Stockton Creek Watershed Plan

Table of Contents

****

This project was funded in part by a grant from the U.S. Environmental Protection Agency under 319(h) of the Clean Water Act through the Kentucky Division of Water to the Kentucky Waterways Alliance (Grant # C9994861-04).

Fleming County Conservation District
25 Meadow Lane
Flemingsburg, KY 41041
Office phone: 606-845-9387
Contact Person: Emily Anderson, emily.anderson@ky.usda.gov

Kentucky Waterways Alliance
120 Webster Street, Suite 222
Louisville, KY 40206
Office phone: 502-589-8008
Contact Person: Tessa Edelen, tessa@kwalliance.org

List of Figures

List of Tables

Stockton Creek (Town Branch) Watershed Plan
Chapter 1: Introduction

The Stockton Creek Watershed Plan focuses on identifying point and nonpoint pollution sources in the watershed, quantifying the pollution coming from each source, and making recommendations for Best Management Practices (BMPs) to improve and protect water quality in Stockton Creek.

Watershed

The Stockton Creek watershed is a 3,780 acre area located in Fleming County, Kentucky (Figure 1.1). Most of the city of Flemingsburg, population 3,010, is located within the Stockton Creek watershed. Stockton Creek is a tributary of Fleming Creek. The Kentucky Division of Water (KDOW) has done a detailed study, called a TMDL, of the Fleming Creek watershed that sets limits for bacteria in the watershed (including Stockton Creek). These watersheds are located in the Licking River Basin.

At the beginning of this watershed planning project, the only water quality data available for Stockton Creek were bacteria levels. Stockton Creek is listed as impaired for primary contact by KDOW. This means that the level of bacteria in the water is too high for people to safely swim in the creek. High levels of bacteria can be caused by animal or human waste getting into the water. One group of bacteria is fecal coliform, which comes from human and animal waste. Fecal coliform levels in Stockton Creek have been tested from 2004-2008.

As part of this project, new data were collected on water quality parameters including bacteria and many other types of data. These new data are reported and discussed in Chapters 3 and 4. These are the data used to determine Best Management Practices and other implementation efforts. The information that already existed about the watershed at the time of this writing, including the bacteria data discussed above, is reviewed in Chapter 2.

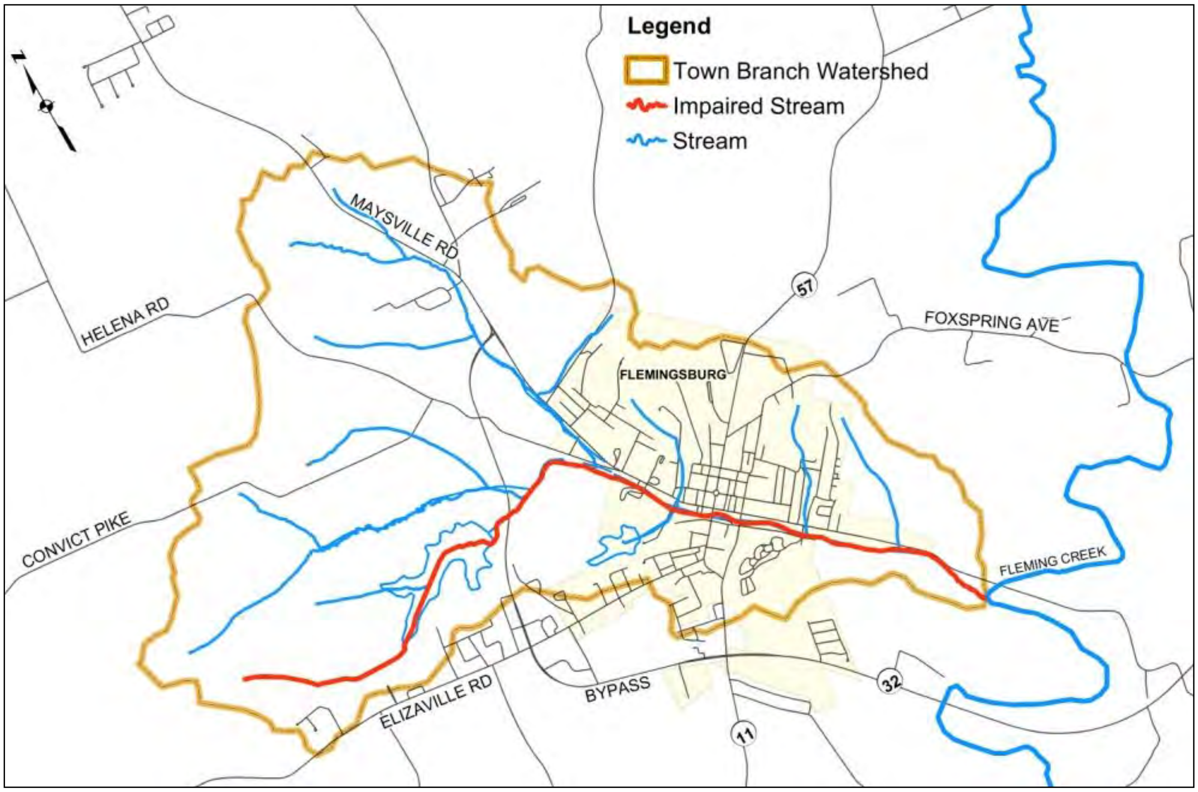

Figure 1.1 Stockton Creek Watershed, Fleming County, Kentucky (Kentucky Geography Network, 2008).

Goals

The Stockton Creek (Town Branch) Watershed Planning Team worked with the community to create a plan that raises awareness of watershed issues, creates healthy streams, enhances the quality of life for all who live and work in the watershed, and protects the watershed for the future.

Specific goals and some possible strategies for the Stockton Creek Watershed Plan included:

Goal #1: Decrease fecal coliform in Stockton Creek, making the creek safe for swimming, wading and other recreation.

Possible Strategies:

Decrease the amount of stormwater runoff into the creek.
Create rain barrel program and involve local artists.
Survey for straight pipes in the area.
Encourage proper septic tank maintenance and survey for failing septic tanks.
Improve filtration by planting native plants and trees.
Encourage the use of rain gardens.
Encourage the use of filter strips near the creek.
Improve wastewater and stormwater systems.
Replace old sewer pipes.

Goal #2: **Educate the public about watershed issues.**

Possible Strategies:

Work with local paper, local access channel, and radio to publicize issues/educational opportunities.

Work with the Extension Service to develop/distribute information on native plants.

Develop a section at county library on watershed issues.

Goal #3: **Improve stream corridor so it is clean, appealing, and provides a more viable habitat for wildlife.**

Possible Strategies:

Clean up dumps and trash in watershed.

Improve habitat by planting native plants and trees.

Clean up buildings falling into creek.

Goal #4: **Control Flooding.**

Possible Strategies:

Decrease the amount of stormwater runoff into the creek.

Create rain barrel program and involve local artists.

Encourage the use of rain gardens.

Improve wastewater and stormwater systems.

These goals and strategies have been refined and added to as the planning process progressed and more data on water quality were collected.

Partners and Stakeholders

This watershed planning effort was funded in part by a grant from the U.S. Environmental Protection Agency under 319(h) of the Clean Water Act through the Kentucky Division of Water to the Kentucky Waterways Alliance.

The Stockton Creek Watershed Planning Team was formed in the fall of 2007. The planning team was made up of partners and stakeholders who worked with the plan's sponsors, the Fleming County Conservation District and the Kentucky Waterways Alliance, to draft the Stockton Creek Watershed Plan. Emily Anderson, of the Fleming County Conservation District, served as the team's facilitator, and Brian O'Neill, of Redwing Ecological Services, was the team's technical assistant.

The Stockton Creek Watershed Planning Team held its first Roundtable in April 2008 to draw more stakeholders into the watershed planning process, increase the public visibility, educate the public on issues facing the Stockton Creek watershed, and to gain stakeholders' input for the planning process. The roundtable was a success, drawing over forty community members. A Roundtable Report is attached as Appendix A.

Partners on the Stockton Creek Watershed Planning Team included:

- City of Flemingsburg, Mayor Louie Flannery and Ben Moran, Codes Enforcement Officer
- Fleming County Conservation District, Emily Anderson
- UDSA Natural Resources Conservation Service
- Fleming County Cooperative Extension Service, Jeff Smith
- Fleming County Fiscal Court, Judge Larry Foxworthy
- Kentucky Division of Conservation, Angie Wingfield
- Kentucky Division of Water, Jim Roe and Brooke Shireman
- Licking River Basin Coordinator, Lajuanda Haight-Maybriar
- Licking River RC&D, Tom Leith
- The Kentucky Waterways Alliance
- Fleming County Garden Club
- Fleming County Chamber of Commerce

The Stockton Creek Watershed Planning Team was also made up of many dedicated residents of the Stockton Creek and Fleming Creek watersheds. The Team gained and lost partners and stakeholders as the planning process went forward.

Stockton Creek (Town Branch) Watershed Plan
Chapter 2: Watershed Inventory

This chapter presents information about the Stockton Creek Watershed that existed when this project began. It was gathered from various sources to gain a better understanding of the watershed. Some of the existing data were collected by Redwing Ecological Services (Redwing). New data collected for this project, also by Redwing, are reported in Chapter 3.

2.1 General watershed description

Stockton Creek begins north of Flemingsburg as many small tributaries that converge just north of town. It then runs through the center of Flemingsburg, which is the county seat of Fleming County. Stockton Creek is also known as Town Branch. It runs along State Route 11 in the northern part of Flemingsburg's town center and follows State Route 32 southeasterly out of town, where it flows into Fleming Creek. Fleming Creek runs generally westward through Fleming County before entering Nicholas County, where it joins the Licking River, which flows in a more northwesterly direction to the Ohio River. See map in Figure 2.1. The Stockton Creek Watershed covers 5.9 square miles, or 3,780 acres.

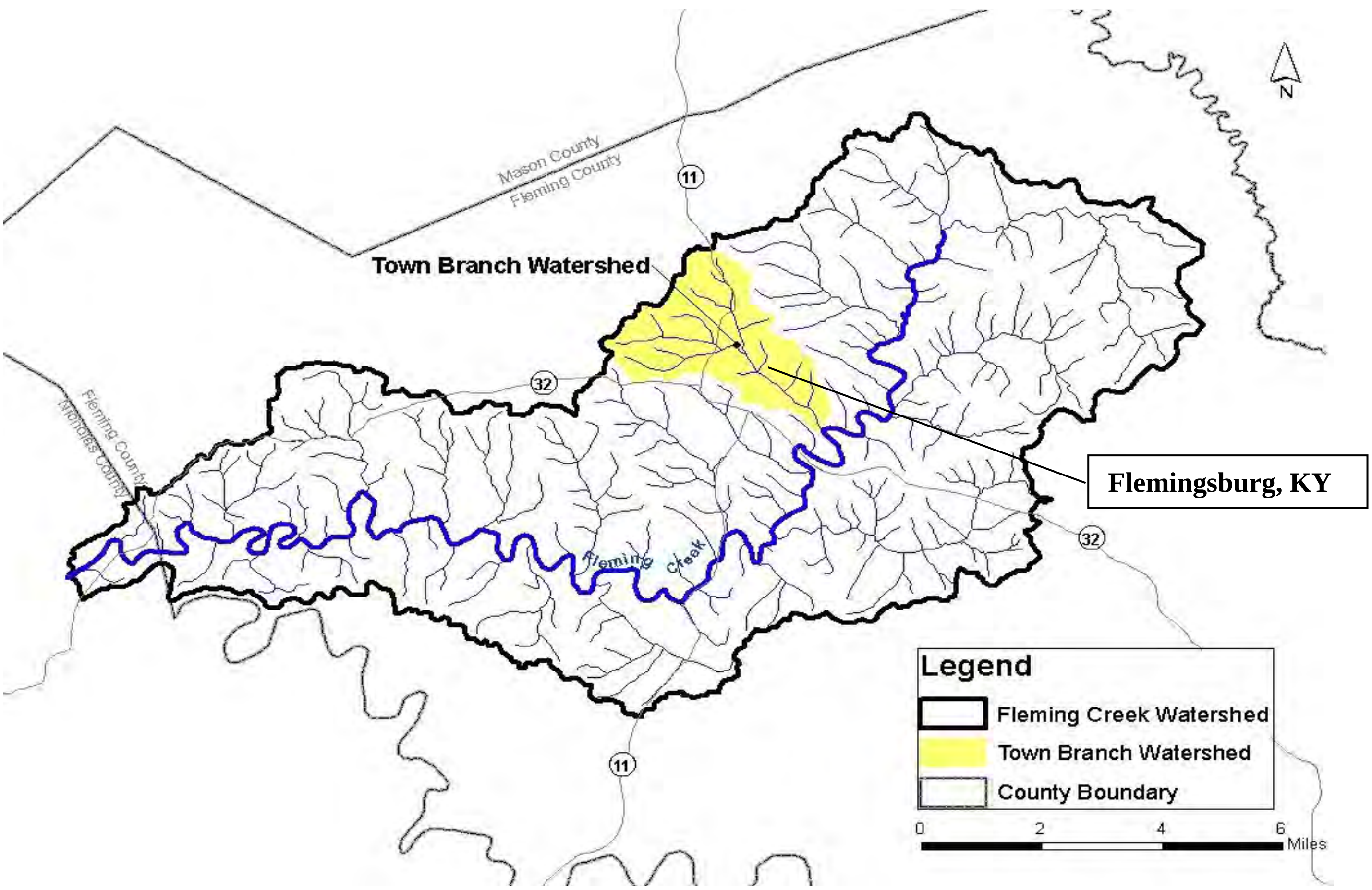

Figure 2.1 The Stockton Creek (Town Branch) Watershed (Redwing Ecological Services, 2008).

The headwaters area of Stockton Creek are predominantly pasture land (56%) with some cultivated crops (10%) and forested areas (9%). In terms of channelization, the upper portions of the watershed still have streams that have been modified to some degree but not as extreme as closer to town. This is typically the case in urban areas. Throughout the entire length of Stockton Creek and at all sampling stations, human encroachment (e.g. mowed lawns, development, cattle grazing, etc.) is evident. Little to no vegetation exists near the streambed, so bank erosion is common. The streambank becomes more and more unstable as you move downstream. The creek has been routed to run under buildings and roads for a portion of its length. Flemingsburg's reservoir was created by damming the southwestern tributary to Stockton, northwest of the town center.

2.1.1 Water Resources

Watershed Boundary

An aerial photograph marked with watershed boundaries, significant tributaries, and area waterbodies can be found in Figure 2.2. The hydrological unit code (HUC) for Stockton Creek is 05100101200080. This 14-digit code is part of the Hydrologic Unit system that is a standardized watershed classification system developed by US Geologic Service. HUCs are watershed boundaries organized by size. The Stockton Creek Watershed is a fairly small watershed. Its HUC has 14 digits to indicate its small size. Other watersheds comparable in size will also have a 14-digit number; it is like an address for the watershed. Bigger watersheds have smaller HUC numbers. HUCs of a certain size class are often referred to by the number of digits in their HUC. Stockton Creek is a HUC-14 while Fleming Creek is a HUC-11.

Hydrology

Stockton Creek is approximately 20,878 linear feet and, like most Kentucky streams, is considered a high-gradient stream based on the abundance of rocky riffles and the small size of the watershed. The gradient of a stream depends on the lay of the land where the streambed is located. If the land where the streambed runs is steep, it is high gradient; if it is flat, the stream is low gradient. There are no long-term monitoring stream gages within Stockton Creek, and existing data regarding stream discharge (flow) are limited. For this reason, discharge data were collected during the monitoring phase of the watershed planning process (see Chapter 3) to provide useful information about base flow conditions.

Stream discharge data collected approximately 0.5 miles upstream of the confluence with Fleming Creek during sampling from 2005 through 2007 averaged 1.14 cubic feet per second (cfs) or 736,445 gallons per day (Fleming Creek Clean Water Action Plan, 2008).

The KY Hydrology Viewer provides information that has been generated from computer models that incorporate the topography and precipitation of an area, but not actual measured data. Stream flow on Stockton Creek near the Middle School was modeled as 4.9 cfs for mean annual flow. For the flow right above the confluence of Stockton and Fleming Creek, the modeled mean annual flow is 7.1 cfs (KY Geonet, 2008).

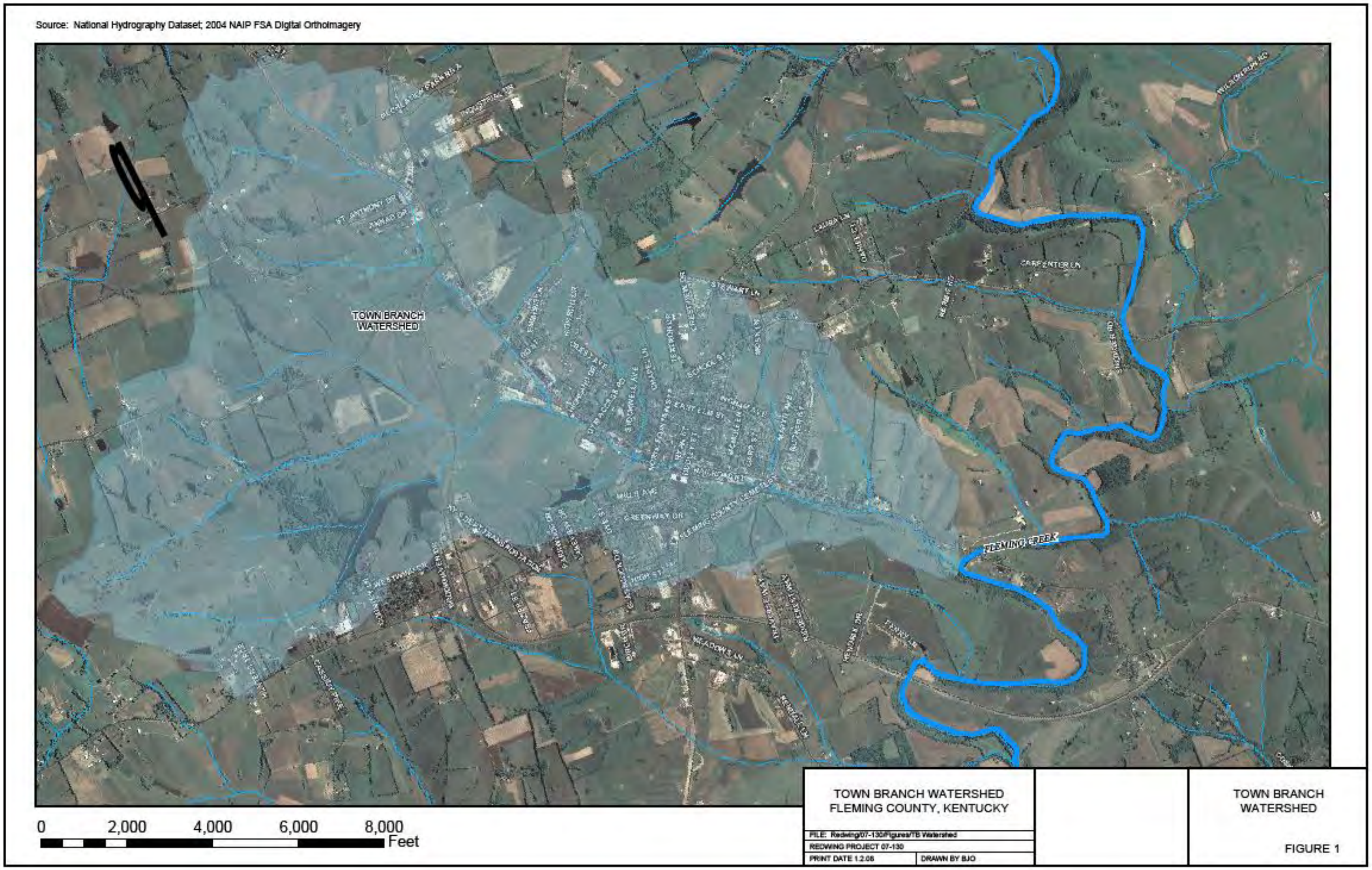

Figure 2.2 Stockton Creek (Town Branch) Watershed (Redwing Ecological Services, 2008).

There are two large reservoirs located within the watershed. One of these is approximately 52 acres and is used for drinking water. The other is approximately 9.5 acres and is used primarily for recreation, although its permit for drinking water use is valid. There are also numerous small farm ponds.

There are 12 tributaries to Stockton Creek that total approximately 56,589 linear feet, or 10.7 miles (USGS National Hydrography Dataset, 2008). Stream flow within the watershed is driven by precipitation and interchange with groundwater. The upper portions of the creek and tributaries within the watershed are dry when precipitation is low.

Climate and precipitation in the Stockton Creek watershed are typical of north-central Kentucky: normal average temperature is 55.2° Fahrenheit and average annual precipitation is 45.91 inches. The prevailing winds come from the south. The average number of heating degree days is 4713,[1] and the average number of cooling degree days is 1154 (US Department of Commerce, National Climatic Data Center, 2008). These are typical for this region of Kentucky. Heating and cooling degree days are the accumulated degrees in Fahrenheit that the average temperature on any day deviates from 65 degrees. Example: if the average temperature for yesterday was 75 you would add 10 heating degree days, but if the temperature was 45 then you would add 20 cooling degree days. Degree days are accumulated on a yearly basis.

The amount of water flowing through Stockton Creek depends in large part on precipitation. Pollution in surface waters like Stockton Creek tends to be greater in times of little precipitation because there is less water to dilute it. It is also tends to be higher after a large rain event because pollutants get washed from the land into the creek. Thus, the precipitation and climate of a watershed have a huge impact on the level of nutrients and pollution found in the surface water.

Groundwater-Surface Interaction

Karst areas are those that have numerous sinkholes, sinking streams, caves, and springs. The underlying rock in these areas is usually limestone. In karst areas, there is a lot of interaction between ground water and surface water in creeks and rivers. This means that water flowing in a surface stream, for example, may 'disappear' underground for several miles, and then resurface much farther downstream. As water moves underground, from hilltops toward a stream through tiny fractures in the limestone bedrock, the rock is slowly dissolved away by weak acids found naturally in rain and soil water. As this happens sinkholes and caves form (Currens, 2002). Karst conditions are important to watershed health because they create the potential for pollutants to move quickly underground to water bodies. The Stockton Creek watershed is an area of non-karst or karst prone topography, as shown in the map in Figure 2.3.

The karst potential map shows the tendency for areas to develop or have karst features such as sinkholes, springs, or caves. The classification is based on lithology (rock composition).

[1] Heating degree day totals are the sum of positive departures of average daily temperature from 65° F.

Limestone is a type of rock with a lot of calcium carbonate and tends to erode easily with water. A karst "prone" area is underlain by bedrock with moderate potential for karst development. Development of karst features in this category is variable and dependent on site-specific conditions. Occurrence of caves may be influenced by physical geography and lithology.

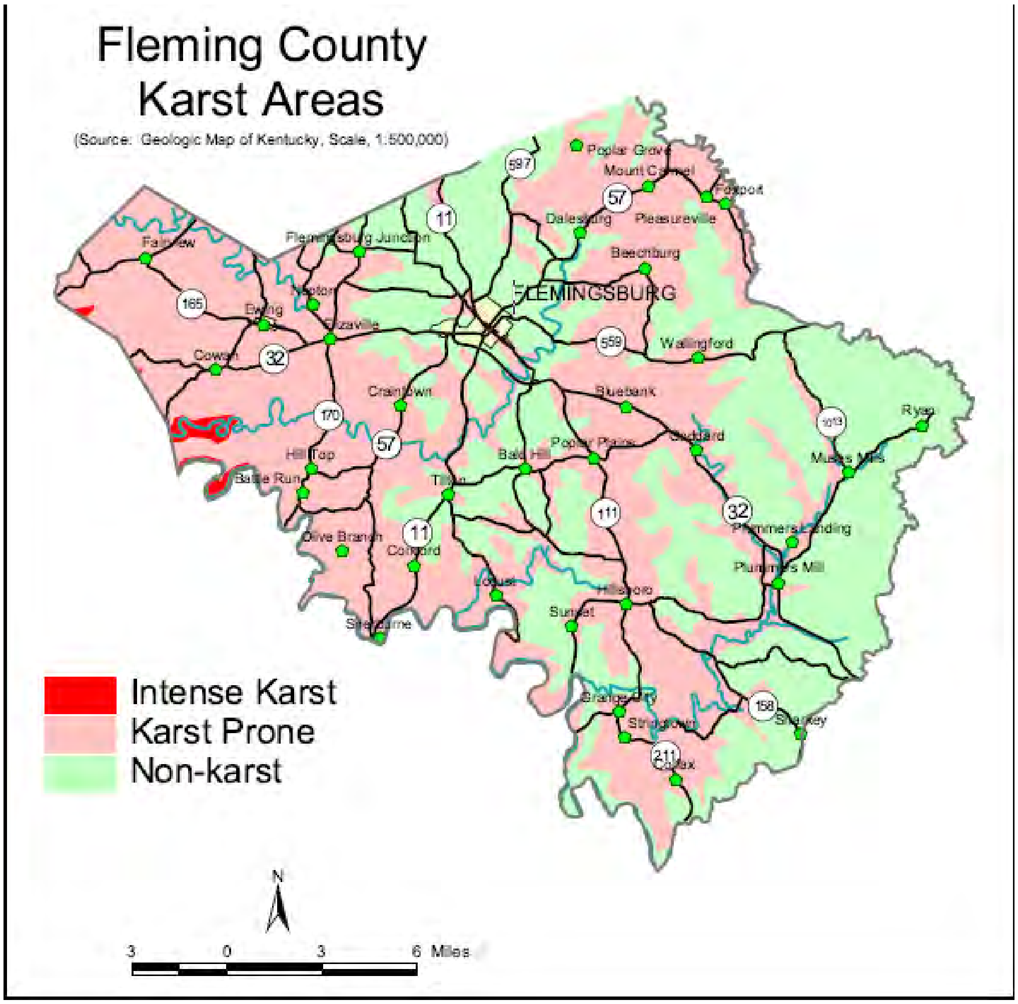

Figure 2.3 Karst areas in and around the Stockton Creek (Town Branch) Watershed (Kentucky Geological Survey, 2008).

