TOTAL MAXIMUM DAILY LOAD (TMDL)

For

Siltation and Habitat Alteration

In The

Ft. Loudoun Lake Watershed (HUC 06010201)

Blount, Knox, Loudon and Sevier Counties, Tennessee

FINAL

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ARS	Agricultural Research Station
BMP	Best Management Practices
CFR	Code of Federal Regulations
CFS	Cubic Feet per Second
DEM	Digital Elevation Model
DWPC	Division of Water Pollution Control
EFO	Environmental Field Office
EPA	Environmental Protection Agency
GIS	Geographic Information System
HUC	Hydrologic Unit Code
LA	Load Allocation
MGD	Million Gallons per Day
MOS	Margin of Safety
MRLC	Multi-Resolution Land Characteristic
MS4	Municipal Separate Storm Sewer System
NED	National Elevation Dataset
NHD	National Hydrography Dataset
NPS	Nonpoint Source
NPDES	National Pollutant Discharge Elimination System
NSL	National Sediment Laboratory
Rf3	Reach File v.3
RM	River Mile
RMCF	Ready Mixed Concrete Facility
STATSGO	State Soil and Geographic Database
SSURGO	Soil Survey Geographic Database
TDA	Tennessee Department of Agriculture
TDEC	Tennessee Department of Environment & Conservation
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
USGS	United States Geological Survey
USLE	Universal Soil Loss Equation
WCS	Watershed Characterization System
WLA	Waste Load Allocation
WMD	Water Management Division
WWTF	Wastewater Treatment Facility

SUMMARY SHEET

FT. LOUDOUN LAKE WATERSHED (HUC 06010201)

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

Impaired Waterbody Information:

State: Tennessee
Counties: Blount, Knox, Loudon, and Sevier
Watershed: Ft. Loudoun Lake Watershed (HUC 06010201)
Watershed Area: 660.9 mi^2
Constituent of Concern: Siltation/Habitat Alteration (excess loading of sediment produced by erosional processes – see Section 3.0)
Impaired Waterbodies: *2004 303(d) List*:

Waterbody ID	Waterbody	RM
06010201022_1000	Gallagher Creek	13.2
06010201026_0100	Roddy Branch	6.4
06010201026_0200	Caney Branch	2.0
06010201026_0300	Hollybrook Branch	2.78
06010201026_0400	Pistol Creek	7.66
06010201026_0410	Springfield Branch	5.48
06010201026_0420	Brown Creek	24.7
06010201026_0430	Laurel Bank Branch	22.72
06010201026_0500	Russell Branch	3.0
06010201026_2000	Little River	17.63
06010201027_0300	Rocky Branch	4.04
06010201027_0400	Peppermint Branch	2.7
06010201028_0100	Spicewood Branch	2.23
06010201028_0300	South Fork Crooked Creek	8.21
06010201028_0500	Flag Branch	7.8
06010201028_1000	Crooked Creek	13.91
06010201032_0810	Tipton Branch	2.5
06010201033_0400	South Fork Ellejoy Creek	2.02
06010201033_0500	Carter Branch	4.63
06010201033_2000	Ellejoy Creek	5.37
06010201034_0200	Wildwood Branch	6.26
06010201037_1000	Little Turkey Creek	14.0
06010201066_0100	Casteel Branch	2.0
06010201066_0200	Twin Branch	1.87
06010201066_0500	McCall Branch	1.73

Impaired Waterbodies: *2004 303(d) List* (Cont.):

Waterbody ID	Waterbody	RM
06010201066_1000	Stock Creek	3.77
06010201067_1000	Third Creek	20.7
06010201080_0100	Whites Creek	10.2
06010201080_1000	First Creek	16.1
06010201083_1000	Floyd Creek	7.7
06010201097_1000	Second Creek	12.8
06010201340_1000	Turkey Creek	15.8
060102011015_1000	Cloyd Creek	11.3
060102011330_2000	Sinking Creek	21.9
060102011697_1000	Fourth Creek	14.9
060102011719_1000	Williams Creek	2.8
060102011721_1000	Baker Creek	3.3
060102011723_1000	Goose Creek	4.9
060102011983_1000	Polecat Creek	1.85

Designated Uses: Fish & aquatic life, irrigation, livestock watering & wildlife, and recreation. Some waterbodies in watershed also classified for domestic and/or industrial water supply.

Applicable Water Quality Standard: Most stringent narrative criteria applicable to fish & aquatic life use classification:

Biological Integrity: The waters shall not be modified through the addition of pollutants or through physical alteration to the extent that the diversity and/or productivity of aquatic biota within the receiving waters are substantially decreased or adversely affected, except as allowed under 1200-4-3-.06.

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

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

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

TMDL Development

General Analysis Methodology:

- Analysis performed using the Watershed Characterization System Sediment Tool (based on Universal Soil Loss Equation) applied to impaired HUC-12 subwatershed areas to calculate existing sediment loads.
- Target sediment loads (lbs/acre/year) are based on the average annual sediment loads from biologically healthy watersheds (Level IV Ecoregion reference sites).
- TMDLs are expressed as the percent reduction in average annual sediment load required for a subwatershed containing impaired waterbodies relative to the appropriate target load.
- 5% of subwatershed target loads are reserved to account for WLAs for Ready Mixed Concrete Facilities (RMCFs) and regulated mining sites. Most loading from these sources is small compared to total loading.
- Since the TSS of STP discharges is generally composed of primarily organic material and is considered to be different in nature than the sediments produced form erosional processes, TSS discharges from STPs were not considered in the TMDL analysis (ref.: Sections 3.0 and 6.0).
- WLAs for Municipal Separate Storm Sewer Systems (MS4s) and NPDES-regulated construction storm water discharges and LAs for nonpoint sources are expressed as the percent reduction in average annual sediment load required for a subwatershed containing impaired waterbodies relative to the appropriate reduced target load (target load minus 5% reserved WLAs for mining sites and RMCFs).

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, LAs for Nonpoint Sources:

HUC-12 Subwatershed (06010201__)	Waterbody ID	Waterbody Impaired by Siltation/ Habitat Alteration	Level IV Ecoregion	TMDL (Required Overall Load Reduction)	Required Load Reduction	
					WLA (MS4s and Construction SW)	LA (Nonpoint Sources)
				[%]	[%]	[%]
0103	06010201032_0810	Tipton Branch	66g	77.6	78.8	78.8
0104	06010201027_0300	Rocky Branch	66e	80.6	81.6	81.6
	06010201033_0400	South Fork Ellejoy Creek				
	06010201033_0500	Carter Branch				
	06010201033_2000	Ellejoy Creek				
0105	06010201026_2000	Little River	67f	46.6	49.3	49.3
	06010201027_0400	Peppermint Branch				
	06010201028_0100	Spicewood Branch				
	06010201028_0300	South Fork Crooked Creek				
	06010201028_0500	Flag Branch				
	06010201028_1000	Crooked Creek				
	06010201034_0200	Wildwood Branch				
0106	06010201026_0100	Roddy Branch	67f	51.8	54.2	54.2
	06010201026_0200	Caney Branch				
	06010201026_0300	Hollybrook Branch				
	06010201026_0500	Russell Branch				
	06010201026_2000	Little River				
	060102011983_1000	Polecat Creek				

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

TMDLs, WLAs for MS4s and Construction Storm Water Sites, LAs for Nonpoint Sources (Cont.):

HUC-12 Subwatershed (06010201__)	Waterbody ID	Waterbody Impaired by Siltation/ Habitat Alteration	Level IV Ecoregion	TMDL (Required Overall Load Reduction	Required Load Reduction	
					WLA (MS4s and Const. SW)	LA (Nonpoint Sources)
				[%]	[%]	[%]
0107	06010201026_0400	Pistol Creek	67f	78.1	79.2	79.2
	06010201026_0410	Springfield Branch				
	06010201026_0420	Brown Creek				
	06010201026_0430	Laurel Bank Branch				
0108	06010201066_0100	Casteel Branch	67h	35.3	38.6	38.6
	06010201066_0200	Twin Branch				
	06010201066_0500	McCall Branch				
	06010201066_1000	Stock Creek				
0201	060102011697_1000	Fourth Creek	67f	65.5	67.2	67.2
	060102011719_1000	Williams Creek				
	060102011721_1000	Baker Creek				
	060102011723_1000	Goose Creek				
0202	06010201080_0100	Whites Creek	67f	66.3	68.0	68.0
	06010201080_1000	First Creek				
0203	06010201097_1000	Second Creek	67f	75.2	76.5	76.5
0204	06010201067_1000	Third Creek	67f	67.2	68.8	68.8
0208	060102011330_2000	Sinking Creek	67f	59.8	61.8	61.8
0209	06010201037_1000	Little Turkey Creek	67f	47.7	50.3	50.3
	06010201340_1000	Turkey Creek				
0210	06010201022_1000	Gallagher Creek	67f	28.0	31.6	31.6
0301	06010201083_1000	Floyd Creek	67f	53.1	55.5	55.5
	060102011015_1000	Cloyd Creek				

WLAs for Mining Sites and RMCFs:

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

Mining Sites Permitted to Discharge TSS and Located in Impaired Subwatersheds

HUC-12 Subwatershed (06010201__)	NPDES Permit No.	Name	TSS Daily Max Limit [mg/l]
0106	TN0072761	Vulcan Construction Materials, LP – Rockford Quarry	40
0107	TN0003042	Vulcan Construction Materials, LP – Maryville Quarry	40
0201	TN0029467	Vulcan Construction Materials, LP – Riverside Drive Quarry	40
0210	TN0071862	Tennessee Marble Company – Brown Quarry	40
	TN0072061	TVM/TSW – Lambert Quarry	40
	TN0072125	TVM/TSW – Endsley Quarry	40
	TN0072621	Vulcan Construction Materials, LP – Friendsville South	40
0301	TN0066397	Greenback Crushed Stone, Inc. – Greenback Quarry	40
	TN0072222	Vulcan Construction Materials, LP – Friendsville Quarry	40
	TN0072699	Tennessee Marble Products Co. – Dabney Pit 1	40

RMCFs Permitted to Discharge TSS and Located in Impaired Subwatersheds

HUC-12 Subwatershed (06010201__)	NPDES Permit No.	Facility Name	TSS Daily Maximum Limit [mg/l]	TSS Cut-off Conc. [mg/l]
0106	TNG110089	Harrison Ready-Mix – Topside Road	50	200
	TNG110245	Rockford Concrete Plant	50	200
0107	TNG110088	Harrison Ready-Mix – Duncan Road	50	200
	TNG110090	Harrison Ready-Mix – Matlock Bend Industrial Park	50	200
	TNG110092	Harrison Ready-Mix – Sands Road	50	200
	TNG110121	Ready Mix Concrete Company	50	200
0201	TNG110246	Rinker Materials S. Central – Neyland Drive	50	200
0204	TNG110157	Southeast Precast Corporation	50	200
0209	TNG110027	Ready Mix Concrete Company	50	200
	TNG110244	Rinker Materials S. Central – W. Knox	50	200
0301	TNG110143	Adams Redi-Mix	50	200

TOTAL MAXIMUM DAILY LOAD (TMDL) FOR SILTATION/HABITAT ALTERATION FT. LOUDOUN LAKE WATERSHED (HUC 06010201)

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 Ft. Loudoun Lake Watershed, designated by the Hydrologic Unit Code (HUC) 06010201 by the USGS, is located in East Tennessee (ref.: Figure 1), primarily in Blount, Knox, Loudon, and Sevier Counties. The Ft. Loudoun Lake 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.

- 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 5500 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.

- 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 Ft. Loudoun Lake Watershed (HUC 06010201) has approximately 14,600 lake acres and 953 miles of streams (NHD) as catalogued in the EPA/TDEC Assessment Database (ADB) and drains 660.9 square miles that empty to the Tennessee River. Watershed land use distribution is based on the 1992 Multi-Resolution Land Characteristic (MRLC) satellite imagery databases derived from Landsat Thematic Mapper digital images from the period 1990-1993. Land use for the Ft. Loudoun Lake Watershed is summarized in Table 1 and shown in Figure 3.

