## TOTAL MAXIMUM DAILY LOAD (TMDL)

For

**Siltation and Habitat Alteration** 

## In The

Upper Duck River Watershed (HUC 06040002)

Bedford, Coffee, Franklin, Giles, Lincoln, Marshall, Maury,

Moore, Rutherford, and Williamson Counties, Tennessee



Prepared by:

Tennessee Department of Environment and Conservation Division of Water Pollution Control 6<sup>th</sup> Floor L & C Tower 401 Church Street Nashville, TN 37243-1534

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## LIST OF ABBREVIATIONS

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
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

#### UPPER DUCK RIVER WATERSHED (HUC 06040002)

#### 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: Bedford, Coffee, Franklin, Giles, Lincoln, Marshall, Maury, Moore, Rutherford and Williamson

Watershed: Upper Duck River (HUC 06040002)

Watershed Area: 1,181 mi<sup>2</sup>

Constituent of Concern: Siltation/Habitat Alteration

Impaired Waterbodies: 2004 303(d) List

Waterbody ID	Impaired Waterbody	RM
TN06040002001_0300	Goose Creek	7.3
TN06040002012_0100	East Rock Creek	16.9
TN06040002012_0700	Snell Branch	4.5
TN06040002012_2000	Big Rock Creek	9.0
TN06040002012_3000	Big Rock Creek	6.0
TN06040002021_0100	Little Sinking Creek	7.6
TN06040002021_1000 & 2000	Sinking Creek	26.4
TN06040002024_0100	Davis Branch	2.2
TN06040002027_0300	Butler Creek	14.2
TN06040002027_1000	Duck River	1.6
TN06040002033_0300	Bell Buckle Creek	11.1
TN06040002038_0300	Hurricane Creek	29.4
TN06040002038_1000	Fall Creek	11.4
TN06040002039_0250	Weakley Creek	13.1
TN06040002039_0300	Alexander Creek	21.1
TN06040002039_3000	North Fork Creek	9.2
TN06040002046_1000	Wilson Creek	19.5
TN06040002047_0300	Lick Creek	8.8
TN06040002048_0100	Thick Creek	13.4
TN06040002048_1000	Caney Creek	13.1

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: M

Most stringent narrative criteria applicable to fish & aquatic life use classification.

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

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

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

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

#### **TMDL Development**

General Analysis Methodology:

- Analysis performed using the Watershed Characterization System Sediment Tool (based on Universal Soil Loss Equation (USLE)) applied to impaired HUC-12 subwatershed areas to calculate existing sediment loads.
- Target sediment loads (lbs/acre/year) are based on the average annual sediment load from biologically healthy watersheds (Level IV Ecoregion reference sites).
- TMDLs are expressed as the percent reduction in average annual sediment load required for a subwatershed containing impaired waterbodies relative to the appropriate target load.
- 5% of subwatershed target loads are reserved to account for Waste Load Allocations

(WLAs) for Ready Mixed Concrete Facilities (RMCFs) and regulated mining sites. Most loading from these sources is small compared to total loading. Since the Total Suspended Solids (TSS) component of Sewage Treatment Plant (STP) discharges is generally composed of primarily organic material and is considered to be different in nature than the sediments produced from erosional processes, TSS discharges from STPs were <u>not</u> considered in the TMDL analysis (ref.: Sections 3.0 and 6.0).

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

Critical Conditions: Methodology takes into account all flow conditions.

Seasonal Variation: Methodology addresses all seasons.

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

### TMDL/Allocations

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

	Waterbody ID Waterbody				<b>Required Load Reduction</b>	
HUC-12 Subwatershed (06040002)		Level IV Ecoregion	TMDL (Required Overall Load Reduction)	WLA (MS4s and Construction SW)	LA (Nonpoint Sources)	
				[%]	[%]	[%]
0203	06040002033_0300	Bell Buckle Creek	71h	4.5	9.2	9.2
0301	06040002027_0300	Butler Creek		54.2	56.5	56.5
0301	06040002027_1000	Duck River		54.2	50.5	50.5
0305	06040002024_0100	Davis Branch		52.3	54.7	54.7
0308	06040002038_0300	Hurricane Creek				
0308	06040002038_1000	Fall Creek				
0309	06040002021_0100	Little Sinking Creek				
0309	06040002021_1000 & 2000	Sinking Creek				
0401	06040002039_3000	North Fork Creek		39.6*	42.8*	
0402	06040002039_0300	Alexander Creek	71i			42.8*
0404	06040002039_0250	Weakley Creek	7 11			
0502	06040002046_1000	Wilson Creek				
0503	06040002047_0300	Lick Creek				
0504	06040002048_0100	Thick Creek				
0504	06040002048_1000	Caney Creek				
0507	06040002001_0300	Goose Creek		32.4	35.8	35.8
0601	06040002012_0700	Snell Branch		26.9	20.5	30.5
0001	06040002012_2000 & 3000	Big Rock Creek	26.8 30.5		30.5	30.5
0602	06040002012_0100	East Rock Creek		39.6*	42.8*	42.8*

\*Assigned TMDLs, WLAs, and LAs. Ref.: Section 7.1.2 and Table 9.

## 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).

HUC-12 Subwatershed (06040002)	NPDES Permit No.	Facility Name	TSS Daily Max Limit	TSS Cut-off Conc. (SW Discharge)	
			[mg/l]	[mg/l]	
0301	TNG110117	Sequatchie Concrete Service			
0301	TNG110309	Bedford County Ready Mix	50	50	200
0601	TNG110032	Childress Concrete Company	50	200	
0001	TNG110069	I.M.I TN, Inc.			

#### RMCFs Permitted to Discharge TSS and Located in Impaired Subwatersheds

Mining Sites Permitted to Discharge TSS and Located in Impaired Subwatersheds

HUC-12 Subwatershed (06040002)	NPDES Permit No.	Name	TSS Daily Max Limit [mg/l]
	TN0066508	Vulcan Construction Materials – Shelbyville Quarry	L
0301 TN0022756		Rogers Group, Inc. – Shelbyville Quarry	
0401	TN0071846	Rogers Group, Inc. – Deason Quarry	40
0507	TN0061395	Rogers Group, Inc. – Columbia Quarry	40
0601 TN0003654		Rogers Group, Inc. – Lewisburg Quarry	
TN007125		Rogers Group, Inc. – Belfast Quarry	

#### TOTAL MAXIMUM DAILY LOAD (TMDL) FOR SILTATION/HABITAT ALTERATION UPPER DUCK RIVER WATERSHED (HUC 06040002)

#### 1.0 INTRODUCTION

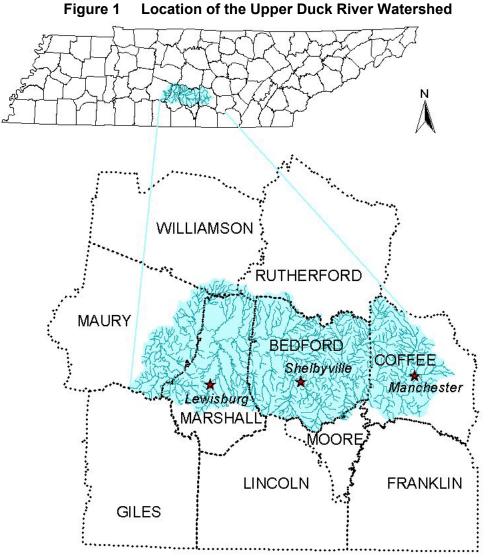
Section 303(d) of the Clean Water Act requires each state to list those waters within its boundaries for which technology based effluent limitations are not stringent enough to protect any water quality standard applicable to such waters. Listed waters are prioritized with respect to designated use classifications 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 Upper Duck River Watershed, Hydrologic Unit Code (HUC) 06040002, is located in Middle Tennessee (ref.: Figure 1) in Bedford, Coffee, Franklin, Giles, Lincoln, Marshall, Maury, Moore, Rutherford, and Williamson Counties. The Upper Duck River Watershed lies within a single Level III ecoregion (Interior Plateau) and contains four Level IV subecoregions as shown in Figure 2 (USEPA, 1997):

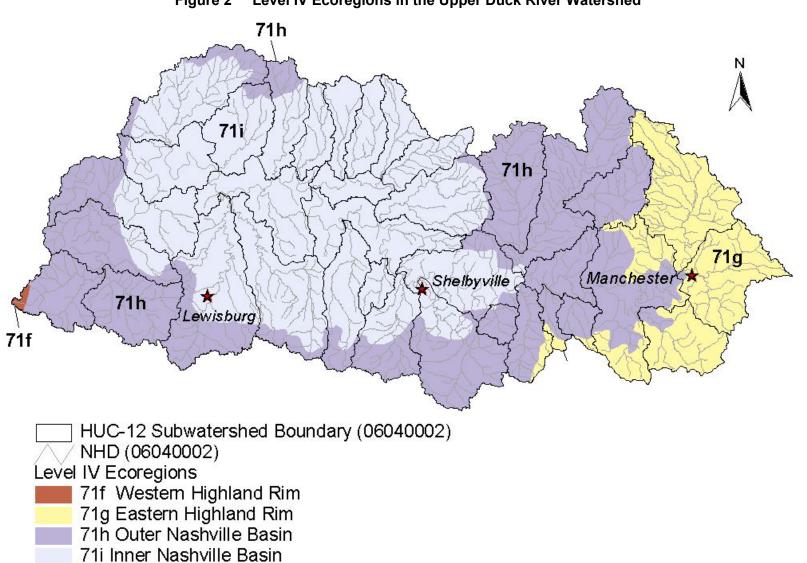
- Western Highland Rim (71f) is characterized by dissected, rolling terrain of open hills, with elevations of 400-1000 feet. The geologic base of Mississippian-age limestone, chert, and shale is covered by soils that tend to be cherty and acidic with low to moderate fertility. Streams are relatively clear with a moderate gradient. Substrates are coarse chert, gravel and sand with areas of bedrock. The native oak-hickory forests were removed over broad areas in the mid-to late 1800's in conjunction with the iron-ore related mining and smelting of the mineral limonite, however today the region is again heavily forested. Some agriculture occurs on the flatter interfluves and in the stream and river valleys. The predominant land uses are hay, pasture, and cattle with some cultivation of corn and tobacco.
- Eastern Highland Rim (71g) has more level terrain than the Western Highland Rim (71f), with landforms characterized as tablelands of moderate relief and irregular plains. Mississippian-age limestone, chert, shale and dolomite predominate. Karst terrain sinkholes and depressions are especially noticeable between Sparta and McMinnville. Numerous springs and spring-associated fish fauna typify the region. Natural vegetation is transitional between the oak-hickory forests to the west and the mixed mesophytic forests of the Appalachian ecoregions (68, 69) to the east. Bottomland hardwoods forests were once abundant in some areas, although much of the original bottomland forest has been inundated by several large impoundments. Barrens and former prairie areas are now primarily oak thickets, pasture or cropland.

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Outer Nashville Basin (71h) is a more heterogeneous region than the Inner Nashville Basin (71I), with rolling and hilly topography with slightly higher elevations. The region encompasses most of the outer areas of the generally non-cherty Ordovician limestone bedrock. The higher hills and knobs are capped by the more cherty Mississippian-age formation, and some Devonian-age Chattanooga shale, remnants of the Highland Rim. The region's limestone rocks and soils are high in phosphorus, and commercial phosphate is mined. Deciduous forest with pasture and cropland are the dominant land covers. The region has areas of intense urban development with the city of Nashville occupying the northwest region. Streams are low to moderate gradient, with productive, nutrient-rich waters, resulting in algae, rooted vegetation, and occasionally high densities of fish. The Nashville Basin has a distinctive fish population, notable for species that avoid the region, as well as those that are present.

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## Figure 2 Level IV Ecoregions in the Upper Duck River Watershed

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Inner Nashville Basin (71i) is less hilly and lower than the Outer Nashville Basin (71h). Outcrops of the Ordovician-age limestone are common. The generally shallow soils are redder and lower in phosphorous than those of the outer basin. Streams are lower gradient than surrounding regions, often flowing over large expanses of limestone bedrock. The most characteristic hardwoods within the inner basin are a maple-oak-hickory-ash-association. The limestone cedar glades of Tennessee, a unique mixed grassland/forest cedar glades vegetation type with many endemic species, are located primarily on the limestones of the Inner Nashville Basin. The more xeric, open characteristics and shallow soils of the cedar glades also result in a distinct distribution of amphibian and reptile species. Urban, suburban, and industrial land use in the region is increasing.

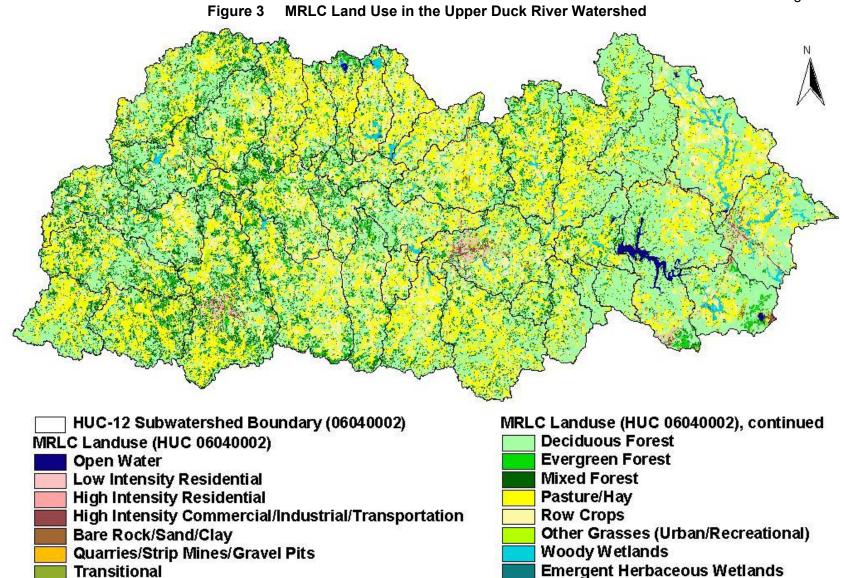
The Upper Duck River Watershed (HUC 06040002) has approximately 1,607 miles of streams and 3,260 lake acres of reservoir (based on the EPA/TDEC Assessment Database (ADB)) and drains approximately 1,181 square miles (ref.: Table 1) to the Tennessee River. Watershed land use distribution is based on the 1992 Multi-Resolution Land Characteristic (MRLC) satellite imagery databases derived from Landsat Thematic Mapper digital images from the period 1990-1993. Land use for the Upper Duck River Watershed is summarized in Table 1 and shown in Figure 3.

Land yes		Area			
Land use	[acres]	[mi <sup>2</sup> ]	[% of watershed]		
Bare Rock/Sand/Clay	3	0.0	0.0		
Deciduous Forest	296,264	462.9	39.2		
Emergent Herbaceous Wetlands	420	0.7	0.1		
Evergreen Forest	27,511	43.0	3.6		
High Intensity Commercial/Industrial/Transportation	5,076	7.9	0.7		
High Intensity Residential	1,190	1.9	0.2		
Low Intensity Residential	5,806	9.1	0.8		
Mixed Forest	85,377	133.4	11.3		
Open Water	4,777	7.5	0.6		
Other Grasses (Urban/Recreational)	3,205	5.0	0.4		
Pasture/Hay	208,807	326.3	27.6		
Quarries/Strip Mines/Gravel Pits	419	0.7	0.1		
Row Crops	106,937	167.1	14.1		
Transitional	652	1.0	0.1		
Woody Wetlands	9,428	14.7	1.2		
Total	755,871	1,181.0	100.0		

 Table 1
 Land Use Distribution - Upper Duck River Watershed

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

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Transitional

#### 3.0 PROBLEM DEFINITION

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

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

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

Several examples of typical stream assessments are shown in Appendix D.

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

Siltation (sedimentation) is the most frequently cited cause of waterbody impairment in Tennessee, impacting over 5,800 miles of streams and rivers (TDEC, 2006). Unlike many chemical pollutants, sediments are typically present in waterbodies in natural or background amounts and are essential to normal ecological function. Excessive sediment loading, however, is a major ecosystem stressor that can adversely impact biota, either directly or through changes to physical habitat.

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

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

#### Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page 7 of 36

Waterbody ID	Waterbody	Miles/ Acres	Source (Pollutant)	Cause (Pollutant)
06040002001_0300	Goose Creek	7.3	Other Habitat Alteration	Pasture Grazing
06040002012_0100	East Rock Creek	16.9	Loss of biological integrity due to siltation/Other Habitat Alterations	Pasture Grazing
06040002012_0700	Snell Branch	4.5	Loss of biological integrity due to siltation/Other Habitat Alterations	Land Development/ Channelization
06040002012_2000	Big Rock Creek	9.0	Nutrients/ Loss of biological integrity due to siltation/Low dissolved oxygen	Major Municipal Point Source/ Discharges from MS4 area
06040002012_3000	Big Rock Creek	6.0	Loss of biological integrity due to siltation/Other Habitat Alterations	Pasture Grazing
06040002021_0100	Little Sinking Creek	7.6	Loss of biological integrity due to siltation/Other Habitat Alterations	Pasture Grazing
06040002021_1000 & 2000	Sinking Creek	26.4	Loss of biological integrity due to siltation/Other Habitat Alterations	Pasture Grazing
06040002024_0100	Davis Branch	2.2	Loss of biological integrity due to siltation	Pasture Grazing
06040002027_0300	Butler Creek	14.2	Other Habitat Alterations	Pasture Grazing/Land Development
06040002027_1000	Duck River	1.6	Escherichia coli/Loss of biological integrity due to siltation	Collection System Failure/ Discharges from MS4 area
06040002033_0300	Bell Buckle Creek	11.1	Loss of biological integrity due to siltation/Other Habitat Alterations/Escherichia coli	Minor Municipal Point Source/ Livestock in Stream
06040002038_0300	Hurricane Creek	29.4	Escherichia coli/Nutrients/Loss of biological integrity due to siltation/Other Habitat Alterations	Pasture Grazing

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

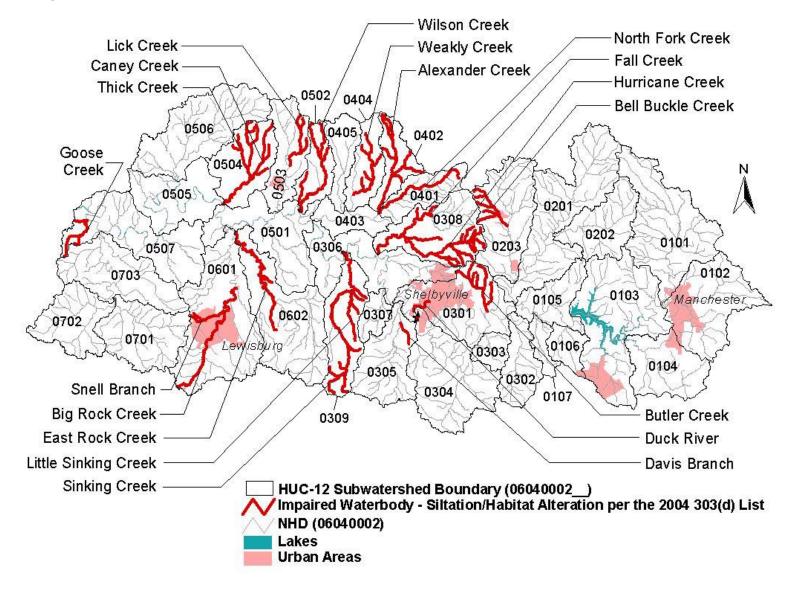
#### Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page 8 of 36

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

Waterbody ID	Waterbody	Miles/ Acres	Source (Pollutant)	Cause (Pollutant)
06040002038_1000	Fall Creek	11.4	Escherichia coli/Nutrients/ Loss of biological integrity due to siltation/Other Habitat Alterations	Pasture Grazing
06040002039_0250	Weakley Creek	13.1	Loss of biological integrity due to siltation/Nutrients/Escherichia coli	Agriculture
06040002039_0300	Alexander Creek	21.1	Loss of biological integrity due to siltation/ Escherichia coli	Pasture Grazing
06040002039_3000	North Fork Creek	9.2	Loss of biological integrity due to siltation/Nutrients/Escherichia coli	Agriculture
06040002046_1000	Wilson Creek	19.5	Escherichia coli/Nitrate/Other Habitat Alterations	Pasture Grazing
06040002047_0300	Lick Creek	8.8	Escherichia coli/Other Habitat Alterations	Livestock in Stream
06040002048_0100	Thick Creek	13.4	Loss of biological integrity due to siltation/Other Habitat Alterations/Escherichia coli	Pasture Grazing
06040002048_1000	Caney Creek	13.1	Nitrate/ Loss of biological integrity due to siltation	Livestock in Stream/ Removal of Riparian Vegetation

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Waterbody ID	Waterbody	Comments
06040002001_0300	Goose Creek (Duck River to headwaters)	2000 TDEC biological survey at mile 1.7 (Old Highway 50). 4 EPT families, 12 total families. Habitat score = 126.
06040002012_0100	East Rock Creek (Big Rock Creek to confluence of Mud Creek)	1999 TDEC biological survey at mile 10.3 (Highway 31A). 3 EPT families, 20 total families. Habitat score = 98. Chemical station at mile 1.8. Coliforms elevated. 1997 TVA survey at mile 1.9 (Anes Station Road). 8 EPT families, 23 total families.
06040002012_0700	Snell Branch (Big Rock Creek to headwaters)	TDEC biological station at mile 0.3 (Highway 272). 1 EPT family, 9 total families. Habitat score = 96.
06040002012_2000	Big Rock Creek (Dry Branch to Collins Hollow Road)	1999 TDEC biological survey at RM 16.8 (Hwy 431, d/s STP). 3 EPT families, 21 total families. Habitat score = 123. Chemical samples also at Highway 31A. Nutrients elevated. 1997 TVA survey at RM 11.5 (McBride Road). 4 EPT families.
06040002012_3000	Big Rock Creek (Collins Hollow Road to headwaters)	1999 TDEC biological survey at mile 19.3 (off Highway 31A, upstream of STP). 1 EPT family, 13 total families. Habitat score = 113.
06040002021_0100	Little Sinking Creek (Sinking Creek to headwaters)	TDEC 2000 probabilistic monitoring station at mile 1.0 at Sims Road. Violated proposed biocriteria for 71i. 1999 TDEC biological survey at mile 1.1 (Sims Road). 1 EPT families, 6 total families. Habitat score = 61.
06040002021_1000	Sinking Creek (Duck River to confluence of Cortner Branch)	TDEC 2000 probabilistic monitoring station at mile 1.2 at Wheel Road. Violated proposed biocriteria for 71i. 1999 TDEC biological survey at mile 8.6 (Gant Road). 1 EPT family, 12 total families. Habitat score = 99.
06040002021_2000	Sinking Creek (Corner Branch to headwaters)	TDEC 2000 probabilistic monitoring station at mile 8.9 u/s of Gant Road. Violated proposed biocriteria for 71i.
06040002024_0100	Davis Branch (Sugar Creek to headwaters)	TDEC 2000 probabilistic monitoring station at mile 0.2 at Richmond Pike. Violated proposed biocriteria for 71i.
06040002027_0300	Butler Creek (Duck River to headwaters)	TDEC biological survey at mile 0.2 (Mullins Mill Road). 6 EPT families, 22 total families. Habitat score = 109.
06040002027_1000	Duck River (Flat Creek to Highway 231)	TDEC stream survey by canoe.

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

## Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page 11 of 36

Waterbody ID	Waterbody	Comments	
06040002033_0300	Bell Buckle Creek (Wartrace Creek to headwaters)	1999 TDEC biological station at mile 1.0 (downsteam STP). 0 EPT families, 16 total families. Habitat score = 95.	
06040002038_0300	Hurricane Creek (Fall Creek to headwaters)	TDEC 2000 probabilistic monitoring station at RM 4.2 (Midland Road). Violated proposed biocriteria for 71i. Elevated fecal. 1999 TDEC biological station at RM 1.8 (Burns Road). 5 EPT families, 23 total families. Habitat score = 94.	
06040002038_1000	Fall Creek (Duck River to headwaters)	TDEC 2000 probabilistic monitoring station at RM 3.0 (Gregory Mill Road). Violated proposed biocriteria for 71i. 1999 TDEC biological & 319 site at RM 1.2 (Old Unionville Road). 5 EPT families, 24 total families. Habitat score = 103. Pathogens elevated.	
06040002039_0250	Weakley Creek (Unnamed tributary to headwaters)	TDEC 2000 probabilistic monitoring station at mile 5.2 at Coopertown Road. Violated proposed biocriteria for 71i. Three 319 stations in this watershed. Pathogens elevated.	
06040002039_0300	Alexander Creek (North Fork Creek to headwaters)	TDEC 2000 probabilistic monitoring station at mile 4.0 u/s of Pepper Hill Road. Violated proposed biocriteria for 71i. E. coli also elevated. Dry when observed in August, 1999.	
06040002039_3000	North Fork Creek (Alexander Creek to headwaters)	TDEC 2000 probabilistic monitoring station at mile 16.4 d/s of Squire Hall Road. Violated proposed biocriteria for 71i.	
06040002046_1000	Wilson Creek (Duck River to headwaters)	2000 TDEC probabilistic station at mile 5.2 at Chapel Hill to Unionville Road. Site did not meet proposed biocriteria for 71i. Elevated E. coli levels. 2000 TDEC biological survey at mile 2.8 (Wright Rd). 4 EPT, 14 total families, habitat=144.	
06040002047_0300	Lick Creek (Spring Creek to headwaters)	TDEC chemical station mile 1.6 (Mt Vernon Road). Coliforms elevated.	
06040002048_0100	Thick Creek (Caney Creek to headwaters)	2000 TDEC probabilistic station at river mile 2.0 off Pyles Road. Site did not meet proposed biocriteria for 71i. (1 EPT genus, 14 total genera, habitat score=131, NCBI=7.59). Dominated by isopods. Fecal coliforms elevated.	
06040002048_1000	Caney Creek (Duck River to headwaters)	2001 TVA biorecon at Lunns Store Rd. 3 EPT families, 1 intolerant, 17 total families. 1999 TDEC biorecons at mile 2.6 & 4.2. 5 EPT families, 20 total, habitat = 124, at mile 2.6. 1997 TVA biorecon at Lunns Store. Road. 6 EPT families, 21 total.	

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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 pollutionsensitive 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 Upper Duck River Watershed listed as impaired due to siltation (excess inorganic sediment produced by erosional processes) and/or appropriate cases of habitat alteration. The TSS in STP effluent is considered to be a distinctly different pollutant and, therefore, is excluded in sediment loading calculations.

#### 4.0 TARGET IDENTIFICATION

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

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

Solids, Floating Materials, and Deposits – There shall be no distinctly visible solids, scum, foam, oily slick, or the formation of slimes, bottom deposits or sludge banks of such size and character that may be detrimental to fish & aquatic life.

Other Pollutants – The waters shall not contain other pollutants that will be detrimental to fish or aquatic life.

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

Turbidity or Color – There shall be no turbidity or color in such amounts or of such character that will materially affect fish & aquatic life.Applicable to the Fish & Aquatic Life use classification:

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

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

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

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

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 guality 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.

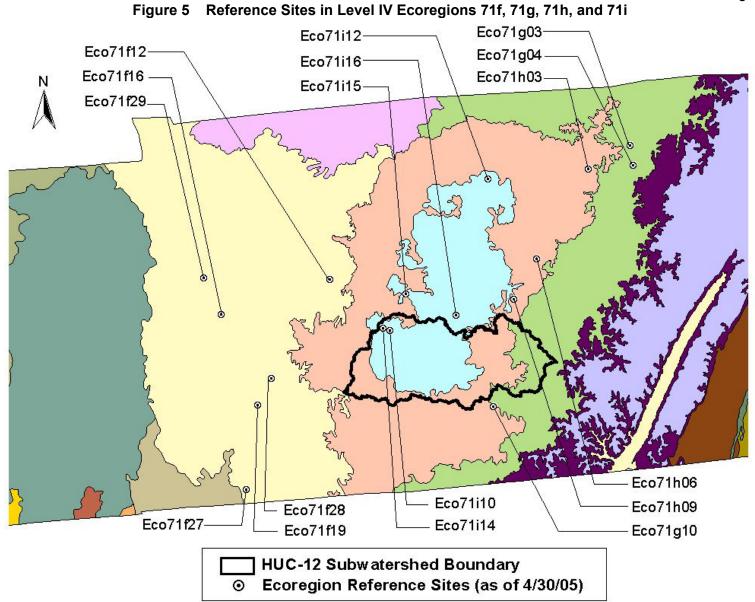
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Using the methodology described in Appendix A, the Watershed Characterization System (WCS) Sediment Tool was used to calculate the average annual sediment load for each of the biologically healthy (reference) watersheds in Level IV ecoregions 71f, 71g, 71h, and 71i. 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 71f, 71g, 71h, and 71i are summarized in Table 4. Reference site locations are shown in Figure 5.

