Office of Water Quality
Total Maximum Daily Load Program

Total Maximum Daily Load (TMDL)
for *Escherichia coli* (*E. coli*)
For the Prairie Creek Watershed, Daviess County

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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 listed on the state's section 303(d) list of impaired waterbodies because they are not meeting state 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 Prairie Creek watershed in Daviess County, Indiana.

Background

In 1998 and 2002, Indiana's section 303(d) list cites the North and South Fork of Prairie Creek as being impaired for *E. coli* in Daviess County. In 2004, Indiana's section 303(d) list cites, in addition to North and South Fork of Prairie Creek, Prairie Creek, Barnes Creek, Bethel Creek, Flat Creek, Dinkin Creek, Antioch Creek, Killion Canal, Eagan Ditch and other tributaries. With the addition of the above streams in 2004, the majority of the Prairie Creek watershed is impaired for *E. coli*. This TMDL addresses approximately 107 miles of Prairie Creek watershed in Daviess County, in southwest Indiana, where recreational uses are impaired by elevated levels of *E. coli* during the recreational season (Figure 1). All of the sixteen (16) segments of the listed streams for this TMDL are located in the West Fork White River Basin in hydrologic unit code 51202020800. The description of the study area, its topography, and other particulars is as follows:

Waterbody Name	303(d) List ID	Segment ID Number(s)	Length (miles)	Impairment
North Fork Prairie Creek	141	INW0281_T1044, INW0282_T1046, INW0283_T1047, INW0281_00	31.0	*E. coli*
South Fork Prairie Creek	141	INW0284_T1049, INW0285_T1050, INW0286_T1051,	11.0	*E. coli*
Barnes Creek and other Tributaries	141	INW0282_00	10.0	*E. coli*
Bethel Creek and other Tributaries	141	INW0283_00	6.0	*E. coli*
Flat Creek and other Tributaries	141	INW0284_00	9.0	*E. coli*
Dinkin Creek and other Tributaries	141	INW0285_00	5.0	*E. coli*
Antioch Creek	141	INW0286_T1166	3.0	*E. coli*
Killion Canal and other Tributaries	141	INW0287_00	18.0	*E. coli*
Eagan Ditch Basin	141	INW0286_T1167	6.0	*E. coli* Nutrients

Waterbody Name	303(d) List ID	Segment ID Number(s)	Length (miles)	Impairment
Prairie Creek	494	INW0287_T1063, INW0288_T1064	8.0	*E. coli* Impaired Biotic Communities

Historical data collected by IDEM documented elevated levels of *E. coli* in North and South Fork of Prairie Creek in 1996. This data was the basis for the listing of the North and South Fork of Prairie Creek on the 1998 303(d) list. IDEM completed an intensive survey of the watershed for North and South Fork of Prairie Creek in 2002. IDEM sampled thirty-one sites five times, with the samples evenly spaced over a 30-day period from April 23, 2002 to May 21, 2002. This period falls within Indiana's recreational season (April 1st through October 31st) (Figure 2). All thirty-one sites violated the single sample maximum standard at least once during this sampling event. The geometric mean could not be calculated for five of the sampling sites, since five samples were not collected or were not usable. Of the remaining twenty-six sites where a geometric mean value could be calculated, only one site, Site 29, did not violate the geometric mean standard. Based on this intensive study in 2002, IDEM determined that an *E. coli* TMDL would need to be completed on the Prairie Creek watershed (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 for TMDL development 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 on water quality within waterbodies covered by this TMDL.

Water quality *E. coli* load duration curves were created by using IDEM's data. A flow duration interval is described as a percentage. Zero percent corresponds to the highest stream discharge (flood condition) and 100 percent corresponds to the lowest discharge (drought condition). The *E. coli* values at two of the sites 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 both the recreational and non-recreational seasons. These two sites are representative of the hydrodynamics of the Prairie Creek watershed (Attachment B).

Numeric Targets

The impaired designated use for the waterbodies in the Prairie Creek 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 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 Prairie Creek 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 North and South Fork of Prairie Creek combine to create Prairie Creek, which then discharges into the West Fork of the White River. The major tributaries of these three waterbodies include Barnes Branch, Thomas Ditch, Flat Creek, Dinken Creek, Antioch Creek, Bagan Ditch, Killion Canal, Barnes Creek and Hawes Ditch. There are also several unnamed tributaries that flow into these major tributaries as well as into Prairie Creek, North and South Fork.

The tributaries of Barnes Creek, Bethel Creek, Flat Creek, Dinkin Creek, Antioch Creek, Killion Canal, and Eagan Ditch are listed on the 2004 303(d) list for *E. coli*. Based on sampling completed in 2002, each of these tributaries is contributing to the impairment of North and South Fork of Prairie Creek and Prairie Creek. Hawes Ditch is not listed on the 2004 303(d) list for *E. coli* and the sampling completed in 2002 confirms that it is not contributing to the impairment on Prairie Creek.

The landuse information, which was gathered from the mid-1970s for the Prairie Creek watershed, consisted of approximately 93% agriculture and 2% developed. The remaining 5% includes forested, wetlands, strip mines, and water. Landuse information was also assembled in 1992 using the Gap Analysis Program (GAP). In 1992, approximately 89% of the landuse in the Prairie Creek watershed is agriculture. The remaining landuse consists of approximately 1% developed, 3% palustrine wetlands, 6% terrestrial, and 0.6% water (Figure 3). A comparison of the mid-1970s landuse with the 1992 landuse information shows that no substantial changes to the Prairie Creek watershed have occurred.

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

Wildlife is a known source of *E. coli* impairments in waterbodies. Based on the habitat in the Prairie Creek watershed, deer and doves are the most plentiful species present in the watershed. Rabbit, quail, and birds of prey are also seen in large numbers in the watershed. In addition, badger, osprey, otters, and short eared owls can been seen occasionally (Montgomery, B., 2004).

Most of the homes within the Prairie Creek watershed are on septics. Failing septic tanks are known sources of *E. coli* impairment in waterbodies. Recently, the Daviess County Health Department has been testing septic systems on newly constructed homes and homes that are sold on the open market. They have found a 40 to 45% failure rate on septic systems tested over the past year (Finch, J., 2004).

National Pollutant Discharge Elimination System (NPDES) Permitted Dischargers

There are two NPDES permitted facilities in the Prairie Creek watershed (Figure 4, Table 1). Both of these permitted facilities are on the South Fork of Prairie Creek. Permit ING040162 is for Black Beauty Coal Company, Viking Mine. This facility does not have a sanitary component to their discharge and is not considered a source of *E. coli*.

Permit IN0034932 is for the Town of Montgomery Wastewater Treatment Plant. Prior to February 2004, the Town of Montgomery Wastewater Treatment Plant permit did not contain *E. coli* limits because it was believed that an extended retention time of sanitary wastewater was sufficient to provide a natural attrition of *E. coli* that would be in compliance with Indiana's *E. coli* WQS. However, recent studies completed by Ron Turco from Purdue University have indicated that *E. coli* may live longer in this environment than originally believed. Therefore, *E. coli* reporting requirements were added to this permit in February of 2004.

Since the addition of the *E. coli* reporting requirement, the Town of Montgomery Wastewater Treatment Plant has reported end-of-pipe *E. coli* limits for April, May, and June of 2004. The *E. coli* values have ranged from 531cfu/100mL to 4070 cfu/100mL geometric mean and 2350 cfu/100mL to 4400 cfu/100mL daily maximum. Based on these reported *E. coli* values, it can be determined that the Town of Montgomery Wastewater Treatment Plant is a source of *E. coli*.

Confined Feeding Operations and Confined Animal Feeding Operations

The removal and disposal of the manure, litter, or processed wastewater that is generated as the result of confined feeding operations fall under the regulations for confined feeding operations (CFO) and confined animal feeding operations (CAFO). There are forty-three (43) CFOs in the Prairie Creek watershed. Of the 43 CFOs, two (2) are considered CAFOs and have general permits (Table 2, Figure 5). 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 CFOs and CAFOs in Prairie Creek watershed have no open enforcement actions at this time. Therefore, these operations are not considered a significant source of *E. coli* for the Prairie Creek TMDL.

There are also many small 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 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 Prairie Creek watershed and the potential sources provides the basis for the development of this TMDL. The linkage is defined as the cause and effect relationship between the selected indicators and the sources. Analysis of this relationship allows for estimating the total assimilative capacity of the stream and any needed load reductions. Analysis of the data for the Prairie Creek watershed indicates that *E. coli* load enters the Prairie Creek watershed through both wet (nonpoint) and dry (point) weather sources.

