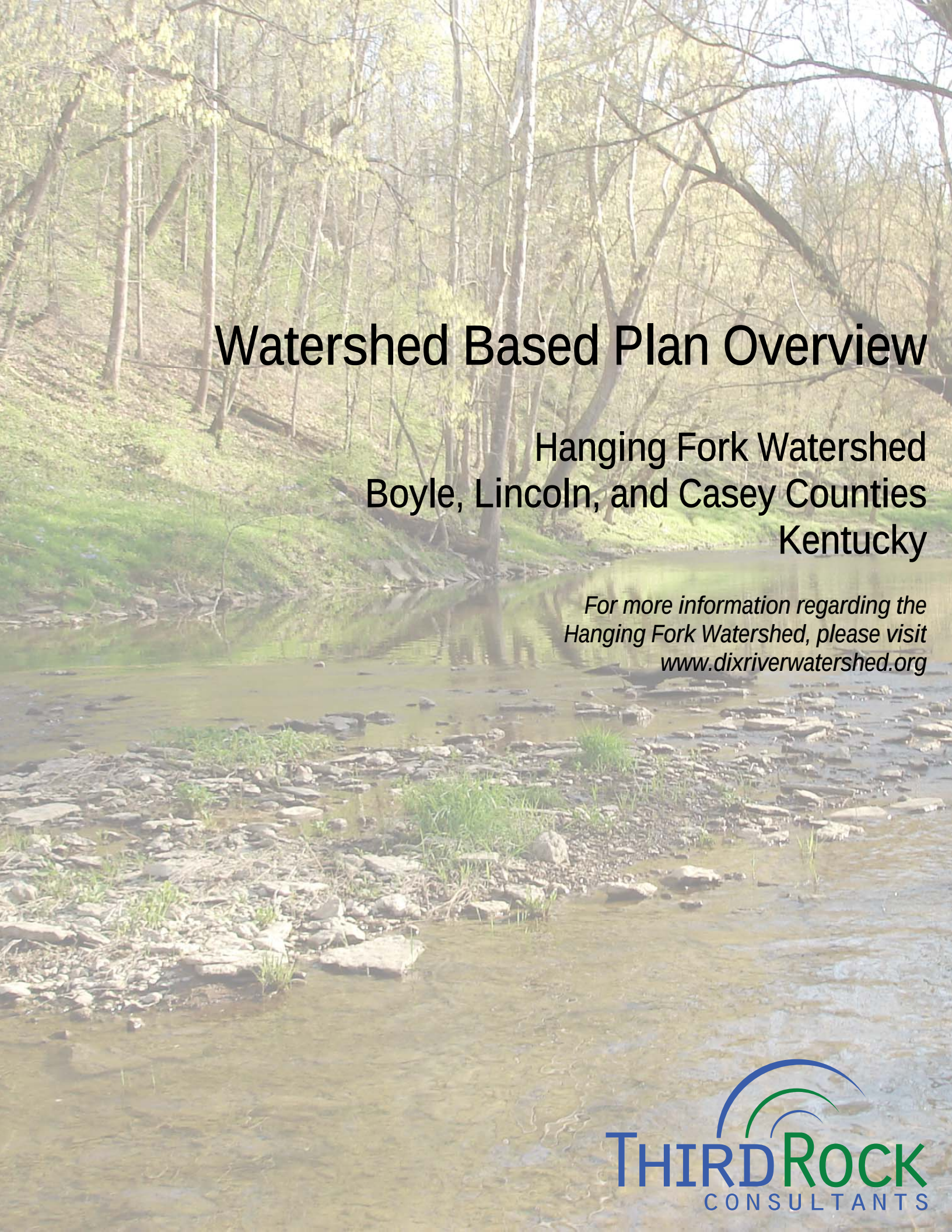


Watershed Based Plan Overview

Hanging Fork Watershed
Boyle, Lincoln, and Casey Counties
Kentucky

For more information regarding the Hanging Fork Watershed, please visit www.dixriverwatershed.org

