Office of Water Quality
Total Maximum Daily Load Program

Final
Total Maximum Daily Load for
Escherichia coli (*E. coli*)
For the West Fork Whitewater Watershed,
Randolph, Wayne, Fayette, Henry, and Franklin Counties

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July 28, 2008

Table of Contents

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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 West Fork Whitewater watershed in Randolph, Wayne, Henry, Franklin, and Fayette Counties in Indiana.

Background

In 2004 Indiana's Section 303(d) List cited the West Fork Whitewater River as being impaired for *E. coli* in Randolph, Wayne, Franklin, Fayette, and Henry counties and has remained on the 303(d) List in subsequent years. In addition to the West Fork Whitewater River, Indiana's 2006 Section 303(d) List cites 31 tributaries (See Table 1) as being impaired for *E. coli.*

The West Fork Whitewater River Watershed is listed on the 2008 303(d) List of Impaired Waterbodies for *E. coli*. Based on the data collected in 2002 by IDEM subsequent sampling in 2007, and the addition of High Resolution Indexing, a reassessment of water quality condition was warranted. The reassessment for the *E. coli* impairment resulted in the addition and change of segment IDs of the following segments in the West Fork Whitewater River watershed to the 2008 303(d) List: (Table 1). All segments in Table 1 reflect the current Assessment Unit IDs in the 303(d) assessment database. Additional data collected in 2007 has been used to propose Category 4A listings for the 2010 303(d) list. These segments do not meet Water Quality Standards and will be place into Category 4A pending approval of TMDL prior to April 1, 2010 (Figure 1, Table 1). These sites are denoted in Table 1 with an "*" in the Segment ID column.

This TMDL will address approximately 605 square miles of the West Fork Whitewater River watershed in Randolph, Wayne, Fayette, Henry and Franklin Counties, Indiana, where recreational uses are impaired by elevated levels of *E. coli* during the recreational season. The West Fork Whitewater River Basin is located in East Central Indiana (Figure 1). All eighty-eight (88) segments of the listed streams for this TMDL are located in the Whitewater Basin, Hydrologic Unit Codes 0508000301, 0508000302, 0508000303, and 0508000304 (Appendix 1).

Table 1: Impaired Segments in the West Fork Whitewater Watershed

County	Stream Name	Segment ID	Segment length	Impairment
Fayette	BEAR CREEK	ING0349_T1005*	5.75	E. coli
	BEAR CREEK - UNNAMED	ING0349_T1005A*	0.78	

	TRIBUTARY	ING0349_T1005B*	1.15	
		ING0349_T1005C*	1.13	
		ING0349_T1005D*	0.47	
		ING0349_T1005E*	1.21	
		ING0349_T1005F*	0.66	
		ING0349_T1005G*	0.90	
	LITTLE WILLIAMS CREEK	ING0347_00*	8.06	
	LITTLE WILLIAMS CREEK - UNNAMED TRIBUTARY	ING0347_00N*	0.41	
		ING0347_00O*	0.32	
		ING0347_00P*	0.43	
		ING0347_00Q*	0.42	
		ING0347_00R*	0.38	
		ING0347_00S*	0.33	
		ING0347_00T*	0.31	
	NOLANDS FORK	ING0335_00*	2.28	
	ROY RUN - UNNAMED TRIBUTARY	ING0318_T1001A*	0.83	
		ING0318_T1001B*	0.51	
	WILLIAMS CREEK	ING0346_00	6.90	
		ING0347_01*	1.92	
Fayette-Henry	ROY RUN	ING0318_T1001	2.53	
	ROY RUN - UNNAMED TRIBUTARY	ING0318_T1001E*	2.60	
Henry	BEAR CREEK - UNNAMED TRIBUTARY	ING0314_T1004A*	0.46	
		ING0314_T1004B1	1.64	
	ROY RUN - UNNAMED TRIBUTARY	ING0318_T1001C*	2.02	
		ING0318_T1001C1*	0.91	
		ING0318_T1001D*	0.61	
Henry-Wayne	BEAR CREEK	ING0314_T1004*	5.41	
	BEAR CREEK - UNNAMED TRIBUTARY	ING0314_T1004B*	1.69	
		ING0314_T1004C*	2.04	
Randolph	BLOOMINGPORT CREEK - UNNAMED TRIBUTARIES	ING0323_T1001*	2.32	
		ING0323_T1001A*	0.96	
		ING0323_T1001B*	0.67	
	LITTLE CREEK - UNNAMED TRIBUTARY	ING0311_T1001A	0.59	
		ING0311_T1001B	0.92	
		ING0311_T1001C	0.57	
		ING0311_T1001D	1.33	
		ING0311_T1001E	0.91	
		ING0311_T1001F	1.10	
		ING0311_T1001G	1.64	
		ING0311_T1001H	0.44	
		ING0311_T1001I	0.44	
	NETTLE CREEK	ING0313_01	1.90	
	PORT RUN	ING0323_T1002*	1.00	
Randolph-Wayne	GREENS FORK	ING0323_00	5.50	
	LITTLE CREEK	ING0311_T1001	7.34	
	NETTLE CREEK	ING0313_02	0.69	E. coli
		ING0313_03	1.48	
Wayne	GREENS FORK	ING0324_01	2.57	

		ING0324_02	3.98	
		ING0325_00	6.87	
		ING0326_00	6.04	
	MARTINDALE CREEK	ING031A_01	3.95	
		ING031A_02	2.60	
		ING031C_01	2.37	
		ING031C_02	3.81	
		ING031C_03	3.53	
		ING031D_03	0.32	
	MORGAN CREEK	ING031B_01	6.38	
		ING031B_02	4.15	
	MORGAN CREEK - UNNAMED TRIBUTARY	ING031B_01A	0.60	
		ING031B_01B	0.59	
		ING031B_01C	0.68	
		ING031B_02A	0.71	
	NETTLE CREEK	ING0313_04	2.67	
		ING0313_05	3.56	
		ING0314_T1002	1.10	
	NOLANDS FORK	ING0331_03	2.74	
		ING0332_01	3.51	
		ING0333_00	8.59	
		ING0334_01*	2.76	
		ING0334_02*	3.54	
		ING0334_03*	4.30	
	NOLANDS FORK - UNNAMED TRIBUTARY	ING0331_03A	0.95	
		ING0331_03B	0.73	
		ING0331_03C	1.10	
	WEST BROOK	ING031B_T1001	3.54	
	WHITEWATER RIVER	ING0312_01	3.90	
		ING0312_02	2.79	
		ING0314_01	1.98	
		ING0314_02	1.54	
		ING0314_03	2.57	
		ING0316_01	1.64	
		ING0316_02	1.07	
		ING031E_01	0.97	
		ING031E_02	4.60	
	WHITEWATER RIVER - UNNAMED TRIBUTARY	ING0316_T1002	4.53	

The description of the study area, its topography, and other particulars are as follows:

Historical data collected by IDEM's Assessment Branch documented elevated levels of *E. coli* in the West Fork Whitewater River watershed from 2002 to 2004. IDEM's Assessment Branch completed a survey of the watershed for the West Fork Whitewater River in 2002. In this survey, IDEM sampled fourteen (14) sites (Figure 2), five times, with the samples evenly spaced over a 30-day period from June 10, 2002, to July 16, 2002. Each of the fourteen sites violated the single sample maximum standard and geometric mean standard with the exception of site GMW040-0006 (SR 44 and SR 1) (Attachment A).

Additionally, in 2007, IDEM sampled 15 sites, each site five times evenly spaced over 30-days from July 23, 2007 to August 15, 2007. Of the 15 sites, three did not exceed the single sample maximum or the geometric mean (GMW020-0035, GMW040-0036, and GMW040-0044). Two additional sites did not exceed the Geometric Mean (GMW040-0043 and GMW030-0026) but did exceed one or more single sample maximums (Attachment A).

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 WWL020-0085, WWL020-0077, WWL020-0081, WWL020-0067, and WWL020-0091, 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 are representative of the hydrodynamics of the West Fork Whitewater (Attachment B).

Numeric Targets

The impaired designated use for the waterbodies in the West Fork Whitewater watershed is for total body contact recreational use during the recreational season, April 1st through October 31st.

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

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

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.

The sanitary wastewater *E. coli* effluent limits from point sources in the non-Great Lakes system during the recreational season, April 1st through October 31st, are also covered under 327 IAC 2-1-6(d).

For the West Fork Whitewater watershed during the recreational season (April 1st through October 31st) 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.

Source Assessment

Watershed Characterization

The West Fork Whitewater River in Randolph, Wayne, Fayette, Henry, and Franklin counties is located in a predominantly agricultural watershed.

Watershed Area by County

County	Sq. Miles	Percent Area
Wayne	273.646	45.2%
Fayette	177.823	29.4%
Randolph	81.243	13.4%
Henry	43.141	7.1%
Franklin	25.427	4.2%
Union	4.159	0.7%
Total:	605.799	100%

The West Fork Whitewater River and its headwater tributaries flow south from Randolph and Henry counties into Wayne County and finally into Franklin County. Several major tributaries flow into the West Fork Whitewater River include; Bowen Ditch, Crete Drain, Franklin Creek, Greens Fork, Kelly Ditch, Line Brook, Mixed Creek, Nettle Creek, Nolands Fork, Pole Creek, Slow Run, and Williams Creek (Figure 1).

Landuse information was assembled using data collected from the 1992 Gap Analysis Program (GAP). In 1992, approximately 82.7% of the landuse in the West Fork Whitewater River watershed was agriculture. The remaining landuse along the West Fork Whitewater River watershed consisted of approximately 14.2% Forested, 2.1% Wetlands, 0.9% Urban, and 0.2% Water (Figure 3). A comparison of landuse information from 1992 with aerial photos taken in 2003 shows there has not been a significant change in landuse in the West Fork Whitewater River watershed.

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.

There are a significant number of homes on septics within the West Fork Whitewater watershed. Failing septic tanks are known sources of *E. coli* impairment in waterbodies. Conversations with

Randolph, Fayette, and Franklin County Health Departments staff indicated that septic failure does occur. No tangible septic failure rates have been established by their Environmental Health Departments at this time. However Henry County Health Department (Pers. Comm. Environmental Section) did not have data readily available. They are currently working on mapping known septic systems and putting them in a GIS Layer for the county, and Wayne County Health Department (Pers. Comm. Marshall Kern) is currently addressing any known septic failures as they receive complaints. In addition, the towns of Greensfork, Milton, and Centerville are in the process of installing a sewer system and Fountain City is looking to improve and increase the sewer system currently installed.

National Pollutant Discharge Elimination System (NPDES) Permitted Dischargers

There are 14 NPDES permitted facilities in the West Fork Whitewater watershed (Figure 4, Table 2).

> Hagerstown STP , Centerville Municipal WWTP, Stuckey's Restaurant, Centerville Rest Area, Connersville Municipal STP, Crazy D’s Truck Plaza, Len-Del MHP, McDonald's #0881, Laurel Municipal WWTP, Hoosier Heartland Travel Center, and Lynn Municipal WWTP have no recorded violations that would result in elevated levels of *E.coli* into the receiving stream.
>
> Woodview MHP has both Total Residual Chlorine (TRC) and *E. coli* limits in the current permit. A violation letter was sent in February 2006 and again in May 2007 indicating the Woodview MHP was not in compliance for E. coli May 2004 through February 2007.In February 2006, the facility arranged to have a 4,000 gallon retention pond to alleviate future E. coli violations.
>
> Pleasantview Subdivision has both Total Residual Chlorine (TRC) and E. coli limits in the current permit. Pleasantview does have one year to meet E. coli monitoring requirements as a provision in their permit. On April 13, 2007 Pleasantview WWTP was issued an Agreed Order. .They are currently under the Agreed Order and are behind on the Compliance Plan. Pleasantview may still be contributing to the water quality impairment for *E. coli* until they are brought back into compliance.
>
> Fountain City WWTP is a Lagoon. Monitoring of *E. coli* is required in the current permit cycle to determine if the detention time within the lagoon system is sufficient treatment for *E.coli*.

Two of the remaining dischargers have Total residual Chlorine (TRC) (Whitewater Industrial Park and Henry County Generating Station) in their permits but these facilities do not have a sanitary component to their discharge and are not therefore considered a source of *E.coli*.

Storm Water General Permit Rule 13

There is 1 one municipal separate storm sewer systems (MS4) community the City of Connersville in the West Fork Whitewater 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). It is difficult to determine if the MS4 communities are a significant source of *E.coli* in the West Fork Whitewater River Watershed.

Combined Sewer Overflows (CSO)

There are two (2) CSO communities in the West Fork Whitewater watershed. The City of Connersville has five (5) Combined Sewer Overflows and the Town of Centerville has one (1) Combined Sewer Overflow. A description of outfall locations and receiving waters can be found in Appendix 3. Connersville is in the process of submitting their CSO Long Term Control Plan to IDEM. They were granted an extension to update their model and alternatives to include sewer separation that will eliminate CSOs 005 and 006. Their model was reviewed by Commonwealth and submitted on 6/27/07. The extension was granted until 06/2008. A meeting was held on 06/23/08 with the Utility Board in order to gain approval of draft LTCP for submittal. Once this permit has been issued and implemented, water quality should improve in the West Fork Whitewater River Watershed. Centerville has submitted their LTCP on May 2002 and was approved and issued a permit on March 9, 2007. CSO outfalls are considered a source of *E.coli* to the West Fork Whitewater.

The town of Centerville has applied for and received their LTCP. They submitted their permit for signature in February 2007 and NPDES permit approval was granted on March 9, 2007.

Concentrated Animal Feeding Operations

The removal and disposal of the manure, litter, or processed wastewater that is generated as the result of concentrated animal feeding operations falls under the regulations for concentrated animal feeding operations (CAFOs). CAFO rules can be found at 327 IAC 5-4-3 (effective 12/28/06) and 327 IAC 5-4-3.1 (effective 3/24/04). Concentrated Animal Feeding operations fall under Federal regulation and Confined Feeding Operations (CFO) fall under State regulations. Due to this difference CAFO loads fall under WLA and CFO loads fall under LA. There eight (8) CAFOs in the West Fork Whitewater watershed (Figure 6) (Table 3). CAFOs could be potential sources of *E.coli*. The current operational CAFOs in the West Fork Whitewater watershed have no open enforcement actions at this time. Therefore, these operations are not considered a significant source of *E. coli* for the West Fork Whitewater watershed TMDL.

Confined 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). The CFO regulations (327 IAC 16, 327 IAC 15) require that operations "not cause or contribute to an impairment of surface waters of the state". IDEM regulates these confined feeding operations under IC 13-18-10, the Confined Feeding Control Law. The rules at 327 IAC 16, which implement the statute regulating confined feeding operations, were effective on March 10, 2002. The rule at 327 IAC 15-15, which regulates concentrated animal feeding operations and complies with most federal CAFO regulations, became effective on March 24, 2004, with two exceptions. 327 IAC 15-15-11 and 327 IAC 15-15-12 became effective on December 28, 2006. CFO and CAFO rules can be found at 327 IAC 5-4-3 (effective 12/28/06) and 327 IAC 5-4-3.1 (effective 3/24/04). The difference between the two feeding operation is that Concentrated Animal Feeding operations fall under

Federal regulation and Confined feeding operations fall under State regulations. Due to this difference CAFO loads fall under WLA and CFO loads fall under LA. There ten (10) CFOs in the West Fork Whitewater watershed (Figure 6) (Table 3).

The animals raised in confined feeding operations produce manure that is stored in pits, lagoons, tanks and other storage devices. The manure is then applied to area fields as fertilizer. When stored and applied properly, this beneficial re-use of manure provides a natural source for crop nutrition. It also lessens the need for fuel and other natural resources that are used in the production of fertilizer. Confined feeding operations, however, can also pose environmental concerns, including the following:

- Manure can leak or spill from storage pits, lagoons, tanks, etc.
- Improper application of manure can contaminate surface or ground water.
- Manure over-application can adversely impact soil productivity.

These concerns can potentially contribute to *E.coli* impairment in a waterbody. There are nine (10) active confined feeding operations exist in the West Fork Whitewater watershed (Figure 5, Table 3)

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 West Fork Whitewater watershed however; it is believed that these small livestock operations may be a source of the *E. coli* impairment.

Linkage Analysis and *E. coli* Load Duration Curves

The linkage between the *E. coli* concentrations in the West Fork Whitewater Name 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 West Fork Whitewater watershed that were sampled by IDEM in 2002 and 2007. 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 West Fork Whitewater watershed (Attachment B). This section will discuss the water quality durations and the linkage of the West Fork Whitewater watershed and the West 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 West Fork Whitewater 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. There is one (1) USGS flow gage stations that represent the flows in the West Fork Whitewater River watershed. The station is USGS gage (03275000) located in near Alpine, Indiana approximately four miles downstream of the lowest point of the watershed addressed in this TMDL.

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).

To further investigate sources of pollution, *E. coli*/precipitation graphs have been created (Attachment B). Elevated levels of *E. coli* during rain events indicate *E. coli* contribution due to run-off. The precipitation data was taken from a weather station in Alpine, IN and managed by the Indiana State Climate Office at Purdue University.

<u>Water Quality Duration Curves and Precipitation Graphs</u>

Load duration curves and precipitation graphs were created for all the sampling sites in the West Fork Whitewater Watershed. However, sample sites WWL020-0085, WWL020-0077, WWL020-0081, WWL020-0067, and WWL020-0091 provides the best description of the sources of *E. coli* to the West Fork Whitewater River watershed (Attachment B).

TMDL Site 5 is located at Crietz Park on an Unnamed Tributary to the West Fork Whitewater. The geometric mean value for Site 5 is 1500 MPN/100mL. The load duration curve shows a relatively constant level of *E. coli* in the stream through most flows. The precipitation graph shows the stream is susceptible to high loads of *E. coli* from run-off with the highest E.coli levels during a 0.2 inch rain event. This is evident that a small amount of rain can cause a considerable effect on the watershed. The stream is consistently in violation of water quality standards even during drier conditions on the chart. This indicates point sources may be contributing along with non point sources. If animals have direct access upstream of Site -0030 this could contribute to *E. coli* violations at dry and wet conditions.

TMDL Site 9 is located at CR 440 E near Waterloo. The geometric mean value for Site 9 is 210 MPN/100mL. The load duration curve shows two exceedances of the single sample with three samples below the water quality standard. The precipitation graph shows that the impaired sampling events were either during a precipitation event or within a few days of a precipitation event. Therefore the stream is susceptible to high loads of *E. coli* from run-off. Since the results seem dependent on precipitation events non-point sources are the most likely source of the higher values seen in a few of the samples.

TMDL Site 11 is located off at Fountain City Park in Fountain City and represents sources in the Nolands Fork portion of the watershed. The geometric mean value for Site 11 is 1092 MPN/100mL. The load duration curve for this site shows violations of the WQS during all flow. The precipitation graph shows the stream violating WQS during wet and dry weather. This indicates point sources may be contributing along with non point sources. If animals have direct access upstream of Site -0004 this could contribute to *E. coli* violations at dry and wet conditions.

TMDL Site 3 is located at SR 38 on Morgan Creek. The geometric mean value for Site 3 is 619 MPN/100mL. The load duration curve shows the lowest *E.coli* samples during the driest time period. The precipitation graph shows that the impaired sampling events were either during a precipitation event or within a few days of a precipitation event. Therefore the stream is susceptible to high loads of *E. coli* from run-off. Since the results seem dependent on precipitation events non-point sources are the most likely source of the high E.coli values.

TMDL Site 7 is located at US 35 near Williamsburg on Greens Fork. The geometric mean value for Site 7 is 395 MPN/100mL. This site shows a consistent level of *E.coli* within the LDC. Most exceedances do not seem to be effected by precipitation. This indicates point sources may be contributing to the source of the impairment. If animals have direct access upstream of Site -0023 this could contribute to *E. coli* violations at dry and wet conditions.

TMDL Site 12 is located at SR 38 on Nolands Fork. The geometric mean value for Site 12 is 650 MPN/100mL. This site shows a consistent level of *E.coli* within the LDC. Most exceedances do not seem to be effected by precipitation. This indicates point sources may be contributing to the source of the impairment. If animals have direct access upstream of Site -0015 this could contribute to *E. coli* violations at dry and wet conditions.

While there are point source contributor to the West Fork Whitewater River watershed a review of the point sources within the watershed does not indicate traditional point sources as a cause. The possible direct access of animals in stream of the presents of straight pipe discharges may be impacting the West Fork Whitewater River watershed during these dry periods. Therefore compliance with the numeric *E. coli* WQS in the West Fork Whitewater River watershed most critically depends on controlling of nonpoint sources using best management plans (BMPs). If the *E. coli* inputs are controlled, then total body contact recreation use in the West Fork Whitewater River watershed will be protected.

<u>Source Linkage</u>

The landuse in this watershed is predominately agricultural with 82.7% of the landuse comprising row crops and pastures. The soils in this sub-watershed necessitate the use of field tiles to drain excess water from the fields. 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 area 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. 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.

Forests only comprise 14.2% of the landuse. The forested areas are located along the stream banks, which creates a buffer strip. Buffer strips assist in slowing the time of transport of the contaminant, in this case *E. coli*, to the stream. Due to the choice of sampling locations, this is only slightly reflected in the results

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.

The fourteen (14) NPDES permitted facilities which contain a sanitary component in their discharge only have upsets recorded during higher flow and flood condition, and can contribute to the impairment during these times, but otherwise they are within their limits the majority of times; therefore, these facilities are not considered significant sources of *E. coli*.

The eighteen (18) permitted CAFO/CFOs are scattered throughout the watershed with the bulk located in the northern two-thirds of the watershed. CAFOs/CFOs could possibly be sources of *E. coli* during high flow conditions. 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 Wayne, Fayette, Randolph, Henry, and Franklin County Health Departments. 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 consistent 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, but not consistently.

There two CSO Communities in the watershed. The City of Connersville has five CSOs and Centerville has one CSO. CSOs would provide a source of E.coli during high flow conditions. According to the load duration curves there are violations of the *E.coli* water quality standard during these flow conditions.

<u>Conclusions</u>

The *E. coli* data have an average single sample maximum violation 60.5% of the time and an average geometric mean violation 75.7% of the time. There is one NPDES permit with an enforcement case open and there are no CFO or CAFO permit violations. The City of Connersville, an MS4 community, is considered a source of *E. coli*. There are two CSO Connersville and Centerville in the watershed and they are considered a source of *E.coli*. 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 that include small animal operations, wildlife, animals with direct access to streams, straight piped, leaking and failing septic systems.

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. 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 West Fork Whitewater 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 West Fork Whitewater 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.

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). Meeting the Water Quality Standards (WQS) of 125 colony forming unit (cfu) per 100 mL as a geometric mean and 235 cfu/100 mL is the overall goal of the TMDL. The geometric mean *E. coli* WQS allows for the best characterization of the watershed. The geometric mean provides a more reliable measure of *E. coli* concentration because it is less subject to random variation (USEPA, 2004). However, by setting the target to meet the 125 cfu/100 mL geometric mean standard, this TMDL also will meet the 235 cfu/100 mL single day standard. 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).

The Wasteload Allocation and Load Allocations in the TMDL are set at 125 cfu/mL, which as stated above, also will meet the 235 cfu/100 mL single day standard.

