Final Total Maximum Daily Load for *E. coli*
7 Stream Segments within the Muddy Creek Watershed
Madison County, Kentucky

Muddy Creek, Madison County, KDOW

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May 2013

Kentucky Department for Environmental Protection
Division of Water

This report is approved for release

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Sandra L. Gruzesky, P.E., Director
Division of Water

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Date

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Glossary of Acronyms

ADD	Area Development District
AFO	Animal Feeding Operation
AWQA	Agriculture Water Quality Act
BMP	Best Management Practices
BMU	Basin Management Unit
CAFO	Confined Animal Feeding Operation
CFR	Code of Federal Regulations
CPP	Continuing Planning Process
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CSO	Combined Sewer Overflow
DEP	Department of Environmental Protection
DMR	Discharge Monitoring Report
DOC	Division of Conservation
ft^3	Cubic feet
GIS	Geographic Information System
GNIS	Geographic Names Information System
HUC	Hydrologic Unit Code
KAR	Kentucky Administrative Regulations
KDFWR	Kentucky Division of Fish and Wildlife Resources
KDOC	Kentucky Division of Conservation
KDOW	Kentucky Division of Water
KGS	Kentucky Geological Survey
KRS	Kentucky Revised Statutes
KIA	Kentucky Infrastructure Authority
KNDOP	Kentucky No Discharge Operational Permit
KPDES	Kentucky Pollution Discharge Elimination System
L	Liter
LA	Load Allocations
LTCP	Long Term Control Plan
MAF	Mean Annual Flow
MGD	Million Gallons per Day
MHP	Mobile Home Park
ml	milliliter
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer Systems
NASS	National Agricultural Statistics Service
NHD	National Hydrography Dataset
NLCD	National Landcover Database
NRCS	Natural Resources Conservation Service
NPDES	National Pollution Discharge Elimination System
NPS	Nonpoint Source
NOV	Notice of Violation

OSTDS	On Site Sewage Treatment and Disposal System
PCR	Primary Contact Recreation
PCS	Permit Compliance System
POTW	Publicly Owned Treatment Works
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RM	River Mile
SCR	Secondary Contact Recreation
SOP	Standard Operating Procedures
SSO	Sanitary Sewer Overflow
STP	Sewage Treatment Plant
SWPB	Surface Water Permits Branch
SWS	Sanitary Wastewater System
SWQMP	Storm Water Quality Management Plan
TMDL	Total Maximum Daily Load
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WAH	Warm Water Aquatic Habitat
WBID	Waterbody Identification Number
WBP	Watershed Based Plan
WLA	Waste Load Allocation
WMB	Watershed Management Branch
WQB	Water Quality Branch
WQC	Water Quality Criteria
WQS	Water Quality Standard
WWTP	Wastewater Treatment Plant

Total Maximum Daily Load (TMDL) Synopsis

State: Kentucky
Major River Basin: Kentucky
USGS HUC8 #: 05100205
County(s): Madison
Pollutant(s) of Concern: *E. coli*

Table S.1 Impaired Waterbodies Addressed in this Bacteria TMDL Document

Waterbody Name	Pollutant	County	GNIS Number	Suspected Sources	Impaired Use (Support Status)
Muddy Creek 0.0 to 20.6	*E. coli*	Madison	KY514141_01	Livestock (Grazing or Feeding Operations), Failing Septic, Illegal Straight Pipe, Other Permitted Small Dischargers	PCR (not supporting)
Muddy Creek 20.6 to 31.4	*E. coli*	Madison	KY514141_02	Livestock (Grazing or Feeding Operations), Failing Septic, Illegal Straight Pipe, Other Permitted Small Dischargers	PCR (not supporting)
UT to Muddy Creek 0.0 to 2.4	*E. coli*	Madison	KY514141_21.3_01	Livestock (Grazing or Feeding Operations), Failing Septic, Illegal Straight Pipe, Other Permitted Small Dischargers	PCR (not supporting)
Viny Fork 0.0 to 4.1	*E. coli*	Madison	KY506062_01	Livestock (Grazing or Feeding Operations), Failing Septic, Illegal Straight Pipe	PCR (not supporting)
Hickory Lick 0.0 to 2.9	*E. coli*	Madison	KY494139_01	Livestock (Grazing or Feeding Operations), Failing Septic, Illegal Straight Pipe	PCR (not supporting)
Clear Creek 0.0 to 4.1	*E. coli*	Madison	KY489606_01	Livestock (Grazing or Feeding Operations), Failing Septic, Illegal Straight Pipe	PCR (not supporting)
Dunbar Branch 0.0 to 2.6	*E. coli*	Madison	KY491284_01	Livestock (Grazing or Feeding Operations), Failing Septic, Illegal Straight Pipe	PCR (not supporting)

Total Maximum Daily Load (TMDL) Synopsis

Kentucky Water Quality Criteria (WQC) and the TMDL Endpoint (i.e. Water Quality Standard/ TMDL Target):

Title 401 KAR 10:031 describe the standards used to "protect the surface waters of the Commonwealth, and thus protect water resources." *Escherichia coli* (*E. coli*) bacteria are pathogen indicator organisms. *E. coli* data are used to indicate the degree of support for primary contact recreation (PCR) use. The stream is assessed as fully supporting the PCR use if the *E. coli* content does not exceed the criterion of 240 colonies per 100 ml in less than 20 percent of samples; it was assessed as partially supporting the PCR use if the criterion was not met in 25-33 percent of samples, and as not supporting the PCR use if the criterion was not met in greater than 33 percent of samples. Streams assessed as either nonsupport or partial support are considered impaired. Stream segments were sampled twice a month in addition to a geometric mean in the spring and fall during the PCR season of May 1 through October 31, 2011.

The WQC in 401 KAR 10:031 (Kentucky's Surface Water Standards) for the PCR use are based on both fecal coliform and *E. coli*. Per 401 KAR 10:031:

"The following criteria shall apply to waters designated as primary contact recreation use during the primary contact recreation season of May 1 through October 31: Fecal coliform content or Escherichia coli content shall not exceed 200 colonies per 100 ml or 130 colonies per 100 ml respectively as a geometric mean based on not less than five (5) samples taken during a thirty (30) day period. Content also shall not exceed 400 colonies per 100 ml in twenty (20) percent or more of all samples taken during a thirty (30) day period for fecal coliform or 240 colonies per 100 ml for Escherichia coli."

Both the geomean and instantaneous criteria of 130 and 240 *E. coli* colonies/100 ml, respectively, were applied to calculate allowable loadings to bring the watershed into compliance with the PCR designated use. The loading requiring the greatest percent reduction was used to set the TMDL for a segment (in every case for Muddy Creek, the instantaneous loading was used).

The TMDL Target is defined as the WQC minus the Margin of Safety (MOS). The MOS can be an implicit or explicit additional reduction applied to the Waste Load allocation (WLA), Load Allocation (LA) or to both types of sources that accounts for uncertainties in the data or TMDL calculations. The TMDL Target is thus 216 colonies per 100ml (240 col/100ml minus a 10% MOS).

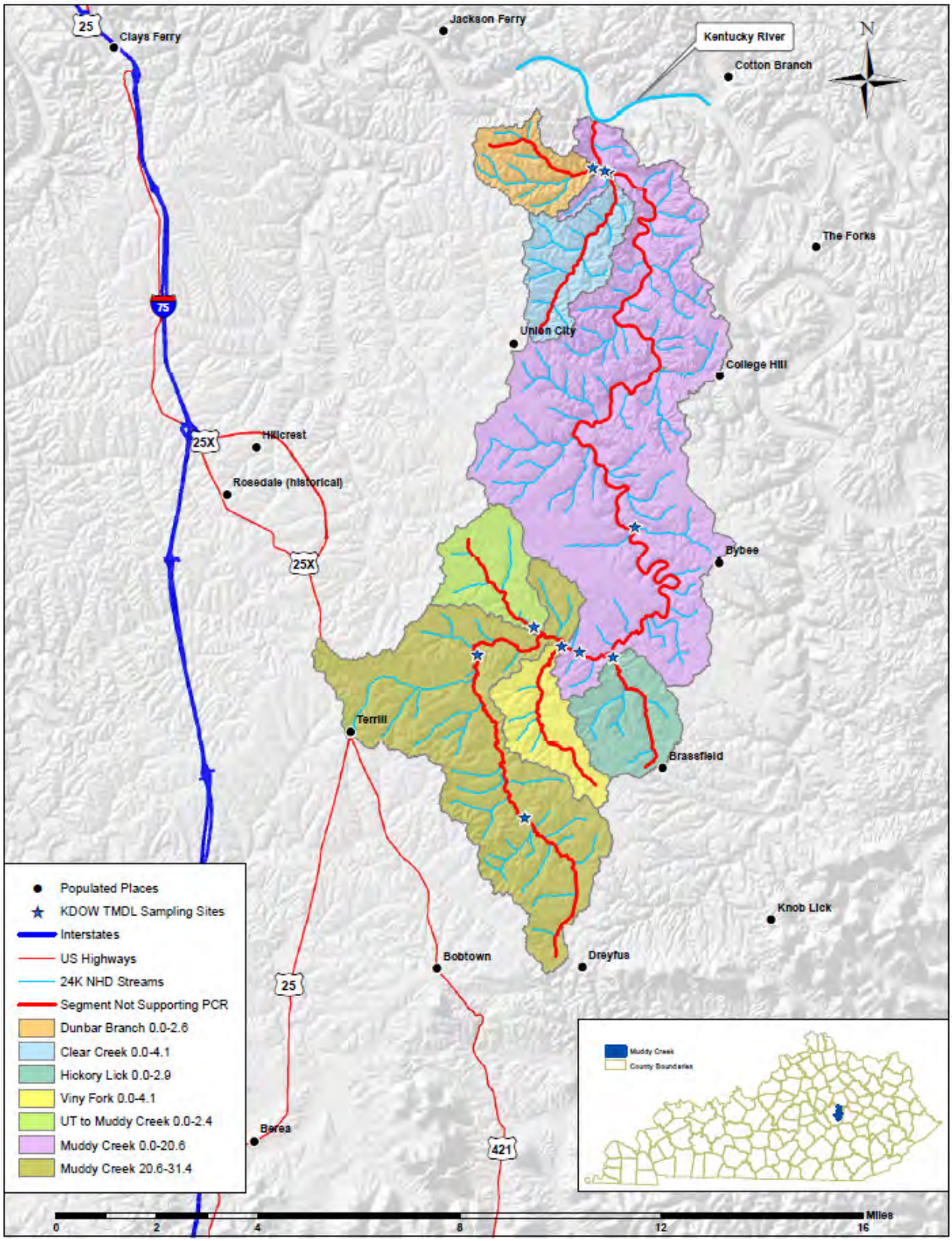

Figure S.1 Location of the Muddy Creek Watershed, Sample Sites and Assessed Stream Segments

Total Maximum Daily Load (TMDL) Synopsis

TMDL Equation and Calculations:

A TMDL calculation is performed as follows:

$$TMDL = WLA + LA + MOS$$
(Equation 1)

The WLA has three components:

$$WLA = SWS\text{-}WLA + MS4\text{-}WLA + Future\ Growth\text{-}WLA$$
(Equation 2)

Where:
TMDL: the WQC, expressed as a load. The WQC is defined in Section 6.0 as an instantaneous concentration of 240 colonies/100 ml for *E. coli* or 400 colonies/100 ml for fecal coliform.
MOS: the Margin of Safety, which can be an implicit or explicit additional reduction applied to sources of pollutants that accounts for uncertainties in the relationship between effluent limits and water quality.
TMDL Target: the TMDL minus the MOS.
WLA: the Wasteload Allocation, which is the allowable loading of pollutants into the stream from KPDES-permitted sources, such as SWSs and MS4s.
SWS-WLA: the WLA for KPDES-permitted sources, which have discharge limits for pathogen indicators (including wastewater treatment plants, package plants and home units).
Future Growth-WLA: the allowable loading for future KPDES-permitted sources, including new SWSs, expansion of existing SWSs, new storm water sources, and growth of existing storm water sources (such as MS4s). Also includes the allocation for the KPDES-permitted sources that existed but were not known at the time the TMDL was written.
Remainder: the TMDL minus the MOS and minus the SWS-WLA (also equal to Future Growth-WLA plus the MS4-WLA and the LA).
MS4-WLA: the WLA for KPDES-permitted municipal separate storm water sewer systems (including cities, counties, roads and right-of-ways owned by the Kentucky Transportation Cabinet (KYTC), universities and military bases).
LA: the Load Allocation, which is the allowable loading of pollutants into the stream from sources not permitted by KPDES and from natural background.
Seasonality: yearly factors that affect the relationship between pollutant inputs and the ability of the stream to meet its designated uses.
Critical Condition: the time period when the pollutant conditions are expected to be at their worst.
MAF: the Mean Annual Flow as defined by USGS.
Adjusted MAF: the MAF plus SWS-WLA design flows.
Critical Flow: the flow used to calculate the TMDL as a load (is equivalent to the Adjusted MAF for MAF TMDLs)
Existing Conditions: the load that exists in the watershed at the time of TMDL development (i.e., sampling) and is causing the impairment.
Percent Reduction: the loading reduction needed to bring the existing condition in line with the TMDL target.

Total Maximum Daily Load (TMDL) Synopsis

Load: concentration * flow * conversion factor
Concentration: colonies per 100 milliliters (colonies/100ml)
Flow (i.e. stream discharge): cubic feet per second (cfs)
Conversion Factor: the value that converts the product of concentration and flow to load (in units of colonies per day); it is derived from the calculation of the following components: (28.31685L/f^3 * 86400seconds/day * 1000ml/L)/ (100ml) and is equal to 24,465,758.4.

Calculation Procedure:

1) The MOS, if an explicit value, is calculated and subtracted from the TMDL first, giving the TMDL Target;
2) Percent reductions are calculated to show the difference between Existing Conditions and the TMDL Target;
3) The SWS-WLA is calculated and subtracted from the TMDL Target, leaving the Remainder;
4) The Future Growth-WLA is calculated and subtracted from the Remainder;
5) If there is a MS4 present upstream of the impaired segment, the MS4-WLA is subtracted from the Remainder based on percent land use, leaving the LA.

Translation of WLAs into Permit Limits

All KPDES-permitted sources must meet permit limits based on the Water Quality Criteria (WQC) in 401 KAR 10:031. SWS-WLAs will be translated into KPDES permit limits as an *E. coli* effluent gross limit of 130 colonies/100 ml as a monthly average and 240 colonies/100 ml as a maximum weekly average or as a fecal coliform effluent gross limit of 200 colonies/100 ml as a monthly average and 400 colonies/100 ml as a maximum weekly average.

The MS4-WLA is not a numerical end-of-pipe limit; it is an in-stream allocation. The MS4-WLA will be addressed through the MS4 permit and implemented through the Stormwater Quality Management Plan (SWQMP) to the Maximum Extent Practicable (MEP).

Total Maximum Daily Load (TMDL) Synopsis

Table S.2 TMDLs and Allocations

TMDL[(1)]	MOS[(2)]	SWS-WLA[(3)]	MS4-WLA	Future Growth - WLA	LA	Mean Annual Flow (cfs)
Muddy Creek into Kentucky River RM 0.0-20.6						
3.46×10^{11} col/day	3.46×10^{10} col/day	1.10×10^{8} col/day	7.13×10^{8} col/day	3.11×10^{9} col/day	3.07×10^{11} col/day	32.2
Muddy Creek into Kentucky River RM 20.6-31.4						
1.59×10^{11} col/day	1.59×10^{10} col/day	0	7.02×10^{8} col/day	2.87×10^{9} col/day	1.40×10^{11} col/day	6.7
UT to Muddy Creek RM 0.0-2.4						
2.54×10^{10} col/day	2.54×10^{9} col/day	0	0	4.58×10^{8} col/day	2.24×10^{10} col/day	4.4
Viny Fork into Muddy Creek RM 0.0-4.1						
2.52×10^{10} col/day	2.52×10^{9} col/day	0	0	2.27×10^{8} col/day	2.25×10^{10} col/day	4.3
Hickory Lick into Muddy Creek RM 0.0-2.9						
2.94×10^{10} col/day	2.94×10^{9} col/day	0	0	2.64×10^{8} col/day	2.62×10^{10} col/day	5
Clear Creek into Muddy Creek RM 0.0-4.1						
2.82×10^{10} col/day	2.82×10^{9} col/day	0	0	2.54×10^{8} col/day	2.51×10^{10} col/day	4.8
Dunbar Branch into Muddy Creek RM 0.0-2.6						
2.17×10^{10} col/day	2.17×10^{9} col/day	0	0	9.78×10^{7} col/day	1.95×10^{10} col/day	3.7

Notes:

(1). TMDLs are expressed as daily loads of *E. coli* colonies by multiplying the WQC by the mean annual streamflow (MAF) and the appropriate conversion factor. MAF is determined by the USGS. The TMDL is the sum of all components.

(2). MOS is explicitly set at 10% of the Water Quality Criterion

(3). Any future KPDES wastewater permitted sources must meet permit limits based on the Water Quality Criterion in 401 KAR 10:031, and must not cause or contribute to an existing impairment. WLA value is based on acute permit limits and design flow for dedicated sanitary outfalls or average daily flow for facilities with comingled waste streams and represents the maximum one-day load that can be discharged to the stream segment.

1.0 Introduction

Section 303(d) of the Clean Water Act requires states to identify waterbodies within their boundaries that have been assessed and are not currently meeting their designated uses (401 KAR 10:026 and 10:031) and that require the development of a Total Maximum Daily Load (TMDL). States must establish a priority ranking for such waters, taking into account their intended uses and the severity of the pollutant. Section 303(d) also requires that states provide a list of this information called the 303(d) list. This list is submitted to the Environmental Protection Agency (EPA) during even-numbered years and each submittal replaces the previous list. The 2010-303(d) information for Kentucky can be found in the 2010 *Integrated Report to Congress on the Condition of Water Resources in Kentucky Volume II. 303(d) List of Surface Waters* (Kentucky Division of Water (KDOW) 2010) and can be obtained at: http://water.ky.gov.

States are also required to develop TMDLs for the pollutants that cause each waterbody to fail to meet its designated uses. The TMDL process establishes the allowable amount (i.e. "load") of the pollutant the waterbody can naturally assimilate while continuing to meet the water quality criteria (WQC) for each designated use. The pollutant load must be established at a level necessary to implement the applicable WQC with seasonal variations and a Margin of Safety (MOS) that takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality. This load is then divided among different sources of the pollutant in a watershed. Information from EPA on TMDLs can be found at: http://www.epa.gov/owow/tmdl.

This TMDL document provides important bacteria allocations and reductions that could assist with developing detailed watershed plans to guide watershed restoration efforts. Watershed Plans for the bacteria impaired Muddy Creek waterbodies should address both KPDES-permitted (point) and non KPDES-permitted (nonpoint) sources of bacteria loadings to the watersheds and should build on existing efforts as well as evaluate new approaches. Comprehensive Watershed Plans should consider both voluntary and regulatory approaches in order to meet water quality standards.

2.0 Problem Definition

The Lower Kentucky River Basin-Muddy Creek, United States Geological Survey (USGS) hydrologic unit code (HUC) 0510020501 is located in central Kentucky near the intersection of Interstates 75 and 64. The area of interest is near the midpoint of the Kentucky River basin and is completely contained within Madison County (Figure 2.1).

2.1 303(d) Listing History

The KDOW Reference Reach Program first assessed Muddy Creek, from RM 0.0 to 20.2 in the 1998 Kentucky Report to Congress on Water Quality, as fully supporting the aquatic life (i.e. WAH) and fish consumption designated uses but not supporting the swimming (i.e. PCR) designated use. This segment of Muddy Creek was placed on the 303(d) List of Impaired Waters, after it was determined to be impaired by pathogens due to grazing related sources. Muddy Creek from RM 20.1 to 29.2 was also assessed as fully supporting the fish consumption designated use but no other uses were assessed (KDOW 1998). A summary of the original assessment information is listed in Table 2.1.

Table 2.1 Original Assessment Information in the Muddy Creek Watershed (1998 Report to Congress on Water Quality)

Waterbody Name	County	GNIS Number	Assessed Use (Support Status)
Muddy Creek 0.0 to 20.2	Madison	KY514141_01	PCR (not supporting)
Muddy Creek 0.0 to 20.2	Madison	KY514141_01	WAH, FC (fully supporting)
Muddy Creek 20.2 to 29.2	Madison	KY514141_02	FC (fully supporting)

The KDOW TMDL Section revisited Muddy Creek in 2011 to conduct a watershed study. KDOW biologists sampled ten sites throughout the watershed collecting water chemistry, bacteria and habitat information. Eight of the ten sites were also sampled for aquatic life. As a result of the sampling effort, KDOW proposes adding five tributaries and one more segment of Muddy Creek to the 2013 Integrated Report to Congress Electronic Update as impaired for the PCR designated use. The *E. coli* TMDL stream segments addressed in this document are listed in Table 2.2 and illustrated on Figure 2.1.

Data used to assess these waterbodies included *E. coli* data collected by the KDOW TMDL Section. General watershed data, available from the Kentucky Geography Network (i.e., geology, land cover, location of KPDES-permitted sources, etc. http://kygeonet.ky.gov) was also analyzed in a geographic information systems (GIS) framework. *E. coli* data are used as an indicator of the presence of bacteria pollution. Suspected sources of impairment include non-KPDES permitted sources (failing Onsite Sewage Treatment and Disposal Systems (OSTDSs), agriculture, livestock, illegal straight-pipe discharge and rural runoff) as well as KPDES permitted sources (Other Permitted Small Flows Discharges).

Table 2.2 Impaired Waterbodies within the Muddy Creek Watershed (USGS HUC 0510020501) Addressed in this TMDL Document

Waterbody Name	Pollutant	County	GNIS Number	Suspected Sources	Impaired Use (Support Status)
Muddy Creek 0.0 to 20.6	*E. coli*	Madison	KY514141_01	Livestock (Grazing or Feeding Operations), Failing Septic, Illegal Straight Pipe, Other Permitted Small Dischargers	PCR (not supporting)
Muddy Creek 20.6 to 31.4	*E. coli*	Madison	KY514141_03	Livestock (Grazing or Feeding Operations), Failing Septic, Illegal Straight Pipe, Other Permitted Small Dischargers	PCR (not supporting)
UT to Muddy Creek 0.0 to 2.4	*E. coli*	Madison	KY514141_21.3_01	Livestock (Grazing or Feeding Operations), Failing Septic, Illegal Straight Pipe, Other Permitted Small Dischargers	PCR (not supporting)
Viny Fork 0.0 to 4.1	*E. coli*	Madison	KY506062_01	Livestock (Grazing or Feeding Operations), Failing Septic, Illegal Straight Pipe	PCR (not supporting)
Hickory Lick 0.0 to 2.9	*E. coli*	Madison	KY494139_01	Livestock (Grazing or Feeding Operations), Failing Septic, Illegal Straight Pipe	PCR (not supporting)
Clear Creek 0.0 to 4.1	*E. coli*	Madison	KY489606_01	Livestock (Grazing or Feeding Operations), Failing Septic, Illegal Straight Pipe	PCR (not supporting)
Dunbar Branch 0.0 to 2.6	*E. coli*	Madison	KY491284_01	Livestock (Grazing or Feeding Operations), Failing Septic, Illegal Straight Pipe	PCR (not supporting)

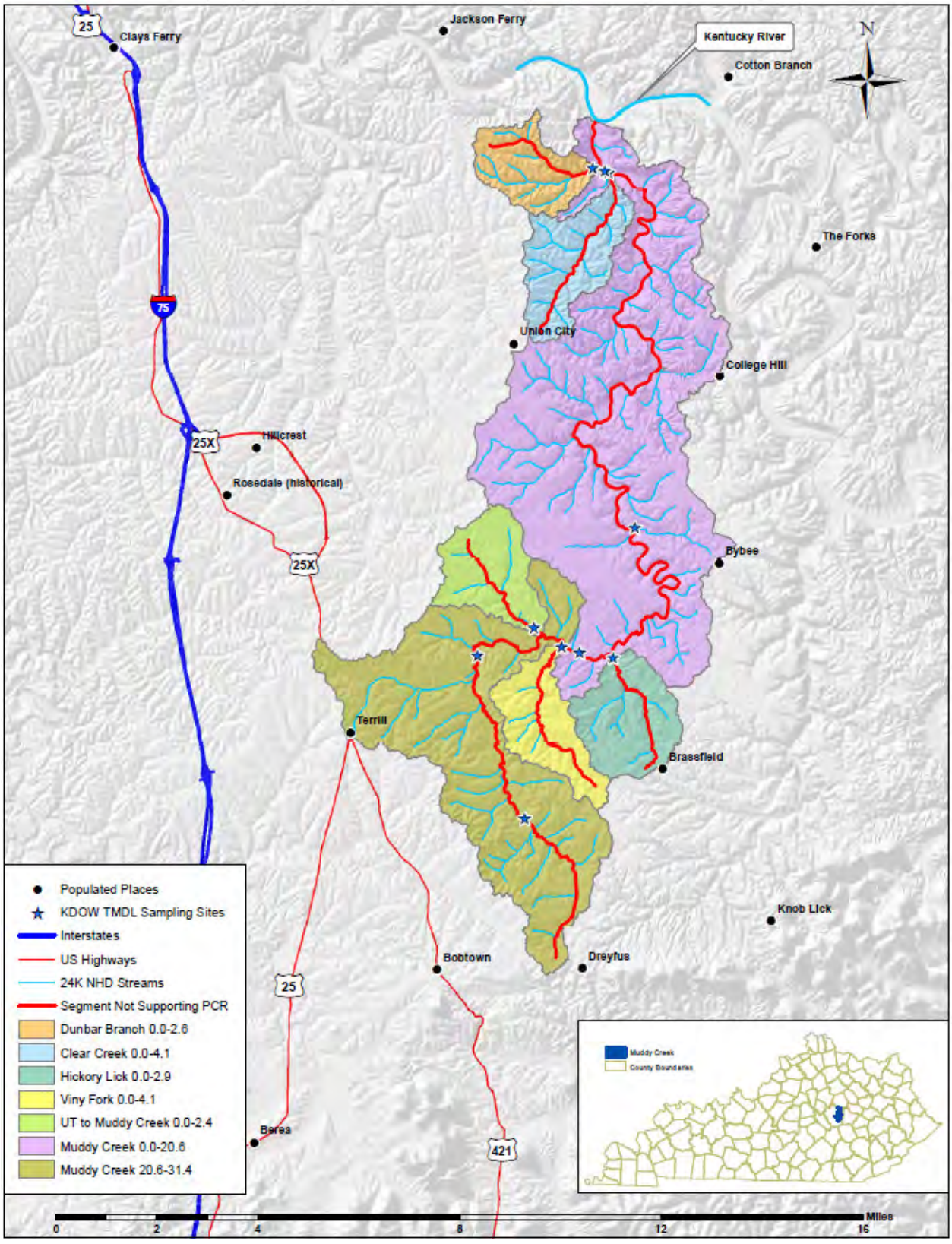

Figure 2.1 Muddy Creek Watershed Location within Madison County in Relation to the Cities of Richmond and Berea, KY

3.0 Physical Setting

The Muddy Creek watershed is located approximately six miles northeast of the city of Berea and two miles east of the city of Richmond – the southeast portion of Richmond's MS4 area clips the westernmost region of the watershed. The stream generally flows north draining five tributaries (a UT, Viny Fork, Hickory Lick, Clear Creek and Dunbar Branch) before emptying into the Kentucky River near River Mile (RM) 189.2; the Kentucky River by and large flows northwest before discharging into the Ohio River in Carrolton, Kentucky.

3.1 Geology

Muddy Creek lies within the Outer Bluegrass ecoregion of the Interior Plateau Level III ecoregion (Woods et al 2002). The watershed is located along the boundary of the Outer Bluegrass and Knobs physiographic regions but is primarily in the Outer Bluegrass - the Outer Bluegrass is associated with the Middle Ordovician period while the Knobs is associated with the Devonian, Silurian and Mississippian periods. Major formations in the area include the Lexington Limestone (a fossiliferous and fossil-fragemental limestone), High Bridge Group (sparingly fossiliferous micrite and minor dolomite), Boyle Dolomite, New Albany Shale (an organic-rich black shale) and the Eastern Outcrop Belt (clay shale and dolomite). This bedrock is not suitable for septic system installation, has shallow soils and locally fast drainage through fractures and sinks to water table. Most of the watershed should consider the phenomenon of swelling shales, where this rock layer and/or soils derived from it may swell when exposed to water or oxygen (KGS 2006).

Faulting in the watershed plays a role in the presence of bedrock formations on the surface especially in the central portion of the watershed (Figure 3.1) – Ordovician bedrock is found in the southern and northern area of the watershed while Silurian and Devonian is found in the central region, along a fault. Seismic activity along these faults occurred millions of years ago and seismic risks are very low (KGS 2006). The presence of faults in a watershed has the potential to influence groundwater/surface water flow - typically, surface water flow will parallel a fracture zone for a distance before sinking off a non-soluble bedrock into a soluble limestone bedrock, near a fault. In the same way, groundwater flow may parallel a fracture zone for a distance before emerging as a spring near the contact (fault) between the soluble limestone and non-soluble bedrock (Ray, KDOW Personal Communication 2007).

The major soil types in Muddy Creek are various types of silt loam and silty clay loam. Some of the major soil series present include the Beasley, Lawrence, Mercer and Shelbyville. Prime areas for farmland are located in the floodplains of valley bottoms (if drained) or some ridgetops in the central and northern area of the watershed (USDA-NRCS, SSURGO database 2008).

Several areas of the watershed are prone to karst features such as sinkholes, sinking streams and springs (see Figure 3.2). A few sinkholes have been mapped in the southwest and northern areas of the watershed and several mapped springs are present. Official watershed boundaries may not be accurate in well-developed karst regions. Although groundwater drainage generally follows topographic basin boundaries, this is not always true in karst areas. Subsurface drainage transfer between surface watersheds in a karst region does occur, which increases or decreases the actual

boundaries of an affected stream basin. This can also influence monitoring station selection when a spring draining a significant portion of the watershed is located in an adjacent basin. The KDOW and the KGS maintain a Karst Atlas of groundwater tracing data and delineated karst groundwater basins (both as static PDF maps and GIS files) that can be downloaded at http://kygeonet.ky.gov. These data should be consulted to determine if karst groundwater flow deviation is present. This work is ongoing and data is updated as information becomes available (Blair 2008).

Karst terrane can create geological hazards such as sudden surface collapse (due to sinkholes), flooding (if a karst pathway becomes clogged with debris or overloaded due to improper surface flow routing), and soil erosion. Karst aquifers are especially sensitive to contamination. Areas underlain by karst hydrology can have rapid groundwater flow rates, with complex routes. Storm water and associated pollutants can enter stream sinks and sinkholes with little or no filtration or attenuation of the contaminants. Groundwater velocities within conduits are commonly measured in thousands of feet per day instead of the typical rate of inches or feet per year in non-karst systems – the maximum recorded conduit groundwater velocity in Kentucky exceeds 2600 feet per hour (Blair 2008).

Karst pathways serve as underground tributaries to surface water, and thus may become a transport pathway for pollutants to streams. Due to the dendritic pattern of karst drainage, nonpoint source pollutants from a large area can coalesce and be focused at a single spring. Conversely, some karst systems may have a radial drainage pattern from a topographic high and disperse point source pollution over a broad area. Improper waste management activities (e.g. dumping into sinkholes, poorly installed or failing OSTDs) or improper best management practices (e.g. lack of buffer strips around sinkholes and sinking streams in agricultural fields) can lead to direct contamination of water supplies. Karst also provides a challenge for nonpoint source pollution management as its pathways have long been regarded as "nature's sewer system" – sinkhole plains, sinking streams, and springs provide a direct connection between surface water and groundwater systems

3.2 Hydrology

Muddy Creek flows in a northerly direction for 31.3 miles and drains an area of 67.86 square miles, or 43,430 acres. Muddy Creek begins as a first order stream that originates approximately six miles northeast of Berea. It quickly becomes a second order stream at RM 31 and a third order at RM 27.9. Finally at RM 19.4 it becomes a fourth order stream before entering the Kentucky River. Muddy Creek drops about 400 feet in elevation from its origin to the mouth.

3.3 Land Cover Distribution

The watershed area of Muddy Creek is approximately 43, 430 acres (or 68 square miles). Land cover is largely agricultural pasture land (50.5%) followed by forest (34.7%). In 2001, only 8.5% of the total land area was developed and mostly located along rural roads and small towns (including Terrill, Bybee and College Hill). The 2001 National Land Cover Dataset (NLCD) overlain with individual USGS Stream Reach Drainage Polygons within a GIS framework was used to determine land cover areas in the watersheds. Figure 3.3 provides a visual demonstration

and Table 3.1 summarizes the land cover by percentage and acres within the watershed. Individual land cover maps from each sample site to the headwaters are included in Section 8. Further discussion of land cover classifications is found in Appendix A.

