Total Maximum Daily Load Report for the Lower East Fork White River Watershed

Final TMDL

December 16, 2019

Prepared for: U.S. Environmental Protection Agency Region 5

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Executive Summary

The Lower East Fork White River Watershed (HUC 0512020815) is located in southwestern Indiana and covers an area of approximately 207 square miles. Overall, it drains approximately 5,742 square miles. The Lower East Fork White River Watershed originates near the southwest corner of Martin County, and then flows west, where it ultimately empties into the northwest corner of Pike County near Petersburg. Land use throughout the watershed is predominantly agriculture with forested areas being the second most abundant land use type. There are no public water supply intakes in the Lower East Fork White River watershed.

The Clean Water Act (CWA) and U.S. Environmental Protection Agency (U.S. EPA) regulations require that states develop Total Maximum Daily Loads (TMDLs) for waters on the Section 303(d) impaired waters list. A TMDL is the total amount of a pollutant that can be assimilated by the receiving water while still achieving water quality standards. TMDLs are composed of the sum of individual waste load allocations (WLAs) for regulated sources and load allocations (LAs) for sources that are not directly regulated. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. Conceptually, this is defined by the equation:

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

The Lower East Fork White River Watershed TMDL was prioritized to be completed at this time based on local interest in addressing water quality, IDEM interest in conducting baseline water quality monitoring for local planning, and a competitive Section 319 application from the local partners to develop a watershed management plan in conjunction with the IDEM sampling and TMDL development for streams impaired by *E. coli*, IBC, nutrients, and dissolved oxygen.

This TMDL has been developed to address *E. coli*, impaired biotic communities (IBC), nutrients, and dissolved oxygen in the Lower East Fork White River watershed in accordance with the TMDL Program Priority Framework. Parameters chosen for TMDL development include *E. coli*, total suspended solids (TSS), and total phosphorus. These parameters will be referred to cumulatively in this report as "pollutants."

After the Indiana Department of Environmental Management (IDEM) identifies a waterbody as having impairment and places the waterbody on Indiana's Section 303(d) list of impaired waters, IDEM implements a sampling plan to determine the extent and the magnitude of the impairment. The next task is to reassess each waterbody using new sampling data and to examine the watershed as a whole. The reassessment data helps IDEM identify the area of concern for TMDL development. As a result of the reassessment for the Lower East Fork White River watershed, the pollutants and the impaired segments for which TMDLs were developed differ from the pollutants and impaired segments appearing on the 2018 Section 303(d) list for the following reason:

- Sampling performed by IDEM in 2017-2018 generated new water quality data that were not available at the time the 2018 Section 303(d) list was developed.

Sampling data collected by IDEM in 2017-2018 at 17 sites were used for the TMDL analysis. The data indicates that 16 of the sample sites violated one or more of the Indiana Water Quality Standards (327 IAC 2).

Potential sources of biotic impairment, *E. coli*, nutrients, and low dissolved oxygen levels in the watershed include both regulated point sources and nonpoint sources. Point sources including wastewater treatment plants (WWTPs) and Public Water Supply (PWS) facilities that discharge wastewater, surface coal mining operations, and stormwater permitted construction activities are regulated through the National Pollutant Discharge Elimination System (NPDES). Nonpoint sources such as unregulated urban stormwater, agricultural run-off, combined feeding operations (CFOs) and faulty and failing septic systems are also potential sources.

Determining the specific reasons for high *E. coli* counts in any given waterbody is challenging. There are many potential sources and *E. coli* counts are inherently variable. Within the Lower East Fork White River watershed, subwatersheds with higher amounts of agricultural landscape also have the highest average *E. coli* counts. It is therefore possible that land application of manure in these subwatersheds is contributing to the elevated *E. coli* counts. However, other factors could also explain this correlation, such as failing septic systems along with small unregulated farming operations that allow livestock to have direct access to streams; these subwatersheds also tend to experience lower flows and thus have less dilution. Specific sources of *E. coli* to each impaired waterbody should be further evaluated during follow-up implementation activities.

Within the Lower East Fork White watershed, subwatersheds with CFOs also have high total phosphorus loads and low dissolved oxygen concentrations. It is therefore possible that field run off in these subwatersheds is contributing to elevated phosphorus loads resulting in lower dissolved oxygen. However, other factors could also explain this correlation, such as upstream loading, failing septic systems, impeded flow, or tillage practice.

Various subwatersheds in the Lower East Fork White River watershed have impaired biotic communities (IBC). Biological communities include fish and aquatic invertebrates, such as insects. These in-stream organisms are indicators of the cumulative effects of activities that affect water quality conditions over time. An IBC listing on Indiana’s 303(d) list, suggests that one or more of the aquatic biological communities is unhealthy as determined by IDEM’s monitoring data. IBC is not a source of impairment but a symptom of other sources. To address these impairments in the Lower East Fork White River watershed, TSS and total phosphorus have been identified as pollutants for TMDL development.

An important step in the TMDL process is the allocation of the allowable loads to individual point sources as well as sources that are not directly regulated. The Lower East Fork White River watershed TMDL includes these allocations, which are presented for each of the 12-digit hydrologic unit code (HUC) subwatersheds containing impairments.

There are seven NPDES permitted facilities located in the Lower East Fork White River watershed. These facilities include a public water supply facility, surface coal mining operations and the City of Jasper MS4. Of these facilities, two have been found to be in violation of their permit limits for TSS. Although some NPDES facilities have been found to be in violation of their permit limits, the majority of the time discharge effluent from these facilities meets water quality standards and/or targets.

There are several types of nonpoint sources located in the Lower East Fork White River watershed, including unregulated livestock operations, agricultural row crop land use, straight piped, leaking or failing septic systems, wildlife, and erosion. Of these, agricultural row crop land use, livestock operations, and erosion are found most often in subwatersheds with elevated levels of *E. coli*, TSS, and total phosphorus. Although Indiana does not have a permitting program for nonpoint sources, many nonpoint sources are addressed through voluntary programs intended to reduce pollutant loads, minimize flow, and improve water quality.

This TMDL report identifies which locations could most benefit from focus on implementation activities. These areas throughout the Lower East Fork White River watershed are referred to as critical areas. It also provides recommendations on the types of implementation activities, including best management practices (BMPs) that key implementation partners in the Lower East Fork White River watershed can consider to achieve the pollutant load reductions calculated for each subwatershed. Table 1 presents potential critical areas which can be used to recommend BMPs identified having a high likely degree of effectiveness to achieve the *E. coli*, TSS, and total phosphorus load reductions allocated to sources in each subwatershed.

Table 1: Critical Conditions for TMDL Parameters

Parameter	Subwatershed (HUC)	Critical Condition				
		High	**Moist**	**Mid-Range**	**Dry**	**Low**
E. coli (MPN/100mL)	Mill Creek (051202081501)	89%	--	99%	90%	--
	Hoffman Run US (Plaster Creek) (051202081407)	NA	--	NA	78%	--
	Slate Creek (051202081503)	26%	--	96%	90%	--
	Sugar Creek (051202081504)	66%	--	90%	90%	--
	Dogwood Lake (051202081505)	--	--	--	--	--
	Birch Creek (051202081506)	NA	90%	90%	66%	--
	Aikman Creek (051202081507)	NA	89%	95%	56%	--
	Bear Creek (051202081508)	38%	90%	94%	63%	--
	Mud Creek (051202081509)	NA	90%	92%	4%	--
Total Phosphorus (mg/L)	Mill Creek (051202081501)	NA	40%	NA	NA	--

Parameter	Subwatershed (HUC)	Critical Condition				
		High	Moist	Mid-Range	Dry	Low
	Hoffman Run US (Plaster Creek) (051202081407)	NA	NA	NA	NA	--
	Slate Creek (051202081503)	NA	58%	NA	6%	--
	Sugar Creek (051202081504)	NA	34%	NA	NA	--
	Dogwood Lake (051202081505)	--	--	--	--	--
	Birch Creek (051202081506)	41%	48%	NA	NA	--
	Aikman Creek (051202081507)	NA	49%	NA	NA	--
	Bear Creek (051202081508)	NA	NA	11%	NA	--
	Mud Creek (051202081509)	3%	41%	NA	NA	--
Total Suspended Solids (mg/L)	Mill Creek (051202081501)	NA	96%	NA	87%	--
	Hoffman Run US (Plaster Creek) (051202081407)	70%	79%	36%	74%	--
	Slate Creek (051202081503)	NA	98%	NA	93%	--
	Sugar Creek (051202081504)	74%	96%	15%	94%	--
	Dogwood Lake (051202081505)	--	--	--	--	--
	Birch Creek (051202081506)	19%	95%	68%	14%	--
	Aikman Creek (051202081507)	NA	98%	NA	NA	--
	Bear Creek (051202081508)	NA	89%	71%	NA	--
	Mud Creek (051202081509)	65%	99%	54%	55%	--

Public participation is an important and required component of the TMDL development process. The following public meetings and public comment periods have been held to further develop this project:

- A kickoff public meeting was held in Haysville, IN on October 23, 2017 to introduce the project and solicit public input. IDEM explained the TMDL process during these meetings, presented initial information regarding the Lower East Fork White River watershed, and answered questions from the public. Information was also solicited from stakeholders in the area.
- On October 23, 2018, IDEM worked with the Pike County Soil and Water Conservation District (SWCD) to host a water monitoring demonstration. The event was held in a public park along a tributary of Little Creek in Haysville, IN. IDEM staff were on-site to explain and/or give

demonstrations on their process for collecting water chemistry, fish through electrofishing techniques, and macroinvertebrates. Results were discussed for the 2017-2018 IDEM sampling of the watershed. The details of the partnership between the Pike County SWCD and IDEM were detailed as well.

- On June 5, 2019, a notice was posted to the Indiana Register to inform stakeholders of new impairments discovered during the 2017-2018 watershed characterization study in the Lower East Fork White River watershed. The notice outlined the findings of the study and listed proposed additions/deletions to the 2020 303(d) list of impaired waters. Public comments were solicited through September 3, 2019. IDEM received no comments regarding the notice.
- A draft TMDL public meeting was held in the watershed at the St. Paul's Lutheran Church, 556 W Haysville Rd, Jasper, IN 47546 on November 12, 2019 at 5:00 PM. The draft findings of the TMDL were presented at the meeting and the public had the opportunity ask questions and provide information to be included in the final TMDL report. A representative from the Pike Co SWCD was in attendance and presented information on the progress of the watershed management plan. A public comment period was from November 8, 2019 to December 8, 2019. IDEM received no comments regarding the notice.

1.0 INTRODUCTION

This section of the Total Maximum Daily Load (TMDL) provides an overview of the Lower East Fork White River watershed location and the regulatory requirements that have led to the development of this TMDL to address impairments in the Lower East Fork White River watershed.

The Lower East Fork White River Watershed TMDL was prioritized to be completed at this time based on local interest in addressing water quality, IDEM interest in conducting baseline water quality monitoring for local planning, and a competitive Section 319 application from the local partners to develop a watershed management plan in conjunction with the IDEM sampling and TMDL development for streams impaired by *E. coli*, IBC, nutrients, and dissolved oxygen.

The Lower East Fork White River watershed (HUC 0512020815), shown in Figure 1, is located in southwest Indiana and drains a total of 207 square miles. The Lower East Fork White River watershed originates near the southwest corner of Martin County, and then flows west, where it ultimately empties into the northwest corner of Pike County near Petersburg. Land use throughout the watershed is split predominantly between forested areas and agricultural uses. There are no public water supply intakes in the Lower East Fork White River watershed.

The Clean Water Act (CWA) and U.S. Environmental Protection Agency (U.S. EPA) regulations require that states develop TMDLs for waters on the Section 303(d) lists. U.S. EPA defines a TMDL as the sum of the individual waste load allocations (WLA) for point sources and load allocations (LA) for nonpoint sources, and a margin of safety (MOS) that addressed the uncertainty in the analysis.

The overall goals and objectives of the TMDL study for the Lower East Fork White River watershed are to:

- Assess the water quality of the impaired waterbodies and identify key issues associated with the impairments and potential pollutant sources.
- Determine current loads of pollutants to the impaired waterbodies.
- Use the best available science and available data to determine the total maximum daily load the waterbodies can receive while fully supporting the impaired designated use(s).
- If current loads exceed the maximum allowable loads, determine the load reduction that is needed.
- Inform and involve the public throughout the project to ensure that key concerns are addressed and the best available information is used.
- Identify critical flow conditions that watershed stakeholders can use to identify critical areas.

- Recommend activities for purposes of TMDL implementation.
- Submit a final TMDL report to the U.S. EPA for review and approval.

Watershed stakeholders and partners can use the final approved TMDL report to craft a watershed management plan (WMP) that meets both U.S. EPA's nine minimum elements under the CWA Section 319 Nonpoint Source Program, as well as the additional requirements under IDEM's WMP Checklist.

Figure 1: Location of Lower East Fork White River Watershed

1.1 Water Quality Standards

Under the CWA, every state must adopt water quality standards to protect, maintain, and improve the quality of the nation's surface waters. These standards represent a level of water quality that will support the CWA's goal of "swimmable/fishable" waters. Water quality standards consist of three different components:

- **Designated uses** reflect how the water can potentially be used by humans and how well it supports a biological community. Examples of designated uses include aquatic life support, drinking water supply, and full body contact recreation. Every waterbody in Indiana has a designated use or uses; however, not all uses apply to all waters. The Lower East Fork White River Watershed TMDLs focus on protecting the designated aquatic life support and full body contact recreational uses of the waterbodies.
- Criteria express the condition of the water that is necessary to support the designated uses. **Numeric criteria** represent the concentration of a pollutant that can be in the water and still protect the designated use of the waterbody. **Narrative criteria** are the general water quality criteria ("free froms…") that apply to all surface waters. Numeric criteria for *E. coli*, Impaired Biotic Communities (IBC), and Dissolved Oxygen were used as the basis of the Lower East Fork White River Watershed TMDLs.
- **Antidegradation** policies provide protection of existing uses and extra protection for high-quality or unique waters.

The water quality standards in Indiana pertaining to *E. coli*, IBC, and nutrients ("the impairments") are described below.

1.1.1 *E. coli*

E. coli is an indicator of the possible presence of pathogenic organisms (e.g., enterococcal *E. coli*, viruses, and protozoa) which may cause human illness. The direct monitoring of these pathogens is difficult; therefore, *E. coli* is used as an indicator of potential fecal contamination. *E. coli* is a sub-group of fecal coliform; the presence of *E. coli* in a water sample indicates recent fecal contamination is likely. Concentrations are typically reported as the count of organisms in 100 milliliters of water (count/100 mL) and may vary at a particular site depending on the baseline *E. coli* level already in the river, inputs from other sources, dilution due to precipitation events, and die-off or multiplication of the organism within the river water and sediments.

The numeric *E. coli* criteria associated with protecting the recreational use are described below.

> *"The criteria in this subsection are to be used to evaluate waters for full body contact recreational uses, to establish wastewater treatment requirements, and to establish effluent limits during the recreational season, which is defined as the months of April through October, inclusive. E. coli bacteria, 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. . . However, a single sample shall be used for making beach notification and closure decisions."* [Source: Indiana Administrative Code Title 327 Water Pollution Control Board. Article 2. Section 1-6(a).]

1.1.2 Nutrients

The term "nutrients" refers to the various forms of nitrogen and phosphorus found in a waterbody. Both nitrogen and phosphorus are necessary for aquatic life, and both elements are needed at some level in a waterbody to sustain life. The natural amount of nutrients in a waterbody varies depending on the type of system. A pristine mountain spring might have little to almost no nutrients, whereas a lowland, mature stream flowing through wetland areas might have naturally high nutrient concentrations. Streams draining larger areas are also expected to have higher nutrient concentrations.

Nutrients generally do not pose a direct threat to the designated uses of a waterbody. However, excess nutrients can cause an undesirable abundance of plant and algae growth through a process called eutrophication. Eutrophication can have many effects on a stream. One possible effect is low dissolved oxygen concentrations caused by excessive plant respiration and/or decay. Ammonia, which is toxic to fish at high concentrations, can be released from decaying organic matter when eutrophication occurs. For these reasons, excessive nutrients can result in the non-attainment of bio-criteria and impairment of the designated use.

Like most states, Indiana has not yet adopted numeric water quality criteria for nutrients. The relevant narrative criteria that apply to the TMDLs presented in this report state the following:

> *"All surface waters at all times and at all places, including waters within the mixing zone, shall meet the minimum conditions of being free from substances, materials, floating debris, oil, or scum attributable to municipal, industrial, agricultural, and other land use practices, or other discharges that do any of the following:" [327 IAC 2-1-6. Sec. 6. (a)(1)]…*
>
> *(a)re in concentrations or combinations that will cause or contribute to the growth of aquatic plants or algae to such degree as to create a nuisance, be unsightly, or otherwise impair the designated uses." [327 IAC 2-1-6. Sec. 6. (a) (1)(D)]*
>
> *(a)re in amounts sufficient to be acutely toxic to, or to otherwise severely injure or kill, aquatic life, other animals, plants, or humans." [327 IAC 2-1-6. Sec. 6. (a) (1)(E)]*

1.1.3 Biological Communities

The water quality regulatory definition of a "well-balanced aquatic community" is "*an aquatic community which is diverse in species composition, contains several different trophic levels, and is not composed mainly of strictly pollution tolerant species*" [327 IAC 2-1-9(49)].

IBC is not a source of impairment but a symptom of other sources. To address these impairments in the Lower East Fork White River Watershed, TSS has been identified as a pollutant for TMDL development. IDEM has not yet adopted numeric water quality criteria for total suspended solids (TSS). The relevant narrative criteria that apply to the TMDLs presented in this report state the following:

> *"All surface waters at all times and at all places, including waters within the mixing zone, shall meet the minimum conditions of being free from substances, materials, floating debris, oil, or scum attributable to municipal, industrial, agricultural, and other land use practices, or other discharges that do any of the following:" [327 IAC 2-1-6. Sec. 6. (a)(1)]…*
>
> *(a)re in concentrations or combinations that will cause or contribute to the growth of aquatic plants or algae to such degree as to create a nuisance, be unsightly, or otherwise impair the designated uses." [327 IAC 2-1-6. Sec. 6. (a) (1)(D)]*
>
> *(a)re in amounts sufficient to be acutely toxic to, or to otherwise severely injure or kill, aquatic life, other animals, plants, or humans." [327 IAC 2-1-6. Sec. 6. (a) (1)(E)]*

In addition, the narrative biological criterion [327 IAC 2-1-3(2)] states the following:

> *"All waters, except those designated as limited use, will be capable of supporting a well-balanced, warm water aquatic community."*

Biological assessments for streams are based on the sampling and evaluation of either the fish communities, the benthic aquatic macroinvertebrate communities, or both. Indices of biotic integrity (IBI) for fish and macroinvertebrate IBI (mIBI) assessment scores, or both, were calculated and compared to regionally-calibrated models. In evaluating fish communities, streams rating as "poor" or worse are classified as non-supporting for aquatic life uses. For benthic aquatic macroinvertebrate communities, individual sites are compared to a statewide calibration at the lowest practical level of identification for Indiana. All sites at or above background for the calibration are considered to be supporting aquatic life uses. Those sites rated as moderately or severely impaired in the calibration are considered to be non-supporting. Waters with identified impairments to one or more biological communities are considered not supporting aquatic life use. The biological thresholds Indiana uses to make use attainment decisions are shown in Table 2 to provide greater context for understanding the range of biological conditions that is considered either fully supporting or impaired.

IDEM's aquatic life use assessments are never based solely on habitat evaluations. However, habitat evaluations are used as supporting information in conjunction with biological data to determine aquatic life use support. Such evaluations, which take into consideration a variety of habitat characteristics as well as stream size, help IDEM to determine the extent to which habitat conditions may be influencing the ability of biological communities to thrive. If habitat is determined to be driving a biological community impairment (IBC) and no other pollutants that might be contributing to the impairment have been identified, the IBC is not considered for inclusion on IDEM's 303(d) List of Impaired Waters (Category 5). In such cases, the waterbody is instead placed in Category 4C for the biological impairment.

Table 2: Lower East Fork White River Watershed Aquatic Life Use Support Criteria for Biological Communities

Biotic Index Score and Associated Assessment Decision	Integrity Class	Corresponding Integrity Class Score	Attributes
Fish community Index of Biotic Integrity (IBI) Scores (Range of possible scores is 0-60)			
Fully Supporting IBI ≥ 36 Indicates Full Support	Excellent	53-60	Comparable to "least impacted" conditions, exceptional assemblage of species
	Good	45-52	Decreased species richness (intolerant species in particular), sensitive species present
	Fair	36-44	Intolerant and sensitive species absent, skewed trophic structure
Not Supporting IBI < 36 Indicates Impairment	Poor	23-35	Many expected species absent or rare, tolerant species dominant
	Very Poor	12-22	Few species and individuals present, tolerant species dominant
	No Organisms	12	No fish captured during sampling.
Benthic aquatic macroinvertebrate community Index of Biotic Integrity (mIBI) Scores Multihabitat (MHAB) Methods (Range of possible scores is 12-60)			
Fully Supporting mIBI ≥ 36 Indicates Full Support	Excellent	53-60	Comparable to "least impacted" conditions, exceptional assemblage of species
	Good	45-52	Decreased species richness (intolerant species in particular), sensitive species present
	Fair	36-44	Intolerant and sensitive species absent, skewed trophic structure
Not Supporting mIBI < 36 Indicates Impairment	Poor	23-35	Many expected species absent or rare, tolerant species dominant
	Very Poor	12-22	Few species and individuals present, tolerant species dominant
	No Organisms	12	No macroinvertebrates captured during sampling.

1.2 Water Quality Targets

Target values are needed for the development of TMDLs because of the need to calculate allowable daily loads. For parameters that have numeric criteria, such as *E. coli*, the target equals the numeric criteria. For parameters that do not have numeric criteria, target values must be identified from some other source. The target values used to develop the Lower East Fork White River Watershed TMDL are presented below.

1.2.1 *E. coli* TMDLs

The target value used for the Lower East Fork White River Watershed TMDL was based on the 235 counts/100 mL single sample maximum component of the water quality standard (i.e., daily loading capacities were calculated by multiplying flows by 235 counts/100 mL). The EPA report, "An Approach for Using Load Duration Curves in the Development of TMDLs" (EPA 2007) [1] describes how the monthly geometric mean (125 counts/100mL) is likely to be met when the single sample maximum value (235 counts/100mL) is used to develop the loading capacity. The process calculates the daily maximum bacteria value that is possible to observe and still attain the monthly geometric mean. If the single sample maximum is set as a never-to-be surpassed value then it becomes the maximum value that can be observed, and all other bacteria values would have to be less than the maximum.

1.2.2 IBC and DO TMDLs

The following sections describe the TMDL target values used for nutrients and TSS when developing IBC and DO TMDLs.

1.2.2.1 Total Phosphorus

Although Indiana has not yet adopted numeric water quality criteria for nutrients, IDEM has identified the following nutrient benchmarks that are used to assess potential nutrient impairments:

- Total phosphorus should not exceed 0.30 mg/L (U.S. EPA's nationwide 1986 Quality Criteria for Waters also known as the *Gold Book*).

The total phosphorus value (0.30 mg/L) was used as the TMDL target during the development of the Lower East Fork White River Watershed TMDL. IDEM has determined that meeting these targets will result in achieving the narrative biological criterion by improving water quality and promoting a well-balanced aquatic community. Phosphorus is interpreted as an average in the NPDES permits. Monitoring data, reviewed by IDEM during the TMDL development process, indicated that when WWTPs were in compliance with their individual permit limit for phosphorus (1.0 mg/L), the in-stream target for phosphorus (0.30 mg/L) was typically met.

1.2.2.2 Total Suspended Solids (TSS)

Although Indiana has not yet adopted numeric water quality criteria for TSS, IDEM has identified a target value based on IDEM's NPDES permitting process. A target of 30.0 mg/L for TSS has been identified as a permit limit for NPDES facilities. A target value of 30.0 mg/L TSS was therefore used as the TSS TMDL target value to ensure consistency with IDEM's NPDES permitting process. IDEM has determined that meeting the TSS target will result in achieving the narrative biological criterion by improving water quality and promoting a well-balanced aquatic community.

Various sub watersheds in the Lower East Fork White River Watershed have IBC impairments. Biological communities include fish and aquatic invertebrates, such as insects. These in-stream organisms are indicators of the cumulative effects of activities that affect water quality conditions over time. An IBC listing on Indiana's 303(d) list means that IDEM's monitoring data shows one or both of the aquatic communities are not as healthy as they should be.

A few subwatersheds in the Lower East Fork White River watershed have dissolved oxygen impairments. Dissolved oxygen is not a source of impairment but a symptom of other sources. To address these impairments in the Southern Whitewater River watershed, phosphorus and TSS, where applicable, have been identified as a pollutant for TMDL development.

Table 3 reiterates the TMDL target values presented in Section 1.0. These are the target values IDEM uses to assess water quality data collected in the Lower East Fork White River watershed.

Table 3: Target Values Used for Development of the Lower East Fork White River Watershed TMDLs

Parameter	Target Value
Total Phosphorus	No value should exceed 0.30 mg/L
Total Suspended Solids	No value should exceed 30.0 mg/L
E. coli	No value should exceed 235 counts/100 mL (single sample maximum)

1.3 Listing Information

1.3.1 Understanding Subwatersheds and Assessment Units

This section presents information concerning IDEM's segmentation process as it applies to the Lower East Fork White River watershed. IDEM identifies the Lower East Fork White River Watershed and its tributaries using a watershed numbering system developed by United States Geological Survey (USGS), Natural Resource Conservation Service (NRCS), and the U.S. Water Resources Council referred to as hydrologic unit codes (HUCs). HUCs are a way of identifying watersheds in a nested arrangement from largest (i.e., those with shorter HUCs) to smallest (i.e., those with longer HUCs) [1]. Figure 2 shows the 12-digit HUCs located in the Lower East Fork White River watershed.

Within each 12-digit HUC subwatershed, IDEM has identified several AUIDs, which represent individual stream segments. Through the process of segmenting waterbodies into AUIDs, IDEM identifies streams reaches and stream networks that are representative for the purposes of assessment. In practice, this process leads to grouping tributary streams into smaller catchment basins of similar hydrology, land use, and other characteristics such that all tributaries within the catchment basin can be expected to have similar potential water quality impacts. Catchment basins, as defined by the aforementioned factors, are typically very small, which significantly reduces the variability in the water quality expected from one stream or stream reach to another. Given this, all tributaries within a catchment basin are assigned a single AUID. Grouping tributary systems into smaller catchment basins also allows for better characterization of the larger watershed and more localized recommendations for implementation activities. Variability within the larger watershed will be accounted for by the differing AUIDs assigned to the different catchment basins.

Table 4 & Table 9 contain the AUIDs in the subwatersheds of the Lower East Fork White River watershed and the associated drainage area. Subsequent sections of the TMDL report organize information by subwatershed (if applicable) and AUID.

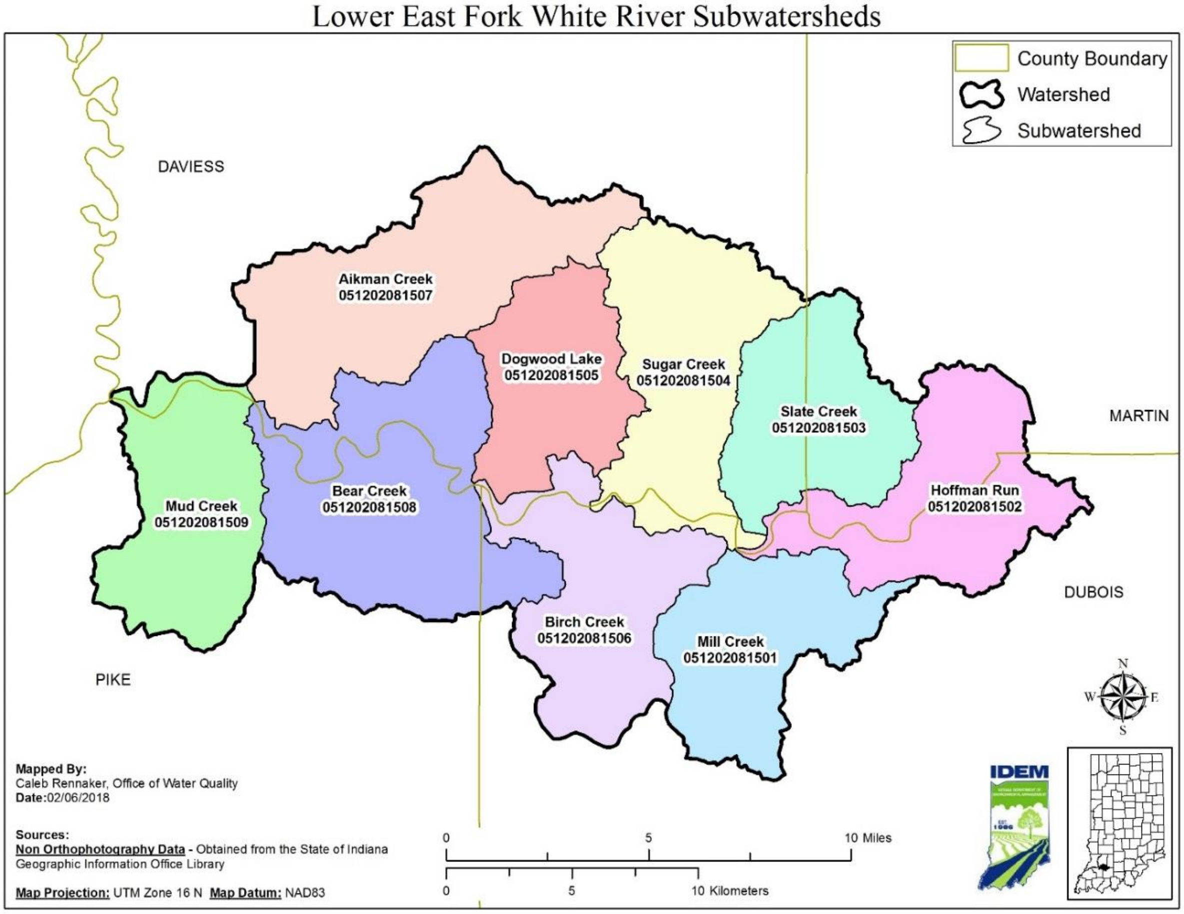

Figure 2: Subwatersheds (12-Digit HUCs) in the Lower East Fork White River Watershed

1.3.2 Understanding 303(d) Listing Information

There are a number of existing impairments in the Lower East Fork White River Watershed from the approved 2018 303(d) List of Impaired Waters (Table 4). The listings and causes of impairment have been adjusted as a result of reassessment data collected at 17 sampling locations in the watershed. Within the Lower East Fork White River Watershed a total of 39 assessment unit IDs (AUIDs) will be cited as impaired for *E. coli*, 16 AUIDs cited as impaired for Fish Tissue, Mercury, and PCB impairments, 8 AUIDs cited as impaired for nutrients, 2 AUIDs cited as impaired for dissolved oxygen, and 10 AUIDs cited as impaired for IBC on Indiana's 2020 303(d) list (Table 4). These impaired segments account for approximately 424 miles. Table 4 presents listing information for the Lower East Fork White River

Watershed, including a comparison of the updated listings with the 2018 listings and associated causes of impairments addressed by the TMDLs. The reassessment data used in updating the listings for the Lower East Fork White River Watershed are available in Appendix B.

