Office of Water Quality
Total Maximum Daily Load Program

Total Maximum Daily Load for *Escherichia coli* (*E. coli*) For the East Fork Whitewater River Watershed, Wayne, Union, Fayette, and Franklin Counties

Prepared by:

Office of Water Quality – TMDL Program
Indiana Department of Environmental Management
100 N. Senate Avenue
Indianapolis, IN 46204

July 6, 2007

Table of Contents

Introduction 1
1.0 Background 1
2.0 Numeric Targets 3
3.0 Source Assessment 3
3.1 Source Assessment – Main Stem sub-watershed 3
3.2 Source Assessment – Tributary sub-watershed 5
4.0 Linkage Analysis and *E. coli* Load Duration Curves 7
4.1 Main Stem Sub-watershed 8
4.1.1 Water Quality Duration Curves 8
4.1.2 Source Linkage 9
4.2 Tributary Sub-watershed 10
4.2.1 Water Quality Duration Curves 10
4.2.2 Source Linkage 10
4.2.3 Conclusions 11
5.0 TMDL Development 11
6.0 Allocations 12
6.1 Wasteload Allocations 12
6.2 Load Allocations 13
6.3 Margin of Safety 13
7.0 Seasonality 14
8.0 Monitoring 14
9.0 Reasonable Assurance Activities 14
10.0 Conclusion 16

Tables and Figures

Table 1a: NPDES Permits in the Main Stem Sub-watershed
Table 1b: NPDES Permits in the Tributary Sub-watershed
Table 2a: Permitted Confined Feeding Operations in the Main Stem Sub-watershed
Table 2b: Permitted Confined Feeding Operations in the Tributary Sub-watershed
Table 3a: Load Reductions for Segments in Main Stem Sub-watershed
Table 3b: Load Reductions for Segments in Tributary Sub-watershed

Figure 1a: East Fork Whitewater River Watershed
Figure 1b: Main Stem Sub-watershed
Figure 1c: Tributary Sub-watershed
Figure 2a: Sampling Sites in Main Stem Sub-watershed
Figure 2b: Sampling Sites in Tributary Sub-watershed
Figure 2c: External Sample Sites
Figure 3a: Landuse in Main Stem Sub-watershed
Figure 3b: Landuse Breakdown for Main Stem Sub-watershed
Figure 4: NPDES Permits in Main Stem Sub-watershed
Figure 5: CSOs and SSOs in Main Stem Sub-watershed
Figure 6: CFOs in Main Stem Sub-watershed
Figure 7a: Landuse in Tributary Sub-watershed
Figure 7b: Landuse Breakdown for Tributary Sub-watershed
Figure 8: NPDES Permits in Tributary Sub-watershed
Figure 9: CFOs in Tributary Sub-watershed

Attachments

A. *E. coli* Data for East Fork Whitewater River Watershed TMDL
B. Water Quality Duration Curves for East Fork Whitewater River Watershed TMDL
C. Load Duration Curves for East Fork Whitewater River Watershed TMDL

Indiana Department of Environmental Management
Total Maximum Daily Load Program
July 6, 2007

Total Maximum Daily Load (TMDL) for *Escherichia coli* (*E. coli*) in East Fork Whitewater River watershed, Wayne, Union, Fayette, and Franklin Counties, Indiana

Introduction

Section 303(d) of the Federal Clean Water Act and the United States Environmental Protection Agency's (USEPA's) Water Quality Planning and Management Regulations (Title 40 of the Code of Federal Regulations (CFR), Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for waterbodies that are not meeting Water Quality Standards (WQS). TMDLs provide states a basis for determining the pollutant reductions necessary from both point and nonpoint sources to restore and maintain the quality of their water resources. The purpose of this TMDL is to identify the sources and determine the allowable levels of *E. coli* bacteria that will result in the attainment of the applicable WQS in the East Fork Whitewater River watershed in Wayne, Union, Fayette, and Franklin counties in Indiana.

This TMDL will examine watersheds assessed by the Indiana Department of Environmental Management (IDEM) in areas where data collected by the state is available. Due to the configuration of the sampling sites and impairments, the East Fork Whitewater River watershed will be addressed in two sections: Main Stem Segments (northern and western section of the watershed) and Tributary Segments (southeastern section of the watershed) (Figure 1a). Sections 3.0, 4.0 and 6.0 have been divided to examine the sub-watersheds separately.

1.0 Background

The East Fork Whitewater River in Union County was initially placed on the 303(d) List of Impaired Waters in 2002 for *E. coli*. Following this, the 2004 303(d) List included the West Fork East Fork Whitewater River, and the East Fork Whitewater River, both in Wayne County, as impaired for *E. coli*. Additionally, the Middle Fork East Fork Whitewater River, Lick Creek, Elkhorn Creek, Silver Creek-Whitewater Lake, and Hanna Creek/Dubois Creek are listed on the 2006 303(d) for *E. coli*.

This TMDL will address approximately 73.96 miles of the East Fork Whitewater River watershed in Wayne, Union, Fayette, and Franklin counties where recreational uses are impaired by elevated levels of *E. coli* during the recreational season. The East Fork Whitewater River watershed is located on the eastern border of southeast Indiana (Figure 1a). All of the eleven (11) segments of the listed streams for this TMDL are located in the Whitewater River Basin in hydrologic unit code number 05080003. The description of the study area, its topography, and other particulars are as follows:

Waterbody Name	Segment ID Number(s)	Length (miles)	Impairment
MIDDLE FORK EAST FORK WHITEWATER RIVER	ING0374_00, ING0374_01	4.26	*E. coli*
WEST FORK EAST FORK WHITEWATER RIVER	ING0375_00, ING0375_T1023	9.5	*E. coli*
WHITEWATER RIVER, EAST FORK	ING0376_T1013,	5.69	*E. coli*

	ING0376_T1027		
Waterbody Name	**Segment ID Number(s)**	**Length (miles)**	**Impairment**
LICK CREEK	ING0377_01	2.15	*E. coli*
ELKHORN CREEK	ING0378_01	7.13	*E. coli*
WHITEWATER RIVER, EAST FORK-UNNAMED TRIBUTARIES (HUNT RD)	ING0379_T1001	6.89	*E. coli*
SILVER CREEK - WHITEWATER LAKE	ING037D_00	25.63	*E. coli*
HANNA CREEK - DUBOIS CREEK	ING037F_00	12.71	*E. coli*

Due to reassessment, there will be additional segments in the East Fork Whitewater River watershed that will be added to the 2008 303(d) List (included in figure). These segments are the tributaries of the West Fork East Fork Whitewater River, Dubois Creek and its tributaries, and the Hanna Creek tributaries.

The East Fork Whitewater River was initially sampled in 1997, leading to the East Fork Whitewater River being listed on the 2002 303(d) List for the impairment of the *E. coli* single day standard. In 2002, an intensive survey of the watershed was conducted. During this period IDEM sampled sixteen sites six times, with the samples evenly spaced over a 30-day period from June 10, 2002, to July 22, 2002. Due to quality issues during sampling, one week of samples had to be dropped, hence the extra week of sampling to replace the samples that could not be used. Five of the sampling sites, GMW070-0053, GMW070-0016, GMW070-0054, GMW070-0006, and GMW070-0056, did not violate the geometric mean standard. Four of the sample sites, GMW070-0053, GMW070-0021, GMW070-0055, and GMW070-0056 did not violate the single day standard. (Figures 2a and 2b, Attachment A)

Additional sampling data exists in this watershed that has been collected by external organizations (Figure 2c, Attachment A). Indiana American Water has *E. coli* sample data from 2003 to 2005. Samples were taken at the Middle Fork Reservoir where the raw water intake is located and on the East Fork east of the City of Richmond at the Main Station. These samples were taken in order assure compliance with the Long Term Phase 2 Enhanced Surface Water Treatment Rule. The Richmond Sanitary District also has sample information that was gathered in 2005 and 2006 to provide more information on MS4 receiving streams. These measurements were taken on one wet day and one dry day during the year in eleven different receiving streams, four of which are located in the East Fork Whitewater River watershed. As part of writing a watershed management plan, the Friends of the Middle Fork along with the Wayne County SWCD have sampled in the Middle Fork of the East Fork watershed at thirteen (13) sites from 2003 to 2006. Lastly, there are two River Watch sampling locations in this watershed that correspond with IDEM sample sites GMW070-0063 and GMW070-0002.

The TMDL development schedule corresponds with IDEM's basin-rotation water quality monitoring schedule. To take advantage of all available resources for TMDL development, impaired waters are scheduled according to the basin-rotation schedule unless there is a significant reason to deviate from this schedule. Waterbodies could be scheduled based on the following:

1) Waterbodies may be given a high or low priority for TMDL development depending on the specific designated uses that are not being met, or in relation to the magnitude of the impairment.

2) TMDL development of waterbodies where other interested parties, such as local watershed groups, are working on alleviating the water quality problem may be delayed to give these other actions time to have a positive impact on the waterbody. If water quality standards still are not met, then the TMDL process will be initiated.

3) TMDLs, that are required due to water quality violations relating to pollutant parameters where no EPA guidance is available, may be delayed to give EPA time to develop guidance.

This TMDL was scheduled based on the data available from the basin-rotation schedule, which represents the most accurate and current information available on water quality within waterbodies covered by this TMDL.

Water quality *E. coli* load duration curves were created using IDEM's data. A flow duration interval is described as a percentage. Zero (0) percent corresponds to the highest stream discharge (flood condition) and 100 percent corresponds to the lowest discharge (drought condition). The *E. coli* values at GMW070-0021, GMW070-0003, GMW070-0004, and GMW070-0015 were plotted with the corresponding flow duration interval to show the *E. coli* violations of the single-sample maximum standard and geometric mean standard during the recreational season. These sampling sites have *E. coli* violations from the 2002 sampling cycle. These sampling sites are representative of the hydrodynamics of the East Fork Whitewater River watershed (Attachment B).

2.0 Numeric Targets

The impaired designated use for the waterbodies in the East Fork Whitewater River watershed is for total body contact recreational use during the recreational season, April 1 through October 31.
327 IAC 2-1-6(d) establishes the total body contact recreational use *E. coli* Water Quality Standard (WQS[1]) for all waters in the non-Great Lakes system as follows:

> *E. coli* bacteria, using membrane filter (MF) count, shall not exceed one hundred twenty-five (125) per one hundred (100) milliliters as a geometric mean based on not less than five (5) samples equally spaced over a thirty (30) day period nor exceed two hundred thirty-five (235) per one hundred (100) milliliters in any one (1) sample in a thirty (30) day period.

For the East Fork Whitewater River watershed during the recreational season (April 1 through October 31) the target level is set at the *E. coli* WQS of 125 per one hundred milliliters as a 30-day geometric mean based on not less than five samples equally spaced over a thirty day period.

3.0 Source Assessment

3.1 Source Assessment – Main Stem sub-watershed

Watershed Characterization

The West Fork of the East Fork Whitewater River headwaters are located in the northeast portion of Wayne County. The headwaters of the Middle Fork of the East Fork and the East Fork Whitewater River are located in western Ohio. All three forks flow southward and converge in central-eastern Wayne County to form the East Fork Whitewater River. The East Fork Whitewater River continues flowing south through Wayne County, Union County, and into the northern portion of Franklin County where it flows into the Whitewater River main stem. There is one impaired Unnamed Tributary in the watershed that flows southeast into the East Fork Whitewater River just south of where the West Fork and Middle Fork converge in southeast Wayne County (Figure 1b).

[1] *E. coli* WQS = 125 cfu/100mL or 235 cfu/100mL; 1 cfu (colony forming units)= 1 mpn (most probable number)

In 1992, approximately 68% of the landuse in the Main Stem sub-watershed was agriculture. The remaining landuse for the Main Stem sub-watershed consisted of approximately 21% forest, 6% urban, 3% water, and 2% wetlands (Figure 3a). Comparing this information to landuse data from 1976 it is shown that agricultural uses have decreased from 77% and forested areas have increased from 9% (Figure 3b). Landuse information was assembled in 1992 using the Gap Analysis Program (GAP). The 1992 GAP landuse information was compared to aerial photography taken in 2003 where no significant changes in landuse were observed.

Wildlife is a known source of *E. coli* impairments in waterbodies. Many animals spend time in or around waterbodies. Deer, geese, ducks, raccoons, turkeys, and other animals all create potential sources of *E. coli*. Wildlife contributes to the potential impact of contaminated runoff from animal habitats, such as urban park areas, forest, and cropland.

Many homes within the Main Stem sub-watershed are on septic systems. Failing septic tanks are known sources of *E. coli* impairment in waterbodies. Conversations with Wayne County Health Department staff indicate out of approximately 8,000 septic systems in the county, 20% to 25% are failing. No tangible septic failure rates have been established by the Franklin County Health Department, Fayette County Health Department, Union County Health Department at this time.

National Pollutant Discharge Elimination System (NPDES) Permitted Dischargers

There are six NPDES permitted facilities in the assessed HUCs of the Main Stem sub-watershed (Figure 4, Table 1a). Three of the six permitted facilities, Richmond Municipal STP, Brookville Municipal STP, and Cloverleaf Mobile Home Park, have *E. coli* limits in their permits.

- Richmond Municipal STP has reported violations of the single day standard 17 times since 2001, however no enforcement actions have been taken. None of the reported violations from the Richmond Municipal STP were recorded at the time of sampling, and therefore are not considered to have impacted sample results.
- Brookville Municipal STP and Cloverleaf Mobile Home Park have no reported violations

One of the six NPDES permitted facilities, Richmond Water Works Corp, has total residual chlorine limits in its permit. However, this discharger is a water treatment facility and does not have a sanitary components to its discharge.

The remaining two of the six dischargers, Silgan Containers Corporation and Stonehenge Concrete and Gravel, do not have *E. coli* or total residual chlorine limits in their permits. Neither of these two dischargers have a sanitary component to their discharge and therefore *E. coli* limits do not apply to their permits. These permitted dischargers are not contributing to the sources of *E. coli* in the Main Stem sub-watershed.

Storm Water General Permit Rule 13

There is one municipal separate storm sewer systems (MS4) community, Richmond, in the Main Stem sub-watershed. A permit for this MS4 was issued in January of 2005. Guidelines for MS4 permits and timelines are outlined in Indiana's Municipal Separate Storm Sewer System (MS4) Rule 13 (327 IAC 15-13-10 and 327 IAC 15-13-11).

Combined Sewer Overflows (CSOs) and Sanitary Sewer Overflows (SSOs)

The City of Richmond is the only CSO community in the Main Stem sub-watershed. There are four CSO outfalls in the City of Richmond that all discharge into the Whitewater River and three of these four outfalls are located in the Main Stem sub-watershed (Figure 5). A long term control plan (LTCP) was received in April of 2002. This LTCP is currently under review at IDEM. Personal communication with a representative from Richmond Sanitary District indicates that work has commenced on CSO improvements. Work on CSO 004 has been completed and work on other CSOs in the community is in progress.

The City of Richmond has three SSO outfalls in the Main Stem Sub-watershed identified (Figure 5). SSOs are prohibited from discharging at any time and any discharge may be addressed through an enforcement action. The City of Richmond and IDEM's Office of Enforcement are currently working on an agreed order to address SSOs in the collection system. SSOs are not a permitted activity and are not considered a legal discharge.

CSO and SSO outfalls are considered a source of *E. coli* to the Main Stem sub-watershed.

Confined Feeding Operations and Concentrated Animal Feeding Operations

The removal and disposal of the manure, litter, or processed wastewater that is generated as the result of confined feeding operations falls under the regulations for confined feeding operations (CFOs) and concentrated animal feeding operations (CAFOs). There is one CFO in the Main Stem sub-watershed (Figure 6). This CFO is not considered a CAFO (Table 2a). The CFO and CAFO regulations (327 IAC 16, 327 IAC 15) require operations "not cause or contribute to an impairment of surface waters of the state." The currently operational animal operation in Main Stem sub-watershed has no open enforcement actions at this time. Therefore, this operation is not considered a significant source of *E. coli* for the Main Stem sub-watershed TMDL.

There are many smaller livestock operations in the watershed. These operations, due to their small size, are not regulated under the CFO or CAFO regulations. These operations may still have an impact on the water quality and the *E. coli* impairment. No specific information on these small livestock operations is currently available for the Main Stem sub-watershed however; it is believed that these small livestock operations may be a source of the *E. coli* impairment.

3.2 Source Assessment – Tributary sub-watershed

Watershed Characterization

The Tributary sub-watershed has four impaired tributaries that flow into the East Fork Whitewater River. Elkhorn Creek starts in southeast Wayne County and flows west and slightly south into the East Fork Whitewater River. The headwaters of Silver Creek are located in the southeast corner of Wayne County and flow south and east before the confluence of the East Fork Whitewater River in west-central Union County. Hanna Creek begins in north eastern Union County, just south of Silver Creek, and flows southwest to the confluence with Dubois Creek and then flows into East Fork Whitewater River in southwest Union County. The confluence of Dubois Creek and Hanna Creek is in south-central Union County where the creek flows west and south before joining with Hanna Creek and then flowing into East Fork Whitewater River (Figure 1c).

Landuse information was assembled in 1992 using the Gap Analysis Program (GAP). In 1992, approximately 81% of the landuse in the Tributary sub-watershed was agriculture. The remaining landuse for the Tributary sub-watershed consisted of approximately 17% forest, 1% wetland, 1% water, and less than 1% urban (Figure 7a). Comparing this information to landuse data from 1976 it is shown that agricultural uses have decreased from 91% and forested areas have increased from 6% (Figure 7b). The 1992 GAP landuse information was compared to aerial photography taken in 2003 where no significant changes in landuse were observed.

Wildlife is a known source of *E. coli* impairments in waterbodies. Many animals spend time in or around waterbodies. Deer, geese, ducks, raccoons, turkeys, and other animals all create potential sources of *E. coli*. Wildlife contributes to the potential impact of contaminated runoff from animal habitats, such as urban park areas, forest, and cropland.

Many homes within the Tributary sub-watershed are on septics. Failing septic tanks are known sources of *E. coli* impairment in waterbodies. Conversations with Wayne County Health Department staff indicate out of approximately 8,000 septic systems in the county, 20% to 25% are failing. No tangible septic failure rates have been established by the Union County Health Department at this time.

National Pollutant Discharge Elimination System (NPDES) Permitted Dischargers

There is one NPDES permitted facility, Liberty Municipal STP, in the Tributary sub-watershed (Figure 8, Table 1b). This discharger does have a sanitary component in its discharge. Liberty Municipal STP has a total residual chlorine limit in its permit. Previously, facilities with design flows less than 1 MGD (typically minor municipals and semi-publics) were not required to have *E. coli* effluent limits or conduct monitoring for *E. coli* bacteria, provided it maintained specific total residual chlorine levels in the chlorine contact tank. The assumption was that as long as chlorine levels were adequate in the chlorine contact tank, the *E. coli* bacteria would be deactivated and compliance with the *E. coli* WQS would be met by default. The original basis for allowing chlorine contact tank requirements to replace bacteria limits was based on fecal coliform, not *E. coli*. No direct correlation between the total residual chlorine levels and *E. coli* bacteria can be conclusively drawn. Further, it has been shown that exceedances of *E. coli* bacteria limits may still occur when the chlorine contact tank requirements are met. Data for this facility has been reviewed and it has been found that the Liberty Municipal STP has had no violations of total residual chlorine limits in the past five years and therefore is not considered a contributing source to the *E. coli* impairment.

