TOTAL MAXIMUM DAILY LOAD (TMDL)

For

Siltation and Habitat Alteration

In The

Lower French Broad River Watershed (HUC 06010107)

Blount, Cocke, Jefferson, Knox, and Sevier

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
EFO	Environmental Field Office
GIS	Geographic Information System
HUC	Hydrologic Unit Code
IPSI	Integrated Pollutant Source Identification
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

LOWER FRENCH BROAD RIVER WATERSHED (HUC 06010107)

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, Cocke, Jefferson, Knox, and Sevier
Watershed: Lower French Broad River Watershed (HUC 06010107)
Watershed Area: 796.5 mi^2
Constituent of Concern: Siltation/Habitat Alteration
Impaired Waterbodies: *2006 303(d) List*

Waterbody ID	Impacted Waterbody	Miles/Acres Impaired
TN06010107010_1000	West Prong Little Pigeon River	8.1
TN06010107010_1800	Mill Creek	5.9
TN06010107010_1900	Walden Creek	2.6
TN06010107010_1950	Walden Creek	8.6
TN06010107038_1000	Dumplin Creek	19.1

Designated Uses: Fish & Aquatic life, Irrigation, Livestock Watering & Wildlife, and Recreation. Some waterbodies in the watershed also classified for Domestic Water Supply, Industrial Water Supply, Naturally Reproducing Trout Stream, and/or 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 (WCS) 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 <u>instream</u> sediment load from biologically healthy watersheds (Level IV Ecoregion reference sites).
- TMDLs are expressed as a percent reduction in average annual <u>instream</u> 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 <u>not</u> considered in the TMDL analysis (ref.: Sections 3.0 and 6.0).
- WLAs for National Pollution Discharge Elimination System (NPDES) regulated construction storm water discharges are expressed as technology-based average annual <u>erosion</u> loads per unit area disturbed.
- WLAs for Municipal Separate Storm Sewer Systems (MS4s) and Load Allocations (LAs) for nonpoint sources are expressed as a percent reduction in average annual <u>instream</u> sediment load required for a subwatershed containing impaired waterbodies relative to the appropriate reduced target load (target load minus the percent reserved for RMCFs, regulated mining sites, and CSW sites).

Critical Conditions: Methodology takes into account all flow conditions.

Seasonal Variation: Methodology addresses all seasons.

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

TMDL/Allocations

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

HUC-12 Subwatershed (06010107___)	Waterbody ID	Waterbody	Level IV Ecoregion	TMDL (Required Overall Load Reduction)	Required Load Reduction		
					WLA		LA (Nonpoint Sources)
					Construction Storm Water	MS4s	
				Instream Sediment [a]	Site Erosion [b]	Instream Sediment [a]	Instream Sediment [a]
				[% Reduction]	[lbs/ac/yr]	[% Reduction]	[% Reduction]
0203	06010107038_1000	Dumplin Creek	67f	0.3	6,000	12.3	12.3
0312	06010107010_1800	Mill Creek	66g	87.0	6,000	95.2	95.2
	06010107010_1900	Walden Creek					
	06010107010_1950	Walden Creek					
0313	06010107010_1000	West Prong Little Pigeon River	67g	33.0	6,000	41.4	41.4

a. Value shown represents the fraction of erosion that reaches stream (instream sediment at the pour point of the HUC-12 subwatershed).

b. Value shown represents erosion from construction sites.

WLAs for the RMCF and Mining Sites:

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

RMCFs Permitted to Discharge TSS and Located in Impaired Subwatersheds

HUC-12 Subwatershed (06010107___)	NPDES Permit No.	Facility Name	TSS Daily Max Limit	TSS Cut-off Conc. (SW Discharge)
			[mg/l]	[mg/l]
0313	TNG110126	Blalock Lumber Company (Sevierville)	50	200

Mining Sites Permitted to Discharge TSS and Located in Impaired Subwatersheds

HUC-12 Subwatershed (06010107___)	NPDES Permit No.	Name	TSS Daily Max Limit
			[mg/l]
0203	TN0065951	Vulcan Construction Materials, LP (Kodak Quarry)	40
0313	TN0003018	Vulcan Construction Materials, LP (Knoxville Quarry)	

TOTAL MAXIMUM DAILY LOAD (TMDL) FOR SILTATION/HABITAT ALTERATION LOWER FRENCH BROAD RIVER WATERSHED (HUC 06010107)

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).

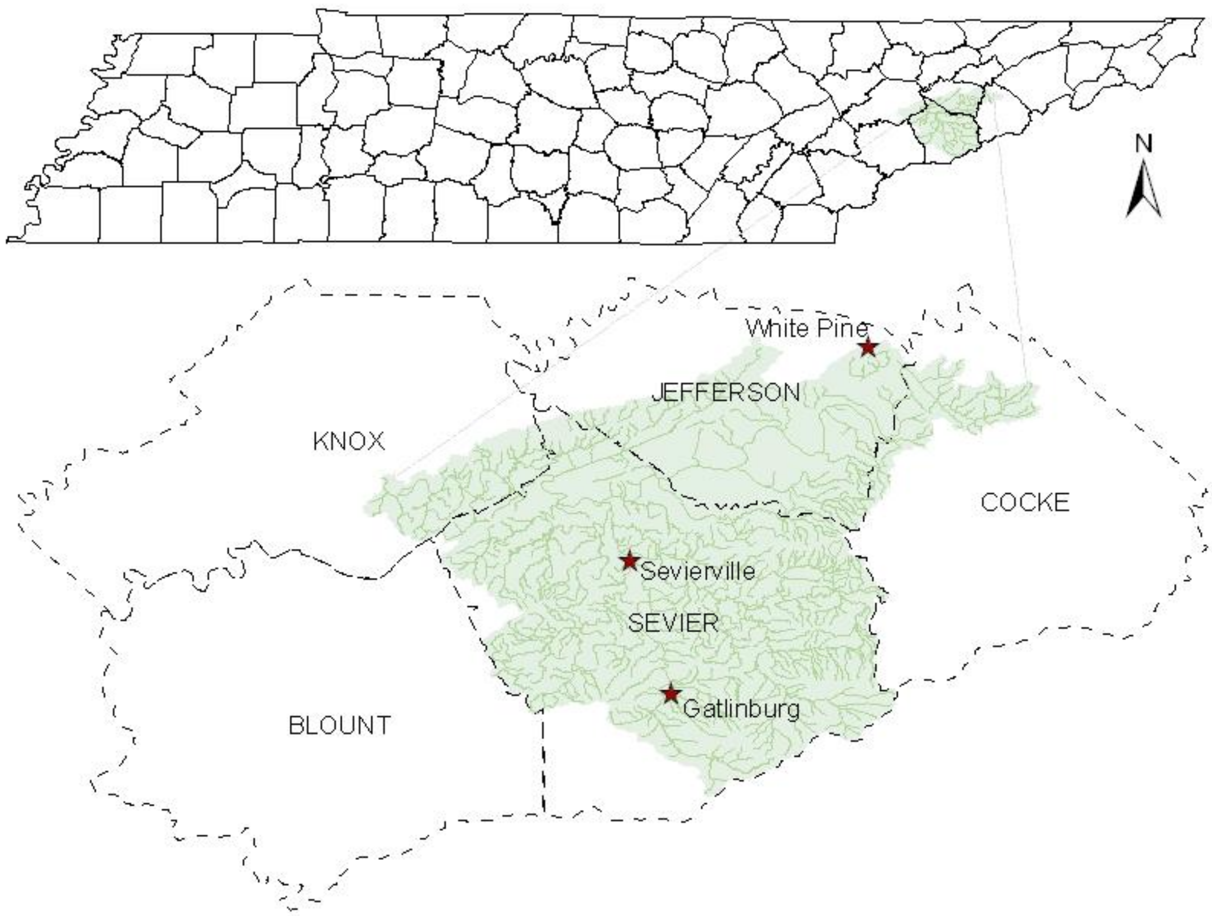
2.0 WATERSHED DESCRIPTION

The Lower French Broad River Watershed, Hydrologic Unit Code (HUC) 06010107, is located in East Tennessee in Blount, Cocke, Jefferson, Knox, and Sevier counties (ref.: Figure 1). The Lower French Broad River Watershed lies within two Level III ecoregions (Blue Ridge Mountains and Ridge and Valley) 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.