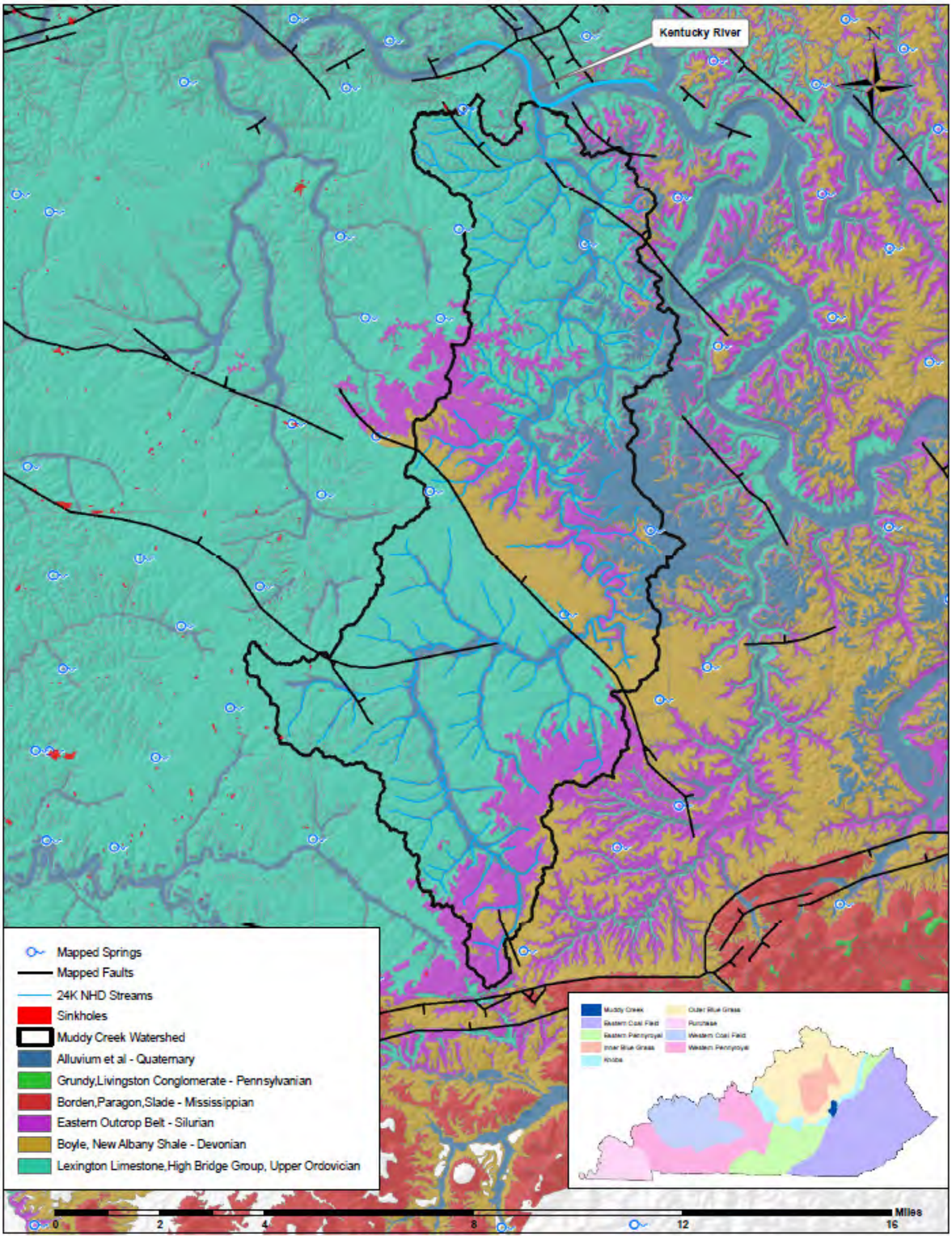

Figure 3.1 Generalized Geologic Map of the Muddy Creek Watershed

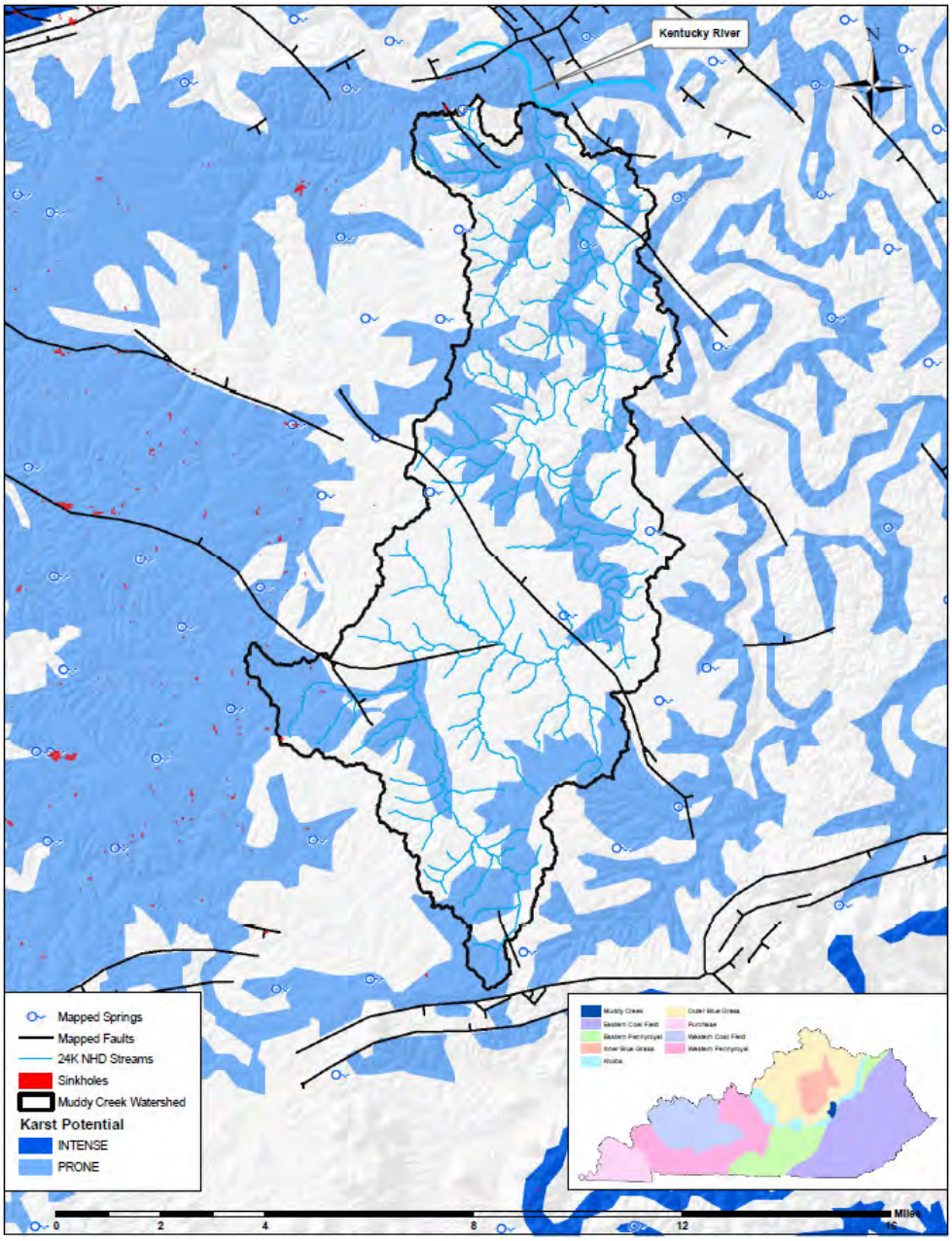

Figure 3.2 Karst Potential within the Muddy Creek Watershed.

Table 3.1 Summary of Land Cover within the Muddy Creek Watershed

Land Use	% of Total Area	Acres	Square Miles
Forest	34.7%	15,084.40	23.57
Agriculture (total)	53.1%	23,056.72	36.03
Pasture	50.5%	21,935.61	34.27
Row Crop	2.6%	1,121.11	1.75
Developed	8.5%	3,702.49	5.79
Natural Grassland	3.0%	1,304.59	2.04
Wetland	0.1%	62.94	0.10
Barren	0.1%	40.92	0.06

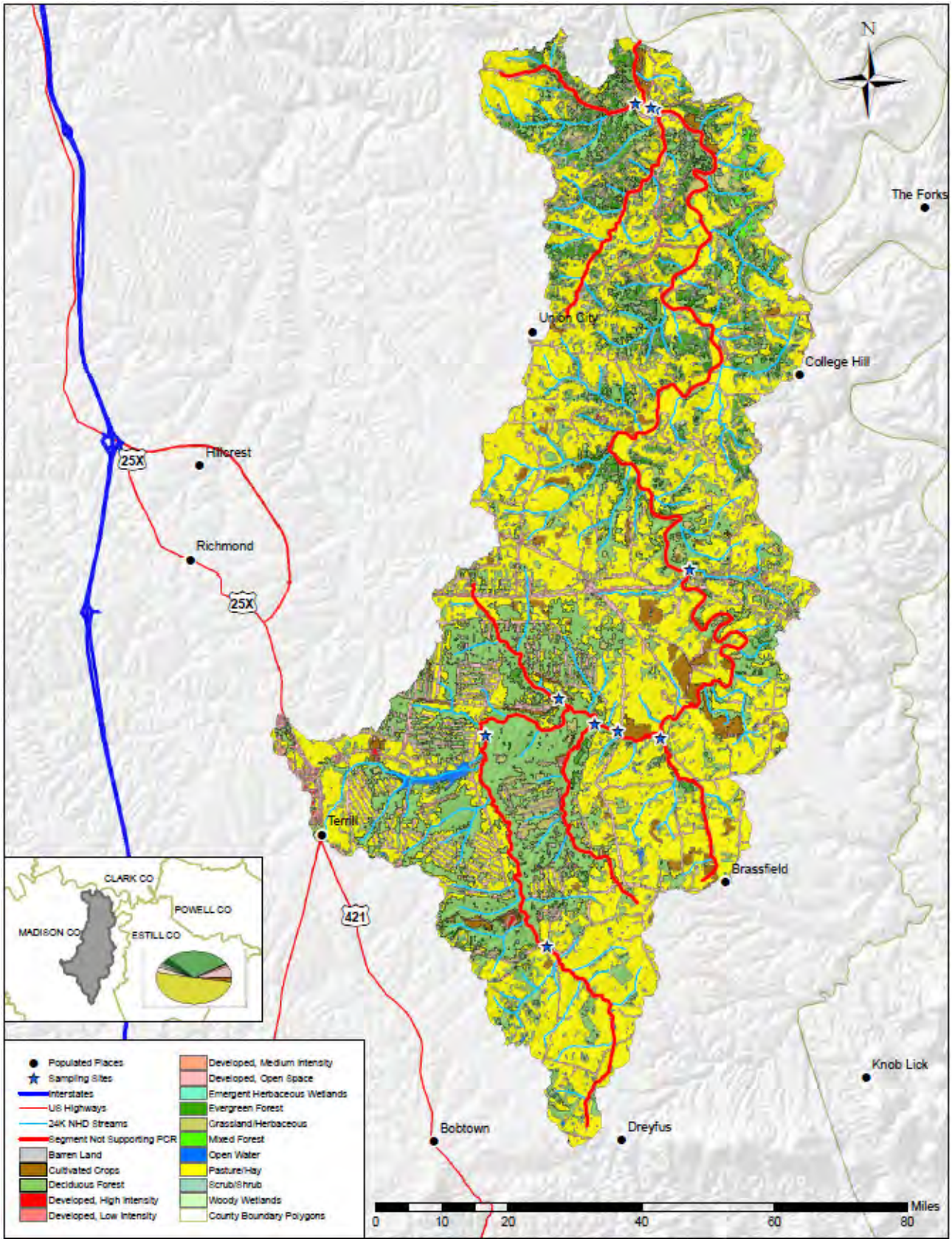

Figure 3.3 Land Cover within the Muddy Creek Watershed (MRLC NLCD 2001)

4.0 Monitoring

KDOW first assessed Muddy Creek in the 1998 Kentucky Report to Congress on Water Quality, as fully supporting the aquatic life and fish consumption designated uses but not supporting the swimming designated use. Muddy Creek was placed on the 303(d) List of Impaired Waters, after it was determined to be impaired by pathogens due to grazing related sources (KDOW 1998).

The USGS has conducted sporadic ground and surface water monitoring in the watershed but the latest data is more than 25 years old.

4.1 KDOW TMDL Monitoring

The TMDL Section of the KDOW monitored ten sites within the Muddy Creek watershed from December 2010 – December 2011. Nutrient data and *E. coli* were collected at all sites in the watershed (Table 4.1, Figure 4.1). Nutrients were collected approximately once a month, while *E. coli* samples were collected twice a month in addition to a geometric mean in the spring and fall. Biological sampling was conducted at 8 of the 10 sites. During these sampling events macroinvertebrates, algae and water chemistry were collected, and a habitat assessment and discharge measurements were completed. At the 2 sites where macroinvertebrates and algae were not collected (DOW04023008 and DOW04023012) habitat assessments were completed. Figure 4.1 shows the assessed stream segments and sampling sites where data were collected for the TMDL. Table 4.1 provides a listing of the sampling locations within the watershed and Table 4.2 presents a statistical summary of the *E. coli* data.

Kentucky experienced a drought during the summer of 2010, but due to a snowy winter and a wet spring in 2011, water levels had recovered from drought conditions throughout the state. As expected, a lack of rain later in the summer resulted in dry or pooled conditions in the headwaters and the tributaries, but the mainstem of Muddy Creek was flowing throughout the summer and could be sampled nearly every visit.

4.1.1 KDOW TMDL Watershed Health Reports

The KDOW TMDL Section has developed a public communication tool, called a Health Report, to share the results of their year long monitoring studies with public and local government officials. The Health Report reports on the water quality and biological health of the watershed and highlights what is doing well and what needs improvement. It also highlights what can be done to help improve water quality and encourages public awareness and participation. The Muddy Creek Health Report Card is presented in Table 4.3; the final Health Report can be found in Appendix B, along with the initial Health Report. These can also be downloaded from the following website, http://water.ky.gov/waterquality/Pages/KentuckyHealthReports.aspx.

Table 4.1 KDOW TMDL Sample Locations and Parameters Collected Within the Muddy Creek Watershed (12/2010 thru 12/2011)

Station Name and ID	Latitude	Longitude	River Mile[(1)]	Stream Segment	Parameters Collected
Clear Creek At Doylesville Rd. Bridge DOW04023014	37.84628	-84.16225	1.3	Clear Creek 0.0 to 4.1	*E. coli,* NO2/NO3; NH3-N; TKN; Total P; Ortho-P; TOC; BOD5; Discharge; Multiparameter
Dunbar Branch Off dirt road off Doylesville Rd. DOW04023015	37.84765	-84.1679	1.1	Dunbar Branch 0.0 to 2.6	*E. coli,* NO2/NO3; NH3-N; TKN; Total P; Ortho-P; TOC; BOD5; Discharge; Multiparameter
Hickory Lick Off Meadowbrook Rd. DOW04023013	37.706479	-84.163716	19.5	Hickory Lick 0.0 to 2.9	*E. coli,* NO2/NO3; NH3-N; TKN; Total P; Ortho-P; TOC; BOD5; Discharge; Multiparameter
Muddy Creek At Doylesville Rd. Bridge DOW04023016	37.84678	-84.16351	1.2	Muddy Creek 0.0 to 20.6	*E. coli,* NO2/NO3; NH3-N; TKN; Total P; Ortho-P; TOC; BOD5; Discharge; Multiparameter
Muddy Creek At KY 52 Bridge DOW04023002	37.7439	-84.1549	13.4	Muddy Creek 0.0 to 20.6	*E. coli,* NO2/NO3; NH3-N; TKN; Total P; Ortho-P; TOC; BOD5; Discharge; Multiparameter
Muddy Creek At Speedwell Rd. Bridge DOW04023012	37.708252	-84.175728	20.3	Muddy Creek 0.0 to 20.6	*E. coli,* NO2/NO3; NH3-N; TKN; Total P; Ortho-P; TOC; BOD5; Discharge; Multiparameter
Muddy Creek on the Bluegrass Army Depot DOW04023009	37.70792	-84.21278	23.6	Muddy Creek 20.6 to 31.4	*E. coli,* NO2/NO3; NH3-N; TKN; Total P; Ortho-P; TOC; BOD5; Discharge; Multiparameter
Muddy Creek At Crooksville Rd. Bridge DOW04023008	37.660613	-84.196563	27.7	Muddy Creek 20.6 to 31.4	*E. coli,* NO2/NO3; NH3-N; TKN; Total P; Ortho-P; TOC; BOD5; Discharge; Multiparameter
UT Muddy Creek on the Bluegrass Army Depot DOW04023010	37.71556	-84.19207	21.3	UT to Muddy Creek 0.0 to 2.4	*E. coli,* NO2/NO3; NH3-N; TKN; Total P; Ortho-P; TOC; BOD5; Discharge; Multiparameter
Viny Fork on the Bluegrass Army Depot DOW04023011	37.7099	-84.18206	20.7	Viny Fork 0.0 to 4.1	*E. coli,* NO2/NO3; NH3-N; TKN; Total P; Ortho-P; TOC; BOD5; Discharge; Multiparameter

Notes: [(1)] This column refers to the river mile on Muddy Creek; for tributaries, it is the point of confluence

Table 4.2 Statistical Summary of *E. coli* Data Collected in the Muddy Creek Watershed during the 2011 PCR Season

Station Name	Number of Observations	% Exceeding Instantaneous WQC (240 colonies/100ml)	Spring 1 Geomean (colonies/ 100mL)(1)	Spring 2 Geomean (colonies/ 100mL)	Fall Geomean (colonies/ 100mL)	Minimum (colonies/ 100mL)	Maximum (colonies/ 100mL)	Average (colonies/ 100mL)
DOW04023002	15	40.0	>5,470	657	2,628	5	>24,192	2,822
DOW04023008	12	83.3	>6,288	1,603	n/a	84	>24,192	3,110
DOW04023009	15	66.7	2,769	581	1,938	78	11,199	1,688
DOW04023010	8	50.0	n/a	n/a	n/a	178	>24,192	6,539
DOW04023011	9	75.0	>5,301	491	n/a	70	>24,192	3,326
DOW04023012	14	71.4	>5,187	>1,275	1,485	30	19,863	2,559
DOW04023013	14	85.7	>6569	1,940	1,151	155	>24,192	4,766
DOW04023014	5	40.0	n/a	n/a	n/a	19	6,488	1,419
DOW04023015	5	80.0	n/a	n/a	n/a	161	4,611	1,394
DOW04023016	15	26.7	4,725	1,281	1,322	2	17,329	2102

Notes: (1) The geomean WQC for *E. coli* is 130 colonies per 100mL

Table 4.3 Muddy Creek Watershed Health Report from the 2011 TMDL Watershed Study

Site ID	Stream Name	O_2		N+P							Site Grade
DOW04023008	Muddy Creek	B	B	A-	F	D		D	D	D	D+
DOW04023009	Muddy Creek	B	A-	A	D	C+	C	D	D	B	C
DOW04023010	UT to Muddy Creek	B	B	A	C	B-	C	D	D	C	C
DOW04023011	Viny Fork	B	B	A	D	B-	B	D	D	A	B-
DOW04023012	Muddy Creek	B	B+	A	D	C		D	F	D	C-
DOW04023013	Hickory Lick	B+	B	B	F	C+	B	D	D	F	C
DOW04023002	Muddy Creek	B	B+	B+	C+	C	B	C	C	C	B-
DOW04023014	Clear Creek	B	B-	A	B-	B	C	D	C	C	C+
DOW04023015	Dunbar Branch	B	B	B+	D-	A	C	D	C	C	C+
DOW04023016	Muddy Creek	B	B+	A	B	C	B	D	C	D	C+
	Watershed Grade	B	B	A	D+	C+	C+	D	D+	C	

Notes:

Signs of water quality and biological health from left to right are: Dissolved Oxygen, Specific Conductivity, Nitrogen & Phosphorous, *E. coli*, Total Suspended Solids, Aquatic Macroinvertebrates, Total Habitat, Riparian Zone and Available Cover. See Appendix B for the complete Muddy Creek Watershed Health Report.

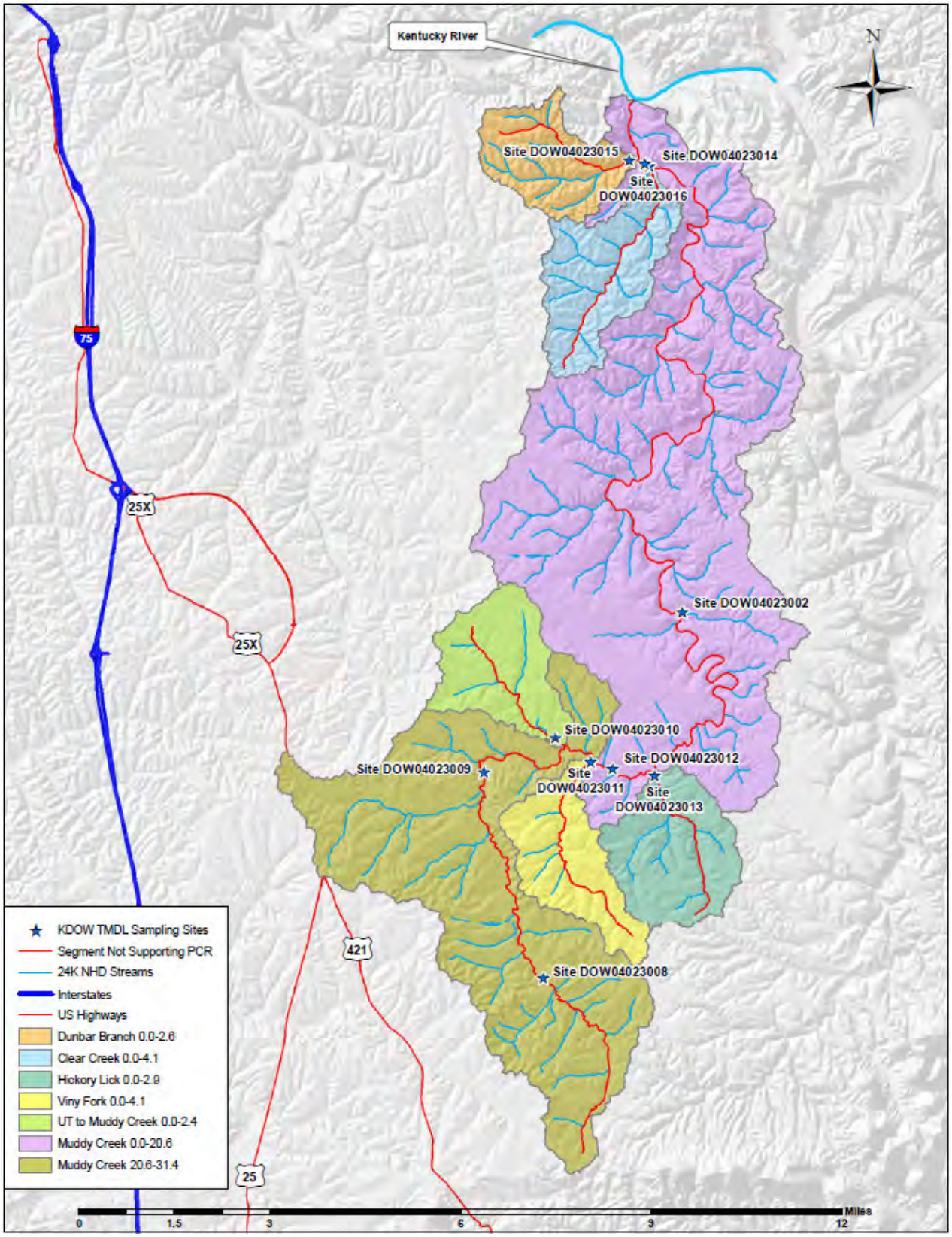

Figure 4.1 Locations of KDOW Sample Sites and Assessed Stream Segments within the Muddy Creek Watershed

5.0 Source Identification

For regulatory purposes, the sources of fecal coliform and *E. coli* in a watershed can be placed into two categories: KPDES-permitted and non KPDES-permitted sources. A KPDES-permitted source requires a Kentucky Pollutant Discharge Elimination System (KPDES) discharge permit, a storm water permit, or a Municipal Separate Storm Sewer System (MS4) permit from the KDOW. KPDES discharge permits include wastewater treatment facilities that discharge directly to a stream, facilities discharging storm water, and some agricultural operations (e.g. Concentrated Animal Feeding Operations (CAFOS) with an individual discharge permit). KPDES is not the only permitting program that may affect water quality or quantity within a watershed; other permitting examples include water withdrawal permits, permits to build structures within a floodplain, permits to construct an on-site sewage treatment disposal system (OSTDS), and permits to land apply waste from sewage treatment plants. However, within the framework of the TMDL process a KPDES-permitted source is defined as one regulated under the KPDES program.

Non KPDES-permitted sources include nonpoint sources of pollution. Nonpoint sources of pollution are often caused by runoff from precipitation over and/or through the ground and are correlated to land use.

5.1 KPDES-permitted Sources

KPDES- permitted sources include all sources regulated by the KPDES permitting program. KPDES permit and point source are defined in 401 KAR 10:001. A Wasteload Allocation (WLA) is assigned to KPDES-permitted sources.

5.1.1 Sanitary Wastewater Systems

Sanitary Wastewater Systems (SWSs) include all facilities with a design flow which are permitted to discharge fecal coliform or *E. coli*. This includes Wastewater Treatment Plants (WWTPs), Sewage Treatment Plants (STPs), package plants and home units. Information obtained from the Water Resource Information System (WRIS, http://kia.ky.gov/wris/), KDOW Surface Water Permits Branch, and Water Infrastructure Branch was used to confirm information associated with wastewater facilities in the watershed as well as acquire background information and any future planned expansions. In addition, in October 1999 and March 2000 the Bluegrass Area Development District (BGADD) wrote a "Summary of Wastewater Treatment Systems" as part of the "Strategic Water Resource Development Plan" (SWRDP) compiled and released by the Water Resource Development Commission of the Governor's Office. Information from this report is for informative purposes only. There are currently five KPDES Wastewater facilities discharging to a bacteria-impaired segment in the watershed. Figure 5.1 shows the location of all KPDES-permitted sources within the Muddy Creek watershed and Table 5.1 provides a summary of permit information. Appendix C contains DMR information from the last five years for each facility. Additional information for KPDES-permitted facilities can be obtained through the Open Records process (http://eec.ky.gov/Pages/OpenRecords.aspx)

The Blue Grass Army Depot provides conventional ammunition services, Chemical Defense Equipment management and manufacturing capabilities for the Department of Defense. They also operate a small sewage treatment system on their property. As discussed in the "*Strategic Water Resource Development Plan*", the Depot has expressed interest in joining a regional treatment system however there is concern for the 'condition of the sanitary sewers that drain the Depot lands'; many of the sewers are now more than 65 years old and present a concern for excessive inflow/infiltration. Though the BGAD does not discharge directly to Muddy Creek or its tributaries, some of their sanitary sewer collection system may lie within the Muddy Creek watershed. System and/or pump station malfunction as well as system overflow during periods of power outages or high precipitation are potential sources of bacteria.

Cole's Moberly Shell (KY0098175) operates a small package treatment plant for their convenience store located at 3306 New Irvine Road in Richmond, KY (closer to Waco, KY). The onsite treatment system has a design capacity of 0.001 MGD and discharges to a unnamed tributary before entering Muddy Creek. According to DMR data submitted to KDOW in the last five years, the facility has exceeded their permit limit for *E. coli* once, chlorine 13 times, and total suspended solids and ammonia nitrogen 3 times. The facility failed to submit its DMRs once in the last five years.

The Riddell residence (KYG400149) operates a home unit at the same location of Cole's Moberly Shell (3306 New Irvine Road, Waco, KY). The home unit has a permitted design capacity of 0.005 MGD. Many home units do not have enough flow to discharge and compliance with permit requirements, especially submitting DMRs, is a chronic issue with at least 97% of permitted home units across the state (see further discussion on home units below). The Riddell residence has failed to submit a DMR to KDOW in the last five years.

Waco Elementary School (KY0074551) operates a small sewage treatment system on their property at 359 Waco Loop in Waco, KY. The package treatment plant has a design capacity of 0.009 MGD and discharges to an unnamed tributary before entering Muddy Creek. The school has failed to submit DMRs in the last five years.

Waco Main Street Store (KY0095168) operates a small sewage treatment system for the commercial/ residential buildings located at 130 College Hill Road in Waco, KY. The store is no longer in business but the property owners still maintain residence. The package treatment plant has a design capacity of 0.0065 MGD and discharges to Muddy Creek. According to DMR data submitted to KDOW in the last five years, the facility has exceeded their permit limits for chlorine a few times and exceeded limits for BOD, chlorine, ammonia nitrogen, DO and total suspended solids once in 2011. The facility has also failed to submit their DMRs in a timely manner several times in the last five years.

Waco Food Mart (KY0101303) operates a small sewage treatment system for their gas station and food mart located at 101 Baumstark Road in Waco, KY. The package treatment plant has a design capacity of 0.001 MGD and discharges to an unnamed tributary before entering Muddy Creek. According to DMR data submitted to KDOW in the last five years, the facility has exceeded their limits for bacteria twice in addition to exceeding limits for chlorine, BOD and ammonia nitrogen several times. The facility has also failed to submit their DMRs in a timely manner several times in the last five years.

Table 5.1 Summary of KPDES-permitted Source Information

KPDES Permit Number	Facility	Flow (cfs)[(1)]	Permit Limit Monthly Average (colonies/ 100 ml)	Permit Limit Maximum Weekly Average (colonies/ 100 ml)	Outfall Latitude And Longitude	WLA (colonies/ day)	TEMPO AI[(2)]
KY0098175	COLE'S MOBERLY SHELL	0.002	130 (E coli)	240 (E coli)	37.73889 -84.18000	9.08×10^{6}	2800
KYG400149	RIDDELL RESIDENCE	0.001	130 (E coli)	240 (E coli)	37.73944 -84.17917	4.54×10^{6}	2853
KY0074551	WACO ELEM SCHOOL	0.014	130 (E coli)	240 (E coli)	37.74083 -84.13556	8.18×10^{7}	35390
KY0095168	WACO MAIN STREET STORE	0.001	130 (E coli)	240 (E coli)	37.74278 -84.14444	5.91×10^{6}	2862
KY0101303	WACO FOOD MART INC	0.002	130 (E coli)	240 (E coli)	37.75194 -84.16194	9.08×10^{6}	2861

Notes:

(1). Flow value is based on design flow for dedicated sanitary outfalls or average daily flow for facilities with comingled waste streams.

(2). The TEMPO AI is an internal KDOW tracking number.

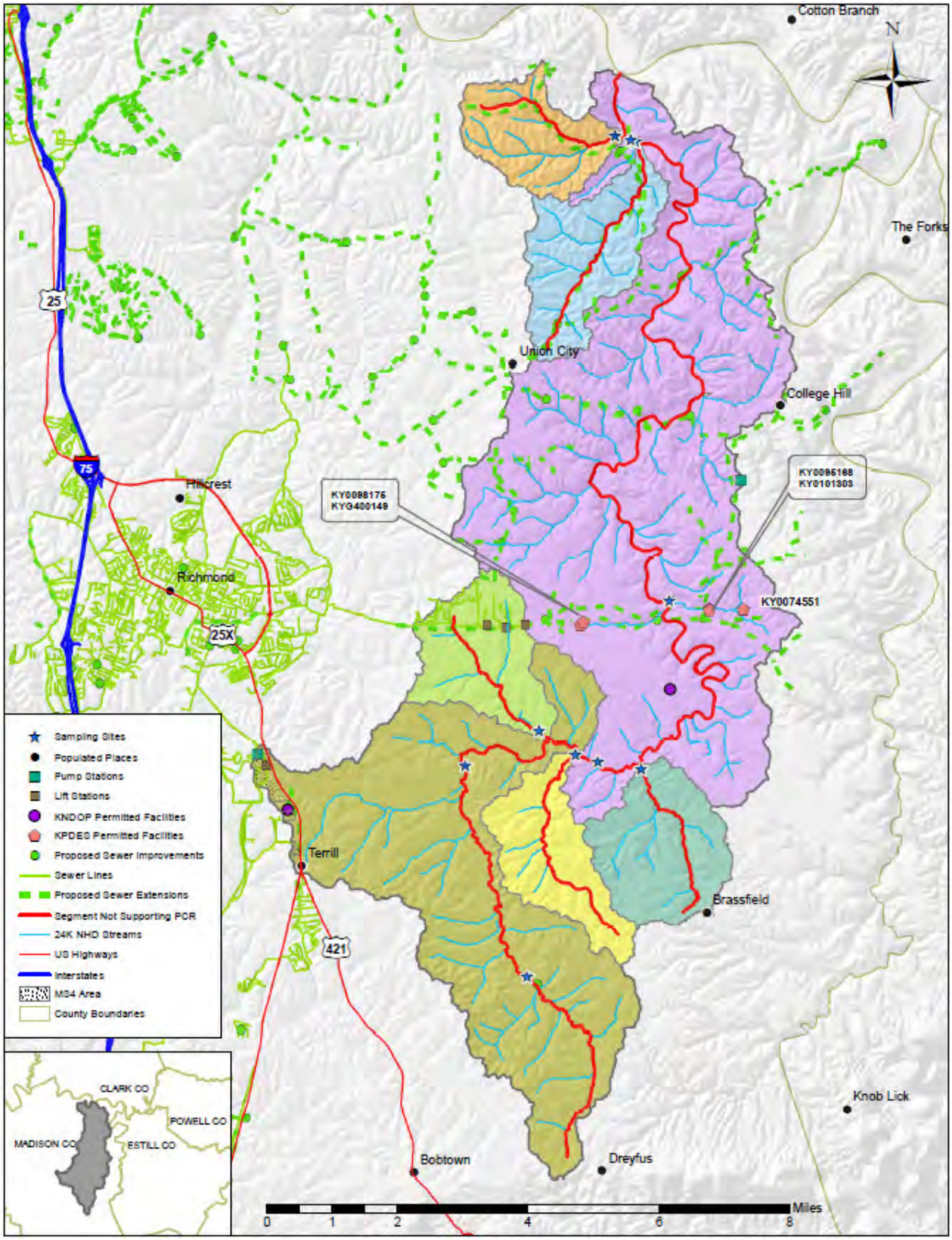

Figure 5.1 Location of KPDES-Permitted Sources and Wastewater Infrastructure within the Muddy Creek Watershed

5.1.1.1 Wastewater Infrastructure

Two permitted wastewater systems have sanitary sewer collection infrastructure within the Muddy Creek watershed but do not discharge to any of its waters. The Richmond Utilities Board operates a sanitary sewer collection system and one lift station in a small area of the southwest portion of Muddy Creek. This wastewater is treated at the Richmond Utilities – Silver Creek plant. The Northern Madison County Sanitation District – Greens Crossing operates a sanitary sewer collection system, three lift stations and two pump stations in the central area of the watershed. This system transfers sanitary wastewater to the Richmond Utilities - Otter Creek plant. System and/or pump station malfunction as well as system overflow during periods of power outages or high precipitation are potential sources of bacteria in the watershed.

5.1.1.2 Wastewater Upgrades and Expansions

The WRIS has been developed through the cooperative efforts of water and wastewater treatment systems and local, regional, and state agencies. It is used by all of these entities, and provides much of the information needed for all aspects of water resource planning--from watershed protection to infrastructure development. This system was used to obtain more detailed information on wastewater systems and any planned upgrades or expansions. Full project profile and system reports can be found in Appendix D.

As seen in Figure 5.1, sewer lines cover a very small portion of the watershed. However there are planned upgrades and expansions covering some of the watershed not currently being serviced by sewer systems. The two systems mentioned above as well as the Northern Madison County Sanitation District – Regional Plant have several projects involving the Muddy Creek watershed on the Clean Water State Revolving Fund List. These projects include sewer line extensions, lift station construction, upgrade of an existing treatment plant and construction of a new one near Waco. All of these projects, once fully funded, will help reduce the potential sources of bacteria in the watershed.

As discussed in the "*Strategic Water Resource Development Plan*", portions of Muddy Creek, especially to the east, are located in rural Madison County outside of the sewer service areas of Richmond and Berea. Though there is planned expansions and upgrades in the watershed, funding for these projects may be slow. Areas not included in these projects may be deemed impractical to extend sewer service due to the unusually high cost per potential customer that must be incurred to finance such expansive sewer system development. Reasons for the high cost are the number of households (11,550), a low customer per mile ratio, rugged terrain, and the long distance from these houses to treatment facilities and existing sewer systems. Suggested instead is that a Revolving Loan Fund Program be established or that the U.S. Army Corps of Engineers 531 program be extended for the installation of a septic tank for each house that does not presently have sanitary sewer service, or could currently have a failing septic system. The generalized proposed cost of this option is $57,750,000 or $5,000 per household ((Kentucky Infrastructure Authority 2000)

5.1.2 MS4 Sources

In developed areas, polluted stormwater runoff is often diverted and concentrated into MS4s, where it ultimately discharges to surface waters with little or no treatment.