Due to the complications of comparing total residual chlorine to *E. coli*, it is difficult to determine to what extent, if any, this discharger could be a source of *E. coli* in the Tributary sub-watershed.

Storm Water General Permit Rule 13

There are no municipal separate storm sewer systems (MS4) communities in the Tributary sub-watershed.

Combined Sewer Overflows (CSOs) and Sanitary Sewer Overflows (SSOs)

There are no CSO or SSO communities in the Tributary sub-watershed.

Confined Feeding Operations and Concentrated Animal Feeding Operations

The removal and disposal of the manure, litter, or processed wastewater that is generated as the result of confined feeding operations falls under the regulations for confined feeding operations (CFOs) and concentrated animal feeding operations (CAFOs). There are two CFOs in the Tributary sub-watershed (Figure 9). Neither CFO is considered a CAFO (Table 2b). The CFO and CAFO regulations (327 IAC 16, 327 IAC 15) require operations "not cause or contribute to an impairment of surface waters of the state." The currently operational animal operations in Tributary sub-watershed have no open enforcement actions at this time. Therefore, these operations are not considered a significant source of *E. coli* for the Tributary sub-watershed TMDL.

There are many smaller livestock operations in the watershed. These operations, due to their small size, are not regulated under the CFO or CAFO regulations. These operations may still have an impact on the water quality and the *E. coli* impairment. No specific information on these small livestock operations is currently available for the Tributary sub-watershed however; it is believed that these small livestock operations may be a source of the *E. coli* impairment.

4.0 Linkage Analysis and *E. coli* Load Duration Curves

The linkage between the *E. coli* concentrations in the East Fork Whitewater River watershed and the potential sources of *E. coli* provides the basis for the development of this TMDL. Analysis of this relationship allows for estimating the total assimilative capacity of the stream and any needed load reductions. Water quality duration curves were created for the sampling sites in the East Fork Whitewater River watershed that were sampled by IDEM in 2002. A flow duration interval is described as a percentage. Zero (0) percent corresponds to the highest stream discharge (flood condition) and 100 percent corresponds to the lowest discharge (drought condition). These sampling sites are representative of the hydrodynamics of the East Fork Whitewater River watershed (Attachment B). This section will discuss the water quality durations and the linkage of the East Fork Whitewater River watershed and the East Fork Whitewater River.

To investigate further the potential sources mentioned above, an *E. coli* load duration curve analysis, as outlined in an unpublished paper by Cleland (2002), was developed for each sampling site in the East Fork Whitewater River watershed. The load duration curve analysis is a relatively new method utilized in TMDL development. The method considers how stream flow conditions relate to a variety of pollutant loadings and their sources (point and non-point).

In order to develop a load duration curve, continuous flow data is required. The USGS gage for the East Fork Whitewater River (gage number 03276000) located at Brookville, Indiana was used for the development of the *E. coli* load duration curve analysis for the East Fork Whitewater River watershed TMDL. USGS gage 03276500 is located at the mouth of the East Fork Whitewater River in Brookville.

The flow data is used to create flow duration curves, which display the cumulative frequency of distribution of the daily flow for the period of record. The flow duration curve relates flow values measured at the monitoring station to the percent of time that those values are met or exceeded. Flows are ranked from extremely low flows, which are exceeded nearly 100 percent of the time, to extremely high flows, which are rarely exceeded. Flow duration curves are then transformed into load duration curves by multiplying the flow values along the curve by applicable water quality criteria values for *E. coli* and appropriate conversion factors. The load duration curves are conceptually similar to the flow duration curves in that the x-axis represents the flow recurrence interval and the y-axis represents the allowable load of the water quality parameter. The curve representing the allowable load of *E. coli* was calculated

using the daily and geometric mean standards of 235 per 100 mL and 125 per 100 mL, respectively. The final step in the development of a load duration curve is to add the water quality pollutant data to the curves. Pollutant loads are estimated from the data as the product of the pollutant concentrations, instantaneous flows measured at the time of sample collection, and appropriate conversion factors. In order to identify the plotting position of each calculated load, the recurrence interval of each instantaneous flow measurement was defined. Water quality pollutant monitoring data are plotted on the same graph as the load duration curve that provides a graphical display of the water quality conditions in the waterbody. The pollutant monitoring data points that are above the target line exceed the water quality standards (WQS); those that fall below the target line meet the WQS (Mississippi DEQ, 2002).

4.1 Main Stem Sub-watershed

4.1.1 Water Quality Duration Curves

Load duration curves were created for all the sampling sites in the Main Stem Sub-watershed. However, sampling sites GMW070-0021, GMW070-0003, and GMW070-0004 on the East Fork Whitewater River have been determined to provide a representative picture of the watershed and provide the best description of the sources of *E. coli* to the Main Stem sub-watershed (Figure 2a, Attachment C). These sampling sites are IDEM sample sites from the intensive study and have *E. coli* sampling data from 2002.

Site GMW070-0021 is located on Middle Fork East Fork Whitewater River near the Indiana-Ohio border in the headwaters. The geometric mean value for site GMW070-0021 is 159 cfu/100mL. Although none of the samples taken at this site violated the single day standard (solid line), there were enough samples above the geometric mean standard (dashed line) that when the geometric mean was calculated it violated the standard. The river was experiencing moist to mid-range flow conditions when the geometric mean standard was violated. Violations occurring during the moist to mid-range flows indicating that sources of *E. coli* at this site might include failing septic systems, MS4 discharge, run-off from agricultural lands, field tiles and cattle and other wildlife in the stream. The low level of *E. coli* in stream during the one dry event during the sampling period indicates that there are not continuous discharges in this area.

Site GMW070-0003 is located on the East Fork Whitewater River just north of the confluence of the West Fork East Fork Whitewater River and is also in the City of Richmond. The average geometric mean value at this site is 411 cfu/100mL. The increase of the geometric mean from the headwaters indicates an increase of contributing factors upstream of this site. Violations in all flow regimes at this sample site indicate contributions from multiple sources. The City of Richmond is a CSO community, which can be an explanation for violations in high and mid-range flow conditions. Failing septic tanks may also be a source of excess *E. coli*, which is also indicated by elevated levels in these flow regimes. High levels of *E. coli* in low flow conditions indicate a direct input into the waterbody such as livestock using the stream as a water supply. Because there are multiple tributaries flowing through many different landuse areas upstream from this sample site, it is expected that these tributaries are also contributing to the *E. coli* violation at this site.

Site GMW070-0004 is located south of the City of Richmond. The average geometric mean at this site is 173 cfu/100mL. This site is the furthest downstream impaired sample site in the Main Stem Sub-watershed. Trends in this sub-watershed have *E. coli* gradually decreasing to the point where the standard is met. At this site the single day standard is only violated once. However, three sample events have violated the geometric mean standard causing the geometric mean to be in violation. The single day standard violation at this sample site occurred during high flow conditions. This violation can be explained by CSO overflow events and possibly contributions from failing septic systems and run-off

events from agricultural areas. The geometric mean standard violation occurred during all flow regimes and suggests a more consistent contribution to the stream.

4.1.2 Source Linkage

The landuse in this watershed is predominately agricultural. Row crops comprise 48% of the landuse. The soils in this sub-watershed necessitate the use of field tiles to drain excess water from the fields. These field tiles then drain to the nearest stream. Field tiles are not themselves sources of *E. coli*, but they can carry *E. coli* from land applied manure, runoff from the fields and pastures, and other sources of *E. coli* not adjacent to the streams. The high *E. coli* value during mid-range to high flow conditions indicates the presence of *E. coli* transportation by field tiles.

Pasture is 20% of the landuse. This indicates the presence of non-regulated smaller animal operations in this sub-watershed. Animals located in these smaller animal operations are not as likely to enter a stream during high flow conditions; however animal wastes may be transported into streams as non-point source run-off during rain events. Since there is a continuous source of *E. coli* present in this watershed during dry conditions, this would indicate that animals have direct access to the stream. Also, the presence of *E. coli* during wet conditions can indicate animal wastes are being transported into streams from rain events.

Wildlife is a known source of *E. coli*. The predominant agricultural and forested landuses in this sub-watershed create ideal habitat for wildlife. Wildlife would contribute during all flow conditions with possible spikes in *E. coli* levels during extreme high flow conditions due to runoff or flooding which carries large quantities of *E. coli* at one time.

There is a lack of *E. coli* sampling for Simpson Creek, Richland Creek, Templeton Creek, Middle Brook, Clay Run, White Creek, Bethel Creek, Gray Branch, segments in Ohio, and other unnamed tributaries as well as portions of the Main Stem Sub-watershed. The location of the sampling sites in this sub-watershed indicates that these tributaries could be contributing to the *E. coli* impairment. It is unclear as to the magnitude that these tributaries contribute to the *E. coli* impairment.

Three of the NPDES permitted facilities in the assessed HUCs in this sub-watershed contain a sanitary component in their discharge. Richmond Municipal STP is the only facility that has any reported violations. All other facilities in this sub-watershed have no reported violations. Since there are no open enforcement cases against these facilities, they are not considered sources of *E. coli*.

The permitted CFO is found in the eastern portion of the sub-watershed. The CFO could be a source of *E. coli* during high flow conditions on the water quality duration curve. This facility has the potential to cause a violation of the *E. coli* water quality standard through land application or a malfunction at the facility. There are no open enforcement cases against this facility; therefore, this facility is not considered a major source of *E. coli*.

Septic systems are a known source of *E. coli* for this watershed based on information provided to IDEM by the Wayne, Franklin, and Fayette County Health Departments (personnel communication). The septic systems described by this information would provide a constant source of *E. coli* particularly during low to mid-range flow conditions. According to the water quality duration curve, there are violations of the *E. coli* water quality standard during these flow conditions. Septic systems can also fail during higher flow conditions by leaching to a field tile or other type of pipe that discharges to the stream. Violations of the *E. coli* water quality standard are shown on the water quality duration curves during high flow as well.

There are three CSO discharge points and three SSO discharge points from the town of Richmond in this watershed. Site GMW070-0063 and Site GMW070-0004 are located downstream of these CSO and SSO discharge points. CSO and SSO discharge points are shown on water quality duration curves during high flow events. It can be concluded that CSOs and SSOs are a source of *E. coli* in this watershed.

4.1.3 Conclusions

The *E. coli* data has an average single sample maximum violation 42% of the time and a geometric mean violation 64% of the time. There are no known CFO or CAFO violations. Richmond Municipal STP is the only NPDES permitted facility with reported violations since 2001, and there is a project currently underway to alleviate this source of the problem. However, CSO and SSO discharge points from the city of Richmond are a significant source of *E. coli* at this time. In addition to the previously mentioned point sources, the water quality duration curves conclude that the other large contributions of *E. coli* in this watershed are nonpoint sources, which include small animal operations, wildlife, leaking and failing septic systems.

4.2 Tributary Sub-watershed

4.2.1 Water Quality Duration Curves

Load duration curves were created for all the sampling sites in the Tributary Sub-watershed. However, sampling site GMW070-0015 on Hanna Creek has been determined to provide a representative picture of the watershed and provide the best description of the sources of *E. coli* to the Tributary sub-watershed. According to sample results and load duration curves, the *E. coli* violations occur in moist conditions while sampling events during dry conditions meet WQS (Figure 2b, Attachment A, Attachment C). Sample site GMW070-0015 is an IDEM sample site and has *E. coli* sample data from 2002. The data indicate that the largest exceedances of the *E. coli* WQS are prevalent during moist conditions (noted by diamonds above the curve on the far left side of the figure in Attachment C).

Site GMW070-0015 is located on Hanna Creek in south-central Union County. The geometric mean value for site GMW070-0015 is 313.48 cfu/100mL. Violations occurred at this sample site during moist and mid-range flow conditions indicating that sources of *E. coli* at this site requires transport over land to reach the receiving stream. Possible sources include failing septic systems, filed tiles, and animal wastes from grazing areas in the watershed.

While there are point source contributions, compliance with the numeric *E. coli* WQS in the East Fork Whitewater River watershed most critically depends on controlling of nonpoint sources using best management plans (BMPs).

4.2.2 Source Linkage

The landuse in this watershed is predominately agricultural. Row crops comprise 66% of the landuse. The soils in this sub-watershed necessitate the use of field tiles to drain excess water from the fields. These field tiles then drain to the nearest stream. Field tiles are not themselves sources of *E. coli*, but they can carry *E. coli* from land applied manure, runoff from the fields and pastures, and other sources of *E. coli* not adjacent to the streams. The high *E. coli* value during mid-range to high flow conditions indicates the presence of *E. coli* transportation by field tiles.

Pasture is 15% of the landuse. This indicates the presence of non-regulated smaller animal operations in this sub-watershed. Animals located in these smaller animal operations are not as likely to enter a stream

during high flow conditions; however, animal wastes may be transported into streams as non-point source run-off during rain events. Since there is a continuous source of *E. coli* present in this watershed during dry conditions, this would indicate that animals have direct access to the stream. Also, a presence of *E. coli* during wet conditions can indicate animal wastes are being transported into streams from rain events.

Wildlife is a known source of *E. coli*. The predominant agricultural and forested landuses in this sub-watershed create ideal habitat for wildlife. Wildlife would contribute during all flow conditions with possible spikes in *E. coli* levels during extreme high flow conditions due to runoff or flooding which carries large quantities of *E. coli* at one time.

There is a lack of *E. coli* sampling for Boston Creek, White Brook, Cream Run, Tea Creek, and other unnamed tributaries. The location of the sampling sites in this watershed indicates that these tributaries could be contributing to the *E. coli* impairment. It is unclear as to the magnitude that these tributaries contribute to the *E. coli* impairment.

Liberty Municipal STP is the only NPDES permitted facility in this watershed that contains a sanitary component in its discharge. However, this facility has not had any violations; therefore, this facility is not considered sources of *E. coli*.

NJJ Farms and Greenwood Swine Farms are the two permitted CFOs that are found in the eastern portion of the watershed. CFOs could be sources of *E. coli* during high flow conditions on the water quality duration curve. These facilities have the potential to cause a violation of the *E. coli* water quality standard through land application or a malfunction at the facility. However, all of these facilities are operating in compliance with their permit.

Septic systems are a known source of *E. coli* for this watershed based on information provided to IDEM by the Franklin, Fayette, and Wayne County Health Departments (personnel communication). The septic systems described by this information would provide a constant source of *E. coli* particularly during low to mid-range flow conditions. Septic systems can also fail during higher flow conditions by leaching to a field tile or other type of pipe that discharges to the stream. Violations of the *E. coli* water quality standard are shown on the water quality duration curves during high flow, but not consistently.

There are no CSO or SSO discharge points in this sub-watershed.

4.2.3 Conclusions

The *E. coli* data has an average single sample maximum violation 60% of the time and a geometric mean violation 80% of the time. There are no known NPDES permits, CFO, or CAFO violations. Based on the water quality duration curves, it can be concluded that the majority of sources of *E. coli* in this watershed are nonpoint sources, which include small animal operations, wildlife, leaking, and failing septic systems.

5.0 TMDL Development

The TMDL represents the maximum loading that can be assimilated by the waterbody while still achieving the Waters Quality Standard (WQS). As indicated in the Numeric Targets section of this document, the target for this *E. coli* TMDL is 125 per one hundred milliliters as a geometric mean based on not less than five samples equally spaced over a thirty-day period from April 1 through October 31, and the single day standard of 235 per one hundred milliliters within a thirty day period.. Concurrent with the selection of a numeric concentration endpoint, TMDL development also defines the critical

conditions that will be used when defining allowable levels. Many TMDLs are designed as the set of environmental conditions that, when addressed by appropriate controls, will ensure attainment of WQS for the pollutant. For example, the critical conditions for the control of point sources in Indiana are given in 327 IAC 5-2-11.1(b). In general, the 7-day average low flow in 10 years (Q7, 10) for a stream is used as the design condition for point source dischargers. However, *E. coli* sources to East Fork Whitewater River watershed arise from a mixture of dry and wet weather-driven conditions, and there is no single critical condition that would achieve the *E. coli* WQS. For the East Fork Whitewater River watershed and the contributing sources, there are a number of different allowable loads that will ensure compliance, as long as they are distributed properly throughout the watershed. The TMDL designated by this document are for the impaired waterbodies listed in the Background section.

For most pollutants, TMDLs are expressed on a mass loading basis (e.g. pounds per day). For *E. coli* indicators, however, mass is not an appropriate measure because *E. coli* is expressed in terms of organism counts (or resulting concentration) (USEPA, 2001). The geometric mean *E. coli* WQS allows for the best characterization of the watershed. Therefore, this *E. coli* TMDL is concentration-based consistent with 327 IAC 5-2-11.1(b) and 40 CFR, Section 130.2 (i) and the TMDL is equal to the geometric mean *E. coli* WQS for each month of the recreational season (April 1 through October 31).

6.0 Allocations

TMDLs are comprised of the sum of individual wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background levels. In addition, the TMDL must include a Margin of Safety (MOS), either implicitly or explicitly, that accounts for uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. Conceptually, this definition is denoted by the equation:

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

The term TMDL represents the maximum loading that can be assimilated by the receiving water while still achieving WQS. The overall loading capacity is subsequently allocated into the TMDL components of WLAs for point sources, LAs for nonpoint sources, and the MOS. This *E. coli* TMDL is concentration-based consistent with USEPA regulations at 40 CFR, Section 130.2(i).

6.1 Wasteload Allocations

As previously mentioned, there are seven permitted dischargers in the East Fork Whitewater River watershed (Tables 1a and 1b). Four of the seven permitted dischargers have a sanitary component to their discharge. Three of these five permitted dischargers already have *E. coli* limits in their permits. The remaining permitted discharger has total residual chlorine limits in their permit. IDEM's TMDL program recommends the addition of *E. coli* limits to this permit during the next permit renewal.

There is one MS4 community, Richmond, in the East Fork Whitewater River watershed. The permit for this MS4 community was issued in January of 2005. Guidelines for MS4 permits are outlined in Indiana's Municipal Separate Storm Sewer System (MS4) Rule 13 (327 IAC 15-13-10 and 327 IAC 15-13-11).

There is one CSO and SSO community in the East Fork Whitewater River Watershed. Richmond is the only city in the watershed with CSOs and SSOs, with four CSO outfalls that discharge into the East Fork

Whitewater River and three SSO outfalls that discharge into the Main Stem Sub-watershed. A Long Term Control Plan (LTCP) was submitted to IDEM in 2001 and is currently under review.

The WLA for permitted activities is equal to the WQS of 125 per one hundred milliliters as a geometric mean based on not less than five samples equally spaced over a thirty-day period from April 1 through October 31, and the single day standard of 235 per one hundred milliliters within a thirty day period.

The WLA for CSO discharge points and MS4 permit activities will be set in the LTCP and MS4 permits to be issued to these facilities. These permits do not allow these activities to cause or contribute to a violation of WQS, which is set in Indiana Administrative Code 327 IAC 2-1.5-8(e)(2).

The WLA for prohibited discharges from SSOs and septic systems with straight pipe discharges directly to streams are set at zero (0.0).

6.2 Load Allocations

The LA for nonpoint sources is equal to the WQS of 125 per one hundred milliliters as a geometric mean based on not less than five samples equally spaced over a thirty-day period from April 1 through October 31, and the single day standard of 235 per one hundred milliliters within a thirty day period. The LA will use the geometric mean of each sampling location to determine the reduction necessary to comply with WQS at each site (Appendix 4).