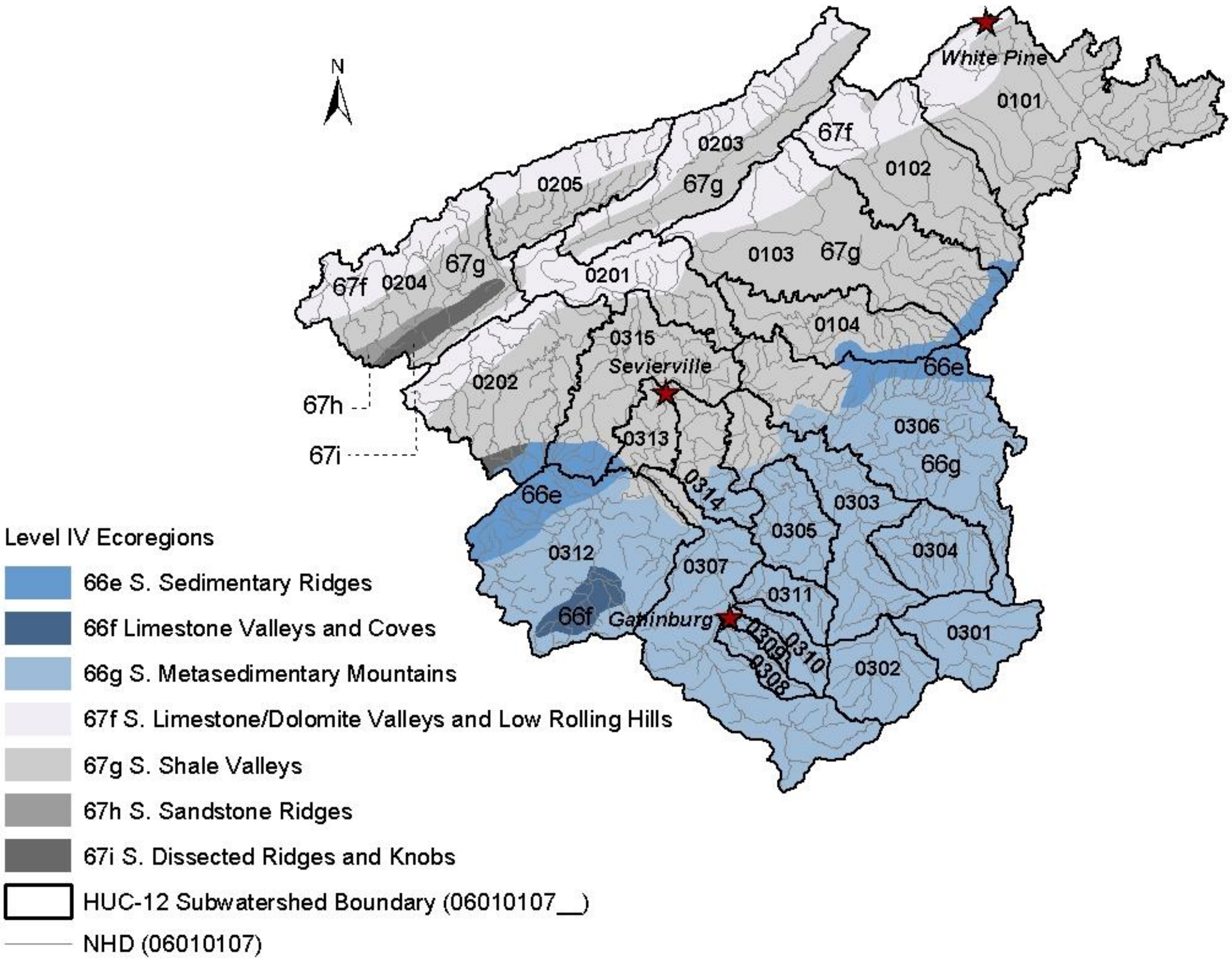
Figure 1 Location of the Lower French Broad River Watershed



- 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.

- The 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 solids vary in their productivity. Landcover includes intensive agriculture, urban and industrial, or areas of thick forest. White oak forests, bottomland oak forests, and sycamore-ash-elm riparian forests are the common forest types, and grassland barrens intermixed with cedar-pine glades also occur here.

Figure 2 Level IV Ecoregions in the Lower French Broad River Watershed



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

- 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.

- The Southern Dissected Ridges and Knobs (67i) contain more crenulated, broken, or hummocky ridges, compared to smoother, more sharply pointed sandstone ridges. Although shale is common, there is a mixture and interbedding of geologic materials. The ridges on the east side of Tennessee's Ridge and Valley tend to be associated with the Ordovician-age 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 of the ecoregion, 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 areas of white oak, mixed mesophytic forest, and tulip poplar on the lower slopes, knobs, and draws.

The Lower French Broad River Watershed (HUC 06010107) has approximately 1,210 miles of streams and 30,400 reservoir/lake acres (based on USEPA/TDEC Assessment Database (ADB)) and drains approximately 796.5 square miles to the Fort Loudoun Lake Reservoir on 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 1990 to 1993. Land use for the Lower French Broad River Watershed is summarized in Table 1 and shown in Figure 3.

3.0 PROBLEM DEFINITION

The State of Tennessee's *2006 303(d) List* (TDEC, 2006) identified a number of waterbodies in the Lower French Broad River Watershed as not fully supporting designated use classifications due, in part, to siltation and/or habitat alteration associated with agriculture, land development, and bank modification such as channelization. These waterbodies are summarized in Table 2 and shown in Figure 4. The designated use classifications for the French Broad River and its tributaries 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, Naturally Reproducing Trout Stream, and/or Trout Stream (TDEC, 2004).

Table 1 Land Use Distribution - Lower French Broad River Watershed

Land use	Area		
	[acres]	[mi^2]	[% of watershed]
Bare Rock/Sand/Clay	12	0.0	0.0
Deciduous Forest	157,876	246.7	31.0
Emergent Herbaceous Wetlands	562	0.9	0.1
Evergreen Forest	105,251	164.5	20.6
High Intensity Commercial/Industrial/Transportation	5,077	7.9	1.0
High Intensity Residential	479	0.7	0.1
Low Intensity Residential	3,559	5.6	0.7
Mixed Forest	110,868	173.2	21.7
Open Water	20,565	32.1	4.0
Other Grasses (Urban/Recreational)	2,685	4.2	0.5
Pasture/Hay	85,310	133.3	16.7
Quarries/Strip Mines/Gravel Pits	203	0.3	0.0
Row Crops	12,272	19.2	2.4
Transitional	3,667	5.7	0.7
Woody Wetlands	1,352	2.1	0.3
Total	509,738	796.5	100.0

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

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 (West Prong Little Pigeon River) is shown in Appendix A.

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

Figure 3 MRLC Land Use in the Lower French Broad River Watershed

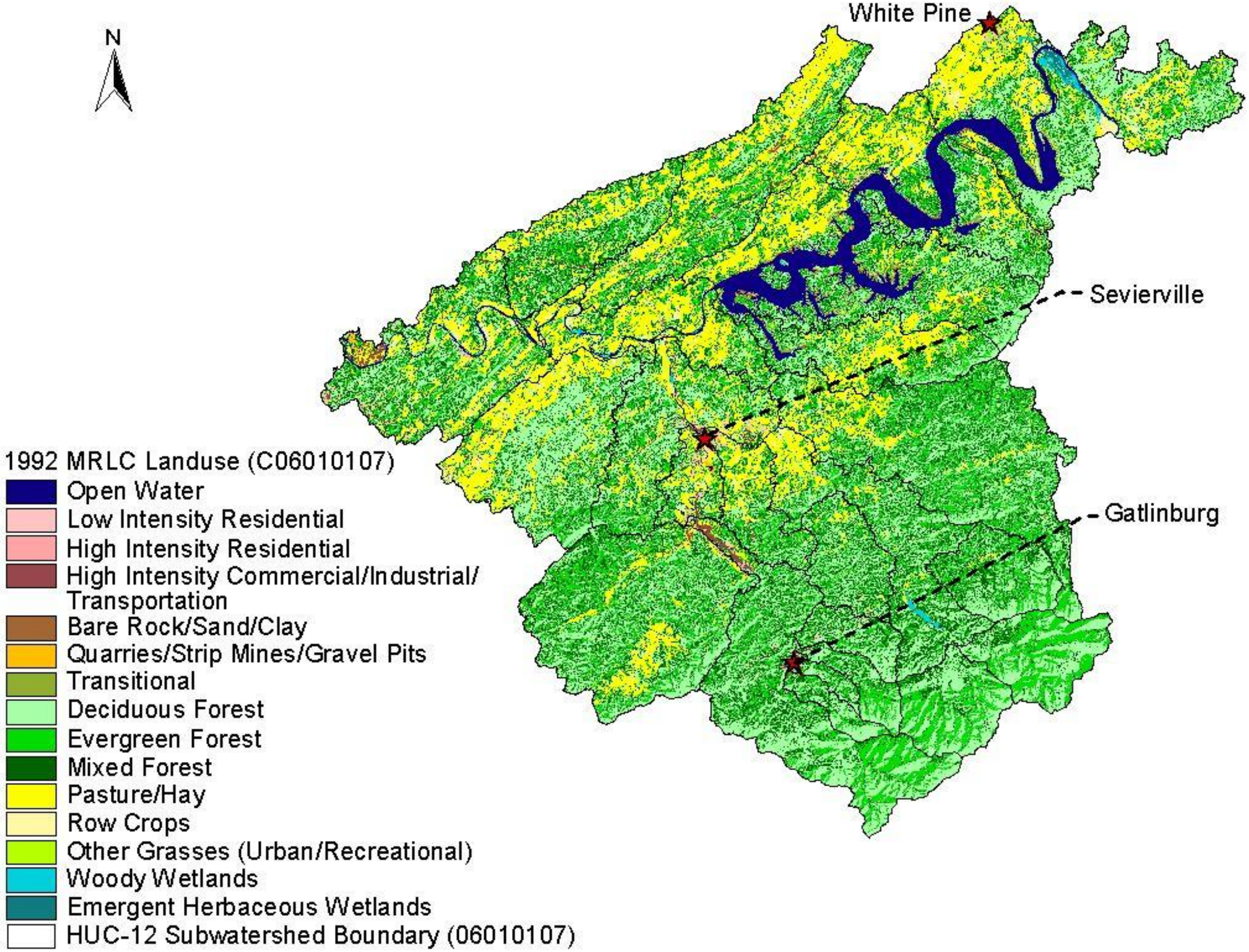


Table 2 *2006 303(d) List* - Stream Impairment Due to Siltation/Habitat Alteration in the Lower French Broad River Watershed

Waterbody ID	Impacted Waterbody	Miles/Acres Impaired	Cause	Pollutant Source
06010107010_1000	West Prong Little Pigeon River	8.1	Escherichia coli Loss of biological integrity due to siltation Phosphorus The trout stream portion of this segment is considered “threatened by elevated water temperatures and low DO.	Septic Tanks Collection System Failure Land Development Channelization
06010107010_1800	Mill Creek	5.9	Physical Substrate Habitat Alterations/Escherichia coli	Collection System Failure Channelization
06010107010_1900	Walden Creek	2.6	Loss of biological integrity due to siltation/Escherichia coli	Pasture Grazing Land Development/Septic Tanks
06010107010_1950	Walden Creek	8.6	Loss of biological integrity due to siltation/Habitat loss due to alteration in stream-side or littoral vegetative cover	Pasture Grazing Land Development
06010107038_1000	Dumplin Creek	19.1	Loss of biological integrity due to siltation/Physical Substrate Habitat Alterations	Pasture Grazing Land Development Channelization

