WATeR) is an all-volunteer organization dedicated to protecting and improving the environment in and around Tellico Reservoir. WATeR is non-profit and non-partisan. The focus is on issues, policies, and practices that promote clean water, air, and natural habitat so that humans can live, work, and play in harmony with native plants and animals as well as with each other. The association strives to work cooperatively with governmental agencies and private organizations with similar goals and responsibilities for environmental protection and appropriate quality economic growth. Public education and demonstration projects are emphasized to make people aware of environmentally friendly practices that affect the watershed. WATeR strives to involve all stakeholders and to represent everyone interested in preserving and enhancing the environmental quality of the Tellico Reservoir Watershed. WATeR has four program committees: Water Quality Improvements, Nature and Hiking Trails, Environmental Education, and Shoreline Trash Collection. WATeR's accomplishments during the first three years include:

- Maintaining a dialog with TVA and TDEC to reflect membership opinion on environmental issues;
- Water quality sampling to answer questions not addressed by TVA or TDEC;
- Public meetings with expert speakers on water quality or environmental protection;
- Demonstration projects to reduce soil erosion and prevent stream sedimentation;
- Collecting tons of trash along the shoreline using hundreds of volunteers;
- Constructing a hiking trail along the eastern shore of Tellico Lake that includes bridges over ravines, trailhead parking facilities, a kiosk with maps and directions, and restrooms; and demonstrating new methods for stabilizing shorelines to prevent wave erosion, intercepting runoff from lawns, and preventing ingress of Canada Geese.

Other information concerning activities of WATeR including how to contact officers of the association is available on the web at http://www.tellicowater.org/.

Figure 8 Location of Agricultural Best Management Practices in the Little Tennessee River Watershed



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. This TMDL will be reevaluated during subsequent watershed cycles and revised as required to assure attainment of applicable water quality standards.

9.0 PUBLIC PARTICIPATION

In accordance with 40 CFR §130.7, the proposed sediment TMDL for the Little Tennessee 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 TMDL 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 TMDL (similar to the website announcement) was included in one of the NPDES permit Public Notice mailings, which was sent to approximately 90 interested persons or groups who had requested this information.

3) A letter was sent to each of the following point source facilities in the Little Tennessee River Watershed that are permitted to discharge treated total suspended solids (TSS) and are located in impaired subwatersheds advising them of the proposed sediment TMDL and its 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:

TN0068969	Craighead Limestone Co. (Craighead Limestone Quarry)
TN0072346	Vulcan Construction Materials (Madisonville Quarry)
TNG110234	R&S Concrete

4) A letter was sent to identified water quality partners in the Little Tennessee River Watershed advising them of the proposed sediment TMDL and its availability on the TDEC website and invited comments. These partners included:

   National Park Service

   Natural Resources Conservation Service

   United States Geological Survey Water Resources Programs – Tennessee District

   U.S. Fish and Wildlife Service

   Tennessee Valley Authority (TVA)

   USDA – Forest Service

   Tennessee Department of Agriculture

   Tennessee Wildlife Resources Agency

   North Carolina Department of Environment and Natural Resources, Division of Water Quality

   The Watershed Association of the Tellico Reservoir

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

TNS075116	Blount County
TNS075591	Loudon 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 this TMDL should be directed to the following members of the Division of Water Pollution Control staff:

Mary L. Wyatt, Watershed Management Section
E-mail: Mary.Wyatt@state.tn.us

Sherry H. Wang, Ph.D., Watershed Management Section
E-mail: Sherry.Wang@state.tn.us

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APPENDIX A

Example of a Typical Stream Assessment (Fork Creek)

Figure A-1 Fork Creek at RM 6.5, Macroinvertebrate Assessment Report – July 22, 2003

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MACROINVERTEBRATE ASSESSMENT REPORT

STATION NUMBER: FORK006.5MO	LOG NUMBER B0307077
STREAM: FORK CREEK	ECOREGION 67F
LOCATION: @ Eve Mills Rd u/s Ford	
HUC TN06010204	SEGMENT ID
SAMPLED BY: SIB/GKH DATE 7/22/03	TAXONOMIST: TWA SCORED BY: AQ. RS.