MS4s are defined in 401 KAR 5:002. EPA has categorized MS4s into three categories: small, medium, and large. The medium and large categories are regulated under the Phase I Storm Water program. Large systems, such as the cities of Lexington and Louisville, have populations in excess of 250,000. Medium systems have populations in excess of 100,000 but less than 250,000; however, there are currently no medium-sized systems in Kentucky. Phase I systems have five-year permitting cycles and have annual reporting requirements. The small MS4 category includes all MS4s not covered under Phase I. Since this category covers a large number of systems, only a select group are regulated under the Phase II rule, either being automatically included based on population (i.e., having a total population over 10,000 or a population per square mile in excess of 1000) or on a case-by-case basis due to the potential to cause adverse impact on surface water. Water quality monitoring is not a requirement of Phase II MS4s, unless the waterbody has an approved TMDL and the MS4 causes or contributes to the impairment for which the TMDL was written (KDOW 2009). A WLA is assigned to all MS4 permits, including the KYTC, universities and military bases.

A small area of the city of Richmond's MS4 community (KYG200006) clips the westernmost portion of the watershed accounting for less than 0.05% of the total watershed area. The Kentucky Transportation Cabinet also has a MS4 permit (KYS000003) and is responsible for stormwater from the pavement and right of way of interstates, parkways, U.S. highways, and state routes within the City of Richmond MS4 boundary. The City of Richmond permit requirements include development of "a stormwater quality management program that is designed to reduce the discharge of pollutants to the maximum extent practible (MEP). The MEP standard involves applying best management practices that are effective in reducing the discharge of pollutants in stormwater runoff. This requires that the permittee use known, available, and reasonable methods of prevention and control of stormwater discharges." The City of Richmond MS4 boundary is shown in Figure 5.1.

5.1.3 Combined Animal Feeding Operations

Operations that are defined as a CAFO pursuant to 401 KAR 5:002 are required to obtain a KPDES permit. Once defined as a CAFO, the operation can be permitted under a KPDES General Permit or a KPDES Individual Permit depending upon the nature of the operation. Conditions of both types of permits include no discharge to surface waters; however, holders of a KPDES Individual Permit may discharge to surface waters during a 25-year (24-hour) or greater storm event.

There are no CAFOs in the Muddy Creek Watershed.

5.2 Non KPDES-permitted Sources

Non KPDES-permitted sources include all sources not permitted by the KPDES permitting program and are often associated with land use. The loads to surface water from non-KPDES permitted sources are regulated by laws such as the Kentucky Agricultural Water Quality Act (AWQA, KRS 224.71-100 through 224.71-145, i.e., implementation of individual agriculture water quality plans and corrective measures), the federal Clean Water Act (i.e., the TMDL process) and 401 KAR 5:037 (Groundwater Protection Plans (GPPs)), among others. A Load Allocation (LA) is assigned to non KPDES-permitted sources.

Unlike KPDES-permitted sources, non KPDES-permitted sources typically discharge pollutants to surface water in response to rain events (MS4s are a notable exception, as they are a KPDES-permitted source that discharges to surface water in response to rain events through a system of storm drains, curbs, gutters, etc.). Non KPDES-permitted sources for bacteria exist in the watershed and fall into various categories including agriculture, properly functioning OSTDS, failing OSTDS, household pets and natural background, which in the case of bacteria in a rural watershed means wildlife. Straight-pipes are a type of illegal, non KPDES-permitted source that may exist in the watershed, but none are known to exist with certainty.

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As mentioned in Section 3, this watershed is located in a karst region. The KGS has developed Generalized Geologic Maps for Land-Use Planning (http://www.uky.edu/KGS/) for every county of the State to inform individuals of the general geologic bedrock condition that can affect a site and its intended uses. For example, the watershed area is underlain with limestone, dolomite and shale bedrock – according to the planning guidance, this type of rock carries severe limitations for septic tank disposal systems depending on the amount of soil cover and depth to impermeable bedrock. A severe limitation is one that is "difficult to overcome and commonly is not feasible because of the expense involved."

5.2.1 Kentucky No Discharge Operational Permits

As stated in 401 KAR 5:005, facilities with agricultural waste handling systems or that dispose of their effluent by spray irrigation but do not discharge to surface waters are required to obtain a Kentucky No Discharge Operational Permit (KNDOP) from the KDOW prior to construction and operation. Animal Feeding Operations (AFOs) receive KNDOP permits. These operations handle liquid waste in a storage component of the operation (e.g. lagoon, pit, or tank) and may land apply the waste via spray irrigation or injection to cropped acreages. Land application of the waste that results in runoff to a stream is prohibited. Facilities that handle animal waste as a liquid are required to submit a Short Form B, construction plans, and a Comprehensive Nutrient Management Plan to the KDOW. Also included in KNDOP requirements are golf courses that land apply treated wastewater via spray irrigation, typically from a holding pond - some industrial operations also spray-irrigate.

There are two KNDOP permits in the Muddy Creek watershed, Eastern Kentucky University Farms and Hardy Oil Co Bulk Plant #3. The location of these facilities is depicted on Figure 5.1.

Table 5.2 KNDOP Permitted Facilities in the Muddy Creek Watershed

KNDOP Number	Facility	KNDOP Type	Latitude	Longitude	TEMPO AI
4023013	Eastern Kentucky University Farms	Educational Services/ Farm	37.724167	-84.155278	10376
151107767	Hardy Oil Co Bulk Plant #3	Retail Trade, Gasoline Stations	37.69861	-84.26278	107767

5.2.2 Agriculture

The Kentucky AWQA was passed by the 1994 General Assembly. The law focuses on the protection of surface water and groundwater resources from agricultural and silvicultural activities. The Act created the Kentucky Agriculture Water Quality Authority (KAWQA), a 15-member peer group comprising farmers and representatives from various agencies and organizations. The Act requires farms greater than 10 acres in size to adhere to the Best Management Practices (BMPs) specified in the Kentucky Agriculture Water Quality Plan. Specific BMPs have been designated for all operations. More information on the Kentucky AWQA and Water Quality Plans can be found at http://conservation.ky.gov/Pages/AgricultureWaterQuality.aspx.

The USDA National Agricultural Statistics Service (NASS) compiles Census of Agriculture data by County for virtually every facet of U.S. agriculture (USDA 2009). The "Census of Agriculture Act of 1997" (Title 7, United States Code, Section 2204g) directs the Secretary of Agriculture to conduct a census of agriculture on a 5-year cycle collecting data for the years ending in 2 and 7. Selected agricultural data from the latest Census of Agriculture reports for Madison County are listed in Table 5.3. These data are based on countywide data with no assumptions made on a watershed level. The percentage of agricultural types of land cover is calculated for the entire watershed in Table 3.1 (Section 3.3) and for each sub-watershed in Section 8.

The Muddy Creek watershed has a substantial agricultural resource with 53.1% of its land use devoted to agricultural operations (Figure 3.3). The prevalent threat to streams from agriculture is bacteria loading from animal wastes. Livestock often lay in or near the streams in search of shade or drinking water. Livestock with access to streams can have a direct impact on water quality when feces are deposited on stream banks or directly in the stream. Animals grazing in pasture often deposit feces on the land - bacteria that do not decay will runoff into streams during wet weather events. Table 3.1 conveys that there are approximately 21,936 acres or 34 square miles of agricultural pastureland use within the 68 square miles of this watershed.

The Ohio State University Agricultural Extension Service released a guidance document for the management of livestock manure. The document contains manure characteristics, handling/storage and application procedures and also addresses some of the issues and considerations involved with manure management (James 2006). A similar (though as not detailed) document is available from the North Carolina State University College of Agriculture and Life Sciences (Shaffer 2005). These documents could be used to estimate pathogenic

contributions from livestock if it could be determined how much manure actually made it to a stream since it is unrealistic that an animal would be directly contributing to a stream throughout the day. However if Standard Operating Procedures for wastewater collection systems and BMPs are utilized, pathogenic contributions to surface waters from livestock operations should not cause an exceedance of the WQC.

Crops may be a source of bacteria if manure is used as a fertilizer. However if BMPs are utilized (as discussed on the KAWQA webpage, http://www.conservation.ky.gov/programs/kawqa/) pathogenic contributions to surface waters should not cause an exceedance of the WQC.

Table 5.3 USDA Agricultural Statistics for Madison County (2007)

Statistic	Madison County
Farms (number/acres)	48/10,560
Cattle and Calves Inventory (farms/ total number)	804/61,076
Beef Cows (farms/total number)	653/26,022
Milk Cows (farms/total number)	21/275
Hogs and Pigs (farms/ total number)	10/585
Horses and Ponies (total number)	340/2,028
Layers 20 weeks old or older (farms/total number)	44/1,039
Broilers & other meat-type chickens sold (farm/total number)	7/302
Corn for grain (acres)	1,787
Tobacco (acres)	1,061
Wheat for grain (acres)	56
Soybeans for beans (acres)	493

5.2.3 Wildlife

Wildlife undoubtedly contributes to bacteria loading. The Kentucky Department of Fish and Wildlife Resources estimate deer densities per square mile for all counties of Kentucky (Yancy, Personal Communication, 2008). There are approximately seven deer per square mile in Madison County (1,856 total).

Estimates of deer populations are shown for the watershed in Table 5.4. The assumption was made that deer remain constant throughout the year and are present (and evenly distributed) on all land classified as agricultural, forested, grasslands, and wetlands – because this is a rural watershed developed land was also included. Estimates of numbers of other types of wildlife are not available for Kentucky.

As stated above, although wildlife contributes bacteria to surface water, such contributions represent natural background conditions and receive no reductions within a TMDL. Wildlife such as opossums, raccoons, rats, and birds that may reside within subdivisions may be a larger contributor to bacteria runoff as these areas tend to have less permeable surfaces.

Table 5.4 Estimated Deer Populations within Muddy Creek

County/ Stream	Watershed Area within County (sq mi)	Deer per Square Mile of Land	Estimated Deer Population in Watershed
Madison County/ Muddy Creek	67.87	7	475

5.2.4 Human Waste

Human waste disposal is of particular concern in rural areas. Areas not served by sewers either employ an Onsite Sewage Treatment and Disposal System (OSTDS) or do not treat their sewage. There are few sewer lines located in the Muddy Creek watershed (Figure 5.1). The rural area not serviced by sewer must either have an OSTDS or may not be treating their sewage. The U.S. Census of 2010 estimated that there was an average of 189.6 persons per square mile in Madison County. OSTDS including septic tank systems are commonly used in areas where providing a centralized sewage collection and treatment system is not cost effective or practical. When properly sited, designed, constructed, maintained, and operated, septic systems are an effective means of disposing and treating domestic waste. The effluent from a well-functioning OSTDS is comparable to secondarily treated wastewater from a sewage treatment plant. When not functioning properly, they can be a source of nutrients (nitrogen and phosphorus), bacteria and other pollutants to both groundwater and surface water.

The USDA Natural Resources Conservation Service (NRCS) National Geospatial Management Center archived and distributed the Soil Survey Geographic (SSURGO) Database which contains the most recent soil survey information in a geographic area. The SSURGO rates the performance of septic tank absorption fields, defined as the area in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Soil ratings are based on soil properties, site features, and the observed performance of the soils - permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of septic tank effluents. Soils in the study area include the Beasley, Brassfield, Mercer and Lawrence series. USDA rates these soil series as very limited for installation of septic tank absorption fields due to slope and severely eroded soils (i.e. shallow soil profiles). Based on the soil ratings and prevailing bedrock formations it is likely many of the septic systems in the watershed are not functioning properly.

A type of non KPDES-permitted source that may exist in the watershed is straight-pipes, which are discrete conveyances that discharge sewage, gray water (i.e., water from household sinks, laundry, etc.) and stormwater to the surface waters of the Commonwealth without treatment. Although straight-pipes meet the definition of a point source as defined in 401 KAR 10:002, EPA considers them to be part of the LA as they are a non KPDES-permitted source.

5.2.5 Household Pets

Although household pets undoubtedly exist in Muddy Creek, their contribution to the LA is deemed to be minimal compared to other sources in the rural portions of the watershed. Pet waste may, however, be a larger contributor to bacteria runoff within subdivisions where there is a tendency to have a higher density of households and less permeable surfaces.

According to the American Veterinary Medical Association, by the end of 2011, 36.5% of all households (nationally) owned an average 1.6 dogs and 30.4% owned an average 2.1 cats.

5.3 Illegal Sources

Both KPDES-permitted and non KPDES-permitted sources can discharge bacteria to surface water illegally. This includes sources that are illegal simply by their existence, such as straight-pipes and SSOs, which receive no allocation. There may also be legal sources that are operating illegally (e.g., outside of regulations, permit limits or conditions, etc.), such as a WWTP bypass or a failing OSTDSs, which receive no allocation above that of a properly functioning system (see Section 7.0 for TMDL allocations).

Another potential illegal source is livestock on farms that have no BMPs (as required under the AWQA) as well as farms where BMPs are present but are insufficient or failing in a manner that causes or contributes to surface water impairment; such farms receive no allocation above that of a farm with properly installed and functioning BMPs. Also included are KNDOPs, AFOs and CAFOs not in compliance with the appropriate regulations that cause or contribute to a surface water impairment.

KDOW expects implementation of these TMDLs to begin with the elimination of illegal sources. This is intended to prevent legally operating sources from having to effect reductions in order to accommodate the pollutant loading of illegal sources. Note this Section of the TMDL is not intended to summarize the universe of potential illegal sources that may discharge pollutants into surface waters, nor does it attempt to summarize the universe of legal sources that may be operating illegally. Instead, it gives examples of illegal sources known to be present or that could be present in the watersheds (e.g., straight-pipes).

6.0 Water Quality Criterion

Title 401 KAR 10:031 describe the standards used to "protect the surface waters of the Commonwealth, and thus protect water resources." *Escherichia coli* (*E. coli*) bacteria are pathogen indicator organisms. *E. coli* data are used to indicate the degree of support for primary contact recreation (PCR) use. The stream is assessed as fully supporting the PCR use if the *E. coli* content does not exceed the criterion of 240 colonies per 100 ml in less than 20 percent of samples; it was assessed as partially supporting the PCR use if the criterion was not met in 25-33 percent of samples, and as not supporting the PCR use if the criterion was not met in greater than 33 percent of samples. Streams assessed as either nonsupport or partial support are considered impaired. Stream segments were sampled twice a month in addition to a geometric mean in the spring and fall during the PCR season of May 1 through October 31, 2011.

The WQC in 401 KAR 10:031 (Kentucky's Surface Water Standards) for the PCR use are based on both fecal coliform and *E. coli*. Per 401 KAR 10:031:

"The following criteria shall apply to waters designated as primary contact recreation use during the primary contact recreation season of May 1 through October 31: Fecal coliform content or Escherichia coli content shall not exceed 200 colonies per 100 ml or 130 colonies per 100 ml respectively as a geometric mean based on not less than five (5) samples taken during a thirty (30) day period. Content also shall not exceed 400 colonies per 100 ml in twenty (20) percent or more of all samples taken during a thirty (30) day period for fecal coliform or 240 colonies per 100 ml for Escherichia coli."

Both the geomean and instantaneous criteria of 130 and 240 *E. coli* colonies/100 ml, respectively, were applied to calculate allowable loadings to bring the watershed into compliance with the PCR designated use. The loading requiring the greatest percent reduction was used to set the TMDL for a segment. See Section 7.0 for TMDL loading calculations.

Because Kentucky has a dual standard for the PCR designated use, development of TMDLs using the *E. Coli* criterion are sufficient to provide TMDLs for fecal coliform-listed segments and vice versa (i.e., development of *E. Coli* TMDLs will protect the PCR use regardless of whether a segment is impaired for *E. Coli*, fecal coliform, or both). Additionally, because the instantaneous limit is lower for PCR than for SCR (400 colonies/100 ml versus 2000 colonies/100 ml), development of TMDLs for the PCR season also protects segments impaired for the SCR use due to fecal coliform.

7.0 Total Maximum Daily Load

The USEPA defines a TMDL as "a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources. Water quality standards are set by States, Territories, and Tribes. They identify the uses for each waterbody, for example, drinking water supply, contact recreation (swimming), and aquatic life support (fishing), and the scientific criteria to support that use. A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The calculation must include a margin of safety to ensure that the waterbody can be used for the purposes the State has designated. The calculation must also account for seasonal variation in water quality. The Clean Water Act, section 303, establishes the water quality standards and TMDL programs (USEPA 2008c)."

7.1 TMDL Equation and Definitions

A TMDL calculation is performed as follows:

$$TMDL = MOS + WLA + LA$$

Where:
TMDL: the WQC or the maximum load the waterbody can naturally assimilate while still meeting the WQC of 240 colonies per 100 ml at a given flow, in units of colonies per day.
MOS: the Margin of Safety, which can be an implicit or explicit additional reduction applied to the WLA, LA or both types of sources that accounts for uncertainties in the data or TMDL calculations. The MOS for these TMDLs was set at 10% to generate an explicit MOS.
TMDL Target: the TMDL minus the MOS.
WLA: the Waste Load Allocation (allowable loadings from KPDES-permitted sources such as SWSs and MS4s.
SWS-WLA: the WLA for KPDES-permitted sources, which have discharge limits for bacteria (including wastewater treatment plants, package plants and home units).
Remainder: the TMDL Target minus the WLA
Future Growth-WLA: the allowable loading for future KPDES-permitted sources, including new SWSs, expansion of existing SWSs, new storm water sources, and growth of existing storm water sources (such as MS4s).
MS4-WLA: the WLA for KPDES-permitted municipal separate storm water sewer systems (including, but not limited to cities, counties, KYTC, universities and military bases).
LA: the Load Allocation, including natural background and non-KPDES permitted sources.
Seasonality: Yearly factors that affect the relationship between pollutant inputs and the ability of the stream to meet its designated uses.
Critical Condition: When the pollutant conditions are expected to be at their worst.
MAF: the Mean Annual Flow as defined by USGS.
Adjusted MAF: the MAF plus SWS-WLA design flows (where applicable).
Critical Flow: the flow used to calculate the TMDL as a load (equivalent to the Adjusted MAF)
Existing Conditions: the load that exists in the watershed at the time of TMDL development (i.e., sampling) and is causing the impairment, see Section 7.6.

Percent Reduction: the reduction needed to bring the existing conditions (i.e., the existing non-SWS sources) in line with the Remainder, see Section 7.7.
Load: Concentration * Flow * Conversion Factor in colonies per day
Concentration: colonies per 100 milliliters (col/100ml)
Flow (i.e. stream discharge): cubic feet per second (cfs)
Conversion Factor: the value which converts the product of Concentration and Flow to Load (in units of colonies per day); it is derived from the calculation of the following components: (28.31685L/cf * 86400sec/day * 1000ml/L)/ (100ml) and is equal to 24465758.4.

The TMDL calculation must take into account seasonality and other factors that affect the relationship between pollutant inputs and the ability of the stream to meet its designated uses. Once a critical flow is obtained (see Sections 7.5 and 7.8), it is then multiplied by the WQC minus the MOS (10%) times the appropriate conversion factors to obtain the TMDL Target load. Allowable loadings from KPDES-permitted sources are then subtracted from the Target load to produce the Remainder. Future growth calculations are then performed and subtracted from the Remainder, leaving the LA.

However, regardless of the procedure used to calculate the TMDL, reductions from existing conditions ultimately must be effected within the watershed only until all stream segments meet the PCR use, or until all sources (except wildlife) are discharging in compliance with the WQC. Once the WQC is met, all sources (apart from wildlife) must continue to discharge at a load that meets the WQC.

7.2 Margin of Safety

The MOS can be an implicit (using conservative assumptions) or explicit (a reserved portion) additional reduction applied to the WLA, LA or to both types of sources that accounts for uncertainties in the data or TMDL calculations. For these TMDLs, a 10% explicit MOS (i.e., 10% of the WQC or 24 colonies/100ml) was reserved to address uncertainties involving loading from non-SWS sources. SWS sources have an implicit MOS based on the fact that they seldom operate at their design flow. The explicit MOS load was calculated using the following equation:

$$\text{MOS (colonies/day)} = \frac{\text{Critical Flow}}{\text{(cfs)}} \times \frac{24}{\text{(colonies/100ml)}} \text{ x } \frac{\text{Conversion Factor}}{24465758.4}$$

7.3 Waste Load Allocation

The WLA is the portion of the TMDL allocated to KPDES-permitted sources within the watershed. There are currently seven KPDES-permitted sources within Muddy Creek.

7.3.1 SWS-WLA

The WLA for KPDES-permitted sources discharging to an impaired segment were calculated using their permitted effluent limits for *E. coli* (i.e. the WQC of 240 col/100 ml) and facility design flow (or average daily flow for facilities with comingled waste streams) by means of the following equation:

$$\text{WLA (colonies/day)} = \text{Design Flow or Average Daily Flow (cfs)} \times \text{240 (colonies/100ml)} \times \text{Conversion Factor 24465758.4}$$

The individual SWS-WLAs for each facility that discharges to an impaired segment are summed to create a final SWS-WLA for that segment. There are a total of five SWS-WLAs in Muddy Creek.

7.3.2 Remainder

The Remainder is not part of the TMDL however; it is used in the TMDL calculations. It is defined as the TMDL Target load minus the sum of all SWS-WLAs.

7.3.3 Future Growth WLA

A TMDL document will often account for future growth of current or new KPDES-permitted sources in order to avoid having to re-open the TMDL when new sources come online or current ones expand. Future growth is represented by a portion of the Remainder which is set aside (i.e. it is not part of the LA nor is it part of the WLA for current/known sources). It can also include existing storm water sources which are later discovered to discharge the pollutant of concern, even though this fact may not be known at the time the TMDL was written. The loading amount reserved for future growth is determined by using Table 7.1 which assumes that growth occurs more rapidly in a developed area (which is determined by the sum of developed open space, developed low intensity, developed medium intensity and developed high intensity areas as defined by the 2001 USGS NLCD) than in rural areas. The Future Growth WLA for each impaired segment is shown in Table 7.2 and calculated using the following formula:

$$\text{Future Growth-WLA} = \text{Remainder} \times \text{Future Growth-WLA percentage}$$

Table 7.1 Future Growth

Percent Developed Area in the Subwatershed	Future Growth WLA Percentage
≥25%	5%
≥20% – <25%	4%
≥15% – <20%	3%
≥10% – <15%	2%
≥5% – <10%	1%
<5%	0.5%

Table 7.2 Future Growth Percentage by Impaired Segment

Waterbody Segment and RMs	Percent Developed Area	Percent of Remainder Set Aside for Future Growth
Muddy Creek 0.0 to 20.6	6.63%	1%
Muddy Creek 20.6 to 31.4	12.57%	2%
UT to Muddy Creek 0.0 to 2.4	14.63%	2%
Viny Fork 0.0 to 4.1	9.04%	1%
Hickory Lick 0.0 to 2.9	5.84%	1%
Clear Creek 0.0 to 4.1	5.24%	1%
Dunbar Branch 0.0 to 2.6	4.10%	0.5%

7.3.4 MS4-WLA

If there is a MS4 within the upstream area of the impaired segment, a MS4-WLA must be calculated. A larger MS4 will not be responsible for other MS4s present within its boundaries (e.g. a City-MS4 is not responsible for a University or KYTC-MS4 within its permitted boundary). The MS4-WLA is calculated using the following equation:

$$\text{Remainder} \times \text{\% of (developed acres in MS4 boundary)/(total acres in subwatershed)} = \text{MS4-WLA}$$

7.4 Load Allocation

The LA is the portion of the TMDL where non KPDES-permitted sources (e.g., nonpoint sources, or those not permitted by KPDES) receive their allocation within the TMDL. Within Muddy Creek, these sources can include properly functioning OSTDS (i.e. septic systems), wildlife, household pets and facilities with properly functioning BMPs (e.g. agricultural farms or landfarms for municipal SWS sludge). LAs were calculated using the following equation:

$$\text{LA} = \text{Remainder} - \text{Future Growth WLA} - \text{MS4-WLA}$$

The available sampling data were insufficient to apportion the existing loading among the various LA sources; therefore, it is attributed to all LA sources. LAs for each impaired segment are presented and discussed in Section 8. As discussed in Section 5.3, implementation of these bacteria TMDLs is expected to begin with the elimination of illegal sources such as failing OSTDS and straight-pipes if present in the watershed. In addition, facilities not in compliance with KNDOP regulations or BMP requirements under the AWQA are also illegal and are expected to come into compliance.

7.5 Seasonality

Seasonality is defined as yearly factors such as temporal variations on source behavior and stream loading than can affect the relationship between pollutant inputs and the ability of the stream to meet its designated uses. This TMDL addresses seasonality by only using samples collected within the PCR season (May - October).

7.6 Critical Condition

The critical condition for nonpoint source bacteria loading typically occurs after a runoff event, preceded by an extended dry period - bacteria accumulate on the land surface (during the dry period) and are subsequently washed off by the rainfall. The critical condition for point source loading typically occurs during periods of low streamflow when dilution (of effluent) is minimized. The Muddy Creek watershed contains both types of sources; therefore the critical condition for each bacteria-impaired segment is defined by the sample showing the highest exceedance.

7.7 TMDLs Calculated as a Daily Load

Federal guidelines of the Clean Water Act require a TMDL to be expressed in terms of a daily load. Due to the limited amount of data available, particularly the absence of stream gages or in-stream flow data, a method was developed utilizing the WQC and Mean Annual Streamflow (MAF). The USGS has generated a MAF value for streams across Kentucky. The MAF values were calculated using the equation found in the USGS Water-Resources Investigations Report 02-4206 "Estimating Mean Annual Streamflow of Rural Streams in Kentucky" (http://ky.water.usgs.gov/pubs/wrir_2002_4206.pdf). The MAF values can be found on the Kentucky Watershed Viewer webpage (http://gis.gapsky.org/watershed/) or downloaded from the Kentucky Geography Network (http://kygeonet.ky.gov/). Once obtained, major inputs (i.e., WWTP design capacity) were added to the MAF to generate a critical flow. The critical flow is then multiplied by the WQC minus the MOS (10%) times the appropriate conversion factors to obtain the TMDL Target (i.e., the allowable daily load).

8.0 TMDL Calculations

Bacteria TMDLs have been developed using a range of techniques from sophisticated watershed-based computer modeling to qualitative assumptions and simple mass balance. An approach focusing on the WQC and MAF was utilized for development of these bacteria TMDLs. The best available data from various sources was analyzed and spatial analysis was performed within a GIS framework to obtain MAF values, assess KPDES-permitted and non KPDES-permitted sources, and appropriately assign TMDL loads. Development of these TMDLs follows the procedures outlined in Kentucky's *Quality Assurance Project Plan (QAPP) for Data Analysis for TMDL Development* and maintains the guidelines set in the *Pathogen TMDL Standard Operating Procedures* for evaluating the TMDL approach (KDOW 2011).

8.1 Data Validation

Data validation was performed as follows:

- Only samples collected from a flowing stream were considered in analysis.
- Quality Analysis/Quality Control Samples (e.g. duplicates and blanks) were excluded from the dataset.
- The data tables show both *E. coli* concentrations and flows; in some cases the flows were measured in-stream at the time the sample was collected. On other occasions no flow data were collected; this may have been due to a high water event that precluded samplers from entering the stream due to safety reasons, or other considerations.
- Some samples were reported using either the *less than* (denoted using the "<") symbol or the *greater than* (denoted using the ">") symbol, indicating the true concentration was unknown but it was either below or above the reported value, respectively. For samples *less than* the reported value, the reported value was used verbatim. For *greater than* values, the values were used verbatim because all showed exceedances of the WQC. While in such cases the exact value of the exceedance is unknown and likely higher than the number reported, the sample still gave insight into the status of the waterbody at the time the sample was taken.

8.2 Individual Stream Segment Analysis

Data collection and analysis from various sources (including Federal, State and local government, and public entities) was carried out for each individually listed stream segment and its associated drainage area. Spatial analysis was also performed within a GIS framework. Most of the data collected for the development of this document can be accessed and downloaded from the Kentucky Geography Network (http://kygeonet.ky.gov).

Results from the watershed sampling event in 2011 indicated new impaired segments in several tributaries of the watershed. An overview of the watershed is followed by a brief discussion of each segment and sampling site along Muddy Creek and then tributaries, beginning in the headwaters.

8.2.1 Muddy Creek of the Kentucky River

Muddy Creek of the Kentucky River is a fourth order stream that is completely contained within Madison County. Muddy Creek flows in a northerly direction for 31.3 miles, drops about 400 feet in elevation and drains an area of 67.86 square miles, or 43,430 acres. Muddy Creek begins as a first order stream that originates approximately six miles northeast of the city of Berea and two miles east of the city of Richmond. It quickly becomes a second order stream at RM 31 and a third order at RM 27.9. Finally at RM 19.4 it becomes a fourth order stream before entering the Kentucky River.

Land cover is largely agricultural pastureland (50.5%) followed by forest (34.7%). In 2001, only 8.5% of the total land area was developed and mostly located along rural roads and small towns (including Terrill, Bybee and College Hill). Though there are only a few mapped sinkholes and springs, approximately 1/3 of the watershed is prone to karst features. The soil and bedrock properties of the watershed can provide a challenge for septic system and basement installation and maintenance but can also provide good farmland in a few areas.

As of the last Census (2010), there were 35,043 housing units and an estimated population of 82, 916 in Madison County. Sewer lines cover a very small portion of the watershed however there are planned upgrades and expansions covering some of the watershed not currently being serviced by sanitary sewer collection systems (Figure 8.1). All other areas of the watershed rely on OSTDS or do not treat their sewage. As discussed in Section 5.1.1.2, funding for these projects may be slow. It is suggested that a Revolving Loan Fund Program be established or that the U.S. Army Corps of Engineers 531 program be extended for the installation of a septic tank for each house that does not presently have sanitary sewer service, or could currently have a failing septic system. The predominant land cover in the watershed is agricultural pastureland followed by forest (Table 8.1).

According to the latest KDOW watershed study the sampling site with the highest percent exceedance of the WQC (83.3%) was the first site in the headwaters of Muddy Creek at RM 27.7 – this area of the watershed is dominated by agricultural pastureland, has no sewers, had a high occurrence of total suspended solids and a lack of habitat, riparian zone and available cover around the waterbody. On the other hand, nutrients and conductivity were fairly low and dissolved oxygen levels were suitable. Hickory Lick had a similar percent exceedance of the WQC (85.7%), is also dominated by agricultural pastureland and had similar signs of water quality and biological health. Dunbar Branch also had a high percent exceedance of the WQC (80%) however its watershed is dominated by forest land and total suspended solids levels were the best in the watershed. The sites with the lowest percent exceedance of the WQC was the site near the mouth of Muddy Creek at RM 1.2 (26.7%) and Clear Creek (40%) – though water quality parameters were suitable at these sites, biological parameters such as riparian zone, total habitat and available cover were lacking. The site near RM 13.4 on Muddy Creek also had a lower percent exceedance of the WQC (40%) – all other signs of water quality and biological health were fair to suitable making this the best overall site in the watershed. More information from the watershed study can be found in Section 4 or Appendix B.

Table 8.1 Land Cover in the Muddy Creek Watershed (NLCD 2001)

Land Use	% of Total Area	Acres	Square Miles
Forest	34.7%	15,084.40	23.57
Agriculture (total)	53.1%	23,056.72	36.03
Pasture	50.5%	21,935.61	34.27
Row Crop	2.6%	1,121.11	1.75
Developed	8.5%	3,702.49	5.79
Natural Grassland	3.0%	1,304.59	2.04
Wetland	0.1%	62.94	0.10
Barren	0.1%	40.92	0.06

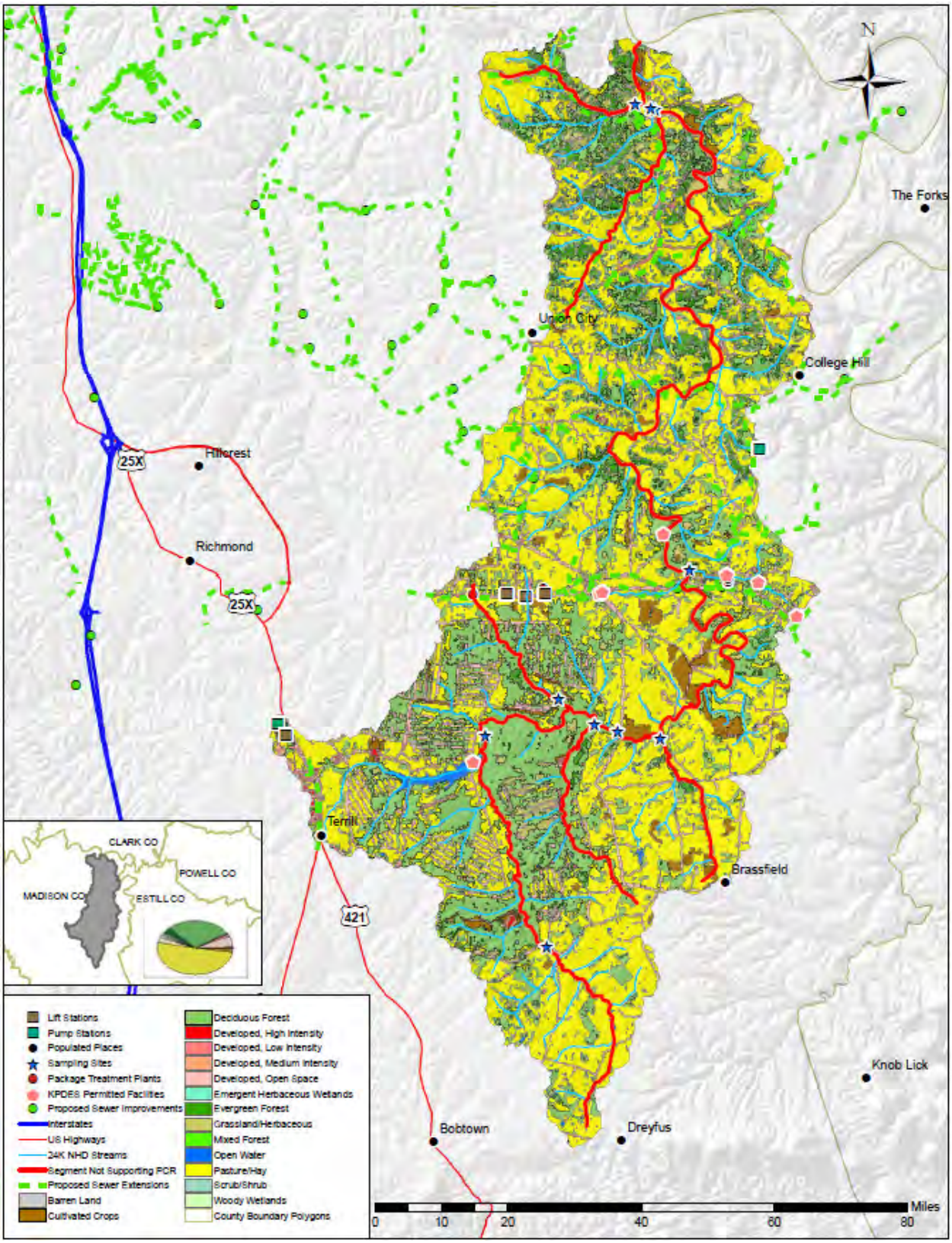

Figure 8.1 Land Cover, KPDES-Permitted Sources and Wastewater Infrastructure within the Muddy Creek Watershed

8.2.1.1 Muddy Creek 20.6 to 31.4 into Kentucky River

Muddy Creek is a third order stream at the bottom of this segment. KDOW monitored two sites within the segment – site DOW04023008 near RM 27.7 showed the highest exceedance from the WQC and therefore was used to set the TMDL for the segment. Exceedance of the WQC (240 col/100ml) was observed in 83.3% of the samples collected – the highest concentration of all samples was greater than 24,192 colonies per 100 ml (Table 8.2). *E. coli* concentrations appear to increase with increased amounts of precipitation that suggests the loading may be caused by non KPDES-permitted (nonpoint) sources in the watershed. However, concentrations also exceed the WQC with little to no precipitation. Because there are no KPDES-permitted sources upstream of RM 27.7, this loading suggests nonpoint sources in the watershed such as straight-pipes, animals in streams or failing OSTDS. There are no sewer lines so residents to this point must rely on OSTDS or do not treat their sewage.