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

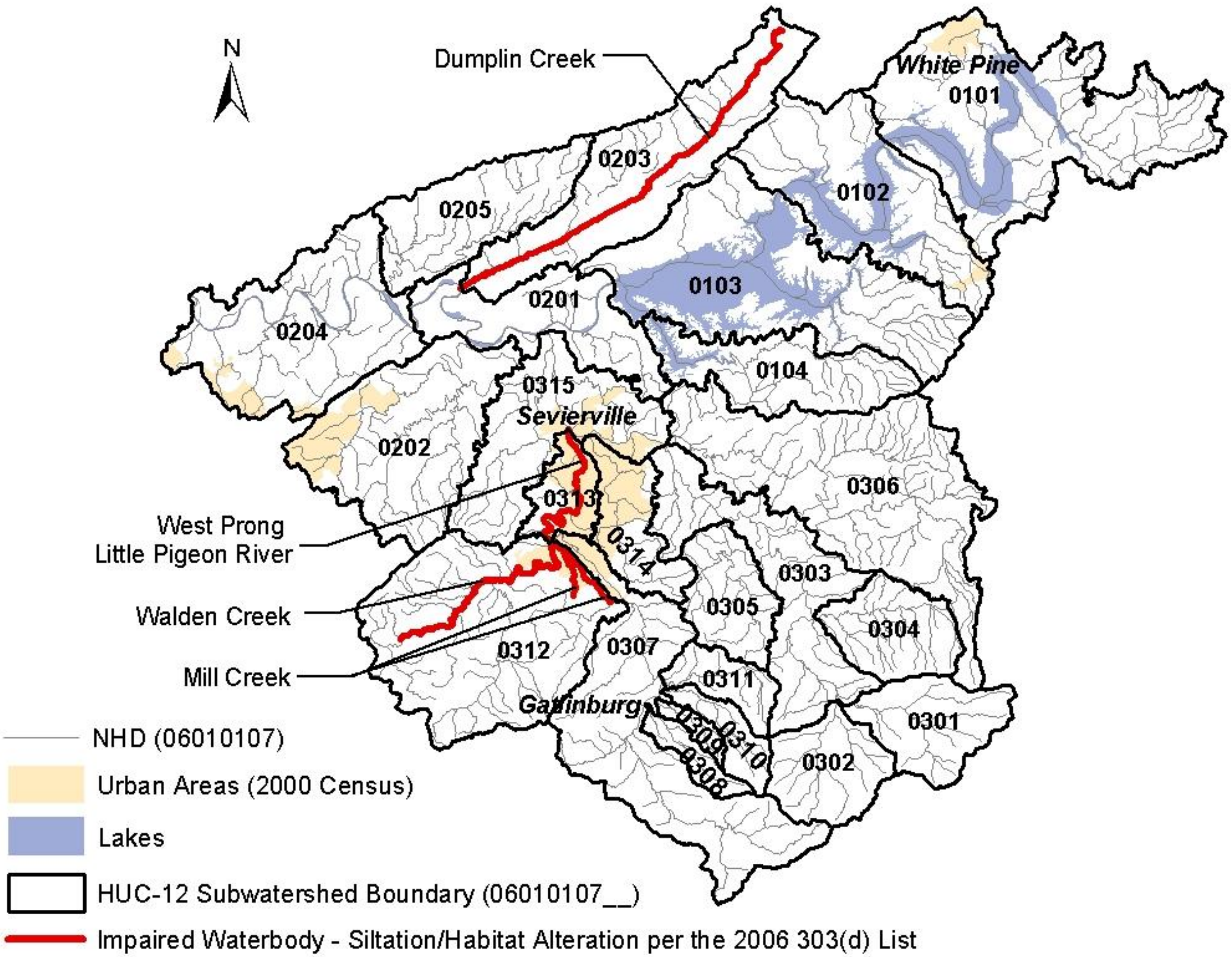


Table 3 Water Quality Assessment of Waterbodies Impaired Due to Siltation/Habitat Alteration

Waterbody ID	Impacted Waterbody	Comments
06010107010_1000	West Prong Little Pigeon River (from Little Pigeon River to Confluence of Walden Creek)	Water contact advisory. 2001 TDEC biorecon at Sevierville City Park. 11 EPT genera, 2 intolerant, 34 total genera. Habitat score = 149. TDEC bacteriological monitoring station near Apple Barn. E. coli geometric mean of 152.
06010107010_1800	Mill Creek (from West Prong Little Pigeon River to Ecoregion break near Sugar Camp)	2001 TDEC biorecon at City Park. 13 EPT genera, 4 intolerant, 35 total genera. Habitat score = 106. Channelized. Did not pass biorecon criteria. TDEC bacteriological monitoring station near mouth. E. coli geometric mean of 202.
06010107010_1900	Walden Creek (from West Prong Little Pigeon River to ecoregion break d/s confluence of Cave Creek)	2001 TDEC biorecon at Tiger Road. 13 EPT genera, 4 intolerant, 33 total genera. Habitat score = 119. TDEC bacteriological monitoring station near mouth. E. coli g.m. of 264.
06010107010_1950	Walden Creek (from ecoregion break just d/s of confluence of Cove Creek to unnamed trib just d/s of South Prong)	2001 TDEC biorecon d/s Clear Creek. 11 EPT genera, 2 intolerant, 30 total genera, habitat = 95.
06010107038_1000	Dumplin Creek (from French Broad River to headwaters)	2001 TDEC biorecon at mile 0.8 (Bent Road). 6 EPT genera, 2 intolerant, 27 total, habitat = 114. Failed biorecon protocol. E coli g.m. = 168. 2001 TVA survey at Hodges Farm. 8 EPT families, 14 intolerant, 22 total families.

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. Excessive sediment loading, however, is a major ecosystem stressor that can adversely impact biota, either directly or through changes to physical habitat.

Excessive sediment loading has a number of adverse effects on fish and 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 Lower French Broad 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 and 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 and aquatic life.

Applicable to the Fish & Aquatic Life use classification:

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

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

In order for a TMDL to be established, a numeric "target" protective of the uses of the water must be identified to serve as the basis for the TMDL. Where State regulation provides a numeric water quality criterion for the pollutant, the criterion is the basis for the TMDL. Where State regulation does not provide a numeric water quality criterion, as in the case of siltation/habitat alteration, a numeric interpretation of the narrative water quality standard must be determined. For the purpose of these TMDLs, the average annual instream sediment load (in lbs/acre/yr), from biologically healthy watersheds, 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 and 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 instream 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 instream 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 instream 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.

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 instream sediment load, due to precipitation-based sources, for all HUC-12 subwatersheds in the Lower French Broad River Watershed (ref.: Figure 4). Existing precipitation-based instream 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 4 Average Annual Instream Sediment Loads of Level IV Ecoregion Reference Sites

Level 4 Ecoregion	Reference Site	Stream	Drainage Area (acres)	Average Annual Instream Sediment Load * [lbs/acre/year]
66e	Eco66e04	Gentry Creek	2,699	151.9
	Eco66e09	Clark Creek	5,886	69.3
	Eco66e11	Lower Higgins Creek	2,189	90.0
	Eco66e17	Double Branch	1,878	135.2
	Eco66e18	Gee Creek	2,728	221.0
			Geometric Mean (Target Load)	**123.1**
66f	Eco66f06	Abrams Creek	13,857	143.8
	Eco66f07	Beaverdam Creek	29,262	265.9
	Eco66f08	Stony Creek	2,477	118.6
			Geometric Mean (Target Load)	**165.5**
66g	Eco66g04	Middle Prong Little Pigeon River	12,469	90.9
	Eco66g05	Little River	19,999	68.3
	Eco66g07	Citico Creek	1,556	93.4
	Eco66g09	North River	7,470	377.7
	Eco66g12	Sheeds Creek	3,568	93.2
			Geometric Mean (Target Load)	**115.3**
67f	Eco67f06	Clear Creek	1,963	513.0
	Eco67f13	White Creek	1,724	272.4
	Eco67f17	Big War Creek	30,062	585.1
			Geometric Mean (Target Load)	**434.0**
67g	Eco67g05	Bent Creek	21,058	904.9
	Eco67g08	Brymer Creek	4,237	605.0
	Eco67g09	Harris Creek	3,054	724.5
	Eco67g10	Flat Creek	13,236	651.8
	Eco67g11	N Prong Fishdam Creek	1,019	853.2
			Geometric Mean (Target Load)	**739.1**
67h	Eco67h04	Blackburn Creek	653	195.6
	Eco67h06	Laurel Creek	1,793	557.2
			Geometric Mean (Target Load)	**330.1**
67i	Eco67i12	Mill Branch	681	279.0
			(Target Load)	**279.0**

* The values shown represent the <u>instream</u> sediment load at the drainage area "pour point" per acre of total drainage area.