Below is an inventory assessment of the available biological and chemistry data for the Lower East Fork White River watershed.

Table 4: Section 303(d) List Information for the Lower East Fork White River for 2018 and 2020

Name of Subwatershed	Current AUID	Length (mi)	2018 Section 303(d) Listed Impairment	Updated Impairments to be listed 2020 303(d)
Mill Creek 051202081501	INW08F1_01	5.51		*E. coli*
	INW08F1_02	3.01		*E. coli*
	INW08F1_03	4.52		*E. coli*
	INW08F1_T1001	1.66		*E. coli*
	INW08F1_T1004	5.99		*E. coli*
	INW08F1_T1005	8.28		*E. coli*
	INW08F1_T1006	4.83		*E. coli*
	INW08F1_T1007	0.46		*E. coli*
	INW08P1085_00	0.38		
Hoffman Run 051202081502	INW08F2_02	9.10	*E. coli, IBC, PCBs (FT)*	*PCBs (FT), IBC*
	INW08F2_03	8.52	*E. coli, IBC, PCBs (FT)*	*PCBs (FT), IBC*
	INW08F2_T1002	4.38		
	INW08F2_T1004	11.37		
	INW08F2_T1005	2.04		
	INW08F2_T1006	2.18		
	INW08F2_T1007	6.03		
	INW08F2_T1008	3.27		
Slate Creek 051202081503	INW08F3_01	3.31		*E. coli, Nutrients*
	INW08F3_02	8.26		*E. coli, IBC, Nutrients*
	INW08F3_03	4.00		*E. coli, IBC, Nutrients, DO*
	INW08F3_T1002	8.83		*E. coli, IBC, Nutrients*
	INW08F3_T1003	1.39		*E. coli, Nutrients*
	INW08F3_T1004	3.74		*E. coli, Nutrients*
	INW08F3_T1005	6.11		*E. coli, Nutrients*
Sugar Creek 051202081504	INW08F4_01	2.70	*PCBs (FT)*	*IBC, PCBs (FT)*
	INW08F4_03	1.72	*PCBs (FT)*	*PCBs (FT)*
	INW08F4_04	0.75	*PCBs (FT)*	*PCBs (FT)*
	INW08F4_T1002	5.85	*E. coli, DO*	*E. coli*
	INW08F4_T1003	2.67	*E. coli, DO*	*E. coli*
	INW08F4_T1004	17.66	*E. coli, DO*	*E. coli, IBC*
	INW08F4_T1005	4.88	*E. coli, DO*	*E. coli*
	INW08F4_T1006	7.25	*E. coli, DO*	*E. coli*
Dogwood Lake 051202081505	INW08F5_01	2.35		
	INW08F5_02	4.72		

Name of Subwatershed	Current AUID	Length (mi)	2018 Section 303(d) Listed Impairment	Updated Impairments to be listed 2020 303(d)
	INW08F5_T1001	3.12		
	INW08F5_T1002	2.22		
	INW08F5_T1003	0.46		
	INW08F5_T1004	3.51		
	INW08F5_T1005A	0.69		
	INW08F5_T1005B	0.49		
	INW08P1016_00	9.84		
Birch Creek 051202081506	INW08F6_02	0.86	*PCBs (FT)*	*PCBs (FT)*
	INW08F6_03	2.32	*PCBs (FT)*	*PCBs (FT)*
	INW08F6_04	3.15	*PCBs (FT)*	*PCBs (FT)*
	INW08F6_T1002	7.99		
	INW08F6_T1003	15.96		*E. coli*
	INW08F6_T1004	3.55		
	INW08F6_T1005	3.10		
	INW08F6_T1006	13.20		*E. coli, IBC*
	INW08F6_T1007	3.73	*PCBs (FT)*	*PCBs (FT)*
	INW08P1084_00	0.17		
Aikman Creek 051202081507	INW08F7_02	6.10		*E. coli*
	INW08F7_03	10.97		*E. coli*
	INW08F7_04	11.03		*E. coli, IBC, Nutrients, DO*
	INW08F7_05	2.06		*E. coli*
	INW08F7_T1001	4.52		*E. coli*
	INW08F7_T1002	2.08		*E. coli*
	INW08F7_T1003	2.55		*E. coli*
	INW08F7_T1004	2.66		*E. coli*
	INW08F7_T1005	3.63		*E. coli*
	INW08F7_T1006	2.40		*E. coli*
	INW08F7_T1007	1.69		*E. coli*
	INW08F7_T1008	1.38		*E. coli*
	INW08F7_T1009	0.24		*E. coli*
Bear Creek 051202081508	INW08F8_02	0.57	*PCBs (FT)*	*PCBs (FT)*
	INW08F8_03	1.63	*PCBs (FT)*	*PCBs (FT)*
	INW08F8_04	5.54	*PCBs (FT)*	*PCBs (FT)*
	INW08F8_05	2.86	*PCBs (FT)*	*PCBs (FT)*
	INW08F8_06	2.05	*PCBs (FT)*	*PCBs (FT)*
	INW08F8_T1001	14.52		
	INW08F8_T1003	7.44		
	INW08F8_T1004	2.94		
	INW08F8_T1006	0.25		
	INW08F8_T1008	16.29		*E. coli, IBC*
	INW08F8_T1009	5.18		*E. coli*
	INW08F8_T1010	8.56		*E. coli, IBC*
	INW08F8_T1011	4.00		

Name of Subwatershed	Current AUID	Length (mi)	2018 Section 303(d) Listed Impairment	Updated Impairments to be listed 2020 303(d)
	INW08F8_T1012	2.73		
	INW08F8_T1013	5.32		
	INW08P1073_00	0.37		
Mud Creek 051202081509	INW08F9_02	3.06	*PCBs (FT)*	*PCBs (FT)*
	INW08F9_03	1.21	*PCBs (FT)*	*IBC, PCBs (FT)*
	INW08F9_T1001	21.04		*E. coli*
	INW08F9_T1002	5.94		
	INW08F9_T1003	1.36		
	INW08F9_T1004	2.38		
	INW08F9_T1005	5.15		
	INW08F9_T1006	5.37		
	INW08F9_T1007	4.39		

Understanding Table 4:

- *Column 1: Name of Subwatershed (12-digit HUC).* Shows the name of the subwatershed at the 12-digit HUC scale. The subwatershed found in this second column is the appropriate scale for what the IDEM's WMP Checklist defines as a subwatershed for the purposes of watershed management planning.
- *Column 2: Current AUID.* Identifies the AUID given to waterbodies within the 12-digit HUC subwatershed for purposes of the 2018 Section 303(d) listing assessment process.
- *Colum 3: Length (mi).* Provides the length in miles of the associated AUID.
- *Column 4: 2018 Section 303(d) Listed Impairment.* Identifies the cause of impairment associated with the 2018 Section 303(d) listing.
- *Column 5: Updated Impairments to be listed 2020 303(d).* Provides the updated causes of impairment if new data and information are available.

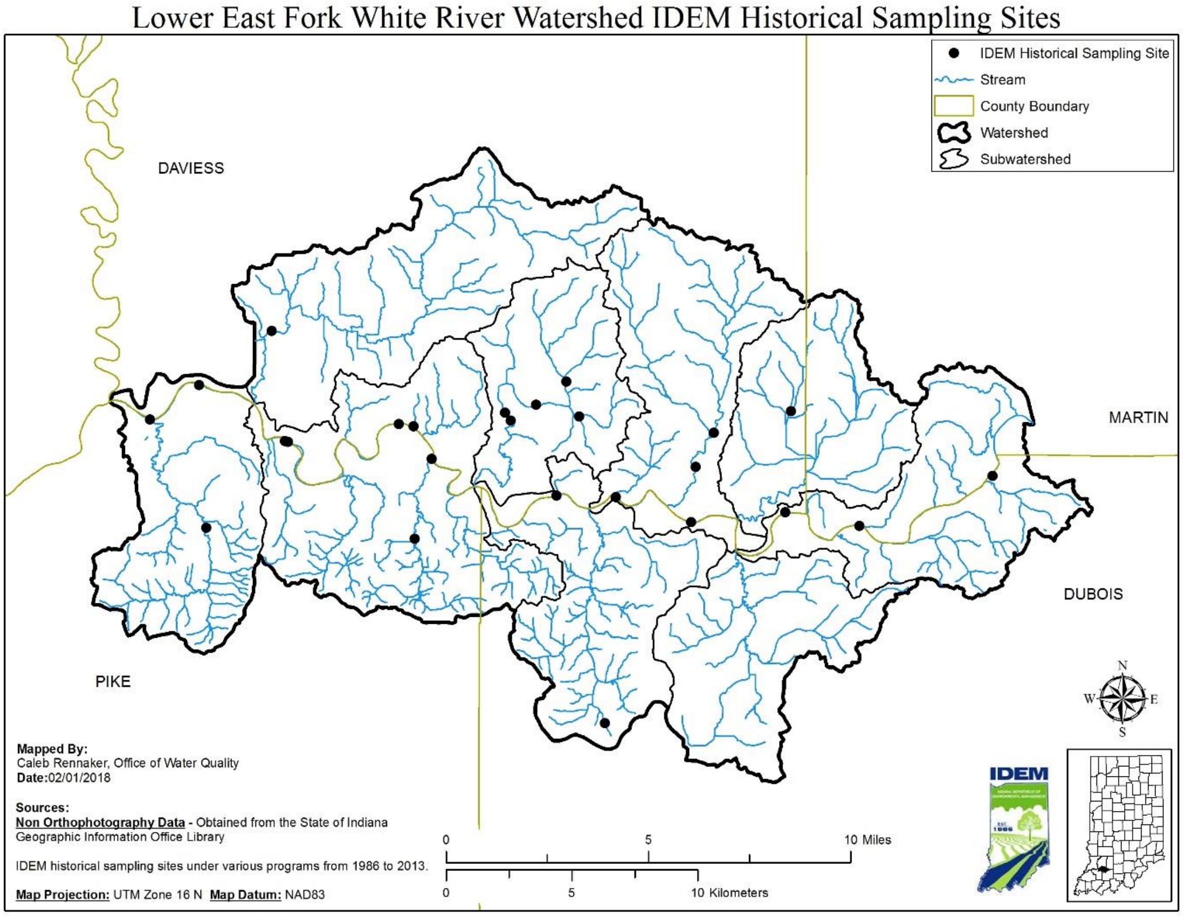

Figure 3: Location of Historical Sampling Sites in the Lower East Fork White River Watershed

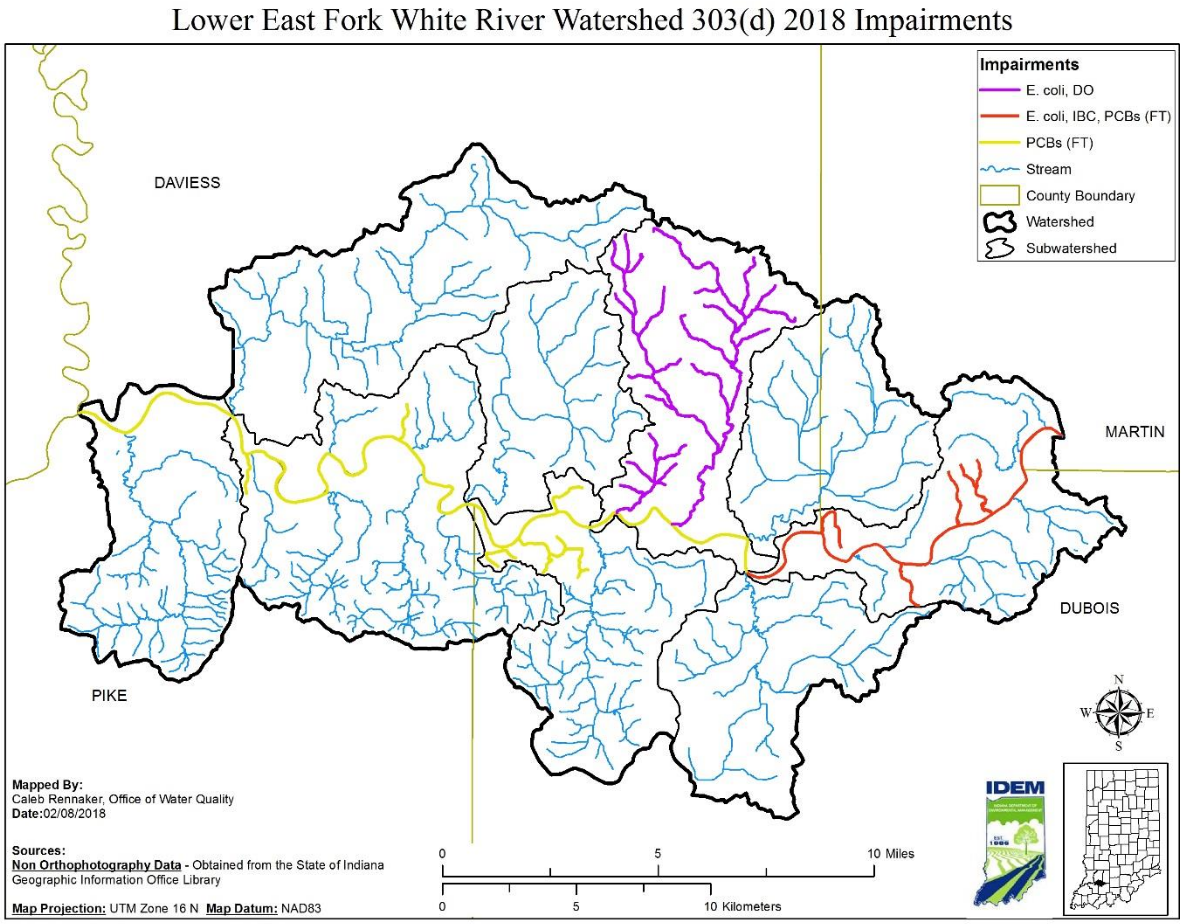

Figure 4: Streams Listed on the 2018 Section 303(d) List in the Lower East Fork White River Watershed

1.4 Water Quality Data

This section of the TMDL report contains a brief characterization of the Lower East Fork White River Watershed water quality information that was collected in development of this TMDL. Understanding the natural and human factors affecting the watershed will assist in selecting and tailoring appropriate and feasible implementation activities to achieve water quality standards.

1.4.1 Water Quality Data

Table 6 summarizes the pathogen data and Table 7 summarizes the water chemistry data within the Lower East Fork White River Watershed by displaying the maximum concentrations at all impaired stations along with the reduction needed to meet the TMDL. Current data sampled in November 2017 through October 2018 by IDEM were used for the TMDL analysis. Table 5 and Figure 5 below show the sampling site locations and information.

The percent reductions were calculated as follows:

$$\%\text{ Reduction } = \frac{(\text{Observed Concentration} - \text{Target Value or WQS})}{\text{Observed Concentration}}$$

Appendix A shows the individual sample results and summaries of all the water quality data for all 17 monitoring stations.

Lower East Fork White River Watershed Sampling Sites

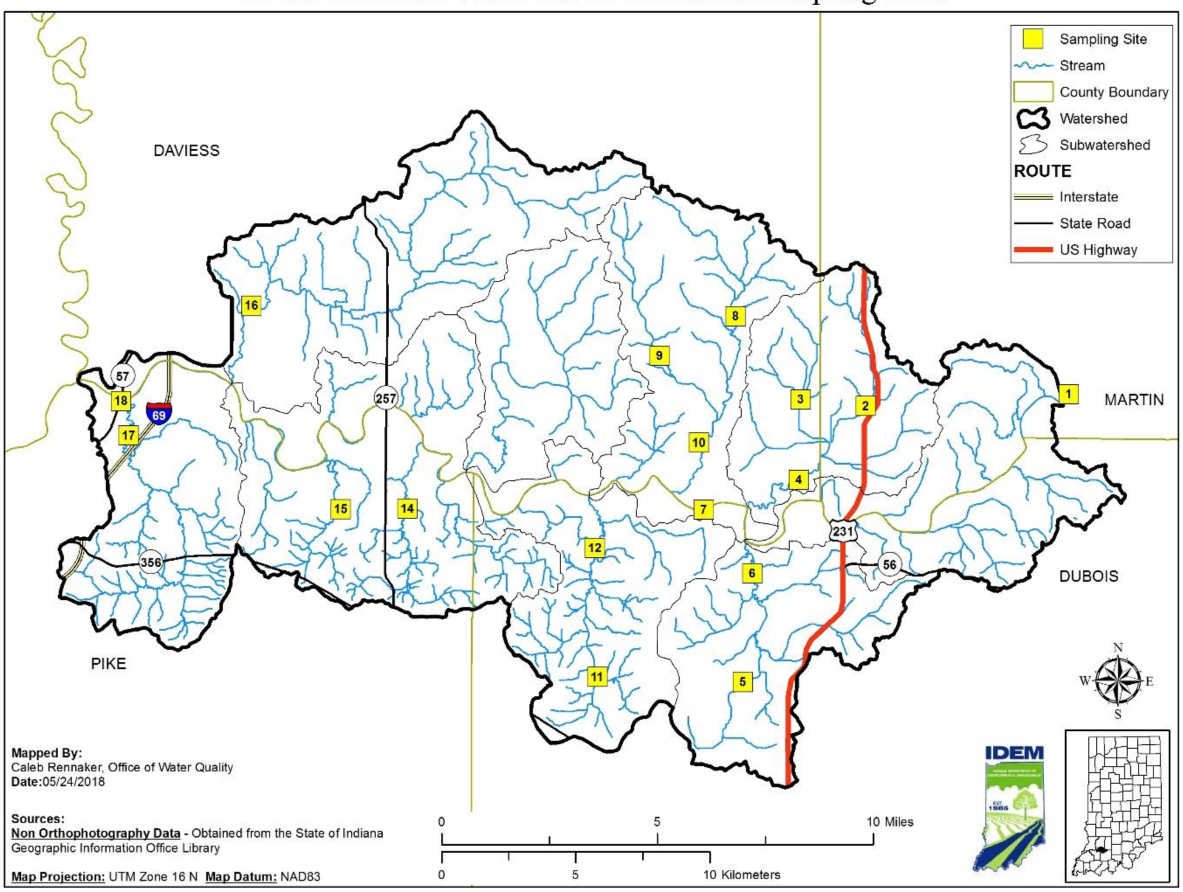

Figure 5: 2017-2018 Sampling Locations for the Lower East Fork White River TMDL Study

Table 5: Lower East Fork White River Sampling Site Information

Site #	Site ID #	Stream Name	Road Name	AUID
1	18T-001	East Fork White River	CR 3 (Abel Hill Rd)	INW08E7_03
2	18T-002	Slate Creek	CR 22	INW08F3_02
3	18T-003	Tributary of Slate Creek	CR 800 S	INW08F3_T1002
4	18T-004	Slate Creek	CR 1250 E	INW08F3_03
5	18T-005	Mill Creek	Portersville	INW08F1_01
6	18T-006	Mill Creek	CR 700 N	INW08F1_03
7	18T-007	East Fork White River	CR 1100 E	INW08F4_01
8	18T-008	Sugar Creek	CR 600 S	INW08F4_T1004
9	18T-009	Sugar Creek	CR 700 S	INW08F4_T1006
10	18T-010	Sugar Creek	CR 900 S	INW08F4_T1003
11	18T-011	Birch Creek	CR 500 N	INW08F6_T1006
12	18T-012	Birch Creek	Portersville	INW08F6_T1003
14	18T-014	Bear Creek	CR 550 N	INW08F8_T1008
15	18T-015	Beech Creek	CR 550 N	INW08F8_T1010
16	18T-016	Aikman Creek	CR 600 S	INW08F7_04
17	18T-017	Mud Creek	CR 725 N	INW08F9_T1001
18	18T-018	East Fork White River	SR 57	INW08F9_03

Understanding Table 5:

- *Column 1: Site #.* Lists the site number that corresponds to the site location in Figure 5.
- *Column 2: Site ID #* . Provides the EPA-assigned number
- *Column 3: Stream Name*. Identifies the stream name that the site is located on.
- *Column 4: Road Name.* Identifies the road name that the site is located on
- *Column 5: AUID.* Identifies the AUID given to waterbodies within the 12-digit HUC subwatershed for purposes of the 2018 Section 303(d) listing assessment process.

1.4.2 *E. coli* Data

For pathogens, 17 sites in the Lower East Fork White River were sampled. Table 6 below provides a summary of pathogen data for all of the subwatersheds in the Lower East Fork White River.

Table 6: Summary of Pathogen Data in Lower East Fork White River by Subwatershed

Subwatershed	Station #	AUID	Period of Record	Total Number of Samples	Percent of Samples Exceeding *E. coli* WQS (#/100 mL) 125	Percent of Samples Exceeding *E. coli* WQS (#/100 mL) 235	Geomean (#/ 100 mL)	Single Sample Maximum (#/ 100 mL)	Percent Reduction Based on Geomean (125/ 100mL)	Percent Reduction Based on SSM (235/100mL)
Mill Creek	WEL-15-0011 (T05)	INW08F1_01	4/9/18-10/15/18	10	50	40	722.1	51,720	82.69	99.55
	WEL-15-0012 (T06)	INW08F1_03	5/21/18-10/15/18	9	100	100	1,739.93	41,060	92.82	99.43
Hoffman Run (US)	WEL-14-0003 (T01)	INW08E7_01	5/21/18-10/15/18	9	11.11	11.11	41.46	1,732.9	0	86.44
Slate Creek	WEL-15-0008 (T02)	INW08F3_02	4/9/18-10/15/18	10	80	60	431.86	15,150	71.06	98.45
	WEL-15-0007 (T04)	INW08F3_03	4/9/18-10/15/18	10	70	50	262.8	4,550	52.44	94.84
	WEL-15-0021 (T03)	INW08F3_T1002	4/9/18-10/15/18	9	55.56	33.33	235.03	>2,419.6	46.82	>90.29
Sugar Creek	WEL-15-0010 (T07) [Hoffman Run (DS)]	INW08F4_01	4/9/18-10/15/18	10	30	20	75.46	>2,419.6	0	90.29
	WEL-15-0018 (T08)	INW08F4_T1004	4/9/18-10/15/18	9	77.78	66.67	320.16	>2,419.6	60.96	>90.29
	WEL-15-0022 (T09)	INW08F4_T1006	4/9/18-10/15/18	10	60	40	233.28	>2,419.6	>46.42	>90.29
	WEL-15-0009 (T10)	INW08F4_T1003	4/9/18-10/15/18	9	88.89	44.44	446.89	12,110	72.03	98.06
Dogwood Lake	WEL-15-0019 (T13)	INW08F5_02	ND	ND	ND	ND	ND	ND	ND	ND
Birch Creek	WEL-15-0013 (T11)	INW08F6_T1006	4/10/18-10/16/18	9	88.89	88.89	767.69	2,419.6	83.72	90.29
	WEL-15-0014 (T12)	INW08F6_T1003	4/10/18-10/16/18	10	80	30	279.24	>2,419.6	>55.24	>90.29
Aikman Creek	WEL170-0008 (T16)	INW08F7_04	4/10/18-10/16/18	10	60	60	360.95	5,910	65.37	96.02
Bear Creek	WEL-15-0015 (T14)	INW08F8_T1008	4/10/18-10/16/18	10	100	80	461.91	>2,419.6	>72.94	>90.29
	WEL-15-0016 (T15)	INW08F8_T1010	4/10/18-10/16/18	10	90	80	698.56	5,200	82.11	95.48
Mud Creek	WEL-15-0020 (T18)	INW08F9_03	4/10/18-10/16/18	10	30	20	115.82	>2,419.6	0	>90.29
	WEL-15-0017 (T17)	INW08F9_T1001	5/22/18-10/16/18	9	88.89	44.44	258.09	3,230	51.57	92.72

ND = No Data; SSM= Single Sample Maximum

Understanding Table 6: Pathogen data for the Lower East Fork White River Watershed indicated the following:

- Reductions of 99 percent or greater are needed to meet the TMDL target values for *E. coli* in Mill Creek.
- Reductions of 98 percent or greater are needed to meet the TMDL target values for *E. coli* in Slate Creek.
- Reductions of 98 percent or greater are needed to meet the TMDL target values for *E. coli* in Sugar Creek.
- Reductions of 90 percent or greater are needed to meet the TMDL target values for *E. coli* in Birch Creek.
- Reductions of 96 percent or greater are needed to meet the TMDL target values for *E. coli* in Aikman Creek.
- Reductions of 95 percent or greater are needed to meet the TMDL target values for *E. coli* in Bear Creek.
- Reductions of 92 percent or greater are needed to meet the TMDL target values for *E. coli* in Mud Creek.

E. coli Concentrations in the Lower East Fork White River Watershed

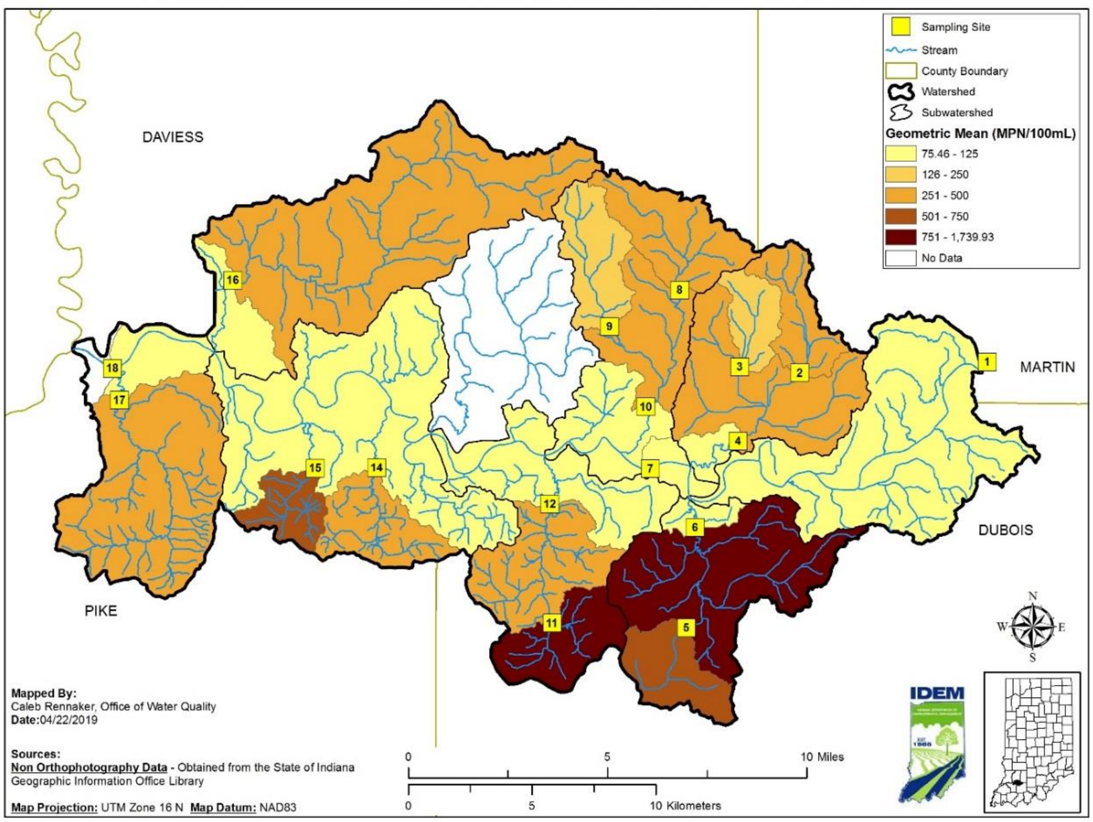

Figure 6: *E. coli* concentrations based on 5-week geometric mean (MPN/100mL) and sampling site drainage areas for 2017-2018. Values over 125 MPN/100mL are not meeting the current WQS for *E. coli*.

1.4.3 Water Chemistry Data

Table 7: Summary of Chemistry Data in Lower East Fork White River Watershed for Nutrients, Total Suspended Solids, and Dissolved Oxygen

Subwatershed	Sampling Station (Station ID)	AUID	Total Phosphorus Single Sample Maximum (mg/L)	Total Phosphorus % Reduction	Total Suspended Solids Single Sample Maximum (mg/L)	Total Suspended Solids % Reduction	Dissolved Oxygen Single Sample Minimum (mg/L)	Dissolved Oxygen % Below WQS
Mill Creek	WEL-15-0011 (T05)	INW08F1_01	0.19	NA	67	55.22%	6.17	NA
	WEL-15-0012 (T06)	INW08F1_03	0.66	54.55%	1,100	97.27%	5.0	NA
Hoffman Run (Upstream)	WEL-14-0003 (T01)	INW08E7_01	0.27	NA	160	81.25%	5.37	NA
Slate Creek	WEL-15-0008 (T02)	INW08F3_02	0.95	68.42%	430	93.02%	6.04	NA
	WEL-15-0007 (T04)	INW08F3_03	0.97	69.07%	2,200	98.64%	3.34	19.76%
	WEL-15-0021 (T03)	INW08F3_T1002	0.33	9.10%	170	82.35%	5.71	NA
Sugar Creek	WEL-15-0010 (T07) [Hoffman Run (DS)]	INW08F4_01	0.33	9.10%	550	94.55%	5.84	NA
	WEL-15-0018 (T08)	INW08F4_T1004	0.46	34.78%	480	93.75%	4.65	NA
	WEL-15-0022 (T09)	INW08F4_T1006	0.081	NA	310	90.32%	5.18	NA
	WEL-15-0009 (T10)	INW08F4_T1003	0.76	60.52%	2,100	98.57%	7.03	NA
Dogwood Lake	NA	NA	NA	NA	NA	NA	NA	NA
Birch Creek	WEL-15-0013 (T11)	INW08F6_T1006	0.4	25%	140	78.57%	6.28	NA
	WEL-15-0014 (T12)	INW08F6_T1003	1.0	70%	1,300	97.69%	4.4	NA
Aikman Creek	WEL170-0008 (T16)	INW08F7_04	0.97	69.07%	2,200	98.64%	2.76	44.93%
Bear Creek	WEL-15-0015 (T14)	INW08F8_T1008	0.35	14.29%	280	89.29%	5.27	NA
	WEL-15-0016 (T15)	INW08F8_T1010	0.22	NA	280	89.29%	4.52	NA

Subwatershed	Sampling Station (Station ID)	AUID	Total Phosphorus Single Sample Maximum (mg/L)	Total Phosphorus % Reduction	Total Suspended Solids Single Sample Maximum (mg/L)	Total Suspended Solids % Reduction	Dissolved Oxygen Single Sample Minimum (mg/L)	Dissolved Oxygen % Below WQS
Mud Creek	WEL-15-0020 (T18)	INW08F9_03	0.31	3.23%	260	88.46%	5.85	NA
	WEL-15-0017 (T17)	INW08F9_T1001	0.98	69.39%	2,400	98.75%	6.15	NA

Understanding Table 7: Water chemistry data for the Lower East Fork White River Watershed indicated the following

- Reductions of 69 percent or greater are needed to meet the TMDL target values for total phosphorus in Slate Creek.
- Reductions of 69 percent or greater are needed to meet the TMDL target values for total phosphorus in Aikman Creek.
- Reductions of 81 percent or greater are needed to meet the TMDL target values for TSS upstream of Hoffman Run.
- Reductions of 98 percent or greater are needed to meet the TMDL target values for TSS in Slate Creek.
- Reductions of 98 percent or greater are needed to meet the TMDL target values for TSS in Sugar Creek.
- Reductions of 97 percent or greater are needed to meet the TMDL target values for TSS in Birch Creek.
- Reductions of 98 percent or greater are needed to meet the TMDL target values for TSS in Aikman Creek.
- Reductions of 89 percent or greater are needed to meet the TMDL target values for TSS in Bear Creek.
- Reductions of 98 percent or greater are needed to meet the TMDL target values for TSS in Mud Creek.