Load allocations may be affected by subsequent work in the watershed. Currently there are several watershed projects or plans in the East Fork Whitewater River watershed. IDEM plans to work with the watershed coordinators in the surrounding areas along with local government agencies to encourage interest in other watershed projects. It is anticipated that watershed projects will be useful in continuing to define and address the nonpoint sources of the *E. coli* in the East Fork Whitewater River watershed.

Additionally, The Friends of the Middle Fork is working with the Wayne County Soil and Conservation District on the implementation phase of its watershed management plan, which is funded with a 319 grant. The Wayne County Soil and Water Conservation District along with WUR Waste Management District have also initiated an education program called Waste-Not to disseminate information to the public about environmental issues and conservation opportunities in the county. It is anticipated that additional watershed projects will be useful in defining the nonpoint sources of the *E. coli* in the East Fork Whitewater River watershed.

6.3 Margin of Safety

A Margin of Safety (MOS) was incorporated into this TMDL analysis. The MOS accounts for any uncertainty or lack of knowledge concerning the relationship between pollutant loading and water quality. The MOS can be either implicit (i.e., incorporated into TMDL analysis thorough conservative assumptions) or explicit (i.e., expressed in the TMDL as a portion of the loadings). This TMDL uses an implicit MOS by applying a couple of conservative assumptions. First, no rate of decay for *E. coli* was applied. *E. coli* bacteria have a limited capability of surviving outside of their hosts and therefore, a rate of decay normally would be applied. However, applying a rate of decay could result in a discharge limit that would be greater than the *E. coli* WQS, thus no rate of decay was applied. Second, the *E. coli* WQS was applied to all flow conditions. This adds to the MOS for this TMDL. IDEM determined that applying the *E. coli* WQS of 125 per one hundred milliliters to all flow conditions and with no rate of decay for *E. coli* is a more conservative approach that provides for greater protection of the water quality.

7.0 Seasonality

Seasonality in the TMDL is addressed by expressing the TMDL in terms of the *E. coli* WQS for total body contact during the recreational season (April 1st through October 31st) as defined by 327 IAC 2-1-6(d). There is no applicable total body contact *E. coli* WQS during the remainder of the year in Indiana. Because this is a concentration-based TMDL, *E. coli* WQS will be met regardless of flow conditions in the applicable season.

8.0 Monitoring

Future *E. coli* monitoring of the East Fork Whitewater River watershed will take place during IDEM's five-year rotating basin schedule and/or once TMDL implementation methods are in place. Monitoring will be adjusted as needed to assist in continued source identification and elimination. IDEM will monitor at an appropriate frequency to determine if Indiana's 30-day geometric mean value of 125 *E. coli* per one hundred milliliters is being met. When these results indicate that the waterbody is meeting the *E. coli* WQS, the waterbody will then be removed from the 303(d) list.

9.0 Reasonable Assurance Activities

Reasonable assurance activities are programs that are in place or will be in place to assist in meeting the East Fork Whitewater River watershed TMDL allocations and the *E. coli* Water Quality Standard (WQS).

9.1 National Pollutant Discharge Elimination System (NPDES) Permitted Dischargers

For the permitted dischargers that have only total residual chlorine limits in their current permits, IDEM's TMDL program proposes the *E. coli* limits and monitoring be added when the next permit renewals are issued.

9.2 Storm Water General Permit Rule 13

The one MS4 community in the East Fork Whitewater River watershed is Richmond. This permit was issued in January 2005 and implementation should have commenced, which will improve the water quality in the East Fork Whitewater River watershed. Guidelines for MS4 permits and timelines are outlined in Indiana's Municipal Separate Storm Sewer System (MS4) Rule 13 (327 IAC 15-13-10 and 327 IAC 15-13-11). These permits address storm water impacts in the East Fork Whitewater River watershed.

9.3 Confined Feeding Operations and Concentrated Animal Feeding Operations

CFO and CAFO are required to manage manure, litter, and process wastewater pollutants in a manner that does not cause or contribute to the impairment of *E. coli* WQS.

9.4 Watershed Projects

The Friends of the Middle Fork working with the Wayne County Soil and Water Conservation District are now in the implantation phase of the Middle Fork Watershed Project. This project has a goal of improving water quality in the Middle Fork watershed and Reservoir by decreasing nonpoint source pollution. Currently the project has accomplished nutrient and pest management practices and increasing

the acreage of no-till practices on agricultural lands. Other project activities include removing direct access of livestock to streams, increasing the area of buffer strips along stream banks, and increasing community awareness of failing septic systems. The Middle Fork Watershed Project is in the area that starts at the southern tip of the Middle Fork Reservoir going north into Ohio. A portion of the watershed is impaired for *E. coli* (segment number ING0374_00), so as the project continues improved water quality should be measurable.

Another initiative in the watershed being led by the Wayne County Soil and Water Conservation District and WUR Waste Management District is *Waste-Not,* an outreach campaign designed to provide information and educate residents about conservation issues and effort going on in the community. Currently education has focused on storm water and includes an informational website, presentations, videos, and a booklet handed out to students at conservation day. Increasing education about issues in the community can lead to improvements in water quality simply be the increased awareness of the impacts activities have on water quality.

IDEM has recently hired a Watershed Specialist for this area of the state. The Watershed Specialist will be available to assist stakeholders with starting a watershed group, facilitating planning activities, and serving as a liaison between watershed planning and TMDL activities in the East Fork Whitewater River watershed.

9.5 TMDLs

A TMDL will be written for the West Fork Whitewater River watershed in 2007-2008. The East Fork Whitewater River is a tributary of this watershed.

9.6 Potential Future Activities

Non-point source pollution, which is the primary cause of *E. coli* impairment in this watershed, can be reduced by the implementation of “best management practices" (BMPs). BMPs are practices used in agriculture, forestry, urban land development, and industry to reduce the potential for damage to natural resources from human activities. A BMP may be structural, that is, something that is built or involves changes in landforms or equipment, or it may be managerial, that is, a specific way of using or handling infrastructure or resources. BMPs should be selected based on the goals of a watershed management plan. Livestock owners, farmers, and urban planners, can implement BMPs outside of a watershed management plan, but the success of BMPs would be enhanced if coordinated as part of a watershed management plan. Following are examples of BMPs that may be used to reduce *E. coli* runoff:

Riparian Area Management - Management of riparian areas protects stream banks and river banks with a buffer zone of vegetation, either grasses, legumes, or trees.

Manure Collection and Storage - Collecting, storing, and handling manure in such a way that nutrients or bacteria do not run off into surface waters or leach down into ground water.

Contour Row Crops - Farming with row patterns and field operations aligned at or nearly perpendicular to the slope of the land.

No-Till Farming - No-till is a year-round conservation farming system. In its pure form, no-till does not include any tillage operations either before or after planting. The practice reduces wind and water erosion, catches snow, conserves soil and water, protects water quality, and provides wildlife habitat. No-till helps control soil erosion and improve water quality by maintaining maximum residue plant levels on the soil

surface. These plant residues: 1) protect soil particles and applied nutrients and pesticides from detachment by wind and water; 2) increase infiltration; and 3) reduce the speed at which wind and water move over the soil surface.

Manure Nutrient-Testing - If manure application is desired, sampling and chemical analysis of manure should be performed to determine nutrient content for establishing the proper manure application rate in order to avoid over-application and run-off.

Drift Fences - Drift fences (short fences or barriers) can be installed to direct livestock movement. A drift fence parallel to a stream keep animals out and prevents direct input of *E. coli* to the stream.

Pet Clean-up / Education - Education programs for pet owners can improve water quality of runoff from urban areas.

Septic Management/Public Education - Programs for management of septic systems can provide a systematic approach to reducing septic system pollution. Education on proper maintenance of septic systems as well as the need to remove illicit discharges could alleviate some anthropogenic sources of *E. coli*.

10.0 Conclusion

The sources of *E. coli* to the East Fork Whitewater River watershed include both point and nonpoint sources. In order for the East Fork Whitewater River watershed to achieve Indiana's *E. coli* WQS, the wasteload and load allocations for the East Fork Whitewater River watershed in Indiana have been set to the *E. coli* WQS of 125 per one hundred milliliters as a geometric mean based on not less than five samples equally spaced over a thirty day from April 1st through October 31st. Achieving the wasteload and load allocations for the East Fork Whitewater River watershed depends on:

1) *E. coli* limits being added to dischargers who monitor for total residual chlorine
2) CFOs continuing to be in compliance of permits
3) Nonpoint sources of *E. coli* being controlled by implementing best management practices in the watershed.
4) Implementation of the *E. coli* TMDL completed on the impaired tributaries in the Middle West Fork White River watershed.
5) Continued work by the City of Richmond on compliance with their MS4 permit.
6) The City of Richmond continuing work on alleviation of CSO discharges during rain events.
7) The City of Richmond addressing the unpermitted discharge from the SSOs.

The next phase of this TMDL is to identify and support the implementation of activities that will bring the East Fork Whitewater River watershed in compliance with the *E. coli* WQS. IDEM will continue to work with its existing programs on implementation. In the event that designated uses and associated water quality criteria applicable to the East Fork Whitewater River watershed are revised in accordance with applicable requirements of state and federal law, the TMDL implementation activities may be revised to be consistent with such revisions. Additionally, IDEM will work with local stakeholder groups to pursue best management practices that will result in improvement of the water quality in the East Fork Whitewater River watershed.

REFERENCES

Cleland, B. 2002 TMDL Development from the "Bottom Up"-Part II. Using Duration Curves to Connect the Pieces. America's Clean Water Foundation.

Dungan, Kelly. Wayne County Soil and Water Conservation District. Personal Communication. 2006

Hill, Dan. Franklin County Health Department. Personal Communication. 2006.

Holeva, LuAnn. Wayne County Soil and Water Conservation District. Personal Communication.

Goss, Fred. Wayne County Health Department. Personal Communication. 2006.

Mississippi Department of Environmental Quality. 2002. Fecal Coliform TMDL for the Big Sunflower River, Yazoo River Basin.

Nicholson, Richard. Indiana American Water. Personal Communication. 2006.

Shirken, Matt. Fayette County Health Department. Personal Communication. 2006.

USEPA. 2001. Protocol for Developing Pathogen TMDLs. United States Environmental Protection Agency, 841-R-00-002.

Wiwi, Robert. Richmond Sanitary District. Personal Communication. 2006.

Table 1a: NPDES Permits in the Main Stem Sub-watershed

Facilities with *E. coli* Limits

Permit No.	Facility Name	Expiration Date	Receiving Waters
IN0025615	Richmond Municipal STP	1/31/2011	East Fork Whitewater River
IN0022446	Brookville Municipal STP	2/29/2008	East Fork Whitewater River
IN0045668	Cloverleaf Mobile Home Park	9/30/2009	King Ditch

Facilities with Total Residual Chlorine Limits and no sanitary component

Permit No.	Facility Name	Expiration Date	Receiving Waters
IN0001511	Richmond Water Works Corp	7/31/2008	Middle Fork East Fork Whitewater River

Facilities with no Total Residual Chlorine or *E. coli* Limits and no sanitary component

Permit No.	Facility Name	Expiration Date	Receiving Waters
IN0003336	Silgan Containers Corp	3/31/2011	Brown's Ditch
ING490014	Stonehenge Concrete and Gravel	Expired 8/31/2005	Lick Creek

Facilities Located in Unassessed HUCs

Permit No.	Facility Name	Permit Limit Type	Expiration Date	Receiving Waters
IN0030988	Barrett Paving Materials, Inc.	No sanitary component	8/31/2008	East Fork Whitewater River
IN0056251	Marathon Ashland Petroleum LLC	No sanitary component	Voidance pending	East Fork Whitewater River
IN0051586	Franklin County Water Association	Total Residual Chlorine	1/31/2007	Brookville Lake

Table 1b: NPDES Permits in the Tributary Sub-watershed

Facilities with Total Residual Chlorine Limits

Permit No.	Facility Name	Expiration Date	Receiving Waters
IN0020681	Liberty Municipal STP	5/31/2007	Silver Creek and Hanna's Creek

Table 2a: Permitted Confined Feeding Operations in the Main Stem Sub-watershed

			Approved Animals				
Log Number	**Name**	**NPDES Permit Number**	**Nursery Pig**	**Grower/Finishers**	**Sowboars**	**Beef**	**Turkeys**
4154	Elkhorn Farm	N/A	420	420	24	200	0

Table 2b: Permitted Confined Feeding Operations in the Tributary Sub-watershed

			Approved Animals				
Log Number	**Name**	**NPDES Permit Number**	**Nursery Pig**	**Grower/Finishers**	**Sowboars**	**Beef**	**Turkeys**
4576	NJJ Farms	N/A	300	1050	180	0	0
630	Greenwood Swine Farms	N/A	0	2000	0	0	0

Table 3a: Load Reductions for Segments in Main Stem Sub-watershed

***E. coli* Standard = 125 mpn/100 mL**			
Stream Name	**Site Number**	***E. coli* (geometric mean)**	**Percent Reduction**
Middle Fk E Fk Whitewater River	GMW070-0021	159.21	21.49%
E Fk Whitewater River	GMW070-0002	728.27	82.84%
W Fk E Fk Whitewater River	GMW070-0003	410.94	69.58%
E Fk Whitewater River	GMW070-0063	353.63	64.65%
E Fk Whitewater River	GMW070-0004	173.05	27.77%
Unnamed Trib	GMW070-0058	255.02	50.98%
E Fk Whitewater River	GMW070-0006	107.31	0.00%
E Fk Whitewater River	GMW070-0056	93.64	0.00%
Whitewater Lake Boat Ramp	GMW070-0054	2.92	0.00%
Quakerstown SRA Swimming Beach	GMW070-0055	2.72	0.00%
Brookville Reservoir	GMW070-0053	1.75	0.00%

Table 3b: Load Reductions for Segments in Tributary Sub-watershed

***E. coli* Standard = 125 mpn/100 mL**			
Stream Name	**Site Number**	***E. coli* (geometric mean)**	**Percent Reduction**
Lick Cr	GMW070-0059	361.85	65.46%
Elkhorn Cr	GMW070-0062	193.1	35.27%
Silver Cr	GMW070-0016	336.12	62.81%
Hanna Cr	GMW070-0015	313.48	60.13%
Dubois Cr	GMW070-0052	550.81	77.31%