Table 8.2 *E. coli* Data Collected for Muddy Creek at Crooksville Rd. Bridge (RM 27.7) - DOW04023008

Collection Date	Instantaneous E Coli (CFU/100 ml)	Geomean E Coli (CFU/100 ml)	Flow (cfs)	Field Precipitation Notes
5/9/11	**866.4**		3.455	Intermittent showers in the past 24 hours; 0.12" rainfall
5/23/11	**>24192**	**2724**	47.757	Intermittent showers in the past 24-48 hours; 0.75" rainfall
5/31/11	**1733**	**1367**	1.416	4 days since 0.1" rainfall (0.47" on 5/27)
6/7/11	**1203**		0.26	10 days since 0.1" rainfall (0.47" on 5/27)
6/14/11	**862**		0.026	3 days since 0.1" rainfall (0.43" on 6/11)
6/21/11	**3448**		8.972	Steady rain in the past 24-48 hours; >2" rainfall
6/28/11	**770**		0.641	Intermittent showers in the past 48 hours; less than 0.1" rainfall (0.06-0.36" on 6/24)
7/13/11	**>2419**		0.042	Intermittent showers in the past 48 hours, less than 0.1" rainfall (0.98" on 7/8)
8/2/11	**326**		0.009	3 days since 0.1" rainfall (0.16" on 7/30)
9/27/11	**1334**		1.142	Intermittent showers in the past 24-48 hours; ~1" in last 24 hours
10/6/11	88		0.02	9 days since 0.1" rainfall (0.42-0.57" on 9/27)
10/11/11	84		0.011	14 days since 0.1" rainfall (0.44-0.69" on 9/26)

Exceedance of WQC	Part of Geomean Calculation	Rain today	Rain in last 24 hours	Rain in last 48 hours	No rain in last 48 hours

Site DOW04023009 is located near RM 23.6 near the BGAD property. There is one KPDES-permitted source located between here and the headwater site, a small portion of the Richmond MS4. Most of this area of the watershed is not on sewer though there is some wastewater infrastructure from the city of Richmond. Exceedance of the WQC (240 col/100ml) was observed in 66.7% of the samples collected – the highest concentration of all samples was 11,199 colonies per 100 ml (Table 8.3). *E. coli* concentrations appear to increase with increased, little or no precipitation which suggests the loading may be caused by a variety of sources in the watershed.

Table 8.3 *E. coli* Data Collected for Muddy Creek on the BGAD (RM 23.6) - DOW04023009

Collection Date	Instantaneous E Coli (CFU/100 ml)	Geomean E Coli (CFU/100 ml)	Flow (cfs)	Field Precipitation Notes
5/9/11	144		13.711	Intermittent showers in the past 24 hours; 0.12" rainfall
5/23/11	**11199**	**751**	71.95	Intermittent showers in the past 24-48 hours; 0.75" rainfall
5/31/11	**488**	**354**	3.641	4 days since 0.1" rainfall (0.47" on 5/27)
6/7/11	166		0.481	10 days since 0.1" rainfall (0.47" on 5/27)
6/14/11	142		0.306	3 days since 0.1" rainfall (0.43" on 6/11)
6/21/11	**1850**		36.067	Steady rain in the past 24-48 hours; >2" rainfall
6/28/11	**260**		1.764	Intermittent showers in the past 48 hours; less than 0.1" rainfall (0.06-0.36" on 6/24)
7/13/11	78		0.377	Intermittent showers in the past 48 hours, less than 0.1" rainfall (0.98" on 7/8)
8/2/11	**461**		0.09	3 days since 0.1" rainfall (0.16" on 7/30)
9/6/11	**836**		0.525	Showers today, steady rain in the past 24-48 hours; >2.5" rainfall
9/20/11	142	**727**	0.233	Showers today, intermittent showers and steady rain in the last 24-48; 0.52" in last 48 hours
9/27/11	**583**		0.36	Intermittent showers in the past 24-48 hours; ~1" in last 24 hours
10/6/11	**345**		0.129	9 days since 0.1" rainfall (0.42-0.57" on 9/27)
10/11/11	**921**		0.119	14 days since 0.1" rainfall (0.44-0.69" on 9/26)
10/20/11	**7701**		18.351	Some showers today, steady rain in the past 24-48 hours; >2" rainfall

Exceedance of WQC	Part of Geomean Calculation	Rain today	Rain in last 24 hours	Rain in last 48 hours	No rain in last 48 hours

The predominant land cover in the watershed to the bottom of this impaired segment is agricultural pastureland followed by forest (Figure 8.2). Based on the WQC and the MAF, the *E. coli* TMDL for the 10.8 mile impaired segment of Muddy Creek is 1.59×10^{11} colonies per day (Table 8.4). According to the data presented, the watershed would have required a 99.11% reduction in bacteria loading during the 2011 PCR season in order to meet the WQC. In addition, any future KPDES wastewater permitted sources must meet permit limits based on the WQC in 401 KAR 10:031 and must not cause or contribute to an existing impairment.

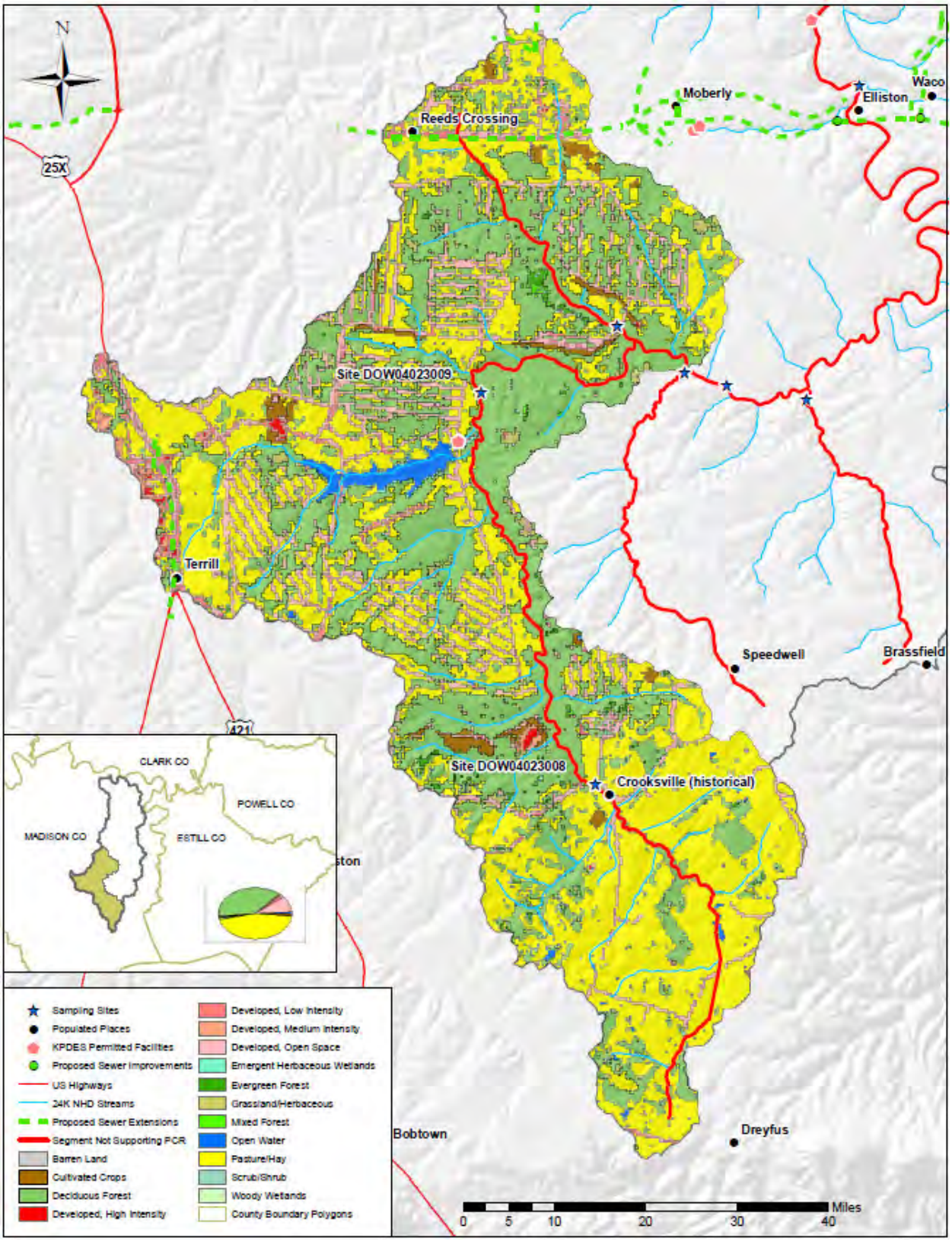

Figure 8.2 Land Cover for Muddy Creek 20.6 to 31.4

Table 8.4 Summary of TMDL Components for Muddy Creek 20.6 to 31.4

TMDL[(1)]	MOS[(2)]	SWS-WLA[(3)]	MS4 - WLA	Future Growth - WLA	LA	Mean Annual Flow (cfs)
1.59×10^{11} col/day	1.59×10^{10} col/day	n/a	7.02×10^{8} col/day	2.87×10^{9} col/day	1.40×10^{11} col/day	6.7

Notes:

(1). The TMDL is the sum of all components. TMDLs are expressed as daily loads of *E. coli* colonies by multiplying the WQC by the MAF and appropriate conversion factors – the instantaneous WQC was used to set the TMDL for this segment since its percent reduction was greater than the geomean WQC. Because the site was not coterminous with the bottom of the segment, the TMDL was multiplied by an area ratio of 4.05.

(2). MOS is explicitly set at 10% of the WQC.

(3). Any future KPDES wastewater permitted sources must meet permit limits based on the WQC in 401 KAR 10:031, and must not cause or contribute to an existing impairment. WLA value is based on design flow (or average daily flow for industrial facilities) and acute permit limits and represents the maximum one-day load that can be discharged to the stream segment.

8.2.1.2 Muddy Creek 0.0 to 20.6 into Kentucky River

Muddy Creek becomes a fourth order stream near the top of this segment around RM 19.4. KDOW monitored three sites within the segment – site DOW04023012 near RM 20.3 showed the highest exceedance from the WQC and therefore was used to set the TMDL for the segment. Exceedance of the WQC (240 col/100ml) was observed in 71.4% of the samples collected – the highest concentration of all samples was greater than 19,863 colonies per 100 ml (Table 8.5). *E. coli* concentrations appear to increase with increased or little precipitation suggesting the loading may be caused by both KPDES-permitted (point) and non KPDES-permitted (nonpoint) sources in the watershed. There is one KPDES-permitted source (i.e. the city of Richmond MS4), one KNDOP (i.e. Eastern Kentucky University Farms) and some wastewater infrastructure upstream of RM 20.3. There are few sewer lines so residents to this point mostly rely on OSTDS or do not treat their sewage.

Site DOW04023002 is located near RM 13.4 and the KY-52 bridge. There are five KPDES-permitted sources located between here and the headwaters: a small portion of the Richmond MS4, the Riddell residence, Waco Elementary School, Cole's Moberly Shell and the Waco Main Street Store. There is also one KNDOP (i.e. Eastern Kentucky University Farms). Most of the watershed is not on sewer though there is some wastewater infrastructure from the city of Richmond and the Northern Madison County Sanitation District (see Figure 5.1); most residents to this point rely on OSTDS or do not treat their sewage. Exceedance of the WQC (240 col/100ml) was observed in 40% of the samples collected – the highest concentration of all samples was greater than 24, 192 colonies per 100 ml (Table 8.6). *E. coli* concentrations appear to increase with increased precipitation which suggests the loading may be caused by non KPDES-permitted (nonpoint) sources in the watershed such as straight-pipes, animals in streams or failing OSTDS or KPDES-permitted (point) sources discharging above permit limits.

Table 8.5 *E. coli* Data Collected for Muddy Creek at Speedwell Road Bridge (RM 20.3) - DOW04023012

Collection Date	Instantaneous E Coli (CFU/100 ml)	Geomean E Coli (CFU/100 ml)	Flow (cfs)	Field Precipitation Notes
5/9/11	166.9		24.505	Intermittent showers in the past 24 hours; 0.12" rainfall
5/23/11	**19863**	**1561**	n/a	Intermittent showers in the past 24-48 hours; 0.75" rainfall
5/31/11	144	**613**	6.103	4 days since 0.1" rainfall (0.47" on 5/27)
6/7/11	**435**		1.041	10 days since 0.1" rainfall (0.47" on 5/27)
6/14/11	**>2419**		0.408	3 days since 0.1" rainfall (0.43" on 6/11)
6/21/11	**3076**		44.85	Steady rain in the past 24-48 hours; >2" rainfall
6/28/11	185		3.227	Intermittent showers in the past 48 hours; less than 0.1" rainfall (0.06-0.36" on 6/24)
7/13/11	**261**		0.676	Intermittent showers in the past 48 hours, less than 0.1" rainfall (0.98" on 7/8)
9/6/11	**1850**		2.232	Showers today, steady rain in the past 24-48 hours; >2.5" rainfall
9/20/11	**649**	**372**	0.83	Showers today, intermittent showers and steady rain in the last 24-48; 0.52" in last 48 hours
9/27/11	**496**		1.84	Intermittent showers in the past 24-48 hours; ~1" in last 24 hours
10/6/11	121		0.086	9 days since 0.1" rainfall (0.42-0.57" on 9/27)
10/11/11	30		0.04	14 days since 0.1" rainfall (0.44-0.69" on 9/26)
10/20/11	**6131**		40.696	Some showers today, steady rain in the past 24-48 hours; >2" rainfall

Exceedance of WQC	Part of Geomean Calculation	Rain today	Rain in last 24 hours	Rain in last 48 hours	No rain in last 48 hours

Table 8.6 *E. coli* Data Collected for Muddy Creek at KY 52 Bridge (RM 13.4) - DOW04023002

Collection Date	Instantaneous E Coli (CFU/100 ml)	Geomean E Coli (CFU/100 ml)	Flow (cfs)	Field Precipitation Notes
5/9/11	230		35.096	Intermittent showers in the past 24 hours; 0.12" rainfall
5/23/11	**>24192**	**691**	n/a	Intermittent showers in the past 24-48 hours; 0.75" rainfall
5/31/11	139	**243**	11.485	4 days since 0.1" rainfall (0.47" on 5/27)
6/7/11	148		2.074	10 days since 0.1" rainfall (0.47" on 5/27)
6/14/11	115		0.778	3 days since 0.1" rainfall (0.43" on 6/11)
6/21/11	**2755**		85.851	Steady rain in the past 24-48 hours; >2" rainfall
6/28/11	130		4.808	Intermittent showers in the past 48 hours; less than 0.1" rainfall (0.06-0.36" on 6/24)

Collection Date	Instantaneous E Coli (CFU/100 ml)	Geomean E Coli (CFU/100 ml)	Flow (cfs)	Field Precipitation Notes
7/13/11	214		1.121	Intermittent showers in the past 48 hours, less than 0.1" rainfall (0.98" on 7/8)
8/2/11	10		0.073	3 days since 0.1" rainfall (0.16" on 7/30)
9/6/11	**1259**		1.818	Showers today, steady rain in the past 24-48 hours; >2.5" rainfall
9/20/11	**461**	**213**	1.415	Showers today, intermittent showers and steady rain in the last 24-48; 0.52" in last 48 hours
9/27/11	**613**		0.457	Intermittent showers in the past 24-48 hours; ~1" in last 24 hours
10/6/11	5		0.316	9 days since 0.1" rainfall (0.42-0.57" on 9/27)
10/11/11	26		0.186	14 days since 0.1" rainfall (0.44-0.69" on 9/26)
10/20/11	**12033**		62.032	Some showers today, steady rain in the past 24-48 hours; >2" rainfall

Exceedance of WQC	Part of Geomean Calculation	Rain today	Rain in last 24 hours	Rain in last 48 hours	No rain in last 48 hours

Site DOW04023016 is located near RM 1.2 and the Doylesville Road bridge. In addition to the sources listed above there is one additional KPDES-permitted source located between here and the site at RM 13.4: the Waco Food Mart. There are no sewer lines between here and RM 13.4 though there is some planned sewer extensions (See Figure 5.1); most residents to this point rely on OSTDS or do not treat their sewage. Exceedance of the WQC (240 col/100ml) was observed in 26.7% of the samples collected – the highest concentration of all samples was greater than 17,329 colonies per 100 ml (Table 8.7). *E. coli* concentrations appear to increase with increased precipitation which suggests the loading may be caused by non KPDES-permitted (nonpoint) sources in the watershed such as straight-pipes, animals in streams or failing OSTDS or KPDES-permitted (point) sources discharging above permit limits.

Table 8.7 *E. coli* Data Collected for Muddy Creek at Doylesville Road Bridge (RM 1.2) - DOW04023016

Collection Date	Instantaneous E Coli (CFU/100 ml)	Geomean E Coli (CFU/100 ml)	Flow (cfs)	Field Precipitation Notes
5/9/11	91		54.441	Intermittent showers in the past 24 hours; 0.12" rainfall
5/23/11	**17329**	**444**	n/a	Intermittent showers in the past 24-48 hours; 0.75" rainfall
5/31/11	58	**162**	18.648	4 days since 0.1" rainfall (0.47" on 5/27)
6/7/11	61		4.12	10 days since 0.1" rainfall (0.47" on 5/27)
6/14/11	46		2.046	3 days since 0.1" rainfall (0.43" on 6/11)
6/21/11	**6131**		99.247	Steady rain in the past 24-48 hours; >2" rainfall
6/28/11	111		6.687	Intermittent showers in the past 48 hours; less than 0.1" rainfall (0.06-0.36" on 6/24)
7/13/11	228		2.206	Intermittent showers in the past 48 hours, less than 0.1" rainfall (0.98" on 7/8)

Collection Date	Instantaneous E Coli (CFU/100 ml)	Geomean E Coli (CFU/100 ml)	Flow (cfs)	Field Precipitation Notes
8/2/11	31		0.203	3 days since 0.1" rainfall (0.16" on 7/30)
9/6/11	**836**		2.933	Showers today, steady rain in the past 24-48 hours; >2.5" rainfall
9/20/11	39	58	0.336	Showers today, intermittent showers and steady rain in the last 24-48; 0.52" in last 48 hours
9/27/11	63		3.633	Intermittent showers in the past 24-48 hours; ~1" in last 24 hours
10/6/11	20		0.484	9 days since 0.1" rainfall (0.42-0.57" on 9/27)
10/11/11	2		0.33	14 days since 0.1" rainfall (0.44-0.69" on 9/26)
10/20/11	**6488**		116.669	Some showers today, steady rain in the past 24-48 hours; >2" rainfall

Exceedance of WQC	Part of Geomean Calculation	Rain today	Rain in last 24 hours	Rain in last 48 hours	No rain in last 48 hours

The predominant land cover in the watershed to the bottom of this impaired segment is agricultural pastureland followed by forest (Figure 8.3). Based on the WQC and the MAF, the *E. coli* TMDL for the 20.6 mile impaired segment of Muddy Creek is 3.48×10^{11} colonies per day (Table 8.8). According to the data presented, the watershed would have required a 98.91% reduction in bacteria loading during the 2011 PCR season in order to meet the WQC. In addition, any future KPDES wastewater permitted sources must meet permit limits based on the WQC in 401 KAR 10:031 and must not cause or contribute to an existing impairment.

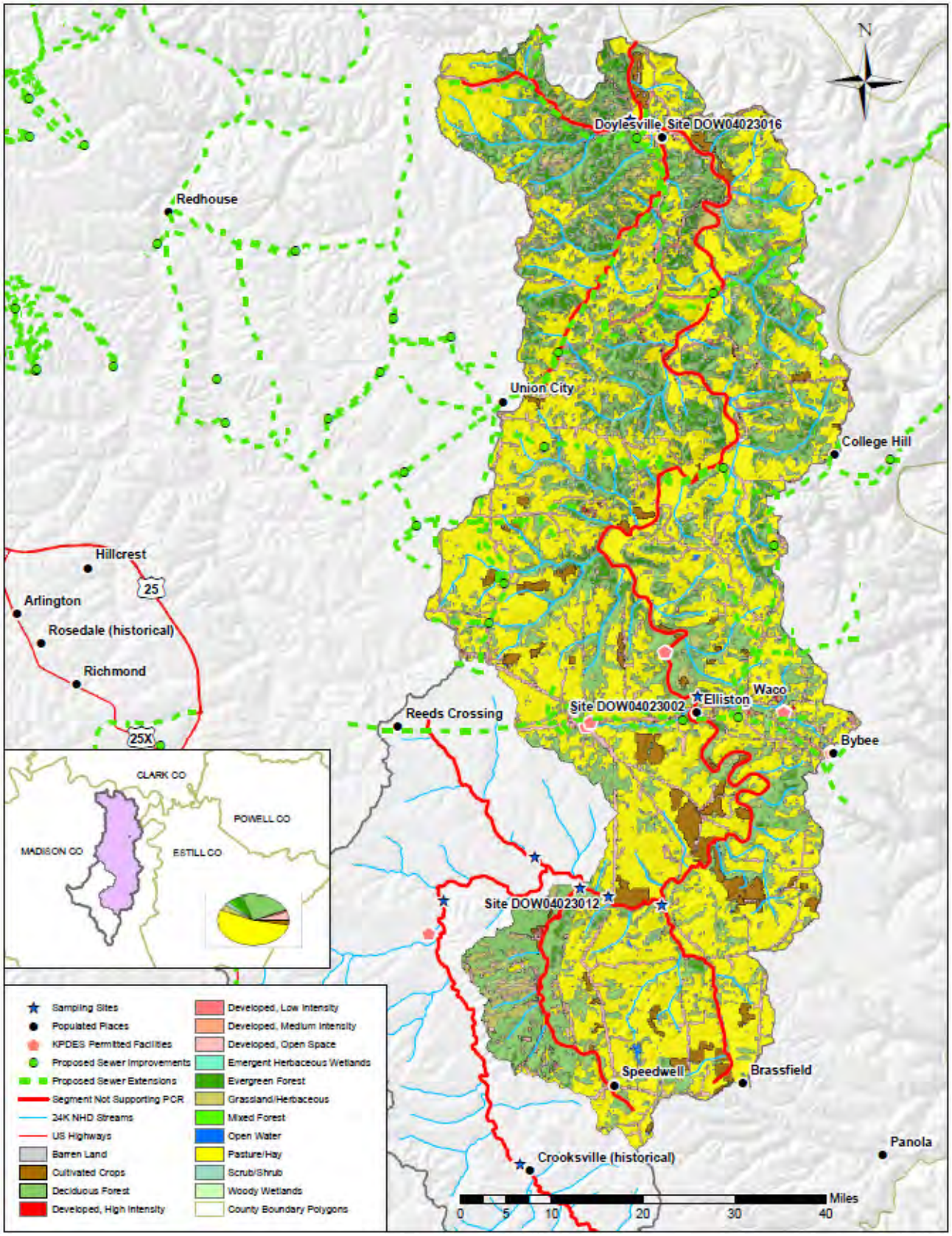

Figure 8.3 Land Cover for Muddy Creek 0.0 to 20.6

Table 8.8 Summary of TMDL Components for Muddy Creek 0.0 to 20.6

TMDL[(1)]	MOS[(2)]	SWS-WLA[(3)]	MS4 - WLA	Future Growth - WLA	LA	Mean Annual Flow (cfs)
3.46×10^{11} col/day	3.46×10^{10} col/day	1.10×10^{8} col/day	7.13×10^{8} col/day	3.11×10^{9} col/day	3.07×10^{11} col/day	32.2

Notes:

(1). The TMDL is the sum of all components. TMDLs are expressed as daily loads of *E. coli* colonies by multiplying the WQC by the MAF and appropriate conversion factors – the instantaneous WQC was used to set the TMDL for this segment since its percent reduction was greater than the geomean WQC. Because the site was not coterminous with the bottom of the segment, the TMDL was multiplied by an area ratio of 1.83.

(2). MOS is explicitly set at 10% of the WQC.

(3). Any future KPDES wastewater permitted sources must meet permit limits based on the WQC in 401 KAR 10:031, and must not cause or contribute to an existing impairment. WLA value is based on design flow (or average daily flow for industrial facilities) and acute permit limits and represents the maximum one-day load that can be discharged to the stream segment.

8.2.1.3 UT to Muddy Creek 0.0 to 2.4 into Muddy Creek

UT to Muddy Creek is a second order stream that discharges to Muddy Creek near RM 21.3. There are no KPDES-permitted sources in the subwatershed though there are three lift stations and proposed sewer extensions (see Figure 5.1) in the headwaters. There are no sewer lines so residents must rely on OSTDS or do not treat their sewage. The subwatershed is dominated by forest land near the mouth and agricultural pastureland in the headwaters (Figure 8.4). Exceedance of the WQC (240 col/100ml) was observed in 50% of the samples collected – the highest concentration of all samples was greater than 24,192 colonies per 100 ml (Table 8.9). *E. coli* concentrations appear to only increase with increased precipitation which suggests the loading may be caused by non KPDES-permitted (nonpoint) sources in the watershed such as straight-pipes, animals in streams or failing OSTDS.

Table 8.9 *E. coli* Data Collected for UT to Muddy Creek on the BGAD (RM 21.3) - DOW04023010

Collection Date	Instantaneous E Coli (CFU/100 ml)	Geomean E Coli (CFU/100 ml)	Flow (cfs)	Field Precipitation Notes
5/9/11	201.4		2.701	Intermittent showers in the past 24 hours; 0.12" rainfall
5/23/11	**>24192**		37.364	Intermittent showers in the past 24-48 hours; 0.75" rainfall
5/31/11	178		0.864	4 days since 0.1" rainfall (0.47" on 5/27)
6/7/11	214		0.099	10 days since 0.1" rainfall (0.47" on 5/27)
6/21/11	**1956**		4.4	Steady rain in the past 24-48 hours; >2" rainfall
6/28/11	228		0.375	Intermittent showers in the past 48 hours; less than 0.1" rainfall (0.06-0.36" on 6/24)
9/6/11	**>24192**		0.637	Showers today, steady rain in the past 24-48 hours; >2.5" rainfall
9/27/11	**1145**		0.372	Intermittent showers in the past 24-48 hours; ~1" in last 24 hours

Exceedance of WQC	Part of Geomean Calculation	Rain today	Rain in last 24 hours	Rain in last 48 hours	No rain in last 48 hours

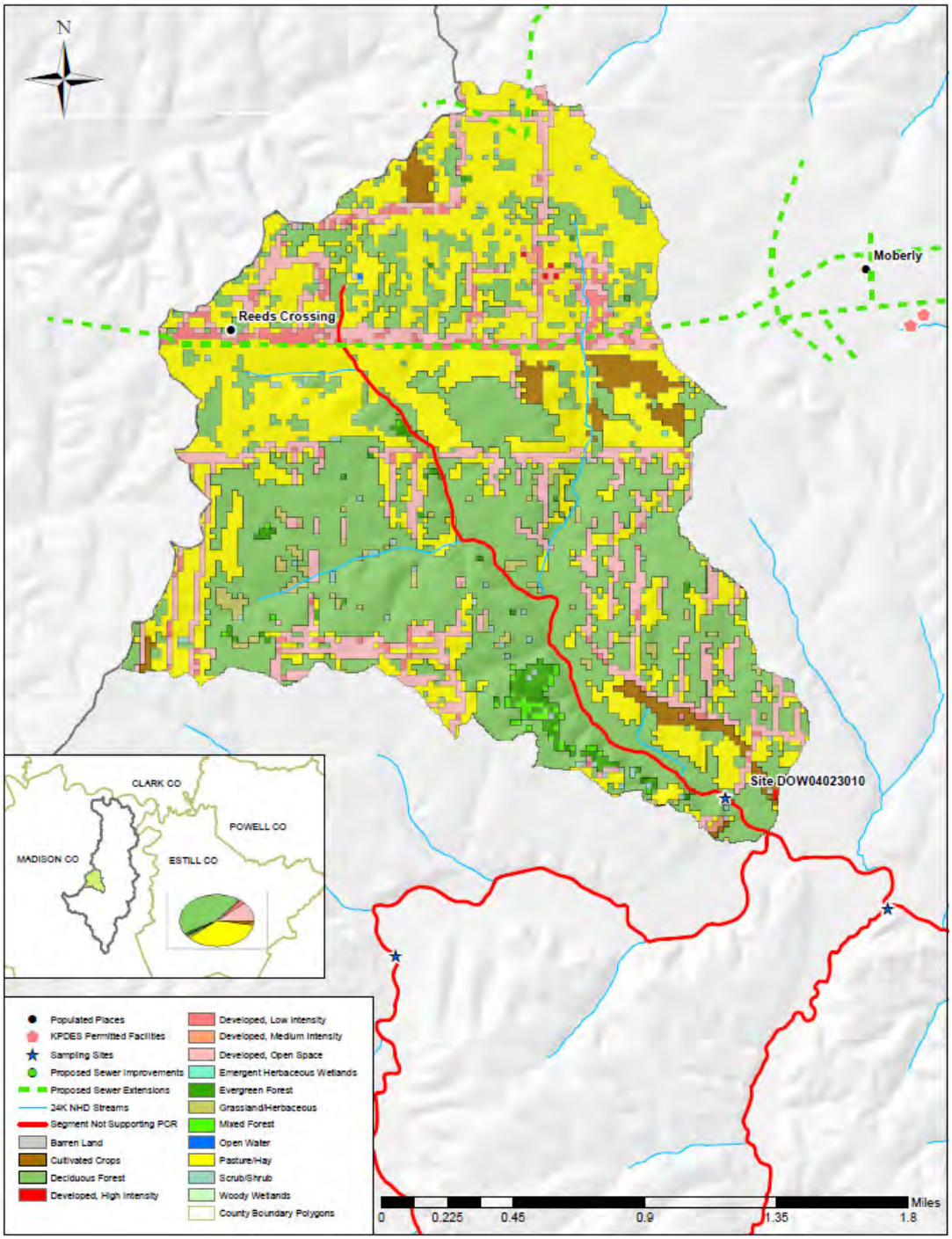

Figure 8.4 Land Cover for UT to Muddy Creek 0.0 to 2.4

Based on the WQC and the MAF, the *E. coli* TMDL for the 2.4 mile impaired segment of UT to Muddy Creek is 2.54×10^{10} colonies per day (Table 8.10). According to the data presented, the watershed would have required a 99.11% reduction in bacteria loading during the 2011 PCR season in order to meet the WQC. In addition, any future KPDES wastewater permitted sources must meet permit limits based on the WQC in 401 KAR 10:031 and must not cause or contribute to an existing impairment.

Table 8.10 Summary of TMDL Components for UT to Muddy Creek 0.0 to 2.4

TMDL[(1)]	MOS[(2)]	SWS-WLA	MS4 - WLA	Future Growth - WLA	LA	Mean Annual Flow (cfs)
2.54×10^{10} col/day	2.54×10^{9} col/day	n/a	n/a	4.58×10^{8} col/day	2.24×10^{10} col/day	4.4

Notes:

(1). The TMDL is the sum of all components. TMDLs are expressed as daily loads of *E. coli* colonies by multiplying the WQC by the MAF and appropriate conversion factors – the instantaneous WQC was used to set the TMDL for this segment since its percent reduction was greater than the geomean WQC. Because the site was not coterminous with the bottom of the segment, the TMDL was multiplied by an area ratio of 1.01.

(2). MOS is explicitly set at 10% of the WQC.

8.2.1.4 Viny Fork 0.0 to 4.1 into Muddy Creek

Viny Fork is a second order stream that discharges to Muddy Creek near RM 20.7. There are no KPDES-permitted sources in the subwatershed though the BGAD property encompasses all but 10-20% of the headwaters. There are no sewer lines so residents must rely on OSTDS or do not treat their sewage. The subwatershed is mostly forest land with agricultural pastureland dominating the headwaters (Figure 8.5). Exceedance of the WQC (240 col/100ml) was observed in 75% of the samples collected – the highest concentration of all samples was greater than 24,192 colonies per 100 ml (Table 8.11). *E. coli* concentrations appear to increase with little or no precipitation which suggests the loading may be caused by non KPDES-permitted (nonpoint) sources in the watershed such as straight-pipes, animals in streams or failing OSTDS.