Flooding

Flooding is a natural phenomenon that occurs regularly with any waterway. Flooding can be worse if an area has a lot of land surfaces that don't allow water to sink in or infiltrate back into the soil ("impervious surface") like a parking lot. This is because there is more water from a rain or snow event running off to the lowest point of town instead of infiltrating. The downtown area of Flemingsburg proper experiences flooding during large rainfall events, especially below Main Cross where the businesses and roads are built over the stream (see Figure 2.6). A healthy riparian zone and an undeveloped floodplain can help decrease the severity of flooding. As an area becomes more developed with more impervious surfaces, the more frequent severe flooding may be. Stream channel modification and filling in of the floodplain are factors that contribute to more frequent and severe flooding.


Figures 2.4 and 2.5 Photos from the 1956 flood in Flemingsburg (Flemingsburg Gazette, 1956).

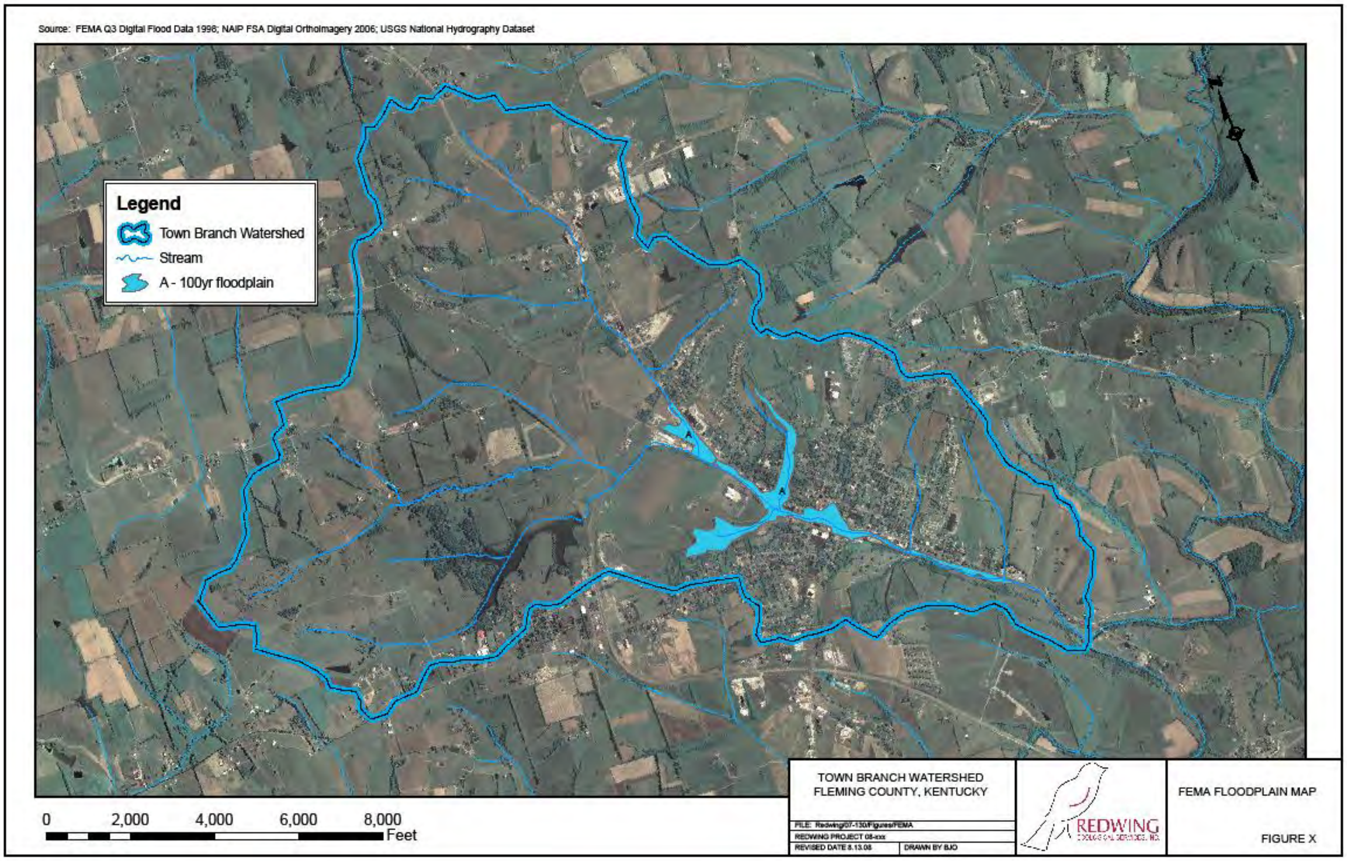

Figure 2.6 Floodplain map for Stockton Creek (Town Branch) Watershed (Redwing Ecological Services, 2008).

Water Supply

In Kentucky, the water withdrawal program, administered by the Kentucky Division of Water (KDOW), regulates all withdrawals of water greater than 10,000 gallons per day from any surface, spring, or groundwater source with the exception of: water required for domestic purposes and agricultural withdrawals, including irrigation.

As of June 9, 2008, according to the Water Quantity Section of KDOW, there were two permitted water withdrawals in the Stockton Creek watershed. These permits are both held by Flemingsburg Utilities. Permit number 0265 allows withdrawal of a monthly average of 600,000 gallons of water per day, throughout the year from the 52 acre, "new" reservoir. Permit number 1023 is a back-up source of water and allows withdrawal of a monthly average of 200,000 gallons of water per day from the 9.5 acre "old" reservoir. The old reservoir is not used for water supply, but for recreation. It has a duckweed problem, but is otherwise well-suited for drinking water if it should ever be needed (Anderson personal communication, 2008). These permits never expire, but are deactivated if they are not used.

According to the Consumer Confidence Report Certification by the Flemingsburg Utility System for 2007, there are three sources of water used to provide drinking water to the Flemingsburg area: the City of Flemingsburg Water Treatment Plant – water withdrawn from the new reservoir, water purchased from the city of Maysville - water withdrawn from the Ohio River, and water purchased from The Greater Fleming County Regional Water Commission – water pumped from deep wells in Lewis County.

Non permitted water withdrawals in the watershed are minimal. Little to no irrigation from the creek for cattle or crops takes place. Livestock tanks in the area are connected to city water, not Stockton Creek.

Watershed Management Activities

Source Water Protection Plans, Wellhead Protection Program, Groundwater Protection Plans

Source Water Protection Plans are required under the Safe Drinking Water Act to assess the quality of water used in a public water system and to formulate protection plans for the source waters used by these systems. There is only one active source of drinking water in the Stockton Creek watershed: Flemingsburg Reservoir. The protection area map (see Figure 2.7) and a preliminary inventory of potential contaminants were completed for the reservoir. As of 2003 and according to KDOW records, there were no point source dischargers in the Source Water Protection area.

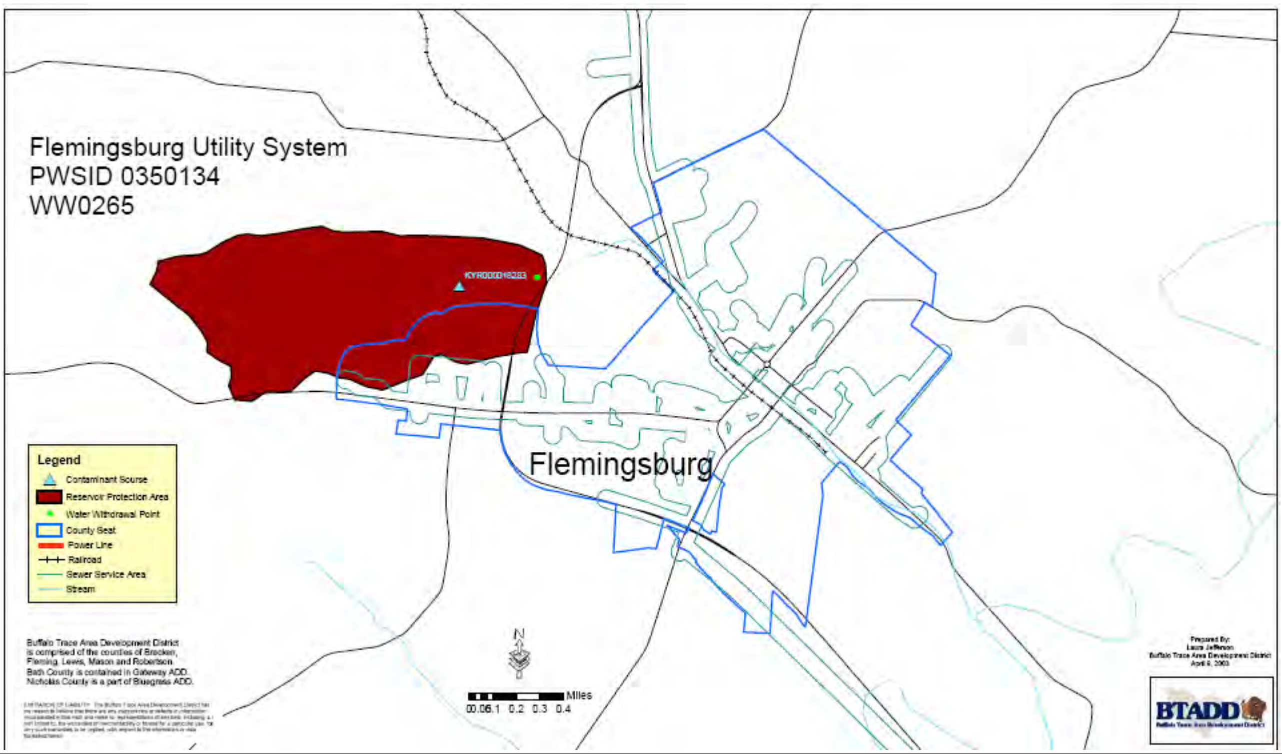

Figure 2.7 Map of the Reservoir Protection Area for the Flemingsburg Reservoir (Buffalo Trace Area Development District, 2008).

Wellhead Protection Plans are used to assist communities that rely on groundwater as their public water source. According to the Wellhead Protection Program of KDOW, there are no Wellhead Protection plans in the Stockton Creek watershed. Though some of the public water for Fleming County comes from groundwater sources, these wells are located in Lewis County.

The public water served in the Stockton Creek watershed is generally hard, leaves deposits, and has taste problems. However, this public water supply system is complex, with intermingling of several sources.

Groundwater Protection Plans (GPPs) are required for anyone engaged in activities that have the potential to pollute groundwater, although there are no requirements to update plans beyond the first three years of use. Activities that would require a GPP include pesticide application or storage for commercial purposes, installation or operation of on-site sewage disposal systems, storing or handling of road oils, or any mining activity. According to the Groundwater Section of KDOW, there are two GPPs in Fleming County. There may be other facilities in the watershed area that need a GPP.

For more information on what types of facilities require GPPs or guidance on how to write a plan, visit the Groundwater Section of the KDOW website. It is part of this watershed-based plan to implement education and awareness campaigns on the need for groundwater protection and active GPPs.

Past and Current Watershed Plans

No watershed plans have been developed for Stockton Creek in the past. Fleming Creek, to which Stockton is a tributary, does have watershed based plan. Part of that plan includes improving the quality and decreasing the fecal coliform loads on Stockton.

Wastewater Authorities

The City of Flemingsburg provides wastewater treatment services to most of the watershed, under the direction of the wastewater supervisor. According to officials, wastewater and stormwater are separated. However, instances of overflow indicate either excess infiltration or some connection of the two systems. The wastewater discharge does include water from all three of the water sources for the watershed area.

Public sewer is provided to about 30 percent of the county's residents. About 3,800 households in the county use on-site wastewater treatment. About 105 customers could be added to public sewer service through new line extensions in 2000-2020. A new or upgraded wastewater treatment facility will be required if a proposed sewer line, the “Ewing Spur,” is constructed.

Agricultural Water Quality Plans

The Kentucky Agriculture Water Quality Act was passed in 1994, with the main goal of protecting surface and groundwater resources from pollution as a result of agriculture and silviculture (forestry) activities. As a result of this law, any farm operation on a tract of land situated on ten or more contiguous acres that engage in agriculture or silviculture activities is to develop and implement a water quality plan based on guidance from the Kentucky Agriculture Water Quality Plan. The Kentucky Agriculture Water Quality Plan consists of best management practices from six areas: 1) Silviculture (forestry), 2) Pesticide & Fertilizer, 3) Farmsteads, 4) Crops, 5) Livestock and 6) Streams and Other Water. Landowners must prepare and implement these plans based on their individual farm operations and keep a record of planning and implementation decisions. The Agriculture Water Quality Plan generally gives an overview of each landowner's decisions regarding how they plan to address potential water quality impacts generated by their operation. These plans are maintained on file with the individual farm operator or owner. A landowner certification can be filed with the Fleming County Soil and Water Conservation District if the owner/operator desires to do so. Because of the self certification requirement established in the Act, there is no way of knowing the actual number of farms with completed water quality plans on their agricultural enterprise. In the Stockton Creek watershed, approximately 2,340 acres have documented Ag Water Quality Plans. In the watershed, approximately 2,494 are utilized for agricultural purposes. Approximately 94% of all agricultural land in the watershed is covered by an Ag Water Quality Plan.

Special Land Use planning

There are currently no special land use planning ordinances or guidelines in effect.

Regulatory Status of Waterways

Kentucky assigns designated uses to each of its waterways, such as recreation, aquatic habitat, and drinking water. For each use, certain chemical, biological, or descriptive ("narrative") criteria apply to protect the stream so that its use can safely continue. The criteria are used to determine whether a stream is listed as "impaired." If a stream is found to be impaired, the EPA requires a watershed plan or Total Maximum Daily Load to be developed.

Designated Uses

Stockton Creek has Kentucky's default designated uses of warm water aquatic habitat and drinking water supply (i.e. suitable for treatment). All of Kentucky's streams are designated with these default uses. This is to keep the streams healthy for people and animals. Stockton also has the designations of primary and secondary contact recreation. These are also default uses. Primary recreation includes swimming and wading. Secondary recreation includes fishing and boating.

Impairment Status

KDOW is required by Congress to evaluate a sampling of creeks and rivers to find out if they are safe for a variety of uses by humans, such as swimming, wading, fishing, drinking, and eating fish from them. Water bodies are also evaluated to find out if they are healthy enough to support other uses, such as a home for the plants and animals that live there. Every two years KDOW is required to send an Integrated Report to Congress and the Environmental Protection Agency about the streams sampled. In addition, they must report on which of those sampled have problems, or are "impaired" for designated use(s).

KDOW is required to complete a study of each of the impaired streams listed in the 303(d) report. This study looks at the pollutants in the part of the stream that is listed and identifies the sources and amounts of those pollutants that are entering the stream. Based on this information, KDOW calculates the amount by which the pollutant must be reduced for the stream to meet its designated uses. This study is called a Total Maximum Daily Load (TMDL), and it can be used to limit the amount of a pollutant that can be discharged into the stream. Stockton Creek has not been assessed for other designated uses by KDOW. No data have been collected by KDOW on the creek since 1998.

The Integrated Report to Congress reports on impaired waterways in the country. It is composed of two parts. Volume I of the report identifies the findings of all of the streams sampled and is called the 305 (b) list. Volume II identifies the findings of only the streams that are impaired and require a TMDL and is called the 303 (d) list. Once the TMDL study is completed and the maximum levels of allowable pollutants have been established, the stream is removed from the 303(d) list, but stays on the 305(b) list of streams that have been sampled.

Special Use Waters

Kentucky identifies certain Special Use Waters, which receive greater protection. These waters include Outstanding State Resource Water, Reference Reach Waters, Kentucky Wild Rivers, Cold Water Aquatic Habitat, Exceptional Waters, Federal Wild River Area, Federal Scenic River Area, and Outstanding National Resource Waters. Special Use designations are made because of some exceptional quality of the water that needs further protection. There are no Special Use Waters in the Stockton Creek watershed. However, Stockton Creek is a tributary to Fleming Creek which enters the Licking River at a segment that is an Outstanding State Resource Water due to mussel populations.

Total Maximum Daily Load Report

The Clean Water Act requires Kentucky to prioritize streams that it lists as impaired for studies that will determine the amount of pollution they can assimilate while still meeting water quality standards. The outcome of such studies is a TMDL Report. These reports set the limits on the pollutants that can be discharged into these waters and provide general guidance for implementation. This watershed plan acts as a useful tool to implement the TMDL.

There is a TMDL for pathogens that was approved in 2001 for all of Fleming Creek watershed, which includes Stockton Creek. This TMDL can be found at online through the KDOW website. It is called the "Fleming Creek Watershed TMDL." River miles 0.0 to 4.0 of Stockton Creek were included in the TMDL and listed as impaired for pathogens. The only designated use for which it was tested was primary recreation (swimming or other direct contact with the water). When a stream is impaired for pathogens, it means that the levels of fecal coliform or *E. coli* (both come from feces of humans or animals) are too high to be safe for human contact. The report cites the probable sources of pathogens as cattle and failing septic and/or sewer systems.

Water Quality Data

Summary of available water quality data

Both the Licking River Watershed Watch and Redwing Ecological Services (Redwing) have been collecting water quality data on Stockton Creek. These data were collected prior to the start of this watershed planning project. New data collected by Redwing for this project are discussed in Chapter 3. The previously collected water quality data available from Redwing are fecal coliform (bacteria) samples taken during the primary contact recreation season (PCR) (May through October) from 2004-2007. Two of the Redwing sample sites were on Stockton Creek, one just above the wastewater treatment plant (WWTP), and one just below the outfall of the WWTP. Two other Redwing sample sites were on Fleming Creek, one just above its confluence with Stockton Creek, and one just below the confluence. From those samples, the impact of Stockton Creek on bacteria levels in Fleming Creek can be examined.

In order to meet Water Quality Standards (WQS), the maximum allowable fecal coliform concentration during the primary recreation season is 400 colonies/100mL. Data in this report are presented as fecal coliform load (colonies/day) and compared against WQS designated for the primary recreation season. Loads were determined from stream discharge measurements taken at the time of each bacteriological water sample. Sites that were inaccessible or dry at the time of the sampling event were not included in the analysis.

For comparison, the frequency of exceedance of WQS for each station during the PCR can be used as a measure of water quality trends. If a station fails to meet WQS every month during the PCR, it would have 100% exceedance. Conversely, if the station meets WQS every month during the PCR, it would have 0% exceedance. The frequency of exceedance and compliance with WQS at each station during the PCR for each year are presented in Table 2.1 for the wastewater treatment plant (WWTP) site, Stockton Creek (Town Branch), and Fleming Creek. The WWTP samples were taken from the outfall pipe, the Stockton Creek (Town Branch) samples were taken from Stockton Creek upstream of the WWTP, and the Fleming Creek samples were taken upstream and downstream of its confluence with Stockton Creek.

Table 2.1 Occurrence of water quality standards exceedance in Stockton Creek, 2004-2007 (Redwing Ecological Services, 2007).

	2004		2005		2006		2007		TOTAL	
Station	Meet	Exceed	Meet	Exceed	Meet	Exceed	Meet	Exceed	Meet	Exceed
Wastewater Treatment Plant	80%	20%	83%	17%	67%	33%	83%	17%	78%	22%
Town Branch	33%	67%	33%	67%	17%	83%	17%	83%	25%	75%
Fleming upstream	0%	100%	0%	100%	33%	67%	33%	67%	16%	84%
Fleming downstream	0%	100%	17%	83%	0%	100%	25%	75%	9%	91%

The WWTP met WQS 78% of the time during the PCR from 2004 through 2007. It exceeded WQS less than 20% of the time with the exception of 2006 where WQS were exceeded during 33% of the PCR. Stockton Creek met WQS only 25% of the time during the PCR from 2004 through 2007 with only 17% compliance during the last two PCR monitoring seasons. Fleming Creek upstream of its confluence with Stockton Creek met WQS during 16% of the PCR from 2004 through 2007. This station did not meet WQS at all during 2004 and 2005 but has improved to 33% compliance during the 2006 and 2007 PCR monitoring seasons. Results downstream of the Fleming Creek/Stockton confluence exceeded WQS during 91% of the PCR from 2004 through 2007 with yearly results ranging from 0% compliance (2004 and 2006) to 25% compliance (2007) during the PCR.

The Licking River Watershed Watch 2008 sampling was conducted at one site in Stockton Creek in May, July, and October. A summary of these samples can be found in Table 2.2.

Table 2.2 Licking River Watershed Watch 2008 data (LRWW, 2008).

Sample ID	Stream	Sample Location	Time	Date	Rainfall	Flow	DO	pH	Temp	Conductivity	*E. coli* cfu/100 mL
L522	Stockton	East of Water St.	9:45	5/10/08	1.5	3	10	8	13	550	7740
L522	Stockton	East of Water St.	10:00	7/12/08	0	3	9.2	8	21	510	3020
L522	Stockton	East of Water St.	11:00	10/11/08	0	3	10	6.5	16	420	520

Biology –The lack of biological data is a data gap that will be filled during the watershed planning process.

Geomorphology and Sediment

Stockton Creek flows through a valley characterized by a high sediment supply with alluvial terraces and floodplains. The creek is generally composed of gravel and cobble and has riffle-pool bed morphology. Some portions of the creek consist primarily of bedrock substrate. Silt is wide spread throughout but is more prevalent in the downstream reaches. It generally has an accessible floodplain. Stockton Creek has a narrow riparian corridor (i.e. area along the streambank) which has been encroached upon by various land uses such as agricultural, residential, and urban development. Areas with cleared riparian vegetation have unstable banks that contribute a high amount of sediment due to bank erosion. Vegetated stream banks with a vegetated buffer are generally stable. Stockton Creek is generally meandering, but much of the creek has been straightened or relocated for various land use activities, particularly the channelized portion that flows through downtown Flemingsburg.

Water Quality Data Gaps

Water quality data gaps for the Stockton Creek Watershed were gaps in the existing data at the time of this writing, previous to new data collection for this planning project. They include specific stream segment data. There are several sampling sites along the creek that consistently report high bacteria and nutrient loads, but the exact sources are not known. This may require a visual assessment by the Stockton Creek watershed team or further water quality sampling.

2.1.2 Natural Features of the Watershed

Geology and Topography

The general topography of the Stockton Creek watershed area is gently rolling hills with mild local relief. Hilltops climb up to 1,000 feet with some valleys less than 100 feet (see Figure 2.8). The area lies within the Outer Bluegrass Region, a region of Ordovician outcrop and limestone.

Soils

The Stockton Creek watershed soils are of the Lowell-Faywood-Cynthiana. The landscape is characterized by broad ridgetops and short side slopes separated by narrow and moderately wide flood plains. The major soils in this area were formed in material weathered from limestone and calcareous shale of Ordovician age. Slopes range from 2-35 percent. This area is dissected by many small drainage ways and intermittent streams and by a few perennial streams. Many areas have sinkholes or depressions through which water drains. Most farm ponds are the embankment type. There are a few small lakes and two reservoirs. This watershed contains approximately 34% Lowell soils, 31% Faywood soils 23% Cynthiana soils, and 12% soils of minor extent. Lowell soils are deep or very deep, well drained and gently sloping to moderately steep. They are on broad ridgetops and side slopes, generally at elevations above the Cynthiana soils. Typically, the surface layer is dark yellowish brown silt loam. The subsoil is silty clay loam and silty clay in the upper part and mottled clay in the lower part. The substratum is olive yellow clay.

Faywood soils are moderately deep, well drained, and gently sloping to very steep. They are on ridgetops and side slopes. Typically, the surface layer is brown silt loam. The subsoil is silty clay in the upper part and brown clay in the lower part. Cynthiana soils are shallow, well drained or somewhat excessively drained, and sloping to very steep. They are on narrow ridgetops and side slopes. Typically, the surface layer is brown silty clay loam. The subsoil is flaggy clay in the upper part and flaggy silty clay in the lower part. Of minor extent in this area are Beasley, Fairmount, Nicholson, and Woolper soils on ridgetops and side slopes; Elk and Otwell soils on stream terraces; and Nolin and Boonesboro soils on flood plains and in upland drainageways and depressions (Anderson personal communication, 2008).

Most areas are used as cropland, hayland, or pasture. The sloping to very steep areas on side slopes generally are used as pasture. Small areas of mixed hardwoods or eastern red cedar are generally on the steep and very steep side slopes. The depth to bedrock, the hazard of erosion, the slope, droughtiness, surface flagstones, and rock outcrops are management concerns for agricultural operations.