Figure 1a: East Fork Whitewater River Watershed

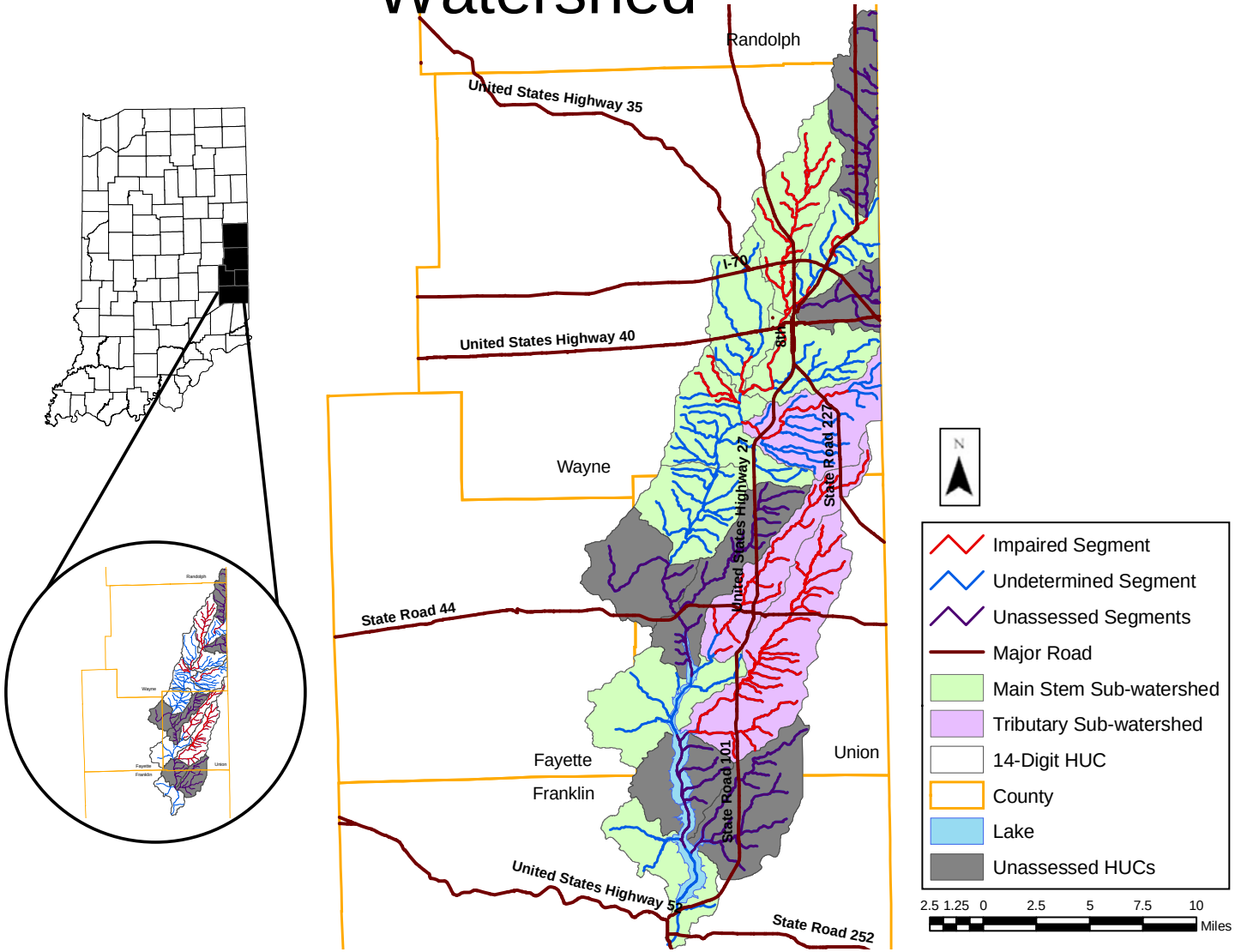


Figure 1b: Main Stem Sub-Watershed

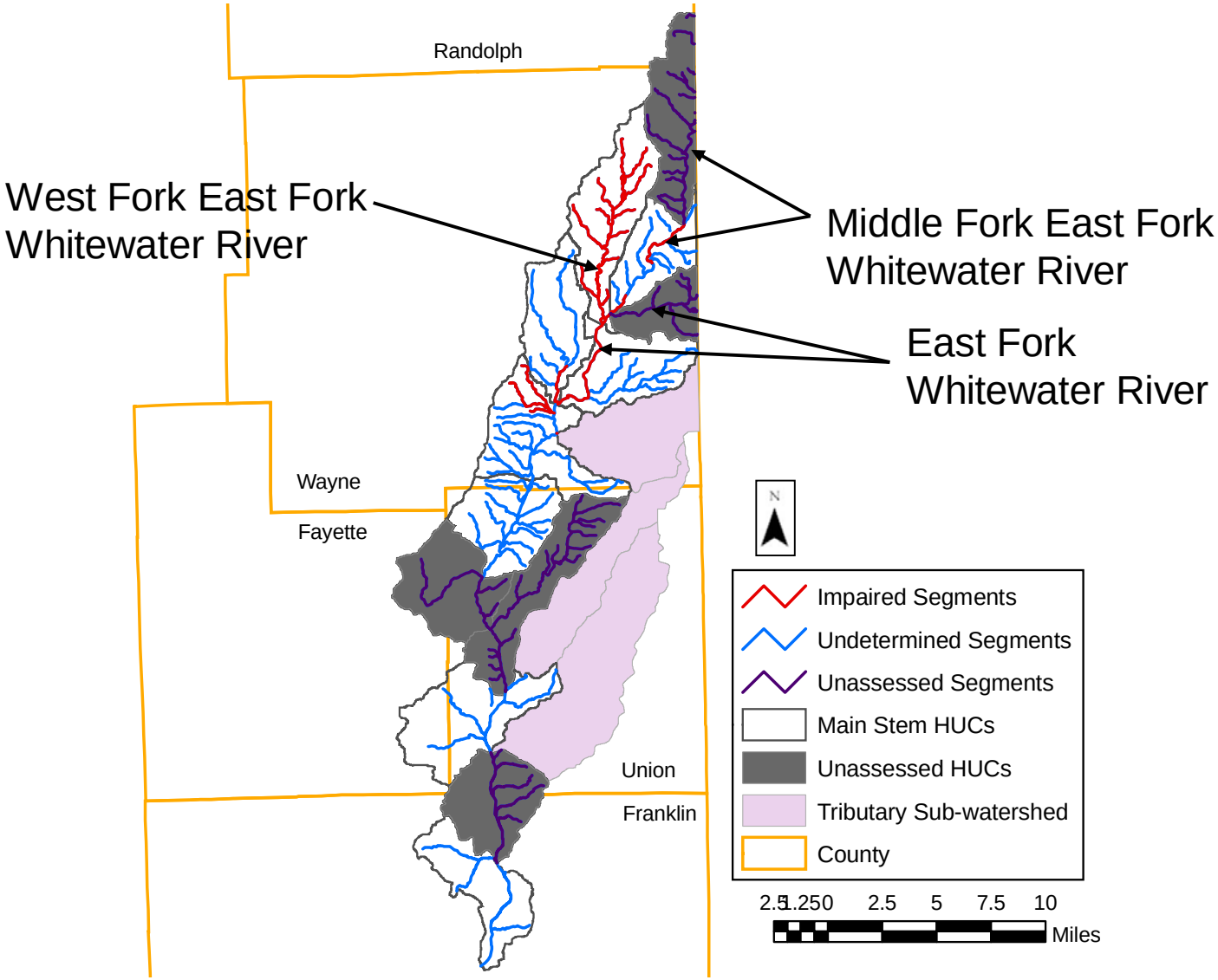


Figure 1c: Tributary Sub-Watershed

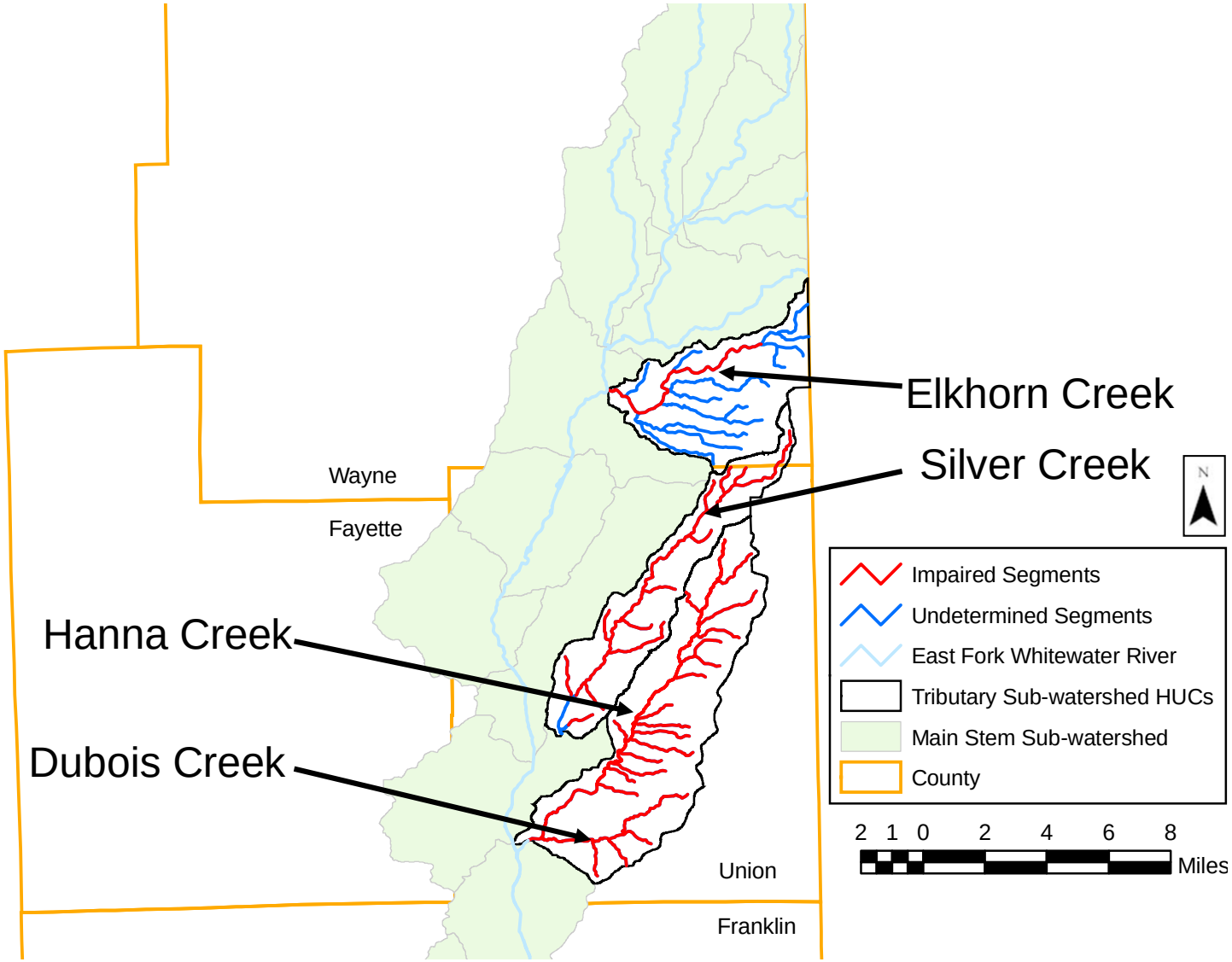


Figure 2a: Sampling Sites in Main Stem Sub-watershed

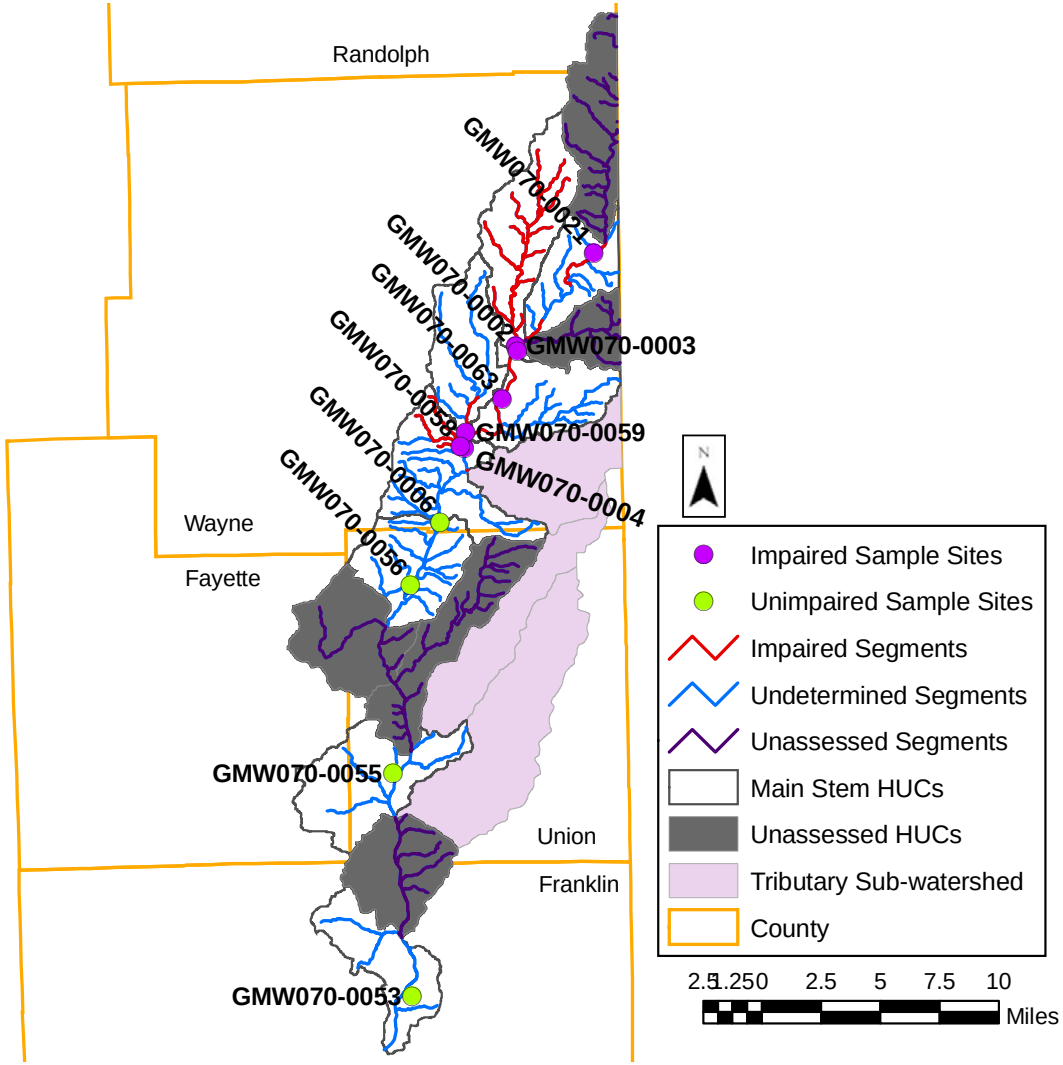


Figure 2b: Sampling Sites in Tributary Sub-watershed

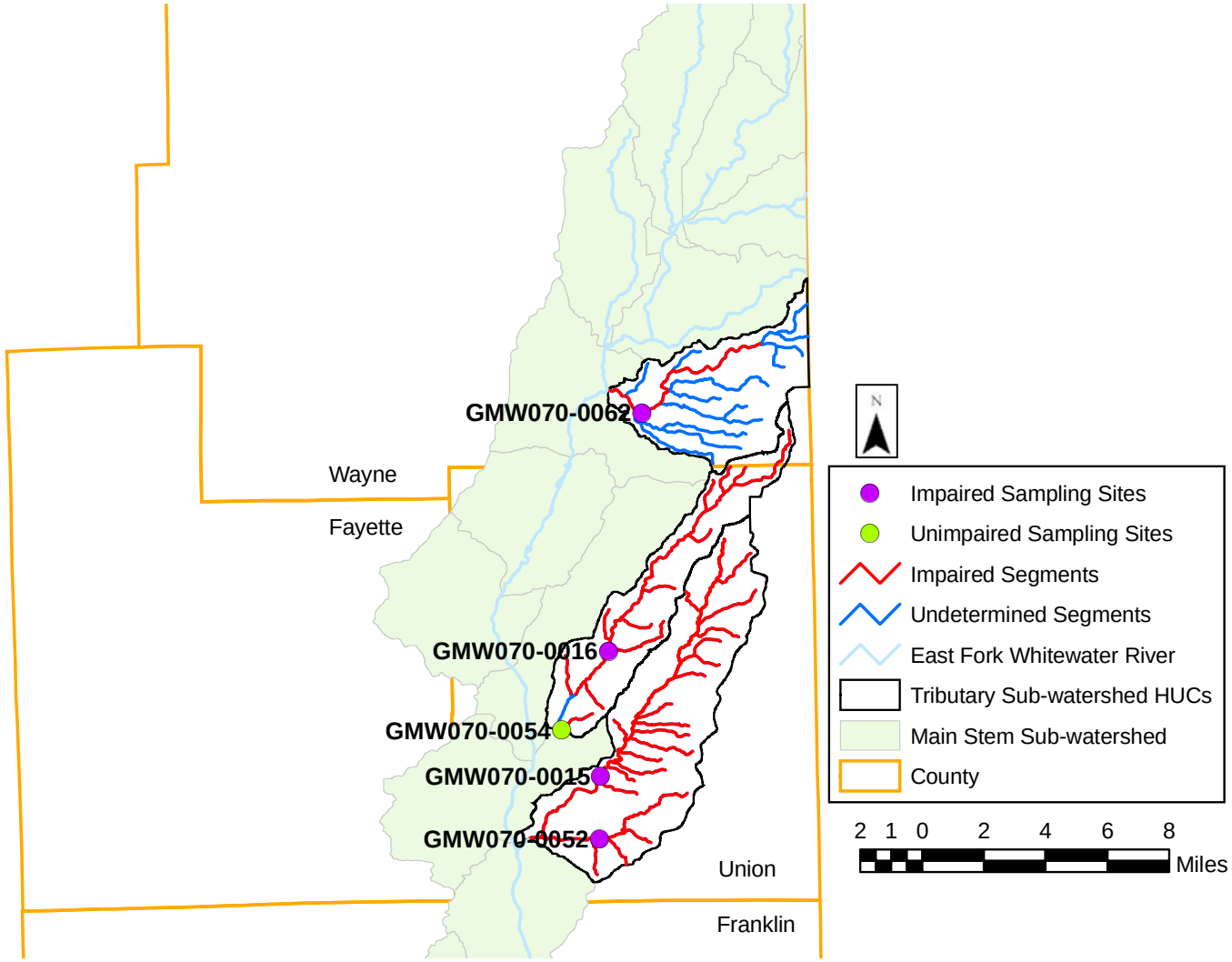


Figure 2c: External Sample Sites

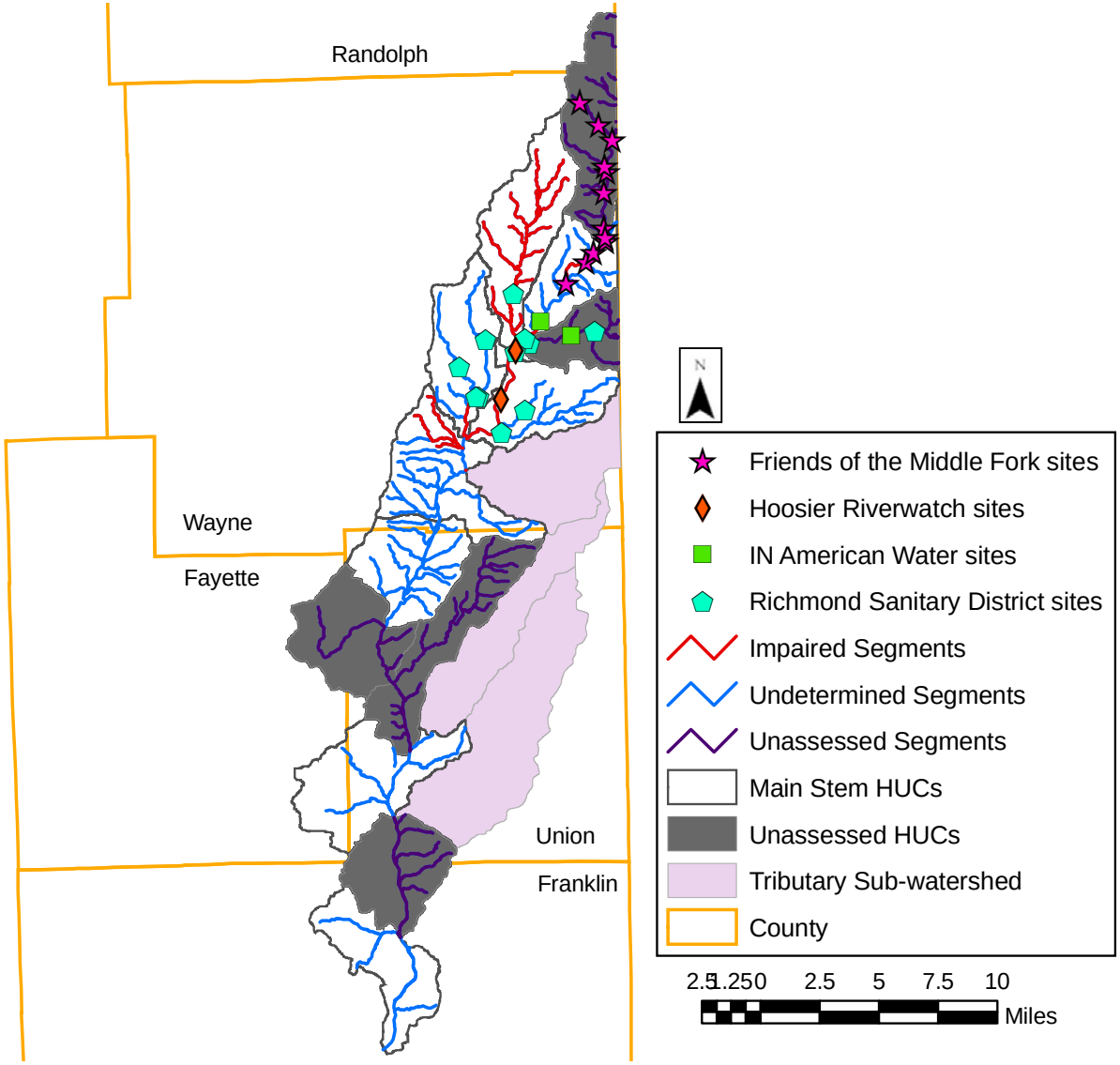


Figure 3a: Landuse in Main Stem Sub-watershed