Table 8.11 E. coli Data Collected for Viny Fork on the BGAD (RM 20.7) - DOW04023011

Collection Date	Instantaneous E Coli (CFU/100 ml)	Geomean E Coli (CFU/100 ml)	Flow (cfs)	Field Precipitation Notes
5/9/11	**658.8**		3.495	Intermittent showers in the past 24 hours; 0.12" rainfall
5/23/11	**>24192**	**750**	47.23	Intermittent showers in the past 24-48 hours; 0.75" rainfall
5/31/11	**326**	**269**	1.025	4 days since 0.1" rainfall (0.47" on 5/27)
6/7/11	70		0.07	10 days since 0.1" rainfall (0.47" on 5/27)
6/14/11	**260**		0.004	3 days since 0.1" rainfall (0.43" on 6/11)
6/21/11	**1658**		6.068	Steady rain in the past 24-48 hours; >2" rainfall
6/28/11	142		0.373	Intermittent showers in the past 48 hours; less than 0.1" rainfall (0.06-0.36" on 6/24)
7/13/11	142		0.317	Intermittent showers in the past 48 hours, less than 0.1" rainfall (0.98" on 7/8)
9/27/11	**2481**		0.542	Intermittent showers in the past 24-48 hours; ~1" in last 24 hours

Exceedance of WQC	Part of Geomean Calculation	Rain today	Rain in last 24 hours	Rain in last 48 hours	No rain in last 48 hours

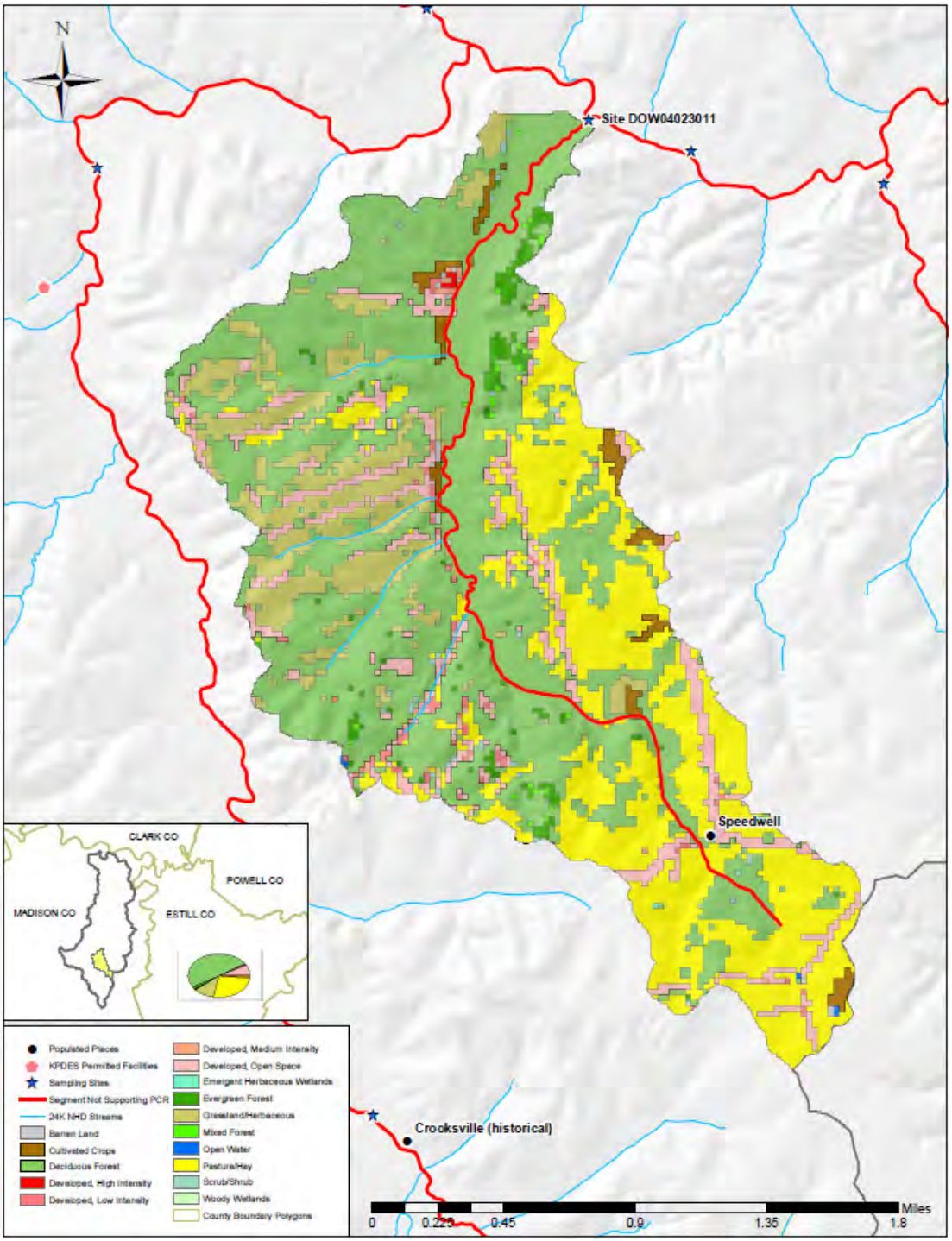

Figure 8.5 Land Cover for Viny Fork 0.0 to 4.1

Based on the WQC and the MAF, the *E. coli* TMDL for the 4.1 mile impaired segment of Viny Fork is 2.52×10^{10} colonies per day (Table 8.12). According to the data presented, the watershed would have required a 99.11% reduction in bacteria loading during the 2011 PCR season in order to meet the WQC. In addition, any future KPDES wastewater permitted sources must meet permit limits based on the WQC in 401 KAR 10:031 and must not cause or contribute to an existing impairment.

Table 8.12 Summary of TMDL Components for Viny Fork 0.0 to 4.1

TMDL[(1)]	MOS[(2)]	SWS-WLA	MS4 - WLA	Future Growth - WLA	LA	Mean Annual Flow (cfs)
2.52×10^{10} col/day	2.52×10^{9} col/day	n/a	n/a	2.27×10^{8} col/day	2.25×10^{10} col/day	4.3

Notes:

(1). The TMDL is the sum of all components. TMDLs are expressed as daily loads of *E. coli* colonies by multiplying the WQC by the MAF and appropriate conversion factors – the instantaneous WQC was used to set the TMDL for this segment since its percent reduction was greater than the geomean WQC.

(2). MOS is explicitly set at 10% of the WQC.

8.2.1.5 Hickory Lick 0.0 to 2.9 into Muddy Creek

Hickory Lick is a third order stream that discharges to Muddy Creek near RM 19.5. There are no KPDES-permitted sources in the subwatershed and there are no sewer lines so residents must rely on OSTDS or do not treat their sewage. The subwatershed is dominated by nearly 75% agricultural pastureland followed by forest (Figure 8.6). Exceedance of the WQC (240 col/100ml) was observed in 85.7% of the samples collected – the highest concentration of all samples was greater than 24,192 colonies per 100 ml (Table 8.13). *E. coli* concentrations appear to increase with increased, little or no precipitation suggesting contribution from various types of nonpoint sources in the watershed such as straight-pipes, animals in streams or failing OSTDS.

Table 8.13 *E. coli* Data Collected for Hickory Lick off Meadowbrook Road (RM 19.5) - DOW04023013

Collection Date	Instantaneous E Coli (CFU/100 ml)	Geomean E Coli (CFU/100 ml)	Flow (cfs)	Field Precipitation Notes
5/9/11	>2419		4.084	Intermittent showers in the past 24 hours; 0.12" rainfall
5/23/11	>24192	1643	22.709	Intermittent showers in the past 24-48 hours; 0.75" rainfall
5/31/11	512	877	1.259	4 days since 0.1" rainfall (0.47" on 5/27)
6/7/11	687		0.446	10 days since 0.1" rainfall (0.47" on 5/27)
6/14/11	194		0.081	3 days since 0.1" rainfall (0.43" on 6/11)
6/21/11	7260		3.978	Steady rain in the past 24-48 hours; >2" rainfall
6/28/11	1046		0.496	Intermittent showers in the past 48 hours; less than 0.1" rainfall (0.06-0.36" on 6/24)
7/13/11	461		0.326	Intermittent showers in the past 48 hours, less than 0.1" rainfall (0.98" on 7/8)
9/6/11	>24192		0.509	Showers today, steady rain in the past 24-48 hours; >2.5" rainfall
9/20/11	292	647	0.137	Showers today, intermittent showers and steady rain in the last 24-48; 0.52" in last 48 hours
9/27/11	789		0.617	Intermittent showers in the past 24-48 hours; ~1" in last 24 hours
10/6/11	155		0.104	9 days since 0.1" rainfall (0.42-0.57" on 9/27)

Collection Date	Instantaneous E Coli (CFU/100 ml)	Geomean E Coli (CFU/100 ml)	Flow (cfs)	Field Precipitation Notes
10/11/11	866		0.351	14 days since 0.1" rainfall (0.44-0.69" on 9/26)
10/20/11	3654		7.444	Some showers today, steady rain in the past 24-48 hours; >2" rainfall

Exceedance of WQC	Part of Geomean Calculation	Rain today	Rain in last 24 hours	Rain in last 48 hours	No rain in last 48 hours

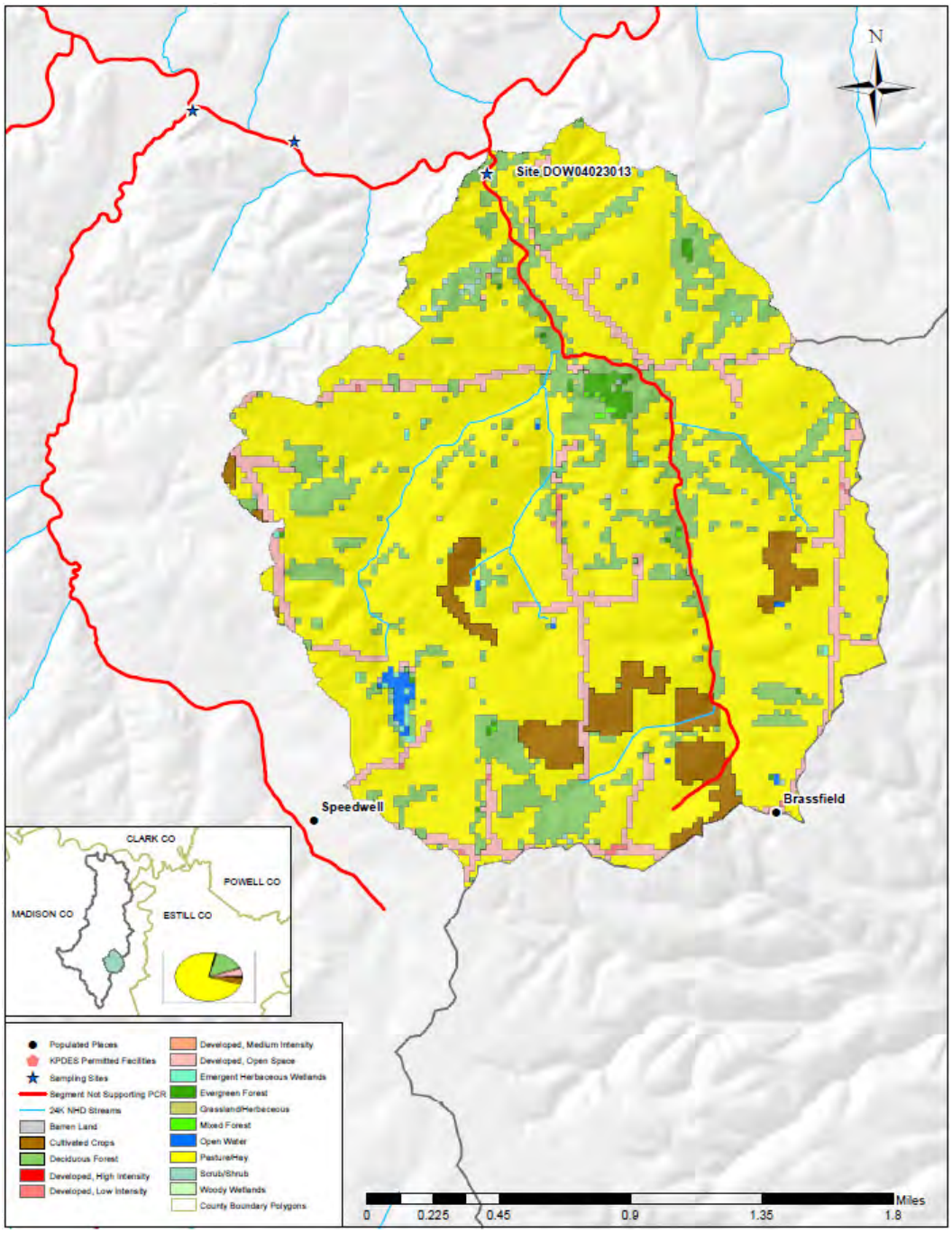

Figure 8.6 Land Cover for Hickory Lick 0.0 to 2.9

Based on the WQC and the MAF, the *E. coli* TMDL for the 2.9 mile impaired segment of Hickory Lick is 2.94×10^{10} colonies per day (Table 8.14). According to the data presented, the watershed would have required a 99.11% reduction in bacteria loading during the 2011 PCR season in order to meet the WQC. In addition, any future KPDES wastewater permitted sources must meet permit limits based on the WQC in 401 KAR 10:031 and must not cause or contribute to an existing impairment.

Table 8.14 Summary of TMDL Components for Hickory Lick 0.0 to 2.9

TMDL(1)	MOS(2)	SWS-WLA	MS4 - WLA	Future Growth - WLA	LA	Mean Annual Flow (cfs)
2.94×10^{10} col/day	2.94×10^{9} col/day	n/a	n/a	2.64×10^{8} col/day	2.62×10^{10} col/day	5

Notes:

(1). The TMDL is the sum of all components. TMDLs are expressed as daily loads of *E. coli* colonies by multiplying the WQC by the MAF and appropriate conversion factors – the instantaneous WQC was used to set the TMDL for this segment since its percent reduction was greater than the geomean WQC.

(2). MOS is explicitly set at 10% of the WQC.

8.2.1.6 Clear Creek 0.0 to 4.1 into Muddy Creek

Clear Creek is a third order stream that discharges to Muddy Creek near RM 1.3. There are no KPDES-permitted sources in the subwatershed though there are some proposed sewer extensions in the eastern area of the watershed (see Figure 8.7). There are no sewer lines so residents must rely on OSTDS or do not treat their sewage. The subwatershed is largely agricultural pastureland followed by forest (Figure 8.7). Exceedance of the WQC (240 col/100ml) was observed in 40% of the samples collected – the highest concentration of all samples was greater than 6,488 colonies per 100 ml (Table 8.15). *E. coli* concentrations appear to increase with increased precipitation suggesting contribution from various types of nonpoint sources in the watershed such as straight-pipes, animals in streams or failing OSTDS.

Table 8.15 *E. coli* Data Collected for Clear Creek at Doylesville Road Bridge (RM 1.3) - DOW04023014

Collection Date	Instantaneous E Coli (CFU/100 ml)	Geomean E Coli (CFU/100 ml)	Flow (cfs)	Field Precipitation Notes
5/9/11	46.5		1.955	Intermittent showers in the past 24 hours; 0.12" rainfall
5/23/11	**6488**		6.933	Intermittent showers in the past 24-48 hours; 0.75" rainfall
5/31/11	19		0.132	4 days since 0.1" rainfall (0.47" on 5/27)
9/6/11	**435**		0.155	Showers today, steady rain in the past 24-48 hours; >2.5" rainfall
9/27/11	108		0.292	Intermittent showers in the past 24-48 hours; ~1" in last 24 hours

Exceedance of WQC	Part of Geomean Calculation	Rain today	Rain in last 24 hours	Rain in last 48 hours	No rain in last 48 hours

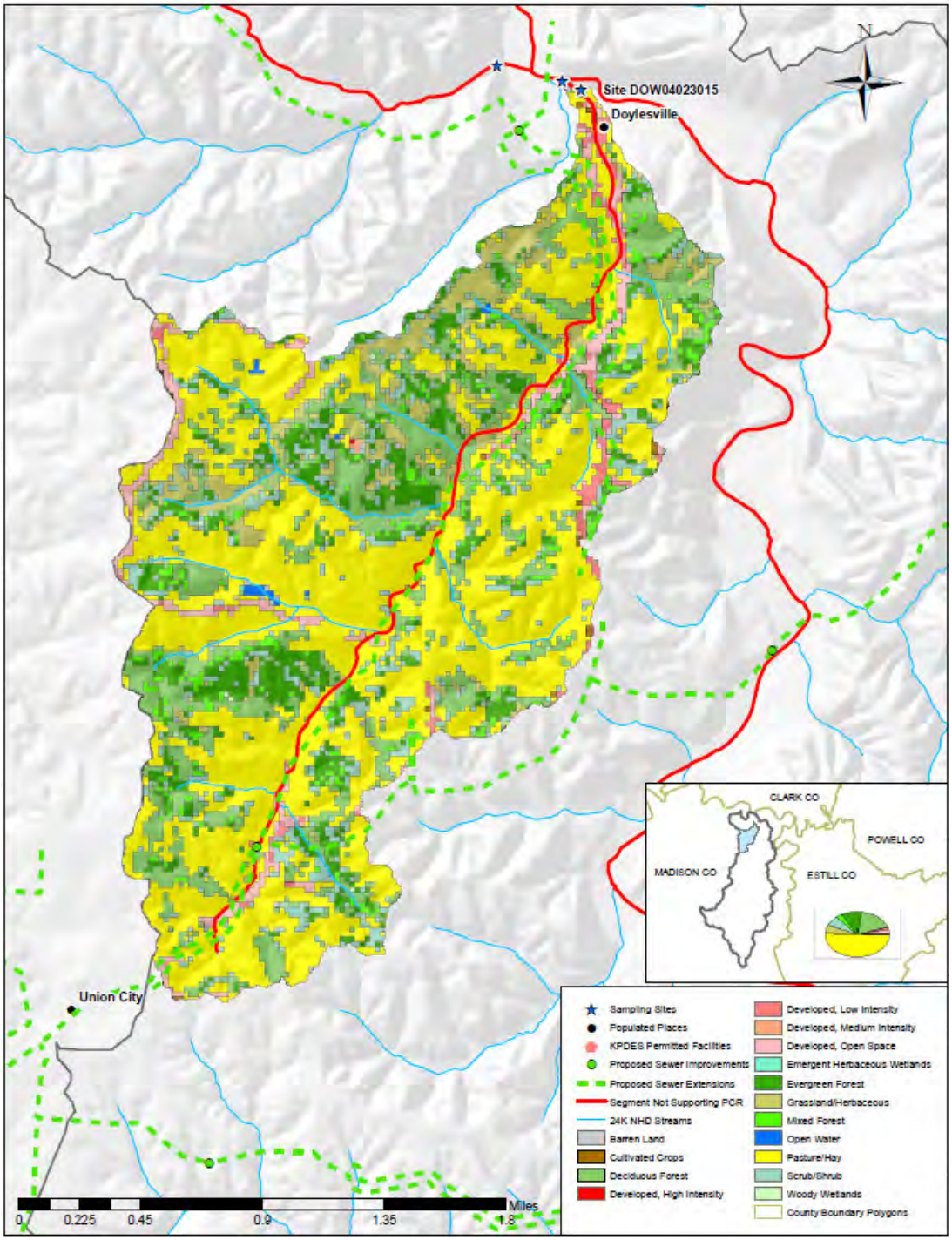

Figure 8.7 Land Cover for Clear Creek 0.0 to 4.1

Based on the WQC and the MAF, the *E. coli* TMDL for the 4.1 mile impaired segment of Clear Creek is 2.82×10^{10} colonies per day (Table 8.16). According to the data presented, the watershed would have required a 96.67% reduction in bacteria loading during the 2011 PCR season in order to meet the WQC. In addition, any future KPDES wastewater permitted sources must meet permit limits based on the WQC in 401 KAR 10:031 and must not cause or contribute to an existing impairment.

Table 8.16 Summary of TMDL Components for Clear Creek 0.0 to 4.1

TMDL[(1)]	MOS[(2)]	SWS-WLA	MS4 - WLA	Future Growth - WLA	LA	Mean Annual Flow (cfs)
2.82×10^{10} col/day	2.82×10^{9} col/day	n/a	n/a	2.54×10^{8} col/day	2.51×10^{10} col/day	4.8

Notes:

(1). The TMDL is the sum of all components. TMDLs are expressed as daily loads of *E. coli* colonies by multiplying the WQC by the MAF and appropriate conversion factors – the instantaneous WQC was used to set the TMDL for this segment since its percent reduction was greater than the geomean WQC.

(2). MOS is explicitly set at 10% of the WQC.

8.2.1.7 Dunbar Branch 0.0 to 2.6 into Muddy Creek

Dunbar Branch is a third order stream that discharges to Muddy Creek near RM 1.1. There are no KPDES-permitted sources in the subwatershed though there are some proposed sewer extensions along the mainstem (see Figure 8.8). There are no sewer lines so residents must rely on OSTDS or do not treat their sewage. The subwatershed is dominated by agricultural pastureland in the headwaters and forest land toward the mouth (Figure 8.7). Exceedance of the WQC (240 col/100ml) was observed in 80% of the samples collected – the highest concentration of all samples was greater than 4,611 colonies per 100 ml (Table 8.17). *E. coli* concentrations appear to increase with increased precipitation suggesting contribution from various types of nonpoint sources in the watershed such as straight-pipes, animals in streams or failing OSTDS.

Table 8.17 *E. coli* Data Collected for Dunbar Branch off Doylesville Road (RM 1.1) - DOW04023015

Collection Date	Instantaneous E Coli (CFU/100 ml)	Geomean E Coli (CFU/100 ml)	Flow (cfs)	Field Precipitation Notes
5/9/11	160.7		1.588	Intermittent showers in the past 24 hours; 0.12" rainfall
5/23/11	**4611**		3.096	Intermittent showers in the past 24-48 hours; 0.75" rainfall
6/21/11	**1017**		0.071	Steady rain in the past 24-48 hours; >2" rainfall
9/6/11	**921**		0.198	Showers today, steady rain in the past 24-48 hours; >2.5" rainfall
9/27/11	**261**		0.132	Intermittent showers in the past 24-48 hours; ~1" in last 24 hours

Exceedance of WQC	Part of Geomean Calculation	Rain today	Rain in last 24 hours	Rain in last 48 hours	No rain in last 48 hours

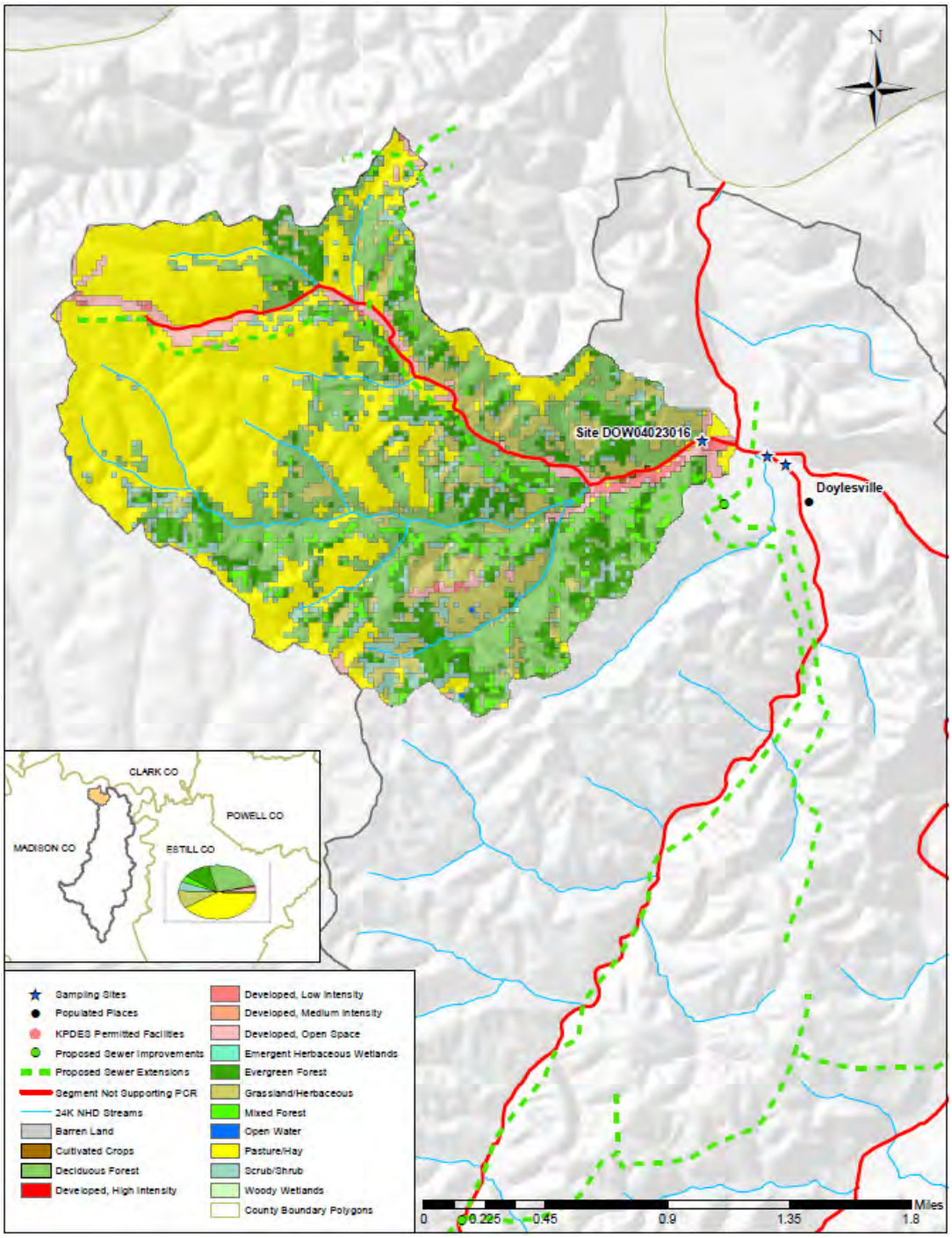

Figure 8.8 Land Cover for Dunbar Branch 0.0 to 2.6

Based on the WQC and the MAF, the *E. coli* TMDL for the 2.6 mile impaired segment of Dunbar Branch is 2.17×10^{10} colonies per day (Table 8.18). According to the data presented, the watershed would have required a 95.32% reduction in bacteria loading during the 2011 PCR season in order to meet the WQC. In addition, any future KPDES wastewater permitted sources must meet permit limits based on the WQC in 401 KAR 10:031 and must not cause or contribute to an existing impairment.

Table 8.18 Summary of TMDL Components for Dunbar Branch 0.0 to 2.6

TMDL[(1)]	MOS[(2)]	SWS-WLA	MS4 - WLA	Future Growth - WLA	LA	Mean Annual Flow (cfs)
2.17×10^{10} col/day	2.17×10^{9} col/day	n/a	n/a	9.78×10^{7} col/day	1.95×10^{10} col/day	3.7

Notes:

(1). The TMDL is the sum of all components. TMDLs are expressed as daily loads of *E. coli* colonies by multiplying the WQC by the MAF and appropriate conversion factors – the instantaneous WQC was used to set the TMDL for this segment since its percent reduction was greater than the geomean WQC.

(2). MOS is explicitly set at 10% of the WQC.

9.0 Implementation

Section 303(e) of the Clean Water Act and 40 CFR Part 130, Section 130.5, require states to have a continuing planning process (CPP) composed of several parts specified in the Act and the regulation. The CPP provides an outline of agency programs and the available authority to address water issues. Under the CPP umbrella, the Watershed Management Branch of KDOW will provide technical support and leadership with developing and implementing watershed plans to address water quality and quantity problems and threats. Developing watershed plans enables more effective targeting of limited restoration funds and resources, thus improving environmental benefit, protection and recovery.

Watershed plans provide an integrative approach for identifying and describing how, when, who and what actions should be taken in order to meet water quality standards. At this time, a comprehensive watershed restoration plan for the Muddy Creek watershed has not been developed. This TMDL document provides bacteria allocations and reduction goals that may assist with developing a detailed watershed plan to guide watershed restoration efforts. In addition, the Muddy Creek Watershed Health Report may also assist with development of a plan as it encourages public awareness and participation and highlights what can be done to help improve water quality such as

- keeping animals out of the stream,
- properly disposing of pet waste,
- reporting sewage leaks and overflows,
- working with local officials to extend or upgrade sewer service,
- properly maintaining septic systems and package treatment plants,
- leaving in place or establishing vegetation along the streams which provide natural filters that stabilize stream banks, minimize erosion, regulate water flow, provide shade, and absorb excess nutrients,
- limiting the use of chemicals, pesticides and fertilizers (or using them according to labels and soil test results),
- keeping storm drains clear of debris, trash or hazardous materials such as petroleum products and
- allowing fallen trees, other woody vegetation and gravel, cobble and boulders to remain in the stream to create habitat for aquatic life.

A watershed plan for the Muddy Creek watershed should address both point and nonpoint sources of pollution in the watershed and should build on existing efforts as well as evaluate new approaches. Because of the specific landscape and location of the impairments in the Muddy Creek watershed, a watershed plan should incorporate all available restoration and protection mechanisms, including any existing Groundwater Protection Plans, storm water or wastewater KPDES permits. A comprehensive watershed plan should consider both voluntary and regulatory approaches to meet water quality standards.

9.1 Kentucky Watershed Management Framework

A Watershed Management Framework approach to Water Quality Management was adopted by the KDOW in 1998. The plan divides Kentucky's major drainage basins into five groups of basins which are cycled through a five year staggered process that involves monitoring, assessment, prioritization, plan development, and plan implementation. As part of the process, a basin coordinator is assigned to each river basin to work with the citizens of the basin to develop a local Watershed Management Team associated with each priority watershed. For more information about the river basins see http://water.ky.gov/watershed/Pages/Basins.aspx.

9.2 Non-Governmental Organizations

There are several Non-Governmental Organizations (NGO) that may be operating in the Muddy Creek watershed that may help to implement the TMDL, particularly with regard to nonpoint source issues. These organizations include Watershed Watch in Kentucky groups and Kentucky Waterways Alliance.

9.2.1 Watershed Watch in Kentucky

Watershed Watch is a citizen's water monitoring effort that relies exclusively on volunteers to provide administration, training, and volunteer and equipment coordination. The volunteers measure basic parameters of stream health to determine whether streams meet important "uses" under the Clean Water Act including aquatic life, human recreation, and drinking water.

Several water quality measurements are taken annually by Watershed Watch groups. Volunteers collect physical measurements, such as temperature, pH, dissolved oxygen, and conductivity. Stream monitoring may also include macroinvertebrate and habitat assessments. Data from annual monitoring is routinely used to help identify problems in the watershed, and assist with prioritizing streams for restoration and protection activities.

For more information about Watershed Watch see:
http://water.ky.gov/wsw/Pages/default.aspx.

9.2.2 Kentucky Waterways Alliance

The formation of Kentucky Waterways Alliance (KWA) was the result of a series of meetings sponsored by the Kentucky Environmental Quality Commission. The KWA has a mission to protect and restore Kentucky's waterways and their watersheds through alliances for watershed stewardship. This includes strengthening community and governmental stewardship for the restoration and preservation of Kentucky's water resources. The Alliance promotes networking, communication and mutual support among groups, government agencies, and businesses working on waterway issues.

For more information about KWA see:
http://www.kwalliance.org.

10.0 Public Participation

This TMDL document was published for a 30-day public comment period between November 15, 2012 and December 15, 2012. A public notice was sent to all newspapers in the Commonwealth of Kentucky and advertisements purchased in the Richmond Register and Berea Citizen newspapers. Additionally, the public notice was distributed electronically through the 'Nonpoint Source Pollution Control' mailing list (http://www.water.ky.gov/sw/nps/Mailing+List.htm) of persons interested in water quality issues as well as the 'Press Release' mailing list maintained by the Governor's Office of media outlets across the Commonwealth.

All comments received during the public notice period were incorporated into the administrative record for this TMDL. After consideration of each comment received, revisions were made accordingly to the final TMDL document and responses prepared and mailed to each individual/ agency participating in the public notice process.

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Appendix A

- Land Use Analysis -

The land uses generated by the 2001 NLCD were consolidated for presentation purposes within the report. All forested land (deciduous, evergreen and mixed) and shrubbery was aggregated and reported as one category. Further, all residential land use area was aggregated and reported as one category; developed land. The NLCD returned small but positive values for three types of residential land uses—Developed Open Space, Low-Intensity Residential, and High-Intensity Residential. Developed Open Space is a term applied to differing types of land use, within urban areas it is the designation given to parkland and other green areas. However, in rural watersheds such as Muddy Creek, it denotes residential areas with insufficient density to be classified as Low-Intensity Residential but is mainly composed of single family residences on large lots (James Seay, 2006, Personal Communication). Further descriptions of the NLCD classifications are provided below.

National Land Cover Database Class Descriptions (Homer et al, 2004)

(11) Open Water - All areas of open water, generally with less than 25% cover of vegetation or soil.

(21) Developed, Open Space - Includes areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20 percent of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes

(22) Developed, Low Intensity - Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20-49 percent of total cover. These areas most commonly include single-family housing units.

(23) Developed, Medium Intensity - Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50-79 percent of the total cover. These areas most commonly include single-family housing units.

(24) Developed, High Intensity - Includes highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80 to100 percent of the total cover.

(31) Barren Land (Rock/Sand/Clay) - Barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.

(41) Deciduous Forest - Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75 percent of the tree species shed foliage simultaneously in response to seasonal change.

(42) Evergreen Forest - Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75 percent of the tree species maintain their leaves all year. Canopy is never without green foliage.

(43) Mixed Forest - Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75 percent of total tree cover.

(52) Shrub/Scrub - Areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20 percent of total vegetation. This class includes true shrubs, young trees in an early successional stage, or trees stunted from environmental conditions.

(71) Grassland/Herbaceous - Areas dominated by grammanoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.

(81) Pasture/Hay - Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20 percent of total vegetation.

(82) Cultivated Crops - Areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20 percent of total vegetation. This class also includes all land being actively tilled.

(90) Woody Wetlands - Areas where forest or shrubland vegetation accounts for greater than 20 percent of vegetative cover and the soil or substrate is periodically saturated with or covered with water.

(95) Emergent Herbaceous Wetlands - Areas where perennial herbaceous vegetation accounts for greater than 80 percent of vegetative cover and the soil or substrate is periodically saturated with or covered with water.

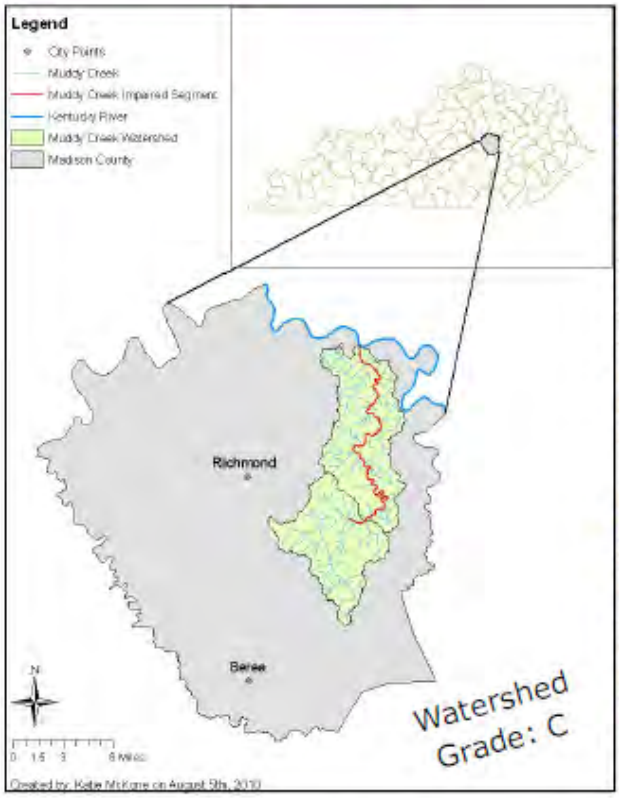
Appendix B

- Muddy Creek Watershed Health Reports –

Kentucky Division of Water
200 Fair Oaks Lane, 4th Floor
Frankfort, KY 40601
Phone: 502-564-3410
Website: http://water.ky.gov/waterquality/Pages/TMDLHealthReports.aspx

Muddy Creek Watershed Health Report

Department for Environmental Protection - Division of Water



The Kentucky Division of Water (DOW) is the state agency responsible for carrying out the requirements of the Clean Water Act to reach the goal of making all waters in Kentucky safe for swimming and fishing (called **designated uses**).

DOW has developed this health report to inform the residents of Madison County of efforts to examine the health of the Muddy Creek Watershed. A **watershed** is an area of land where runoff flows to a common stream. When streams come together, the two streams' watersheds combine to make a larger watershed. Many small streams, such as Viny Fork and Clear Creek, flow into Muddy Creek. Eventually, Muddy Creek flows into the Kentucky River, and is therefore part of the Kentucky River Watershed.

Upon initial evaluation it was determined that most of Muddy Creek does not support all of the **designated uses** required by the Clean Water Act (colored red on the map). The U.S. Environmental Protection Agency (EPA) requires that states conduct watershed studies on all such non-supporting waters to calculate the maximum amount of pollutant(s) a creek can receive and still be healthy. This amount is known as a **Total Maximum Daily Load**, or TMDL, which can be thought of as a watershed diet.