THIRD ROCK CONSULTANTS

BACKGROUND

The Hanging Fork watershed covers approximately 95 square miles in Boyle, Lincoln, and a small portion of Casey County as shown in Exhibit 1, on page 2. Junction City and Hustonville are located in the watershed area. Tributaries to Hanging Fork include Blue Lick Creek, Martin's Branch, Peyton Creek, Knoblick Creek, White Oak Creek, Harris Creek, Spears Creek, Baughman Branch, and Frog Branch. Hanging Fork is a tributary to the Dix River, which is impounded downstream to form Herrington Lake. Initially, the 303(d) list of impaired surface waters in Kentucky listed Hanging Fork as a first priority impaired stream (nonsupporting) for swimming, indicating that swimming use of the waterway may not be advisable. This report listed the sources of the impairment as "agriculture (grazing-related sources)" and "land disposal (onsite wastewater systems – septic tanks and/or straight pipes)."

Hanging Fork at KY 150

Measuring Flow in Hanging Fork

In an effort to develop solutions to the problems in the Hanging Fork watershed, a two-year monitoring study was conducted. This study was used to develop a watershed based plan, which, according to the US Environmental Protection Agency is "a means to resolve and prevent water quality problems that result from both point source (single, localized sources, such as straight pipes) and nonpoint source (indirect sources, such as stormwater runoff) problems." In addition, the study will be used to develop Total Maximum Daily Load (TMDL) recommendations for the watershed. TMDLs identify pollutant sources and the amount of pollutants each source contributes, and make recommendations for how much of each pollutant the stream can receive without violating water quality standards.

The watershed based plan further identified some of the pollutants in the watershed and their sources. This report, *Watershed Based Plan, Hanging Fork Watershed,* provides a comprehensive analysis of these results if further information is desired.

WATERSHED DESCRIPTION

The Hanging Fork watershed includes portions of both the Knobs and the Outer Bluegrass ecoregions, indicating that the geology of the area is complex and includes both limestone and shale bedrock. Land use in the watershed is primarily agricultural (64 percent) and forested (34 percent) with a small percentage of urban areas.

City, county, lake and watershed boundaries downloaded via the Kentucky GeoNet. National hydrography dataset downloaded from the Kentucky Office of GIS at <http://ogi.ky.gov/gisdata.htm>.National hydrography dataset downloaded from the Kentucky Division of Geographic Information at <http://ogi.ky.gov/gisdata.htm>. County Road mapping was obtained from the Kentucky Transportation Cabinet.

Charts indicate the sources of fecal contributions by source according to the Fecal Chart Key below. Sampling for the DNA samples used to track sources was conducted during dry weather conditions and not during a storm event..

Fecal Chart Key

- % Human Fecal Contribution
- % Cattle Fecal Contribution
- % Unidentified by DNA testing

Hanging Fork at Mouth 8X

Hanging Fork at US 150 13X

Junction City 4X

Oak Creek 7X

Knob Lick 15X

Moores Lane 11X

McCormick Church 27X

North Tributary 5X

Blue Lick 14X

Frog Branch

Hanging Fork Main Stem and Tributaries 32X

Peyton Creek

Blue Lick Branch

Chicken Bristle 24X

McKinney Branch 27X

Peyton Creek

McKinney Branch

Baughman Branch 15X

West of Hustonville 14X

Baughman Branch

West Hustonville

Junction City

Danville

Stanford

Hustonville

Lancaster

BOYLE

LINCOLN

GARRARD

LEBANON ROAD

ALUM SPRINGS ROAD

JOHNSON BRANCH ROAD

FORKLAND ROAD

WHITE OAK ROAD

HOGUE HOLLOW ROAD

STEWARTS LANE

AIRPORT ROAD

NO NAME

SCOTTSBURG ROAD

GLADYS DRIVE

LINVILLE ROAD

CHRISMAN LANE

SPOONAMORE ROAD

WEAVER LANE

RIVER ROAD

WILDERNESS TRAIL

NO NAME

Dix River

RANKIN ROAD

LOGAN HUBBLE ROAD

NO NAME

NO NAME PATRICK ROAD

GOSHEN ROAD

LOW DRIVE

NO NAME DRIVE

EASTWOOD DRIVE

FOSTER LANE

LEE DRIVE

'BOWEN'S LOOP ROAD'