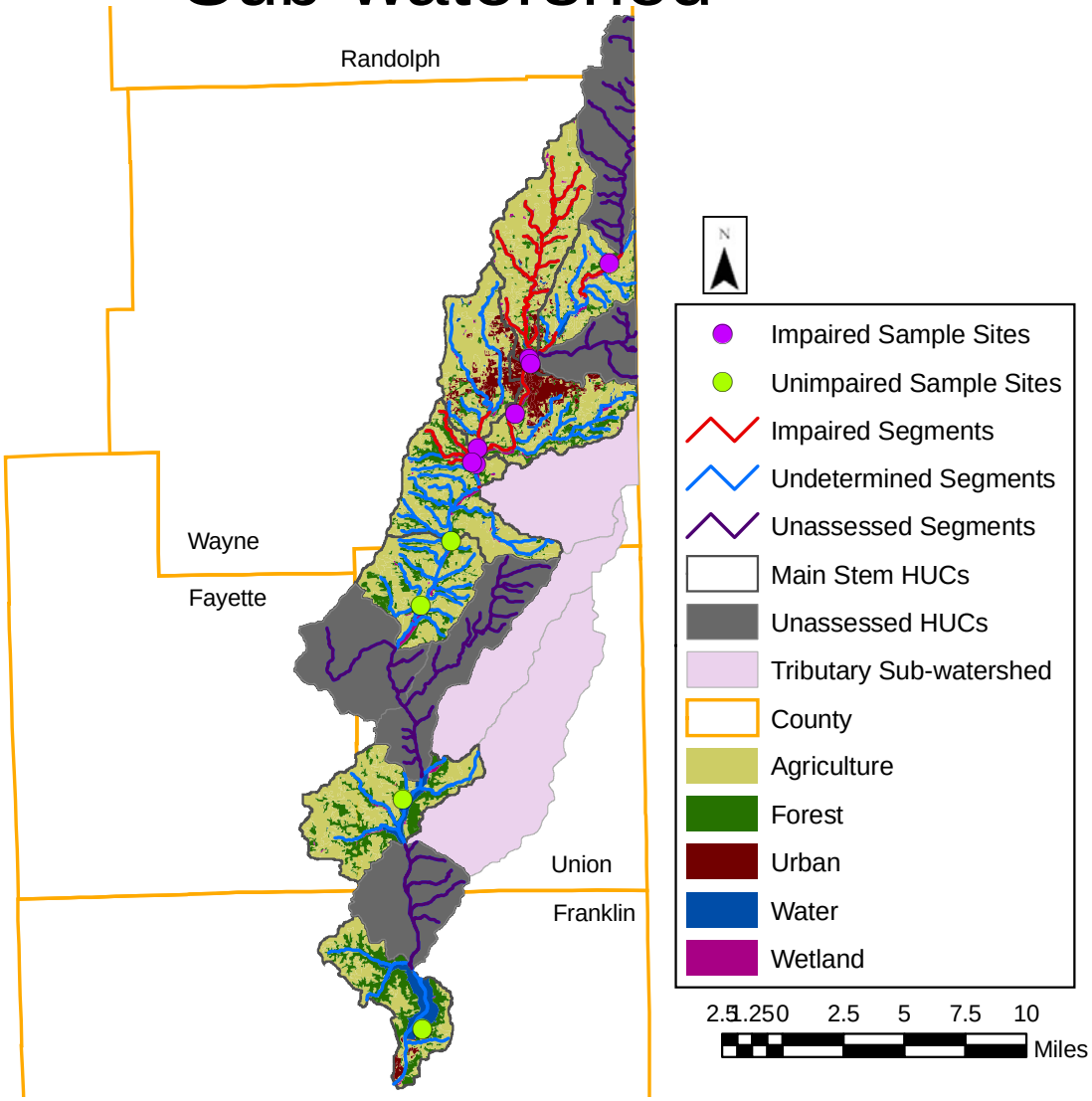
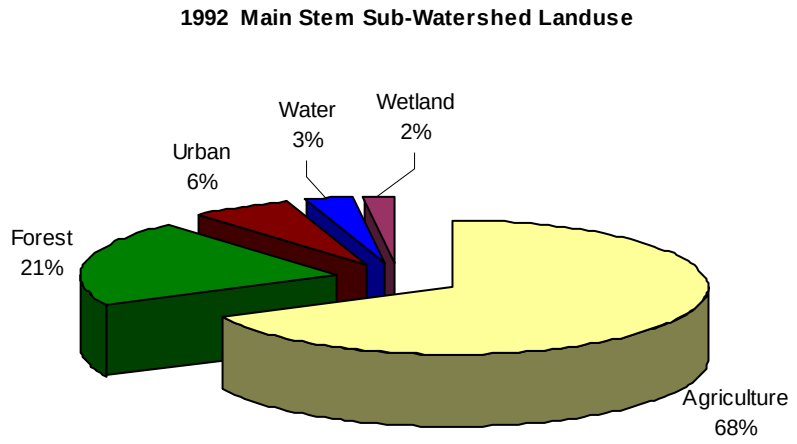


Figure 3b: Landuse Breakdown Main Stem Sub-watershed



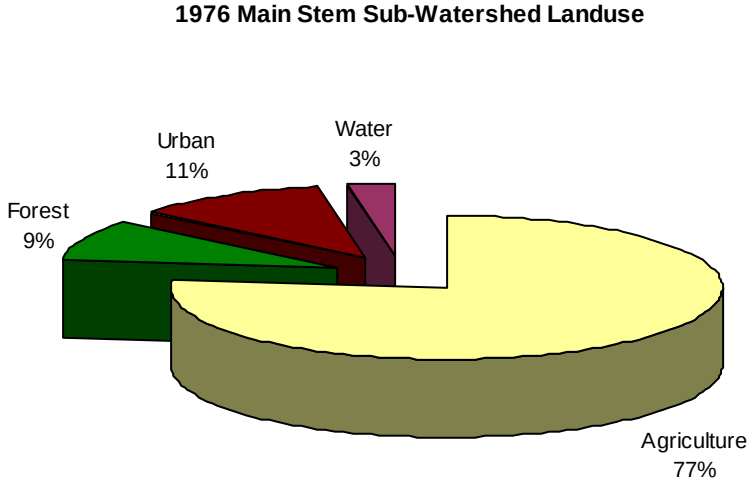


Figure 4: NPDES Permits in Main Stem Sub-watershed

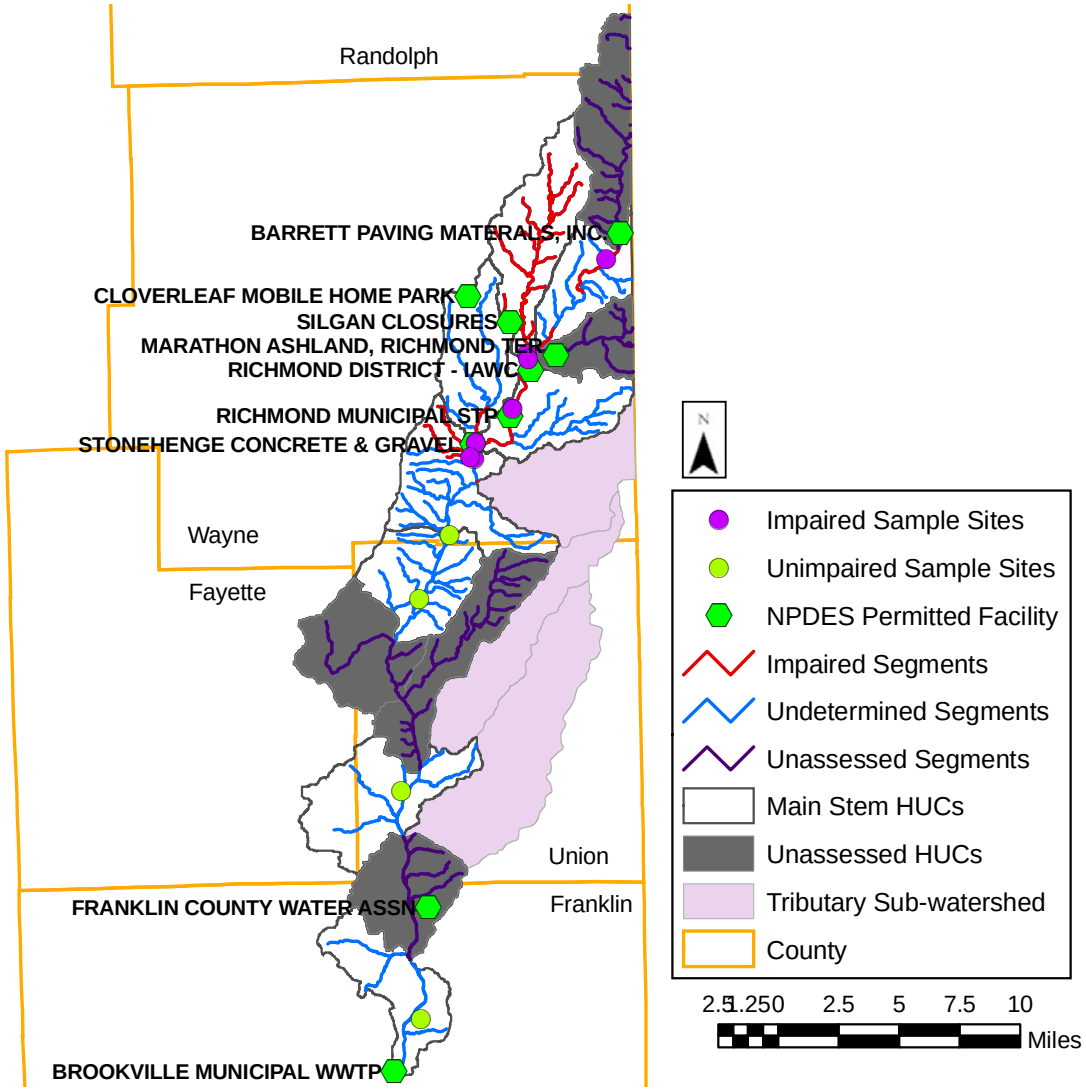


Figure 5: CSOs and SSOs in Main Stem Sub-watershed

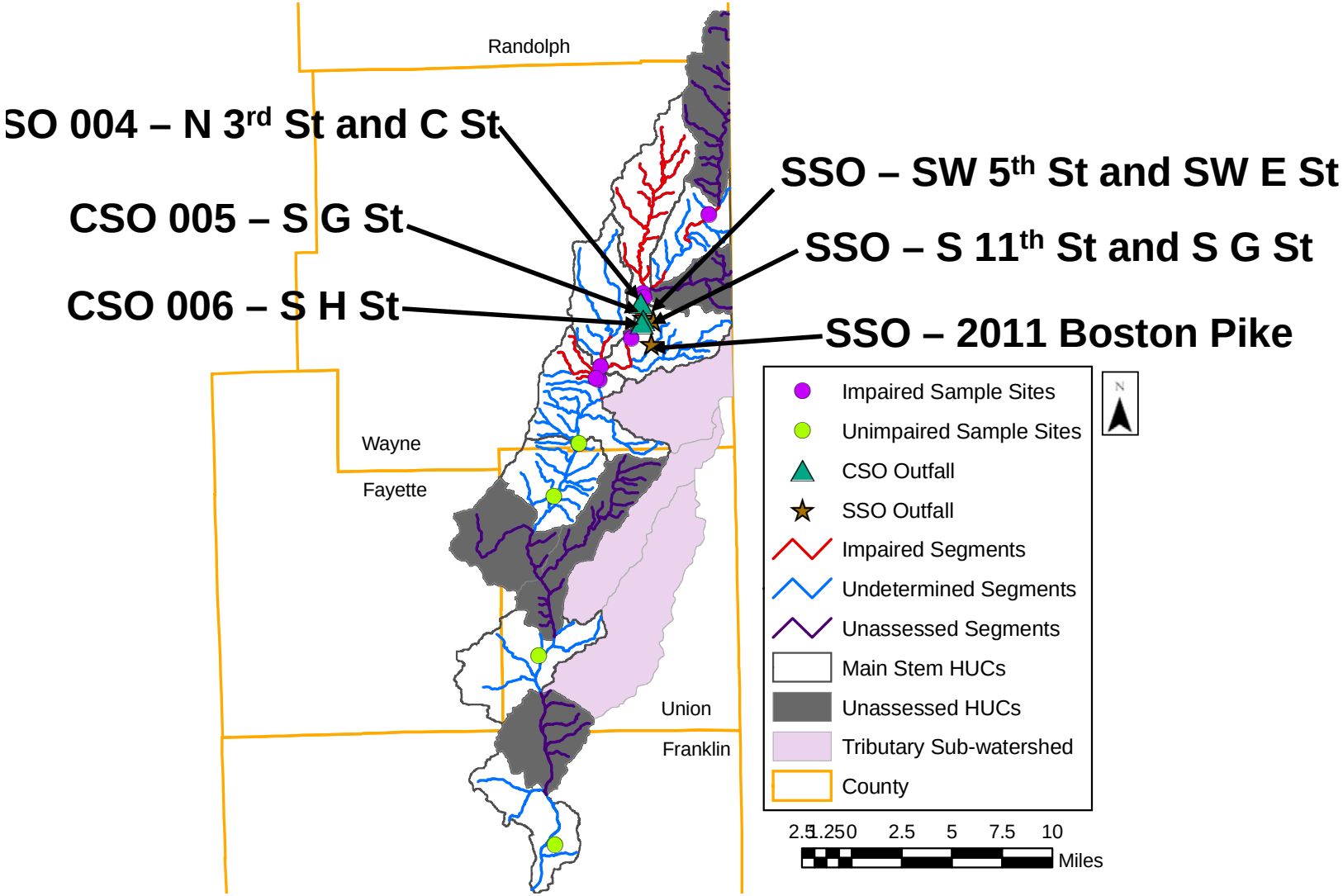


Figure 6: CFOs in Main Stem Sub-watershed

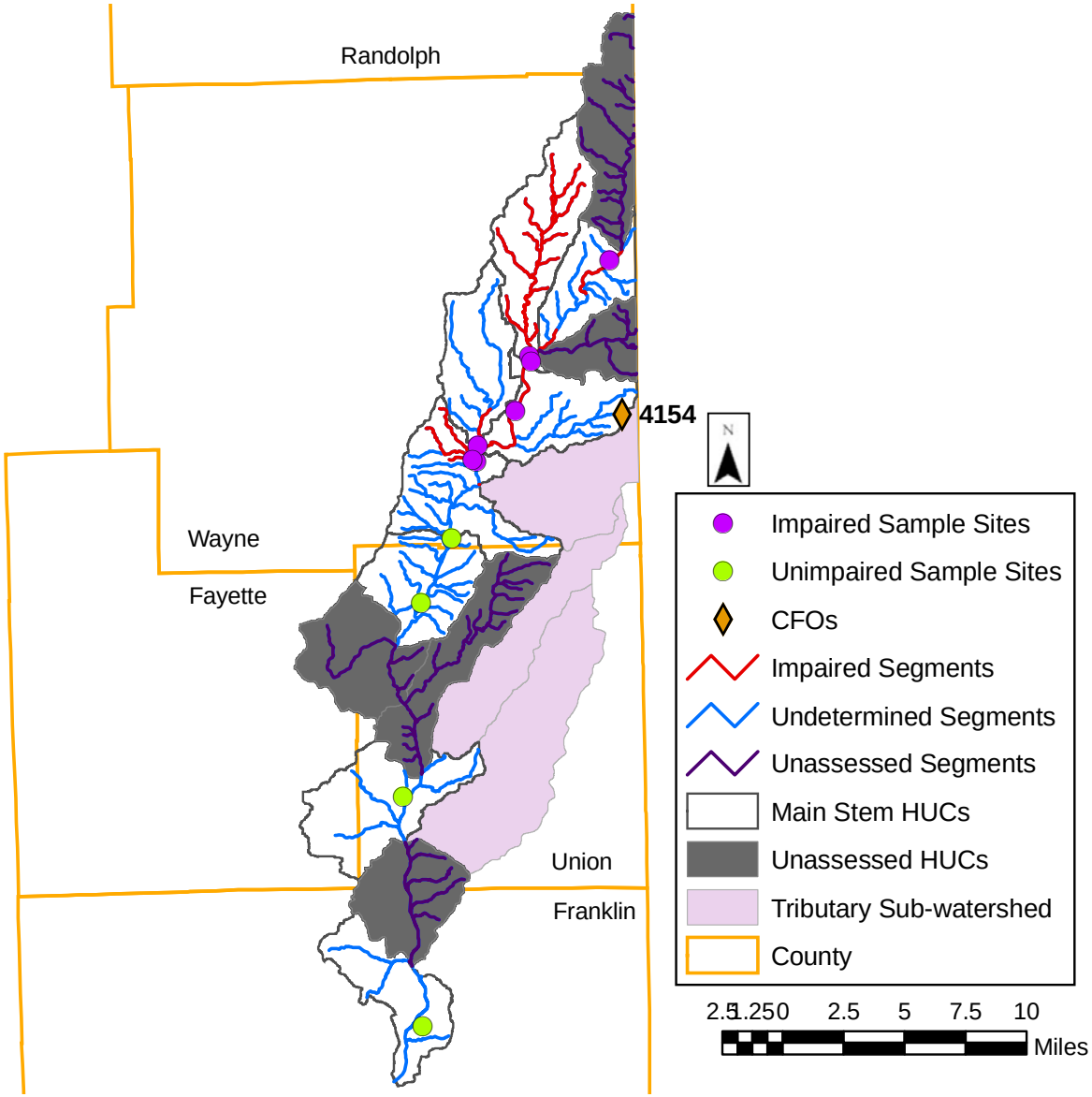


Figure 7a: Landuse in Tributary Sub-watershed

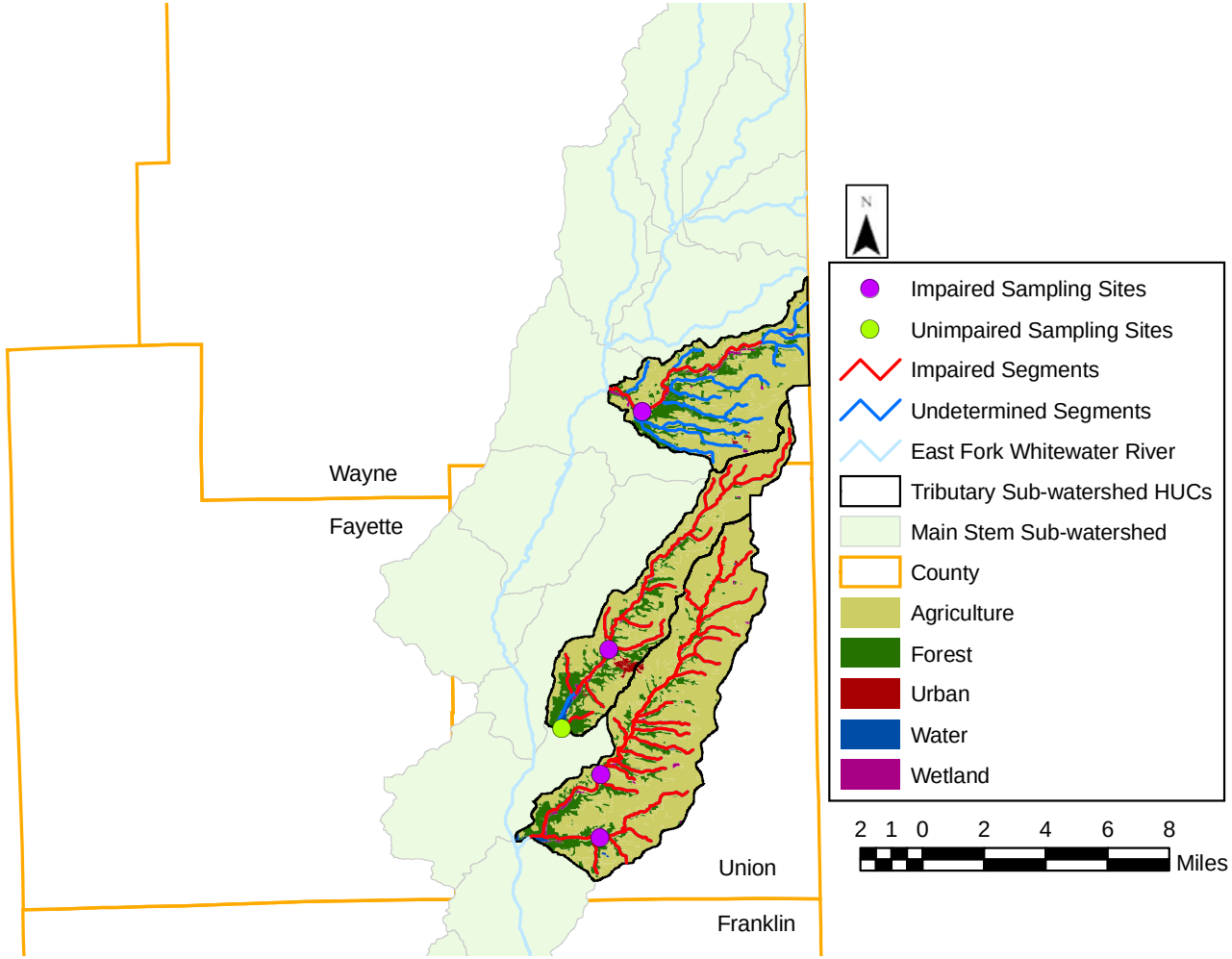
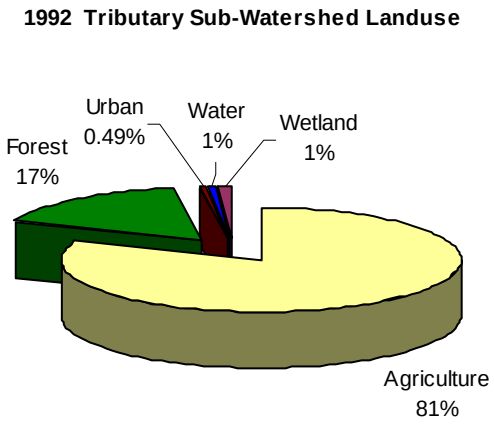