DHA Check 12-20-04

Note if this is a new station send additional station information requested on header of stream survey form to PAS)

SAMPLE TYPE (circle one) BIORECON SQBANK SQKICK

BIORECON

METRIC	FAMILY LEVEL		GENUS LEVEL	
	Value	Score	Value	Score
Taxa Richness				
EPT Richness				
Intolerant Taxa				

BR INDEX SCORE: ________ TARGET SCORE FOR ECOREGION: ________

Comments

SEMIQUANTITATIVE SAMPLE Total: 214

METRIC	VALUE	SCORE
Taxa Richness	32 ✓	6 ✓
EPT Richness	5 ✓	2 ✓
% EPT	40.2	4 ✓
% OC	~~34~~ 35.0	4 ✓
NCBI	~~5.18~~ 4.91	4 ✓
% Dominant	17.2	6 ✓
% Clingers	64.5 ✓	6 ✓

SQ INDEX SCORE 32 ✓ TARGET SCORE FOR ECOREGION 32

% NUTRIENT TOLERANT ORGANISMS 59.8 ✓
(Cheumatopsyche, Lirceus, Physella, Baetis, Psephenus, Stenelmis, Simulium, Elimia, Oligochaeta, Polypedilum, Rheotanytarsus, Stenacron, Cricotopus, Chironomus).

Comments

HABITAT ASSESSMENT SCORE 109 RR/HIGH GRAD. (or) ____GP/LOW GRAD.

HABITAT GUIDELINES FOR SUBREGION (Circle one) PASS FAIL

Figure A-2 Fork Creek at RM 7.5, Stream Survey Form – July 22, 2003

& Site moved 1.0 mile U/S

007.5M STREAM SURVEY FORM #1

STREAM SURVEY INFORMATION

STATION NUMBER:	FORK007.5MO	ASSESSORS:	SSB/GKH
STREAM NAME:	Fork Creek	DATE:	7/22/03
STATION LOCATION:	Off Bell Mills Rd nr. Ford	TIME:	1115
COUNTY CODE:(FIPS)	123 (STATE CODE) 62	STREAM MILE:	6.5
WBID#/HUC:	TN06010204	STREAM ORDER:	
HUC NAME:	Little TN River	ADB SEGMENT	
LAT/LONG DEC:	N35.64359 W-84.32017	3Q20:	
ECOLOGICAL SUBREGION:	67F	ELEVATION (ft):	947
USGS QUAD:	131 NE	GAZETTEER PAGE	42

PROJECT/PURPOSE:

SAMPLES COLLECTED

Aquatic Life Assessed: Macroinvertebrates Fish Algae Other:

Type of benthic sample: BIORECON SQ KICK SQ BANK DENDY SURBER OTHER

CHEMICALS Y or N

FIELD MEASUREMENTS

METERS USED: Mini Sonde

pH	7.52 SU	DISSOLVED OXYGEN	7.81 PPM (%84.5)
CONDUCTIVITY	302.2 UMHOS	TIME	
TEMPERATURE	18.11 °C	OTHERS	7.6

Previous 48 hours Precip: UNKNOWN NONE LITTLE MODERATE HEAVY FLOODING

Ambient Weather: SUNNY CLOUDY BREEZY RAIN SNOW AIR TEMP:

WATERSHED CHARACTERISTICS

UPSTREAM SURROUNDING LAND USE: (estimated %)

PASTURE	20	URBAN		RESID	
CROPS		INDUSTRY		OTHER	
FOREST	80	MINING			

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

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

PHYSICAL STREAM CHARACTERISTICS LENGTH OF STREAM REACH ASSESSED (m):

SURROUNDING LAND USE :

ESTIMATE %

	RDB	LDB		RDB	LDB		RDB	LDB
PASTURE	20		ROAD URBAN	1	20	RESID.	10	20
CROPS			INDUSTRY			OTHER		
FOREST	70	60	MINING					

% CANOPY COVER: Estimated: 82.16 Open(0-10) Partly Shaded(11-45) Mostly Shaded(46-80) Shaded(>80)