Total Phosphorus Concentrations in the Lower East Fork White River Watershed

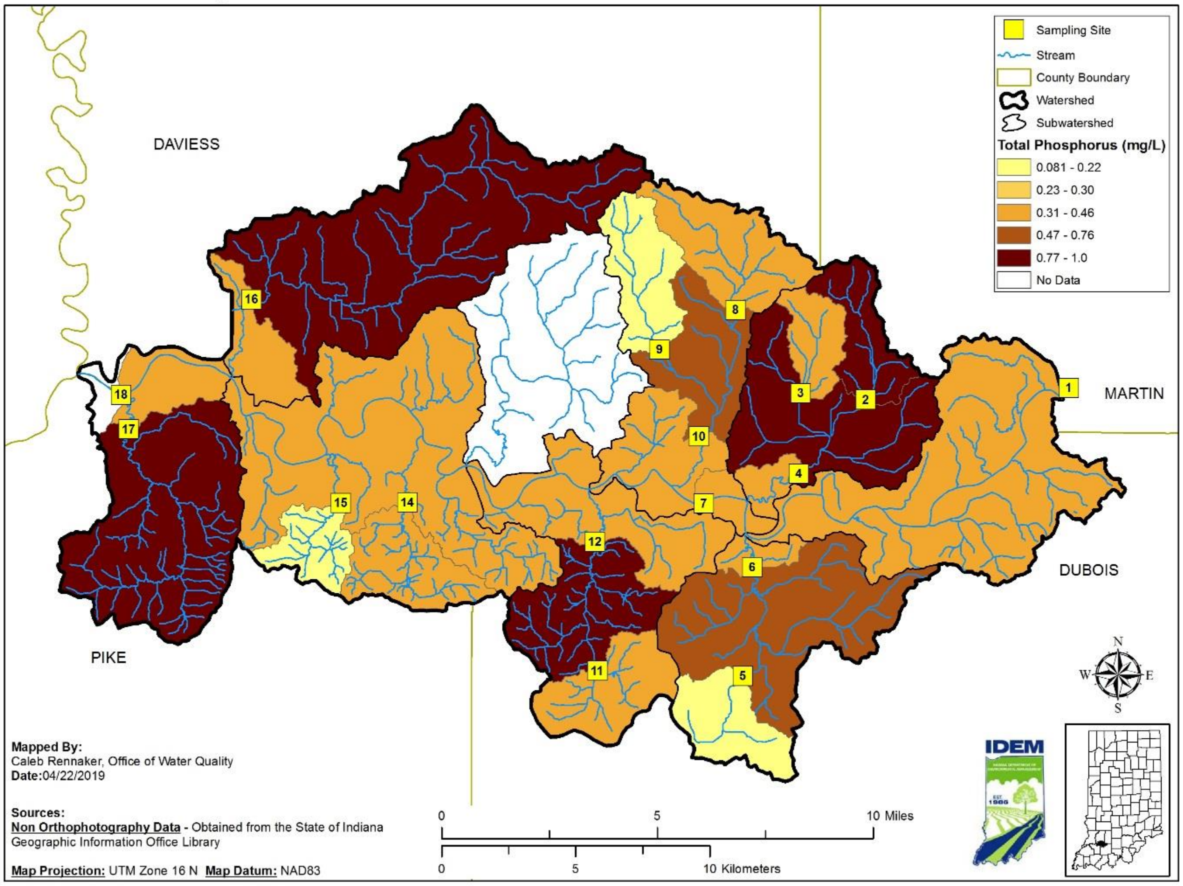

Figure 7: Total phosphorus concentrations based on single sample maximum concentration (mg/L) and sampling site drainage areas for 2017-2018. Values over 0.30 mg/L are not meeting the water quality target value for total phosphorus.

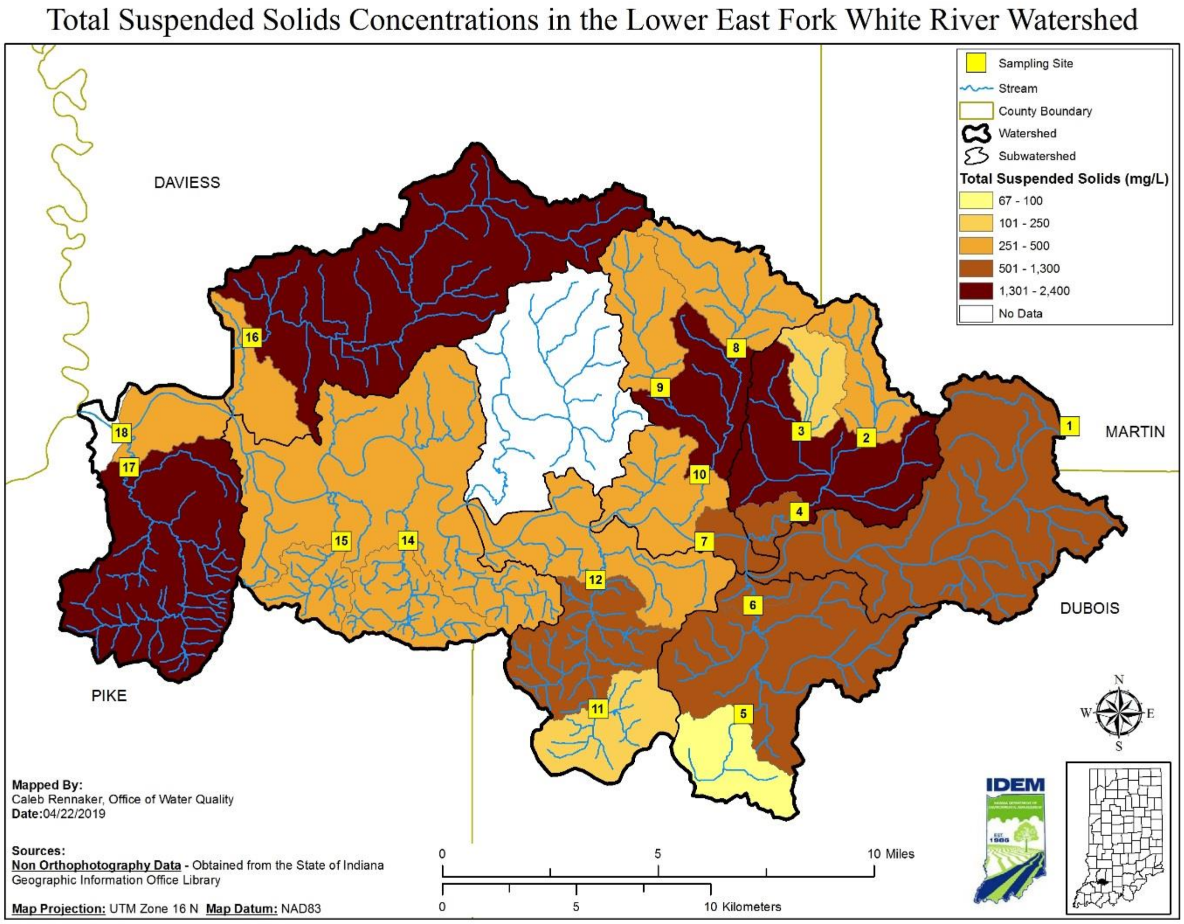

Figure 8: Total Suspended Solids concentrations based on single sample maximum concentration (mg/L) and sampling site drainage areas for 2017-2018. Values over 30 mg/L are not meeting the water quality target value for TSS.

1.4.4 Biological Data

Sampling performed by IDEM in July and August 2018 documented widespread biological impairments in the Lower East Fork White River Watershed as summarized in Table 8. Fish community sampling took place at 17 sample sites in the Lower East Fork White River Watershed. Sampling data indicate that the overall biological integrity of the Lower East Fork White River Watershed was fair. Sampling resulted in 11 of the 17 sites failing established criteria for aquatic life support for fish and/or macroinvertebrates.

Through the TMDL efforts, IDEM has identified several potential reasons for the widespread impairments:

- TSS can reduce plants available for consumption by inhibiting growth of submerged aquatic plants, lower dissolved oxygen levels by reducing light penetration which impairs algal growth, impair the ability of fish to see and catch food, increase stream temperature, clog fish gills which may decrease disease resistance, slow growth rates, and prevent the development of eggs and larvae.

- Total phosphorus can cause excessive plant production resulting in increased turbidity, decrease dissolved oxygen levels, and cause greater fluctuations in diurnal dissolved oxygen and pH levels resulting in lower stream diversity.

Attaining the TSS and total phosphorus target values shown in Table 3 will address the causes of IBC impairments.

Table 8: Impaired Biotic Community Stream Segments in the Lower East Fork White River Watershed Identified During July/August 2018 Sampling

SW	Sampling Site		Stream Name	Score	Integrity Class	QHEI	Score	Integrity Class	QHEI
	Site #	Station ID		mIBI	mIBI	mIBI	IBI	IBI	IBI
Mill Creek	T05	WEL-15-0011	Mill Creek	38	Fair	43	44	Fair	46
	T06	WEL-15-0012	Mill Creek	38	Fair	52	46	Good	60
Hoffman Run US	T01	WEL-14-0003	East Fork White River	26	Poor	51	16	Very Poor	60
Slate Creek	T02	WEL-15-0008	Slate Creek	30	Poor	39	40	Fair	52
	T04	WEL-15-0007	Slate Creek	38	Fair	48	34	Poor	48
	T03	WEL-15-0021	Tributary of Slate Creek	38	Fair	38	30	Poor	26
Sugar Creek	T07	WEL-15-0010	East Fork White River	32	Poor	46	38	Fair	61
	T08	WEL-15-0018	Sugar Creek	34	Poor	56	34	Poor	57
	T09	WEL-15-0022	West Fork Sugar Creek	38	Fair	44	46	Good	47
	T10	WEL-15-0009	Sugar Creek	38	Fair	63	42	Fair	51
Birch Creek	T11	WEL-15-0013	Birch Creek	32	Poor	41	40	Fair	32
	T12	WEL-15-0014	Birch Creek	38	Fair	62	44	Fair	54
Aikman Creek	T16	WEL170-0008	Aikman Creek	40	Fair	44	28	Poor	41
Bear Creek	T14	WEL-15-0015	Bear Creek	32	Poor	50	36	Fair	55
	T15	WEL-15-0016	Beech Creek	34	Poor	41	44	Fair	52
Mud Creek	T18	WEL-15-0020	East Fork White River	30	Poor	54	16	Very Poor	54
	T17	WEL-15-0017	Mud Creek	40	Fair	51	38	Fair	52

Notes: SW = Subwatershed, IBI = Index of Biotic Integrity for fish community, mIBI = Index of Biotic Integrity for macroinvertebrate community, QHEI = Qualitative Habitat Evaluation Index. Scores were calculated using IDEM's *Summary of Protocols: Probability Based Site Assessment*. (IDEM, 2005). Values in red indicate scores which are not supportive of a healthy aquatic community.

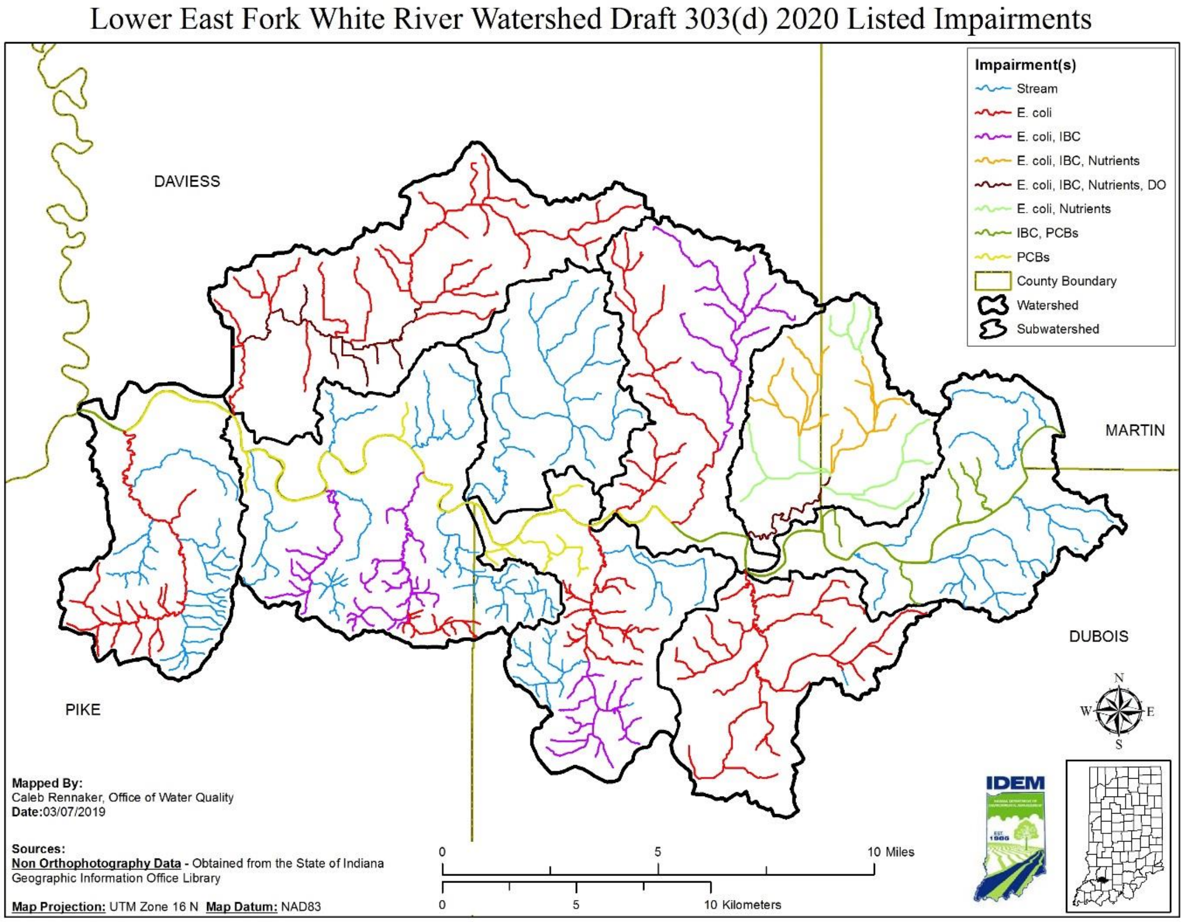

Figure 9: Streams to be listed on the Draft 2020 Section 303(d) List in the Lower East Fork White River Watershed

2.0 DESCRIPTION OF THE WATERSHED AND SOURCE ASSESSMENT

This section of the TMDL report contains a brief characterization of the Lower East Fork White River Watershed to provide a better understanding of the historic and current conditions of the watershed that affect water quality and contribute to the impairments. Understanding the natural and human factors affecting the watershed will assist in selecting and tailoring appropriate and feasible implementation activities to achieve water quality standards.

As discussed in Section 1.3.1, the Lower East Fork White River watershed contains nine 12-digit HUC subwatersheds. Examining subwatersheds enables a closer examination of key factors that affect water quality. The subwatersheds include:

- Mill Creek (051202081501)
- Hoffman Run (051202081502)
- Slate Creek (051202081503)
- Sugar Creek (051202081504)
- Dogwood Lake (051202081505)
- Birch Creek (051202081506)
- Aikman Creek (051202081507)
- Bear Creek (051202081508)
- Mud Creek (051202081509)

The following table contains the names of the nine subwatersheds of the Lower East Fork White River watershed and their associated drainage area.

Table 9: Lower East Fork White River Subwatershed Drainage Areas

Name of Subwatershed	12-digit HUC	Area Within Watershed (sq. miles)	Percent of Watershed Area	Drainage Area (sq miles)	Percent of Total Drainage Area
Mill Creek	051202081501	19.57	9.43%	19.57	0.34%
Hoffman Run	051202081502	22.42	10.81%	5,556.86	96.78%
Slate Creek	051202081503	18.73	9.03%	18.73	0.33%
Sugar Creek	051202081504	24.13	11.63%	5,619.3	87.87%
Dogwood Lake	051202081505	16.75	8.08%	16.75	0.29%
Birch Creek	051202081506	21.84	10.53%	5,641.14	98.25%
Aikman Creek	051202081507	30.41	14.66%	30.41	0.53%
Bear Creek	051202081508	32.57	15.70%	5,690.47	99.11%
Mud Creek	051202081509	21.0	10.12%	5,741.76	100.0%

Understanding Table 9: Land area helps IDEM to define the pollutant load reductions needed for each AU in each 12-digit HUC subwatershed that comprises the Lower East Fork White River watershed. Information in each column is as follows:

- *Column 1: Name of Subwatershed.* Lists the name of the subwatersheds.
- *Column 2: 12-digit HUC.* Identifies the subwatershed's 12-digit HUC.
- *Column 3: Area Within Watershed*. Provides the area of each subwatershed within the overall watershed in square miles.
- *Column 4: Percent of Watershed Area.* Indicates the percent of land area of each subwatershed, providing a relative understanding of the portions of each subwatershed compared to the overall Lower East Fork White River watershed.
- *Column 5: Drainage Area.* Quantifies the area the specific subwatershed drains in square miles.
- *Column 6: Percent of Total Drainage Area.* Indicates the percent of the total drainage area, providing a relative understanding of the portion of the subwatershed in the overall Lower East Fork White River watershed.

IDEM bases load calculations on the drainage area for each of the 12-digit HUC subwatersheds. The information contained in this table is the foundation for the technical calculations found in Sections 3.0 and 4.0 of this report. This table will help watershed stakeholders look at the smaller subwatersheds within the Lower East Fork White River watershed and understand the smaller areas contributing to the impaired waterbody, helping to quantify the geographic scale that influences source characterization and areas for implementation.

The term "point source" refers to any discernible, confined and discrete conveyance, such as a pipe, ditch, channel, tunnel, or conduit, by which pollutants are transported to a waterbody. It also includes vessels or other floating craft from which pollutants are or may be discharged. By law, the term "point source" also includes: confined feeding operations (which are places where animals are confined and fed); and illicitly connected "straight pipe" discharges of household waste. Permitted point sources are regulated through the National Pollutant Discharge Elimination System (NPDES).

Nonpoint sources include all other categories not classified as point sources. In urban areas, nonpoint sources can include leaking or faulty septic systems, run-off from lawn fertilizer applications, pet waste, and other sources. In rural areas, nonpoint sources can include run-off from cropland, pastures and animal feeding operations, and inputs from streambank erosion, leaking, failing or straight-piped septic systems, and wildlife.

2.1 Land Use

Land use patterns provide important clues to the potential sources of impairments in a watershed. Land use information for the Lower East Fork White River watershed is available from the National Agricultural Statistics Service (NASS) cropland data layer. These data categorize the land use for each 30 meters by 30 meters parcel of land in the watershed based on satellite imagery from circa 2017. Figure 7 displays the spatial distribution of the land uses and the data are summarized in Table 10. Additionally, Table 11 displays the breakdown of land uses within each of the nine subwatersheds.

Land use in the Lower East Fork White River watershed is primarily agriculture, comprising 48 percent of the Lower East Fork White River watershed. Corn and soybean crops are not typically associated with high *E. coli* loads, unless they have been fertilized with manure. Approximately 29 percent of the land is forest. Pasture/hay represents 14 percent of the watershed and could indicate the presence of animal feedlots which can be significant sources of *E. coli*, TSS, and/or nutrients. The remaining land categories represent less than 10 percent of the total land area.

The Lower East Fork White River watershed has a diverse network of streams. Tributaries include Sugar Creek, Bear Creek, Mud Creek, Hoffman Run, Aikman Creek, Birch Creek, Slate Creek, and Mill Creek among others. The watershed is unique in being influenced heavily by being the lowest drainage point for the East Fork White River. Forested areas are more pronounced in the eastern portions of the watershed surrounding Hoffman Run and also around Dogwood Lake. Urban areas are limited primarily to the northern portions of the city of Jasper, IN near the headwaters of Mill Creek. Waters drain to the East Fork White River and flow west where they eventually leave the Lower East Fork White River Watershed and flow into the White River. Many threatened and endangered species call this watershed home. Various species of darters such as Western Sand Darter (Ammocrypta clara) and Tippecanoe Darter (Etheostoma tippecanoe) can be found in the watershed and surrounding counties and are dependent upon the health of the aquatic system. Additional information on state endangered, threatened and rare species can be found on the DNR website (http://www.in.gov/dnr/naturepreserve/4666.htm).

Table 10: Land Use of the Lower East Fork White River Watershed

Land Use	Watershed		
	Area		Percent
	Acres	Square Miles	
Agricultural Land	66,552.33	103.99	50.16
Developed Land	7,828.30	12.23	5.90
Forested Land	41,671.90	65.11	31.41
Hay/Pasture	13,148.87	20.55	9.91
Open Water	3,236.07	5.06	2.44
Shrub/Scrub	15.12	0.02	0.01
Wetlands	226.40	0.35	0.17
TOTAL	**132,679**	**207.31**	**100%**

Understanding Table 10: The predominant land use types in the Lower East Fork White River watershed can indicate potential sources of *E. coli*, TSS, and nutrient loadings. Different types of land uses are characterized by different types of hydrology. For example, developed lands are characterized by impervious surfaces that increase the potential of stormwater events during high flow periods delivering *E. coli*, TSS, and nutrients to downstream streams and rivers. Forested land and wetlands allow water to infiltrate slowly thus reducing the risks of polluted water running off into waterbodies. In addition to differences in hydrology, land use types are associated with different types of activities that could contribute pollutants to the watershed. Understanding types of land uses will help identify the type of implementation approaches that watershed stakeholders can use to achieve *E. coli*, TSS, and nutrient load reductions.

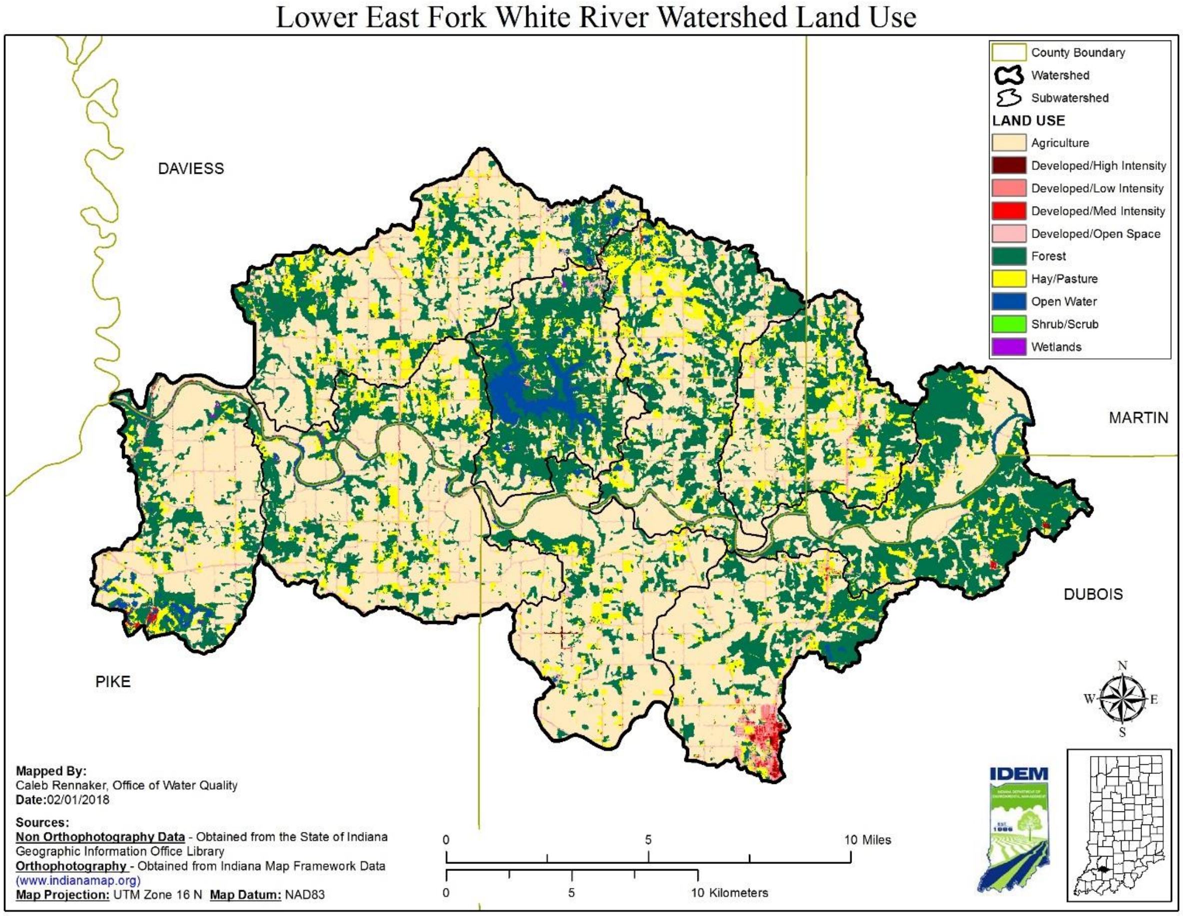

Figure 10: Land use in the Lower East Fork White River Watershed

Table 11: Land Use in the Lower East Fork White River Subwatersheds

Subwatershed	Area	Land Use							Total
		Agriculture	Developed	Forest	Hay/ Pasture	Open Water	Shrub/ Scrub	Wetlands	
Mill Creek (051202081501)	Acres	6,669	1,458	3,401	946	47	1	2	12,523
	Sq. Mi.	10.42	2.28	5.31	1.48	0.07	0.00	0.00	19.57
	Percent	53%	12%	27%	8%	0%	0%	0%	100%
Hoffman Run (051202081502)	Acres	4,988	435	7,535	1,076	308	<1	12	14,354
	Sq. Mi.	7.79	0.68	11.77	1.68	0.48	0.00	0.02	22.43
	Percent	35%	3%	52%	7%	2%	0%	0%	100%
Slate Creek (051202081503)	Acres	5,227	746	4,047	1,935	30	0	2	11,987
	Sq. Mi.	8.17	1.17	6.32	3.02	0.05	0.00	0.00	18.73
	Percent	44%	6%	34%	16%	0%	0%	0%	100%
Sugar Creek (051202081504)	Acres	6,719	732	5,377	2,227	368	4	24	15,450
	Sq. Mi.	10.50	1.14	8.40	3.48	0.57	0.01	0.04	24.14
	Percent	43%	5%	35%	14%	2%	0%	0%	100%
Dogwood Lake (051202081505)	Acres	2,534	542	5,465	885	1,258	<1	34	10,719
	Sq. Mi.	3.96	0.85	8.54	1.38	1.97	0.00	0.05	16.75
	Percent	24%	5%	51%	8%	12%	0%	0%	100%
Birch Creek (051202081506)	Acres	9,632	752	2,334	1,039	211	2	9	13,980
	Sq. Mi.	15.05	1.18	3.65	1.62	0.33	0.00	0.01	21.84
	Percent	69%	5%	17%	7%	2%	0%	0%	100%
Aikman Creek (051202081507)	Acres	10,598	1,175	5,393	2,122	159	1	16	19,464
	Sq. Mi.	16.56	1.84	8.43	3.32	0.25	0.00	0.02	30.41
	Percent	54%	6%	28%	11%	1%	0%	0%	100%
Bear Creek (051202081508)	Acres	12,390	1,179	4,829	1,983	393	4	62	20,840
	Sq. Mi.	19.36	1.84	7.55	3.10	0.61	0.01	0.10	32.56
	Percent	59%	6%	23%	10%	2%	0%	0%	100%
Mud Creek (051202081509)	Acres	7,797	809	3,291	936	463	3	67	13,366
	Sq. Mi.	12.18	1.26	5.14	1.46	0.72	0.00	0.10	20.88
	Percent	58%	6%	25%	7%	3%	0%	1%	100%

2.1.1 Cropland

Croplands can be a source of *E. coli*, sediments, and nutrients. Accumulation of nutrients and *E. coli* on cropland occurs from decomposition of residual crop material, fertilization with chemical (e.g., anhydrous ammonia) fertilizers, manure fertilizers, inorganic fertilizers, wildlife excreta, irrigation water, and application of waste products from municipal and industrial wastewater treatment facilities. The majority of nutrient loading from cropland occurs from fertilization with commercial and manure fertilizers (U.S. EPA, 2003). Use of manure for nitrogen supplementation often results in excessive phosphorus loads relative to crop requirements (U.S. EPA, 2003).

Data available from the National Agricultural Statistic Service (NASS) were downloaded to estimate crop acreage in the subwatersheds. The 2017 NASS statistics were used in the analysis as shown in Table 12 and displayed in Figure 11.