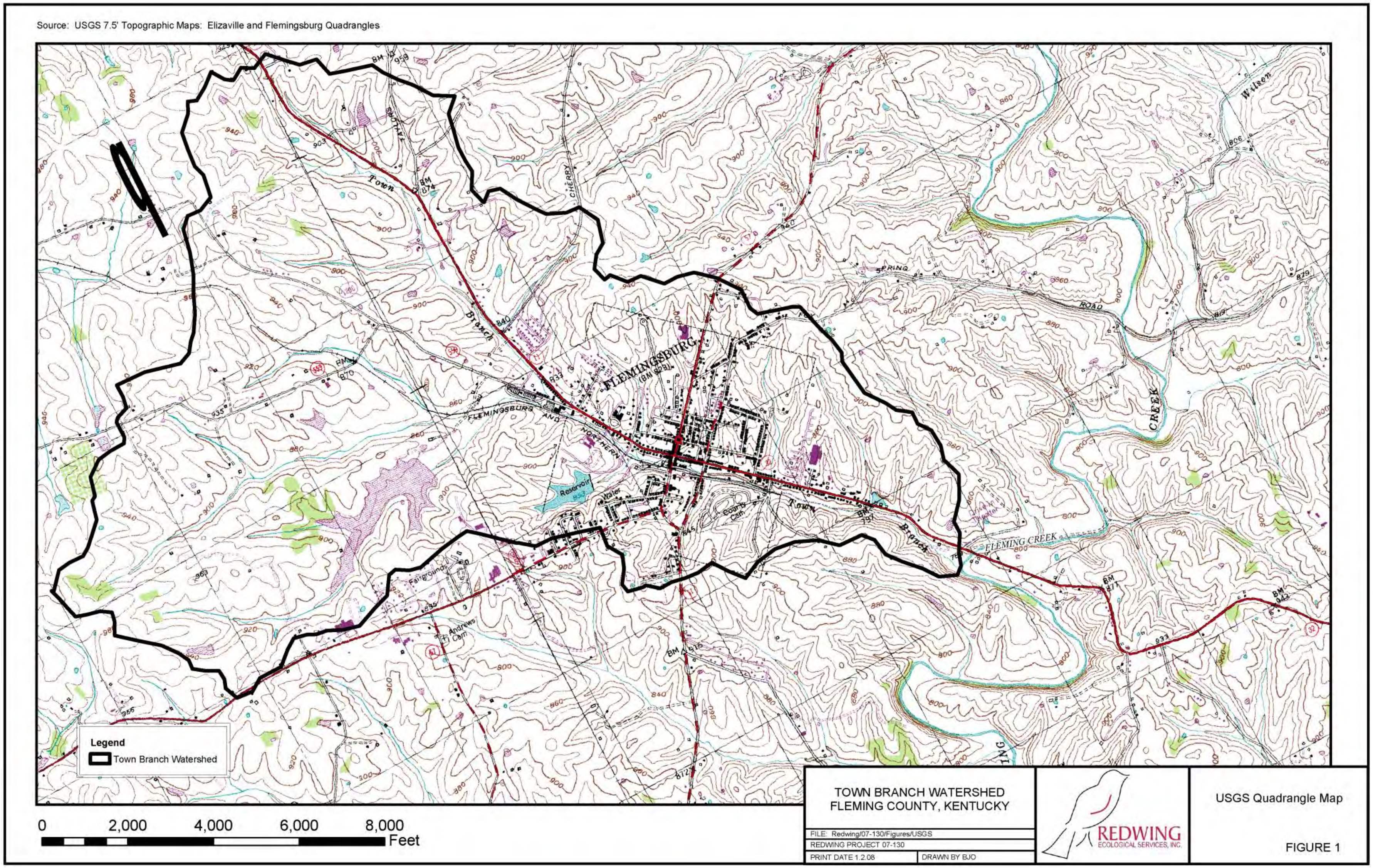

Figure 2.8 Topographic Map of Fleming County, including the Stockton Creek Watershed (Redwing Ecological Services, 2009).

The gently sloping and sloping soils on this area are suited to some urban uses, but the moderately steep to very steep soils are poorly suited. The slope, the depth to bedrock, a moderate shrink-swell potential, the clayey subsoil, and slow permeability are limitations. Low strength is a limitation on sites for local roads (see Figure 2.9).

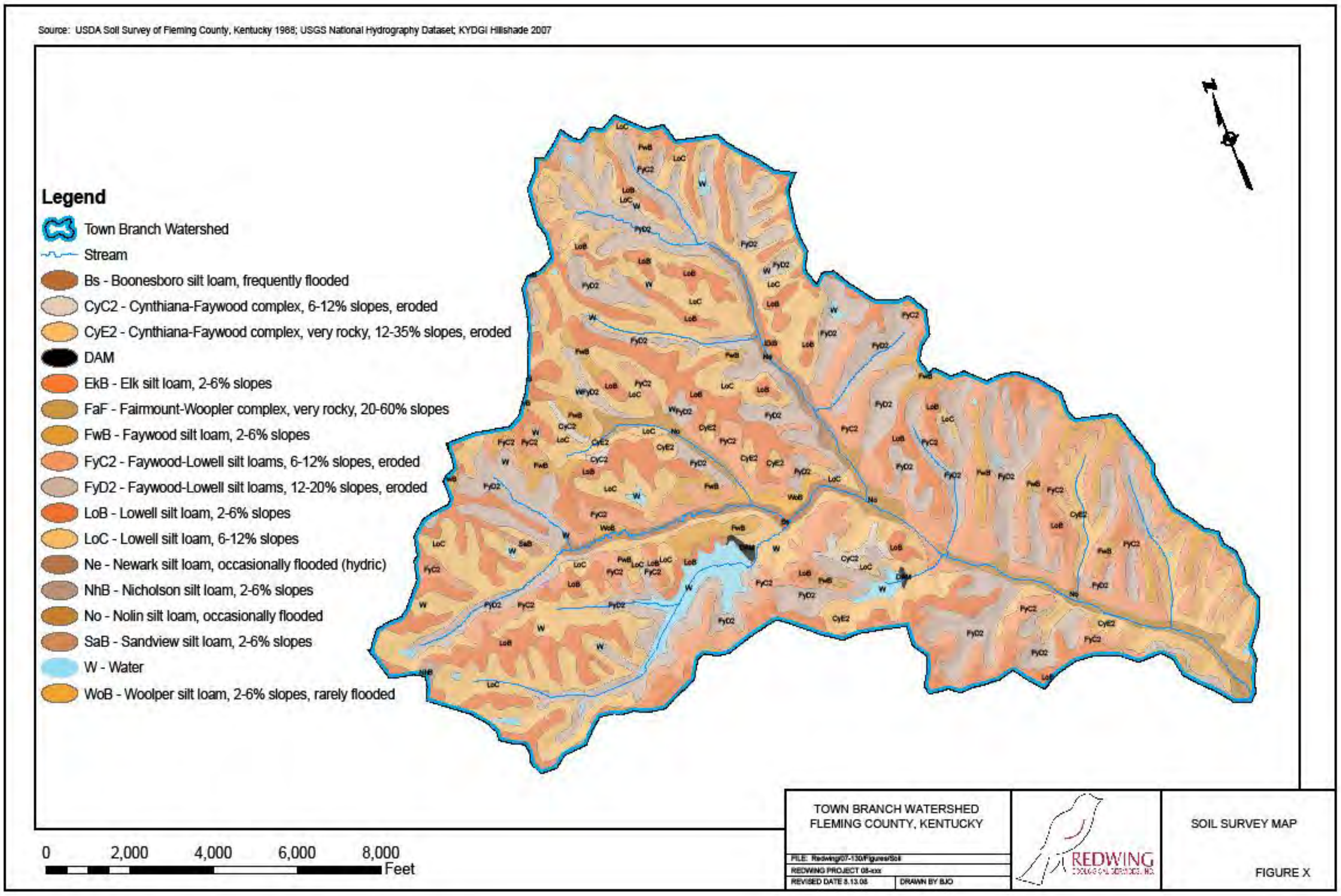

Figure 2.9 Soils of Stockton Creek Watershed (Redwing Ecological Services, 2008).

Riparian Ecosystem

A riparian ecosystem is the land on both sides of a waterway. It can be populated by many types of trees, shrubs, or grasses. A healthy riparian area is full of native vegetation along the streambank, providing habitat to many sorts of animals. There are the additional benefits of stream bank stabilization and a physical barrier to cattle. Also, the stream will benefit from cooler water temperatures due to the vegetation shading. This can lead to beneficial levels of dissolved oxygen which is important for aquatic life. According to observations from Redwing Ecological Services personnel, much of the riparian ecosystem in the Stockton Creek watershed is degraded or unvegetated. See Figure 2.10 for the canopy tree cover (area shaded by trees and other vegetation) in the watershed.

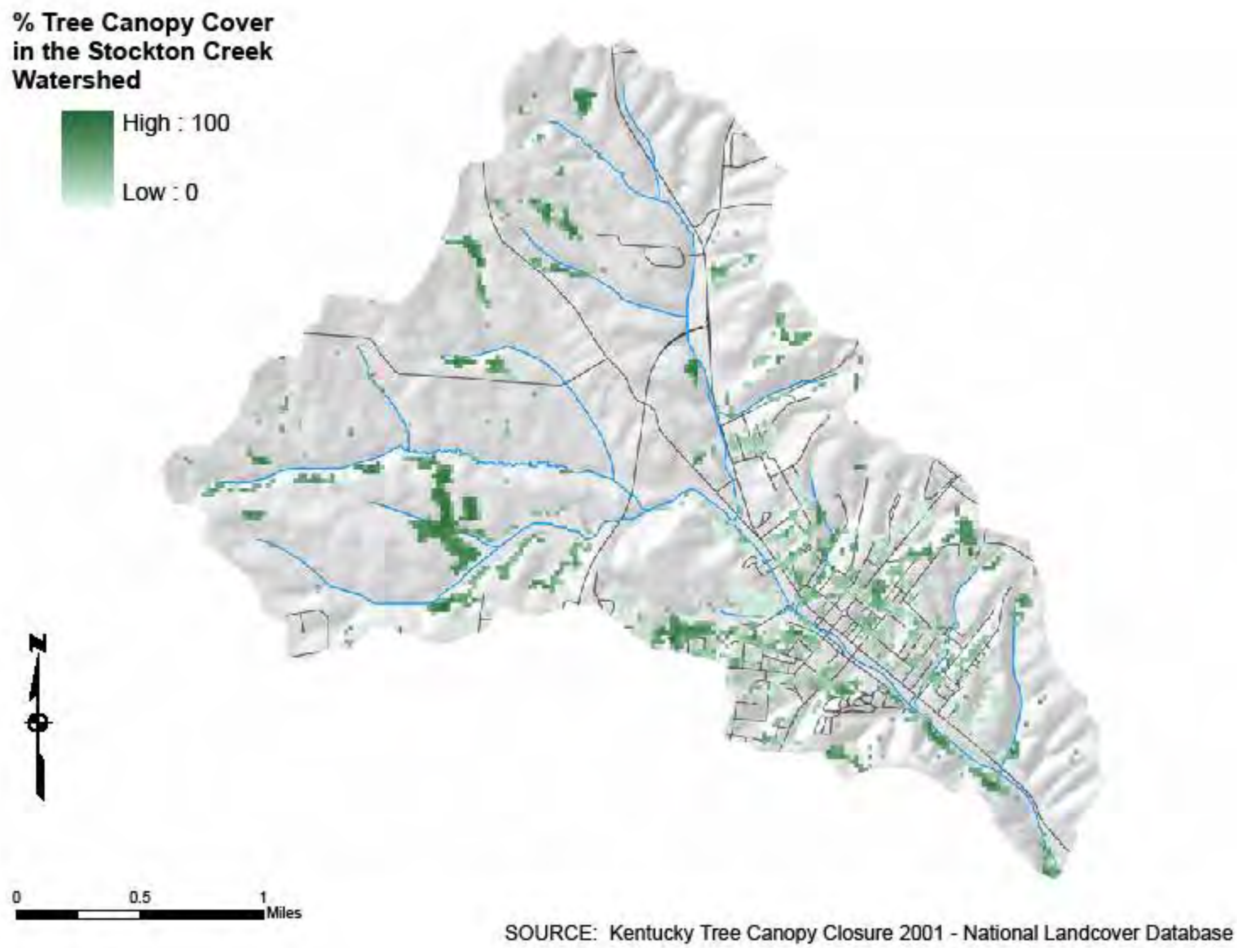

Figure 2.10 Tree Canopy Cover in the Stockton Creek (Town Branch) watershed (Redwing Ecological Services, 2009 from the National Landcover Database, 2001).

Fauna

The Kentucky State Nature Preserves Commission tracks sightings of endangered, threatened, or special fauna (animals) in Kentucky. Data specific to Stockton Creek are not available, but the species in table 2.3 below have been identified in the Fleming Creek watershed.

Table 2.3 Threatened or endangered species in the Fleming Creek Watershed (KSNPC, 2009).

Common Name	Scientific Name	Conservation Status
Sixbanded Longhorn Beetle	*Dryobius sexnotatus*	Threatened
Eastern Hellbender Salamander	*Cryptobranchus allenganiensis alleganiensis*	Threatened
Sharp-shinned Hawk	*Accipiter striatus*	Threatened

A healthy riparian area and a diversity of fauna in the watershed can be good indicators of overall stream rigor and good water quality.

2.1.3 Human Activities Affecting Water Resource Quality

Point Sources

Point source pollution is the pollution that has a known source, or discharge point. Examples of point sources could include industrial and wastewater treatment plants that discharge directly into a stream. In Kentucky, most point sources are required to have a permit through the Kentucky Pollutant Discharge Elimination System or KPDES. According to the EPA's Envirofacts website, there are four entities that have KPDES permits in the Stockton Creek Watershed (see Appendix C). See Figure 2.11 for the locations of KPDES permits in the watershed.

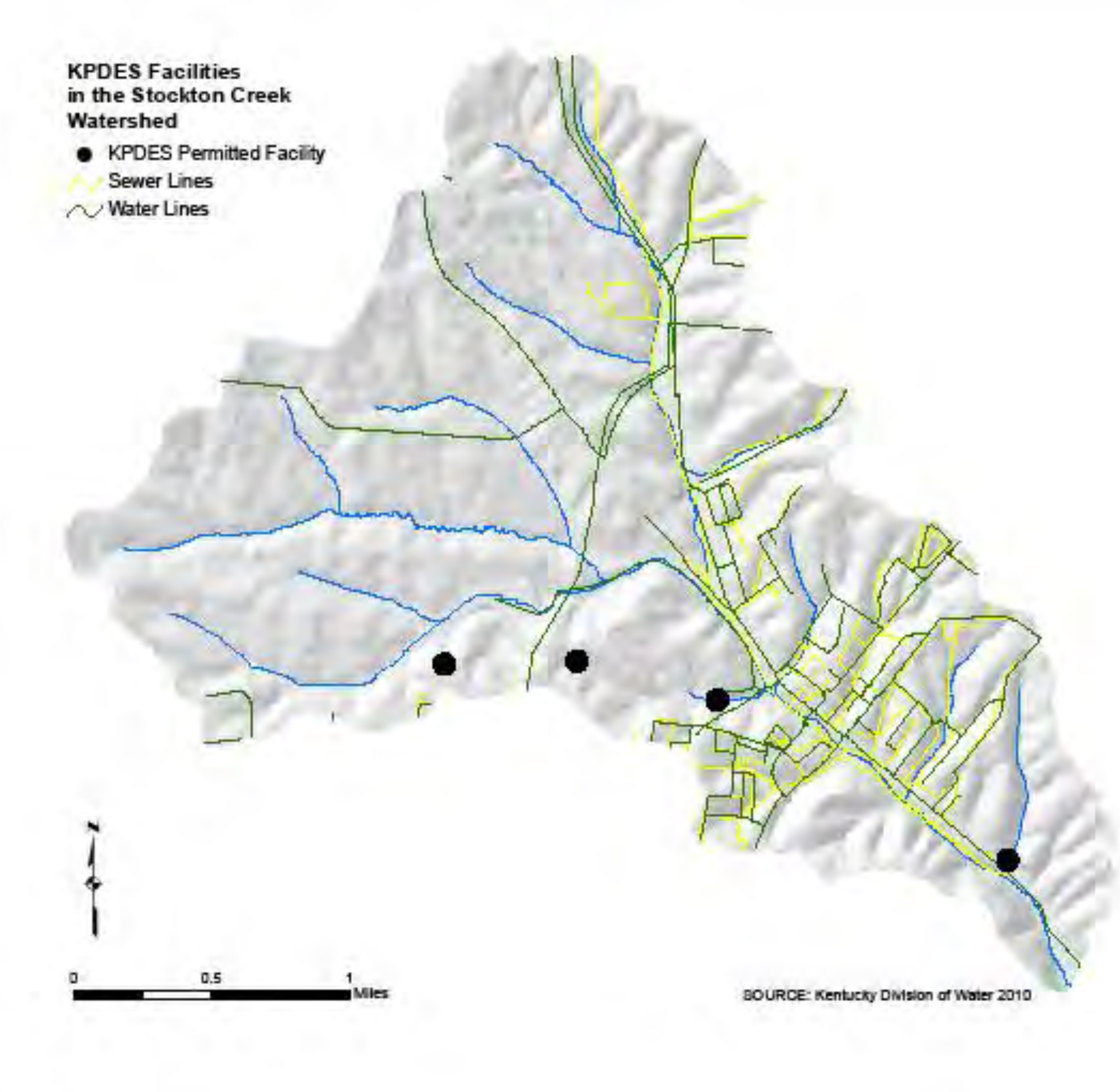

Figure 2.11: KPDES permit holder locations in Stockton Creek Watershed (KDOW, 2010).

Regulations and programs for wetlands and in-stream construction or disturbance
Section 404 of the Clean Water Act regulates the discharges of dredged or fill materials into the waters of the United States, including small stream and wetlands adjacent or connected to regulated waters. Activities that result in physical disturbances to wetlands or streams are regulated by the US Army Corps of Engineers under Clean Water Act section 404 and require a Clean Water Act section 401 Water Quality Certification issued by KDOW. There are no special ordinances or regulations protecting wetlands or streams from in-stream disturbance in the Stockton Creek watershed. A Freedom of Information Act request to the U.S. Army Corps of Engineers by Kentucky Waterways Alliance staff for all 404 permits issued in Fleming County from 2000 to February 2009 show that there were no 404 permits issued in the Stockton Creek watershed area during that time period (Edelen personal communication, 2009).

Stormwater runoff is precipitation (usually rain) that gathers from various hard surfaces such as buildings and parking lots, schools, and neighborhoods, and then becomes concentrated as it flows toward the creek. In this way, it can serve as a source of pollution. If it is discharged through a stormwater channel or pipe it is a point source pollutant. If it is not concentrated and runs overland, it would be a nonpoint source pollutant. Both sources increase runoff volume and lead to erosion and sedimentation problems as well as the collection and transportation of pollutants.

Nonpoint Sources and Land Use
The health of surface and groundwater resources is significantly influenced by runoff from land uses in the surrounding watershed, known as nonpoint sources of pollution. Aspects considered when exploring the potential for nonpoint source pollution include land uses, impervious surfaces, livestock access to creek, and unsewered areas.

Farming activities cover about sixty five percent (65.4%) of Stockton Creek's watershed, with fifty five percent (55%) in pasture or hay production and more than ten percent (10.4%) in cultivated crops. Woodlots occupy more than twenty percent (20.9%), which are generally dispersed throughout the watershed. Some type of development occurs on more than eight percent (8%) of the watershed. There is no high intensity development. Medium intensity development occurs next to segments of roadways, predominantly in and on the upstream side of Flemingsburg (see Table 2.4 and Figure 2.12 below).

Table 2.4 Land Cover in the Stockton Creek Watershed (National Land Cover Database, through Redwing Ecological Services Data published 2001 using 2000 survey).

Land cover Category	Land cover Type	Percent Cover	Total acres (3780)
Agriculture	Pasture/Hay	55.8	2,500 ac
	Cultivated Crops	10.4	
Woodlots	Mixed Forest	9.2	790 ac
	Deciduous Forest	7.9	
	Evergreen Forest	3.8	
Developed	Developed: Open Space	4.5	313 ac
	Developed: Medium Intensity	2.4	
	Developed: Low Intensity	1.4	
Urban/Recreational Grasses		3.4	128 ac
Open Water		1.3	49 ac

Impervious Surfaces

Each type of land use can create nonpoint source pollution. Developed areas cover less acreage in the watershed, yet are of special concern because they create impervious surfaces. These impervious surfaces, including paved areas, rooftops, and even hard-packed ground, diminish water quality conditions and stream health. These surfaces carry water faster, with more force, picking up pollutants as they go and causing problems related to sediment transport and generation. Increases in impervious surfaces correspond with increases in temperature. In large urban areas, this is referred to as a “heat island,” but the effects are felt any where there are large areas of impervious surfaces. Impervious surfaces occur in Stockton Creek watershed along major roadways and throughout Flemingsburg proper (see Figure 2.13).

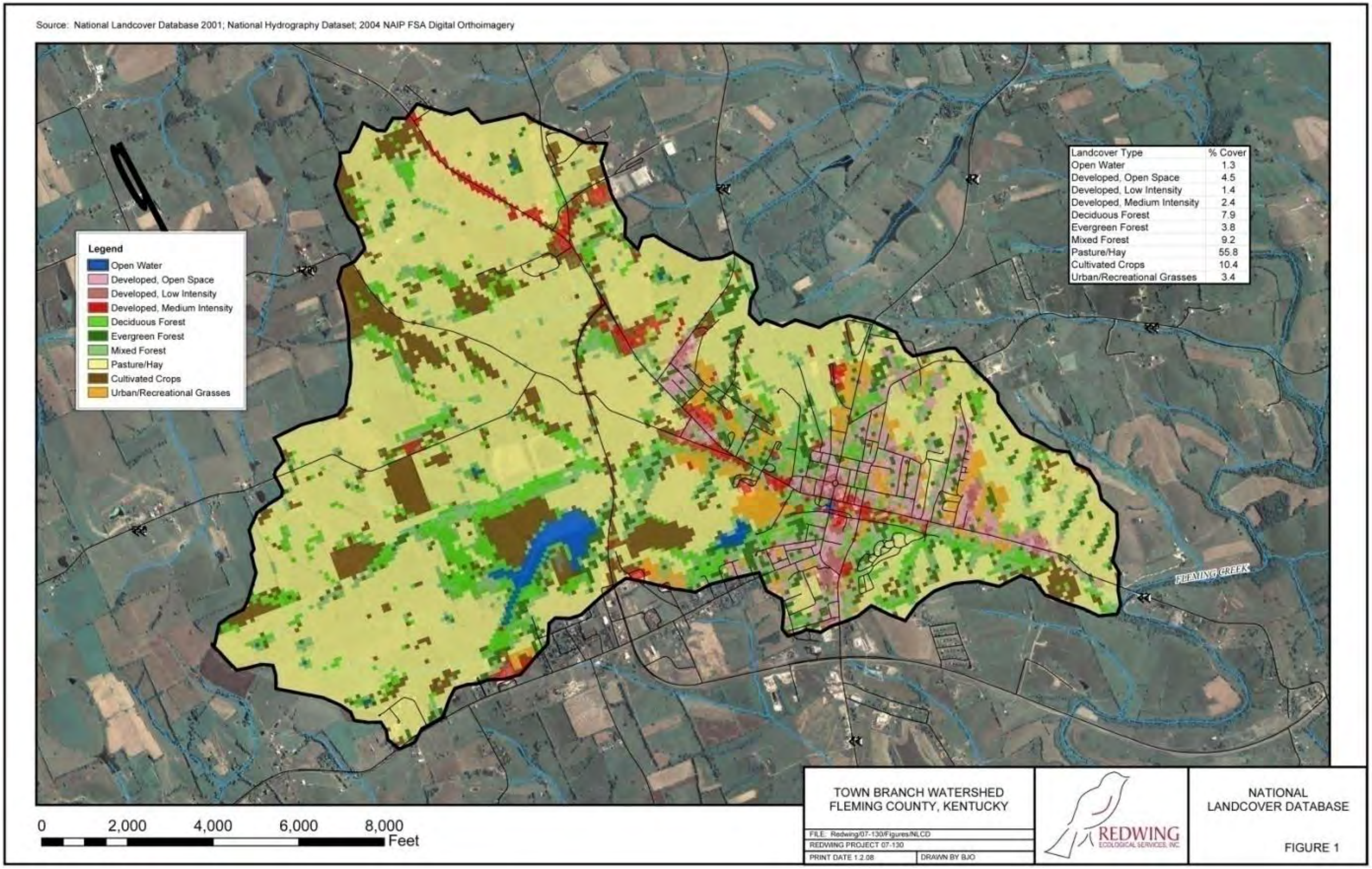

Figure 2.12 Land Use in Stockton Creek (Town Branch) Watershed (Redwing Ecological Services, 2008).