Measured: U/S 76 D/S 80 LB 80 RB 80

BANK HEIGHT (m): 1 HIGH WATER MARK (m): 1.5

SEDIMENT DEPOSITS: NONE SLIGHT MODERATE EXCESSIVE BLANKET

TYPE: SLUDGE MUD SAND SILT NONE OTHER Contaminated Y or N

TURBIDITY CLEAR SLIGHT MODERATE HIGH OPAQUE

ALGAE PRESENT? NONE SLIGHT MODERATE CHOKING TYPE

AQUATIC VEGET. ROOTED FLOATING TYPE

ADDITIONAL COMMENTS:(oil sheen, odor, colors) Site moved ~ 1.0 miles U/S due to lack of habitat & Dam

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Figure A-3 Fork Creek at RM 7.5, Front of Field Sheet – July 22, 2003

Y Site Moved 1.0 mile u/s

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HABITAT ASSESSMENT DATA SHEET- HIGH GRADIENT STREAMS (FRONT)

STREAM NAME FORK Creek		LOCATION Off Eve Mills Rd. u/s	
STATION #	RIVER MILE	STREAM CLASS	
LAT	LONG	RIVER BASIN Little TN RV	
STORET# FORK007.5MC		AGENCY	
INVESTIGATORS SJB/GKH			
FORM COMPLETED BY SJB		DATE 7/22 TIME 1115 AM PM	REASON FOR SURVEY Watershed

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
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 from of newfall, but not yet prepared for colonization (may rate at high end of scale)	20-40% mix of stable 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 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
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 76% surrounded by fine sediment.
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow) (Slow is<0.3m/s deep is >0.5m)	Only 3 of the 4 regimes present (if fast-shallow is missing score lower than 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 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
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 far development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
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.	Waters 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 18	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

Figure A-4 Fork Creek at RM 7.5, Back of Field Sheet – July 22, 2003

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HABITAT ASSESSMENT DATA SHEET- HIGH GRADIENT STREAMS (BACK)

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 18	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
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 5-7); 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 >35.
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
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 area, "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 Protective (score each bank) Note: determine left or right side by facing downstream	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 5 (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
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 6 (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

TOTAL SCORE 116

Figure A-5 Photo of Fork Creek at RM 4.5 – July 22, 2003

Figure A-6 Photo of Fork Creek at RM 4.5 – July 22, 2003

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:

$$A = R \times K \times LS \times C \times P$$

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:

<u>R - Rainfall Erosivity Index</u>

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.

<u>K - Soil Erodibility Factor</u>

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.

<u>LS - Topographic Factor</u>

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.

<u>C - Crop/Vegetation and Management Factor</u>

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 this TMDL. 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 United States Geological Survey (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 4. All of the sediment analyses were performed on the basis of these drainage areas. Land use distribution for impaired subwatersheds is summarized in Appendix C.

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)
     $DR = 0.417762 * A^{(-0.134958)} - 1.27097$, 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 Little Tennessee 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 *2006 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 *2006 303(d) List*)

HUC-12 Subwatershed (06010204__)	***EROSION***				
	Road [tons/yr]	**Source [tons/yr]**	**Total [tons/yr]**	**%Road**	**%Source**
0205	8,997.0	14,862.0	23,859	37.7	62.3
0409	4,715.4	6,784.6	11,500	41.0	59.0
0502	6,122.6	16,610.7	22,733	26.9	73.1
0504	6,386.4	8,939.2	15,326	41.7	58.3
0505	6,880.6	22,529.2	29,410	23.4	76.6

Table B-2 Calculated Sediment Delivery to Surface Waters - Subwatersheds with Waterbodies Impaired Due to Siltation/Habitat Alteration (Documented on the *2006 303(d) List*)

HUC-12 Subwatershed (06010204__)	***SEDIMENT***				
	Road [tons/yr]	**Source [tons/yr]**	**Total [tons/yr]**	**%Road**	**%Source**
0205	4,994.6	6,038.0	11,033	45.3	54.7
0409	2,553.9	1,633.0	4,187	61.0	39.0
0502	2,963.7	4,823.1	7,787	38.1	61.9
0504	3,685.0	2,768.7	6,454	57.1	42.9
0505	3,465.5	8,291.1	11,757	29.5	70.5

Table B-3 Unit Loads - Subwatersheds with Waterbodies Impaired Due to Siltation/Habitat Alteration (Documented on the *2006 303(d) List*)