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:

$$\text{TMDL} = \sum\text{WLAs} + \sum\text{LAs} + \text{MOS}$$

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).

<u>Wasteload Allocations</u>

As previously mentioned, there are 21 permitted dischargers in the West Fork Whitewater watershed. Fourteen of the 21 permitted dischargers have a sanitary component to their discharge. All Fourteen of the 14 permitted dischargers already have *E. coli* limits in their permits.

There is one MS4 community in the West Fork Whitewater watershed. The City of Connersville INR040021Guidelines 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).

There are two (2) CSO communities in the West Fork Whitewater watershed. The City of Connersville has five (5) Combined Sewer Overflows and the Town of Centerville has one (1) Combined Sewer Overflow. A description of outfall locations and receiving waters can be found in Appendix 3. Connersville is in the process of submitting their CSO Long Term Control Plan to IDEM. Once this permit has been issued and implemented, water quality should improve in the West Fork Whitewater River Watershed. Centerville has submitted their LTCP in May of 2002 and was approved and issued a permit on March 9, 2007. Once these permits have been implemented, water quality should improve in the West Fork Whitewater River Watershed. CSO outfalls are considered a source of E.coli to the West Fork Whitewater.

The WLA is set at 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 1st through October 31st.

<u>Load Allocations</u>

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 1st through October 31st. 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. There is currently one 319 watershed project in the West Fork Whitewater River Watershed. Wayne county Soil and Water Conservation District has a 319 Project that became active in February 2008 and will be active until August 2011. The project will focus on *E.coli* reduction using education outreach and river clean up days and to develop a Watershed Management Plan for the West Fork Whitewater for future BMP implementation. IDEM plans to continue working with the watershed coordinators in the surrounding areas along with local government agencies to encourage interest in watershed projects. It is anticipated that additional watershed projects will be useful in continuing to define and address the nonpoint sources of the *E. coli* in the West Fork Whitewater River watershed.

<u>Margin of Safety</u>

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.

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 1^{st} through October 31^{st}) 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.

Monitoring

Future *E. coli* monitoring of the West Fork Whitewater 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.

Reasonable Assurance Activities

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

<u>Storm Water General Permit Rule 13</u>

Municipal Separate Storm Sewer System (MS4) permits have been issued in the state of Indiana. There is currently one MS4 communities in the area addressed by this West Fork Whitewater River Watershed TMDL. The MS4 permits being issued and implemented, will improve the water quality in the West 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).

<u>Confined Feeding Operations and Concentrated Animal Feeding Operations</u>

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

<u>Watershed Projects</u>
There is currently one 319 watershed project in the West Fork Whitewater River Watershed. Wayne county Soil and Water Conservation District has a 319 Project that became active in February 2008 and will be active until August 2011. The project will focus on *E.coli* reduction using education outreach and river clean up days and to develop a Watershed Management Plan for the West Fork Whitewater for future BMP implementation.

IDEM has a Watershed Specialist assigned 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 West Fork Whitewater watershed.

<u>Potential Future Activities</u>

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 streambanks 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.

Conclusion

The sources of *E. coli* to the West Fork Whitewater watershed include both point and nonpoint sources. In order for the West Fork Whitewater watershed to achieve Indiana’s *E. coli* WQS, the wasteload and load allocations for the West Fork Whitewater 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 West Fork Whitewater watershed depends on:

1) CFOs not violating their permits
2) Nonpoint sources of *E. coli* being controlled by implementing best management practices in the watershed.
3) Implementation of the *E. coli* TMDL completed on the impaired tributaries in the West Fork Whitewater River watershed.

The next phase of this TMDL is to identify and support the implementation of activities that will bring the West Fork Whitewater 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 West Fork Whitewater 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 West Fork Whitewater 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.

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

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

Table 2: NPDES Permits in the West Fork Whitewater Watershed

Facilities with *E. coli* Limits and Total Residual Chlorine

Permit No.	Facility Name	Receiving Waters
IN0022535	Centerville STP	Nolands Fk
IN0032336	Connersville STP	W Fk Whitewater R
IN0038849	Stop-One Truck Plaza	Martindale Cr
IN0039560	Woodview MHP	Unnamed trib to Pinhook Drain
IN0043371	Stucky's Restaurant	Unnamed trip to Nolands Fk
IN0044776	Pleasantview Subdivision	Unnamed trib to Williams Cr
IN0051870	Len-Del HMP	Unnamed trip to Franklin Cr
IN0053791	McDonalds #0881	Martindale Cr

Facilities with *E. coli* limits

Permit No.	Facility Name	Receiving Waters
IN0020010	Hagerstown STP	W Fk Whitewater R
IN0031321	Centerville Rest Area	Unnamed trib to Nolands Fk
IN0040240	Laurel Municipal WWTP	W. Fk Whitewter R
IN0053643	Hoosier Heartland Travel Center	Symons Cr
IN0040967	Lynn Municipal WWTP	Mud Cr

Facilities with Lagoon System

Permit No.	Facility Name	Receiving Waters
IN0040029	Fountain City WWTP	Fountain Cr

Table 3: Permitted Confined Feeding Operations in the West Fork Whitewater Watershed

Permit Number	Permit Type	Operation Name	Status	Hogs	Beef/Dairy Cattle
6452	CAFO	Symons Creek Swine, LLC	ACTIVE	8000	
363	CAFO	David Drake – Home Farm	ACTIVE	3150	
3999	CAFO	Ivy's Spring Creek Farm	ACTIVE	6700	
6413	CAFO	Horseshoe Bend Farm	ACTIVE	7742	
6412	CAFO	Martindale Creek Farm	ACTIVE	7742	
759	CAFO	Natural Pork Production II, LLC	ACTIVE	17072	
6419	CAFO	Sickels Hog Farm	ACTIVE	8000	
6384	CAFO	Donbar Investmetns, LLC	ACTIVE	3600	
3823	CFO	Simpkins Farm INC	ACTIVE	1950	100
2389	CFO	Simmermons Farm INC, North Farm	ACTIVE	3093	
3074	CFO	Lowell and Patricia Wise	ACTIVE	1588	
511	CFO	Bowman Dairy Farm LLC	ACTIVE	0	300
1431	CFO	L-Hil Dairy Farm	ACTIVE	0	100
428	CFO	Drake Purebred Farms	ACTIVE	464	
4955	CFO	R&K Kissel Farms Inc	ACTIVE	2112	
4619	CFO	Radford Farms	ACTIVE	2130	
3542	CFO	Harris Farms	ACTIVE	796	
4334	CFO	Rex Clements	ACTIVE	1985	

Table 4: Load Reductions for Segments in West Fork Whitewater Watershed

***E. coli* Standard = 125 mpn/100 mL**			
Stream Name	**Site Number**	***E. coli* (geometric mean)**	**Percent Reduction**
W Fk Whitewater River	1	782	84.01%
Nettle Cr	2	691	81.92%
Morgan Cr	3	619	79.81%
Martindale Cr	4	323	61.28%
Unnamed Trib of W Fk Whitewater	5	1500	91.67%
Greens Fk	6	250	50.03%
Greens Fk	7	395	68.39%
Greens Fk	8	516	75.78%
W Fk Whitewater River	9	210	40.44%
Nolands Fk	10	250	50.10%
Nolands Fk	11	1092	88.55%
Nolands Fk	12	651	80.79%
Williams Cr	13	213	41.34%
W Fk Whitewater River	14	99	N/A
Whitewater River	15	466.4	73.20%
Bear Cr	16	1235.0	89.88%
Morgan Cr	17	279.8	55.32%
Roy Run	18	651.4	80.81%
Greens Fork	19	336.1	62.81%
Greens Fork	20	183.9	32.04%
Whitewater River	21	99.5	N/A
Bloomingport Cr	22	528.3	76.34%
Nolands Fk	23	357.3	65.01%
Nolands Fk	24	97.8	N/A
Whitewater River	25	65.6	N/A
Little Williams Cr	26	833.0	84.99%
Whitewater River	27	67.8	N/A
Whitewater River	28	27.8	N/A
Bear Cr	29	1998.6	93.75%
Whitewater River	30	57.3	N/A

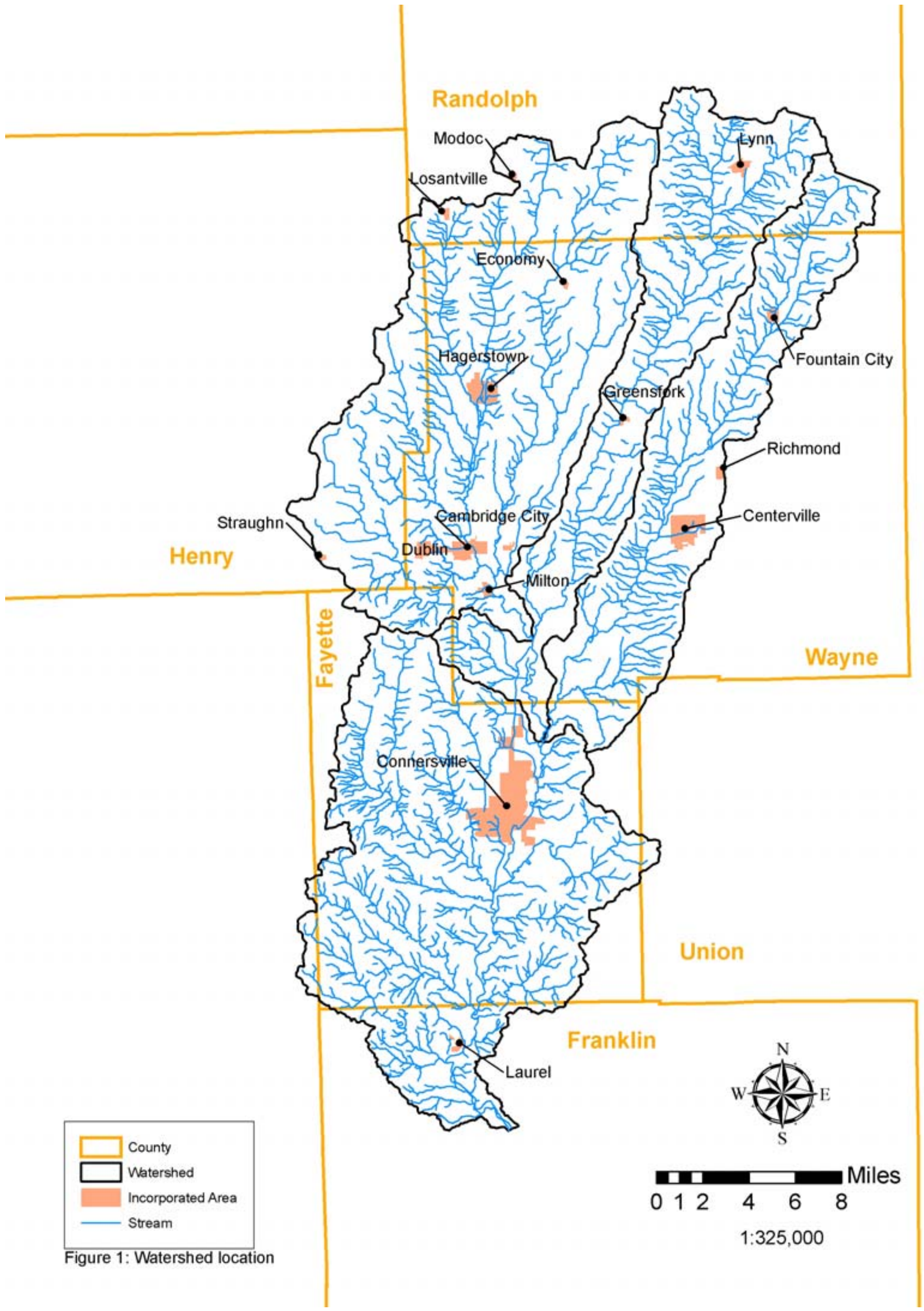

Figure 1: Watershed location

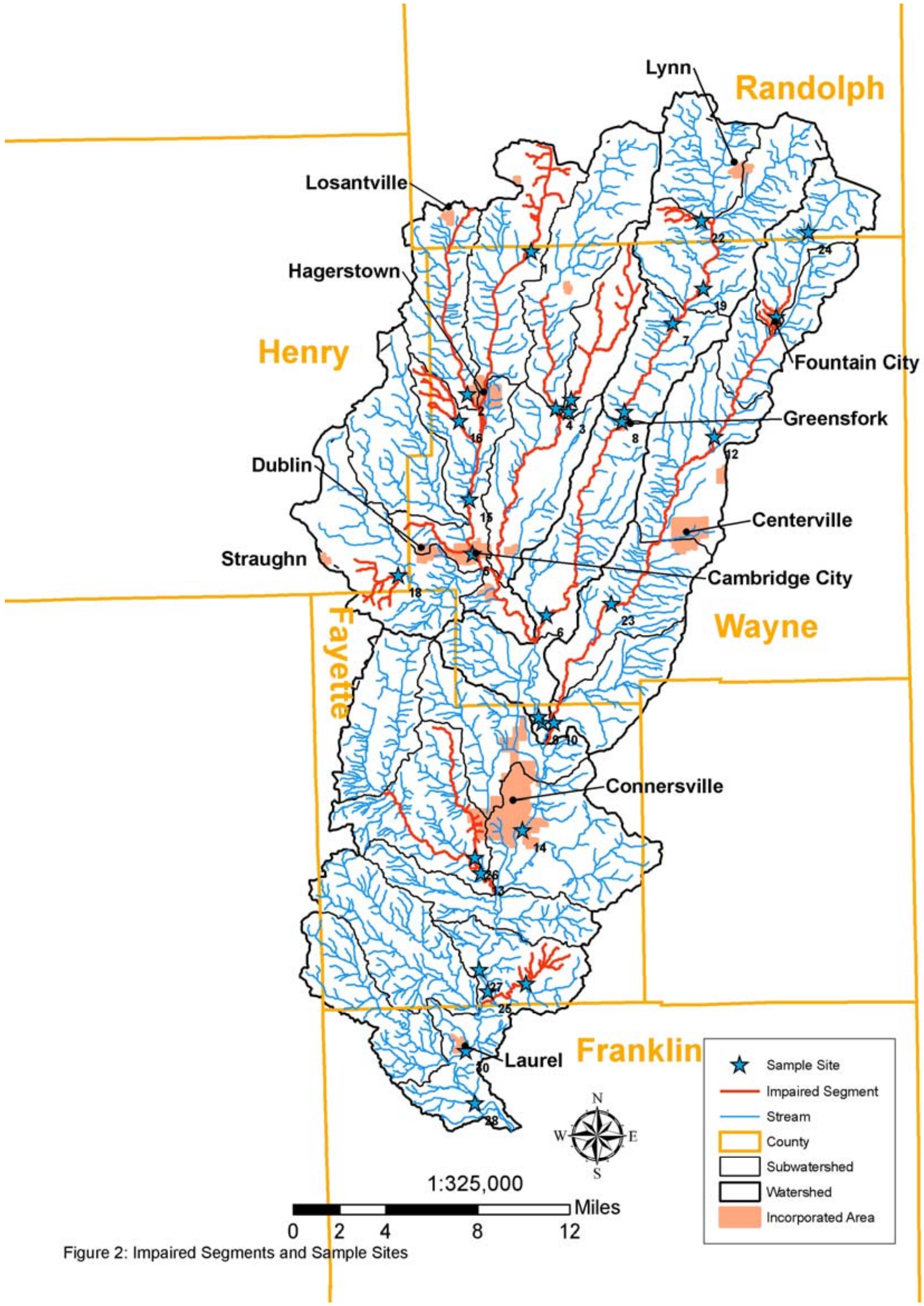

Figure 2: Impaired Segments and Sample Sites

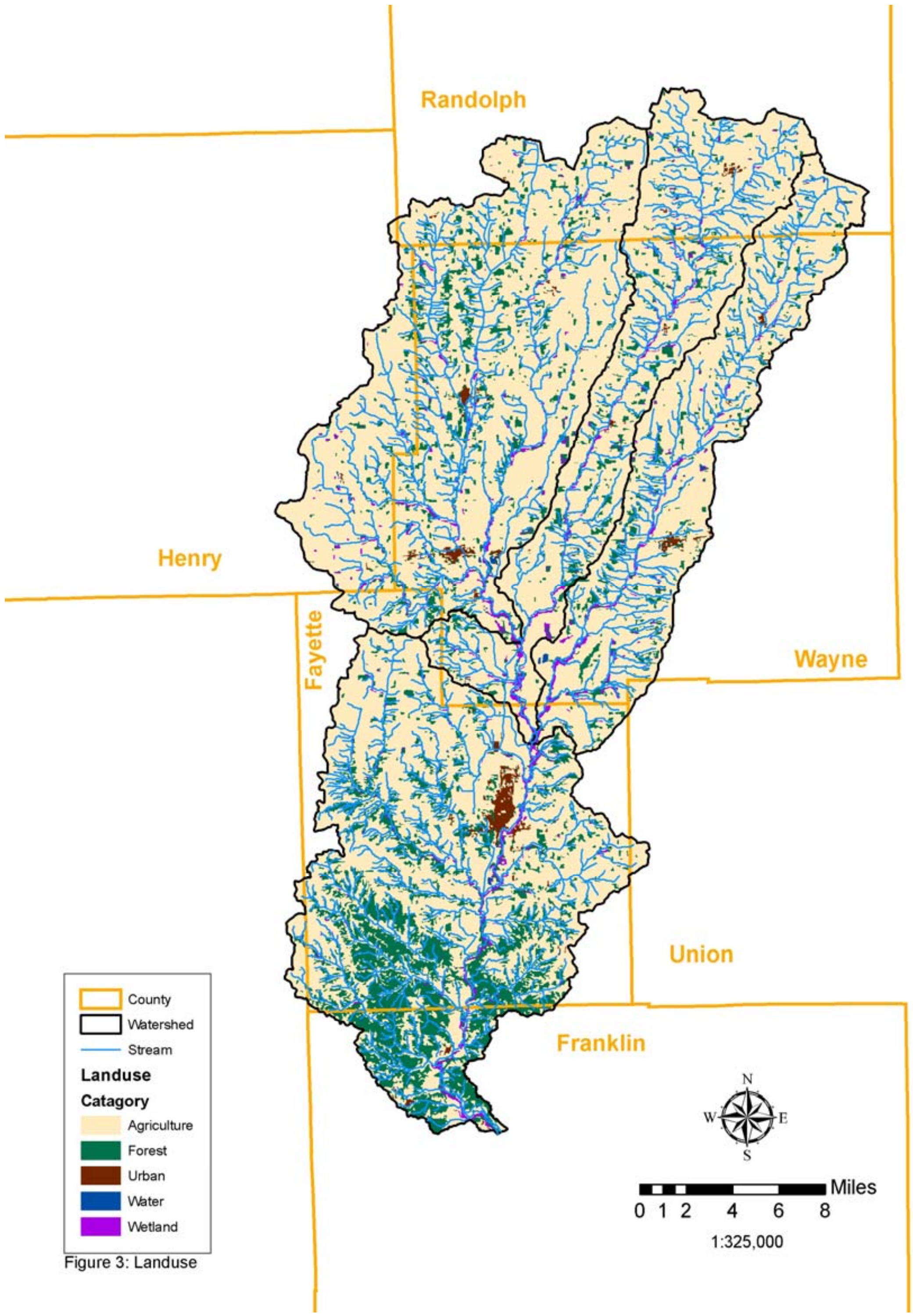

Figure 3: Landuse

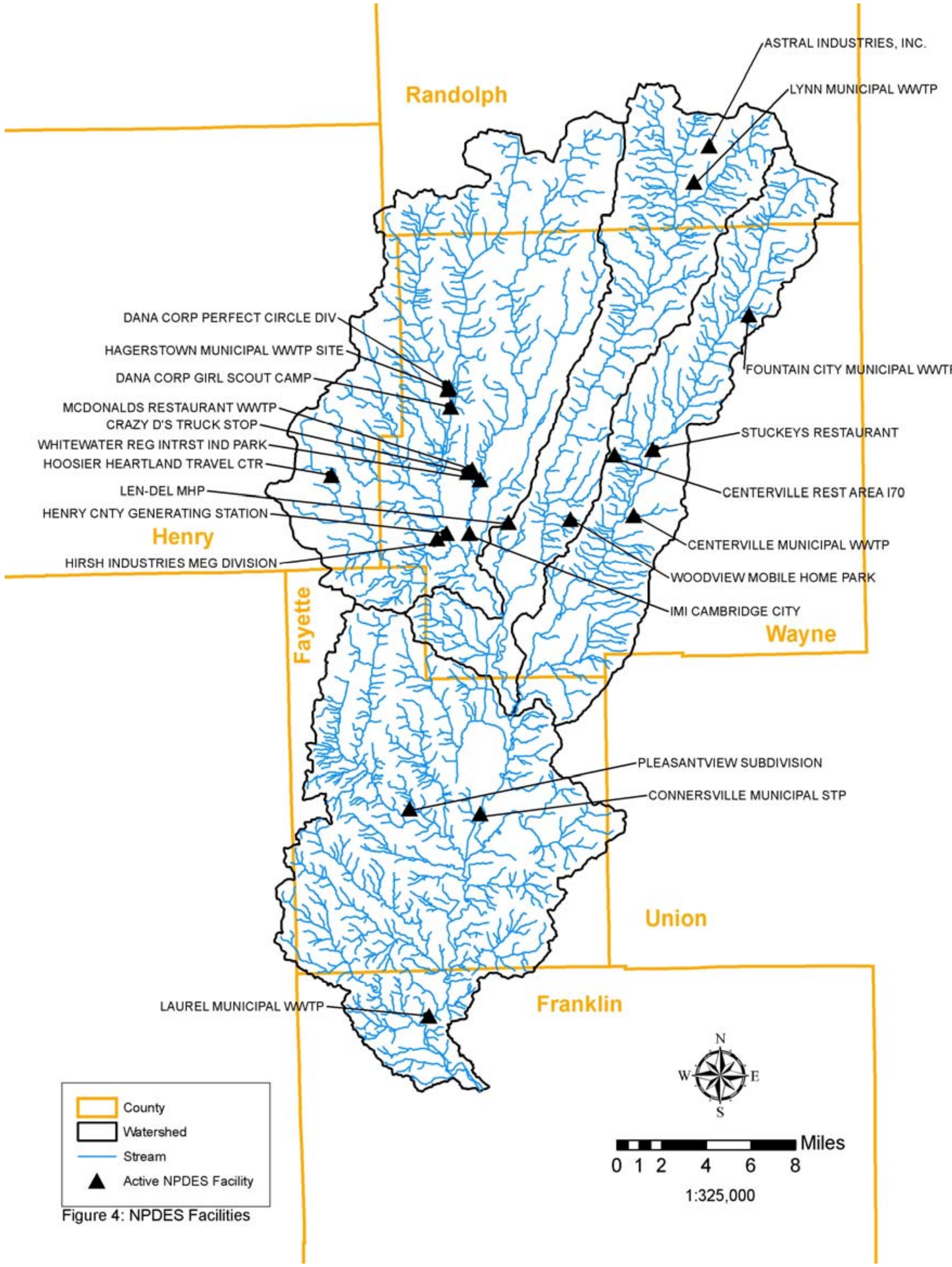

Figure 4: NPDES Facilities

Figure 5: Combined Sewer Overflow Location

Figure 6: CAFOs and CFOs

Attachment A

E. coli Data for West Fork Whitewater Watershed TMDL

Project	Stream_Name	Description	14-huc	LSITE	Coliforms	E_Coli	Flag
2002 E. coli in Whitewater River	Garrison Cr	SR 121, On Franklin/Fayette Co. Line	5080003040100	GMW040-0031	2420.0	210.5	B
2002 E. coli in Whitewater River	Garrison Cr	SR 121, On Franklin/Fayette Co. Line	5080003040100	GMW040-0031	2420.0	298.7	Q
2002 E. coli in Whitewater River	Greens Fk	S Jacksonburg Rd - E of Milton at Kirlin R.	5080003020060	GMW020-0001	2420.0	156.5	
2002 E. coli in Whitewater River	Greens Fk	S Jacksonburg Rd - E of Milton at Kirlin R.	5080003020060	GMW020-0001	2420.0	209.8	Q
2002 E. coli in Whitewater River	Greens Fk	S Jacksonburg Rd - E of Milton at Kirlin R.	5080003020060	GMW020-0001	2420.0	224.7	
2002 E. coli in Whitewater River	Greens Fk	US 35 at Williamsburg	5080003020040	GMW020-0023	2420.0	238.2	
2002 E. coli in Whitewater River	Greens Fk	US 35 at Williamsburg	5080003020040	GMW020-0023	2420.0	248.1	
2002 E. coli in Whitewater River	Greens Fk	S Jacksonburg Rd - E of Milton at Kirlin R.	5080003020060	GMW020-0001	2420.0	272.3	
2002 E. coli in Whitewater River	Greens Fk	SR 38	5080003020040	GMW020-0024	2420.0	365.4	
2002 E. coli in Whitewater River	Greens Fk	SR 38	5080003020040	GMW020-0024	2420.0	410.6	
2002 E. coli in Whitewater River	Greens Fk	S Jacksonburg Rd - E of Milton at Kirlin R.	5080003020060	GMW020-0001	2420.0	488.4	
2002 E. coli in Whitewater River	Greens Fk	US 35 at Williamsburg	5080003020040	GMW020-0023	2420.0	488.4	Q
2002 E. coli in Whitewater River	Greens Fk	US 35 at Williamsburg	5080003020040	GMW020-0023	2420.0	517.2	
2002 E. coli in Whitewater River	Greens Fk	SR 38	5080003020040	GMW020-0024	2420.0	517.2	Q
2002 E. coli in Whitewater River	Greens Fk	SR 38	5080003020040	GMW020-0024	2420.0	613.1	
2002 E. coli in Whitewater River	Greens Fk	US 35 at Williamsburg	5080003020040	GMW020-0023	2420.0	648.8	