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 Prairie Creek 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 nonpoint).

In order to develop a load duration curve, continuous flow data is required. The USGS gauge for the West Fork White River (03374000) located in Petersburg, Indiana was used for the development of the *E. coli* load duration curve analysis for the Prairie Creek watershed TMDL. USGS gauge 03374000 is located downstream from the mouth of Prairie Creek on the West Fork of the White River; therefore, the drainage area for the Prairie Creek watershed is accounted for in the drainage area for this gauge. In order to obtain an estimated flow for the Prairie Creek watershed, the drainage area was calculated at the mouth of the Prairie Creek watershed (152 square miles) and compared to the drainage area for USGS gauge 03374000 (11,125 square miles). The flow for USGS gauge 03374000 was then multiplied by the percent of drainage area that is accounted for in the total drainage area at the USGS gauge. The calculated flow number and drainage area for the Prairie Creek watershed were then used to create the load duration curves for the Prairie Creek watershed.

The flow data is used to create flow duration curves that 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 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 *E. coli* per 100 ml and 125 *E. coli* 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 and 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 Waters Quality Standard (WQS); those that fall below the target line meet WQS (Mississippi DEQ, 2002).

Load duration curves were created for all the sampling sites in the Prairie Creek watershed. However, the sampling sites of CR 450 E on the North Fork of Prairie Creek and CR 300 E on

the South Fork of Prairie Creek provide the best description of the sources of *E. coli* to the Prairie Creek watershed (Figure 2, Attachment C). This is because these two sites have monitoring data from 1996 and 2002. The data indicate that the largest exceedances of the *E. coli* WQS are prevalent during wet weather events (noted by diamonds above the curve on the far left side of the figure in Attachment C). Dry weather contributions are also a source of *E. coli* to the Prairie Creek watershed (noted by the diamonds above the curve on far right side of the figure in Attachment C).

While there are point source contributions, compliance with the numeric *E. coli* WQS in the Prairie Creek watershed most critically depends on the control of nonpoint sources using best management plans (BMPs). If the *E. coli* inputs can be controlled, then the total body contact recreational use in Prairie Creek watershed will be protected.

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 critical conditions that, when addressed by appropriate controls, will ensure attainment of the 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 Prairie Creek 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 Prairie Creek 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). 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).

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).

Wasteload Allocations

As mentioned previously, there are two NPDES permits located in the Prairie Creek watershed. Town of Montgomery WWTP (IN0034932) is the only permit that has a sanitary component to its discharge and since February of 2004 has been required to monitor for *E. coli*. Based on the current *E. coli* values that have been reported from the Town of Montgomery WWTP, IDEM's TMDL program recommends the addition of *E. coli* limits to IN0034932 during their next permit renewal.

There are also two CAFO operations in the Prairie Creek watershed that have general NPDES permits. Under these NPDES permits, the CAFO must not violate water quality standards. 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.

Load Allocations

The LA 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 assumption used in this load allocation strategy is that there are equal bacterial loads per unit area for all lands within the watershed. Therefore, the relative responsibility for achieving the necessary reductions of bacteria and maintaining acceptable conditions is determined by the amount of land under the jurisdiction of the various local units of government within the watershed. This gives a clear indication of the relative amount of effort that will be required by each entity to restore and maintain the designated total body contact recreational use of the Prairie Creek watershed.

The Daviess County government entities and their corresponding portions of the land area in the Prairie Creek watershed are as follows: Barr Township (25.99%); Washington Township (20.67%); Bogard Township (17.68%); Van Buren Township (15.82%); Steele Township (13.26%);Madison Township (5.74%);and Perry Township (0.84%).(ESRI, 2004) (Table 3 and Figure 6.)

Load allocations may be affected by subsequent work in the watershed. There is a watershed project that has been proposed for this watershed. It is anticipated that this watershed project will be useful in further defining the nonpoint sources of the *E. coli* in the Prairie Creek watershed.

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 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 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.

Monitoring

Future monitoring of the Prairie Creek watershed will take place during IDEM's five-year rotating basin schedule and/or once TMDL implementation methods are in place. During the five-year rotating basin schedule, IDEM will monitor the Prairie Creek watershed for *E. coli.* Monitoring will be adjusted as needed to assist in continued source identification and elimination. When these results indicate that the waterbody is meeting the *E. coli* WQS, 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.

Reasonable Assurance Activities

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

Confined Feeding Operations and Confined Animal Feeding Operations

CFOs and CAFOs are required to manage manure, litter, and processed wasterwater pollutants in a manner that does not cause or contribute to the impairment of the *E. coli* WQS.

National Pollutant Discharge Elimination Systems

327 IAC 5-2-11.1(h) requires effluent limits to be included in NPDES permits for pollutants discharged at levels that have the reasonable potential to cause an exceedance of water quality standards. Since the Town of Montgomery Wastewater Treatment Plant (IN0034932) has reported *E. coli* values above the *E. coli* water quality standard, they will be required at some point in the future to modify their treatment system to comply with Indiana's *E. coli* Water Quality Standards.

Watershed Projects

There is a 319 proposal that was submitted for the Prairie Creek watershed to address the *E. coli* impairment. This proposal is still under negotiations, however it is believed that this project will

help to further identify and reduce the nonpoint sources that are contributing to the *E. coli* impairment in the Prairie Creek watershed.

In addition, 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 Prairie Creek Watershed.

Potential Future Activities:

Nonpoint 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 riverbanks 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 Prairie Creek watershed include both point and nonpoint sources. In order for the Prairie Creek watershed to achieve Indiana's *E. coli* WQS, the wasteload and load allocations for the Prairie Creek 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 Prairie Creek watershed depends on:

1) permitted facilities meeting their permit limits;
2) CAFOs and CFOs not violating their permits; and
3) nonpoint sources of *E. coli* being controlled by implementing best management practices in the watershed.

The next phase of this TMDL is to identify and support the implementation of activities that will bring the Prairie Creek 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 Prairie Creek watershed are revised in accordance with applicable requirements of state and federal law, the TMDL implementation activities may be adjusted 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 Prairie Creek watershed.

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Table 1: NPDES Permits in the Prairie Creek Watershed

Permit No.	Facility Name	Receiving Waters
IN0034932	Town of Montgomery WWTP	South Fork Prairie Creek
ING040162	Black Beauty Coal Company, Viking Mine	South Fork Prairie Creek

Table 2: Permitted Confined Feeding Operations and Confined Animal Feeding Operations in the Prairie Creek Watershed

			Approved Animals							
Log Number	**Name**	**NPDES Permit Number**	**Nursery Pig**	**Growerfinishers**	**Sowboars**	**Beef**	**Dairy**	**Dairy Calves**	**Layers**	**Turkeys**
100	Keith E. Graber & Son Dairy						205			
101	Udder Delite Dairy, Inc						195	65		
269	RL Wilson Family Farms	ING800269		960						68500
609	Sand Hill Pork, Inc		640	1200	366					
611	Layer Operation								139000	
1231	Slaubaugh Farms					275				
1370	Steve Biggins		475	475						
3510	Lloyd Graber		500	500						
4070	Willis Graber			820						
4094	Raymond Graber									17200
4118	Burkhart Farms		840	500	191					
4202	Adrian O'Conner									22000
4441	Eaton Farms			900						
4443	David E. Knepp & Sons									54000
4453	Loren Graber									54000
4459	Lloyd Graber		1000							
4499	Larry Swartzentruber		240	780	230					
4516	John R Knepp		500		317					
4530	E. Dale Stoll		200	300	82					
4531	Omer Graber Farm	ING804531			558					
4543	Ira Wagler			540						
4571	Enos Wittmer		200	710	132	12				
4599	Phil Myers		325	570	106	95				
4609	Leroy Wittmer		1644	400						
4636	Melvin W Graber		200	520	20					

			Approved Animals							
Log Number	**Name**	**NPDES Permit Number**	**Nursery Pig**	**Growerfinishers**	**Sowboars**	**Beef**	**Dairy**	**Dairy Calves**	Layers	**Turkeys**
4711	Darrell D Wagler		220	800	106					
4930	Larry Graber		180	480	83					
4940	Norman Wagler		420	240	159					
4969	Marvin Holstine									44000
4977	Wilbur E Wagler			900	66					
6011	Turkeys-Like-Us									42000
6090	Ridge Farms									14000
6094	Melvin Wittmer									36000
6104	Turkey Downs									44000
6116	H. Knepp & Sons									44000
6117	Donald Healy									44000
6182	Wagler Poultry Inc.									44000