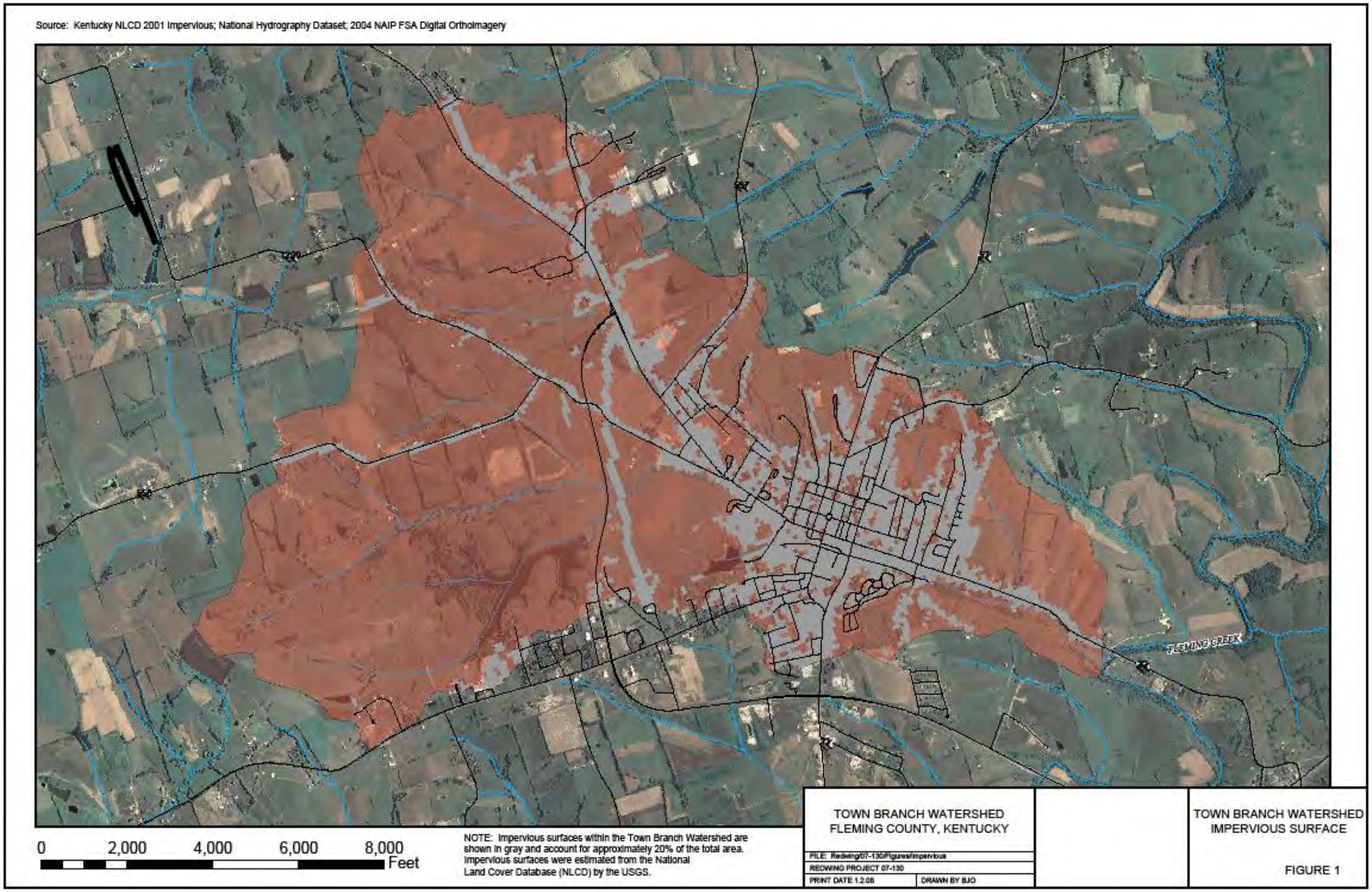

Figure 2.13 Impervious Surfaces of Stockton Creek (Town Branch) Watershed (Redwing Ecological Services, 2008).

Nonpoint source pollution is influenced by local management of land uses. In the Stockton Creek watershed, zoning occurs in the lower portion of the watershed, roughly estimated to include less than 25 percent of the watershed acreage. The zoned area is occupied by moderate and low-density residential zones, with a central business district flanking the main street and the Stockton Creek mainstem. Areas zoned public/institutional/recreational include publicly held properties such as schools, parks, cemeteries, and the reservoir. Several commercial areas and mobile home parks are located in or at the edges of the watershed.

Development planning is not particularly relevant to this watershed plan, since large scale growth is not expected. There is commercial growth and retrofit potential, however, and codes and ordinances might be reconsidered for compatibility with watershed planning.

Unsewered Areas
According to the Fleming County Health Department, there have been no reports of failing septic systems in the Stockton Creek watershed. The condition and potential releases from unsewered areas are unknown. The city of Flemingsburg is the only part of Fleming County that is served by sewer lines.

2.1.4 Demographics and Social Issues
Flemingsburg's 2007 census population was projected to be 2,673, in a county of 14,820 (Applied Geographic Solutions, 2008). Most of the town's population is in the Stockton Creek watershed, but areas of expected growth are outside the watershed. Flemingsburg's population is generally spread across age groupings, with somewhat lower population in age groups 65 and older. Median age is 38.1. Fleming County's personal incomes are generally lower than Kentucky's, overall, averaging $20,083 in 2006 compared to Kentucky's 2006 average of $29,729 (US Department of Economics, 2008).

The population in Flemingsburg has remained fairly constant or decreasing in recent years, while the population in the surrounding county has increased slightly (< 1%). Population and development growth is expected in the county, but not in the Stockton Creek watershed. However, the Stockton Creek watershed area does offer some redevelopment options.

2.2 Plan for collecting more data
The watershed planning process included monitoring to characterize baseline conditions, biological habitat, water quality characteristics (phosphorus, nitrogen, and suspended solids), and bacteria levels and load. The sampling plan is provided in Appendix B [the "Quality Assurance Project Plan (QAPP): Creating a Formula for Success in the Salt and Licking River Basins grant #04-12: Monitoring plan for the Town Branch Watershed Plan"].

2.3 Summary and conclusions

2.3.1 Problems of the watershed
The problems of the watershed, as determined by the existing data presented in this chapter, consist of riparian areas, septic line, and development issues. In the riparian zone, the

streambank is unvegetated and degraded for much of its length. This leads to high rates of erosion and unhealthy aquatic habitat. Cattle access to streams is contributing to the high bacteria levels. Development issues include problems with culverts, impervious surfaces and runoff, inflow and infiltration issues with waste water and sanitary water lines, and streambank channelization. Nonpoint source pollution from agricultural areas, septic tanks, construction, and area homes also plays a role in the excessive nutrient and bacteria loads.

2.3.2 Healthy streams and healthy areas of your watershed

The new reservoir is in good condition and provides great fish habitat and waterfowl hunting grounds. There are many areas of the watershed where cattle have been fenced out of the stream and where landowners are choosing to revegetate the stream bank.

2.3.4 Areas and streams with challenges

The portions of Stockton Creek that run through town are challenged. The state of many of the small tributaries is not fully understood. There are sampling sites that consistently report excessive levels of bacteria. These sites also represent a challenge to overall watershed health.

Works Cited

Anderson, Emily. 2008. Fleming County Conservation District. Personal communication.

Applied Geography Solutions. 2008. Retrieved in 2008 from: http://www.directionsmag.com/companies/Applied_Geographic_Solutions,Inc.(AGS)

Currens, J.C. 2002. Kentucky is Karst County! What You Should Know About Sinkholes and Springs. *Kentucky Geological Survey Information Circular 4: Series XXII.* Retrieved June 5, 2008, from http://kgsweb.uky.edu/olops/pub/kgs/ic04_12.pdf

Edelen, Tessa. 2009. Kentucky Waterways Alliance. Personal communication about materials obtained from the U.S. Army Corps of Engineers.

Fleming Creek Clean Water Action Plan. 2007. Fleming County Conservation District.

Flemingsburg Gazette. 1956. Historic photos retrieved with librarian assistance.

Kentucky Geonet 2009. United States Geological Survey, Hydrology of Kentucky. Retrieved from: http://kygeonet.ky.gov/kyhydro/viewer.htm

Kentucky State Nature Preserves Commission. 2009. Retrieved in 2009 from: http://www.naturepreserves.ky.gov/NR/rdonlyres/91E0A271-E42F-45E1-B8D8-741D45366EB2/0/countylist2009.pdf

Local Climatological Data (2006). Station of Record: Blue Grass Airport, Lexington, KY.

U.S. Department of commerce, Bureau of Economic analysis. 2008. Retrieved in 2008 from: http://www.bea.gov/newsreleases/regional/lapi/lapi_newsrelease.htm

USGS National Hydrography Dataset (2008). Retrieved from: http://nhd.usgs.gov/data.html

Stockton Creek – Chapter 3
Data Analysis

Prior to development of this watershed plan, water quality data for Stockton Creek were limited to the downstream portion of the watershed near the confluence with Fleming Creek. In order to more accurately assess the watershed in terms of water quality and potential pollutant sources, nine sampling sites were established throughout the watershed and sampled once per month from July through October 2008. In addition to the four monthly sampling events, two wet-weather sampling events were conducted in November 2008. During each of the water quality sampling events, in-stream measurements included: stream discharge (amount of water in the stream), temperature, pH, dissolved oxygen, and specific conductivity. Water samples were also collected for laboratory analyses including fecal coliform and *Escherichia coli* (*E. coli*) colony counts, total phosphorous (TP), total suspended solids (TSS), and Total Kjeldahl Nitrogen (TKN). A biological habitat assessment at each sample location was completed using the EPA's Rapid Bioassessment Protocol (RBP) visual-based habitat assessment methodology (Barbour et al. 1999).

This chapter presents the results of these sampling efforts and an assessment of the data to determine the types of impairments in Stockton Creek and their causes and sources within the watershed. The assessment is based on three analytical techniques: comparison of water quality data to state water quality criteria, use of stream assessment protocols, and pollutant load calculations. First, an introduction to Kentucky's water quality standards and regional water quality benchmarks is presented. Second, a description of the types of monitoring data collected for this plan is provided followed by the Stockton Creek monitoring results, including pollutant loading calculations. Next, data are examined in the context of each catchment area within the Stockton Creek Watershed. Pollutant loads and percent reductions required to meet water quality criteria or benchmarks are discussed for each catchment area. Finally, a summary of the present and future stressors within the Stockton Creek watershed is discussed.

Several issues regarding monitoring data collected for this project should be noted at the outset. Laboratory detection limits for Total Kjeldahl Nitrogen (TKN) concentrations in the collected samples were above the Bluegrass Bioregion benchmark and therefore samples with TKN concentrations below the laboratory detection limit were not included in the analysis. Due to laboratory equipment limitations and variability in distillation volumes, two of the Total Phosphorus (TP) samples had minimum detection limits above the Bluegrass Bioregion benchmark and therefore were not included in the analysis. Also, during three of the six monitoring events (July, August, and September), samples at station TB1 were collected from the outfall of the Fleming County Wastewater Treatment Plant rather than from the main channel of Stockton Creek. Therefore, the samples collected at the outfall were not included in the following analysis. Data with extraordinarily high or low values were flagged as outliers and not included in the analysis. By omitting these data, we are maintaining the integrity of the entire data set.

Water quality standards
The Clean Water Act requires states to establish water quality standards. The Kentucky Division of Water (KDOW) set forth standards for a number of pollutants and parameters that are used to indicate the presence of pollutants (Figure 3.1).

Parameter	Values
Dissolved Oxygen	≥ 5.0 mg/l Daily Average; ≥ 4.0 mg/l Instantaneous
pH	6.0 – 9.0 Standard Units
Temperature	≤ 89° F(31.7° C) Instantaneous; 84° F (28.9° C) 30-Day Summer Average (July-September)
Total Dissolved Solids	No adverse effects on indigenous aquatic community
Total Suspended Solids	No adverse effects on indigenous aquatic community
Settleable Solids	No adverse effects on indigenous aquatic community
Ammonia (Un-ionized)	< 0.05 mg/l after mixing
Fecal Coliform (Primary Contact Recreation)	≤ 200 CFU / 100 ml geometric mean based on a min. of 5 samples over 30 days, 5/1 – 10/31. ≥ 20% of samples shall not exceed 400 CFUs over 30 days.
Escherichia coli (Primary Contact Recreation)	≤ 130 CFU / 100 ml geometric mean based on a min. of 5 samples over 30 days, 5/1 – 10/31. ≥ 20% of samples shall not exceed 240 CFU / 100 ml over 30 days.
Fecal Coliform (Secondary Contact Recreation)	1000 CFU / 100 ml geometric mean based on a min. of 5 samples over 30 days, year-round. ≥ 20% of samples shall not exceed 2000 CFU / 100 ml over 30 days.

Figure 3.1 Numeric Criteria: Warmwater Aquatic Habitat, Primary/Secondary Contact Recreation (Kentucky State Water Quality Standards (401 KAR 10:031).

For some substances, however, KDOW has not yet set water quality standards. For these substances, like Total Phosphorus (TP) and Total Suspended Solids (TSS), this plan has used non-published mean parameter concentrations for reference reaches in the Bluegrass Bioregion to evaluate conditions in Stockton Creek (Figure 3.2). To create these parameters, KDOW collected data on some of the relatively undegraded, unimpaired streams in the Bluegrass Region.

pH	8.06 SU		Arsenic	0.002 mg/L
DO	9.06 mg/L		Barium	0.021 mg/L
Specific Conductance	457.6 µmhos		Cadmium	0.001 mg/L
Temperature	17.6^{o}C		Calcium	66.56 mg/L
Ammonia	0.044 mg/L		Chromium	0.001 mg/L
Nitrate+Nitrite	0.656 mg/L		Copper	0.001 mg/L
TKN	0.320 mg/L		Iron	0.535 mg/L
Total Phosphorus	0.132 mg/L		Lead	0.002 mg/L
Hardness	224.3 mg/L		Magnesium	13.19 mg/L
Alkalinity	194.8 mg/L		Manganese	0.115 mg/L
Acidity	4.71 mg/L		Mercury	0.00005 mg/L
TDS	290.2 mg/L		Nickel	0.016 mg/L
TSS	9.82 mg/L		Potassium	3.54 mg/L
Chloride	10.6 mg/L		Selenium	0.002 mg/L
Fluoride	0.227 mg/L		Silver	0.0046 mg/L
Sulfate	47.3 mg/L		Sodium	8.91 mg/L
TOC	3.04 mg/L		Zinc	0.023 mg/L

Aluminum	0.356 mg/L			

Figure 3.2 Mean Parameter Concentrations from Reference Reaches in the Bluegrass Bioregion.
Note: Aluminum through Zinc above based on only 8 samples per parameter.
(Kentucky Division of Water, 2010).

Monitoring Data

Monitoring data collected as part of this Stockton Creek Watershed Plan can be categorized into three types: habitat, physiochemical, and bacteriological.

Habitat Data

Biological stream habitat data examine the quality of in-stream and riparian habitat that directly influences the biological integrity of the stream. These data reflect the structure and function of aquatic communities, habitat, and health and abundance of aquatic species or fish populations. Redwing Ecological Services evaluated stream habitat within each catchment using the *Rapid Bioassessment Protocol (RBP)* developed by the Environmental Protection Agency (EPA). The RBP consists of ten parameters rated on a scale from 0 (lowest) to 20 (highest). Parameter scores are categorized as follows: Optimal (20-16), Suboptimal (15-11), Marginal (10-6) and Poor (5-0). The sum of the parameter scores indicates the overall habitat ranking. Habitat rankings for the Bluegrass Bioregion with a sum of parameter scores ≥ 156 are considered streams that are fully supporting their designated use; rankings between 142 and 155 are partially supporting; and rankings ≤ 141 are non-supporting.

Figure 3.3 below shows waterway characteristics (parameters) examined with the RBP, with maximum scores for each and minimal scores required to rate "suboptimal" for that parameter. *Epifaunal Substrate/Available Cover* refers to the relative quantity and variety of natural structures is the stream, such as various sizes of rocks, fallen trees, logs and branches, undercut banks, and available food sources to support favorable habitat for aquatic life. *Embeddedness* refers to amount of sediment between rocks in the stream bottom, as sediment deposition increases the diversity of aquatic life decreases. *Velocity/Depth Regime* refers to variation in flow, e.g. pools vs. riffles, increased diversity within the stream channel provides increased habitat for aquatic life. *Sediment Deposition* refers to the amount of sediment accumulating within the channel, e.g. sand bars. *Channel flow Status* refers to the extent of which the channel is full of water. *Channel Alteration* refers to amount of channelization. *Frequency of Riffles* refers to distance between riffles. *Bank Stability* refers to the condition of the stream bank and measures whether stream banks are eroded or have the potential for erosion. Steep banks, for example, are more likely to collapse and experience erosion (EPA, 2009). *Vegetative Protection* measures the amount of streamside and riparian vegetation. The roots of streamside plants help hold soil in place, and thus, reduce the amount of erosion that is likely to occur. *Riparian Vegetative Zone Width* refers to the width of the adjacent vegetated zone. For more information about the RBP, see the EPA's Wetlands, Oceans, and Watersheds website or materials.

	Epifuanal Substrate	Emb-edness	Velocity/Depth	Sedimnt Deposit	Channel Flow	Channel Alter	Frequen Riffle	Bank Stabilty		Veget-ative Protec		Ripa-rian width	
								LB	RB	LB	RB	LB	RB
Best possible score	20	20	20	20	20	20	20	10	10	10	10	10	10
Minimum score for suboptimal rating	11	11	11	11	11	11	11	6	6	6	6	6	6

Figure 3.3: Parameters for Rapid Bioassessment Protocols, with indications of scoring rates.

Physiochemical Data

A second type of monitoring data is physiochemical data. Data collected for this analysis included: conductivity, dissolved oxygen, pH (acidity), temperature, turbidity, total suspended solids, nutrients and discharge. These parameters are not necessarily pollutants, but are measurable indicators that can point to other problems.

Conductivity, or specific conductance, is a measure of how well water can conduct an electrical current. Conductivity increases with increasing amount and mobility of ions. These ions, which come from the breakdown of compounds, conduct electricity because they are negatively or positively charged when dissolved in water. Specific conductance is, thus, an indirect measure of the presence of dissolved solids such as chloride, nitrate, sulfate, phosphate, sodium, magnesium, calcium, and iron, and can be used as an indicator of water pollution.

Nutrients are chemicals that act as fertilizer to promote algae and other vegetative growth in waterbodies. High levels of nutrients can cause health problems in drinking water and can support algae growth that in turn causes problems, like low dissolved oxygen. Two nutrients of particular interest are phosphorus and nitrogen. Both are common components of fertilizers, wildlife, pet or livestock waste, and human sewage. Soil erosion is a major contributor of phosphorus and nitrogen to streams along with overgrazed pasture land, stream bank erosion, and wastewater treatment plant discharge. Nitrogen is of special concern due to health risks associated with drinking water and by-products of treating drinking water that contains high nitrogen. For this project, total Kjeldahl Nitrogen was used to assess nitrogen concentrations. Total Kjeldahl nitrogen is a measure of reduced forms of nitrogen such as ammonium and amino forms of organic nitrogen.

Discharge (sometimes called ‘flow’ or ‘in-stream flow’) is a fundamental property of streams that affects everything from water temperature to the concentration of various substances in the water. The amount of sediment and debris a stream can carry depends on its discharge, larger volumes of water can carry more sediment and pollutants without degrading water quality by way of dilution. Precipitation events that contribute to increased stream discharge may also wash higher amounts of particulate and dissolved materials from the watershed directly into the stream.

Discharge measurements reveal the correlation of stream dynamics with storm events and provide clues as to whether pollutants are from nonpoint or point sources. For example, if *E. coli* concentrations increase during rainfall events, the source is likely surface runoff, e.g. livestock or wildlife, and in some locations it could be due to exceedance of wastewater treatment capacities. However, if concentrations increase during low flows, the source is more likely point source such as "straight pipes" or other discharges.

Total Suspended Solids (TSS) are solids in water that can be trapped by a filter, such as silt, decaying plant and animal matter, industrial wastes, and sewage. High concentrations of suspended solids can cause many problems for stream health and aquatic life. The solids can block light from entering the stream and decrease rates of photosynthesis. TSS can also clog the gills of fish and create low visibility conditions for aquatic life. High TSS in a stream can mean higher concentrations of bacteria, nutrients, pesticides, and metals in the water.

Bacteriological Monitoring Data
The third type of monitoring data is bacteriological monitoring data, which most often measures the presence of bacteria (pathogens). Due to land use characterization and other characteristics of the watershed, bacteriological monitoring by Redwing was conducted for pathogens such as fecal coliform and *E. coli*.

Pathogens are commonly measured by monitoring *E. coli*, which is a type of bacteria found in the digestive tracts of humans and animals. Most strains of *E. coli* are harmless, but can act as an indicator of other, harmful pathogens found in untreated human or livestock waste. Such waste, released into water, can expose people to bacteria, viruses, and protozoa. These pathogens (disease-causing organisms) have a relatively short survival period upon entering surface water, so information about adjacent or upstream land uses and discharges provides key evidence to sources. Sources can include wildlife, livestock, pet, and human sources. Children, the elderly, and people with weakened immune systems are most likely to develop illnesses or infections after having contact with polluted water. High levels of *E. coli* and other pathogens from human and animal waste do not have an adverse effect on aquatic organisms.

Data Presentation
Figure 3.4 below presents the results of the 2008 bacteria sampling for Stockton Creek. Primary Contact Recreation Season (PCR) is May 1 through Oct 31, and during this time, fecal coliform counts shall not exceed 400 colonies per 100 ml in 20% or more of all samples taken during a 30 day period or 240 colonies per 100 ml for *E. coli.* During Secondary Contact Recreation Season (SCR) fecal coliform levels are not to exceed 2,000 colonies per 100 ml in 20% or more of all samples taken during a 30 day period. *E. coli* wet weather monitoring results were held to PCR water quality criteria, even though the samples were collected in November. Values in **bold** indicate exceedance of water quality standards. Bacteria concentrations typically exceeded water quality standards for fecal coliform and *E. coli* with few exceptions.

E. coli **RESULTS**	**2008**				Wet Weather Events	
	July	August	Sept	Oct	13-Nov	25-Nov
Station	EC/100mL	EC/100mL	EC/100mL	EC/100mL	EC/100mL	EC/100mL
1	60	20	**580**	**6000***	**6160***	**520***
2	**682**	170	**920**	**9600**	**3100**	**1760**
3	**5510**	**738**	**1200**	**440**	**1360**	**4560**
4	**10344**	**402**	**1100**	*0*	**3340**	**1500**
5	62	60	**400**	**11600**	**1240**	**1720**
6	**870**	**370**	240	**2400**	**3600**	**920**
7	**1560**	*0*	**2380**	**8800**	**2000**	**1380**
8	NA	**10344**	100	**6000**	**48380**	**720**
9	NA	**432**	**740**	**5200**	**1520**	**520**
FECAL COLIFORM RESULTS	**2008**					
Station	FC/100mL	FC/100mL	FC/100mL	FC/100mL	FC/100mL	FC/100mL
1	*0*	80	120	360	1240*	120*
2	**700**	300	**700**	**480**	740	1400

Figure 3.4: Bacteriological monitoring results 2008 (Redwing Ecological Services, 2009). *sample taken on the mainstem of Stockton Creek. Data presented in *italics* are considered outliers and not included in the overall assessment; Data present in **bold** exceed water quality criteria.

Note that the fecal coliform levels at Stations 1 and 2 are sometimes higher than the *E. coli* levels (Figure 3.4). When asked about this phenomenon, Redwing Ecological Services, in turn, asked the laboratory that processed the data samples. The laboratory in charge of these samples reported thusly:

> *It is not unusual to see E. coli counts higher than fecal coliform counts when there is a large amount of human waste being deposited into the stream. We have seen this on several occasions on the results from the Licking River and its tribs. Even though E. coli is a subset, it is possible for the E. coli present to be higher than the Klebsiella or other fecal coliforms. The majority of fecal coliforms are E. coli.* (Wright personal communication, 2010).

No other testing, such as microbial source testing, has been done to ascertain the source of the fecal coliform or *E. coli*. The assertion that large amounts of human waste are being deposited into the stream have not been specifically investigated or documented.

Figure 3.5 presents the results of the nutrient/physicochemical water quality monitoring conducted in 2008. Values flagged with an asterisk (*) indicate exceedance of numeric water quality criteria or bioregion benchmarks. Discharge values flagged with this symbol (‡) indicate low-flow stream conditions during the monitoring event which required estimates of velocity. Some parameters were not measured during all sampling events and are indicated in the table as “NA” meaning not available due to stream conditions. Cells in the table in *italics* indicate outliers, and therefore are considered suspect (they were not used in the watershed assessment).