2002 E. coli in Whitewater River	Greens Fk	SR 38	5080003020040	GMW020-0024	2420.0	770.1	
2002 E. coli in Whitewater River	Martindale Cr	SR 38	5080003010100	GMW010-0029	2420.0	172.3	
2002 E. coli in Whitewater River	Martindale Cr	SR 38	5080003010100	GMW010-0029	2420.0	222.4	
2002 E. coli in Whitewater River	Martindale Cr	SR 38	5080003010100	GMW010-0029	2420.0	307.6	Q
2002 E. coli in Whitewater River	Martindale Cr	SR 38	5080003010100	GMW010-0029	2420.0	488.4	
2002 E. coli in Whitewater River	Martindale Cr	SR 38	5080003010100	GMW010-0029	2420.0	613.1	
2002 E. coli in Whitewater River	Morgan Cr	SR 38	5080003010110	GMW010-0028	2420.0	141.4	
2002 E. coli in Whitewater River	Morgan Cr	SR 38	5080003010110	GMW010-0028	2420.0	517.2	
2002 E. coli in Whitewater River	Morgan Cr	SR 38	5080003010110	GMW010-0028	2420.0	770.1	
2002 E. coli in Whitewater River	Morgan Cr	SR 38	5080003010110	GMW010-0028	2420.0	816.4	
2002 E. coli in Whitewater River	Morgan Cr	SR 38	5080003010110	GMW010-0028	2420.0	1986.3	Q
2002 E. coli in Whitewater River	Nettle Cr	SR 38 East of Hagerstown	5080003010030	GMW010-0027	2420.0	307.6	
2002 E. coli in Whitewater River	Nettle Cr	SR 38 East of Hagerstown	5080003010030	GMW010-0027	2420.0	613.1	Q
2002 E. coli in Whitewater River	Nettle Cr	SR 38 East of Hagerstown	5080003010030	GMW010-0027	2420.0	648.8	
2002 E. coli in Whitewater River	Nettle Cr	SR 38 East of Hagerstown	5080003010030	GMW010-0027	2420.0	648.8	
2002 E. coli in Whitewater River	Nettle Cr	SR 38 East of Hagerstown	5080003010030	GMW010-0027	2420.0	1986.3	
2002 E. coli in Whitewater River	Nolands Fk	CR 440 N, East of SR1 and CR 450 N	5080003030050	GMW030-0002	1413.6	151.5	
2002 E. coli in Whitewater River	Nolands Fk	CR 440 N, East of SR1 and CR 450 N	5080003030050	GMW030-0002	2420.0	167.4	
2002 E. coli in Whitewater	Nolands Fk	CR 440 N, East of SR1 and CR 450 N	5080003030050	GMW030-	2420.0	290.9	Q

River				0002			
2002 E. coli in Whitewater River	Nolands Fk	CR 440 N, East of SR1 and CR 450 N	5080003030050	GMW030-0002	2420.0	325.5	
2002 E. coli in Whitewater River	Nolands Fk	CR 440 N, East of SR1 and CR 450 N	5080003030050	GMW030-0002	2420.0	410.6	
2002 E. coli in Whitewater River	Nolands Fk	SR 38	5080003030030	GMW030-0015	2420.0	461.1	
2002 E. coli in Whitewater River	Nolands Fk	SR 38	5080003030030	GMW030-0015	2420.0	579.4	
2002 E. coli in Whitewater River	Nolands Fk	SR 38	5080003030030	GMW030-0015	2420.0	579.4	
2002 E. coli in Whitewater River	Nolands Fk	Park in Fountain City, US27 North of Richmond	5080003030010	GMW030-0004	2420.0	613.1	
2002 E. coli in Whitewater River	Nolands Fk	SR 38	5080003030030	GMW030-0015	2420.0	770.1	
2002 E. coli in Whitewater River	Nolands Fk	Park in Fountain City, US27 North of Richmond	5080003030010	GMW030-0004	2420.0	816.4	Q
2002 E. coli in Whitewater River	Nolands Fk	SR 38	5080003030030	GMW030-0015	2420.0	980.4	Q
2002 E. coli in Whitewater River	Nolands Fk	Park in Fountain City, US27 North of Richmond	5080003030010	GMW030-0004	2420.0	1203.3	
2002 E. coli in Whitewater River	Nolands Fk	Park in Fountain City, US27 North of Richmond	5080003030010	GMW030-0004	2420.0	1299.7	
2002 E. coli in Whitewater River	Nolands Fk	Park in Fountain City, US27 North of Richmond	5080003030010	GMW030-0004	2420.0	1986.3	
2002 E. coli in Whitewater River	Unnamed Trib of W Fk Whitewate	At Cretz park, Cambridge City (Ford at gate of park)	5080003010060	GMW010-0030	2420.0	920.8	
2002 E. coli in Whitewater River	Unnamed Trib of W Fk Whitewate	At Cretz park, Cambridge City (Ford at gate of park)	5080003010060	GMW010-0030	2420.0	1413.6	Q
2002 E. coli in Whitewater River	Unnamed Trib of W Fk Whitewate	At Cretz park, Cambridge City (Ford at gate of park)	5080003010060	GMW010-0030	2420.0	1553.1	
2002 E. coli in Whitewater River	Unnamed Trib of W Fk Whitewate	At Cretz park, Cambridge City (Ford at gate of park)	5080003010060	GMW010-0030	2420.0	1553.1	
2002 E. coli in Whitewater River	Unnamed Trib of W Fk Whitewate	At Cretz park, Cambridge City (Ford at gate of park)	5080003010060	GMW010-0030	2420.0	2420.0	
2002 E. coli in Whitewater River	W Fk Whitewater River	U.S.52 Just East of SR229 Metamora	5080003040130	GMW040-0009	2419.0	25.6	

2002 E. coli in Whitewater River	W Fk Whitewater River	U.S.52 Just East of SR229 Metamora	5080003040130	GMW040-0009	2420.0	25.9	
2002 E. coli in Whitewater River	W Fk Whitewater River	U.S.52 Just East of SR229 Metamora	5080003040130	GMW040-0009	2420.0	31.3	Q
2002 E. coli in Whitewater River	W Fk Whitewater River	SR 44 and SR 1	5080003040030	GMW040-0006	2420.0	33.2	
2002 E. coli in Whitewater River	W Fk Whitewater River	U.S.52 Just East of SR229 Metamora	5080003040130	GMW040-0009	2420.0	64.0	B
2002 E. coli in Whitewater River	W Fk Whitewater River	U.S.52 Just East of SR229 Metamora	5080003040130	GMW040-0009	2420.0	65.0	
2002 E. coli in Whitewater River	W Fk Whitewater River	SR 44 and SR 1	5080003040030	GMW040-0006	2420.0	95.9	Q
2002 E. coli in Whitewater River	W Fk Whitewater River	SR 44 and SR 1	5080003040030	GMW040-0006	2420.0	101.4	B
2002 E. coli in Whitewater River	W Fk Whitewater River	CR 440 E of SR1 Waterloo	5080003020070	GMW020-0025	2420.0	104.6	
2002 E. coli in Whitewater River	W Fk Whitewater River	CR 440 E of SR1 Waterloo	5080003020070	GMW020-0025	2420.0	127.4	Q
2002 E. coli in Whitewater River	W Fk Whitewater River	SR 44 and SR 1	5080003040030	GMW040-0006	2420.0	162.4	
2002 E. coli in Whitewater River	W Fk Whitewater River	SR 44 and SR 1	5080003040030	GMW040-0006	2420.0	178.9	
2002 E. coli in Whitewater River	W Fk Whitewater River	CR 440 E of SR1 Waterloo	5080003020070	GMW020-0025	2420.0	191.8	
2002 E. coli in Whitewater River	W Fk Whitewater River	Crietz Park Cambridge city	5080003020070	GMW020-0005	2420.0	224.7	
2002 E. coli in Whitewater River	W Fk Whitewater River	CR 440 E of SR1 Waterloo	5080003020070	GMW020-0025	2420.0	344.8	
2002 E. coli in Whitewater River	W Fk Whitewater River	US 35 at SR1	5080003010010	GMW010-0026	2420.0	387.3	
2002 E. coli in Whitewater River	W Fk Whitewater River	CR 440 E of SR1 Waterloo	5080003020070	GMW020-0025	2420.0	461.1	
2002 E. coli in Whitewater River	W Fk Whitewater River	Crietz Park Cambridge city	5080003020070	GMW020-0005	2420.0	517.2	Q
2002 E. coli in Whitewater River	W Fk Whitewater River	Crietz Park Cambridge city	5080003020070	GMW020-0005	2420.0	547.5	
2002 E. coli in Whitewater	W Fk Whitewater River	US 35 at SR1	5080003010010	GMW010-	2420.0	686.7	

River				0026			
2002 E. coli in Whitewater River	W Fk Whitewater River	US 35 at SR1	5080003010010	GMW010-0026	2420.0	816.4	
2002 E. coli in Whitewater River	W Fk Whitewater River	US 35 at SR1	5080003010010	GMW010-0026	2420.0	866.4	Q
2002 E. coli in Whitewater River	W Fk Whitewater River	Crietz Park Cambridge city	5080003020070	GMW020-0005	2420.0	920.8	
2002 E. coli in Whitewater River	W Fk Whitewater River	Crietz Park Cambridge city	5080003020070	GMW020-0005	2420.0	1413.6	
2002 E. coli in Whitewater River	W Fk Whitewater River	US 35 at SR1	5080003010010	GMW010-0026	2420.0	1553.1	
2002 E. coli in Whitewater River	Whitewater River	Laurel Rd, East of SR 121, North of US 52	5080003040110	GMW040-0005	2420.0	29.5	
2002 E. coli in Whitewater River	Whitewater River	Laurel Rd, East of SR 121, North of US 52	5080003040110	GMW040-0005	2420.0	40.2	Q
2002 E. coli in Whitewater River	Whitewater River	Laurel Rd, East of SR 121, North of US 52	5080003040110	GMW040-0005	2420.0	52.0	
2002 E. coli in Whitewater River	Whitewater River	Laurel Rd, East of SR 121, North of US 52	5080003040110	GMW040-0005	2420.0	86.2	B
2002 E. coli in Whitewater River	Whitewater River	Laurel Rd, East of SR 121, North of US 52	5080003040110	GMW040-0005	2420.0	116.2	
2002 E. coli in Whitewater River	Williams Cr	CR 225 S West of SR 121at CR 200N, South of Connerville	5080003040070	GMW040-0003	2420.0	122.3	
2002 E. coli in Whitewater River	Williams Cr	CR 225 S West of SR 121at CR 200N, South of Connerville	5080003040070	GMW040-0003	2420.0	154.1	B
2002 E. coli in Whitewater River	Williams Cr	CR 225 S West of SR 121at CR 200N, South of Connerville	5080003040070	GMW040-0003	2420.0	206.3	Q
2002 E. coli in Whitewater River	Williams Cr	CR 225 S West of SR 121at CR 200N, South of Connerville	5080003040070	GMW040-0003	2420.0	261.3	
2002 E. coli in Whitewater River	Williams Cr	CR 225 S West of SR 121at CR 200N, South of Connerville	5080003040070	GMW040-0003	2420.0	435.2	
2007 Corvallis E. coli	Bear Cr	Bear Creek Rd	5080003010040	GMW010-0041	2420.0	613.1	
2007 Corvallis E. coli	Bear Cr	Bear Creek Rd	5080003010040	GMW010-0041	12033.0	816.4	
2007 Corvallis E. coli	Bear Cr	Bear Creek Rd	5080003010040	GMW010-0041	2420.0	980.4	

2007	Corvallis	E. coli	Bear Cr	Little Bear Rd	5080003040090	GMW040-0045	2420.0	1299.7
2007	Corvallis	E. coli	Bear Cr	Little Bear Rd	5080003040090	GMW040-0045	2420.0	1732.9
2007	Corvallis	E. coli	Bear Cr	Bear Creek Rd	5080003010040	GMW010-0041	2420.0	2419.2
2007	Corvallis	E. coli	Bear Cr	Little Bear Rd	5080003040090	GMW040-0045	2420.0	2419.2
2007	Corvallis	E. coli	Bear Cr	Little Bear Rd	5080003040090	GMW040-0045	2420.0	2419.2
2007	Corvallis	E. coli	Bear Cr	Little Bear Rd	5080003040090	GMW040-0045	2420.0	2419.2
2007	Corvallis	E. coli	Bear Cr	Bear Creek Rd	5080003010040	GMW010-0041	2420.0	2420.0
2007	Corvallis	E. coli	Bloomingport Cr	CR 1000 S	5080003020030	GMW020-0036	2420.0	290.9
2007	Corvallis	E. coli	Bloomingport Cr	CR 1000 S	5080003020030	GMW020-0036	2420.0	344.8
2007	Corvallis	E. coli	Bloomingport Cr	CR 1000 S	5080003020030	GMW020-0036	2420.0	613.1
2007	Corvallis	E. coli	Bloomingport Cr	CR 1000 S	5080003020030	GMW020-0036	2420.0	727.0
2007	Corvallis	E. coli	Bloomingport Cr	CR 1000 S	5080003020030	GMW020-0036	2420.0	920.8
2007	Corvallis	E. coli	Greens Fork	Mineral Springs Rd	5080003020040	GMW020-0033	2420.0	101.0
2007	Corvallis	E. coli	Greens Fork	Center Rd	5080003020030	GMW020-0029	2420.0	142.1
2007	Corvallis	E. coli	Greens Fork	Mineral Springs Rd	5080003020040	GMW020-0033	2420.0	151.5
2007	Corvallis	E. coli	Greens Fork	Mineral Springs Rd	5080003020040	GMW020-0033	2420.0	201.4
2007	Corvallis	E. coli	Greens Fork	Mineral Springs Rd	5080003020040	GMW020-0033	2420.0	209.8
2007	Corvallis	E. coli	Greens Fork	Center Rd	5080003020030	GMW020-0029	2420.0	260.2
2007	Corvallis	E. coli	Greens Fork	Mineral Springs Rd	5080003020040	GMW020-	2420.0	325.5

				0033		
2007 Corvallis E. coli	Greens Fork	Center Rd	5080003020030	GMW020-0029	2420.0	387.3
2007 Corvallis E. coli	Greens Fork	Center Rd	5080003020030	GMW020-0029	2420.0	488.4
2007 Corvallis E. coli	Greens Fork	Center Rd	5080003020030	GMW020-0029	2420.0	613.1
2007 Corvallis E. coli	Little Williams Cr	Williams Rd	5080003040070	GMW040-0040	2420.0	488.4
2007 Corvallis E. coli	Little Williams Cr	Williams Rd	5080003040070	GMW040-0040	2420.0	613.1
2007 Corvallis E. coli	Little Williams Cr	Williams Rd	5080003040070	GMW040-0040	2420.0	770.1
2007 Corvallis E. coli	Little Williams Cr	Williams Rd	5080003040070	GMW040-0040	2420.0	1119.9
2007 Corvallis E. coli	Little Williams Cr	Williams Rd	5080003040070	GMW040-0040	2420.0	1553.1
2007 Corvallis E. coli	Morgan Cr	Gilmer Rd	5080003010110	GMW010-0044	2420.0	172.0
2007 Corvallis E. coli	Morgan Cr	Gilmer Rd	5080003010110	GMW010-0044	2420.0	178.5
2007 Corvallis E. coli	Morgan Cr	Gilmer Rd	5080003010110	GMW010-0044	2420.0	235.9
2007 Corvallis E. coli	Morgan Cr	Gilmer Rd	5080003010110	GMW010-0044	2420.0	325.5
2007 Corvallis E. coli	Morgan Cr	Gilmer Rd	5080003010110	GMW010-0044	2420.0	727.0
2007 Corvallis E. coli	Nolands Fk	CR 1100 S	5080003030010	GMW030-0026	2420.0	35.0
2007 Corvallis E. coli	Nolands Fk	CR 1100 S	5080003030010	GMW030-0026	2419.2	58.1
2007 Corvallis E. coli	Nolands Fk	CR 1100 S	5080003030010	GMW030-0026	2420.0	88.2
2007 Corvallis E. coli	Nolands Fk	Log Cabin Rd	5080003030040	GMW030-0025	2420.0	172.0
2007 Corvallis E. coli	Nolands Fk	Log Cabin Rd	5080003030040	GMW030-0025	2420.0	201.4

2007 Corvallis E. coli	Nolands Fk	CR 1100 S	5080003030010	GMW030-0026	2420.0	201.4
2007 Corvallis E. coli	Nolands Fk	CR 1100 S	5080003030010	GMW030-0026	2420.0	248.1
2007 Corvallis E. coli	Nolands Fk	Log Cabin Rd	5080003030040	GMW030-0025	2420.0	365.4
2007 Corvallis E. coli	Nolands Fk	Log Cabin Rd	5080003030040	GMW030-0025	2420.0	410.6
2007 Corvallis E. coli	Nolands Fk	Log Cabin Rd	5080003030040	GMW030-0025	2420.0	1119.9
2007 Corvallis E. coli	Roy Run	CR 950 S	5080003010080	GMW010-0045	2420.0	218.7
2007 Corvallis E. coli	Roy Run	CR 950 S	5080003010080	GMW010-0045	2420.0	547.5
2007 Corvallis E. coli	Roy Run	CR 950 S	5080003010080	GMW010-0045	2420.0	727.0
2007 Corvallis E. coli	Roy Run	CR 950 S	5080003010080	GMW010-0045	2420.0	1119.9
2007 Corvallis E. coli	Roy Run	CR 950 S	5080003010080	GMW010-0045	2420.0	1203.3
2007 Corvallis E. coli	Whitewater River	CR 121	5080003040130	GMW040-0044	2420.0	18.5
2007 Corvallis E. coli	Whitewater River	CR 640 S	5080003040090	GMW040-0043	2420.0	22.6
2007 Corvallis E. coli	Whitewater River	CR 121	5080003040130	GMW040-0044	2420.0	23.1
2007 Corvallis E. coli	Whitewater River	CR 121	5080003040130	GMW040-0044	2420.0	30.9
2007 Corvallis E. coli	Whitewater River	CR 121	5080003040130	GMW040-0044	2420.0	35.0
2007 Corvallis E. coli	Whitewater River	CR 121	5080003040130	GMW040-0044	2420.0	35.9
2007 Corvallis E. coli	Whitewater River	SR 121	5080003040090	GMW040-0036	2420.0	36.4
2007 Corvallis E. coli	Whitewater River	CR 640 S	5080003040090	GMW040-0043	2420.0	44.8
2007 Corvallis E. coli	Whitewater River	SR 121	5080003040090	GMW040-	2420.0	55.6

				0036		
2007 Corvallis E. coli	Whitewater River	CR 640 S	5080003040090	GMW040-0043	2420.0	56.5
2007 Corvallis E. coli	Whitewater River	CR 100 E	5080003020070	GMW020-0035	2420.0	57.6
2007 Corvallis E. coli	Whitewater River	CR 640 S	5080003040090	GMW040-0043	2420.0	57.6
2007 Corvallis E. coli	Whitewater River	SR 121	5080003040090	GMW040-0036	2420.0	59.4
2007 Corvallis E. coli	Whitewater River	SR 121	5080003040090	GMW040-0036	2420.0	62.0
2007 Corvallis E. coli	Whitewater River	CR 100 E	5080003020070	GMW020-0035	2420.0	66.3
2007 Corvallis E. coli	Whitewater River	CR 100 E	5080003020070	GMW020-0035	2419.2	127.4
2007 Corvallis E. coli	Whitewater River	CR 100 E	5080003020070	GMW020-0035	2420.0	129.1
2007 Corvallis E. coli	Whitewater River	CR 100 E	5080003020070	GMW020-0035	2420.0	155.3
2007 Corvallis E. coli	Whitewater River	SR 121	5080003040090	GMW040-0036	2420.0	162.4
2007 Corvallis E. coli	Whitewater River	Cambridge Rd	5080003010040	GMW010-0035	2420.0	307.6
2007 Corvallis E. coli	Whitewater River	Cambridge Rd	5080003010040	GMW010-0035	2420.0	325.5
2007 Corvallis E. coli	Whitewater River	Cambridge Rd	5080003010040	GMW010-0035	2420.0	410.6
2007 Corvallis E. coli	Whitewater River	CR 640 S	5080003040090	GMW040-0043	2420.0	435.2
2007 Corvallis E. coli	Whitewater River	Cambridge Rd	5080003010040	GMW010-0035	2420.0	547.5
2007 Corvallis E. coli	Whitewater River	Cambridge Rd	5080003010040	GMW010-0035	2420.0	980.4