MOORES LANE

HATCHER ROAD

SAND KNOB ROAD

HARRIS CREEK ROAD

VONLINGER ROAD

NO NAME

BUTCHERTOWN ROAD

SPEARSES LANE

FFERIES ROAD

BLACK PIKE

BLUE LICK ROAD

MARTINS TRAIL

NEWLAND'S LANE

BROCK DRIVE

SPOONAMORE LANE

NO NAME

BONEYVILLE ROAD

SWOPE ROAD

MIRACLE-GERKE

150NL

127

150

27

JC01 JC02 JC03 JC04 JC05 JC06 JC07 JC08 JC09

NO01 NO02 NO03

FR01 FR02 FR03 FR04

BL01 BL02 BL03 BL04

HF01 HF02 HF03 HF04 HF05 HF06 HF07 HF08 HF09

PE01 PE02 PE03 PE04 PE05 PE06

MC01 MC02 MC03 MC04 MC05

BA01 BA02 BA03 BA04 BA05 BA06 BA07 BA08

WH01 WH02 WH03 WH04 WH05 WH06

#X Multiplier of E. Coli Exceedance Limit, on Average

Water Quality Monitoring Site

Microbial Source Tracking Site

Stream

Lake

Watershed Boundary

City Boundary

County Boundary

1 0 1 Miles

Exhibit 1
Monitoring Sites and Fecal Input Sources
Hanging Fork Watershed
Boyle, Casey and Lincoln Counties, Kentucky

MONITORING SUMMARY

In addition to existing water quality information, a comprehensive water quality study of the watershed was conducted, which included collecting monthly samples from fourteen sites in the Hanging Fork watershed over a one-year period from 2006 to 2007. In a follow-up monitoring plan in 2007 and 2008, fifty-four sites, including seven of the sites previously monitored, were investigated further because of pathogen and habitat-related impacts. Sampling was conducted in a variety of conditions, including storm and low flow stream periods, as pollutant sources differ depending on specific conditions. The locations of these sites may be found on Exhibit 1.

WHAT ARE THE PROBLEMS?

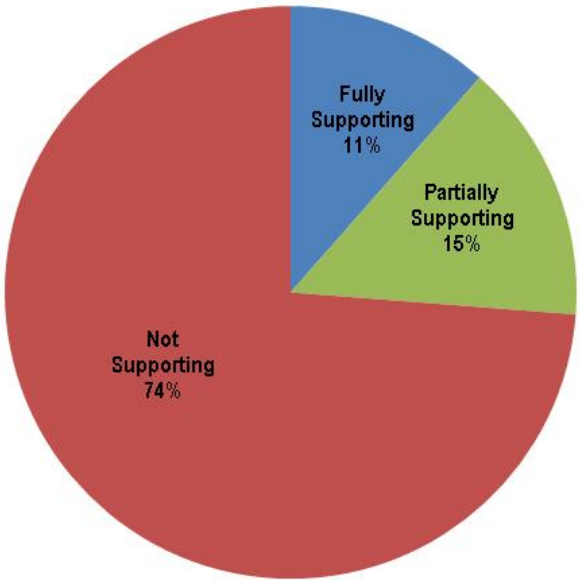
As a result of the monitoring study, additional streams in the Hanging Fork watershed have been identified as impaired and listed on the 2008 303(d) list of impaired surface waters. Risk of disease due to human sewage and animal wastes is the most serious impairment to the watershed. Poor aquatic habitat is common throughout the watershed due to sparse vegetation surrounding streams. Each of the impacts identified in the monitoring are explained in more detail below.