Level 4 Ecoregion	Reference Site	Stream	Drainage Area	Average Annual Sediment Load					
Ecolegion	Site		(acres)	[lbs/acre/year]					
	Eco71f12	South Harpeth Creek	6,746	1267.5					
	Eco71f16	Wolf Creek	9,879	246.0					
	Eco71f19	Brush Creek	5,416	846.8					
71f	Eco71f27	Swanegan Branch	3,201	772.4					
	Eco71f28	Little Swan Creek	4,730	209.9					
	Eco71f29	Hurricane Creek	43,549	1,047.6					
		Geometric Mean (Ta	rget Load)	596.0					
	Eco71g03	Flat Creek	14,145	342.1					
71g	Eco71g04	Spring Creek	17,090	493.6					
, ig	Eco71g10	Hurricane Creek	3,565	270.3					
Geometric Mean (Ta			rget Load)	357.4					
	Eco71h03	Flynn Creek	8,318	754.7					
71h	Eco71h06	Clear Fork	8,779	563.9					
/	Eco71h09	Carson Fork	7,934	516.4					
		Geometric Mean (Tar	get Load)	603.5					
	Eco71i10	Flat Creek	12,200	512.2					
	Eco71i12	Cedar Creek	17,852	449.8					
71i	Eco71i14	Little Flat Creek	4,273	444.3					
/ 11	Eco71i15	Harpeth River	43,239	449.5					
	Eco71i16	West Fork Stones River	15,500	287.4					
		Geometric Mean (Ta	rget Load)	Geometric Mean (Target Load) 421.0					

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

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#### 5.0 WATER QUALITY ASSESSMENT AND DEVIATION FROM TARGET

Using the methodology described in Appendix A, 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 Upper Duck River 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.

HUC-12 Subwatershed (06040002)	Level IV Ecoregion	Existing Sediment Load [lbs/ac/yr]			
0203	71h	632			
0301		919			
0305		882			
0308		383			
0309		335			
0401		334			
0402		232			
0404	71i	239			
0502		320			
0503		390			
0504		287			
0507		623			
0601		575			
0602		394			

# Table 5Existing Sediment Loads in SubwatershedsWith Impaired Waterbodies

#### 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 from Municipal Separate Storm Sewer Systems (MS4s). A TMDL must provide Waste Load Allocations (WLAs) for all NPDES regulated point

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

### 6.1 Point Sources

## 6.1.1 NPDES Regulated Wastewater Treatment Facilities

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

## 6.1.2 NPDES Regulated Ready Mixed Concrete Facilities

Discharges from regulated Ready Mixed Concrete Facilities (RMCFs) may contribute sediment to surface waters as TSS discharges (TSS discharged from RMCFs is composed of primarily inorganic material and is therefore included as a source for TMDL development). Most of these facilities obtain coverage under NPDES Permit No. TNG110000, *General NPDES Permit for Discharges of Storm Water Runoff and Process Wastewater Associated With Ready Mixed Concrete Facilities* (TDEC, 2003). This permit establishes a daily maximum TSS concentration limit of 50 mg/l on process wastewater effluent and specifies monitoring procedures for storm water discharges. Facilities are also required to develop and implement storm water pollution prevention plans (SWPPPs). Discharges from RMCFs are generally intermittent, and contribute a small portion of total sediment loading to HUC-12 subwatersheds (ref.: Appendix C). In some cases, for discharges into impaired waters, sites may be required to obtain coverage under an individual NPDES permit. Of the nine permitted RMCFs in the Upper Duck River Watershed as of November 28, 2005, four are located in impaired subwatersheds. These facilities are listed in Table 6 and shown in Figure 6.

## 6.1.3 NPDES Regulated Mining Sites

Discharges from regulated mining activities may contribute sediment to surface waters as TSS (TSS discharged from mining sites is composed of primarily inorganic material and is therefore included as a source for TMDL development). Discharges from active mines may result from dewatering operations and/or in response to storm events, whereas discharges from permitted inactive mines are only in response to storm events. Inactive sites with successful surface reclamation contribute relatively little solids loading. Of the eight permitted mining sites in the Upper Duck River Watershed (as of November 28, 2005), six are located in impaired subwatersheds. These are listed in Table 7 and shown in Figure 6. Sediment loads (as TSS) to waterbodies from mining site discharges are very small in relation to total sediment loading (ref.: Appendix C).

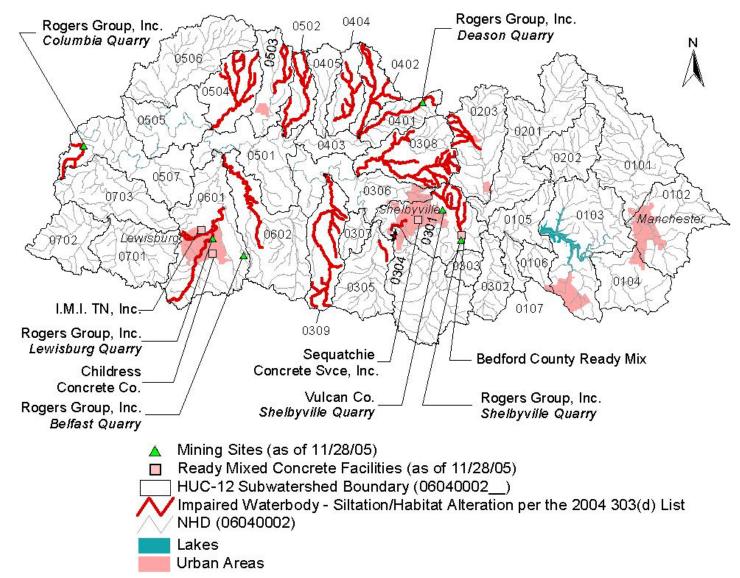


Figure 6 NPDES Regulated RMCFs and Mining Sites Located in Impaired Subwatersheds

#### 6.1.4 NPDES Regulated Construction Activities

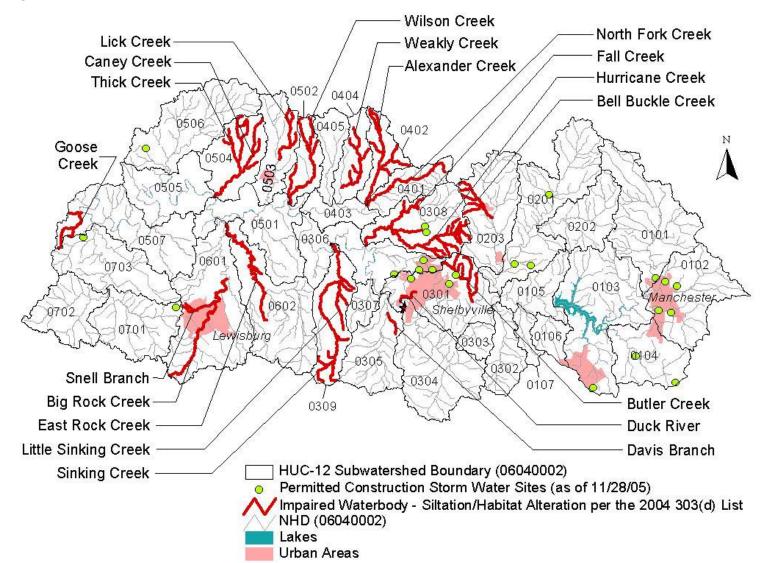
Discharges from NPDES regulated construction activities are considered point sources of sediment loading to surface waters and occur in response to storm events. Currently, discharges of storm water from construction activities disturbing an area of one acre or more must be authorized by an NPDES permit. Most of these construction sites obtain coverage under NPDES Permit No. TNR10-0000, *General NPDES Permit for Storm Water Discharges Associated With Construction Activity* (TDEC, 2005a). Since construction activities at a site are of a temporary, relatively short-term nature, the number of construction sites covered by the general permit at any instant of time varies. Of the 25 permitted active construction sites in the Upper Duck River Watershed on November 28, 2005, six were in impaired subwatersheds (ref.: Figure 7).

# Table 6 NPDES Regulated Ready Mixed Concrete Facilities Located in Impaired Subwatersheds (as of November 28, 2005)

HUC-12 Subwatershed (06040002)	NPDES Permit No.	Facility Name	TSS Daily Max Limit	TSS Cut-off Conc. (SW discharge)
			[mg/l]	[mg/l]
0.301		Sequatchie Concrete Service		200
		Bedford County Ready Mix	50	
0601	TNG110032	Childress Concrete Company	50	200
0001	TNG110069	I.M.I TN, Inc.		

# Table 7NPDES Regulated Mining Sites Permitted to Discharge TSS and Located in<br/>Impaired Subwatersheds (as of November 28, 2005)

HUC-12 Subwatershed (06040002)	NPDES Permit No.	Name	TSS Daily Max Limit [mg/l]
0301 TN0066508		Vulcan Construction Materials – Shelbyville Quarry	
0301	TN0022756	Rogers Group, Inc. – Shelbyville Quarry	
0401	TN0071846	Rogers Group, Inc. – Deason Quarry	40
0507	TN0061395	Rogers Group, Inc. – Columbia Quarry	40
0601 TN000365		Rogers Group, Inc. – Lewisburg Quarry	
0001	TN0071251	Rogers Group, Inc. – Belfast Quarry	





#### 6.1.5 NPDES Regulated Municipal Separate Storm Sewer Systems (MS4s)

MS4s may discharge sediment to waterbodies in response to storm events through road drainage systems, curb and gutter systems, ditches, and storm drains. These systems convey urban runoff from surfaces such as bare soil and wash-off of accumulated street dust and litter from impervious surfaces during rain events. Phase I of the EPA storm water program requires large and medium MS4s to obtain NPDES storm water permits. Large and medium MS4s are those located in incorporated places or counties serving populations greater than 100,000 people. At present, there are no Phase I MS4s in the Upper Duck River Watershed.

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

NPDES Permit Number	Phase	Permittee Name
TNS077615	II	Lewisburg
TNS075531	II	Shelbyville
TNS077631	II	Tullahoma
TNS075647	II	Rutherford County
TNS075795	I	Williamson County

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

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

#### 6.2 Nonpoint Sources

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

- Natural erosion occurring from the weathering of soils, rocks, and uncultivated land; geological abrasion; and other natural phenomena.
- Erosion from agricultural activities can be a major source of sedimentation due to the

large land area involved and the land-disturbing effects of cultivation. Grazing livestock can leave areas of ground with little vegetative cover. Unconfined animals with direct access to streams can cause streambank damage.

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

For impaired waterbodies within the Upper Duck River Watershed, the primary sources of nonpoint sediment loads come from agriculture, roadways, and urban sources. The watershed land use distribution based on the 1992 MRLC satellite imagery databases is shown in Appendix B 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:

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

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

TMDL analyses are performed on a 12-digit hydrologic unit code (HUC-12) area basis for subwatersheds containing waterbodies identified as impaired due to siltation and/or habitat alteration on the 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 approach described in Section 7.1.1 was selected as the most appropriate for sediment TMDLs in the Upper Duck River Watershed. TMDL, WLA, and LA development for these subwatersheds are addressed in Sections 7.2, 7.3, and 7.4, respectively. This procedure was modified as noted in Section 7.1.2 for several subwatersheds.

#### 7.1.1 WCS Sediment Tool

Sediment loading analysis for waterbodies impaired due to siltation/habitat alteration in the Upper Duck River Watershed was accomplished using the Watershed Characterization System (WCS) Sediment Tool. This ArcView geographic information system (GIS) based model is described in Appendix A 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 Upper Duck River Watershed sediment TMDLs.
- The Sediment Tool was also used to determine the existing average annual sediment loads of impaired watersheds located in the same Level IV ecoregion. Impaired watersheds are defined as 12-digit HUCs containing one or more waterbodies identified as impaired due to siltation/habitat alteration on the State's 2004 303(d) List (ref: Figure 4).
- The existing average annual sediment load of each impaired HUC-12 subwatershed was compared to the average annual load of the appropriate reference (biologically healthy) watershed and an <u>overall</u> required percent reduction in loading calculated. For each impaired HUC-12 subwatershed, the TMDL is equal to this <u>overall</u> required reduction:

(Existing Load) - (Target Load) TMDL = \_\_\_\_\_\_ x 100 (Existing Load)

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.

Note: In several subwatersheds, the calculated existing load is lower than the calculated target load. This case is addressed in Section 7.1.2 and Appendix D.

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

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

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

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

Details of the analysis methodology are more fully described in Appendix A. 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).

7.1.2 Sediment Tool Analysis Anomalies

There are nine HUC-12 subwatersheds in the Upper Duck River Watershed that have been assessed (primarily on the basis of biological surveys as stated in Section 3.0) as impaired due to siltation and/or habitat alteration, for which the results of the Sediment Tool based analysis indicate that the existing sediment load is smaller than the target load. These subwatersheds are:

L	
060400020308	Fall Creek and Hurricane Creek
060400020309	Sinking Creek and Little Sinking Creek
060400020401	North Fork Creek
060400020402	Alexander Creek
060400020404	Weakley Creek
060400020502	Wilson Creek
060400020503	Lick Creek
060400020504	Caney Creek and Thick Creek
060400020602	East Rock Creek

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These subwatersheds require a more thorough investigation to determine site-specific causes of impairment. A detailed analysis is presented in Appendix D. In consideration, however, of the assessment of waterbodies in these subwatersheds as impaired due to siltation and/or habitat alteration, TMDLs, WLAs for construction storm water sites, WLAs for MS4s, and LAs for nonpoint sources were assigned based on the predominant Level IV ecoregion in each HUC-12 subwatershed (71i for all nine subwatersheds) using the following procedure:

- Assigned TMDLs were determined to be equal to the geometric mean of the <u>overall</u> required load reductions (TMDLs) of other impaired HUC-12 subwatersheds predominantly in Level IV ecoregion 71i.
- Assigned WLAs for construction storm water, WLAs for MS4s, and LAs for nonpoint sources for the subwatersheds were determined to be equal to the geometric mean of the WLA & LA load reductions of other impaired HUC-12 subwatersheds predominantly in Level IV ecoregion 71i.
- 7.2 TMDLs for Impaired Subwatersheds

Sediment TMDLs for subwatersheds containing waterbodies identified as impaired for siltation/habitat alteration are summarized in Table 8. The determination of assigned TMDLs, WLAs for MS4s and construction SW, and LAs for HUC-12 subwatersheds where the Sediment Tool analysis resulted in existing loads lower than target loads are shown in Table 9.

- 7.3 Waste Load Allocations
- 7.3.1 Waste Load Allocations for NPDES Regulated Ready Mixed Concrete Facilities

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

7.3.2 Waste Load Allocations for NPDES Regulated Mining Activities

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

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HUC-12 Subwatershed (06040002)	Waterbody ID	Waterbody Impaired by Siltation/ Habitat Alteration	Level IV Ecoregion	Existing Sediment Load	Target Load	TMDL (overall required load reduction)
				[lbs/ac/yr]	[lbs/ac/yr]	[%]
0203	06040002033_0300	Bell Buckle Creek	71h	632	603.5	4.5
0301	06040002027_0300	Butler Creek		919		54.2
0301	06040002027_1000	Duck River		313		54.2
0305	06040002024_0100	Davis Branch		882		52.3
0308	06040002038_0300	Hurricane Creek	- 383	383	421.0	
0300	06040002038_1000	Fall Creek		335		
0309	06040002021_0100	Little Sinking Creek				
0000	06040002021_1000 & 2000	Sinking Creek				39.6*
0401	06040002039_3000	North Fork Creek		334 232		
0402	06040002039_0300	Alexander Creek	71i			
0404	06040002039_0250	Weakley Creek	7.11	239		
0502	06040002046_1000	Wilson Creek		320		
0503	06040002047_0300	Lick Creek		390		
0504	06040002048_0100	Thick Creek		287		
0004	06040002048_1000	Caney Creek		207		
0507	06040002001_0300	Goose Creek		623		32.4
0601	06040002012_0700	Snell Branch		575		26.8
	06040002012_2000 & 3000	Big Rock Creek	]	575		20.0
0602	06040002012_0100	East Rock Creek		394		39.6*

\*Assigned TMDL. Ref.: Section 7.1.2 and Table 9.

		Required Load Reduction						
Level IV Ecoregion	Impaired HUC-12 Subwatershed (06040002) <sup>a</sup>	TMDL (required overall load reduction) <sup>b</sup>	overall load					
		[%]	[%]	[%]				
	0301	54.2	56.5	56.5				
	0305	52.3	54.7	54.7				
71i	0507	32.4	35.8	35.8				
	0601	26.8	30.5	30.5				
	Geometric Mean	39.6	42.8	42.8				

# Table 9 Determination of Assigned TMDLs, WLAs, and LAs, for Certain Impaired Subwatersheds

a. HUC-12 Subwatersheds where (existing load) > (target load)

b. See Table 8

c. See Table 10

## 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 10). 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 Activity* (TDEC, 2005a). WLAs should not be construed as numeric permit limits.

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

Municipal separate storm sewer systems (MS4s) are regulated by the State's NPDES program (ref.: Section 6.1.5). Since MS4s have the potential to discharge TSS to surface waters, WLAs are specified for these systems. WLAs are established for each HUC-12 subwatershed containing a waterbody identified on the 2004 303(d) List as impaired due to siltation and/or habitat alteration (ref.: Table 2). WLAs are expressed as the required percent reduction in the estimated average annual sediment loading for an impaired subwatershed, relative to the estimated average annual sediment loading (minus the 5% allocated to RMCFs and regulated mining sites) of a biologically healthy (reference) subwatershed located in the same Level IV ecoregion (ref.: Table 10). WLAs apply to MS4 discharges in the impaired subwatershed for which the WLA was developed and will

		Percent Reduction – Average	Annual Sediment Load		
HUC-12 Subwatershed (06040002)	Level IV Ecoregion	WLAs (Construction SW and MS4s)	LAs (Nonpoint Sources)		
(00040002)		[%]	[%]		
0203	71h	9.2	9.2		
0301		56.5	56.5		
0305		54.7	54.7		
0308					
0309					
0401					
0402		42.8*	42.8*		
0404	71i	72.0	42.0		
0502					
0503					
0504					
0507		35.8	35.8		
0601		30.5	30.5		
0602		42.8*	42.8*		

# Table 10Summary of WLAs for MS4s and Construction Storm Water Sites<br/>and LAs for Nonpoint Sources

\*Assigned WLAs and LAs. Ref.: Section 7.1.2 and Table 9.

# 7.4 Load Allocations for Nonpoint Sources

All sources of sediment loading to surface waters not covered by the NPDES program are provided a Load Allocation (LA) in these TMDLs. LAs are established for each HUC-12 subwatershed containing a waterbody identified on the 2004 303(d) List as impaired due to siltation and/or habitat alteration (ref. Table 2). LAs are expressed as the required percent reduction in the estimated average annual sediment loading for the impaired subwatershed, relative to the estimated average annual sediment loading (minus 5%) of a biologically healthy (reference) subwatershed located in the same Level IV ecoregion (ref.: Table 10).

# 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 A).

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 A). This is a statistic calculated from the annual summation of rainfall energy in every storm and its maximum 30-minute intensity.

## 8.0 IMPLEMENTATION PLAN

- 8.1 Point Sources
- 8.1.1 NPDES Regulated Ready Mixed Concrete Facilities

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

8.1.2 NPDES Regulated Mining Sites

Six of the eight NPDES regulated mining sites in the Upper Duck River Watershed are located in impaired subwatersheds (ref.: Table 7). WLAs will be implemented through the existing permit requirements for these sites.

8.1.3 NPDES Regulated Construction Storm Water

The WLAs provided to existing and future NPDES regulated construction activities will be implemented through appropriate erosion prevention and sediment controls and Best Management Practices (BMPs) as specified in NPDES Permit No. TNR10-0000, *General NPDES Permit for Storm Water Discharges Associated With Construction Activity* (TDEC, 2005a). This permit requires the development and implementation of a site-specific Storm Water Pollution Prevention Plan (SWPPP) prior to the commencement of construction activities. The SWPPP must be prepared in accordance with good engineering practices and the latest edition of the *Tennessee Erosion and Sediment Control Handbook* (TDEC, 2002) and must identify potential sources of pollution at a construction site that would affect the quality of storm water discharges and describe practices to be used to reduce pollutants in those discharges. In addition, the permit specifies a number of special requirements for discharges entering high quality waters or waters identified as impaired due to siltation. The permit does <u>not</u> authorize discharges that would result in a violation of a State water quality standard.

Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page 30 of 36 e requirements of the *General NPDES Permit for* 

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

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

For existing and future regulated discharges from municipal separate storm sewer systems (MS4s), WLAs will be implemented through Phase I and II MS4 permits. These permits will require the development and implementation of a Storm Water Management Plan (SWMP) that will reduce the discharge of pollutants to the "maximum extent practicable" and not cause or contribute to violations of State water quality standards. Both the *NPDES General Permit for Discharges from Small Municipal Separate Storm Sewer Systems* (TDEC, 2003a) and the TDOT individual MS4 permit (TNS077585) require SWMPs to include the following six minimum control measures:

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

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

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

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

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

#### 8.2 Nonpoint Sources

The Tennessee Department of Environment & Conservation (TDEC) has no direct regulatory authority over most nonpoint source discharges. Reductions of sediment loading from nonpoint sources (NPS) will be achieved using a phased approach. Voluntary, incentive-based mechanisms will be used to implement NPS management measures in order to assure that measurable reductions in pollutant loadings can be achieved for the targeted impaired waters. Cooperation and active participation by the general public and various industry, business, and environmental groups is critical to successful implementation of TMDLs. Local citizen-led and implemented management measures offer the most efficient and comprehensive avenue for reduction of loading rates from nonpoint sources. There are links to a number of publications and information resources on EPA's Nonpoint Source Pollution website (<u>http://www.epa.gov/owow/nps/pubs.html</u>) 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: <u>http://www.state.tn.us/environment/wpc/watershed/</u>). 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 262 BMPs in the Upper Duck River Watershed as of September 2, 2005, 112 are in sediment-impaired subwatersheds (ref.: Figure 8).

An excellent example of stakeholder involvement and action is described in the *Big Rock Creek Watershed Final Management Plan, March 2003* (NCDRP, 2003), prepared by the Center for Watershed Protection for The Nature Conservancy, Duck River Project. This development of this plan was funded, in part, under an agreement with the Tennessee Department of Agriculture, Nonpoint Source Program and a U.S. Environmental Protection Agency Assistance Agreement (#C9994674-01-0). This plan was based on an extensive evaluation of stream conditions, various investigations and analyses, and usage surveys of conservation practices in the Big Rock Creek subwatershed. The plan establishes subwatershed goals and recommendations to meet these

http://www.cwp.org/watershed services/Big Rock es.pdf

### 8.3 Evaluation of TMDL Effectiveness

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

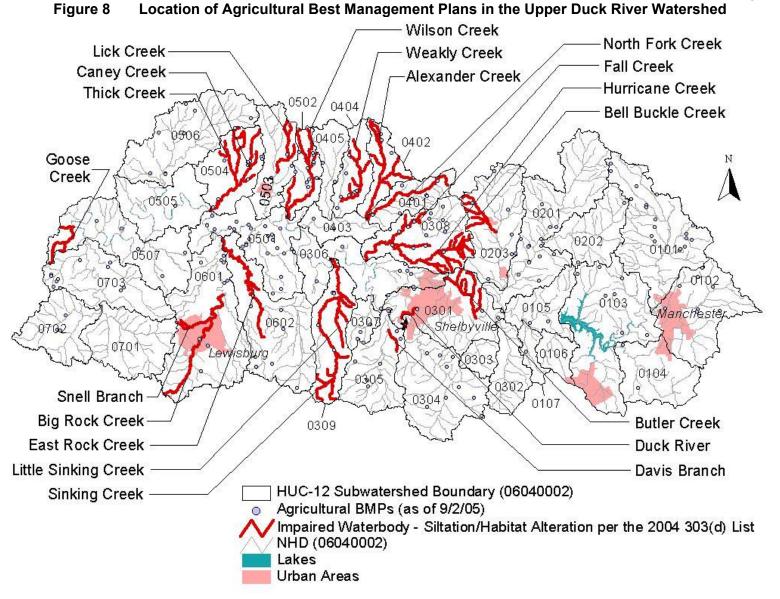
## 9.0 PUBLIC PARTICIPATION

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

- 1) Notice of the proposed TMDLs was posted on the Tennessee Department of Environment and Conservation website. The notice invited public and stakeholder comments and provided a link to a downloadable version of the TMDL document.
- 2) Notice of the availability of the proposed TMDLs (similar to the website announcement) was included in one of the NPDES permit Public Notice mailings, which was sent to approximately 90 interested persons or groups who had requested this information.
- 3) A letter was sent to following point source facilities in the Upper Duck River Watershed that are permitted to discharge treated total suspended solids (TSS) and are located in impaired subwatersheds advising them of the proposed sediment TMDLs and their availability on the TDEC website. The letter also stated that a written copy of the draft TMDL document would be provided on request. Letters were sent to the following facilities:

TNG110117	Sequatchie Concrete Service
TNG110309	Bedford County Ready Mix
TNG110032	Childress Concrete Company
TNG110069	I.M.I TN, Inc.
TN0066508	Vulcan Construction Materials – Shelbyville Quarry
TN0022756	Rogers Group, Inc. – Shelbyville Quarry
TN0071846	Rogers Group, Inc. – Deason Quarry
TN0061395	Rogers Group, Inc. – Columbia Quarry
TN0003654	Rogers Group, Inc. – Lewisburg Quarry
TN0071251	Rogers Group, Inc. – Belfast Quarry

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

> Natural Resources Conservation Service Tennessee Department of Agriculture Tennessee Valley Authority Tennessee Wildlife Resources Agency USDA – Forest Service USGS Water Resource Programs The Nature Conservancy

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

TNS077615	Lewisburg
TNS075531	Shelbyville
TNS077631	Tullahoma
TNS075647	Rutherford County
TNS075795	Williamson County
TNS077585	Tennessee Department of Transportation (TDOT)

#### **10.0 FURTHER INFORMATION**

Further information concerning Tennessee's TMDL program can be found on the Internet at the Tennessee Department of Environment and Conservation website: <u>http://www.state.tn.us/environment/wpc/tmdl/</u>

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

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

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

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## **APPENDIX A**

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

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average annual soil erosion of watersheds and evaluating the effects of land use changes and implementation of BMP measures.

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

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

where:

A = average annual soil loss in tons per acre

R = rainfall erosivity index

K = soil erodibility factor

LS = topographic factor - L is for slope length and S is for slope

C = crop/vegetation and management factor

P = conservation practice factor

Evaluating the factors in USLE:

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

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

#### K - Soil Erodibility Factor

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

## LS - Topographic Factor

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

## C - Crop/Vegetation and Management Factor

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

P - Conservation Practice Factor

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

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

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

## Sediment Modeling Methodology

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

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

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

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

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

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

 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 these delineations is summarized in Appendix B. All of the sediment analyses were performed on the basis of these drainage areas. The following steps are accomplished using the WCS Sediment Tool:

- 3. For a selected watershed or subwatershed, a sediment project is set up in a new view that contains the data layers that will be subsequently used to calculate erosion and sediment delivery.
- 4. A stream grid for each delineated subwatershed was created by etching a stream coverage, based on National Hydrology Dataset (NHD), to the DEM grid.
- 5. For each 30 by 30 meter grid cell within the subwatershed, the Sediment Tool calculates the potential erosion using the USLE based on the specific cell characteristics. The model then calculates the potential sediment delivery to the stream grid network. Sediment delivery can be calculated using one of the four available sediment delivery equations:
  - Distance-based equation (Sun and McNulty, 1998) Mad = M \* (1-0.97 \* D/L) where: Mad = mass moved (tons/acre/yr) M = sediment mass eroded (ton) D = least cost distance from a cell to the nearest stream grid (ft) L = maximum distance the sediment may travel (ft)
  - Distance Slope-based equation (Yagow et al., 1998) DR = exp(-0.4233 \* L \* So) So = exp (-16.1 \* r/L+ 0.057)) - 0.6 where: DR = sediment delivery ration L = distance to the stream (m) r = relief to the stream (m)
  - Area-based equation (USDASCS, 1983)  $DR = 0.417762 * A^{(-0.134958)} - 1.27097$ ,  $DR \le 1.0$ where: DR = sediment delivery ratio A = area (sq miles)
  - WEEP-based regression equation (Swift, 2000)
     Z = 0.9004 0.1341 \* X<sup>2</sup> + X<sup>3</sup> 0.0399 \* Y + 0.0144 \* Y<sup>2</sup> + 0.00308 \* Y<sup>3</sup>
     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 Upper Duck River Watershed.