Attachment B

Water Quality Duration Curves for West Fork Whitewater Watershed TMDL

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Attachment C

Load Duration Curves for West Fork Whitewater Watershed TMDL

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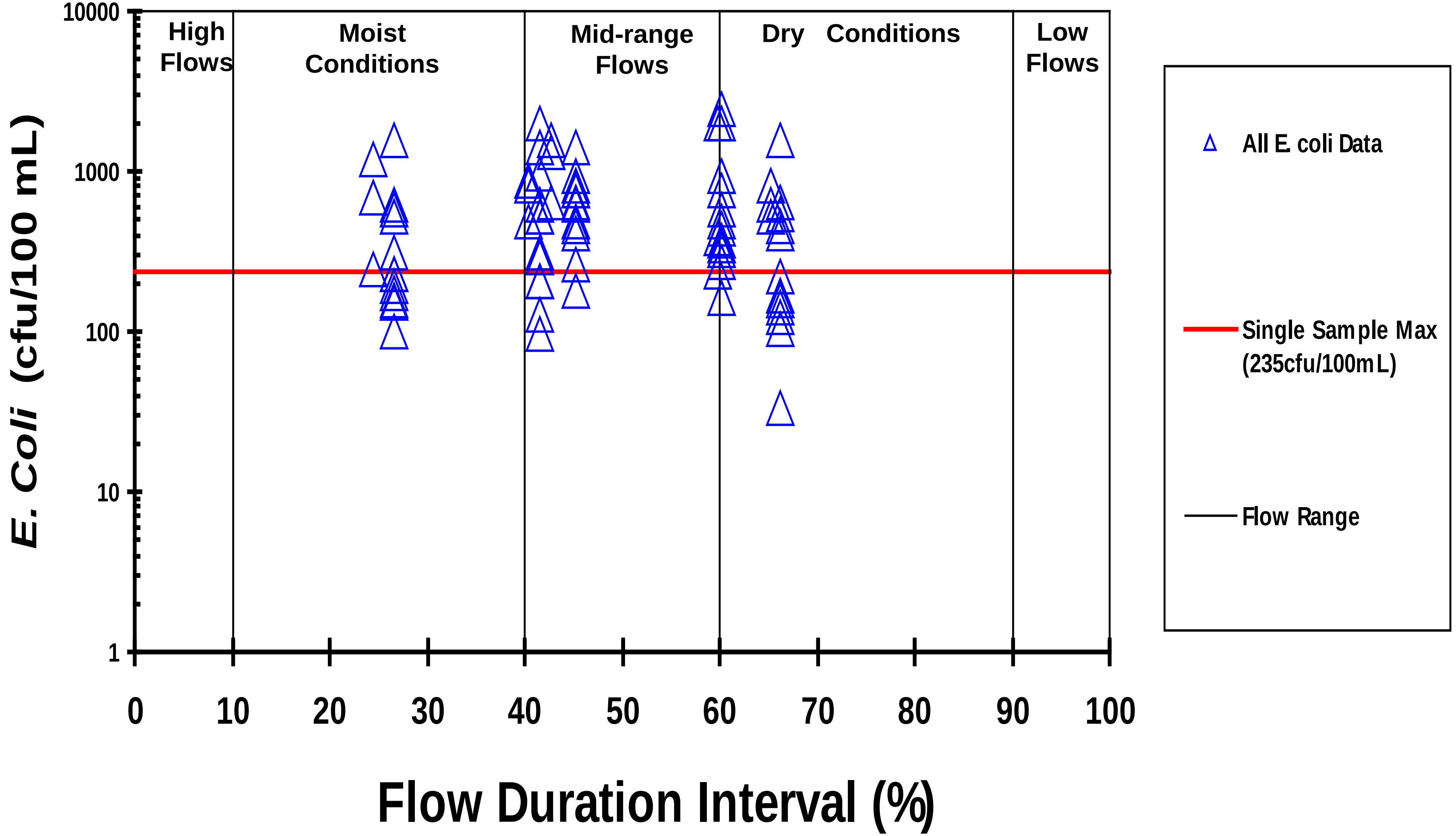
Attachment D

Precipitation Curves for
West Fork Whitewater Watershed TMDL

West Fork Whitewater River

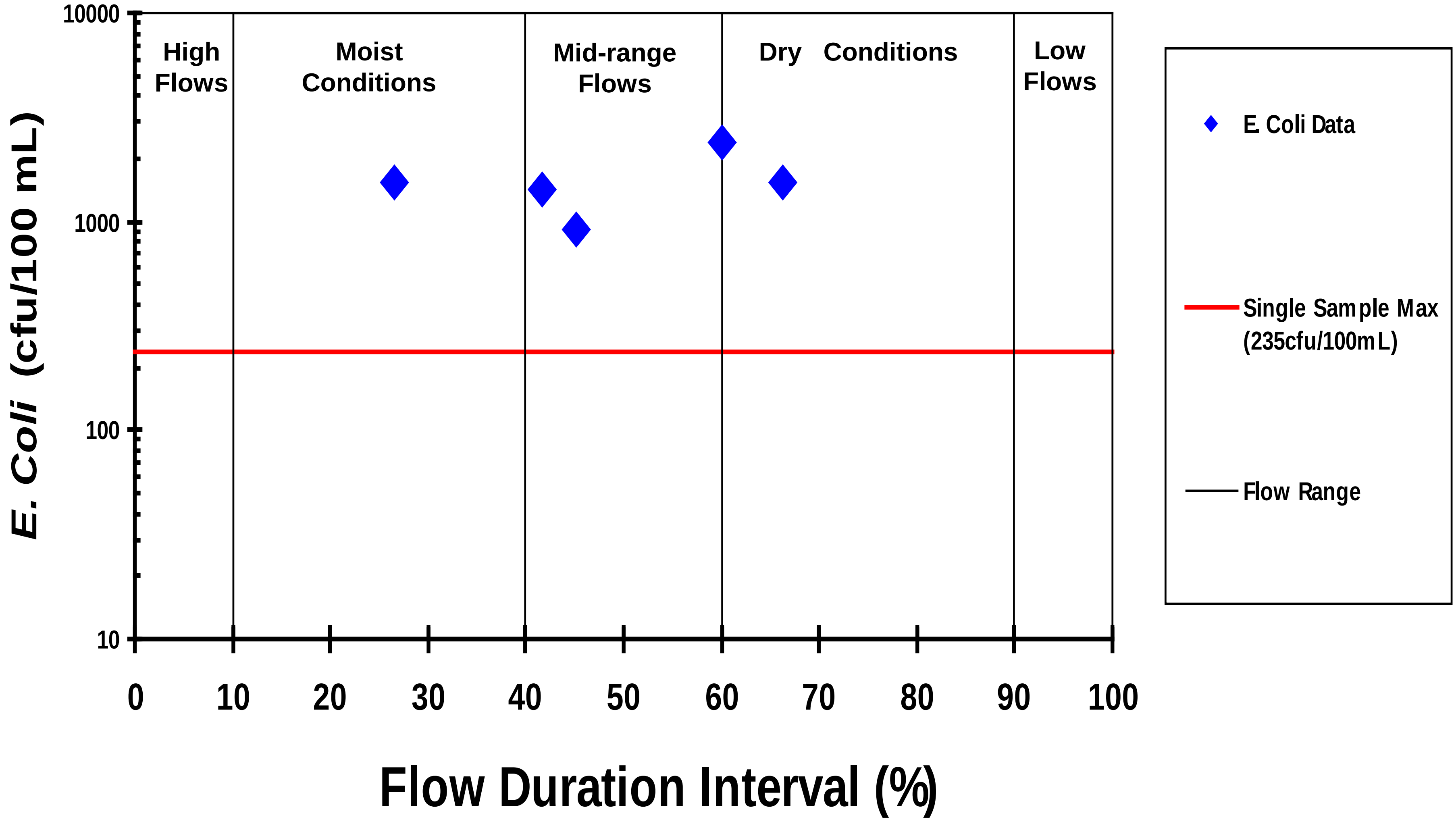
E. coli Water Quality Duration Curve

(all sites)



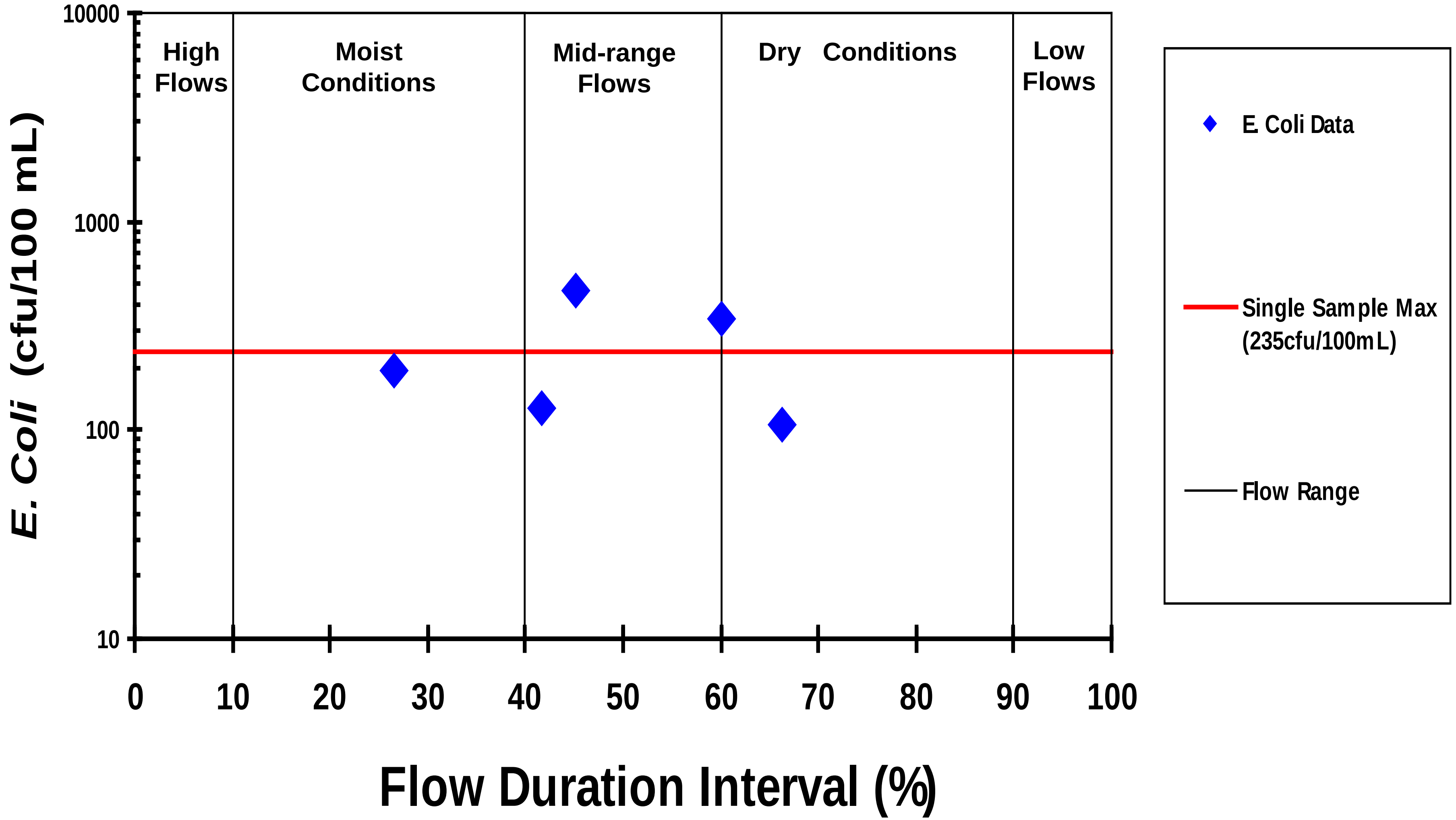
IDEM Water Quality Data & USGS Gage 03275000 Stream Flow Data
Upstream Drainage Area is 522 square miles

Unnamed Tributary
at Crietz Park, Cambridge City, IN
E. coli Water Quality Duration Curve - Site: GMW010-0030



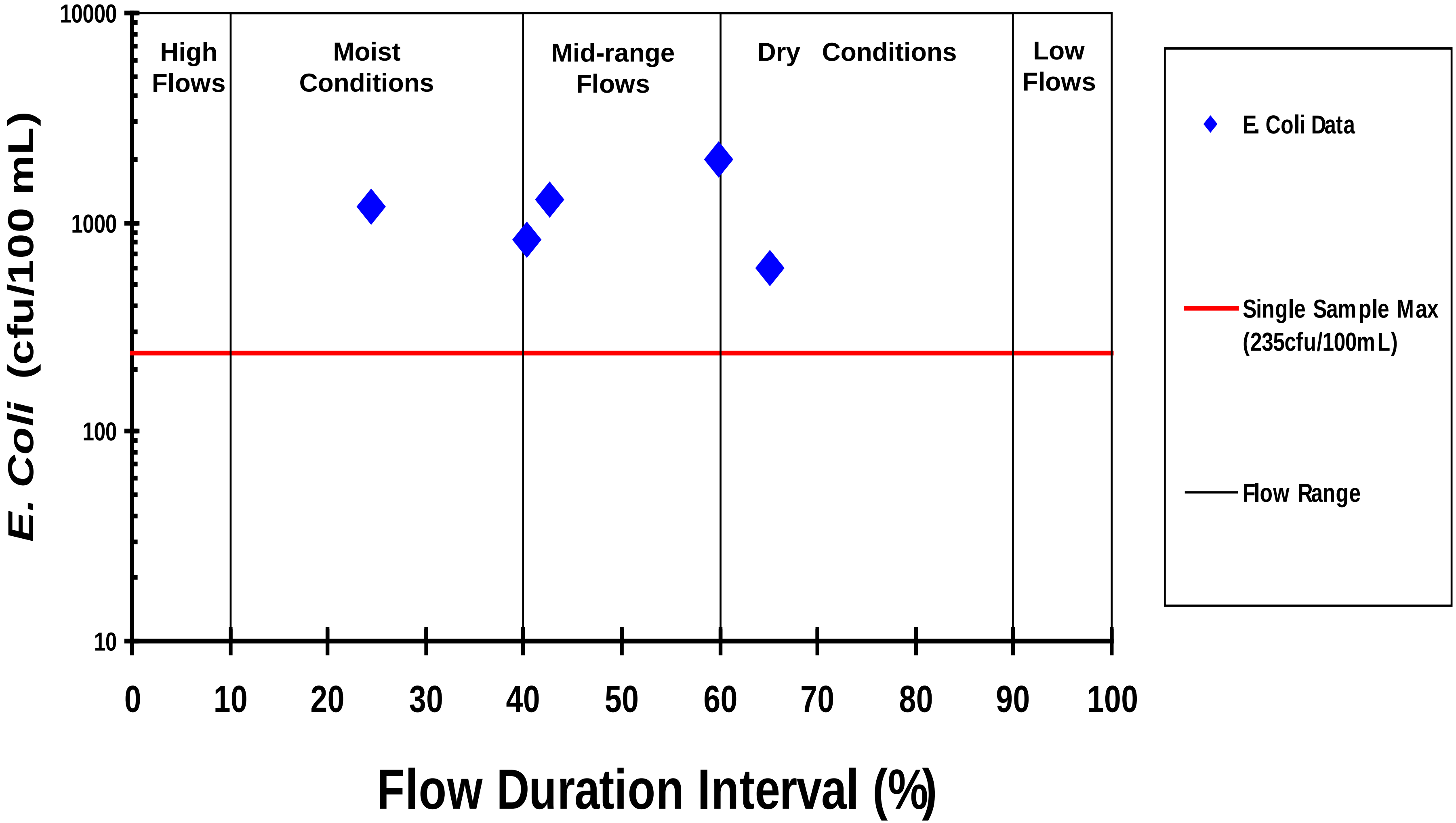
IDEM Water Quality Data & USGS Gage 03275000 Stream Flow Data
Upstream Drainage Area is 1.0 square miles

West Fork Whitewater River
at CR 440 E near Waterloo, IN
E. coli Water Quality Duration Curve - Site: GMW020-0025



IDEM Water Quality Data & USGS Gage 03275000 Stream Flow Data
Upstream Drainage Area is 310 square miles

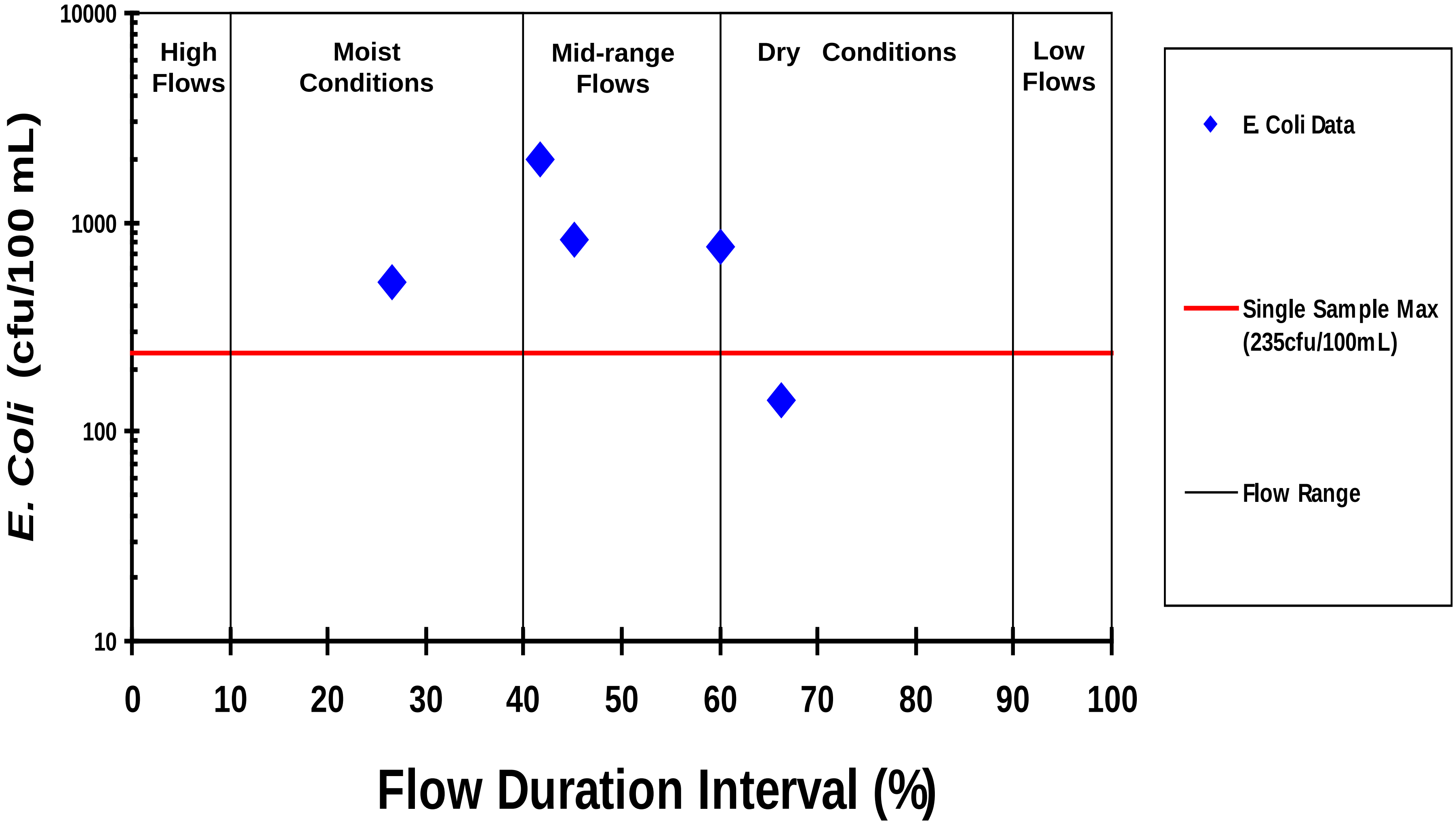
Nolands Fork
at Fountain City Park, Fountain City, IN
E. coli Water Quality Duration Curve - Site: GMW030-0004



IDEM Water Quality Data & USGS Gage 03275000 Stream Flow Data
Upstream Drainage Area is 17.0 square miles