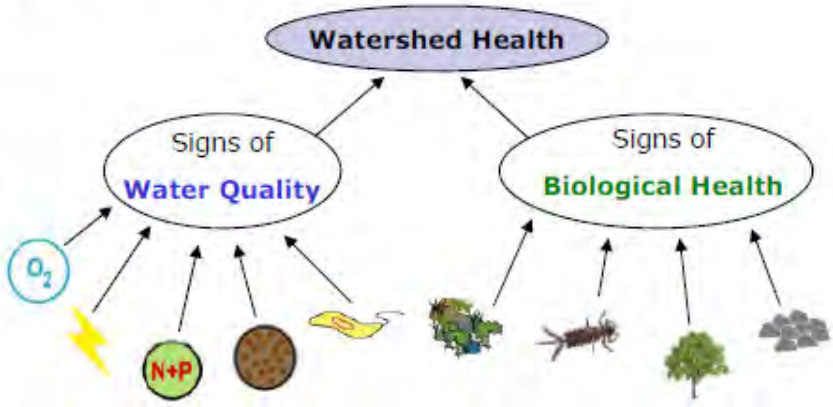
In 2011 DOW biologists conducted a watershed study of Muddy Creek to gather scientific information. Based on this information, DOW has given a "report card grade" of **C** to the **Muddy Creek Watershed**. This health report explains where the impaired segments are located, describes the signs of health that went into assigning the grades for each watershed and provides information on how the grades can be improved.

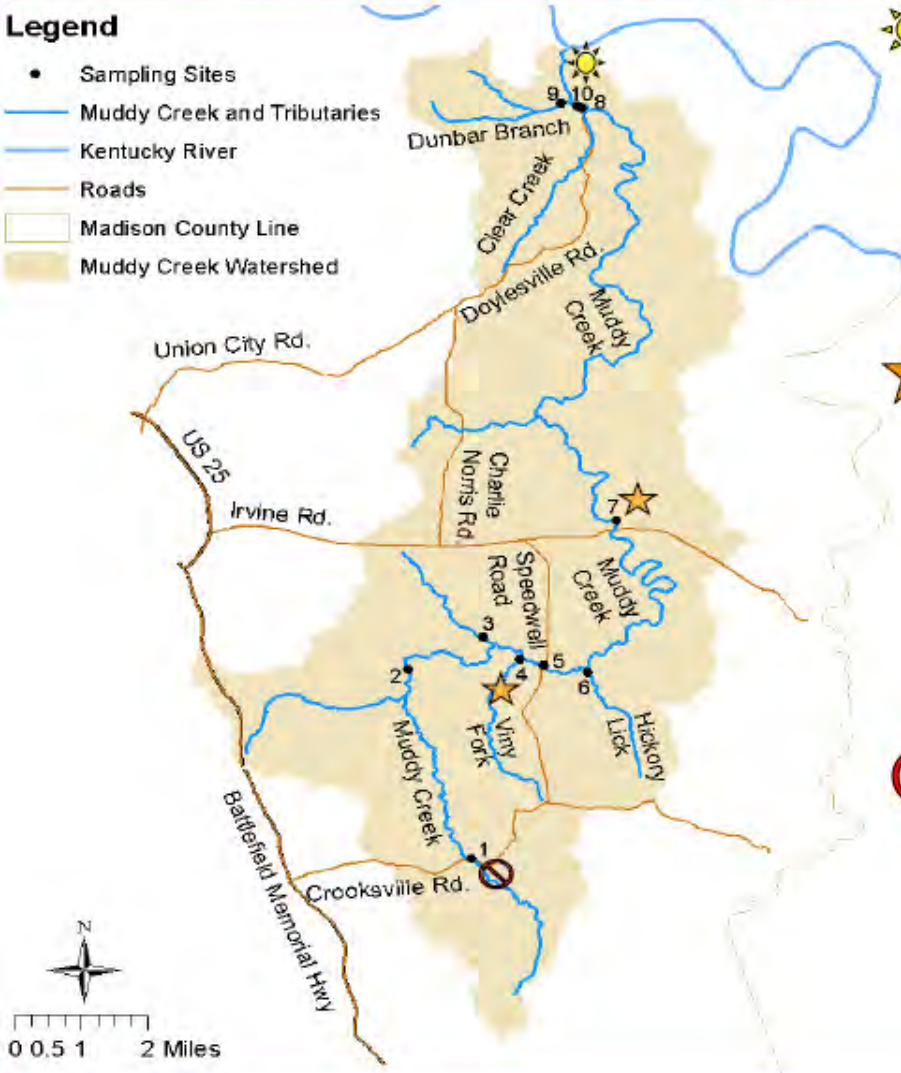
Additional Resources

- **Like** "Kentucky Watershed Health Reports" on Facebook.
- Check out our webpage for all watershed Health Reports at http://water.ky.gov/waterquality/Pages/TMDLHealthReports.aspx
- Friends of Muddy Creek watershed group; contact Tom Edwards at tom.edwards07@yahoo.com
- **Making changes at home and work:** Bluegrass PRIDE at www.bgpride.org/gallery1.htm
- **Volunteering:** Watershed Watch in Kentucky at water.ky.gov/wsw/Pages/default.aspx or contact Jo Ann Palmer at 800-928-0045 or JoAnn.Palmer@ky.gov
- **What are other watersheds doing?**
  - Hinkston Creek Watershed Protection Project at http://www.hinkstoncreek.org/index.html
  - Strodes Creek Conservancy at http://www.strodescreek.org
  - Friends of Stoner Creek at http://www.stonercreek.us/
- **Grants and Programs**
  - KY's Nonpoint Source (Runoff) Pollution program: water.ky.gov/nsp/Pages/default.aspx
  - KY's Natural Resource Conservation Service: www.ky.nrcs.usda.gov/
  - KY's 319 Grant program: water.ky.gov/Funding/Pages/NonpointSource.aspx or contact James Roe at 502-564-3410 or James.Roe@ky.gov
  - Kentucky Agricultural Water Quality Act: http://www.bae.uky.edu/awqpt/background.htm

How was Muddy Creek Graded?

1. Information collected was divided into signs of **water quality** or signs of **biological health**.
2. Each sign received a grade, A through F, according to the results of our study, which were compared to health and science requirements and DOW scientific information.
3. The grades from each biological health sign were averaged to achieve a biological health score.
4. Similarly, each sign of water quality was averaged to achieve a water quality score.
5. These two scores were averaged to achieve a **watershed health grade.**





Best for Swimming: Site 10 (Muddy Creek at Doylesville Road bridge crossing) had the lowest average concentration of *E. coli*. About 78% of the time *E. coli* concentrations are well below the level considered unsafe. But, swim at your own risk after rain events when the water is murky.

Best in Show: Site 7 (Muddy Creek at KY-52 bridge crossing) and site 4 (Viny Fork on the Bluegrass Army Depot) tied for the highest site grade with a B-. Site 7 had the highest overall habitat score, while Site 4 had the widest riparian zone in the entire watershed. It's no surprise that some of the best bug populations were found at these 2 sites.

Worst in Show: Site 1 (Muddy Creek at Crooksville Road bridge crossing) had the lowest site grade with a D+. This site had the highest average *E. coli* concentration. Additionally, TSS and all biological health signs scored Ds. On the positive side, all other water quality signs were on par with the rest of the watershed.

Signs of Water Quality

Dissolved Oxygen (DO): Concentration of oxygen dissolved in water and readily available to fish and other aquatic organisms.

Specific Conductivity: A measure of the ability of water to conduct an electrical current, which is used for approximating the total dissolved solids content of water. Low specific conductivity is desired, and increasing specific conductivity negatively impacts fish and aquatic bugs.

Nitrogen and Phosphorus (Nutrients): Although natural sources of nutrients exist, human activity is a major source of nutrient pollution, including municipal sewage treatment plants, industrial outflows, commercial fertilizers and animal waste.

***E. coli*:** A type of bacteria that lives in the intestinal tract of humans and other warm-blooded animals. To receive an A, and therefore not be impaired for Primary Contact Recreation (PCR), the *E. coli* concentrations were above the level considered safe for swimming 0—20% of the time. Grades B through F indicate an impairment for PCR and reflect *E. coli* levels that were above the standard 20—100% of the time.

Total Suspended Solids (TSS): A cloudy condition in water due to suspended silt or organic matter. As TSS increase, fish and aquatic bugs experience stress and altered behavior.

Signs of Biological Health

Total Habitat: Stream habitat is assessed by scoring 10 habitat signs, which are both living and nonliving parts of the surroundings that support an organism, population or community.

Aquatic Macroinvertebrates (bugs): An animal without a backbone, large enough to be seen with the naked eye. They are often the immature forms of insects that live on land as adults and are an important food source for fish. Different species prefer different habitats, and some are more tolerant of pollution than others.

Riparian Zone: A component of total habitat that is defined by the land adjacent to a stream that has distinct soil types and plant communities, which aid in absorbing water and shading the stream. To receive an A, the riparian zone must be at least 18 yards wide on each side of the stream.

Available Cover: A component of total habitat, which looks at the quantity and variety of structures in the creek that provide fish and aquatic bugs a place to hide, feed, reproduce and raise young. Examples include cobble and boulders, fallen trees, logs, branches, root mats, undercut banks and aquatic vegetation.

Site #	Creek Name	O_2		N+P							Site Grade
1	Muddy Creek	B	B	A-	F	D		D	D	D	**D+**
2	Muddy Creek	B	A-	A	D	C+	C	D	D	B	**C**
3	Muddy Creek Tributary	B	B	A	C	B-	C	D	D	C	**C**
4	Viny Fork	B	B	A	D	B-	B	D	D	A	**B-**
5	Muddy Creek	B	B+	A	D	C		D	F	D	**C-**
6	Hickory Lick	B+	B	B	F	C+	B	D	D	F	**C**
7	Muddy Creek	B	B+	B+	C+	C	B	C	C	C	**B-**
8	Clear Creek	B	B-	A	B-	B	C	D	C	C	**C+**
9	Dunbar Branch	B	B	B+	D-	A	C	D	C	C	**C+**
10	Muddy Creek	B	B+	A	B	C	B	D	C	D	**C+**
	Sign Grade	**B**	**B**	**A**	**D+**	**C+**	**C+**	**D**	**D+**	**C**	

Summary: An even spread from positive to negative

POSITIVES

Dissolved oxygen (DO) levels were suitable for fish and bugs most of the time. Some lower DO levels that lowered the average grade from an A to a B may have resulted from high levels of suspended sediment, which shades photosynthetic organisms and increases bacterial communities that consume oxygen.

Specific conductivity levels were reasonably low throughout the watershed, indicating a level of total dissolved solids that should not negatively impact the biological communities.

Nutrient levels were also low throughout the watershed, which demonstrates that nutrient inputs are not increasing due to human activities in the watershed.

GRAY AREA

Total Suspended Solids (TSS), on average, scored a C+. Some sites were worse than others, but in general, TSS levels rose following rain events indicating that exposed sediment was being washed into the stream.

The riparian zone was wide at a few sites (site 2 and 4), but overall, the riparian zone width was reduced to less than 10 yards to as narrow as 1 yard, while 18 yards is considered ideal.

While the water quality was suitable for **aquatic macroinvertebrates (bugs)**, the habitat and available cover were often lacking. As a result, the bugs communities were reduced to a level of 'fair' and scored a C+ on average.

NEGATIVES

E. coli levels were above the standard considered safe for swimming between 25% (B) and 85% (F) of the time, depending on the site. When *E. coli* levels are elevated, there is an increased risk of gastrointestinal illness if the water is swallowed or an infection if contact is made with an open sore or wound. Therefore, all of Muddy Creek and its tributaries are considered impaired for Primary Contact Recreation.

Available Cover was greatly reduced throughout the watershed, scoring Cs, Ds and 1 F. This cover is important for a healthy population of aquatic bugs and fish.

Total habitat was reduced throughout the watershed, with all but one site (7) scoring Ds. Total habitat is the base of the building blocks for a healthy population of aquatic organisms, and when it is reduced, biological health begins to degrade.

What can you do?

- Make every effort to **protect the good** that remains. Work with local government and land owners to protect areas that are less degraded and improve land management to minimize further degradation.
- **Trees are the best way to protect and restore water quality and biological health.**
  - Leave in place or establish vegetation alongside streams to provide natural filters that stabilize stream banks, minimize erosion, regulate water flow, provide shade, retain sediment and absorb excess nutrients.
  - Plant trees and do not mow within 18 yards of the stream bank.
- **To improve habitat**
  - Allow fallen trees, logs, leaves, gravel, cobble and boulders to remain in the stream to create habitat for fish and bugs to feed, find refuge and reproduce.
  - Minimize streamside and within stream grazing by animals.
  - Reduce sediment inputs (see 'To Reduce TSS').
- **To keep water safe for swimming**
  - Maintain functional septic systems and replace failing septic systems
  - Properly dispose of pet waste
  - Keep animals out of the stream
- **To reduce TSS**
  - Maintain streamside vegetation
  - Plant cover crops
  - Install settling ponds
  - Reduce animal access to streamside grazing
  - Guard waterways during construction activities
- **Other Tips**
  - Keep grass clippings and petroleum products out of storm drains; this material enters the stream directly without treatment.
  - Leave no trace: dispose of trash and recyclables properly.
  - Organize a creek clean-up to remove existing liter along and within Muddy Creek.
  - Service your vehicle regularly to prevent oil and antifreeze leaks and reduce noxious emissions.
- **Volunteer**
  - Become a certified citizen water quality monitor or join the Friends of Muddy Creek watershed group.
- **Education**
  - Check out some of the resources provided on the front page. Knowing how our daily actions affect water quality is half the battle to improving it.

Department for Environmental Protection
Kentucky Division of Water
200 Fair Oaks Lane, 4th Floor
Frankfort, KY 40601
Phone: 502-564-3410
Website: http://water.ky.gov

Muddy Creek Watershed

December 6th, 2010

In the 1960s government officials started to realize how polluted streams, rivers and lakes of the U.S. had become. In 1972, Congress passed laws, known as **The Clean Water Act** (CWA), to protect surface water. The goal of the CWA is for all waters in the U.S. to be safe for swimming, fishing and drinking (called **uses**).

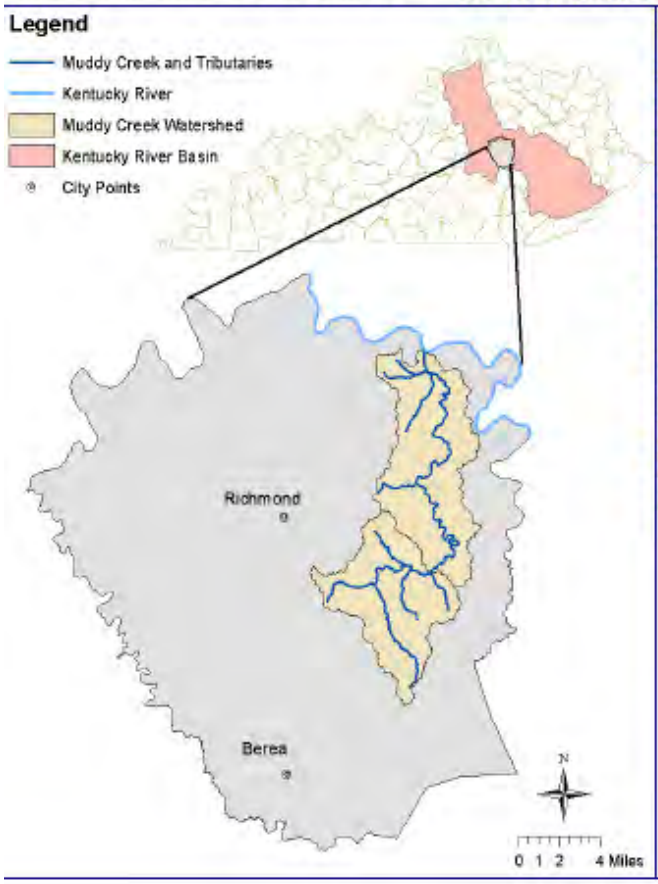
We rely on local water sources for water to drink. We pay water treatment plants to withdraw and treat water with chemicals or other processes to make it safe for drinking. The dirtier the water, the more expensive it is to clean the water, which makes drinking water more expensive. The cleanliness of water is also referred to as **water quality**.

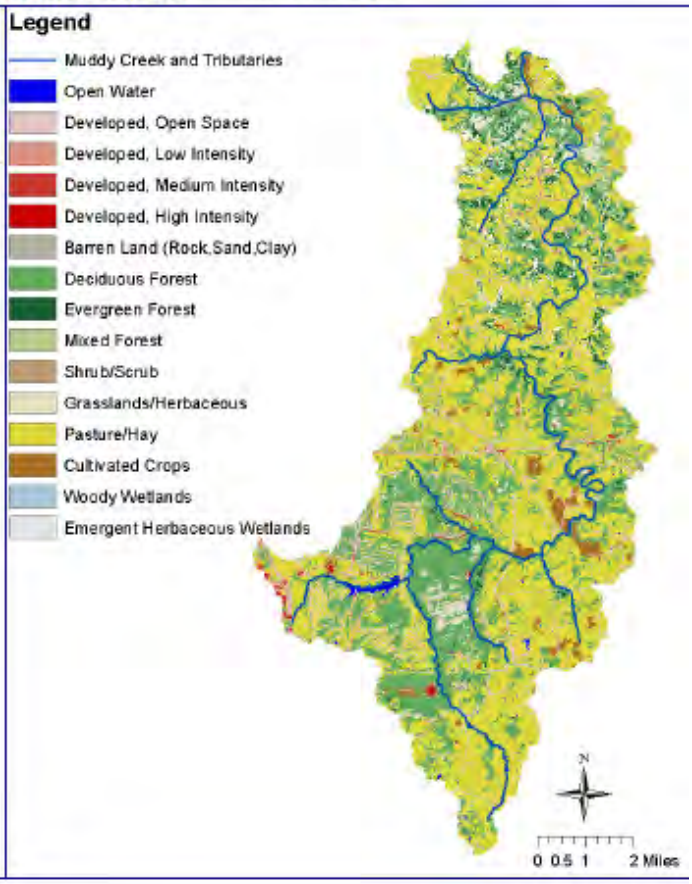
We all affect water quality because we all live in a watershed. A **watershed** is an area of land where runoff flows to a common stream. When streams come together, the two streams' watersheds combine to make a larger watershed. The **Muddy Creek** Watershed (see map below, left) is a small watershed within a much larger watershed called the Kentucky River Basin.

There are two types of pollution that can affect a watershed: **point sources** and **nonpoint sources**. Point sources are any distinct points from which pollutants are or may be discharged. Examples include any pipe, ditch, channel, tunnel, well or concentrated animal feeding operation. Nonpoint sources are pollutants originating from the land surface that have no well-defined source. The pollutants are generally carried off the land by storm water.

Land use is the best way to understand how humans may potentially pollute the watershed in which they live. Cities and towns tend to have more point sources due to the number of facilities required to clean the water used in households and businesses, and may also have an increase in nonpoint sources due to impervious surfaces such as roads, parking lots and sidewalks. Rural areas tend to have more nonpoint source pollution associated with agriculture. Animal waste, fertilizers, pesticides and loose soil, which is exposed when trees are cut down, may enter the stream during rain events.

The map below (right) shows the land use for the **Muddy Creek** Watershed. Much of the watershed is yellow, demonstrating that the major land use is pasture/hay. However, green also dominates the land use map, demonstrating that forest is a major feature of the landscape.





How is a waterbody used?

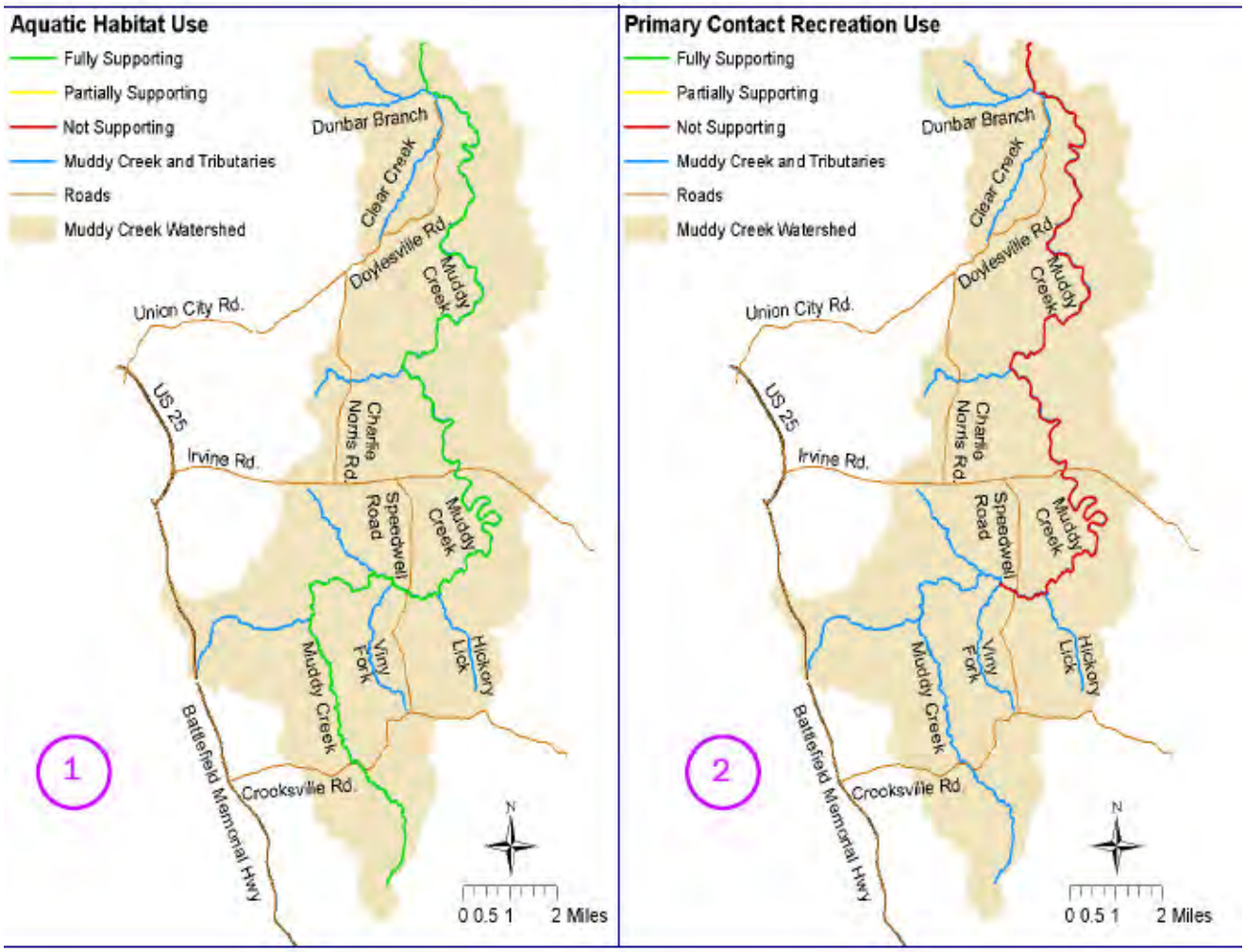
The Clean Water Act (CWA) requires states to submit a report to congress, called the 305 (b) list, which reports the water quality of streams, rivers and lakes within the state that have been assessed. To prepare this report, the Kentucky Division of Water (DOW) identifies the designated uses of a waterbody and then assess the waterbody to see if the water is clean enough to meet these uses.

Designated uses for Muddy Creek are:

- Aquatic Habitat (map 1) - water quality promotes a healthy population of plants and animals that live in the water
- Primary Contact Recreation (map 2) - water is safe for human swimming.

Upon assessment, it was determined that Muddy Creek fully supports the Aquatic Habitat Use. Therefore, its entire length is highlighted green in map 1. Conversely, it was found that Muddy Creek does not support the Primary Contact Recreation Use. Therefore, river miles 0—20.2 are highlighted red in map 2. Since Muddy Creek does not meet its Primary Contact Recreation Use, it is considered impaired.

For a stream to be listed as impaired for Primary Contact Recreation, *E. coli* concentrations exceeded the level considered safe for swimming at least 20 percent of the time when the assessment was completed. When *E. coli* concentrations are elevated, there is a risk of gastrointestinal illness if the water is swallowed or infection if contact is made with an open sore or wound.



Another requirement of the CWA is the 303 (d) list of impaired waters. This report lists all of the assessed waters from the 305(b) list that partially support or do not support their uses and identifies the pollutant that is causing the impairment.

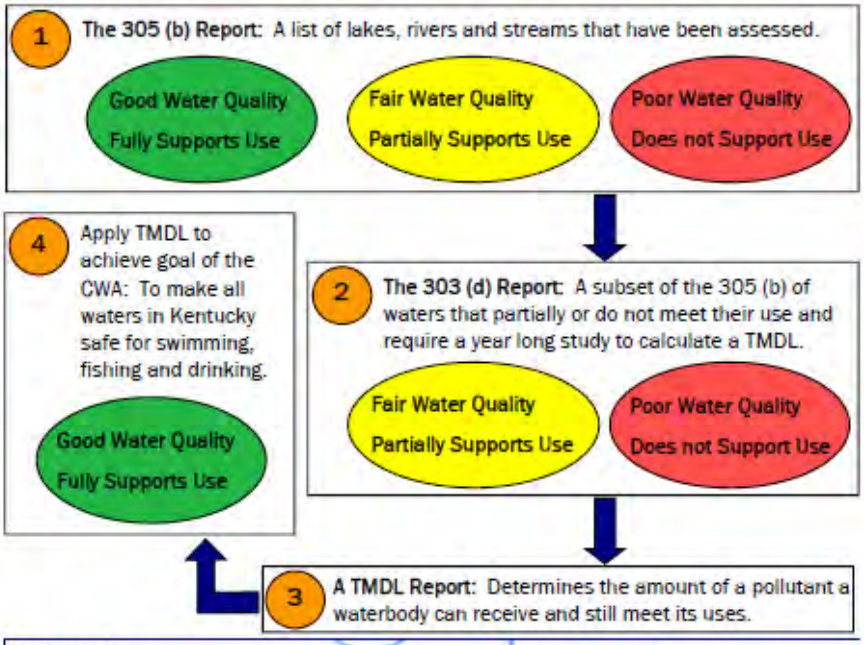
Impaired waters on the 303(d) list are required to have a Total Maximum Daily Load (TMDL) calculated for each pollutant. A TMDL calculation is the total amount of pollutant(s) a waterbody can receive and still meet its designated use(s).

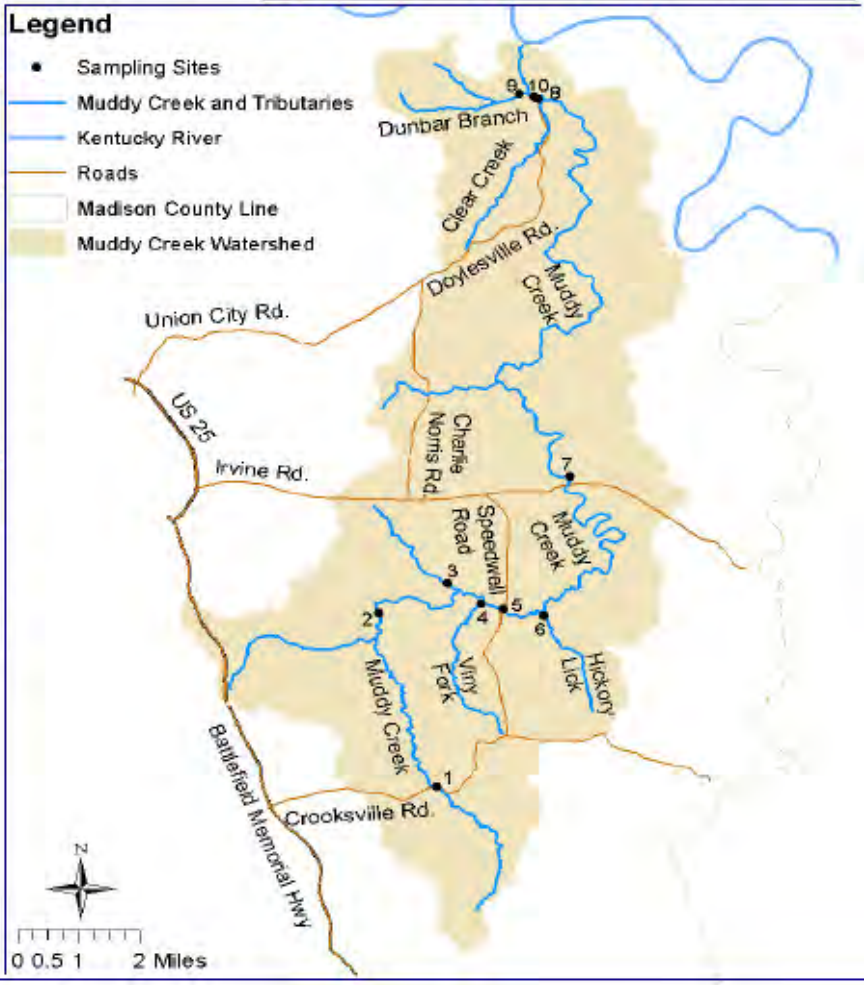
Muddy Creek is on the 303 (d) list and will be studied from November 2010 through October 2011 by the Kentucky DOW, TMDL Section. A TMDL report for Muddy Creek will be written as a result of the year long study, which will be made available to the public with the goal of improving water quality.

DOW biologists will sample 10 sites throughout the Muddy Creek watershed once a month from November 2010 through April 2011, and then two or three times a month from May through October 2011 at the locations shown in the map to the right.

Even though Muddy Creek is only listed as impaired for Primary Contact Recreation, which relates to *E. coli* levels, many other parameters will be measured to better understand the current state of Muddy Creek's water quality. At each site the following will be measured or collected:

- Dissolved oxygen
- Specific conductivity
- Nutrients
- *E. coli*
- Bugs
- Algae
- Habitat





Each measurement made or sample collected is considered a sign of Water Quality or a sign of Biological Health. These signs demonstrate how pollution entering the stream impacts the overall health of the **Muddy Creek Watershed**. Below, each sign of watershed health that the DOW will measure or collect is defined.

Signs of Water Quality

Dissolved Oxygen: Concentration of oxygen dissolved in water and readily available to fish and other aquatic organisms.

Specific Conductivity: A measure of the ability of water to conduct an electrical current, which is used for estimating the total dissolved solids content of water. Low specific conductivity is desired, and increasing specific conductivity negatively impacts fish and aquatic bugs.

Nitrogen and Phosphorus (Nutrients): Although natural sources of nutrients exist, major sources of nutrient pollution are typically caused by man's activities and include municipal sewage-treatment plants, industrial outflows, commercial fertilizers and animal waste.

E. Coli: A type of bacteria that lives in the intestinal tract of man and other warm-blooded animals.

Signs of Biological Health

Total Habitat: Stream habitat is assessed by scoring 10 habitat signs, which are both living and nonliving parts of the surroundings that support an organism, population or community.

Aquatic Macroinvertebrates (bugs): An animal without a backbone, large enough to be seen with the naked eye. They are often the immature forms of insects that live on land as adults and are an important food source for fish. Different species prefer different habitats, and some are more tolerant of pollution than others.

Riparian Zone: A component of total habitat that is defined by the land adjacent to a stream that has distinct soil types and plant communities, which aid in absorbing water and shading the stream. An ideal riparian zone is at least 18 yards wide on each side of the stream.

Available Cover: A component of total habitat, which looks at the quantity and variety of structures in the creek that provide fish and bugs a place to hide, feed, reproduce and raise young. Examples include cobble and boulders, fallen trees, logs, branches, root mats, undercut banks and aquatic vegetation.

Algae: (singular form is alga) A simple, rootless plant that is an important source of food and produces oxygen via photosynthesis. However, when excess nutrients enter the stream and there is enough sunlight due to a lack of trees, algae can bloom. During a bloom, algae can lower the dissolved oxygen as they die and decay, which negatively affects bugs and fish.

What can you expect?

* Within the **next year**, DOW biologists will begin collecting water and biological samples in the watershed every month. If you see them, feel free to ask questions about their work.

* Within the **next two years**, DOW will distribute an informal "health report" of the Muddy Creek Watershed to share results of the study and explain ways the community can help improve water quality.

* Within the next **five years**, DOW will write a TMDL for the Muddy Creek Watershed and release it for public comment before submitting it to the U.S. Environmental Protection Agency for approval. The TMDL will outline which pollutants need to be reduced and by how much for the watershed to meet its designated uses.

* Within the **decade**, TMDL implementation and community efforts will help improve water quality and biological health of the Muddy Creek Watershed.