Figure 7b: Landuse Breakdown Tributary Sub-watershed



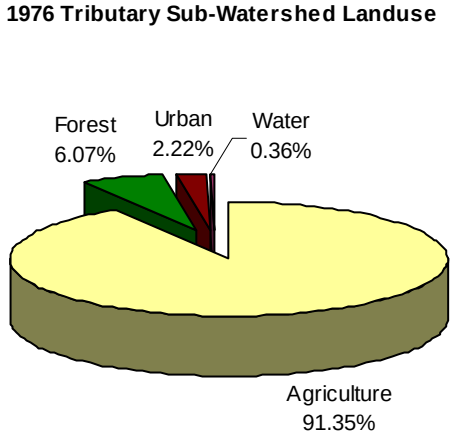


Figure 8: NPDES Permits in Tributary Sub-watershed

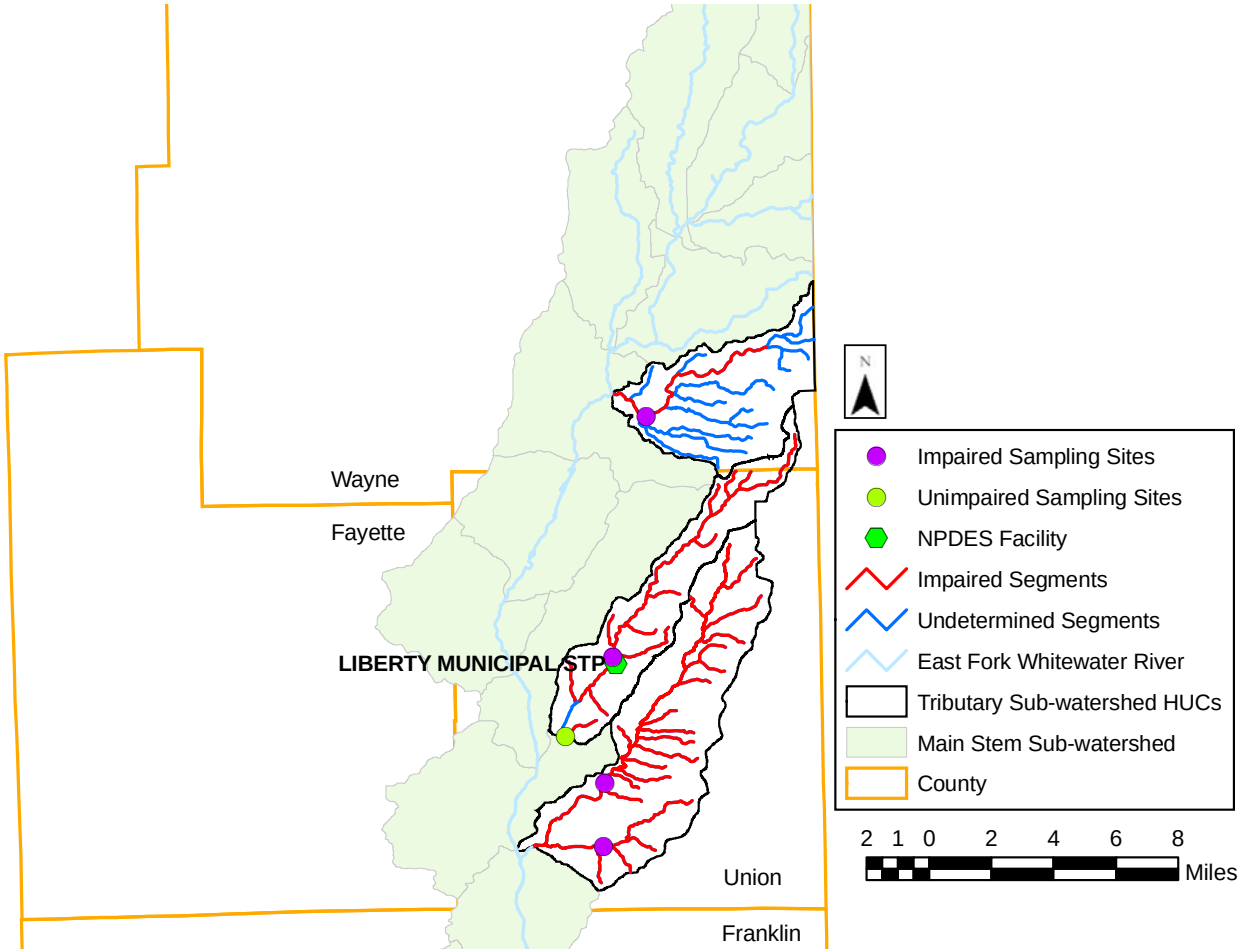
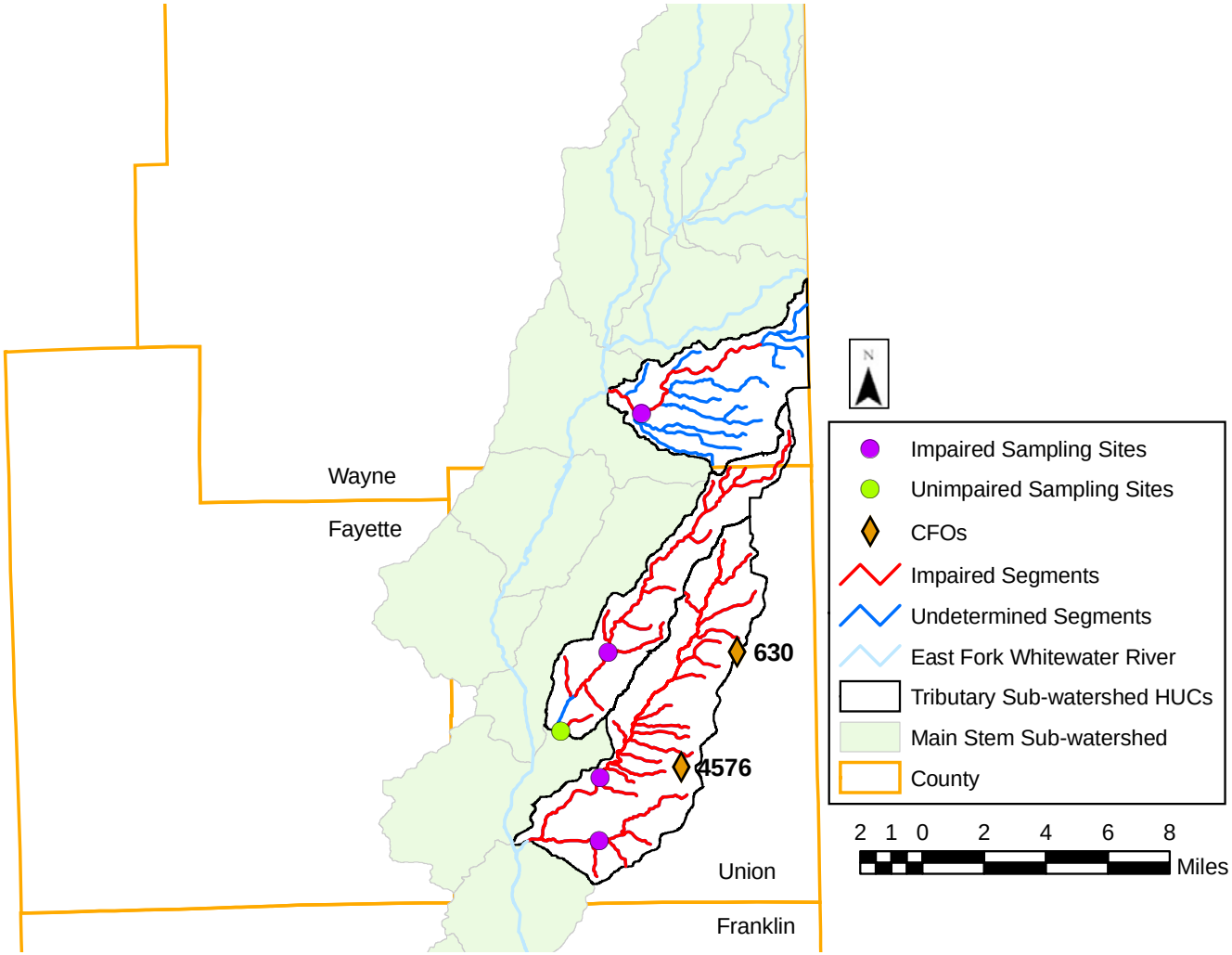


Figure 9: CFOs in Tributary Sub-watershed



Attachment A

E. coli Data for East Fork Whitewater River Watershed TMDL

<<left intentionally blank for double-sided printing>>

IDEM Data
Main Stem Segments

Site #	Project ID	L-Site #	Stream Name	Description	Sample #	Sample Date	E.coli (MPN/100mL)	Geometric Mean
2	1997 Synoptic	GMW070-0002	E Fk Whitewater River	Sim Hodgin Pkwy	DA10526	10/2/97	6600	N/A
					DA10425	7/23/97	800	
					DA10320	6/11/97	800	
1	2002 E. coli in Whitewater River	GMW070-0021	Middle Fk E Fk Whitewater Rive	SR 227 at Middleboro	AA11342	6/10/2002	121.1	159.21
					AA11525	6/24/2002	166.4	
					AA11857	7/1/2002	234.2	
					AA12235	7/8/2002	191.8	
					AA12319	7/15/2002	113	
2	2002 East Fork Whitewater River TMDL Assessment	GMW070-0002	E Fk Whitewater River	Sim Hodgin Pkwy	AA11639	6/24/2002	365.4	728.27
					AA11923	7/1/2002	980.4	
					AA12286	7/8/2002	2400	
					AA12372	7/15/2002	547.5	
					AA11639	6/24/2002	435.2	
3	2002 E. coli in Whitewater River	GMW070-0003	W Fk E Fk Whitewater River	Bridge Ave, Richmond	AA11343	6/10/2002	155.3	410.94
					AA11343	6/24/2002	1732.8	
					AA11859	7/1/2002	344.8	
					AA12236	7/8/2002	307.6	
					AA12320	7/15/2002	410.6	
4	2002 East Fork Whitewater River TMDL Assessment	GMW070-0063	E Fk Whitewater River	Test Road	AA11638	6/24/2002	727	353.63
					AA11922	7/1/2002	770.1	
					AA12284	7/8/2002	119.1	
					AA12370	7/15/2002	285.1	
					AA12396	7/22/2002	290.9	
5	2002 East Fork Whitewater River TMDL Assessment	GMW070-0059	Lick Cr	Bridge on Abington Road, approx. 2 1/2 miles SW of Richmond	AA11636	6/24/2002	387.3	361.85
					AA11920	7/1/2002	344.1	
					AA12283	7/8/2002	307.6	
					AA12369	7/15/2002	328.2	
					AA12395	7/22/2002	461.1	

Site #	Project ID	L-Site #	Stream Name	Description	Sample #	Sample Date	E.coli (MPN/100mL)	Geometric Mean
6	2002 East Fork Whitewater River TMDL Assessment	GMW070-0004	E Fk Whitewater River	Beelor Rd	AA11637	6/24/2002	206.3	173.05
					AA11921	7/1/2002	461.1	
					AA12285	7/8/2002	74.9	
					AA12371	7/15/2002	101.7	
					AA12397	7/22/2002	214.2	
7	2002 East Fork Whitewater River TMDL Assessment	GMW070-0058	Unnamed Trib	Near intersection of Abington Pike and Beelor Road, 3 miles SW of Richmond	AA11635	6/24/2002	191.8	255.02
					AA11919	7/1/2002	193.5	
					AA12282	7/8/2002	238.2	
					AA12368	7/15/2002	517.2	
					AA12394	7/22/2002	235.9	
9	2002 East Fork Whitewater River TMDL Assessment	GMW070-0006	E Fk Whitewater River	Abington Pike Rd bridge, East edge of Abington	AA11633	6/24/2002	160.7	107.31
					AA11917	7/1/2002	488.4	
					AA12280	7/8/2002	55.6	
					AA12366	7/15/2002	52	
					AA12392	7/22/2002	62.7	
10	2002 East Fork Whitewater River TMDL Assessment	GMW070-0056	E Fk Whitewater River	Brownsville Road Bridge in Yankee Town	AA11631	6/24/2002	103.9	93.64
					AA11915	7/1/2002	231	
					AA12278	7/8/2002	52.8	
					AA12364	7/15/2002	71.2	
					AA12390	7/22/2002	79.8	
13	2002 E. coli in Whitewater River	GMW070-0055	Quakerstown SRA Swimming Beach	West Side of Brookville Reservoir	AA11376	6/12/2002	9.1	2.72
					AA11566	6/26/2002	4.1	
					AA11899	7/3/2002	1	
					AA12275	7/10/2002	4	
					AA12362	7/17/2002	1	
16	2002 E. coli in Whitewater River	GMW070-0053	Brookville Reservoir	Boat Ramp East side Dam End off SR 101	AA11370	6/12/2002	1	1.75
					AA11559	6/26/2002	4.1	
					AA11892	7/3/2002	2	
					AA12269	7/10/2002	2	
					AA12350	7/17/2002	1	

Tributary Segments

Site #	Project ID	L-Site #	Stream Name	Description	Sample #	Sample Date	E.coli (MPN/100mL)	Geometric Mean
8	2002 East Fork Whitewater River TMDL Assessment	GMW070-0062	Elkhorn Cr	Bridge upstream of SR27 crossing	AA11634	6/24/2002	69.5	193.10
					AA11918	7/1/2002	307.6	
					AA12281	7/8/2002	178.9	
					AA12367	7/15/2002	228.2	
					AA12393	7/22/2002	307.6	
11	2002 E. coli in Whitewater River	GMW070-0016	Silver Cr	Brownsville Rd	AA11374	6/12/2002	290	336.12
					AA11563	6/26/2002	166.9	
					AA11897	7/3/2002	325.5	
					AA12273	7/10/2002	1986.3	
					AA12354	7/17/2002	137.1	
12	2002 E. coli in Whitewater River	GMW070-0054	Whitewater Lake Boat Ramp	Whitewater Memorial State Park, West of SR 101	AA11375	6/12/2002	1	2.92
					AA11565	6/26/2002	2	
					AA11898	7/3/2002	4	
					AA12274	7/10/2002	8.6	
					AA12355	7/17/2002	3.1	
14	2002 E. coli in Whitewater River	GMW070-0015	Hanna Cr	SR 101	AA11372	6/12/2002	344.1	313.48
					AA11561	6/26/2002	435.2	
					AA11894	7/3/2002	461.1	
					AA12271	7/10/2002	816.4	
					AA12352	7/17/2002	53.7	
15	2002 E. coli in Whitewater River	GMW070-0052	Dubois Cr	SR 101 East of Brookville Resv.	AA11371	6/12/2002	461.1	550.81
					AA11560	6/26/2002	1300	
					AA11893	7/3/2002	488.4	
					AA12270	7/10/2002	727	
					AA12351	7/17/2002	238.2	

External Data
Richmond Sanitary District: *E. coli* Results (CFU / 100 mL)

Sample Date	EFWWR near Footbridge at Weir Dam	EFWWR at Test Road Bridge	East Fork Whitewater River South of WWTP	Sample Date	EFWWR near Footbridge at Weir Dam	EFWWR at Test Road Bridge	EFWWR South of WWTP
10/18/2002	100	200	250	10/22/2003	100	250	50
10/24/2002	350	150	50	10/29/2003	400	450	600
10/28/2002	300	400	300	4/7/2004	436	250	105
4/4/2003	450	200	150	4/15/2004	461	272	79
4/11/2003	800	300	100	4/23/2004	1553	1046	1046
4/16/2003	750	150	150	4/29/2004	118	152	140
4/23/2003	500	400	100	5/6/2004	238	199	130
4/30/2003	250	150	0	5/13/2004	190	249	125
5/7/2003	No Result	1250	1700	5/20/2004	>4840	>4840	>4840
5/15/2003	1650	800	900	5/26/2004	996	364	316
5/22/2003	1150	750	600	6/4/2004	688	316	384
5/28/2003	4400	5500	200	6/9/2004	816	548	687
6/4/2003	650	450	500	6/25/2004	3080	3464	2748
6/11/2003	1050	2450	3200	7/1/2004	404	316	164
6/18/2003	1250	950	750	7/8/2004	470	360	170
6/25/2003	700	1100	500	7/15/2004	240	250	120
7/3/2003	800	350	200	7/23/2004	3260	4350	4350
7/8/2003	4300	9000	7200	7/28/2004	444	248	212
7/16/2003	2800	3000	1950	8/4/2004	12980	No Sample	>48400
7/23/2003	13600	3800	10950	8/12/2004	592	122	156
8/1/2003	800	1250	800	8/19/2004	350	280	320
8/7/2003	950	2200	1400	8/27/2004	1414	727	921
8/14/2003	750	700	650	9/7/2004	750	210	390
8/22/2003	900	650	600	9/16/2004	291	517	461
8/28/2003	850	900	1250	9/24/2004	>2420	2420	1986
9/4/2003	1100	750	800	9/30/2004	>4840	1842	1034
9/9/2003	550	300	No Result	10/8/2004	1044	740	344
9/17/2005	850	500	350	10/15/2004	4884	1145	400
9/24/2003	1250	1350	750	10/22/2004	372	488	568
10/1/2003	1550	1600	950	10/27/2004	384	668	508
10/9/2003	400	200	100	11/10/2004	140	201	579
10/17/2003	450	850	750	11/18/2004	225	727	1203
12/1/2004	518	568	7944	4/28/2005	1842	616	870
12/10/2004	261	435	980	5/3/2005	548	727	579

Sample Date	EFWWR near Footbridge at Weir Dam	EFWWR at Test Road Bridge	East Fork Whitewater River South of WWTP	Sample Date	EFWWR near Footbridge at Weir Dam	EFWWR at Test Road Bridge	EFWWR South of WWTP
12/17/2004	86	308	387	5/20/2005	2828	1632	1732
12/21/2004	86	201	299	6/3/2005	1986	1203	1300
12/30/2004	>2420	2420	>2420	6/10/2005	1096	346	166
1/11/2005	1540	>4840	>4840	6/17/2005	1664	638	238
1/21/2005	>2420	1733	1203	6/23/2005	1158	212	116
1/26/2005	1414	1986	>2420	7/7/2005	822	230	238
2/4/2005	1226	3466	3972	7/14/2005	3106	1454	356
2/11/2005	1096	552	1034	7/21/2005	1842	222	168
2/15/2005	520	774	690	8/12/2005	219	140	202
2/25/2005	320	460	500	8/19/2005	1226	>4840	3974
3/4/2005	613	816	727	8/26/2005	1098	976	582
3/18/2005	365	64	67	9/23/2005	398	132	278
3/23/2005	2420	816	770	9/28/2005	320	544	220
3/31/2005	690	156	150	10/13/2005	250	94	108
4/8/2005	332	372	358	4/6/2006	186	127	130
4/13/2005	866	687	411	4/13/2006	187	157	70
4/19/2005	411	99	137	5/4/2006	>2420	>2420	>2420