Figure 1 Location of the Ft. Loudoun Lake Watershed

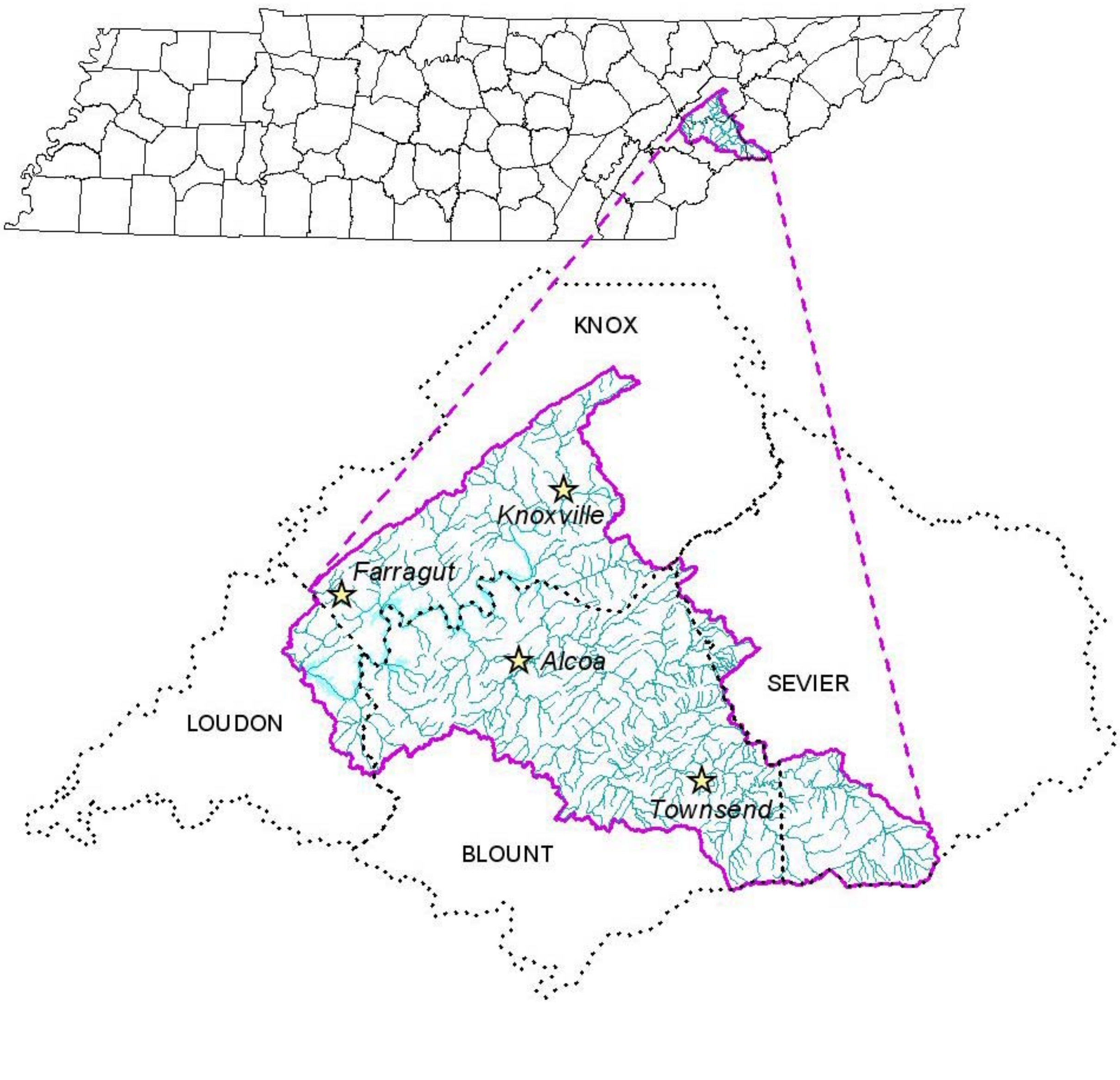


Figure 2 Level IV Ecoregions in the Ft. Loudoun Lake Watershed

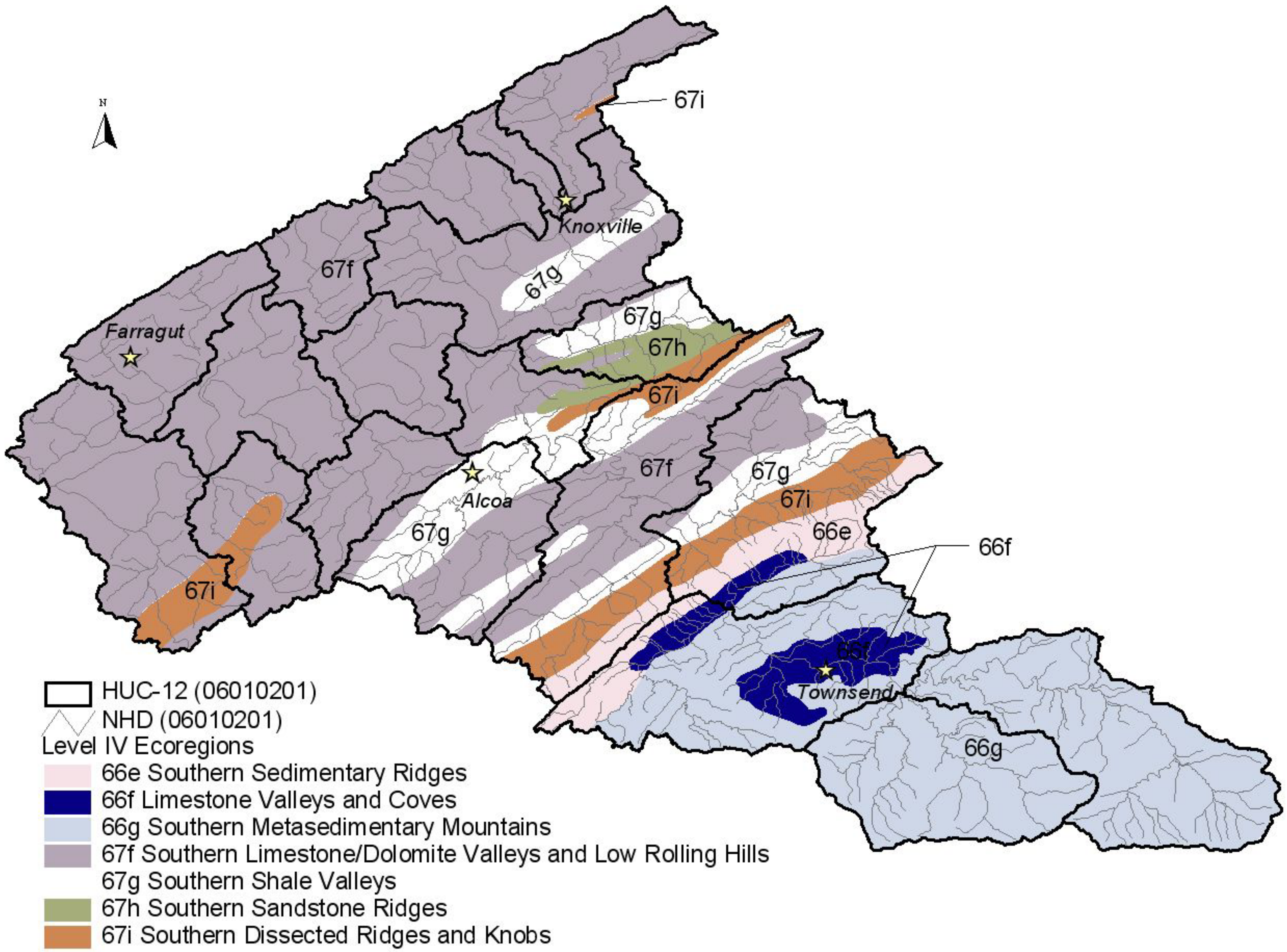
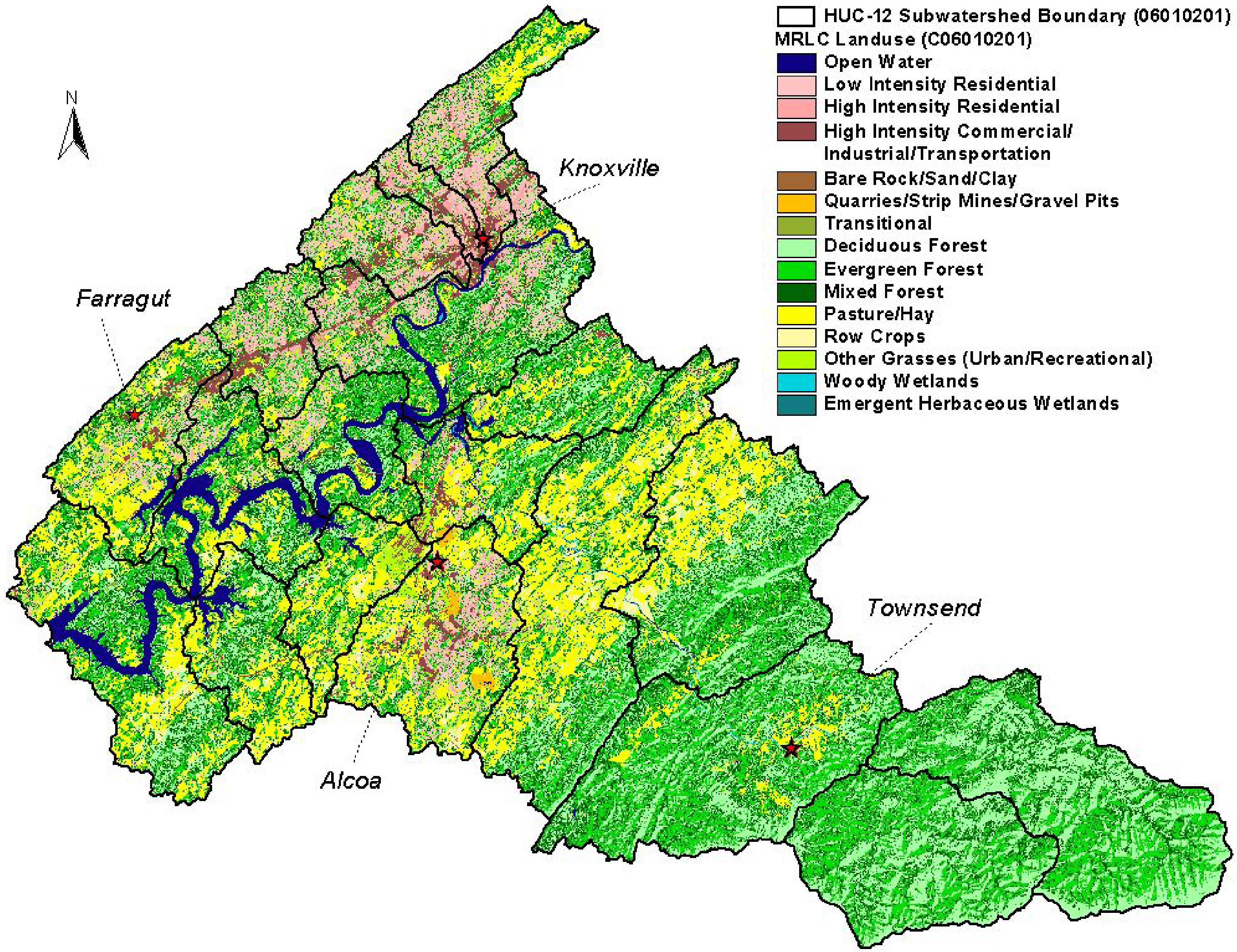


Table 1 Land Use Distribution - Ft. Loudoun Lake Watershed

Land Use	Area		
	[acres]	[mi^2]	[% of watershed]
Bare Rock/Sand/Clay	3	0.0	0.0
Deciduous Forest	93,658	146.3	22.1
Emergent Herbaceous Wetlands	37	0.1	0.0
Evergreen Forest	89,205	139.4	21.1
High Intensity Commercial/Industrial/ Transportation	11,446	17.9	2.7
High Intensity Residential	6,795	10.6	1.6
Low Intensity Residential	27,773	43.4	6.6
Mixed Forest	86,452	135.1	20.4
Open Water	13,151	20.5	3.1
Other Grasses (Urban/Recreational)	11,645	18.2	2.8
Pasture / Hay	66,955	104.6	15.8
Quarries/Strip Mines/Gravel Pits	818	1.3	0.2
Row Crops	14,359	22.4	3.4
Transitional	236	0.4	0.1
Woody Wetlands	428	0.7	0.1
Total	**422,962**	**660.9**	**100.0**

Figure 3 MRLC Land Use in the Ft. Loudoun Lake Watershed



3.0 PROBLEM DEFINITION

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

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

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

A typical example of a stream assessment (Gallagher Creek) 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 lake beds. Sediment is created by the weathering of host rock and delivered to stream channels through various erosional processes, including sheetwash, gully and rill erosion, wind landslides, dry gravel, and human excavation. In addition, sediments are often produced as a result of stream channel and bank erosion and channel disturbance. Movement of eroded sediments downslope from their points of origin into stream channels and through stream systems is influenced by multiple interacting factors (USEPA, 1999).

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

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

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

Table 2 ***2004 303(d) List*** **- Stream Impairment Due to Siltation/Habitat Alteration in the Ft. Loudoun Lake Watershed**

Waterbody Segment ID	Waterbody Segment Name	Miles/Acres Impaired	Cause (Pollutant)	Source (Pollutant)
06010201022_1000	Gallagher Creek	13.2	Loss of biological integrity due to siltation	Pasture Grazing
06010201026_0100	Roddy Branch	6.4	Habitat loss due to alteration in stream-side or littoral vegetative cover/Physical Substrate Habitat Alteration/Loss of biological integrity due to siltation/ Escherichia coli	Pasture Grazing/Channelization/ Removal of Riparian Habitat
06010201026_0200	Caney Branch	2.0	Physical Substrate Habitat Alteration	Sand, Gravel, Rock Mining or Quarries
06010201026_0300	Hollybrook Branch	2.78	Habitat loss due to alteration in stream-side or littoral vegetative cover/Loss of biological integrity due to siltation	Pasture Grazing
06010201026_0400	Pistol Creek	7.66	Loss of biological integrity due to siltation/Escherichia coli	Discharges from MS4 area
06010201026_0410	Springfield Branch	5.48	Loss of biological integrity due to siltation	Discharges from MS4 area
06010201026_0420	Brown Creek	24.7	Habitat loss due to alteration in stream-side or littoral vegetative cover/Nitrates/Loss of biological integrity due to siltation	Discharges from MS4 area/Land Development
06010201026_0430	Laurel Bank Branch	22.72	Loss of biological integrity due to siltation/Escherichia coli	Discharges from MS4 area
06010201026_0500	Russell Branch	3.0	PCBs/Loss of biological integrity due to siltation	Contaminated Sediment/ RCRA Hazardous Waste/ Discharges from MS4 area
06010201026_2000	Little River		This 17.63 mile section of the Little River has been identified as “threatened” due to a documented decline in diversity at biological stations at miles 7.6 and 9.6. The specific stressor is undetermined.	*(Left blank intentionally)*

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

Waterbody Segment ID	Waterbody Segment Name	Miles/Acres Impaired	Cause (Pollutant)	Source (Pollutant)
06010201027_0300	Rocky Branch	4.04	Habitat loss due to alteration in stream-side or littoral vegetative cover/Loss of biological integrity due to siltation	Pasture Grazing
06010201027_0400	Peppermint Branch	2.7	Loss of biological integrity due to siltation	Discharges from MS4 area/ Pasture Grazing
06010201028_0100	Spicewood Branch	2.23	Loss of biological integrity due to siltation	Streambank Modifications
06010201028_0300	South Fork Crooked Creek	8.21	Habitat loss due to alteration in stream-side or littoral vegetative cover/ Loss of biological integrity due to siltation	Pasture Grazing
06010201028_0500	Flag Branch	7.8	Habitat loss due to alteration in stream-side or littoral vegetative cover/Loss of biological integrity due to siltation	Pasture Grazing/Discharges from MS4 area
06010201028_1000	Crooked Creek	13.91	Loss of biological integrity due to siltation/Escherichia coli	Pasture Grazing/Livestock in Stream
06010201032_0810	Tipton Branch	2.5	Habitat loss due to alteration in stream -side or littoral vegetative cover/Loss of biological integrity due to siltation	Upstream Impoundments
06010201033_0400	South Fork Ellejoy Creek	2.02	Habitat loss due to alteration in stream-side or littoral vegetative cover	Pasture Grazing
06010201033_0500	Carter Branch	4.63	Habitat loss due to alteration in stream-side or littoral vegetative cover	Pasture Grazing
06010201033_2000	Ellejoy Creek	5.37	Nitrates/Loss of biological integrity due to siltation/Escherichia coli	Pasture Grazing

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

Waterbody Segment ID	Waterbody Segment Name	Miles/Acres Impaired	Cause (Pollutant)	Source (Pollutant)
06010201034_0200	Wildwood Branch	6.26	Habitat loss due to alteration in stream-side or littoral vegetative cover/Escherichia coli	Pasture Grazing
06010201037_1000	Little Turkey Creek	14.0	Loss of biological integrity due to siltation	Discharges from MS4 area
06010201066_0100	Casteel Branch	2.0	Loss of biological integrity due to siltation	Pasture Grazing/ Discharges from MS4 area
06010201066_0200	Twin Branch	1.87	Habitat loss due to alteration in stream-side or littoral vegetative cover/Loss of biological integrity due to siltation	Pasture Grazing/ Discharges from MS4 area
06010201066_0500	Mccall Branch	1.73	Loss of biological integrity due to siltation	Discharges from MS4 area/Streambank Modification
06010201066_1000	Stock Creek	3.77	Physical Substrate Habitat Alteration/Loss of biological integrity due to siltation/Escherichia coli	Pasture Grazing/Channelization
06010201067_1000	Third Creek	20.7	Nitrates/Loss of biological integrity due to siltation/Other Anthropogenic Habitat Alterations/Escherichia coli	Discharges from MS4 area/Urbanized High Density Area/Land Development/Collection System Failure
06010201080_0100	Whites Creek	10.2	Other Anthropogenic Habitat Alterations/Escherichia coli	Discharges from MS4 area/ Streambank Modification
06010201080_1000	First Creek	16.1	Nitrates/Loss of biological integrity due to siltation/Other Anthropogenic Habitat Alterations/Escherichia coli	Discharges from MS4 area/Urbanized High Density Area/Collection System Failure

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

Waterbody Segment ID	Waterbody Segment Name	Miles/Acres Impaired	Cause (Pollutant)	Source (Pollutant)
06010201083_1000	Floyd Creek	7.7	Loss of biological integrity due to siltation/Escherichia coli	Pasture Grazing
06010201097_1000	Second Creek	12.8	Other Anthropogenic Habitat Alterations/Nitrates/Loss of biological integrity due to siltation/ Escherichia coli	Discharges from MS4 area/Urbanized High Density Area/Collection System Failure
060102010340_1000	Turkey Creek	15.8	Loss of biological integrity due to siltation/Escherichia coli	Discharges from MS4 area
060102011015_1000	Cloyd Creek	11.3	Loss of biological integrity due to siltation/Physical Substrate Habitat Alteration/Escherichia coli	Pasture Grazing/Livestock in Stream
060102011330_2000	Sinking Creek	21.9	Habitat loss due to alteration in stream-side or littoral vegetative cover/Loss of biological integrity due to siltation	Discharges from MS4 area
060102011697_1000	Fourth Creek	14.9	Physical Substrate Habitat Alteration/Escherichia coli	Discharges from MS4 area/Channelization
060102011719_1000	Williams Creek	2.8	Other Anthropogenic Habitat Alterations/Escherichia coli	Discharges from MS4 area/Collection System Failure
060102011721_1000	Baker Creek	3.3	Nitrates/Other Anthropogenic Habitat Alterations /Escherichia coli	Discharges from MS4 area/Collection System Failure
060102011723_1000	Goose Creek	4.9	Loss of biological integrity due to siltation/Other Anthropogenic Habitat Alterations/ PCBs/Escherichia coli	Collection System Failure/Discharges from MS4 area/RCRA Hazardous Waste
060102011983_1000	Polecat Creek	1.85	Habitat loss due to alteration in stream-side or littoral vegetative cover/Loss of biological integrity due to siltation	Land Development/ Channelization

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

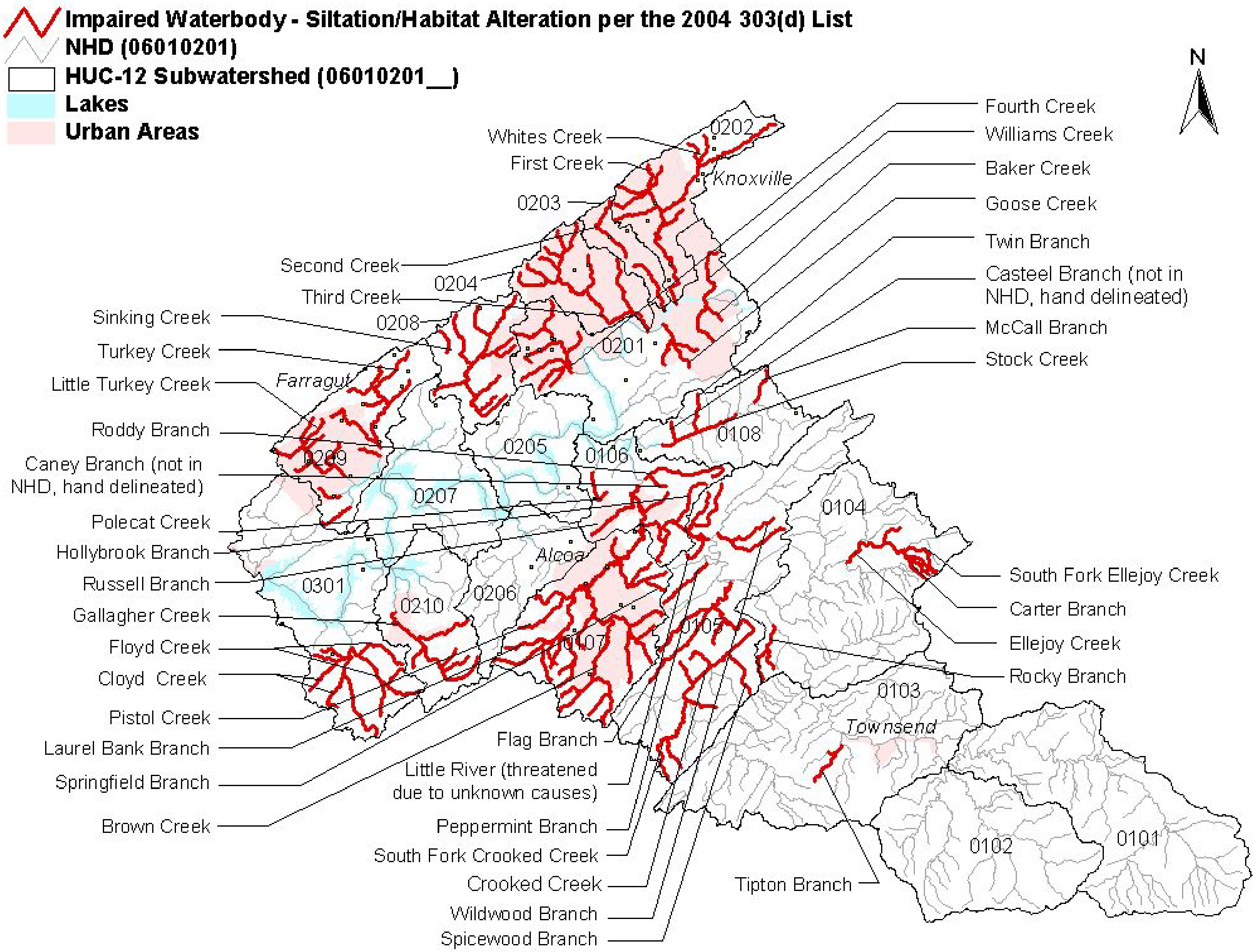


Table 3 Water Quality Assessment of Waterbodies Impaired Due to Siltation/Habitat Alteration