Appendix C

- Discharge Monitoring Report (DMR) Information for KPDES-permitted Sources –

DMR Numeric Violations

BOD, carbonaceous 5-day

NPDES ID	Monitoring	Outfall	Limit Set	DMR Value	Limit Value	Limit Units
KY0095168	7/1/2011	001	2-SANITARY WASTEWATER	<.167	.15	Pounds per Day
KY0099317	1/1/2008	001	1-SANITARY WASTEWATER	231	30.	Milligrams per Liter
KY0099317	10/1/2008	001	1-SANITARY WASTEWATER	56	30.	Milligrams per Liter
KY0099317	1/1/2008	001	1-SANITARY WASTEWATER	231	60.	Milligrams per Liter
KY0099317	1/1/2008	001	1-SANITARY WASTEWATER	2.77	.63	Pounds per Day
KY0099317	10/1/2008	001	1-SANITARY WASTEWATER	1.35	.63	Pounds per Day
KY0099317	1/1/2008	001	1-SANITARY WASTEWATER	2.77	1.25	Pounds per Day
KY0099317	10/1/2008	001	1-SANITARY WASTEWATER	1.35	1.25	Pounds per Day
KY0101303	1/1/2007	001	1-SANITARY WASTEWATER	.25	.17	Pounds per Day
KY0101303	1/1/2008	001	1-SANITARY WASTEWATER	.217	.17	Pounds per Day

Chlorine, total residual

NPDES ID	Monitoring	Outfall	Limit Set	DMR Value	Limit Value	Limit Units
KY0095168	10/1/2008	001	2-SANITARY WASTEWATER	.2	.011	Milligrams per Liter
KY0095168	1/1/2009	001	2-SANITARY WASTEWATER	.36	.011	Milligrams per Liter
KY0095168	7/1/2009	001	2-SANITARY WASTEWATER	.35	.011	Milligrams per Liter
KY0095168	10/1/2009	001	2-SANITARY WASTEWATER	.015	.011	Milligrams per Liter
KY0095168	1/1/2010	001	2-SANITARY WASTEWATER	.014	.011	Milligrams per Liter
KY0095168	7/1/2011	001	2-SANITARY WASTEWATER	.019	.011	Milligrams per Liter
KY0095168	10/1/2011	001	2-SANITARY WASTEWATER	.012	.011	Milligrams per Liter
KY0095168	10/1/2008	001	2-SANITARY WASTEWATER	.2	.019	Milligrams per Liter
KY0095168	1/1/2009	001	2-SANITARY WASTEWATER	.36	.019	Milligrams per Liter
KY0095168	7/1/2009	001	2-SANITARY WASTEWATER	.35	.019	Milligrams per Liter
KY0098175	12/1/2007	001	1-SANITARY WASTEWATER	.21	.011	Milligrams per Liter
KY0098175	4/1/2008	001	1-SANITARY WASTEWATER	.013	.011	Milligrams per Liter
KY0098175	7/1/2008	001	1-SANITARY WASTEWATER	.015	.011	Milligrams per Liter
KY0098175	7/1/2009	001	1-SANITARY	.019	.011	Milligrams per Liter

NPDES ID	Monitoring	Outfall	Limit Set	DMR Value	Limit Value	Limit Units
			WASTEWATER			
KY0098175	10/1/2009	001	1-SANITARY WASTEWATER	.019	.011	Milligrams per Liter
KY0098175	4/1/2010	001	1-SANITARY WASTEWATER	.019	.011	Milligrams per Liter
KY0098175	7/1/2010	001	1-SANITARY WASTEWATER	.014	.011	Milligrams per Liter
KY0098175	10/1/2010	001	1-SANITARY WASTEWATER	.019	.011	Milligrams per Liter
KY0098175	1/1/2011	001	1-SANITARY WASTEWATER	<.02	.011	Milligrams per Liter
KY0098175	7/1/2011	001	1-SANITARY WASTEWATER	.019	.011	Milligrams per Liter
KY0098175	10/1/2011	001	1-SANITARY WASTEWATER	.019	.011	Milligrams per Liter
KY0098175	1/1/2012	001	1-SANITARY WASTEWATER	.019	.011	Milligrams per Liter
KY0098175	12/1/2007	001	1-SANITARY WASTEWATER	.21	.019	Milligrams per Liter
KY0098175	1/1/2011	001	1-SANITARY WASTEWATER	<.02	.019	Milligrams per Liter
KY0101303	4/1/2008	001	1-SANITARY WASTEWATER	.012	.011	Milligrams per Liter
KY0101303	10/1/2008	001	1-SANITARY WASTEWATER	.015	.011	Milligrams per Liter
KY0101303	1/1/2009	001	1-SANITARY WASTEWATER	.019	.011	Milligrams per Liter
KY0101303	4/1/2009	001	1-SANITARY WASTEWATER	.013	.011	Milligrams per Liter
KY0101303	7/1/2009	001	1-SANITARY WASTEWATER	.015	.011	Milligrams per Liter
KY0101303	10/1/2009	001	1-SANITARY WASTEWATER	.015	.011	Milligrams per Liter
KY0101303	1/1/2010	001	1-SANITARY WASTEWATER	.018	.011	Milligrams per Liter
KY0101303	7/1/2010	001	1-SANITARY WASTEWATER	.015	.011	Milligrams per Liter
KY0101303	10/1/2010	001	1-SANITARY WASTEWATER	.019	.011	Milligrams per Liter
KY0101303	1/1/2012	001	1-SANITARY WASTEWATER	.019	.011	Milligrams per Liter

Fecal coliform

NPDES ID	Monitoring	Outfall	Limit Set	DMR Value	Limit Value	Limit Units
KY0099317	1/1/2008	001	1-SANITARY WASTEWATER	Not Received	200.	Number per 100 Milliliters
KY0099317	7/1/2008	001	1-SANITARY WASTEWATER	24000	200.	Number per 100 Milliliters
KY0099317	10/1/2008	001	1-SANITARY WASTEWATER	3600	200.	Number per 100 Milliliters
KY0099317	1/1/2008	001	1-SANITARY WASTEWATER	Not Received	400.	Number per 100 Milliliters
KY0099317	7/1/2008	001	1-SANITARY WASTEWATER	24000	400.	Number per 100 Milliliters

NPDES ID	Monitoring	Outfall	Limit Set	DMR Value	Limit Value	Limit Units
KY0099317	10/1/2008	001	1-SANITARY WASTEWATER	3600	400.	Number per 100 Milliliters
KY0101303	10/1/2007	001	1-SANITARY WASTEWATER	210	200.	Number per 100 Milliliters

E. coli

NPDES ID	Monitoring	Outfall	Limit Set	DMR Value	Limit Value	Limit Units
KY0020737	2/1/2010	001	1-SANITARY	150	130.	Number per 100 Milliliters
KY0020737	2/1/2010	001	1-SANITARY	2420	240.	Number per 100 Milliliters
KY0020737	3/1/2010	001	1-SANITARY	1120	240.	Number per 100 Milliliters
KY0098175	12/1/2007	001	1-SANITARY WASTEWATER	160	130.	Number per 100 Milliliters
KY0101303	7/1/2008	001	1-SANITARY WASTEWATER	150	130.	Number per 100 Milliliters

Nitrogen, ammonia total

NPDES ID	Monitoring	Outfall	Limit Set	DMR Value	Limit Value	Limit Units
KY0095168	7/1/2011	001	2-SANITARY WASTEWATER	<.032	.02	Pounds per Day
KY0095168	7/1/2011	001	2-SANITARY WASTEWATER	<.032	.03	Pounds per Day
KY0098175	7/1/2011	001	1-SANITARY WASTEWATER	8.24	4.	Milligrams per Liter
KY0098175	7/1/2011	001	1-SANITARY WASTEWATER	8.24	6.	Milligrams per Liter
KY0098175	7/1/2010	001	1-SANITARY WASTEWATER	.033	.03	Pounds per Day
KY0098175	10/1/2010	001	1-SANITARY WASTEWATER	.081	.08	Pounds per Day
KY0098175	7/1/2011	001	1-SANITARY WASTEWATER	.069	.03	Pounds per Day
KY0098175	7/1/2011	001	1-SANITARY WASTEWATER	.069	.05	Pounds per Day
KY0099317	1/1/2008	001	1-SANITARY WASTEWATER	43	10.	Milligrams per Liter
KY0099317	7/1/2008	001	1-SANITARY WASTEWATER	5	4.	Milligrams per Liter
KY0099317	10/1/2008	001	1-SANITARY WASTEWATER	31	10.	Milligrams per Liter
KY0099317	1/1/2008	001	1-SANITARY WASTEWATER	43	20.	Milligrams per Liter
KY0099317	10/1/2008	001	1-SANITARY WASTEWATER	31	20.	Milligrams per Liter
KY0099317	1/1/2008	001	1-SANITARY WASTEWATER	.52	.21	Pounds per Day
KY0099317	7/1/2008	001	1-SANITARY WASTEWATER	.12	.08	Pounds per Day
KY0099317	10/1/2008	001	1-SANITARY WASTEWATER	.74	.21	Pounds per Day
KY0099317	1/1/2008	001	1-SANITARY	.52	.42	Pounds per Day

NPDES ID	Monitoring	Outfall	Limit Set	DMR Value	Limit Value	Limit Units
			WASTEWATER			
KY0099317	10/1/2008	001	1-SANITARY WASTEWATER	.74	.42	Pounds per Day
KY0101303	7/1/2010	001	1-SANITARY WASTEWATER	7.44	4.	Milligrams per Liter
KY0101303	7/1/2011	001	1-SANITARY WASTEWATER	6.3	4.	Milligrams per Liter
KY0101303	7/1/2010	001	1-SANITARY WASTEWATER	7.44	6.	Milligrams per Liter
KY0101303	7/1/2011	001	1-SANITARY WASTEWATER	6.3	6.	Milligrams per Liter
KY0101303	7/1/2010	001	1-SANITARY WASTEWATER	.043	.03	Pounds per Day
KY0101303	7/1/2011	001	1-SANITARY WASTEWATER	.053	.03	Pounds per Day
KY0101303	7/1/2011	001	1-SANITARY WASTEWATER	.053	.05	Pounds per Day

Dissolved Oxygen

NPDES ID	Monitoring	Outfall	Limit Set	DMR Value	Limit Value	Limit Units
KY0099317	7/1/2008	001	1-SANITARY WASTEWATER	4.07	7.	Milligrams per Liter
KY0095168	7/1/2011	001	2-SANITARY WASTEWATER	5.2	7.	Milligrams per Liter
KY0101303	7/1/2011	001	1-SANITARY WASTEWATER	6.9	7.	Milligrams per Liter

RDX, total

NPDES ID	Monitoring	Outfall	Limit Set	DMR Value	Limit Value	Limit Units
KY0020737	2/1/2012	001	1-SANITARY	26.8	2.	Micrograms per Liter
KY0020737	3/1/2012	001	1-SANITARY	28.2	2.	Micrograms per Liter

Solids, total suspended

NPDES ID	Monitoring	Outfall	Limit Set	DMR Value	Limit Value	Limit Units
KY0095168	4/1/2010	001	2-SANITARY WASTEWATER	40	30.	Milligrams per Liter
KY0095168	7/1/2011	001	2-SANITARY WASTEWATER	64	30.	Milligrams per Liter
KY0095168	7/1/2011	001	2-SANITARY WASTEWATER	64	45.	Milligrams per Liter
KY0095168	7/1/2011	001	2-SANITARY WASTEWATER	<.534	.15	Pounds per Day
KY0095168	7/1/2011	001	2-SANITARY WASTEWATER	<.534	.23	Pounds per Day
KY0098175	10/1/2009	001	1-SANITARY WASTEWATER	31	30.	Milligrams per Liter
KY0098175	7/1/2010	001	1-SANITARY	34	30.	Milligrams per Liter

NPDES ID	Monitoring	Outfall	Limit Set	DMR Value	Limit Value	Limit Units
			WASTEWATER			
KY0098175	1/1/2011	001	1-SANITARY WASTEWATER	48	30.	Milligrams per Liter
KY0098175	1/1/2011	001	1-SANITARY WASTEWATER	48	45.	Milligrams per Liter
KY0098175	7/1/2010	001	1-SANITARY WASTEWATER	.284	.25	Pounds per Day
KY0098175	1/1/2011	001	1-SANITARY WASTEWATER	.4	.25	Pounds per Day
KY0098175	1/1/2011	001	1-SANITARY WASTEWATER	.44	.37	Pounds per Day
KY0099317	10/1/2008	001	1-SANITARY WASTEWATER	49	30.	Milligrams per Liter
KY0099317	5/1/2009	001	1-SANITARY WASTEWATER	34	30.	Milligrams per Liter
KY0099317	10/1/2008	001	1-SANITARY WASTEWATER	1.18	.63	Pounds per Day
KY0101303	7/1/2010	001	1-SANITARY WASTEWATER	39	30.	Milligrams per Liter

Appendix D

- WRIS Reports -

The following paragraphs explaining the WRIS and WRIS portal were copied from their website in July 2012 and can be accessed at http://kia.ky.gov/wris/.

> The Water Resource Information System (WRIS) has been developed through the cooperative efforts of water and wastewater treatment systems and local, regional, and state agencies. It is used by all these entities, and provides much of the information needed for all aspects of water resource planning--from watershed protection to infrastructure development. The WRIS includes a geographic information system (GIS), and information on water resources, drinking water systems, wastewater treatment systems, project development, emergency response, regulations, and planning.
>
> The WRIS is comprised of strategic plans, water resource maps and publications, systems management information, reporting and regulatory requirements, guidance and training documents, procedural guidance and forms for project implementation and funding, and internet links to support services. Interactive maps in the system support planning and regionalization efforts. The interactive maps also facilitate drought monitoring and response, and rapid response to contamination emergencies. The GIS contains data for water and wastewater treatment facilities, water lines, water sources, storage facilities, sewer lines, and a database of non-spatial systems information. The GIS provides the fundamental data needed for the planning and emergency response activities. Using the GIS infrastructure data in computer models allows for cost-effective analysis of engineering alternatives, and facilitates the efficiencies needed to meet the needs of Kentucky's infrastructure development.

WRIS system reports can be generated using system data accessed via the WRIS portal. Likewise project profile forms can be generated using project profile data accessed via the WRIS portal. The Richmond Utilities Board operates a sanitary sewer collection system in a small area of the southwest portion of Muddy Creek. This wastewater is treated at the Richmond Utilities – Silver Creek plant. The Northern Madison County Sanitation District – Greens Crossing operates a sanitary sewer collection system in the headwaters of the UT to Muddy Creek subwatershed. This system, in the central western portion of the watershed, transfers sanitary wastewater to the Richmond Utilities - Otter Creek plant. The Northern Madison County Sanitation District – Regional Plant does not currently have infrastructure within Muddy Creek however it does have several projects involving the Muddy Creek watershed on the Clean Water State Revolving Fund List. These projects include sewer line extensions, lift station construction, upgrade of an existing treatment plant and construction of a new one near Waco. All of these projects, once fully funded, will help Muddy Creek restore its water quality and designated uses. These systems and projects are discussed further in Sections 5 and 8 of the document. The WRIS system reports and project profiles are included below.

WRIS System Data Report

KY0103357 - Richmond Utilities - Silver Creek

DOW Permit ID: **KY0103357**
Link: EPA PCS Report
DOW Permit Type: **WASTE WATER (KPDES)**
Link: EPA ECHO Report
DOW Permit Name: **Richmond Silver Creek STP**
WRIS System Name: **Richmond Utilities - Silver Creek**
System Type: **KPDES Public Wastewater** Receiving Waters: **Silver Crk**
ADD ID: **BGADD** Primary County: **Madison** Dow Field Office: **Frankfort**
Permit Dates: Issued: **12.08.2008** Expired: **01.31.2014** Inactivated:

SYSTEM CONTACT INFORMATION

Contact: **Stephen Winkler**
Title:
Address Line 1: **Richmond Utilities Board**
Address Line 2: **PO Box 700**
City **Richmond** State: **KY** Zip: **40476**
Phone: **859-623-2323** EMail:
Data Source: **KENTUCKY DIVISION OF WATER**

Date Last Modified: 06.03.2010

OWNER ENTITY INFORMATION

Entity Type: **City / Municipal Utility** PSC Group ID: **8805700**
Entity Name: **Richmond Water Gas and Sewage Works**
Web URL: **http://richmondutilities.com**
Office EMail:
Office Phone: **859-623-2323** Toll Free: Fax: **859-624-0805**

Mail Address Line 1: **PO Box 700**	Phys Address Line 1: **300 Hallie Irvine St**
Mail Address Line 2:	Phys Address Line 2:
Mail City, State Zip: **Richmond, KY 40476-0700**	Phys City, State Zip: **Richmond, KY 40476-0700**
Contact: **STEPHEN WINKLER**	Manager:
Contact Title: **GENERAL MANAGER**	Manager Title:
Contact EMail: **salthauser@richmondutilities.com**	Manager EMail:
Contact Phone: **859-623-2323**	Manager Phone:
Contact Cell:	Manager Cell:

Authorized Official: **Jim Barnes**
Auth. Official Title: **Mayor**
Auth. Official EMail: **jbarnes@richmond.ky.us**
Auth. Official Phone: **859-623-1000** Auth. Official Cell:
Data Source: **KENTUCKY PUBLIC SERVICE COMMISSION**

Date Last Modified: 05.16.2012

DEMOGRAPHIC INFORMATION

Counties Directly Served: **1**
Directly Serviceable Population: **400**
Indirectly Serviceable Population:
Total Serviceable Population: **400**

Note: Population counts are based on KIA census block overlay with WRIS mapped features.

County Served	Connection Count	Serviceable Population
Madison	1,500	400
Totals	**1,500**	**400**

System Respondent ADD WMP Date

WRIS System Data Report

KY0103357 - Richmond Utilities - Silver Creek

DOW Permit ID: **KY0103357**
Link: EPA PCS Report
DOW Permit Type: **WASTE WATER (KPDES)**
Link: EPA ECHO Report
DOW Permit Name: **Richmond Silver Creek STP**
WRIS System Name: **Richmond Utilities - Silver Creek**
System Type: **KPDES Public Wastewater**
Receiving Waters: **Silver Crk**
ADD ID: **BGADD**
Primary County: **Madison**
Dow Field Office: **Frankfort**
Permit Dates: Issued: **12.08.2008**
Expired: **01.31.2014**
Inactivated:

FISCAL ATTRIBUTES

Date Established: **08.01.2006**
Employees: **3**

Does this system:

(a) Operate a wastewater treatment facility? **Yes**
(b) Send wastewater to other systems to be treated? **No**
(c) Treat wastewater from other systems? **No**

What is the customer cost per 4,000 gallons of treated water? **$15.65**
Comments: **WAITING ON NUMBERS FROM STEPHEN WINKLER**

Date Last Modified: **05.08.2012**

WRIS System Data Report

KY0103357 - Richmond Utilities - Silver Creek

DOW Permit ID: KY0103357
Link: EPA PCS Report
DOW Permit Type: WASTE WATER (KPDES)
Link: EPA ECHO Report
DOW Permit Name: Richmond Silver Creek STP
WRIS System Name: Richmond Utilities - Silver Creek
System Type: KPDES Public Wastewater
Receiving Waters: Silver Crk
ADD ID: BGADD
Primary County: Madison
Dow Field Office: Frankfort
Permit Dates: Issued: 12.08.2008
Expired: 01.31.2014
Inactivated:

SYSTEM PLANNING

Wastewater Treatment Plants (KIA):

Facility Name	Design Capacity (MGD)	Max Hydr. Capacity (MGD)	Ave. Daily Flow (MGD)
SILVER CREEK WASTEWATER TREATMENT PLANT	1.000	3.020	0.160

✓ This system has an approved facility plan.

Estimated percentage of facility plan constructed: 85%
Date facility plan last revised or amended: 01.01.2005
Number of manholes in collection system: 355
Percentage of sewer lines 20 years or older: 10

DOW Design Capacity (MGD): 1.000
Annual Volume Treated (MG): 71.900
KISOP Volume Sent (MG):
Total Annual Volume (MG): 71.900

KISOP Customers:
Residential Customers: 30
Commercial Customers: 1,150
Institutional Customers:
Industrial Customers: 15
Other Customers:
Total Customers: 1,195
Comments:

Date Last Modified: 08.15.2010

WMP Site Visit - Survey Information:

Site Visit / Survey Date: 05.02.2012
Survey Administrator: Samantha Myers
Principal Respondent: STEPHEN WINKLER
Other Respondent(s):
Comments:

Date Last Modified: 05.08.2012

WRIS System Data Report

KY0103357 - Richmond Utilities - Silver Creek

DOW Permit ID: **KY0103357** — Link: EPA PCS Report

DOW Permit Type: **WASTE WATER (KPDES)** — Link: EPA ECHO Report

DOW Permit Name: **Richmond Silver Creek STP**

WRIS System Name: **Richmond Utilities - Silver Creek**

System Type: **KPDES Public Wastewater** | Receiving Waters: **Silver Crk**

ADD ID: **BGADD** | Primary County: **Madison** | Dow Field Office: **Frankfort**

Permit Dates: Issued: **12.08.2008** | Expired: **01.31.2014** | Inactivated:

SYSTEM MAINTENANCE

This system has a policy manual in place containing the following items:

- ✓ Personnel Policies
- ✓ Operation and Maintenance Procedures
- ✓ Emergency Operation Procedures
- ✓ Standard Operating Procedures
- ✓ Routine Maintenance Program
- ✓ Backup Sources

- ✓ The management of this system participates in regular training activities.
- ✓ System operator(s) participate in regular training activities.
- ✓ This system utilizes standard specifications.

  Date standard specifications last revised: **01.01.2008**

  Date of last infiltration analysis:
- ✓ This system has periodic service outages.

  Cause(s): **Clogged main**
- ✓ This system experiences problematic weather.

  Weather: **Lift stations and wastewater treatment plants lose electricity during storms.**
- ✓ This system has localized problems.

  The following components are associated with locaized problems:

  Problem location(s): **City limits- richmond**

  Problem diameter(s): **8.00**

  Problem Material(s): **Clay pipe**

  Problem cause(s):

  Other problem characteristics:
- ✓ This system has as-built plans (record drawings).

  Est. degree of accuracy for as-built plans (%):
- ✓ This system uses an on-staff inspector(s) for construction projects.

Date of last infiltration analysis:

Maintenance notes for this system:

Date Last Modified: 05.26.2009

WRIS System Data Report

KYP000071 - Northern Madison County Sanitation District - Greens Crossing

DOW Permit ID: KYP000071 — Link: EPA PCS Report
DOW Permit Type: WASTE WATER (KPDES) — Link: EPA ECHO Report
DOW Permit Name: Greens Crossing Collection Sys
WRIS System Name: Northern Madison County Sanitation District - Greens Crossing
System Type: KPDES KISOP (Inter-System) — Receiving Waters: Richmond Utilities
ADD ID: BGADD — Primary County: Madison — Dow Field Office: Frankfort
Permit Dates: Issued: 03.16.2009 — Expired: 04.30.2014 — Inactivated:

SYSTEM CONTACT INFORMATION

Contact: Elliot Turner
Title: Manager
Address Line 1: 201 Aqueduct Dr Suite B-9
Address Line 2:
City Richmond — State: KY — Zip: 40475
Phone: 859-626-0431 — EMail:
Data Source: KENTUCKY INFRASTRUCTURE AUTHORITY

Date Last Modified: 11.23.2010

OWNER ENTITY INFORMATION

Entity Type: Sanitation District (KRS 220) — PSC Group ID:
Entity Name: Northern Madison Sanitation District
Web URL:
Office EMail: jrowe@roweins.com
Office Phone: 859-626-7888 — Toll Free: — Fax: 859-626-5077

Mail Address Line 1: 201 Aqueduct Dr Ste B-9 PO Box 674
Mail Address Line 2:
Mail City, State Zip: Richmond, KY 40476
Contact: Elliott Turner
Contact Title:
Contact EMail: nmcsdelliott@bellsouth.net
Contact Phone: 859-626-7888
Contact Cell:

Phys Address Line 1: 100 MCCRAY WAY
Phys Address Line 2:
Phys City, State Zip: Richmond, KY 40475
Manager: James D Rowe
Manager Title: Chairman
Manager EMail: jrowe@roweins.com
Manager Phone: 859-626-7888
Manager Cell:

Authorized Official: James D Rowe
Auth. Official Title:
Auth. Official EMail: jrowe@roweins.com
Auth. Official Phone: 859-626-7888 — Auth. Official Cell:
Data Source: KENTUCKY INFRASTRUCTURE AUTHORITY

Date Last Modified: 05.08.2012

DEMOGRAPHIC INFORMATION

Counties Directly Served: 1
Directly Serviceable Population: 874
Indirectly Serviceable Population:
Total Serviceable Population: 874

County Served	Connection Count	Serviceable Population
Madison	303	874
Totals	303	874

Note: Population counts are based on KIA census block overlay with WRIS mapped features.

System Respondent _____ ADD WMP _____ Date _____

WRIS System Data Report

KYP000071 - Northern Madison County Sanitation District - Greens Crossing

DOW Permit ID: **KYP000071** — Link: EPA PCS Report

DOW Permit Type: **WASTE WATER (KPDES)** — Link: EPA ECHO Report

DOW Permit Name: **Greens Crossing Collection Sys**

WRIS System Name: **Northern Madison County Sanitation District - Greens Crossing**

System Type: **KPDES KISOP (Inter-System)** Receiving Waters: **Richmond Utilities**

ADD ID: **BGADD** Primary County: **Madison** Dow Field Office: **Frankfort**

Permit Dates: Issued: **03.16.2009** Expired: **04.30.2014** Inactivated:

FISCAL ATTRIBUTES

Date Established: **01.01.2003** Employees: **4**

Does this system:

(a) Operate a wastewater treatment facility? **No**

(b) Send wastewater to other systems to be treated? **Yes**

(c) Treat wastewater from other systems? **No**

What is the customer cost per 4,000 gallons of treated water? **$37.00**

Comments:

Date Last Modified: **11.23.2010**

The following facilities treat water from this KISOP system:

Treatment DOW Permit ID	Treatment Name	Ann. Vol. (MG)
KY0107107	Richmond Utilities - Otter Creek	16.400
	Totals	**16.400**

- MG = Million Gallons
- KISOP = Kentucky Inter-System Operating Permit

WRIS System Data Report

KYP000071 - Northern Madison County Sanitation District - Greens Crossing

DOW Permit ID: **KYP000071** — Link: EPA PCS Report

DOW Permit Type: **WASTE WATER (KPDES)** — Link: EPA ECHO Report

DOW Permit Name: **Greens Crossing Collection Sys**

WRIS System Name: **Northern Madison County Sanitation District - Greens Crossing**

System Type: **KPDES KISOP (Inter-System)** Receiving Waters: **Richmond Utilities**

ADD ID: **BGADD** Primary County: **Madison** Dow Field Office: **Frankfort**

Permit Dates: Issued: **03.16.2009** Expired: **04.30.2014** Inactivated:

SYSTEM PLANNING

✓ This system has an approved facility plan.

Estimated percentage of facility plan constructed: **80%**

Date facility plan last revised or amended: **01.01.2004**

Number of manholes in collection system: **131**

Percentage of sewer lines 20 years or older:

DOW Design Capacity (MGD):

Annual Volume Treated (MG):

KISOP Volume Sent (MG): **16.400**

Total Annual Volume (MG): **16.400**

KISOP Customers:

Residential Customers: **283**

Commercial Customers: **9**

Institutional Customers:

Industrial Customers:

Other Customers:

Total Customers: **292**

Comments:

Date Last Modified: 05.08.2012

WMP Site Visit - Survey Information:

Site Visit / Survey Date: **05.02.2012**

Survey Administrator: **Samantha Myers**

Principal Respondent: **Elliott Turner**

Other Respondent(s):

Comments:

Date Last Modified: 05.08.2012

WRIS System Data Report

KYP000071 - Northern Madison County Sanitation District - Greens Crossing

DOW Permit ID: **KYP000071** — Link: EPA PCS Report

DOW Permit Type: **WASTE WATER (KPDES)** — Link: EPA ECHO Report

DOW Permit Name: **Greens Crossing Collection Sys**

WRIS System Name: **Northern Madison County Sanitation District - Greens Crossing**

System Type: **KPDES KISOP (Inter-System)** | Receiving Waters: **Richmond Utilities**

ADD ID: **BGADD** | Primary County: **Madison** | Dow Field Office: **Frankfort**

Permit Dates: Issued: **03.16.2009** | Expired: **04.30.2014** | Inactivated:

SYSTEM MAINTENANCE

This system has a policy manual in place containing the following items:

- ✓ Personnel Policies
- ✓ Operation and Maintenance Procedures
- ✓ Emergency Operation Procedures
- ✓ Standard Operating Procedures
- ✓ Routine Maintenance Program
- ✓ Backup Sources

- ✓ The management of this system participates in regular training activities.
- ✓ System operator(s) participate in regular training activities.
- ✓ This system utilizes standard specifications.

Date standard specifications last revised:

Date of last infiltration analysis:

This system has periodic service outages.

Cause(s):

This system experiences problematic weather.

Weather:

This system has localized problems.

The following components are associated with localized problems:

Problem location(s):

Problem diameter(s):

Problem Material(s):

Problem cause(s):

Other problem characteristics:

- ✓ This system has as-built plans (record drawings).

Est. degree of accuracy for as-built plans (%): **95%**

- ✓ This system uses an on-staff inspector(s) for construction projects.

Date of last infiltration analysis:

Maintenance notes for this system:

Date Last Modified: 05.08.2012

WRIS System Data Report

KY0105376 - Northern Madison County Sanitation District - Regional Plant

DOW Permit ID: KY0105376 — Link: EPA PCS Report
DOW Permit Type: WASTE WATER (KPDES) — Link: EPA ECHO Report
DOW Permit Name: Northern Madison Co SD
WRIS System Name: Northern Madison County Sanitation District - Regional Plant
System Type: KPDES Public Wastewater — Receiving Waters: Kentucky Rv
ADD ID: BGADD — Primary County: Madison — Dow Field Office: Frankfort
Permit Dates: Issued: 03.24.2009 — Expired: 04.30.2014 — Inactivated:

SYSTEM CONTACT INFORMATION

Contact: Elliott Turner
Title: Manager
Address Line 1: NmcSd / James Rowe, Ch of Bd
Address Line 2: PO Box 674
City: Richmond — State: KY — Zip: 40476
Phone: 859-626-0431 — EMail:
Data Source: KENTUCKY INFRASTRUCTURE AUTHORITY
Date Last Modified: 11.23.2010

OWNER ENTITY INFORMATION

Entity Type: Sanitation District (KRS 220) — PSC Group ID:
Entity Name: Northern Madison Sanitation District
Web URL:
Office EMail: jrowe@roweins.com
Office Phone: 859-626-7888 — Toll Free: — Fax: 859-626-5077

Mail Address Line 1: 201 Aqueduct Dr Ste B-9 PO Box 674	Phys Address Line 1: 100 MCCRAY WAY
Mail Address Line 2:	Phys Address Line 2:
Mail City, State Zip: Richmond, KY 40476	Phys City, State Zip: Richmond, KY 40475
Contact: Elliott Turner	Manager: James D Rowe
Contact Title:	Manager Title: Chairman
Contact EMail: nmcsdelliott@bellsouth.net	Manager EMail: jrowe@roweins.com
Contact Phone: 859-626-7888	Manager Phone: 859-626-7888
Contact Cell:	Manager Cell:

Authorized Official: James D Rowe
Auth. Official Title:
Auth. Official EMail: jrowe@roweins.com
Auth. Official Phone: 859-626-7888 — Auth. Official Cell:
Data Source: KENTUCKY INFRASTRUCTURE AUTHORITY
Date Last Modified: 05.08.2012

DEMOGRAPHIC INFORMATION

Counties Directly Served: 1
Directly Serviceable Population: 4,518
Indirectly Serviceable Population:
Total Serviceable Population: 4,518

County Served	Connection Count	Serviceable Population
Madison	846	4,518
Totals	846	4,518

Note: Population counts are based on KIA census block overlay with WRIS mapped features.

System Respondent — ADD WMP — Date

WRIS System Data Report

KY0105376 - Northern Madison County Sanitation District - Regional Plant

DOW Permit ID: **KY0105376** — Link: EPA PCS Report

DOW Permit Type: **WASTE WATER (KPDES)** — Link: EPA ECHO Report

DOW Permit Name: **Northern Madison Co SD**

WRIS System Name: **Northern Madison County Sanitation District - Regional Plant**

System Type: **KPDES Public Wastewater** | Receiving Waters: **Kentucky Rv**

ADD ID: **BGADD** | Primary County: **Madison** | Dow Field Office: **Frankfort**

Permit Dates: Issued: **03.24.2009** | Expired: **04.30.2014** | Inactivated:

FISCAL ATTRIBUTES

Date Established: **01.01.2008** Employees: **4**

Does this system:

(a) Operate a wastewater treatment facility? **Yes**

(b) Send wastewater to other systems to be treated? **No**

(c) Treat wastewater from other systems? **No**

What is the customer cost per 4,000 gallons of treated water? **$54.00**

Comments:

Date Last Modified: **05.08.2012**

WRIS System Data Report

KY0105376 - Northern Madison County Sanitation District - Regional Plant

DOW Permit ID: **KY0105376** — Link: EPA PCS Report

DOW Permit Type: **WASTE WATER (KPDES)** — Link: EPA ECHO Report

DOW Permit Name: **Northern Madison Co SD**

WRIS System Name: **Northern Madison County Sanitation District - Regional Plant**

System Type: **KPDES Public Wastewater** | Receiving Waters: **Kentucky Rv**

ADD ID: **BGADD** | Primary County: **Madison** | Dow Field Office: **Frankfort**

Permit Dates: Issued: **03.24.2009** | Expired: **04.30.2014** | Inactivated:

SYSTEM PLANNING

Wastewater Treatment Plants (KIA):

Facility Name	Design Capacity (MGD)	Max Hydr. Capacity (MGD)	Ave. Daily Flow (MGD)
REGIONAL WWTP	1.000	4.000	0.190

✓ This system has an approved facility plan.

Estimated percentage of facility plan constructed: **30%**

Date facility plan last revised or amended: **04.01.2004**

Number of manholes in collection system: **225**

Percentage of sewer lines 20 years or older: **30**

DOW Design Capacity (MGD): **1.000**

Annual Volume Treated (MG): **58.000**

KISOP Volume Sent (MG):

Total Annual Volume (MG): **58.000**

KISOP Customers:

Residential Customers: **838**

Commercial Customers: **8**

Institutional Customers:

Industrial Customers:

Other Customers:

Total Customers: **846**

Comments:

Date Last Modified: 05.08.2012

WMP Site Visit - Survey Information:

Site Visit / Survey Date: **05.02.2012**

Survey Administrator: **Samantha Myers**

Principal Respondent: **Elliot Turner**

Other Respondent(s):

Comments:

Date Last Modified: 05.08.2012

WRIS System Data Report

KY0105376 - Northern Madison County Sanitation District - Regional Plant

DOW Permit ID: KY0105376 — Link: EPA PCS Report

DOW Permit Type: WASTE WATER (KPDES) — Link: EPA ECHO Report

DOW Permit Name: Northern Madison Co SD

WRIS System Name: Northern Madison County Sanitation District - Regional Plant

System Type: KPDES Public Wastewater | Receiving Waters: Kentucky Rv

ADD ID: BGADD | Primary County: Madison | Dow Field Office: Frankfort

Permit Dates: Issued: 03.24.2009 | Expired: 04.30.2014 | Inactivated:

SYSTEM MAINTENANCE

This system has a policy manual in place containing the following items:

- ✓ Personnel Policies
- ✓ Operation and Maintenance Procedures
- ✓ Emergency Operation Procedures
- ✓ Standard Operating Procedures
- ✓ Routine Maintenance Program
- ✓ Backup Sources

- ✓ The management of this system participates in regular training activities.
- ✓ System operator(s) participate in regular training activities.
- ✓ This system utilizes standard specifications.

  Date standard specifications last revised: **06.01.2008**

  Date of last infiltration analysis: **06.01.2007**

- This system has periodic service outages.

  Cause(s):

- ✓ This system experiences problematic weather.

  Weather: **Wet weather / rain**

- ✓ This system has localized problems.

  The following components are associated with locaized problems:

  Problem location(s): **Older section of system**

  Problem diameter(s): **BSTIRD GTOM 8-15**

  Problem Material(s); **PVC, CLAY**

  Problem cause(s):

  Other problem characteristics:

- ✓ This system has as-built plans (record drawings).

  Est. degree of accuracy for as-built plans (%): **85%**

- ✓ This system uses an on-staff inspector(s) for construction projects.

Date of last infiltration analysis: **06.01.2007**

Maintenance notes for this system:

Date Last Modified: 05.08.2012

WRIS System Data Report

KY0105376 - Northern Madison County Sanitation District - Regional Plant

The following projects are associated with this system:

PNUM	Applicant	Project Status	Funding Status	Schedule	Project Title	Profile Modified	GIS Modified
SX21151018	Northern Madison Sanitation District	Constructed	Fully Funded	0-2 Years	Whitehall State Shrine Lift Station Project	05.14.2012	11.29.2010
SX21151022	Northern Madison Sanitation District	Pending	Not Funded	3-5 Years	BOONE VILLAGE WASTEWATER COLLECTION SYSTEM	11.10.2011	02.07.2011
SX21151023	Northern Madison Sanitation District	Pending	Not Funded	3-5 Years	TRADITIONS WASTEWATER COLLECTION SYSTEM	11.10.2011	02.07.2011
SX21151024	Northern Madison Sanitation District	Pending	Not Funded	6-10 Years	WATERFORD PLACE WASTEWATER COLLECTION SYSTEM	11.10.2011	04.12.2011
SX21151025	Northern Madison Sanitation District	Pending	Not Funded	3-5 Years	MOCKINGBIRD HILL WASTEWATER COLLECTION SYSTEM	11.10.2011	02.07.2011
SX21151026	Northern Madison Sanitation District	Pending	Not Funded	6-10 Years	LEXINGTON HEIGHTS WASTEWATER COLLECITON SYSTEM	11.10.2011	02.07.2011
SX21151027	Northern Madison Sanitation District	Pending	Not Funded	6-10 Years	PINNUR ACRES WASTEWATER COLLECTION SYSTEM	11.10.2011	04.12.2011
SX21151028	Northern Madison Sanitation District	Pending	Not Funded	3-5 Years	SIMPSON LANE WASTEWATER SYSTEM	11.23.2011	03.18.2011
SX21151029	Northern Madison Sanitation District	Pending	Not Funded	3-5 Years	WALNUT GROVE & WOODLAND ESTATES WASTEWATER	11.10.2011	08.30.2011
SX21151030	Northern Madison Sanitation District	Pending	Not Funded	6-10 Years	WELLS RIDGE WASTEWATER COLLECTION	11.10.2011	03.18.2011
SX21151032	Northern Madison Sanitation District	Pending	Not Funded	3-5 Years	SHILOH CREST WASTEWATER COLLECTION SYSTEM	11.10.2011	03.18.2011
SX21151033	Northern Madison Sanitation District	Pending	Not Funded	6-10 Years	QUAIL WEST WASTEWATER COLLECTION SYSTEM	11.10.2011	03.18.2011
SX21151036	Northern Madison Sanitation District	Approved	Partially Funded	0-2 Years	Muddy Creek Wastewater Treatment Plant	03.13.2012	11.14.2011

Clean Water Project Profile

Legal Applicant: **Northern Madison Sanitation District**
Project Title: **NMCSD - EXPANSION OF WASTEWATER PLANT**
Project Number: **SX21151003** View Map
Submitted By: **BGADD**
Funding Status: **Not Funded**
Primary County: **Madison**
Project Status: **Approved**
Planning Unit: **Unit 7**
Project Schedule: **6-10 Years**
Multi-County: **Yes**
E-Clearinghouse SAI:
ECH Status:
Applicant Entity Type: **Sanitation District (KRS 220)**
Date Approved (AWMPC): **04-29-2003**

Project Description:

EXPANSION OF THE WASTEWATER TREATMENT PLANT TO 2.0 MGD. THERE WILL BE ADDITIONAL COLLECTOR AND INTERCEPTOR LINES INSTALLED.