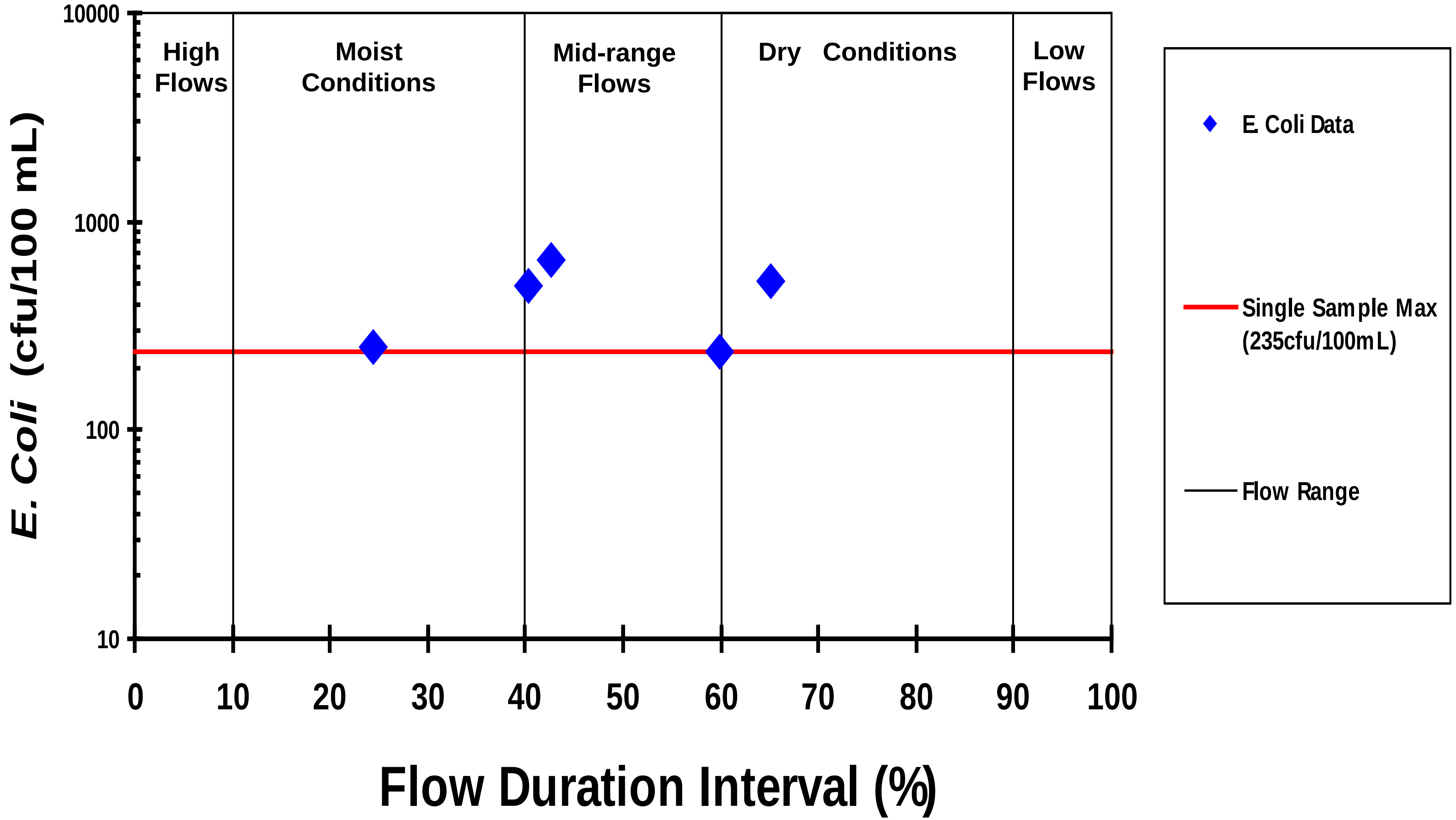
Morgan Creek
at SR 38

E. coli Water Quality Duration Curve - Site: GMW010-0028



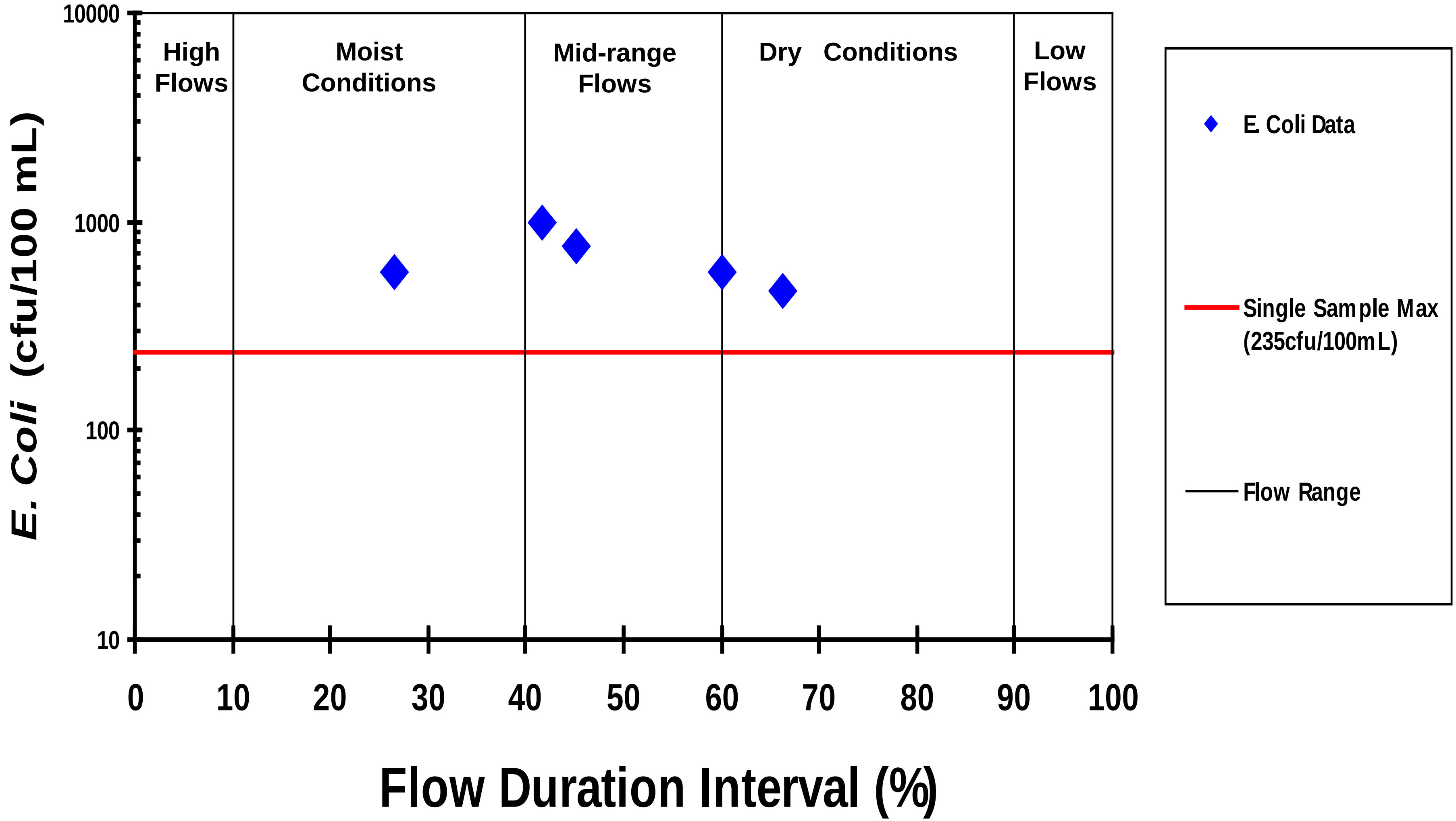
IDEM Water Quality Data & USGS Gage 03275000 Stream Flow Data
Upstream Drainage Area is 15.0 square miles

Greens Fork
at US 35 near Williamsburg, IN
E. coli Water Quality Duration Curve - Site: GMW020-0023

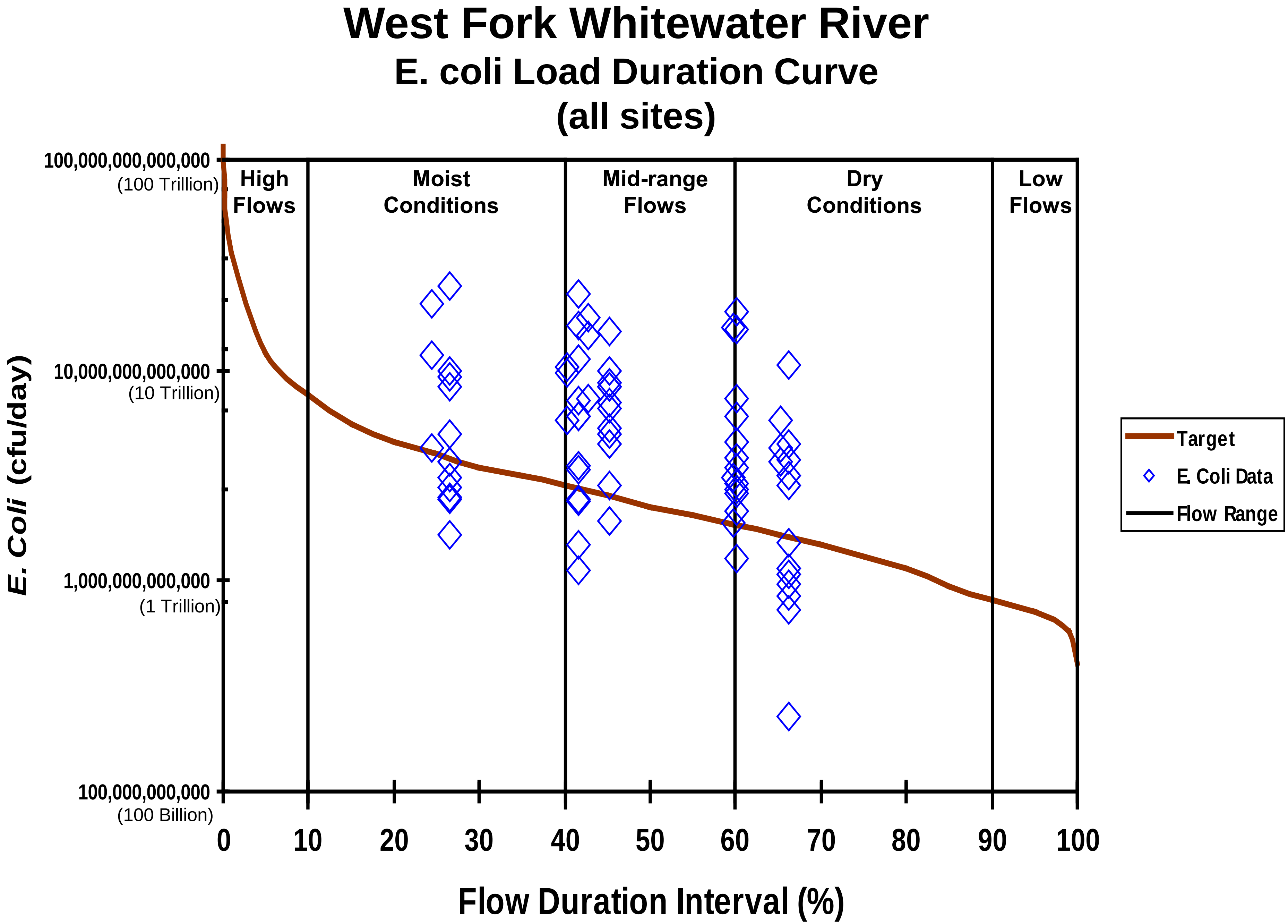


IDEM Water Quality Data & USGS Gage 03275000 Stream Flow Data
Upstream Drainage Area is 49.0 square miles

Nolands Fork
at SR 38
E. coli Water Quality Duration Curve - Site: GMW030-0015

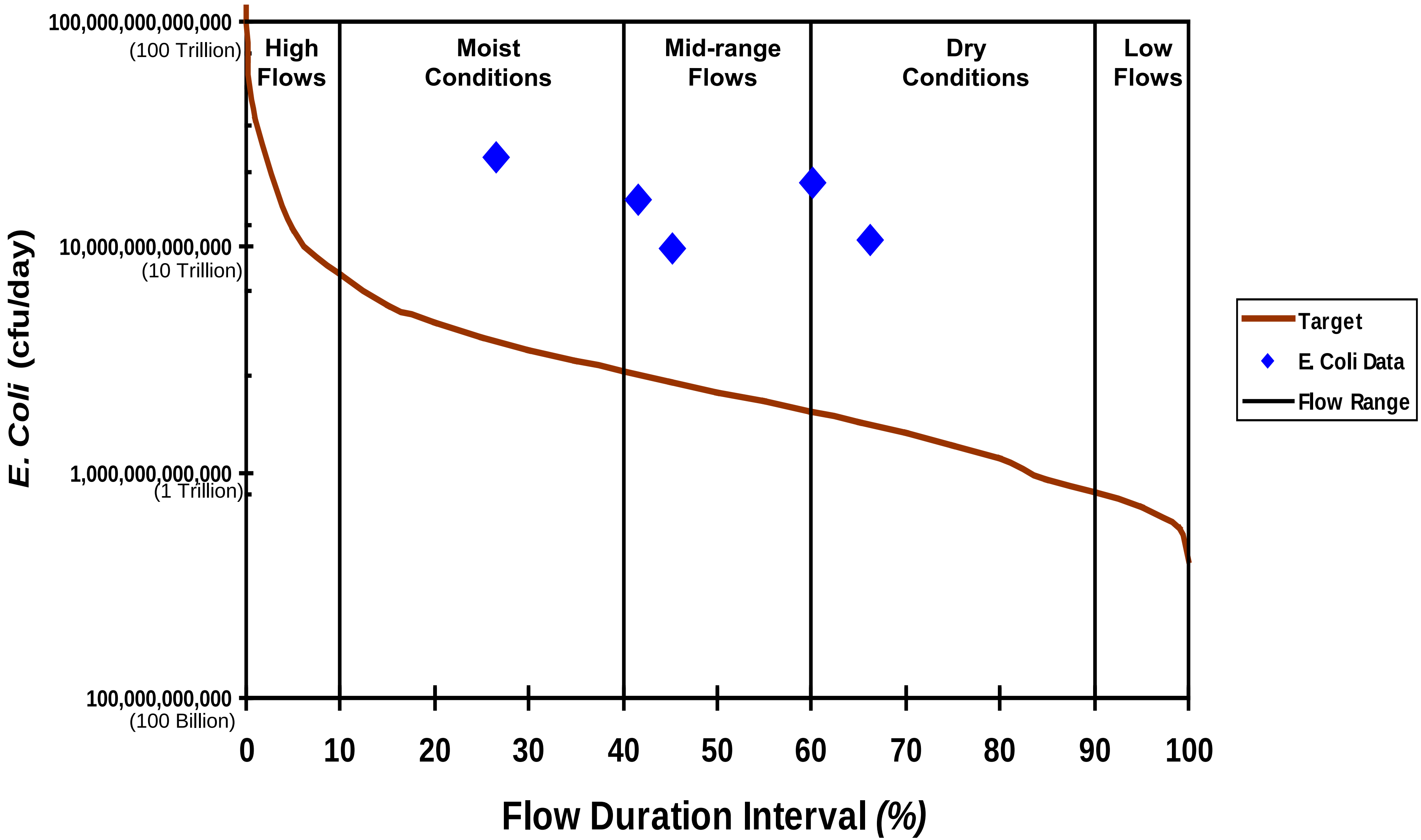


IDEM Water Quality Data & USGS Gage 03275000 Stream Flow Data
Upstream Drainage Area is 42.0 square miles



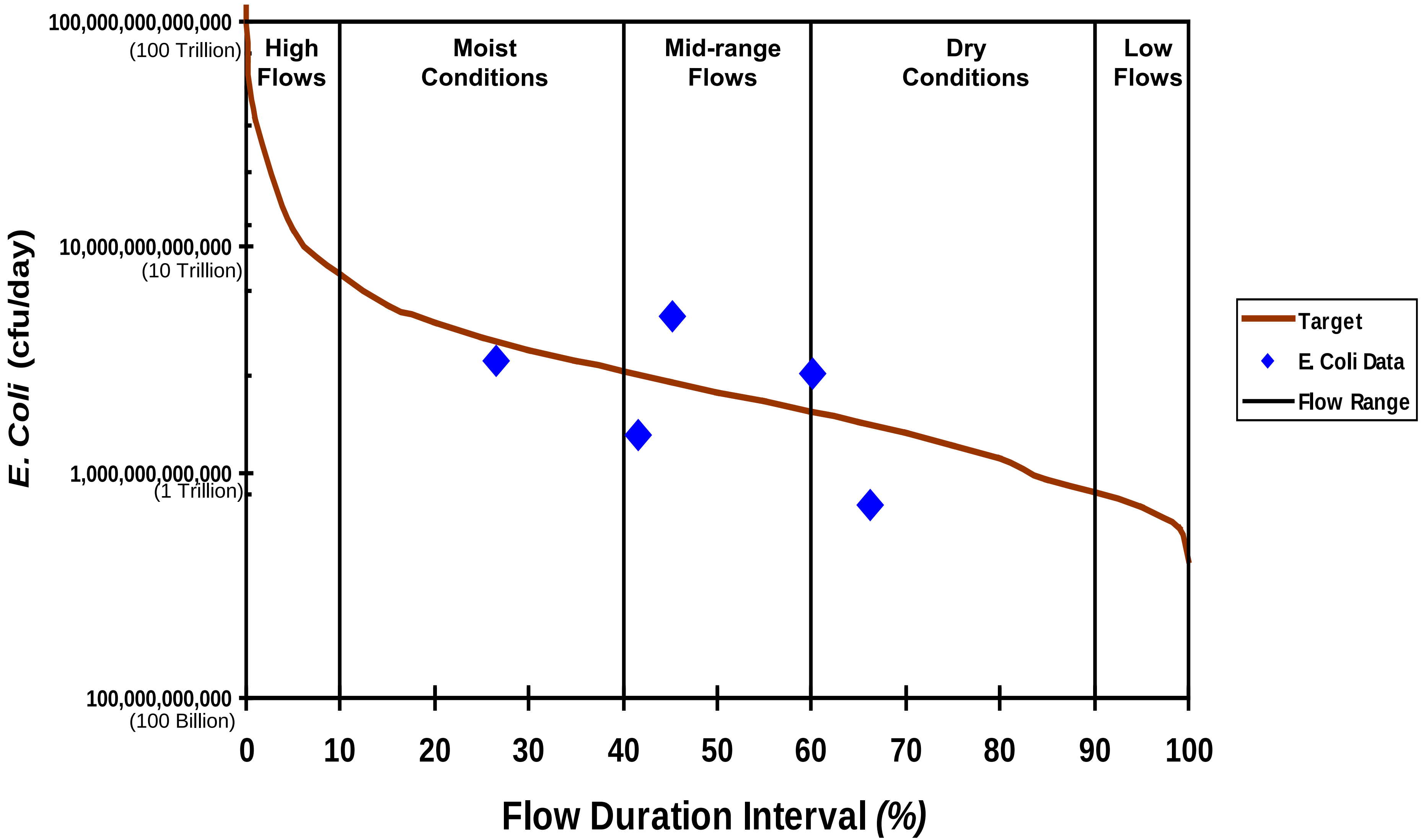
IDEM Water Quality Data & USGS Gage 03275000 Stream Flow Data
Upstream Drainage Area is 522 square miles

Unnamed Tributary
at Crietz Park, Cambridge City, IN
E. coli Load Duration Curve - Site: GMW010-0030



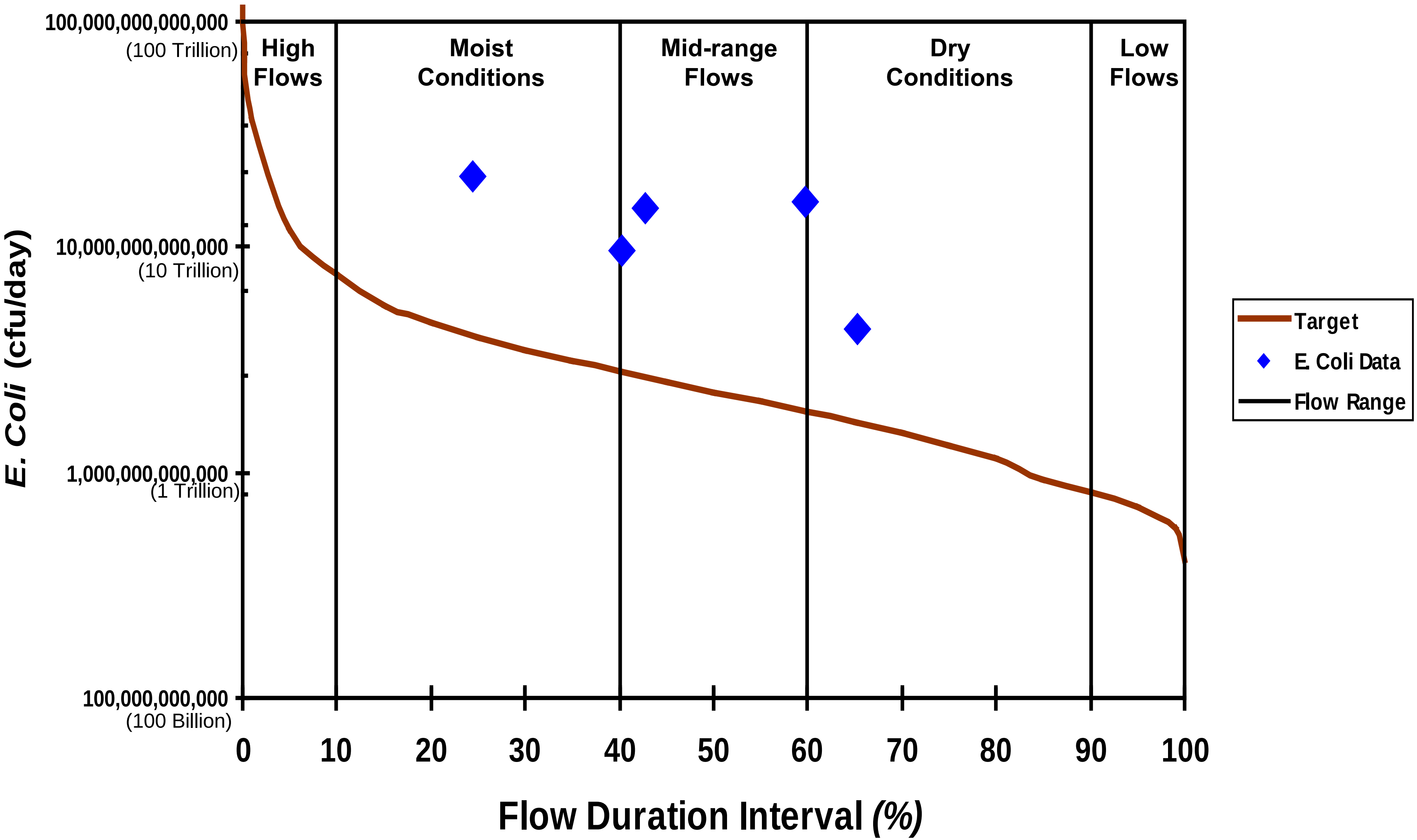
IDEM Water Quality Data & USGS Gage 03275000 Stream Flow Data
Upstream Drainage Area is 1.0 square miles

West Fork Whitewater River
at CR 440 E near Waterloo, IN
E. coli Load Duration Curve - Site: GMW020-0025



IDEM Water Quality Data & USGS Gage 03275000 Stream Flow Data
Upstream Drainage Area is 310 square miles

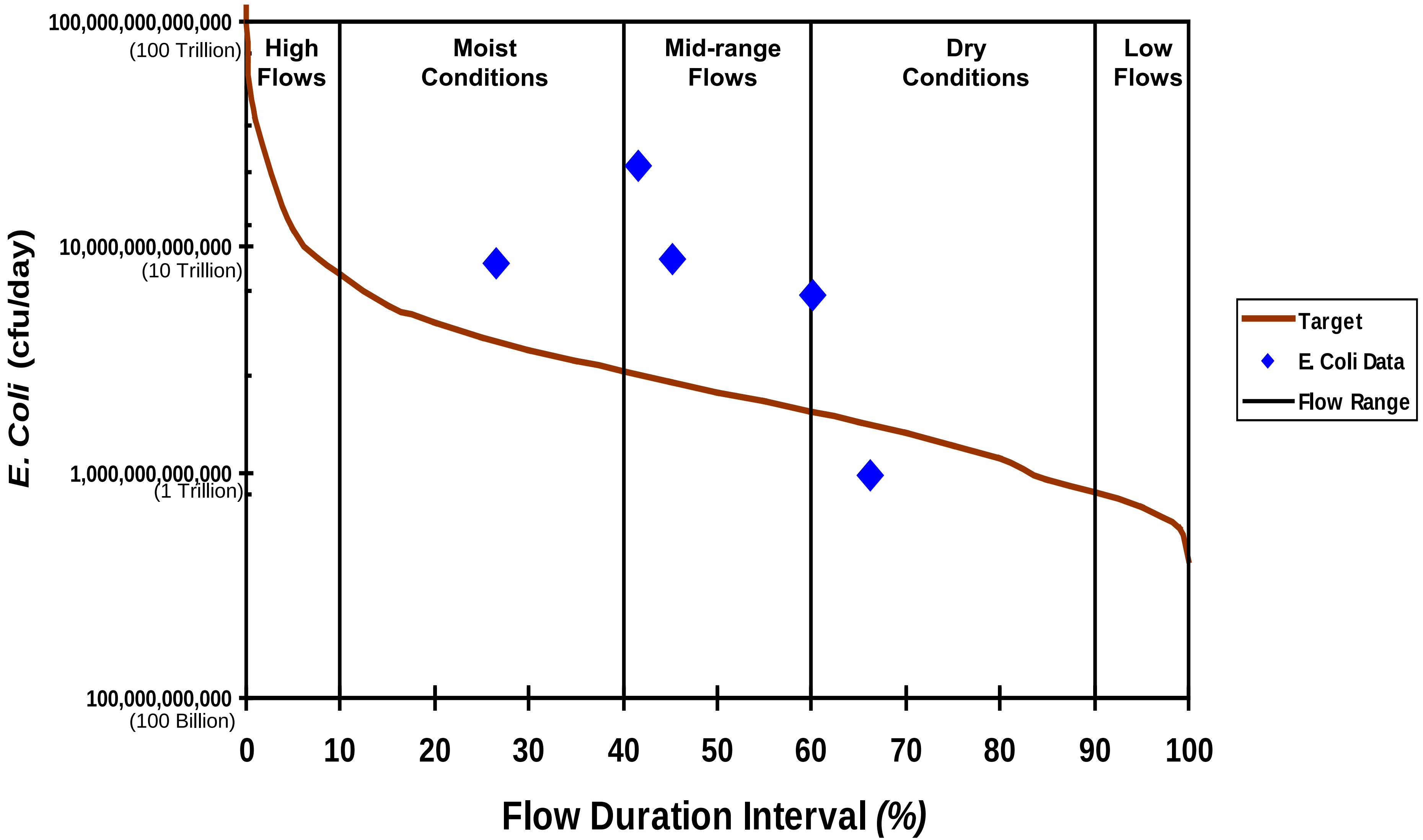
Nolands Fork
at Fountain City Park, Fountain City, IN
E. coli Load Duration Curve - Site: GMW030-0004