Table 12: Major Cash Crop Acreage in the Lower East Fork White River Watershed

Subwatershed	Crop	Total Acreage	% of Subwatershed Cash Crop Acreage
Mill Creek (051202081501)	Corn	3,098	50%
	Soybean	3,103	50%
	Winter Wheat	7	0%
	Total	6,208	100%
Hoffman Run (051202081502)	Corn	2,682	54%
	Soybean	2,259	46%
	Winter Wheat	3	0%
	Total	4,944	100%
Slate Creek (051202081503)	Corn	2,957	60%
	Soybean	1,950	40%
	Winter Wheat	<1	0%
	Total	4,907	100%
Sugar Creek (051202081504)	Corn	3,035	47%
	Soybean	3,420	53%
	Winter Wheat	7	0%
	Total	6,463	100%
Dogwood Lake (051202081505)	Corn	1,147	48%
	Soybean	1,235	52%
	Winter Wheat	1	0%
	Total	2,383	100%
Birch Creek (051202081506)	Corn	5,111	55%
	Soybean	4,196	45%
	Winter Wheat	9	0%
	Total	9,315	100%
Aikman Creek (051202081507)	Corn	4,648	47%
	Soybean	5,207	53%
	Winter Wheat	2	0%
	Total	9,857	100%
Bear Creek (051202081508)	Corn	5,190	43%
	Soybean	7,014	57%
	Winter Wheat	3	0%
	Total	12,206	100%
Mud Creek (051202081509)	Corn	4,331	56%
	Soybean	3,456	44%
	Winter Wheat	5	0%
	Total	7,793	100%

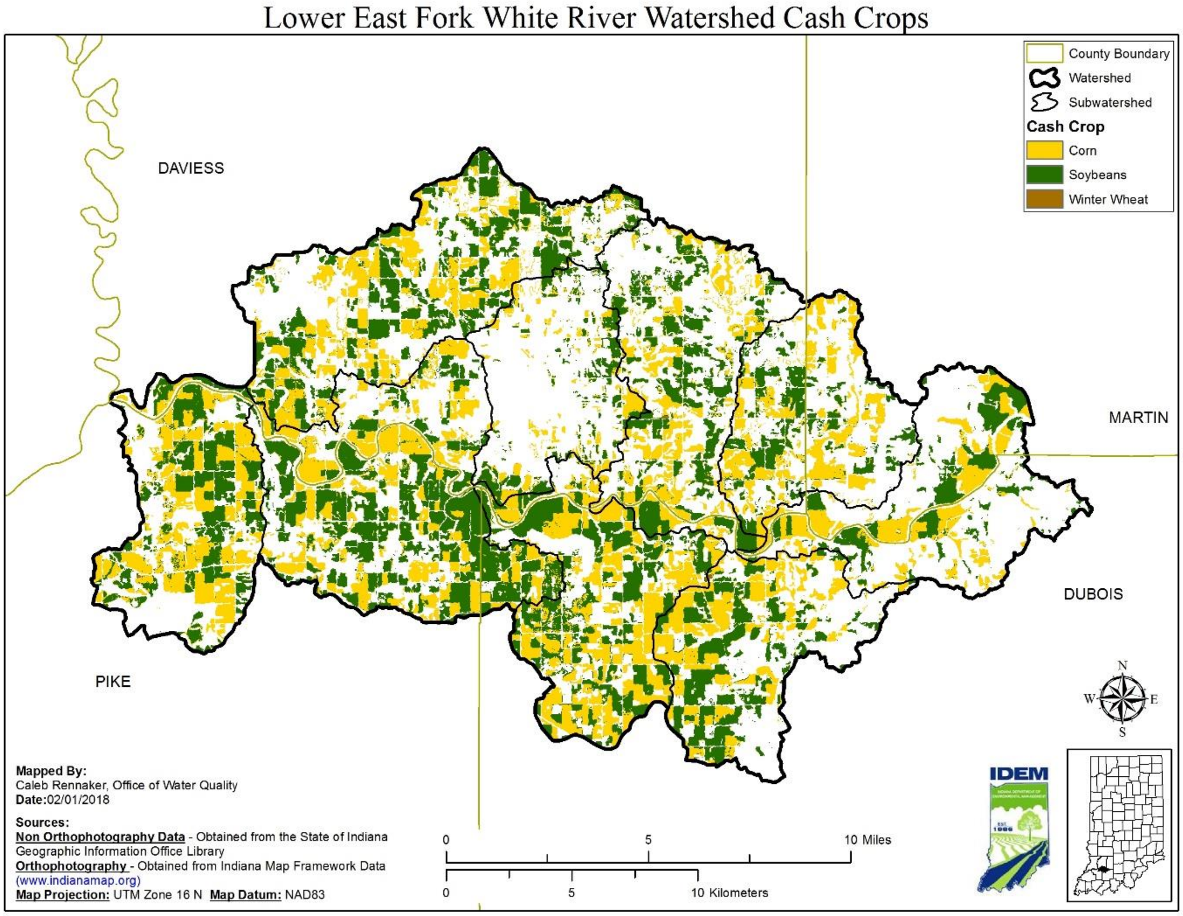

Figure 11: Cash Crop Acreage in the Lower East Fork White River Subwatersheds

2.1.2 Hay/Pastureland

Run-off from pastures and livestock operations can be potential agricultural sources of *E. coli*, nutrients, and TSS. For example, animals grazing in pasturelands deposit manure directly upon the land surface and, even though a pasture may be relatively large and animal densities low, the manure will often be concentrated near the feeding and watering areas in the field. These areas can quickly become barren of plant cover, increasing the possibility of erosion and contaminated run-off during a storm event.

Livestock are potential source of *E. coli*, nutrients, and TSS to streams, particularly when direct access is unrestricted and/or where feeding structures are located adjacent to riparian areas. Watershed specific data are not available for livestock populations. The amount of hay/pasture land across the landscape can be used to as an indicator for potential areas of higher densities from livestock. Information on permitted livestock facilities within the Lower East Fork White River watershed are presented in Figure 12: Grassland and Pastureland in the Lower East Fork White River Watershed with CFO locations in Lower East Fork White River and Table 13.

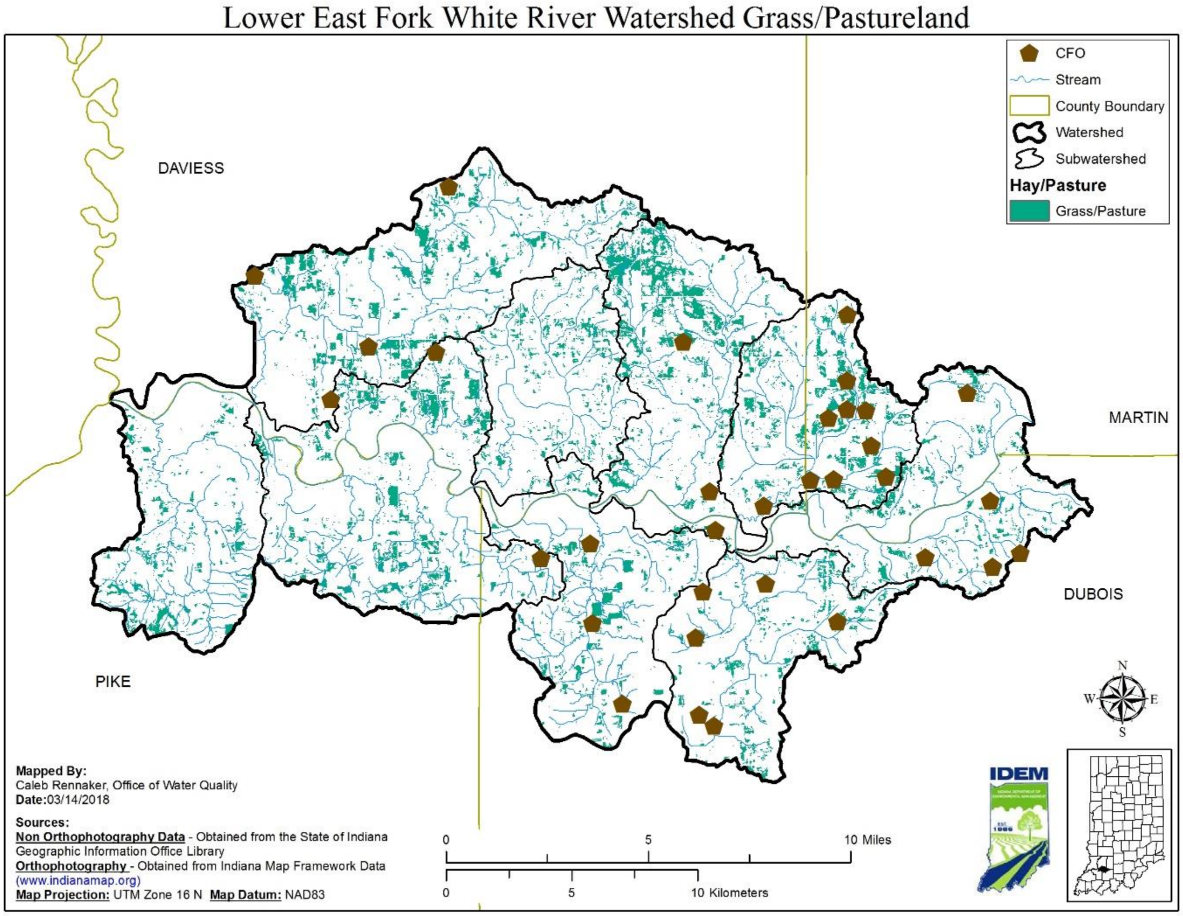

Figure 12: Grassland and Pastureland in the Lower East Fork White River Watershed with CFO locations in Lower East Fork White River

2.1.3 Confined Feeding Operations (CFOs) and Animal Feeding Operations (AFOs)

A CFO is an agricultural operation where animals are kept and raised in confined situations. It is a lot or facility (other than an aquatic animal production facility) where the following conditions are met:

- Animals have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period
- Crops, vegetation, forage growth, or post-harvest residues are not sustained in the normal growing season over 50 percent of the lot or facility.
- The number of animals present meets the requirements for the state permitting action.

Confined feeding operations that are not classified as concentrated animal feeding operations (CAFOs) are known as confined feeding operations (CFOs) in Indiana. Non-CAFO animal feeding operations identified as CFOs by IDEM are considered nonpoint sources by U.S. EPA. Indiana's CFOs have state issued permits and are therefore categorized as nonpoint sources for the purposes of this TMDL. CFO permits are “no discharge” permits. Therefore it is prohibited for these facilities to discharge to any water of the State.

The CFO regulations (327 IAC 19, 327 IAC 15-16) 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 19, which implement the statute regulating confined feeding operations, were effective on July 1, 2012. The rule at 327 IAC 15-16, which regulates CAFOs and incorporates by reference the federal NPDES CAFO regulations, became effective on July 1, 2012. It should be noted that there are currently zero facilities in Indiana that have an NPDES permit under 15-16.

The animals raised in CFOs 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. CFOs can also be a potential source of *E. coli* due to the following:

- Improper application of manure can contaminate surface or ground water.
- Manure over application or improper application can adversely impact soil productivity.

There are 33 CFOs in the Lower East Fork White River watershed as shown below in Table 13 and in Figure 12.

Table 13**:** CFOs in the Lower East Fork White River Watershed

Subwatershed	CFO Permit ID	Operation Name	County	Animal Type and Permitted number
Mill Creek	1245	T & J Hoffman Farm, LLC	Dubois	Nursery Pigs: 500 Finishers: 1,200
	3884	Mill Creek Farms	Dubois	Nursery Pigs: 500 Finishers: 1,000 Sows: 230 Beef Cattle: 230
	4542	Haysville Mill Farm Incorporated	Dubois	Turkeys: 45,250
	4923	Mike Haase	Dubois	Nursery Pigs: 280 Finishers: 374 Sows: 80
	6296	Weisheit Brothers Farm	Dubois	Nursery Pigs: 1.100 Finishers: 1,600

Subwatershed	CFO Permit ID	Operation Name	County	Animal Type and Permitted number
				Sows: 390 Beef Cattle: 50
	6535	Fuhrman Farms	Dubois	Turkeys: 47,400
Hoffman Run	880	Ronald D Divine	Martin	Finishers: 2,480
	2794	Deer Run	Dubois	Layers: 874,110
	3745	Wabash Valley Produce Incorporated Sky View Farm	Dubois	Pullets: 896,896
	3749	D C Poultry Incorporated	Dubois	Turkeys: 54,000
	6446	Farbest Farms Brooder 1	Dubois	Turkeys: 74,800
Slate Creek	3207	Josh & Kristi Ausbrooks	Martin	Finishers: 840
	3554	NSL Farms Incorporated	Martin	Finishers: 4,000
	3648	Matheis Poultry 1	Martin	Layers: 100,000
	3930	Lottes Farms Incorporated	Martin	Finishers: 4,400 Turkeys: 28,000
	4020	Slate Creek Farms	Daviess	Nursery Pigs: 2,600 Finishers: 1,100 Beef Cattle: 230
	4447	Matheis Poultry 2	Martin	Layers: 100,000
	4856	Zach Taylor	Martin	Finishers: 800
	6244	Kopps Turkey Sales Incorporated Caleb Ridge	Martin	Turkeys: 54,000
	6432	White River, LLC Eagle Farms	Martin	Finishers: 20,000
	6539	Farbest Farms Brooder Hub 2	Martin	Turkeys: 99,802

Subwatershed	CFO Permit ID	Operation Name	County	Animal Type and Permitted number
Sugar Creek	132	Mehne Farms Incorporated	Dubois	Finishers: 1,500 Beef Cattle: 500 Beef Calves: 200
	4071	Armes Boys	Daviess	Finishers: 1,200
	6832	For Him Farms	Daviess	Turkeys: 60,000
Birch Creek	2723	Schnarr Farms	Dubois	Nursery Pigs: 1,000 Finishers: 750
	3025	Edward G Barley	Dubois	Finishers: 1,400
	6221	Luther R Mann	Dubois	Nursery Pigs: 550 Finishers: 650 Sows: 250 Boars: 16
Aikman Creek	3961	Don Kendall 4 K Swine Incorporated Jones Farm	Daviess	Finishers: 900
	6534	Mitchell Barber	Daviess	Turkeys: 30,000
	6965	Heartland Turkey Farms, LLC	Daviess	Poults: 40,000
Bear Creek	608	Jay Armes Armes Grain & Livestock	Daviess	Nursery Pigs: 1,015 Finishers: 5,000
	3033	John F Jackle Jackle Farms Incorporated	Dubois	Nursery Pigs: 240 Finishers: 1,080
	4582	Aikman Creek, LLC	Daviess	Turkeys: 54,000

2.2 Topography and Geology

Topographic and geologic features of a watershed play a role in defining a watershed's drainage pattern. Figure 13 below displays the topography of the watershed. Information concerning the topography and geology within the Lower East Fork White River Watershed is available from the Indiana Geological and Water Survey (IGWS). The Lower East Fork White River Watershed originates in Martin County and travels west through Dubois, Daviess, and Pike Counties, eventually discharging into the White River. The Lower East Fork White River Watershed is located in the Southern Hills and Lowlands physiographic region which is characterized by knolls and ridges with gorges and ridges to the south. It is unique in Indiana by not having been covered by glacial till.

The entire bedrock surface of Indiana consists of sedimentary rocks. The major kinds of sedimentary rock in Indiana include limestone, dolomite, shale, sandstone, and siltstone. The northern two-thirds of Indiana are composed of glacial deposits containing ground water. These glacial aquifers exist where sand and gravel bodies are present within clay-rich glacial till (sediment deposited by ice) or in alluvial, coastal, and glacial outwash deposits. Ground water availability is much different in the southern unglaciated part of Indiana. There are few unconsolidated deposits above the bedrock surface, and the voids in bedrock (other than karst dissolution features) are seldom sufficiently interconnected to yield useful amounts of ground water. Reservoirs, such as Monroe Lake and Patoka Lake, are used for water supply in lieu of water wells in southern Indiana. The IGWS website contains information about the geology of Indiana (https://igws.indiana.edu/GroundWater).

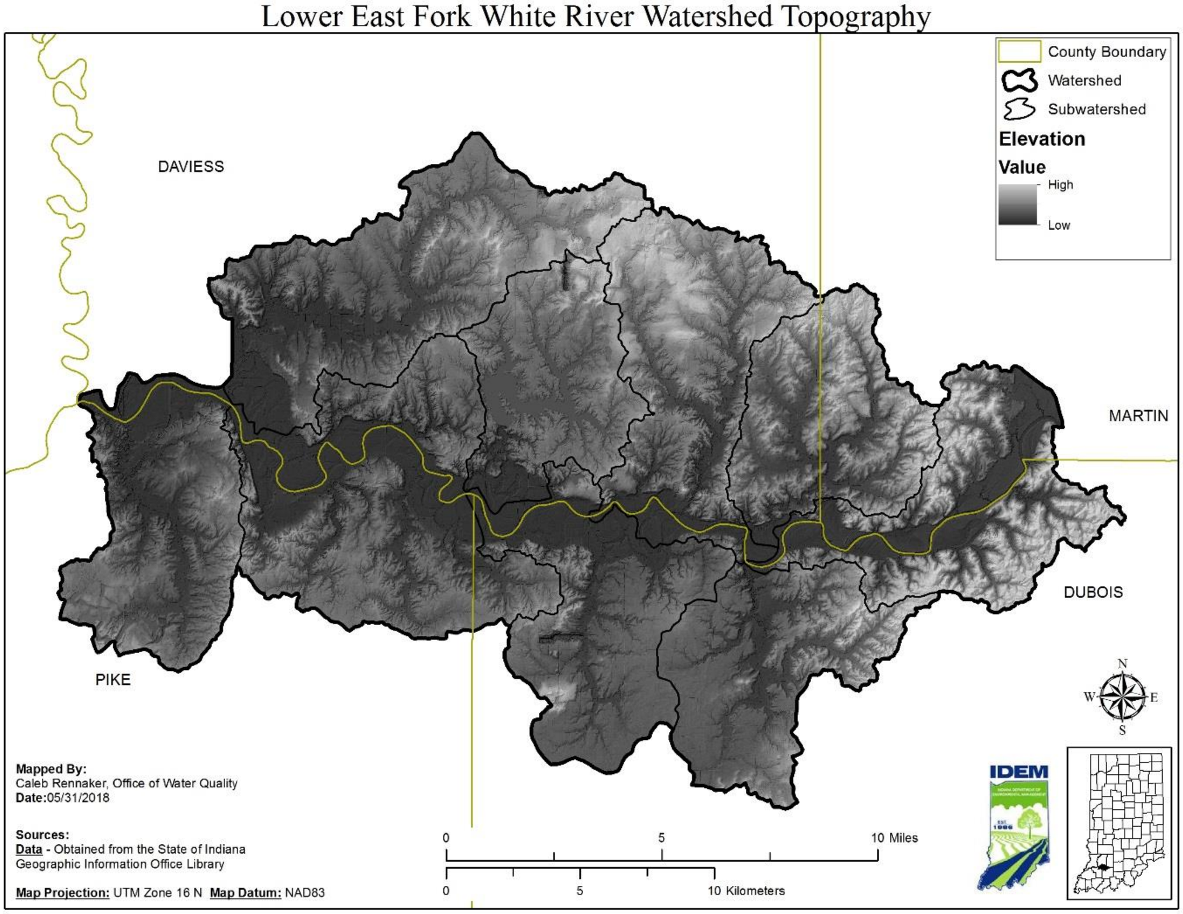

Figure 13: Topography of the Lower East Fork White River Watershed. Digital Elevation Data (DEM) was taken from the state of Indiana's Geographic Information Office (GIO).

2.2.1 Karst Geology

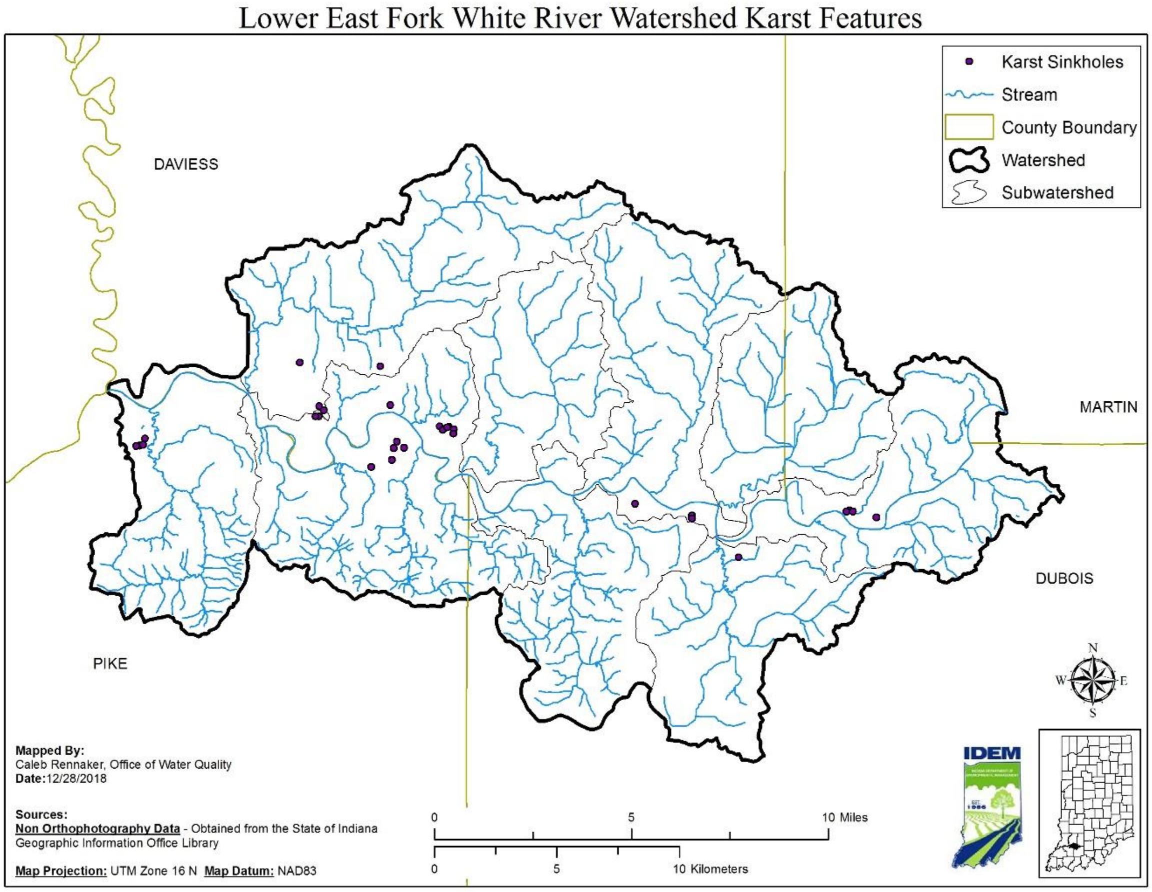

Figure 14: Karst Features in the Lower East Fork White River Watershed

Karst regions are characterized by the presence of limestone or other soluble rocks, where drainage has been largely diverted into subsurface routes. The topography of such areas is dominated by sinkholes, sinking streams, large springs, and caves. Many subsurface drainage networks in this area are fed by surface streams that sink into caves or swallow holes. Activities that impact the surface water quality can thus be expected to affect ground water as well. Due to the nature of conduit flow, impacts are likely to be ephemeral, and determination of exact directions of transport or affected conduits may be problematic in the absence of detailed dye-tracing studies. While the State of Indiana has performed dye-tracing studies in southern Indiana, none have been performed within the Lower East Fork White River Watershed (Atlas of hydrogeologic terrains and settings of Indiana, 1995). Figure 14, above, displays the location of the karst features of the watershed.

The Indiana Karst Conservancy is a 501(c)(3) non-profit organization dedicated to the preservation and conservation of Indiana's unique karst features. Unfortunately, many karst features are subject to incompatible or damaging uses. Most are on private land, occasionally with owners unware of their significance or apathetic to their preservation. The IKC provides protection and awareness of karst features and the unique habitat they provide. For more information regarding the IKC, visit their website at http://www.ikc.caves.org/.

2.3 Soils

There are different soil characteristics that can affect the health of the watershed. Some of these characteristics include soil drainage, septic tank suitability, soil saturation, and soil erodibility.

2.3.1 Soil Drainage

The hydrologic soil group classification is a means for categorizing soils by similar infiltration and run-off characteristics during periods of prolonged wetting. The NRCS has defined four hydrologic groups for soils, described in Table 14 (NRCS, 2001). Data for the Lower East Fork White River watershed were obtained from the USDA Soil Survey Geographic (SSURGO) database. Downloaded data were summarized based on the major hydrologic group in the surface layers of the map unit and are displayed below in Figure 15 and Table 15.

The majority of the watershed is covered by category D soils (59%) followed by category B soils (28%), category C soils (10%), and category A soils (3%). Category B soils are moderately deep and well drained, while Category C soils are finer and allow for slower infiltration. This means that regular flooding is likely not typical in much of this watershed, but could potentially occur on occasion and transport pollutants across the landscape.

Table 14: Hydrologic Soil Groups

Hydrologic Soils Group	Description
A	Soils with high infiltrations rates. Usually deep, well drained sands or gravels. Little run-off.
B	Soils with moderate infiltration rates. Usually moderately deep, moderately well drained soils.
C	Soils with slow infiltration rates. Soils with finer textures and slow water movement.
D	Soils with very slow infiltration rates. Soils with high clay content and poor drainage. High amounts of run-off.

Understanding Table 14: Typically, clay soils that are poorly drained have lower infiltration rates, while well-drained sandy soils have the greatest infiltration rates. Soil infiltration rates can affect pollutant loading within a watershed. During high flows, areas with low soil infiltration capacity can flood and therefore discharge high pollutant loads to nearby waterways. In contrast, soils with high infiltration rates can slow the movement of pollutants to streams.

Table 15: Hydrologic Soil Groups in the Lower East Fork White River Subwatersheds

	Hydrologic Soil Group			
Subwatershed	**A**	**B**	**C**	**D**
Mill Creek	**0.00%**	**25.08%**	**21.72%**	**53.21%**
Hoffman Run	**2.14%**	**40.19%**	**29.01%**	**28.67%**
Slate Creek	**1.48%**	**33.45%**	**0.90%**	**64.18%**
Sugar Creek	**1.52%**	**27.76%**	**10.62%**	**60.10%**
Dogwood Lake	**0.68%**	**15.50%**	**6.55%**	**77.26%**
Birch Creek	**0.08%**	**36.16%**	**16.84%**	**46.92%**
Aikman Creek	**0.41%**	**17.23%**	**1.95%**	**80.41%**
Bear Creek	**7.74%**	**34.34%**	**4.92%**	**53.00%**
Mud Creek	**7.97%**	**16.13%**	**2.68%**	**73.22%**

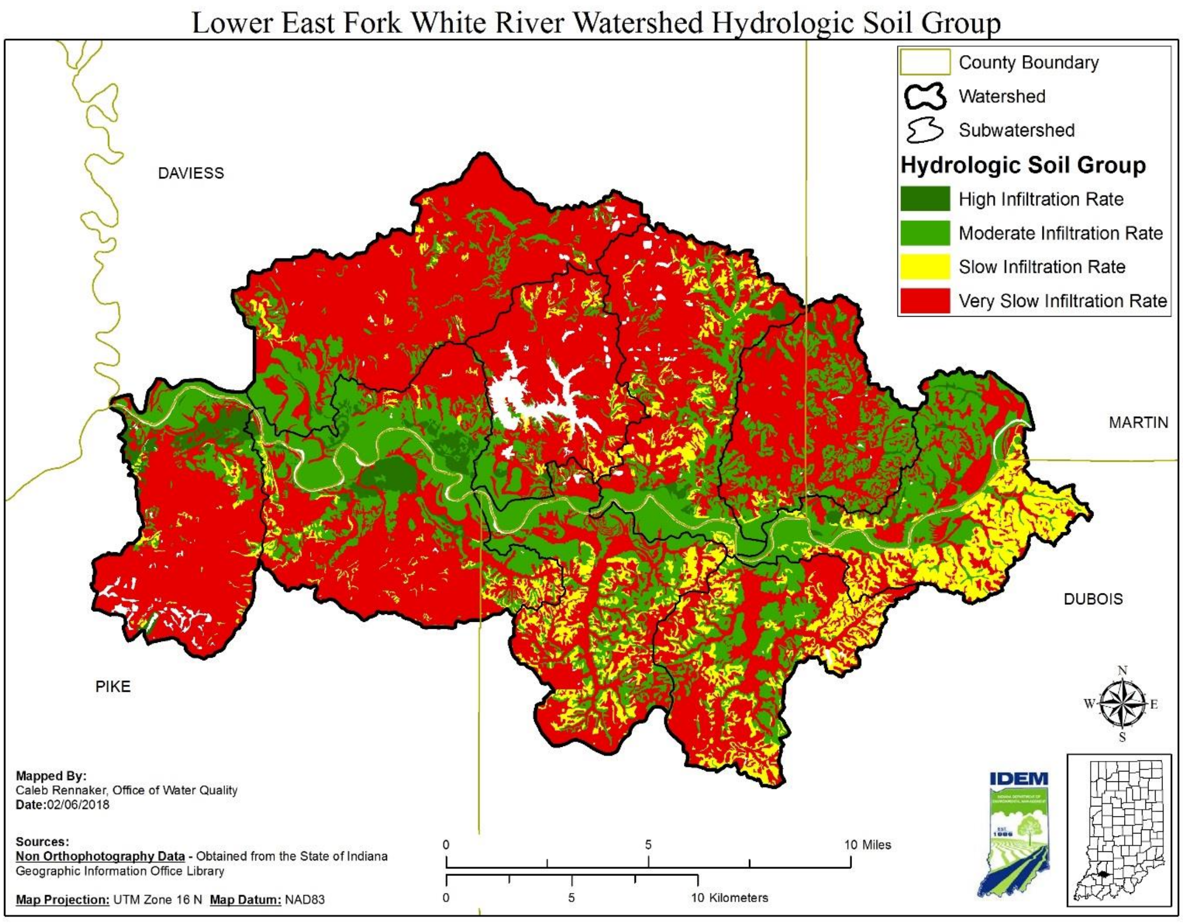

Figure 15: Hydrological Soil Groups in the Lower East Fork White River Watershed

2.3.2 Septic Tank Absorption Field Suitability

Septic systems require soil characteristics and geology that allow gradual seepage of wastewater into the surrounding soils. Seasonal high water tables, shallow compact till and coarse soils present limitations for septic systems. While system design can often overcome these limitations (i.e., perimeter drains, mound systems or pressure distribution), sometimes the soil characteristics prove to be unsuitable for any type of traditional septic system.

Heavy clay soils require larger (and therefore more expensive) absorption fields; while sandier, well-drained soils are often suitable for smaller, more affordable gravity-flow trench systems.

The septic system is considered failing when the system exhibits one or more of the following:

1. The system refuses to accept sewage at the rate of design application thereby interfering with the normal use of plumbing fixtures

2. Effluent discharge exceeds the absorptive capacity of the soil, resulting in ponding, seepage, or other discharge of the effluent to the ground surface or to surface waters

3. Effluent is discharged from the system causing contamination of a potable water supply, ground water, or surface water.

Figure 16 shows ratings that indicate the extent to which the soils are suitable for septic systems within the Lower East Fork White River Watershed. Only that part of the soil between depths of 24 and 60 inches is evaluated for septic system suitability. The ratings are based on the soil properties that affect absorption of the effluent, construction, maintenance of the system, and public health.

Soils labeled “very limited” indicate that the soil has at least one feature that is unfavorable for septic systems. Approximately 91 percent of the Lower East Fork White River watershed is considered “very limited” in terms of soil suitability for septic systems. These limitations generally cannot be overcome without major soil reclamation or expensive installation designs. Approximately less than 3 percent of the soils within the Lower East Fork White River watershed are “not rated,” meaning these soils have not been assigned a rating class because it is not industry standard to install a septic system in these geographic locations. Approximately 6 percent of the soils in the Lower East Fork White River watershed are designated “somewhat limited,” meaning that the soil type is suitable for septic systems.