Waterbody Segment ID	Waterbody Segment Name	Comments
06010201022_1000	Gallagher Creek (Tennessee River to headwaters)	2003 TDEC RBPIII and chemical station at mile 2.6 (Unitia Road). One E. coli observation out of 12 over 1,000. G.M. = 267. 1997 TVA station at mile 3.2. 7 EPT families, 15 total families. Fish IBI 26 "very poor". Bacteriological data also.
06010201026_0100	Roddy Branch (Little River to headwaters)	2003 TDEC chemical station at mile 0.6 (Roddy Branch Road). One E. coli observation out of 10 over 1,000. G.M. = 282. 2000 LAB biorecon at mile 0.6 (Roddy Branch Road). 9 EPT genera, 1 intolerant, 29 total genera. BR score = 7. Habitat score = 89. 1998 TDEC biological survey 0.6. 12 EPT genera, FAL assessment based on NCBI =4.95. Habitat score = 119. 387 G.M. E.coli.
06010201026_0200	Caney Branch (Little River to headwaters)	2001 Mining Section biorecon u/s Caney Branch Road. Zero EPT genera, 1 intolerant, 16 total genera. Habitat score = 64. Failed biorecon criteria. 2000 LAB biorecon at mile 0.1 (Roddy Branch Road). Zero EPT genera, zero intolerant, 6 total genera. BR score = 3. Habitat score = 66.
06010201026_0300	Hollybrook Branch (Little River to headwaters)	2000 LAB biorecon at mile 0.5 (Martin Mill Road). 6 EPT genera, 2 intolerant, 22 total genera. BR score = 7. Habitat score = 86.
06010201026_0400	Pistol Creek (Little River to headwaters)	2000 LAB RBPIII at mile 0.2 (Singleton Road). 4 EPT genera, 32 total genera. Index Score = 28. Failed biocriteria. Habitat score = 121. 1998 TDEC biological survey mile 1.9. 2 EPT genera, 13 total taxa, NCBI 6.33. Habitat assessment =99. 299 E. coli G.M. TVA survey at mile 1.9 . 36 IBI.
06010201026_0410	Springfield Branch (Pistol Creek to headwaters)	2000 LAB biorecon at mile 0.3 (McCarther Road). 1 EPT genera, 1 intolerant, 13 total genera. BR score = 3. Habitat score = 97.
06010201026_0420	Brown Creek (Pistol Creek to headwaters)	2000 LAB biorecon at mile 0.2 (Washington Street). 5 EPT genera, 1 intolerant, 17 total genera. BR score = 5. Habitat score = 93. Duncan Branch, a trib, also assessed. 2000 LAB biorecon at mile 0.3 (Duncan Road). 1 EPT genera, zero intolerant, 14 total genera. BR score = 3. Habitat score = 99. 1999 TDEC chemical station at mile 3.9 (Highway 321). Nitrate-nitrite elevated.

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

Waterbody Segment ID	Waterbody Segment Name	Comments
06010201026_0430	Laurel Bank Branch (Pistol Creek to headwaters)	2000 LAB biorecon at mile 1.0 (Settlement Road). 6 EPT genera, 3 intolerant, 26 total genera. BR score = 5. Habitat score = 92. A trib, Culton Creek, also assessed. 2000 LAB biorecon at mile 0.1 (Highway 129). 2 EPT genera, zero intolerant, 15 total genera. BR score = 3. Habitat score = 108. 1999 TDEC station at Highway 334. Fecal coliform elevated.
06010201026_0500	Russell Branch (Little River to headwaters)	2003 TDEC pathogen station at mile 0.9 (Singleton Road). One out of 10 E. coli observations over 1,000. G.M. = 291. 2000 LAB RBPIII at mile 0.9 (Singleton Road). 3 EPT genera, 34 total genera. Index score = 26. Failed biocriteria. Habitat score = 83.
06010201026_2000	Little River (Roddy Branch to Nails Branch)	2003 TDEC chemical station at mile 7.0 (Williams Mill Road). None out of ten E. coli observations over 1,000. G.M. = 117. 2003 TDEC chemical station at mile 9.6 (Alcoa WTP). One out of ten E. coli observations over 1,000. G.M. = 183. 2000 LAB RBPIII at mile 8.0 (d/s Pistol Creek). 2 EPT genera, 25 total genera. (Couldn't be scored.) 1998 TDEC stations at 7.6 & 9.6. 1996 TVA biological station at mile 8.9 (Rockford). 12 EPT families, 27 total families.
06010201027_0300	Rocky Branch (Little River to headwaters)	2000 LAB biorecon at mile 0.8 (Cambridge Road). 6 EPT genera, 4 intolerant, 21 total genera. BR score = 7. Habitat score = 92.
06010201027_0400	Peppermint Branch (Little River to headwaters)	2000 LAB biorecon at mile 0.7 (off Hitch Road). 5 EPT genera, 2 intolerant, 20 total genera. BR score = 5. Habitat score = 102.
06010201028_0100	Spicewood Branch (Crooked Creek from Little River to headwaters)	2000 LAB biorecon at mile 0.4 (off Hatcher Road). 6 EPT genera, 7 intolerant, 21 total genera. BR score = 7. Habitat score = 119.
06010201028_0300	South Fork Crooked Creek (Crooked Creek to headwaters)	2000 LAB biorecon at mile 0.1 (Wilkinson Pike). 7 EPT genera, 2 intolerant, 22 total genera. BR score = 5. Habitat score = 89.

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

Waterbody Segment ID	Waterbody Segment Name	Comments
06010201028_0500	Flag Branch (Crooked Creek to headwaters, Includes Gravelly Creek)	2000 LAB biorecon at mile 0.7 (Centennial Road). 6 EPT genera, 2 intolerant, 21 total genera. BR score = 5. Habitat score = 113.
06010201028_1000	Crooked Creek (Little River to headwaters)	2000 LAB RBPIII at mile 1.1 (Davis Ford Road). 6 EPT genera, 38 total genera. Index score = 32. Habitat score = 76. 2000 LAB biorecon at mile 5.3 (off Hwy 73). 3 EPT genera, 2 intolerant, 17 total genera. BR score = 5. Habitat score = 92. 2003 TDEC RBPIII at mile 7.2 (Whites Mill Road). 7 EPT genera, 20 total genera. Index score = 30. Failed biocriteria. Habitat score = 129. 2000 LAB biorecon at mile 7.2 (Whites Mill Road). 7 EPT genera, 3 intolerant, 20 total genera. BR score = 9. Habitat score = 87. 1998 TDEC station at 1.1. 12 EPT genera, NCBI 4.51. Habitat assessment score = 130. 1326 G.M. E.coli. 1999 TVA station at 3.1. 30 IBI (poor). 10 EPT families, 25 total families.
06010201032_0810	Tipton Branch (Short Creek to headwaters)	2000 LAB biorecon at mile 0.4 (d/s Laurel Lake). 3 EPT genera, zero intolerant, 11 total genera. BR score = 3. Habitat score = 100. Also assessed some tribs to Laurel Lake. 2000 LAB biorecon on Slate Quarry Hollow at mile 0.1 (Laurel Valley Road). 7 EPT genera, 3 intolerant, 24 total genera. BR score = 5. Habitat score = 63. Also 2000 LAB biorecon on Cooper Hollow Hollow at mile 0.1 (Laurel Valley Road). Not enough flow to assess.
06010201033_0400	South Fork Ellejoy Creek (Ellejoy Creek to headwaters)	2000 LAB biorecon at mile 0.1 (Dripping Springs Road). 5 EPT genera, 5 intolerant, 22 total genera. BR score = 5. Habitat score = 105.
06010201033_0500	Carter Branch (Ellejoy Creek to headwaters)	2000 LAB biorecon at mile 0.1 (Old Chilhowee Road). 7 EPT genera, 5 intolerant, 22 total genera. BR score = 5. Habitat score = 99.
06010201033_2000	Ellejoy Creek (Millstone Creek to headwaters)	2003 TDEC RBPIII and chemical station at mile 8.0 (Davis Road). Three out of twelve E. coli observations over 1,000. G.M. = 421. 4 EPT genera, 20 total genera. Index score = 28. Failed biocriteria. Habitat score = 94. 2003 TDEC chemical station at mile 10.1 (Ellejoy Road). Three out of twelve E. coli observations over 1,000. G.M. = 283.

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

Waterbody Segment ID	Waterbody Segment Name	Comments
06010201034_0200	Wildwood Branch (Nails Creek to headwaters.)	2003 TDEC chemical station at mile 0.1 (Andy Harris Road). Two out of thirteen E. coli observations over 1,000. G.M. = 448. 2000 LAB biorecon at mile 0.1 (Andy Harris Road). 7 EPT genera, 2 intolerant, 22 total genera. BR score = 5. Habitat score = 148.
06010201037_1000	Little Turkey Creek (Fort Loudoun Embayment to headwaters)	2003 TDEC RBPIII and pathogen station at mile 1.4 (Virtue Road). 4 EPT genera, 19 total genera. Index score = 28. Failed biocriteria. Habitat score = 144. One E. coli sample out of twelve was over 1,000. G.M. of E. coli = 151. 1998 TVA station at mile 1.4 (Virtue Road). IBI score of 20 (very poor). 3 EPT families, 15 total families.
06010201066_0100	Casteel Branch (Stock Creek to headwaters)	2000 LAB biorecon at mile 0.5 (off Tipton Station Road). 8 EPT genera, 5 intolerant, 27 total genera. BR score = 7. Habitat score =122.
06010201066_0200	Twin Branch (Stock Creek to headwaters)	2000 LAB biorecon at mile 0.5 (off Tipton Station Road). 6 EPT genera, 4 intolerant, 25 total genera. BR score = 5. Habitat score =101.
06010201066_0500	Mccall Branch (Stock Creek to headwaters)	2003 TDEC pathogen station at mile 0.7 (off Tipton Station Road). One sample out of 12 E. coli observations were over 1,000. G.M. of samples was 208. 2000 LAB biorecon at mile 0.7 (u/s Tipton Station Road). 5 EPT genera, 1 intolerant, 20 total genera. BR score = 5. Habitat score = 110.
06010201066_1000	Stock Creek (Little River to confluence of Grandview Branch)	2003 TDEC chemical station at mile 2.0 (Hall Road). Two out of twelve E. coli observations over 1,000. G.M. = 245. 2003 TDEC RBPIII and chemical station at mile 3.2 (Martin Mill Road). Two out of twelve E. coli observations over 1,000. G.M. = 348. 7 EPT genera, 20 total genera. Index score = 30. Failed biocriteria. Habitat score = 111. 2003 TDEC chemical station at mile 4.6 (Newbert Springs Mill Road). Two out of twelve E. coli observations over 1,000. G.M. = 388.

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

Waterbody Segment ID	Waterbody Segment Name	Comments
06010201067_1000	Third Creek (Fort Loudoun to headwaters)	Water contact advisory for pathogens. 2003 TDEC RBPIII and pathogen station at mile 1.0 (Tyson Park foot bridge). 2 EPT genera, 20 total genera. Index score = 14. Failed biocriteria. Habitat score = 135. Three E. coli samples out of twelve was over 940. G.M. of E. coli = 618. 2003 TDEC pathogen station at mile 1.5 (Concord Street). One E. coli samples out of twelve was over 1,000. G.M. of E. coli = 561. Also station on East Fork Third Creek: 2003 TDEC pathogen station at mile 0.1 (Tyson Park). Three E. coli samples out of twelve was over 1,000. G.M. of E. coli = 701. TVA biological surveys at mile 4.0 (1 EPT family, 10 total families), plus at Cumberland Ave (1 EPT family, 7 total families).
06010201080_0100	Whites Creek (First Creek to headwaters)	2003 TDEC pathogen station at mile 0.1 (I-640). One E. coli sample out of twelve was over 1,000. G.M. of E. coli = 586. 1997 TVA biological survey at mile 0.6 (Nora Road). 4 EPT families, 15 total families.
06010201080_1000	First Creek (Fort Loudoun to headwaters)	2003 TDEC pathogen station at mile 0.1 (Volunteer Landing). Five E. coli samples out of twelve was over 940.. G.M. of E. coli = 806. 2003 TDEC pathogen station at mile 5.7 (I-640). One E. coli sample out of twelve was over 1,000. G.M. of E. coli = 632. TVA stations at mile 2.8 (3 EPT families, 13 total families) and at mile 6.1 (3 EPT families, 8 total families). Water contact advisory.
06010201083_1000	Floyd Creek (Fort Loudoun to headwaters)	2003 TDEC pathogen station at mile 0.5 (Kiser Station Road). Ten E. coli samples out of twelve was over 1,000. G.M. of E. coli = 1622. 1999 LAB biological survey at mile 0.5 (Kiser Station Road). 7 EPT genera, zero intolerant, 15 total genera. BR score = 7. Habitat score = 120. E. coli elevated (1733). Cows in creek. TVA station at mile 1.4. IBI = 28 (poor). 10 EPT families, 18 total.
06010201097_1000	Second Creek (Fort Loudoun to headwaters)	Long-term water contact advisory. 2003 TDEC RBPIII and pathogen station at mile 0.1 (Neyland Drive). 2 EPT genera, 21 total genera. Index score = 18. Failed biocriteria. Habitat score = 104. Ten E. coli sample out of twelve was over 1,000. G.M. of E. coli = 1838. TVA stations at Cumberland Ave (0 EPT families, 9 total families) and at Davanna Road (0 EPT families, 8 total families). Water contact advisory.
060102011015_1000	Cloyd Creek (Fort Loudoun Reservoir to headwaters)	2003 TDEC pathogen station at mile 1.5 (near Hickory Valley). Three E. coli samples out of twelve was over 1,000. G.M. of E. coli = 591. 1999 LAB biological survey at mile 1.5 (near Hickory Valley). 5 EPT genera, zero intolerant, 21 total families. BR score = 5. Habitat score = 90. E. coli elevated (2419). Cows in creek. TVA station at mile 2.6. Fish IBI = 36 (poor).

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

Waterbody Segment ID	Waterbody Segment Name	Comments
060102011330_2000	Sinking Creek (Interstate I-40 to where it emerges from the cave)	Long-term water contact advisory due to pathogens. Stream should be reassessed.
06010201340_1000	Turkey Creek (Fort Loudoun to headwaters)	2003 TDEC RBPIII and pathogen station at mile 2.6 (Kingston Pike). 4 EPT genera, 20 total genera. Index score = 30. Failed biocriteria. Habitat score = 125. Three E. coli sample out of twelve was over 1,000. G.M. of E. coli = 452. Nitrates removed from listing because levels generally lower. 1998 TVA survey. IBI = 28 (poor). 4 EPT families.
060102011697_1000	Fourth Creek (Fort Loudoun Reservoir to headwaters)	2003 TDEC RBPIII and pathogen station at mile 1.2 (d/s of Westland Drive). 2 EPT genera, 24 total genera. Index score = 30. Failed biocriteria. Habitat score = 143. Two E. coli sample out of twelve was over 1,000. G.M. of E. coli = 296. 1997 TVA station at Northshore Drive. IBI score = 20 (very poor). 2 EPT families, 10 total families.
060102011719_1000	Williams Creek (Fort Loudoun Reservoir to headwaters)	2003 TDEC RBPIII and pathogen station at mile 0.7 (Riverside Drive). 3 EPT genera, 17 total genera. Index score = 26. Failed biocriteria. Habitat score = 124. Two E. coli sample out of twelve was over 1,000. G.M. of E. coli = 231. 1997 TVA biological survey at Riverside Drive. 1 EPT family, 4 total families.
060102011721_1000	Baker Creek (Fort Loudoun Reservoir to headwaters)	2003 TDEC RBPIII and pathogen station at mile 0.3 (Lelland Drive). 2 EPT genera, 26 total genera. Index score = 24. Failed biocriteria. Habitat score = 98. Six E. coli sample out of twelve was over 1,000. G.M. of E. coli = 1188. 1997 TVA biological survey at Beech Street. 1 EPT families, 17 total families.
060102011723_1000	Goose Creek (Fort Loudoun to headwaters)	Water contact advisory. Witherspoon Superfund site. 2003 TDEC RBPIII and pathogen station at mile 0.8 (Mary Vestel Park). 1 EPT genera, 23 total genera. Index score = 24. Failed biocriteria. Habitat score = 110. Two E. coli samples out of twelve over 1,000. G.M. of E. coli = 509. 1997 TVA station at mile 0.5 (Mary Vestal Park). IBI = 30, zero EPT families, 10 total families.
060102011983_1000	Polecat Creek (Fort Loudoun Reservoir from Fort Loudoun Reservoir to headwaters)	2000 LAB biorecon at mile 1.0 (Pearly Smith Road). 1 EPT genera, zero intolerant, 14 total genera. BR score = 3. Habitat score = 78.

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

Historically, waterbodies in Tennessee have been assessed as not fully supporting designated uses due to siltation when the impairment was determined to be the result of excess loading of the inorganic sediment produced by erosional processes. In cases where impairment was determined to be caused by excess loading of the primarily organic particulate material found in sewage treatment plant (STP) effluent, the cause of pollution was listed as total suspended solids (TSS) or organic enrichment. In consideration of this practice, this document presents the details of TMDL development for waterbodies in the Ft. Loudoun Lake 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.