HUC-12 Subwatershed (06010204__)	HUC-12 Subwatershed Area	***UNIT LOADS***			
		Erosion		**Sediment**	
	[acres]	**[tons/ac/yr]**	**[lbs/ac/yr]**	**[tons/ac/yr]**	**[lbs/ac/yr]**
0205	38,156	0.625	1,251	0.289	578
0409	19,043	0.604	1,208	0.220	440
0502	27,689	0.821	1,642	0.281	562
0504	19,925	0.769	1,538	0.324	648
0505	30,316	0.970	1,940	0.388	776

APPENDIX C

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

Table C-1 Little Tennessee River Watershed - Impaired Subwatershed Land Use Distribution

Land Use	Subwatershed (06010204__)									
	0205		0409		0502		0504		0505	
	[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	8,369	21.9	5,019	26.4	2,920	10.5	3,609	18.1	4,631	15.3
Emergent Herbaceous Wetlands	0	0.0	0	0.0	0.0	0.0	0	0.0	0	0.0
Evergreen Forest	8,381	22	3,068	16.1	3,605	13	3,433	17.2	3,164	10.4
High Intensity Commercial/ Industrial/Transportation	127	0.3	42	0.2	172	0.6	203	1	157	0.5
High Intensity Residential	7	0.0	0	0.0	19	0.1	43	0.2	3	0.0
Low Intensity Residential	303	0.8	108	0.6	371	1.3	320	1.6	203	0.7
Mixed Forest	8,696	22.8	4,342	22.8	4,010	14.5	3,937	19.8	5,683	18.7
Open Water	139	0.4	442	2.3	335	1.2	410	2.1	290	1.0
Other Grasses (Urban/Recreational)	48	0.1	35	0.2	386	1.4	141	0.7	216	0.7
Pasture/Hay	9,598	25.2	4,672	24.5	12,635	45.6	6,148	30.9	12,177	40.2
Quarries/Strip Mines/Gravel Pits	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Row Crops	2,432	6.4	1,244	6.5	3,235	11.7	1,615	8.1	3,611	11.9
Transitional	56	0.1	70	0.4	0	0.0	66	0.3	182	0.6
Woody Wetlands	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total	**38,156**	**100**	**19,043**	**100**	**27,689**	**100**	**19,925**	**100**	**30,316**	**100.0**

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

Land Use	Ecosite Subwatershed											
	Eco66e04		Eco66e09		Eco66e11		Eco66e17		Eco66e18		Eco66f06	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand	0	0.0	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	469	25.0	977	35.8	4,352	31.4
Emergent Herbaceous Wetlands	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.0
Evergreen Forest	210	7.8	1,157	19.7	386	17.6	696	37.0	884	32.4	4,893	35.3
High Intensity Commercial/ Industrial/Transportation	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	0.0
High Intensity Residential	0	0.0	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	0	0.0
Mixed Forest	449	16.5	1,569	26.7	567	25.9	696	37.0	843	30.9	2,867	20.7
Open Water	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.0
Other Grasses (Urban/Recreational)	0	0.0	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	1,567	11.3
Quarries/Strip Mines/Gravel Pits	0	0.0	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	0	0.0
Transitional	0	0.0	0	0.0	0	0.0	0	0.0	23	0.8	0	0.0
Woody Wetlands	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	174	1.3
Total	**2,699**	**99.4**	**5,886**	**100.0**	**2,189**	**100.2**	**1,878**	**99.9**	**2,728**	**99.9**	**13,857**	**100.0**

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

Land Use	Ecosite Subwatershed									
	Eco66f07		Eco66f08		Eco66g04		Eco66g05		Eco66g07	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand	36	0.1	0	0.0	0	0.0	0	0.0	0	0.0
Deciduous Forest	11,868	40.6	1,487	59.8	5,688	45.6	9,186	45.9	256	16.4
Emergent Herbaceous Wetlands	15	0.1	0	0.0	0	0.0	0	0.0	0	0.0
Evergreen Forest	7,100	24.3	342	13.8	5,326	42.7	7,239	36.2	856	54.9
High Intensity Commercial/ Industrial/Transportation	28	0.1	0	0.0	1	0.0	0	0.0	0	0.0
High Intensity Residential	1	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Low Intensity Residential	87	0.3	0	0.0	0	0.0	0	0.0	0	0.0
Mixed Forest	7,570	25.9	622	25.0	1,434	11.5	3,570	17.8	443	28.4
Open Water	4	0.0	0	0.0	11	0.1	2	0.0	0	0.0
Other Grasses (Urban/Recreational)	81	0.3	0	0.0	0	0.0	0	0.0	0	0.0
Pasture/Hay	2,077	7.1	25	1.0	7	0.1	1	0.0	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	232	0.8	11	0.4	3	0.0	2	0.0	0	0.0
Transitional	118	0.4	0	0.0	0	0.0	0	0.0	0	0.0
Woody Wetlands	45	0.2	0	0.0	0	0.0	0	0.0	0	0.0
Total	**29,262**	**100.0**	**2,488**	**100.0**	**12,469**	**100.0**	**19,999**	**100.0**	**1,556**	**99.8**