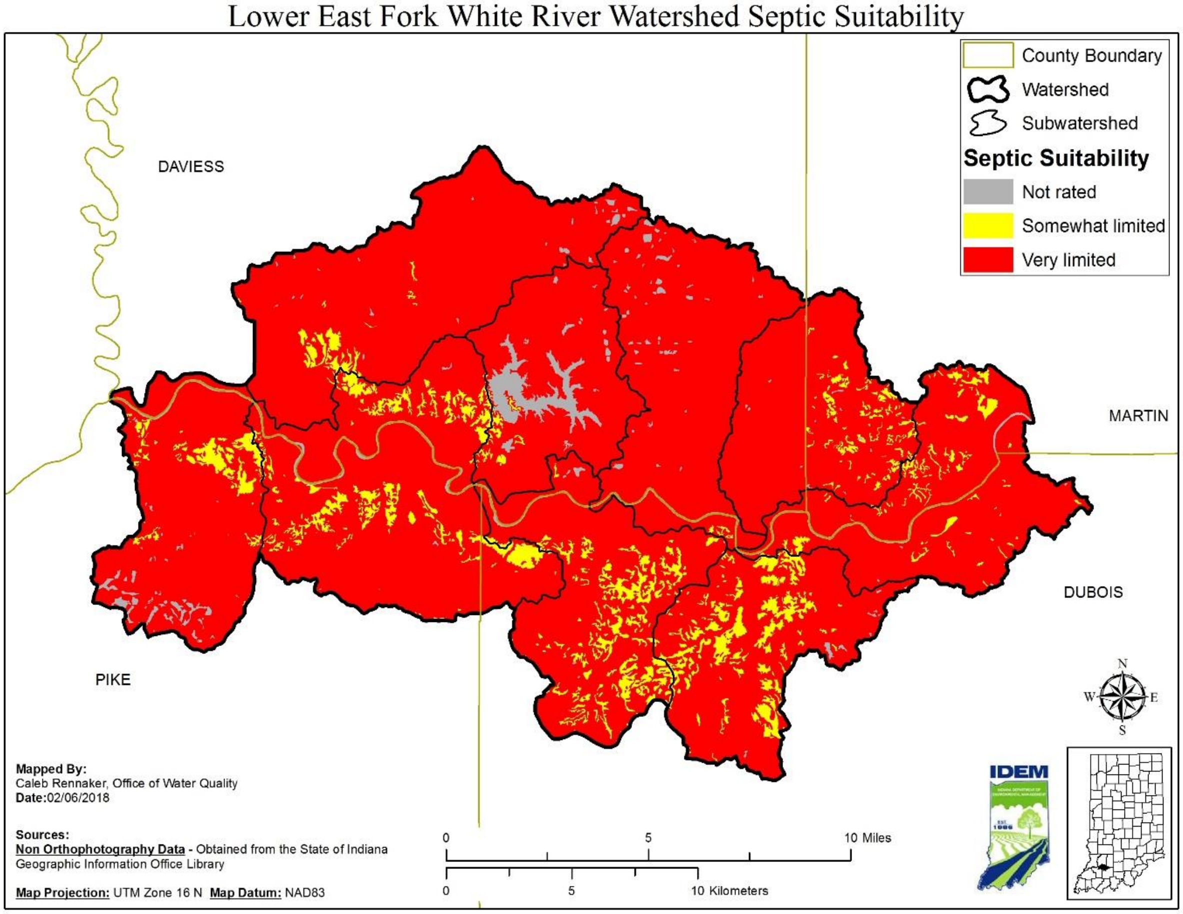

Figure 16: Suitability of Soils for Septic Systems in the Lower East Fork White River Watershed

Onsite Wastewater Treatment Systems

Onsite wastewater treatment systems (e.g., septic systems) that are properly designed and maintained should not serve as a source of contamination to surface waters. However, onsite systems do fail for a variety of reasons. Common soil-type limitations which contribute to failure are: seasonal water tables, compact glacial till, bedrock, coarse sand and gravel outwash and fragipan. When these septic systems fail hydraulically (surface breakouts) or hydrogeological (inadequate soil filtration) there can be adverse effects to surface waters due to *E. coli*, nitrate + nitrite, and total phosphorus (Horsely and Witten, 1996). Septic systems contain all the water discharged from homes and business and can be significant sources of pathogens and nutrients.

The Indiana State Department of Health (ISDH) regulates (410 IAC 6-8.3) through the local health departments the residential onsite sewage disposal program. Onsite sewage disposal systems (i.e., septic systems) are those, which do not result in an off-lot discharge of treated effluent, typically consisting of a septic tank to settle out and digest sewage solids, followed by a system of perforated piping to distribute the treated wastewater for absorption into the soil. More than 800,000 onsite sewage disposal systems are currently used in Indiana. Local health departments issue more than 15,000 permits per year for new systems, and about 6,000 permits for repairs.

410 IAC 6-8.3-52 General sewage disposal requirements

Sec. 52. (a) No person shall throw, run, drain, seep, or otherwise dispose into any of the surface waters or ground waters of this state, or cause, permit, or suffer to be thrown, run, drained, allowed to seep, or otherwise disposed into such waters, any organic or inorganic matter from a dwelling or residential onsite sewage system that would cause or contribute to a health hazard or water pollution. (b) The: (1) design; (2) construction; (3) installation; (4) location; (5) maintenance; and (6) operation; of residential onsite sewage systems shall comply with the provisions of this rule.

410 IAC 6-8.3-55 Violations; permit denial and revocation

Sec. 55. (a) Should a residential onsite sewage system fail, the failure shall be corrected by the owner within the time limit set by the health officer. (b) If any component of a residential onsite sewage system is found to be: (1) defective; (2) malfunctioning; or (3) in need of service; the health officer may require the repair, replacement, or service of that component. The repair, replacement, or service shall be conducted within the time limit set by the health officer. (c) Any person found to be violating this rule may be served by the health officer with a written order stating the nature of the violation and providing a time limit for satisfactory correction thereof.

A comprehensive database of septic systems within the Lower East Fork White River watershed is not available; therefore, the rural population of each subwatershed was calculated to obtain a general representation of the number of systems. The U.S. Census provides the total number of people within a county as well as the total urban and rural population of the county. Subwatershed population is estimated by using the census block population found within each area. It is assumed that the numbers of septic systems in the subwatersheds are directly proportional to rural household density. An additional estimate of septic systems can be made using the 1990 US Census, as that is the last Census that inventoried how household wastewater is disposed. The rural households in the Lower East Fork White River subwatersheds are shown in

Table 16, along with a calculated density (total rural households divided by total area). The rural household density can be used to compare the different subwatersheds within the Lower East Fork White River watershed.

It should also be noted that hydrologic soil group A and B soils have good infiltration rates and have less risk for failing septic systems due to this factor. Group C and D soils have slow infiltration rates with finer textures and slow water movement. Table 15 illustrates the hydrologic soil groups for the Lower East Fork White River subwatersheds.

Table 16: Rural and Urban Household Density in the Lower East Fork White River Subwatersheds

Subwatershed	County	Area of County in Subwatershed (mi²)	County Households in Subwatershed	Urban Households	Rural Households	Rural Household Density (Houses/mi²)	Urban Household Density (Houses/mi²)
Mill Creek	Dubois	19.56	2,156	1,298	858	**43.9**	**66.4**
	Total	**19.56**	**2,156**	**1,298**	**858**		
Hoffman Run	Daviess	0.41	0	0	0	**7.4**	**0.0**
	Dubois	11.74	129	0	129		
	Martin	10.27	38	0	38		
	Total	**22.42**	**167**	**0**	**167**		
Slate Creek	Daviess	8.6	94	40	54	**10.2**	**2.1**
	Martin	10.13	137	0	137		
	Total	**18.73**	**231**	**40**	**191**		
Sugar Creek	Daviess	22.54	120	0	120	**5.9**	**0.0**
	Dubois	1.58	22	0	22		
	Martin	0.01	0	0	0		
	Total	**24.13**	**142**	**0**	**142**		
Dogwood Lake	Daviess	16.75	60	0	60	**3.6**	**0.0**
	Total	**16.75**	**60**	**0**	**60**		
Birch Creek	Daviess	1.84	2	0	2	**9.2**	**0.0**
	Dubois	19.96	200	0	200		
	Pike	0.04	0	0	0		
	Total	**21.84**	**202**	**0**	**202**		
Aikman Creek	Daviess	30.41	402	0	402	**13.2**	**0.0**
	Total	**30.41**	**402**	**0**	**402**		
Bear Creek	Daviess	9.7	115	0	115	**10.2**	**0.0**
	Dubois	3.01	19	0	19		
	Pike	19.86	199	0	199		
	Total	**32.57**	**333**	**0**	**333**		
Mud Creek	Daviess	1.18	0	0	0	**10.2**	**0.0**
	Pike	19.7	213	0	213		
	Total	**20.88**	**213**	**0**	**213**		

2.3.3 Soil Saturation and Wetlands

Soils that remain saturated or inundated with water for a sufficient length of time become hydric through a series of chemical, physical, and biological processes. Once a soil takes on hydric characteristics, it retains those characteristics even after the soil is drained. Hydric soils have been identified in the Lower East Fork White River Watershed and are important in consideration of wetland restoration activities. Approximately 4,103 acres or 29 percent of the Lower East Fork White River Watershed area contains soils that are considered hydric, as shown in Table 17. However, a large majority of these soils have been drained for either agricultural production or urban development and would no longer support a wetland. The location of remaining hydric soils, as shown in Figure 17, can be used to consider possible locations of wetland creation or enhancement. There are many components in addition to soil type that must be considered before moving forward with wetland design and creation. Additional information on wetlands can be found on the IDEM website http://www.in.gov/idem/wetlands/.

Table 17: Hydric Soils by Subwatershed in the Lower East Fork White River Watershed

Subwatershed	Map Symbol	Hydric Soil Types	Acres
Mill Creek	Ba	Bartle silt loam	31
	Bo	Bonnie silt loam	433
	DuA	Dubois silt loam, 0 to 2% slope	993
	DuB	Dubois silt loam, 2 to 6% slope	80
	JoA	Johnsburg silt loam	30
	MgA	McGary silt loam	195
	Mo	Montgomery silty clay loam	100
	No	Nolin silt loam	26
	OtA	Otwell silt loam	734
	Pg	Peoga silt loam	1,345
	Ph	Petrolia silty clay loam	30
	Sf	Steff silt loam	183
	St	Stendal silt loam	1,436
		Total	**5,615**
Hoffman Run	Ba	Bartle silt loam	30
	BgeAH	Birds silt loam	214
	BgeAW	Birds silt loam	5
	Bo	Bonnie silt loam	5
	Ch	Chagrin silt loam	412
	JoA	Johnsburg silt loam	1
	MgA	McGary silt loam	39
	NbhAH	Newark silt loam	589
	No	Nolin silt loam	556
	NprAH	Nolin silt loam	420
	Pg	Peoga silt loam	2
	Ph	Petrolia silty clay loam	15
	Sf	Steff silt loam	68
	St	Stendal silt loam	62
	StdAW	Stendal silt loam	376
	WaaAH	Wakeland silt loam	323
	WaaAW	Wakeland silt loam	32
	ZcaAQ	Zipp silty clay	87
		Total	**3,237**
Slate Creek	Ba	Bartle silt loam	75
	BgeAH	Birds silt loam	33
	BgeAW	Birds silt loam	7

Subwatershed	Map Symbol	Hydric Soil Types	Acres
	Bo	Bonnie silt loam	3
	MikAQ	McGary silty clay loam	1
	Sr	Stendal silt loam	1,067
	WaaAH	Wakeland silt loam	254
	WaaAW	Wakeland silt loam	288
	ZcaAQ	Zipp silty clay	4
		Total	**1,733**
Sugar Creek	Ba	Bartle silt loam	72
	Bo	Bonnie silt loam	12
	Ch	Chagrin silt loam	127
	Mg	McGary silt loam	55
	No	Nolin silt loam	256
	Ph	Petrolia silty clay loam	33
	Sr	Stendal silt loam	319
	Vg	Vigo silt loam	268
	Wa	Wakeland silt loam	669
		Total	**1,810**
Dogwood Lake	Ba	Bartle silt loam	1,427
	Mg	McGary silt loam	20
	Po	Petrolia silty clay loam	137
	Vg	Vigo silt loam	187
	Wa	Wakeland silt loam	777
		Total	**2,548**
Birch Creek	Ba	Bartle silt loam	43
	Bo	Bonnie silt loam	106
	Ch	Chagrin silt loam	153
	DuA	Dubois silt loam	1,416
	DuB	Dubois silt loam	67
	MgA	McGary silt loam	87
	Mo	Montgomery silty clay loam	8
	No	Nolin silt loam	562
	OtA	Nolin silty clay loam	786
	Pg	Otwell silt loam	1,239
	Ph	Peoga silt loam	541
	Sf	Petrolia silty clay loam	188
	St	Steff silt loam	1,306
	Wa	Stendal silt loam	42
		Total	**6,543**
Aikman Creek	Ay	Ayrshire fine sandy loam	26
	Ba	Bartle silt loam	1,106
	IvA	Iva silt loam	1,320
	Ly	Lyles loam	45
	Mg	McGary silt loam	115
	Mo	Montgomery silty clay loam	320

Subwatershed	Map Symbol	Hydric Soil Types	Acres
	Pe	Peoga silt loam	14
	Po	Petrolia silty clay loam	289
	Sr	Stendal silt loam	45
	Vg	Vigo silt loam	46
	Wa	Wakeland silt loam	3,340
		Total	**6,666**
Bear Creek	AoC	Alvin-Bloomfield complex	525
	Ay	Ayrshire fine sandy loam	43
	Ba	Bartle silt loam	306
	Bb	Beaucoup silty clay loam	71
	Bg	Belknap silt loam	91
	Bh	Birds silt loam	44
	Bk	Birds silt loam	163
	Bo	Bonnie silt loam	46
	Ch	Chagrin silt loam	3
	DbA	Dubois silt loam	406
	DuA	Dubois silt loam	119
	DuB	Elkinsville silt loam	29
	EkA	Haymond silt loam	61
	Hd	Iva silt loam	473
	IvA	Lindside silt loam	92
	Ln	Markland silty clay loam	415
	MbC3	McGary silty clay loam	35
	MgA	Montgomery silty clay	137
	Mt	Nolin silt loam	92
	No	Nolin silty clay loam	988
	OtA	Otwell silt loam	29
	Pe	Peoga silt loam	64
	Pg	Petrolia silty clay loam	37
	Ph	Petrolia silty clay loam	229
	Pm	Reesville silt loam	45
	Po	Steff silt loam	70
	ReA	Stendal silt loam	85
	Sf	Wakeland silt loam	45
	So	Alvin-Bloomfield complex	266
	Sr	Ayrshire fine sandy loam	4
	St	Bartle silt loam	184
	Wa	Beaucoup silty clay loam	1,399
		Total	**6,594**
Mud Creek	AoC	Alvin-Bloomfield complex	401
	Ar	Armiesburg silty clay loam	6
	Ay	Ayrshire fine sandy loam	136
	Ba	Bartle silt loam	1
	Bb	Beaucoup silty clay loam	74
	Bg	Belknap silt loam	1,129

Subwatershed	Map Symbol	Hydric Soil Types	Acres
	Bh	Birds silt loam	25
	Bk	Birds silt loam	7
	Bo	Bonnie silt loam	212
	EkA	Elkinsville silt loam	21
	Hd	Haymond silt loam	278
	Ln	Lindside silt loam	72
	MbC3	Markland silty clay loam	34
	MgA	McGary silty clay loam	136
	Mt	Montgomery silty clay	24
	No	Nolin silty clay loam	552
	Pe	Peoga silt loam	179
	Ph	Petrolia silty clay loam	138
	Pm	Petrolia silty clay loam	13
	Po	Reesville silt loam	109
	ReA	Steff silt loam	58
	Sf	Stendal silt loam	23
	So	Wakeland silt loam	77
	Wa	Alvin-Bloomfield complex	399
		Total	**4,103**

Understanding Table 17: Areas with the most acreage of hydric soils might contain opportunities for wetland restoration activities that could help address water quality impairments.

Nationally, since the late 1600s roughly 50% of the wetlands in the lower 48 states have been lost. Indiana has lost a large number of its wetlands. In the 1800s and 1900s millions of acres of wetlands were converted into farms, cities, and roads, and we converted wetlands to protect our health. Before the conversion of wetlands, there were over 5.6 million acres of wetlands in the state, wetlands such as bogs, fens, wet prairies, dune and swales, cypress swamps, marshes, and swamps. In the early 1700s, wetlands covered 25% of the total area of Indiana. That number has been greatly reduced. By the late 1980s over 4.7 million acres of wetlands had been lost - wetlands now cover less than 4% of Indiana. (http://www.in.gov/idem/wetlands/2335.htm)

Wetlands are home to wildlife. More than one-third (1/3) of America's threatened and endangered species live only in wetlands, which means they need them to survive. Over 200 species of birds rely on wetlands for feeding, nesting, foraging, and roosting. Wetlands provide areas for recreation, education, and aesthetics. More than 98 million people hunt, fish, birdwatch, or photograph wildlife. Americans spend $59.5 billion annually on these activities. (http://www.in.gov/idem/wetlands/2335.htm)

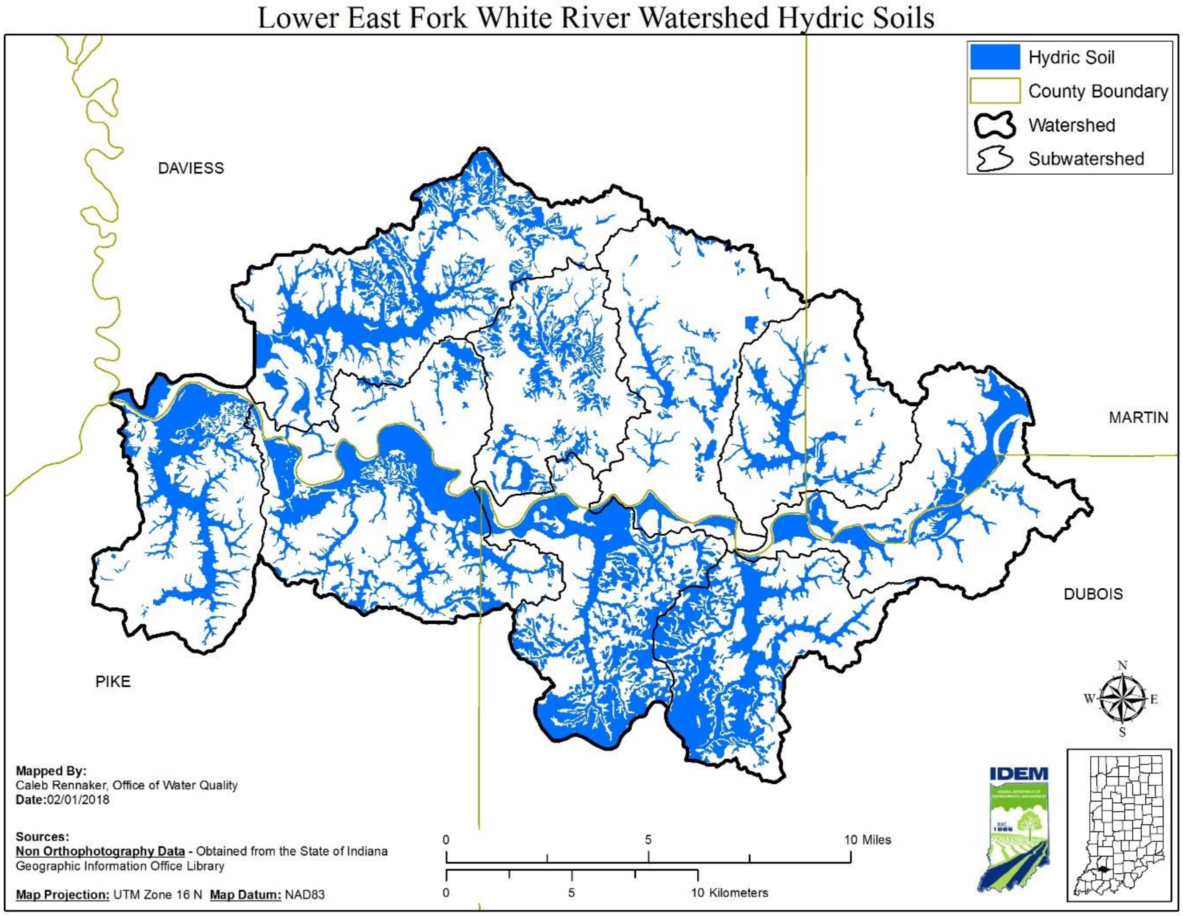

Figure 17: Hydric Soils in the Lower East Fork White River Watershed
(Data on hydric soils by county available from NRCS at
https://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/survey/)

Wetland plants and soils naturally store and filter nutrients and sediments. Calm wetland waters, with their flat surface and flow characteristics, allow these materials to settle out of the water column, where plants in the wetland take up certain nutrients from the water. As a result, our lakes, rivers and streams are cleaner and our drinking water is safer. Man-made wetlands can even be used to clean wastewater, when properly designed. Wetlands also recharge our underground aquifers - over 70% of Indiana residents rely on ground water for part or all of their drinking water needs.(http://www.in.gov/idem/wetlands/2335.htm)

Wetlands protect our homes from floods. Like sponges, wetlands soak up and slowly release floodwaters. This lowers flood heights and slows the flow of water down rivers and streams. Wetlands also control erosion. Shorelines along rivers, lakes, and streams are protected by wetlands, which hold soil in place, absorb the energy of waves, and buffer strong currents. (http://www.in.gov/idem/wetlands/2335.htm)

Wetland areas act to buffer wide variations in flow conditions that result from storm events. They also allow water to infiltrate slowly thus reducing the risks of contaminated water run-off into waterbodies. Agencies such as the USGS and U.S. Fish and Wildlife Service (USFWS) estimate that Indiana has lost approximately 85 percent of the state's original wetlands. Currently, the Lower East Fork White River watershed contains approximately 8,162 acres of wetlands or 6.15 percent of the total surface area.

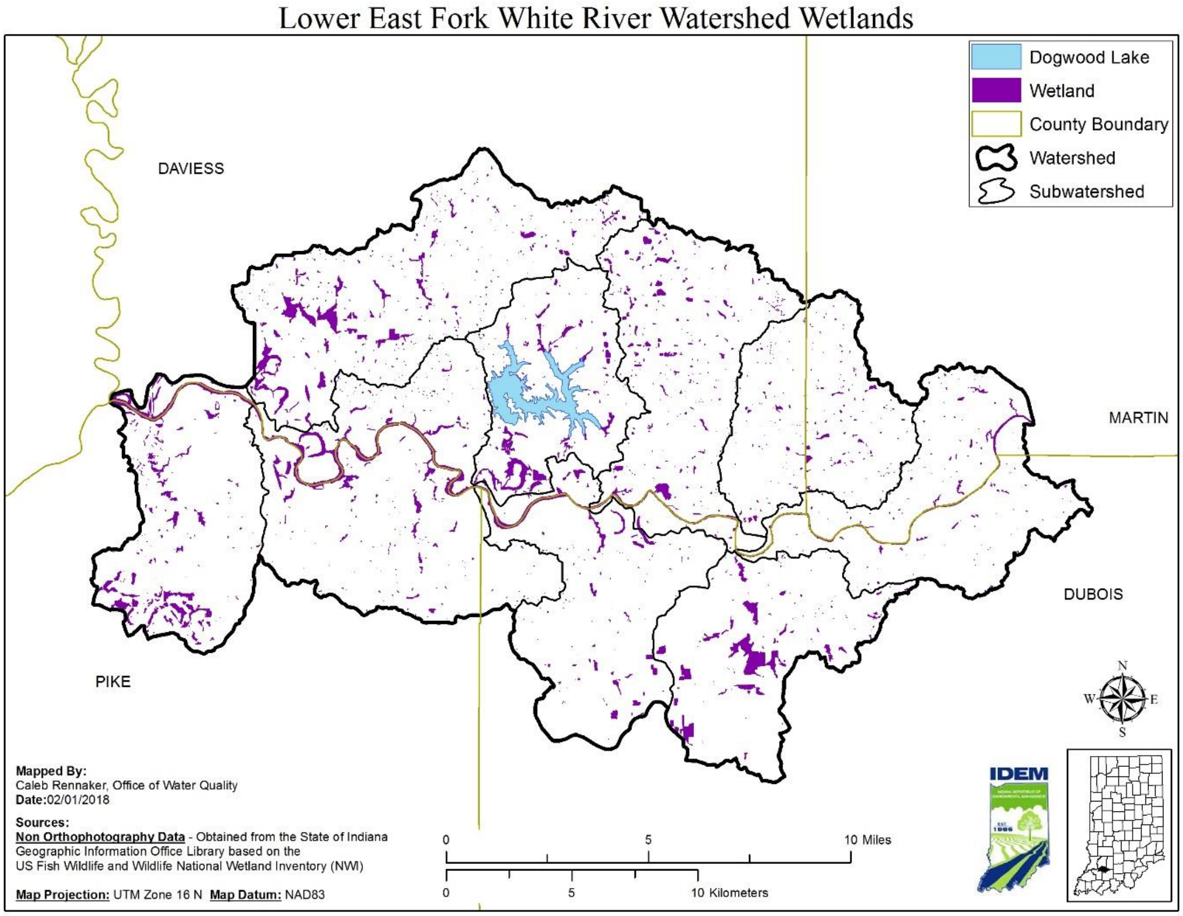

Figure 18: Location of Wetlands in the Lower East Fork White River Watershed

The USFWS has the responsibility for mapping wetlands in the United States. Those map products are currently held in the Fish and Wildlife Service Wetland Database (sometimes referred to as the National Wetlands Inventory or NWI). Figure 18 shows estimated locations of wetlands as defined by the USFWS's NWI. Wetland data for Indiana is available from the U.S. Fish and Wildlife Service's NWI at https://www.fws.gov/wetlands/data/Mapper.html. The NWI was not intended to produce maps that show exact wetland boundaries comparable to boundaries derived from ground soil surveys, and boundaries are generalized in most cases. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis. Therefore, the estimate of the current extent of wetlands in the Lower East Fork White River

Watershed from the NWI may not agree with those listed in Section 2.1, which are based upon the MRLC dataset. For more information on the wetland classification codes visit http://www.fws.gov/wetlands/Data/Wetland-Codes.html. The U.S. Fish and Wildlife Service uses data standards to increase the quality and compatibility of its data.

Changes to the natural drainage patterns of a watershed are referred to as hydromodifications. Historically, drain tiles have been used throughout Indiana to drain marsh or wetlands and make it either habitable or tillable for agricultural purposes. While tile drainage is understood to be pervasive – estimated at thousands of miles in Indiana – it is extremely challenging to quantify on a watershed basis because these tiles were established by varying authorities including County Courts, County Commissioners, or County Drainage Boards (See: http://indianacountysurveyors.org/directory.html#)

In addition to tile drainage, regulated drains are another form of hydromodification. A regulated drain is a drain which was established through either a Circuit Court or Commissioners Court of the County prior to January 1, 1966 or by the County Drainage Board since that time. Regulated drains can be an open ditch, a tile drain, or a combination of both. The County Drainage Board can construct, maintain, reconstruct, or vacate a regulated drain.

2.3.4 Soil Erodibility

Although erosion is a natural process within stream ecosystems, excessive erosion negatively impacts the health of watersheds. Erosion increases sedimentation of the streambeds, which impacts the quality of habitat for fish and other organisms. Erosion also impacts water quality as it increases nutrients and decreases water clarity. As water flows over land and enters the stream as run-off, it carries pollutants and other nutrients that are attached to the sediment. Sediment suspended in the water blocks light needed by plants for photosynthesis and clogs respiratory surfaces of aquatic organisms.

The NRCS maintains a list of highly erodible lands (HEL) units for each county based upon the potential of soil units to erode from the land (https://efotg.sc.egov.usda.gov/references/public/NE/HEL_Intro.pdf). HELs are especially susceptible to the erosional forces of wind and water. Wind erosion is common in flat areas where vegetation is sparse or where soil is loose, dry, and finely granulated. Wind erosion damages land and natural vegetation by removing productive top soil from one place and depositing it in another. The classification for HELs is based upon an erodibility index for a soil, which is determined by dividing the potential average annual rate of erosion by the soil unit's soil loss tolerance (T) value, which is the maximum annual rate of erosion that could occur without causing a decline in long-term productivity. The soil types and acreages in the Lower East Fork White River Watershed are listed in Table 18. HELs and potential HELs in the Lower East Fork White River Watershed are mapped in Figure 19.

A total of 126,337 acres or 94 percent of the Lower East Fork White River watershed is considered highly erodible or potentially highly erodible. Rainfall surrounding the Lower East Fork White River Watershed is moderately heavy with an annual average of 52.5 inches. This rainfall and climate data specific to the watershed is available from the Midwestern Regional Climate Center http://mrcc.isws.illinois.edu/CLIMATE/. Heavy rainfall increases flow rates within streams as the volume and velocity of water moving through the stream channels increases. Velocity of water also increases as streambank steepness increases.

Streambank erosion is potentially a significant source of TSS in the Lower East Fork White River Watershed. Streambank erosion is a natural process but can be accelerated due to a variety of human activities:

Vegetation located adjacent to streams flowing through crop or pasture fields is often removed to promote drainage or cattle access to water. The loss of vegetation makes the streambanks more susceptible to erosion due to the loss of plant roots.

Extensive areas of agricultural tiles promote much quicker delivery of rainfall into streams than would occur without subsurface drainage, which could potentially contribute to streambank erosion due to high velocities and shear stress.

The creation of impervious surfaces (e.g., streets, rooftops, driveways, parking lots) can also lead to rapid run-off of rainfall and higher stream velocities that might cause streambank erosion.