Tipton Branch (Waterbody ID TN06010201032_0810) is listed on the *2004 303(d) List* as impaired due to siltation and alteration in stream-side or littoral vegetative cover due to upstream impoundment. The source "upstream impoundment" is typically associated with problems related to low dissolved oxygen or thermal modifications. Field office staff have documented a site specific problem on Tipton Branch below the Laurel Lake impoundment that is causing an increased silt load to the stream. A weir in the dike on Tipton Branch that forms Laurel Lake drains through a channel with riprap for about 70 yards and concrete for about 30 more yards. A stream survey dated October 25, 2000 indicated that the creek had bypassed the concrete channel flowing under the concrete and forming a side channel. About 100 yards downstream of the concrete, an eroded and entrenched channel was draining the ridge. The gravel/cobble bottom was embedded in silt and clay and showed evidence of continuous severe erosion during high flow/floods. Therefore, TMDLs for excess sediment were developed for Tipton Branch.

4.0 TARGET IDENTIFICATION

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

Applicable to all use classifications (Fish & Aquatic Life shown):

> Solids, Floating Materials, and Deposits – There shall be no distinctly visible solids, scum, foam, oily slick, or the formation of slimes, bottom deposits or sludge banks of such size and character that may be detrimental to fish & aquatic life.
>
> Other Pollutants – The waters shall not contain other pollutants that will be detrimental to fish or aquatic life.

Applicable to the Domestic Water Supply, Industrial Water Supply, Fish & Aquatic Life, and Recreation use classifications (Fish & Aquatic Life shown):

> Turbidity or Color – There shall be no turbidity or color in such amounts or of such character that will materially affect fish & aquatic life.

Applicable to the Fish & Aquatic Life use classification:

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

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

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

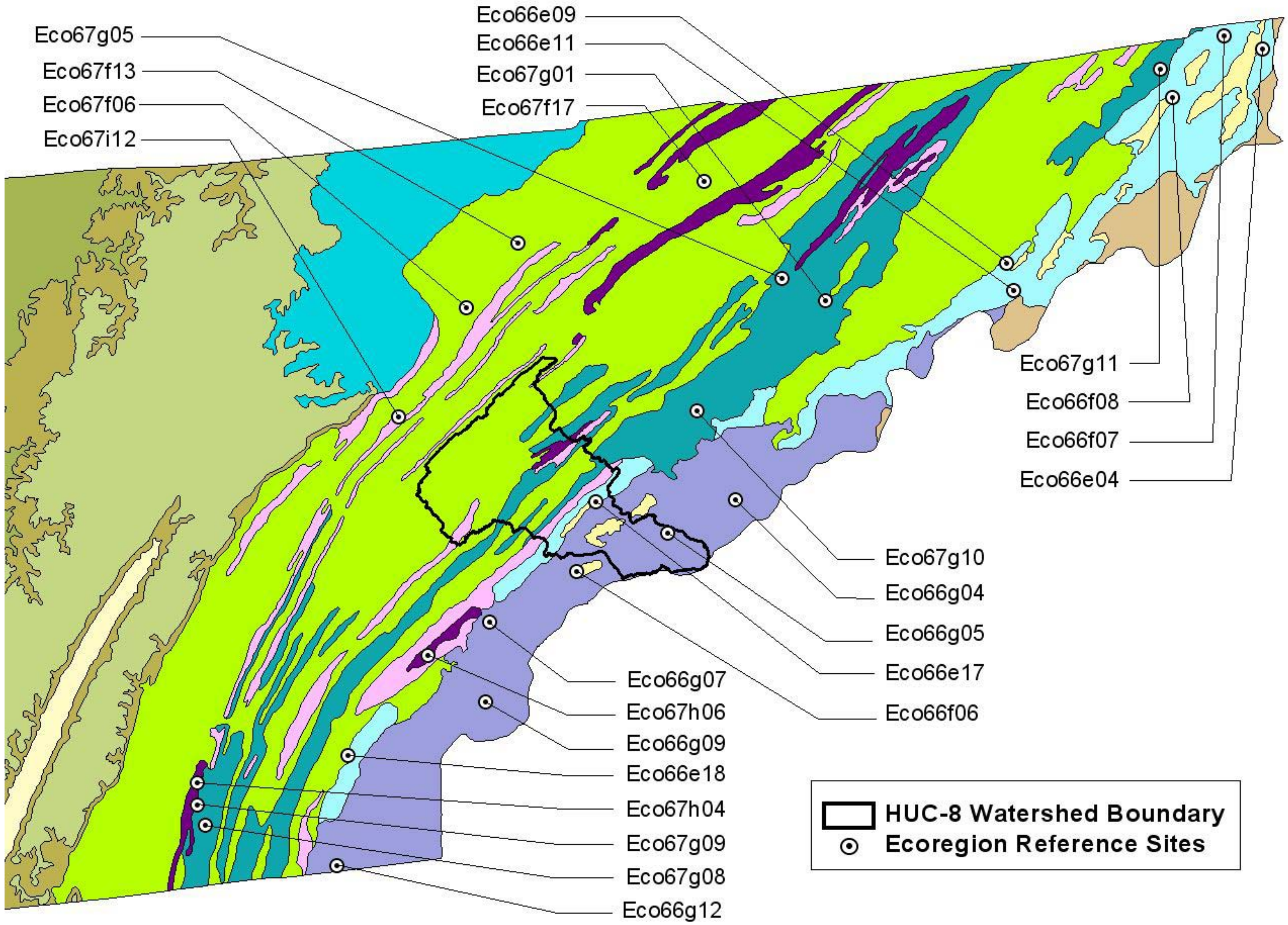
Using the methodology described in Appendix B, the Watershed Characterization System (WCS) Sediment Tool was used to calculate the average annual sediment load for each of the biologically healthy (reference) watersheds in Level IV ecoregions 66e, 66f, 66g, 67f, 67g, 67h, and 67i. The geometric mean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

> *Note: Ecoregion reference sites are continually reviewed, with sites added or deleted as circumstances warrant. Using the methodology described in Appendix B, the WCS Sediment Tool was used to determine the average annual sediment loads, due to precipitation-based sources, for the active Level IV ecoregion reference sites as of June 3, 2003. The WCS sediment tool utilizes DEM and MRLC coverages to calculate the sediment loads. The stations listed in Table 4 and shown in Figure 5 are the ecoregion reference sites as of June 3, 2003 for which the average annual sediment loads could be calculated with current information.*

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

Level 4 Ecoregion	Reference Site	Stream	Drainage Area (acres)	Average Annual Sediment Load [lbs/acre/year]
66e	Eco66e04	Gentry Creek	2,699	146.6
	Eco66e09	Clark Creek	5,886	67.6
	Eco66e11	Lower Higgins Creek	2,189	88.8
	Eco66e17	Double Branch	1,878	131.8
	Eco66e18	Gee Creek	2,728	213.4
			Geometric Mean (Target Load)	**119.9**
66f	Eco66f06	Abrams Creek	13,857	133.6
	Eco66f07	Beaverdam Creek	29,262	264.2
	Eco66f08	Stony Creek	2,477	115.8
			Geometric Mean (Target Load)	**159.9**
66g	Eco66g04	Middle Prong Little Pigeon River	12,469	85.6
	Eco66g05	Little River	19,998	68.0
	Eco66g07	Citico Creek	1,556	93.0
	Eco66g09	North River	7,470	375.5
	Eco66g12	Sheeds Creek	2,281	65.9
			Geometric Mean (Target Load)	**106.0**
67f	Eco67f06	Clear Creek	1,975	396.0
	Eco67f13	White Creek	1,724	272.0
	Eco67f17	Big War Creek	30,062	581.4
			Geometric Mean (Target Load)	**397.1**
67g	Eco67g01	Little Chucky Creek	24,024	582.3
	Eco67g05	Bent Creek	21,058	903.9
	Eco67g08	Brymer Creek	4,237	604.1
	Eco67g09	Harris Creek	3,054	726.8
	Eco67g10	Flat Creek	13,236	654.4
	Eco67g11	N Prong Fishdam Creek	1,019	865.8
			Geometric Mean (Target Load)	**712.6**
67h	Eco67h04	Blackburn Creek	653	184.5
	Eco67h06	Laurel Creek	1,793	842.1
			Geometric Mean (Target Load)	**394.2**
67i	Eco67i12	Mill Branch	681	281.0
			Geometric Mean (Target Load)	**281.0**

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



5.0 WATER QUALITY ASSESSMENT AND DEVIATION FROM TARGET

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

Table 5 Existing Sediment Loads in Subwatersheds With Impaired Waterbodies

Huc-12 Subwatershed (06010201____)	Level IV Ecoregion	Existing Sediment Load
		[lbs/ac/yr]
0103	66g	474
0104	66e	619
0105	67f	743
0106	67f	823
0107	67f	1,812
0108	67h	609
0201	67f	1,149
0202	67f	1,178
0203	67f	1,604
0204	67f	1,209
0208	67f	987
0209	67f	759
0210	67f	551
0301	67f	848

6.0 SOURCE ASSESSMENT

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

NPDES are considered nonpoint sources. The TMDL must provide a Load Allocation (LA) for these sources.

6.1 Point Sources

6.1.1 NPDES-Regulated Wastewater Treatment Facilities

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

6.1.2 NPDES-Regulated Mining Sites

Discharges from regulated mining activities may also 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. There are ten permitted mining sites in the Ft. Loudoun Lake Watershed (as of September 9, 2005). All ten permitted mining sites are located in impaired subwatersheds, as listed in Table 6 and shown in Figure 6. Sediment loads (as TSS) to waterbodies from mining site discharges are negligible in relation to total sediment loading (ref.: Appendix D).

6.1.3 NPDES-Regulated Ready Mixed Concrete Facilities

Discharges from regulated Ready Mixed Concrete Facilities (RMCFs) may contribute sediment to surface waters as TSS (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 waterbodies impaired for siltation as indicated on the *2004 303(d) List*, sites may be required to obtain coverage under an individual NPDES permit. There are twelve permitted RMCFs in the Ft. Loudoun Lake Watershed (as of October 18, 2005) and eleven are located in impaired subwatersheds. These facilities are listed in Table 7 and shown in Figure 6.

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*

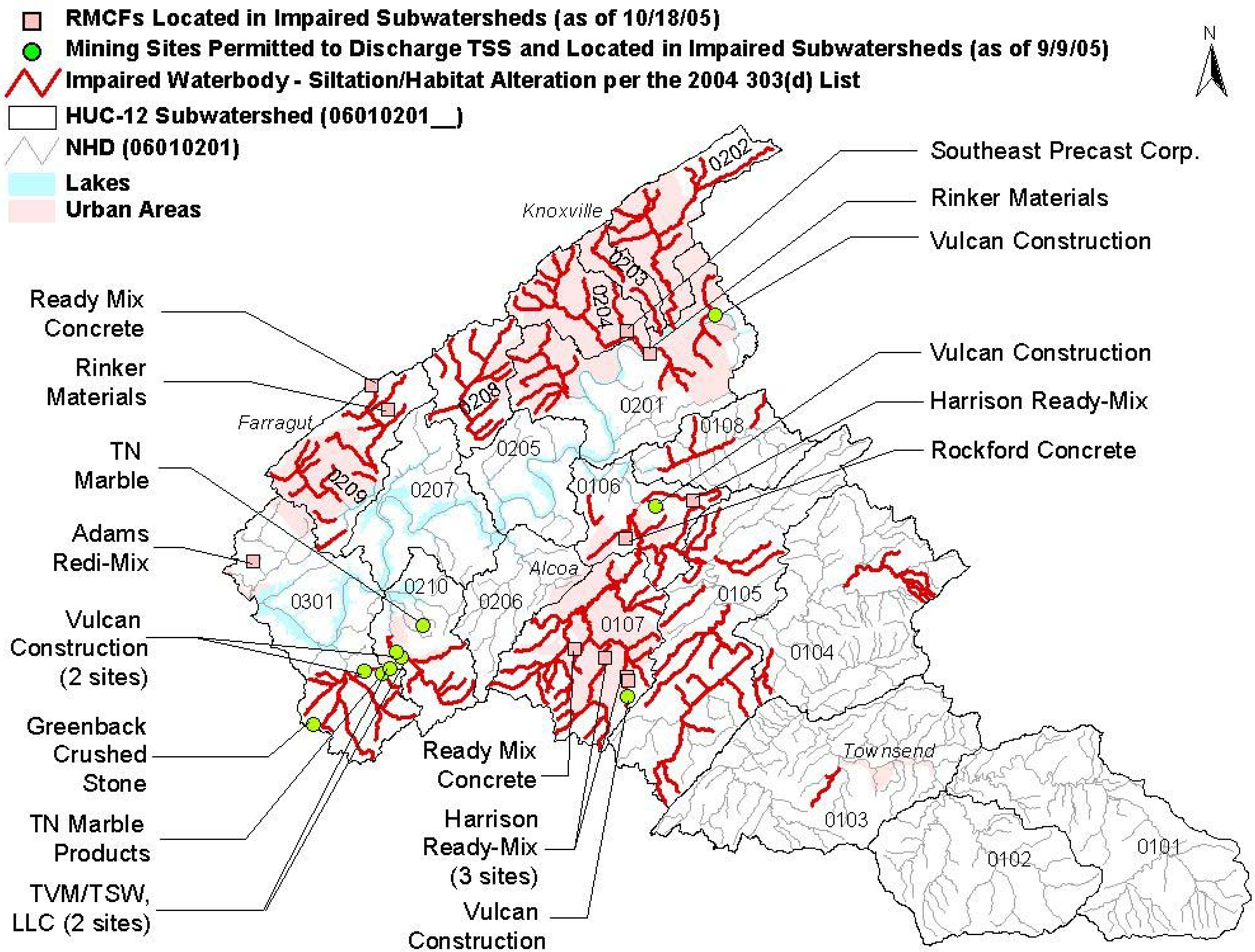
Table 6 NPDES-Regulated Mining Sites Permitted to Discharge TSS and Located in Impaired Subwatersheds (as of September 9, 2005)

HUC-12 Subwatershed (06010201__)	NPDES Permit No.	Facility Name	TSS Daily Maximum Limit [mg/l]
0106	TN0072761	Vulcan Construction Materials, LP – Rockford Quarry	40
0107	TN0003042	Vulcan Construction Materials, LP – Maryville Quarry	40
0201	TN0029467	Vulcan Construction Materials, LP – Riverside Drive Quarry	40
0210	TN0071862	Tennessee Marble Company – Brown Quarry	40
	TN0072061	TVM/TSW, LLC – Lambert Quarry	40
	TN0072125	TVM/TSW – Endsley Quarry	40
	TN0072621	Vulcan Construction Materials, LP – Friendsville South	40
0301	TN0066397	Greenback Crushed Stone, Inc. – Greenback Quarry	40
	TN0072222	Vulcan Construction Materials, LP – Friendsville Quarry	40
	TN0072699	Tennessee Marble Products Co. – Dabney Pit 1	40

Table 7 NPDES-Regulated Ready Mixed Concrete Facilities Located in Impaired Subwatersheds (as of October 18, 2005)

HUC-12 Subwatershed (06010201__)	NPDES Permit No.	Facility Name	TSS Daily Maximum Limit [mg/l]	TSS Cut-off Conc. [mg/l]
0106	TNG110089	Harrison Ready-Mix – Topside Road	50	200
	TNG110245	Rockford Concrete Plant	50	200
0107	TNG110088	Harrison Ready-Mix – Duncan Road	50	200
	TNG110090	Harrison Ready-Mix – Matlock Bend Industrial Park	50	200
	TNG110092	Harrison Ready-Mix – Sands Road	50	200
	TNG110121	Ready Mix Concrete Company	50	200
0201	TNG110246	Rinker Materials S. Central – Neyland Drive	50	200
0204	TNG110157	Southeast Precast Corporation	50	200
0209	TNG110027	Ready Mix Concrete Company	50	200
	TNG110244	Rinker Materials S. Central – W. Knox	50	200
0301	TNG110143	Adams Redi-Mix	50	200

Figure 6 NPDES-Regulated Mining Sites and Ready Mixed Concrete Facilities in Impaired Subwatersheds



(TDEC, 2005a). Since construction activities at a site are of a temporary, relatively short-term nature, the number of construction sites covered by the general permit at any instant of time varies. In the Ft. Loudoun Lake Watershed, there were 438 permitted active construction sites on October 18, 2005 (ref.: Figure 7).