		7.22.08	8.19.08	9.16.08	10.21.08	11.13.08	11.25.08
1	Discharge (cfs)	1.18	2.03	0.69	0.01‡	2.11	6.71
	TP (mg/L)	5.25*	9.6*	6.9*	3.65*	0.64*	0.26*
	TSS (mg/L)	2	10*	5	1	7	8
	TKN (mg/L)	8.57*	6.71*	5.45*	5.26*	1.71*	1.52*
	Temp (°F)	75.5	71.7	70.2	62.3	NA	46.7
	Sp. Cond (µS/cm)	793	800	1007	712	510	572
	DO (mg/L)	8.30	8.94	9.17	11.76	NA	14.69
	pH	8.34	8.47	8.29	7.71	7.20	7.85
2	Discharge (cfs)	0.23	0.18	0.69	0.01‡	2.47	3.18
	TP (mg/L)	0.11	<0.066	<0.066	<0.066	0.2*	0.1
	TSS (mg/L)	6	1	3	1	5	5
	TKN (mg/L)	6.26*	<2.00†	<1.74†	<2.00†	1.69*	2.13*
	Temp (°F)	81.9	77.1	71.1	61.2	NA	44.2
	Sp. Cond (µS/cm)	515	525	436	458	560	553
	DO (mg/L)	10.93	12.39	13.35	14.26	NA	15.87
	pH	8.99	9.19*	9.72*	8.53	7.70	8.27
3	Discharge (cfs)	0.29	0.12	0.96	0.01‡	1.41	2.47
	TP (mg/L)	0.11	<0.066	<0.066	<0.066	0.8*	0.1
	TSS (mg/L)	12*	<1	<1	3	74*	3
	TKN (mg/L)	6.65*	<1.79†	<1.98†	<1.07†	3.78*	<1.45†
	Temp (°F)	77.8	71.1	66.3	64.3	NA	44.2
	Sp. Cond (µS/cm)	591	570	526	411	460	509
	DO (mg/L)	11.58	11.70	11.82	14.97	NA	14.76
	pH	9.12*	9.26*	9.37*	8.74	7.90	7.94
4	Discharge (cfs)	0.56	0.16	0.73	0.01‡	0.71	2.83
	TP (mg/L)	<0.066	0.09	<0.066	<0.066	0.14*	0.12
	TSS (mg/L)	9	9	7	<1	<1	3
	TKN (mg/L)	5.29*	<1.57†	<1.82†	<2.00†	<1.44†	1.55*
	Temp (°F)	80.5	81.0	70.8	55.5	NA	43.7
	Sp. Cond (µS/cm)	468	190	365	408	530	520
	DO (mg/L)	11.62	15.15	10.24	13.06	NA	16.70
	pH	9.47*	9.54*	9.38*	8.21	7.70	7.83
5	Discharge (cfs)	0.05	0.03	0.01‡	0.01‡	1.06	0.35
	TP (mg/L)	<0.066	<0.066	2.45*	NA	<0.33†	0.11
	TSS (mg/L)	5	7	*1318*	NA	10*	36*
	TKN (mg/L)	5.06*	<1.44†	4.4*	NA	<1.35†	<1.52†
	Temp (°F)	78.7	84.0	81.4	65.4	NA	44.9
	Sp. Cond (µS/cm)	NA	401	425	360	540	370
	DO (mg/L)	5.75	6.57	8.85	10.31	NA	12.99
	pH	8.26	8.54	9.12*	8.50	7.90	7.56
6	Discharge (cfs)	0.12	0.04	0.02	0.01‡	0.35	1.06
	TP (mg/L)	0.09	0.14*	0.28*	<0.066	0.6*	0.32*
	TSS (mg/L)	5	4	40*	3	5	61*

		7.22.08	8.19.08	9.16.08	10.21.08	11.13.08	11.25.08
	TKN (mg/L)	2.83*	<1.12†	4.48*	<2.00†	1.61*	<1.65†
	Temp (°F)	83.6	84.3	72.9	64.9	NA	43.7
	Sp. Cond (µS/cm)	NA	NA	*22*	521	570	563
	DO (mg/L)	15.32	11.78	10.62	11.44	NA	14.70
	pH	9.56*	8.40	9.53*	8.19	7.60	7.61
7	Discharge (cfs)	0.01‡	0.01‡	0.01‡	0.01‡	0.01‡	0.01‡
	TP (mg/L)	0.22*	<0.066	0.59*	NA	0.6*	0.16*
	TSS (mg/L)	20*	8*	165*	NA	15*	32*
	TKN (mg/L)	8.23*	1.73*	27.1*	NA	2.91*	3.65*
	Temp (°F)	80.5	70.4	67.9	50.6	NA	40.0
	Sp. Cond (µS/cm)	*1*	615	776	411	850	510
	DO (mg/L)	4.41	3.77*	4.55	11.82	NA	15.19
	pH	7.67	8.60	8.66	8.13	7.60	7.09
8	Discharge (cfs)	0	0.01‡	0.01‡	0.01‡	0.01‡	0.01‡
	TP (mg/L)	<0.066	<0.066	0.17*	<0.066	<0.33†	0.15*
	TSS (mg/L)	10*	4	78*	17*	17*	10*
	TKN (mg/L)	3.64*	<1.37†	6.04*	3.19*	1.51*	<1.39†
	Temp (°F)	87.5	86.5	74.4	59.9	NA	44.4
	Sp. Cond (µS/cm)	NA	592	394	730	560	540
	DO (mg/L)	12.97	11.08	10.90	10.95	NA	13.44
	pH	9.01*	9.15*	9.54*	7.76	7.60	7.48
9	Discharge (cfs)	0	0.01‡	0.01‡	0.01‡	0.06	0.01‡
	TP (mg/L)	0.09	<0.066	0.09	<0.13	1.4*	0.19*
	TSS (mg/L)	15*	2	13*	3	48*	20*
	TKN (mg/L)	3.93*	<1.33†	3.54*	2.12*	3.3*	<1.39†
	Temp (°F)	81.6	73.3	66.2	54.8	NA	43.3
	Sp. Cond (µS/cm)	737	820	897	767	610	508
	DO (mg/L)	10.29	8.50	14.06	9.73	NA	12.83
	pH	8.83	9.01*	8.91	7.60	7.40	7.28

Figure 3.5: Nutrient/physicochemical water quality monitoring results 2008.

‡indicate estimated discharge because of low-flow conditions that did not register on the flow meter. *indicate exceedance of benchmarks or water quality standards. Cells in the table in *italics* represent data outliers which should not be included in the overall assessment.

† indicates detectable limit greater than water quality benchmark and therefore not used in overall assessment

Pollutant Loading

In order to effectively set goals for reducing pollutants, the Stockton Creek Watershed plan must be able to tie the amount of each pollutant of concern to the causes and to the amounts of those pollutants the stream can carry and still comply with water quality criteria. For example, data may show that *E. coli* levels in a stream must be reduced by 50% per day, and if the sole cause is proven to be cattle grazing adjacent to the stream, watershed team members can work with the landowner to take management measures that have been shown to reduce input by 50% on a daily basis. The amount of pollution is referred to as a "pollutant load." This watershed plan calculates daily and annual loading for pollutants of concern and determines the pollutant load reduction needed to meet state water quality criteria or benchmarks.

Pollutant loading can be calculated using monitoring data or literature values, or it can be calculated using models that incorporate land use information and therefore potential sources. For this project, loads were calculated. Only data collected specifically for this project were used in the pollutant load calculations and were only used when they were determined to be reliable. To calculate load, one first multiplies sample concentrations by discharge (flow), which provides the load at a specific time, an *instantaneous load*. This was directly adjusted to an annual load calculation using time factors, e.g. seconds/day etc. An annual load enables (1) comparison of the existing load to acceptable loads, (2) target alterations for achieving acceptable loads, and (3) projections of land use and discharge changes necessary to achieve load reductions. Projections are made using literature values for impacts of specific changes in land use and discharge practices.

The calculation of existing loads in Stockton Creek, using a limited amount of data, is somewhat rough. More data points would produce more specific, accurate loading information, relating concentrations to flow, and may reveal better insights into specific sources and their magnitude. But these methods are not feasible under the budget and timeframes of this project. Nonetheless, the load calculations, augmented by local knowledge and other existing data, provide enough information to effectively set reasonable priorities, action items, and benchmarks.

There are many ways to analyze data, and part of creating a watershed plan is deciding upon the details of the analysis. After some discussion, it was decided that in calculating loads, the arithmetic mean (the average) would be used instead of the geometric mean because the geometric mean tends to remove outliers from a dataset. This can be very important in maintaining the integrity of data in some instances. For this project, with the small data set, it was determined that the arithmetic mean was more appropriate.

Data Review per Catchment

The following data are presented based on local knowledge of the watershed. Local landmarks are used whenever possible, and information about other land uses is provided including sewer or septic systems. This information helps to connect the dots about potential sources of pollutants and water quality data. In Chapter 4, there are aerial photos of each catchment with corresponding BMP recommendations. These BMP recommendations are based on the pollutant load per catchment and local knowledge of the watershed.

It should be noted that in the calculation of pollutant loads presented in the figures below, some data were excluded based on discrepancies with reporting limits or other concerns. So, for example, the TSS for catchment TB1 shows no need for a reduction. This is good news, but this percentage is based on only three data points, so it does not necessarily represent a comprehensive view of water quality. Figures 3.7 – 3.10 show all of the pollutant loading data with the excluded data highlighted in blue. In the pollutant load charts shown in the catchment basins below, the percent reduction required per pollutant is shown in red.

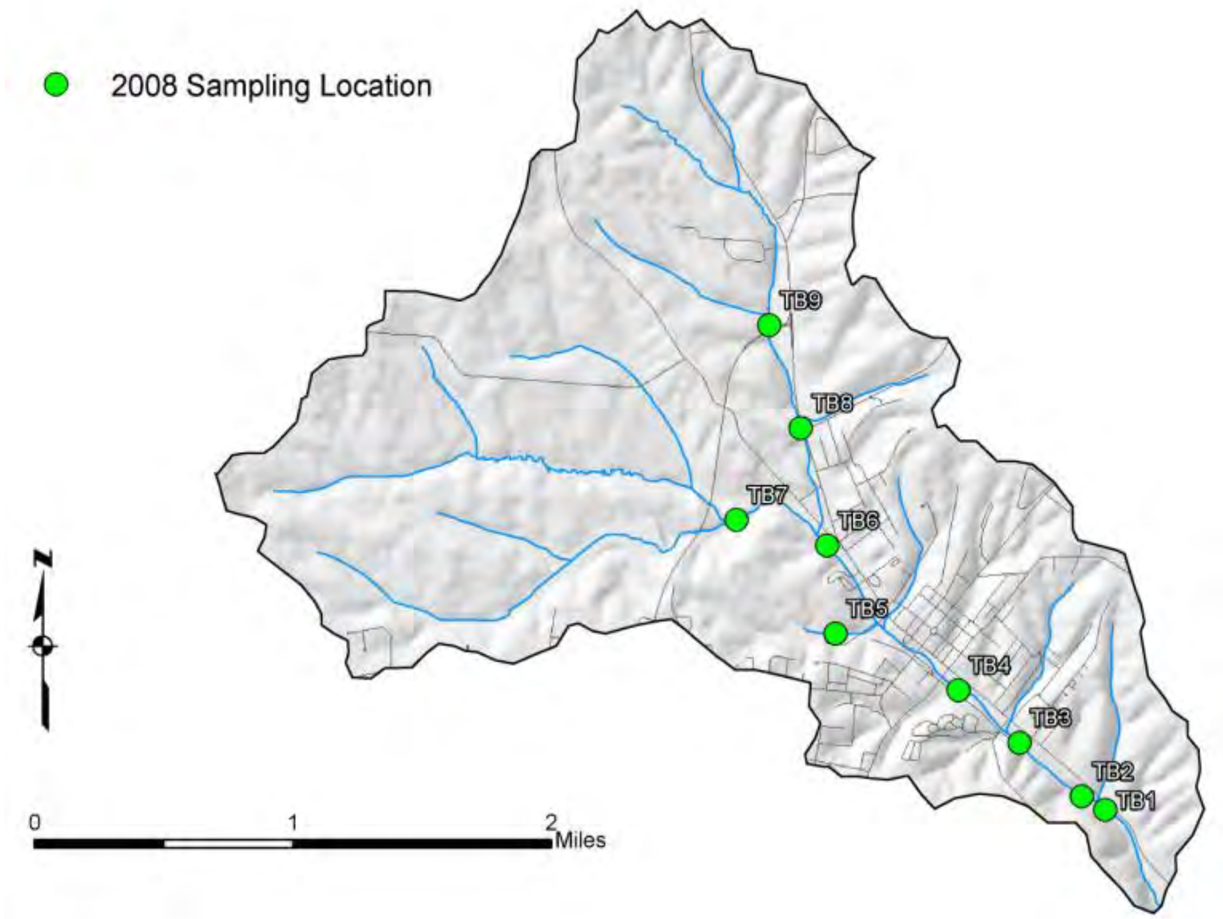

Figure 3.6: Stockton Creek Watershed sampling locations (Redwing Ecological Services, 2009)

TB 1

TB 1 is the farthest downstream catchment, 76% of the land is used for agriculture and 15% is developed. Within this catchment is the Flemingsburg Waste Water Treatment Plant (WWTP), but the majority of the homes in this area have septic systems. The majority of the stream is accessible to livestock with very little riparian habitat. The stream bank vegetation is almost completely comprised of tall fescue. The Habitat Score was 88, non-supporting. This sampling site exceeded the standards for *E. coli*, total phosphorus, and TKN on all accepted sampling dates. Three of the six samples (October, November 13, and November 25) were accepted for this site as the other samples were collected from the WWTP outfall.

TSS

TB1	Annual Load (lbs/year)	30940.79
	Target Load (lbs/year)	56969.72
	% Reduction	0.00

TKN

TB1	Annual Load (lbs/year)	16417.95
	Target Load (lbs/year)	1856.45
	% Reduction	88.69

E. coli

Site		
TB1	Annual Load (cfu/year)	1.31697E+14
	Target Load (cfu/year)	9.46E+12
	% Reduction Needed	92.81

Total Phosphorus

TB1	Annual Load (lbs/year)	3911.51
	Target Load (lbs/year)	1147.38
	% Reduction Needed	70.67

TB2

The TB2 catchment begins just above Rucker Street and ends just above the WWTP. Agriculture accounts for 67% of the land use, and 27% of the land is developed within this catchment. All of the homes and businesses in this area are connected to city sewer. The west side of the main channel of Stockton Creek in this area is completely agriculture, while the east side is completely residential. Cattle have access to the stream for the majority of this segment. *E. coli* and fecal coliform data collected for this site did not meet water quality standards, and the pH was out of the acceptable range during July, August, and September. The Habitat Score for this site was 94, non-supporting. Water quality concerns that need to be addressed are *E. coli*, TKN, and pH.

TSS

TB2	Annual Load (lbs/year)	7763.63
	Target Load (lbs/year)	21782.54
	% Reduction	0.00

TKN

TB2	Annual Load (lbs/year)	7453.09
	Target Load (lbs/year)	709.82
	% Reduction	90.48

E. coli

TB2	Annual Load (cfu/year)	2.73023E+13
	Target Load (cfu/year)	2.42E+12
	% Reduction Needed	91.13

Total Phosphorus

TB2	Annual Load (lbs/year)	224.78
	Target Load (lbs/year)	292.80
	% Reduction Needed	0.00

TB3

TB 3 catchment contains more developed land at 52% and agricultural land is at only 34%. This catchment is completely served by city sewer. The Habitat Score for this site is 131, non-supporting. The Fleming County Cemetery is located in this catchment, but the majority of this catchment is residential and adjacent to an unnamed tributary, with the business district adjacent to the mainstem of Stockton Creek. The majority of agriculture land in this catchment is hayland and the total head of cattle is relatively small. *E. coli*, pH, Total Phosphorus, TKN, and Total Suspended Solid samples collected for site all exceeded water quality standards.

TSS

TB3	Annual Load (lbs/year)	27040.37
	Target Load (lbs/year)	16949.14
	% Reduction	37.32

TKN

TB3	Annual Load (lbs/year)	9000.99
	Target Load (lbs/year)	552.31
	% Reduction	93.86

E. coli

TB3	Annual Load (cfu/year)	1.80868E+13
	Target Load (cfu/year)	1.89E+12
	% Reduction Needed	89.57

Total Phosphorus

TB3	Annual Load (lbs/year)	347.50
	Target Load (lbs/year)	227.83
	% Reduction Needed	34.44

TB4

The TB4 catchment contains the majority of downtown Flemingsburg, beginning at Dave's Chevron and extending to just below Flemingsburg Christian Church. This catchment is completely served by city sewer and is 55% developed. The stream corridor is almost completely developed, the habitat score for this reach is 131 and therefore non-supporting. Collected water quality data indicate there are pH, TKN, and *E. coli* problems. This catchment has experienced flooding issues and may have storm water issues.

TSS

TB4	Annual Load (lbs/year)	8203.33
	Target Load (lbs/year)	16111.35
	% Reduction	0

TKN

TB4	Annual Load (lbs/year)	5611.08
	Target Load (lbs/year)	525.01
	% Reduction	90.64

E. coli

TB4	Annual Load (cfu/year)	2.97+13
	Target Load (cfu/year)	2.14E+12
	% Reduction Needed	92.81

Total Phosphorus

TB4	Annual Load (lbs/year)	149.85
	Target Load (lbs/year)	216.57
	% Reduction Needed	0.00

TB5

TB5 catchment contains the old reservoir and Lakeview subdivision, 53% of the land is used for pasture / hayland and 22% is used for residential dwellings. This catchment exceeds water quality standards for *E. coli*, Total Phosphorus, TKN, and Total Suspended Solids. This catchment is not a typical stream, but more of a vegetated swale. The habitat score for this reach was 106, non-supporting.

TSS

TB5	Annual Load (lbs/year)	10633.98
	Target Load (lbs/year)	7201.77
	% Reduction	32.28

TKN

TB5	Annual Load (lbs/year)	3468.88
	Target Load (lbs/year)	234.68
	% Reduction	93.23

E. coli

TB5	Annual Load (cfu/year)	5.61239E+12
	Target Load (cfu/year)	5.36E+11
	% Reduction Needed	90.45

Total Phosphorus

TB5	Annual Load (lbs/year)	145.75
	Target Load (lbs/year)	28.59
	% Reduction Needed	80.39

TB6

The TB6 catchment contains several businesses, including Farmers Stockyards, Southern States Coop, and several maintenance garages and old gas stations. The Town Motel, which was a designated brownfield, was also located in this catchment. It was demolished in November, 2009. This area is completely served by municipal sewer, but only 26% of the land is developed. Sixty-six percent of the land is used for agricultural purposes. Water quality data for this catchment show a need for reduction in *E. coli*, Total Suspended Solids, TKN, and Total Phosphorus. The pH for this catchment is also out the acceptable range. The Total Habitat Score for TB6 is 120, non-supporting.

TSS

TB6	Annual Load (lbs/year)	10325.26
	Target Load (lbs/year)	5155.63
	% Reduction	50.07

TKN

TB6	Annual Load (lbs/year)	1561.04
	Target Load (lbs/year)	168.00
	% Reduction	89.24

E. coli

TB6	Annual Load (cfu/year)	3.37592E+12
	Target Load (cfu/year)	5.79E+11
	% Reduction Needed	82.86

Total Phosphorus

TB6	Annual Load (lbs/year)	130.90
	Target Load (lbs/year)	69.30
	% Reduction Needed	47.06

TB7

Catchment TB 7 has only 5% developed land, the majority of the land is used for agricultural purposes, mainly pasture for grazing cattle. Cattle have access to approximately 90% of the waterways in this catchment. The Total Habitat Score was 125, non-supporting. Municipal sewer serves only approximately 10% of this catchment. The new reservoir and high school are located here as well as a junkyard and a few illegal dumps. Water quality concerns that need to be addressed are *E. coli*, TKN, pH, Total Phosphorus, and Total Suspended Solids.

TSS

TB7	Annual Load (lbs/year)	945.02
	Target Load (lbs/year)	193.34
	% Reduction	79.54

TKN

TB7	Annual Load (lbs/year)	171.76
	Target Load (lbs/year)	6.30
	% Reduction	96.33

E. coli

TB7	Annual Load (cfu/year)	2.39946E+11
	Target Load (cfu/year)	2.14E+10
	% Reduction Needed	91.07

Total Phosphorus

TB7	Annual Load (lbs/year)	6.44
	Target Load (lbs/year)	2.60
	% Reduction Needed	59.66

TB8

The TB8 catchment contains 21% developed land. The developed land is adjacent to the mainstem of Stockton and is comprised mainly of used car lots, junk yards, maintenance garages, and manufactured housing sale lots and is fully served by municipal sewer. This section of stream has been completely channelized and acts more like a vegetated swale than an actual stream. Agricultural land comprises 72% of the land in this catchment and is mainly utilized as hayland with limited pasture land. The Total Habitat Score was 111, non-supporting. Water quality concerns that need to be addressed are *E. coli*, TKN, pH, and Total Suspended Solids.

TSS

TB8	Annual Load (lbs/year)	413.45
	Target Load (lbs/year)	161.11
	% Reduction	61.03

TKN

TB8	Annual Load (lbs/year)	58.74
	Target Load (lbs/year)	5.25
	% Reduction	91.06

E. coli

TB8	Annual Load (cfu/year)	1.17075E+12
	Target Load (cfu/year)	2.14E+10
	% Reduction Needed	98.17

Total Phosphorus

TB8	Annual Load (lbs/year)	1.85
	Target Load (lbs/year)	2.17
	% Reduction Needed	0.00

TB9

TB9 catchment contains the headwaters of Town Branch; located here is the local golf course, a few small subdivisions, small industrial park, and local feed store. The remaining land (83%) is utilized mainly for pasture and hayland. Only about 20% of this catchment is served by municipal sewer. Cattle have unlimited access to the majority of the stream. Catchment TB9 shows need for reductions in *E. coli*, Total Phosphorus, TKN, and Total Suspended Solids. The Total Habitat Score is 105, non-supporting.

TSS

TB9	Annual Load (lbs/year)	564.39
	Target Load (lbs/year)	322.23
	% Reduction	42.91

TKN

TB9	Annual Load (lbs/year)	98.00
	Target Load (lbs/year)	10.50
	% Reduction	89.29

E. coli

TB9	Annual Load (cfu/year)	3.0051E+11
	Target Load (cfu/year)	4.29E+10
	% Reduction Needed	85.73

Total Phosphorus

TB9	Annual Load (lbs/year)	10.75
	Target Load (lbs/year)	4.33
	% Reduction Needed	59.72

It is important to note that several of the catchments had elevated levels of pH. Elevated pH throughout the watershed during the 2008 monitoring period is likely a result of the extent and severity of the nutrient impairment. Increased nutrients, particularly nitrogen and phosphorus, contribute to excessive algae growth. Increased rates of photosynthesis can increase creek pH. Lime, which may be applied to lawns, crops, or golf courses, can also contribute to higher pH levels in the creek if it is washed into the creek during rain events or during landscaping activities. The causes of both pathogen and nutrient impairments also contribute to pH and other physicochemical water changes in Stockton Creek.

TSS

Site		7.22.08	8.19.08	9.16.08	10.21.08	11.13.08	11.25.08
TB1	Discharge (cfs)	1.18	2.03	0.69	0.01	2.12	6.71
	TSS (mg/L)	2	10	5	1	7	8
	Daily Load (lbs/day)	12.73	109.50	18.61	0.05	80.05	289.55
TB2	Discharge (cfs)	0.23	0.18	0.69	0.01	2.47	3.18
	TSS (mg/L)	6	1	3	1	5	5
	Daily Load (lbs/day)	7.44372	0.97092	11.16558	0.05394	66.6159	85.7646
TB3	Discharge (cfs)	0.29	0.12	0.96	0.01	1.41	2.47
	TSS (mg/L)	12	<1	<1	3	74	3
	Daily Load (lbs/day)	18.77112	0.64728	5.17824	0.16182	562.80996	39.96954
TB4	Discharge (cfs)	0.56	0.16	0.73	0.01	0.71	2.83
	TSS (mg/L)	9	9	7	<1	<1	3
	Daily Load (lbs/day)	27.18576	7.76736	27.56334	0.05394	3.82974	45.79506
TB5	Discharge (cfs)	0.05	0.03	0.01	0.01	1.06	0.35
	TSS (mg/L)	5	7	X	NA	10	36
	Daily Load (lbs/day)	1.3485	1.13274	X	X	57.1764	67.9644
TB6	Discharge (cfs)	0.12	0.04	0.02	0.01	0.35	1.06
	TSS (mg/L)	5	4	40	3	5	61
	Daily Load (lbs/day)	3.2364	0.86304	4.3152	0.16182	9.4395	348.77604
TB7	Discharge (cfs)	0.01	0.01	0.01	0.01	0.01	0.01
	TSS (mg/L)	20	8	165	NA	15	32
	Daily Load (lbs/day)	1.0788	0.43152	8.9001	X	0.8091	1.72608
TB8	Discharge (cfs)	0	0.01	0.01	0.01	0.01	0.01
	TSS (mg/L)	10	4	78	17	17	10
	Daily Load (lbs/day)	0	0.21576	4.20732	0.91698	0.91698	0.5394
TB9	Discharge (cfs)	0	0.01	0.01	0.01	0.06	0.01
	TSS (mg/L)	15	2	13	3	48	20
	Daily Load (lbs/day)	0	0.10788	0.70122	0.16182	15.53472	1.0788

Figure 3.7 All sites data for Total Suspended Solids (Redwing Ecological Services, 2009).
Highlighted cells represent data that were not used due to QAQC issues.
Notes: Blue values indicate estimate Q because of low flow conditions that did not register on the flow meter. Red indicates exceedance of average values or WQ Standards.