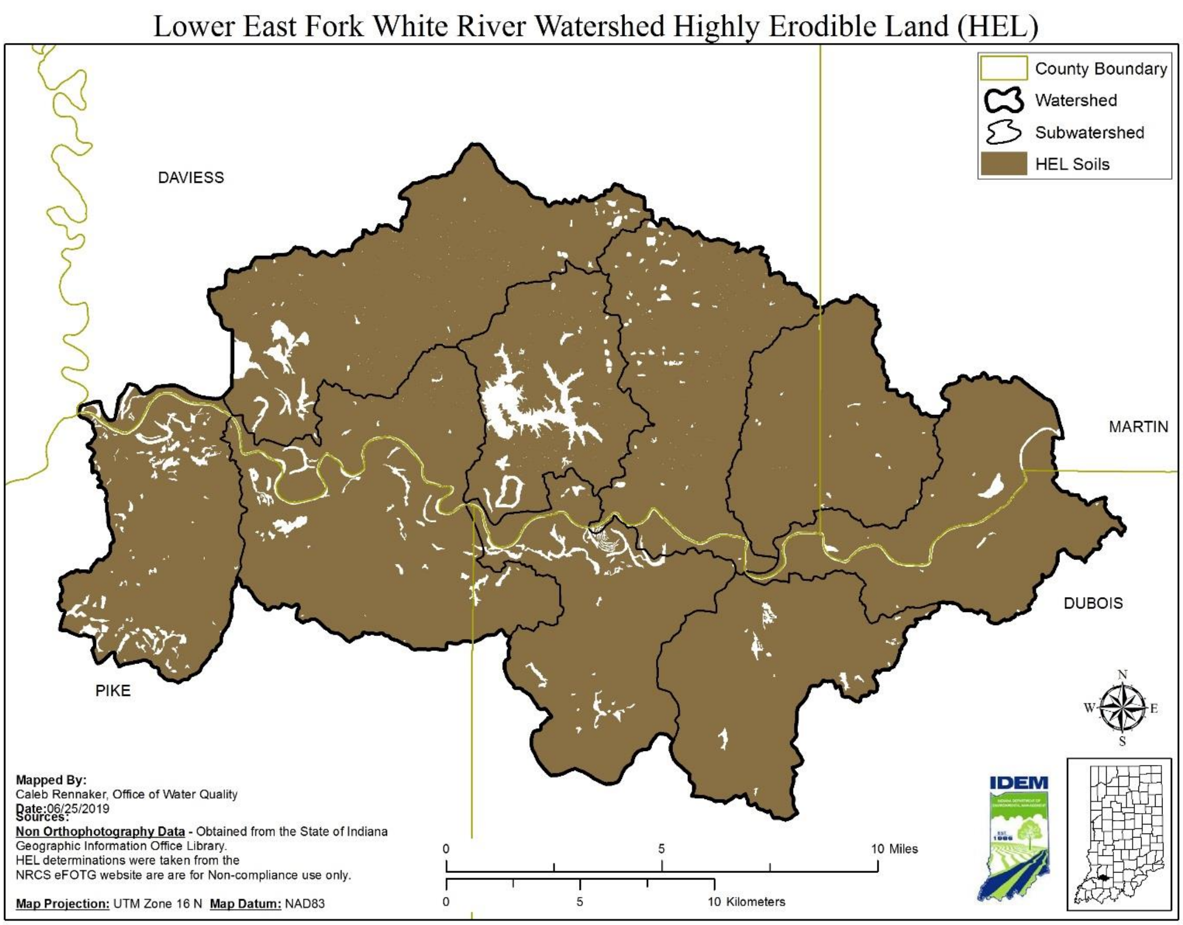

Figure 19: Location of Highly Erodible Lands (HEL) in the Lower East Fork White River Watershed

Table 18: HEL/Potential HEL Total Acres in the Lower East Fork White River Watershed

Map Symbol	HEL/Potential HEL Soil Types	Acres
AbqD3	Adyeville silt loam, 12 to 18 percent slopes, severely eroded	15
AciG	Adyeville-Tipsaw complex, 20 to 60 percent slopes	65
AdA	Alford silt loam, 0 to 2 percent slopes	2
AdB2	Alford silt loam, 2 to 6 percent slopes, eroded	829
AdC2	Alford silt loam, 6 to 12 percent slopes, eroded	521
AfB	Alford silt loam, 2 to 6 percent slopes	380
AfC2	Alford silt loam, 6 to 12 percent slopes, eroded	265
AfE2	Alford silt loam, 15 to 25 percent slopes, eroded	198
AgrB	Apalona-Zanesville silt loams, 2 to 6 percent slopes	1,481
AgrC2	Apalona-Zanesville silt loams, 6 to 12 percent slopes, eroded	747
AgrC3	Apalona-Zanesville silt loams, 6 to 12 percent slopes, severely eroded	356
AgyB	Apalona-Udorthents complex, 2 to 6 percent slopes	2
AlB2	Alford silt loam, 2 to 6 percent slopes, eroded	946
AlC2	Alford silt loam, 6 to 12 percent slopes, eroded	240
AlC3	Alford silt loam, 6 to 12 percent slopes, severely eroded	184
AlD2	Alford silt loam, 12 to 18 percent slopes, eroded	40
AlD3	Alford silt loam, 12 to 18 percent slopes, severely eroded	357
AlE2	Alford silt loam, 18 to 25 percent slopes, eroded	85
AlE3	Alford silt loam, 18 to 25 percent slopes, severely eroded	15
AmoC2	Alvin-Bloomfield loamy fine sands, 4 to 10 percent slopes, eroded	46
AmoE	Alvin-Bloomfield loamy fine sands, 15 to 35 percent slopes	65
AnB	Alvin fine sandy loam, 2 to 6 percent slopes	561
AoC	Alvin-Bloomfield complex, 6 to 15 percent slopes	926
Ar	Armiesburg silty clay loam, occasionally flooded	6
Ba	Bartle silt loam	3,092
Bg	Belknap silt loam, frequently flooded	1,220
BgeAH	Birds silt loam, 0 to 1 percent slopes, frequently flooded, brief duration	248
BgeAW	Birds silt loam, 0 to 1 percent slopes, occasionally flooded, very brief duration	12
Bh	Birds silt loam, occasionally flooded	69
Bk	Birds silt loam, frequently flooded	170
BlB	Bloomfield loamy fine sand, 2 to 6 percent slopes	90
BlC	Bloomfield loamy fine sand, 6 to 12 percent slopes	295
BlD	Bloomfield loamy fine sand, 12 to 18 percent slopes	113
BlF	Bloomfield loamy fine sand, 18 to 35 percent slopes	680
Bo	Bonnie silt loam, frequently flooded	1,496
Bu	Burnside silt loam, occasionally flooded	160
CcB2	Cincinnati silt loam, 2 to 6 percent slopes, eroded	375
CcC2	Cincinnati silt loam, 6 to 12 percent slopes, eroded	685
CcC3	Cincinnati silt loam, 6 to 12 percent slopes, severely eroded	1,791
CcD2	Cincinnati silt loam, 12 to 18 percent slopes, eroded	1,070
CcD3	Cincinnati silt loam, 12 to 18 percent slopes, severely eroded	2,262
Ch	Chagrin silt loam, frequently flooded	694
CktF	Chetwynd loam, 18 to 35 percent slopes	9
ClF	Chetwynd silt loam, 25 to 50 percent slopes	45
Cu	Cuba silt loam, frequently flooded	1,060
CwaAH	Cuba silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	22
DbA	Dubois silt loam, 0 to 2 percent slopes	406
DuA	Dubois silt loam, 0 to 2 percent slopes	2,528
DuB	Dubois silt loam, 2 to 6 percent slopes	175
EkA	Elkinsville silt loam, 0 to 2 percent slopes	82
FaB	Fairpoint silt loam, reclaimed, 1 to 15 percent slopes	7,432
FbC	Fairpoint-Bethesda complex, 8 to 15 percent slopes	227
FbG	Fairpoint-Bethesda complex, 25 to 70 percent slopes	326
GacAW	Gatchel loam, 1 to 3 percent slopes, occasionally flooded, very brief duration	218
GbF	Gilpin-Berks complex, 25 to 50 percent slopes	560
GlD2	Gilpin silt loam, 12 to 18 percent slopes, eroded	1,207

Map Symbol	HEL/Potential HEL Soil Types	Acres
GlD3	Gilpin silt loam, 12 to 18 percent slopes, severely eroded	1,637
GlE	Gilpin silt loam, 18 to 25 percent slopes	969
GlE3	Gilpin silt loam, 18 to 25 percent slopes, severely eroded	142
GnE	Gilpin silt loam, 15 to 30 percent slopes	75
GnE3	Gilpin silt loam, 15 to 25 percent slopes, severely eroded	32
GoF	Gilpin-Berks complex, 20 to 50 percent slopes	1,368
GuD	Gilpin-Orthents complex, 12 to 25 percent slopes	7
HbB	Haubstadt silt loam, 1 to 6 percent slopes	1,367
HcgAH	Haymond silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	24
HcgAW	Haymond silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	4
Hd	Haymond silt loam, frequently flooded	6,988
HeA	Henshaw silt loam, 0 to 3 percent slopes	147
HkE2	Hickory silt loam, 18 to 25 percent slopes, eroded	1,119
HkF	Hickory silt loam, 18 to 50 percent slopes	1,126
HoA	Hosmer silt loam, 0 to 2 percent slopes	748
HoB2	Hosmer silt loam, 2 to 6 percent slopes, eroded	9,608
HoB3	Hosmer silt loam, 2 to 6 percent slopes, severely eroded	207
HoC2	Hosmer silt loam, 6 to 12 percent slopes, eroded	507
HoC3	Hosmer silt loam, 6 to 12 percent slopes, severely eroded	2,795
HoD2	Hosmer silt loam, 12 to 18 percent slopes, eroded	636
HoD3	Hosmer silt loam, 12 to 18 percent slopes, severely eroded	1,733
IoA	Iona silt loam, 0 to 2 percent slopes	115
IvA	Iva silt loam, 0 to 2 percent slopes	1,805
IvB2	Iva silt loam, 2 to 4 percent slopes, eroded	21
JoA	Johnsburg silt loam, 0 to 2 percent slopes	32
Ln	Lindside silt loam, frequently flooded	487
MaB2	Markland silt loam, 2 to 6 percent slopes, eroded	119
MaD2	Markland silt loam, 6 to 18 percent slopes, eroded	57
MbC3	Markland silty clay loam, 6 to 15 percent slopes, severely eroded	69
MdvC3Q	Markland silty clay loam, 6 to 15 percent slopes, severely eroded, rarely flooded	17
Mg	McGary silt loam	190
MgA	McGary silt loam, 0 to 2 percent slopes	595
MrcG	Minnehaha parachannery silty clay loam, 35 to 75 percent slopes	33
MuA	Muren silt loam, 0 to 2 percent slopes	10
NaeB	Nawakwa silt loam, 2 to 8 percent slopes	189
NaeD	Nawakwa silt loam, 8 to 20 percent slopes	500
NaeF	Nawakwa silt loam, 20 to 35 percent slopes	116
NbhAH	Newark silt loam, 0 to 2 percent slopes, frequently flooded	589
NeD3	Negley loam, 12 to 18 percent slopes, severely eroded	833
NeF	Negley loam, 18 to 50 percent slopes	464
NgC2	Negley silt loam, 6 to 12 percent slopes, eroded	883
NgD2	Negley silt loam, 12 to 18 percent slopes, eroded	553
No	Nolin silt loam, frequently flooded	1,553
NprAH	Nolin silt loam, 0 to 2 percent slopes, frequently flooded	556
OrD	Orthents, 6 to 25 percent slopes	353
OtA	Otwell silt loam, 0 to 2 percent slopes	1,549
OtB	Otwell silt loam, 2 to 6 percent slopes	2,448
OtC2	Otwell silt loam, 6 to 12 percent slopes, eroded	1,028
OtC3	Otwell silt loam, 6 to 12 percent slopes, severely eroded	1,655
OtD3	Otwell silt loam, 12 to 18 percent slopes, severely eroded	1,265
PaB	Parke silt loam, 2 to 6 percent slopes	603
PaC2	Parke silt loam, 6 to 12 percent slopes, eroded	745
PaC3	Parke silt loam, 6 to 12 percent slopes, severely eroded	14
PaD2	Parke silt loam, 12 to 18 percent slopes, eroded	47
PaD3	Parke silt loam, 12 to 18 percent slopes, severely eroded	324
PbbC2	Parke silt loam, 6 to 12 percent slopes, eroded	58
PbbD2	Parke silt loam, 12 to 18 percent slopes, eroded	72

Map Symbol	HEL/Potential HEL Soil Types	Acres
PcB	Pekin silt loam, 2 to 6 percent slopes	127
PcrB	Pekin silt loam, 2 to 6 percent slopes	39
Pe	Peoga silt loam	257
PeB	Pekin silt loam, 2 to 6 percent slopes, rarely flooded	54
PeC2	Pekin silt loam, 6 to 12 percent slopes, eroded, rarely flooded	30
Pg	Peoga silt loam	2,623
PkA	Pike silt loam, 0 to 2 percent slopes	1,063
PkB	Pike silt loam, 2 to 6 percent slopes	782
PlfB	Pike silt loam, 2 to 6 percent slopes	109
PpD3	Pike silt loam, 12 to 18 percent slopes, severely eroded	359
PrA	Princeton fine sandy loam, 0 to 2 percent slopes	261
PrB	Princeton fine sandy loam, 2 to 6 percent slopes	245
PrB2	Princeton fine sandy loam, 2 to 6 percent slopes, eroded	382
PrC	Princeton fine sandy loam, 6 to 12 percent slopes	332
PrC2	Princeton fine sandy loam, 6 to 12 percent slopes, eroded	194
PrD2	Princeton fine sandy loam, 12 to 18 percent slopes, eroded	293
PrF	Princeton fine sandy loam, 20 to 60 percent slopes	307
PryB	Potawatomi silt loam, 1 to 3 percent slopes	19
ReA	Reesville silt loam, 0 to 2 percent slopes	143
Sf	Steff silt loam, frequently flooded	506
SfvB2	Shircliff silty clay loam, 2 to 6 percent slopes, eroded	22
So	Stendal silt loam, frequently flooded	343
Sr	Stendal silt loam, frequently flooded	1,436
St	Stendal silt loam, frequently flooded	3,302
StaAW	Steff silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	69
StdAW	Stendal silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	62
Sw	Stonelick fine sandy loam, frequently flooded	72
SyB2	Sylvan silt loam, 2 to 6 percent slopes, eroded	164
SyC3	Sylvan silt loam, 6 to 12 percent slopes, severely eroded	141
SyF	Sylvan silt loam, 25 to 50 percent slopes	17
TlA	Tilsit silt loam, 0 to 2 percent slopes	12
TlB	Tilsit silt loam, 2 to 6 percent slopes	886
Vg	Vigo silt loam	501
Wa	Wakeland silt loam, frequently flooded	6,625
WaaAH	Wakeland silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	577
WaaAW	Wakeland silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	320
WeC2	Wellston silt loam, 6 to 12 percent slopes, eroded	183
WeC3	Wellston silt loam, 6 to 12 percent slopes, severely eroded	7
WeD2	Wellston silt loam, 12 to 18 percent slopes, eroded	1,275
WeD3	Wellston silt loam, 12 to 18 percent slopes, severely eroded	1,171
WeE	Wellston silt loam, 15 to 30 percent slopes	746
WeF	Wellston silt loam, 25 to 35 percent slopes	121
WhfB	Wellston silt loam, 2 to 6 percent slopes	24
WhfC2	Wellston silt loam, 6 to 12 percent slopes, eroded	861
WhfD2	Wellston silt loam, 12 to 18 percent slopes, eroded	377
WhfD3	Wellston silt loam, 12 to 18 percent slopes, severely eroded	1,156
WokAH	Wilbur silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	307
WokAW	Wilbur silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	235
WpfG	Wellston-Tipsaw-Adyeville complex, 18 to 70 percent slopes	144
WpnE	Wellston-Adyeville complex, 12 to 30 percent slopes	2,622
WprAH	Wirt loam, 0 to 2 percent slopes, frequently flooded, brief duration	360
ZaB2	Apalona-Zanesville silt loams, 2 to 6 percent slopes, eroded	1,277
ZaC2	Apalona-Zanesville silt loams, 6 to 12 percent slopes, eroded	1,551
ZaC3	Apalona-Zanesville silt loams, 6 to 12 percent slopes, severely eroded	757
ZaD2	Zanesville silt loam, 12 to 18 percent slopes, eroded	6
ZaD3	Zanesville silt loam, 12 to 18 percent slopes, severely eroded	49
ZnC2	Apalona-Zanesville silt loams, 6 to 12 percent slopes, eroded	2,049

Map Symbol	HEL/Potential HEL Soil Types	Acres
ZnC3	Apalona-Zanesville silt loams, 6 to 12 percent slopes, severely eroded	46
	Total	**126,337**

Understanding Table 18 and Figure 19. Areas with the most acreage of HEL might contribute to water quality impairments associated with excessive erosion, including IBC/TSS, and might contain opportunities for restoration to decrease erosion.

The Indiana State Department of Agriculture (ISDA) tracks trends in conservation and cropland through annual county tillage transects. Data collected through the tillage transect county data found at https://secure.in.gov/isda/2383.htm help determine adoption of conservation practices and estimate the average annual soil loss from Indiana's agricultural lands. The latest figures for the counties in the Lower East Fork White River Watershed are shown in Table 19. Tillage practices captured in ISDA's tillage transect include living cover, no-till, conservation till, and conventional tillage practices. According to ISDA living cover includes living cover crops and cereal grains planted into cash crops using direct seeding or broadcast methods. No-till is any direct seeding system including site preparation, with minimal soil disturbance. Conservation till is any tillage system leaving 16% to 75% residue cover after planting, excluding no-till (includes mulch and reduced tillage). Conventional tillage is any tillage system leaving less than 15% residue cover after planting. (ISDA)

Table 19: Tillage Transect Data for 2017 by County in the Lower East Fork White River Watershed

	Tillage Practice 2017							
	Living Cover		No-till		Conservation Till		Conventional Till	
County	Corn	Soybean	Corn	Soybean	Corn	Soybean	Corn	Soybean
Daviess	11,435 ac 13%	16,594 ac 23%	35,184 ac 40%	62,048 ac 86%	51,896 ac 59%	8,658 ac 12%	- 0%	1,443 ac 2%
Dubois	8,616 ac 17%	6,435 ac 14%	33,957 ac 67%	42,284 ac 92%	13,684 ac 27%	2,758 ac 6%	3,041 ac 6%	460 ac 1%
Martin	503 ac 3%	1,631 ac 11%	9,222 ac 55%	14,825 a 100%	7,545 ac 45%	- 0%	- 0%	- 0%
Pike	2,529 ac 8%	9,160 ac 22%	28,456 ac 90%	39,973 ac 96%	2,529 8%	833 ac 2%	632 ac 2%	833 ac 2%

Understanding Table 19: According to the table, no-till is predominant in all counties in the Lower East Fork White River watershed for soybeans and most counties for corn. Conventional till is the least used practice across all counties for both corn and soybeans.

2.3.5 Streambank Erosion

Streambank erosion is potentially a significant source of pollutants in the Lower East Fork White River watershed. Streambank erosion is a natural process but can be accelerated due to a variety of human activities. Vegetation located adjacent to streams flowing through crop or pasture fields is often removed to promote drainage or cattle access to water. The loss of vegetation makes the streambanks more susceptible to erosion due to the loss of plant roots. Extensive areas of agricultural tiles promote much quicker delivery of rainfall into streams than would occur without subsurface drainage, which could potentially contribute to streambank erosion, due to high velocities and shear stress. The creation of impervious surfaces (e.g., streets, rooftops, driveways, parking lots) can also lead to rapid run-off of rainfall and higher stream velocities that might cause streambank erosion.

2.4 Wildlife and Classified Lands

2.4.1 Wildlife

The Indiana Department of Natural Resources (IDNR) is the primary entity responsible for monitoring wildlife populations and habitats throughout Indiana. Wildlife such as deer, geese, ducks, etc. can be sources of *E. coli* and nutrients. Little information exists surrounding feces depositional patterns of wildlife and a direct inventory of wildlife populations is generally not available. However, based on the *Bacteria Source Load Calculator* developed by the Center for TMDL and Watershed Studies, bacteria production by animal type is estimated as well as their preferred habitat. Higher concentrations of wildlife in the habitats described in Table 20 could contribute *E. coli* and nutrients to the watershed, particularly during high flow conditions or flooding events.

Table 20: Bacteria Source Load by Species

Wildlife Type	*E. coli* Production Rate (cfu/day – animal)	Habitat
Deer	1.86×10^8	Entire Watershed
Raccoon	2.65×10^7	Low density on forests in rural areas; high density on forest near a permanent water source or near cropland
Muskrat	1.33×10^7	Near ditch, medium sized stream, pond or lake edge
Goose	4.25×10^8	Near main streams and impoundments
Duck	1.27×10^9	Near main streams and impoundments
Beaver	2.00×10^5	Near streams and impoundments in forest and pastures

2.4.2 Classified Lands

Managed lands shown in Table 21 include natural and recreation areas which are owned or managed by the Indiana Department of Natural Resources, federal agencies, local agencies, non-profit organizations, and conservation easements. Classified lands are public or private lands containing areas supporting growth of native or planted trees, native or planted grasses, wetlands, or other acceptable types of cover that have been set aside for managed production of timber, wildlife habitat, and watershed protection. Natural areas provide ideal habitat for wildlife. Some of the more common wildlife often found in natural areas include white-tailed deer, raccoon, muskrat, fowl, and beaver. While wildlife is known to contribute *E.coli* and nutrients to the surface waters, natural areas provide economic, ecological, and social benefits and should be preserved and protected. Management practices such as impervious surfaces reduction, native vegetation plantings, wetland creation, and riparian buffer maintenance will help in reducing stormwater run-off transporting pollutants to the streams. Table 21 and Figure 20 show the managed lands within the Lower East Fork White River Watershed. Table 22 and Figure 20 show the classified lands within Lower East Fork White River Watershed.

Table 21: Managed Lands within the Lower East Fork White River Watershed

Unit Name	Manager	Area (acres)
Portersville Bridge Public Access Site	DNR Fish and Wildlife	1
Wening-Sherritt Seep Springs Nature Preserve	DNR Nature Preserves	76
Glendale Fish and Wildlife Area	DNR Fish and Wildlife	8,117
	Total	**8,194**

Table 22: Classified Lands within the Lower East Fork White River Watershed

Classified Lands (Acres)	
Subwatershed	**Total**
Mill Creek	810
Hoffman Run	1,906
Slate Creek	592
Sugar Creek	131
Dogwood Lake	10
Birch Creek	274
Aikman Creek	242
Bear Creek	66
Mud Creek	365
Grand Total	**4,396**

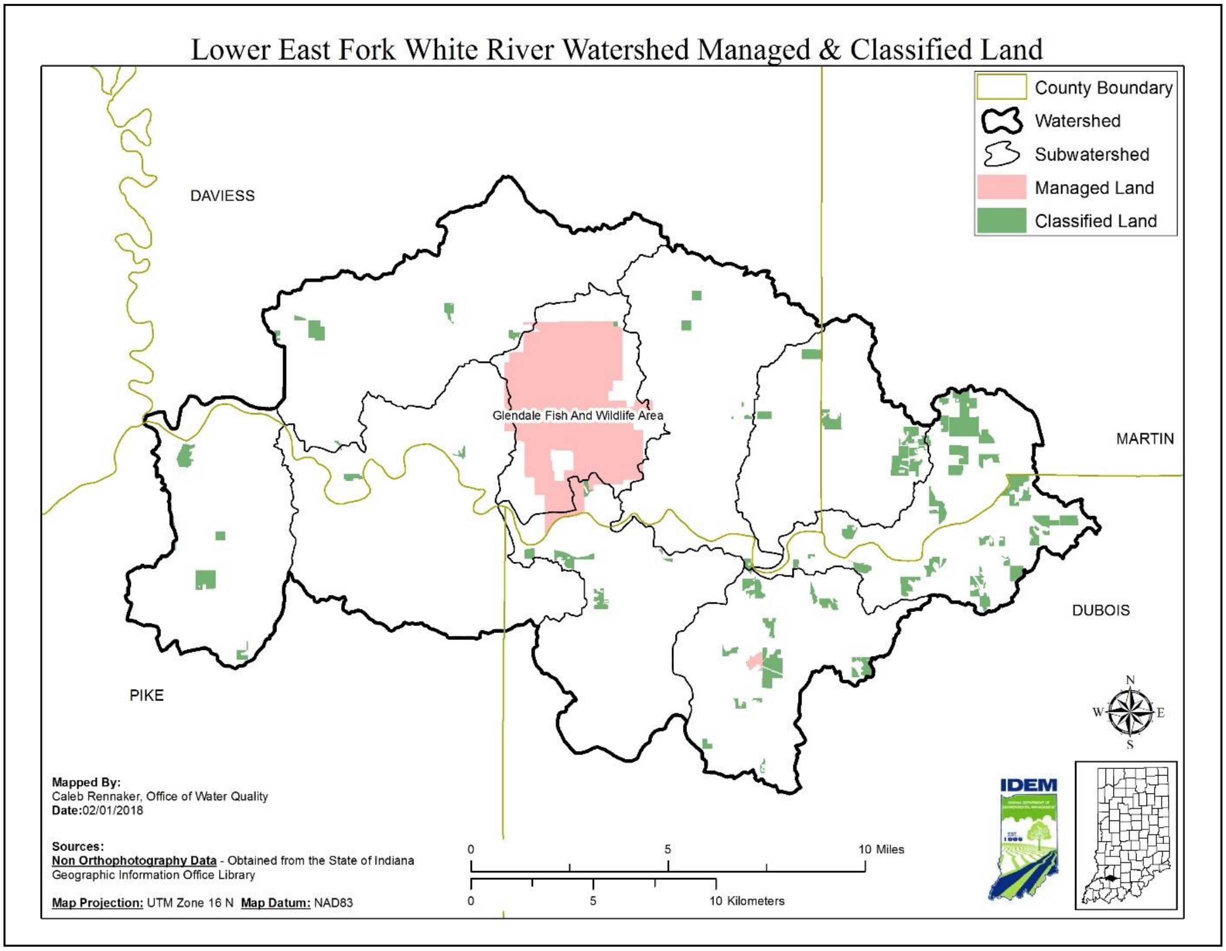

Figure 20: Managed and Classified Lands within the Lower East Fork White River Watershed

2.5 Climate and Precipitation

Climate varies in Indiana depending on latitude, topography, soil types, and lakes. Information on Indiana's climate is available through sources including the Midwestern Regional Climate Center (http://mrcc.isws.illinois.edu/CLIMATE/).

Climate data from Station USC00128036 located in Shoals, IN were used for climate analysis of the Lower East Fork White River Watershed. Monthly data from 1908 - 2018 were available at the time of analysis. In general, the climate of the region is continental with hot, humid summers and cold winters. From 2008 to 2018, the average winter temperature in Shoals was 35.2°F and the average summer temperature was 72.7°F. The average growing season (consecutive days with low temperatures greater than or equal to 32 degrees) is 183 days.

Examination of precipitation patterns is also a key component of watershed characterization because of the impact of run-off on water quality. From 2008 to 2018, the annual average precipitation in Shoals at Station USC00128036 was approximately 52.5 inches, including approximately 13.1 inches on average of total annual Lower East Fork White River snowfall.

Rainfall intensity and timing affect watershed response to precipitation. This information is important in evaluating the effects of stormwater on the Lower East Fork White River Watershed. Using data from USC00128036 during 2008 to 2018, 82 percent of the measureable precipitation events were low intensity (i.e., less than 0.2 inches), while 4 percent of the measurable precipitation events were greater than one inch.

Understanding when precipitation events occur helps in the linkage analysis in Section 4.0, which correlates flow conditions to pollutant concentrations and loads. Data indicates that the wet weather season in the Lower East Fork White River Watershed occurs between the months of March and May.

2.6 Human Population

Counties with land located in the Lower East Fork White River Watershed include Pike, Daviess, Dubois, and Martin. Major government units with jurisdiction at least partially within the Lower East Fork White River Watershed include Jasper and Alfordsville. U.S. Census data for each county during the past three decades are provided in Table 23.

Table 23: Population Data for Counties in Lower East Fork White River Watershed

County	1990	2000	2010
Daviess	27,533	29,820	31,648
Dubois	36,616	39,674	41,889
Martin	10,369	10,369	10,334
Pike	12,509	12,837	12,845
TOTAL	***87,027***	***92,700***	***96,716***

Understanding Table 23: Water quality is linked to population growth because a growing population often leads to more development, translating into more houses, roads, and infrastructure to support more people. The table provides information that shows how population has changed in each of the counties located in the Lower East Fork White River Watershed over time. In addition, understanding population trends can help watershed stakeholders to anticipate where pressures might increase in the future and where action in the Lower East Fork White River could help prevent further water quality degradation.

Estimates of population within Lower East Fork White River Watershed are based on US Census data 2010 and the percentage of census blocks in urban and rural areas (Table 24). Based on this analysis, the estimated population of the watershed is 9,050 with approximately 68 percent of the population classified as rural residents and 32 percent classified as urban residents. Figure 21 below indicates population density within the Lower East Fork White River Watershed.

Table 24: Estimated Population in the Lower East Fork White River Watershed

County	2010 Population	Total Estimated Watershed Urban Population	Total Estimated Watershed Rural Population	Total Estimated Watershed Population	Percent of Total Watershed Population
Daviess	31,648	94	1,836	1,930	21.3%
Dubois	41,889	2,802	2,935	5,737	63.4%
Martin	10,334	0	410	410	4.5%
Pike	12,845	0	973	973	10.8%
TOTAL	***96,716***	**2,896**	**6,154**	**9,050**	**100.0%**

Understanding Table 24: Understanding where the greatest population is concentrated within the Lower East Fork White River Watershed will help watershed stakeholders understand where different types of water quality pressures might currently exist. In general, watersheds with large urban populations are more likely to have problems associated with lots of impervious surfaces, poor riparian habitat, flashy stormwater flows, and large wastewater inputs. Alternatively, watersheds with mostly a non-urban population are more likely to suffer problems from failing septic systems, agricultural run-off, and other types of poor riparian habitat (e.g., channelized streams). Comparing the information in Table 23 with the information in Table 24 can provide an understanding of how population might change in the Lower East Fork White River Watershed and which counties are experiencing the most growth and shifts in urban and non-urban population. Population change can serve as an indicator for changes in land uses. For example, growing populations might mean more development, resulting in increased impervious surfaces and more infrastructure (e.g., sanitary sewer and storm sewer). Declining population in areas of the Lower East Fork White River Watershed might signify communities with under-utilized infrastructure and indicate opportunities to "rightsize" existing infrastructure and promote changes to land use that would benefit water quality (e.g., green infrastructure).

A report by the Indiana Advisory Commission on Intergovernmental Relations (ACIR) surveyed county health department officials statewide from 2016 to 2017. Of the 444 unsewered communities reported statewide, the study was able to identify 192 of those communities where at least 25 percent of the individual wastewater treatment systems were failing. Unsewered communities were defined as "contiguous geographical areas containing at least 25 homes and/or businesses that are not served by sewers" (Palmer et. al, 2019). Table 25 reports unsewered communities by countiy relevant to the Lower East Fork White River watershed.

Table 25: Unsewered residences/businesses reported by county in 2016-2017.

County	Unsewered Communities	Residences	Businesses
Daviess	No Report	No Report	No Report
Dubois	1	132	16
Martin	5	110	0
Pike	7	115	12

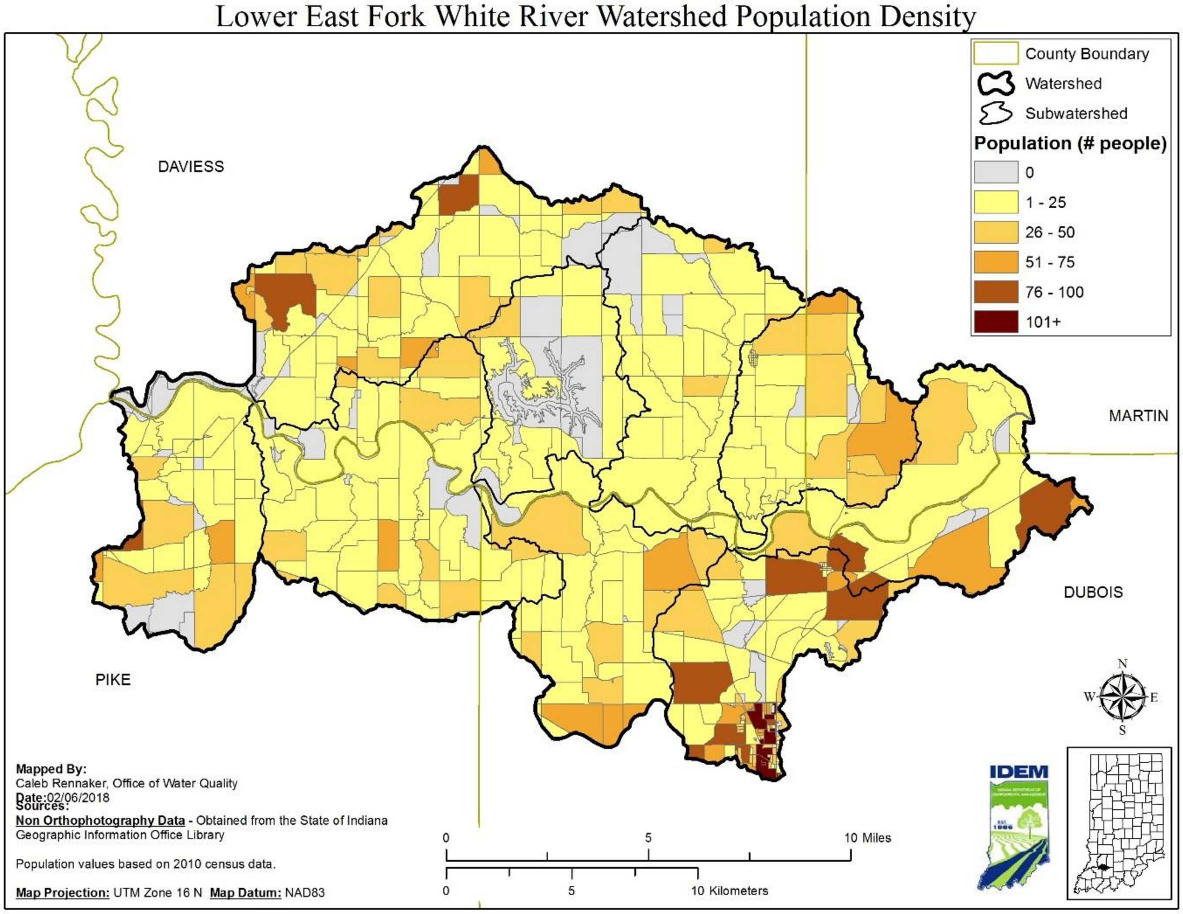

Figure 21: Population Density in the Lower East Fork White River Watershed

2.6.1 Urban Stormwater

In areas not covered under the NPDES MS4 program, stormwater run-off from developed areas is not regulated under a permit and is therefore a nonpoint source. Run-off from urban areas can carry a variety of pollutants originating from a variety of sources. Typically urban sources of nutrients are fertilizer application to lawns and pet waste, which is also a source of *E. coli*. Depending on the amount of developed, impervious land in a watershed, urban nonpoint source inputs can result in localized or widespread water quality degradation. The percent and distribution of developed land in the Lower East Fork White River Watershed is discussed in Section 2.6. However, inputs from urban sources are difficult to quantify. Estimates can be made of residential areas that might receive fertilizer treatment. These estimates provide insight into the potential of urban nonpoint sources as important sources of nutrients, TSS, and *E. coli* in the Lower East Fork White River Watershed.