IDEM Water Quality Data & USGS Gage 03275000 Stream Flow Data
Upstream Drainage Area is 17.0 square miles

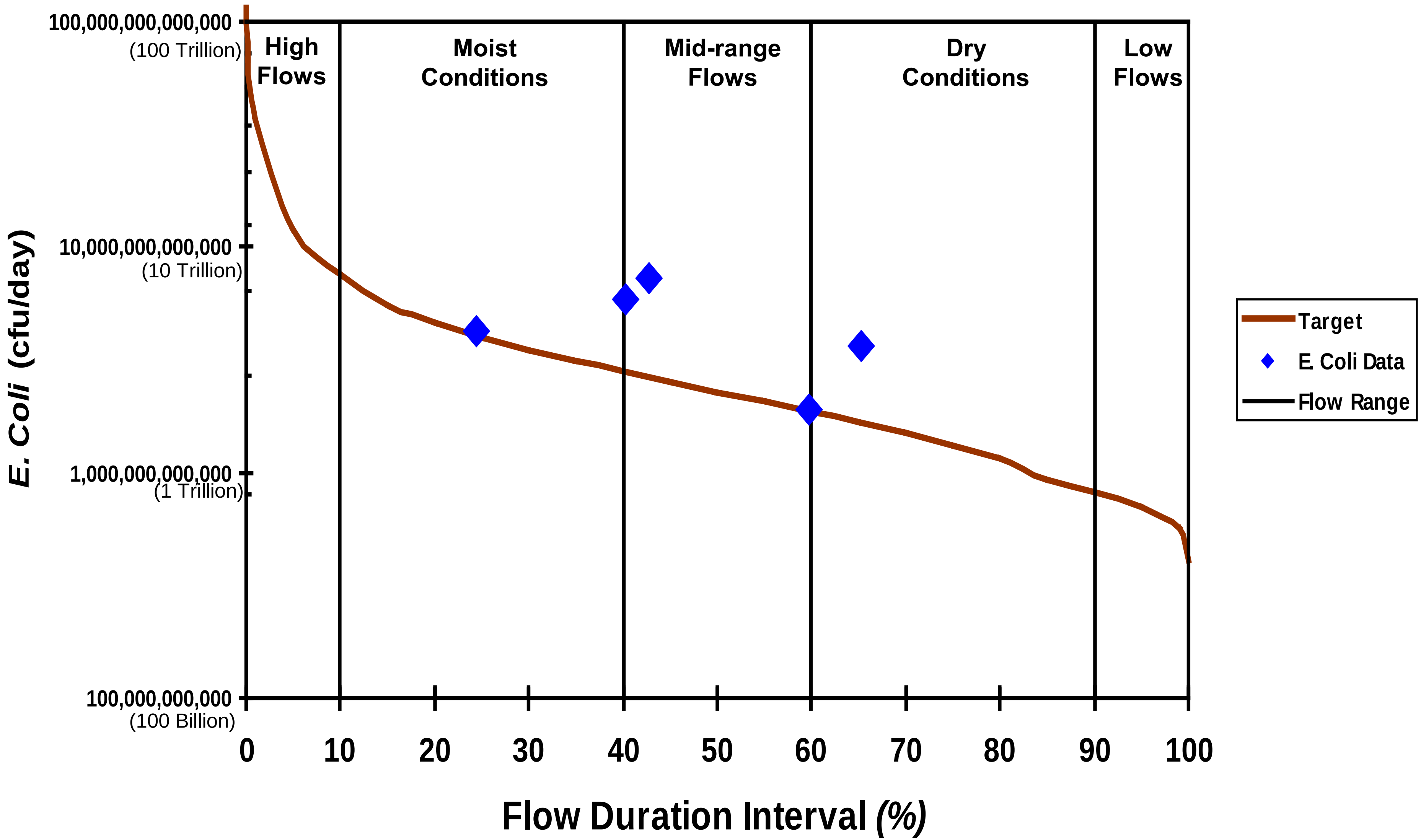
Morgan Creek
at SR 38

E. coli Load Duration Curve - Site: GMW010-0028



IDEM Water Quality Data & USGS Gage 03275000 Stream Flow Data
Upstream Drainage Area is 15.0 square miles

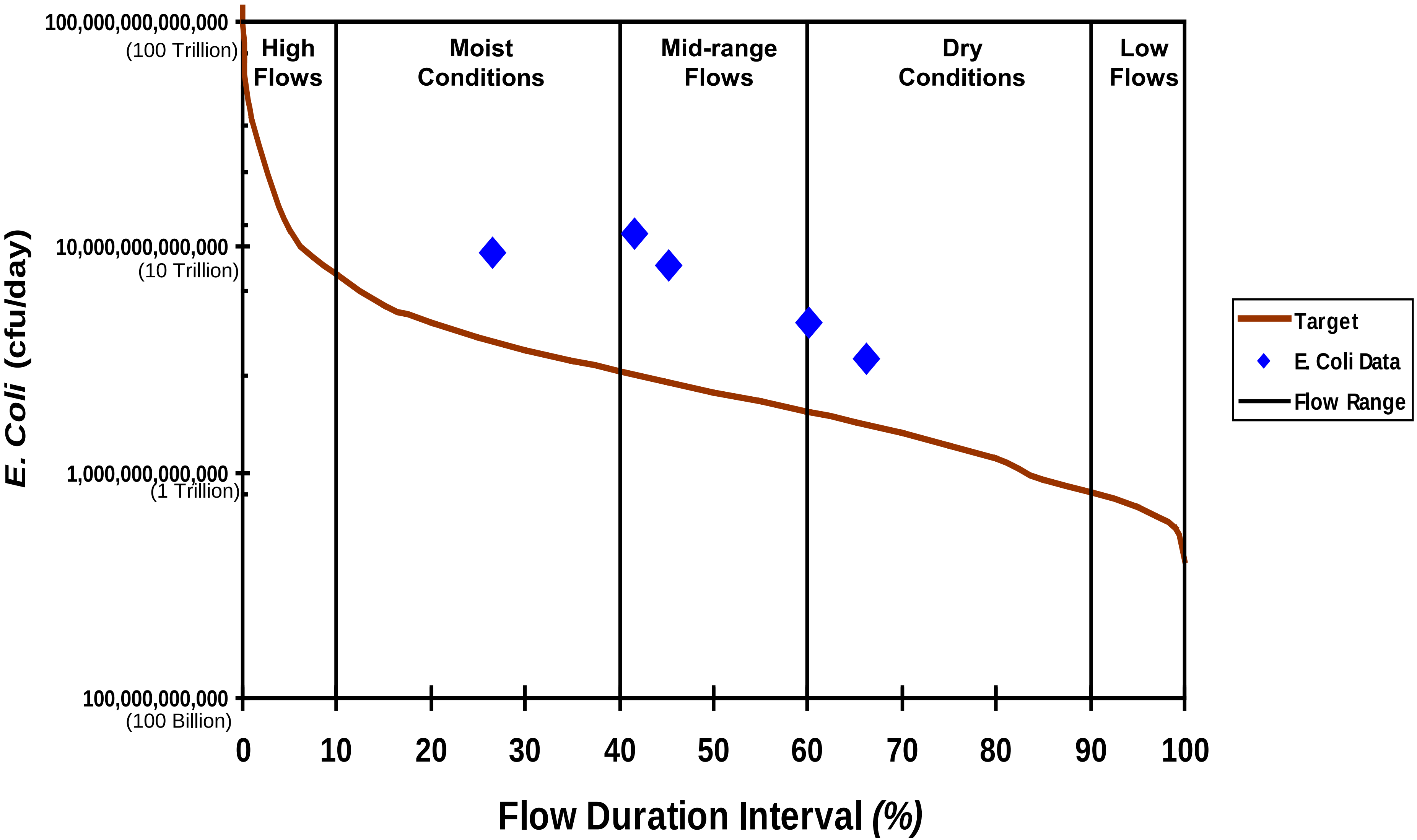
Greens Fork
at US 35 near Williamsburg, IN
E. coli Load Duration Curve - Site: GMW020-0023



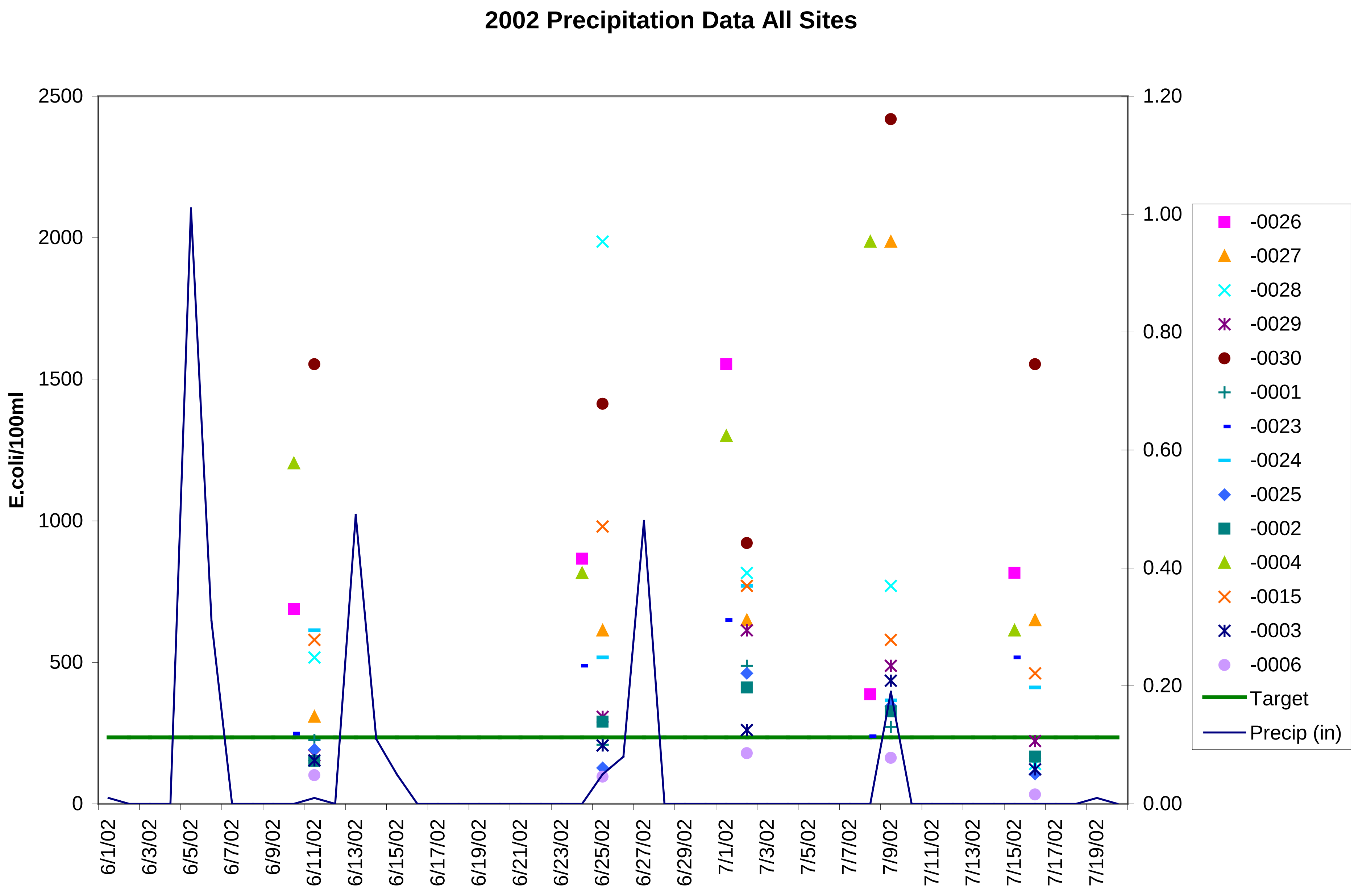
IDEM Water Quality Data & USGS Gage 03275000 Stream Flow Data
Upstream Drainage Area is 49.0 square miles

Nolands Fork
at SR 38

E. coli Load Duration Curve - Site: GMW030-0015

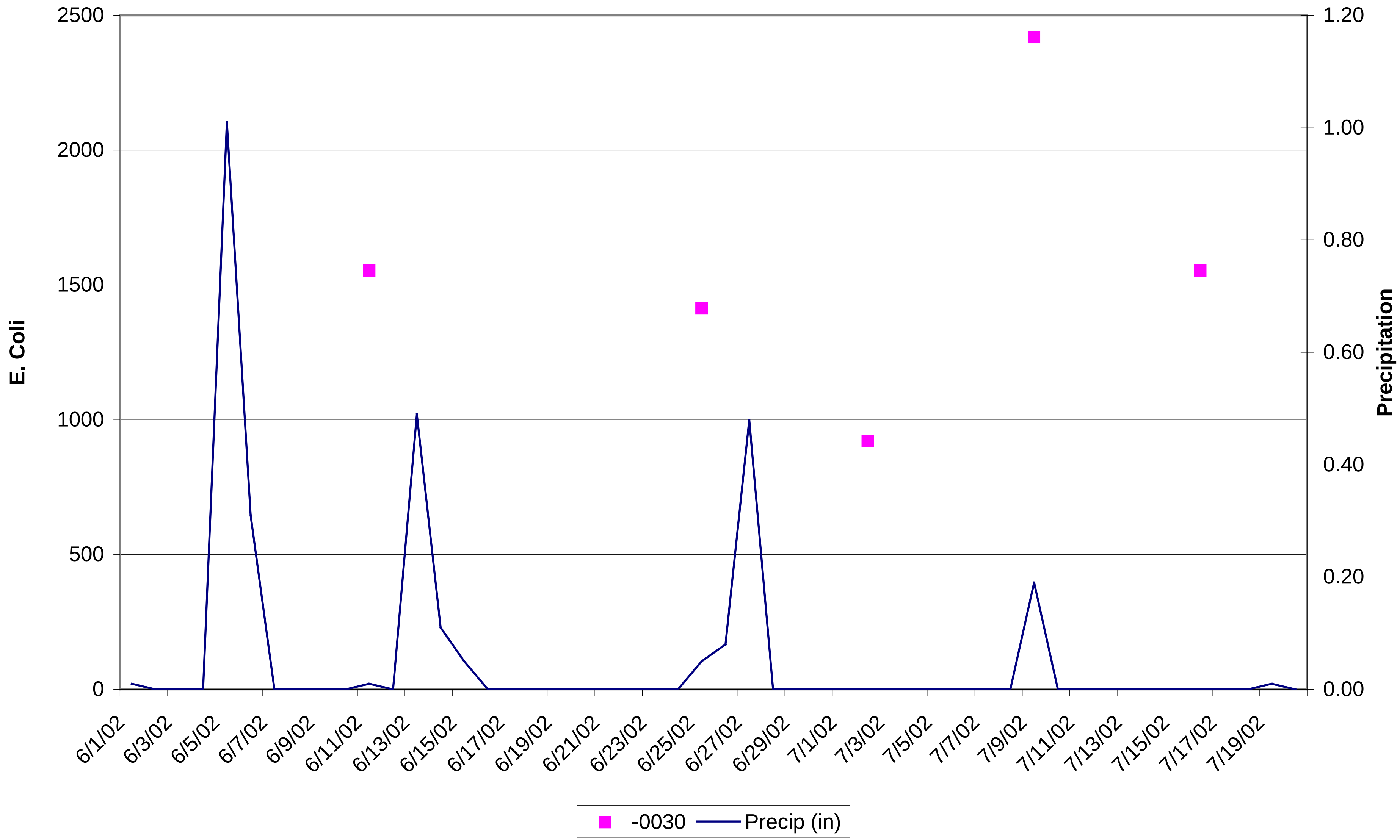


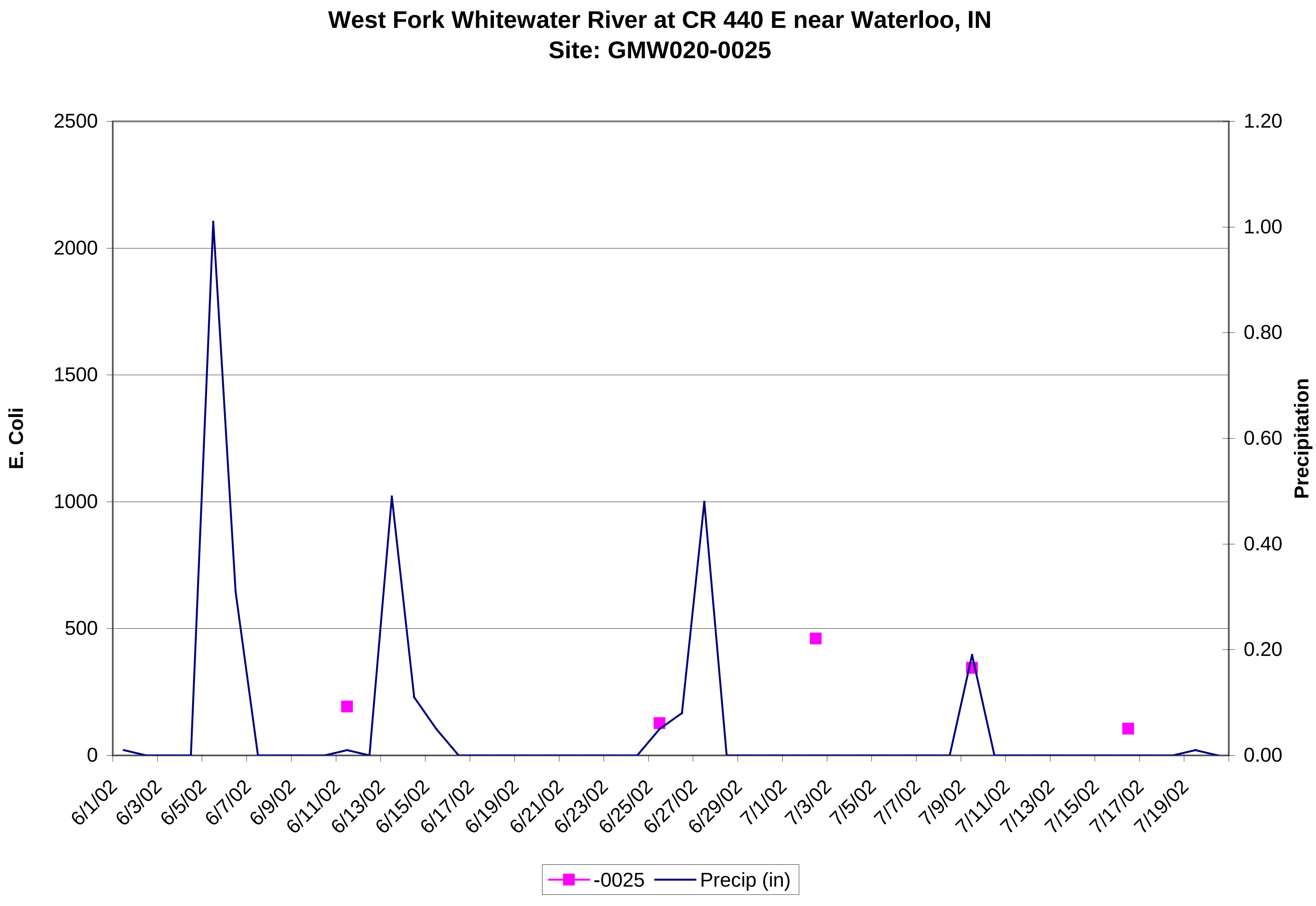
IDEM Water Quality Data & USGS Gage 03275000 Stream Flow Data
Upstream Drainage Area is 42.0 square miles



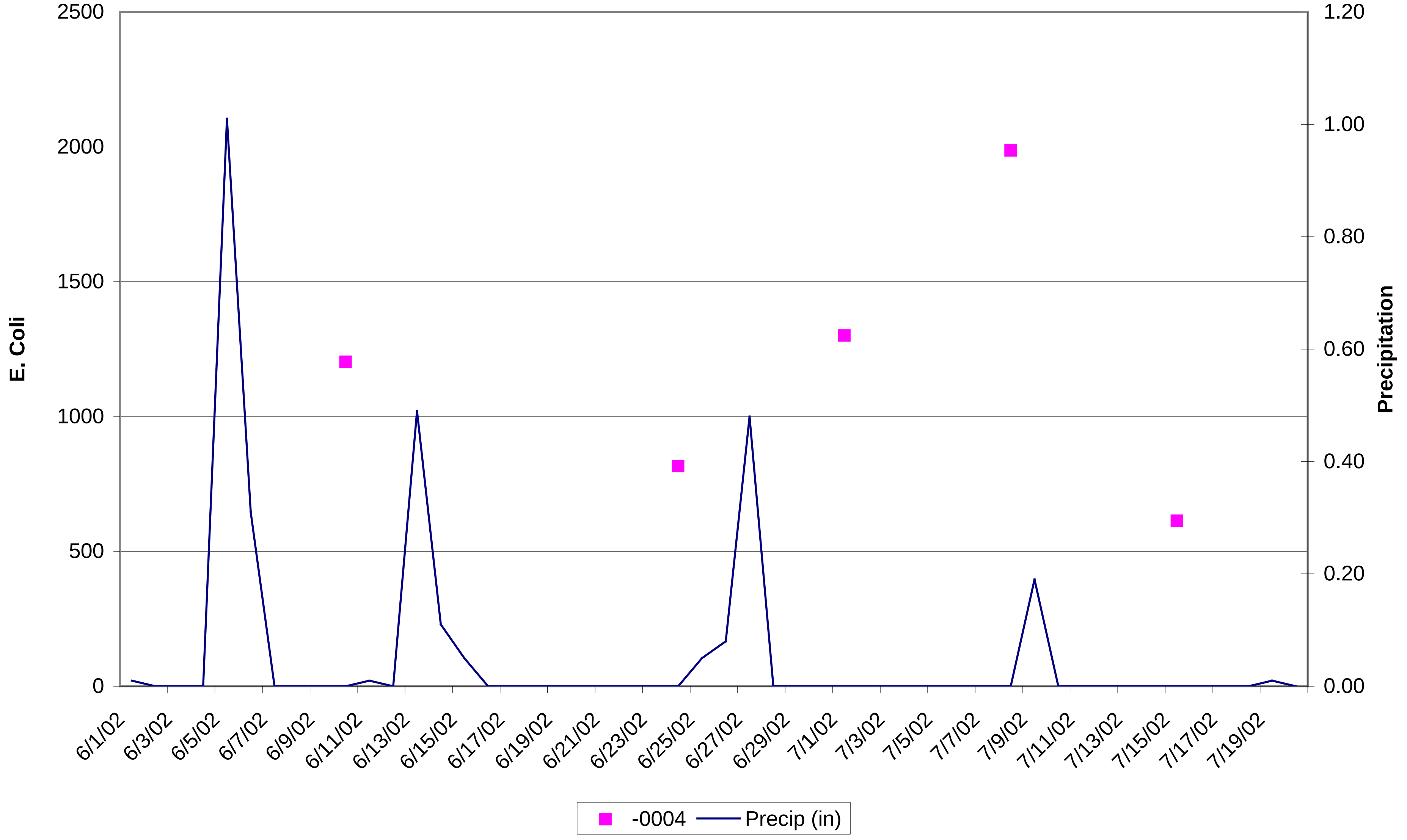
2002 Precipitation Data All Sites
E.coli/100ml
2500
2000
1500
1000
500
0
1.20
1.00
0.80
0.60
0.40
0.20
0.00
6/1/02
6/3/02
6/5/02
6/7/02
6/9/02
6/11/02
6/13/02
6/15/02
6/17/02
6/19/02
6/21/02
6/23/02
6/25/02
6/27/02
6/29/02
7/1/02
7/3/02
7/5/02
7/7/02
7/9/02
7/11/02
7/13/02
7/15/02
7/17/02
7/19/02
-0026
-0027
-0028
-0029
-0030
-0001
-0023
-0024
-0025
-0002
-0004
-0015
-0003
-0006
Target
Precip (in)