TKN

Site		7.22.08	8.19.08	9.16.08	10.21.08	11.13.08	11.25.08
TB1	Discharge (cfs)	1.18	2.03	0.69	0.01	2.12	6.71
	TKN (mg/L)	8.57	6.71	5.45	5.26	1.71	1.52
	Daily Load (lbs/day)	54.55	73.47	20.28	0.28	19.55	55.01
TB2	Discharge (cfs)	0.23	0.18	0.69	0.01	2.47	3.18
	TKN (mg/L)	6.26	2	1.74	2	1.69	2.13
	Daily Load (lbs/day)	7.7662812	1.94184	6.4760364	0.10788	22.5161742	36.5357196
TB3	Discharge (cfs)	0.29	0.12	0.96	0.01	1.41	2.47
	TKN (mg/L)	6.65	1.79	1.98	1.07	3.78	1.45
	Daily Load (lbs/day)	10.402329	1.1586312	10.2529152	0.0577158	28.7489412	19.318611
TB4	Discharge (cfs)	0.56	0.16	0.73	0.01	0.71	2.83
	TKN (mg/L)	5.29	1.57	1.82	2	1.44	1.55
	Daily Load (lbs/day)	15.979186	1.3549728	7.1664684	0.10788	5.5148256	23.660781
TB5	Discharge (cfs)	0.05	0.03	0.01	0.01	1.06	0.35
	TKN (mg/L)	5.06	1.44	4.4	NA	1.35	1.52
	Daily Load (lbs/day)	1.364682	0.2330208	0.237336	X	7.718814	2.869608
TB6	Discharge (cfs)	0.12	0.04	0.02	0.01	0.35	1.06
	TKN (mg/L)	2.83	1.12	4.48	2	1.61	1.65
	Daily Load (lbs/day)	1.8318024	0.2416512	0.4833024	0.10788	3.039519	9.434106
TB7	Discharge (cfs)	0.01	0.01	0.01	0.01	0.01	0.01
	TKN (mg/L)	8.23	1.73	27.1	NA	2.91	3.65
	Daily Load (lbs/day)	0.4439262	0.0933162	1.461774	X	0.1569654	0.196881
TB8	Discharge (cfs)	0	0.01	0.01	0.01	0.01	0.01
	TKN (mg/L)	3.64	1.37	6.04	3.19	1.51	1.39
	Daily Load (lbs/day)	0	0.0738978	0.3257976	0.1720686	0.0814494	0.0749766
TB9	Discharge (cfs)	0	0.01	0.01	0.01	0.06	0.01
	TKN (mg/L)	3.93	1.33	3.54	2.12	3.3	1.39
	Daily Load (lbs/day)	0	0.071740	0.190948	0.114353	1.068012	0.074977

Figure 3.8 All sites data for TKN (Redwing Ecological Services, 2009). *Highlighted cells represent data that were not used due to QAQC issues. Notes: Blue values indicate estimate Q because of low flow conditions that did not register on the flow meter. Red indicates exceedance of average values or WQ Standards.*

Total Phosphorus

Site		7.22.08	8.19.08	9.16.08	10.21.08	11.13.08	11.25.08
TB1	Discharge (cfs)	1.18	2.03	0.69	0.01	2.12	6.71
	TP (mg/L)	5.25	9.6	6.9	3.65	0.64	0.26
	Daily Load (lbs/day)	33.42	105.12	25.68	0.20	7.32	9.41
TB2	Discharge (cfs)	0.23	0.18	0.69	0.01	2.47	3.18
	TP (mg/L)	0.11	<0.066	<0.066	<0.066	0.2	0.1
	Daily Load (lbs/day)	0.1364682	0.06408072	0.24564276	0.00356004	2.664636	1.715292
TB3	Discharge (cfs)	0.29	0.12	0.96	0.01	1.41	2.47
	TP (mg/L)	0.11	<0.066	<0.066	<0.066	0.8	0.1
	Daily Load (lbs/day)	0.1720686	0.04272048	0.34176384	0.00356004	6.084432	1.332318
TB4	Discharge (cfs)	0.56	0.16	0.73	0.01	0.71	2.83
	TP (mg/L)	<0.066	0.09	<0.066	<0.066	0.14	0.12
	Daily Load (lbs/day)	0.19936224	0.0776736	0.25988292	0.00356004	0.5361636	1.8318024
TB5	Discharge (cfs)	0.05	0.03	0.01	0.01	1.06	0.35
	TP (mg/L)	<0.066	<0.066	2.45	NA	X	0.11
	Daily Load (lbs/day)	0.0178002	0.01068012	0.132153	X	X	0.207669
TB6	Discharge (cfs)	0.12	0.04	0.02	0.01	0.35	1.06
	TP (mg/L)	0.09	0.14	0.28	<0.066	0.6	0.32
	Daily Load (lbs/day)	0.0582552	0.0302064	0.0302064	0.00356004	1.13274	1.8296448
TB7	Discharge (cfs)	0.01	0.01	0.01	0.01	0.01	0.01
	TP (mg/L)	0.22	<0.066	0.59	NA	0.6	0.16
	Daily Load (lbs/day)	0.0118668	0.00356004	0.0318246	X	0.032364	0.0086304
TB8	Discharge (cfs)	0	0.01	0.01	0.01	0.01	0.01
	TP (mg/L)	<0.066	<0.066	0.17	<0.066	X	0.15
	Daily Load (lbs/day)	0	0.00356004	0.0091698	0.00356004	X	0.008091
TB9	Discharge (cfs)	0	0.01	0.01	0.01	0.06	0.01
	TP (mg/L)	0.09	<0.066	0.09	<0.13	1.4	0.19
	Daily Load (lbs/day)	0	0.00356004	0.0048546	0.0070122	0.453096	0.0102486

Figure 3.9 All sites data for Total Phosphorus (Redwing Ecological Services, 2009). *Highlighted cells represent data that were not used due to QAQC issues. Notes: Blue values indicate estimate Q because of low flow conditions that did not register on the flow meter. Red indicates exceedance of average values or WQ Standards.*

E. coli

Site		7.22.08	8.19.08	9.16.08	10.21.08	11.13.08	11.25.08
TB1	Discharge (cfs)	1.18	2.03	0.69	0.01	2.12	6.71
	E. coli (cfu/100mL)	60	20	580	6000	6160	520
	Daily Load (cfu/day)	1.73E+09	9.91E+08	9.77E+09	1.46E+09	3.19E+11	8.52E+10
TB2	Discharge (cfs)	0.23	0.18	0.69	0.01	2.47	3.18
	E. coli (cfu/100mL)	682	170	920	9600	3100	1760
	Daily Load (cfu/day)	3.83E+09	7.47E+08	1.55E+10	2.34E+09	1.87E+11	1.37E+11
TB3	Discharge (cfs)	0.29	0.12	0.96	0.01	1.41	2.47
	E. coli (cfu/100mL)	5510	738	1200	440	1360	4560
	Daily Load (cfu/day)	3.90E+10	2.16E+09	2.81E+10	1.07E+08	4.68E+10	2.75E+11
TB4	Discharge (cfs)	0.56	0.16	0.73	0.01	0.71	2.83
	E. coli (cfu/100mL)	10344	402	1100	0	3340	1500
	Daily Load (cfu/day)	1.41E+11	1.57E+09	1.96E+10	0.00E+00	5.79E+10	1.04E+11
TB5	Discharge (cfs)	0.05	0.03	0.01	0.01	1.06	0.35
	E. coli (cfu/100mL)	62	60	400	11600	1240	1720
	Daily Load (cfu/day)	7.57E+07	4.39E+07	9.76E+07	2.83E+09	3.21E+10	1.47E+10
TB6	Discharge (cfs)	0.12	0.04	0.02	0.01	0.35	1.06
	E. coli (cfu/100mL)	870	370	240	2400	3600	920
	Daily Load (cfu/day)	2.55E+09	3.61E+08	1.17E+08	5.86E+08	3.08E+10	2.38E+10
TB7	Discharge (cfs)	0.01	0.01	0.01	0.01	0.01	0.01
	E. coli (cfu/100mL)	1560	0	2380	8800	2000	1380
	Daily Load (cfu/day)	3.81E+08	0.00E+00	5.81E+08	2.15E+09	4.88E+08	3.37E+08
TB8	Discharge (cfs)	0	0.01	0.01	0.01	0.01	0.01
	E. coli (cfu/100mL)	NA	10344	100	6000	48380	720
	Daily Load (cfu/day)	#VALUE!	2.52E+09	2.44E+07	1.46E+09	1.18E+10	1.76E+08
TB9	Discharge (cfs)	0	0.01	0.01	0.01	0.06	0.01
	E. coli (cfu/100mL)	NA	432	740	5200	1520	520
	Daily Load (cfu/day)	#VALUE!	1.05E+08	1.81E+08	1.27E+09	2.23E+09	1.27E+08

Figure 3.10 All sites data for *E. coli* (Redwing Ecological Services, 2009).

Notes: Blue values indicate estimate Q because of low flow conditions that did not register on the flow meter. Red indicates exceedance of average values or WQ Standards.

Present and Future Stressors in the Watershed

The Stockton Creek Watershed is a diverse and dynamic system with ever changing constraints placed upon the natural system. Flemingsburg is an old town built on top of and adjacent to the stream, and as the infrastructure ages, it causes unpredictable stains upon the system. Infrastructure in the community is continually being repaired, replaced, demolished, or left in failing conditions all causing adverse affects to the stream to different degrees. The downtown section of Flemingsburg has structures built over the stream in various degrees of structural soundness. As these buildings become increasingly unstable they pose substantial risks to the integrity of Stockton Creek. The municipal sewer system originally installed in the 1960's is in great need of line upgrades and repairs, a large percentage of the service lines that are in use are the original clay tile pipes and are in need of replacement. The Flemingsburg Water Treatment Plant is also located on the mainstem of Stockton Creek and is need of major upgrades to the system. Flemingsburg is a small community with little recent growth, and does not expect any major growth in the near future. However the planning and zoning ordinances have only been recently implemented and enforced. The planning and zoning for Flemingsburg and Fleming County will need to be revised and fully implemented and enforced to prevent additional water quality degradation in the Stockton Creek Watershed.

The town of Flemingsburg built completely around the Stockton Creek also increases stormwater runoff entering the stream causing flooding. This problem will only increase if measures are not implemented to limit the amount of impervious surfaces in the watershed. Currently a new Justice Center and adjacent parking lot are being constructed (in the floodplain) and are greatly increasing the amount of impervious surface in the watershed. Increasing the impervious surface and decreasing infiltration will only increase the flooding problems already experienced in the downtown area.

Agriculture, being the primary land use in the watershed will likely have the largest impact on stream health now as well as in the future. Agriculture as an industry is ever changing due to influences of nature, economics, and politics. When soybeans are high everybody plants beans, and when cattle are high everybody raises cattle. These trends greatly influence the amount and types of pollutants entering Stockton Creek. Educating the land users in the watershed about water quality, proper land use, and Best management Practices will be the key to addressing the issue of agriculture generated stressors in the watershed.

<u>Works Cited</u>

Commonwealth of Kentucky. 2009. Kentucky Administrative Regulations, Title 401, Chapter 10 Water Quality Standards, Section 031 Surface Water Standards. 401 KAR 10:031.

Kentucky Division of Water (KDOW). 2010. Mean Parameter Concentrations from Reference Reaches in the Bluegrass Bioregion. Data available upon request from Kentucky Division of Water, Nonpoint Source and Basin Team Section.

Wright, Rita. 2010. Personal communication. Morehead State University Water Testing Laboratory.

Stockton Creek Watershed Plan
Chapter 4 – Action Planning

The Stockton Creek Watershed Team and community members set preliminary goals for Stockton Creek during the first roundtable event. These goals are: (1) Decrease fecal coliform in Stockton Creek, (2) Educate the public about watershed issues, (3) Improve stream corridor to be clean and viable for wildlife, and (4) Control flooding.

Chapter 3 presented and analyzed data including pollutant loads. This chapter examines objectives, sites, indicators, Best Management Practices (BMPs), and Action Items for each BMP, based on needs analyzed in Chapter 3. *BMPs* are the land use practices, educational initiatives, and policies that will impact the watershed. *Action Items* are the steps needed to encourage, plan, install, maintain, and monitor the success of BMPs and water quality improvements. Once Action Items were selected, the Team fully developed and analyzed them to create an effective pathway to a better Stockton Creek.

It is important to remember that the ultimate goal of all the BMPs is to improve water quality in Stockton Creek. It is, therefore, necessary to make those connections between BMPs, action items, and water quality. Following the BMPs and Action Item lists are aerial photos of each of the watershed catchments. Ideally, this plan would include load reductions expected from each BMP, for each catchment. This step of planning will be part of the 2009 Stockton Creek Implementation Plan conducted by the Fleming County Conservation District.

After the discussion of the goals and associated BMPs, there are narrative summaries of each of the water quality issues facing Stockton Creek, beginning on page 56. Associated BMP and Action Items tables can be found in Appendix D.

4.1 Goal 1: Decrease Fecal Coliform in Stockton Creek

The *objective* for decreasing fecal coliform and *E. coli* in Stockton Creek is to have the creek meet state pathogen standards for both the primary and secondary recreation season – that is, year round. Indicators for this objective are the concentrations of fecal coliform and *E. coli* as measured instream.

BMPs

Chapters 2 and 3 discussed the land-uses of the watershed and pointed to possible sources of pathogens. The goal of decreasing pathogens in the creek requires a multi-fold approach. Healthy riparian areas and pastures help catch runoff polluted with pathogens while cleaning up septic tanks and limiting livestock access to the creek reduces the source.

BMPs to target both these areas will include:

- Sewer line inflow and infiltration (leakages that take in creek water or leak sewer water into the creek) investigation and repair
- Septic cleanout/maintenance programs and/or educational campaign

- Pasture renovation and management
- Fencing livestock out of stream and providing alternative watering systems
- Increased vegetation along stream throughout watershed

Action Items

- Work with health department and local government to establish septic and sewer education campaign
- Work with Waste Water Treatment Plant to continue sewer line testing to identify problem leaks or breaks
- Replace and/or enlarge 70% of existing water lines
- Monitor disconnected downspouts
- Partner with USDA, NRCS, and local conservation district to assist local agricultural producers in creating healthier pastures through rotational grazing and inner fencing techniques
- Help local producers install fencing along stream and alternative watering systems by connecting them potential cost share assistance and funding sources
- Start local campaign to re-vegetate and manage the streamside area by establishing native grasses, shrubs, and trees throughout the watershed

4.2 Goal 2: Educate the Public about Watershed Issues

The o*bjective* for educating the public is to have adequate public support for each aspect of the watershed plan and increased citizen and local leader understanding of the necessity for and methods of watershed protection. The goal of educating the public about watershed issues will be focused on the areas of general watershed concepts, riparian areas, the connection between sewer/septic maintenance and instream water quality, stormwater runoff, and healthy pastures.

Indicators of public support and understanding are difficult to measure. Participation in restoration and clean-up efforts is one way. Local government support for Action Items is another. Also, a yearly visual documentation of revegetative stream banks can be conducted.

BMPs

- Public education relating to septic tank operation and maintenance and proper sewer usage
- Develop working relationship with local Planning Commission
- Encourage pasture renovation and management including inner fencing, alternative watering systems, and keeping cattle out of stream
- Work with school kids to remove invasive plants and restore/re-vegetate riparian areas
- Facilitate media coverage about issues and efforts to restore watershed

Action Items

- Annual summer stream walk
- Annual fall community roundtable
- Work with local health department to create educational materials and conduct cooperative workshop with Kentucky Onsite Wastewater Association
- Team members attend Planning Commission meeting and provide input
- Host Farm Field Day that demonstrate proper installation and maintenance of BMPs
- Work with partners to initiate development of invasive plant removal and outdoor classroom program
- Erosion Prevention and Control workshop with area developers and city officials
- Develop relationship with local media staff to ensure understanding of watershed issues and implementation plans

4.3 Goal 3: Improve stream corridor to be free of trash and viable for wildlife

Team members have expressed their desire to have a clean creek, one free of trash and litter. An indicator for this goal is a simple visual assessment of the creek.
Since loss of habitat appears to be the limiting factor for healthy aquatic biology, the *objective* for this goal is to increase and improve habitat in locations identified by monitoring and team input. One way to rate habitat is to use the Rapid Biological Protocol (RBP) assessment system from the EPA. RBP scores were given to each sub-basin during the data collecting period. The scores were discussed and reported in chapter 3.

Because the majority of the watershed is agricultural, habitat improvement will consist mainly of increasing the riparian buffer. All sub-basin units need improved native plantings of trees, shrubs, and grasses. As discussed in chapter 3, sampling sites TB3, 4, and 7 received the highest RBP scores. Sites TB5, 6, 8, and 9 were in the middle, and sites TB1 and 2 were poor.
Potential indicators: habitat and biological monitoring. Selected *indicators* are Rapid Biological Assessment (RBP) scores. Physical habitat scores (RBP) reflect impairment at the entire watershed level. The overall level of physical degradation is associated with riparian clearing, cattle access, and excessive flashiness associated with increased impervious area.

BMPs

- Trash clean-up efforts during the Annual Creek Walk
- Adopt a stream mile program to pick up trash and report on visual habitat improvement
- Riparian setbacks of 50 feet for all new development
- Work with Extension Office to connect more landowners with CWAP and EQUIP programs
- Tree, shrub, and native grass planting in all areas of watershed with willing landowners
- Promote use of permeable pavement, bioinfiltration areas, and other low impact development techniques to reduce runoff and/or increase infiltration throughout the watershed

Action Items

- Present and work with the Fleming County Planning Commission on the value of riparian setbacks and habitat
- Volunteer Work Days to remove invasive plants along the stream
- Meet with local agricultural leaders and organizations about how to best connect them with available resources
- Establishing a native vegetation planting day with school kids and the Garden Club
- Ordinance development to allow future development to be storm-water friendly
- Educational activities about stormwater pollution
- Rain garden demonstration sites
- Rain barrel program

4.4 Goal 4: Control Flooding

The o*bjective* for control flooding is to reduce the occurrence and severity of flooding in Flemingsburg through stormwater runoff reduction and re-vegetating riparian areas. *Indicators* of controlling flooding will be reduced flooding!

BMPs

- Work with local government and businesses to reduce flooding in downtown Flemingsburg through the use of stormwater friendly design, low impact design techniques such as pervious pavement, curb cuts, infiltration basins, bioswales, rain gardens and barrels, other appropriate techniques, and native plants
- Educate the public about stormwater issues and their connection to water quality through educational signs near stormwater friendly designs, demonstration sites, workshops on 'greening' your home and office

Action Items

- Create parking lot that will capture precipitation and allow for infiltration of stormwater runoff
- Create a rain garden demonstration site working with Flemingsburg Garden Club and other volunteers
- Create rain garden on high school/hospital/library/extension office grounds with volunteer support
- Promote rain barrel usage at home and area businesses by offering them at a discounted price and with installation assistance
- Facilitate contractor, developer, and city official workshop on low impact development design

Watershed catchment pollutant load reductions

As discussed in Chapter 3, pollutant loads are one way to think about the water quality improvements that need to be made in a watershed. In looking at the watershed at the catchment level, BMPs and action items can be recommended and implemented to address the specific water quality issues found there. The following aerial photos are of each catchment in the watershed. They are accompanied by the pollutant load reductions needed that were presented in Chapter 3 along with BMPs that will address these pollutant load reductions. This plan does not detail the pollutant reduction expected from each BMP, but it is still useful to view the watershed in terms of catchment area and recommended BMPs. More details on the BMPs can be found in the attached BMP and action items tables.

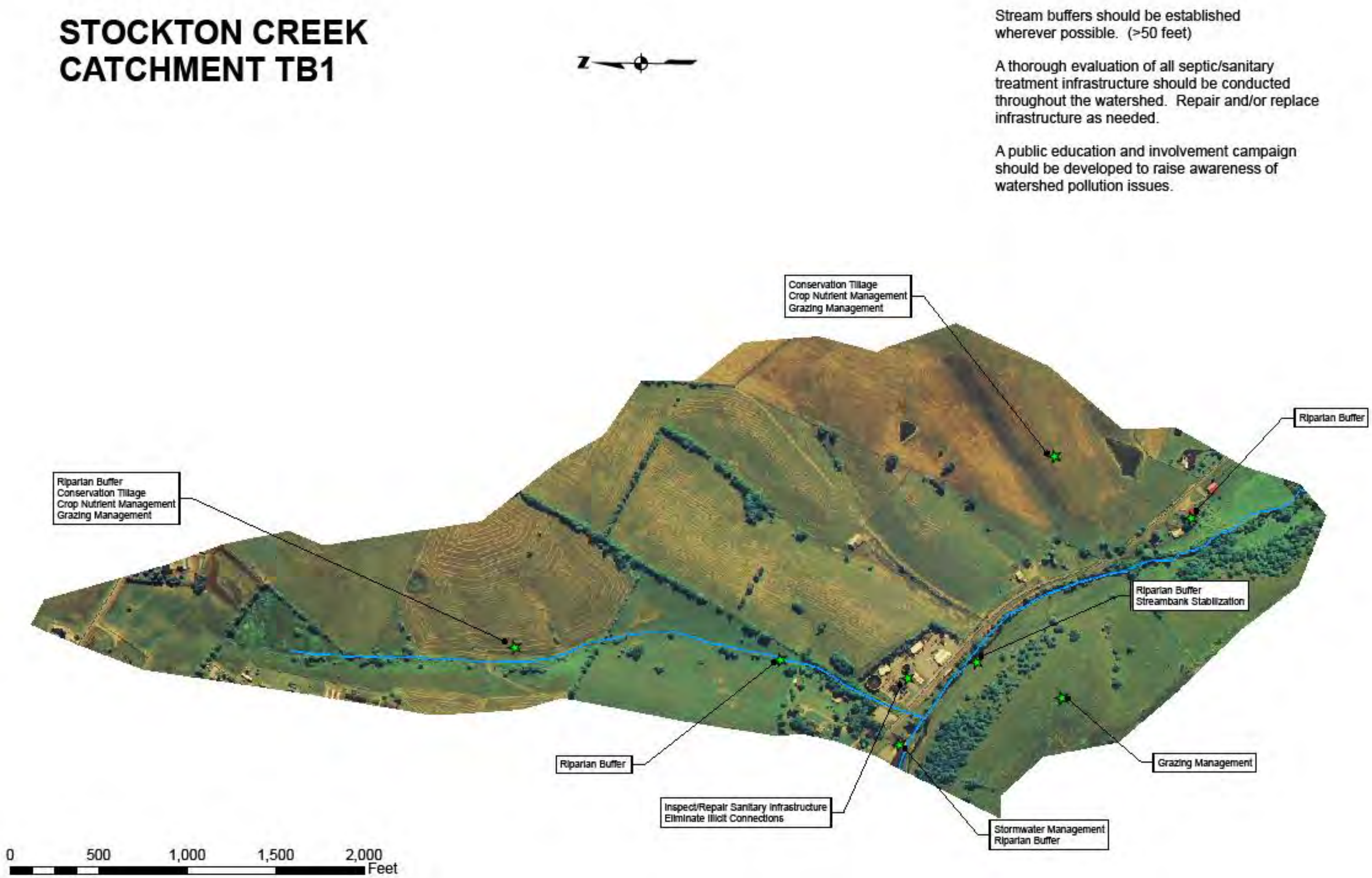

Figure 4.1 Catchment TB1 BMP recommendations and Load Reductions needed
TB1 needs the following load reductions: TSS – 0%; TKN – 88.69%; *E. coli* – 92.81%; TP – 70.67%; Habitat – 88, non-supporting

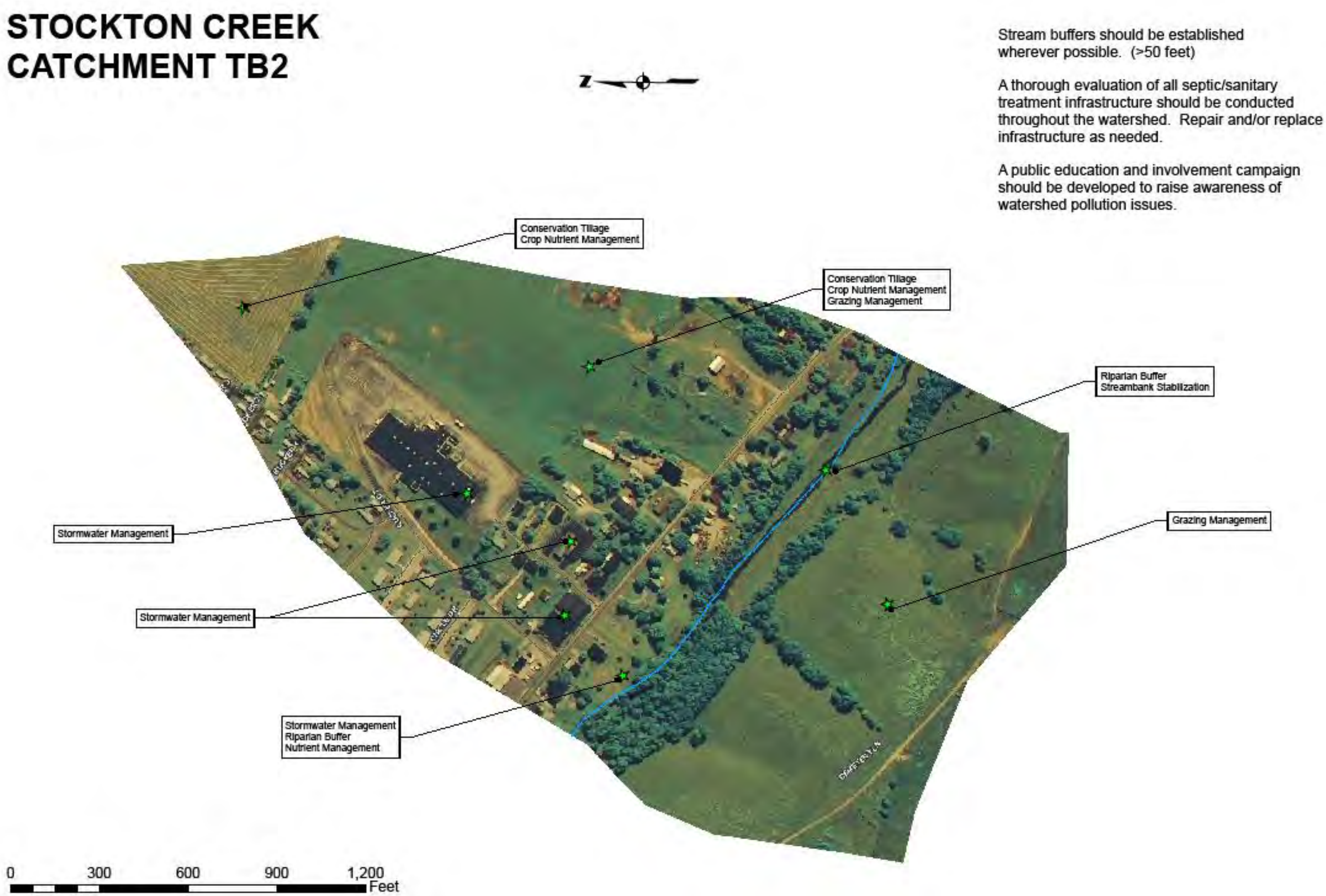

Figure 4.2 Catchment TB2 BMP recommendations and Load Reductions needed
TB2 needs the following load reductions: TSS – 0%; TKN – 90.48%; *E. coli* – 91.13%; TP – 0%; Habitat – 94, non-supporting