Table 3: Land Area Distribution for the Prairie Creek Watershed

Municipality	**Square Mile**	**Percent**
Barr Township	39.46	25.99
Washington Township	31.378	20.67
Bogard Township	26.849	17.68
Van Buren Township	24.02	15.82
Steele Township	20.13	13.26
Madison Township	8.72	5.74
Perry Township	1.269	0.84
Total	**151.83**	**100**

Figure 1: Prairie Creek Watershed TMDL

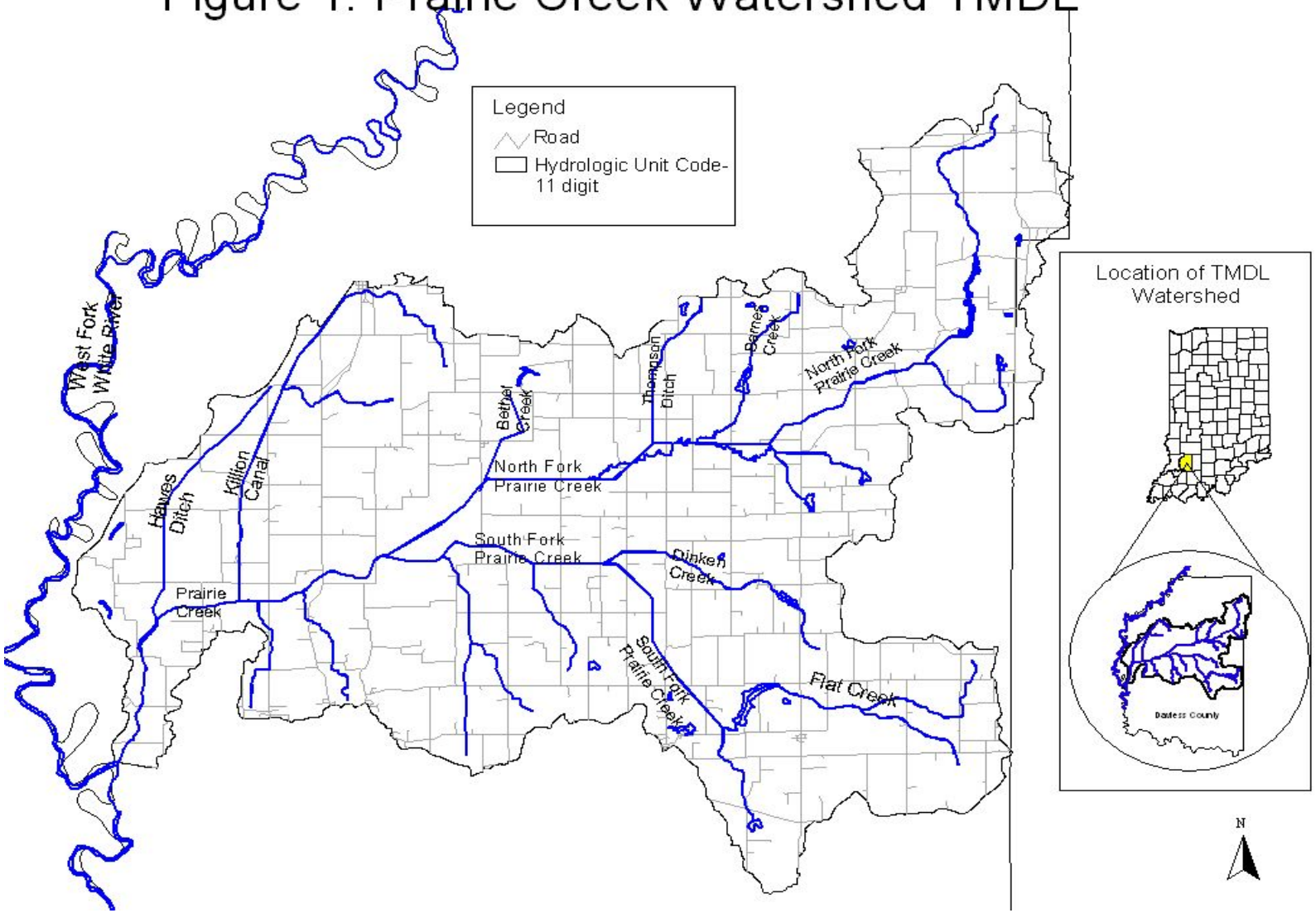


Figure 2: IDEM Sampling Sites in Prairie Creek Watershed

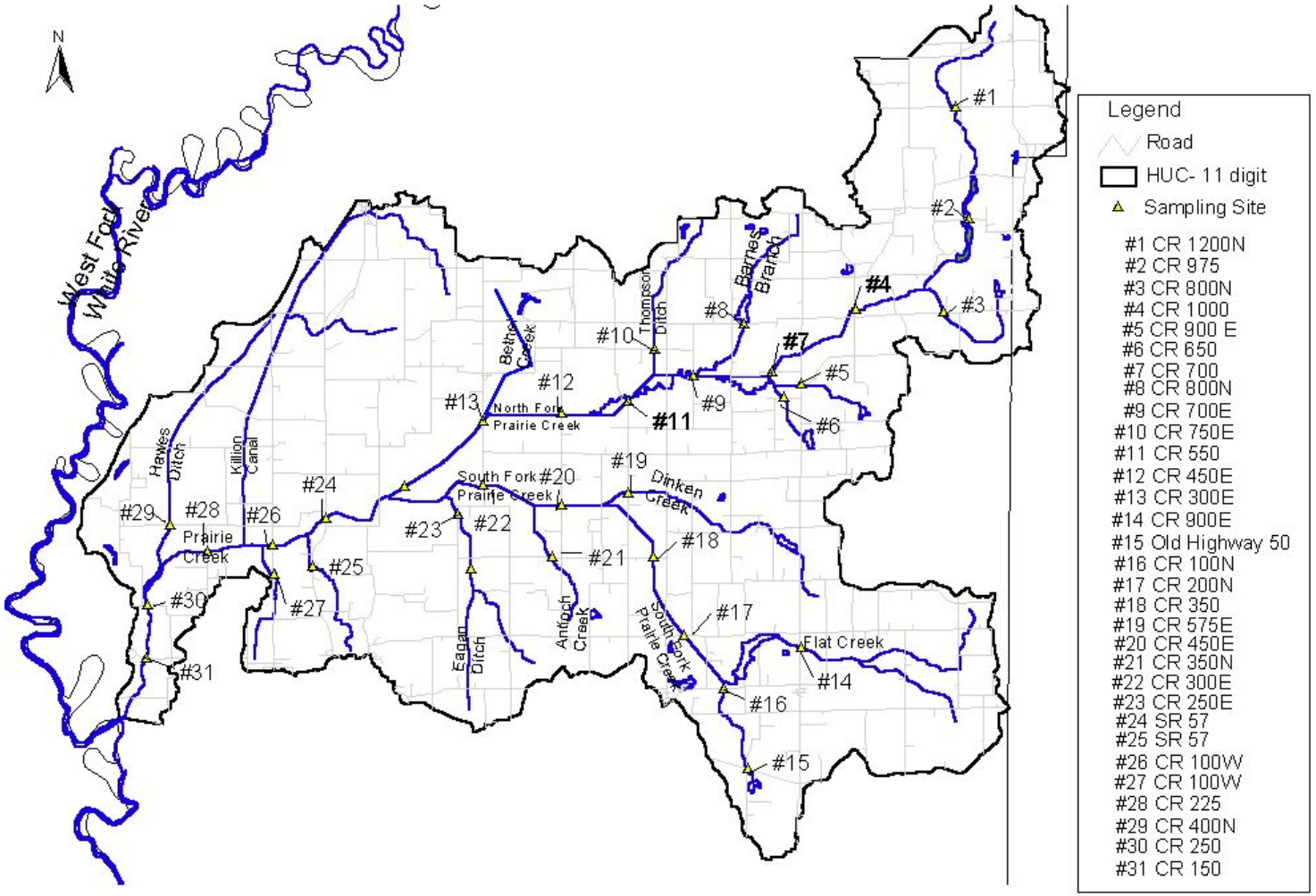


Figure 3: Landuse in Prairie Creek Watershed

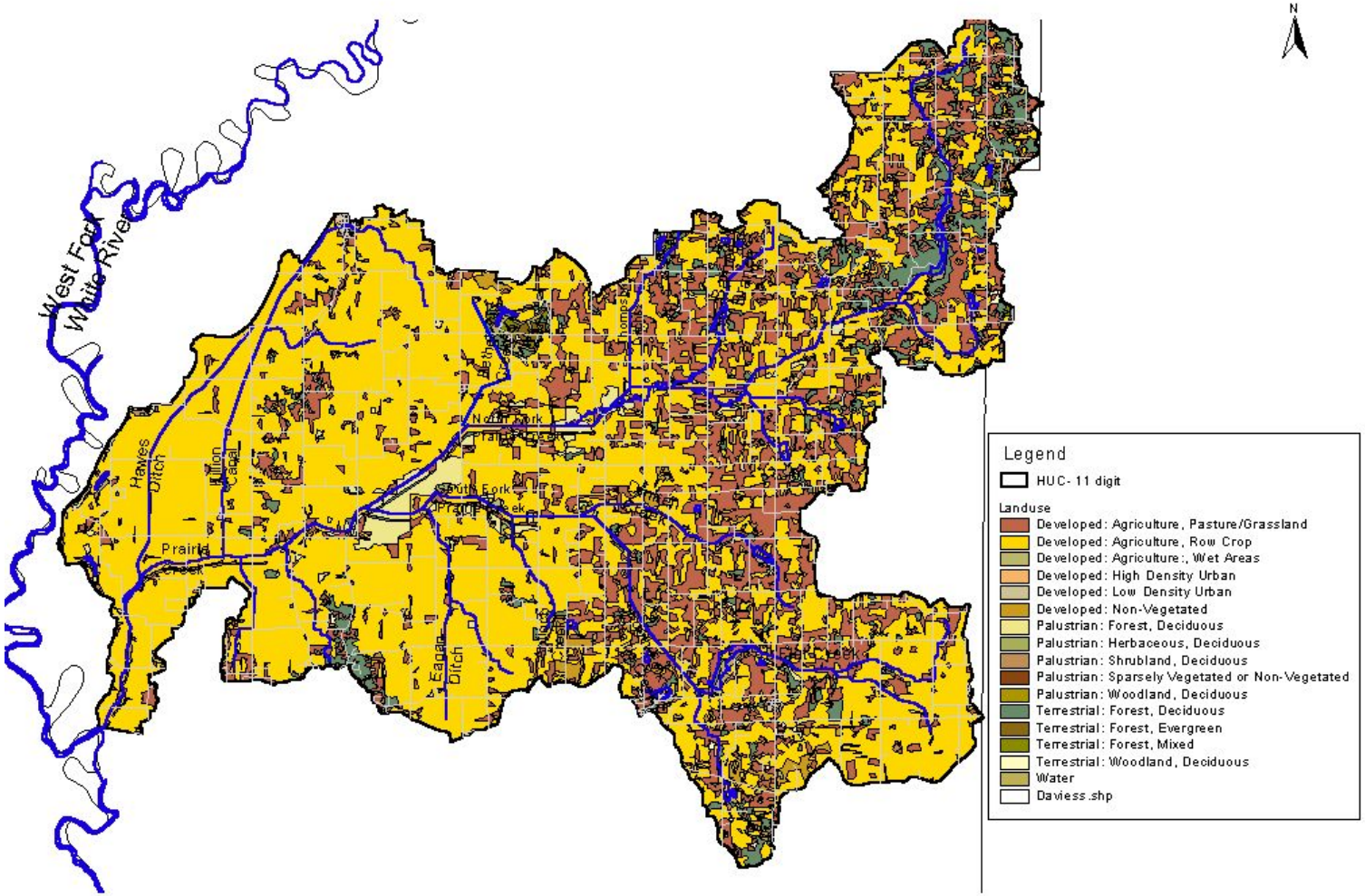


Figure 4: NPDES Permits in Prairie Creek Watershed

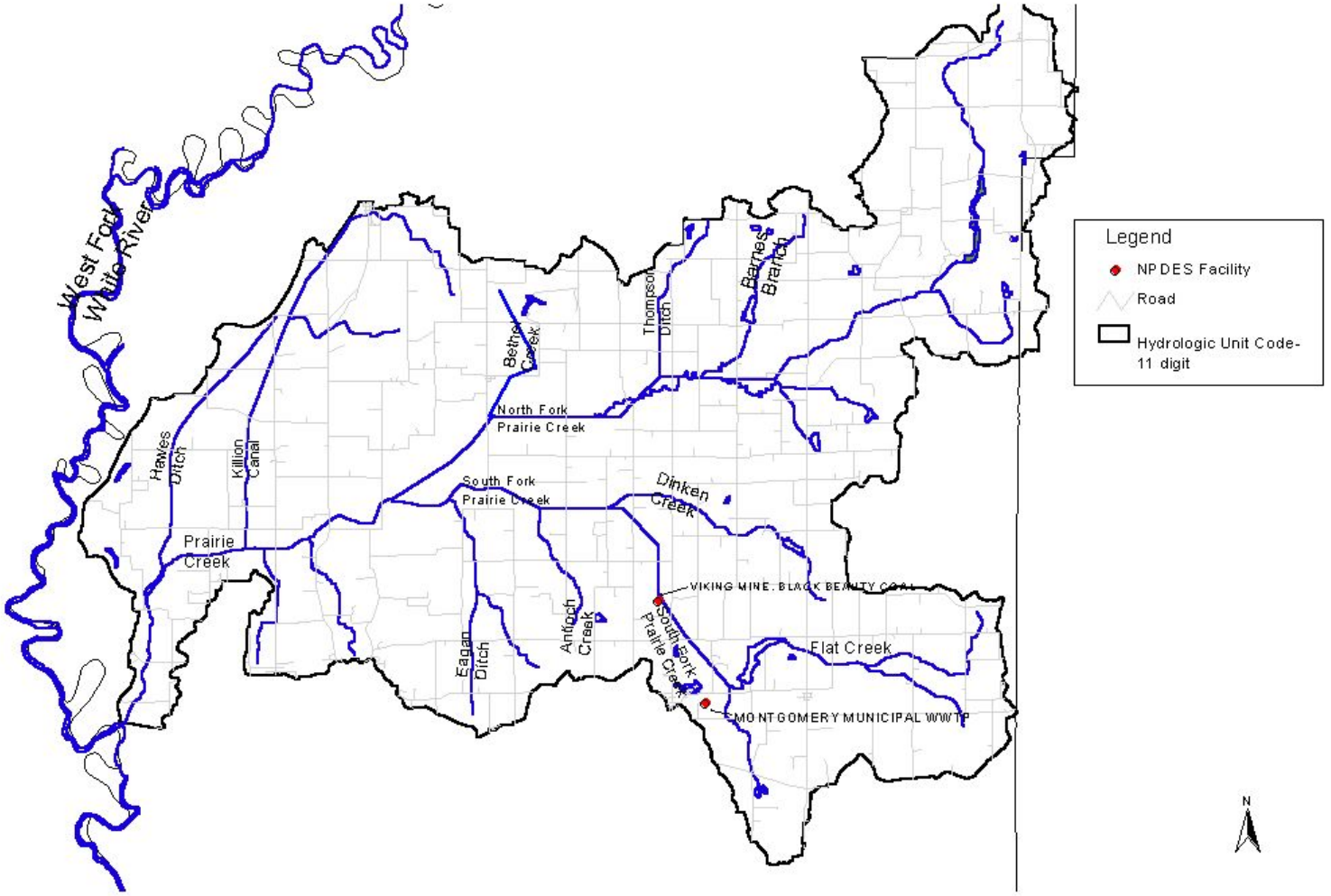


Figure 5: Permitted Confined Feeding Operations in Prairie Creek Watershed

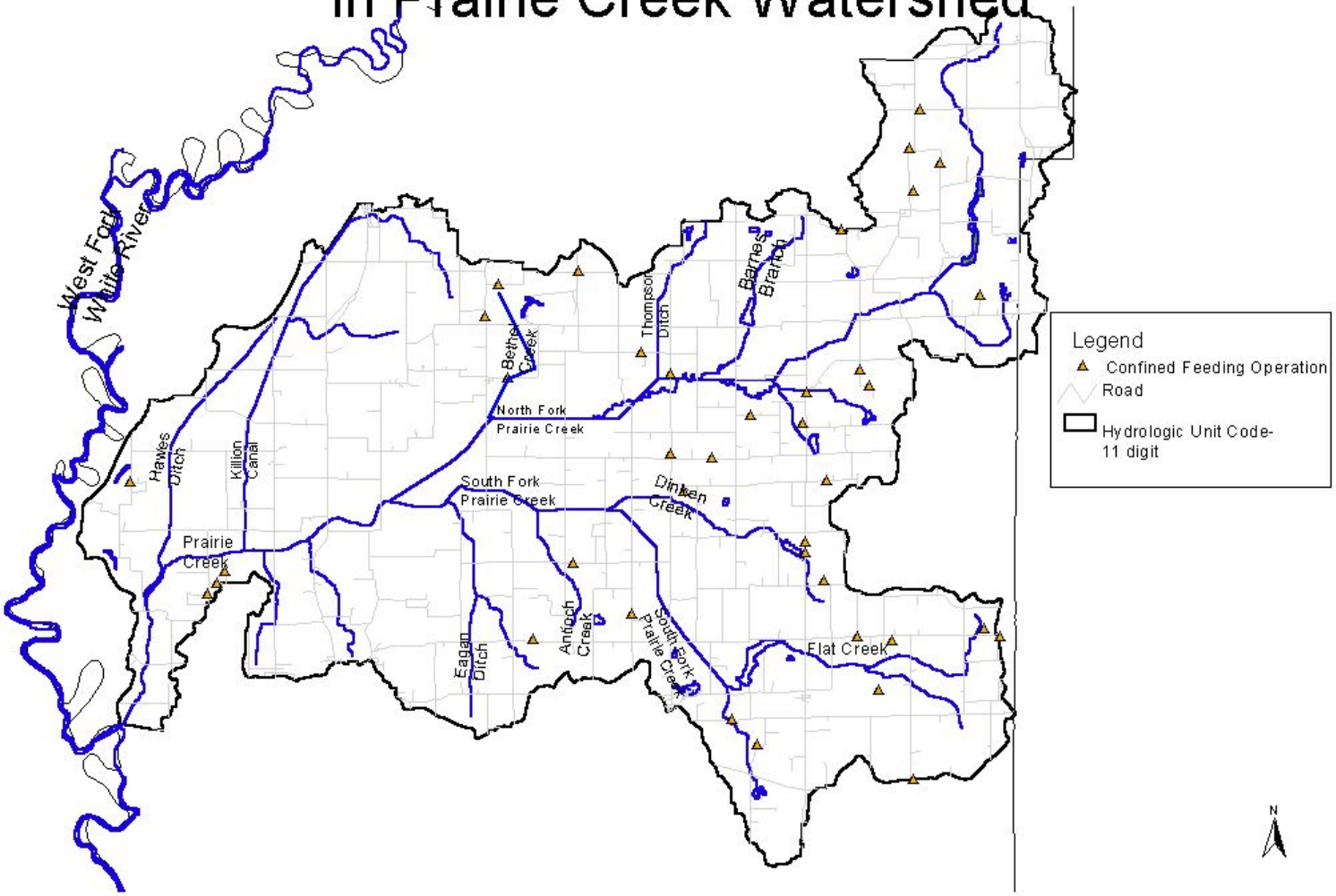