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

Land Use	Ecosite Subwatershed									
	Eco66g09		Eco66g12		Eco67f06		Eco67f13		Eco67f17	
	[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	5,341	71.4	811	22.7	1,678	85.6	1,505	87.2	17,329	57.6
Emergent Herbaceous Wetlands	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Evergreen Forest	578	7.7	1,814	50.9	43	2.2	76	4.4	2,869	9.5
High Intensity Commercial/Industrial/Transportation	0	0.0	0	0.0	1	0.0	0	0	0.0	0.1
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	2	0.1	0	0.0	16	0.1
Mixed Forest	1,510	20.2	938	26.3	233	11.9	132	7.6	4,178	13.9
Open Water	0	0.0	0	0.0	0	0.0	0	0.0	4	0.0
Other Grasses (Urban/Recreational)	0	0.0	0	0.0	0	0.0	0	0.0	10	0.0
Pasture/Hay	35	0.5	0	0.0	6	0.3	10	0.6	5,296	17.6
Quarries/Strip Mines/Gravel Pits	0	0.0	0	0.0	0	0.0	0	0.0	77	0.3
Row Crops	1	0.0	0	0.0	0	0.0	1	0.1	258	0.9
Transitional	6	0.1	4	0.1	0	0.0	0	0.0	4	0.0
Woody Wetlands	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total	**7,470**	**99.8**	**3,568**	**100.0**	**1,963**	**100.1**	**1,724**	**99.9**	**30,062**	**100.0**

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

Land Use	Ecosite Subwatershed							
	Eco67g05		Eco67g08		Eco67g09		Eco67g10	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand	0	0.0	0	0.0	0	0.0	0	0.0
Deciduous Forest	2,690	12.8	1,076	25.4	1,603	52.5	3,165	23.9
Emergent Herbaceous Wetlands	0	0.0	0	0.0	0	0.0	0	0.0
Evergreen Forest	2,154	10.2	721	17.0	696	22.8	2,669	20.2
High Intensity Commercial/Industrial/Transportation	101	0.5	23	0.5	1	0.0	17	0.1
High Intensity Residential	24	0.1	1	0.0	2	0.1	6	0.0
Low Intensity Residential	114	0.5	64	1.5	48	1.6	48	0.4
Mixed Forest	3,787	18.0	1,087	25.7	497	16.3	2,619	19.8
Open Water	7	0.0	2	0.1	1	0.0	4	0.0
Other Grasses (Urban/Recreational)	193	0.9	46	1.1	10	0.3	16	0.1
Pasture/Hay	10,049	47.7	1,019	24.1	156	5.1	4,420	33.4
Quarries/Strip Mines/Gravel Pits	0	0.0	0	0.0	0	0.0	0	0.0
Row Crops	1,933	9.2	198	4.7	40	1.3	272	2.1
Transitional	0	0.0	0	0.0			0	0.0
Woody Wetlands	8	0.0	0	0.0	0	0.0	0	0.0
Total	**21,058**	**100.0**	**4,237**	**100.0**	**3,054**	**100.0**	**13,236**	**100.0**