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

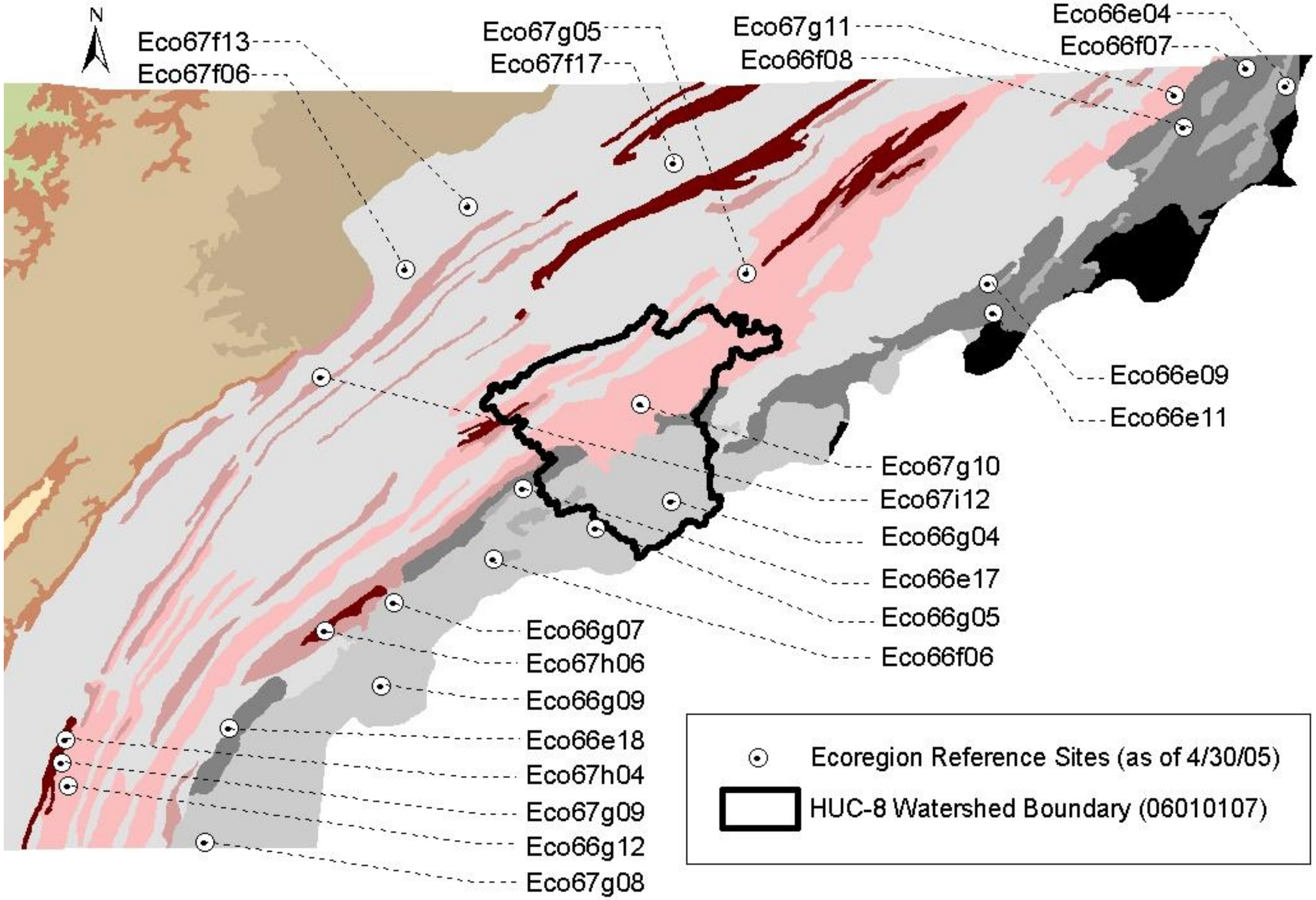


Table 5 Existing Instream Sediment Loads in Subwatersheds With Impaired Waterbodies

HUC-12 Subwatershed (06010107____)	Level IV Ecoregion	Existing Instream Sediment Load *
		[lbs/ac/yr]
0203	67f	435
0312	66g	887
0313	67g	1,103

* The values shown represent the instream sediment load at the subwatershed "pour point" per acre of total subwatershed area.

6.0 SOURCE ASSESSMENT

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

6.1 Point Sources

6.1.1 NPDES Regulated Wastewater Treatment Facilities

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

6.1.2 NPDES Regulated Ready Mixed Concrete Facilities

Discharges from regulated Ready Mixed Concrete Facilities (RMCFs) may contribute sediment to surface waters as TSS discharges (TSS discharged from RMCFs is composed of primarily inorganic material and is therefore included as a source for TMDL development). Most of these facilities obtain coverage under NPDES Permit No. TNG110000, *General NPDES Permit for Discharges of Storm Water Runoff and Process Wastewater Associated With Ready Mixed Concrete Facilities* (TDEC, 2003). This permit establishes a daily maximum TSS concentration limit of 50 mg/l on process wastewater effluent and specifies monitoring procedures for storm water discharges. Facilities are also required to develop and implement storm water pollution prevention plans (SWPPPs). Discharges from RMCFs are generally intermittent, and contribute a small portion of total sediment loading to HUC-12 subwatersheds (ref.: Appendix D). In some cases, for discharges into impaired waters, sites may be required to obtain coverage under an individual NPDES permit. Of the nine permitted RMCFs in the Lower French Broad River Watershed as of June 4, 2007, one is located in an impaired subwatershed. This facility is listed in Table 6 and shown in Figure 6.

Table 6 NPDES Regulated Ready Mixed Concrete Facilities Located in Impaired Subwatersheds (as of June 4, 2007)

HUC-12 Subwatershed (06010107___)	NPDES Permit No.	Facility Name	TSS Daily Max Limit	TSS Cut-off Conc. (SW Discharge)
			[mg/l]	[mg/l]
0313	TNG110126	Blalock Lumber Company (Sevierville)	50	200

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 five permitted mining sites in the Lower French Broad River Watershed as of June 4, 2007, two are located in impaired subwatersheds. These 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 Impaired Subwatersheds (as of June 4, 2007)

HUC-12 Subwatershed (06010107___)	NPDES Permit No.	Name	TSS Daily Max Limit
			[mg/l]
0203	TN0065951	Vulcan Construction Materials, LP (Kodak Quarry)	40
0313	TN0003018	Vulcan Construction Materials, LP (Knoxville Quarry)	

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 179 permitted active construction storm water sites in the Lower French Broad River Watershed on March 7, 2007, 49 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, the City of Knoxville (TNS068055) is the only Phase I MS4 in the Lower French Broad 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). Of the eight permitted Phase II small MS4s in the Lower French Broad River Watershed, four have urban jurisdiction which at least in part lies within an impaired HUC-12 subwatershed and are therefore subject to the WLA developed in Section 7.3.4 (Ref.: Figure 8):

NPDES Permit Number	Permittee Name
TNS075485	Pigeon Forge
TNS075523	Sevierville
TNS075116	Blount County
TNS075655	Sevier County

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

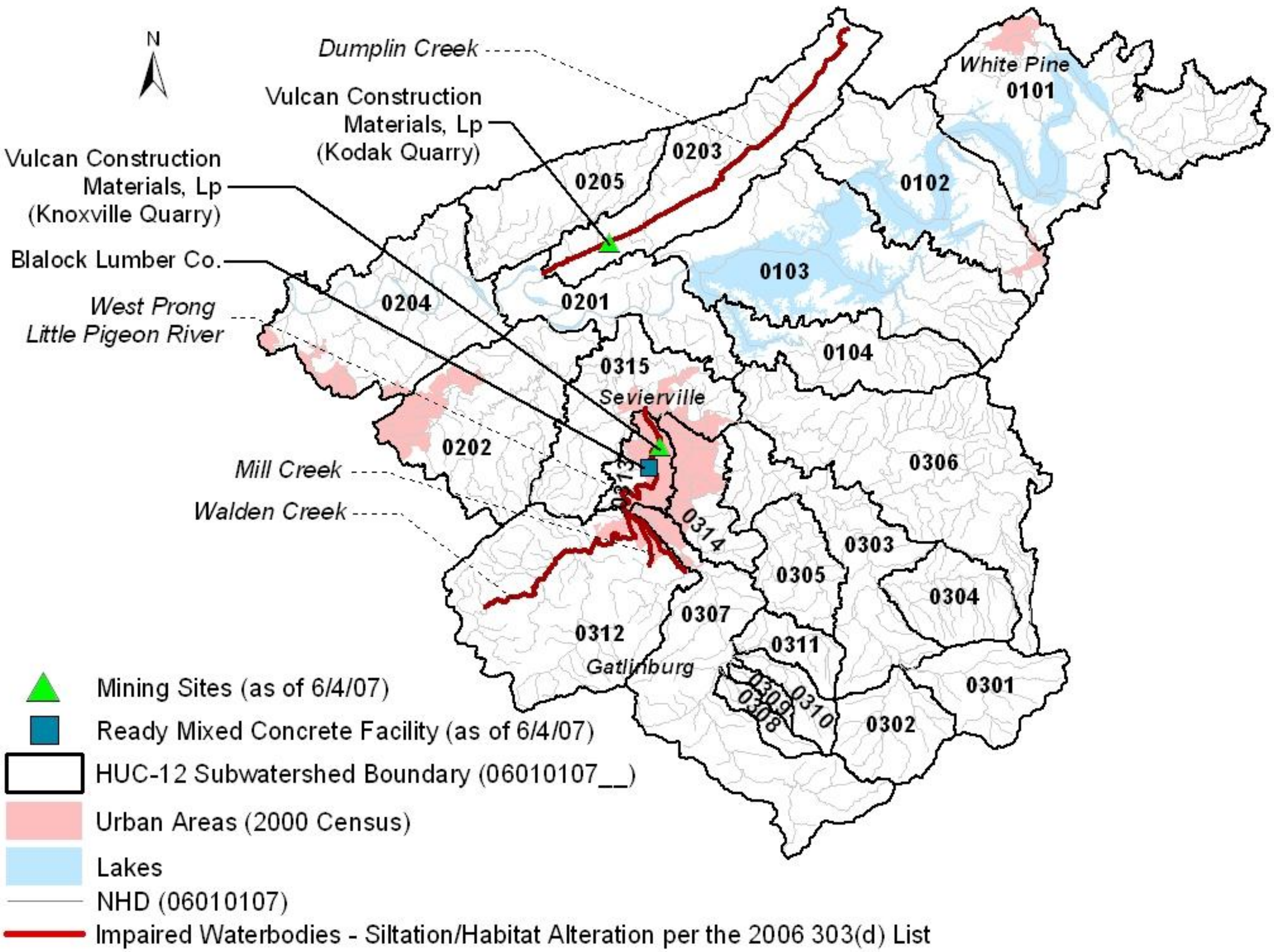


Figure 7 Location of NPDES Permitted Construction Storm Water Sites in the Lower French Broad River Watershed