- 6. The total sediment delivered upstream of each subwatershed "pour point" is calculated. The sediment analysis provides the calculations for six new parameters:
  - Source Erosion estimated erosion from each grid cell due to the land cover
  - Road Erosion estimated erosion from each grid cell representing a road
  - Composite Erosion composite of the source and road erosion layers
  - Source Sediment estimated fraction of the soil erosion from each grid cell that reaches

the stream (sediment delivery)

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

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

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

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

HUC-12	EROSION					
Subwatershed	Road	Source	Total	%Road	%Source	
(06040002)	[tons/yr]	[tons/yr]	[tons/yr]	/onudu	/050urce	
0203	3,647	14,135	17,782	20.5	79.5	
0301	6,093	22,622	28,715	21.2	78.8	
0305	2,080	18,306	20,386	10.2	89.8	
0308	1,889	11,140	13,029	14.5	85.5	
0309	1,433	8,354	9,786	14.6	85.4	
0401	675	4,514	5,189	13.0	87.0	
0402	607	3,745	4,352	13.9	86.1	
0404	838	4,226	5,064	16.5	83.5	
0502	860	4,527	5,387	16.0	84.0	
0503	1,675	8,742	10,417	16.1	83.9	
0504	1,443	9,908	11,350	12.7	87.3	
0507	4,432	22,798	27,230	16.3	83.7	
0601	8,392	24,919	33,311	25.2	74.8	
0602	2,938	17,862	20,799	14.1	85.9	

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

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HUC-12			SEDIMENT		
Subwatershed	Road	Source	Total	%Road	9/ Source
(06040002)	[tons/yr]	[tons/yr]	[tons/yr]	%R0au	%Source
0203	2,103	6,114	8,217	25.6	74.4
0301	2,810	9,760	12,569	22.4	77.6
0305	1,363	7,337	8,699	15.7	84.3
0308	821	3,987	4,808	17.1	82.9
0309	596	2,764	3,360	17.7	82.3
0401	291	1,622	1,913	15.2	84.8
0402	181	1,047	1,228	14.7	85.3
0404	259	1,135	1,394	18.6	81.4
0502	292	1,345	1,637	17.8	82.2
0503	593	2,555	3,148	18.8	81.2
0504	400	2,315	2,715	14.7	85.3
0507	1,742	7,938	9,680	18.0	82.0
0601	3,751	8,573	12,324	30.4	69.6
0602	1,107	5,778	6,885	16.1	83.9

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

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

HUC-12	HUC-12	UNIT LOADS				
Subwatershed (06040002_)	Subwatershed Area	Erosion		Sediment		
(00040002)	[acres]	[tons/ac/yr]	[lbs/ac/yr]	[tons/ac/yr]	[lbs/ac/yr]	
0203	26,017	0.683	1,367	0.316	632	
0301	31,477	1.049	2,098	0.459	919	
0305	19,720	1.034	2,068	0.441	882	
0308	25,096	0.519	1,038	0.192	383	
0309	20,044	0.488 976		0.168	335	
0401	11,450	0.453	906	0.167	334	
0402	10,567	0.412 824		0.116	232	
0404	11,657	0.434 869		0.120	239	
0502	10,244	0.526 1,052		0.160	320	
0503	16,161	0.645 1,289		0.195	390	
0504	18,949	0.599 1,198		0.143	287	
0507	31,086	0.876 1,752		0.311	623	
0601	42,847	0.777 1,555		0.288	575	
0602	34,925	0.596	1,191	0.197	394	

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## **APPENDIX B**

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

	Subwatershed (06040002)								
Land Use	02	0203		0301		0305		0308	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]	
Bare Rock/Sand/Clay	0	0.0	0	0.0	0	0.0	0	0.0	
Deciduous Forest	8,350	32.1	5,555	17.6	6,820	34.6	6,918	27.6	
Emergent Herbaceous Wetlands	4	0.0	0	0.0	10	0.0	5	0.0	
Evergreen Forest	1,097	4.2	4,783	15.2	317	1.6	826	3.3	
High Intensity Commercial/Industrial/Transportation	80	0.3	684	2.2	84	0.4	244	1.0	
High Intensity Residential	18	0.1	174	0.6	0	0.0	0	0.0	
Low Intensity Residential	143	0.5	1,824	5.8	40	0.2	116	0.5	
Mixed Forest	3,427	13.2	6,849	21.8	1,850	9.4	2,286	9.1	
Open Water	14	0.1	15	0.0	22	0.1	19	0.1	
Other Grasses (Urban/Recreational)	71	0.3	1,040	3.3	4	0.0	129	0.5	
Pasture/Hay	9,967	38.3	9,177	29.2	7,068	35.8	8,938	35.6	
Quarries/Strip Mines/Gravel Pits	0	0.0	14	0.0	0	0.0	0	0.0	
Row Crops	2,449	9.4	1,350	4.3	3,379	17.1	5,335	21.3	
Transitional	0	0.0	11	0.0	0	0.0	7	0.0	
Woody Wetlands	396	1.5	0	0.0	126	0.6	272	1.1	
Total	26,017	100.0	31,477	100.0	19,720	100.0	25,096	100.0	

 Table B-1
 Upper Duck River Watershed - Impaired Subwatershed Land Use Distribution

			Subwate	rshed (060	040002	)		
Land Use	0309		040	)1	040	)2	040	)4
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand/Clay	0	0.0	0	0.0	0	0.0	0	0.0
Deciduous Forest	8,357	41.7	2,604	22.7	2,030	19.2	2,323	19.9
Emergent Herbaceous Wetlands	0	0.0	17	0.1	14	0.1	99	0.8
Evergreen Forest	1,040	5.2	206	1.8	198	1.9	375	3.2
High Intensity Commercial/Industrial/ Transportation	16	0.1	46	0.4	3	0.0	76	0.7
High Intensity Residential	0	0.0	0	0.0	0	0.0	6	0.0
Low Intensity Residential	61	0.3	32	0.3	15	0.1	66	0.6
Mixed Forest	2,574	12.8	777	6.8	700	6.6	980	8.4
Open Water	5	0.0	4	0.0	1	0.0	38	0.3
Other Grasses (Urban/Recreational)	5	0.0	0	0.0	18	0.2	5	0.0
Pasture/Hay	4,302	21.5	4,512	39.4	4,451	42.1	3,992	34.2
Quarries/Strip Mines/Gravel Pits	0	0.0	0	0.0	0	0.0	0	0.0
Row Crops	3,684	18.4	2,974	26.0	2,884	27.3	3,019	25.9
Transitional	0	0.0	0	0.0	0	0.0	0	0.0
Woody Wetlands	1	0.0	278	2.4	254	2.4	678	5.8
Total	20,044	100.0	11,450	100.0	10,567	100.0	11,657	100.0

Table B-1 (Cont.) Upper Duck River Watershed - Impaired Subwatershed Land Use Distribution

		Sub	owatershed (0	6040002	)	
Land Use	05	02	050	)3	05	04
	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand/Clay	0	0.0	0	0.0	0	0.0
Deciduous Forest	2,414	23.6	3,342	20.7	7,166	37.8
Emergent Herbaceous Wetlands	0	0.0	0	0.0	0	0.0
Evergreen Forest	486	4.7	854	5.3	993	5.2
High Intensity Commercial/Industrial/Transportation	11	0.1	164	1.0	28	0.1
High Intensity Residential	0	0.0	17	0.1	6	0.0
Low Intensity Residential	13	0.1	162	1.0	47	0.2
Mixed Forest	1,090	10.6	2,112	13.1	2,641	13.9
Open Water	4	0.0	7	0.0	4	0.0
Other Grasses (Urban/Recreational)	0	0.0	56	0.3	0	0.0
Pasture/Hay	4,362	42.6	6,643	41.1	4,431	23.4
Quarries/Strip Mines/Gravel Pits	0	0.0	0	0.0	0	0.0
Row Crops	1,863	18.2	2,804	17.3	3,610	19.1
Transitional	0	0.0	0	0.0	0	0.0
Woody Wetlands	0	0.0	0	0.0	23	0.1
Total	10,244	100.0	16,161	100.0	18,949	100.0

 Table B-1 (Cont.)
 Upper Duck River Watershed - Impaired Subwatershed Land Use Distribution

	Subwatershed (06040002)							
Land Use	05	07	060	)1	060	)2		
	[acres]	[%]	[acres]	[%]	[acres]	[%]		
Bare Rock/Sand/Clay	0	0.0	0	0.0	0	0.0		
Deciduous Forest	12,860	41.4	11,830	27.6	11,075	31.7		
Emergent Herbaceous Wetlands	0	0.0	0	0.0	1	0.0		
Evergreen Forest	1,247	4.0	2,514	5.9	1,898	5.4		
High Intensity Commercial/Industrial/Transportation	86	0.3	583	1.4	56	0.2		
High Intensity Residential	1	0.0	199	0.5	0	0.0		
Low Intensity Residential	52	0.2	1,232	2.9	124	0.4		
Mixed Forest	5,243	16.9	8,241	19.2	4,591	13.1		
Open Water	307	1.0	33	0.1	20	0.1		
Other Grasses (Urban/Recreational)	18	0.1	768	1.8	40	0.1		
Pasture/Hay	6,215	20.0	12,438	29.0	9,921	28.4		
Quarries/Strip Mines/Gravel Pits	54	0.2	121	0.3	0	0.0		
Row Crops	4,785	15.4	4,832	11.3	7,015	20.1		
Transitional	21	0.1	9	0.0	1	0.0		
Woody Wetlands	199	0.6	47	0.1	184	0.5		
Total	31,086	100.0	42,847	100.0	34,925	100.0		

Table B-1 (Cont.) Upper Duck River Watershed - Impaired Subwatershed Land Use Distribution

				Ec	osite Su	bwaters	hed			
Land Use	Eco71f12		Eco71f16		Eco71f19		Eco7	1f27	Eco	71f28
	[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	4,839	71.7	9,655	97.7	4,403	81.3	1,888	59.0	4,175	88.3
Emergent Herbaceous Wetlands	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Evergreen Forest	39	0.6	21	0.2	73	1.4	909	28.4	155	3.3
High Intensity Commercial/ Industrial/Transportation	1	0.0	7	0.1	1	0.0	10	0.3	5	0.1
High Intensity Residential	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Low Intensity Residential	5	0.1	0	0.0	2	0.0	0	0.0	1	0.0
Mixed Forest	155	2.3	68	0.7	57	1.1	233	7.3	99	2.1
Open Water	2	0.0	0	0.0	1	0.0	0	0.0	1	0.0
Other Grasses (Urban/Recreational)	0	0.0	0	0.0	1	0.0	0	0.0	4	0.1
Pasture/Hay	1,242	18.4	94	1.0	251	4.6	6	0.2	166	3.5
Quarries/Strip Mines/Gravel Pits	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Row Crops	461	6.8	0	0.0	493	9.1	48	1.5	99	2.1
Transitional	1	0.0	33	0.3	98	1.8	108	3.4	25	0.5
Woody Wetlands	0	0.0	0	0.0	35	0.7	0	0.0	0	0.0
Total	6,746	100.0	9,879	100.0	5,416	100.0	3,201	100.0	4,730	100.0

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

			Ec	osite Sub	watershee	ł		
Land Use	Eco7	1f29	Eco71g03		Eco71	lg04	Eco7	1g10
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand/Clay	0	0.0	0	0.0	0	0.0	0	0.0
Deciduous Forest	34,312	78.8	6,703	47.4	9,087	53.2	2,726	76.6
Emergent Herbaceous Wetlands	0	0.0	0	0.0	0	0.0	0	0.0
Evergreen Forest	190	0.4	1,206	8.5	384	2.2	80	2.2
High Intensity Commercial/Industrial/Transportation	44	0.1	13	0.1	143	0.8	23	0.6
High Intensity Residential	0	0.0	0	0.0	4	0.0	0	0.0
Low Intensity Residential	49	0.1	90	0.6	132	0.8	3	0.1
Mixed Forest	741	1.7	2,635	18.6	1,612	9.4	169	4.8
Open Water	60	0.1	2	0.0	3	0.0	0	0.0
Other Grasses (Urban/Recreational)	42	0.1	175	1.2	33	0.2	54	1.5
Pasture/Hay	4,022	9.2	3,138	22.2	4,331	25.3	335	9.4
Quarries/Strip Mines/Gravel Pits	0	0.0	0	0.0	42	0.2	0	0.0
Row Crops	3,752	8.6	184	1.3	1,319	7.7	170	4.8
Transitional	289	0.7	0	0.0	0	0.0	5	0.1
Woody Wetlands	48	0.1	0	0.0	0	0.0	0	0.0
Total	43,549	100.0	14,145	100.0	17,090	100.0	3,565	100.1

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

			Ecc	site Subv	vatershed			
Land Use	Eco7	1h03	Eco71h06		Eco7	1h09	Eco7	'1i10
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand/Clay	0	0.0	0	0.0	0	0.0	0	0.0
Deciduous Forest	6,784	81.6	7,788	88.7	6,264	79.0	4,782	39.2
Emergent Herbaceous Wetlands	0	0.0	0	0.0	0	0.0	0	0.0
Evergreen Forest	137	1.6	137	1.6	245	3.1	677	5.5
High Intensity Commercial/Industrial/ Transportation	20	0.2	2	0.0	6	0.1	4	0.0
High Intensity Residential	14	0.2	0	0.0	0	0.0	0	0.0
Low Intensity Residential	136	1.6	2	0.0	36	0.5	10	0.1
Mixed Forest	757	9.1	604	6.9	722	9.1	2,425	19.9
Open Water	0	0.0	1	0.0	0	0.0	1	0.0
Other Grasses (Urban/Recreational)	52	0.6	0	0.0	0	0.0	8	0.1
Pasture/Hay	395	4.7	193	2.2	494	6.2	3,339	27.4
Quarries/Strip Mines/Gravel Pits	0	0.0	0	0.0	0	0.0	0	0.0
Row Crops	23	0.3	50	0.6	167	2.1	955	7.8
Transitional	0	0.0	1	0.0	0	0.0	0	0.0
Woody Wetlands	0	0.0	0	0.0	0	0.0	0	0.0
Total	8,318	100.1	8,779	100.0	7,934	100.0	12,200	100.0

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

			E	cosite Sul	owatershee	b		
Land Use	Eco7	1i12	Eco71i14		Eco71i15		Eco7	1i16
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand/Clay	0	0.0	0	0.0	0	0.0	0	0.0
Deciduous Forest	4,495	25.2	1,687	39.4	11,842	27.4	5,535	35.7
Emergent Herbaceous Wetlands	0	0.0	0	0.0	12	0.0	46	0.3
Evergreen Forest	640	3.6	95	2.2	2,334	5.4	887	5.7
High Intensity Commercial/Industrial/ Transportation	96	0.5	1	0.0	125	0.3	33	0.2
High Intensity Residential	0	0.0	0	0.0	5	0.0	3	0.0
Low Intensity Residential	55	0.3	5	0.1	262	0.6	70	0.5
Mixed Forest	2,106	11.8	526	12.3	6,707	15.5	2,178	14.1
Open Water	7	0.0	0	0.0	61	0.1	7	0.0
Other Grasses (Urban/Recreational)	35	0.2	0	0.0	139	0.3	24	0.2
Pasture/Hay	6,846	38.4	1,311	30.7	14,171	32.8	3,665	23.6
Quarries/Strip Mines/Gravel Pits	0	0.0	0	0.0	0	0.0	0	0.0
Row Crops	3,571	20.0	574	13.4	7,163	16.6	2,403	15.5
Transitional	0	0.0	73	1.7	109	0.3	1	0.0
Woody Wetlands	0	0.0	0	0.0	310	0.7	647	4.2
Total	17,852	100.0	4,273	99.9	43,239	100.0	15,500	100.0

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

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## APPENDIX C

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

### **Determination of Existing Point Source Sediment Loads**

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

#### Ready Mixed Concrete Facilities (RMCFs)

Total loading from RMCFs is the sum of loading from process wastewater discharges and storm water runoff. Estimates of loading (ref.: Table C-1) from RMCFs located in an impaired subwatershed were determined as follows.

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

AAL<sub>RMCF</sub> = \_\_\_\_\_\_(Q<sub>d</sub>) x (MAvg) (8.34 lb-l/gal-mg) (365 days/yr) (A<sub>HUC-12</sub>)

where: AAL<sub>RMCF</sub> = Average annual load [lb/ac/yr]  $Q_d$  = Facility design flow [MGD] MAvg = Monthly average concentration limit for TSS [mg/l]  $A_{HUC-12}$  = Area of impaired HUC-12 subwatershed [acres]

The existing loading from storm water runoff for RMCFs is based on an assumed runoff from the site drainage area, the daily maximum permit limit for TSS, and the area of the HUC-12 subwatershed in which each facility is located (ref.: Table C-1). Site runoff was estimated by assuming that one-half of the annual precipitation falling on the site drainage area results in runoff. Annual precipitation for the Upper Duck River Watershed is approximately 52 in/yr (Midwest Plan Service, 1985).

(A<sub>d</sub>) (DMax) (Precip) (0.2266 lb-l/ac-in-mg) (0.5)

(A<sub>HUC-12</sub>)

where: AAL<sub>RMCF</sub> = Average annual load [lb/ac/yr] A<sub>d</sub> = Facility (site) drainage area [acres] DMax = Daily maximum concentration limit for TSS [mg/l] Precip = Average annual precipitation for watershed [in/yr] A<sub>HUC-12</sub> = Area of impaired HUC-12 subwatershed [acres]

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Table C-1 Estimate of Existing Loads - Ready Mixed Concrete Facilities

			Proc	Process Wastewater			Storm Water Runoff			
HUC-12 Subwatershed (06040002)	Subwatershed Area	NPDES Permit No.	Estimated Flow	Daily Maximum TSS Limit	Annual Average Load	Site Drainage Area	TSS Cut-off Conc.	Annual Average Load	Annual Average Load	
			[MGD]	[mg/l]	[lb/ac/yr]	[acres]	[mg/l]	[lb/ac/yr]	[lb/ac/yr]	
0301	27,369	27 360 TNG110117				12.0		0.5166	0.517	
0301	27,509	TNG110309	0.0001	0.0001 50	0.0006	3.0	200	0.1292	0.130	
0601	42,847	TNG110032	0.0001		0.0004	14.6		0.4015	0.402	
0001	42,047	TNG110069				2.5		0.0688	0.069	

#### Mining Sites

Existing loads for permitted mining sites are based on an assumed runoff from the site drainage area, the daily maximum permit limit for TSS, and the area of the HUC-12 subwatershed in which the mining site is located (ref.: Table C-2). Site runoff was estimated by assuming that one half of the annual precipitation falling on the site area results in runoff. Annual precipitation for the Upper Duck River Watershed is approximately 52 in/yr (Midwest Plan Service, 1985).

where: AAL<sub>Mining</sub> = Average annual load [lb/yr] A<sub>d</sub> = Facility (site) drainage area [acres] DMax = Daily maximum concentration limit for TSS [mg/l] Precip = Average annual precipitation for watershed [in/yr] A<sub>HUC-12</sub> = Area of impaired HUC-12 subwatershed [acres]

Table C-2	Estimate of Existing Load – NPDES Permitted Mining Sites
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HUC-12 Subwatershed	Subwatershed Area	NPDES Permit No.	Site Drainage Area	Daily Maximum TSS Limit	Annual Average Load
(06040002)	[acres]		[acres]	[mg/l]	[lb/ac/yr]
0301	27,369	TN0022756	200		1.722
0301	27,369	TN0066508	95		0.822
0401	11,450	TN0071846	169	40	3.478
0507	31,086	TN0061395	125	40	0.950
0601	42,847	TN0003654	80		0.440
0001	42,847	TN0071251	64		0.353

## 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 C-3).

HUC-12 Subwatershed (06040002)	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]	[%]
	TN0022756	Mining	1.722				
	TN0066508	Mining	0.822				
0301	TNG110309	RMCF	0.130				
	TNG110117	RMCF	0.517				
	Subwatershed	0301 Total	3.191	919	0.35	421	0.76
0401	TN0071846	Mining	3.478	334	1.04	421	0.83
0507	TN0061395	Mining	0.950	623	0.15	421	0.23
	TN0003654	Mining	0.440				
	TN0071251	Mining	0.353				
0601	TNG110032	RMCF	0.402				
	TNG110069	RMCF	0.069				
	Subwatershed	0601 Total	1.264	575	0.22	421	0.30

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

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

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# APPENDIX D

Site Specific Analysis of Predicted Zero Load Reduction in Certain Impaired Subwatersheds

#### D1.0 Predicted Zero Load Reduction of Impaired Watersheds

As described in Appendix A, the Watershed Characterization System (WCS) Sediment Tool (v.2.6) was used to determine the existing annual average sediment load for impaired HUC-12 subwatersheds. This GIS-based tool applies the Universal Soil Loss Equation (USLE) to digitized spatial data (land use, roads, soils, elevation, etc.) to calculate erosion from land surfaces and sediment delivery to the stream network.

There are nine HUC-12 subwatersheds in the Upper Duck River watershed that have been assessed as impaired due to siltation, but the Sediment Tool analysis indicates that no sediment load reduction is required (the model-calculated sediment loads for these drainage areas are less than the TMDL target loads). Based on stream monitoring and watershed reconnaissance by Field Office and State Lab personnel, the source of impairment for each of these subwatersheds was determined to be pasture grazing, agricultural sources, or livestock in the stream.

HUC-12 Subwatershed	Impaired Waterbody	Source
060400020308	Hurricane Creek Fall Creek	Pasture Grazing Pasture Grazing
060400020309	Sinking Creek Little Sinking Creek	Pasture Grazing Pasture Grazing
060400020401	North Fork Creek	Agriculture
060400020402	Alexander Creek	Pasture Grazing
060400020404	Weakley Creek	Agriculture
060400020502	Wilson Creek	Pasture Grazing
060400020503	Lick Creek	Livestock in Stream
060400020504	Caney Creek Thick Creek	Livestock in Stream Pasture Grazing
060400020602	East Rock Creek	Pasture Grazing

In these cases, model limitations and/or site-specific factors that are not considered in the analysis may be causes of waterbody impairment. Relevant factors may include:

- The USLE-based model only takes into account erosion from land surfaces that result from precipitation. Sediment loading from streambank erosion is not considered.
- The current MRLC land use data used by the Sediment Tool was produced from satellite imagery from 1992 through 1995 and was created in a 30-meter by 30-meter cell-sized grid. One specific land use type is assigned to each grid cell causing a loss of resolution in the data. The land use has also changed in some areas of the watershed since the

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satellite imagery was developed. The land use shown for this watershed is typically pasture grazing, with some forested areas. In some areas, however, row crops have replaced pasture and forest, resulting in a higher actual sediment load delivered to the stream network than the Sediment Tool analysis would indicate.

- The National Hydrography Database (NHD) stream data coverage used was created at 1:100,000 scale. Many smaller streams and headwater tributaries are not represented in this coverage and, therefore, not considered in the modeling process.
- Other localized factors, such as lack of riparian vegetation, livestock access to streams, and/or karst topography (see Section D2.0), that are not represented in the model may affect sediment loading.

Details of stream assessments and discussion of other relevant factors for each of the nine impaired subwatersheds are presented in Sections D3.0 through D11.0

### D2.0 Karst Topography in the Upper Duck River Watershed

The Upper Duck River Watershed is located in a karst region of Tennessee (ref.: Figure D-1). Karst topography refers to an irregular topography that is characterized by sinkholes, streamless valleys, and streams that disappear into the underground. These are developed by the action of surface and underground water in soluble rocks such as limestone (Stokes et al., 1978).

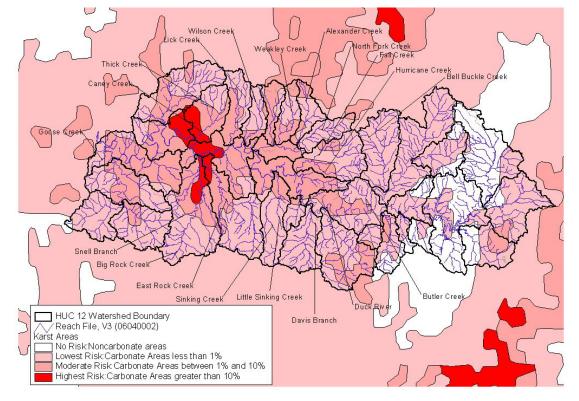


Figure D-1 Karst Risk Regions (based on % Carbonate) in the Upper Duck Watershed

### D3.0 Hurricane Creek and Fall Creek (060400020308) Subwatershed Analysis

Hurricane Creek (TN06040002038\_0300) was placed on the 303(d) list of impaired streams in 2002 as impacted by pathogens, nutrients, siltation and other habitat alterations from pasture grazing. The 2004 303(d) List indicated the stream was impaired due to Escherichia coli and nutrients, loss of biological integrity due to siltation and other habitat alterations, from pasture grazing. The land use in the areas was primarily pasture grazing.

Hurricane Creek was monitored in 2003 at RM 15.9 and at RM 6.6 by the Nashville Environmental Field Office. Notes report in that area, the stream had minimal sediment deposits (ref.: Figures D-2 and D-3) and was classified as fully supporting. However, in the lower reaches, the stream conditions were impacted by low flow and siltation. The stream assessment in 2001 by aquatic biologists from the State Lab at RM 0.2 (ref.: Figures D-4 and D-5) indicated heavy sediment deposits and suboptimal vegetative protection. A biorecon showed 1 EPT, 1 intolerant, and 12 total families. The stream assessment in 1999 by the Nashville Environmental Field Office (ref.: Figures D-6 and D-7) at RM 1.8 noted moderate sediment deposits, high siltation in the stream, some riparian loss and access to the stream by cows (a path was described from the barn to the stream). There were long, deep, still pools with algae noted (ref.: Figure D-8), due to low flow at the time of the visit. An abbreviated biorecon indicated that while there were quite a few total taxa (23), EPT (5) was low.

Fall Creek (TN06040002038\_1000) was placed on the 303(d) list of impaired streams in 2002 as impacted by pathogens, nutrients, siltation and habitat alterations, from pasture grazing. The *2004 303(d) List* indicated the stream was impaired due to Escherichia coli and nutrients, loss of biological integrity due to siltation and other habitat alterations, from pasture grazing.

Fall Creek was monitored at RM 1.1 in 1999 by the Nashville Environmental Field Office. Notes report very low flow, moderate bank erosion, algae choking the stream, and cows alongside the stream (ref.: Figures D-9 through D-12). Fall Creek was also monitored at RM 6.1 in 2001 by aquatic biologists from the State Lab. They noted moderate sedimentation and siltation, marginal vegetative protection and a greatly decreased riparian zone (ref.: Figures D-13 through D-17). Monitoring conducted the next day at RM 1.2 showed moderate sediment and algae and slight siltation in the stream (ref.: Figures D-18 through D-20).

# D4.0 Sinking Creek (060400020309) including Little Sinking Creek Subwatershed Analysis

Sinking Creek (TN06040002021\_1000 and \_2000) was placed on the 303(d) list of impaired streams in 2002 as impacted by siltation and habitat alterations from pasture grazing. This stream was shown on the 2004 303(d) List as being impaired by loss of biological integrity due to siltation and other habitat alterations from pasture grazing.

Sinking Creek was monitored in 1999 by the Nashville Environmental Field Office. A biorecon at RM 8.6 showed 1 EPT, 1 intolerant, and 12 total families. Notes report the sediment deposits were moderate to excessive in areas (ref.: Figures D-21 and D-22). The banks were tall and eroded with many trees falling into the stream (ref.: Figures D-23 and D-24).