Unnamed Tributary at Crietz Park, Cambridge City, IN
Site: GMW010-0030

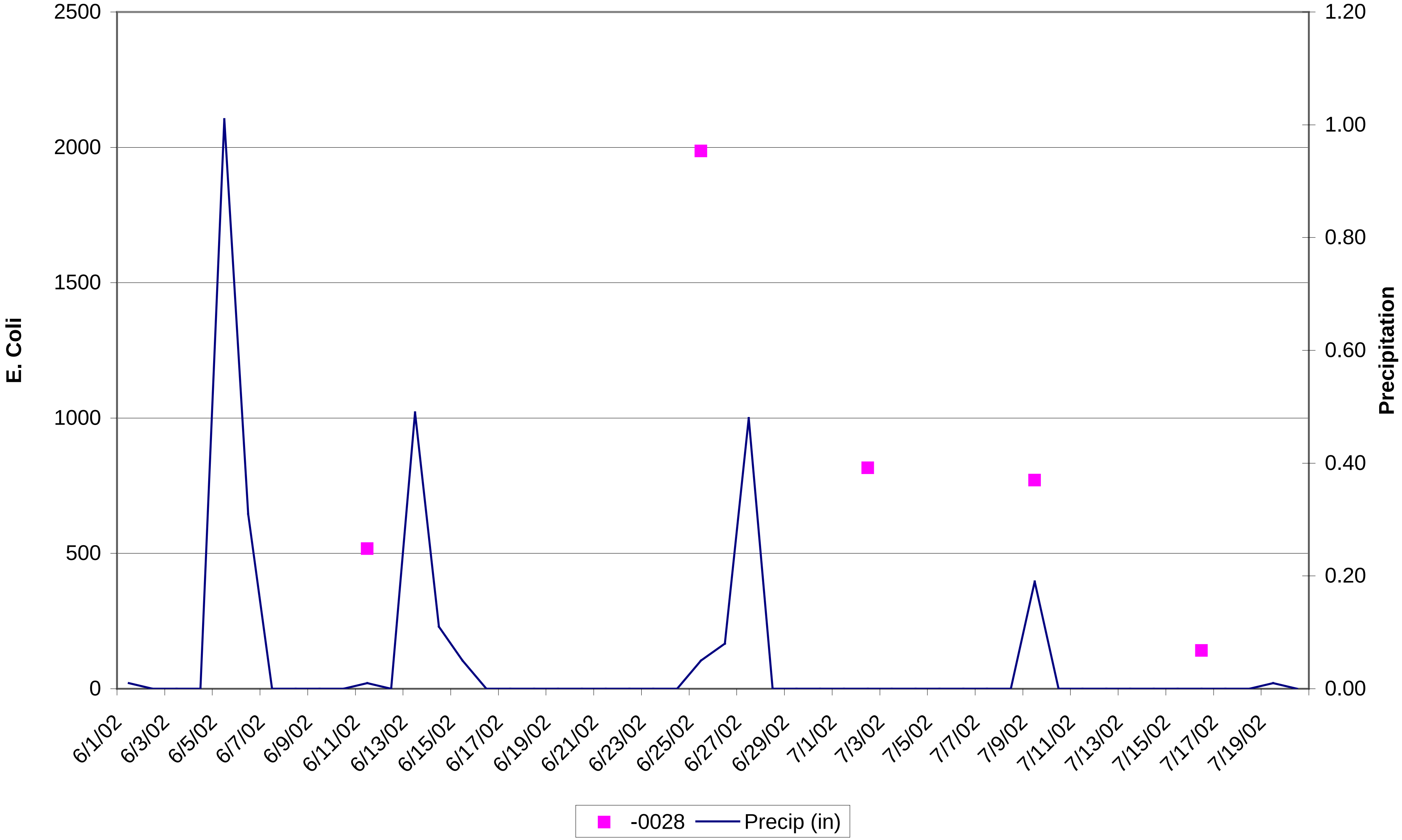


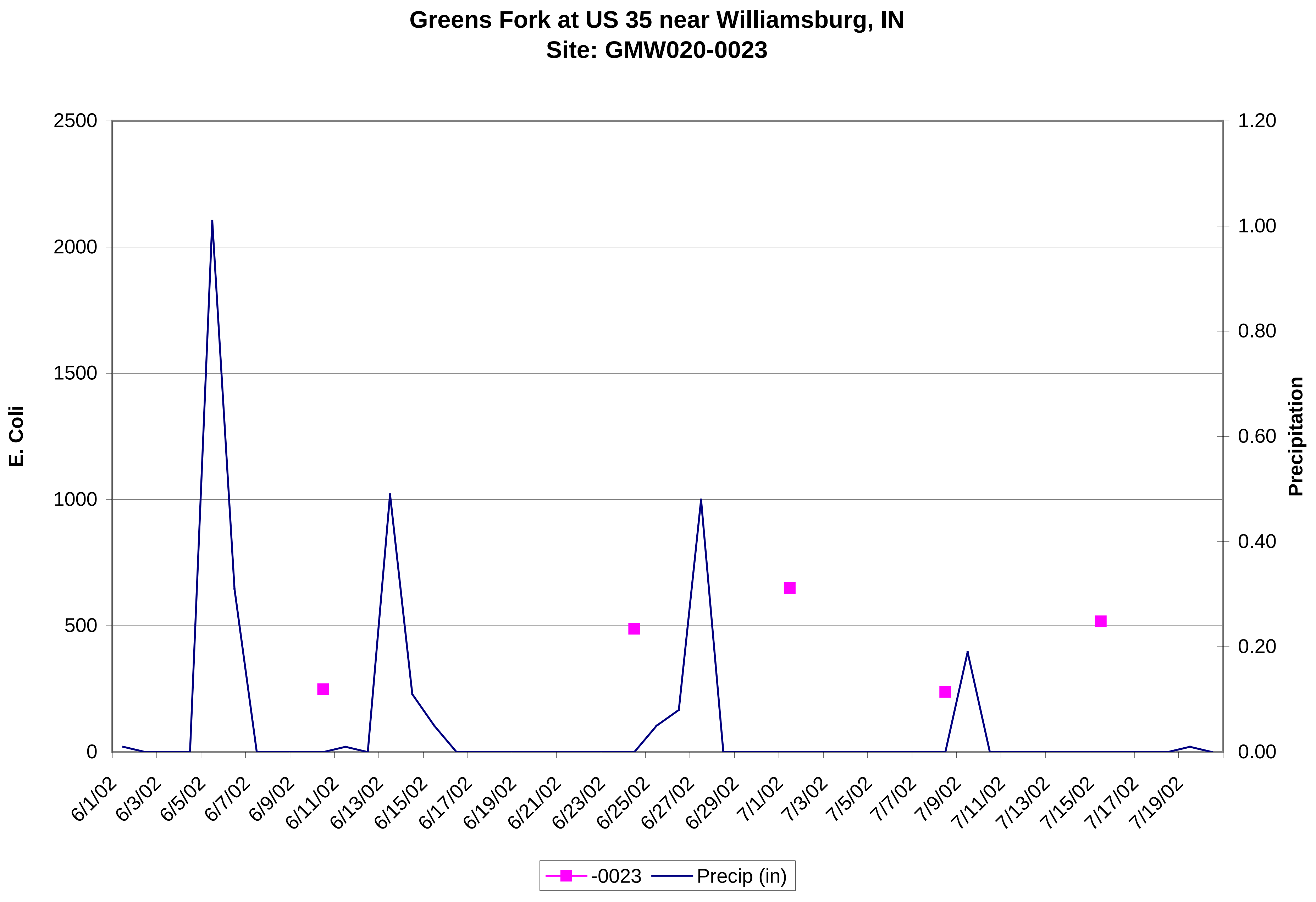

West Fork Whitewater River at CR 440 E near Waterloo, IN
Site: GMW020-0025
E. Coli
Precipitation
2500
2000
1500
1000
500
0
1.20
1.00
0.80
0.60
0.40
0.20
0.00
6/1/02
6/3/02
6/5/02
6/7/02
6/9/02
6/11/02
6/13/02
6/15/02
6/17/02
6/19/02
6/21/02
6/23/02
6/25/02
6/27/02
6/29/02
7/1/02
7/3/02
7/5/02
7/7/02
7/9/02
7/11/02
7/13/02
7/15/02
7/17/02
7/19/02
-0025
Precip (in)

Nolands Fork at Fountain City Park, Fountain City, IN
Site: GMW030-0004



Morgan Creek at SR 38
Site: GMW010-0028





Greens Fork at US 35 near Williamsburg, IN
Site: GMW020-0023
E. Coli
Precipitation
2500
2000
1500
1000
500
0
1.20
1.00
0.80
0.60
0.40
0.20
0.00
6/1/02
6/3/02
6/5/02
6/7/02
6/9/02
6/11/02
6/13/02
6/15/02
6/17/02
6/19/02
6/21/02
6/23/02
6/25/02
6/27/02
6/29/02
7/1/02
7/3/02
7/5/02
7/7/02
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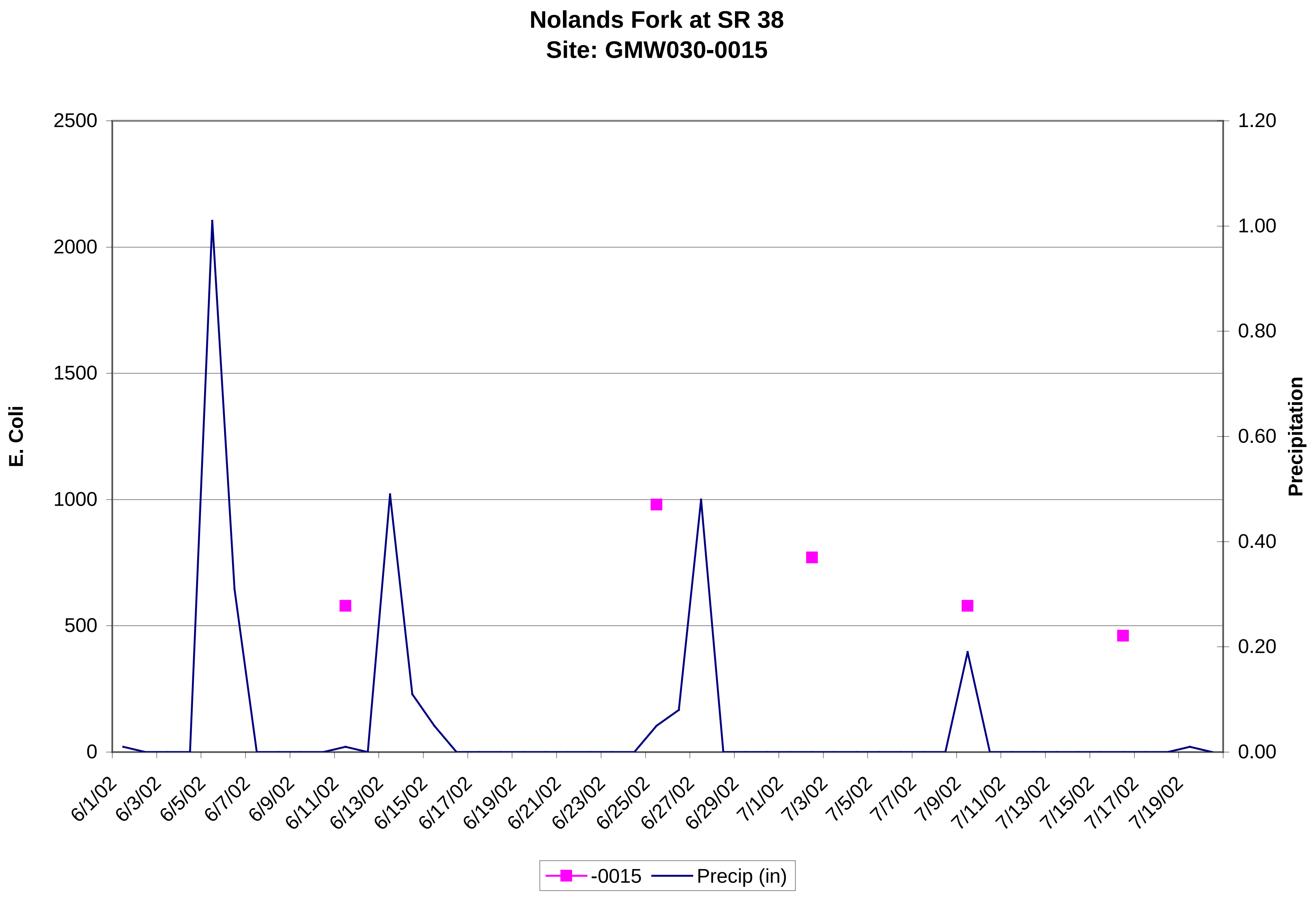
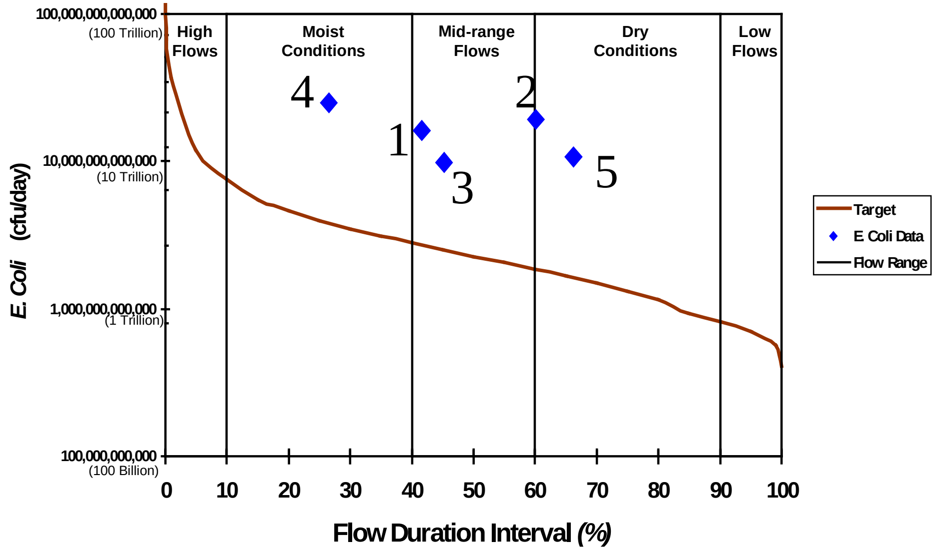
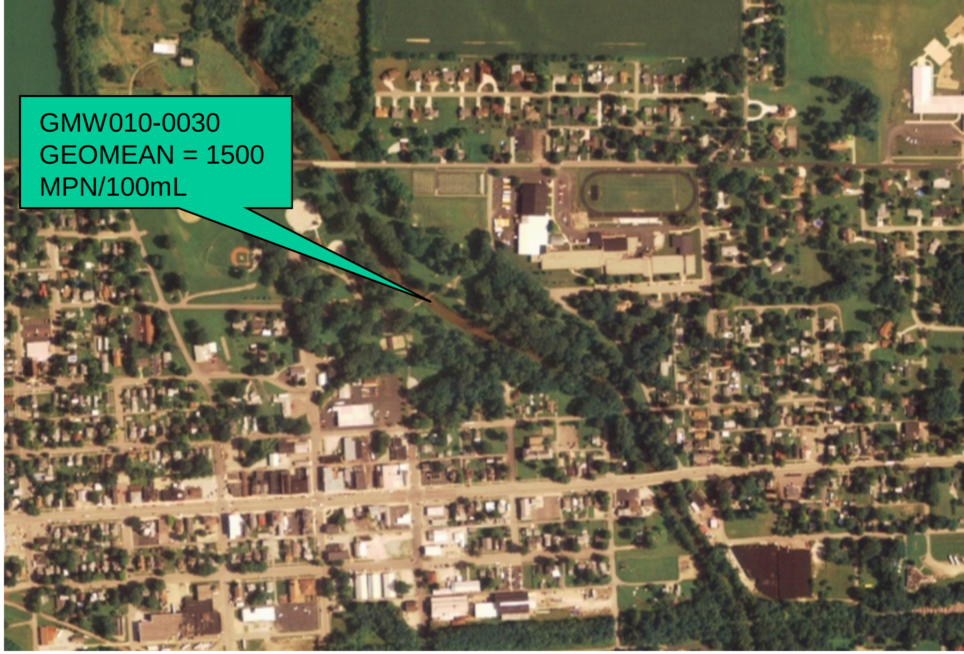
7/11/02
7/13/02
7/15/02
7/17/02
7/19/02
-0023
Precip (in)



Nolands Fork at SR 38
Site: GMW030-0015
E. Coli
Precipitation
2500
2000
1500
1000
500
0
1.20
1.00
0.80
0.60
0.40
0.20
0.00
6/1/02
6/3/02
6/5/02
6/7/02
6/9/02
6/11/02
6/13/02
6/15/02
6/17/02
6/19/02
6/21/02
6/23/02
6/25/02
6/27/02
6/29/02
7/1/02
7/3/02
7/5/02
7/7/02
7/9/02
7/11/02
7/13/02
7/15/02
7/17/02
7/19/02
-0015
Precip (in)

Unnamed Tributary
at Crietz Park, Cambridge City, IN
E. coli Load Duration Curve - Site: GMW010-0030

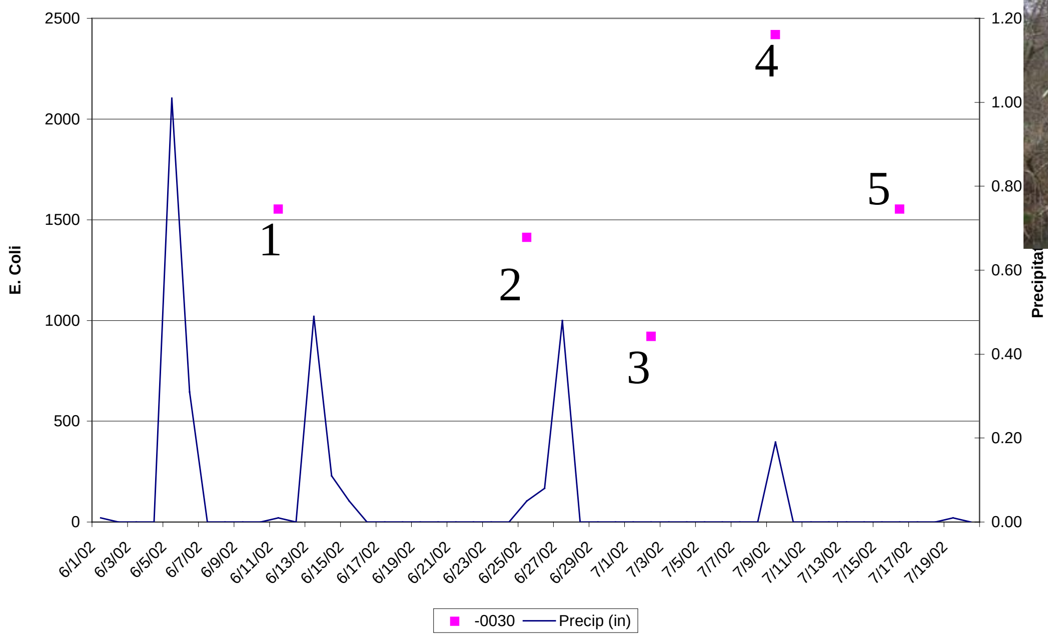




IDEM Water Quality Data & USGS Gage 03275000 Stream Flow Data
Upstream Drainage Area is 1.0 square miles