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

Land Use	Ecosite Subwatershed							
	Eco67g11		Eco67h04		Eco67h06		67i12	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand	0	0.0	0	0.0	0	0.0	0	0.0
Deciduous Forest	719	70.6	447	68.3	485	27.0	457	67.1
Emergent Herbaceous Wetlands	0	0.0	0	0.0	0	0.0	0	0.0
Evergreen Forest	162	15.9	66	10.1	612	34.1	93	13.7
High Intensity Commercial/Industrial/Transportation	0	0.0	0	0.0	1	0.0	1	0.2
High Intensity Residential	0	0.0	0	0.0	0	0.0	3	0.5
Low Intensity Residential	0	0.0	0	0.0	0	0.0	0	0.0
Mixed Forest	138	13.5	132	20.2	657	36.6	112	16.4
Open Water	0	0.0	0	0.0	30	1.6	0	0.1
Other Grasses (Urban/Recreational)	0	0.0	0	0.0	0	0.0	0	0.0
Pasture/Hay	0	0.0	4	0.6	7	0.4	12	1.7
Quarries/Strip Mines/Gravel Pits	0	0.0	0	0.0	0	0.0	0	0.0
Row Crops	0	0.0	3	0.4	0	0.0	2	0.4
Transitional	0	0.0	0	0.0	1	0.1	0	0.0
Woody Wetlands	0	0.0	0	0.0	0	0.0	0	0.0
Total	**1,019**	**100.0**	**653**	**99.7**	**1,793**	**99.9**	**681**	**100.0**

APPENDIX D

Estimate of Existing Point Source Loads for NPDES Permitted RMCFs and Mining Sites

Determination of Existing Point Source Sediment Loads

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

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-1) from the RMCF located in an impaired subwatershed were determined as follows.

The existing loading from process wastewater discharge for the RMCF is based on facility design flow, the monthly average 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-1.

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

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 the RMCF is based on an assumed runoff from the site drainage area, the cut-off concentration for TSS, and the area of the HUC-12 subwatershed in which the facility is located (ref.: Table D-1). Site runoff was estimated by assuming that one-half of the annual precipitation falling on the site drainage area results in runoff. Annual precipitation for the Little Tennessee River Watershed is approximately 52 in/yr (Midwest Plan Service, 1985).

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

where: AAL_{RMCF} = Average annual load [lb/ac/yr]
A_d = Facility (site) drainage area [acres]
COConc = Cut-off Concentration 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 Loads - Ready Mixed Concrete Facilities

HUC-12 Subwatershed (06020001__)	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 Cut-off Concentration	Annual Average Load	
			[MGD]	[mg/l]	[lb/ac/yr]	[acres]	[mg/l]	[lb/ac/yr]	[lb/ac/yr]
0504	19,925	TNG110234	0.0001	50	0.0008	3	200	0.1774	0.178

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-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 Little Tennessee River Watershed is approximately 52 in/yr (Midwest Plan Service, 1985).

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

where: AAL_{Mining} = Average annual load [lb/ac/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-2 Estimate of Existing Loads – NPDES Permitted Mining Sites

HUC-12 Subwatershed (06010204___)	Subwatershed Area	NPDES Permit No.	Site Drainage Area	Daily Maximum TSS Limit	Annual Average Load
	[acres]		[acres]	[mg/l]	[lb/ac/yr]
0505	30,316	TN0068969	86	40	0.669
		TN0072346	63		0.490

Total Existing Point Source Loads for Impaired HUC-12 Subwatersheds

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

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

HUC-12 Subwatershed (06010204__)	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]	[%]
0504	TNG110234	RMCF	**0.178**	648	**0.03**	284.3	**0.06**
0505	TN0068969	Mining	0.669				
	TN0072346	Mining	0.490				
	Subwatershed 0505 Total		**1.159**	776	**0.15**	467.6	**0.25**

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 LOAD (TMDL) FOR SILTATION & HABITAT ALTERATION IN THE LITTLE TENNESSEE RIVER WATERSHED (HUC 06010204), TENNESSEE

Announcement is hereby given of the availability of Tennessee's proposed Total Maximum Daily Load (TMDL) for siltation and habitat alteration in the Little Tennessee River Watershed located in southeast 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.

One waterbody in the Little Tennessee River Watershed is listed on Tennessee's final 2006 303(d) list as not supporting designated use classifications due, in part, to siltation and habitat alteration associated with agricultural sources (pasture grazing). The TMDL utilizes 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 TMDL requires reductions in sediment loading of approximately 49% in the listed waterbody.

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

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

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 TMDL are invited to submit their comments in writing no later than August 21st, 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.