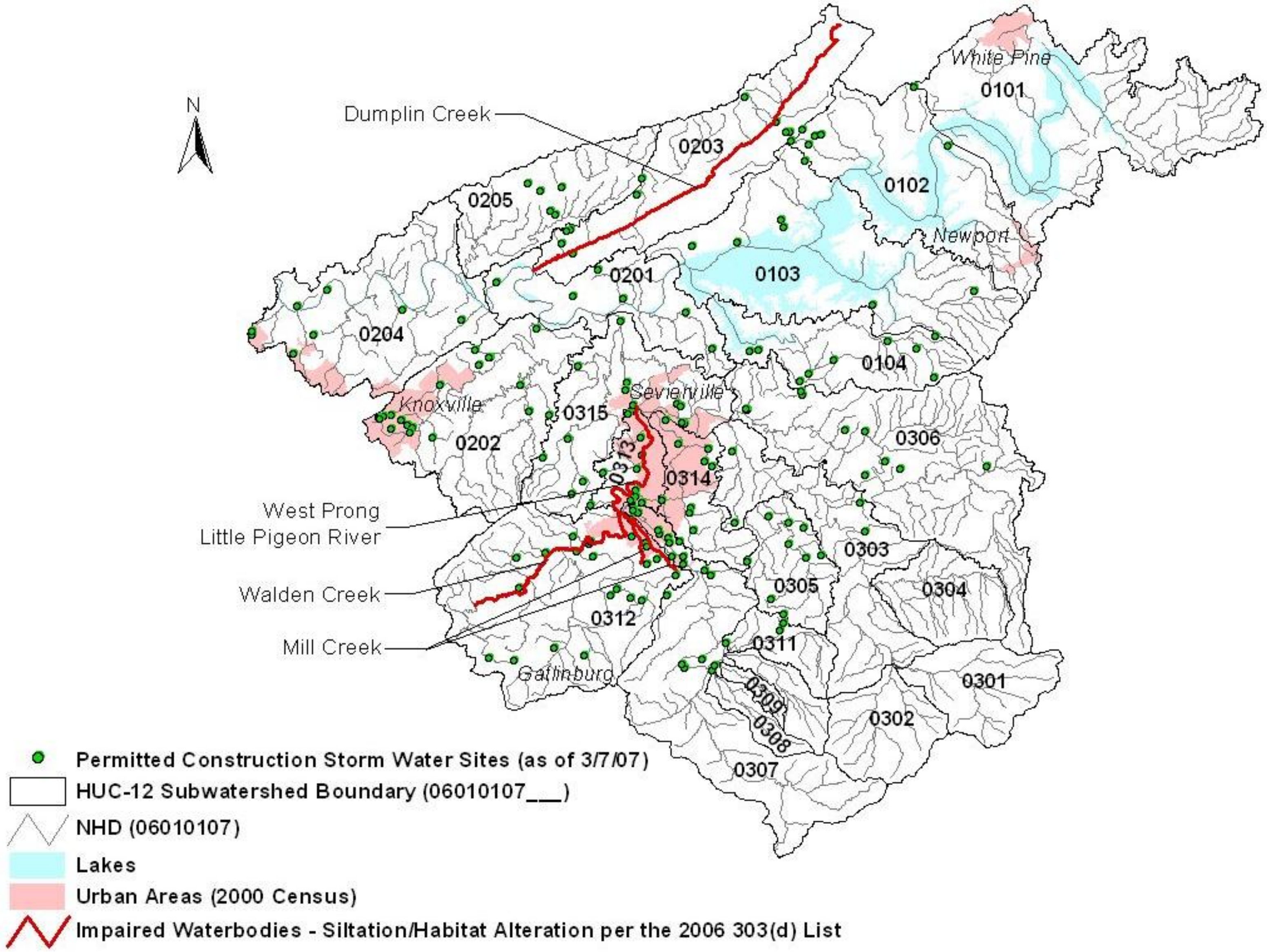
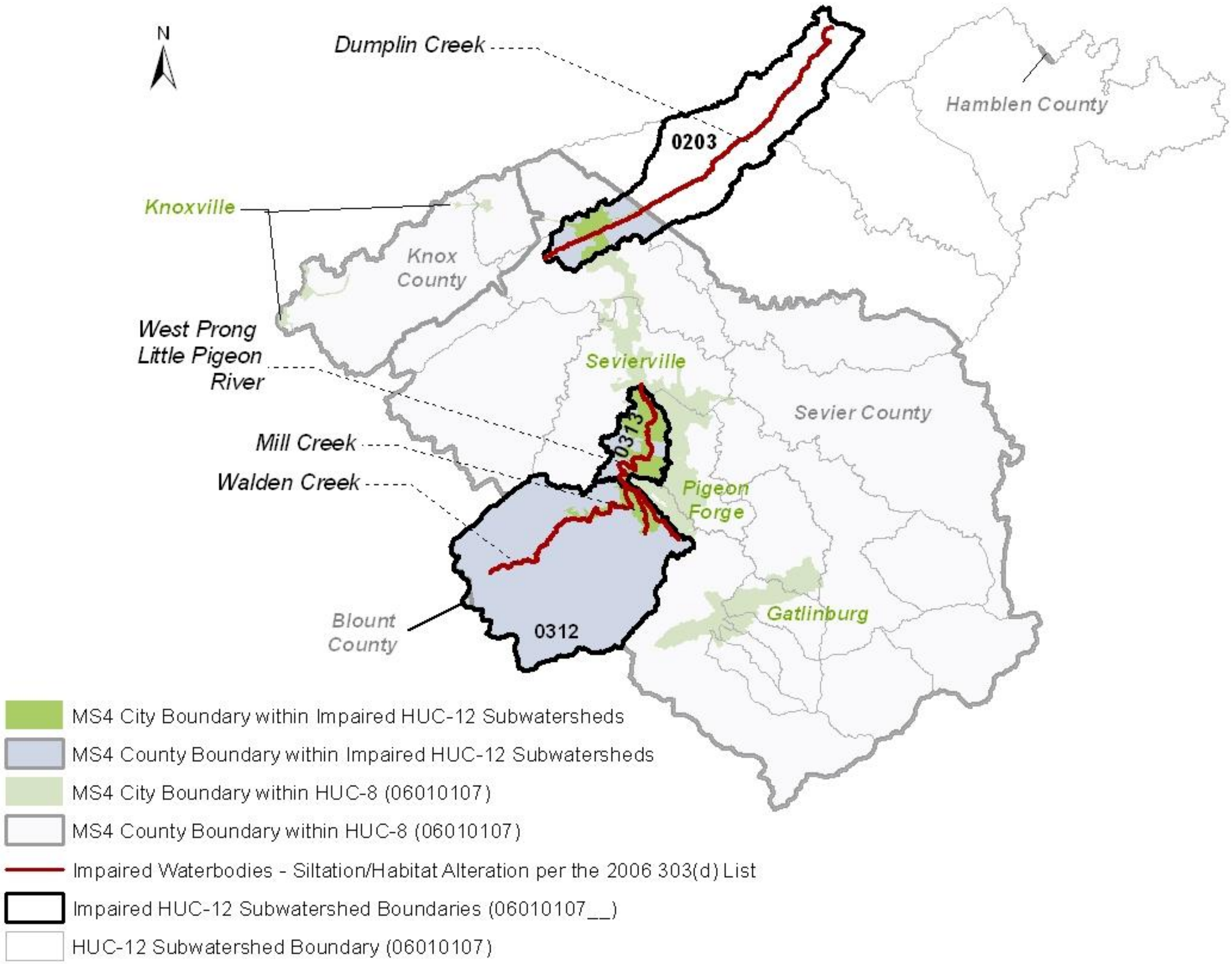


Figure 8 Location of Urban Jurisdictions with MS4 Permits in the Lower French Broad River Watershed



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 at http://www.state.tn.us/environment/wpc/stormh2o/.

6.2 Nonpoint Sources

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

- Natural erosion occurring from the weathering of soils, rocks, and uncultivated land; geological abrasion; and other natural phenomena.
- Erosion from agricultural activities can be a major source of sedimentation due to the large land area involved and the land-disturbing effects of cultivation. Grazing livestock can leave areas of ground with little vegetative cover. Unconfined animals with direct access to streams can cause streambank damage.
- Urban erosion from bare soil areas under construction and washoff of accumulated street dust and litter from impervious surfaces.
- Erosion from unpaved roadways can be a significant source of sediment to rivers and streams. It occurs when soil particles are loosened and carried away from the roadway, ditch, or road bank by water, wind, or traffic. The actual road construction (including erosive road-fill soil types, shape and size of coarse surface aggregate, poor subsurface and/or surface drainage, poor road bed construction, roadway shape, and inadequate runoff discharge outlets or “turn-outs” from the roadway) may aggravate roadway erosion. In addition, external factors such as roadway shading and light exposure, traffic patterns, and road maintenance may also affect roadway erosion. Exposed soils, high runoff velocities and volumes, and poor road compaction all increase the potential for erosion.
- Runoff from abandoned mines may be significant sources of solids loading. Mining activities typically involve removal of vegetation, displacement of soils, and other significant land disturbing activities.
- Soil erosion from forested land that occurs during timber harvesting and reforestation activities. Timber harvesting includes the layout of access roads, log decks, and skid trails; the construction and stabilization of these areas; and the cutting of trees. Established forest areas produce very little soil erosion.

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

7.0 DEVELOPMENT OF TOTAL MAXIMUM DAILY LOAD

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

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

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

TMDL analyses are performed on a 12-digit hydrologic unit 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 sediment TMDLs in the Lower French Broad River Watershed.

Sediment loading analysis for waterbodies impaired due to siltation/habitat alteration in the Lower French Broad 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 instream sediment loads (in lbs/acre/yr) of these reference watersheds serve as target values for the Lower French Broad River Watershed sediment TMDLs.

- The Sediment Tool was also used to determine the existing average annual instream 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 instream sediment load of each impaired HUC-12 subwatershed was compared to the average annual instream sediment load of the appropriate reference (biologically healthy) watershed and an overall required percent reduction in instream sediment loading calculated. For each impaired HUC-12 subwatershed, the TMDL is equal to this overall required reduction (ref.: Table 8):

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

  Although the Sediment Tool uses the best road, elevation, and land use GIS coverages available, the resulting 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 5% 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).

- In each impaired subwatershed, a percentage of the ecoregion-based target load was reserved to account for WLAs for NPDES permitted storm water discharges from construction sites. The amount of target load reserved is subwatershed specific (see Appendix E). WLAs for construction storm water activities are technology-based and represent erosion from sites with properly designed, installed, and maintained erosion and sediment control BMPs.

- For each impaired HUC-12 subwatershed, WLAs for MS4s and LAs for nonpoint sources were considered to be the percent load reduction required to decrease the existing average annual instream sediment load to the target load minus the percent reserved for RMCFs, mining sites, and construction storm water (CSW).

$$\text{WLA}_{\text{MS4s and LAs}} = \frac{(\text{Existing Load}) - \{[(0.95)\ (\text{Target Load})] - (\text{Reserved CSW Load})\}}{(\text{Existing Load})} \times 100$$

- TMDLs, WLAs for MS4s, and LAs for nonpoint sources are expressed as a percent reduction in average annual instream 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 are small with respect to storm water induced sediment loading for all subwatersheds, further reductions from these facilities were not considered warranted (ref.: Appendix D). WLAs for construction stormwater sites are expressed as technology-based average annual erosion loads per unit area disturbed.