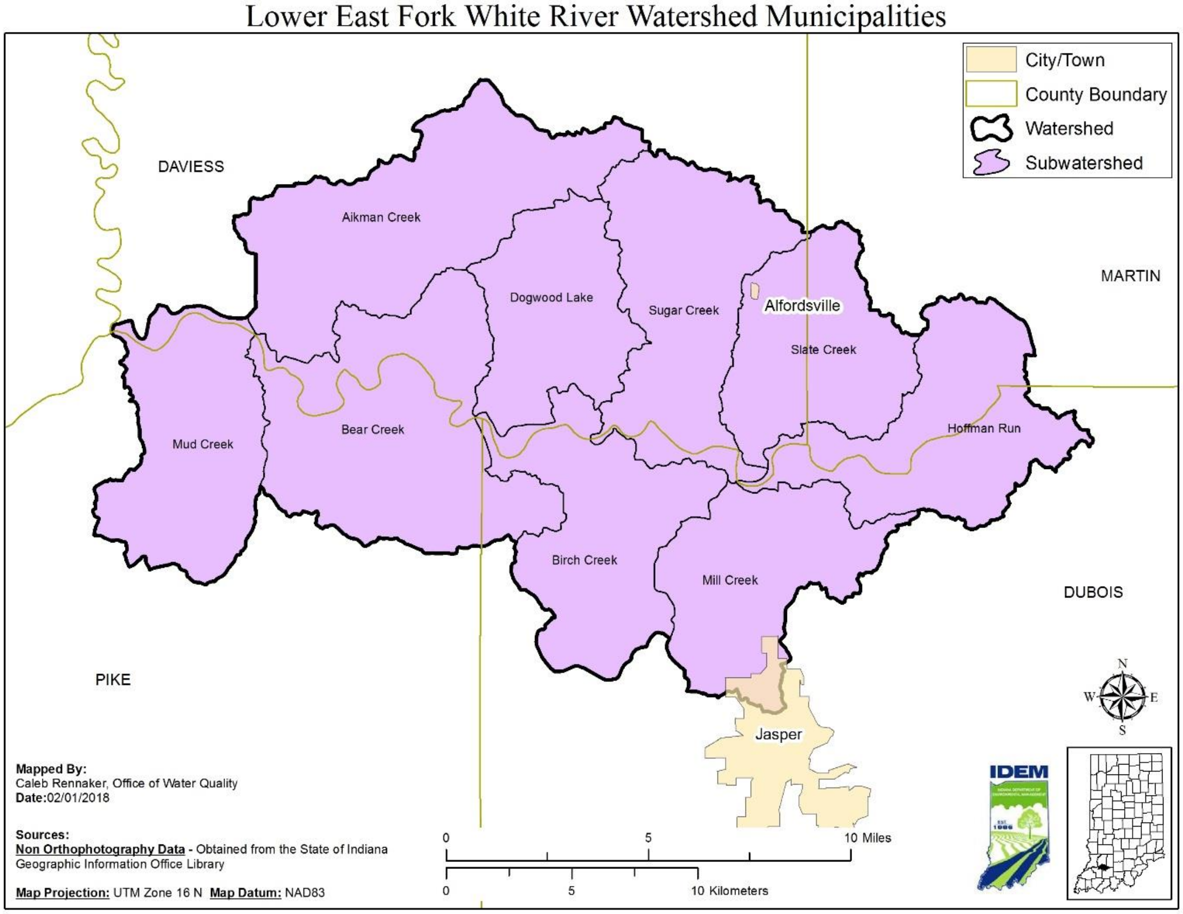

Figure 22: Municipalities in the Lower East Fork White River Watershed

2.7 Abandoned Mine Lands

Indiana been coal mined (surface and underground) from the late 1800's until the mid-1900's. Historic practices can have a significant impact on the streams and surrounding landscapes. Several of these impacts include:

- Residual strip mine ponds and mine waste piles (gob piles)
- Surface hydrology alteration
- Elimination of some headwater streams
- Altered topography and vegetation
- Increased stream bank erosion and sedimentation
- Alteration of fish habitat
- Increased in-stream metals concentrations

The residual effects of historic mining can have a significant influence on water quality as acid mine drainage (AMD) from seeps, mine tailings/gob piles, and exposed coal seams enter into streams and their tributaries. AMD generally displays elevated levels of one or more parameters including acidity, metals, sulfates, and suspended solids (Bauers et al, 2006).

It should also be noted that there is an important distinction between abandoned mine lands and current mining practices. Current mines are required to comply with the Surface Mining Control and Reclamation Act of 1977, which addresses the water-quality problems associated with AMD and requires that extensive information about the probable hydrologic consequences of mining and reclamation be included in mining-permit application so that the regulatory authority can determine the probable cumulative impact of mining on the hydrology. Since the onset of the Act, best management practices have been employed at all current mine sites and are aimed at minimizing adverse effects to the hydrologic balance. As a result, the current mines in the Lower East Fork White River watershed are not considered significant sources of the impairments noted in this TMDL.

For purposes of this TMDL, point sources are identified as permitted discharge points or discharges having responsible parties, and nonpoint sources are identified as any pollution sources that are not point sources. For example, there is not a single point of discharge associated with abandoned mine lands. Therefore, run-off from these areas consists of overland flow, and were treated in the allocations as nonpoint sources. As such, the discharges associated with these land uses were assigned LAs. The decision to assign LAs to nonpoint sources is not a determination by IDEM as to whether there are unpermitted point source discharges within these land uses. In addition, the assignment of LAs to nonpoint sources is not a determination that these discharges are exempt from NPDES permitting requirements.

2.8 Point Sources

This section summarizes the potential point sources of *E. coli*, TSS, and total phosphorus in the Lower East Fork White River Watershed, as regulated through the National Pollutant Discharge Elimination System (NPDES) Program. Facilities with NPDES permits to discharge wastewater within the Lower East Fork White River watershed include Public Water Supplies (PWS) and industrial facilities.

There are seven active NPDES permitted facilities within the Lower East Fork White River watershed. Based on their permitted effluent, Otwell Water Corporation and surface mine operations in the watershed are potential sources of TSS. Additionally, the city of Jasper MS4 community is impacted by stormwater run-off, and is a potential source of *E. coli*, TSS, and total phosphorus.

2.8.1 Public Water Supply (PWS)

Public Water Supply facilities have NPDES permits to discharge within the Lower East Fork White River Watershed. There is one active PWS that discharges wastewater containing TSS within the Lower East Fork White River.

The Otwell Water Corporation (IN0052086) contains two outfalls which directly discharge into an unnamed ditch that flows to the East Fork White River. At the point of discharge, the unnamed tributary has a $Q_{7,10}$ low flow value of 0.0 cfs. Ground water is the source of the permitted facility's drinking water. The wastewater discharged at Outfall 001 consists of floor drain run-off. The wastewater discharged at Outfall 002 consists of filter backwash. The backwash undergoes sedimentation prior to discharge. The facility has an average discharge of approximately 0.002 MGD.

Effluent from this facility is a point source of TSS. As discussed in Section 1.2, the TMDL target value for TSS is 30.0 mg/L or interpreted from current permit limits. This target value can be used to establish potential permit limits. TSS is interpreted as a daily maximum in the NPDES permit for this facility.

Flows used to calculate sediment loads from each treatment plant are estimated based on current flow data from data monitoring reports (DMR) or design flows from the facility permits when actual flow data is not available. Sediment concentrations used to calculate sediment loads from each treatment plant are based on known technological limitations of the facilities (literature values for facilities with similar treatment levels).

The facility's permit effluent limit for TSS is set at the NPDES permit limit of 40 mg/L daily maximum. Average design flow was determined from information reported by the facility during the permitting process. Discharges from this facility are not believed to be significant contributions of TSS in the subwatershed. Meeting the assigned WLA will be achieved through compliance with the NPDES permit limits.

Table 26: NPDES Permitted Wastewater Treatment Plants Discharging within the Lower East Fork White River Subwatersheds

Subwatershed	Facility Name	Permit Number	AUID	Receiving Stream	Average Design Flow (MGD)
Bear Creek	Otwell Water Corporation	IN0052086	INW08F8_T1001	Unnamed Tributary of East Fork White River	0.002

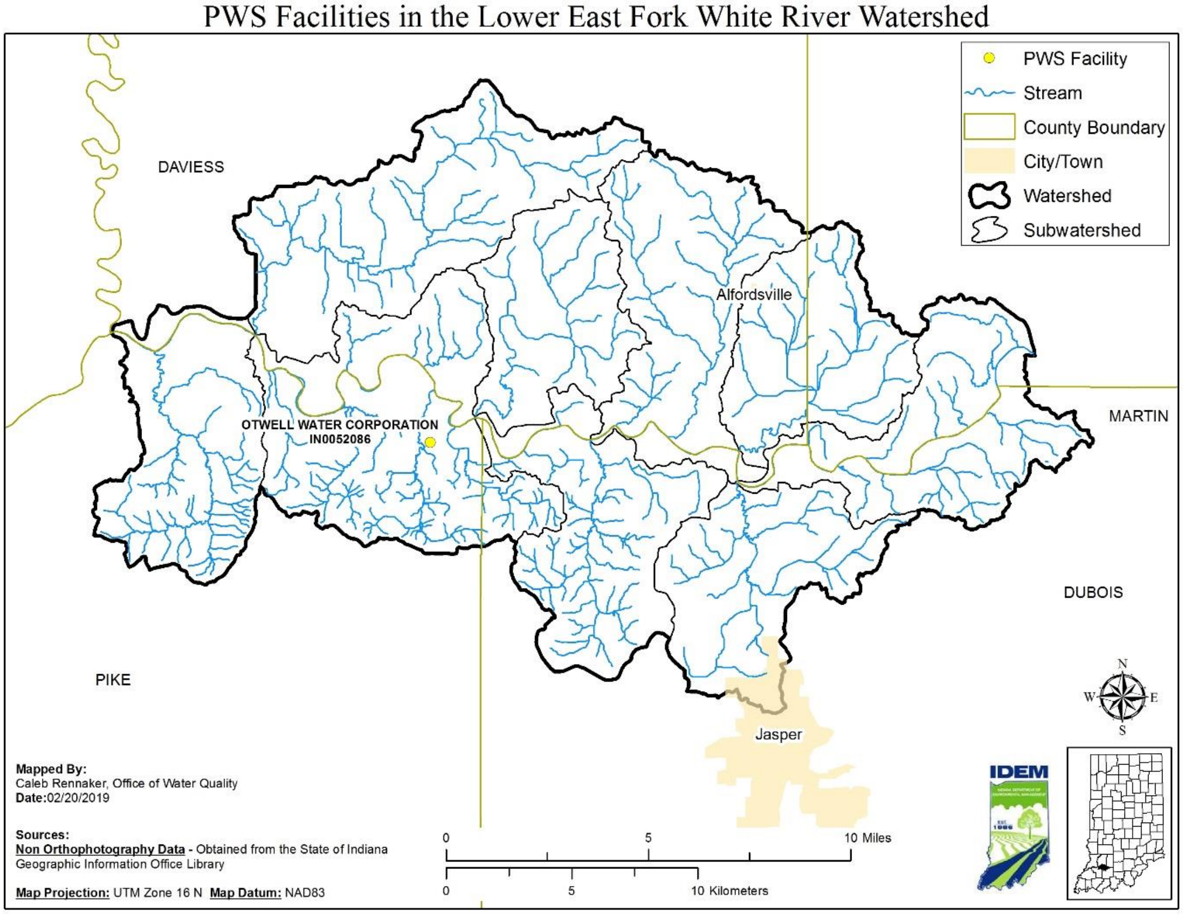

Figure 23: NPDES Permitted Public Water Supply (PWS) facilities discharging within the Lower East Fork White River Watershed

2.8.2 Coal Mining

Facilities engaging in mining of coal, coal processing, and reclamation activities are regulated through a NPDES General Permit under 327 IAC 15-7. The purpose of this rule is to regulate wastewater discharges from surface mining, underground mining, and reclamation projects which utilize sedimentation basin treatment for pit dewatering and surface run-off and to require best management practices for stormwater run-off to protect the public health, existing water uses, and aquatic biota.

The five industrial dischargers associated with active mining activities (Solar Sources Charger Mine, Solar Sources Shamrock Mine, Solar Sources Cannelburg Mine, Peabody Midwest Viking Corning Pit, and Trust Resources Vigo Captain Daviess Mine) are potential sources of TSS. Trust Resources Vigo Captain Daviess Mine has not currently began mining operations. However, they have been issued permits, and provided a list of outfall locations. The WLA for this facility was estimated by using the total permitted area in absence of bonded acreage data which likely overestimates the actual disturbed area. The discharges at these facilities are the result of stormwater that is collected at the facility and discharged via the permitted discharge pipe. These discharges are permitted by rule under the general permit rule 327 IAC 15-7. These permits have varying discharge limits based on dry and wet weather discharge flow rates. For wet weather discharges, dilution rates are assumed and limits are suspended. Individual WLAs for mining facilities are based on a permit limit of 70 mg/L daily max for TSS, and are implemented through compliance with their NPDES permit.

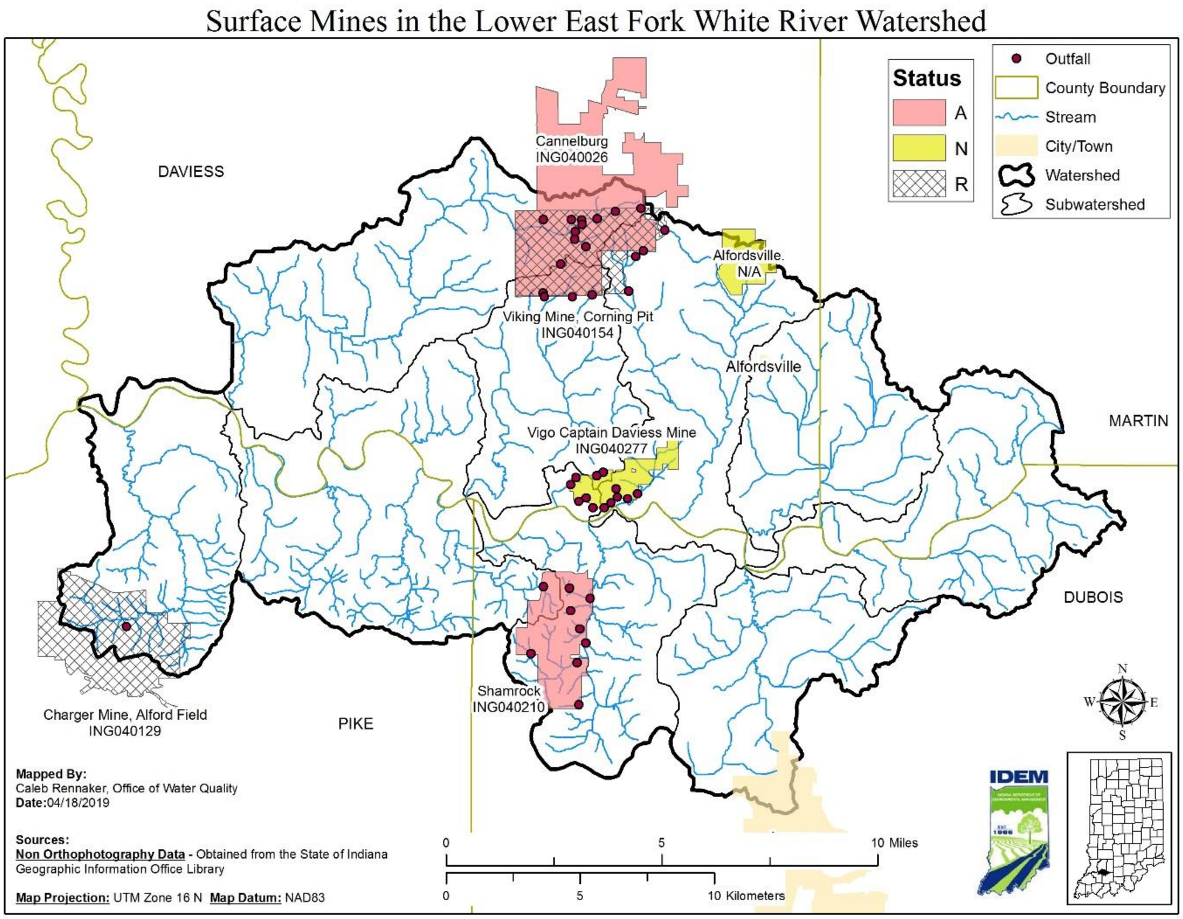

Figure 24: Surface mines in the Lower East Fork White River watershed. Permit status indicated by the following letters: A – active; N – new permit bonded (no overburden removal or coal extracted); R - overburden removal and coal extraction complete.

2.8.3 Compliance and Inspections

The following table presents a summary of permit compliance for NPDES facilities in the Lower East Fork White River watershed for the five-year period of 2014-2018.

Table 27: Summary of Inspections and Permit Compliance in the Lower East Fork White River Watershed

Subwatershed	Facility Name	NPDES Permit Number	Stream	Inspections for the Last Five Years	Violations for the Last Five Years			
					Permit Feature	Year	Parameter	Exceedance
Mill Creek	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hoffman Run	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Slate Creek	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sugar Creek	Peabody Midwest Mining, LLC – Viking Corning Pit	ING040154	Sugar Creek	Inspected by IDNR: 2018: 3 times 2017: 5 times 2016: 4 times 2015: 3 times 2014: 3 times	NA	NA	NA	NA
	Solar Sources Inc. – Cannelburg Mine	ING040026	Sugar Creek	Inspected by IDNR: 2018: 3 times 2017: 3 times 2016: 4 times 2015: 4 times 2014: 4 times	NA	NA	NA	NA

Subwatershed	Facility Name	NPDES Permit Number	Stream	Inspections for the Last Five Years	Violations for the Last Five Years			
					Permit Feature	Year	Parameter	Exceedance
Dogwood Lake	Peabody Midwest Mining, LLC – Viking Corning Pit	ING040154	Mud Creek/Dogwood Lake	Inspected by IDNR: 2018: 3 times 2017: 5 times 2016: 4 times 2015: 3 times 2014: 3 times	038 038	2016 2016	total Iron (as Fe) TSS	Daily Avg: 82% Daily Avg: 40%
Birch Creek	Solar Sources Inc. – Shamrock Mine	ING040210	Birch Creek	Inspected by IDNR: 2018: 2 times 2017: 4 times 2016: 5 times 2015: 2 times 2014: 4 times	004 005 005 006 010 010	2015 2015 2018 2015 2015 2016	total Iron (as Fe) pH pH TSS pH pH	Daily Avg: 7% Daily Max: 2% Daily Max: 8% Daily Avg: 3% Daily Max: 1% Daily Max: 7%
Aikman Creek	Peabody Midwest Mining, LLC – Viking Corning Pit	ING040154	Aikman Creek	Inspected by IDNR: 2018: 3 times 2017: 5 times 2016: 4 times 2015: 3 times 2014: 3 times	011 011	2016 2017	total Iron (as Fe) total Iron (as Fe)	Daily Avg: 49% Daily Avg: 33%
	Solar Sources Inc. – Cannelburg Mine	ING040026	Aikman Creek	Inspected by IDNR: 2018: 3 times 2017: 3 times 2016: 4 times 2015: 4 times 2014: 4 times	NA	NA	NA	NA

Subwatershed	Facility Name	NPDES Permit Number	Stream	Inspections for the Last Five Years	Violations for the Last Five Years			
					Permit Feature	Year	Parameter	Exceedance
Bear Creek	Otwell Water Corp.	IN0052086	Bear Creek	12/12/17: Violations observed 7/8/16: Satisfactory 1/12/15: Violations observed	N/A	N/A	N/A	N/A
	Solar Sources Inc. – Shamrock Mine	ING040210	Tributary of E Fork White River	Inspected by IDNR: 2018: 2 times 2017: 4 times 2016: 5 times 2015: 2 times 2014: 4 times	N/A	N/A	N/A	N/A
Mud Creek	Solar Sources Mining, LLC – Charger Mine	ING040129	Mud Creek	Inspected by IDNR: 2018: 6 times 2017: 5 times 2016: 13 times 2015: 7 times 2014: 10 times	N/A	N/A	N/A	N/A

2.8.4 Stormwater

2.8.4.1 Construction Stormwater

Stormwater run-off associated with construction activity is regulated under 327 IAC 15-5 which is commonly known as Rule 5. Rule 5 is a performance-based regulation designed to reduce pollutants that are associated with construction and/or land disturbing activities. In Indiana most construction projects subject to Rule 5 are administered through a general permit. The requirements of Rule 5 now apply to all persons who are involved in construction activity (which includes clearing, grading, excavation, and other land disturbing activities) that results in the disturbance of one (1) acre or more of total land area. If the land disturbing activity results in the disturbance of less than one (1) acre of total land area, but is part of a larger common plan of development or sale, the project is still subject to stormwater permitting.

Rule 5 requires the development of a construction plan. The plan outlines how erosion and sedimentation will be controlled on the project site to minimize the discharge of sediment off-site or to a water of the state. Secondly, the plan addresses other pollutants that may be associated with construction activity. This can include disposal of building materials, management of fueling operations, etc. Finally, the plan should also address pollutants that will be associated with the post-construction land use. It is the responsibility of the project site owner to implement the stormwater pollution prevention plan. In addition, it is critical that the site is monitored during the construction process and in-field modifications are made to address the discharge of sediment and other pollutants from the project site. This may require modification of the plan and field changes on the project site, as necessary, to prevent pollutants, including sediment, from leaving the project site.

If an adverse environmental impact from a project site is evident, a Rule 5 permit or, in more significant situations, an individual stormwater permit, may be required. An individual stormwater permit is typically required only if IDEM determines that the discharge will significantly lower water quality. If an individual stormwater permit is required, notice will be given to the project site owner. The average annual construction acreage numbers in Table 28 were calculated by using the past five years of permitted construction sites in each subwatershed.

Table 28: Average Permitted Construction Acreage in the Lower East Fork White River Subwatersheds from 2014-2018.

Subwatershed	Estimated Annual Construction Acreage
Mill Creek	19
Hoffman Run	0
Slate Creek	0
Sugar Creek	8
Dogwood Lake	0
Birch Creek	0
Aikman Creek	4
Bear Creek	0
Mud Creek	11

2.8.4.2 Municipal Separate Storm Sewer Systems (MS4)

Municipal Separate Storm Sewer Systems (MS4s) are regulated by 327 IAC 15-13 (Rule 13), the municipal stormwater general permit rule. MS4s are defined as a conveyance or system of conveyances owned by a state, city, town, or other public entity that discharges to waters of the United States and is designed or used for collecting or conveying stormwater. Regulated conveyance systems include roads with drains, municipal streets, catch basins, curbs, gutters, storm drains, piping, channels, ditches, tunnels and conduits. It does not include combined sewer overflows (CSOs) and publicly owned treatment works.

The CWA requires stormwater discharges from certain types of urbanized areas to be permitted under the NPDES program. In 1990, Phase I of these requirements became effective, and municipalities with a population served by an MS4 of 100,000, or more, were regulated. Under Phase I federal stormwater regulations, regulated MS4 entities were required to obtain individual permits. In 1999, Phase II became effective and any entity responsible for an MS4 conveyance, regardless of population size, could potentially be regulated. IDEM foresees that the vast majority, if not all, of the Phase II MS4 entities in Indiana will be covered under general permits. A general permit is a single permit that is written to cover multiple permittees with similar characteristics. No written draft permit is issued to the permittee under a general permit. Under 327 IAC 15-2-9(b) an individual NPDES permit is required when water quality standards are not being met under the general permit, technology or regulatory change has occurred that causes the implementation of specific controls or limitations not expressed in the general permit, or a general permit is no longer appropriate based on permittee changes. If any of these situations occur, MS4 entities covered under this general permit rule may be required to terminate coverage and apply for an individual MS4 permit.

MS4 conveyances within urbanized areas have one of the greatest potentials for polluted stormwater run-off. The Federal Register Final Rule explains the reason as: “urbanization alters the natural infiltration capacity of the land and generates...pollutants...causing an increase in stormwater run-off volumes and pollutant loadings.” Based on increased population and proportionally higher pollutant sources, urbanization results, “in a greater concentration of pollutants that can be mobilized by, or disposed into, stormwater discharges.” MS4s can be significant sources of *E. coli*, nutrients, and sediment because they transport urban run-off that can be affected by pet waste, illicit sewer connections, failing septic systems, fertilizer, construction, and streambank erosion from hydrologic modifications.

There is one MS4 entities in the Lower East Fork White River Watershed as shown in Table 29 and Figure 25. Municipal boundaries and MS4 boundaries are not always the same, but are often used to delineate the regulated MS4 area if a system map is not readily available. The MS4 WLAs are developed at High and Moist flow regimes; it is not expected that the MS4 will have non stormwater discharges. The MS4 operator shall develop a stormwater quality management plan (SWQMP) that includes a commitment to develop and implement a strategy to detect and eliminate illicit discharges to the MS4 conveyance.

Table 29: MS4 Communities in the Lower East Fork White River Watershed

Subwatershed	MS4 Community	Permit ID	Area in Drainage (Acres)	Percentage of Mill Creek Subwatershed
Mill Creek	Jasper	INR040067	1,245.57	9.95%

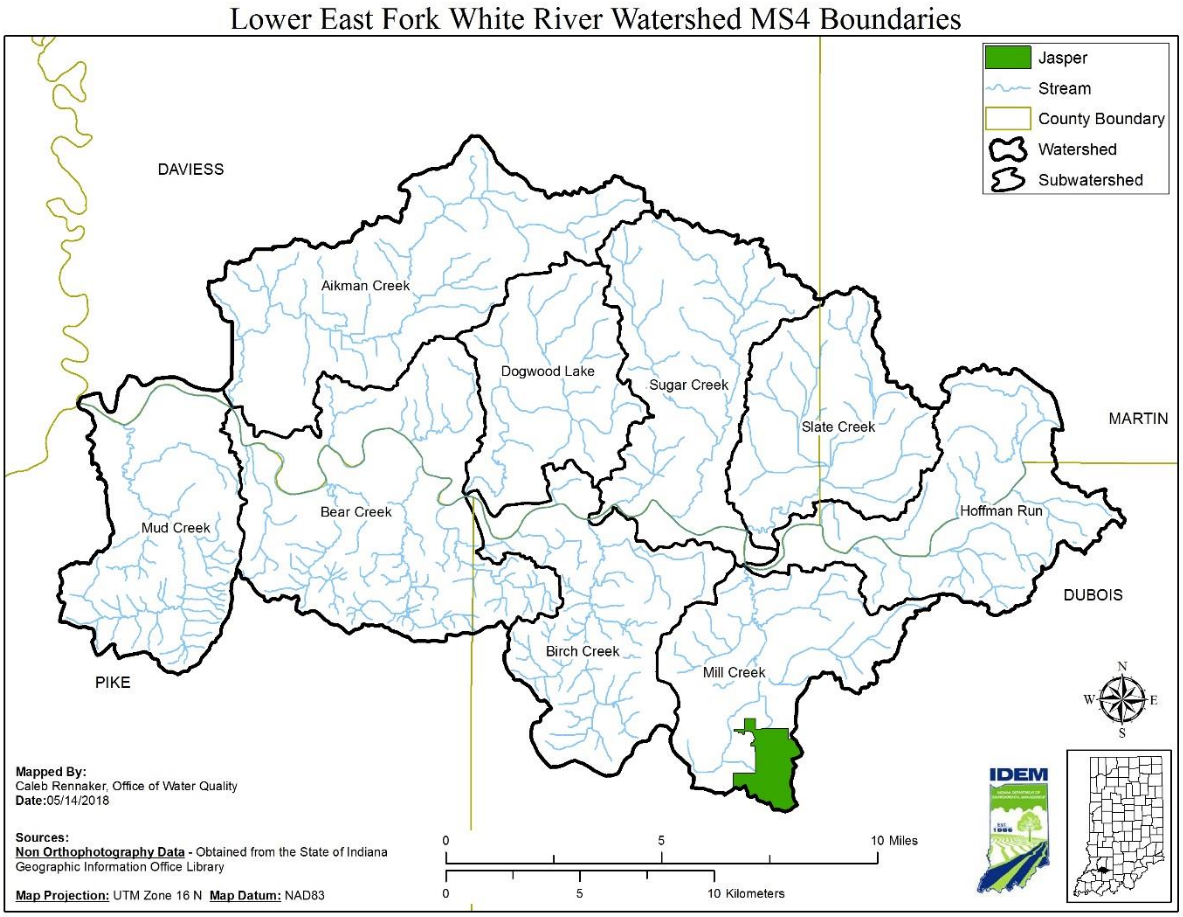

Figure 25: MS4 boundaries in the Lower East Fork White River Watershed

2.9 Summary

The information presented in Section 1.0 helps to provide a better comprehensive understanding of the conditions and characteristics in the Lower East Fork White River watershed that, when coupled with the sources presented in Section 2.0, affect both water quality and water quantity. In summary, the predominant land uses in the Lower East Fork White River watershed of agriculture and forestry serve as indicators as to the type of sources that are likely to contribute to water quality impairments in the Lower East Fork White River watershed. Human population in the Lower East Fork White River watershed indicates where more infrastructure-related pressures on water quality might exist. The subsections on topography and geology, as well as soils, provide information on the natural features that affect hydrology in the Lower East Fork White River watershed. These features interact with land use activities and human population to create pressures on both water quality and quantity in the Lower East Fork White River watershed. Lastly, the subsection on climate and precipitation provides information on water quantity and the factors that influence flow, which ultimately affects the influence of stormwater on the watershed. Collectively, this information plays an important role in understanding the sources that contribute to water quality impairment during TMDL development and crafting the linkage analysis that connects the observed water quality impairment to what has caused that impairment.