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					ember 19, 2003	
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Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final)

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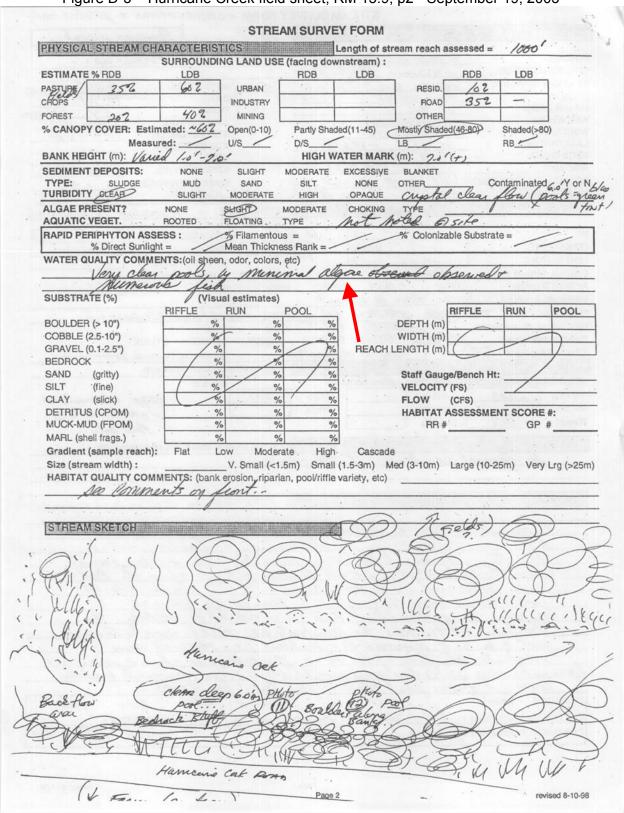


Figure D-3 Hurricane Creek field sheet, RM 15.9, p2 - September 19, 2003

Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-7 of D-70

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Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-8 of D-70 Figure D-5 Hurricane Creek field sheet, RM 0.2, p2 - July 18, 2001

AJISVH	L STREAM CH	ARACTERIST	ICS (cont.)		1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.					
maium	- Streetin Str	RIFFLE	RUN	POOL		Staff Gaug		it:	-	
EPTH (m	1	211	211	10	_	VELOCITY				
VIDTH (m	0	10'	75'			FLOW	(CFS)	-		
		101	10'		]	HABITAT	ASSESSM	ENT SCO	RE #:	
REACH LE	NGTH (m)	10.			- 6	RR #)	0	GP #	10243.9	
Gradient (	sample reach):	FlatLow	(Mode Hi	igh · Casca	ade					
	am width) :	V. Small +1.5				arge (10-25r	n) Very L	.rg (>25m)		
size (strea	ATE (%) Parti	icle Count - 10	0 points (n	un).	Circle one:	RIFFLE	RUN			
	A CONTRACTOR OF A CONTRACTOR OFTA CONT	abbreviation	Record measure	ed particle size.	Use abbrev, below	for smaller siz	05.			
ize (mm)	description silt/clay	cl	1-10						100	
0.062		vfs	11-20					_		
	very fine sand	fs	21-30					-		
.125250		ms	31-40		122 30				13	
0.25-0.50	med sand	CS	41-50					37 311	0.0.1 8.1	
0.5-1.0	coarse sand	(use actual size)	51-60			hard have				
1.0-2.0	very coarse sand	(use actual size)	61-70					-		
2.0-64.0	gravel	(use actual size)	71-80	1			1			
64-256	cobble	(use actual size)	81-90	1				10		
256-4096	boulder		91-100	1			1			
	bedrock	bdrx	91-100							
	woody debris	WOOD	OCKS	-						
		(Visual estin	nates)				Sec. Sec.	1000	ter inter	~
SUBSTRA	412 (70)	RIFFLE	RUN	POOL			RIFFLE	RUN		OL
ROUNDER	2 (> 10")	%		%	% CLAY	(slick)	5	% 5		%
BOULDER		%		%	% SILT			%	%	%
COBBLE		%		%	% DETRITUS	(CPOM)		%	%	%
	(0.1-2.5")	90%		%		D (FPOM)	LUAD OL	%	%	%
	W.	1 70							0/	%
SAND STREAM CLASSIN	(gritty) A USE SUPPO FIED FOR:	RT:	]	BIOLOGI	MARL (she	II frags.) ENT F SAMPLES	k	%	 	
CLASSIE Dom. H20 TIER II/T Trout >>	(gritty) A USE SUPPO FIED FOR: O Supply	RT: Ind. H2O Su Navigation	]	BIOLOGI LIST LO RELATIV DOMINA VERY AE ABUNDA	%         MARL (she           ICAL ASSESSM         G           G NUMBERS OF         F           ABUNDANCE         NT (>=50):           BUND. (30-49):         ANT (10-29):	II frags.) ENT F SAMPLES	k:	%		ABITAT
SAND STREAM CLASSIN Dom. H20 TIER II/T Trout >>	(gritty) A USE SUPPO FIED FOR: O Supply IER III Nat. Repr?	RT: Ind. H2O Su Navigation	]	BIOLOGI LIST LO RELATIV DOMINA VERY AE ABUNDA COMMO	%         MARL (she           ICAL ASSESSM         G           G NUMBERS OF         FE           ABUNDANCE         OF           NT (>=50):         SUND. (30-49):           ANT (10-29):         N           N (3-9):         SUND. (30-9):	II frags.) ENT F SAMPLES	i:	%		
SAND STREAM CLASSII Dom. H20 TIER II/T Trout >> WATER POSTED	(gritty) A USE SUPPO FIED FOR: O Supply IER III Nat. Repr? WITHDRAWL NO	RT: Ind. H2O Suj Navigation OTED Bacteriologica Do Not Consu	I Advis.	BIOLOGI LIST LO RELATIV DOMINA VERY AE ABUNDA	%         MARL (she           ICAL ASSESSM         G           G NUMBERS OF         FE           ABUNDANCE         OF           NT (>=50):         SUND. (30-49):           ANT (10-29):         N           N (3-9):         SUND. (30-9):	II frags.) ENT F SAMPLES	: : : : : : : : : : : : : : : : : : :	%		
SAND STREAM CLASSIN Dom. H20 TIER II/T Trout >> WATER 1 POSTED Fish Tiss SUPPOR FULLY SU COMME	(gritty) A USE SUPPO FIED FOR: O Supply IER III Nat. Repr? WITHDRAWL NO	RT: Ind. H2O Sun Navigation DTED Bacteriologica Do Not Consu Precautionary PARTIALLY	I Advis. me	BIOLOGI LIST LO RELATIV DOMINA VERY AE ABUNDA COMMO RARE (<	%         MARL (she           ICAL ASSESSM         G           G NUMBERS OF         FE           ABUNDANCE         OF           NT (>=50):         SUND. (30-49):           ANT (10-29):         N           N (3-9):         SUND. (30-9):	II frags.) ENT E SAMPLES E OF TAXA	T (NED AT 10 SCO		HU HU HU HU HI HI HI HI HI HI HI HI HI HI HI HI HI	IG (NS) IC A

Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-9 of D-70 sheet RM 1.8 p1 - July 18, 2001

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	AL SUBREGION		JUB					
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Additional L	ist Attached? Ye	s) / No		Samples ret	unieu / 1 Of	O Gump		- martino -
FIELD ANA	LYSIS:			1		DISSOLVED	OXYGEN [	XK
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Ambient W		SUNNY /	CLOUDY	BREEZY	RAIN	SNOW >	86°F(+),	Memiel o
								/
UPSTREAM		G LAND USE		watershed of		30%		
UPSTREA PASTURE CROPS	M SURROUNDING	G LAND USE URBAN INDUSTRY			10%-1			
PASTURE	M SURROUNDING	G LAND USE: URBAN INDUSTRY	: (estimated %	6) <u>PO/</u> RESID OTHER	10%-1	52		
UPSTREAM PASTURE CROPS FOREST IMPACTS	M SURROUNDING	G LAND USE URBAN INDUSTRY MINING , M(oderate),	: (estimated %	6) <u>FO</u> RESID OTHER itude. Blank	10%-1	52	Unknown	(9000)
UPSTREAM PASTURE CROPS FOREST IMPACTS CAUSES	M SURROUNDING	G LAND USE: URBAN INDUSTRY MINING , M(oderate), Flow Alter.	: (estimated % H(igh) magni (1500)	6) <u>PO</u> RESID OTHER itude. Blank SOURCES	/0%-/3 = not obser	52	Unknown Municipal	(2000)
UPSTREAT PASTURE CROPS FOREST IMPACTS CAUSES Pesticides	M SURROUNDING 202 /0-202 rated S(light) (0200)	G LAND USE: URBAN INDUSTRY MINING , M(oderate), Flow Alter. Habitat Alt.	: (estimated %	6) <u>PO/</u> RESID OTHER itude. Blank SOURCES Point Sourc	= not obser	52 ved (0100) (2000)	and the second design of the s	(2000) (5000)
UPSTREAL PASTURE CROPS FOREST IMPACTS CAUSES Pesticides Metals	M SURROUNDING 202 /0-202 rated S(light) (0200) (0500)	G LAND USE: URBAN INDUSTRY MINING , M(oderate), Flow Alter. Habitat Alt. Thermal Alt.	(estimated % H(igh) magni (1500) (1600) (1400)	6) <u>PO/</u> RESID OTHER itude. Blank SOURCES Point Sourc	/0%-/3 = not obser	52 ved (0100) (2000)	Municipal Mining Road /bridge	(2000) (5000) (3100)
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revised 8-10-98

Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-10 of D-70

PHYSICAL STREAM	HARACTERIS	TICS (con	t.)	
Station .	RIFFLE	RUN	POOL	Openeral Course Development
DEPTH (m)	-0	0	1-2'(+)	Substrate Staff Gauge/Bench Ht:
WIDTH (m)	101	0	15-201	8-11-90
REACH LENGTH (m)	6	0	20141	
			12011	grand 52 HABITAT ASSESSMENT SCORE #: 94
Gradient (sample reach)	Flat Low	Mode. H	ligh Cascad	GF #
Size (stream width) : BIOLOGICAL ASSESSME	V. Small (<1.	5m) Small	(1.5-3m) Me	d (3-10m) Large (10-25m) Very Lrg (>25m)
LIST LOG NUMBERS OF	ENT SAMPLES			very Lrg (>25m)
RELATIVE ABUNDANCE	OF TAYA		None	
DOMINANT (>=50):			a de	НАВІЛ
VERY ABUND.(30-49):			se atta	the
ABUNDANT (10-29):		-		
COMMON (3-9):				
DADE (2)				and send and star in the start and
RARE (<3):	-			and a party second as showing
				present man and an and a second se
TREAM USE SUPPOR	T.			March 1 and 1 and 1 and 1
Dom. H2O Supply		PECIFICAL	LY CLASSIFIE	ED FOR: (circle)
VATER WITHDRAWL NOT	Ing. m20 Suppl	ly	Navigation	TIER II/TIER III Trout >> Nat. Repr?
S STREAM POSTED? (circ		Contra March	sales in the	Hat Keply
Contraction of the fight		Fish Tissue A	Advis.: D	Do Not Consume Precautionary
ASED ON OBSERVATION	B	acteriological A	Advis.	
ASED ON ORSERVATION	S AND DATA, S	STREAM IS:(	circle)	
	CURRARTING		,,	
OMMENTS photos	SUPPORTING	BUT THREATS	CALCED COLO	PARTIALLY SUPPORTING (PS) NONSUPPORTING (NS)
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OMMENTS: photos War	SUPPORTING	BUT THREATS	CALCED COLO	PARTIALLY SUPPORTING (PS) NONSUPPORTING (NS) ( Are path from Barn tock + 30 4/5 # 29 ( Les water ling deep atthe pola) = sulable Hutrillik - de mater alle in the
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Figure D-7 Hurricane Creek field sheet, RM 1.8, p2 - July 18, 2001

Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-11 of D-70 Figure D-8 Photo of Hurricane Creek upstream of sample site, RM 0.2 - July 18, 2001



Hurricane Creek (HURRI000.2MY) upstream view. Site located 100 yds upstream of old Hwy 50. PAA/CAP, 07/18/01.

Sinking Creek was monitored at RM 1.2 and 8.9 by aquatic biologists from the State Lab on as a site of the probabilistic monitoring study. The stream at RM 1.2 was found have very low flow or dry on July 24, 2000 and October 17, 2000 (ref.: Figures D-25 through D-27). It contained flow on January 12, 2000, April 13, 2000, and again on May 8, 2001. These three sampling events noted slight or no siltation at this location. Land use upstream was mostly pasture.

The stream at RM 8.9 was found to be stagnant with little or no flow on July 26, 2000 and October 17, 2000. It contained flow on January 13, 2000, April 18, 2000, and again on May 9, 2001. These three sampling events noted moderate siltation at this location. Land use upstream was mostly pasture.

Little Sinking Creek (TN06040002021\_0100) was placed on the 303(d) list of impaired streams in 2002 as impacted by siltation and habitat alterations from pasture grazing. Little Sinking Creek is a tributary to Sinking Creek. Sinking Creek was visited in 1999 by the Nashville Environmental Field Office. As the staff was driving up in the watershed to determine pollution sources and land use changes for Sinking Creek, they stopped at RM 3.1 on Little Sinking Creek. They noted that pasture grazing was dominant in the watershed and this site had little to no riparian area (ref.: Figure D-28).

Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002)

Opper Duck		7/24/06 - Final) e D-12 of D-70
Fall Creek field sheet, RM 1.1, p	1 - August 18, 1999	
STREAM SURVEY FORM	FALL OOUT. BE	B FALL CEX (Full)
TION STORET#		(and us ( and )

Figure D-9

è.

	M SURVEY IN				STORE	T#		Fall G
STREA			CReek			1251 3		
	M LOCATION:	90	1 Unionvil	le PO (US	~ 200')			uni-tru
	Y CODE:(FIPS)	003 BEDRO	RO (STATE COD	E) TN 02		ASSESS	ORS:	AM Goodh
MAJOR		loon	Duck R			DATE:		Upd 08/18/99
WBID#/			64000203	8		TIME:		3:30 - 6-000
WBID N			1 CRK	ALL REPORT	and the second	STREAM	MILE:	RM 1.21 K
	NG DEG:	35°3	3'08"/86°32	404 (grio)	)		ORDER:	~ yth
LAT/LO	NG DEC:			1				
USGS C	UAD:	71S	E Unionial	6.TN	720 L	3020: 4	TILE # 13 GS (35° 33 35 98/80 (35° 33'	03 0.0 (40
Drains t	:		ER RM 2		-	ELEVATI	ON (ft):	~ 680
ECOLO	GICAL SUBREGI		(INB)		and a second	FIELD#		1
OBJECT	000000000000000000000000000000000000000		5		-	TILLD#		Fall Cet 17
	ES COLLECTE	-	5					
			165		METERS	USED:	Hy.	de lab minit.
	ALS Y or N	-	? Maeroinvert		Fish	Algae	Other.	
Additiona	al List Attached?	Yes / No		Samples re	turned ?	or N Sam	pling Method	Full Sitercon
FIELD A	NALYSIS:							1 and Drokecen
pH		7.64 1	2.63 SI			DISCOUNT	D ONOCELL	00.10
CONDUC	TIVITY			-			DOXYGEN	7.91 7.60 F
			216.1 UMHO	-		TIME		5:15pm/5:20
TEMPERA			r / /			OTHERS	Batt	61.521 61.5
Previous	48 hours Precip:	UNKNOWN	NONB /	LITTLE	MODERAT	E HEAVY	FLOODING	a martin the start
Ambient	Weather:	SUNNY	CLOUDY	BREEZY	RAIN	SNOW >	Quer A	
		-					177 600	nny, pleasant
WATER	SHED CHARAC	TERISTICS	App % of	watershed of	veerued.	2000		
					Jaci veu.	202		
ASTURE	AM SURROUNDI	NG LAND USE	:: (estimated 9	%)				
PASTURE	70%	URBAN	B. Dura	RESID	15-20%	2		
CROPS		INDUSTRY	3	OTHER				
FOREST	10-15%	MINING			S135			
MPACTS			, H(igh) magni	itude Blank	= not obee	nind	1	
CAUSES	inter equipti	Flow Alter.	(1500)	SOURCES	- not obse	aveu	Linknown	(0000)
Pesticides	(0200)	Habitat Alt.	(1600) m/4	Point Source	Induct	(0100)	Unknown	(9000)
Metals	(0500)	Thermal Alt.	(1400)		a. Indust	(0100)	Municipal	(2000)
Ammonia	the second se	Pathogens	(1700)	Logging	I and David	(2000)	Mining	(5000)
Chlorine	(0700)	Oil & grease		Construction	Land Deve		Road /bridge	
Nutrients	(0900)	The second se	and the second se	U/S Dam		(8800)	Urban Runot	
H	(1000)	Unknown	(0000)	Riparian loss		(7600) 7m/4	Contract of the local division of the local	ilization (7700)
		Siltation	(1100) 5/m	Agriculture:		(1000)		edlot (1600)
Other:	nrichment / L <del>ow E</del>	(Agae)	(1200) #	And the second sec	azing-riparia	an (1410) m/H	Dredging	(7200)
		. /		Other:				
	AL STREAM CH	ARACTERIS	TICS	LENGTH OF	STREAM	AREA ASSESS	BED (m):	1000 M
MYSIC/	UDINIC LAND UC	E (facing dow	nstream) :		100			And the second se
	VDING LAND US							
URROU				RDB	IDB		PDP	100
URROU	E % RDB	LDB	1	RDB	LDB	-	RDB	LDB
STIMAT ASTURE			URBAN	RDB	LDB	RESID.	RDB 5%	LDB 5%
STIMAT ASTURE	E % RDB	LDB 862	URBAN	RDB	LDB	RESID.		
SURROUI STIMAT ASTURE ROPS	E % RDB	LDB	-	RDB	LDB			
SURROUI STIMAT ASTURE ROPS OREST	E % RDB 80 - 90%	LDB 862 152	INDUSTRY MINING			OTHER	5%	5%
SURROUI ESTIMAT ASTURE ROPS OREST CANOP	80 - 90% /5 - 5% Y COVER:	LDB \$62 /52 482	INDUSTRY MINING Open(0-10)	Partly Shade	d(11-45)	OTHER Mostly Shi	5%	5%
SURROUI ESTIMAT AASTURE ROPS OREST CANOP	E % RDB 80 - 90% /5 - 5% Y COVER: GHT (m):	LDB \$62 /52 <u>482</u> <u>482</u>	INDUSTRY MINING Open(0-10) Camefall 1/2	Partly Shade	d(11-45) ATER MAR	Mostly Sha	5%	5%
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Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-13 of D-70 Figure D-10 Fall Creek field sheet, RM 1.1, p2 - August 18, 1999

PHYSICAL STREAM C	HARACTERIS	STICS (cont	1	
	RIFFLE	RUN	POOL	Staff Gauge/Bench Ht:
DEPTH (m)	n	0	1-2'	VELOCITY (CFS)
WIDTH (m)	0	0	10-20'	FLOW (CFS)
REACH LENGTH (m)	0	6	30(4)	HABITAT ASSESSMENT SCORE #: /0.3
	_ 1_			<u>RR #</u> <u>GP #</u>
Gradient (sample reach):			High Cascade	
Size (stream width) : BIOLOGICAL ASSESSME		.5m) Small	(1.5-3m) (Med (3-1	0m> Large (10-25m) Very Lrg (>25m)
LIST LOG NUMBERS OF			(# 1195 -	>
RELATIVE ABUNDANCE	OF TAXA		1 11	HABITA
OOMINANT (>=50):		man	No allacke	
ERY ABUND.(30-49):			e l	/
ABUNDANT (10-29): COMMON (3-9):	-			
CARE (<3):				
		1000		
TREAM USE SUPPOR	T:	SPECIFICA	LLY CLASSIFIED FO	OR: (circle)
om. H2O Supply	Ind. H2O Sup	-		ER II/TIER III Trout >> Nat. Repr?
ATER WITHDRAWL NO	and the second second second second	111	neous koth	A Long and the state of the second second
S STREAM POSTED? (cir	rcle)	Fish Tissue	e Advis.: Do No	t Consume Precautionary
		Bacteriologica	al Advis.	
	NC AND DATA	. STREAM IS	S:(circle)	
SASED ON OBSERVATIO	SUPPORTIN	NG, BUT THREA	TENED (TH)	TIALLY SUPPORTING (PS) NONSUPPORTING (NS)
	SUPPORTIN	NG, BUT THREA	TENED (TH)	TIALLY SUPPORTING (PS) NONSUPPORTING (NS)
ULLY SUPPORTING (FS)	SUPPORTIN	NG, BUT THREA	TENED (TH)	as mate Chigital # 33th # 39th # 31 Algae ma
COMMENTS: photos 2000	SUPPORTIN	NG, BUT THREA Photo # Morth #	Y 4/2 #5 2/2 #6 alg	TIALLY SUPPORTING (PS) NONSUPPORTING (NS) We make digital #334 #3204 #31 digae ma hu anea - pour low flow () this our hodes + 1246 Bouldan no. 2 002
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THE SUPPORTING (FS) COMMENTS: photos COX THE CARE is the Time + cateronic EPT (Total 1)	SUPPORTIN for N Roll # C Winilow to Reputed ~ The 303d	NG. BUT THREA Photo # Morth - B Barch	Y 4/2 #5 2/2 #6 alg	ne mak Chiqitel #334 #300 #31 Algae ma hu area - your low flow of this grass holes + 12 Able Boulden rece pice (Distatas of this time, - this stream
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### Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-14 of D-70

### Figure D-11 Fall Creek Habitat Assessment, RM 1.1, front page - August 18, 1999

STREAM NAME FAll Oct	LOCATION Of Ald Unionialle Pd
STATION # RIVERMILE	STREAM CLASS
LATLONG	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS	makes property of the state of the
FORM COMPLETED BY	DATE 08/18/79 TIME 5:25 AM THE WS

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

Habitat		Conditio	n Category				
Parameter	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 obvious; substrate unstable or lacking.			
SCORE //	20 19 18 17 16	15 14 13 12 (1)	10 9 8 7 6	5 4 3 2 1 0			
2. Embeddedness SCORE /3 3. Velocity/Depth Regime SCORE 6 4. Sediment	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 /3	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). (Sow 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 6	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.	deposition in pools.	bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions,	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 13	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.	available channel; or <25% of channel	available channel, and/or inffle substrates are	Very little water in channel and mostly present as standing pools.			
SCORE 7	20 19 18 17 16	15 14 13 12 11	10 9 8 77 6	5 4 3 2 1 0			

total 103 - Jai Habitat, but low flow - no ruffles - bedrock bottom stream + chokenj algae y Cours along sile creek + ruparian lose ....

# Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-15 of D-70 gust 18, 1999

Figure D-12 Fa	all Creek Habitat Assessment,	RM 1.1, back page -	· August 18, 199
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	Habitat				T		Condit	I	-			1	-	-	-	
	Parameter	0	ptima	al	-	Subop	timal	-	Mar	ginal			Po	or		
	6. Channel Alteration	. Channel dredging absent of		7.4		ent or present, usually in areas of bridge abutments;			or sl pres and reac	nnelizati nsive; en horing st ent on b 40 to 80 h channe upted.	mbankn ructure oth ban % of st	nents s ks; ream	80% of channe	f the st lized a ed. In great	nent; rearr and strea y alte	m ered (
	SCORE /9	20 (19	18	17 16	5 15 1	4 13	12 11	10	9	8 7	6	5 4	3	2	1	
	7. Frequency of Riffles (or bends)	Occurrenc relatively i of distance riffles divi of the strea (generally variety of I In streams are continu placement other large obstruction	freque betwo ded by am <7: 5 to 7 habitat where ious, of bou , natur	nt; ratio een y width 1 ); t is key. riffles ulders or ral	infrequ betwee by the stream 15.	ent; dis n riffle width o	s divided	bend prov dista divid	asional r ; bottom ide some nce betw led by th tream is	habita veen rif	t; fles of	Genera or shall habitat; riffles o width o ratio of	low rif distar divided of the s	fles; ice b by t	poor etwe	
l	SCORE 6	20 19	18	17 16	15 1	4 13	12 11	10	9 8	7	(6	5 4	3	2	1 (	
	8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stab of erosion of failure abse minimal; li for future p <5% of ban	or ban ent or ttle po problem nk affe	k otential ms.	erosion	mostly -30% o	all areas o healed f bank in	areas	erately u of bank of erosion poten s.	in reach	has	Unstabl areas; "r frequent sections obvious 60-1009 erosiona	t along and b bank : 6 of ba	strai ends sloug nk h	ight thing	
1	SCORE 6 (LB)	Left Bank	10	9	8	7	0	5	4	3		2	1		0	
L	SCORE (RB)	Right Bank	10	9	8	7	0	5	4	3		2	1		0	
	9. Vegetative Protection (score each bank)	More than 9 streambank immediate r covered by vegetation, trees, under or nonwood macrophyte disruption ti grazing or n minimal or almost all pi to grow natu	surfac riparia native includ story s ly s; vege hrough nowini not even lants a urally.	etative dent; llowed	of plants represen evident l full plan potential extent; n	ank sur by nation, but is not ted; dis but not t growt to any nore that the poten neight	ve one class well- sruption affecting h great	stream cover disrup patche closel vegeta than o potent height	% of the nbank su ed by ve tion obves of bar y croppe tion cor ne-half remaini	e soil of mmon; l of the stubble	ess	Less tha streamba covered disruptio vegetatio removed 5 centim average s	ank sur by veg on of st on is ve on has to eters o	rfaces getati tream ery h been or less	s on; ibanl igh; s in	
	SCORE S(LB)	Left Bank	10	9	8	7	6	5	) 4	3	4	2	1		0	
S	SCORE 3 (RB)	Right Bank	10	9	8	7	6	5	4	3	>	2	1	-	0	
VV b	0. Riparian Vegetative Zone Width (score each ank riparian zone)	Width of rip >18 meters; activities (i.e lots, roadbed cuts, lawns, have not imp	humar e., park is, clea or crop pacted	n king ar- ps)	Width of 12-18 me activities zone only	have in	uman mpacted	6-12 n activit	of ripari neters; hi ies have great de	uman impacte	ed	Width of <6 meters riparian v to human	s: little /egetat	ion d	0	
	CORE 5 (LB)	Left Bank	10	9	8	7	6	5	> 4	3		2	1	1	0	
10	CORE 3 (RB)	Right Bank	10	9	8	7	6	5	4	3		2	1.1.1		0	

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

103 Total Score

63

Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-16 of D-70

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MIGOR MANALAMAZOTA

Fall Creek field sheet, RM 6.1, p1 - September 11, 2001

	STRE	AM SURV	EY FORM				
STABLISHED STATION	FILL IN SHADED BLANKS OF F	HEADER	NEW STATIC	ON	FILL IN ALL HEADER	BLANKS FOR	CLEWSAN
lank data fields indicate r	no change from previous sa		2001	NDN	A NEW STATION		
TREAM SURVEY INFO	RMATION		STORET#	FALI	MailB.	E	
TREAM SURVEY INFO	EAL CREEK	15.79410 <b>168</b> 12	1980 CONSIGNATION OF				
TREAM LOCATION:	tan cruch	Pinkat	on /tit	hago R	र्र		
UNTY CODE:(FIPS)	COS (STATE CODE)			ASSESSO		KAS/STZ	\$
AJOR BASIN	LIDDEC DUCK	obso	High Cas	DATE:		9/10/01	<u></u> 0
BID#/HUC:	-4/1 010040002	HOLEY ROM	(mE.e. th line	TIME:		0'820	
BID NAME:				STREAM I		_ (0.1	
AT/LONG DEG:			_	STREAM O		A. 1 1. A. 1 3 5 5.	110-01-0
AT/LONG DEC:	N35.58447, W86,	48686	- I light the second second	REACH FI	LE #	00010020	(many ease
SGS QUAD:	TRSW		-	3Q20:		824	
rains to:	rm	rm	-1 0	ELEVATIO	Ν (π):	001	1000 JAP 1 1
COLOGICAL SUBREGION	N: 715		-	FIELD#			
BJECTIVES: (),00		tershe	zd				
AMPLES COLLECTED	The second se		METE	RS USED:	ScoutA		
HEMICALS YON L	ife Assessed? Macroinvertet	orates	Fish	Algae	Other:	SQKICK +BU	neari
dditional List Attached		Samples re	eturned ? Or	N Sam	pling Method:	Grab	
and the second	55.7 140	e .	- All	e Pier Const	00%	57.2 /56	.4
IELD ANALYSIS:	17112 /2111 au	1		DISSOLVE		5.0915.0	
H	7,43,17.44 SU	-			DUNIGEN	821/80	
ONDUCTIVITY	369/371 UMHOS	1		TIME	4 7	1	
EMPERATURE	2110/21.07 C			OTHERS	Batt.	11.50/11.	21
revious 48 hours Precip:	UNKNOWN NONE	LITTLE)	MODERATE	HEAVY	FLOODING		
mbient Weather:	SUNNY CLOUDY	BREEZY	RAIN	SNOW A	170F		
			21 18 2	.08. (M	02.1	(161-8.5.	816800
ASTURE 30	URBAN	RESID		-			
ROPS com TO	INDUSTRY	OTHER	Shacip				
OPEST 10	MINING	BaMOND	01781		and a share the second		
MPACTS rated S(light	t), M(oderate), H(igh) magni	itude. Blan	k = not obser	ved		(2222)	
AUSES	Flow Alter. (1500)	SOURCES	Suncon		Unknown	(9000)	
Pesticides (0200)	Habitat Alt. (1600)	Point Sour		(0100)	Municipal	(2000)	20 10 101
Aetals (0500)	Thermal Alt. (1400)	Logging		(2000)	Mining	(5000) e (3100)	1037 ASA
Ammonia (0600)	Pathogens (1700)		on;Land Devel		Road /bridge		71211283V
Chlorine (0700)	Oil & grease (1900)	U/S Dam		(8800)	Urban Runo	pilization (7700)	
Nutrients (0900)	Unknown (0000)	Riparian Ic		(7600)	Bank destad	eedlot (1600)	00000
oH (1000)	Siltation (1100) M	Agriculture		(1000) M	Dredging	(7200)	0.000 106/13
Organic Enrichment / Low [	D.O. (1200)		grazing-riparia	1 (1410)	Dredging	(1200)	
Other:		Other:			DEED Imili		
PHYSICAL STREAM CH	ARACTERISTICS	LENGTH	OF STREAM A	AREA ASSE	sacu (m).		
SURROUNDING LAND US	E (facing downstream) :					www.	1/conop U 4
ESTIMATE % RDB	LDB	RDB	LDB	49 \ \$1	RDB	LDB	1110
PASTURE	URBAN			RESI	D		
00	Stablers 70 INDUSTRY	5 P	march	OTHE	R	Rel CO	D 48
	20 MINING	-	200	-			110
FOREST 20		Bartly Sh	aded(11-45)	Mostiv S	shaded(46-80)	) Shaded(>80)	40
% CANOPY COVER:	54% Open(0-10)		WATER MAR		Zm	6 G	RG
BANK HEIGHT (m):	0.3m						
SEDIMENT DEPOSITS:	NONE SLIGHT	MODERAT				aminated Y	or N
TYPE: SLUDGE	MUD SAND	SILT	> NONE	OTHER			
TURBIDITY CLEAR	SLIGHT MODERATE	HIGH	OPAQUE	HODEDAT	CHOKING		
EXCESSIVE ALGAE PRES			SLIGHT	MODERAT	CHOKING		
QUATIC VEGET.	ROOTED FLOATING	TYPE	Alone				
ADDITIONAL COMMENTS	S:(oil sheen, otor, colors)	A					
	and the same	11					
				•17			
	in the second						
			101 P			revised 8-	10-98
		Page					

Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-17 of D-70

Figure D-14	Fall Creek field sheet, RM 6.1, p2 - September 11, 2001	
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PHYSICA	L STREAM CI	HARACTERIS	TICS (cont.)						
		RIFFLE	RUN	POOL	Salar	Staff Gauge/	Bench Ht:	OTATE G.	March and
DEPTH (m	1)	3"	0.5Pt	13m	·	ELOCITY (C	FS)	1001 8006	
WIDTH (m	the second se	Lem	iom	4m	-		FS) -	WEL 7 27 V 711	
	NGTH (m)	Sm	LOOM	8m	-	ABITAT AS		SCORF #	
REACH LE		<u>Sm</u>	1000	1 011		R#100		GP #	
	sample reach):		-	igh Casca	- Contraction of the local division of the l		Q.L.		
	am width) :	V. Small (<1.5				e (10-25m)	Very Lrg (>	25m)	0.111.0
	ATE (%) Part				Circle one: Use abbrev, below for	RIFFLE	RUN	1	
size (mm) <0.062	descriptio.	abbreviation cl	1-10	d particle size.	Use abbrev, below for	r smaller sizes.	2200 T	1:03	
	silt/clay very fine sand	vfs	11-20				and the second		
0.125250	fine sand	fs	21-30						
		1	31-40	+		1	1000	SUP2R	
0.25-0.50	med sand	ms	41-50		1000121				
0.5-1.0	coarse sand	CS	and the second se		1.3.2 5.6.1	N NAME	-		
1.0-2.0	very coarse sand	(use actual size)	51-60				37	1030-001	
2.0-64.0	gravel	(use actual size)	61-70		Contraction of the second				
64-256	cobble	(use actual size)	71-80	S. Dentruces	-			0000	
256-4096	boulder	(use actual size)	81-90						
NOT CO.	bedrock	bdrx	91-100			The local of		18183	
	woody debris	wood			0.6	72575	24		
FILL OUT	EITHER SUBST	RATE INFO BL	OCKS		н.,				
SUBSTRA		(Visual estim			· 12	(DIA)	1218	10	UTANAR
	0	RIFFLE	RUN	POOL	auton a	R			POOL
BOULDER	(> 10")	10 %	5 %	5 %	CLAY (S	slick)	%	. %	%
COBBLE (2		30 %	30 %		advertised of the second starts		5 %	15) %	20%
GRAVEL (	the second se	40 %	30 %		-	POM)	%	%	%
BEDROCK		%	%		and the second state of the state of the		%	%	%
				TI	MUCK-MUD (F	POM)	701		
SAND	(gritty)	10 %	20 %	BIOLOGIC	MARL (shell fr	ags.)	%	%	%
SAND STREAM CLASSIFI Dom. H2O TIER II/TIE	(gritty) USE SUPPOR ED FOR: Supply R III	10 %	20 %	BIOLOGIC LIST LOG RELATIVE DOMINANT	MARL (shell from AL ASSESSMEN NUMBERS OF S/ ABUNDANCE OF (>=50):	ags.) T AMPLES: F TAXA	% K BOIO	% 9019	%
SAND STREAM CLASSIFI Dom. H2O TIER II/TIE Trout >>	(gritty) USE SUPPOR ED FOR: Supply R III Nat. Repr?	Ind. H2O Supp Navigation	20 %	BIOLOGIC. LIST LOG RELATIVE DOMINANT VERY ABU	MARL (shell fri AL ASSESSMEN NUMBERS OF S/ ABUNDANCE OF (>=50): ND.(30-49):	ags.) T AMPLES: F TAXA	%	% 9019	
SAND STREAM CLASSIFI Dom. H2O TIER II/TIE Trout >>	(gritty) USE SUPPOR ED FOR: Supply R III	Ind. H2O Supp Navigation	20 %	BIOLOGIC LIST LOG RELATIVE DOMINANT VERY ABU ABUNDAN	MARL (shell fri AL ASSESSMEN NUMBERS OF S/ ABUNDANCE OF (>=50): ND.(30-49): F (10-29):	ags.) T AMPLES: F TAXA	% K BOIO	% 9019	
SAND STREAM CLASSIFI Dom. H2O TIER II/TIE Trout >>	(gritty) USE SUPPOR ED FOR: Supply R III Nat. Repr?	Ind. H2O Supp Navigation	20 %	BIOLOGIC LIST LOG RELATIVE DOMINANT VERY ABU ABUNDAN COMMON	MARL (shell fri AL ASSESSMEN NUMBERS OF S/ ABUNDANCE OF (>=50): ND.(30-49): T (10-29): 3-9):	ags.) T AMPLES: F TAXA	% K BOIO	% 9019	
SAND STREAM CLASSIFI Dom. H2O TIER II/TIE Trout >>	(gritty) USE SUPPOR ED FOR: Supply R III Nat. Repr? VITHDRAWL NO	Ind. H2O Supp Navigation	20 %	BIOLOGIC LIST LOG RELATIVE DOMINANT VERY ABU ABUNDAN	MARL (shell fri AL ASSESSMEN NUMBERS OF S/ ABUNDANCE OF (>=50): ND.(30-49): T (10-29): 3-9):	ags.) T AMPLES: F TAXA	% K BOIO	% 9019	
SAND STREAM CLASSIFI Dom. H2O TIER II/TIE Trout >> WATER W	(gritty) USE SUPPOR ED FOR: Supply R III Nat. Repr? ITHDRAWL NO	Ind. H2O Supp Navigation TED Bacteriological A Do Not Consum	20 % ply Advis.	BIOLOGIC LIST LOG RELATIVE DOMINANT VERY ABU ABUNDAN COMMON	MARL (shell fri AL ASSESSMEN NUMBERS OF S/ ABUNDANCE OF (>=50): ND.(30-49): T (10-29): 3-9):	ags.) T AMPLES: F TAXA	% K BOIO	% 9019	
SAND STREAM CLASSIFI Dom. H2O TIER II/TIE Trout >> WATER W POSTED F Fish Tissue	(gritty) USE SUPPOR ED FOR: Supply R III Nat. Repr? ITHDRAWL NO FOR: a Advis.:	Ind. H2O Supp Navigation TED Bacteriological A	20 % ply Advis.	BIOLOGIC LIST LOG RELATIVE DOMINANT VERY ABU ABUNDAN COMMON	MARL (shell fri AL ASSESSMEN NUMBERS OF S/ ABUNDANCE OF (>=50): ND.(30-49): T (10-29): 3-9):	ags.) T AMPLES: F TAXA	% K BOIO	% 9019	
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SAND STREAM CLASSIFI Dom. H2O TIER II/TIE Trout >> WATER W POSTED F Fish Tissue SUPPORT	(gritty) USE SUPPOR ED FOR: Supply R III Nat. Repr? ITHDRAWL NO FOR: a Advis.:	Ind. H2O Supp Navigation TED Bacteriological A Do Not Consum Precautionary	20 % ply Advis.	BIOLOGIC. LIST LOG RELATIVE DOMINANT VERY ABU ABUNDAN COMMON RARE (<3):	MARL (shell fri AL ASSESSMEN NUMBERS OF S/ ABUNDANCE OF (>=50): ND.(30-49): T (10-29): 3-9):	ags.) T AMPLES: FTAXA SQKIC Biotec	% ( <u>K BOIO</u> (on BOIO)	% 9019	HABITAT
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### Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-18 of D-70

Figure D-15 Habitat Assessment, RM 6.1, front page - September 11, 2001

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

STREAM NAME Fall C	LOCATION of PINKston Rel
STATION # RIVERMILE_(11)	STREAM CLASS
LAT LONG	RIVER BASIN
STORET # FALLOOD. 1BE	AGENCY Labs Br
INVESTIGATORS KUS/SUB	Coursell and a local sector and the course of the course o
FORM COMPLETED BY	DATE 9/10/01 TIME OBST AM PM REASON FOR SURVEY Upper Duck Weterles

Habitat		Conditi	on Category	
Parameter	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, undernut 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 habit obvious: substrate unstable or lacking:
SCORE A	20 19 18 17 16	5 15 14 13 2 11	10 9 8 7 6	5 4 3 2 1
2. Embeddedness	Gravel, cobble, and boulder particles are 0- 25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25- 50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50- 75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
score 9	20 19 18 17 16	15 14 13 12 11	10 (9) 8 7 6	5 4 3 2 1
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow- deep, <u>slow-shallow</u> , fast- deep, <u>fast-shallow</u> ). (Sow 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 veloc depth regime (usually slow-deep).
SCORE 10	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or line sediment: 5-30% (20-50% for low- gradient) of the bottom affected; slight deposition in pools.	obstructions.	Heavy deposits of fine material, increased bar development; more tha 50% (80% for low- gradient) of the bottom changing frequently; pools almost absent du to substantial sediment deposition.
SCORE 7	20 19 18 17 16	15 14 13 12 11	10 (9) 8 7 6	5 4 3 2 1 (
Channel Flow	exposed.	-25% of channel	riffle substrates are	Very little water in channel and mostly present as standing pools.
CORE 7	20 19 18 17 16	15 14 13 12 11	10 (9) 8 7 6	5 4 3 2 1 0

## Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-19 of D-70

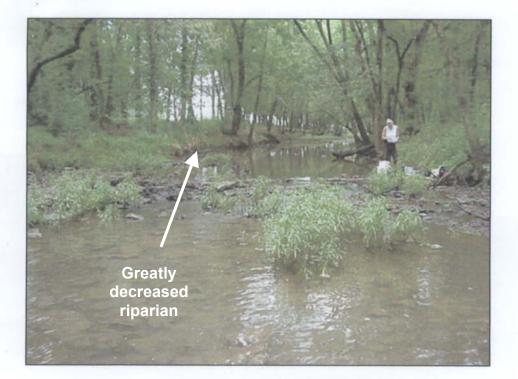
Figure D-16 Fall Creek Habitat Assessment, RM 6.1, back page - September 11, 2001

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

						Conditio	on Categ	ory	Stand Las			
	Habitat Parameter	Optimal		S	ubopti	mal		Margi	nal	1	Poo	r
	6. Channel Alteration	Channelization or dredging absent or minimal: stream with normal pattern.		Some cl present, of bridg evidenc channel dredgin past 20 present, channel oresent.	usually e abuth e of pas ization, g, (grea yr) may but rec ization	in areas nents: i.e., ter than be ent	or sho preset	ring stru ring stru it on bot to 30% channeli	h banks: of stream	gabion 80% o channe disrupt	lized an	ant; over ann read id ream altered
	SCORE 20	20/ 19 18 17	16	15 14	1 13	12 11	10	98	7 6	5 4	3 3	1 1
	7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ration of distance between nffles divided by widt of the stream <7:1 (generally 5 to 7); variety of habitat is ke in streams where niffle are continuous, placement of boulders other large, natural	h y. s or	Occurre infreque between by the w stream is 15.	nt: dist riffles ridth of	divided	bend: provid distant divide	e some : te berwe d by the	ontours	or shall habitat	ivided	at water es: poor e berwe by the sam is :
	SCORE O	obstruction is importan	16	15 14	13	12 11	10	9 3	7 6	5 4	3 2	1 (
	(score each bank) Note: determine left or right side by facing downstream. SCORS 7 (L3)	failure absent or minimal: little potentia for future problems. <5% of bank affected. Left Bank 10	9	erosion over. 5- reach ha erosion.	30% 31	bank :n			rt during	sections	s bank si 15 of ban	nds: oughing
	SCORE (LB)	Cutt Blant 10	9	8	7	6	1 5	4	3	1 2	1	0
	9. Vegetative Protection (score each bank)	More than 90% of the sreambank surfaces an immediate ripanan zon covered by narve vegetanon, including trees, understory shruo: or nonwoody macrophytes; vegetativ disruption through grazing or mowng minimal or not evident almost all plans allows to grow naturally.	s.	70-90% streamba covered vegetatic of plants represent evident 5 full plant potential extent if	ink surfi by native on, but of is not v ted; disr but not a t growth to any nore that e poten teight	ve one class veil- uption uffecting t great	streami covered disrupt patches closely vegetat than on potenti	s of the bank surf by vegion obvia of bare cropped ion corra- e-haif or al blant i errainin	mon: less tite tubole	Less the streamb covered disruptive vegetati removed 5 centra average	ank surf by vege on of se on is ver on has b i to neters or	ices earroan ry high: een less in
	SCORE 7 (LB)	Left Bank 10 9	1	8	(7)	6	5	4	3	2	1	0
		Right Bank 10 9	1	3	7	6	5	4	3	2	1	0
	10. Riparian Vegetative Zone Width (score each bank npanan zone)	Width of riparian zone >13 meters: human activities (i.e., parking lots, roadbeds, clear- cuts, 'awns, or crops) have not impacted zone		Width of 12-18 me activities zone only	have in	man	6-12 m	of noana sters: hu is have i great dea	man mpacted	Width o <6 mete npanan to huma	rs: little vegenne	or no on due tes.
	SCORE Z (LB)	Left Bank 10 9	7	8	7	6	5	4	3	6	) 1	0
- 1	SCORE (RS)	Right Bank 10	5)	3	7	6	5	4	3	2	K	0

Total Score 10

Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-20 of D-70 Figure D-17 Photo of Fall Creek, RM 6.1 - September 11, 2001



## Fall Creek (FALL006.1BE) off Pinkston Rd. View upstream of the collection area. Collected 9/10/01 @ 0920, KJS/SJB.

Little Sinking Creek was also monitored at RM 1.0 by aquatic biologists from the State Lab on as a site of the probabilistic monitoring study. The stream at RM 1.2 was found have very low flow or dry on July 26, 2000 and October 17, 2000 (ref.: Figures D-29 and D-30). It contained flow on February 07, 2000, April 18, 2000, and again on May 9, 2001. These sampling events all documented excessive sediment in the stream. Cattle had access to the stream and there was little to no riparian vegetation.

The Sinking Creek subwatershed appears to show both a sediment load from near-stream agricultural activities as well as low benthic macroinvertebrate communities due to low flow. The lack of water is most likely due to a combination of karst topography in the area (ref.: Figure D-1) and extreme drought conditions that occurred during the sampling period. The subwatershed based modeling results for the Sinking Creek watershed suggests that the average annual sediment load should not have caused impairment had the localized problem not existed. This kind of localized problem that occurs at a specific area could not be detected

Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Ρ

Page D-21 of D-70	Page	D-21	of	D-7	0
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ASTURE AN SURROUND ASTURE AOPS OREST 100 MPACTS rated S(lig CAUSES Pesticides (0200) Metals (0500) Ammonia (0600)	DING LAND USE URBAN INDUSTRY MINING ght), M(oderate), Flow Alter. Habitat Alt. Thermal Alt. Pathogens	: (estimated %	o) RESID OTHER tude. Blank SOURCES Point Sourc Logging Constructio	<pre>x = not obse</pre>	(0100) (2000) el (3200)	Municipal Mining Road /bridge	(2000)	
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## Figure D-18 Fall Creek field sheet, RM 1.2, p1 - September 11, 2001

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### Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-22 of D-70

Figure D-19 Fall Creek Habitat Assessment, RM 1.2, front page - September 11, 2001

INVEST FORM C	DN # T # FALLO TIGATORS K COMPLETED B Habitat Parameter Epifaunal bstrate/ ailable Cover	DI /STB KTS Optimal Greater than 30% of substrate favorable for epifuunal colonization and fish cover, mix of	STREAM CLASS RIVER BASIN AGENCY Labs A DATE 9/11/01 TIME 9 20 AM	KEASON FOR SU	Anna 13
STORE INVEST FORM ( I. E Sub Ave	Habitat Parameter Epifaunal	DI. DBE DI. STB DI. STB DI. STB DI. SBE DI.	AGENCY Labos & DATE <u>9/11/01</u> TIME <del>19 20</del> AM Condition Suboptimal	REASON FOR SL Upper De	
INVEST FORM C	Habitat Parameter Epifaunal	DI /STB KTS Optimal Greater than 30% of substrate favorable for epifuunal colonization and fish cover, mix of	DATE 9/1/01 TIME 9/20 AM Condition	REASON FOR SL Upper De	
FORM C	COMPLETED B Habitat Parameter Epifaunal bstrate/	Optimal Greater than 30% of substrate favorable for epifaunal colonization and fish cover, mix of	Conditio Suboptimal	an Category	
I. E Sub Ava	Habitat Parameter Epifaunal bstrate/	Optimal Optimal Greater than 30% of substrate favorable for epifuanal colonorazion and fish cover, mix of	Conditio Suboptimal	an Category	
Sut Av:	Parameter Epifaunal bstrate/	Greater than 50% of substrate favorable for epitaunal colonization and fish cover, mix of	Suboptimal		
Sut Av:	Parameter Epifaunal bstrate/	Greater than 50% of substrate favorable for epitaunal colonization and fish cover, mix of	Suboptimal		
Sut Av:	bstrate/	Greater than 50% of substrate favorable for epitaunal colonization and fish cover, mix of			Poor
sco		snags, submerged logs, dercut banks, cobole or other stable habitat and at stage to allow full colonization potential (i.e., logs:snags that are <u>not</u> new fail and <u>not</u> transient).	habitat, well-suited for full colonization potential, adequate habitat for maintenance of populations, presence of additional substrate in the form of new full, but not yet; prepared for colonization (may rate at high end of scule).	10-30% mix of stable habitat, habitat a uitability less than desirable, substrate frequently disturbed or removed L. the Habitat	Less than 10% stable habitat, lack of habitat is obvious, substrate unstable or lacking
G BERNERA	ORE 7	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	ool Substrate	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud. or clay; mud may be dominant; some root mats and submerged vegetation present	All mud or clay or sand bottom: little or no root mat: no submerged vegetation Begriztion is dom. b	Hard-pan clay or bedrock, no root mat or vegetation
sco	ORE	20 19 18 17 16	15 14 13 12 (1)	10 9 8 7 6	5 4 3 2 1 0
3. P	ool Variability	Even mix of large- shallow, large-deep, small-shallow, small- deep pools present	Majority of pools large- deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small- shallow or pools absent.
SCO	DRE 17	20 10 18 (17) 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	ediment osition	Little or no enlargement of islands or point bars and less than 5% <20% for low-gradient streams) of the bottom afterted 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 sedimention old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected, sediment deposits at obstructions, 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.
SCO	DRE 7	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Ci Statu	hannel Flow us	Water reaches base of both lower banks, and minimal amount of channel subsitiate 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 nffle substrates are mostly exposed	
sco	DRE 8	20 19 18 17 16	15 14 13 12 11	10 9 5 7	5 4 3 2 1 0
	50	. ż	1	n	reas Parrot

Rupid Bioassessment Protocols for Use in Streams and Rivers

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Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-23 of D-70 Figure D-20 Photo of Fall Creek Habitat Assessment, RM 1.2 - September 11, 2001



Fall Creek (FALL001.2BE) 100 yards u/s Hwy 41A. View u/s of the sampling area. Collected 9/11/01 @ 1115, KJS/SJB.

by a general purpose USLE based HUC-12 sediment loading model. Based upon our monitoring and watershed reconnaissance Sinking Creek (and especially Little Sinking Creek) needs to have agricultural best management practices, including animal exclusion and establishment of riparian vegetation, installed to correct the sediment sources observed. It appears that the majority of the sediment load is coming from Little Sinking Creek with some loading occurring from bank erosion in Sinking Creek.

### D5.0 North Fork Creek (060400020401) Subwatershed Analysis

North Fork Creek (TN06040002039\_3000) was placed on the *2002 303(d) List* as impacted due to siltation, nutrients, and pathogens from agricultural sources. The listing stream was shown as impaired on the *2004 303(d) List* due to loss of biological integrity due to siltation, nutrients, and Escherichia coli from agricultural sources.

Staff from the Nashville Environmental Field Office visited North Fork Creek at RM 9.4 on August 18, 1999 (ref.: Figures D-31 through D-33). This was a cursory visit to see if the stream had improved since being listed on the 1998 303(d) list. Observations confirmed it was still impaired at this time. It was noted that the flow was very low and the water was stagnant and choked with algae. The stream had poor riparian and cattle were observed in the creek upstream.

Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final)

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Page D-2	4 of D-70

Figure D-21 Sinking Creek field sheet, p1 - December 17, 1999

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WBID NAME:		SINKA	S CRK. 1	et al.		STREAM	MILE:	RM81
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AT/LONG DEC:		35.459/	671 -86,6	116671		REACH F	LE #_	· · · · · · · · · · · · · · · · · · ·
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mbient Weather:	3	KINKAP /	\$1000x	BREEZY	RAIN	SNOW >_S	so of Clou	As us sun / sume
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Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-25 of D-70

Figure D-22 Sinking Creek field sheet, p2 - December 17, 1999

STREAM SURVEY FORM PHYSICAL STREAM CHARACTERISTICS (COIL) DEPTH (m) RIFFLE RUN POOL RATE FUOTR Staff Gauge/Bench Ht: Reading to 2 VELOCITY (CFS) Adde 30 2 FLOW (CFS) Flow 101 FLOW (CFS) Flow 101 FLOW (CFS) Stack 101 FLOW (C 2-10" 5-2 2-3 WIDTH (m) 2-8 3-4 2 -REACH LENGTH (m) 15-200 8' 10' Gradient (sample reach): Flat Cow> Mode. High Cascade V. Small (<1.5m) Small (1.5-3m) (ed (3-10m) Large (10-25m) Very Lrg (>25m) Size (stream width) : NOLDANCAL ASSESSMENT LIST LOG NUMBERS OF SAMPLES RELATIVE ARUNDANCE OF TAXA HABITAT DOMINANT (>=50): 99 VERY ABUND.(30-49): ABUNDANT (10-29): COMMON (3-9): RARE (<3): STREAM USE SUPPORT Dom. H2O Supply Ind. H2O Supply Navigation TIER W/TIER W Trout >> Nat Repr? WATER WITHDRAWL NOTED IS STREAM POSTED? (circle) Fish Treaue Advie Do Not Consume Precautionary Bactenological Advis. BASED ON OBSERVATIONS AND DATA, STREAM IS:(circle) FULLY SUPPORTING (FS) SUPPORTING, BUT THREATENED (TH) PARTIALLY SUPPORTING (PS) NONSUPPORTING (NS) COMMENTS photos Dor N Roll # Pholo # 29 28 Nor: Assibility of steen recentle day other commen note Va Marry, Poor no recercion inte Bu to IND MITULE ST 15/Lon. in other m dom this Sauing 07 Tim m Aluch Ro STREAM SKETCH am in Mastarantirasien fall ensio ----Page 2 \_ . revised 8-10-98 I (Rospents) - (yard) -----\_\_\_ 1000

Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-26 of D-70



Figure D-24 Photo of Sinking Creek downstream - December 17, 1999



Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-27 of D-70



Figure D-25 Photo of Sinking Creek upstream - July 24, 2000

Figure D-26 Photo of Sinking Creek downstream - July 24, 2000



Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-28 of D-70



Figure D-27 Photo of Sinking Creek upstream - October 16, 2000

Figure D-28 Photo of Little Sinking Creek upstream - December 12, 1999



Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-29 of D-70 ttle Sinking Creek upstream July 26, 2000



Figure D-29 Photo of Little Sinking Creek upstream - July 26, 2000

Figure D-30 Photo of Little Sinking Creek downstream - July 26, 2000



Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-30 of D-70

North Fork Creek was monitored at RM 7.7 and 16.4 by aquatic biologists from the State Lab on as a site of the probabilistic monitoring study. The stream at RM 7.7 was found have very low flow or dry on July 24, 2000 and October 17, 2000 (ref.: Figures D-34 through D-36). It contained flow on February 1, 2000, April 17, 2000, and again on May 8, 2001. All three sampling events noted slight to moderate siltation. Land use upstream was mostly pasture with cattle.

North Fork creek at RM 16.4 was found to have very low flow or dry on July 25, 2000 and October 16, 2000 (ref.: Figures D-37 and D-38). It contained flow on January 11, 2000, April 19, 2000, and again on May 10, 2001 (ref.: Figure D-38). All three sampling events noted moderate siltation. Land use upstream was mostly pasture with cattle.

From the monitoring data, it appears that the benthic community in North Fork Creek may be impacted from a lack of water. The lack of water is most likely due to the karst topography in the area (ref.: Figure D-1) and the extreme drought conditions noted during the sampling period. When flow did exist and the stream was monitored, the presence of sediment and some turbidity were noted. Near stream sediment sources most likely came from the surrounding agricultural land uses. A detailed and intensive watershed reconnaissance survey is recommended for further pollutant source identification. Cattle were noted in the area but the riparian conditions of these pastures were not documented.

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Figure D-31 North Fork Creek field sheet, RM 9.4 - August 18, 1999

Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-31 of D-70 Figure D-32 Photo of North Fork Creek RM 9.4 upstream - August 18, 1999

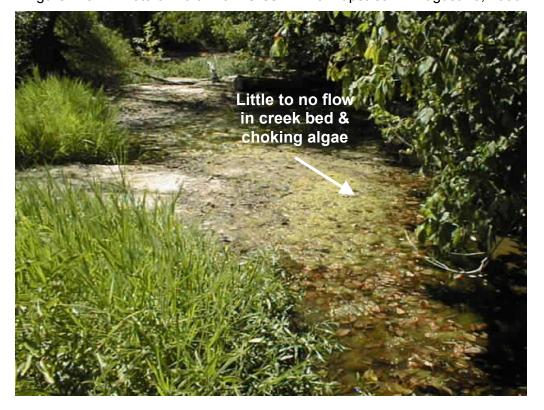


Figure D-33 Photo of North Fork Creek RM 9.4 downstream - August 18, 1999



Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-32 of D-70 Figure D-34 Photo of North Fork Creek RM 7.7 upstream low flow - July 24, 2000



Figure D-35 Photo of North Fork Creek RM 7.7 downstream stagnant low flow - July 24, 2000



Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-33 of D-70

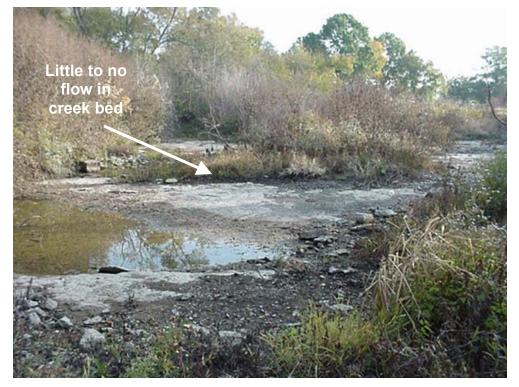


Figure D-36 Photo of North Fork Creek RM 7.7 upstream dry - October 17, 2000

Figure D-37 Photo of North Fork Creek RM 16.4 upstream dry - July 25, 2000



Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-34 of D-70



Figure D-38 Photo of North Fork Creek RM 16.4 downstream dry - July 25, 2000

Figure D-39 Photo of North Fork Creek RM 16.4 upstream - May 10, 2000



#### D6.0 Alexander Creek (060400020402) Subwatershed Analysis

Alexander Creek (TN06040002039\_0300) was placed on the *2002 303(d)* List of impaired streams as impairment by pathogens and siltation from pasture grazing. The *2004 303(d)* List indicated the stream was impaired by the loss of biological integrity due to siltation and Escherichia coli due to pasture grazing.

Alexander Creek was visited by staff from the Nashville Environmental Field Office on August 18, 1999 and observed to be dry (ref.: Figures D-40 through D-42).

Alexander Creek was revisited by aquatic biologists from the State Lab on July 24, 2000, October 17, 2000, and on September 12, 2001 and was observed to be dry (ref.: Figures D-43 through D-45). Aquatic biologists from the State Lab monitored the site on January 10, 2000, April 13, 2000, and May 10, 2001 when flow was present (ref.: Figure D-46).

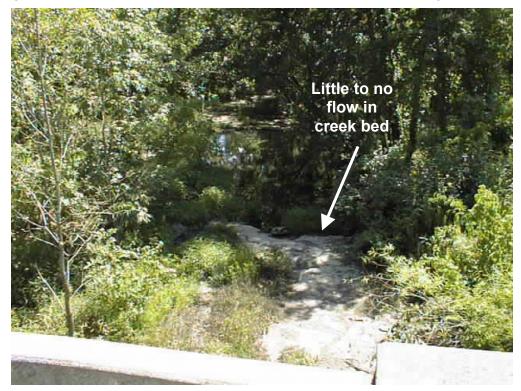
From the monitoring reports, it appears that the impairment of Alexander Creek may be due to hydrologic stress of benthic macroinvertebrates. The lack of water is most likely due to the karst terrain in the area (ref.: Figure D-1). Flow likely exists during storm events but drains underground during low and normal flow conditions. When flow did exist and the stream was monitored the presence of sediment and high turbidity were noted. This likely corresponds to flows from previous rain events. The sources of deposited sediment are most likely from the surrounding agricultural land uses. A comprehensive and intensive watershed reconnaissance survey is recommended for further pollutant source identification.