6.1.5 NPDES-Regulated Municipal Separate Storm Sewer Systems

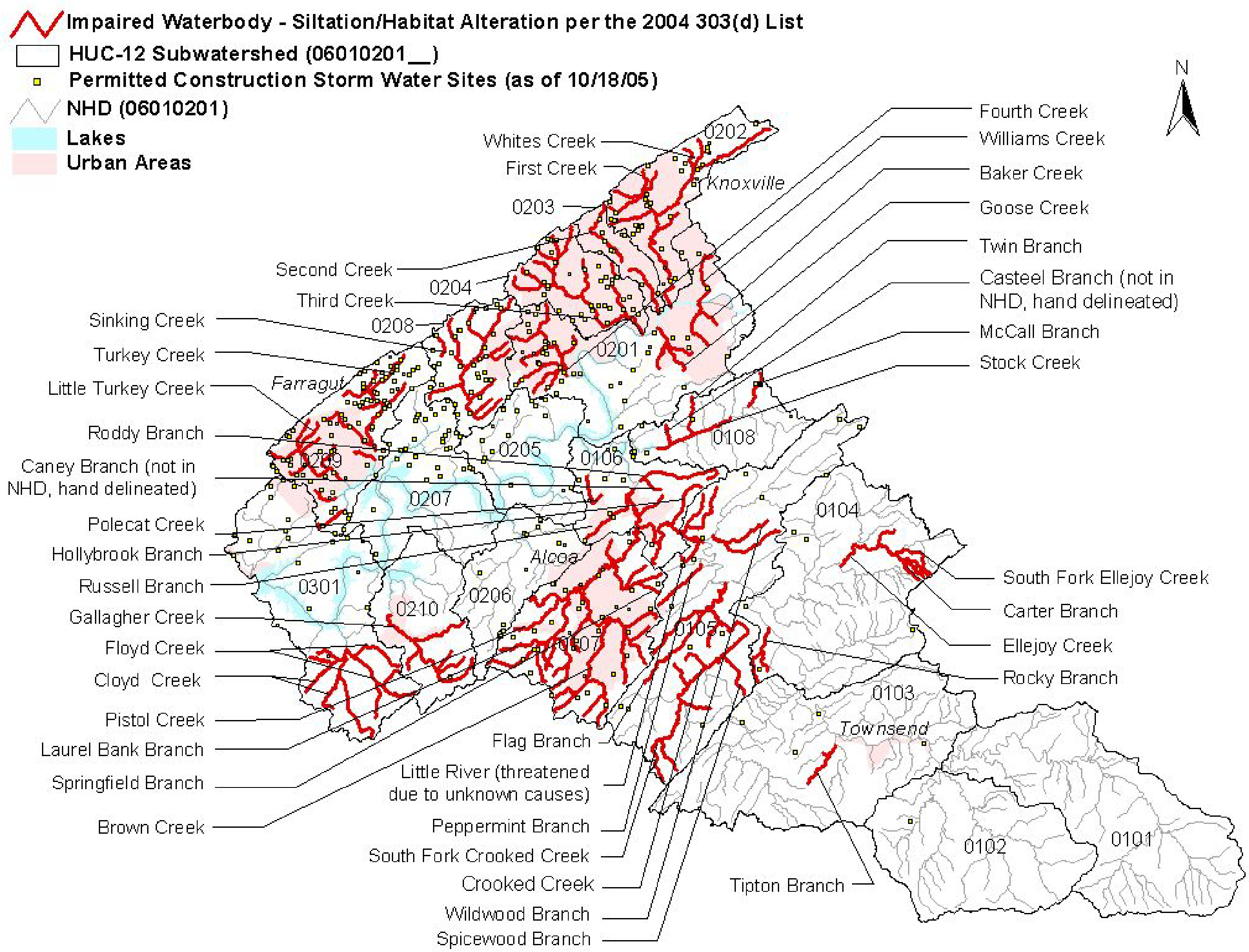
MS4s may also discharge sediment to waterbodies in response to storm events through road drainage systems, curb and gutter systems, ditches, and storm drains. These systems convey urban runoff from surfaces such as bare soil and wash-off of accumulated street dust and litter from impervious surfaces during rain events. Large and medium MS4s serving populations greater than 100,000 people are required to obtain NPDES storm water permits. At present, there is only one MS4 of this size in the Ft. Loudoun Lake Watershed (City of Knoxville, TNS068055). As of March 2003, small MS4s serving urbanized areas, or having the potential to exceed instream water quality standards, are required to obtain a permit under the *NPDES General Permit for Discharges from Small Municipal Separate Storm Sewer Systems* (TDEC, 2003a). An urbanized area is defined as an entity with a residential population of at least 50,000 people and an overall population density of 1,000 people per square mile. Eight permittees are covered under Phase II of the NPDES Storm Water Program. The nine permitted MS4s in the Ft. Loudoun Lake Watershed are as follows:

NPDES Permit Number	Phase	Permittee Name
TNS068055	I	City of Knoxville Municipal Separate Storm Drain System
TNS075116	II	Blount County
TNS075132	II	City of Alcoa
TNS075299	II	City of Farragut
TNS075434	II	City of Maryville
TNS075582	II	Knox County
TNS075591	II	Loudon County
TNS075655	II	Sevier County
TNS077798	II	City of Lenoir City

An NPDES Permit is pending for the University of Tennessee at Knoxville (TNS076121).

The Tennessee Department of Transportation (TDOT) is being issued an MS4 permit (TNS077585) for State roads in urban areas. The federal guidance for Phase I Municipal Separate Storm Sewer Systems shall apply as well as the Amended Consent Order and Agreement between TDOT and the Division of Water Pollution Control dated March 10, 2004. Information regarding storm water permitting in Tennessee may be obtained from the TDEC website at http://www.state.tn.us/environment/wpc/stormh2o/.

Figure 7 Location of NPDES Permitted Construction Storm Water Sites in the Ft. Loudoun Lake Watershed



6.2 Nonpoint Sources

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

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

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

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

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

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

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

For the listed waterbodies within the Ft. Loudoun Lake 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:

$$TMDL = \Sigma\ WLAs + \Sigma\ LAs + MOS$$

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

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

7.1 Analysis Methodology

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

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

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

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

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

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

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

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

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

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

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

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

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

7.2 TMDLs for Impaired Subwatersheds

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

7.3 Waste Load Allocations

7.3.1 Waste Load Allocations for NPDES-Regulated Mining Activities

All ten mining sites in the Ft. Loudoun Lake Watershed with NPDES permits are located in impaired subwatersheds (ref.: Table 6). Since sediment loading from mining sites is small (ref.: Appendix D) compared to the total loading for impaired subwatersheds, the WLAs are considered to be equal to the existing permit requirement for these sites.

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

HUC-12 Subwatershed (06010201__)	Waterbody ID	Waterbody Impaired by Siltation/Habitat Alteration	Level IV Ecoregion	Existing Sediment Load [lbs/ac/yr]	Target Load [lbs/ac/yr]	TMDL (required load reduction) [%]
0103	06010201032_0810	Tipton Branch	66g	474	106.0	77.6
0104	06010201027_0300	Rocky Branch	66e	619	119.9	80.6
	06010201033_0400	South Fork Ellejoy Creek				
	06010201033_0500	Carter Branch				
	06010201033_2000	Ellejoy Creek				
0105	06010201026_2000	Little River	67f	743	397.1	46.6
	06010201027_0400	Peppermint Branch				
	06010201028_0100	Spicewood Branch				
	06010201028_0300	South Fork Crooked Creek				
	06010201028_0500	Flag Branch				
	06010201028_1000	Crooked Creek				
	06010201034_0200	Wildwood Branch				
0106	06010201026_0100	Roddy Branch	67f	823	397.1	51.8
	06010201026_0200	Caney Branch				
	06010201026_0300	Hollybrook Branch				
	06010201026_0500	Russell Branch				
	06010201026_2000	Little River				
	060102011983_1000	Polecat Creek				
0107	06010201026_0400	Pistol Creek	67f	1812	397.1	78.1
	06010201026_0410	Springfield Branch				
	06010201026_0420	Brown Creek				
	06010201026_0430	Laurel Bank Branch				

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

Table 8 (Cont.) Sediment TMDLs for Subwatersheds with Waterbodies Impaired for Siltation/Habitat Alteration

HUC-12 Subwatershed (06010201__)	Waterbody ID	Waterbody Impaired by Siltation/Habitat Alteration	Level IV Ecoregion	Existing Sediment Load	Target Load	TMDL (required load reduction)
				[lbs/ac/yr]	[lbs/ac/yr]	[%]
0108	06010201066_0100	Casteel Branch	67h	609	394.2	35.3
	06010201066_0200	Twin Branch				
	06010201066_0500	McCall Branch				
	06010201066_1000	Stock Creek				
0201	060102011697_1000	Fourth Creek	67f	1,149	397.1	65.5
	060102011719_1000	Williams Creek				
	060102011721_1000	Baker Creek				
	060102011723_1000	Goose Creek				
0202	06010201080_0100	Whites Creek	67f	1,178	397.1	66.3
	06010201080_1000	First Creek				
0203	06010201097_1000	Second Creek	67f	1,604	397.1	75.2
0204	06010201067_1000	Third Creek	67f	1,209	397.1	67.2
0208	060102011330_2000	Sinking Creek	67f	987	397.1	59.8
0209	06010201037_1000	Little Turkey Creek	67f	759	397.1	47.7
	06010201340_1000	Turkey Creek				
0210	06010201022_1000	Gallagher Creek	67f	551	397.1	28.0
0301	06010201083_1000	Floyd Creek	67f	848	397.1	53.1
	060102011015_1000	Cloyd Creek				

7.3.2 Waste Load Allocations for NPDES-Regulated Ready Mixed Concrete Facilities

Of the twelve Ready Mixed Concrete Facilities (RMCFs) in the Ft. Loudoun Lake Watershed with NPDES permits, eleven are located in impaired subwatersheds (ref.: Table 7). Since sediment loading from RMCFs 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.

7.3.3 Waste Load Allocations for NPDES-Regulated Construction Activities

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

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

HUC-12 Subwatershed (06010201__)	Level IV Ecoregion	Percent Reduction – Average Annual Sediment Load	
		WLAs (MS4s and Construction SW)	LAs (Nonpoint Sources)
		[%]	[%]
0103	66g	78.8	78.8
0104	66e	81.6	81.6
0105	67f	49.3	49.3
0106	67f	54.2	54.2
0107	67f	79.2	79.2
0108	67h	38.6	38.6
0201	67f	67.2	67.2
0202	67f	68.0	68.0
0203	67f	76.5	76.5
0204	67f	68.8	68.8
0208	67f	61.8	61.8
0209	67f	50.3	50.3
0210	67f	31.6	31.6
0301	67f	55.5	55.5

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

Municipal separate storm sewer systems (MS4s) are regulated by the State's NPDES program (ref.: Section 6.1.5). Since MS4s have the potential to discharge TSS to surface waters, WLAs are specified for these systems. WLAs are established for each HUC-12 subwatershed containing a waterbody identified on the *2004 303(d) List* as impaired due to siltation or habitat alteration (ref.: Table 2). WLAs are expressed as the required percent reduction in the estimated average annual sediment loading for an impaired subwatershed, relative to the estimated average annual sediment loading (minus the 5% allocated to RMCFs and regulated mining sites) of a biologically healthy (reference) subwatershed located in the same Level IV ecoregion (ref.: Table 9).

WLAs provided to NPDES-regulated MS4s will be implemented as Best Management Practices (BMPs) as specified in Phase I and II MS4 permits. WLAs should <u>not</u> be construed as numeric permit limits.

7.4 Load Allocations for Nonpoint Sources

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

7.5 Margin of Safety

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

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

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

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

7.6 Seasonal Variation

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

8.0 IMPLEMENTATION PLAN

8.1 Point Sources

8.1.1 NPDES-Regulated Mining Sites

All ten of the mining sites in the Ft. Loudoun Lake Watershed are located in impaired subwatersheds (ref.: Table 6). WLAs will be implemented through the existing permit requirements for these sites.

8.1.2 NPDES-Regulated Ready Mixed Concrete Facilities

Eleven of the twelve RMCFs in the Ft. Loudoun Lake Watershed are located in impaired subwatersheds (ref.: Table 7). 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).

8.1.3 NPDES-Regulated Construction Storm Water

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

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

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

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

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

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

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

- The SWPPP must certify that erosion and sediment controls are designed to control runoff from a 5-year, 24-hour storm event.

- More frequent (twice weekly) inspections of erosion and sediment controls.

- If a discharger is complying with the SWPPP, but is contributing to the impairment of a stream, the SWPPP must be revised and implemented to eliminate further impairment to the stream. If these changes are not implemented within 7 days of receipt of notification, coverage under the general permit will be terminated and continued discharges covered under an individual permit. The construction project must be stabilized until the revised SWPPP is implemented or an individual permit issued. No earth disturbing activities, except for stabilization, are authorized until the individual permit is issued.

- For an outfall in a drainage area of a total of 5 or more acres, a temporary (or permanent) sediment basin that provides storage for a calculated volume of runoff from a 5-year, 24-hour storm and runoff from each acre drained, or equivalent control measures, shall be provided until final stabilization of the site.

- A 60-foot natural riparian buffer zone adjacent to a receiving stream designated as impaired or high quality waters must be preserved, to the maximum extent practicable, during construction activities at the site.

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

8.1.4 NPDES-Regulated Municipal Separate Storm Sewer Systems (MS4s)

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

- Public education and outreach on storm water impacts
- Public involvement/participation
- Illicit discharge detection and elimination
- Construction site storm water runoff control
- Post-construction storm water management in new development and re-development
- Pollution prevention/good housekeeping for municipal operations

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

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

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

8.2 Nonpoint Sources

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

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

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

- Detailed surveys of impaired subwatersheds to identify additional sources of sediment loading.
- Advocacy of local area ordinances and zoning that will minimize sediment loading to waterbodies, including establishment of buffer strips along streambanks, reduction of activities within riparian areas, and minimization of road and bridge construction impacts.
- Educating the public as to the detrimental effects of sediment loading to waterbodies and measures to minimize this loading.
- Advocacy of agricultural BMPs (e.g., riparian buffer, animal waste management systems, waste utilization, stream stabilization, fencing, heavy use area treatment protection, livestock exclusion, etc.) and practices to minimize erosion and sediment transport to streams. The Tennessee Department of Agriculture (TDA) keeps a database of BMPs implemented in Tennessee. Of the 187 BMPs in the Ft. Loudoun Lake Watershed as of October 18, 2005, 174 are in sediment-impaired subwatersheds (see Figure 8).

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 604(b) Little River Participatory Watershed Project, and the Pistol Creek TMDL Project. A discussion of each follows.

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.

The 604(b) Little River Participatory Watershed Project was recently completed within the Little

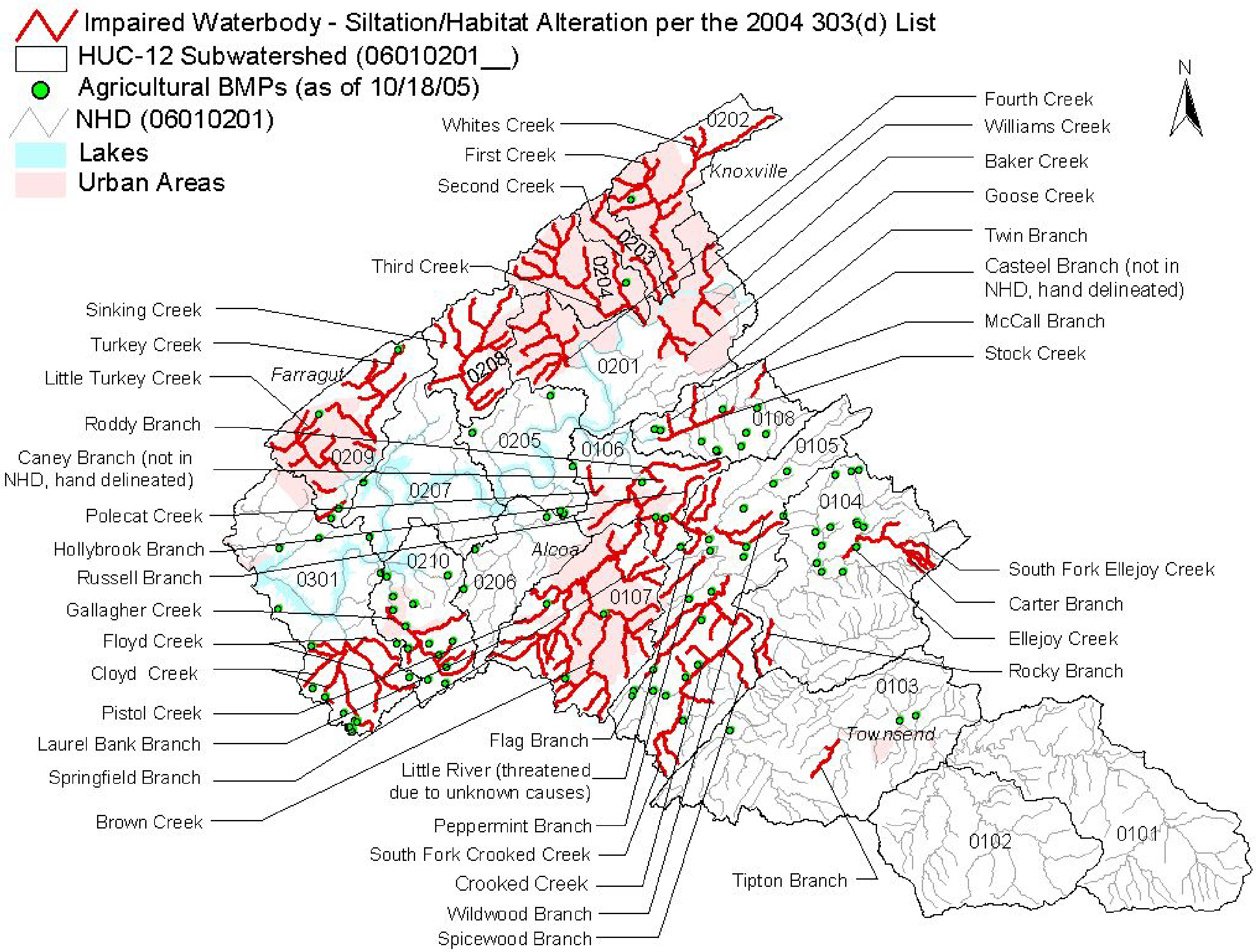
River watershed by a group of organizations, including the University of Tennessee Community Partnership Center, the Tennessee Valley Authority, the University of Tennessee Dept. of Urban and Regional Planning, and the Little River Watershed Association (ref.: Appendix E). The objective of the project was to test the effectiveness of participatory methods and tools in watershed planning, to develop new methods and tools, and to become a model for stakeholder-driven environmental planning for the nation. The project was also intended to build capacity for future watershed restoration and protection efforts.

The Pistol Creek TMDL Project is currently being funded by TDEC (ref.: Appendix F). The Blount County Extension is the lead organization for a project located in Pistol Creek, a tributary of the Little River. The objective of the project is to organize a community-based volunteer effort focused on collecting water samples, identifying pollution sources, and making recommendations for solutions.