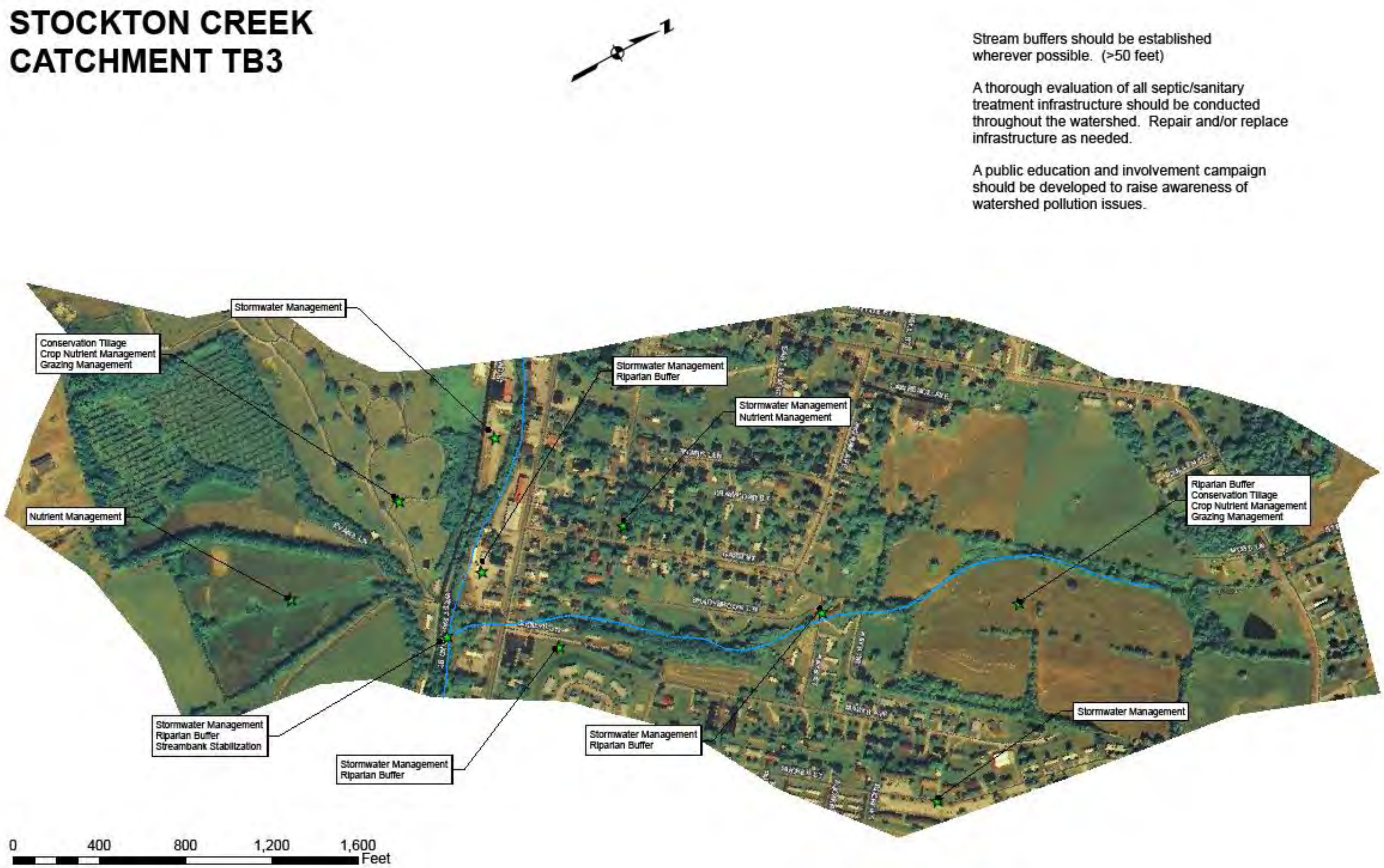

Figure 4.3 Catchment TB3 BMP recommendations and Load Reductions needed
TB3 needs the following load reductions: TSS – 37.32%; TKN – 93.86%; *E. coli* – 91.13%; TP – 0%; Habitat – 131, non-supporting

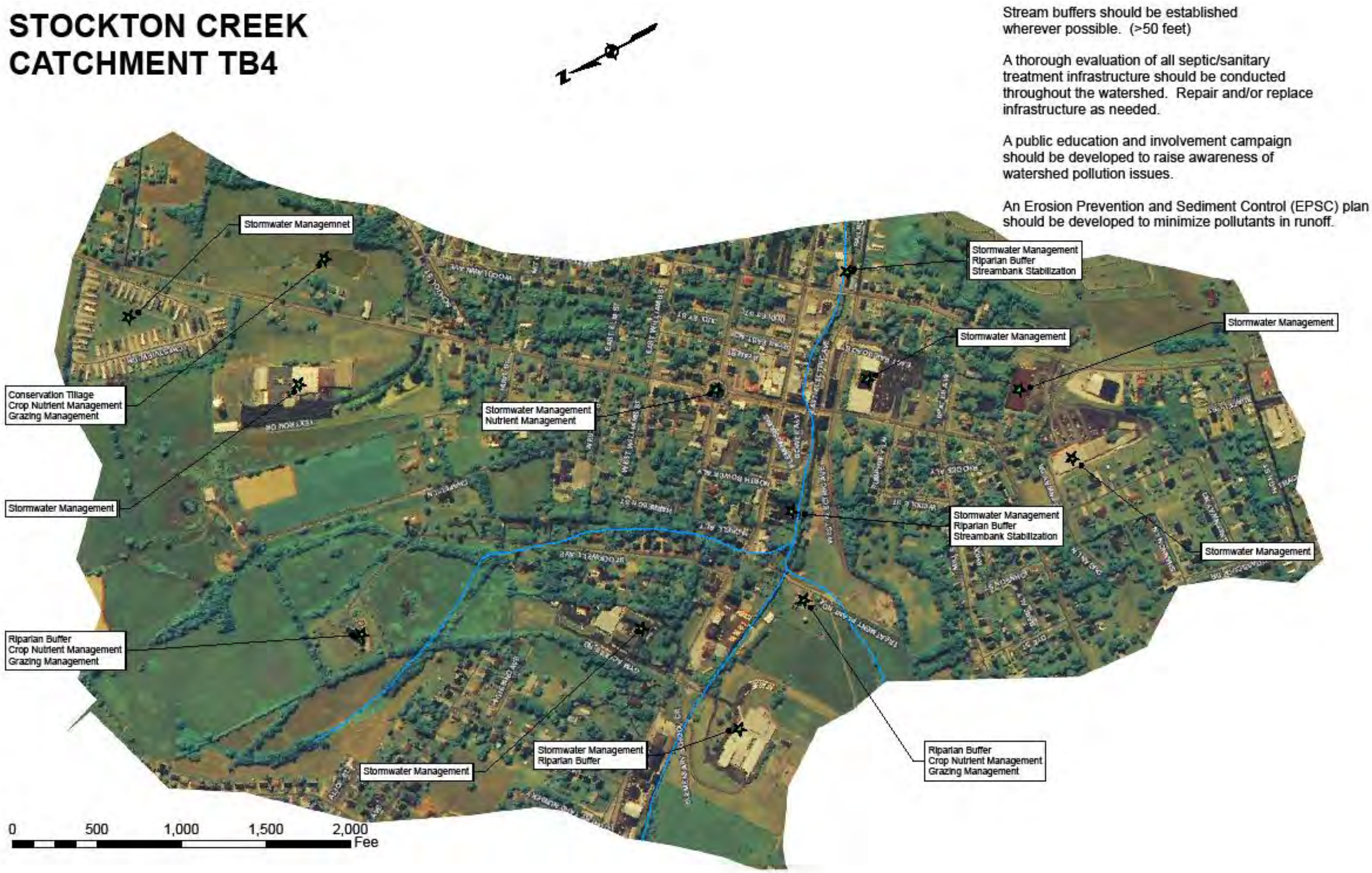

Figure 4.4 Catchment TB1 BMP recommendations and Load Reductions needed
TB4 needs the following load reductions: TSS – 0%; TKN – 90.64%; *E. coli* – 92.81%; TP – 0%; Habitat – 131, non-supporting

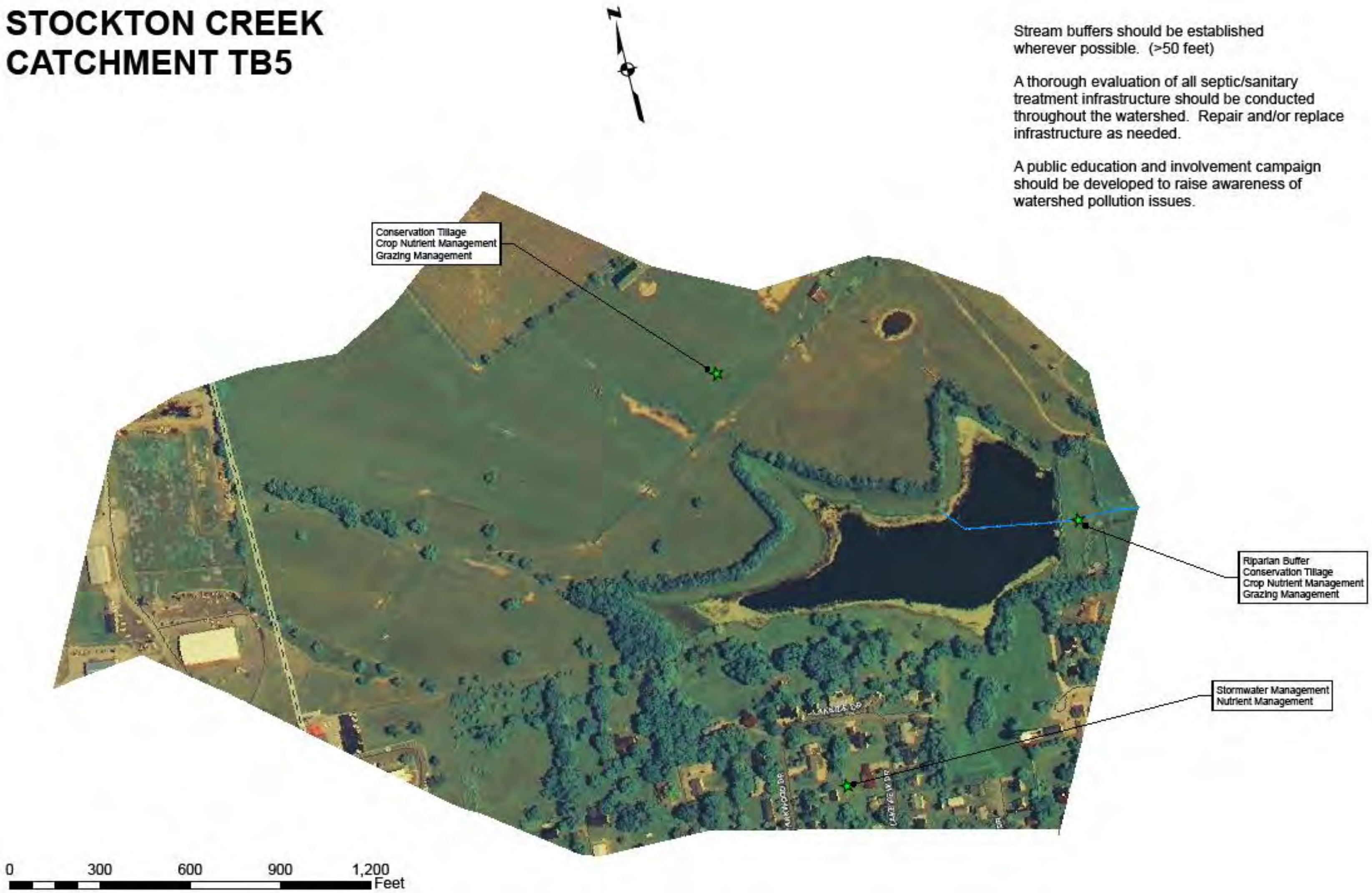

Figure 4.5 Catchment TB1 BMP recommendations and Load Reductions needed
TB5 needs the following load reductions: TSS – 32.28%; TKN – 93.23%; *E. coli* – 90.45%; TP – 80.39%; Habitat – 106, non-supporting

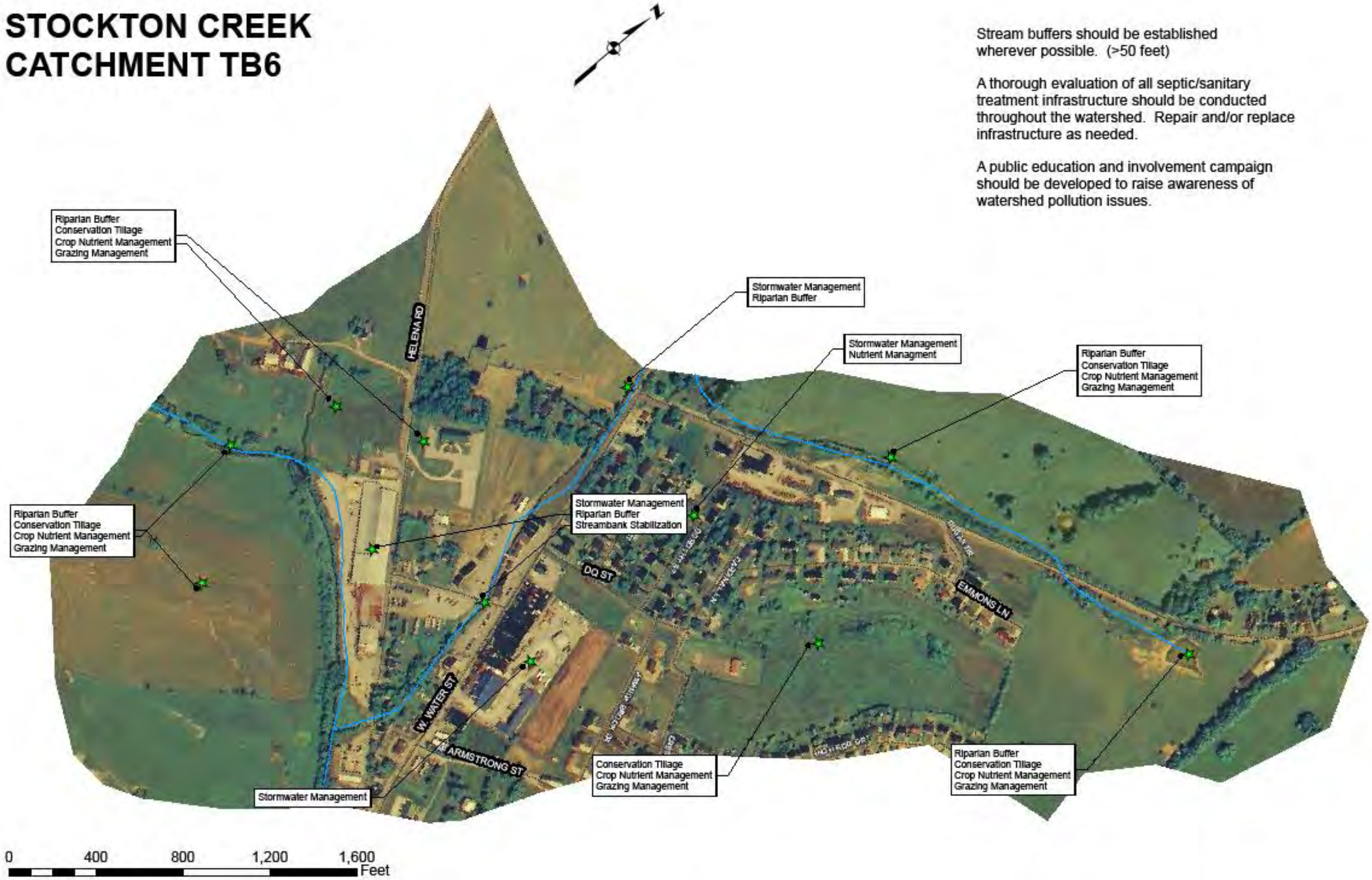

Figure 4.6 Catchment TB6 BMP recommendations and Load Reductions needed
TB6 needs the following load reductions: TSS – 50.07%; TKN – 93.23%; *E. coli* – 90.45%; TP – 80.39%; Habitat – 120, non-supporting

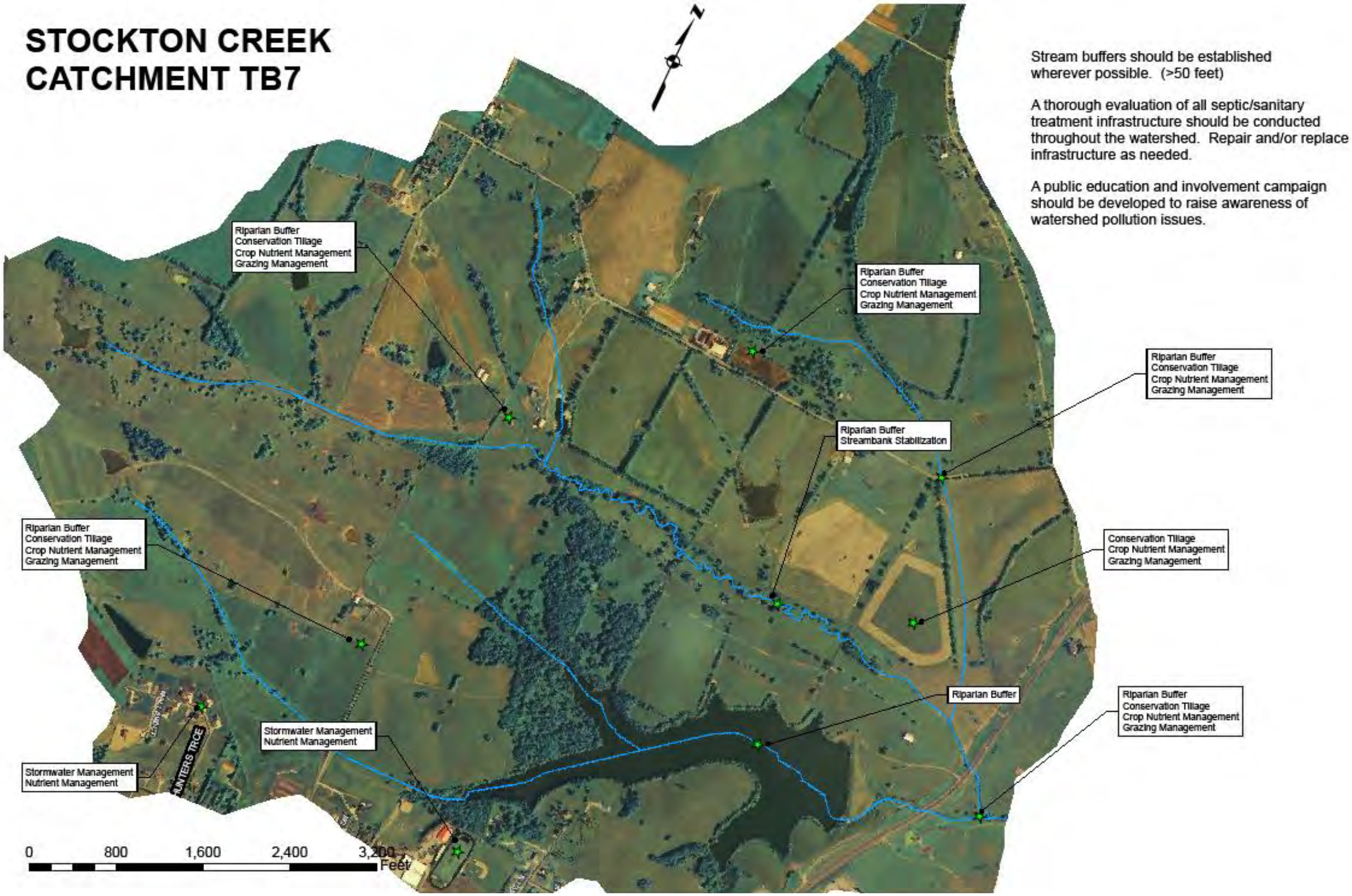

Figure 4.7 Catchment TB1 BMP recommendations and Load Reductions

TB7 needs the following load reductions: TSS – 79.54%; TKN – 89.24%; *E. coli* – 82.86%; TP – 47.06%; Habitat – 125, non-supporting

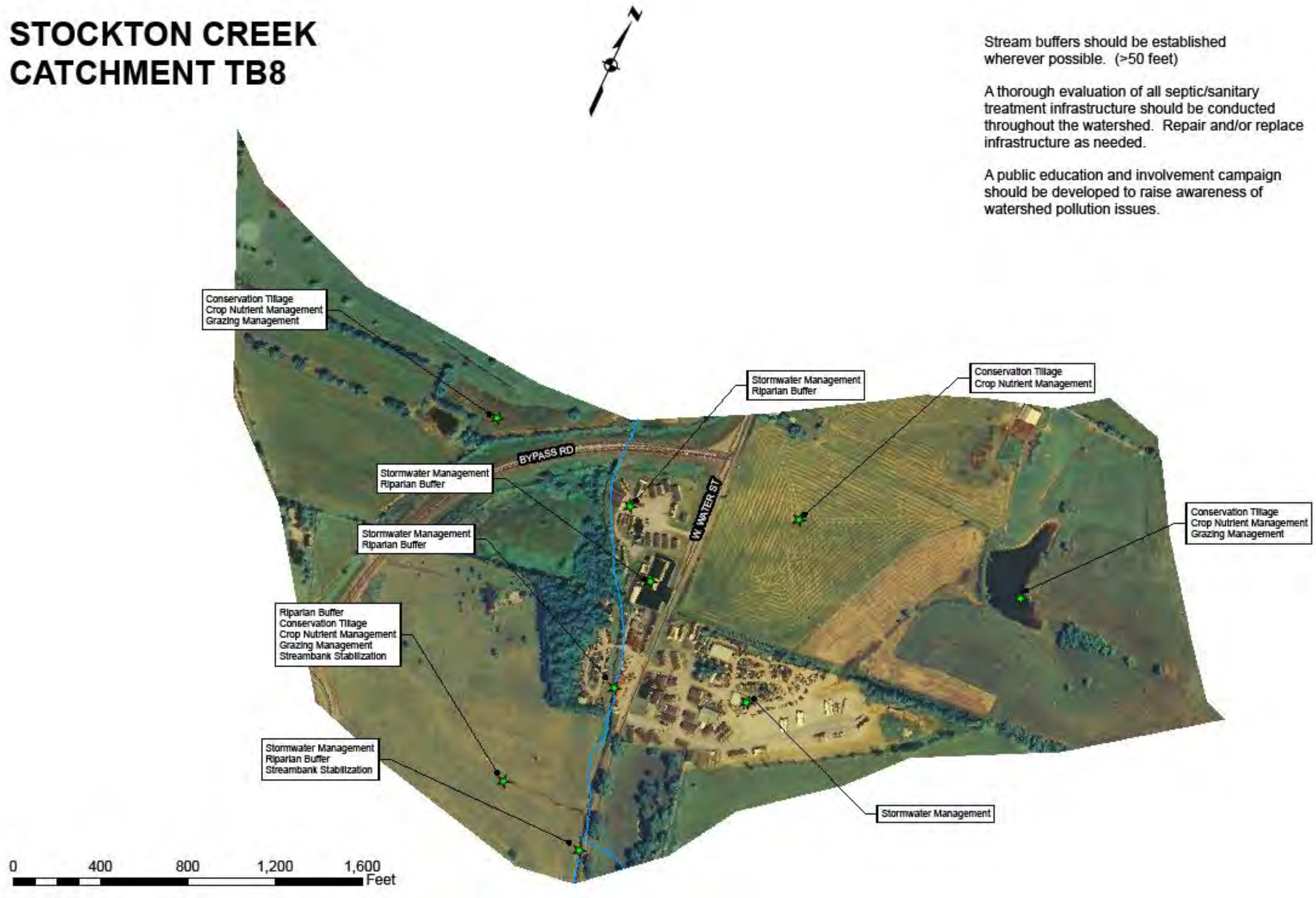

Figure 4.8 Catchment TB8 BMP recommendations and Load Reductions
TB8 needs the following load reductions: TSS – 61.03%; TKN – 96.33%; *E. coli* – 98.17%; TP – 0%; Habitat – 111, non-supporting

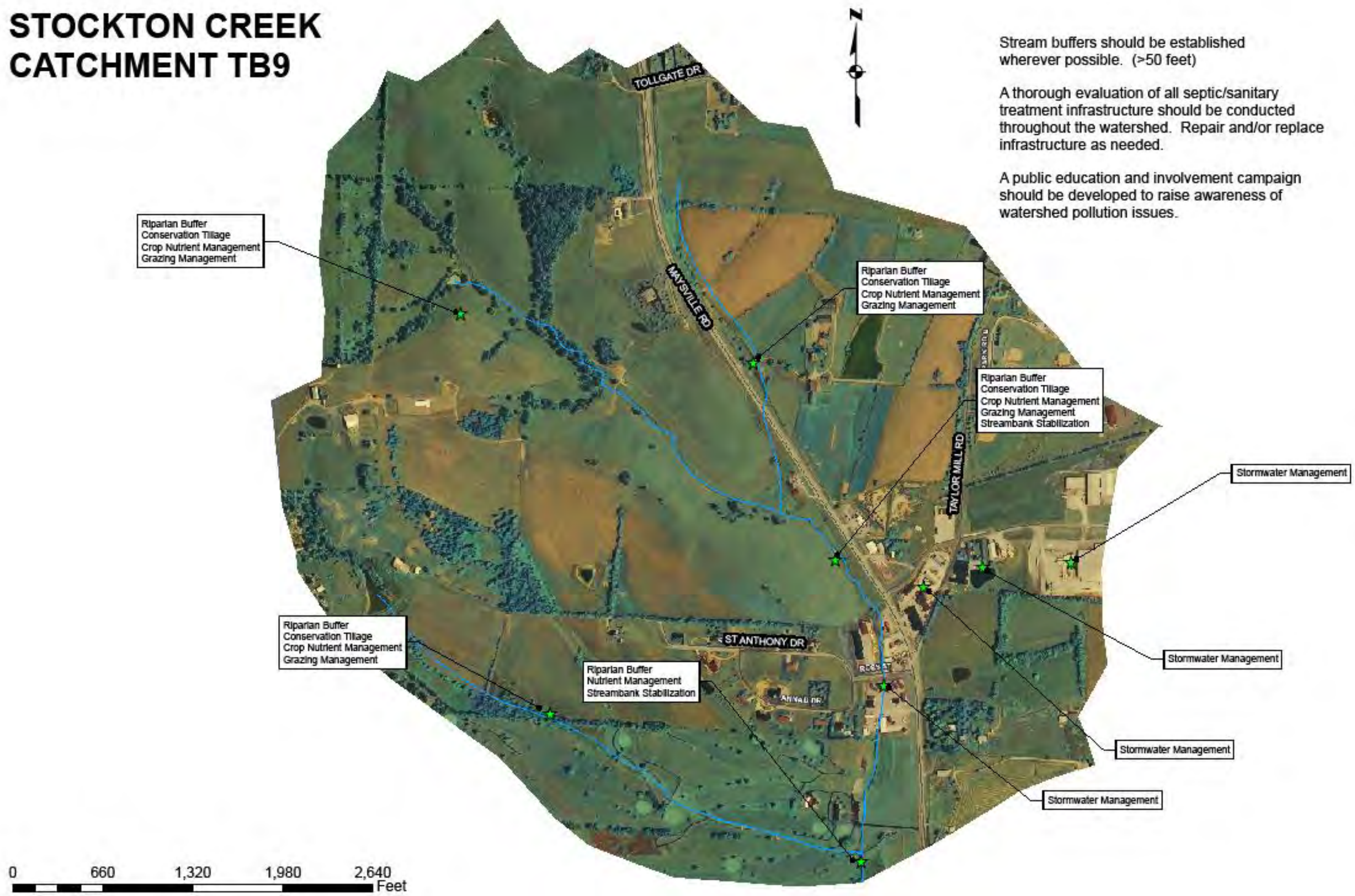

Figure 4.9 Catchment TB9 BMP recommendations and Load Reductions
TB9 needs the following load reductions: TSS – 42.91%; TKN – 89.29%; *E. coli* – 85.73%; TP – 59.72%; Habitat – 105, non-supporting

4.5 Water Quality Issue Narratives

The following section will discuss each of the major issues facing Stockton Creek. Some of them are pollutants, like bacteria. Some are not pollutants, but are water quality parameters that in their current state or quantity are degrading the quality of Stockton Creek, like conductivity. As discussed in chapter three, the biggest issues facing Stockton Creek's water quality are bacteria and nutrients along with degraded stream habitat.