Need for Project:
Briefly describe how this project promotes public health or achieves and/or maintains compliance with the Clean Water Act or Safe Drinking Water Act:
IMPROVEMENT OF ENVIRONMENTAL CONDITIONS THROUGHOUT THE AREA BY ELIMINATING SURFACING SANITARY WASTEWATER.

Project Alternatives:

Alternate A:
JETTECH SEQUENCING BATCH REACTOR. (SELECTED ALTERNATIVE)

Alternate B:
PARKSON BIOLAC AERATED LAGOON SYSTEM

Alternate C:
ORBAL OXIDATION DITCH

Legal Applicant:

Entity Type: **Sanitation District (KRS 220)** PSC Group ID:
Entity Name: **Northern Madison Sanitation District**
Web URL:
Office EMail: **jrowe@roweins.com**
Office Phone: **859-626-7888** Toll Free: Fax: **859-626-5077**

Mail Address Line 1: **201 Aqueduct Dr Ste B-9 PO Box 674**
Mail Address Line 2:
Mail City, State Zip: **Richmond, KY 40476**
Contact: **Elliott Turner**
Contact Title:
Contact EMail: **nmcsdelliott@bellsouth.net**
Contact Phone: **859-626-7888**
Contact Cell:

Phys Address Line 1: **100 MCCRAY WAY**
Phys Address Line 2:
Phys City, State Zip: **Richmond, KY 40475**
Manager: **James D Rowe**
Manager Title: **Chairman**
Manager EMail: **jrowe@roweins.com**
Manager Phone: **859-626-7888**
Manager Cell:

Authorized Official: **James D Rowe**
Auth. Official Title:
Auth. Official EMail: **jrowe@roweins.com**
Auth. Official Phone: **859-626-7888** Auth. Official Cell:
Data Source: **KENTUCKY INFRASTRUCTURE AUTHORITY** Date Last Modified: **05.08.2012**

Clean Water Project Profile

SX21151003 - Northern Madison Sanitation District
NMCSD - EXPANSION OF WASTEWATER PLANT

Project Administrator (PA) Information

Name: **Bryan Kirby**
Title: **Administrator**
Organization: **Community & Economic Development Associates, Inc.**
Address Line 1: **PO Box 855**
Address Line 2:
City: **Richmond** State: **KY** Zip: **40475**
Phone: **859-624-3396** Fax: **859-575-4175**

Project Engineer (PE) Information:

☒ This project requires a licensed Professional Engineer.

License No: **PE 9382**
PE Name: **Paul D. Nesbitt**
Phone: **859-233-3111** Fax:
E-Mail: **pnesbitt@nei-ky.com**
Firm Name: **Nesbitt Engineering, Inc.**
Addr Line 1: **Paul D. Nesbitt, President**
Addr Line 2: **Nesbitt Engineering, Inc.**
Addr Line 3: **227 North Upper Street**
City: **Lexington** State: **KY** Zip: **40507**
Status: **Current** Disciplinary Actions: **NO**
Issued: **01-16-1976** Expires: **06-30-2014**

Engineering Firm Information:

Permit No: **331**
Firm Name: **Nesbitt Engineering, Inc.**
Phone: **859-233-3111** Fax: **859-259-2717**
Web URL: **http://www.nei-ky.com/**
EMail: **pnesbitt@nei-ky.com**
Addr Line 1: **227 N Upper St.**
Addr Line 2:
City: **Lexington** State: **KY** Zip: **40507**
Status: **Current** Disciplinary Actions: **NO**
Issued: **07-06-1993** Expires: **12-31-2012**

Clean Water Project Profile

SX21151003 - Northern Madison Sanitation District
NMCSD - EXPANSION OF WASTEWATER PLANT

Project Cost Classification:

Administrative Exp.:	
Legal Exp.:	
Land, Appraisals, Easements:	
Relocation Exp. & Payments:	
Planning:	
Engineering Fees - Design:	
Engineering Fees - Construction:	
Engineering Fees - Inspection:	
Engineering Fees - Other:	
Construction:	**$ 43,313,000**
Equipment:	
Miscellaneous:	
Contingencies:	
Total Project Cost:	**$ 43,313,000**

Construction Cost Categories:

WWTP Secondary Portion:	**$ 2,938,000**
WWTP Advanced Portion:	**$ 187,500**
Inflow & Infiltration Correction:	**$ 0**
Major Sewer Rehabilitation:	**$ 0**
Collector Sewers:	**$ 21,701,200**
Interceptor Sewers, including Pump Stations:	**$ 18,486,300**
Combined Sewer Overflow Correction:	**$ 0**
NPS Urban:	**$ 0**
Non-Categorized Cost:	
Total Construction:	**$ 43,313,000**

Total Sustainable Infrastructure Costs:

Note: Total Sustainability Infrastructure Costs are included within construction and other costs reported in this section. This breakout is provided for SRF review purposes.

Project Funding Sources:

Total Project Cost: **$43,313,000**

Total Committed Funding: **$0**

Funding Gap: **$43,313,000 (Not Funded)**

☐ This project will be requesting SRF funding for Federal FY 2013.

Funding Source	Amount	Funding Status	Applicable Date
Total:			

Detailed Project Schedule:

Environmental Review Status:

RD Approval:

CDBG Approval:

No approval, but Cross-Cutter Scoping Completed:

Construction Permit Application Date:

Construction Permit Application Status:

KPDES Permit Application Date:

KPDES Permit Application Status:

Estimated Bid Date:

Estimated Construction Start Date:

Clean Water Project Profile

SX21151003 - Northern Madison Sanitation District
NMCSD - EXPANSION OF WASTEWATER PLANT

The following systems are beneficiaries of this project:

DOW PERMIT ID	System Name

Project Ranking by AWMPC:

Regional Ranking(s):	BGADD	50
Planning Unit Ranking:		
Total Points:		55

Plans and Specifications:

- ☐ Plans and specs have been sent to DOW.
- ☐ Plans and specs have been reviewed by DOW.
- ☐ Plans and specs have been sent to PSC.
- ☐ Plans and specs have been reviewed by PSC.

Demographic Impacts (GIS Census Overlay):

	For Project Area	For Included Systems(s)
Serviceable Population	**8,243**	
Serviceable households	**3,464**	
Med. Household Income	**$50,050**	

New or Improved Service:

	Survey Based	GIS Census Overlay
To Unserved Households		**3464**
To Underserved Households		
To Total Households		**3464**

Economic Impacts:

Jobs Created	**770**
Jobs Retained	**770**

CW Specific Impacts:

Wastewater Volumes (MGD):

For this project:	
For included system(s):	**0.000**
Reduced by this project:	

Other CW Specific Impacts:

- ☐ This project provides regionalization and/or consolidation of wastewater treatment systems.
- ☐ This project includes an on-site mound, and/or decentralized WW treatment system.
- ☐ This project is necessary to achieve full or partial compliance with a court order, agreed order, or a judicial or administrative concent decree.
- ☐ This project achieves voluntary compliance (violation with no order).
- ☐ This project is consistent with the approved facility plan.
- ☐ This project will have a positive impact on drinking water sources within a 5 mile radius.

Planning Needs:

- ☐ Combined Sewer Overflow (CSO) Correction.
- ☐ Sanitary Sewer Overflow (SSO) Correction.
- ☐ Replacement or Rehabilitation of Aging Infrastructure.
- ☑ New Treatment Plant.
- ☑ New Collector Sewers and Appurtenances.
- ☐ Decentralized Wastewater Treatment Systems.
- ☐ Upgrade to Advanced Treatment.
- ☐ Rehab/Upgrade/Expansion of Existing Treatment Plant.
- ☑ New Interceptor Sewers and Appurtenances.
- ☐ Storm Water Control.
- ☐ Non-Point Source (NPS) Pollution Control.
- ☐ Recycled Water Distribution.
- ☐ Planning.
- ☐ Other (specify):

Project Inventory (Mapped Features):

Point Features:

DOW Permit ID	Count	FeatureType	Purpose	Status	Existing Capacity	Proposed Capacity	Units
KY0105376	27	LIFTSTATION		NEW		0.00	
KY0105376	1	SEWAGE TREATMENT PLANT		NEW		0.00	MGD

Line Features:

DOW Permit ID	Line Type	Purpose	Activity	Size (in.)	Material	Length (LF)
KY 0105376	SEWER LINE	COLLECTOR	EXTENSION	8.00	PVC	493,661
KY 0105376	SEWER LINE	INTERCEPTOR	EXTENSION	8.00	PVC	123,535
KY 0105376	SEWER LINE	INTERCEPTOR	EXTENSION	8.00	UNKNOWN	52,987
					Total Length	670,183

Administrative Components:

☐ Planning ☑ Design ☑ Construction ☑ Management

Wastewater Treatment Plants Eliminated:

☑ This project includes the elimination of wastewater treatment plant(s).

DOW Permit ID	Facility Type	System Name	Eliminated Plants	Hydrolic Capacity (MGD)
KY 0024406	PTP	Fort Boonesborough State Park	Ft. Boonesborough State Park	0.000
KY 0082422	PTP	EKU D J Williams Firing Range	EKU Rifle Range	0.000
KY 0099317	PTP	Bybee Grocery	Bybee Grocery	0.000
KY 0102067	PTP	Boones Trace LLC	Boonesborough State Park	0.000
			Total	0.000

Sanitary Sewer Components:

☑ This project includes a new wastewater treatment plant.

Proposed design capacity (MGD): **0.000**

☐ This project includes an expansion of an existing wastewater treatment plant.

Current design capacity (MGD): **0.000**

Current treatment volume (MGD): **0.000**

Proposed design capacity (MGD): **0.000**

☐ This project includes rehabilitation of an existing wastewater treatment plant.

☐ This project includes upgrades to an existing wastewater treatment plant.

☐ This project includes rehabilitation or replacement of aging infractructure.

Total length of replaced infrastructure (LF): **0**

☑ This project includes new collector sewers.

Total length of replaced infrastructure (LF): **493,661**

☑ This project includes new interceptor sewers.

Total length of new interceptor sewer (LF): **176,522**

☑ This project includes elimination of existing sewer system components.

Number of raw sewage discharges eliminated: **0**

Number of failing septic systems eliminated: **1100**

Number of non-failing septic systems eliminated: **1100**

Clean Water Project Profile

Legal Applicant:	**Northern Madison Sanitation District**		
Project Title:	**Muddy Creek Wastewater Treatment Plant**		
Project Number:	**SX21151036** View Map	Submitted By:	**BGADD**
Funding Status:	**Partially Funded**	Primary County:	**Madison**
Project Status:	**Approved**	Planning Unit:	**Unit 7**
Project Schedule:	**0-2 Years**	Multi-County:	**No**
E-Clearinghouse SAI:		ECH Status:	
Applicant Entity Type:	**Sanitation District (KRS 220)**		
Date Approved (AWMPC):	**12-09-2011**		

Project Description:

****project revised on 11/11/11** This project will involve construction of a new wastewater treatment plant near Waco, to regionalize collection and treatment for the area. This first phase will involve redirecting flow from the greens crossing area to the new treatment plant. Approximately 15,000 LF of force main, 10,000 LF of gravity sewer, 3,000 LF of laterals, and 30 manholes will be installed. The project will include upgrade of an existing pump station and construction of two new ones. Sewer will extend to and eliminate two exisisting package treatment plants and up to 28 homes.**

Need for Project:
Briefly describe how this project promotes public health or achieves and/or maintains compliance with the Clean Water Act or Safe Drinking Water Act.

To help regionlaize the area and eventually eliminate approximately 3 package plants currently operating in the area. Set up are for future connections.

Project Alternatives:

Alternate A:

Pump wastewater eleven miles to NMCSD regional facility.

Alternate B:

Continue to pay the City of Richmond rates that would force NMCSD to raise the minimum customer rate by 2014 to $60 (2,200 gallons). This is a very low income area.

Alternate C:

Discontinue sanitary service in this area.

Legal Applicant:

Entity Type:	**Sanitation District (KRS 220)**	PSC Group ID:	
Entity Name:	**Northern Madison Sanitation District**		
Web URL:			
Office EMail:	**jrowe@roweins.com**		
Office Phone:	**859-626-7888** Toll Free:	Fax:	**859-626-5077**
Mail Address Line 1:	**201 Aqueduct Dr Ste B-9 PO Box 674**	Phys Address Line 1:	**100 MCCRAY WAY**
Mail Address Line 2:		Phys Address Line 2:	
Mail City, State Zip:	**Richmond, KY 40476**	Phys City, State Zip:	**Richmond, KY 40475**
Contact:	**Elliott Turner**	Manager:	**James D Rowe**
Contact Title:		Manager Title:	**Chairman**
Contact EMail:	**nmcsdelliott@bellsouth.net**	Manager EMail:	**jrowe@roweins.com**
Contact Phone:	**859-626-7888**	Manager Phone:	**859-626-7888**
Contact Cell:		Manager Cell:	
Authorized Official:	**James D Rowe**		
Auth. Official Title:			
Auth. Official EMail:	**jrowe@roweins.com**		
Auth. Official Phone:	**859-626-7888**	Auth. Official Cell:	
Data Source:	**KENTUCKY INFRASTRUCTURE AUTHORITY**	Date Last Modified:	05.08.2012

Clean Water Project Profile

SX21151036 - Northern Madison Sanitation District
Muddy Creek Wastewater Treatment Plant

Project Administrator (PA) Information

Name: **Elliott Turner**
Title: **Manager**
Organization: **Norther Madison County Sanitation District**
Address Line 1: **201 Aqueduct Drive, Suite B-9**
Address Line 2:
City: **Richmond** State: **KY** Zip: **40475**
Phone: **859-626-7888** Fax:

Project Engineer (PE) Information:

☒ This project requires a licensed Professional Engineer.

License No: **PE 22083**
PE Name: **Mark H. Feibes**
Phone: **859-233-3111** Fax: **859-259-2717**
E-Mail: **mfeibes@nei-ky.com**
Firm Name: **Nesbitt Engineering, Inc.**
Addr Line 1: **Nesbitt Engineering Inc**
Addr Line 2: **227 North Upper Street**
Addr Line 3:
City: **Lexington** State: **KY** Zip: **40507**
Status: **Current** Disciplinary Actions: **NO**
Issued: **08-07-2001** Expires: **06-30-2013**

Engineering Firm Information:

Permit No: **331**
Firm Name: **Nesbitt Engineering, Inc.**
Phone: **859-233-3111** Fax: **859-259-2717**
Web URL: **http://www.nei-ky.com/**
EMail: **pnesbitt@nei-ky.com**
Addr Line 1: **227 N Upper St.**
Addr Line 2:
City: **Lexington** State: **KY** Zip: **40507**
Status: **Current** Disciplinary Actions: **NO**
Issued: **07-06-1993** Expires: **12-31-2012**

Clean Water Project Profile

SX21151036 - Northern Madison Sanitation District
Muddy Creek Wastewater Treatment Plant

Estimated Budget

Project Cost Classification:

Administrative Exp.:	$ 5,000
Legal Exp.:	$ 5,000
Land, Appraisals, Easements:	$ 120,000
Relocation Exp. & Payments:	
Planning:	$ 5,000
Engineering Fees - Design:	$ 67,221
Engineering Fees - Construction:	$ 28,809
Engineering Fees - Inspection:	$ 60,500
Engineering Fees - Other:	$ 8,470
Construction:	$ 2,940,000
Equipment:	
Miscellaneous:	
Contingencies:	$ 100,000
Total Project Cost:	**$ 3,340,000**

Construction Cost Categories:

WWTP Secondary Portion:	$ 440,000
WWTP Advanced Portion:	
Inflow & Infiltration Correction:	
Major Sewer Rehabilitation:	
Collector Sewers:	$ 180,000
Interceptor Sewers, including Pump Stations:	$ 850,000
Combined Sewer Overflow Correction:	
NPS Urban:	
Non-Categorized Cost:	$ 1,470,000
Total Construction:	**$ 2,940,000**

Total Sustainable Infrastructure Costs:

Note: Total Sustainability Infrastructure Costs are included within construction and other costs reported in this section. This breakout is provided for SRF review purposes.

Project Funding Sources:

Total Project Cost: **$3,340,000**

Total Committed Funding: **$100,000**

Funding Gap: **$3,240,000 (Partially Funded)**

☐ This project will be requesting SRF funding for Federal FY 2013.

Funding Source	Amount	Funding Status	Applicable Date
Local	$100,000	Committed	10/1/2011
Total:	$100,000		

Detailed Project Schedule:

Environmental Review Status:

RD Approval:

CDBG Approval:

No approval, but Cross-Cutter Scoping Completed:

Construction Permit Application Date:

Construction Permit Application Status:

KPDES Permit Application Date:

KPDES Permit Application Status:

Estimated Bid Date:

Estimated Construction Start Date:

Clean Water Project Profile

SX21151036 - Northern Madison Sanitation District
Muddy Creek Wastewater Treatment Plant

The following systems are beneficiaries of this project:

DOW PERMIT ID	System Name
KY0105376	Northern Madison County Sanitation District - Regional Plant

Project Ranking by AWMPC:

Regional Ranking(s):	BGADD	130
Planning Unit Ranking:		2
Total Points:		37

Plans and Specifications:

- ☐ Plans and specs have been sent to DOW.
- ☐ Plans and specs have been reviewed by DOW.
- ☐ Plans and specs have been sent to PSC.
- ☐ Plans and specs have been reviewed by PSC.

Demographic Impacts (GIS Census Overlay):

	For Project Area	For Included Systems(s)
Serviceable Population	229	4,518
Serviceable households	108	1,749
Med. Household Income	$43,993	$61,903

New or Improved Service:

	Survey Based	GIS Census Overlay
To Unserved Households		108
To Underserved Households		
To Total Households		108

Economic Impacts:

Jobs Created	
Jobs Retained	

CW Specific Impacts:

Wastewater Volumes (MGD):

For this project:	
For included system(s):	4.000
Reduced by this project:	

Other CW Specific Impacts:

- ☑ This project provides regionalization and/or consolidation of wastewater treatment systems.
- ☐ This project includes an on-site mound, and/or decentralized WW treatment system.
- ☐ This project is necessary to achieve full or partial compliance with a court order, agreed order, or a judicial or administrative concent decree.
- ☐ This project achieves voluntary compliance (violation with no order).
- ☐ This project is consistent with the approved facility plan.
- ☐ This project will have a positive impact on drinking water sources within a 5 mile radius.

Planning Needs:

- ☐ Combined Sewer Overflow (CSO) Correction.
- ☐ Sanitary Sewer Overflow (SSO) Correction.
- ☐ Replacement or Rehabilitation of Aging Infrastructure.
- ☑ New Treatment Plant.
- ☑ New Collector Sewers and Appurtenances.
- ☐ Decentralized Wastewater Treatment Systems.
- ☐ Upgrade to Advanced Treatment.
- ☐ Rehab/Upgrade/Expansion of Existing Treatment Plant.
- ☑ New Interceptor Sewers and Appurtenances.
- ☐ Storm Water Control.
- ☐ Non-Point Source (NPS) Pollution Control.
- ☐ Recycled Water Distribution.
- ☐ Planning.
- ☐ Other (specify):

Project Inventory (Mapped Features):

Point Features:

DOW Permit ID	Count	FeatureType	Purpose	Status	Existing Capacity	Proposed Capacity	Units
KY0105376	1	SEWAGE TREATMENT PLANT		NEW		100,000.00	MGD

Line Features:

DOW Permit ID	Line Type	Purpose	Activity	Size (in.)	Material	Length (LF)
KY 0105376	SEWER LINE	COLLECTOR	EXTENSION	4.00	PVC	2,172
KY 0105376	SEWER LINE	INTERCEPTOR	EXTENSION	6.00	PVC	10,524
KY 0105376	SEWER LINE	INTERCEPTOR	EXTENSION	8.00	PVC	10,442
					Total Length	23,138

Administrative Components:

☑ Planning ☑ Design ☑ Construction ☐ Management

Wastewater Treatment Plants Eliminated:

☐ This project includes the elimination of wastewater treatment plant(s).

Sanitary Sewer Components:

☑ This project includes a new wastewater treatment plant.

Proposed design capacity (MGD): **100000.000**

☐ This project includes an expansion of an existing wastewater treatment plant.

Current design capacity (MGD): **0.000**

Current treatment volume (MGD): **0.000**

Proposed design capacity (MGD): **0.000**

☐ This project includes rehabilitation of an existing wastewater treatment plant.

☐ This project includes upgrades to an existing wastewater treatment plant.

☐ This project includes rehabilitation or replacement of aging infractructure.

Total length of replaced infrastructure (LF): **0**

☑ This project includes new collector sewers.

Total length of replaced infrastructure (LF): **2,172**

☑ This project includes new interceptor sewers.

Total length of new interceptor sewer (LF): **20,966**

☐ This project includes elimination of existing sewer system components.

Number of raw sewage discharges eliminated:

Number of failing septic systems eliminated:

Number of non-failing septic systems eliminated:

Sustainable Infrastructure - Green Infrastructure:

Green stormwater infrastructure includes a wide array of practices at multiple scales that manage wet weather and that maintains and restores natural hydrology by infiltrating, evapotranspiring and harvesting and using stormwater. On a regional scale, green infrastructure is the preservation and restoration of natural landscape features, such as forests, floodplains, and wetlands, coupled with policies such as infill and redevelopment that reduce overall imperviousness in a watershed. On the local scale, green infrastructure consists of site and neighborhood-specific practices, such as:

Component	Cost
☐ Bioretention	**$0**
☐ Trees	**$0**
☐ Green Roofs	**$0**
☐ Permeable Pavement	**$0**
☐ Cisterns	**$0**
☐ Constructed Wetlands	**$0**
☐ Urban Forestry Programs	**$0**
☐ Downspout Disconnection	**$0**
☐ Riparian Buffers and Wetlands	**$0**
☐ Sustainable Landscaping and Site Design	**$0**
☐ Purchase of land or easements on land for riparian and wetland protection or restoration.	**$0**
☐ Fencing to divert livestock from streams and stream buffers.*	**$0**
Total Green Infrastructure Cost:	**$0**

** Indicates a business case may be required for this item.*

There are no Green Infrastructure components specified for this project.

Clean Water Project Profile

Legal Applicant:	**Northern Madison Sanitation District**		
Project Title:	**TERRILL WASTEWATER COLLECTION SYSTEM EXTENSION**		
Project Number:	**SX21151037** View Map	Submitted By:	**BGADD**
Funding Status:	**Not Funded**	Primary County:	**Madison**
Project Status:	**Approved**	Planning Unit:	**Unit 7**
Project Schedule:	**3-5 Years**	Multi-County:	**No**
E-Clearinghouse SAI:		ECH Status:	
Applicant Entity Type:	**Sanitation District (KRS 220)**		
Date Approved (AWMPC):	**04-11-2008**		

Project Description:

CONSTRUCT NEW GRAVITY SEWER AND FORCE MAIN SEWER LINES TO SERVE HOMES AND BUSINESSES NORTH OF EXISTING COLLECTION SYSTEM.

Need for Project:

Briefly describe how this project promotes public health or achieves and/or maintains compliance with the Clean Water Act or Safe Drinking Water Act:

IMPROVEMENT OF ENVIRONMENTAL CONDITIONS THROUGHOUT THE AREA BY ELIMINATING SURFACING SANITARY WASTEWATER.

Project Alternatives:

Alternate A:

COMBINATION SEWER SYSTEM - GRAVITY WHERE FEASIBLE AND FORCE MAIN THE REMAINING.

Alternate B:

FORCE MAIN SYSTEM - UTILIZE FORCE MAINS AND GRINDERS TO SERVE EXISTING BUSINESSES AND HOMES.

Alternate C:

NO ACTION. HOMEOWNERS AND BUSINESSES WILL CONTINUE TO USE EXISTING ON-SITE TREATMENT FACILITIES

Legal Applicant:

Entity Type:	**Sanitation District (KRS 220)**	PSC Group ID:	
Entity Name:	**Northern Madison Sanitation District**		
Web URL:			
Office EMail:	**jrowe@roweins.com**		
Office Phone:	**859-626-7888** Toll Free:	Fax:	**859-626-5077**
Mail Address Line 1:	**201 Aqueduct Dr Ste B-9 PO Box 674**	Phys Address Line 1:	**100 MCCRAY WAY**
Mail Address Line 2:		Phys Address Line 2:	
Mail City, State Zip:	**Richmond, KY 40476**	Phys City, State Zip:	**Richmond, KY 40475**
Contact:	**Elliott Turner**	Manager:	**James D Rowe**
Contact Title:		Manager Title:	**Chairman**
Contact EMail:	**nmcsdelliott@bellsouth.net**	Manager EMail:	**jrowe@roweins.com**
Contact Phone:	**859-626-7888**	Manager Phone:	**859-626-7888**
Contact Cell:		Manager Cell:	
Authorized Official:	**James D Rowe**		
Auth. Official Title:			
Auth. Official EMail:	**jrowe@roweins.com**		
Auth. Official Phone:	**859-626-7888**	Auth. Official Cell:	
Data Source:	**KENTUCKY INFRASTRUCTURE AUTHORITY**	Date Last Modified:	05.08.2012

Clean Water Project Profile

SX21151037 - Northern Madison Sanitation District
TERRILL WASTEWATER COLLECTION SYSTEM EXTENSION

Project Administrator (PA) Information

Name: **Elliott Turner**
Title: **Manager**
Organization: **Norther Madison County Sanitation District**
Address Line 1: **201 Aqueduct Drive, Suite B-9**
Address Line 2:
City: **Richmond** State: **KY** Zip: **40475**
Phone: **859-626-7888** Fax:

Project Engineer (PE) Information:

☒ This project requires a licensed Professional Engineer.

License No: **PE 25716**
PE Name: **Matthew Ray Curtis**
Phone: **859-251-4127** Fax: **859-251-4137**
E-Mail: **mcurtis@kyengr.com**
Firm Name: **Kentucky Engineering Group PLLC**
Addr Line 1: **Nesbitt Engineering Inc**
Addr Line 2: **227 North Upper Street**
Addr Line 3:
City: **Lexington** State: **KY** Zip: **40507**
Status: **Current** Disciplinary Actions: **NO**
Issued: **12-26-2007** Expires: **06-30-2013**

Engineering Firm Information:

Permit No: **2889**
Firm Name: **Kentucky Engineering Group PLLC**
Phone: **859-251-4127** Fax: **859-251-4137**
Web URL: **http://www.kyengr.com/**
EMail: **jthompson@kyengr.com**
Addr Line 1: **161 N. Locust St.**
Addr Line 2:
City: **Versailles** State: **KY** Zip: **40383**
Status: **Current** Disciplinary Actions: **NO**
Issued: **02-19-2009** Expires: **12-31-2012**

Clean Water Project Profile

SX21151037 - Northern Madison Sanitation District
TERRILL WASTEWATER COLLECTION SYSTEM EXTENSION

Project Cost Classification:

Administrative Exp.:	
Legal Exp.:	
Land, Appraisals, Easements:	
Relocation Exp. & Payments:	
Planning:	
Engineering Fees - Design:	
Engineering Fees - Construction:	
Engineering Fees - Inspection:	
Engineering Fees - Other:	
Construction:	**$ 383,000**
Equipment:	
Miscellaneous:	
Contingencies:	
Total Project Cost:	**$ 383,000**

Construction Cost Categories:

WWTP Secondary Portion:	**$ 0**
WWTP Advanced Portion:	**$ 0**
Inflow & Infiltration Correction:	**$ 0**
Major Sewer Rehabilitation:	**$ 0**
Collector Sewers:	**$ 383,000**
Interceptor Sewers, including Pump Stations:	**$ 0**
Combined Sewer Overflow Correction:	**$ 0**
NPS Urban:	**$ 0**
Non-Categorized Cost:	
Total Construction:	**$ 383,000**

Total Sustainable Infrastructure Costs:

Note: Total Sustainability Infrastructure Costs are included within construction and other costs reported in this section. This breakout is provided for SRF review purposes.

Project Funding Sources:

Total Project Cost: **$383,000**

Total Committed Funding: **$0**

Funding Gap: **$383,000 (Not Funded)**

☐ This project will be requesting SRF funding for Federal FY 2013.

Funding Source	Amount	Funding Status	Applicable Date
Total:			

Detailed Project Schedule:

Environmental Review Status:

RD Approval:

CDBG Approval:

No approval, but Cross-Cutter Scoping Completed:

Construction Permit Application Date:

Construction Permit Application Status:

KPDES Permit Application Date:

KPDES Permit Application Status:

Estimated Bid Date:

Estimated Construction Start Date:

Clean Water Project Profile

SX21151037 - Northern Madison Sanitation District
TERRILL WASTEWATER COLLECTION SYSTEM EXTENSION

The following systems are beneficiaries of this project:

DOW PERMIT ID	System Name
KY0102971	Northern Madison County Sanitation District - Battlefield Estates

Project Ranking by AWMPC:

Regional Ranking(s):	BGADD	40
Planning Unit Ranking:		
Total Points:		60

Plans and Specifications:

- ☐ Plans and specs have been sent to DOW.
- ☐ Plans and specs have been reviewed by DOW.
- ☐ Plans and specs have been sent to PSC.
- ☐ Plans and specs have been reviewed by PSC.

Demographic Impacts (GIS Census Overlay):

	For Project Area	For Included Systems(s)
Serviceable Population	393	1,590
Serviceable households	167	683
Med. Household Income	$49,744	$46,680

New or Improved Service:

	Survey Based	GIS Census Overlay
To Unserved Households		167
To Underserved Households		
To Total Households		167

Economic Impacts:

Jobs Created	
Jobs Retained	

CW Specific Impacts:

Wastewater Volumes (MGD):

For this project:	
For included system(s):	0.000
Reduced by this project:	

Other CW Specific Impacts:

- ☐ This project provides regionalization and/or consolidation of wastewater treatment systems.
- ☐ This project includes an on-site mound, and/or decentralized WW treatment system.
- ☐ This project is necessary to achieve full or partial compliance with a court order, agreed order, or a judicial or administrative concent decree.
- ☐ This project achieves voluntary compliance (violation with no order).
- ☐ This project is consistent with the approved facility plan.
- ☐ This project will have a positive impact on drinking water sources within a 5 mile radius.

Planning Needs:

- ☐ Combined Sewer Overflow (CSO) Correction.
- ☐ Sanitary Sewer Overflow (SSO) Correction.
- ☐ Replacement or Rehabilitation of Aging Infrastructure.
- ☐ New Treatment Plant.
- ☑ New Collector Sewers and Appurtenances.
- ☐ Decentralized Wastewater Treatment Systems.
- ☐ Upgrade to Advanced Treatment.
- ☐ Rehab/Upgrade/Expansion of Existing Treatment Plant.
- ☐ New Interceptor Sewers and Appurtenances.
- ☐ Storm Water Control.
- ☐ Non-Point Source (NPS) Pollution Control.
- ☐ Recycled Water Distribution.
- ☐ Planning.
- ☐ Other (specify):

Project Inventory (Mapped Features):

Point Features:

DOW Permit ID	Count	FeatureType	Purpose	Status	Existing Capacity	Proposed Capacity	Units

Line Features:

DOW Permit ID	Line Type	Purpose	Activity	Size (in.)	Material	Length (LF)
KY 0105376	SEWER LINE	COLLECTOR	EXTENSION	8.00	PVC	9,883
					Total Length	9,883

Administrative Components:

☐ Planning ☑ Design ☑ Construction ☑ Management

Wastewater Treatment Plants Eliminated:

☐ This project includes the elimination of wastewater treatment plant(s).

Sanitary Sewer Components:

☐ This project includes a new wastewater treatment plant.

Proposed design capacity (MGD): **0.000**

☐ This project includes an expansion of an existing wastewater treatment plant.

Current design capacity (MGD): **0.000**

Current treatment volume (MGD): **0.000**

Proposed design capacity (MGD): **0.000**

☐ This project includes rehabilitation of an existing wastewater treatment plant.

☐ This project includes upgrades to an existing wastewater treatment plant.

☐ This project includes rehabilitation or replacement of aging infractructure.

Total length of replaced infrastructure (LF): **0**

☑ This project includes new collector sewers.

Total length of replaced infrastructure (LF): **9,883**

☐ This project includes new interceptor sewers.

Total length of new interceptor sewer (LF): **0**

☐ This project includes elimination of existing sewer system components.

Number of raw sewage discharges eliminated: **0**

Number of failing septic systems eliminated: **0**

Number of non-failing septic systems eliminated: **0**

Sustainable Infrastructure - Green Infrastructure:

Green stormwater infrastructure includes a wide array of practices at multiple scales that manage wet weather and that maintains and restores natural hydrology by infiltrating, evapotranspiring and harvesting and using stormwater. On a regional scale, green infrastructure is the preservation and restoration of natural landscape features, such as forests, floodplains, and wetlands, coupled with policies such as infill and redevelopment that reduce overall imperviousness in a watershed. On the local scale, green infrastructure consists of site and neighborhood-specific practices, such as:

Component	Cost
☐ Bioretention	$0
☐ Trees	$0
☐ Green Roofs	$0
☐ Permeable Pavement	$0
☐ Cisterns	$0
☐ Constructed Wetlands	$0
☐ Urban Forestry Programs	$0
☐ Downspout Disconnection	$0
☐ Riparian Buffers and Wetlands	$0
☐ Sustainable Landscaping and Site Design	$0
☐ Purchase of land or easements on land for riparian and wetland protection or restoration.	$0
☐ Fencing to divert livestock from streams and stream buffers.*	$0
Total Green Infrastructure Cost:	**$0**

** Indicates a business case may be required for this item.*

There are no Green Infrastructure components specified for this project.