Characterizing Physical Stream Impairments

Habitat Assessment

Habitat assessment evaluates the physical structure of streams to determine how these factors influence water quality. Healthy streams provide diverse habitat for numerous species, and the assessment also determines the potential for the stream to provide habitat. The Kentucky Division of Water has established four categories to rank the quality of the habitat a stream provides, listed in the order of best to worst: "fully supporting," "supporting but threatened," "partially supporting," and "not supporting."

Figure 1 - Habitat Evaluation of Hanging Fork



Of the sixty-one sites surveyed in Hanging Fork, the majority of the sites were determined to have poor habitat (Figure 1). Although the poor habitat designations were due to different factors at various sites, common trends were observed in the watershed.

In the agricultural areas of the watershed, the poorest habitats frequently occurred in streams that pass through grazing areas. Cattle allowed to graze along the creek trample the banks and impact habitat by creating erosion that impacts aquatic habitat with sediment. Grazing also reduces habitat as cattle consume much of the streamside vegetation. Forested streams were generally in better condition than streams in agricultural areas.

In general, habitat of smaller streams and tributaries near the outer boundaries of the watershed, particularly in the southern portion, was much more impacted than on the larger Hanging Fork. Although the habitat of all streams in the watershed was not assessed, these trends appear representative of streams throughout the watershed.

The most negative impact to a stream's ability to provide habitat is due to the vegetated area surrounding the stream, called the riparian zone, being either absent or underdeveloped. The riparian zone is important because it provides wildlife habitat, reduces stream erosion, filters nutrients, traps sediment, and provides canopy cover to the stream. Improving the riparian zone by vegetating the area within sixty feet of each stream bank with native plant species and reducing disturbance (human activity, livestock damage, etc.) will provide the greatest improvement to stream habitat.

Impact of Cattle Grazing in Hanging Fork

Pathogens

Pathogens are organisms that are capable of causing disease, such as bacteria, viruses, protozoa, or fungi. Pathogens enter streams through sewage or animal wastes and present a health risk to people who use the streams recreationally. Because testing for individual pathogens is unfeasible, *E. coli* was sampled as an indicator of sewage or animal wastes in streams within the Hanging Fork watershed. Results indicated that concentrations of *E. coli* often ranged from ten to one thousand times greater than the statewide limit. At their highest levels, some locations in the Hanging Fork watershed had *E. coli* levels similar to those found in the input to a wastewater treatment plant. Thus, the most significant impact in Hanging Fork is the fecal pollution of the watershed.

Overall, concentrations of *E. coli* were much higher in the southern portion of the watershed, averaging nearly double those found in the northern portion. Therefore, additional testing to identify the source of the fecal inputs and the relative concentrations of fecal bacteria in individual tributaries was focused in this area.

Despite the dominant agricultural land use of the watershed, human inputs were overwhelmingly shown to be the source of fecal inputs at the ten sites in which DNA testing was conducted. Generally, human inputs were found to contribute 75 percent of the fecal bacteria in the watershed. Cattle were identified as the second most abundant source, contributing 50 percent of fecal matter in some places, but averaging 25 percent or less. The source components in different geographical areas are shown in Exhibit 1.

DNA markers indicated that multiple residences throughout each watershed division are contributing to the high fecal levels. Testing to indicate the freshness of the fecal sources supports this conclusion. Since no residences outside of Junction City are serviced by sewer systems, failing septic systems and straight pipes are the dominant source of these high fecal levels. To a lesser degree, cattle contribute to the fecal impairment of the Hanging Fork watershed.

Algal Blooms

Algal blooms are rapid increases in the stream's algal population that are caused by an abundance of nitrogen, phosphorus, and sunlight. Algal blooms were observed throughout the watershed but were especially abundant at Moores Lane. Concentrations of chlorophyll *a,* an indicator of algal blooms, were above the ecoregion average at all sites in which it was measured.