Each issue narrative begins with a brief explanation of the parameter in question, lists the causes and sources of this situation in the Stockton Creek watershed, and lists BMPs to help alleviate the issue. It is important to remember that there are many types of BMPs. The ones listed in the following narratives are directly related to improving that water quality issue. All of the BMPs and action items are in the BMP tables which can be found in Appendix D.

The following water quality narratives list BMPs, organized by the water quality issue, like bacteria. The preceding aerial photos and BMP recommendations list BMPs, organized by watershed catchment area, like TB1. All this information is getting to the point that water quality improvement in a watershed is best made based on the water quality data for specific issues per catchment area. So the aerial photos with BMP recommendations, the water quality narrative, and the BMP tables can all be used together to gain a fuller picture of the work that needs to be done.

Issue: Bacteria

E. coli are bacteria that live in the gut of all warm blooded animals. If their fecal matter enters our waterways, *E. coli* can be detected in the water. Some types of *E. coli* can cause serious illness, but most are not harmful. *E. coli* represents the potential for other harmful disease-causing organisms; it serves as an indicator of the amount of fecal matter getting into the water. The most common sources are homes (failing septic systems or straight pipes), livestock, or wastewater treatment plants.

Causes/Sources/Pollutants
Septic and sewer discharge, effluent from wastewater treatment plants, runoff from, pastureland, and livestock in stream

Desired Conditions
Lower levels of *E. coli* and fecal coliform colonies in Stockton Creek
Primary and Secondary Recreation Contact designations restored

Best Management Practices (BMPs)
1. Install rain gardens and rain barrels to reduce stormwater runoff
2. Education and outreach on maintaining sewer and septic systems
3. Vegetate degraded riparian areas with native trees, shrubs, and grasses
4. Fence off livestock from Stockton Creek and encourage rotational grazing/inner fencing

Measurable Criterion
Fecal coliform colonies, unvegetated portions of streambank

	Target Value	**Analysis/ Model Method**	**Interim Targets Short-term**	**Interim Target Mid-term**	**Interim Target Long-term**
Fecal Coliform (PCR)	200 CFU/100 ml geometric mean for 5 samples over 30 days, 5/1-10/31. 20% or more of samples must not exceed 400 CFUs	Grab sample/ Colilert	All samples </= 1,000 CFUs	All samples </= 800 CFUs	All samples </= 200 CFUs
***E. coli* (PCR)**	130 CFU/100 ml geometric mean for 5 samples over 30 days, 5/1-10/31. 20% or more of samples must not exceed 240 CFUs	Grab sample/ Colilert	All samples </= 800 CFU/ml	All samples </= 600 CFUs	All samples </= 130 CFUs
Fecal Coliform	1000 CFU/100 ml geometric mean for 5 samples over 30 days, year round. 20% or more of samples must not exceed 2000 CFUs	Grab sample/ Colilert	All samples </= 1,000 CFU/ml	All samples </= 1,000 CFU/ml	All samples </= 1,000 CFUs

Figure 4.10 Objective Bacteria Reduction (Stockton Creek Watershed Team, 2009).

Issue: Nutrients

Runoff from agricultural, residential, stormwater and industrial effluent often contain nutrients that can have adverse affects on water quality. Total Kjeldahl Nitrogen (TKN) is the sum of organic nitrogen and ammonia in a water body. High TKN can result from sewage and manure discharges to water. Phosphorus (expressed here as Total Phosphorus or TP) comes mainly from septic systems, industrial discharges, agricultural fields, urban runoff, construction sites, and feedlots.

Causes/Sources/Pollutants
Stormwater runoff, septic and sewer discharge, effluent from wastewater treatment plants, and runoff from pastureland

Desired Conditions
Reduce nutrient loading in Stockton Creek to be in compliance with Kentucky state water quality standards for warm water aquatic habitat or benchmarks, specifically for TKN and TP.

Best Management Practices
1. Education on stormwater and water quality issues
2. Construct rain garden demonstration sites with educational signage
3. Encourage rain barrel usage with homeowners and businesses
4. Protect existing riparian areas and help restore degraded areas with native plants
5. Promote rotational grazing, other pasture restoration measures, and fencing

Measurable Criterion
Ammonia, Total Kjeldahl Nitrogen (TKN), Total Phosphorus (TP), Nitrate, Sulfate

	Target Value	Analysis/Model Method	Interim Targets Short-term	Interim Target Mid-term	Interim Target Long-term
Ammonia	< 0.05 mg/L after mixing	Standard Method 4500-NG3G	Meet target value in low flow	Meet target value in low and moderate flow	Meet target value in all flows
TKN	0.320 mg/L	SM4500	Meet target value in low flow	Meet target value in low and moderate flow	Meet target value in all flows
Total Phosphorus	0.132 mg/L	EPA 365-1	Meet target value in low flow	Meet target value in low and moderate flow	Meet target value in all flows
Nitrate	0.656 mg/L	EPA Method 300	Meet target value in low flow	Meet target value in low and moderate flow	Meet target value in all flows
Sulfate	47.3 mg/L	EPA Method 300	Meet target value in low flow	Meet target value in low and moderate flow	Meet target value in all flows

Figure 4.11 Objective Nutrient Reduction (Stockton Creek Watershed Team, 2009).

Issue: Siltation

When particles of soil, silt, and earth enter a stream, they eventually settle to the stream bottom. Siltation can cause a variety of problems in streams from aquatic habitat loss to loss of productivity. Soil particles often carry along other pollutants into the water. Total Suspended Solids (TSS) is one way to measure how much siltation is happening. TSS contain a wide variety of materials such as silt, decaying plant and animal matter, industrial wastes, and sewage. High concentrations of suspended solids can cause many problems for stream health and aquatic life.

Causes/Sources/Pollutants
Erosion from construction sites, agricultural fields, and roads
Increased stream flows from stormwater runoff and impervious surfaces
Streambank erosion

Desired Conditions
No adverse effects on indigenous aquatic communities from TSS. Stream bottom (substrate) should be suitable for native fish and macroinvertebrate populations. The substrate is 25 percent or less embedded by fine sediment.

Measurable Criterion
Total Suspended Solids and Substrate condition

Best Management Practices (BMPs)
1. Education and outreach on erosion prevention
2. Reduce stormwater runoff through the installation of rain gardens and barrels
3. Protect and restore existing riparian areas and revegetate degraded areas
4. Promote pasture restoration, rotational grazing, and inner fencing

	Target Value	**Analysis/Model Method**	**Interim Targets Short-term**	**Interim Target Mid-term**	**Interim Target Long-term**
Total Suspended Solids	No adverse effects on indigenous aquatic community	Turbidity and TSS analyzer	No adverse effects on indigenous aquatic community	No adverse effects on indigenous aquatic community	No adverse effects on indigenous aquatic community
Substrate Condition	Substrate 25% or less embedded by fine sediment	Visual Assessment	50% embedded by fine sediment	40% embedded by fine sediment	25% embedded by fine sediment

Figure 4.12 Objective Siltation Reduction (Stockton Creek Watershed Team, 2009).

Issue: Habitat Modification

Stream habitat is very important to the health of aquatic organisms and water quality. Physical, man-made alterations to the channel, floodplain, or riparian zone of a stream (channelization, culverting headwater streams, destruction of riparian cover, levee construction) can alter and degrade stream habitat. The EPA's Rapid Biological Protocol assigns a numeric score to a stream reach based on a variety of factors.

Causes/Sources/Pollutants

Construction, impervious surfaces, agriculture, stream channelization, loss of riparian areas, livestock in stream or on the banks

Desired Conditions

- A well-developed riparian area providing some canopy over the stream
- Presence of adequate aquatic habitats in the form of root mats and coarse woody debris
- Greater than (>) 70 percent (or >50 percent for low gradient) mix of rubble, gravel, boulders, submerged logs, root mats, aquatic vegetation or other stable habitats for aquatic organisms
- Rapid Biological Protocol score of 135, fully supporting habitat
- Score of 11 or better for Bank Stability, Vegetative Protection, and Riparian Vegetation Zone Width (combined score for both banks)

Best Management Practices

1. City and County ordinances and zoning that prevents or limits direct stream rerouting or modification, erosion during construction projects, and stormwater runoff
2. Education and outreach concerning stormwater runoff issues
3. Protection and expansion of riparian areas
4. Fence livestock out of stream

Measurable Criterion

Improved fish and macroinvertebrate habitat and Visual Assessments (Qualitative)

	Target Value	Analysis/ Model Method	Interim Targets Short-term	Interim Target Mid-term	Interim Target Long-term
Visual Assessment	Score of 11 or better for Bank Stability, Vegetative Protection, and Riparian Vegetation Zone Width (combined score for both banks)	Bank Stability score sheet	Improving bank stability score	Fair	Good
Visual Assessment	RBP score of 135 or higher, a fully supporting habitat	RBP score sheet	Improving RBP score	Fair	Good

Figure 4.13 Objective Better Habitat (Stockton Creek Watershed Team, 2009).

Stockton Creek Chapter 5
Implementation, Organization, Monitoring, and Evaluation

Organization

The Fleming County Conservation District (FCCD) will oversee all aspects of the Watershed Plan. The FCCD has received a US EPA 319(h) grant to fund the Fleming Creek Watershed Coordinator position thru 2012. The Watershed Coordinator will keep projects moving according to schedule, analyze monitoring data, seek new funding and resource opportunities, and share results with the community. The watershed coordinator will administer the 319(h) Stockton Creek Watershed Plan Implementation grant and initiate BMP implementation. The FCCD will continue to seek funding to retain a watershed coordinator and to implement additional BMPs.

Through the process of writing this watershed based plan a Stockton Creek Group has been formed. This group will serve as the core implementation and technical teams, additional resources will be added on an as needed basis depending on implementation requirements.

Monitoring Plan

Future 319(h) funded monitoring will be conducted in accordance with a KDOW approved QAPP. The FCCD will be involved in continued water quality monitoring for *E. coli*, TKN, TP, Total Suspended Solids, Dissolved Oxygen, Temperature, and Conductivity at 9 sites in the watershed. After each monitoring cycle is completed and data compiled for analysis the Water Quality Monitoring Plan will be evaluated and modified according to the results of the monitoring data. For example sites may be added or deleted, parameters added or deleted, or the sampling frequency changed. Each spring after all data sets are analyzed, compared, and quality assured the information will be presented by the Watershed Coordinator during a public meeting hosted by the Fleming County Conservation District.

Evaluation

Evaluation of the implementation of the Stockton Creek Watershed Plan will be conducted in March of every year by the Stockton Creek project committee, comprised of local concerned citizens and agency personnel. Evaluation will be based on implementation of the prioritized BMPs outlined in Ch 4 and any monitoring data accumulated for the year.

All BMPs identified in Ch 4 will be evaluated as to whether they are implemented, in progress, planned, no longer needed, or other needs. If a BMP is identified as having other needs someone will be assigned to address these concerns. A spreadsheet will be constructed to identify the status of all BMPs and will be filed at the Fleming County Conservation District with all other records for the Stockton Creek Watershed Based Plan.

Any water quality data acquired will also be presented at this time for discussion by the committee. The Watershed Coordinator, Emily Anderson, will quality assure and present all data, with load reduction calculations and any additional information on the health of the watershed.

Presentation

The Stockton Creek Project Committee will meet every March for the evaluation of the project. This annual meeting will include water quality data updates, educational and outreach efforts, and other related information. Additionally a public Creek Walk will be held every May, the walk will be a tool to educate and inform the public about the health of Stockton Creek. The Fleming County Conservation district will host a public meeting every October to educate and update the community on issues concerning the watershed. Flemingsburg has three local newspapers, a local radio station, and a local public TV access channel that will be used to keep the public informed about the progress and activities going on the Stockton Creek watershed.

This project is funded in part by a grant from the U.S. Environmental Protection Agency under 319(h) of the Clean Water Act through the Kentucky Division of Water to the Kentucky Waterways Alliance (Grant # C9994861-04).

Appendix A – Roundtable Report

Stockton Creek First Roundtable Report

Outline

I. Executive Summary

II. Introduction
A. Background Information
B. Roundtable Agenda
C. How Roundtable Information will be utilized

III. Responses from Roundtable

IV. Conclusion

A. Impacts of the Roundtable on the Planning Process and the Community

B. Roundtable Participant Evaluation Results

I. Executive Summary

The Stockton Creek (Town Branch) Watershed Roundtable was held on April 3, 2008 at the Fleming County Cooperative Extension Service in Flemingsburg. The event attracted 44 participants, most previously not involved with the Town Branch Watershed Planning Project.

A tributary of Fleming Creek, the Stockton Creek (Town Branch) watershed is located in Fleming County, Kentucky. To address point and nonpoint source pollution in the creek, the Stockton Creek Watershed Planning Team, Fleming County Conservation District, and the Kentucky Waterways Alliance are working together, with community input, to create a watershed plan.

The roundtable was held to draw more stakeholders into the watershed planning process, increase the public visibility, educate the public on issues facing the Stockton Creek (Town Branch) watershed, and to gain stakeholders' input for the planning process. Several roundtable participants volunteered to serve on the Watershed Planning Team, several others indicated interest in being trained to test water quality in Town Branch, and some participants were interested in being part of a Clean-Up Day for Town Branch. Furthermore, according to the roundtable evaluations, participants learned about issues facing the watershed. Finally, the publicity received and the high attendance indicated that public visibility was enhanced by the event.

The overall project to develop a watershed plan is funded in part by a grant from the U.S. Environmental Protection Agency under §319(h) of the Clean Water Act through the Kentucky Division of Water to the Kentucky Waterways Alliance *(Grant # C9994861-04).* The Stockton Creek Watershed Planning Team will continue to work to develop the plan through early 2010. A second watershed roundtable will be held in 2009, once a draft watershed plan has been completed, to present the plan to the public.

II. Introduction

A. Background Information

A tributary of Fleming Creek, the Stockton Creek watershed is located in Fleming County, Kentucky. Most of the city of Flemingsburg, population 3,010, is located within the watershed. The developed areas of Flemingsburg make up around 8% of the watershed. Otherwise, the area is largely agricultural. Over 55% of the Stockton watershed is used for pasture or hay, and over 10% of the watershed is in cultivated crops. Over 20% of the watershed is forested. There are two drinking water reservoirs in the watershed.

Stockton Creek is listed as impaired for primary contact recreation by the Kentucky Division of Water. Fecal coliform levels in Town Branch have been tested from 2004-2007. Throughout this time period, one test point in Town Branch failed to meet acceptable levels for fecal coliform 75% of the time. To address point and nonpoint pollution in Stockton Creek, the Stockton Creek Watershed Planning Team, Fleming County Conservation District, and the

Kentucky Waterways Alliance are working together, with community input, to create a watershed plan.

The roundtable was held to draw more stakeholders into the watershed planning process, increase the public visibility, educate the public on issues facing the watershed, and to gain stakeholders' input for the planning process.

B. Roundtable Agenda

The Stockton Creek Watershed Roundtable was held on the evening of Thursday, April 3, 2008. As participants arrived at the event, they were asked to register, and urged to look at the Nonpoint Source Pollution Storyboards and other information on watersheds provided by KWA, Fleming County Conservation District, and the EPA. Participants were also provided dinner during this time period.

After registration and dinner, there were four presentations on various aspects of the Watershed Planning Project. Katie Holmes from the Kentucky Waterways Alliance presented background on watersheds and the watershed planning process. Lajuanda Haight-Maybriar, the Licking River Basin Coordinator, spoke about how our actions on the land affect our water. Emily Anderson, of the Fleming County Conservation District, and the Project Facilitator, gave some background on the Town Branch watershed and why it was chosen for this project. Finally, Brian O'Neill from Redwing Ecological Services, and Technical Assistant for the project, presented on Town Branch's water quality.

Following the presentations, participants broke into three small groups, each lead by a facilitator, to discuss the following questions:

- How do you use the creek?
- How would you like to use it?
- How do you use the watershed?
- Why is the Town Branch watershed important to you?
- What are your concerns about the watershed?
- What are your goals for the watershed?
- Where do you see the watershed in 5 years?

Following the small group discussions, participants were urged to turn in their evaluations of the roundtable, which were designed to measure their knowledge of watershed issues before and after the roundtable, as well as their opinions related to the watershed plan. (See Section IV B. for the results of the evaluations.) Participants were also urged to turn in a form if they were interested in any of the following:

- ❑ Receiving updates on the Town Branch Watershed Plan Project (2008-2010)
- ❑ Joining the Town Branch Watershed Planning Team
- ❑ Being trained to monitor water quality in Town Branch
- ❑ Participating in a Town Branch Clean Up

C. How Roundtable Information Will be Utilized

The Stockton Creek Watershed Planning Team is in the beginning stages of working on a watershed plan for the Stockton Creek watershed. Throughout the planning process, the team will consider the input from roundtable participants, and will decide which problems and goals should be incorporated into the scope of the plan. Once the plan has been drafted, around the summer of 2009, it will be presented to the public for further input at a second roundtable.
All comments from participants in the roundtable have been included in this report to provide an accurate representation of the discussion that occurred. Some comments may not be appropriate to incorporate into the plan at this time, but all feedback will be reviewed by the team.

III. Responses from Roundtable

Participants at the roundtable were asked the following questions:

- How do you use the creek?
- How would you like to use it?
- How do you use the watershed?
- Why is the Town Branch watershed important to you?
- What are your concerns about the watershed?
- What are your goals for the watershed?
- Where do you see the watershed in 5 years?

The following were the participants' responses:

How do you use the creek?
1. Drive over it
2. Look at it
3. Afraid to use it
4. Sewage eventually goes in it
5. As a boundary: you can't use the creek
6. Irrigation for garden
7. Kids play in the creek
8. Beaver habitat (near elementary school)
9. Enjoyment/tourism

How would you like to use it?
1. Swimming/wading
2. Fishing
3. As focal point for park
4. Walking trail along it

How do you use the watershed?
1. Lawn care service – apply fertilizer
2. Flower garden – apply pesticides
3. Neighbors' dogs use it

4. Agriculture – livestock
5. City salt storage
6. Gas stations – underground storage tank leaks
7. Houses on it
8. Shop – businesses
9. Drive on it – roads

Why is Stockton Creek important to you?
1. Tied to health
2. City drinking water supply
3. If clean, promotes business and tourism
4. Part of total world environment – we have to start here to do our part

What are your concerns about the watershed?
1. Flood control
2. Contaminated – grandson wants to play in it
3. Erosion
4. Lowered groundwater table
5. Aging infrastructure – old and broken sewer pipes
6. Old sewer pipes run in creek
7. Litter
8. Sewer overflow
9. Dumping – appliances/trash
10. Buildings falling into creek
11. Creek is cleaner now than 15 years ago – people may not be as concerned because of this
12. Filling station – any leaks?
13. Possible impact from stockyards
14. Possible impact from golf course
15. Possible impact from factories – industrial park
16. Possible impact from highway, roads, parking lots
17. Straight pipes

What are your goals for the watershed?
1. Citizen education and awareness. Ideas: through schools, clubs, 4-H, newspaper, school education, success story – Battle Creek Michigan, town meetings, informational signs
2. Control flooding – better drainage
3. Replace old sewer pipes
4. Make it pretty in town – flowers, etc.
5. Walking trail by creek
6. Clean up dumps
7. Kids can fish and wade
8. Clean up buildings falling into creek
9. Clean up trash
10. Decrease amounts of fecal coliform in water
11. Peace and quiet around residential areas
12. Designated recreational areas

13. Safe for animals to drink form
14. Identify point sources of pollution – do a survey of all straight pipes

Where do you see the watershed in 5 years?
1. Depends on how much money we have
2. Better public awareness and buy-in

IV. Conclusion

A. Impacts of the Roundtable on the Community and the Planning Process

Publicity for the roundtable reached many watershed residents. Flyers advertising the event were mailed to all residents and businesses in the watershed. Flyers about the event were posted around town prior to the roundtable. A reporter from *The Flemingsburg Gazette* attended the roundtable, and published an article on the event. On April 23, *The Flemingsburg Gazette* ran another article on water quality issues in Stockton Creek.

The roundtable drew additional residents from the Stockton Creek watershed and the surrounding area to be part of the planning process. Furthermore, two Flemingsburg City Council Members, Meredith Story and Marty Voiers, attended the roundtable. The Watershed Planning Team will benefit from the added knowledge of the watershed that these residents bring to the table, and will be strengthened with the support of additional local government representatives. Through discussions held at the roundtable, the Watershed Planning Team learned about additional issues to add to the plan, and has attracted a broad base of interested citizens to call upon when it is time to implement Best Management Practices in the watershed.

B. Roundtable Participant Evaluation Results

At the conclusion of the event, participants were urged to turn in their evaluations of the roundtable, which were designed to measure their knowledge of watershed issues before and after the roundtable, as well as their opinions related to the watershed plan. The results from the surveys show that the roundtable participants learned a great deal about watersheds and watershed planning and pollution in Stockton Creek. Furthermore, the results show that the roundtable participants have a moderate-to-high expectation that the Stockton Creek Watershed Plan will succeed, and they feel confident that their concerns and goals for the watershed had been heard and considered for the watershed plan. Results from the roundtable evaluations are below:

SCALE	1 Low	2 Low-to-Moderate	3 Moderate	4 Moderate -to-High	5 High	Total # of responses	Average Weight
Your understanding of activities that cause water pollution							
Before the Roundtable		1	3	2	6	**12**	**4.1**
After the Roundtable			2	1	9	**12**	**4.6**
Your understanding of the definition and processes of watershed planning							
Before the Roundtable	1	5	4		2	**12**	**2.8**
After the Roundtable			1	7	4	**12**	**4.3**
Your understanding of the activities that cause water pollution in Town Branch watershed							
Before Roundtable	2	2	2	4	2	**12**	**3.2**
After Roundtable			2	5	5	**12**	**4.3**
Your understanding of the project to develop a watershed plan for Town Branch watershed							
Before the Roundtable	1	8	2		2	**13**	**2.5**
After the Roundtable			2	5	6	**13**	**4.3**
Please rate your expectation for success for the watershed plan							
			5	5	4	**14**	**3.9**
Please rate confidence that your concerns about the watershed were heard at the Roundtable							
			2	7	5	**14**	**4.2**
Please rate your confidence that your contributions to the watershed plan project were heard							
			2	7	5	**14**	**4.2**

Appendix B – Stockton Creek QAPP

Stockton Creek Watershed Plan Quality Assurance Project Plan (QAPP) to be added later. It is currently on file at the Kentucky Division of Water.

Appendix C – KPDES

Kentucky Pollutant Discharge Elimination System (KPDES) facilities located in the Stockton Creek Watershed:

NPDES ID	FACILITY NAME	ADDRESS	COUNTY NAME	PERMIT ISSUED DATE	PERMIT EXPIRED DATE	SIC CODE	SIC DESC
KY0039357	BULK PLANT INC FLEMINGSBRG #39	1306 ELIZAVILLE RD FLEMINGSBURG, KY 41041	FLEMING	SEP-24-2007	OCT-31-2012	5171	PETROLEUM BULK STATIONS AND TERMINALS
KY0021229	FLEMINGSBURG STP	HWY 32 FLEMINGSBURG, KY 41041	FLEMING	NOV-12-2009	DEC-31-2014	4952	SEWERAGE SYSTEMS
KYG640009	FLEMINGSBURG WTP	W WATER ST FLEMINGSBURG, KY 41041	FLEMING	SEP-19-2004	AUG-31-2009	4941	WATER SUPPLY
KYG500108	KTC FLEMING CO MAINT & EQ GAR	ELIZAVILLE RD FLEMINGSBURG, KY 41041	FLEMING	JAN-24-2003	MAR-31-2008	4173	TERMINAL AND SERVICE FACILITIES FOR MOTOR VEHICLE PASSENGER TRANSPORTATION

All permitted wastewater discharge information for Kentucky can be found at the Kentucky Division of Water website: http://www.water.ky.gov/permitting/wastewaterpermitting/KPDES/

Appendix D – Best Management Practices and Action Item Tables

Please see the attached tables.