8.3 Evaluation of TMDL Effectiveness

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

Figure 8 Location of Agricultural Best Management Plans in the Ft. Loudoun Lake Watershed



9.0 PUBLIC PARTICIPATION

In accordance with 40 CFR §130.7, the proposed sediment TMDLs for the Ft. Loudoun Lake 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.

3) A letter was sent to point source facilities in the Ft. Loudoun 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:

TNG110089	Harrison Ready-Mix – Topside Road
TNG110245	Rockford Concrete Plant
TNG110088	Harrison Ready-Mix – Duncan Road
TNG110090	Harrison Ready-Mix – Matlock Bend Industrial Park
TNG110092	Harrison Ready-Mix – Sands Road
TNG110121	Ready Mix Concrete Company
TNG110246	Rinker Materials South Central – Neyland Drive
TNG110157	Southeast Precast Corporation
TNG110027	Ready Mix Concrete Company
TNG110244	Rinker Materials South Central – W Knox
TNG110143	Adams Redi – Mix
TN0072761	Vulcan Construction Materials, LP – Rockford Quarry
TN0003042	Vulcan Construction Materials, LP – Maryville Quarry
TN0029467	Vulcan Construction Materials, LP – Riverside Drive Quarry
TN0071862	Tennessee Marble Company – Brown Quarry
TN0072061	TVM/TSW, LLC – Lambert Quarry
TN0072125	TVM/TSW – Endsley Quarry
TN0072621	Vulcan Construction Materials, LP – Friendsville South
TN0066397	Greenback Crushed Stone, Inc. – Greenback Quarry
TN0072222	Vulcan Construction Materials, LP – Friendsville Quarry
TN0072699	Tennessee Marble Products Co. – Dabney Pit 1

4) A letter was sent to local interagency and stakeholder groups in the Ft. Loudoun Lake Watershed 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 upon request. A letter was sent to the following interagency and local stakeholder groups:

    Natural Resources Conservation Service
    USGS Water Resource Programs
    USDA – Forest Service
    Tennessee Valley Authority
    Tennessee Department of Agriculture
    Tennessee Wildlife Resources Agency
    Blount County Planning Commission
    Tennessee Izaak Walton League
    Little River Watershed Association

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

TNS068055	City of Knoxville Municipal Separate Storm Drain System
TNS075116	Blount County
TNS075132	City of Alcoa
TNS075299	City of Farragut
TNS075434	City of Maryville
TNS075582	Knox County
TNS075591	Loudon County
TNS075655	Sevier County
TNS077798	City of Lenoir City
TNS077585	Tennessee Department of Transportation (TDOT)
TNS076121	University of Tennessee at Knoxville

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:

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APPENDIX A

Example of Stream Assessment (Gallagher Creek)

Figure A-1 Gallagher Creek Habitat Assessment Field Data Sheet, front – December 4, 2003

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

STREAM NAME Gallagher Creek	LOCATION Hill Rd bridge [illegible]
STATION # ____ RIVERMILE 2.6	STREAM CLASS
LAT ____ LONG ____	RIVER BASIN Ft. Loudon
STORET # GALLA002.6BT	AGENCY WPC
INVESTIGATORS JBD/[illegible]	
FORM COMPLETED BY JBD	DATE 12/4/03 TIME [illegible] AM PM / REASON FOR SURVEY 303(d)

Parameters to be evaluated in sampling reach

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 form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
SCORE 17	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 12	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 17	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Figure A-2 Gallagher Creek Habitat Assessment Field Data Sheet, back – December 4, 2003

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

Parameters to be evaluated broader than sampling reach

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

Total Score 147

APPENDIX B

Watershed Sediment Loading Model

WATERSHED SEDIMENT LOADING MODEL

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

Sediment Analysis

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

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

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

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

Sediment analyses can be performed for single or multiple watersheds.

Universal Soil Loss Equation

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

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

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

where:

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

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

P - Conservation Practice Factor

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

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

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

Sediment Modeling Methodology

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

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

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

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

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

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

2. Using WCS, the entire watershed was delineated into subwatersheds corresponding to USGS 12-digit Hydrologic Unit Codes (HUCs). These delineations are shown in Figure 4. Land use distribution for the impaired subwatersheds is summarized in Appendix C. All of the sediment analyses were performed on the basis of these drainage areas.

The following steps are accomplished using the WCS Sediment Tool:

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

4. A stream grid for each delineated subwatershed was created by etching a stream coverage, based on Reach File v. 3 (Rf3) or National Hydrography 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 ratio
  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 Ft. Loudoun Lake 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 proposed *2004 303(d) List* as impaired for siltation and/or habitat alteration are summarized in Tables B-1, B-2 and B-3, respectively.

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

HUC-12 Subwatershed (06010201__)	***EROSION***				
	Road [tons/yr]	**Source [tons/yr]**	**Total [tons/yr]**	**%Road**	**%Source**
0103	14,391	3,393	17,784	80.9	19.1
0104	10,936	11,368	22,304	49.0	51.0
0105	13,785	19,549	33,333	41.4	58.6
0106	7,227	4,672	11,899	60.7	39.3
0107	17,206	29,302	46,508	37.0	63.0
0108	5,177	3,615	8,792	58.9	41.1
0201	27,641	12,249	39,890	69.3	30.7
0202	13,013	2,987	15,999	81.3	18.7
0203	5,774	950	6,724	85.9	14.1
0204	12,166	2,579	14,745	82.5	17.5
0208	10,064	2,499	12,563	80.1	19.9
0209	9,672	5,245	14,917	64.8	35.2
0210	4,234	6,957	11,191	37.8	62.2
0301	12,786	14,587	27,374	46.7	53.3

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

HUC-12 Subwatershed (06010201__)	*SEDIMENT*				
	Road [tons/yr]	Source [tons/yr]	Total [tons/yr]	%Road	%Source
0103	8,418	1,516	9,935	84.7	15.3
0104	7,385	4,495	11,881	62.2	37.8
0105	6,980	8,438	15,418	45.3	54.7
0106	3,834	1,925	5,759	66.6	33.4
0107	9,295	13,485	22,780	40.8	59.2
0108	2,708	1,455	4,163	65.1	34.9
0201	11,889	5,975	17,864	66.6	33.4
0202	6,884	1,250	8,134	84.6	15.4
0203	2,886	,547	3,434	84.1	15.9
0204	5,673	1,008	6,681	84.9	15.1
0208	4,542	850	5,392	84.2	15.8
0209	4,185	2,294	6,479	64.6	35.4
0210	2,083	1,979	4,062	51.3	48.7
0301	7,241	5,858	13,099	55.3	44.7

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

HUC-12 Subwatershed (06010201__)	*UNIT LOADS*			
	Erosion		Sediment	
	[tons/ac/yr]	[lbs/ac/yr]	[tons/ac/yr]	[lbs/ac/yr]
0103	0.424	849	0.237	474
0104	0.581	1,163	0.310	619
0105	0.804	1,607	0.372	743
0106	0.850	1,701	0.412	823
0107	1.850	3,700	0.906	1,812
0108	0.644	1,287	0.305	609
0201	1.283	2,567	0.575	1,149
0202	1.159	2,318	0.589	1,178
0203	1.570	3,140	0.802	1,604
0204	1.334	2,669	0.605	1,209
0208	1.150	2,300	0.494	987
0209	0.874	1,748	0.380	759
0210	0.759	1,519	0.276	551
0301	0.886	1,771	0.424	848

APPENDIX C

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

Table C-1 Ft. Loudoun Lake Watershed – Impaired Subwatershed Land Use Distribution

Land Use	Subwatershed (06010201___)							
	0103		0104		0105		0106	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand/Clay	0	0.0	0	0.0	0	0.0	0	0.0
Deciduous Forest	14,515	34.6	10,873	28.3	6,911	16.7	1,882	13.4
Emergent Herbaceous Wetlands	0	0.0	0	0.0	0	0.0	18	0.1
Evergreen Forest	13,768	32.8	8,136	21.2	6,749	16.3	2,406	17.2
High Intensity Commercial/Industrial/Transportation	79	0.2	79	0.2	249	0.6	814	5.8
High Intensity Residential	3	0.0	2	0.0	50	0.1	179	1.3
Low Intensity Residential	146	0.3	106	0.3	991	2.4	715	5.1
Mixed Forest	10,366	24.7	8,626	22.5	8,103	19.5	2,397	17.1
Open Water	51	0.1	59	0.2	68	0.2	626	4.5
Other Grasses (Urban/Recreational)	76	0.2	18	0.0	1,427	3.4	632	4.5
Pasture/Hay	2,686	6.4	8,183	21.3	13,929	33.6	3,635	26.0
Quarries/Strip Mines/Gravel Pits	0	0.0	0	0.0	0	0.0	81	0.6
Row Crops	111	0.3	2,204	5.7	2,869	6.9	526	3.8
Transitional	14	0.0	0	0.0	3	0.0	0	0.0
Woody Wetlands	102	0.2	75	0.2	128	0.3	79	0.6
Total	**41,918**	**100.0**[a]	**38,362**	**100.0**[a]	**41,477**	**100.0**	**13,991**	**100.0**

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

Table C-1 (Cont.) Ft. Loudoun Lake Watershed – Impaired Subwatershed Land Use Distribution

Land Use	Subwatershed (06010201___)							
	0107		0108		0201		0202	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand/Clay	0	0.0	0	0.0	2	0.0	0	0.0
Deciduous Forest	1,652	6.6	3,055	22.4	4,411	14.2	1,383	10.0
Emergent Herbaceous Wetlands	0	0.0	17	0.1	2	0.0	0	0.0
Evergreen Forest	2,751	10.9	3,114	22.8	5,455	17.5	1,556	11.3
High Intensity Commercial/Industrial/Transportation	1,652	6.6	141	1.0	1,892	6.1	956	6.9
High Intensity Residential	794	3.2	19	0.1	1,479	4.8	1,104	8.0
Low Intensity Residential	3,809	15.1	291	2.1	5,517	17.7	3,375	24.5
Mixed Forest	3,559	14.2	3,471	25.4	6,583	21.2	2,417	17.5
Open Water	51	0.2	115	0.8	2,048	6.6	10	0.1
Other Grasses (Urban/Recreational)	2,246	8.9	215	1.6	1,213	3.9	851	6.2
Pasture/Hay	6,356	25.3	2,725	20.0	1,609	5.2	1,781	12.9
Quarries/Strip Mines/Gravel Pits	678	2.7	0	0.0	60	0.2	0	0.0
Row Crops	1,573	6.3	473	3.5	725	2.3	371	2.7
Transitional	21	0.1	0	0.0	72	0.2	0	0.0
Woody Wetlands	0	0.0	25	0.2	18	0.1	0	0.0
Total	**25,141**	**100.0** [a]	**13,661**	**100.0**	**31,085**	**100.0**	**13,804**	**100.0** [a]

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

Table C-1 (Cont.) Ft. Loudoun Lake Watershed – Impaired Subwatershed Land Use Distribution

Land Use	Subwatershed (06010201___)							
	0203		0204		0208		0209	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand/Clay	0	0.0	0	0.0	0	0.0	0	0.0
Deciduous Forest	312	7.3	874	7.9	794	7.3	1,401	8.2
Emergent Herbaceous Wetlands	0	0.0	0	0.0	0	0.0	0	0.0
Evergreen Forest	286	6.7	1,193	10.8	2,119	19.4	2,713	15.9
High Intensity Commercial/Industrial/Transportation	881	20.6	1,384	12.5	836	7.7	916	5.4
High Intensity Residential	828	19.3	1,070	9.7	625	5.7	282	1.7
Low Intensity Residential	1,166	27.2	3,427	31.0	2,988	27.4	2,042	12.0
Mixed Forest	411	9.6	1,540	13.9	1,836	16.8	3,133	18.4
Open Water	4	0.1	6	0.1	9	0.1	422	2.5
Other Grasses (Urban/Recreational)	268	6.3	771	7.0	667	6.1	944	5.5
Pasture/Hay	12	0.3	569	5.2	795	7.3	4,363	25.6
Quarries/Strip Mines/Gravel Pits	0	0.0	0	0.0	0	0.0	0	0.0
Row Crops	114	2.7	207	1.9	240	2.2	829	4.9
Transitional	0	0.0	10	0.1	14	0.1	20	0.1
Woody Wetlands	0	0.0	0	0.0	0	0.0	0	0.0
Total	**4,282**	**100.0**[a]	**11,051**	**100.0**[a]	**10,922**	**100.0**[a]	**17,065**	**100.0**[a]

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

Table C-1 (Cont.) Ft. Loudoun Lake Watershed – Impaired Subwatershed Land Use Distribution

Land Use	Subwatershed (06010201___)			
	0210		0301	
	[acres]	[%]	[acres]	[%]
Bare Rock/Sand/Clay	0	0.0	0	0.0
Deciduous Forest	2,698	18.3	5,421	17.5
Emergent Herbaceous Wetlands	0	0.0	0	0.0
Evergreen Forest	2,345	15.9	5,800	18.8
High Intensity Commercial/Industrial/Transportation	152	1.0	214	0.7
High Intensity Residential	16	0.1	29	0.1
Low Intensity Residential	209	1.4	526	1.7
Mixed Forest	3,302	22.4	6,866	22.2
Open Water	732	5.0	2,886	9.3
Other Grasses (Urban/Recreational)	63	0.4	447	1.4
Pasture/Hay	4,335	29.4	7,105	23.0
Quarries/Strip Mines/Gravel Pits	0	0.0	0	0.0
Row Crops	885	6.0	1,586	5.1
Transitional	1	0.0	30	0.1
Woody Wetlands	0	0.0	0	0.0
Total	**14,739**	**100.0** [a]	**30,910**	**100.0** [a]

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

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** [a]	**5,886**	**100.0**	**2,189**	**100.2** [a]	**1,878**	**99.9** [a]	**2,728**	**99.9** [a]	**13,857**	**100.0**

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

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	9,481	46.4	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	7,282	35.7	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	3,647	17.9	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	2	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** [a]	**12,469**	**100.0**	**20,415**	**100.0**	**1,556**	**99.8** [a]

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

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	22,717	73.1	2,080	20.3	1,686	85.4	1,640	87.6	17,329	57.6
Emergent Herbaceous Wetlands	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Evergreen Forest	2,424	7.8	5,537	54.0	44	2.2	77	4.1	2,869	9.5
High Intensity Commercial/Industrial/Transportation	1	0.0	0	0.0	1	0.0	0	0.0	22	0.1
High Intensity Residential	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Low Intensity Residential	10	0.0	0	0.0	2	0.1	0	0.0	16	0.1
Mixed Forest	5,765	18.6	2,620	25.5	236	12.0	143	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	54	0.2	0	0.0	6	0.3	10	0.5	5,296	17.6
Quarries/Strip Mines/Gravel Pits	0	0.0	0	0.0	0	0.0	1	0.0	77	0.3
Row Crops	2	0.0	0	0.00.0	0	0.0	0	0.0	258	0.9
Transitional	53	0.2	19	0.2	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	**31,029**	**99.9** [a]	**10,256**	**100.0**	**1,975**	**100.1** [a]	**1,870**	**99.9** [a]	**30,062**	**100.0**

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

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

Land Use	Ecosite Subwatershed									
	Eco67g01		Eco67g05		Eco67g08		Eco67g09		Eco67g10	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand	90	0.4	1	0.0	0	0.0	0	0.0	0	0.0
Deciduous Forest	7,241	30.1	3,247	12.5	1,076	25.4	1,293	55.0	3,165	23.9
Emergent Herbaceous Wetlands	2	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Evergreen Forest	2,255	9.4	2,857	11.0	721	17.0	571	24.3	2,669	20.2
High Intensity Commercial/Industrial/Transportation	253	1.1	125	0.5	23	0.5	1	0.0	17	0.1
High Intensity Residential	7	0.0	24	0.1	1	0.0	1	0.0	6	0.0
Low Intensity Residential	332	1.4	117	0.5	64	1.5	22	0.9	48	0.4
Mixed Forest	3,706	15.4	4,978	19.2	1,087	25.7	420	17.9	2,619	19.8
Open Water	6	0.0	8	0.0	2	0.1	1	0.1	4	0.0
Other Grasses (Urban/Recreational)	209	0.9	201	0.8	46	1.1	0	0.0	16	0.1
Pasture/Hay	8,107	33.7	12,105	46.6	1,019	24.1	34	1.5	4,420	33.4
Quarries/Strip Mines/Gravel Pits	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Row Crops	1,775	7.4	2,302	8.9	198	4.7	8	0.3	272	2.1
Transitional	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Woody Wetlands	41	0.2	11	0.0	0	0.0	0	0.0	0	0.0
Total	**24,024**	**100.0**	**25,976**	**100.0**	**4,237**	**100.0**	**2,352**	**100.1** [a]	**13,236**	**100.0**

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

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

Land Use	Ecosite Subwatershed									
	Eco67g11		Eco67h04		Eco67h06		Eco67h08		67i12	
	[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	719	70.6	447	68.3	485	27.0	542	79.6	479	71.3
Emergent Herbaceous Wetlands	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Evergreen Forest	162	15.9	66	10.1	612	34.1	89	13.0	73	10.8
High Intensity Commercial/Industrial/Transportation	0	0.0	0	0.0	1	0.0	0	0.0	1	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	0	0.0	0	0.0	3	0.5
Mixed Forest	138	13.5	132	20.2	657	36.6	49	7.3	105	15.7
Open Water	0	0.0	0	0.0	30	1.6	0	0.0	0	0.1
Other Grasses (Urban/Recreational)	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0
Pasture/Hay	0	0.0	4	0.6	7	0.4	0	0.0	9	1.3
Quarries/Strip Mines/Gravel Pits	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Row Crops	0	0.0	3	0.4	0	0.0	0	0.0	2	0.4
Transitional	0	0.0	0	0.0	1	0.1	0	0.0	0	0.0
Woody Wetlands	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total	**1,019**	**100.0**	**653**	**99.7** [a]	**1,793**	**99.9** [a]	**681**	**100.1** [a]	**672**	**100.2** [a]

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

APPENDIX D

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

Determination of Existing Point Source Sediment Loads

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

Mining Sites

Existing loads for permitted mining sites are based on an assumed runoff from the site drainage area, the daily maximum permit limit for TSS, and the area of the HUC-12 subwatershed in which the mining sites are located (ref.: Table D-1). Site runoff was estimated by assuming that one half of the annual precipitation falling on the site area results in runoff. Annual precipitation for the Ft. Loudoun Lake watershed is approximately 48 in/yr.