Algal blooms impact streams in a number of ways. The unattractive appearance can detract from the recreational value of the stream, causing property values to decline. Because of their volume, they also reduce habitat for some aquatic species. Algal blooms can also reduce nighttime concentrations of dissolved oxygen, which can be deadly to fish. Because dissolved oxygen was not measured at night, it is unknown whether the algal blooms are producing toxic conditions. However, no fish kills were observed in the watershed.

To reduce the occurrence of algal blooms, remediation should focus on reducing the input of nutrients (such as nitrogen and phosphorus) into the stream and increasing the riparian shading of the stream. By decreasing nutrient levels, less food is available to fuel abundant algal growth. A vegetated riparian corridor with canopy cover will decrease the amount of sunlight reaching the stream and reduce the presence of algae.

HOW CAN WE FIX THE PROBLEMS?

The primary objectives of the Best Management Practices (BMPs) focus on pathogen reduction and physical impairment improvements. Both of these focus areas will also require public education. Exhibits 2 and 3, pages 6 and 7, show areas in greatest need of pathogen and physical BMP installations.

In regards to the reduction of *pathogens*, BMPs are recommended for both human and livestock sources:

- Reduce human fecal inputs from septic tanks.
  - Address failing and improperly maintained septic systems.
  - Replace septic systems with a sanitary sewer collection system.

- Reduce fecal inputs from livestock.
  - Restrict agricultural grazing from the riparian zone.
  - Install filter strips along waterways to reduce fecal input from runoff.

The cost of the sewer system is estimated at $5.813 million and replacement of the remaining failing septic systems is estimated at $1.228 million. The cost of fencing materials to reduce cattle inputs is estimated at $238,000.

For *physical* stream improvements the follow BMPs are recommended:

- Increase stream shading – conduct riparian tree and shrub planting.
- Increase riparian vegetated width – re-vegetation and mowing restrictions.

Map Document: (P:\Project_Files\Kentucky\5167E_KDOW_WBP\Mapping\GIS\Hanging_Fork_Brief_Exhibit_2.mxd) 10/5/2009 -- 3:36:39 PM sje

Sewer & Septic data downloaded from the Kentucky Geonet at <http://kygeonet.ky.gov/metadataexplorer/>. County Road mapping was obtained from the Kentucky Transportation Cabinet. County and city boundaries downloaded via the Kentucky GeoNet.