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

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

7.3 Waste Load Allocations

7.3.1 Waste Load Allocations for NPDES Regulated Ready Mixed Concrete Facilities

Of the nine permitted Ready Mixed Concrete Facilities (RMCFs) in the Lower French Broad River Watershed with NPDES permits as of June 4, 2007, 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 facilities.

7.3.2 Waste Load Allocations for NPDES Regulated Mining Activities

Of the five permitted mining sites in the Lower French Broad River Watershed with NPDES permits as of June 4, 2007, two are located in impaired subwatersheds (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 (ref.: Section 6.1.4). 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) and are equal to an average annual <u>erosion</u> load from the construction site of 6,000 lbs/ac/yr (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).

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

HUC-12 Subwatershed (06010107___)	Waterbody ID	Waterbody	Level IV Ecoregion	Instream Sediment		
				Existing Load	Target Load	TMDL (Required Overall Load Reduction)
				[lbs/ac/yr]	[lbs/ac/yr]	[% Reduction]
0203	06010107038_1000	Dumplin Creek	67f	435	434.0	0.3
0312	06010107010_1800	Mill Creek	66g	887	115.3	87.0
	06010107010_1900	Walden Creek				
	06010107010_1950	Walden Creek				
0313	06010107010_1000	West Prong Little Pigeon River	67g	1,103	739.1	33.0

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 instream sediment loading for an impaired subwatershed, relative to the estimated average annual instream sediment loading of a biologically healthy (reference) subwatershed located in the same Level IV ecoregion (minus the percent reserved for RMCFs, regulated mining sites, and CSW sites). WLAs apply to MS4 discharges in the impaired subwatershed for which the WLA was developed and will be implemented as Best Management Practices (BMPs) as specified in Phase I and II MS4 permits (ref.: Table 9). WLAs should not be construed as numeric limits.

7.4 Load Allocations for Nonpoint Sources

All sources of sediment loading to surface waters not covered by the NPDES program are provided a Load Allocation (LA) in these TMDLs (ref.: Section 6.2). 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 (ref.: Table 9) are expressed as the required percent reduction in the estimated average annual instream sediment loading for the impaired subwatershed, relative to the estimated average annual instream sediment loading of a biologically healthy (reference) subwatershed located in the same Level IV ecoregion (minus the percent reserved for RMCFs, regulated mining sites, and CSW sites). LAs should not be construed as numeric limits.

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

HUC-12 Subwatershed (06010107___)	Level IV Ecoregion	Required Load Reduction		
		WLA		LA (Nonpoint Sources)
		Construction Storm Water Site Erosion [b]	MS4s Instream Sediment [a]	Instream Sediment [a]
		[lbs/ac/yr]	[% Reduction]	[% Reduction]
0203	67f	6,000	12.3	12.3
0312	66g	6,000	95.2	95.2
0313	67g	6,000	41.4	41.4

a. Value shown represents the fraction of erosion that reaches stream (instream sediment at the pour point of the HUC-12 subwatershed).

b. Value shown represents erosion from construction sites.

7.5 Margin of Safety

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

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

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

In most presently impaired subwatersheds, some amount of explicit MOS is realized due to the WLAs specified for NPDES permitted 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 nine NPDES regulated RMCFs in the Lower French Broad River Watershed as of June 4, 2007 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 Runoff and Process Wastewater Associated With Ready Mixed Concrete Facilities* (TDEC, 2003).

8.1.2 NPDES Regulated Mining Sites

Two of the five NPDES regulated mining sites in the Lower French Broad River Watershed are located in impaired subwatersheds (ref.: Table 7 and Figure 6). 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 Activity (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 Activity* 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 (EFO) (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 241 BMPs in the Lower French Broad River Watershed as of January 4, 2006, 29 are in sediment-impaired subwatersheds (ref.: Figure 9).

An excellent example of stakeholder involvement for the implementation of nonpoint source load allocations (LAs) specified in an approved TMDL is the Integrated Pollutant Source Identification (IPSI) conducted by Tennessee Valley Authority (TVA). The IPSI was conducted by TVA in Blount County and in the Little River watershed (TVA, 2003). The IPSI provided detailed source information on a watershed scale, including the location of geographic features that are known or suspected to contribute nonpoint source pollution within the watersheds. The survey of animal operations identified beef cattle, milk cows, and horse operations and classified the sites by relative size and proximity to a stream. Analysis of geographic data also identified septic systems that were suspect. Suspect systems were defined as systems exhibiting a visible plume or drain field, or at locations that are questionable for on-site septic systems. Use of information included in an IPSI can aid in identification of pollution sources that should be targeted for pollution reduction programs.

8.3 Evaluation of TMDL Effectiveness

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

9.0 PUBLIC PARTICIPATION

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

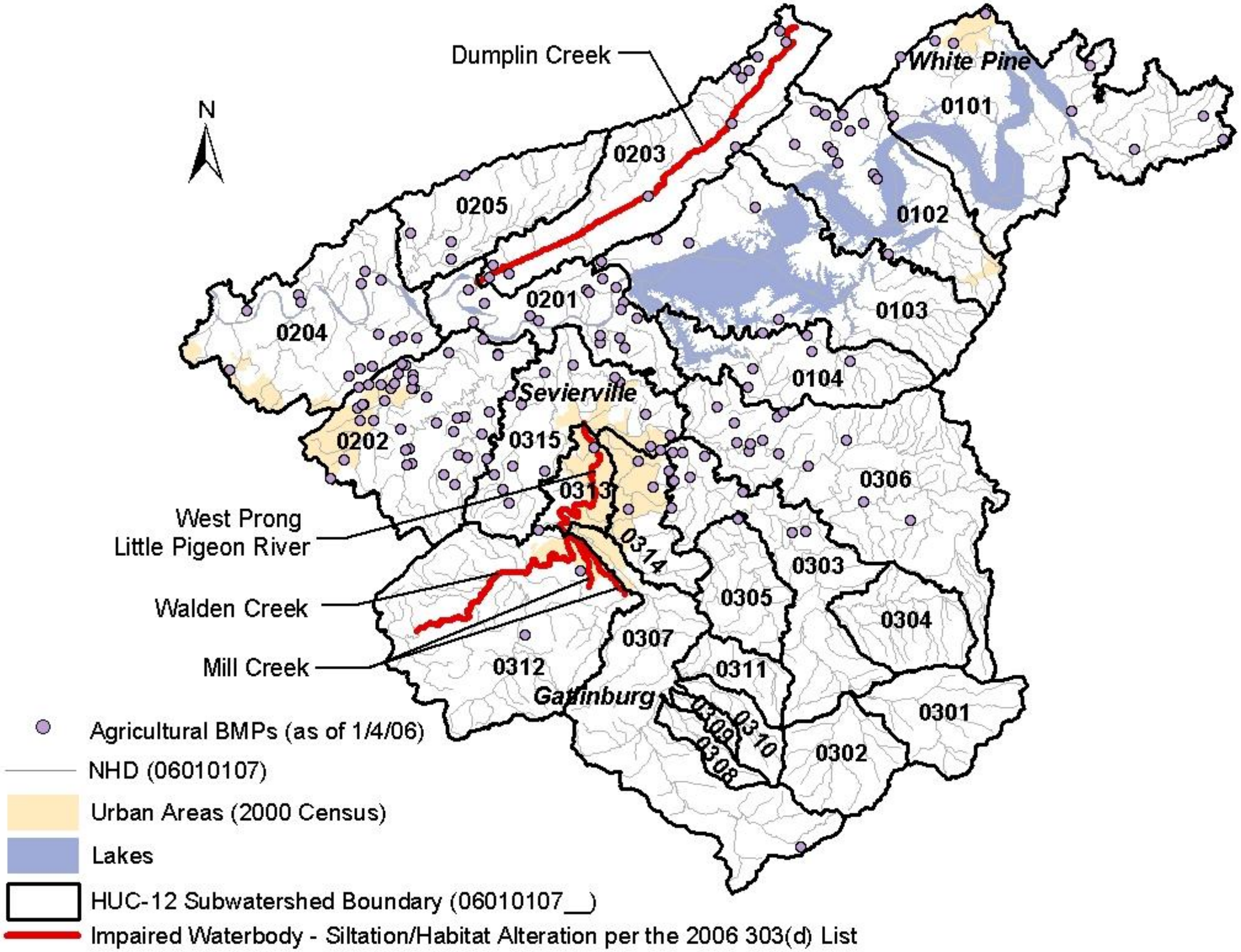
1) Notice of the proposed TMDLs was posted on the Tennessee Department of Environment and Conservation website. The notice invited public and stakeholder comments and provided a link to a downloadable version of the TMDL document.