Attachment C : 2 of 7

Unnamed Tributary at Crietz Park, Cambridge City, IN
Site: GMW010-0030

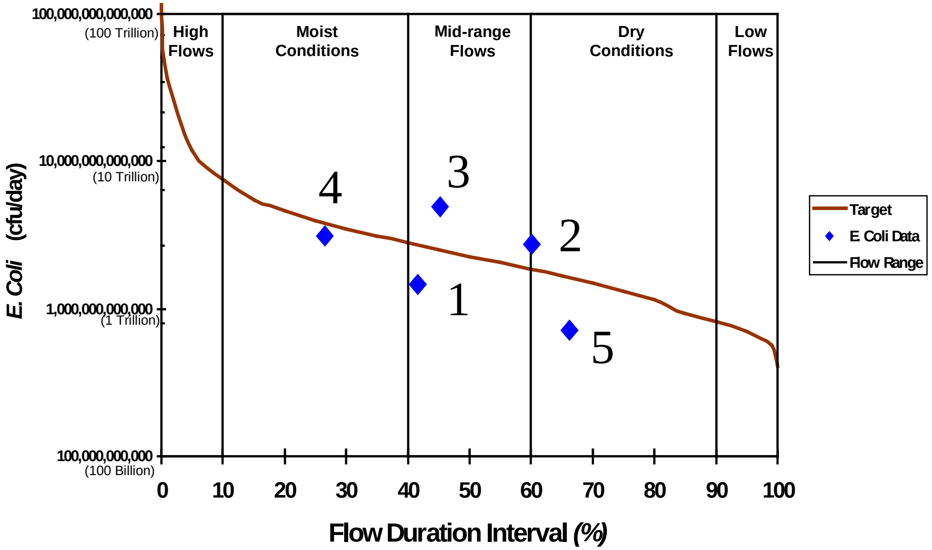


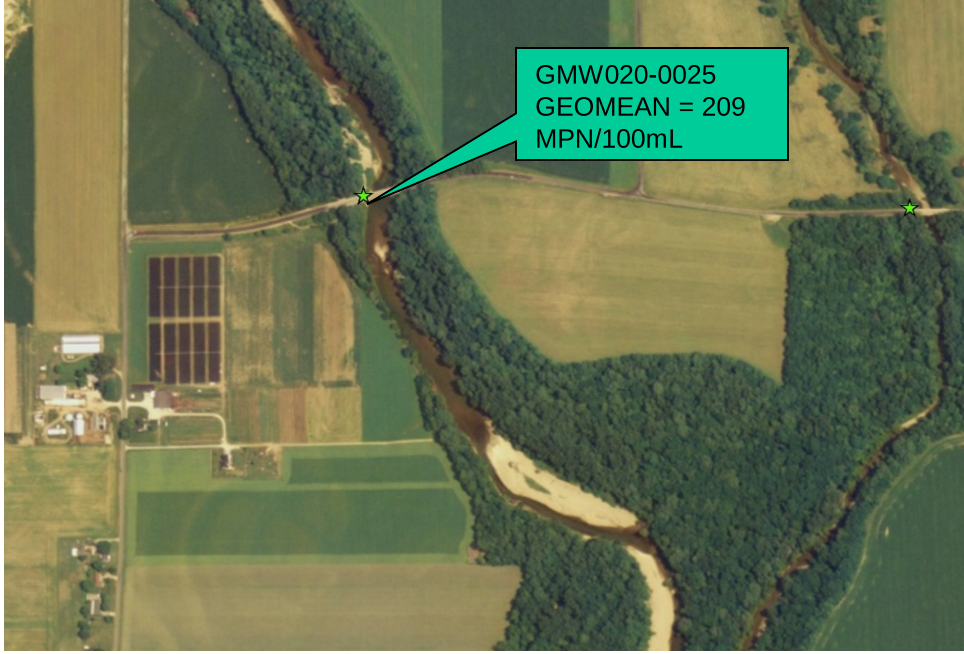
UPSTREAM

DOWNSTREAM

West Fork Whitewater River
at CR 440 E near Waterloo, IN

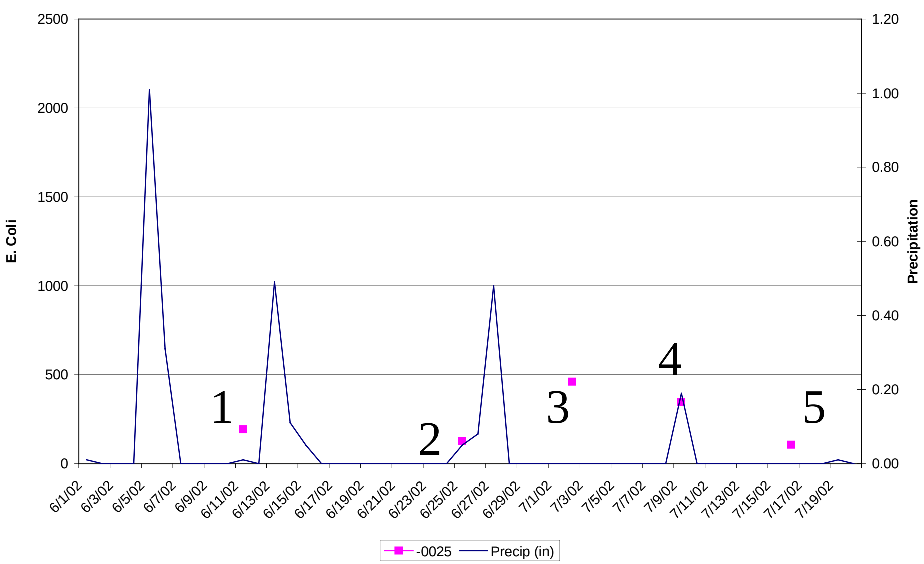
E. coli Load Duration Curve - Site: GMW020-0025



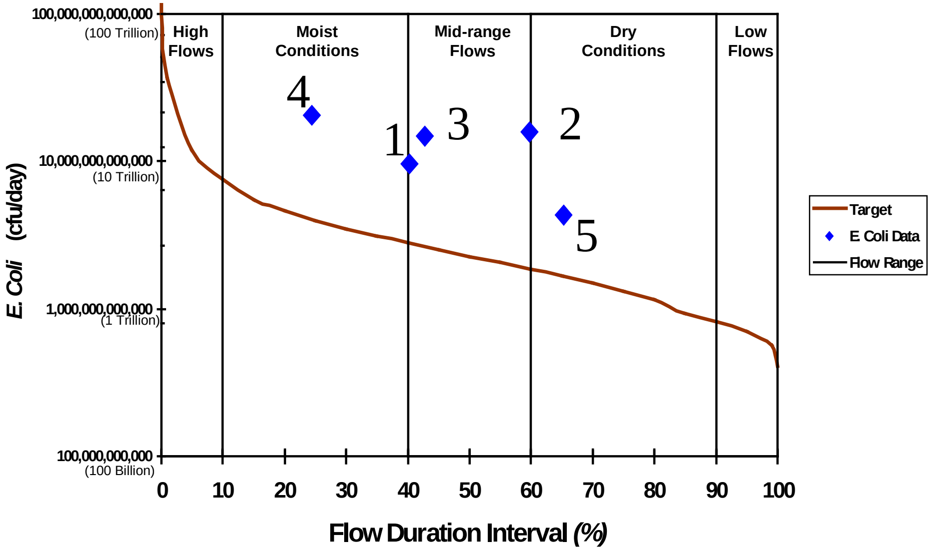


IDEM Water Quality Data & USGS Gage 03275000 Stream Flow Data
Upstream Drainage Area is 310 square miles

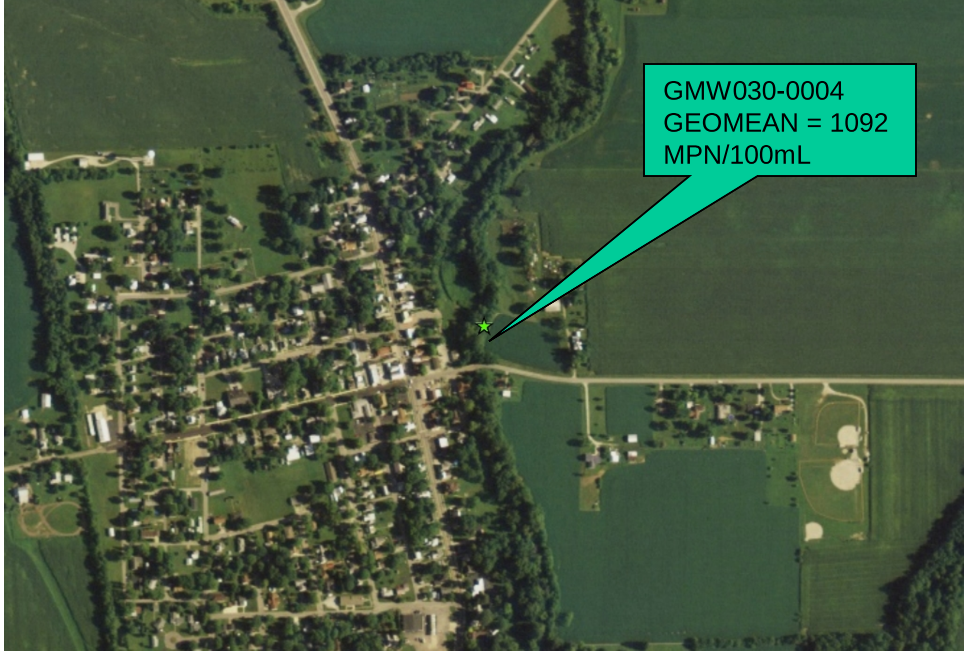
West Fork Whitewater River at CR 440 E near Waterloo, IN
Site: GMW020-0025



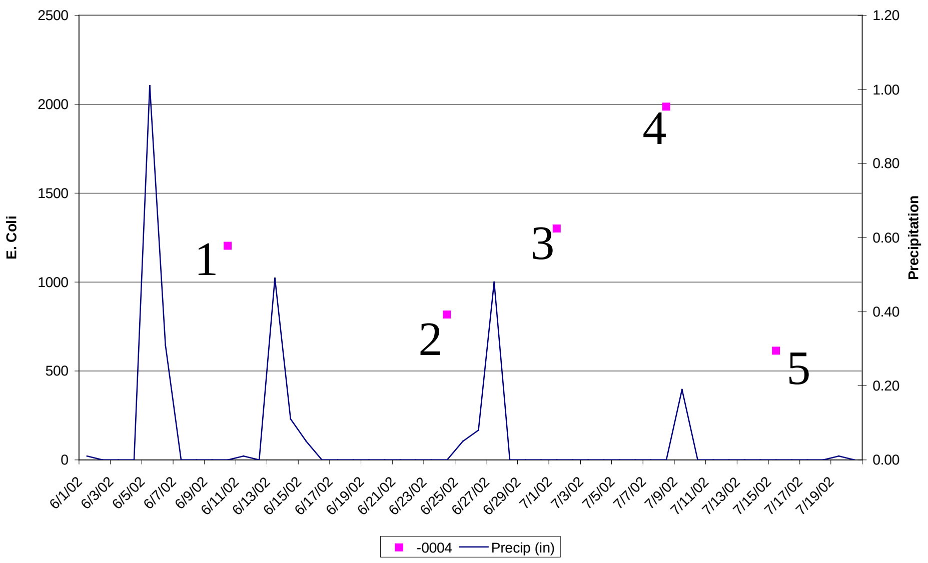
Nolands Fork
at Fountain City Park, Fountain City, IN
E. coli Load Duration Curve - Site: GMW030-0004



IDEM Water Quality Data & USGS Gage 03275000 Stream Flow Data
Upstream Drainage Area is 17.0 square miles

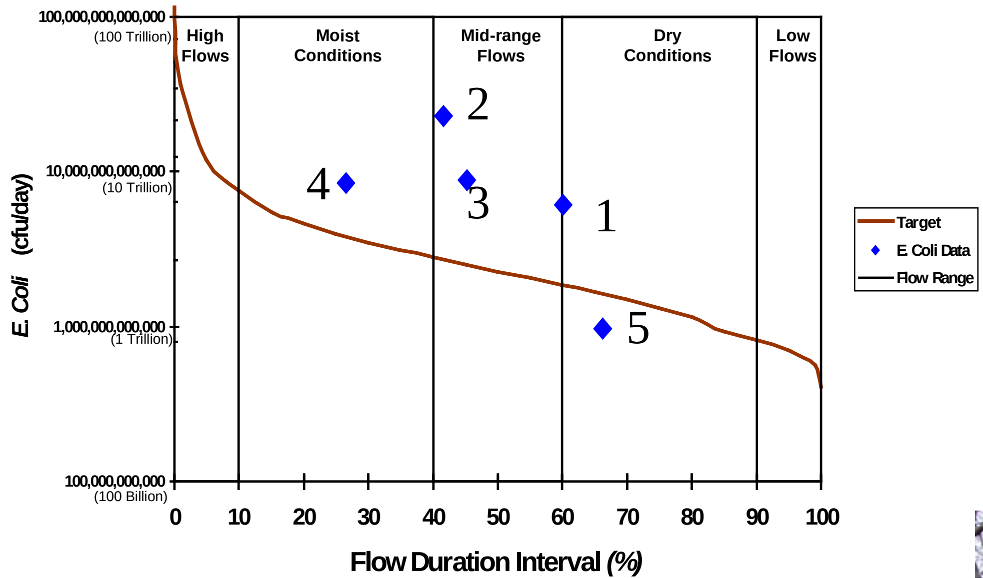


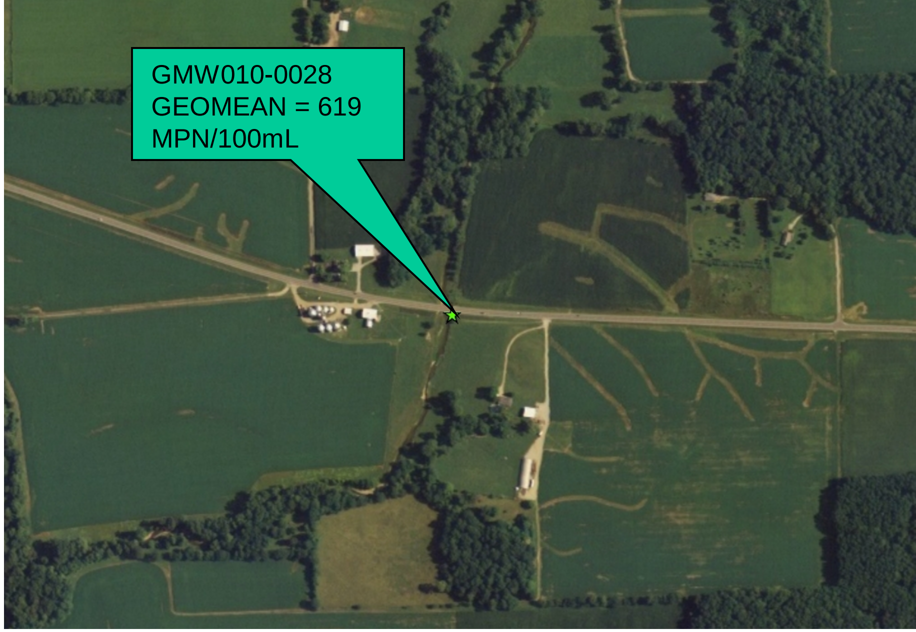
Nolands Fork at Fountain City Park, Fountain City, IN
Site: GMW030-0004



Morgan Creek
at SR 38

E. coli Load Duration Curve - Site: GMW010-0028



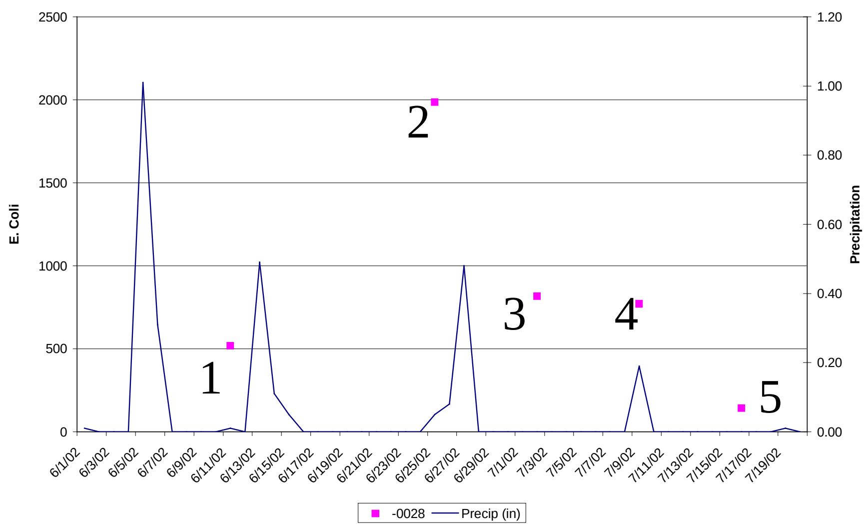


IDEM Water Quality Data & USGS Gage 03275000 Stream Flow Data
Upstream Drainage Area is 15.0 square miles

Attachment C : 5 of 7

UPSTREAM

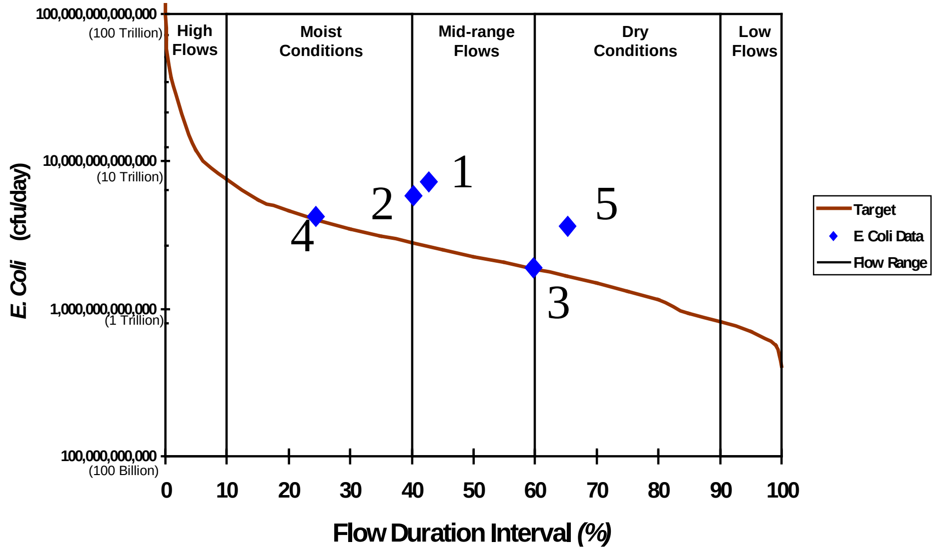
Morgan Creek at SR 38
Site: GMW010-0028



DOWNSTREAM

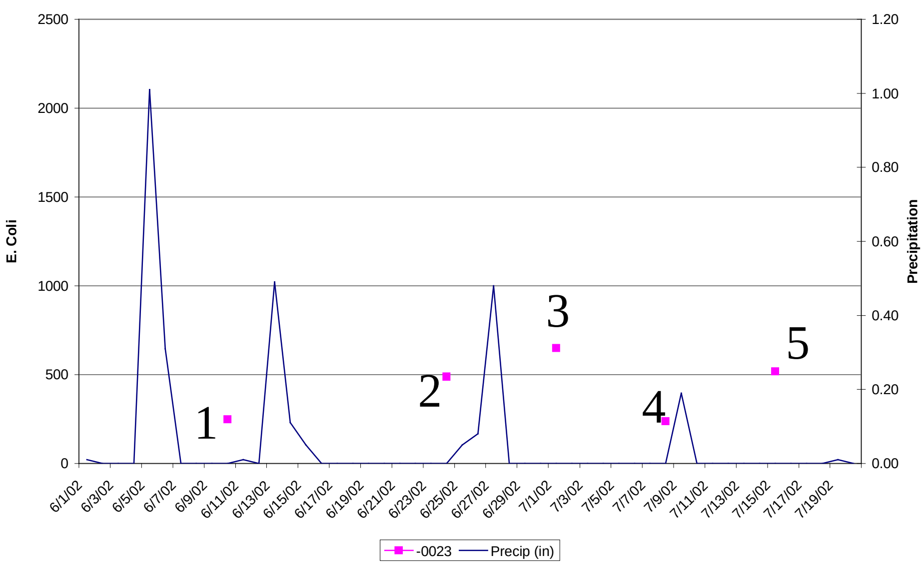
Attachment D : 5 of 7

Greens Fork
at US 35 near Williamsburg, IN
E. coli Load Duration Curve - Site: GMW020-0023



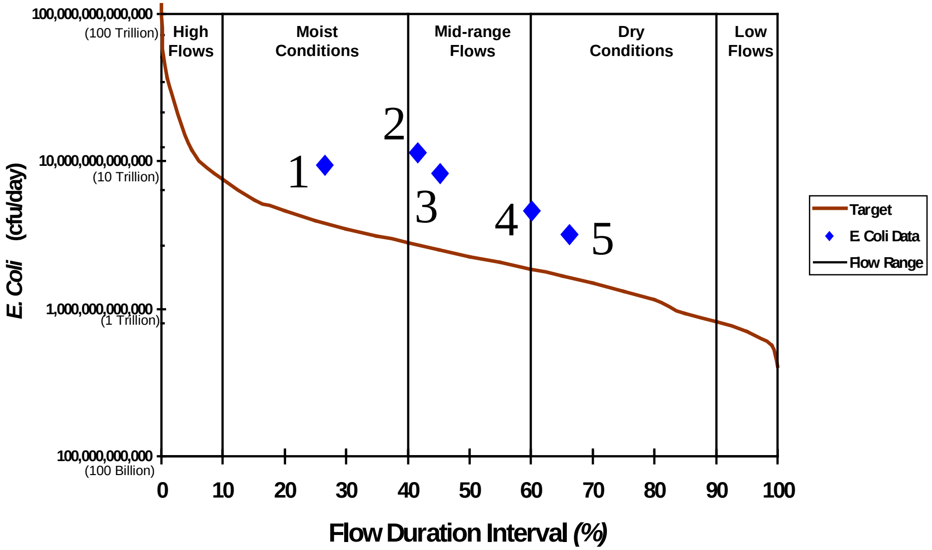
IDEM Water Quality Data & USGS Gage 03275000 Stream Flow Data
Upstream Drainage Area is 49.0 square miles

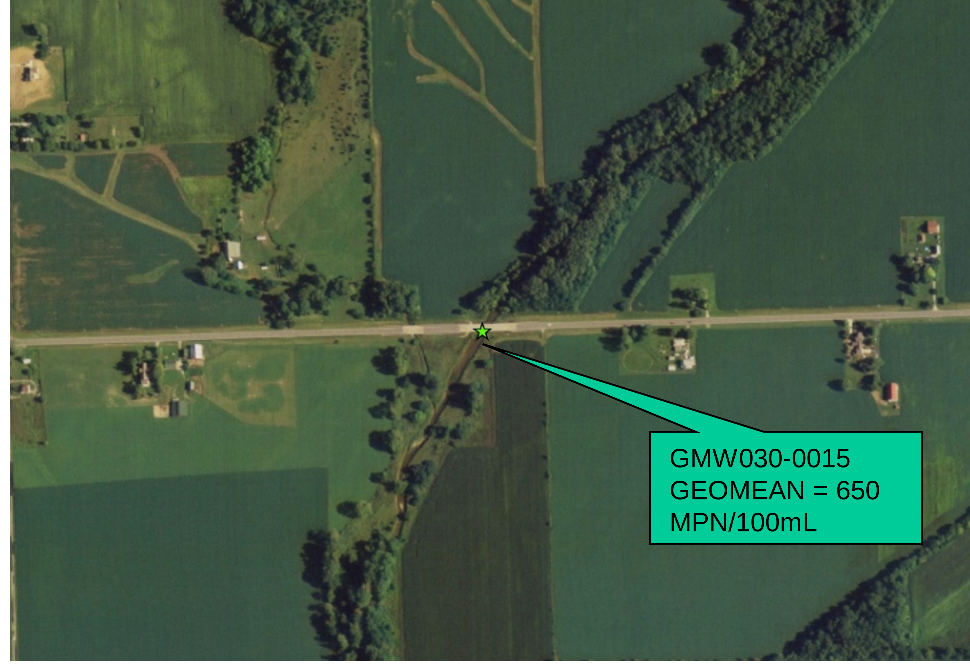
Greens Fork at US 35 near Williamsburg, IN
Site: GMW020-0023



Nolands Fork at SR 38

E. coli Load Duration Curve - Site: GMW030-0015





IDEM Water Quality Data & USGS Gage 03275000 Stream Flow Data
Upstream Drainage Area is 42.0 square miles

Nolands Fork at SR 38
Site: GMW030-0015