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

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

Ready Mixed Concrete Facilities (RMCFs)

Total loading from RMCFs is the sum of loading from process wastewater discharges and storm water runoff. Estimates of loading (ref.: Table D-2) from these ten sources were determined based on facility estimated flow and the daily maximum permit limit for TSS for process wastewater discharges and based on methods similar to those used to determine mining site loads for storm water runoff along with the area of the HUC-12 subwatershed in which the facility is located. Loads are expressed as average annual loads per unit area and are summarized in Table D-2.

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-1 Estimate of Existing Load – NPDES Permitted Mining Sites

HUC-12 Subwatershed (06010201___)	Subwatershed Area	Precipitation[a]	NPDES Permit No.	Site Drainage Area	Daily Maximum TSS Limit	Annual Average Load
	[acres]	[in/yr]		[acres]	[mg/l]	[lb/ac/yr]
0106	13,991	48	TN0072761	94.0	40	1.462
0107	25,141	48	TN0003042	392.0	40	3.392
0201	31,085	48	TN0029467	146.0	40	1.022
0210	14,739	48	TN0071862	49.0	40	0.723
			TN0072061	4.9	40	0.072
			TN0072125	33.0	40	0.487
			TN0072621	29.7	40	0.438
0301	30,910	48	TN0066397	166.0	40	1.168
			TN0072222	28.0	40	0.197
			TN0072699	9.5	40	0.067

a. *Livestock Waste Facilities Handbook*, 2nd Edition, 1985, Figure 11-12b

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

HUC-12 Subwatershed	Subwatershed Area	NPDES Permit No.	Process Wastewater			Storm Water Runoff			Total Annual Ave Load
			Est. Flow	Daily Max TSS Limit	Annual Ave Load	Site Drain Area	TSS Cut-off Conc	Annual Ave Load	
	[acres]		[MGD]	[mg/l]	[lb/ac/yr]	[acres]	[mg/l]	[lb/ac/yr]	[lb/ac/yr]
0106	13,991	TNG110089	0.0001	50	0.0011	12	200	0.9718	0.934
		TNG110245	0.0001	50	0.0011	3.49	200	0.2826	0.272
0107	25,141	TNG110088	0.0001	50	0.0006	12	200	0.5408	0.520
		TNG110090	0.0001	50	0.0006	4.4	200	0.1983	0.191
		TNG110092	0.0001	50	0.0006	5.5	200	0.2479	0.239
		TNG110121	0.0001	50	0.0006	1.7	200	0.0766	0.074
0201	31,085	TNG110246	0.0001	50	0.0005	3.84	200	0.1400	0.135
0204	11,051	TNG110157	0.0001	50	0.0014	6.6	200	0.6767	0.651
0209	17,065	TNG110027	0.0001	50	0.0009	3.47	200	0.2304	0.222
		TNG110244	0.0001	50	0.0009	1.97	200	0.1308	0.126
0301	30,910	TNG110143	0.0001	50	0.0005	6	200	0.2199	0.212

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

HUC-12 Subwatershed (06010201__)	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]	[%]
0106	TN0072761	Mining	1.5				
	TNG110089	RMCF	1.0				
	TNG110245	RMCF	0.3				
	Subwatershed 0106 Total		**2.8**	823	**0.34**	397.1	**0.70**
0107	TN0003042	Mining	3.5				
	TNG110088	RMCF	0.5				
	TNG110090	RMCF	0.2				
	TNG110092	RMCF	0.2				
	TNG110121	RMCF	0.1				
	Subwatershed 0107 Total		**4.6** [a]	1,812	**0.25**	397.1	**1.16**
0201	TN0029467	Mining	1.1				
	TNG110246	RMCF	0.1				
	Subwatershed 0201 Total		**1.2**	1,149	**0.10**	397.1	**0.30**
0204	TNG110157	RMCF	**0.7**	1,209	**0.06**	397.1	**0.17** [a]
0209	TNG110027	RMCF	0.2				
	TNG110244	RMCF	0.1				
	Subwatershed 0209 Total		**0.4** [a]	759	**0.05**	397.1	**0.09** [a]
0210	TN0071862	Mining	0.8				
	TN0072061	Mining	0.1				
	TN0072125	Mining	0.5				
	TN0072621	Mining	0.5				
	Subwatershed 0210 Total		**1.8** [a]	551	**0.33**	397.1	**0.45**
0301	TN0066397	Mining	1.2				
	TN0072222	Mining	0.2				
	TN0072699	Mining	0.1				
	TNG110143	RMCF	0.2				
	Subwatershed 0301 Total		**1.7**	848	**0.20**	397.1	**0.43**

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

APPENDIX E

604(b) Watershed Project in the Little River Watershed

Little River Participatory Watershed Planning Process Project Proposal (2003) and Third & Fourth Quarterly Reports (2004)

604(b) PROJECT PROPOSAL: JULY 25, 2003; AMENDED AUGUST 14, 2003

NAME OF PROJECT

Little River Participatory Watershed Planning Process

LEAD ORGANIZATIONS

Blount County
The Community Partnership Center of the University of Tennessee, Knoxville

COOPERATING ORGANIZATIONS

The Tennessee Valley Authority will contribute technical assistance to the project. The TVA will also contribute $20,000 in non-federal matching funds to the project.

The Department of Urban and Regional Planning at the University of Tennessee will contribute a graduate assistant to the project.

The Little River Watershed Association will contribute technical assistance to the project.

PROJECT ABSTRACT

The Community Partnership Center (CPC) of the University of Tennessee, Knoxville is a leader in the development and implementation of participatory planning processes for community and economic development. The CPC will adapt these same tools and methods to address environmental and water quality issues and, in the process, create a model for stakeholder-driven watershed planning.

This focus of this effort will be the Little River Watershed, in Blount County, Tennessee. Flowing out of the Great Smokey Mountains National Park, the Little River is under increasing environmental pressure due to increasing development and unsustainable agricultural practices.

This project will result in the development of informed citizen workgroups that will address the protection and preservation of the Little River Watershed. These groups will form the foundation of a participatory planning process, which will subsequently develop recommendations for enhancing and preserving the Little River and its resources. The project will also create published research on the role and potential of public participation in the environmental planning process. In addition, the project will also lead to increased citizen awareness of water resources and increased capacity among residents to address environmental issues.

PROJECT OBJECTIVE

This project will test the effectiveness of participatory methods and tools in watershed planning, will lead to the development of new methods and tools, and will become a model for stakeholder-driven environmental planning for the nation. The project will also build capacity for future watershed restoration and protection efforts.

BACKGROUND INFORMATION

The University of Tennessee Community Partnership Center (CPC), a research and community outreach unit of the Department of Urban and Regional Planning, will be responsible for financial and program management of this project. The mission of the Community Partnership Center is to link university resources with urban and rural grassroots community groups to understand and address the core problems facing communities in Tennessee. We strive to create mutually respectful research and action partnerships that embody and promote equitable and democratic principles. We are committed to strengthening the capacity of both community and university partners to build healthy, flourishing communities.

Since 1994, the CPC has worked toward meeting this mission through local, regional, and national programs in several ways:

- By facilitating research, service-learning, and volunteer opportunities for University of Tennessee faculty and students,
- By developing and implementing participatory approaches and methods for research and planning for sustainable economic and community development,
- By working with at-risk youth and other groups to increase their capacity for positive personal and collective change,
- By conducting applied research, and program and service evaluations, and
- By providing technical assistance and contract services.

In the 1990s, the CPC gained national recognition for innovation in evaluation approaches and methods through the National Learning Initiative, a participatory evaluation for USDA of ten rural Empowerment Zone and Enterprise Communities across the United States. In 1998, CPC received funding from the Ford Foundation to refine and implement these approaches and to develop additional capacity for these approaches and methods to be used by community-based organizations, funding agencies, researchers, and local government. In recognition of its efforts, the CPC received a HUD Best Practices Award in 2000.

The CPC has implemented participatory evaluation and participatory planning projects in variety of contexts and settings. Recently, for example, the center developed and conducted an evaluation of a community environmental health grants program that has funded ten community coalitions across the United States to assess hazards in low-income housing and develop community-based remediation and enforcement strategies.

Since 2001 the CPC, as part of the Consortium of Appalachian Centers and Institutes convened by the Appalachian Regional Commission, initiated a combined teaching and research project based in Cocke County, Tennessee, an ARC designated distressed county. The resulting class, undertaken by the CPC and the University's Department of Urban and Regional Planning, helped residents of Cocke County establish values and visions for future sustainable economic and community development. Today, the CPC continues to work in Cocke County as students engage residents and conduct research to attract environmentally-friendly industries to the community.

Most recently, the CPC was named by the ARC as a technical assistance service provider for distressed Appalachian communities. As part of this program, the CPC is using a participatory planning approach to assist communities in three ARC-designated distressed counties in the preparation of action and funding plans to address local areas of concern, including environmental and land use issues.

KEY PERSONNEL

Tim Ezzell, Acting Director
Dr. Ezzell serves as acting director of the Community Partnership Center at the University of Tennessee. He is a graduate of Auburn University and the University of Tennessee and holds an M.A. and a Ph.D. in History as well as an M.S.P in Urban and Regional planning. In addition to his duties at the CPC, Dr. Ezzell also teaches courses in historic preservation planning and participatory methods for sustainable development in the University's Department of Urban and Regional Planning and serves as the University's liaison to the Consortium of Appalachian Centers of Learning. His research interests include participatory planning methods, sustainable development, historic preservation, new urbanism, and planning history.

Prior to joining the CPC, Dr. Ezzell taught in the History Department at the University of Tennessee and performed policy research for the University's Energy, Environment, and Resources Center. He has also worked for *Nine Counties. One Vision*, a nonprofit regional visioning and planning project in East Tennessee. He is the author of numerous reports and papers and has presented research before both professional and academic audiences.

Eric Ogle, Program Coordinator
Eric Ogle holds a Bachelor of Science in Business Administration in Marketing, Logistics, and Transportation, and a Master of Science in Environmental Planning from the University of Tennessee. Mr. Ogle has worked in the Marketing Communications department of the Tennessee Valley Authority in Knoxville and formerly served as Director of Tourism for Cocke County, Tennessee. He has also worked on a comprehensive plan for the town of Cumberland Gap, Tennessee and a sector plan for North Knoxville. He has performed cluster analyses and associated research for Chattanooga Area Regional Council of Governments (CARCOG) that helped determine future strategic direction of a 14-county region. Recently, he also developed programs and agendas, hosted visitors, and taught international participants for two of the University of Tennessee's International Sustainable Development Training programs. His research interests include the development of sustainable eco-tourism, economic development, and the diffusion of mobile information technology into rural and distressed communities.

INTRODUCTION

CPC's approach to planning is rooted in a deep-seated commitment to sustainable development through broad-based community participation. Our approach attempts to answer the challenges of the sustainability movement, to find ways to effectively manage growth, and to plan for the future in ways that will not compromise the quality for life of future generations. It assumes that decisions about growth management and future development are highly complex and embedded in the dynamics of social, economic, political, and environmental systems. It also assumes that within communities there are complexities of values, perceptions, and the relative power of the various stakeholder groups affected by these decisions, and uncertainties and urgency surrounding growth issues.

In order to make choices about how to use their limited resources, communities need choice processes based on an understanding of the important linkages and trade-offs that exist among their community's quality of life, their social, economic and environmental assets, along with the potential for various stakeholders to benefit differently from the choices made. Our approach includes processes, data gathering, and decision tools that can be used by communities to sustainably plan for their future. It takes into consideration stakeholder and other contextual differences, the collaborative development of information, and the collaborative development of appropriate decision tools and processes. In essence, it is focused on process and specific decision products. We believe that this approach will greatly enhance the potential for sustainable community-based growth management, conservation, and development choices in the target communities.[1]

The Planning Team process used by the CPC is derived from research on adult learning and our experience in the field of community participation. In this process, participants representing all segments of the community go through nine phases of research, evaluation, and decision-making. These phases, presented as informal questions, lead team members through a complete, circular, and ongoing research process that can continue to address community issues long after the initial question has been resolved. The questions, or phases of the process are:

1. How will we work together? What are our goals?
2. What do we need to learn and why?
3. How do we find out about what we need to learn?
4. Who will do what and when?
5. What are we learning and what does it mean?
6. How do we make changes with what we have learned?
7. What differences have we made?

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[1] For more information on the evolution of participatory planning methods, see John Gaventa, et. al., *The Evaluation and Learning Initiative of the National Empowerment Zone and Enterprise Community Program: Review and Recommendations for Phase II Support. Vol. II., Literature Review* (Knoxville: CPC/UT Department of Sociology, 1995), 97-106.

8. How do we celebrate our victories?
9. What next?

In the past, the CPC has used this approach to address a wide variety of community and neighborhood concerns, including sustainable development and the preservation of local environmental resources. Recently we also began looking for opportunities to apply and adapt these methods to address other issues, including water quality, air quality, and the preservation of cultural and historic resources. As part of this effort, we are currently working with the Tennessee Valley Authority and local watershed partnerships to develop a model of participatory watershed planning. The CPC's experience working in the Little River Watershed will provide the data necessary to create an effective, transferable model for meaningful citizen participation in the environmental planning process.

PROJECT IMPLEMENTATION

Phase I:
Building Citizen Workgroups

The project will begin with an overview of the Little River Watershed and the identification of its stakeholders. The CPC will conduct a qualitative evaluation of the watershed, its population, and related land uses. Based on these findings, CPC will divide the watershed into five Watershed Planning Zones (WPZ). Each of these zones will then become home to a Watershed Planning Group (WPG). These groups, composed of local stakeholders, will become the heart of the participatory watershed plan. In addition, CPC will also form a watershed plan Steering Committee which will consist of representatives from each of the WPGs.

Ideally, each of these WPGs will contain a broad representation of local stakeholders. To insure this, CPC will also conduct a preliminary stakeholder analysis of each zone. All stakeholders and residents will be invited to participate in the planning process. CPC, however, recognizes the importance of broad based participation in the planning process. Working with community leaders, business leaders, and elected officials CPC will identify key stakeholders representing various interests and groups within each zone. These individuals will then be personally invited to participate with other members of the community in their WPG.

It is important to note that this stakeholder analysis will continue for the life of the project. CPC will work to maintain this diverse representation to insure that all parties are "at the table."

The CPC will conduct an awareness building campaign that will coincide with these preliminary assessments. This campaign will be designed to heighten awareness of watershed and water quality issues. It will also promote the upcoming participatory process and will encourage community involvement through informative literature and an interactive website.

Throughout this initial phase of the project, CPC will work closely with the Little River Watershed Association (LRWA). LRWA staff and member will assist CPC in identifying stakeholders, creating educational media, and organizing events. In addition, CPC will consult with the LRWA to avoid the unnecessary duplication of materials and services related to the project.

At the close of the initial phase, CPC will conduct the first round of planning workshops. Introductory workshops will be held in each of the WPZ's. These initial sessions will have the following goals:

- Explain the participatory process
- Begin building familiarity among participants
- Explain goals of the planning process
- Begin educating participants about the watershed
- Begin building Watershed Planning Groups

Phase II:
Building Knowledge of the Watershed

The second phase of the project will concentrate on building awareness of the watershed, its problems, and its potential. To accomplish this, CPC will utilize a combination of traditional and innovative educational and research tools. WPG members will take part in a number of programs and exercises, including the following:

Watershed Forums

The CPC will conduct a series of watershed forums designed to highlight issues facing the Little River. Local and regional water quality experts, such as representatives from UT, TVA, TDEC, LRWA, and the Alcoa corporation, will give interactive talks with WPGs throughout the watershed. The talks will also be videotaped and made available to all participants and WPGs. Watershed forums, which will be digitally recorded, will also be made available to the general public on the project's website.

Participatory Research

Working with these local water quality experts, CPC will develop a series of participatory research projects. Residents and stakeholders, including local youth, will conduct basic research into local water quality and issues confronting the Little River. Research tools will include the use of stakeholder water quality testing exercises and participant use of IPSI, the Integrated Pollutant Source Identification database. Results of these research projects will be shared with the media and all project participants. These results, and the research methodology, will also be published on the project website.

Watershed Snapshot

One of the most effective participatory tools developed by CPC is the community snapshot exercise, an activity which utilizes photography to help identify and address local issues. CPC will adapt this tool for use in addressing environmental concerns. Participants will be given single use cameras and instructed to record opportunities and obstacles to watershed preservation.[2] Results of this exercise will be digitized and shared in subsequent workshops. Participants will also analyze results and share findings with other WPGs.

Watershed Mapping

Participants will take part in a watershed mapping exercise. Similar to community mapping, this activity will have participants draw maps of the watershed as they see it. These maps will then be compared with actual maps, revealing participant perception of the watershed and will point out gaps in their knowledge of the area. During this exercise, participants will also begin to identify "hot spots" or "flash points" which would indicate areas of critical concern throughout the watershed.