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

TNG110126	Blalock Lumber Company (Sevierville)
TN0065951	Vulcan Construction Materials, LP (Kodak Quarry)
TN0003018	Vulcan Construction Materials, LP (Knoxville Quarry)

Figure 9 Location of Agricultural Best Management Practices in the Lower French Broad River Watershed



4) A letter was sent to identified water quality partners in the Lower French Broad River Watershed advising them of the proposed sediment TMDLs and their 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)

   Tennessee Department of Agriculture

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

TNS068055	Knoxville
TNS075116	Blount County
TNS075329	Gatlinburg
TNS075485	Pigeon Forge
TNS075523	Sevierville
TNS075582	Knox County
TNS075655	Sevier County
TNS077585	Tennessee Department of Transportation (TDOT)

10.0 FURTHER INFORMATION

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

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

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

Mary L. Wyatt, Watershed Management Section
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 Stream Assessment (West Prong Little Pigeon River)

Figure A-1 West Prong Little Pigeon River at RM 1.7, macroinvertebrate assessment report sheet – August 29, 2005

Division of Water Pollution Control
SOP for Macroinvertebrate Stream Surveys
Revision: 4
Effective Date: March 2005
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MACROINVERTEBRATE ASSESSMENT REPORT

STATION NUMBER: WPLPI001.7SV	LOG NUMBER: B0509011	
STREAM: West Prong Little Pigeon River	ECOREGION(s): 67G	
LOCATION: Sevierville City Park	DATE: 8/29/05	
HUC: ~~TN06010106~~ TN06010107 KJS 9/28/05	SEGMENT ID:	
STREAM ORDER: 5	DRAINAGE AREA:	
SAMPLED BY: JEB/LEE	ID BY:CAP	SCORED BY: CAP 9/16/05

If new station send additional 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:______ *Do not score if inappropriate size/order or not 80% in bioregion

Comments

SEMIQUANTITATIVE SAMPLE

QC-Scoring KJS 9/28/05

METRIC	VALUE	SCORE*
Total Number	201	NA
Taxa Richness	26	4 ✓
EPT Richness	11	4 ✓
% EPT	72.0	6 ✓
% OC	12.5	6 ✓
NCBI	3.65	6 ✓
% Dominant	15.0	6 ✓
% Clingers	58.5	6 ✓

TARGET SCORE FOR ECOREGION __32___ SQ INDEX SCORE ___38✓__* WQcb 9/28/05 KJS
*** Do not score if inappropriate size/order, sample type or not 80% in bioregion**

% NUTRIENT TOLERANT ORGANISMS _______33.0__________
(Cheumatopsyche, Lirceus, Physella, Baetis, Psephenus, Stenelmis, Simulium, Elimia, Oligochaeta, Polypedilum, Rheotanytarsus, Stenacron, Cricotopus, Chironomus)

COMMENTS :

HABITAT ASSESSMENT SCORE _144__RR/HIGH GRAD. (or) _____GP/LOW GRAD.

HABITAT GUIDELINES FOR SUBREGION (Circle one) PASS FAIL

Figure A-2 West Prong Little Pigeon River at RM 1.7, front of field sheet – August 29, 2005

Division of Water Pollution Control
SOP for Macroinvertebrate Stream Surveys
Revision 3
Effective Date: November 2003
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HABITAT ASSESSMENT DATA SHEET- HIGH GRADIENT STREAMS (FRONT)

STREAM NAME West Prong Little Pigeon River	LOCATION Sevierville City Park
STATION # WPLPI001.7SV	ECOREGION 67G
LAT LONG	RIVER BASIN Lower French Broad
WBID/HUC 06010107	INVESTIGATORS JEB/LEE/JSTAN
FORM COMPLETED BY JEB/LEE	DATE 8/29/05 TIME 4:25 AM PM

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
15 SCORE 14	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.
13 SCORE 14	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)
18 SCORE 18	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
12 SCORE 13	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.
17 SCORE 17	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

temp - 25.12 °C
d.o. - 7.92
pH - 7.58
cond - 168
TDS - 0.109

24

Figure A-3 West Prong Little Pigeon River at RM 1.7, back of back of field sheet – August 29, 2005

Division of Water Pollution Control
SOP for Macroinvertebrate Stream Surveys
Revision 3
Effective Date: November 2003
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HABITAT ASSESSMENT DATA SHEET- HIGH GRADIENT STREAMS (BACK)

Station ID WPLPI001.7SV Date 8/29/05

	Habitat Parameter	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.
16	SCORE 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
17/16	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.
16	SCORE 17	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
5	SCORE 4 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
9	SCORE 9 (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
4	SCORE 3 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
9	SCORE 9 (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.
1	SCORE 2 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
6	SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

TOTAL SCORE 144 WQb 9/23/05 KJS

Figure A-4 Photo of West Prong Little Pigeon River, downstream of Cates Road (approximately at RM 10.9) – July 19, 2006

Figure A-5 Photo of West Prong Little Pigeon River upstream of Dollywood Lane (approximately at RM 12.2) – July 19, 2006

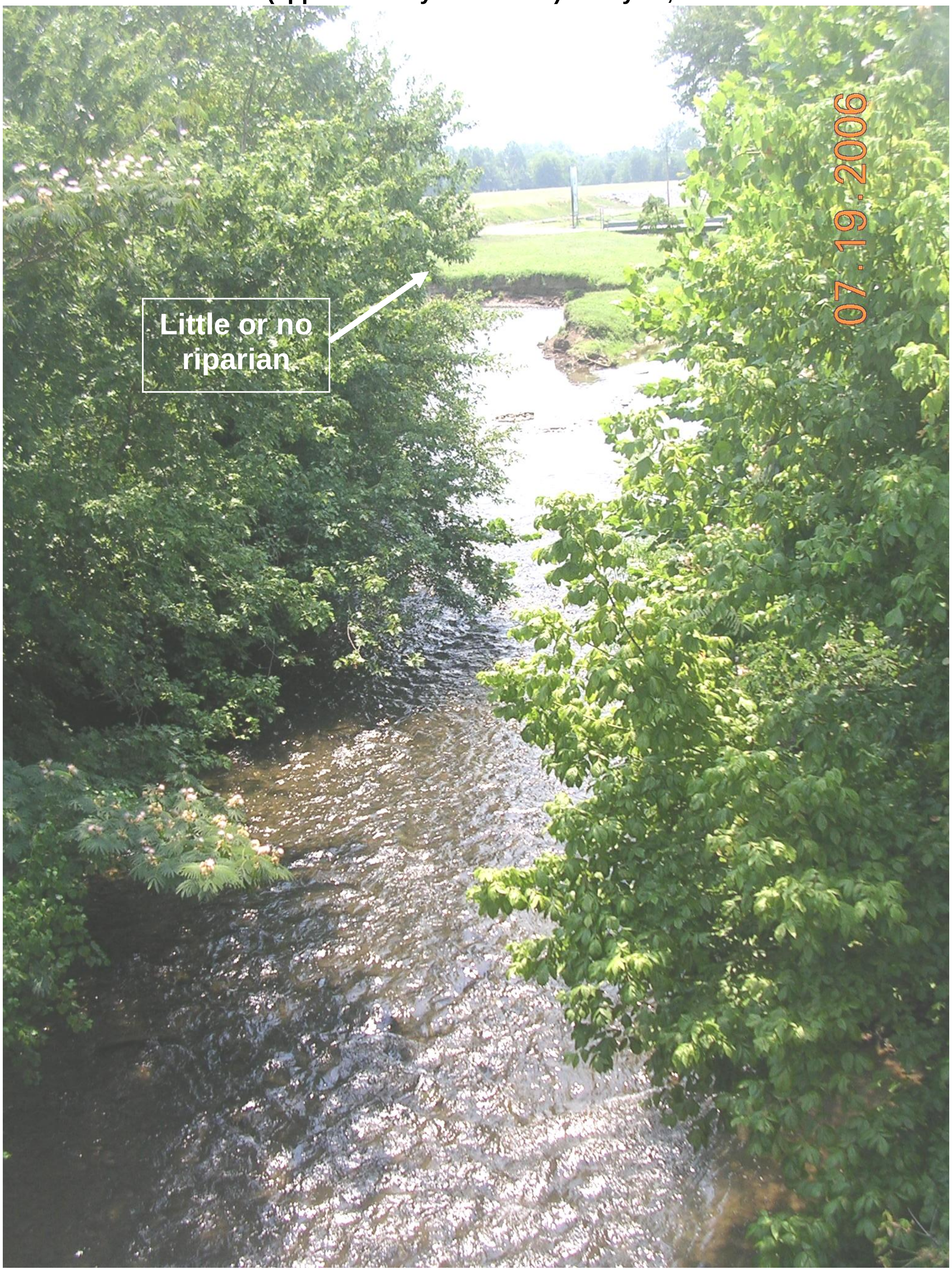

Figure A-6 Photo of West Prong Little Pigeon River downstream of Dollywood Lane (approximately at RM 12.2) – July 19, 2006

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.3.0). 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:

R - Rainfall Erosivity Index

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

K - Soil Erodibility Factor

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

LS - Topographic Factor

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

C - Crop/Vegetation and Management Factor

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

P - Conservation Practice Factor

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

Estimates of the USLE parameters, and thus the soil erosion as computed from the USLE, are provided by the Natural Resources Conservation Service's (NRCS) National Resources Inventory (NRI) 1994. The NRI database contains information of the status, condition, and trend of soil, water and related resources collected from approximately 800,000 sampling points across the country.

The soil losses from the erosion processes described above are localized losses and not the total amount of sediment that reaches the stream. The fraction of the soil lost in the field that is eventually delivered to the stream depends on several factors. These include, the distance of the source area from the stream, the size of the drainage area, and the intensity and frequency of rainfall. Soil losses along the riparian areas will be delivered into the stream with runoff-producing rainfall.

Sediment Modeling Methodology

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

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

   DEM (grid) - The Digital Elevation Model (DEM) layers that come with the basic WCS distribution system are shapefiles of coarse resolution (300x300m). A higher resolution DEM grid layer (30x30m) is required. The National Elevation Dataset (NED) is available from the United States Geologic 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 Soil Survey Geographic Database (SSURGO) soil data (1:24k) 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 State Soil and Geographic Database (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 the 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 Lower French Broad 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 (06010107__)	*EROSION*				
	Road [tons/yr]	Source [tons/yr]	Total [tons/yr]	%Road	%Source
0203	8,884.6	10,528.5	19,413	45.8	54.2
0312	28,395.3	4,081.1	32,476	87.4	12.6
0313	3,623.7	4,977.5	8,601	42.1	57.9

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 (06010107__)	*SEDIMENT*				
	Road [tons/yr]	Source [tons/yr]	Total [tons/yr]	%Road	%Source
0203	3,593.3	3,043.2	6,637	54.1	45.9
0312	16,172.9	2,050.4	18,223	88.7	11.3
0313	2,061.6	1,270.7	3,332	61.9	38.1

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

HUC-12 Subwatershed (06010107__)	HUC-12 Subwatershed Area	*UNIT LOADS*			
		Erosion		Sediment	
	[acres]	[tons/ac/yr]	[lbs/ac/yr]	[tons/ac/yr]	[lbs/ac/yr]
0203	30,503	0.636	1,273	0.218	435
0312	41,109	0.790	1,580	0.443	887
0313	6,042	1.424	2,847	0.552	1,103

APPENDIX C

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

Table C-1 Lower French Broad River Watershed - Impaired Subwatershed Land Use Distribution

Land Use	Subwatershed (06010107___)					
	0203		0312		0313	
	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand/Clay	0	0.0	0	0.0	0	0.0
Deciduous Forest	5,653	18.5	14,696	35.7	1,175	19.4
Emergent Herbaceous Wetlands	0	0.0	0	0.0	0	0.0
Evergreen Forest	5,824	19.1	11,106	27	839	13.9
High Intensity Commercial/Industrial/Transportation	534	1.7	167	0.4	235	3.9
High Intensity Residential	3	0.0	12	0.0	90	1.5
Low Intensity Residential	70	0.2	184	0.4	383	6.3
Mixed Forest	6,443	21.1	10,755	26.2	1,212	20.1
Open Water	19	0.1	12	0.0	120	2.0
Other Grasses (Urban/Recreational)	206	0.7	75	0.2	177	2.9
Pasture/Hay	10,622	34.8	3,834	9.3	1,472	24.4
Quarries/Strip Mines/Gravel Pits	0	0.0	0	0.0	75	1.2
Row Crops	1,114	3.7	257	0.6	262	4.3
Transitional	14	0.0	11	0.0	1	0.0
Woody Wetlands	0	0.0	0	0.0	0	0.0
Total	30,503	100	41,109	100	6,042	100

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	1,476	59.7	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	341	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	620	25.1	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	29	1.2	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	2,477	100.1	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	0.1
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	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 Ready Mixed Concrete Facilities 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 methodologies 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 RMCFs located in impaired subwatersheds were determined as follows.