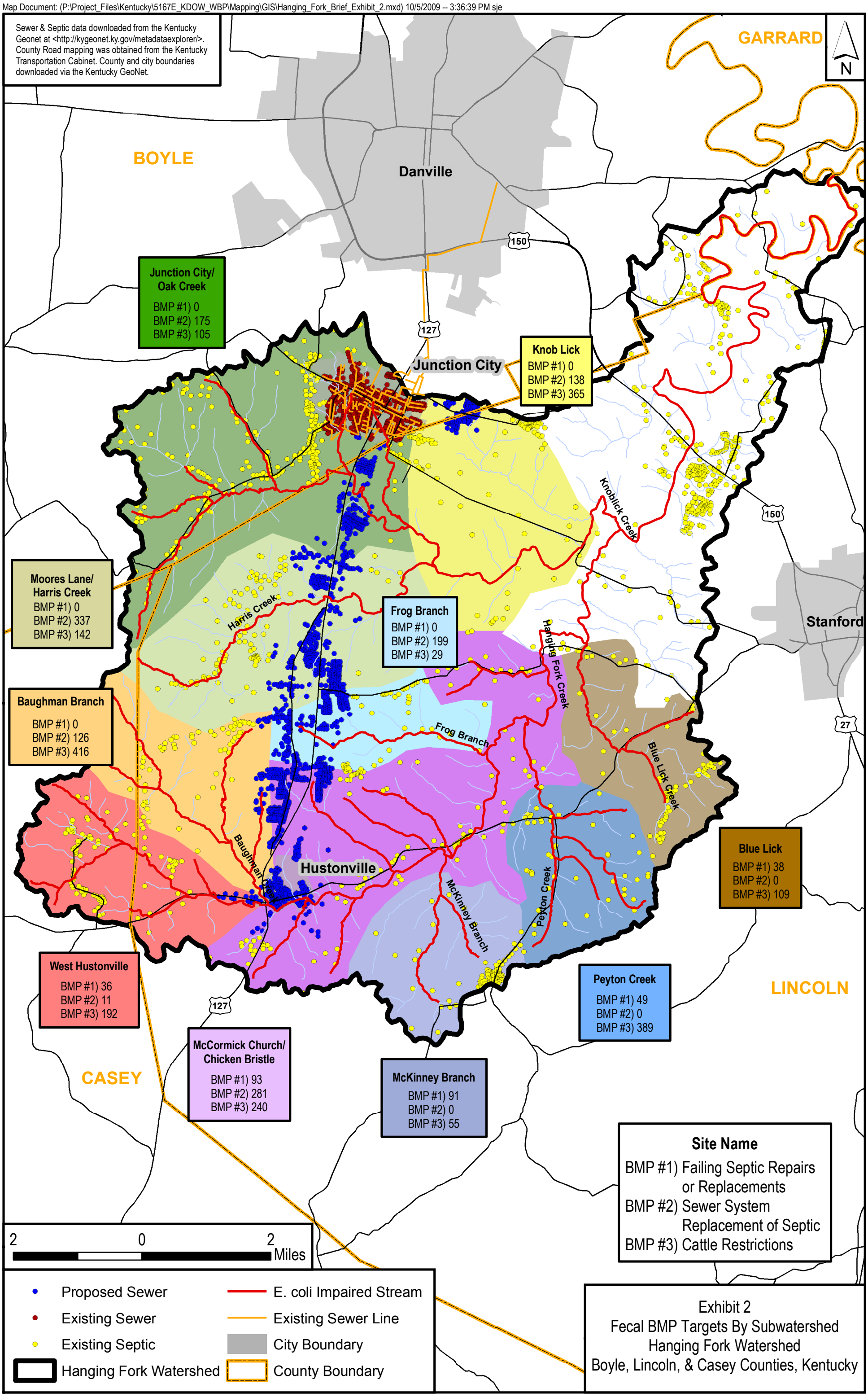


Exhibit 2
Fecal BMP Targets By Subwatershed
Hanging Fork Watershed
Boyle, Lincoln, & Casey Counties, Kentucky

Map Document: (P:\Project_Files\Kentucky\5167E_KDOW_WBP\Mapping\GIS\Exhibit_13_BMPs.mxd) 9/15/2009 -- 3:22:36 PM sje

Sewer & Septic data downloaded from the Kentucky Geonet at <http://kygeonet.ky.gov/metadataexplorer/>. County Road mapping was obtained from the Kentucky Transportation Cabinet. County and city boundaries downloaded via the Kentucky GeoNet. Aerial photography obtained from the USDA-FSA for Lincoln dated 2004.