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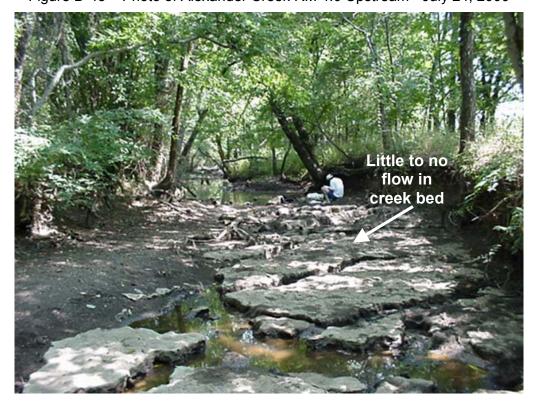
Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-36 of D-70 Figure D-41 Photo of Alexander Creek RM 0.8 Upstream - August 18, 1999

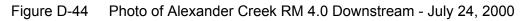


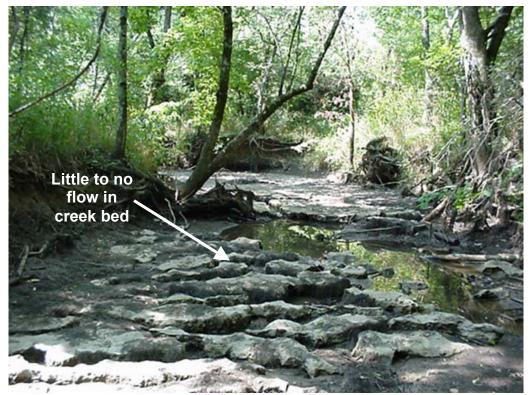
Figure D-42 Photo of Alexander Creek RM 0.8 Downstream - August 18, 1999



Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-37 of D-70 Figure D-43 Photo of Alexander Creek RM 4.0 Upstream - July 24, 2000







Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-38 of D-70



Figure D-45 Photo of Alexander Creek RM 0.4 - October 17, 2000

Figure D-46 Photo of Alexander Creek RM 0.4 - April 13, 2000



#### D7.0 Weakley Creek (060400020404) Subwatershed Analysis

Weakley Creek (TN06040002039\_0250) was placed on the *2002 303(d) List* as impacted due to siltation, nutrients, and pathogens from agricultural sources. The *2004 303(d) List* showed the stream as impaired due to loss of biological integrity due to siltation, nutrients and Escherichia coli due to agricultural sources.

Staff from the Nashville Environmental Field Office monitored Weakley Creek at RM 0.2 on August 18, 1999 (ref.: Figures D-47 through D-50). A biorecon showed 7 EPT, 4 intolerant, and 26 total families. These data were not high enough to rate the stream as fully supporting.

Weakley Creek was monitored at RM 5.2 by aquatic biologists from the State Lab on as a site of the probabilistic monitoring study. The stream was found dry on July 25, 2000 and October 17, 2000 (ref.: Figures D-51 through D-53). It contained flow on January 10, 2000, April 17, 2000, and again on May 8, 2001. All three sampling events noted moderate siltation. Land use upstream was mostly pasture with cattle.

Weakley Creek was also monitored by aquatic biologists from the State Lab on September 10, 2001 at RM 1.7. A semiquantitative sample showed the macroinvertebrate community was rated as fully supporting. However, it was noted that the stream had very little flow with a fractured bedrock bottom. Water appeared to flow in and out of the deep fractures. The flow upstream of the site was ponded and slow moving (ref.: Figure D-54). The monitoring showed moderate silt and high turbidity.

From the monitoring data, it appears that the benthic community in Weakley Creek may be impacted from a lack of water. The lack of water is most likely due to the karst topography in the area (ref.: Figure D-1) and extreme drought conditions during the sampling period. When flow did exist and the stream was monitored, the presence of sediment and some turbidity were noted. Near stream sediment sources most likely came from the surrounding agricultural land uses. A detailed and intensive watershed reconnaissance survey is recommended for further pollutant source identification. Cattle were noted in the area but the riparian conditions of these pastures were not documented.

#### D8.0 Wilson Creek (060400020502) Subwatershed Analysis

Wilson Creek (TN06040002046\_1000) was placed on the *2002 303(d) List* as impacted due to habitat alteration, nitrates, and pathogens from agricultural sources. The *2004 303(d) List* showed the stream as impaired by Escherichia coli, nitrates and other habitat alterations due to pasture grazing.

Staff from the Nashville Environmental Field Office visited Wilson Creek at RM 2.9 on January 10, 2000. A biorecon showed 5 EPT, 5 intolerant, and 14 total families. Notes report the presence of moderate sediment deposits from the upper watershed. However, it was noted that even though at this time there was flow in the stream it was likely that there was little to no flow previously. The impacts noted may have been due to recent unusually low flow conditions.

Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-40 of D-70

	Figure D-4	7 Weakl	ey Cree	k RM 0.2	2 field sh	eet, p1 -	August 2	18, 1999	
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Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final)

Page	D-41	of D-7	0

Figure D-48 Weakley Creek RM 0.2 field sheet, p2 - August 18, 1999

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Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-42 of D-70 Figure D-49 Photo of Weakley Creek RM 0.2 Upstream - August 18, 1999

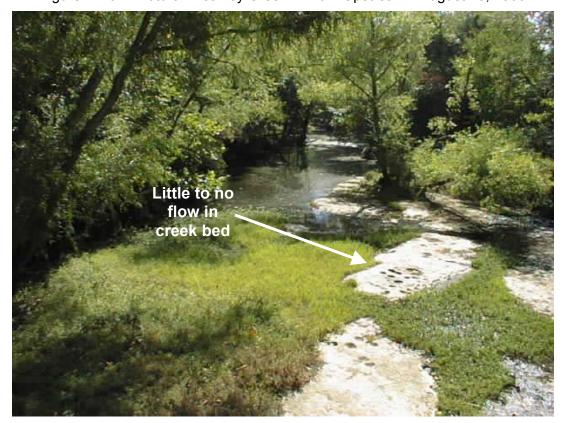


Figure D-50 Photo of Weakley Creek RM 0.2 Downstream - August 18, 1999



Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-43 of D-70 Figure D-51 Photo of Weakley Creek RM 5.2 Upstream - July 25, 2000



Figure D-52 Photo of Weakley Creek RM 5.2 Downstream - July 25, 2000



Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-44 of D-70 Figure D-53 Photo of Weakley Creek RM 5.2 Upstream - October 17, 2000



Figure D-54 Photo of Weakley Creek RM 1.7 Upstream - September 10, 2001



Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-45 of D-70

Wilson Creek was also monitored at RM 5.2 by aquatic biologists from the State Lab on as a site of the probabilistic monitoring study. The stream was found have very low flow or dry on July 25, 2000. It contained flow on all other sampling events. All three sampling events noted excessive siltation (ref.: Figure D-55). It was also noted that dairy cattle were present and had been in the stream to water (ref.: Figures D-56 through D-58). The riparian areas were thin to poor. The impacts from low flow are likely due to a combination of possible karst areas (ref.: Figure 1) as well as extreme drought conditions that occurred during the sampling period.

## D9.0 Lick Creek (060400020503) Subwatershed Analysis

Lick Creek (TN06040002047\_0300) was placed on the 303(d) list of impaired streams in 2002 as impacted by pathogens and other habitat alterations from livestock in the stream. The 2004 303(d) List showed the stream as impaired by Escherichia coli and other habitat alterations from livestock in the stream.

Lick Creek was monitored at RM 1.8 in 1999 and again in 2001 by the Nashville Environmental Field Office. In the quick screening conducted on July 9, 1999, large floating mats of algae were noted on dark brown water. Additionally, the water was low, with still, dark pools. Notes from the monitoring visit on September 17, 2001 (ref.: Figures D-59 through D-63) report the presence of moderate sediment deposits, slight turbidity, siltation and algae, along with suboptimal vegetative protection and riparian zone. The impacts are from a combination of low flow that is likely due to possible karst areas (ref.: Figure D-1) and uncontrolled access to the streams by cows.

## D10.0 Caney Creek and Thick Creek (060400020504) Subwatershed Analysis

Caney Creek (TN06040002048\_1000) was placed on the 303(d) list of impaired streams in 2002 as impacted by nitrates and siltation from riparian loss and pasture grazing. The 2004 303(d) List indicated that the stream was impaired due to nitrates and loss of biological integrity due to siltation. Causes listed included Livestock in the Stream and Removal of Riparian Vegetation.

Caney Creek was monitored in 1999 by the Nashville Environmental Field Office. A biorecon at RM 2.6 showed 5 EPT, 2 intolerant, and 20 total families. Notes report the presence of sediment deposits from the upper watershed. It was noted that there were new subdivision developments going in on the right bank downstream (ref.: Figure D-64). The stream was moderately turbid at this time giving the water a dark brown color (ref.: Figures D-65 through D-67).

The upper portions of the watershed were visited during the sampling period to look for possible sources of sediment (ref.: Figure D-68). Photographs of RM 4.2 showed heavy agricultural influence and a potential sediment source. The land use in the area was primarily pasture grazing. Stream banks were exposed and muddy with poor vegetation or cover. Cattle were observed loafing in the stream and along or on the stream banks. (ref.: Figures D-69 and D-70).

Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-46 of D-70

Figure D-55 Wilson Creek field sheet, p1 - October 16, 2000

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Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-47 of D-70

Figure D-56 Wilson Creek field sheet, p2 - October 16, 2002

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0.125250	fice sand	rs.	21-30			<u>+</u>			<u> </u>	
0 25-0.50	med sand	ms	31-40			<del>}</del> +			+ +	
0 5-1.0	coarse sand	සා (දෙක සෝගන් 5629)	41-50				1 1	-	+	
1.0-2.0 2.0-64.0	very coarse sand gravel	(USH 3C:LB) S-2P	61-70				<del>       </del>			
2.D-64.0 64-256	Glane		71-8G	1			<u>i</u>			
256-4096	bouider	(LSE 3004 9424)	81-90							
_	betvock	odrx	91-100	1			1 1			
	woody debris	boow					1 1	t		
FILL OUT	EITHER SUBST	RATE INFO BL	OCKS		i dit totered	<u> </u>	<u></u>		<u></u>	<u></u>
SUBSTRA		(Visual estim	iates)				DIES: 5	RUN		POOL
no	5 (n. 1971)	RIFFLE %	RUN 9	PCOL	% CLAY	(slick)	RIFFLE	% NON	%	- <u></u>
BOULDER					% SILT	(41.4.1)	10	%	%	7: %
GRAVEL		10 %			% DETRITUS	S (CPOM)		%	%	%
BEDROCH	5C2 17.0	3.5 %				D (FPCM)		%	%	%
SAND	(gritty)	20 %			% MARL (sh	ell frags )	8	%	%	%
e 1699 (96 1699)										*** * **
STREAM	USE SUPPOR		]		CAL ASSESS				,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	STORY SHOW
		(SST) (SST)	7.9							
CLASSIF	IED FOR:			LIST LOC	G NUMBERS O	F SAMPLES.	9			
277077833	TED FOR: Supply	Ind H2O Sup	iply	RELATIV	EABUNDANC		č.		<u>4</u> _	ABITAT
277077833	Supply	Ind H2O Sup Navigation	ιρίγ		E ABUNDANC		č		<u>+</u>	
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Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-48 of D-70



Figure D-57 Photo of Wilson Creek - October 16, 2000

Figure D-58 Photo of Wilson Creek - May 10, 2000



Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-49 of D-70

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Figure D-59	Lick Creek field sheet, p1 - September 17,	2001

TABLISH	ED STATION		ADED BLANKS OF HE		NEW STATIC		NEW STATION		
lank data f	fields indicate n	o change from	previous sai	npinig.	STORET#	ITKO	21.8 ML		
TREAM S	URVEY INFO	RMATION			STOKE I#	LILLA	1 1 101-		
REAM:		Lick C	reek	110	111 10	rnon Re	1		
TREAM LC	CATION:		200 42		INT UP	ASSESSOR	S:	STRIDRL	
OUNTY CO	DDE:(FIPS)		STATE CODE	27		DATE:	-	10/01	
AJOR BAS	SIN		Duck			TIME:	-	1030	
BID#/HUC	::	TN'060	F0002			STREAM M	LE:	1.8	
BID NAME	E:					STREAM OF			
AT/LONG	DEG:			Aliant	a	REACH FILL	Contraction ( )		1.600140
AT/LONG	DEC:	N 35.66620		AH: 736	17.	3Q20:		A DOWN	
ISGS QUA	D:		NW	rm		ELEVATION	(ft):	136	0.35.0
)rains to:		rm	-			FIELD#	• • •		0.121.0
COLOGIC	AL SUBREGIO	N: 71	1	1.1.1			BACIAL MARK		and a state
DBJECTIVE	ES:	Upper	· Duck	Nater	shed		And the second second		
SAMPLES	COLLECTED	distant of the state		$\cap$	METE	RS USED:	al and the states	Biorecon	
CHEMICALS	and so it is the second s	ife Assessed?	Macroinverteb	rates	Fish	Algae	Other:		
	ist Attached? (		0	Samples ret	urned ? (Y)or	N Sampl	ing monitor /	SQ KICK	
	And the second sec	es / no		The start	. •		2	669.7 1%	67.5
FIELD ANA	LYSIS:					DISSOLVED	OXYGEN	6.25/6.03	PPM
рH		7.47/7.50				TIME			
CONDUCTIV	ITY	381/382	UMHOS						
TEMPERATI		19.20/19.20				OTHERS	-		
	hours Precip:	UNKNOWN	NONE	LITTLE	MODERATE	HEAVY	FLOODING		
Ambient W		SUNNY	CLOUDY	BREEZY	RAIN	SNOW			
Ambient w	eaurer.	e la				in the second			
	HED CHARAC	TEDISTICS	App. % of w	atershed of	oserved:				
WATERSI	HED CHARAC	I ERIS HOS		and the second se				Contraction 2	
UPSTREAM	M SURROUNDI	NG LAND USE:	(estimated %	)	5	7			
STURE	35	URBAN		RESID		-			1
CROPS		INDUSTRY		OTHER					
FOREST	166-	MINING		BILLIN FLOLE	TOLL.			Contra mentione	-
IMPACTS	rated S/ligh	t), M(oderate),	H(igh) magnit	tude. Blank	a = not obser	ved	in the second	(9000)	2010/07
CAUSES	Turcu ofing.	Flow Alter.	(1500)	SOURCES	and the second second		Unknown	(2000)	Pager
Pesticides	(0200)	Habitat Alt.	(1600)	Point Source	e: Indust	(0100)	Municipal	(5000)	CONTRACT.
Metals	(0500)	Thermal Alt.	(1400)	Logging	110	(2000)	Mining	121201	STAN
Ammonia	(0600)	Pathogens	(1700)		n;Land Devel		Road /bridge		
Chlorine	(0700)	Oil & grease	(1900)	U/S Dam		(8800)	Urban Runot	ilization (7700	1
and the second se	(0900)	Unknown	(0000)	Riparian los		(7600)	Bank destab	edlot (1600)	
	(1000)	Siltation	(1100)	Agriculture		(1000)	and the second se	(7200)	
	nrichment / Low	D.O.	(1200)	Livestock g	razing-riparia	n (1410)	Dredging	(1200)	-
Other:	inclutioner cont			Other:				1	
DUVEICA	AL STREAM C	HARACTERIS	TICS	LENGTH C	F STREAM	AREA ASSES	SED (m):		
PHIOR	L OTALAND U	CE line dou	(netream) :						
	NDING LAND U		nou carry .	RDB	LDB		RDB	LDB	
ESTIMAT	E % RDB	LDB	7	1100		RESID	10	10	
PASTURE	40	40	URBAN	-	-	OTHER		HO TENR	
CROPS			INDUSTRY		-	- OTHER			
FOREST	50	50	MINING					Chaded/2801	
	PY COVER:	7= 66.2%	Open(0-10)	Partly Sha	aded(11-45)	Mestly S	haded(46-90)	Shaded(>80)	
10 CANOR		2m	XXX	HIGH	WATER MAR	RK (m):	X X X	2 AAAA	
DANIE LIP		CONTRACTOR OF THE OWNER	SLIGHT	MODERATI	E EXCESSIV	E BLANKET		212.2 XX	V ar M
BANK HE	T DEPOSITS:	NONE	SAND	SID	NONE	OTHER	Conta	aminated	Y or N
SEDIMEN		GLIGH	MODERATE	HIGH	OPAQUE	CIGNIC			
SEDIMEN TYPE:	SLUDGE			NONE	SLIGHT	MODERATE	CHOKING		
SEDIMEN TYPE: TURBIDI	TY CLEAR			NUNE					_
SEDIMEN TYPE: TURBIDI XCESSI	TY CLEAR	ESENT2		-	-				
SEDIMEN TYPE: TURBIDI XCESSI AQUATIO	TY CLEAR IVE ALGAE PRE C VEGET.	ROOTED	FLOATING	TYPE			VIVI	NY Y	
SEDIMEN TYPE: TURBIDI XCESSI AQUATIO	TY CLEAR	ROOTED		-	-		XXX	NX S	-
SEDIMEN TYPE: TURBIDI ACESSI AQUATIO ADDITIO	TY CLEAR IVE ALGAE PRE C VEGET. NAL COMMEN	ESENI2 ROOTED TS:(oil sheen, o	dor, colors)	-	-		XXX	XX	V
SEDIMEN TYPE: TURBIDI ACESSI AQUATIO ADDITIO	TY CLEAR IVE ALGAE PRE C VEGET.	ESENI2 ROOTED TS:(oil sheen, o	dor, colors)	-	-		W	XX	X

Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-50 of D-70

# Figure D-60 Lick Creek field sheet, p2 - September 17, 2001

		ULADA CTEOLO		EAM SUR						
MYSICA	AL STREAM C	HARACTERIS	Consideration Consideration of the	Inoci						
DEDTIL		RIFFLE	RUN	POOL 4-6"	-		auge/Bend	h Ht:	· · · · · · · · · · · · · · · · · · ·	
DEPTH (n				3m /1Pm			TY (CFS)	-	1000	
WIDTH (n					-	FLOW	(CFS)		),188	
REACH LI	ENGTH (m)		1	lipm	1	HABIT. RR #	AT ASSES	SMENT S	2 - 0	
Gradient	(sample reach)	: Flat Low	Mode. Hi	gh Casca	ade		TTAL	G	110.	
	am width) :	V. Small (<1.5		and the second se	led (3-10m	) Large (10-	25m) Ver	y Lrg (>2	5m)	
		ticle Count - 10			Circle					
ize (mm)	description				Use abbrev	below for smalle				
0.062	silt/clay	cl	1-10							
.062-0.125	very fine sand	vfs	11-20	1	I					
125250	fine sand	fs	21-30			1			1	
.25-0.50	med sand	ms	31-40		1					
.5-1.0	coarse sand	cs	41-50							
.0-2.0	very coarse sand	(use actual size)	51-60				-			
.0-64.0	gravel	(use actual size)	61-70						_	
56-4096	cobble boulder	(use actual size)	71-80 81-90							
56-4096	bedrock	(use actual size)	91-100							
	bedrock woody debris	bdrx wood	91-100							
FILL OUT		TRATE INFO BL	OCKS		1		- 1			
SUBSTRA		(Visual estim								
		•	RUN	POOL	1		RIFFL	E RI	JN PC	OL
BOULDER	R (> 10")	) %	) %		CLAY	(slick)		%	%	%
COBBLE (	A REAL PROPERTY AND A REAL	%	%		% SILT		5	%	%	%
GRAVEL (		%	/ %	and the second s		TUS (CPOM)	-	%	%	%
BEDROCH		%	%		_	-MUD (FPOM)		%	%	%
SAND	(gritty)	%	%		MARL	(shell frags.)		%	%	%
OTDEAM	USE SUPPO	DT.		BIOLOGIC	AI ACCE	COMENT				
		at.								
	IED FOR:			100000000000000000000000000000000000000		S OF SAMPLE				
	Supply	Ind. H2O Supp	bly	200000000000000000000000000000000000000	000000000000000000000000000000000000000	NCE OF TAX	4		HA	BITAT
				DOMINAN			R. No. 1970			
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TIER II/TIE Trout >>	Nat. Repr?			ABUNDAN	IT (10-29): (3-9):				2000 54	
TIER II/TIE Trout >> WATER W	Nat. Repr? VITHDRAWL NC		Advis.	ABUNDAN	IT (10-29): (3-9):					
TIER II/TIE Trout >> WATER W	Nat. Repr? VITHDRAWL NO	DTED Bacteriological A Do Not Consum		ABUNDAN	IT (10-29): (3-9):					
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#### Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-51 of D-70 Habitat Assessment, front page - September 17, 2001

Figure D-61 Lick Creek Habitat Assessment, front page - September 17, 2001

Division of Water Pollution Control SOP for Macroinvertebrate Stream Surveys Revision 2 Effective Date: March 2002 Appendix B: Page 4 of 12

HABITAT ASSESSMENT DATA SHEET- HIGH GRADIENT STREAMS (FRONT)

SIATION #       RIVER MILE       STREAM CLASS         AT       LONG       RIVER BASIN       LOOC         INVESTIGATORS       SDP/ML       AGENCY       Loss 424 C.O.         INVESTIGATORS       SDP/ML       AGENCY       Loss 424 C.O.         INVESTIGATORS       SDP/ML       Notestigation       Rever RE BASIN       Notestigation         INVESTIGATORS       SDP/ML       Suboptimal       Marginal       Poor         I. Epifaunal       Suboptimal       Marginal       20-40% mix of stable habitat. colonization potential; aubitat; lack of h       20-40% mix of stable habitat. colonization potential; aubitat; lack of h       20-40% mix of stable habitat. colonization potential; aubitat; lack of h       20-40% mix of stable habitat. colonization potential; aubitat; lack of h       20-40% mix of stable habitat. colonization potential; aubitat; lack of h       20-40% mix of stable habitat. colonization potential; aubitat; lack of h       20-40% mix of stable habitat. colonization potential; aubitat; lack of h       20-40% mix of stable habitat. colonization potential; aubitat; lack of h       20-40% mix of stable habitat. colonization potential; aubitat; lack of h       20-40% mix of stable habitat. colonization potential; aubitat; lack of h         Q       18       17       16       15       14       13       11       10       8       7       6       5       4       3         2. Embeddednes	AM NAME /		LOCATION	200 H J/S Mt.	Vernon Rd.
STORET#	ON #		STREAM C	LASS	vernen re-
NVESTIGATORS       STP       DATE       TIME       DATE       TIME       REASON FOR SURJEY         FORM COMPLETED BY       STP       AND PM       Reason FOR SURJEY       Reason FOR SURJEY         Habitat Parameter       Condition Category       Optimal       Suboptimal       Marginal       Poor         1. Epifaunal Cover       Greater than 70% of substrate favorable for opifaunal colonization and fish kover; mix of snags, submerged logs undercut banks, coble or other stable habitat and at stage to allow full       Greater than 70% of substrate for olonization potential; adequate habitat for under ubanks, coble or other stable habitat are not new full and tot transient)       20-40% mix of stable habitat; availability less than disturbed or removed       Less than 20% st habitat; lack of h obvious; substrat or lacking         SCORE       20       19       18       17       16       15       14       13       12       10       8       7       6       5       4       3         SCORE       20       19       18       17       16       15       14       13       12       10       9       8       7       6       5       4       3         SCORE       20       19       18       17       16       15       14       13       12       10       9       8       7			_ RIVER BAS	SIN Loper Duck	
DATES/// Marginal       REASON FOR SURJEY         DATES/// Marginal       REASON FOR SURJEY         Mabitat Parameter         Condition Category         Optimal       Marginal       Poor         I. Epifaunal       Greater than 70% of substrate colonization and fish cover, mix for snags, submerged logs undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., fall and not transient)       Substrate in the from of newfall, but not yet prepared for colonization potential (i.e., fall and not transient)       Gravel, cobble, and boulder particles are 0.25% surrounded by fine sediment.       Gravel, cobble, and boulder particles are 0.25% surrounded by fine sediment.       Gravel, cobble, and boulder particles are 25-0% surrounded by fine sediment.       Gravel, cobble, and boulder particles are 25-0% surrounded by fine sediment.       Only 3 of the 4 regimes present (if fast-shallow is surrounded by fine sediment.       Only 3 of the 4 regimes present (if fast-shallow is surrounded by fine sediment.       Only 3 of the 4 regimes present (if fast-shallow is surrounded by fine sediment.         SCORE       20       19       18       17       16       15       14       13       Velocity/depth regimes present (if fast-shallow is shallow (Slow is=0.3m/s dee	# LICKOOL	ICKOOL.SML	AGENCY (	abs for C.O.	A Children I
Habitat Parameter       STB       Aug PM       Notesting       Augesting         Habitat Parameter       Condition Category       Optimal       Suboptimal       Marginal       Poor         1. Epifaunal Cover       Greater than 70% of substrate favorable for epifaunal colonization potential (i.e., logs/snags that are not new fall and not transient)       Greater than 70% of substrate favorable fabitat 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 (i.e., logs/snags that are not new fall and not transient)       20-40% mix of stable habitat; well-suited for full colonization potential (i.e., logs/snags that are not new fall and not transient)       20-40% mix of stable habitat; well-suited for full colonization potential (i.e., logs/snags that are not new fall and not transient)       20-40% mix of stable habitat; well-suited for full colonization potential (i.e., logs/snags that are not new fall and not transient)       20-40% mix of stable habitat; wells under yet prepared for colonization (may rate at high end of scale)       20-40% mix of stable habitat; wells under yet prepared for colonization potential (i.e., logs/snags that are not new surrounded by fine sediment.       Gravel, cobble, and boulder particles are 25-50%       Gravel, cobble, and boulder particles are con-75% surrounded by fine sediment. </td <td>COMPLETED BY</td> <td>ETED BY</td> <td>DATERINA</td> <td>TRUE MEE LEE</td> <td></td>	COMPLETED BY	ETED BY	DATERINA	TRUE MEE LEE	
Habitat Parameter       Condition Category       Optimal       Marginal       Poor         1. Epifaunal Cover       Greater than 70% of substrate avorable for epifunal 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, stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient)       20-40% mix of stable habitat, advisable habitat, stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient)       20-40% mix of stable habitat, decimable, substrate frequently disturbed or removed       Less than 20% st availability less than desimble, substrate frequently disturbed or removed         SCORE       20       19       18       17       16       15       14       13       12       11       10       8       7       6       5       4       3         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 0-25% surrounded by fine sediment.       Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment.       Gravel, cobble, and boulder particles are 0-25%		STB			Ned Assessment
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 log undercut banks, cobble or other stable habitat for maintenance of populations; presence of additional substrate in form of newfall, but not yet prepared for colonization (may rate at high end of scale)         20-40% mix of stable habitat; availability less than desirable; substrate frequently disturbed or removed         Less than 20% st habitat; lack of h obvious; substrat or lacking           Q         9         18         17         16         15         14         13         12         11         0         Q         8         7         6         5         4         3           2. Embeddedness Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment.         Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment.         Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment.         Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment.         Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment.         Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment.         Gravel, cobble, and boulder particles are 0-75%         Gravel, cobble, and boulder particles are 0-75%         Gravel, cobble, and boulder particles are 0-0-75%         Gravel, cobble, and boulder particles are 0-0-75%         Gravel, cobble, and boulder particles are 0-0-75%         Gravel, cobbl	Contraction of the second				
1. Epifaunal       Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of stable habitat, colonization and fish cover; more stable habitat and at stage to allow full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the from of newfall and not transient)       20-40% mix of stable habitat, availability less than desirable; substrate frequently disturbed or removed       Less than 20% st. habitat, availability less than desirable; substrate frequently disturbed or removed         Q       colonization potential (i.e., logs/snags that are not new fall and not transient)       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 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.       Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble, nast erg 0-25% surrounded by fine sediment. Layering of cobble, nast erg 0-25% surrounded by fine sediment. Layering of cobble, nast erg 0-25% surrounded by fine sediment. Layering of cobble, nast erg 0-25% surrounded by fine sediment. Score low shallow, fast-deep, fast-shallow is missing score lower than regimes present (if fast-shallow is missing score lower than regimes).       Only 3 of the 4 regimes present (if fast-shallow is missing score lower than regimes).       Dominated by 1         SCORE       20       19       18       17       16       15       14       13       12       11       10       9       8       7       6       5       4       3			ptimal	Marginal	Poor
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 50-75% surrounded by fine sediment.       Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.       Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.       Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.       Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.       Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.       Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.       Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.       Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.       Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.       Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.       Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.       Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.         Score       20       19       18       17       16       15       14       13       11       00       9       7       6       5       4       3         Score       20       19       18       17       16	te/Available fa cc m uu ot stu cc fa to lo	ilable favorable for epifaunal well-s colonization and fish cover; colon mix of snags, submerged logs undercut banks, cobble or other stable habitat and at stage to allow full substr colonization potential (i.e., newfa logs/snags that are not new for co	suited for full ization potential; uate habitat for tenance of populations; nce of additional rate in the from of all, but not yet prepared olonization (may rate at	20-40% mix of stable habitat; availability less than desirable; substrate frequently	Less than 20% stable habitat; lack of habitat is obvious; substrate unstabl
particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.particles are 25-50% surrounded by fine sediment.Only 2 in the colorie, and bounder particles are 50-75% surrounded by fine sediment.Only 2 in the sediment.Only 2 of the 4 habitat regimes present (if fast- shallow, fast-deep, fast- shallow, iSow-shallow, fast-deep, fast- shallow) (Slow is<0.3m/s deep is >0.5m)Only 3 of the 4 regimes present (if fast-shallow is missing score lower than regimes).Only 3 of the 4 regimes present (if fast- shallow) is missing, score low)Only 2 of the 4 habitat regimes present (if fast- shallow are missing, score low)Dominated by 1 velocity/depth regimes present (if fast- shallow is missing, score low)SCORE201918171615141312111098765434. Sediment DepositionLittle or no enlargement of islands or point bars and less than 5% (<20% for low- gradient streams) of the bottom affected by sediment depositionSome 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 poolsModerate deposition of new gravel, sand or fine sediment; sonstrictions, and bends; absent due to sultable of the bottom of frequently; pools absent due to sultable of the bottom of frequently; pools	20			10 @ 8 7 6	5 4 3 2
3. Velocity/Depth Regime       All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast- shallow) (Slow is<0.3m/s	pa su	particles are 0-25% partic surrounded by fine sediment. Layering of cobble provides	cles are 25-50%	particles are 50-75%	Gravel, cobble, and bould particles are more than 76 surrounded by fine sediment.
Regime       regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow) (Slow is<0.3m/s deep is >0.5m)       present (if fast-shallow is missing score lower than regimes).       regimes present (if fast-shallow are missing, score low)       regimes present (if fast-shallow are missing, score low)       velocity/depth re (usually slow-deep is >0.5m)         SCORE       20       19       18       17       16       15       14       13       12       10       9       8       7       6       5       4       3         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 by sediment deposition in pools       Moderate deposition in pools       Heavy deposits or deposition in frequently; pools abstructions, constrictions, and bends;	20	20 19 18 17 16 15	14 13 12 11	10 9 (8) 7 6	5 4 3 2 1
4. Sediment Deposition       Little or no enlargement of islands or point bars and less than 5% (<20% for low- gradient streams) of the bottom affected by sediment deposition       Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low- gradient) of the bottom affected; slight deposition in pools       Moderate deposition of new gravel, sand or fine sediment; 50-80% for low- gradient streams) of the bottom affected by sediment       Heavy deposits of material, increas development; mostly 50% (80% for low- gradient) of the bottom affected; sediment deposition	re sl st	regimes present (slow-deep, slow-shallow, fast-deep, fast- shallow) (Slow is<0.3m/s regim	ent (if fast-shallow is ing score lower than	regimes present (if fast- shallow or slow-shallow are	Dominated by 1 velocity/depth regime (usually slow-deep)
Deposition       islands or point bars and less than 5% (<20% for low- gradient streams) of the bottom affected by sediment deposition       formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low- gradient) of the bottom affected is glight deposition in pools       rectar of the gravel, sand or fine sediment; (50-80% for low-gradient) of the bottom affected; sediment deposition, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low- gradient) of the bottom affected; seliment pools       rectar of the gravel, sand or fine sediment; (50-80% for low- gradient) of the bottom affected; seliment deposition, and bends; absent due to sul       rectar formation, mostly gravel, sand or fine sediment; (50-80% for low- gradient) of the bottom affected; seliment deposition, and bends;       rectar formation, mostly formation, mostly formation, mostly formation, mostly from affected; seliment deposition, and bends;       rectar formation, mostly formation, mostly for how- gravel, sand for ho	20	20 19 18 17 16 15	14 13 12 11	10 9 3 7 6	5 4 3 2
prevalent.	ion is th gub b	islands or point bars and less than 5% (<20% for low – gradient streams) of the 5-30% bottom affected by sediment deposition affect	ation, mostly from el, sand or fine sediment; % (20-50% for low- ient) of the bottom ted; slight deposition in	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	Heavy deposits of fine material, increased far development; more than 50% (80% for low-gradie of the bottom changing frequently; pools almost absent due to substantial sediment deposition
SCORE 20 19 18 17 16 15 14 13 12 11 10 9 8 (7) 6 5 4 3	2	20 19 18 17 16 15	14 13 12 11	10 9 8 7 6	5 4 3 2
5. Channel Flow Status 3. Water reaches base of both lower banks, and minimal amount of channel substrate is exposed. 3. Water fills>75% of the available channel; or 25 % of channel substrate is exposed. 3. Water fills>75% of the available channel, and/or riffle substrates are mostly exposed. 3. Water fills>75% of the available channel, and/or riffle substrates are mostly exposed.	5. Channel Flow Status 12 Water reaches base of both lower banks, and minimal amount of channel substrate		able channel; or 25 % of	available channel, and/or riffle substrates are mostly	Very little water in chann and mostly present as standing pools.
SCORE 20 19 18 17 16 15 14 (13) 12 11 10 9 8 7 6 5 4 3	5	20 19 18 17 16 15	14 (13) 12 11	10 9 8 7 6	5 4 3 2