Watershed Tours

In further increase awareness of the watershed, CPC will also conduct a series of watershed tours for WPG members. These tours will be designed to help familiarize group members with portions of the watershed outside of their immediate community and help build awareness of impacts both upriver and downstream. Activities will include walking tours, and may also include guided auto or canoe trips as well.

Mentoring Trip

CPC will take representatives from each WPG on a day trip to a mentor watershed. Participants will visit a watershed in the region that has successfully addressed similar issues. There, they will meet with community and watershed leaders and learn how and if their methods could successfully applied to the Little River.

SUBSEQUENT ACTIVITIES

The activities undertaken as part of this project will establish a foundation for a planning process, to be undertaken the flowing year. As part of this process, to be funded separately, participants will utilize the knowledge and data collected during Phase I and Phase II to develop a detailed report and plan which would include specific recommendations for improving and protecting the Little River Watershed.

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[2] Virtually all elements of these cameras are recycled and reused.

During this second year of the program, participants will also develop implementation and evaluation plans. CPC will also compile data on the project and its successful implementation. At the close of the project, the CPC will develop and issue a report on the planning process and the applicability of participatory methods to watershed and environmental issues. Among the specific criteria for evaluation will be:

- Number of workshop participants
- Inclusiveness of process
- Number of recommendations implemented
- Environmental benefits
- Level of project visibility

Results of this study will be shared with TDA, TDEC, LRWA, TVA, and the EPA. Findings will also be published in appropriate professional and academic journals and delivered at national and regional conferences.

TIMETABLE

First Quarter

Promote project
Hold "kick-off" event and launch project web site
Hold initial workshops and form Watershed Planning Groups
Conduct stakeholder analysis
Submit first quarterly update

Second Quarter

Begin watershed forums
Initiate particpatory research projects
Continue stakeholder analysis
Submit second quarterly update

Third Quarter

Continue watershed forums
Continue participatory research projects
Conduct watershed mapping exercises
Conduct watershed tours
Submit third quarterly update

Fourth Quarter

Continue participatory research projects
Complete watershed tours
Conduct mentoring trip
Complete plans for next phase of project
Evaluate project and issue findings
Submit final project report

Third Quarterly Report
July-September, 2004
Little River Watershed Project
604(b) Grant
University of Tennessee Community Partnership Center

During the third quarter of the project, the Community Partnership Center (CPC) concluded the educational phase of the Little River process and continued with preparations for the planning phase of the project. The major tasks accomplished this quarter are as follows:

Awareness Building

CPC continued to promote the Little River, Big Future planning process, generating more than a half-dozen articles in the Maryville *Daily Times* and Knoxville *News-Sentinel.* CPC staff also conducted phone interviews with a local radio station. CPC staff also created and distributed mailings, such as the postcard below, to promote the project and announce project events.

Little River, Big Future

The Little River is one of East Tennessee's most important natural resources and is the source of Blount County's drinking water.

Because of all various types of resources found in the region, the Little River Watershed is one of the fastest developing areas in the State of Tennessee.

It is important that we work together now to insure mportant local resources are protected for future generations.

Take part in these free programs to learn about the multiple impacts on water quality and how you can help develop a plan to better manage the natural resources of the Little River Watershed.

Program sponsors include Tennessee Valley Authority, the Tennessee Department of Environment and Conservation, the Little River Water Quality Forum, and the Little River Watershed Association. Program facilitation provided by the University of Tennessee Community Partnership Center.

--- August Program Calendar ---

Growth, Development, and Water Quality
Tuesday, August 3, 2004
Begins at 6:30pm - 8:00pm
Blount County Library*

Discover the environmental impacts of increased development from local government officials as they tell about the work they do to insure resource quality.

Little River Watershed Field Trip
Tuesday, August 17, 2004
Repeating tours, 3:00pm - 7:00pm
Maryville Water Filtration Plant
3635 Sevierville Road

Join us at the City of Maryville's Open House as we tour the facility and understand the water treatment process.

It may be called the Little River, but it has a Big Future!

For more information call 974-4542 or click **www.littleriverbigfuture.org**

*Except for providing meeting space, the Blount County Public Library is not in any manner connected with this meeting, and neither the Library or the Board of Trustees endorses any position expressed by the group.

Watershed Forums

During the second quarter, CPC continued the series of watershed forums with two additional educational events. In July, the CPC hosted a public seminar on Urban Best Management Practices, featuring speakers from the stormwater management departments of the City of Maryville, the City of Alcoa, and Blount County.

Photos from the August Forum

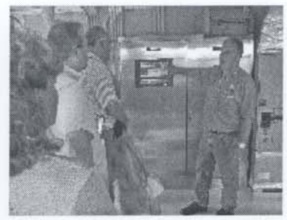
In September, CPC held the final forum, an event titled "Watershed Success Stories." This forum featured three presenters. Suzi Wilkins Berl, a consultant for conservation organizations, spoke about her experiences with the Farmington River Watershed Association in Connecticut. Callie Dobson, Executive Director of the Hiwassee River Watershed Coalition spoke about her organization and projects. Muiread Craft discussed efforts to restore Southwest Virginia's Guest River, as spotlighted by EPA as a watershed success story.

Forums were generally well attended and were effective at not only educating the public, but also stimulating discussion of local water quality issues. Residents expressed particular concern over sediment and other development issues, reflecting the rapid residential growth in the area.

Field Exercise

In August, CPC joined with the City of Maryville to conduct an open house of the community's newly renovated water treatment facility. CPC staff occupied a table with the Little River Watershed Association, distributed *Little River, Big Future* posters and fact sheets, and answered questions from residents. Visitors were also able to take a tour of the water treatment plant, and learn - firsthand - the impact the Little River has on their supply of drinking water.





Photos from the Field Exercise

Additional Activities

CPC staff continued to meet with local stakeholders to coordinate future project activities. Additional funding from the ALCOA foundation was delayed, but future receipt of the funds was confirmed. Project partners agreed to conduct the planning phase of the process in 2005, after the holiday season. Local partners also expressed concern about possible confusion among residents between this process and the existing Blount County planning process being conducted ny Hunter Interests.

Fourth Quarterly Report
October - December, 2004
Little River Watershed Project
604(b) Grant
University of Tennessee Community Partnership Center

Summary

During the fourth quarter of the project, the Community Partnership Center (CPC) concluded the educational phase of the Little River process and continued with preparations for the planning phase of the project. The major tasks accomplished this quarter are as follows:

- CPC staff evaluated results from the watershed forums and field exercises and reviewed comments from workshop participants.
- CPC staff began preparations for the planning phase of the watershed process.
- CPC secured funding to promote and conduct the planning phase.

Workshop Results

The workshops and field exercises conducted in the Spring and Summer of 2004 established a knowledge base for the upcoming planning phase of the project. Participants benefitted from these events in the following ways:

- Participants gained a better understanding of watersheds and watershed dynamics.
- Participants gained a better understanding of watershed issues, including urban runoff, impervious surfaces, agricultural pollution, and rain events.
- Participants acquired a basic knowledge of best management practices for development, agriculture, and residential living.
- Participants gained a better understanding of the natural and cultural resources of the Little River Watershed.
- Participants learned about the relationship between the water quality in the river and the water they drink and use in their daily lives.
- Participants learned about successful water quality programs in peer communities and saw the potential for such programs in their communities.

Other Activities

In December CPC received a $12,500 grant from the ALCOA Foundation to conduct the planning phase of the little river process. After meeting with project partners, CPC agreed to conduct a series of four planning workshops to be conducted in watershed communities in Spring, 2005.

Next Steps

In preparation for the planning phase, CPC is conducting the following activities:

- CPC is developing a methodology for the planning workshops
- CPC is working with project partners to promote these workshops
- CPC is evaluating dates and sites for these workshops

APPENDIX F

Proposed Watershed Project in the Little River Watershed

Pistol Creek TMDL Project Proposal (2005)

Proposal to the Tennessee Department of Environment and Conservation
Nonpoint Source Program
FY 2005

NAME OF PROJECT

Pistol Creek TMDL Project

LEAD ORGANIZATION

Blount County Extension
219 Court Street
Maryville, TN 37804
865-982-6430

CONTACT PERSON

Melissa Nance-Richwine
Little River Watershed Assn.
1004 E. Lamar Alexander Parkway
Maryville, TN 37804
865-980-2130

COOPERATING ORGANIZATIONS

Little River Watershed Association (LRWA)
Little River Water Quality Forum
TDEC, Water Pollution Control
Tennessee Valley Authority
City of Alcoa
City of Maryville

Estimated Start Date

July 1st 2005

Estimated End Date

July 1st 2006

Progress Reports

Prepared every quarter and sent to division

PROJECT ABSTRACT

The Blount County Extension (BCE) is the lead organization for a project located in the lower portion of the Little River watershed in Blount County, Tennessee. The objective of this project is to collect water samples that can be used to produce a TMDL for Pistol Creek, which is impacted, by siltation and Escherichia Coli. BCE will contract Little River Watershed Association to do the work on this project.

The Little River is a river of special economic, biological, and scenic value that has shown signs of degradation caused by growth and human activity in the Blount County area; currently the Little River is classified as threatened on the 305(b) list. The designated uses of Pistol Creek have been identified as impaired primarily by siltation from contaminated sediment, land development, and hazardous waste.

The project outputs will include an organized volunteer/stakeholder team that will collect water samples and identify pollution sources and make recommendations for solutions to be summarized in a final report. Expected outcomes are data to develop a TMDL, an informed public with an organizational basis for positive sustained actions focused on removal of Pistol Creek from the impaired list. Another outcome is a transferable model of community-based watershed stewardship.

PROJECT OBJECTIVE

This project will seek to organize a community-based volunteer effort focused on collecting water samples, identify pollution sources and make recommendations for solutions. Efforts to improve water quality frequently fail due to lack of sufficient orientation, preparation and support of stakeholder involvement. This project will be a community-based stakeholder involved effort.

PROJECT LOCATION

The project will be located in Blount County, Tennessee. Pistol Creek is a tributary watershed of the Little River (HUC # 06010201-030). Pistol Creek is listed as impaired on the 2002 TDEC 303(d) report under segment number TN06010201026-0400. This sub-watershed is located in Maryville and Alcoa, TN.

PROJECT LEADER EXPERIENCE

The project leader is Melissa Nance-Richwine. Nance-Richwine is the Executive Director of the LRWA. This individual will oversee the project and assure coordination of the project with board members, cooperating agencies, stakeholders, and volunteers.

Nance-Richwine has a B.A. in Environmental Sociology from the University of Tennessee and has over 6 years experience working with environmental organizations. She has designed and implemented many successful projects and programs, raised funds, and managed several complex projects funded by private foundations, donors and government agencies. Working with volunteers she has just completed collecting samples on Short Creek to be used for a TMDL.

INTRODUCTION

The Little River originates in the Clingman's Dome area of the Great Smoky Mountain National Park and travels through the cities of Townsend, Maryville, Alcoa, and Rockford, and then flows into the Tennessee River. The Little River watershed covers an area of 380 square miles including most of Blount County as well as portions of Sevier and Knox counties. This waterway serves as a source of drinking water for 85,000 residents; provides resources for farmers; businesses and industry in the area, supports recreational activities for both residents and the 1,600,000 tourists who visit this area annually; and is home to several federally endangered species.

Some signs of degradation in the river caused by development, poor agricultural practices, failing septic systems and other conditions in the watershed have been observed in recent years. Twenty Two stream segments within the watershed are included on the State of Tennessee 2004 303(d) water quality list of impaired streams. The importance of the Little River watershed is such that analysis and elimination of potential problems is essential for the maintenance of the economic, biological, and scenic value of the area. The river is a vital life support and the entire community benefits if the Little River remains healthy. Local residents have the greatest direct impact on the river especially downstream. The people of the area are the primary source of problems as well as solutions for the Little River's future. Thus a community-based effort will ensure the success of any water quality improvement project on the Little River.

The Blount County Extension (BCE) will work with, LRWA a grassroots non-profit organization, that was formed through citizen and business input at community meetings held throughout the past several years. The mission of LRWA is to protect, preserve, and enhance the Little River and its tributaries through mobilizing public support, building public awareness and promoting best management practices. The key objectives of the Association are to promote educational activities that benefit the river and the watershed, focus on efforts to protect the river, distribute current information to the community, and assist citizens in taking positive action.

Pistol Creek is a tributary of the Little River. TDEC monitoring of Pistol Creek --benthic surveys, bacteriological data and chemical grab samples--has shown that siltation and pathogens are the major cause of impairment. 7.66 miles of the stream are listed for not supporting its designated usage. The source of this contamination is attributed to discharges from MS4 area.

PROJECT IMPLEMENTATION

This project is designed to collect samples for use in a TMDL, assist a sub-watershed community of the Little River in gaining a local watershed perspective, and build a base from which to initiate community water quality improvements impacting a 303(d) stream. Lack of public awareness and basic knowledge of watersheds and the absence of an established organizational infrastructure for sustained community-based planning combine to constrain water quality improvement efforts. This project is designed to demonstrate how such formidable obstacles can be overcome.

The project will use a community-based model to focus on the accomplishment of our goals within a small manageable watershed. Key features of this model are community ownership, grass-roots involvement, focused volunteer management, and balanced representation. The approach (a) allows local people to participate in the development of a TMDL (b) develop and implementation of proactive watershed management assessment, (c) attempts to bring all the affected interests, both private and pubic, together to establish common objectives and resolve issues as a team, and (d) establishes a process open to everyone who has an interest in watershed issues.

A base of volunteers from the community would act to shape and implement project activities serving the goals of this proposal. The central feature of the project would be a volunteer support and development system. This system would include management of a volunteer development process structured to prepare, recruit, select, assign work and role responsibilities to, recognize and evaluate volunteers. The support system would be managed to seek facts, share information, build knowledge and awareness, encourage participation and bring positive results in light of project aims.

The first step of the project would be to complete final preparations such as brief agency cooperators, complete list of volunteer task descriptions, training modules, and test participation models. A process for recruiting interested volunteers from within the Pistol Creek watershed as well as the larger Little River watershed community would include advertisements, flyers, canvassing of community-based organizational membership and word-of-mouth. Interested volunteers would attend project orientation sessions. Each individual signing on to volunteer their services and skills would be required to participate in a comprehensive training session where they would learn about project objectives and procedures, water quality basics, and Pistol Creek watershed. They would be given work assignments, which would clarify their responsibilities, the nature of their specialized training, and team membership. Two teams would be composed of individuals who would either measure flow or take grab samples. Overall results of the volunteer effort would be compiled into a final project report. Volunteer effort and results would be given positive recognition at regular intervals during the project and at the end of the project. TDEC will work with the Blount County Extension (BCE) and LRWA to assure quality control of the sampling and coordinate with the analyses that will be done.

SITE LOCATIONS & PARAMETERS

#1 N 35.75923 W 83.95798
#2 N 35.73803 W 83.97804
#3 N 35.773500 W 84.00408
#4 N 35.75299 W 84.00636
#5 N 35.76935 W 83.98254
#6 N 35.79257 W 83.97089
#7 N 35.78605 W 83.95652
#8 N 35.81527 W 83.94209

Pathogens - Fecal Coliform
Enterococcus
E. Coli

Nutrients - NH3
No2/No3
Total Phosphorus
TRN

Siltation - TSS (suspended residue)
Residue, settleable
Residue, dissolved
Turbidity

PH, Flow, Conductivity, Dissolved oxygen, Temperature

MILESTONES

- Within one month of the contract start date; Volunteer job descriptions and role responsibilities will be addressed
- Within two months of the contract start date; training modules and materials will be prepared, purchased and ready for implementation.
- Within two months of the contract start date; a coordinating meeting with cooperating organizations will be held.
- Within three months of the contract start date; two required comprehensive volunteer training sessions would be held.
- Within four months of the contract start date; sampling will begin (total sample times is 12)
- Within six months of the contract start date; a meeting with cooperating organizations will be held.
- Within eight months of the contract start date; a benthic Survey will be conducted.
- Within one year of the contract start date; sampling will be completed.
- Within one year of the contract start date; a volunteer recognition and program review event will be held.
- Within one year of the contract start date: a final report and the raw data will be given to the Division.

MEASURES OF SUCCESS

- Increased knowledge of basic water issues measured through pre-project and post-project evaluations.
- Development of a volunteer base representing diverse segments of the watershed community including those not currently associated with LRWA.
- Identification of pollution/contamination sources.
- Data to be used in the development of a TMDL

WORK PLAN

Task 1 - (getting started) recruit volunteers through public meetings and from Short Creek Team, Meet with Jonathon Burr to select sampling locations, gather training materials, schedule training dates, hold training workshops

Task 2 - (sampling) work with volunteers to collect samples 12 times during the one year time frame

Task 3 - (wrapping it up) gather data into report and submit to division, hold volunteer appreciation event

Assumption: start date is July 1, 2005													
							'06						
Month:	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JULY
Task One: getting started													
Task Two: sampling													
Task Three: wrap it up													

APPENDIX G

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 FORT LOUDOUN LAKE WATERSHED (HUC 06010201), TENNESSEE

Announcement is hereby given of the availability of Tennessee's proposed Total Maximum Daily Loads (TMDLs) for siltation and habitat alteration in the Ft. Loudoun Lake 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 Ft. Loudoun Lake watershed are listed on Tennessee's proposed 2004 303(d) list as not supporting designated use classifications due, in part, to siltation and habitat alteration associated with land development, urban runoff, and agricultural sources. The TMDLs utilize Tennessee's general water quality criteria, ecoregion reference site data, land use data, digital elevation data, a sediment loading and delivery model, and an appropriate Margin of Safety (MOS) to establish reductions in sediment loading which will result in reduced in-stream concentrations and the attainment of water quality standards. The TMDLs require reductions in sediment loading of approximately 22% 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.php

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

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

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

Persons wishing to comment on the TMDLs are invited to submit their comments in writing no later than July 25th, 2005 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.