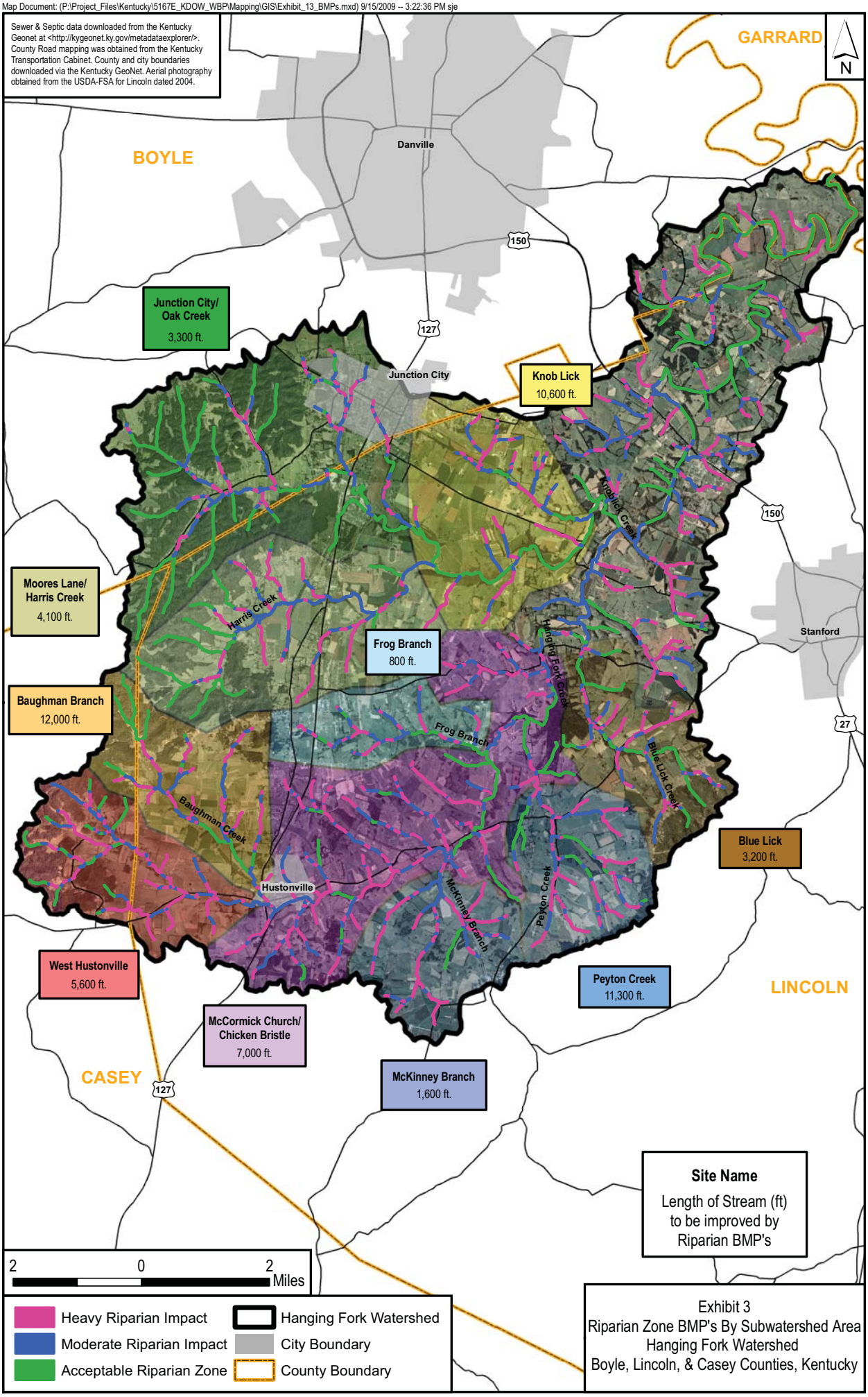


Exhibit 3
Riparian Zone BMP's By Subwatershed Area
Hanging Fork Watershed
Boyle, Lincoln, & Casey Counties, Kentucky

Because fencing should be used to restrict cattle from the riparian area, the majority of the costs in repairing the physical habitat are included in the $$238,000 fencing estimate, as long as the vegetation is allowed to reestablish.

Educational activities should increase the knowledge of water quality issues such that citizens and local officials can address impairments with appropriate codes, ordinances, and other practices. Specific actions should include:

- Hire local water quality advocate for planning decisions.
- Increase public education by increasing accessibility to water quality related information.
- Encourage community interest in stream improvement.
- Examine and recommend updates to local codes and ordinances.

ADDITIONAL INFORMATION

Detailed information and comprehensive analysis of monitoring data from the Hanging Fork watershed is available in the *Watershed Monitoring Report* for the Dix River Watershed. This document is available online at www.dixriverwatershed.org. A hard copy is also available at the Lincoln County Public Library and in Hustonville City Hall.