The existing loading from process wastewater discharge for RMCFs is based on facility design flow, the monthly average permit limit for TSS, and the area of the HUC-12 subwatershed in which the facilities are located. Loads are expressed as average annual loads per unit area and are summarized in Table D-1.

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

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

The existing loading from storm water runoff for RMCFs is based on an assumed runoff from the site drainage area, the daily maximum permit limit for TSS, and the area of the HUC-12 subwatershed in which each 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 Lower French Broad River Watershed is approximately 48 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 (06010107__)	Subwatershed Area	NPDES Permit No.	Process Wastewater			Storm Water Runoff			Total Average Annual Load
			Estimated Flow	Daily Maximum TSS Limit	Average Annual Load	Site Drainage Area	TSS Cut-off Concentration	Average Annual Load	
			[MGD]	[mg/l]	[lb/ac/yr]	[acres]	[mg/l]	[lb/ac/yr]	[lb/ac/yr]
0313	6,042	TNG110126	0.0001	50	0.0025	6.00	200	1.0801	1.083

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 Lower French Broad River Watershed is approximately 48 in/yr (Midwest Plan Service, 1985).

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

where: AAL_{Mining} = Average annual load [lb/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-12} = Area of impaired HUC-12 subwatershed [acres]

Table D-2 Estimate of Existing Load – NPDES Permitted Mining Sites

HUC-12 Subwatershed (06010107___)	Subwatershed Area	NPDES Permit No.	Site Drainage Area	Daily Maximum TSS Limit	Annual Average Load
	[acres]		[acres]	[mg/l]	[lb/ac/yr]
0203	30,503	TN0065951	217	40	1.548
0313	6,042	TN0003018	192		6.913

Total Existing Point Source Loads for Impaired HUC-12 Subwatersheds

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

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

HUC-12 Subwatershed (06010107__)	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]	[%]
0203	TN065951	Mining	1.548				
	Subwatershed 0203 Total		1.548	435	0.36	434.0	0.36
0313	TN0003018	Mining	6.913				
	TNG110126	RMCF	1.083				
	Subwatershed 0313 Total		7.995	1,103	0.72	739.1	1.08

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

APPENDIX E

Waste Load Allocations
for NPDES Permitted Construction Storm Water Sites

In the description of the WCS Sediment Tool in Appendix B, it was stated that model output consists of both erosion and sediment parameters. The composite erosion value is the estimated erosion from road and land cover, while the composite sediment parameter is the fraction of soil erosion from road and land cover that is delivered to the stream network. The composite sediment value for a subwatershed represents the instream sediment load at the "pour point" of the subwatershed. TMDLs, WLAs, and LAs are primarily developed from composite sediment values. WLAs assigned to construction storm water (CSW) sites are an exception, however, in that the WLAs are technology-based and interpreted as erosion from construction sites.

In the *Environmental Assessment for Proposed Effluent Guidelines and Standards for the Construction and Development Category* (USEPA, 2002), it is stated that

> EPA's methodology for estimating construction site pollutant loadings builds upon the methodology used in the *Economic Analysis of the Final Phase II Storm Water Rule* (USEPA, 1999). ········
>
> The Phase II EA estimated that in the absence of any controls, construction sites on average generate approximately 40 tons of TSS per acre per year. In addition, the Phase II EA estimated that properly designed, installed and maintained erosion and sediment (E&S) control BMPs, in combination, can potentially achieve a 90 to 95 percent reduction in sediment runoff.

This indicates that TSS discharges from CSW sites with properly designed, installed, and maintained erosion and sediment control BMPs should range from 4,000 lbs/ac/yr to 8,000 lbs/ac/yr. An erosion load of 6,000 lbs/ac/yr was selected an achievable, technology-based WLA for construction activities.

In order to account for the WLA assigned to CSW sites, the following procedure was used (HUC-12 subwatershed 060101070203 is used as an example):

1. The total disturbed area of all permitted construction storm water sites in an impaired subwatershed was determined from permit records and the percent of total subwatershed area disturbed calculated.

$$\%(A)_{CSW} = \frac{\Sigma\, A_{CSW}}{A_{Subwatershed}} \times (100)$$

For subwatershed 060101070203:

$$\%(A)_{CSW} = \frac{(136\text{ acres})}{(30{,}503\text{ acres})} \times (100) = 0.45\%$$

2. In order to account for the transitory nature of construction activities, the value used in subsequent calculations was estimated as follows:

   a. For percent of total subwatershed area disturbed less than 1.25%, a minimum value of 1.5% was used for subsequent calculations.

   b. For percent of total subwatershed area disturbed equal to or greater than 1.25%, a value of 120% of the percent of total subwatershed area disturbed, rounded up to the nearest tenth of a percent was used for subsequent calculations.

   The resulting value is considered to be a reasonable indication of subwatershed area under construction at any time. For subwatershed 060101070203, 1.5% was used.

3. The composite erosion and composite instream sediment loads calculated in Appendix B (Tables B-1 & B-2) were noted and the ratio of total subwatershed erosion to total instream sediment calculated. This ratio was considered to be representative for the entire subwatershed.

   For subwatershed 060101070203:

$$\text{S/E Ratio} = \frac{(\text{Sediment Load})_{0203}}{(\text{Erosion Load})_{0203}} = \frac{(6{,}637\ \text{tons/yr})}{(19{,}413\ \text{tons/yr})} = 0.342$$

4. The erosion load due to CSW sites in the subwatershed, normalized to the subwatershed area, was derived from the subwatershed area, CSW WLA of 6,000 lbs/ac/yr, and percent of subwatershed area disturbed by construction activities (ref.: Step 2).

$$(\text{Erosion Load})_{CSW} = \frac{\cancel{(A_{0203})} \times (\%_{CSW}/100) \times (WLA_{CSW})}{\cancel{(A_{0203})}}$$

   For subwatershed 060101070203:

$$(\text{Erosion Load})_{CSW} = (0.015) \times (6{,}000\ \text{lbs/ac/yr}) = 90.0\ \text{lbs/ac/yr}$$

5. The erosion load due to construction activities calculated in Step 4 was converted to an equivalent instream sediment load (at the subwatershed "pour point") using the sediment to erosion ratio determined in Step 3.

$$(\text{Sediment Load})_{CSW} = (\text{Erosion Load})_{CSW} \times (\text{S/E Ratio})$$

   For subwatershed 060101070203:

$$(\text{Sediment Load})_{CSW} = (90.0\ \text{lbs/ac/yr}) \times (0.342) = 30.8\ \text{lbs/ac/yr}$$

   This value, the instream sediment load at the subwatershed "pour point" due to discharges from CSW sites, is used in the analysis procedure described in Section 7.1 to calculate WLAs for MS4s and LAs for nonpoint sources. Instream sediment loads for other impaired subwatersheds are summarized in Table E-1.

Table E-1 Determination of Instream Sediment Load Due to Discharges from Construction Storm Water Sites

Subwatershed (06010107__)	Subwatershed Area	CSW Disturbed Area	Actual CSW % (A_{CSW}/ A_{SubWS})	1.2 x Actual CSW % (if Actual CSW % >1.25%)	Value Used for Calcs.	Instream Sediment Load	Erosion Load	Sediment to Erosion (S/E) Ratio	Erosion Load From CSW	Instream Sediment Load Due to CSW
	[acres]	[acres]	[%]	[%]	[%]	[tons/yr]	[tons/yr]		[lbs/ac/yr]	[lbs/ac/yr]
0203	30,503	136	0.446	N/A	1.5	6,637	19,413	0.342	90.0	30.8
0312	41,109	659	1.602	1.92	2.0	18,223	32,476	0.561	120.0	67.3
0313	6,042	118	1.956	2.35	2.4	3,332	8,601	0.387	144.0	55.8

APPENDIX F

Public Notice Announcement

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

PUBLIC NOTICE OF AVAILABILITY OF PROPOSED TOTAL MAXIMUM DAILY LOADS (TMDLs) FOR SILTATION & HABITAT ALTERATION IN THE LOWER FRENCH BROAD RIVER WATERSHED (HUC 06010107), TENNESSEE

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

A number of waterbodies in the Lower French Broad River Watershed are 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 land development, urban runoff, agricultural sources, and bank modification. The TMDLs utilize Tennessee's general water quality criteria, ecoregion reference site data, land use data, digital elevation data, a sediment loading and delivery model, and an appropriate Margin of Safety (MOS) to establish reductions in sediment loading which will result in reduced in-stream concentrations and the attainment of water quality standards. The TMDLs require reductions in sediment loading of approximately 1% to 87% in the listed waterbodies.

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

http://www.state.tn.us/environment/wpc/tmdl/proposed.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 TMDLs are invited to submit their comments in writing no later than July 16th, 2007 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.