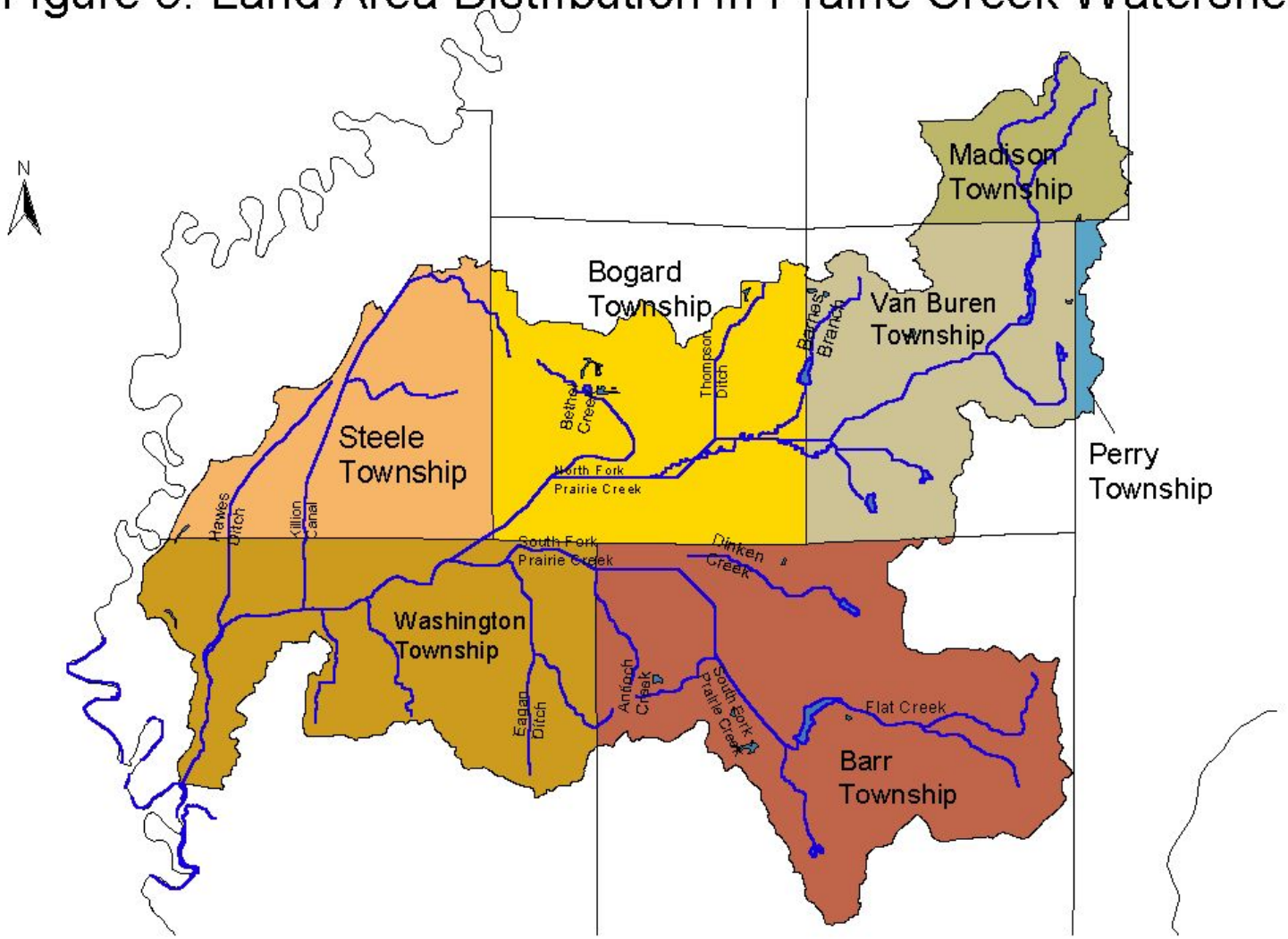


Figure 6: Land Area Distribution in Prairie Creek Watershed



Attachment A

Prairie Creek Watershed *E. coli* Data

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Attachment B

Water Quality Duration Curves for Prairie Creek Watershed TMDL

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Attachment C

Load Duration Curves for Prairie Creek Watershed TMDL

Attachment A: Prairie Creek Watershed *E. coli* Data

Site #	Project ID	L-Site #	Stream Name	Description	Sample #	Sample Date	E. coli (MPN/100 mL)	Geometric Mean
1	2002 Prairie Creek Assessment	WWL080-0036	North Fork Prairie Creek	CR 1200 N (right side)	AA10179	04/23/02	1553	>1133
					AA10239	04/30/02	308	
					AA10598	05/07/02	>2419	
					AA10634	05/14/02	816	
					AA10670	05/21/02	1986	
2	2002 Prairie Creek Assessment	WWL080-0034	North Fork Prairie Creek	CR 975	AA10180	04/23/02	2419	>1573
					AA10238	04/30/02	1046	
					AA10599	05/07/02	>2419	
					AA10635	05/14/02	>2419	
					AA10672	05/21/02	649	
3	2002 Prairie Creek Assessment	WWL080-0033	Unnamed Tributary	CR 800 N	AA10181	04/23/02	24192	>3014
					AA10236	04/30/02	2419	
					AA10600	05/07/02	>2419	
					AA10637	05/14/02	>2419	
					AA10673	05/21/02	726	
4	2002 Prairie Creek Assessment	WWL080-0032	North Fork Prairie Creek	CR 1000	AA10182	04/23/02	9804	>1780
					AA10235	04/30/02	1733	
					AA10601	05/07/02	>2419	
					AA10638	05/14/02	>2419	
					AA10674	05/21/02	190	
5	2002 Prairie Creek Assessment	WWL080-0031	Unnamed Tributary	CR 900 E	AA10183	04/23/02	10462	>1600
					AA10234	04/30/02	726	
					AA10602	05/07/02	>2419	
					AA10639	05/14/02	>2419	
					AA10675	05/21/02	236	