Receiving Stream 2005 Sample Data

Parameter	RS1DRY	RS1WET	RS2DRY	RS2WET	RS3DRY	RS3WET
E. coli	609	1920	4611	14140	0	620
	RS4DRY	**RS4WET**	**RS5DRY**	**RS5WET**	**RS6DRY**	**RS6WET**
	110	1850	203	3610	384	1320

MS4 Receiving Stream 2006 Sample Data

Sample Date	Location	*E. coli*		Sample Date	Location	*E. coli*
5/10/2006	RS1DRY	196		5/16/2006	RS1WET	670
5/10/2006	RS2DRY	246		5/16/2006	RS2WET	430
5/10/2006	RS3DRY	20		5/16/2006	RS3WET	450
5/10/2006	RS4DRY	112		5/16/2006	RS4WET	570
5/10/2006	RS5DRY	160		5/16/2006	RS5WET	500
5/10/2006	RS6DRY	126		5/16/2006	RS6WET	550

Sites 1, 2, 5, and 6 located on the East Fork Whitewater River
Site 3 located on the Middle Fork of the East Fork Whitewater River
Site 4 located on the West Fork of the East Fork Whitewater River

Indiana American Water *E. coli* Monitoring

SAMPLE ID	LABORATORY ID	PLANT NAME	COLLECTION		TURBIDITY (NTU)	RESULTS	
						Total Coliform	*E. coli*
			DATE	TIME		MPN/ 100mL	MPN/ 100mL
CG49255-EC	M-18-1	Middle Fork	9/17/03	13:06	5		4.2
CG49254-EC	M-18-1	Main Station	9/17/03	10:57	0.168		<1
CG54645-EC	M-18-1	Middle Fork	10/20/03	9:00	7		11.1
CG54644-EC	M-18-1	Main Station	10/20/03	8:00	0.1		1
CG58024-EC	M-18-1	Middle Fork	11/17/03	11:10	6		83.1
CG58025-EC	M-18-1	Main Station	11/17/03	10:30	0.1		<1
CG59619-EC	M-18-1	Middle Fork	12/16/03	11:15	8		13.7
CG59620-EC	M-18-1	Main Station	12/16/03	10:00	0.2		<1
CH01357-EC	M-18-1	Middle Fork	1/19/04	10:30	20		27
CH01356-EC	M-18-1	Main Station	1/19/04	10:50	0.1		<1
CH04728-EC	M-18-1	Middle Fork	2/17/04	9:30	6		4.2
CH04727-EC	M-18-1	Main Station	2/17/04	9:45	0.1		<1
CH07076-EC	M-18-1	Middle Fork	3/15/04	9:00	5	88.5	2
CH07075-EC	M-18-1	Main Station	3/15/04	11:00	0.12	3.1	<1
CH09730-EC	M-18-1	Middle Fork	4/14/04	10:00	9	50	2
CH09731-EC	M-18-1	Main Station	4/14/04	9:00	0.1	14	<1
CH13654-EC	M-18-1	Middle Fork	5/17/04	10:00	5	1184	3.1

CH13653-EC	M-18-1	Main Station	5/17/04	9:00	0.1	32.4	<1
CH16105-EC	M-18-1	Middle Fork	6/14/04	10:00	19	2710	69.7
CH16104-EC	M-18-1	Main Station	6/14/04	9:00	0.1	73.8	2
CH21034-EC	M-18-1	Middle Fork	7/13/04	10:00	5	782	8.7
CH21035-EC	M-18-1	Main Station	7/13/04	9:00	0.1	8.7	<1
CH34424-EC	M-18-1	Middle Fork	8/16/04	10:00	13	288	3.1
CH34425-EC	M-18-1	Main Station	8/16/04	9:00	0.1	20.7	<1
CH40147-EC	M-18-1	Middle Fork	9/13/04	10:00	7	200.5	11.1
CH40146-EC	M-18-1	Main Station	9/13/04	9:00	0.1	34.4	<1
CH47065-EC	M-18-1	Middle Fork	10/18/04	13:00			
CH47066-EC	M-18-1	Main Station	10/18/04	14:00			
CH52552-EC	M-18-1	Middle Fork	11/15/04	10:00	5	453	34.4
CH52553-EC	M-18-1	Main Station	11/15/04	9:00	0.1	9.9	<1
CH55698-EC	M-18-1	Middle Fork	12/13/04	10:00	10	2005	38.4
CH55690-EC	M-18-1	Main Station	12/13/04	9:00	0.2	15	<1
CH61744-EC	M-18-1	Main Station	1/17/05	8:30	0.2	15	1
CH61745-EC	M-18-1	Middle Fork	1/17/05	9:00	91	14450	200.5
CH67620-EC	M-18-1	Main Station	2/14/05	10:00	0.1	8.7	<1
CH67621-EC	M-18-1	Middle Fork	2/14/05	9:00	20	7380	53.1
CJ02303-EC	C-08-01	Main Station	3/14/05	9:00	0.1	3	<1

CJ02304-EC	C-08-01	Middle Fork	3/14/05	10:00	5	74	<1
CJ09557-EC	C-08-01	Main Station	4/18/05	9:00	0.2	16	<1
CJ09558-EC	C-08-01	Middle Fork	4/18/05	10:00	10	27	2
CJ11863-EC	C-08-01	Main Station	5/16/05	9:00	0.1	10	<1
CJ11864-EC	C-08-01	Middle Fork	5/16/05	10:00	18	>200	313
CJ20397-EC	C-08-01	Main Station	6/14/05	9:00	0.1	>200	3
CJ20398-EC	C-08-01	Middle Fork	6/14/05	10:00	2	>200	13
CJ39735-EC	C-08-01	Middle Fork	7/18/05	10:00	2	>2419	3
CJ40047-EC	C-08-01	Middle Fork	8/15/05	9:00	6	>200	1
CJ48351-EC	C-08-01	Middle Fork	9/19/05	9:00	6	>200	15
CJ42362-EC	C-08-01	Middle Fork	10/17/05	9:00	8	200	<1
CJ53163-EC	C-08-01	Middle Fork	11/7/05	10:00	15	>200	162
CJ55526-EC	C-08-01	Middle Fork	12/19/05	10:00	9	121	2

Hoosier RiverWatch Data

Site ID	Watershed Name	Date	River Name	Description	E-coli (colonies 100 mL)	General Coliforms (colonies 100 mL)
683	Whitewater 05080003	10/18/2002	East Fork Whitewater River (west branch)	near intersection of Sim HodginParkway and Bridge Avenue-Bicentennial Park	160	
683	Whitewater 05080003	9/24/2005	East Fork Whitewater River (west branch)	near intersection of Sim HodginParkway and Bridge Avenue-Bicentennial Park		20

Data collected by the Friends of the Middle Fork is available in hard copy form.

Attachment B

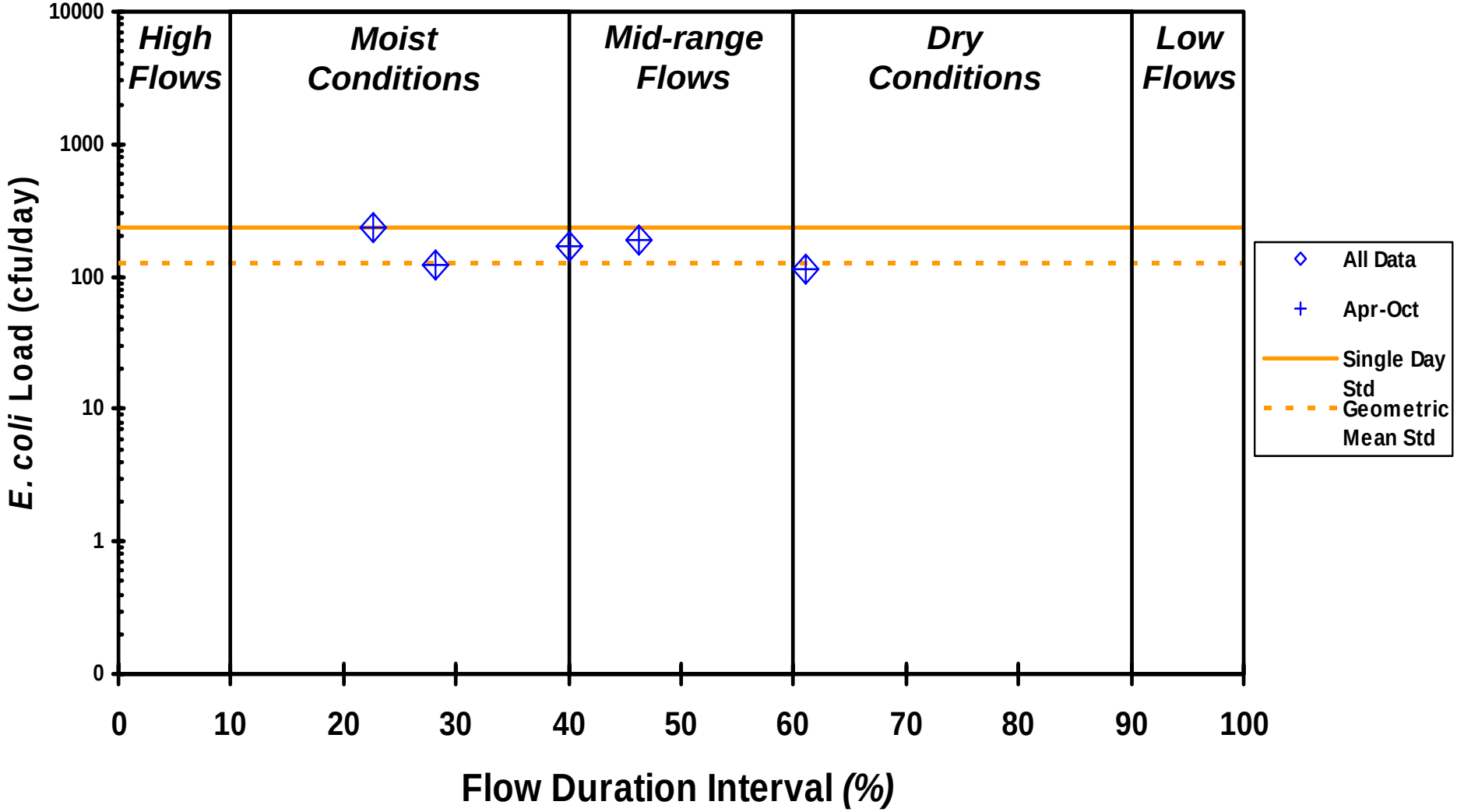
Water Quality Duration Curves for East Fork Whitewater River Watershed TMDL