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#### Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-52 of D-70 Figure D-62 Lick Creek Habitat Assessment, back page - September 17, 2001

Division of Water Pollution Control SOP for Macroinvertebrate Stream Surveys Revision 2 Effective Date: March 2002 Appendix B: Page 5 of 12

#### HABITAT ASSESSMENT DATA SHEET- HIGH GRADIENT STREAMS (BACK)

Service Mark	Condition Cate	egory	1											
	Optimal		12 19 19	Subopti	mal			Margina	1		Poor	1211		
6. Channel Alteration	Channelization absent or minin normal pattern.	nal; si		usually i abutmen channeli (greater be prese	anneliza in areas o its; evide ization, i than pasi nt, but re ization is	of bridge nce of pa e., dredg t 20 yr) r ccent	ast ging, may	Channeli extensive or shorin present o and 40 to reach cha disrupted	; emban g structu n both b 80% of annelized	kments ires, anks; stream	Banks sh cement; o stream re and disru habitat g removed	over 80% ach cha pted. Ir reatly al	% of the nnelizenstream tered	he ced m
SCORE	20 19 18	(1	7) 16	15 14	4 13	12	11	10 9	8	7 6	5 4	3	2	1
7. Frequency of Riffles (or bends)	Occurrence of f frequent; ratio between riffles of the stream < 7); variety of his streams where continuous, pla boulders or oth obstruction is ir	of dis divid 7:1 (g abitat riffles iceme	tance ed by width generally 5- is key. In s are ent of ge, natural	infreque riffles d the strea	nce of rif ent; distant ivided by im is bet	nce betw the wid	ith of	Occasion bottom c some hal between the width between	ontours bitat; dis riffles di n of the s	provide tance ivided by stream is	Generally shallow r distance divided b stream is	iffles; p between by the w	oor ha riffle idth o	abitat s of the
SCORE	20 19 18	1	7 16	15 14	13	12	11	10 19	) 8	7 6	5 4	3	2	1
<ol> <li>Bank Stability (score each bank)</li> <li>Note: determine left or right side by facing downstream.</li> </ol>	Banks stable; e erosion or bank minimal; little future problem affected.	c failu poten	ire absent or tial for	small ar healed o	tely stabl reas of en over. 5-30 has area	osion mo 0% of ba	ostly ank	Moderate 60 % of has areas erosion p floods	bank in of erosi	reach ion; high	Unstable "raw" and straight s obvious 1 100% of scars	eas frequencies fr	and b and b	long ends ng; 60
SCORE (LB)	Left Bank	10	9	8	7	6		5	4	3	2	1	0	
SCORE <u>5</u> (RB)	Right Bank	10	9	8	7	6		(5)	4	3	2	1	0	
9. Vegetative Protective (score each bank) Note: determine left or right side by facing downstream	More than 90% streambank su immediate ripa by native vege trees, understo nonwoody may vegetative disr grazing or mor not evident; al allowed to gro	rfaces arian tation ry shi croph ruptio wing most	s and zone covered a, including rubs, or ytes; n through minimal or all plants	surfaces vegetati plants i disrupti affectini potentia more th		l by natione class ll-represe ant but no ant grow great ext half of th	ve s of ented; ot rth .tent; ne	50-70% streamba covered disruptio patches closely o vegetation than one potentia height ro	ank surfa by veget on obvio of bare s cropped on comm c-half of l plant s	tation; us; coil or non; less the tubble	Less that streamba by veget streamba very hig been ren centimet average	ank surfa ation; di ank veget h; veget hoved to ters or le	aces c isrupt etation ation 5 ess in	ion o 1 is has
SCORE (LB)	Left Bank	10	9	8	Ð	6		5	4	3	2	1	0	)
SCORE (RB)	Right Bank	10	9	8	7	0	-	5	4	3	2	1	(	)
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of ripar meters; human parking lots, r cuts, lawns or impacted zone	n acti oadb crop	vities (i.e. eds, clear- s) have not	meters	a series	activities		12 mete	rs; huma s have in	mpacted	Width o meters: vegetati activitie	little or on due t	no rip	arian
SCORE (LB)	Left Bank	10	9	8	7	6	1	5	4	3	2	1	-	0
SCORE (RB)	Right Bank	10	9	8	7	(6)	1	5	4	3	2	1		0

Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-53 of D-70

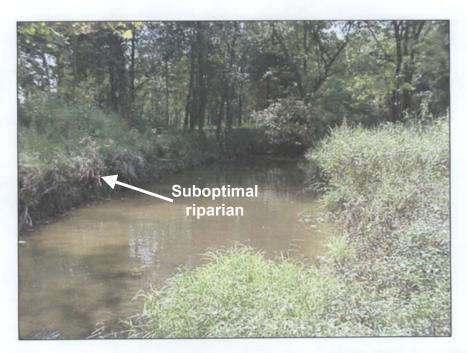


Figure D-63 Photo of Lick Creek - September 17, 2001

Lick Creek (LICK001.8ML) 200 d/s of Mt. Vernon Road. 9/17/01 at 1030

Thick Creek (TN06040002048\_0100) was placed on the 303(d) list of impaired streams in 2002 as impacted by siltation and other habitat alterations from pasture grazing. The stream's listing continued on the *2004 303(d) List* as impaired for Escherichia coli and other habitat alterations, from livestock in the stream.

Thick Creek was monitored at RM 2.0 in 2001 by the Nashville Environmental Field Office. Notes report the presence of moderate sediment deposits, slight siltation and moderate amounts of algae, with suboptimal vegetative protection. The stream was slightly turbid at this time giving the water a dark brown color (ref.: Figures D-71 through D-73).

Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-54 of D-70

			STR	REAM SUR	VEY FOR	<b>u</b>	ALL VI	1 Indal	1201
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WBID#/HUC:	•••••••		14000 2048			TIME:		- aur	13.46 0
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LAT/LONG D	DEC:		5' 57"		-	REACH		- 11.	
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						/**/**			
	កុមនៃពិភូទិត្រូវបា		- Bucs		*5* <u>**********************************</u>		<b>8</b> 9.344000		
CHEMICALS		ife Assessed?	Wacroinvert	ebrates	Fish	Algae	Other;		
Additional Lis	st Attached?	es / No		Samples re	eturned ? (Do	orN Sar	npling Method:	Breter	Fall
FIELD ANAL	YSIS:								
ж		2.20 /	2.66 S			DISCOLVI	ED OXYGEN	[2 25 1 1	-
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						TIME	_	10:20 / 10	25 Am
TEMPERATUR	Service and the service of the servi		A second s	C		OTHERS	34#	50 2/4	9.2 2
Previous 48 h	iours Precip.	ONKNOWN	NONE /	LITTLE	MODERATE				
Ambient Wea	ther;	SUNNY	(CLOUDY)	BREEZY	RAIN	SNOW 7	7"85°F, hu	emiel sor	De
	SURROUNDIN 50-702 102			%) RESID/R OTHER		2 > <sup>7</sup> 1000 50	ib distriction in	i area	
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JPSTREAM S ASTURE ROPS OREST MPACTS AUSES	SURROUNDIN <u> </u>	G LAND USE URBAN INDUSTRY MINING I, M(oderate), Flow After.	: (estimated ) H(igh) magn (1600)	%) RESID/A OTHER itude. Blank SOURCES	/ _2064) 1 =		Unknown	(9000)	
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Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-55 of D-70

Figure D-65 Caney Creek field sheet, p2 - July 9, 1999

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Size (stream width) :	V. Small (<1.5	m) Small (1.5	-3m) (Med	( <u>3-10m</u> ) La	rge (10-25m) Very Lrg (>25m)
LIST LOG NUMBERS OF	SAMPLES:	<u> </u>	1-4 1 -		
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Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-56 of D-70



Photo of Caney Creek RM 2.6 Upstream - July 9, 1999 Figure D-66

Photo of Caney Creek RM 2.6 Downstream - July 9, 1999 Figure D-67



Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-57 of D-70

	Ing) For: TN 0 6 04000 2048	Sub WS Canay Cet	WS Upper Puck.
Date: Fri. 07/09/99 Stre	m: Canay Cet	WBA: ①	RF3#
Creek: Conay Tet WBA(1)	OVERVIEW: COMMEN		ch: No / Yes (back of page)]
Co: Marshall	WS%observ/Land use(%): 975/fure Water(L/W/D/Fkrw/Appear/Canopy): / 0		
Location: Thick Rd	On site rip % (LDB/RDB): Aup less = + 0/	2 pasture 208 trues 102 Rd 20	2 long . e. A to 2 angaz
	WHabkais, substra:	cour - Bark enochof + mu	Ally pooled unter = Steam
Lat/Long: 35" 38'00"/ 86" 44 25"	Meler Reads: Temp Con		DO Other;
RM: 4.2 To (RM): Prot P. (109.2)	EPT/Total Taxa: C		
Quad: 71 NW CHapel Hill.	Comments; Cane, Clek was to	A DI I COS N - 2	<u> </u>
	_ Tost dying the	us this site anon	the site ( full Figuren) -
Weather: 35° F Humily No 11		alle stille	1 4 111
Weather: 95°F Humide (Houds, Time: 100-130 Stream Order: 3AA	Alow - ported w	ater, Cows in cree	a malle at site low

Figure D-69 Photo of Caney Creek RM 4.2 Upstream - July 9, 1999



Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-58 of D-70 Figure D-70 Photo of Caney Creek RM 4.2 Downstream - July 9, 1999



# D11.0 East Rock Creek (060400020602) Subwatershed Analysis

East Rock Creek (TN06040002012\_0100) was placed on the 303(d) list of impaired streams in 2002 as impacted by siltation and other habitat alterations from pasture grazing. The 2004 303(d) List indicated that the stream was impaired by loss of biological integrity due to siltation and other habitat alterations from pasture grazing.

East Rock Creek was monitored at RM 10.3 in 1999 by the Nashville Environmental Field Office and at RM 1.8 in 2001 by aquatic biologists from the State Lab. Notes from the assessment on December 8, 1999 (ref.: D-74 through D-77) indicate that the stream was highly turbid with floating algae mats, giving the water a dark brown color, with mud and moderate to excessive siltation noted. Notes from the assessment on July 24, 2001 (ref.: Figures D-78 through D-82) indicate that the stream vegetative protection had been disrupted, with very little riparian vegetative zone. Few trees were noted on the banks, which were deemed unstable, and no undergrowth was observed. Cows had full access to the stream. The impacts are from a combination of low flow that is likely due to possible karst areas (ref.: Figure D-1) and uncontrolled access to the streams by cows.

#### Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-59 of D-70

Figure D-71 Thick Creek Habitat Assessment Sheet, front page - May 29, 2001

STREAM NAMETHECK002. OML	LOCATION
STATION #RIVERMILE	STREAM CLASS
LATLONG	RIVER BASIN
STORET # THICKOO2.0ML	AGENCY Labs For LO
INVESTIGATORS	AGENCY Labs For LO
FORM COMPLETED BY	DATE 5/29/01 REASON FOR SURVEY

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

Habitat		Condit	ion Category	1
Parameter	Ontimal	Subontimal	Marginal	Paor
l. Epifaunai Substrate Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover: mix of snags, submerged logs, undercut banks, coboie or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are act new fall and act transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate is the form of newfail, but not yet prepared for colonization (may rate at high end of scale).		Less than 20% stable habitatt lack of habit bowoust substrate unstable or lacking.
SCORE 7	20 19 18 17 16	15 14 13 12 11	10 9 3 0 6	5 4 3 2 1
2. Embeddedness	Gravel, cobbie, and boulder particles are 0- 25% surrounded by fine sediment. Layening 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.	Gravei, cobbie, and bouider particles are more than 75% surrounded by fine sediment.
SCORE 14	20 19 18 17 16	15 (12) 13 12 11	10 9 3 7 6	5 4 3 2 1
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow- deep, <u>four-inallow</u> ) fast- deep, <u>fast-inallow</u> ). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if last-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 I veloci depth regime (usually slow-deep).
score 3	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 (3) 2 1 (
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	deposition in pools.	bars: 30-30% (50-30%) for low-gradient; of the bottom affected; sediment deposits at obstructions.	Heavy deposits of fine material, increased bar development; more than 50% (30% for low- gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	9/3 7 6	5 4 3 2 1 0
5. Channel Flow Status	both lower banks, and a minimal amount of	<25% of channel of a	available channel, and/or contile subscrates are	Very little water in hannel and mostly resent as standing roois.
CORE 4	20 19 13 17 16	15 14 13 12 11	10 9 3 7 5	5 (=) 3 2 1 0

#### Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-60 of D-70

Figure D-72 Thick Creek Habitat Assessment Sheet, back page - May 29, 2001

	Habitat			T			on Catego		adae and	1			
	Parameter	Optimal		9	Suboptir	nal		Margin	121		Poo	r	_
	6. Channel Alteration	Channelization o dredging absent o minimal: stream normal pattern.	r	present of bridg evidence channel dredgin past 20 present.	e abutr e of pas ization. g. (great yr) may but rece ization	in areas tents; t i.e., ter than be tent	extension or shore present and 40	ve; emb ng struc on both to 30% hanneliz	banks: of stream	gabion 80% of channe	the stre lized an ed. Inst greatly	am re d ream altere	20
	SCORE 20	20/ 19 18	17 16	15 1.	4 13	12 11	10 9	8	7 6	5 4	3 2	2 1	
ipung reach	7. Frequency of Riffles (or bends)	Occurrence of rif relatively frequer of distance between filles divided by of the stream <1: (generally 5 to 7) variety of habitat In streams where are continuous, placement of bou other large, nature obstruction is imit	en width l is key. ntfles lders or	between	nce of n ent: dista n rifles o vidth of s betwee	ince fivided the	divided	some h betwee	ontours	General or shall habitati nifles d width a rate of	distance ivided i the sc	es: por	ve
	SCORE	20 19 13	17 16	15 1-	13	12 11	10 9	3	7 6	5 4	3 2	l	(
a a mineres to be evaluated broader than sampling reach	3. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evit of erosion or bank failure absent or minimal; little po for future problem <5% of bank affet	tential	infreque	mostly h	l areas of lealed bank in	50% of	erosion:	able: 30- reach has ; high t during	Unstable areas: " frequent sections obvious 50-1009 erosiona	aw" are along i and ber bank si 5 of ban	nds: ought	.:
Valu	SCORE (LB)	Left Bank 10	9	8	G	) 6	5	4	3	2	l	0	
-	SCORE 8 (RB)	Right Bank 10	9	18	7	6	5	4	3	2	l	0	
	9. Vegetative Protection (score each bank)	More than 90% of streambank surface immediate ripanal covered by narve vegetation, includ trees, understory is or nonwoody macrophytes: veg disruption through grazing or mowin minimal or not ev almost all plants a to grow naturally	ing hruos, etative	ot plants represen evident i fuil plan potential extent: n	ink surfa by nativ on, but o is not w ted; disr but not a t growth to any i nore than the potent teight	e ne class veil- uption ffecung great	50-70% streamba covered disruotio patches o closely o vegetatio than one potential height re	nk surf: by vege n obvic of bare s ropped n comm -haif of plant st	ration: us: non: less the ubble	Less tha streamba covered disrupno vegetato vegetato removed 5 centim average	ink surf by vege on of sa on is ver on has b ito eters of stubble	ices intion earnor ry higi cen iess in heigh	1: 1: 1: 1:
	SCORE _ (LB)	Left Bank 10	9	8	(7)	6	5	4	3	2	1	0	_
	SCORE 8 (RB)	Right Bank 10	9	3	) 7	6	5	4	3	2	1	0	S.
	10. Riparian Vegetative Zone Width (score each bank aparan zone)	Width of riparian >13 meters: huma activities (i.e., par lots, roadbeds, cle cuts, lawns, or cro have not impacted	n king ar- os)	Width of 12-18 ma activities zone onl	have in	man macted	Width of 6-12 met activities zone a gr	ers; hun have in eat deai	nan mpacted	Width of <5 meter npartan to humar	5: little vegetit 1 102vit 4	or no on due tes.	
	-	Left Bank 10	9	8	7	6	5	4	3	0	1	0	_
	SCORE Z (L3)	Lett Bank To	-									0	

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

Total Score 17

Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-61 of D-70 Figure D-73 Photo of Thick Creek RM 2.0 upstream - May 29, 2001



Thick Creek (THICK002.0ML) upstream of sample site located 100 yds u/s Pyles Rd. PAD/BGL, 5/29/01.

Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002)

(7/24/06 -	Final)
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			•	EAM SURV	1			0	· P. 61
STREAM SU	IDMON INITO	DHATION			STORET	-	ANT, MITATION.	- OI	6 Reck (
STREAM:	INVESTICAS		ck CRK		STONET				
STREAM LOC	NOITA		wy 3/A	o teres	11	an Mal		)	
COUNTY COL			ISTATE CODE	A TANMU		ASSESSO	DRS	DIMA	odhae
MAJOR BASI			HCK R	-1 /10 010	2	DATE:			2/08/99
WBID#/HUC:			0400020/2		-	TIME:			3:15 pm
WBID NAME:			lock, et al.	digit and	Sector 1	STREAM	MILE:		10-3
LAT/LONG DE	EG:	35.30'	05 / 86°42'	50 (geis)	Ī	STREAM	ORDER:	~4	
LAT/LONG DE	EC:	35.501	3891-86.71	3889		REACH F	ILE #		
USGS QUAD:			Faimington			3020:0359	65 9220 (RM4.2)	0.	and the subscription of th
Drains to:			OCK ORK (R	(11.9)	_	ELEVATIO	ON (ft):	690	
ECOLOGICAL	SUBREGIO	N: INB	(111)		_	FIELD#		Bib K	act(A)
OBJECTIVES	<u>.</u>	WS.	Screen						
SAMPLES C	OLLECTED	No		and the second second	METERS L	USED:	Kude	clab in	<u>nenaii</u>
CHEMICALS Y	Yor N L	ife Assessed?	Macroinverte	ebrates>	Fish	Algae	Other:		/
Additional List	Attached? Y	BS / No	and the second s	Samples ret	turned ? Y d	Sam	pling Method:	2 Full &	Torenam
FIELD ANALY	-	-							
pH			SI	7 (Ho	ale AB	7 DISSOLVE	DOXYGEN		PPM
CONDUCTIVITY	~		ÚMHO	- 1.7	BINAD	TIME			-
TEMPERATURE			-		· prince ]	OTHERS			-
		UNKNOWN	NOUE		HODEDATE		FLOODING		-
Previous 48 ho			NONE	(LITTLE)	MODERATE				
Ambient Weath	her:	SUNNY	CLOUDY	BREEZY	RAIN	SNOW >	50-7-		
	10%	URBAN	: (estimated 9		15-76 (	(+)			
FOREST	10-202	INDUSTRY MINING		RESID/La		Ø			
FOREST	10-202	INDUSTRY MINING , M(oderate)	, H(igh) magn	RESID/Ld OTHER		FJ		(9000)	
CROPS	/0 - 20 2 rated S(light)	INDUSTRY MINING , M(oderate), Flow Alter.	, H(igh) magn (1500)	RESID/LA OTHER itude. Blank SOURCES	= not obser	The second second	Unknown	(9000)	
CROPS FOREST IMPACTS CAUSES Pesticides (02)	/0 - 20 2 rated S(light)	INDUSTRY MINING , M(oderate), Flow Alter. Habitat Alt.	, <b>H(igh) magn</b> (1500) (1600)	itude. Blank SOURCES Point Source	= not obser	(0100)	Municipal	(2000)	
CROPS FOREST IMPACTS CAUSES Pesticides (02) Metals (050	/0 - 20 2 rated S(light) 00) 00)	INDUSTRY MINING , M(oderate), Flow Alter.	, <b>H(igh) magn</b> (1500) (1600)	RESID/LA OTHER itude. Blank SOURCES	= not obser	(0100) (2000)		(2000) (5000)	
CROPS	/0 - 20 2 rated S(light) 00) 00)	INDUSTRY MINING , M(oderate), Flow Alter. Habitat Alt. Thermal Alt.	H(igh) magn (1500) (1600) (1400) (1700)	RESID OTHER itude. Blank SOURCES Point Source Logging	= not obser	(0100) (2000)	Municipal Mining	(2000) (5000) (3100)	
CROPS CONCEPTION OF CONCEPTION	/0 - 20 2 rated S(light) 00) 00) 00) 00) 00)	INDUSTRY MINING , M(oderate), Flow Alter. Habitat Alt. Thermal Alt. Pathogens Oil & grease Unknown	H(igh) magn (1500) (1600) (1400) (1700) (1900) (0000)	itude. Blank SOURCES Point Source Logging Construction U/S Dam Riparian loss	= not obser e: Indust n;Land Devel s	(0100) (2000) I (3200) (8800) (7600)	Municipal Mining Road /bridge Urban Runoff Bank destabi	(2000) (5000) (3100) f (4000) lization (770	
CROPS CAUSES FOREST MIDACTS CAUSES Pesticides (020 Metals (050 Ammonia (060 Chlorine (077 Nutrients (090 DH (100	/0 - 20 2 rated S(light) 00) 00) 00) 00) 00) 00)	INDUSTRY MINING , M(oderate), Flow Alter. Habitat Alt. Thermal Alt. Pathogens Oil & grease Unknown Siltation	H(igh) magn (1500) (1600) (1400) (1700) (1900) (0000) (1100)	RESID/Contract OTHER itude. Blank SOURCES Point Source Logging Construction U/S Dam Riparian loss Agriculture:	= not obser e: Indust n;Land Devel s Row crop	(0100) (2000) I (3200) (8800) (7600) (1000)	Municipal Mining Road /bridge Urban Runoff Bank destabi Intensive Fer	(2000) (5000) (3100) f (4000) lization (770 edlot (1600)	
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CROPS FOREST IMPACTS CAUSES Pesticides (02) Metals (050 Ammonia (06 Chlorine (07 Nutrients (090 OFH (100 Organic Enrich Other: PHYSICAL S SURROUNDIN ESTIMATE % F FASTURE CROPS FOREST % CANOPY CO BANK HEIGHT SEDIMENT DE	/6 - 20 2 rated S(light) 00) 00) 00) 00) 00) 00) 00) 0	INDUSTRY MINING , M(oderate), Flow Alter. Habitat Alt. Thermal Alt. Pathogens Oil & grease Unknown Siltation O. ARACTERIS (facing dow LDB 4/0 2-60 5-/0 2 -2-4' NONE	H(igh) magn (1500) (1600) (1400) (1400) (1700) (1900) (0000) (1100) (1200) TICS mstream) : URBAN INDUSTRY MINING	RESID/A OTHER OTHER Point Source Logging Construction U/S Dam Riparian los: Agriculture: Livestock gro Other: LENGTH OF RDB Bartly Shade HIGH W	= not obser e: Indust n;Land Devel s Row crop azing-riparia F STREAM / LDB	(0100) (2000) I (3200) (8800) (7600) (1000) in (1410) AREA ASSES RESID. OTHER Monty Sh	Municipal Mining Road /bridge Urban Runoff Bank destabi Intensive Fer Dredging SED (m): RDB /5-2	(2000) (5000) (3100) f (4000) lization (770 edlot (1600) (7200) //202 LDB 30-40 §	
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Page 1

revised 8-10-98

Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final)

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PHYSICAL STREAM C	HADACTED	CTICS (com					
	RIFFLE	RUN	POOL	Т	Staff Gauge/Ber	ach Ut:	
DEPTH (m)	16	4-8"	12'(4)	-			1.5
WIDTH (m)	treue	41	8.10'	Sec. and	VELOCITY (CFS)		100000
REACH LENGTH (m)	all	41	10'(+)	12. (1200 Mg	FLOW (CFS)		2
(in)	Type	17	1001	1	RR #	GP #	18
Gradient (sample reach)	Flat to	> Mode	High Cascad	le		OF #	
Size (stream width) :					rge (10-25m) Ve	ny   ra (>25m)	
BIOLOGICAL ASSESSMI	ENT				90 (10-2011) 00	ay cig (~2011)	
LIST LOG NUMBERS OF			Time				
RELATIVE ABUNDANCE	OF TAXA		100	al TA	a noves again		HABITA
DOMINANT (>=50):		2,018	(see a	lached	>	STATES AND STATES	98
VERY ABUND.(30-49):							
ABUNDANT (10-29):					1. A.		
COMMON (3-9):		ACAUSE					
RARE (<3):	-		C. Son Stranding and	and the second second	and the second	the then a shirt	Discourse and
		-	1. 10 10 10				
					and a strengthe	1	
STREAM USE SUPPOR	IT:	SPECIFICA	LLY CLASSIF	ED FOR: (circl	e) ,		
Dom. H2O Supply	Ind. H2O Su	pply	Navigation	TIER II/TIER	III Trout	>> Nat. Repr?	
VATER WITHDRAWL NO		IN STAL	COOM CONTRACT				
S STREAM POSTED? (cir	rcle)	Fish Tissue	Advis.:	Do Not Consume	Precautionary		
ULLY SUPPORTING (FS)		Photo # 5	84 / \$3 dls	PARTIALLY SUR argutal or	st studence		ich
FULLY SUPPORTING (FS)	varied (0	Photo # 5	84 / \$3 dls	area up	ly) 15 + residence + Aller Weed frage Brow to clege parts	u O site, A (Not: 2 n el= 11abi Se assassion	news
the second se	varied (0 1 prolect 6 fuls = E ilde OTAS 6 the Ac vuly 14 st	Photo # ? - and ) / f - turbed of - Cet 9 -	84 / 83 ds antines 1 anter y a anes statu Lion pro Otpoffe	ange tal or love mats love mats love mats love - hut to found in to = (PS	1/2) + Alle Weed + Alle Weed + Chief Brow to cliep parts - as "" in to Alot : 10	1. O site, M (Ilst: : B n es 11 all Sie assession H's, very fee	unto).
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Figure D-75 East Rock Creek field sheet, p2 - December 8, 1999

#### Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-64 of D-70

Figure D-76 East Rock Creek Habitat Assessment, front page - December 8, 1999

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

STREAM NAME EAST Rock Clerk	LOCATION @ farmenton off Huy 31A
STATION # RIVERMILE	_ STREAM CLASS
LATLONG	RIVER BASIN U. Duck
STORET # 7N - 2012	AGENCY UPC
INVESTIGATORS AMG	
FORM COMPLETED BY * *	DATE Wed 12/08/92 REASON FOR SURVEY

		Conditio	n Category	the second s			
Habitat Parameter	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).	Less than 20% stable habitat; lack of habitat obvious; substrate unstable or lacking.					
SCORE //	20 19 18 17 16	15 14 13 12 61	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 //	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). (Sow is < $0.3 \text{ m/s}$ , deep is > $0.5 \text{ m.}$ )	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).		Dominated by 1 velocity depth regime (usually slow-deep).			
SCORE 8	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 /0	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 9	20 19 18 17 16	15 14 13 12 11	10 (9) 8 7 6	5 4 3 2 1 0			

Total 98 : Generally HABitat @ thu site ansast of pooled tu of varying depths (some awas quite dees) in floating wae mats & come dussaced - no two uffler & Harlis vater .... repairan varied (non exist, in areas) & high Water redimentation

#### Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-65 of D-70 Assessment, back page - December 8, 1999

Figure D-77	East Rock Creek	Habitat Assessment,	back page -	December 8,	1999
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Habitat	-	-	-		1	-		ion Cat	egory		_	-		_		
Parameter	-	Opti	mal		-	Subop	timal		Ma	rginal			Po	or		
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.			redging absent or present, usually in areas of bridge abutments;				s exte or s pres and reac	Channelization may be extensive; embankment or shoring structures present on both banks; and 40 to 80% of strean reach channelized and disrupted.				ts gabion or cement; ov 80% of the stream reachannelized and			
SCORE 15	20 1	9 18	17	16	(15)1	4 13	3 12 11	10	9	8 7		5 5 4	3	2	1 (	
7. Frequency of Riffles (or bends)	Occurrer relative of dista riffles d of the si (genera variety In stream are cont placeme other lan obstruct	ly freq nce be livided tream lly 5 to of habi ms who inuous ent of b rge, na	uent; r tween by wi <7:1 o 7); itat is l ere riff s, boulder tural	ratio dth key. les rs or	by the v	ent; die n riffle vidth o	stance s divided	bend prov dista divid	l; botto ide son nce bet ied by t tream i	riffle or m conto ne habit ween ri the widt s betwe	at; ffles h of	or shal habitat riffles width	ally all llow rif divided of the s f >25.	fles; i ice be i by t	poor etwee he	
SCORE 10	20 19	18	17	16	15 14	13	12 11	(10)	9	8 7	6	5 4	3	2	1 0	
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.			f 60% areas erosio	Moderately unstable; 30- 60% of bank in reach has areas of erosion; high erosion potential during floods.				Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing 60-100% of bank has erosional scars.				
SCORE 6 (LB)	Left Ban	k 10		9	8	7	6	5	4		3	2	1		0	
SCORE 6 (RB)	Right Ba	nk 10	11.10	9	8	7	6	5	4	F	3	2	1	N.F.T.	0	
9. Vegetative Protection (score each bank)	More tha streamba immedia covered l vegetatio trees, und or nonwo macrophy disruption grazing o minimal almost all to grow n	nk sur te ripar by nati n, incl derstor oody ytes; vo n throu or not o l plants aturall	faces a rian zo ve uding y shrul egetati igh ing eviden s allow	t; ve	of plants represent evident b full plant potential extent; m	nk sur by nati n, but is not ed; dis ut not growt to any ore that e poten eight	ve one class well- sruption affecting h great	stream cover disrup patche closel vegeta than o potent height	ed by v tion ob s of ba y cropp tion co ne-half	urfaces egetatio vious; re soil c ed mmon; of the t stubbl	or less	Less tha streamb covered disruption vegetation removed 5 centim average	ank sur by veg on of si on is ve on has i to neters o	faces ream ery hi been r less	on; bank gh; in	
SCORE 3 (LB)	Left Bank	c 10	9	-	8	7	6	5	4	(3	$\mathbf{D}$	2	1	(	D	
SCORE 3 (RB)	Right Bar	nk 10	9		8	7	6	5	4	(3		2	1	(	)	
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of >18 meter activities lots, roadh cuts, lawn have not i	(i.e., pa beds, c is, or ci	arking lear- rops)	1	Width of 12-18 me activities zone only	ters; hi have in	mpacted	6-12 m	eters; h	impact		Width of <6 meter riparian to human	s: little	or no	0	
SCORE 3 (LB)	Left Bank	10		9	8	7	6	5	4	(3	>	2	1	0	)	
SCORE 3 (RB)	Right Ban			9	8	7	6	5	4	6		2		0	-	

# HABITAT ASSESSMENT FIELD DATA SHEET-HIGH GRADIENT STREAMS (BACK)

Total Score \_ 98

1

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Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-66 of D-70

# Figure D-78

East Rock Creek field sheet, p1 - July 24, 2001

		SILL	AN SURVE	YFORM			
STABLISHED STATION	FILL IN SH	ADED BLANKS OF H	EADER	NEW STATIO	N F	LL IN ALL HEADER BL	ANKS FOR
ank data fields indicate n			impling.		A	NEW STATION	
TREAM SURVEY INFOR	NATION			STORET#	EROCI	001.8N	16
TREAM:	FAST	- BOCK	Creek				
REAM LOCATION:	Contraction of the second seco	is cits	Anes	Static	mRd	ila, di Hisiatukora	to 1000
OUNTY CODE:(FIPS)	117 1	(STATE CODE)	59		ASSESSOR	s:	KS/CHP
	Uppe		2)(		DATE:		7/04/01
AJOR BASIN		40002	-15		TIME:	_	1409
BID#/HUC:	N35.5				STREAM MI	LE:	1.8
VBID NAME:		7537Le			STREAM OF	RDER:	
AT/LONG DEG:	a180.	13510			REACH FILE	E #	
AT/LONG DEC:	1.1	ISF			3Q20:	2	
JSGS QUAD:		101	rm		ELEVATION	(ft):	1d09
Drains to:	rm				FIELD#	-	SAN NUM CONTRACTO
COLOGICAL SUBREGION		L	t see a			Missing All	
DBJECTIVES: (Inpr	- Duck	whe	rswall		000010000000000000000000000000000000000	1	
SAMPLES COLLECTED	ANT THE PARTY OF		nd nion Reinfield	METER	RS USED:	Mansond	
HEMICALS YOOR N LI	ife Assessed?	Macroinverteb	orates >	Fish	Algae	Other	Brunecon.
			Samples retu	urned ? (Yor )	N Sampl	ing Method:	SQBank
Additional List Attached Ye	INO INO			-	- Land Article	POT	14068.5
FIELD ANALYSIS:		1 the state of the	1		DISCOUNTS	- F	5.31 PPN
ьн	7.35	SU			DISSOLVED	OATGEN -	1408
CONDUCTIVITY	359.Z	UMHOS			TIME	AV TO DO TO	
	27.00	С			OTHERS	desire Vi	7.4 Bett
TEMPERATURE			LITTLE	MODERATE	HEAVY	FLOODING	
Previous 48 hours Precip:		NONE		RAIN		U90°F	
Ambient Weather:	SUNNY	CLOUDY	BREEZY	RAIN	314044	OTO F	
PASTURE 100	URBAN		RESID OTHER		occes	Cours ha	- advised
	MINING	1024120.20	and the second	Sec. 1			-0.53
FOREST	t), M(oderate),	H(igh) magni	itude, Blank	= not observ	ved	and the second	
	Flow Alter.	(1500)	SOURCES			Unknown	(9000)
CAUSES		(1600)	Point Source	e: Indust (	(0100)	Municipal	(2000)
Pesticides (0200)	Thermal Alt.		Logging		(2000)	Mining	(5000)
Metals (0500)	and the second se	(1700)	Construction	n;Land Devel	(3200)	Road /bridge	(3100)
(0000)			and the second se		(8800)	Urban Runoff	(4000)
Ammonia (0600)		(1900)	IU/S Dam				
Chlorine (0700)	Oil & grease		U/S Dam Riparian los	s	(7600)	Bank destabil	ization (7700)
Chlorine (0700) Nutrients (0900)	Oil & grease Unknown	(0000)	Riparian los		(7600)	Bank destabil Intensive Fee	ization (7700)
Chlorine (0700) Nutrients (0900) pH (1000)	Oil & grease Unknown Siltation	(0000) (1100) M	Riparian los Agriculture:	Row crop	(1000)	Bank destabil Intensive Fee Dredging	ization (7700)
Chlorine         (0700)           Nutrients         (0900)           pH         (1000)           Organic Enrichment / Low I	Oil & grease Unknown Siltation	(0000)	Riparian los Agriculture: Livestock gr		(1000)	Intensive Fee	ization (7700) edlot (1600)
Chlorine         (0700)           Nutrients         (0900)           pH         (1000)           Organic Enrichment / Low I           Other:	Oil & grease Unknown Siltation D.O.	(0000) (1100) M (1200)	Riparian los Agriculture: Livestock gr Other:	Row crop ( razing-ripariar	(1000) n (1410) M	Intensive Fee Dredging	ization (7700) edlot (1600)
Chlorine         (0700)           Nutrients         (0900)           pH         (1000)           Organic Enrichment / Low I           Other:           PHYSICAL STREAM CH	Oil & grease Unknown Siltation D.O.	(0000) (1100) M (1200)	Riparian los Agriculture: Livestock gr Other:	Row crop ( razing-ripariar	(1000)	Intensive Fee Dredging	ization (7700) edlot (1600)
Chlorine         (0700)           Nutrients         (0900)           pH         (1000)           Organic Enrichment / Low I           Other:           PHYSICAL STREAM CH	Oil & grease Unknown Siltation D.O.	(0000) (1100) M (1200)	Riparian los Agriculture: Livestock gr Other: LENGTH O	Row crop ( razing-ripariar	(1000) n (1410) M AREA ASSES	Intensive Fee Dredging SED (m):	ization (7700) edlot (1600) (7200)
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# Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-67 of D-70

#### Figure D-79 East Rock Creek field sheet, p2 - July 24, 2001

AAN	RIFFLE	RUN	POOL			auge/Bench	Ht: -	01010		
		2=			VELOC	TV IOFOL				
					VELOC	ITY (CFS)	-			
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	and the second se		MARE (-3).		2010-0001					
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	scription Viciay ry fine sand e sand e sand e sand arse sand ry coarse sand avel bble uilder drock tody debris <b>THER SUBSTI</b> (%) 10") -10") -2.5") <b>THER SUBPOR</b> 0 FOR: upply III Nat. Repr? HDRAWL NOT R: dvis.: <b>TATUS;</b> RTING (FS)	scription abbreviation totay cl ny fine sand vfs e sand fs ed sand ms arse sand cs ny coarse sand (use actual size) bible (use actual size) drock bdrx body debris wood FHER SUBSTRATE INFO BL (%) (Visual estime RIFFLE 10") % -10") % -2.5") % fritty) % SE SUPPORT: 0 FOR: upply Ind. H2O Sup Nat. Repr? HDRAWL NOTED R: Bacteriological / dvis.: Do Not Consum Precautionary FATUS; RTING (FS) PARTIALLY SU ETCH My SS SY or N Roll #	scription       abbreviation       Record measure         btdiay       cl       1-10         ny fine sand       vfs       11-20         e sand       fs       21-30         add sand       ms       31-40         arse sand       cs       21-70         py coarse sand       (use actual size)       51-60         by coarse sand       (use actual size)       61-70         bble       (use actual size)       61-70         bble       (use actual size)       61-70         bble       (use actual size)       81-90         drock       bdrx       91-100         ody debris       wood       wood         ftHER SUBSTRATE INFO BLOCKS       (%)       (Visual estimates)         (%)       (Visual estimates)       %       30         ftftty)       %       30       %         SE SUPPORT:       %       20       %         piply <td>scription       abbreviation       Record measured particle size. U         billing       1-10       1         ny fine sand       vfs       11-20         e sand       fs       21-30         arse sand       cs       31-40         yr coarse sand       (use actual size)       51-60         avel       (use actual size)       61-70         bible       (use actual size)       81-90         ulder       (use actual size)       81-90         oddy debris       wood       1         free SUBSTRATE INFO BLOCKS       (%)       91-100         10")       96       5       96         10")       96       5       96         10")       96       5       96         10")       96       5       96         10")       96       5       96         11"       Navigation       DOMINANT         PFOR:       LIST LOG NU         11       Navigation       DOMINANT         Nat Repr?       VERY ABUN         HDRAWL NOTED       ABUNDANT         COMMON (3       R:       Bacteriological Advis.         RARE (&lt;3):</td> Do Not Consume	scription       abbreviation       Record measured particle size. U         billing       1-10       1         ny fine sand       vfs       11-20         e sand       fs       21-30         arse sand       cs       31-40         yr coarse sand       (use actual size)       51-60         avel       (use actual size)       61-70         bible       (use actual size)       81-90         ulder       (use actual size)       81-90         oddy debris       wood       1         free SUBSTRATE INFO BLOCKS       (%)       91-100         10")       96       5       96         10")       96       5       96         10")       96       5       96         10")       96       5       96         10")       96       5       96         11"       Navigation       DOMINANT         PFOR:       LIST LOG NU         11       Navigation       DOMINANT         Nat Repr?       VERY ABUN         HDRAWL NOTED       ABUNDANT         COMMON (3       R:       Bacteriological Advis.         RARE (<3):	scription       abbreviation       Record measured particle size. Use abbrev. b         Volay       cl       1-10       1-10         yr fire sand       yfs       21-30       1         asand       ms       31-40       1         arse sand       cs       41-50       1         yr coarse sand       (use actual size)       51-60       1         yred       (use actual size)       61-70       1         bble       (use actual size)       81-90       1         ulder       (use actual size)       81-90       1         drock       bdrx       91-100       1       1         ulder       (use actual size)       81-90       1       1         frees       weld       (use actual size)       81-90       1       1         ordy debris       wood       91-100       1       1       1         frees       Weld       90       5%       %       %       1       1         frees       RIFFLE       RUN       POOL       0       0       1       1       1       1       1       1       1       1       1       1       1       1       1       1<	scription t/clay       abbreviation of the sand       Record measured particle size. Use abbrev, below for smaller to proceed to the sand         tops in a sand       district in the sand       1-10       1       1         arse sand       cs       21-30       1       1         arse sand       cs       41-50       1       1         y coarse sand       cs       41-50       1       1         y coarse sand       cs       61-70       1       1         top coarse sand       (use actual size)       61-70       1       1         bile       (use actual size)       81-90       1       1       1         uider       (use actual size)       81-90       1       1       1       1         uider       (use actual size)       81-90       1       1       1       1         10''       % <td>Scription         abbreviation         Record measured particle size. Use abbrev. below for smaller sizes.           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Vifay         d         1-10         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1</td>	Scription         abbreviation         Record measured particle size. Use abbrev. below for smaller sizes.           Volay         cl         1-10         1         1         1           y fine sand         ys         21-30         1         1         1         1           dd sand         ms         31-40         1         1         1         1         1         1           y coarse sand         (use actual size)         51-60         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1	Stription         abbreviation         Record measured particle size. Use abbrev. below for smaller sizes.           Viciay         cl         1-10         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1	Section         abbreviation         Record measured particle size. Use abbrev. below for smaller sizes.           Vifay         d         1-10         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1	

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Figure D-80 East Rock Creek Habitat Assessment, front page - July 24, 2001

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# HABITAT ASSESSMENT FIELD DATA SHEET-LOW GRADIENT STREAMS (FRONT)

STREAM NAME East Rock G.	LOCATION 75 yds as Anes Station Rd
STATION #RIVERMILE	STREAM CLASS
LATLONG	RIVER BASIN
STORET = EROCK COI. SML	AGENCY Lobs For CO
INVESTIGATORS KJS/CAP	normal pattern. evel, evel, evel, evel
FORM COMPLETED BY	DATE 7/24/01 REASON FOR SURVEY

	Habitat	Condition Category									
	- arameter	Optimal	Suboptimal	Marginal	Poor						
	1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epificanal colonization and fish cover, mix of snags, submerged logs, dercut 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 mansient).	30-50% mix of stable habitat; well-suited for full colonization potential, adequate habitat for maintenance of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	16-30% mix of stable habitat, habitat availability less chan desirable, substrate frequently disturbed or temoved	Less than 10% stable habitat lock of habitat obvious, substrate unstable or lacking						
10	SCORE 10	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1						
CURRENT OF SAULTING FORCH	2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud. or clay; mud may be dominant; some root mats and submerged yepetation mesent	All mud or clay or sand bottom: little or no root mat; no submerged vegetation	Hard-pan clay or becrock, no root mat or vegetation						
100	SCORE	20 19 18 17 16	15 12 13 12 11	10 9 8 7 6	5 4 3 2 1 0						
	3. Pool Variability	Even max of larget shallow, large-deep, small-shallow, small- deep pools present.	Majonty of pools large- deep: very few shallow:	Shallow pools much more prevalent than deep puols	Majority of pools small shallow or pools absent						
LIN IS	SCORE	20 19 18 17 16	15 14 13 12	10 9 8 7 6	543210						
Latameters to	4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 955 <2056 for low-gradient streams) of the bottom affected hy- sedament deposition	Some new increase in bar formation, mostly from gravel, sand or the sediment; 5-30ru (20-50rt) for low- gradient) of the bottom alfected; 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, constructions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development, more that \$0°6 (80°c for low- gradient) of the Swittern changing frequently, pools almost absent due to substantial sediment deposition.						
110	SCORE 9	20 19 18 17 16	15 14 13 12 11	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 subsitiate is exposed	Water fills >73% of the available channel, or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or nifle substrates are mostly exposed.	Very little water in channel and mostly present as granding pools.						
0	SCORE 10	20 19 18 17 16	15 14 13 12 11 3	10 9 8 7 6	5 4 3 2 1 0						

## Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page D-69 of D-70

# Figure D-81 East Rock Creek Habitat Assessment, back page - July 24, 2001

DRAFT REVISION-July 28, 1997
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#### HABITAT ASSESSMENT FIELD DATA SHEET-LOW GRADIENT STREAMS (BACK)

	Habitat Parameter	Condition Category								
	Farantett	Optimal	Suboptimal			largina		-	Poor	
	6. Channel Alteration	Channelization or dredging absent or minimal stream with normal pattern. Cour hove full eccess Bobs u/std/s	Some channelization present, usually in areas of bridge aburments; evidence of past channelization, i.e., dredging, I greater than past 20 yr) may be present, but recent channelization is not areasent.		Channelization may be extensive; embankments or shoring tructures present on both banks; and 40 to 80% of Stream reach channelized and disrupted.			Banks shored with gabian or coment; over 50% of the stream read channelized and disrupted. Instream habits greatly altered o removed entirely.		
	SCORE 13	20 19 18 17 16	13 14 (13) 12	11	10 9	8	7 ó	5 4	3 2	1 0
hampling reach	7. Channel Sinuotiry	The bends in the stream increase the stream length 3 to 4 times lenger than if it was in a smaight line. (Note - channel braiding is considered normal in coastal planes and other low-lying areas. This parameter is not easily rated in these areas	The bends in the st increase the stream length 2 to 3 innes longer than if it wa straight line.		The bend increase : length 2 t longer th stranght li	he stres o 1 time	im ts	Waterwa	stranghi has be zed for	107
	SCORE 9	20 19 18 17 16	15 14 13 12	11	:0 9	8	7 6	5 . 4	3 2	1 0
he evaluated broader than so	R. Bank Stability (score each bank)	Banks stable; evidence of crossion or bank failure absent or minimal; hitle potential for future problems. <5% of bank affected.	Moderately stable: infrequent, snall areas of ernsion mostly heated over. 5-30° of bank in reach has areas of erosion.		Moderately unstable: 30- 60% of bank in reach bas areas of erosion; high erosion potential during 7- ods.			Cinstable, many croded areas; "raw" areas trequent along straight sections and bends, obvious bank sloughing; 60-100% of bank has crossional sears.		
	SCORE (LB)	Left Bank 10 9	001811 71 21	0	5	4	3	$(\tilde{z})$		0
Parameters to he eva	SCORE 3 (RB)	Right Bank 10 9	8 7	6	5	4	0	2	1	0
	9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream	Nore than 90% of the streambank surfaces and immediate ngarnan zone covered by native vegetation, including mess, understory shrubs, or notwody imacrophytes, vegetative disruption through grazing or mowing minimal or not evident; aimost all plants allowed to grow naturally.	10.00% 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 subble height remaining.		S0-70% 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 if centimeters or less in average stubble height.			
	SCORE (LB)	Left Bank 10	8 7	6	5	4	3	(2)	1	0
	SCORE (RB)	Right Bank 10	8 7	6	5	4	(1)	2	1	0
	10. Riparian Vegetative Zone Wideb (secre 200 bank riparian zone)	Width of riparian zone >13 meters; human activities (i.e., parking loss readbrids, thinks, thi lawing, or crops) have not impacted zone	Width of npanan zone 12-18 meters; human activities have impacted activities have impacted activities minimally.		Width of npanan zone 5- 12 meters: human activities have impacted zone a great deal.		Width of viparian zone <6 meters: little or no reparan vegetation due to human activities			
1	SCORE (LB)	Left Bank 10. 9	8 7	6	5	4	3	(2)	an the	0
	SCORE IRBI	Right Bank 10 9	8 7	6	. 5	4	3	2		0
	And the Party of t								11	

Appendix A-1 Habitat Assessment and Physicochemical Characterization Field Data Sheets - Form 1

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Photo of East Rock Creek at RM 1.8 - July 24, 2004 Figure D-82

East Rock Creek (EROCK001.8ML) 100 yards u/s Anes Station Rd. View upstream of the sample area. Col. KJS/CAP 7/24/04 @ 1403.

> Note: This photo highlights the poor riparian vegetative zone, as indicated in the stream assessment above. The stream is adjacent to a roadway, with poor canopy and no fencing so that cattle have full access to the stream.

Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page E-1 of E-2

# APPENDIX E

**Public Notice Announcement** 

Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page E-2 of E-2

# 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

#### UPPER DUCK RIVER WATERSHED (HUC 06040002), TENNESSEE

Announcement is hereby given of the availability of Tennessee's proposed Total Maximum Daily Loads (TMDLs) for siltation and habitat alteration in the Upper Duck River Watershed located in middle 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 Upper Duck River Watershed are listed on Tennessee's final 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 4% to 54% 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. (note: this was subsequently changed to http://www.state.tn.us/environment/wpc/tmdl/proposed.shtml)

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

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

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

Persons wishing to comment on the TMDLs are invited to submit their comments in writing no later than April 24th, 2006 to:

Division of Water Pollution Control Watershed Management Section 6<sup>th</sup> 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.

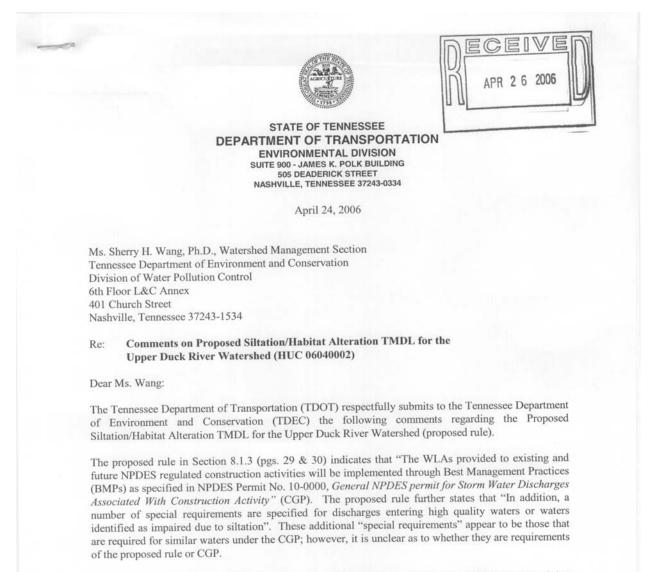
**The TMDL and supporting information are on file at the Division of** Water Pollution Control, 6<sup>th</sup> Floor, L & C Annex, 401 Church Street, Nashville, Tennessee. They may be inspected during normal office hours. Copies of the information on file are available on request.

Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page F-1 of F-3

# **APPENDIX F**

**Public Comments Received** 

#### Letter from TDOT dated April 24, 2006:



TDOT presumes that the special requirements are a restatement of portions of the CGP language and that compliance with all of the CGP language would meet the proposed rule intent. Without a clarifying statement, these special requirements could be interpreted as TMDL requirements which could effectively void some of the exemptions provided by the CGP in Sections 4.4.2 and 4.4.3.

TDOT asserts that the statement with this section, "Strict compliance with the provisions of the *General* NPDES Permit for Storm Water Discharges Associated With Construction Activity (TDEC, 2005a) can reasonably be expected to achieve reduced sediment loads to streams" states the emphasis on the importance of these special requirements. If these special requirements must be restated, TDOT suggests confirming that the special requirements are part of the CGP, by changing the language to "In addition, a number of special requirements are specified by the CGP for discharges entering high quality waters or waters identified as impaired due to siltation." This would reaffirm that the special requirement language

Siltation/Habitat Alteration TMDL Upper Duck River Watershed (HUC 06040002) (7/24/06 - Final) Page F-3 of F-3

Ms. Sherry H. Wang April 24, 2006 Page 2 of 2

was taken from the CGP and that compliance with that permit will determine permit eligibility as it relates to NPDES Regulated Construction Storm Water in TMDL watersheds.

TDOT's proposed Municipal Separate Storm Sewer System (MS4) permit includes sampling of runoff to test pre- and post-implementation of BMPs before they are introduced as a storm water management tool. TDOTs proposed Storm Water Management Plan (SWMP) and monitoring plan shall be submitted back to the Nashville Central Office for approval. In Section 8.1.4 (pg. 31), TDOT suggests indicating in the TMDL that TDOT's SWMP and associated sampling/monitoring plan will be submitted to and approved by the Nashville Central Office of TDEC within the SWMP and not the local Environmental Field Office within 12 months of the approval date of this TMDL.

TDOT greatly appreciates this opportunity to comment and TDEC's consideration of our comments on the proposed rulemaking. Feel free to call me at (731) 935-0325 if you have any questions regarding TDOT's comments.

Sincerely K. Knok

Mf. Jod∛K. Knok TDOT Project Compliance Coordinator Environmental Division

DJD:JLH:ALD:jkk

 cc: Mr. Doug Delaney, ED Director (via email) Mr. John Hewitt, TDOT Permits Office Manager (via email) Ms. Angie Duncan, Storm Water and Project Compliance Section Manager (via email) Ms. Deedee Kathman, TDOT Ecology Section (via email) Chrono. File Reading file

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**APPENDIX G** 

**Response to Public Comments** 

#### Response to TDOT letter dated April 24, 2006:

#### Issue No. 1 (summarized)

The special requirements detailed in Section 8.1.3 of the TMDL appear to restate requirements of the NPDES Permit No. 10-0000, *General NPDES Permit for Storm Water Discharges Associated with Construction Activity* (TDEC, 2005a), thereby eliminating the possible applicability of some of the exemptions provided in the general permit.

#### Response to Issue No. 1

Section 8.1.3 was revised to clarify that unless otherwise stated, full compliance with the requirements of the *General NPDES Permit for Storm Water Discharges Associated With Construction Activity* is considered to be consistent with the WLAs specified in Section 7.3.3 of this TMDL document.

## Issue No. 2 (summarized)

Since TDOT's proposed Municipal Separate Storm Sewer System (MS4) permit specifies that TDOT's proposed Storm Water Management Plan (SWMP) and monitoring plan shall be submitted to the Nashville Central Office for approval, TDOT would prefer the TMDL language not require TDOT to submit a detailed plan describing the monitoring program to the appropriate Environmental Field Office (EFO) of the Division of Water Pollution Control within 12 months of the approval date of the TMDL.

#### Response to Issue No. 2

The local EFO staff is best suited to evaluating the detailed plans describing the monitoring program. Therefore, the requirement for submitting a detailed plan to the appropriate Environmental Field Office (EFO) of the Division of Water Pollution Control within 12 months of the approval date of the TMDL remains as previously stated.