Site #	Project ID	L-Site #	Stream Name	Description	Sample #	Sample Date	E. coli (MPN/100 mL)	Geometric Mean
6	2002 Prairie Creek Assessment	WWL080-0030	Unnamed Tributary	CR 650	AA10184	04/23/02	12033	>2196
					AA10233	04/30/02	1986	
					AA10603	05/07/02	>2419	
					AA10640	05/14/02	>2419	
					AA10676	05/21/02	365	
7	2002 Prairie Creek Assessment	WWL080-0029	North Fork Prairie Creek	CR 700	AA10185	04/23/02	1986	>1354
					AA10232	04/30/02	325	
					AA10604	05/07/02	>2419	
					AA10641	05/14/02	>2419	
					AA10677	05/21/02	1203	
8	2002 Prairie Creek Assessment	WWL080-0028	Barnes Branch	CR 800 N	AA10186	04/23/02	1120	>1612
					AA10231	04/30/02	687	
					AA10605	05/07/02	>2419	
					AA10642	05/14/02	>2419	
					AA10678	05/21/02	>2419	
9	2002 Prairie Creek Assessment	WWL080-0026	North Fork Prairie Creek	CR 700 E	AA10187	04/23/02	>2419	N/A
					AA10230	04/30/02	1989	
10	2002 Prairie Creek Assessment	WWL080-0024	Thomas Ditch	CR 750 E	AA10188	04/23/02	12033	>2490
					AA10229	04/30/02	1300	
					AA10607	05/07/02	>2419	
					AA10644	05/14/02	>2419	
					AA10680	05/21/02	>2490	
11	2002 Prairie Creek Assessment	WWL080-0022	North Fork Prairie Creek	CR 550	AA10190	04/23/02	>2419	>1954
					AA10228	04/30/02	1674	
					AA10608	05/07/02	>2419	
					AA10645	05/14/02	>2419	
					AA10681	05/21/02	1203	

Site #	Project ID	L-Site #	Stream Name	Description	Sample #	Sample Date	E. coli (MPN/100 mL)	Geometric Mean
12	2002 Prairie Creek Assessment	WWL080-0001	North Fork Prairie Creek	CR 450 E	AA10191	04/23/02	15531	>2477
					AA10226	04/30/02	1414	
					AA10609	05/07/02	>2419	
					AA10646	05/17/02	>2419	
					A10682	05/21/02	726	
	1996 Synoptic	WWL080-0001	North Fork Prairie Creek	CR 450 E	D120386	03/05/96	460	N/A
					D120989	05/09/96	3400	
					D121369	06/12/96	110	
					D121756	07/23/96	1250	
					D122228	10/17/96	420	
13	2002 Prairie Creek Assessment	WWL080-0018	North Fork Prairie Creek	CR 300 E	AA10192	04/23/02	199	>462
					AA10224	04/30/02	91	
					AA10610	05/07/02	>2419	
					AA10647	05/14/02	>2419	
					AA10683	05/21/02	199	
14	2002 Prairie Creek Assessment	WWL080-0035	Flat Creek	CR 900 E	AA10144	04/23/02	6867	>2865
					AA10250	04/30/02	2419	
					AA10614	05/07/02	>2419	
					AA10650	05/14/02	>2419	
					AA10688	05/21/02	1986	
15	2002 Prairie Creek Assessment	WWL080-0004	South Fork Prairie Creek	Old Highway 50	AA10143	04/23/02	71	>706
					AA10248	04/30/02	517	
					AA10612	05/07/02	>2419	
					AA10648	05/14/02	>2419	
					AA10684	05/21/02	816	
16	2002 Prairie Creek Assessment	WWL080-0027	South Fork Prairie Creek	CR 100 N	AA10147	04/23/02	980	>1249
					AA10260	04/30/02	816	
					AA10615	05/07/02	>2419	
					AA10651	05/14/02	>2419	
					AA10687	05/21/02	649	

Site #	Project ID	L-Site #	Stream Name	Description	Sample #	Sample Date	E. coli (MPN/100 mL)	Geometric Mean
17	2002 Prairie Creek Assessment	WWL080-0025	South Fork Prairie Creek	CR 200 N	AA10148	04/23/02	15531	>3030
					AA10259	04/30/02	1986	
					AA10617	05/07/02	>2419	
					AA10653	05/14/02	>2419	
					AA10688	05/21/02	1414	
18	2002 Prairie Creek Assessment	WWL080-0023	South Fork Prairie Creek	CR 350	AA10149	04/23/02	24192	>2998
					AA10257	04/30/02	1421	
					AA10618	05/07/02	>2419	
					AA10654	05/14/02	>2419	
					AA10689	05/21/02	1203	
19	2002 Prairie Creek Assessment	WWL080-0021	Dinken Creek	CR 575 E	AA10151	04/23/02	>2419	>2263
					AA10256	04/30/02	1732	
					AA10619	05/07/02	>2419	
					AA10655	05/14/02	>2419	
					AA10690	05/21/02	2419	
20	2002 Prairie Creek Assessment	WWL080-0020	South Fork Prairie Creek	CR 450 E	AA10152	04/23/02	17329	>2903
					AA10255	04/30/02	1565	
					AA10620	05/07/02	>2419	
					AA10656	05/14/02	>2419	
					AA10691	05/21/02	1300	
21	2002 Prairie Creek Assessment	WWL080-0019	Antioch Creek	CR 350 N	AA10153	04/23/02	2419	>1777
					AA10254	04/30/02	>2419	
					AA10621	05/07/02	>2419	
					AA10657	05/14/02	>2419	
					AA10692	05/21/02	517	