<<left intentionally blank for double-sided printing>>

East Fork Whitewater River

Water Quality Duration Curve

Site: GMW070-0021



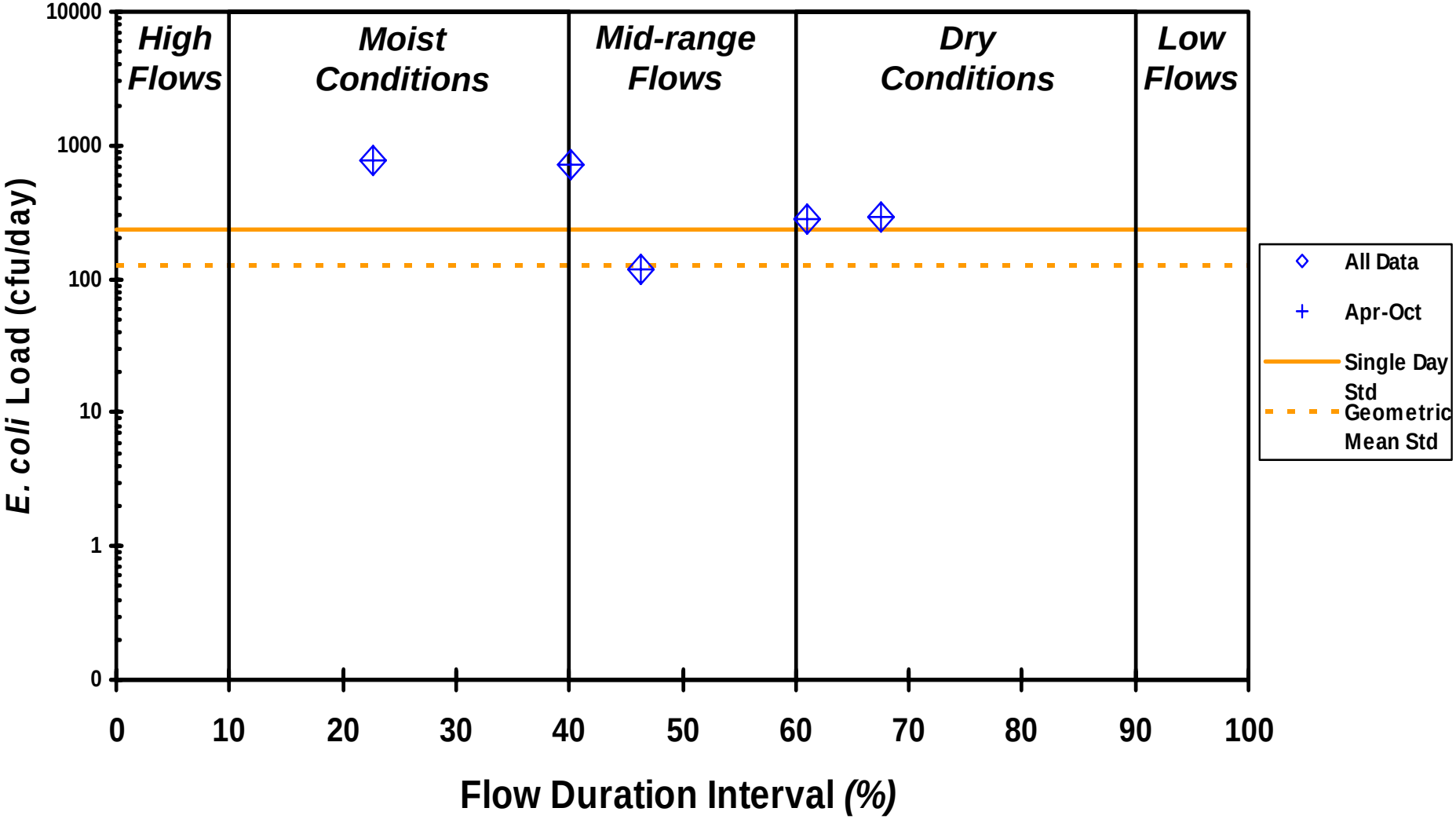
IDEM Data & USGS Gage Duration Interval

380 square miles

East Fork Whitewater River

Water Quality Duration Curve

Site: GMW070-0063



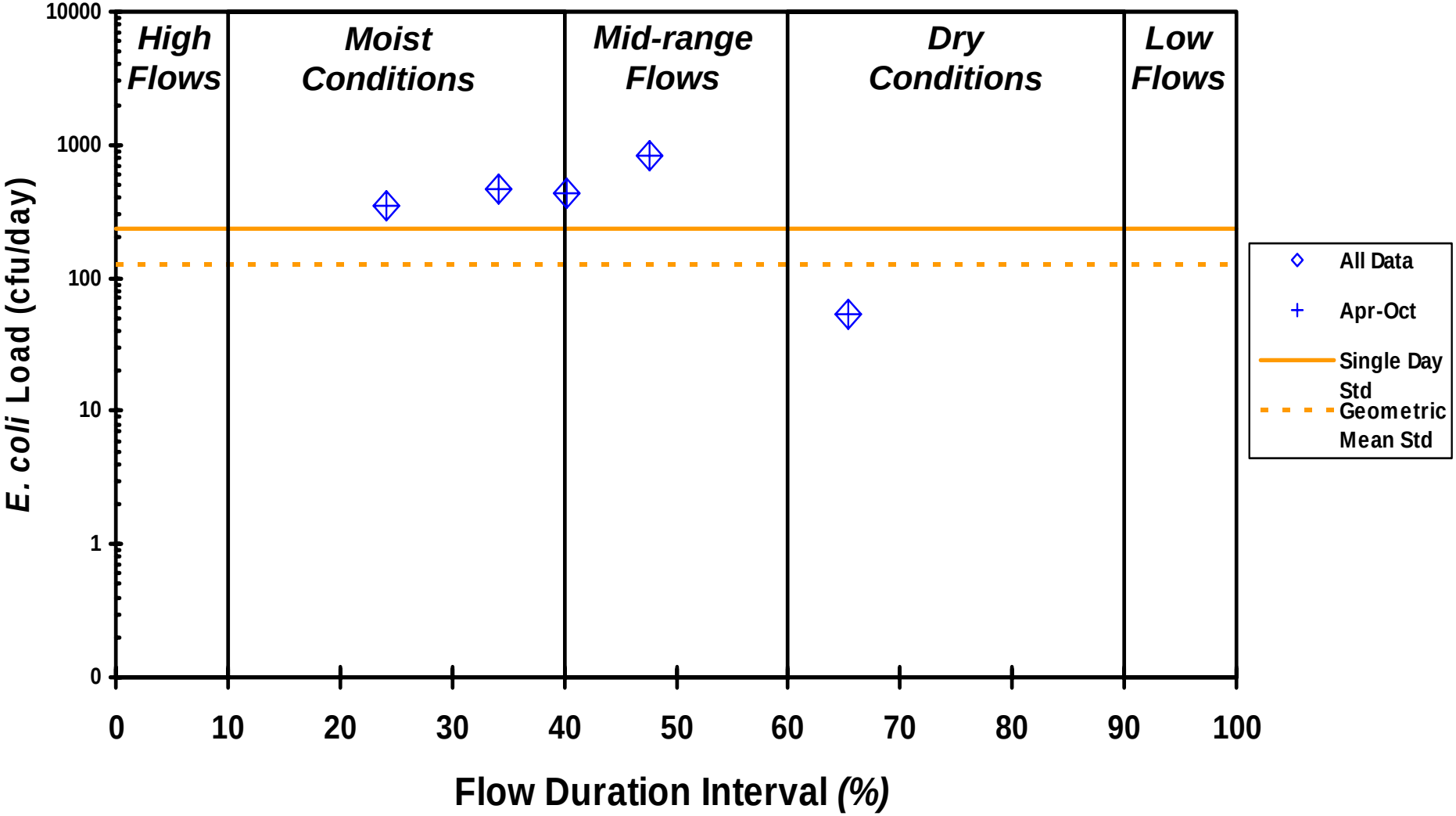
IDEM Data & USGS Gage Duration Interval

380 square miles

East Fork Whitewater River

Water Quality Duration Curve

Site: GMW070-0015



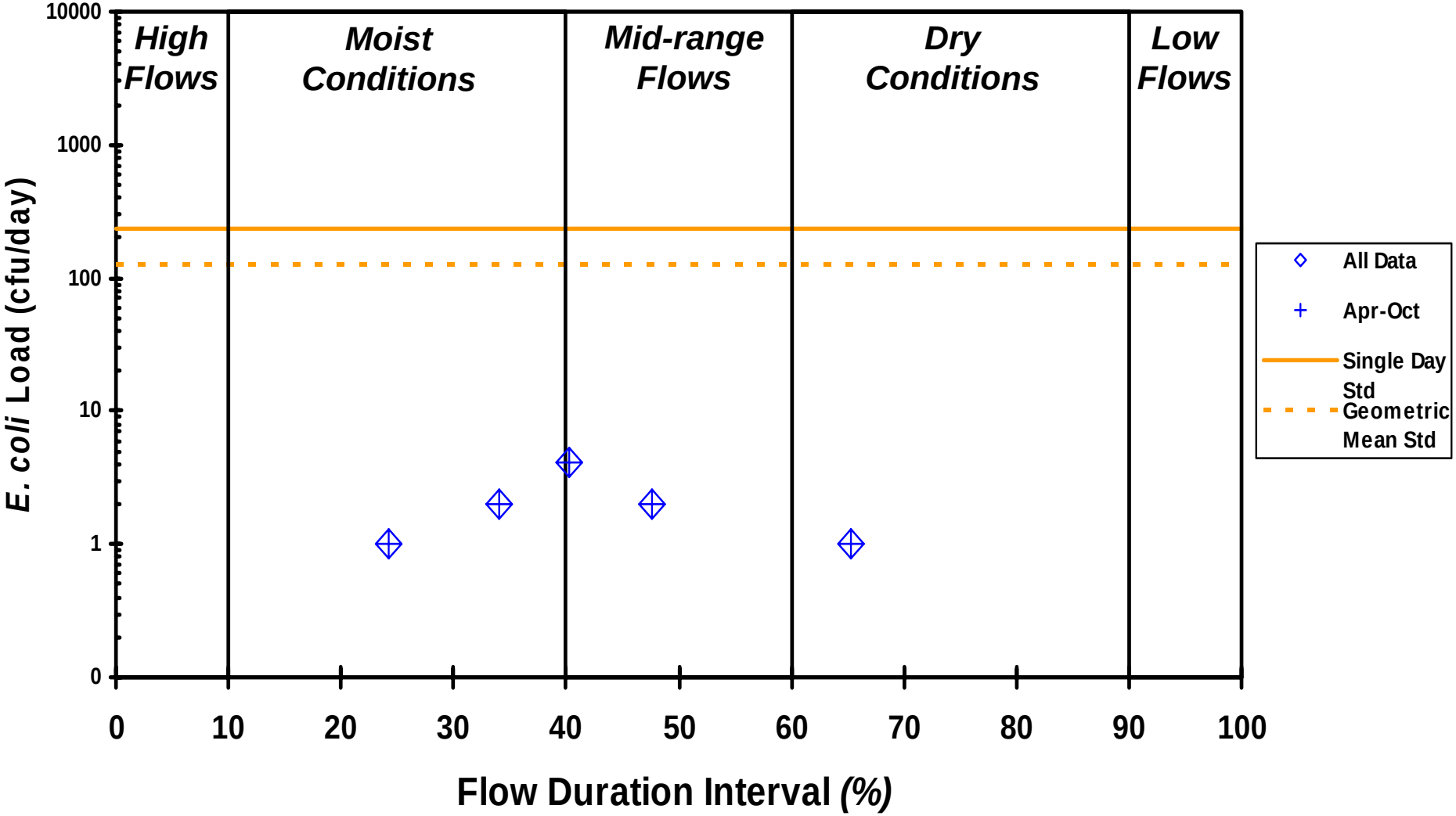
IDEM Data & USGS Gage Duration Interval

380 square miles

East Fork Whitewater River

Water Quality Duration Curve

Site: GMW070-0053



IDEM Data & USGS Gage Duration Interval

380 square miles

Attachment C

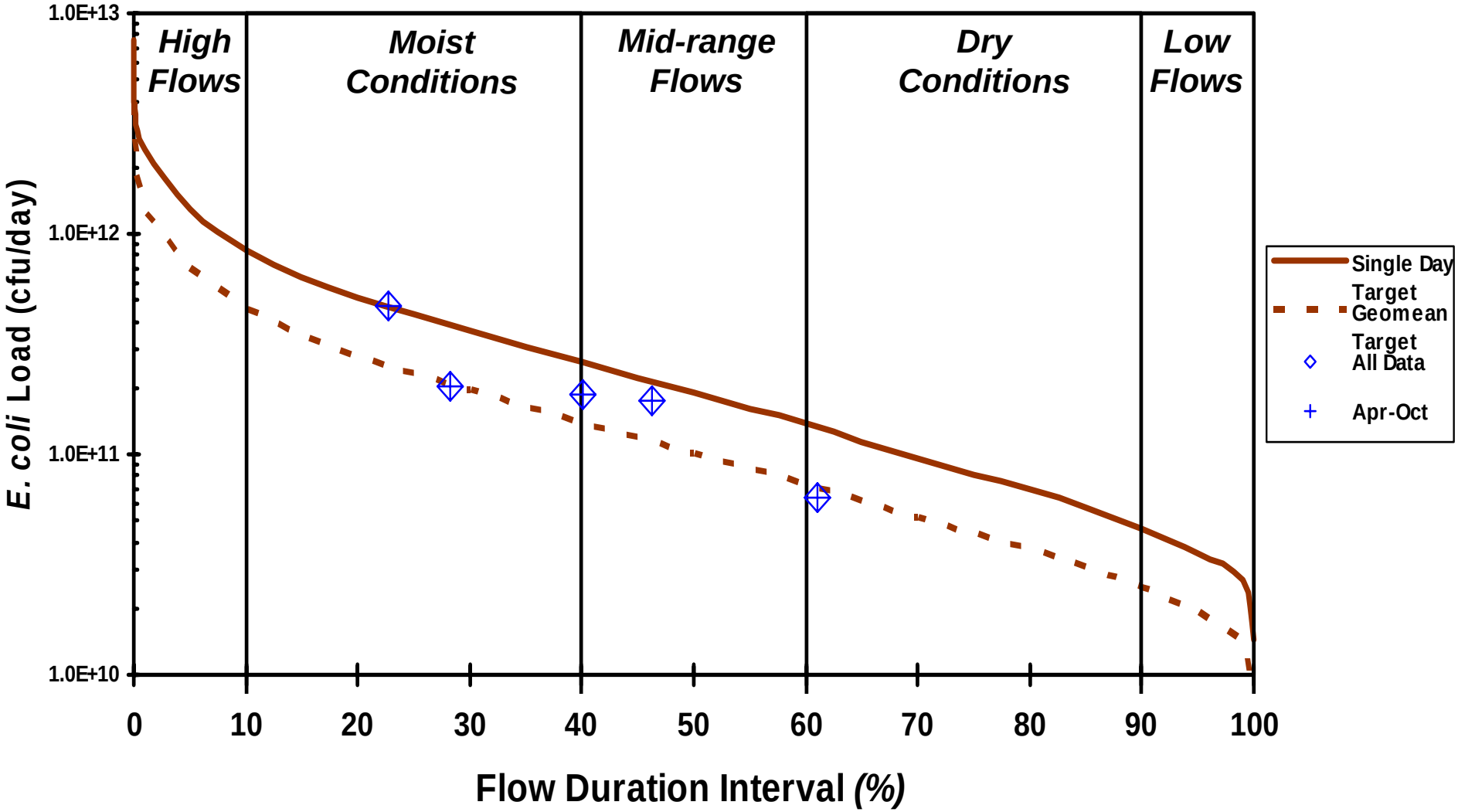
Load Duration Curves for
East Fork Whitewater River Watershed TMDL

<<left intentionally blank for double-sided printing>>

East Fork Whitewater River

Load Duration Curve

Site: GMW070-0021



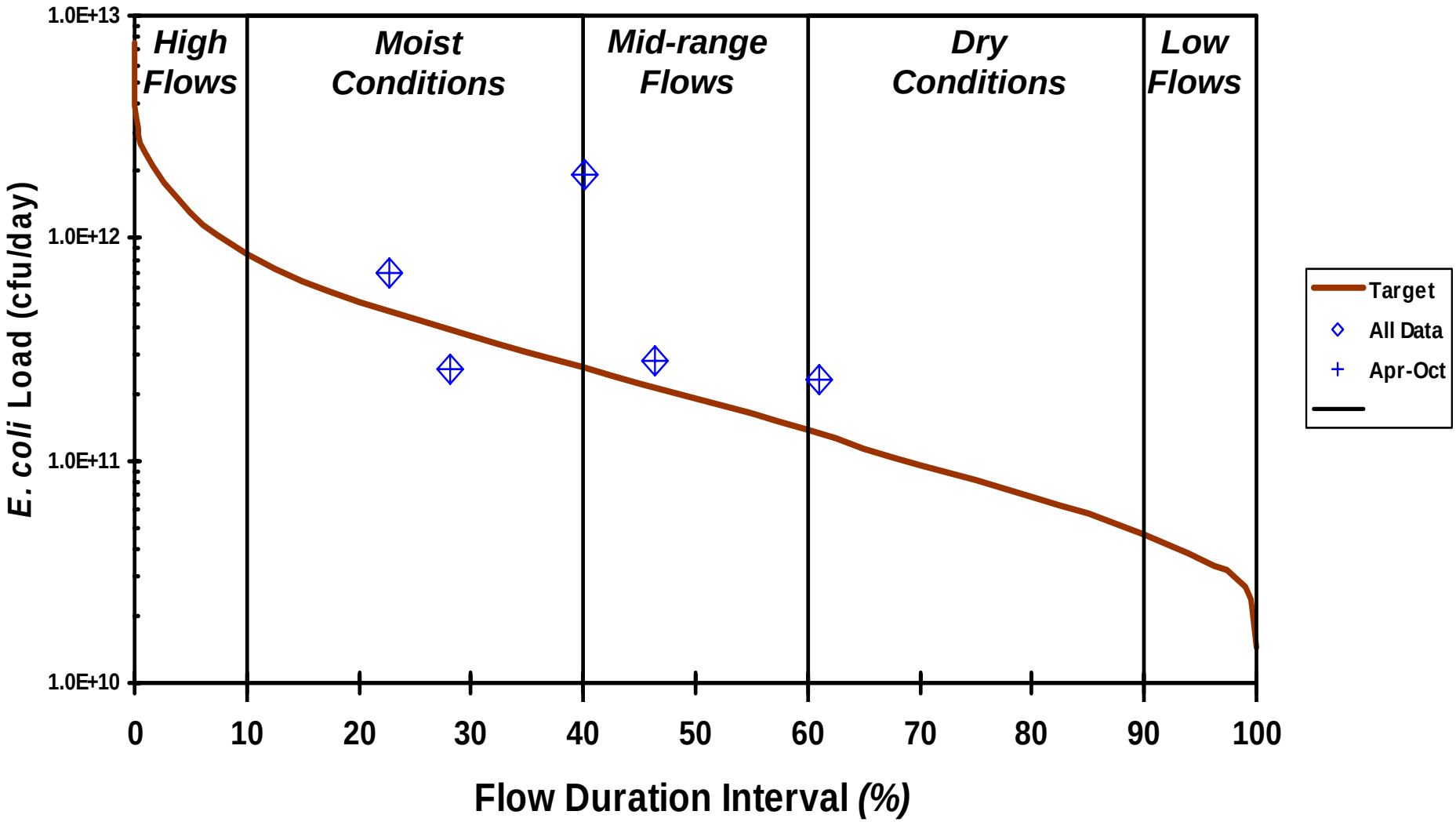
IDEM Data & USGS Gage Duration Interval

380 square miles

East Fork Whitewater River

Load Duration Curve

Site: GMW070-0003



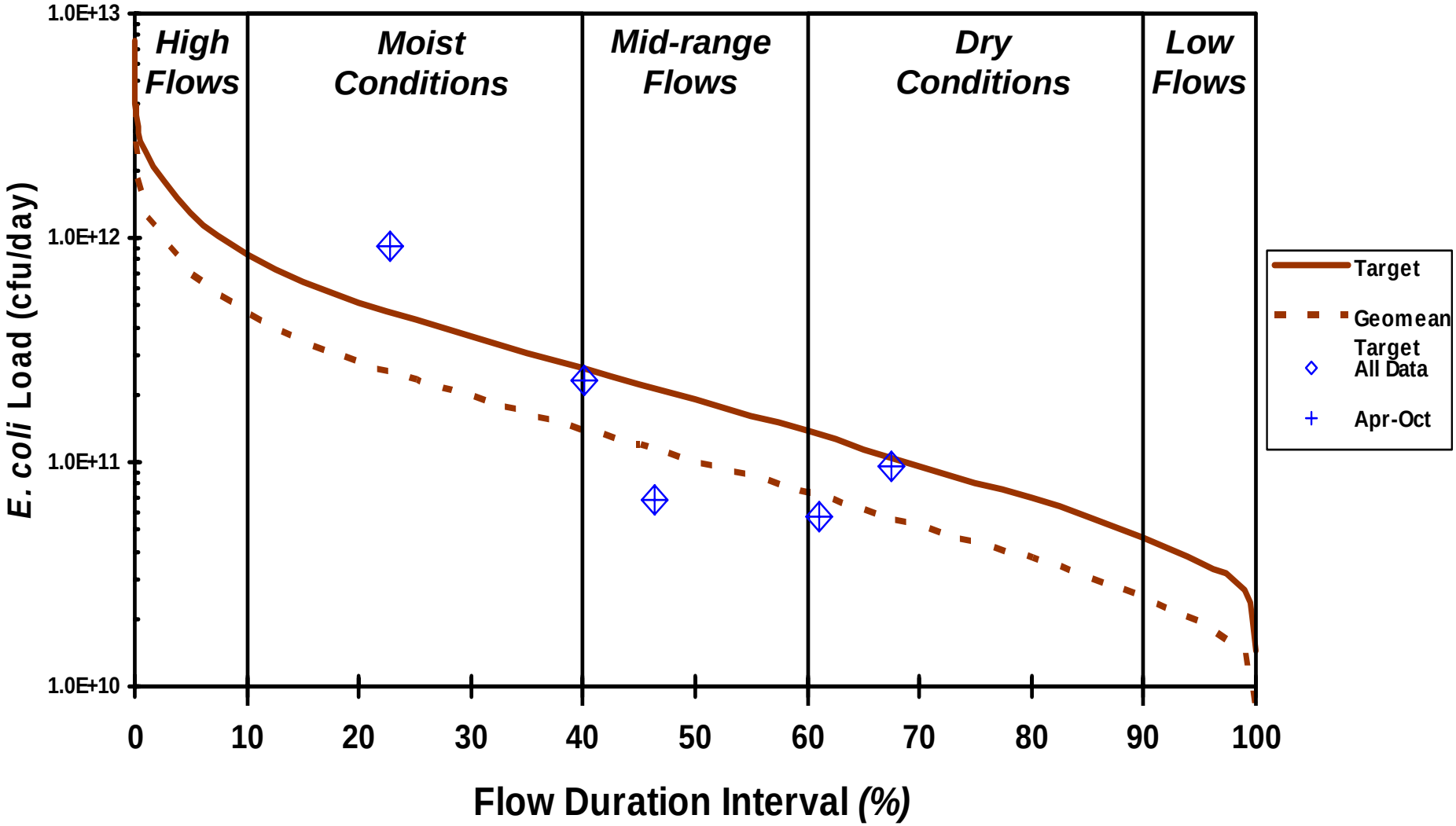
IDEM Data & USGS Gage Duration Interval

380 square miles

East Fork Whitewater River

Load Duration Curve

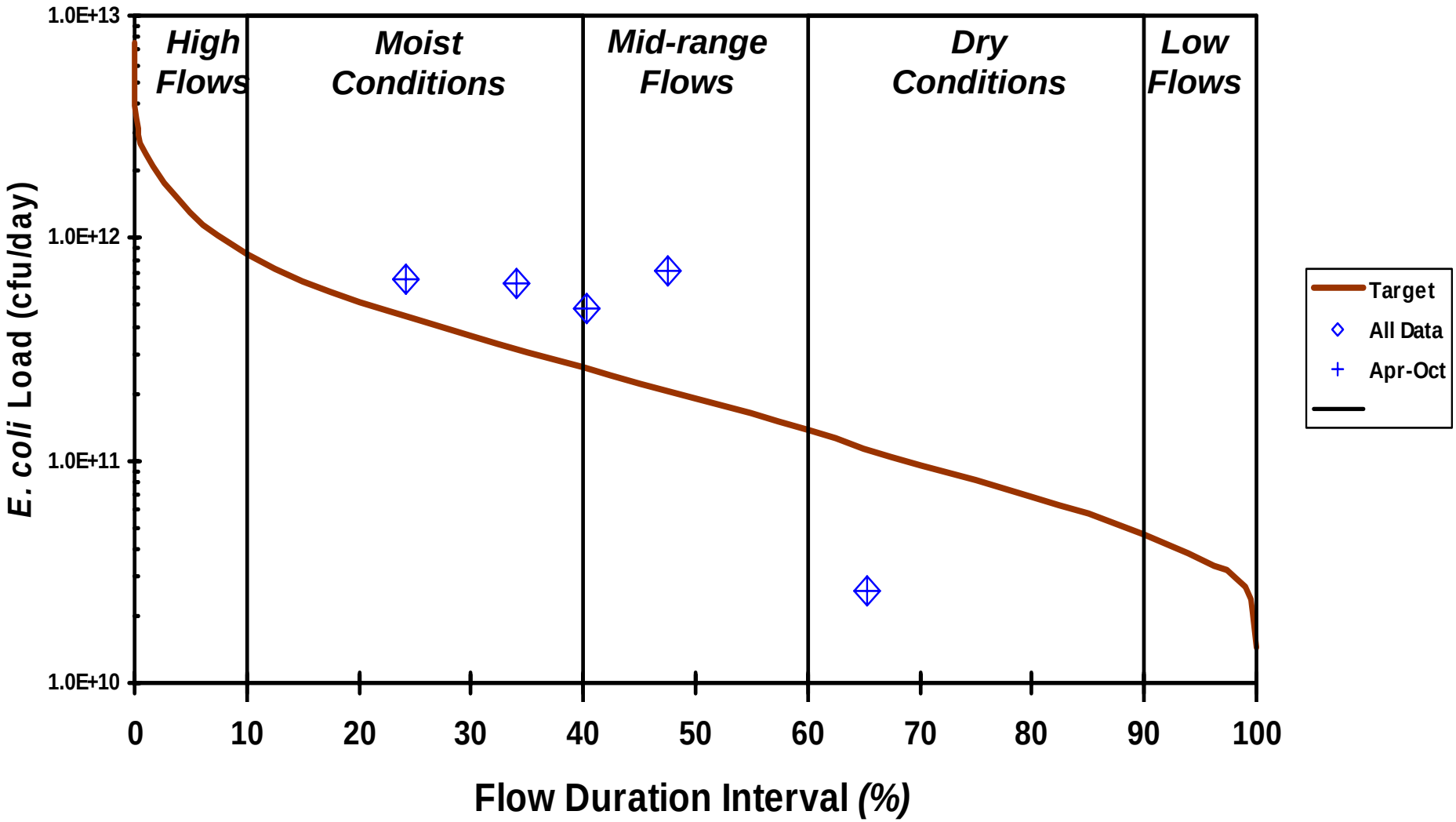
Site: GMW070-0004



IDEM Data & USGS Gage Duration Interval

380 square miles

Hanna Creek
Load Duration Curve
Site: GMW070-0015



IDEM Data & USGS Gage Duration Interval

380 square miles