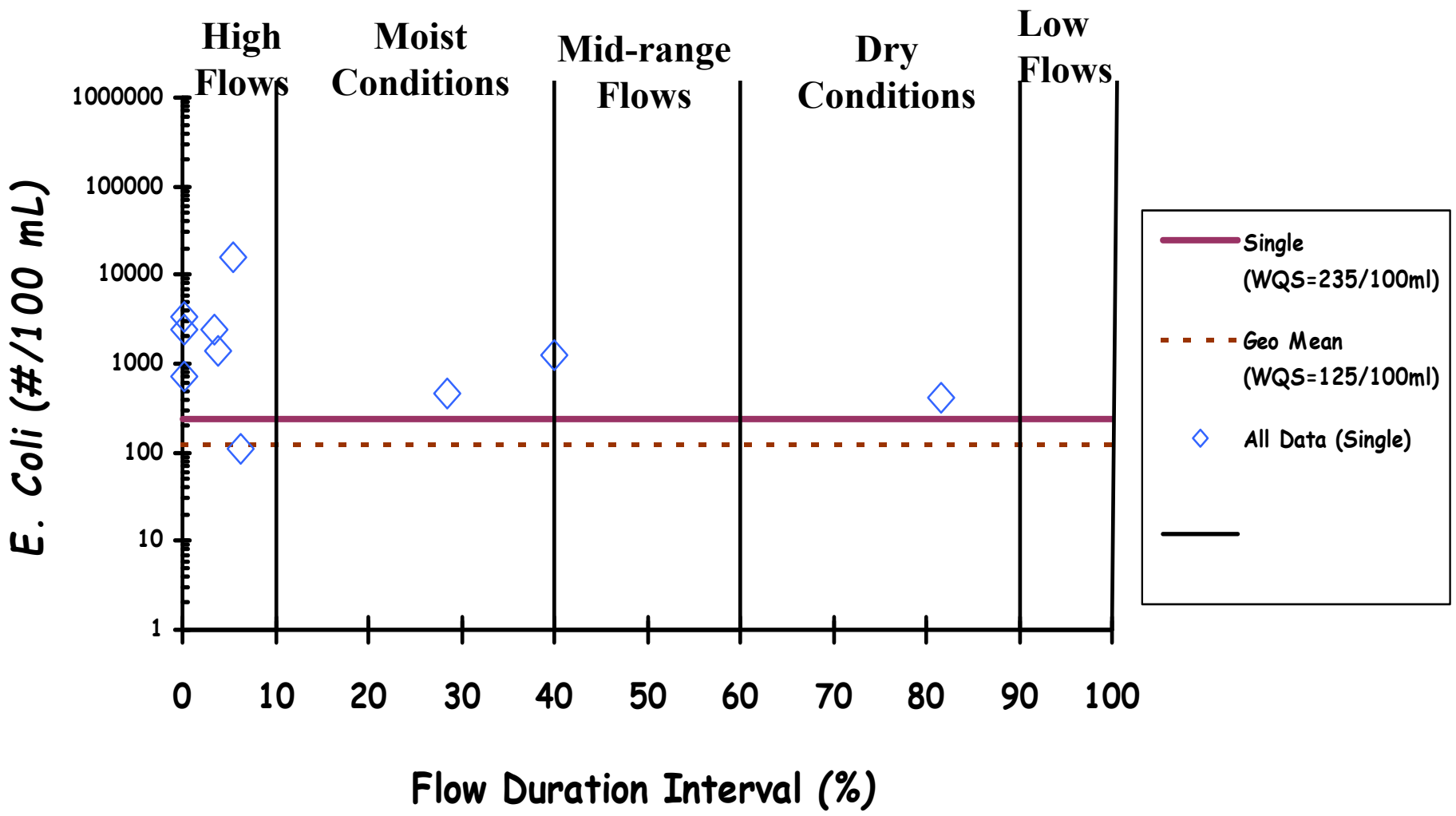
Site #	Project ID	L-Site #	Stream Name	Description	Sample #	Sample Date	E. coli (MPN/100 mL)	Geometric Mean
22	2002 Prairie Creek Assessment	WWL080-0002	South Fork Prairie Creek	CR 300 E	AA10154	04/23/02	19862	N/A
					AA10154	04/30/02	1986	
					AA10622	05/07/02	>2419	
					AA10693	05/21/02	613	
	1996 Synoptic	WWL080-0002	South Fork Prairie Creek	CR 300 E	D120387	03/05/96	1200	N/A
					D120990	05/09/96	1800	
					D121370	06/12/96	800	
					D121754	07/23/96	260	
					D122229	10/17/96	460	
23	2002 Prairie Creek Assessment	WWL080-0017	Bagan Ditch	CR 250 E	AA10155	04/23/02	491	N/A
					AA10252	04/30/02	132	
					AA10623	05/07/02	2419	
					AA10694	05/21/02	2419	
24	2002 Prairie Creek Assessment	WWL080-0008	Prairie Creek	SR 57	AA10158	04/23/02	214	>956
					AA10251	04/30/02	1467	
					AA10624	05/07/02	>2419	
					AA10660	05/14/02	>2419	
					AA10695	05/21/02	435	
25	2002 Prairie Creek Assessment	WWL080-0040	Unnamed Tributary	SR 57	AA10159	04/23/02	1414	>1298
					AA10264	04/30/02	770	
					AA10625	05/07/02	>2419	
					AA10661	05/14/02	2419	
					AA10696	05/21/02	579	
26	2002 Prairie Creek Assessment	WWL080-0014	Prairie Creek	CR 100 W	AA10163	04/23/02	10462	>2164
					AA10249	04/30/02	1414	
					AA10627	05/07/02	>2419	
					AA10663	05/14/02	>2419	
					AA10698	05/21/02	548	

Site #	Project ID	L-Site #	Stream Name	Description	Sample #	Sample Date	E. coli (MPN/100 mL)	Geometric Mean
27	2002 Prairie Creek Assessment	WWL080-0012	Unnamed Tributary	CR 100 W	AA10162	04/23/02	517	>669
					AA10247	04/30/02	285	
					AA10626	05/07/02	>2419	
					AA10662	05/14/02	1986	
					AA10697	05/21/002	190	
28	2002 Prairie Creek Assessment	WWL080-0011	Prairie Creek	CR 225	AA10164	04/23/02	11199	>1883
					AA10246	04/30/02	934	
					AA10628	05/07/02	>2419	
					AA10664	05/14/02	>2419	
					AA10699	05/21/02	387	
29	2002 Prairie Creek Assessment	WWL080-0010	Hawes Ditch	CR 400 N	AA10165	04/23/02	114	>82
					AA10245	04/30/02	58	
					AA10629	05/07/02	435	
					AA10700	05/21/02	33	
					AA10701	05/21/02	38	
30	2002 Prairie Creek Assessment	WWL080-0009	Prairie Creek	CR 250	AA10166	04/23/02	9804	N/A
					AA10243	04/30/02	708	
					AA10630	05/07/02	>2419	
31	2002 Prairie Creek Assessment	WWL080-0039	Prairie Creek	CR 150	AA10167	04/23/02	10462	N/A
					AA10261	04/30/02	770	
					AA10631	05/07/02	>2419	

North Fork Prairie Creek at 450 E

WQ Duration Curve *(2002 Monitoring Data)*

Site: WWL080-0001



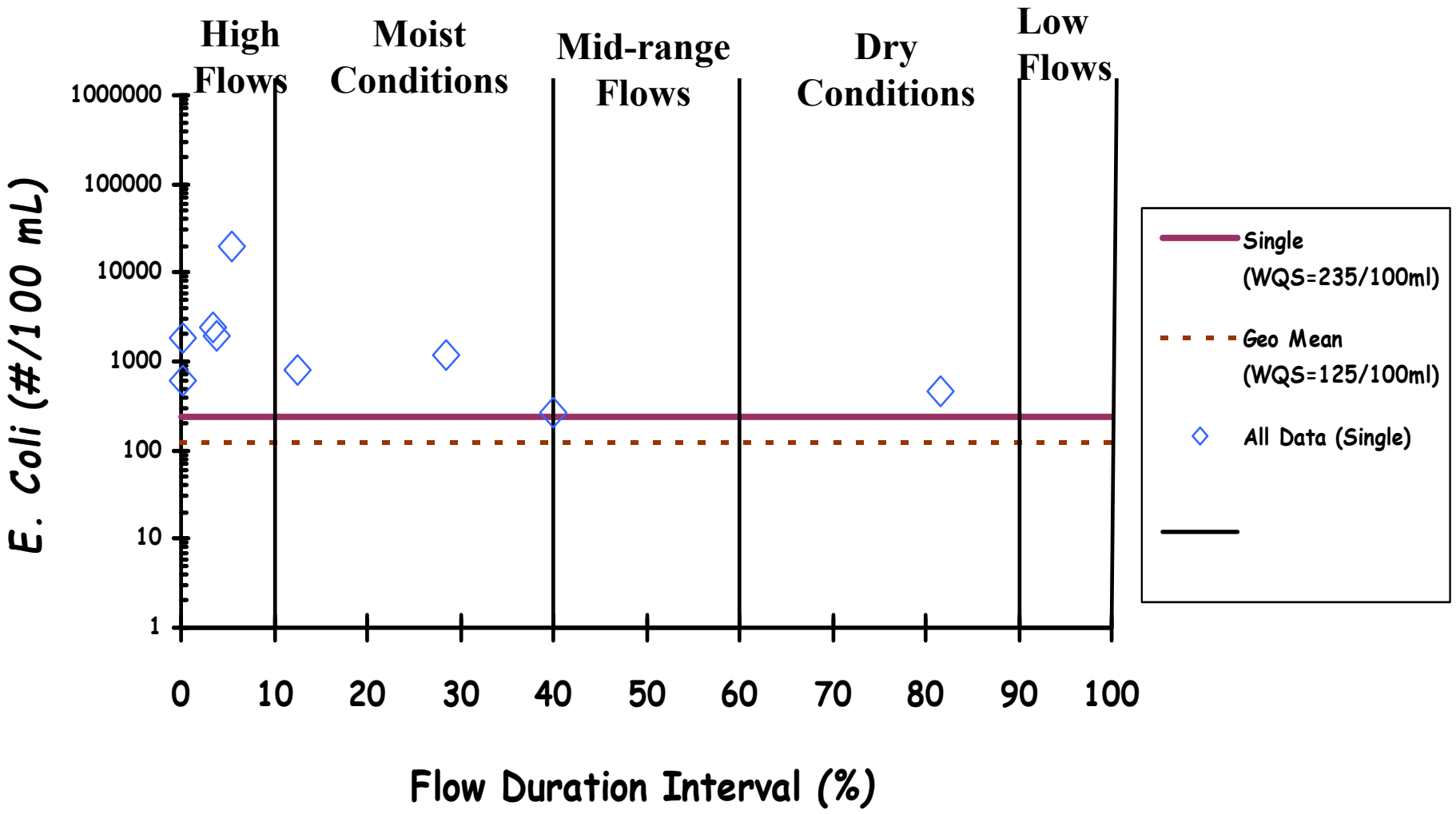
IDEM Data & USGS Gage Duration Interval

152 square miles

South Fork Prairie Creek at CR 300 E

WQ Duration Curve *(2002 Monitoring Data)*

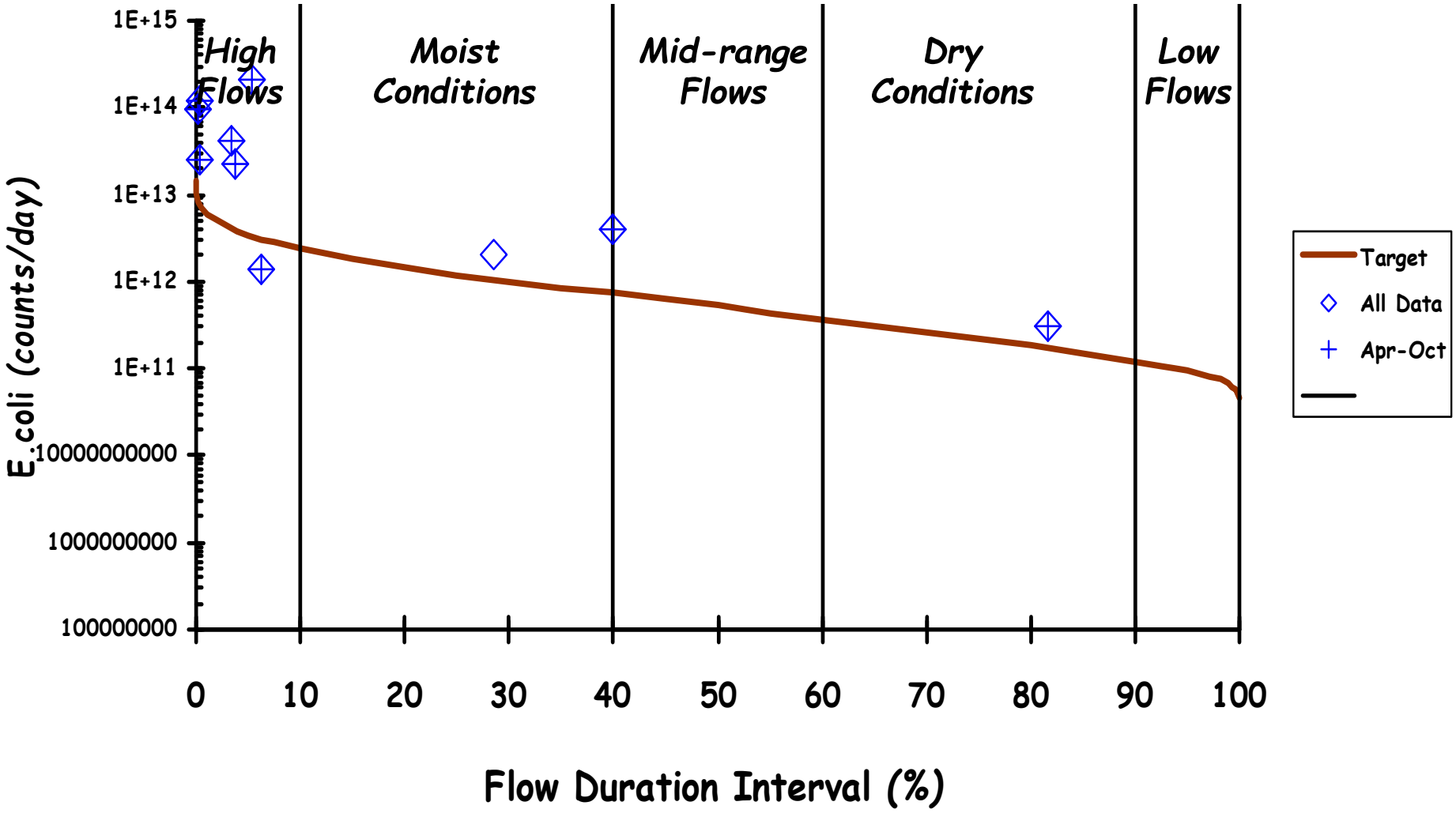
Site: WWL080-0002



IDEM Data & USGS Gage Duration Interval

152 square miles

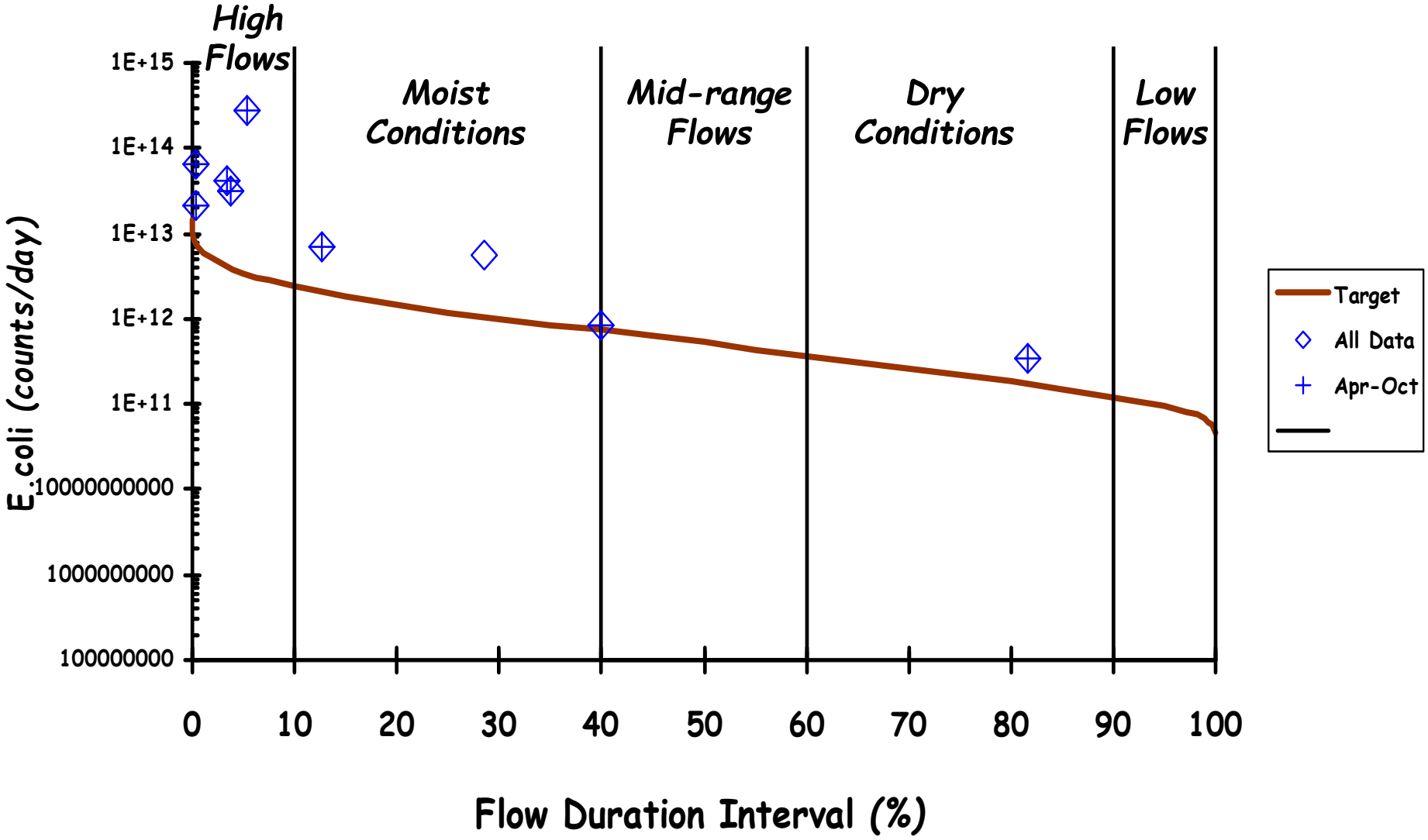
North Fork Prairie Creek at CR 450 E
Load Duration Curve *(1996, 2002 Monitoring Data)*
Site: WWL080-0001



IDEM Data & USGS Gage Duration Interval

152 square miles

South Fork Prairie Creek at CR 300 E
Load Duration Curve *(1996, 2002 Monitoring Data)*
Site: WWL080-0002



IDEM Data & USGS Gage Duration Interval

152 square miles