3.0 TECHNICAL APPROACH

Previous sections of the report have provided a description of the Lower East Fork White River watershed and summarized the applicable water quality standards, water quality data, and identified the potential sources of *E. coli*, TSS, and total phosphorus for assessment units in each subwatershed. This section presents IDEM's technical approach for using water quality sampling data and flow data for each subwatershed as described in Section 4.0 to estimate the current allowable loads of *E. coli*, TSS, and total phosphorus in each subwatershed. This section focuses on describing the methodology and is helpful in understanding subsequent sections of the TMDL report.

3.1 Load Duration Curves

To determine allowable loads for the TMDL, IDEM uses a load duration curve approach. This approach helps to characterize water quality problems across flow conditions and provides a visual display that assists in determining whether loadings originate from point or nonpoint sources. Load duration curves present the frequency and magnitude of water quality violations in relation to the allowable loads, communicating the magnitude of the needed load reductions.

Developing a load duration curve is a multi-step process. To calculate the allowable loadings of a pollutant at different flow regimes, the load duration curve approach involves multiplying each flow by the TMDL target value or Water Quality Standard and an appropriate conversion factor. The steps are as follows:

- A flow duration curve for the stream is developed by generating a flow frequency table and plotting the observed flows in order from highest (left portion of curve) to lowest (right portion of curve).
- The flow curve is translated into a load duration (or TMDL) curve. To accomplish this, each flow value is multiplied by the TMDL target value or Water Quality Standard with the appropriate conversion factor and the resulting points are graphed. Conversion factors are used to convert the units of the target (e.g., #/100 mL for *E. coli*) to loads (e.g., MPN/day for *E. coli*) with the following factors used for this TMDL:
- *E. coli*: Flow (cfs) x TMDL Concentration Target (#/100mL) x Conversion Factor (24,465,758.4) = Load (MPN/day)
- Total Phosphorus and TSS: Flow (cfs) x TMDL Concentration Target (mg/L) x Conversion Factor (5.39) = Load (lb/day)
- To estimate existing loads, each water quality sample is converted to a load by multiplying the water quality sample concentration by the estimated daily flow on the day the sample was

collected and the appropriate conversion factor. Then, the existing individual loads are plotted on the TMDL graph with the curve.

- Points plotting above the curve represent violations of the applicable water quality standard or exceedances of the applicable target and the daily allowable load. Those points plotting below the curve represent compliance with standards and the daily allowable load.
- The area beneath the load duration curve is interpreted as the loading capacity of the stream. The difference between this area and the area representing the current loading conditions above the curve is the load that must be reduced to meet water quality standards.

The load duration curve approach can consider seasonal variation in TMDL development as required by the CWA and U.S. EPA's implementing regulations. Because the load duration curve approach establishes loads based on a representative flow regime, it inherently considers seasonal variations and critical conditions attributed to flow conditions.

The stream flows displayed on water quality or load duration curves may be grouped into various flow regimes to aid with interpretation of the load duration curves. The flow regimes are typically divided into the following five "hydrologic zones" (U.S. EPA, 2007):

- High Flows: Flows in this range represent flooding or near flooding stages of a stream. These flows are exceeded 0 – 10 percent of the time.
- Moist Conditions: Flows in this range are related to wet weather conditions. These flows are exceeded 10 – 40 percent of the time.
- Mid-Range Flows: Flows in this range represent median stream flow conditions. These flows are exceeded 40 – 60 percent of the time.
- Dry Conditions: Flows in this range are related to dry weather flows. These flows are exceeded 60 -90 percent of the time.
- Low Flows: Flows in this range are seen in drought-like conditions. These flows are exceeded 90 -100 percent of the time.

The load duration curve approach helps to identify the sources contributing to the impairment and to roughly differentiate between sources. Exceedances of the load duration curve at higher flows (0-40 percent ranges) are indicative of wet weather sources (e.g., nonpoint sources, regulated stormwater discharges). Exceedances of the load duration curve at lower flows (60 to 100 percent range) are indicative of point source sources (e.g., wastewater treatment facilities, livestock in the stream). Table 30 summarizes the general relationship between the five hydrologic zones and potentially contributing source areas (the table is not specific to any individual pollutant). For example, the table indicates that impacts from wastewater treatment plants are usually most pronounced during dry and low flow zones because there is less water in the stream to dilute their loads. In contrast, impacts from channel bank erosion is most pronounced during high flow zones because these are the periods during which stream velocities are high enough to cause erosion to occur.

Table 30: Relationship between Load Duration Curve Zones and Contributing Sources

Contributing Source Area	Duration Curve Zone				
	High	Moist	Mid-Range	Dry	Low
Livestock direct access to streams				M	H
Wildlife direct access to streams				M	H
Pasture Management	H	H	M		
On-site wastewater systems/Unsewered Areas	M	M-H	H	H	H
Riparian Buffer areas		H	H	M	
Abandoned mines	H	H	H	H	H
Stormwater: Impervious		H	H	H	
Stormwater: Upland	H	H	M		
Field drainage: Natural condition	H	M			
Field drainage: Tile system	H	H	M-H	L-M	
Bank erosion	H	M			

Note: Potential relative importance of source area to contribute loads under given hydrologic condition (H: High; M: Medium; L: Low)

3.2 Stream Flow Estimates

Daily stream flows are necessary to implement the load duration curve approach. Load duration assessment locations in the Lower East Fork White River watershed were chosen based on the location of the impaired stream segments and the availability of water quality samples to estimate existing loads.

The USGS does not operate any stream flow gaging stations in the Lower East Fork White River watershed. Since there are no continuous flow data for the Lower East Fork White River watershed, flow data were estimated for the Lower East Fork White River watershed using flow data from a neighboring "surrogate" watershed. This is a standard practice when developing TMDLs for ungaged watersheds and is appropriate when the two watersheds are located close to one another and have similar land use and soil characteristics.

The USGS gage for the East Fork White River at Shoals, IN (03373500) located just downstream of the confluence of the Lower East Fork White River and the Blue River was used for the development of the *E. coli*, TSS, and total phosphorus load duration curve analysis for the Lower East Fork White River watershed TMDL. USGS gage 03373500 is located in Martin County. Gage 03373500 drains approximately 4,927 sq. miles in the Lower East Fork White (HUC 8: 05120208) watershed as shown in Figure 26.

Table 31: USGS Site Assignment for Development of Load Duration Curve

Gage Location	Gage ID	Period of Record
East Fork White River at Shoals, IN	03373500	2008-2018

Since the load duration approach requires a stream flow time series for each site included in the analysis, stream flows were extrapolated from USGS gage 03373500 for each assessment location by using a multiplier based upon the ratio of the upstream drainage area for a given location to the drainage area of the Lower East Fork White River watershed.

Flows were estimated using the following equation:

$$Q_{ungaged} = \frac{A_{ungaged}}{A_{gaged}} \times Q_{gaged}$$

Where,

$Q_{ungaged}$: Flow at the ungaged location
Q_{gaged}: Flow at surrogate USGS gage station
$A_{ungaged}$: Drainage area of the ungaged location
A_{gaged}: Drainage area of the gaged location

In this procedure, the drainage area of each of the load duration stations was divided by the drainage area of the surrogate USGS gage. The flows for each of the stations were then calculated by multiplying the flows at the surrogate gage by the drainage area ratios. Additional flows were added to certain locations to account for municipal wastewater treatment plants that discharge upstream and are not directly reflected in the load duration curve method.

Table 32: Load Duration Curve Key Flow Percentile Estimates

Subwatershed	Drainage Area (sq. miles)	Flow Duration Exceedance Interval Flows (cfs)				
		High (5%)	Moist (25%)	Mid-Range (50%)	Dry (75%)	Low (95%)
Mill Creek	19.57	85	36	17	6	2
Hoffman Run	5,556.86	24,136	10,356	4,895	1,836	655
Slate Creek	18.73	81	35	16	6	2
Sugar Creek	5,619.3	24,407	10,473	4,950	1,856	662
Dogwood Lake	16.75	73	31	15	6	2
Birch Creek	5,641.14	24,502	10,513	4,969	1,863	665
Aikman Creek	30.41	132	57	27	10	4
Bear Creek	5,690.47	24,716	10,605	5,013	1,880	671
Mud Creek	5,741.76	24,939	10,701	5,058	1,897	677

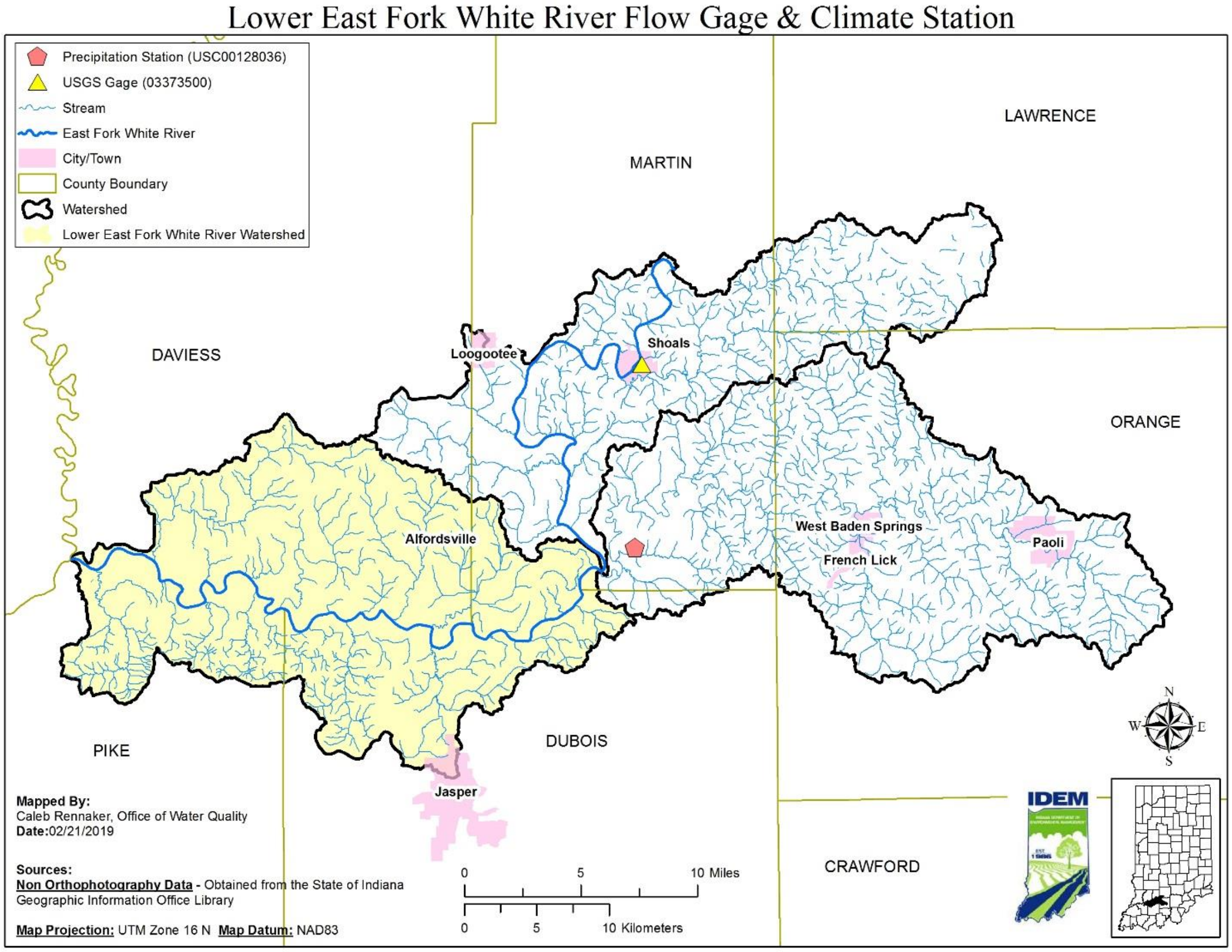

Figure 26: Location of Surrogate Flow Gage in Shoals, IN

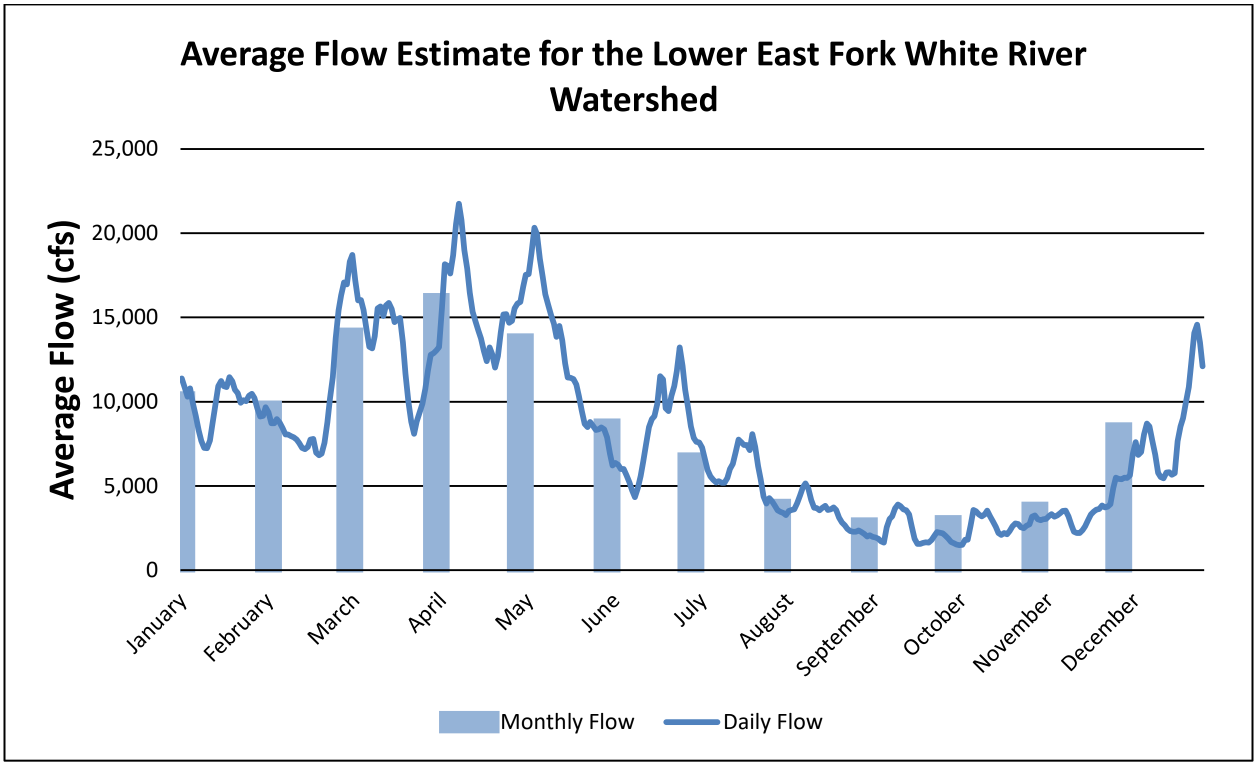

Figure 27: Average Daily Flow Estimate for the Lower East Fork White River Watershed for data from 2008-2018

3.3 Margin of Safety (MOS)

Section 303(d) of the Clean Water Act and U.S. EPA regulations at 40 CFR 130.7 require that "TMDLs shall be established at levels necessary to attain and maintain the applicable narrative and numeric water quality standards with seasonal variations and a MOS which takes into account any lack of knowledge concerning the relationship between limitations and water quality." U.S. EPA guidance explains that the MOS may be implicit (i.e., incorporated into the TMDL through conservative assumptions in the analysis) or explicit (i.e., expressed in the TMDL as loadings set aside for the MOS). This TMDL uses both an implicit and explicit MOS. An implicit MOS was used by applying a couple of conservative assumptions. A moderate explicit MOS has been applied by reserving ten percent of the allowable load. Ten percent was considered an appropriate MOS based on the following considerations:

- The use of the load duration curve approach minimizes a great deal of uncertainty associated with the development of TMDLs because the calculation of the loading capacity is simply a function of flow multiplied by the target value. Most of the uncertainty is therefore associated with the estimated flows in each assessed segment which were based on extrapolating flows from the nearest USGS gage.
- An additional implicit MOS for *E. coli* is included because the load duration analysis does not address die-off of pathogens.

- An additional implicit MOS for pollutants is realized in that when in compliance NPDES permitted sources are seldom discharging at their allowable limits.

3.4 Future Growth Calculations

Population trends are indicating that this watershed has been increasing (Table 23) over the past two decades; uncertainty in future populations in the Lower East Fork White River Watershed have led IDEM to choose to allocate 5% of the loading capacity toward future growth. IDEM anticipates that land uses will likely be changing in the watershed in the future and, in anticipation of those land use changes, has set aside 5% of the loading capacity to address increased bacteria and nutrient loads from those future contributors. Mining activity continues to play an important role in land use activities and disturbance in the Lower East Fork White River watershed. Mining operations are not static in the landscape, and may move outfall locations as activities are conducted. Additionally, new sources of mining activities can change based on new technology for extracting coal and/or economic feasibility. As such, IDEM has chosen to allocate 10% of the loading capacity to address increased sediment loads from future contributors.

4.0 Linkage Analysis

A linkage analysis connects the observed water quality impairment to what has caused that impairment. An essential component of developing a TMDL is establishing a relationship between the source loadings and the resulting water quality. Potential point and nonpoint sources are inventoried in Section 2.0 and water quality data within the Lower East Fork White River Watershed are discussed in Section 1.4. The purpose of this section of the report is to evaluate which of the various potential sources is most likely to be contributing to the observed water quality impairments.

The load duration curves illustrate water quality standards and target value violations during all flow ranges that occurred during sampling events. A discussion of sampling sites in the subwatershed is included following the figures. Each discussion begins with a table that provides a summary of the subwatershed, including impaired segment AUID, drainage area, sampling sites, listed segments, land use, NPDES facilities, MS4 community, CSO communities, CFOs, and CAFOs, as well as LAs, WLAs, and MOS values for pollutants of concern. Evaluating the load duration curves and precipitation graphs with consideration of these watershed characteristics allows for identification of potential point and nonpoint sources that are contributing to elevated pollutants of concern concentrations.

Load duration curves were created for each subwatershed in the Lower East Fork White River watershed that were sampled by IDEM in 2017-2018. The load duration curve method considers how stream flow conditions relate to a variety of pollutant loadings and their sources (point and nonpoint). Section 3.0 summarizes the load duration curve approach. This section discusses the load duration curves and the linkage between the potential sources in the Lower East Fork White River watershed and the observed water quality impairment.

To further investigate sources, water quality precipitation graphs have been created. Elevated levels of pollutants during rain events indicate contributions of pollutants due to run-off. The precipitation data was taken from a weather station in Shoals, IN and managed by the Midwestern Regional Climate Center.

The following sections discuss the load duration curves, precipitation graphs and linkage of sources to the water quality exceedances for each subwatershed. Load duration curves and precipitation graphs were created for each subwatershed.

4.1 Pollutants

E. coli

Establishing a linkage analysis for *E. coli* is challenging because there are so many potential sources and *E. coli* counts have a high degree of variability. While it is difficult to perform a site-specific assessment of the causes of high *E. coli* for each location in a watershed, it is reasonable to expect that general patterns and trends can be used to provide some perspective on the most significant sources. Additional information is outlined in Section 1.1.1.

E. coli sources typically associated with high flow and moist conditions include failing onsite wastewater systems, urban stormwater/CSOs, run-off from agricultural areas, and bacterial re-suspension from the streambed. *E. coli* sources typically associated with low flow conditions include a large number of homes on failing or illicitly connected septic systems that would provide a constant source. Elevated *E. coli* levels at low flow could also result from inadequate disinfection at wastewater treatment plants or animals with direct access to streams.

Total Phosphorus

Nutrients come in many forms, including nitrogen, phosphorus, ammonia, total Kjeldahl nitrogen (TKN), nitrite, and nitrate. Information presented in the water quality assessment describes nutrient conditions in the Lower East Fork White River watershed. Additional information is outlined in Sections 1.1.2 and 1.1.3.

Total phosphorus concentrations are naturally low in surface waters, but high in rivers and streams located in agricultural and urban areas, or that receive wastewater discharges. High phosphorus levels in streams increase the growth of plants and algae, reducing the quality of the habitat and causing low oxygen levels at night when the plants and algae are respiring but not photosynthesizing.
The load duration curves indicate that nonpoint sources as well as point sources may be contributing to the impairment, however there are no permitted dischargers for phosphorus. Nonpoint sources might include sediment-bound phosphorus that enters the river during erosional processes, as well as the run-off of storms over fertilized fields and residential areas. Septic systems might also be a potential source of phosphorus if the systems are failing and located adjacent to the streams.

Total Suspended Solids (TSS)

Developing a linkage analysis to address the connection between siltation and its effect on aquatic life uses often involves an evaluation of multiple factors. The interaction between erosion processes and hydrology is an important part of the assessment, with land use, riparian areas, and channel conditions being key considerations. Each can play a potential role in both creating and solving sediment problems. The sediment issues can occur when external inputs (e.g., sediment, run-off volume) to the stream become excessive, or when stream characteristics are altered so that it can no longer assimilate the loads, or a combination of both occur. Additional information is outlined in Section 1.1.3.

Sheet erosion is the detachment of soil particles by raindrop impact and their removal by water flowing overland as a sheet instead of in channels or rills. Rill erosion refers to the development of small, ephemeral concentrated flow paths, which function as both sediment source and sediment delivery systems for erosion on hillslopes. Sheet and rill erosion occurs more frequently in areas that lack or have sparse vegetation.

Bank and channel erosion refers to the wearing away of the banks of a stream or river. High rates of bank and channel erosion can often be associated with water flow and sediment dynamics being out of balance. This may result from land use activities that either alter flow regimes, adversely affect the floodplain and streamside riparian areas, or a combination of both. Hydrology is a major driver for both sheet/rill and stream channel erosion. Bank and channel erosion is made worse when streams are straightened or channelized because channelization shortens overall stream lengths and results in increased velocities, bed and bank erosion, and sedimentation. Modified stream channels often have little habitat structure and variability necessary for diverse and abundant aquatic species. Channelization also disconnects streams from floodplain and riparian areas that are often converted to developed or agricultural lands.

Since monitoring began, TSS in the Lower East Fork White River watershed has sporadically exceeded the target. TSS tends to exceed target values in the spring and summer months, although data is incomplete or lacking for the winter months. High loads in the spring may be related to the plowing and planting of agricultural fields occurring during these months, increasing the opportunity for sheet and rill erosion. Further analysis pairing the TSS concentrations with flow conditions reveals elevated TSS concentrations during high flows and slightly lower concentrations during mid-range and lower flow conditions. Elevated TSS concentrations during high flows are consistent with significant loads coming from stream bank and gully erosion.

4.2 Mill Creek

The Mill Creek subwatershed drains approximately 20 square miles. The subwatershed drains into the main stem of the East Fork White River just north of Jasper, IN. The land use is primarily agriculture (53%) followed by forested land (27%) and hay and developed land (12%). There is one MS4 permit held by the city of Jasper (INR040067) which covers approximately 10% of the subwatershed by area. The majority of the subwatershed is rural indicating homes pump to on-site septic systems. Based on the septic suitability of the soil, this entire subwatershed is very limited. Maintenance and inspections of septic systems in the area is important to ensure proper function and capacity. The landscape in the area is relatively flat leading to its intense conversion to agricultural production and use. In many areas of the subwatershed there are little to no remaining riparian buffers left along its banks due to agricultural practices. Despite its flat nature the subwatershed does contain significant amounts of highly erodible soil types. These soil types can be susceptible to sheet, rill, and isolated gully erosion, and can contribute to sediment loss from agricultural lands, as well as lands from high gradient slopes.

Many of the waterways in this subwatershed are identified as having hydric soil types in their riparian zones. These areas could be potential locations for wetland restoration or high functioning two-stage ditch implementation. With a land use of less than 10 percent pasture land a heavy presence of pasture animals is not expected. There are 6 permitted CFOs in the watershed.

There are two monitoring sites located in this subwatershed, WEL-15-0011 (T05) and WEL-15-0012 (T06), both established on Mill Creek. In 2017-2018 this watershed was sampled 27 times between the two sites resulting in both failing WQS for *E.coli*. These stream reaches will be placed on the 2020 303(d) list of impaired waters. The *E. coli* geomean for T05 was 722.1 MPN with 4/10 samples in exceedance of the single sample max; while T06 had a geomean of 1,739.93 with 9/9 samples in exceedance of the single sample max. The geomeans from site T05 and T06 were taken on the same day approximately one hour apart for five consecutive weeks. High *E. coli* levels are reflective of high animal concentration and land application of waste. The fish community IBI score for site T05 was 44 (fair) and the QHEI was 46 (poor). The macro community mIBI score was 38 (fair) and the QHEI was 43 (Poor). The fish community IBI score for site T06 was 46 (good) and the QHEI was 60 (good). The macro community mIBI score was 38 (fair) and the QHEI was 52 (good). Load Duration curves for the Mill Creek subwatershed is listed in Table 33.

Based on the water quality duration graphs and limited permitted sources, it can be concluded that the majority of sources of *E. coli* in this watershed are nonpoint sources. There are approximately 35 miles of stream in the subwatershed. Based on IDEM data collected in 2017-2018 impairments include 34 stream miles for *E. coli* listed on the 2020 303(d) List of Impaired Waters. Therefore, TMDLs have been developed to address all *E. coli* impairments in Mill Creek.

Table 33: Summary of Mill Creek Subwatershed Characteristics

Mill Creek (051202081501)					
Drainage Area	19.57 square miles				
Surface Area	19.57 square miles				
TMDL Sample Site	WEL-15-0011, WEL-15-0012				
Listed Segments	INW08F1_01; INW08F1_02; INW08F1_03; INW08F1_T1001; INW08F1_T1004; INW08F1_T1005; INW08F1_T1006; INW08F1_T1007				
Listed Impairments [TMDL(s)]	*E. coli* [*E. coli*]				
Land Use	Agricultural Land: 53% Forested Land: 27% Developed Land: 12% Open Water: <1% Pasture/Hay: 8% Grassland/Shrubs: <1% Wetland: <1%				
NPDES Facilities	City of Jasper MS4 (INR040067)				
CAFOs	NA				
CFOs	T & J Hoffman Farm, LLC (Farm ID: 1245), Mill Creek Farms (Farm ID: 3884), Haysville Mill Farm Inc. (Farm ID: 4542), Mike Haase (Farm ID: 4923), Weisheit Brothers Farm (Farm ID: 6296), Fuhrman Farms (Farm ID: 6535)				
TMDL *E. coli* Allocations (MPN/day)					
Allocation Category **Duration Interval (%)**	**High Flows** **5%**	**Moist Conditions** **25%**	**Mid-Range Flows** **50%**	**Dry Conditions** **75%**	**Low Flows** **95%**
LA	3.741E+11	1.605E+11	8.424E+10	3.159E+10	1.127E+10
WLA (Total)	4.132E+10	1.773E+10	0.000E+00	0.000E+00	0.000E+00
MOS (10%)	4.887E+10	2.097E+10	9.911E+09	3.717E+09	1.326E+09
Future Growth (5%)	2.444E+10	1.048E+10	4.956E+09	1.858E+09	6.629E+08
TMDL = LA+WLA+MOS	**4.887E+11**	**2.097E+11**	**9.911E+10**	**3.717E+10**	**1.326E+10**

WLA (Individual)					
City of Jasper MS4	4.132E+10	1.773E+10	NA	NA	NA

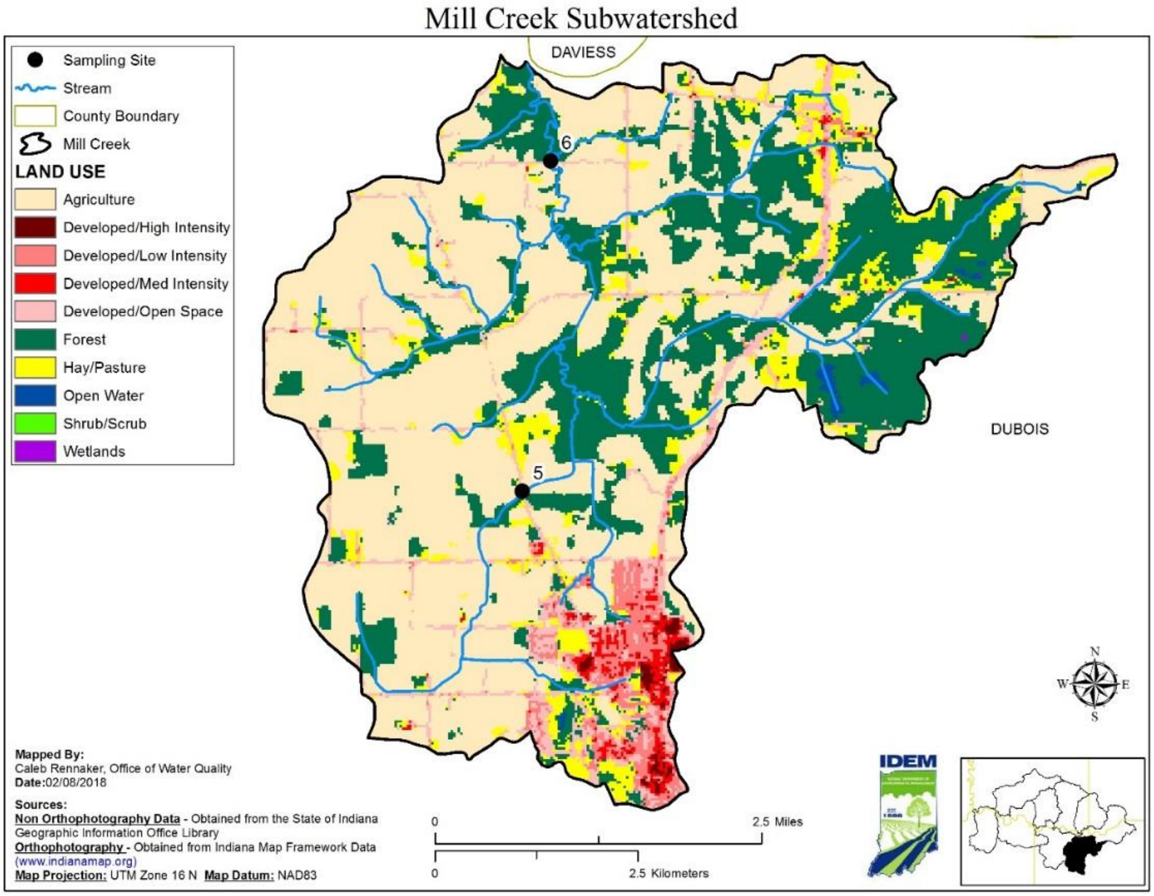

Figure 28: Sampling stations in Mill Creek Subwatershed

The precipitation graph for these sites shows the streams are susceptible to high loads of *E. coli* from run-off. The streams are consistently in violation of water quality standards even during drier conditions on the chart. This indicates point sources may be contributing along with nonpoint sources. If animals have direct access to streams this could contribute to *E. coli* violations at dry and wet conditions. Water quality duration graphs are presented in Appendix D.

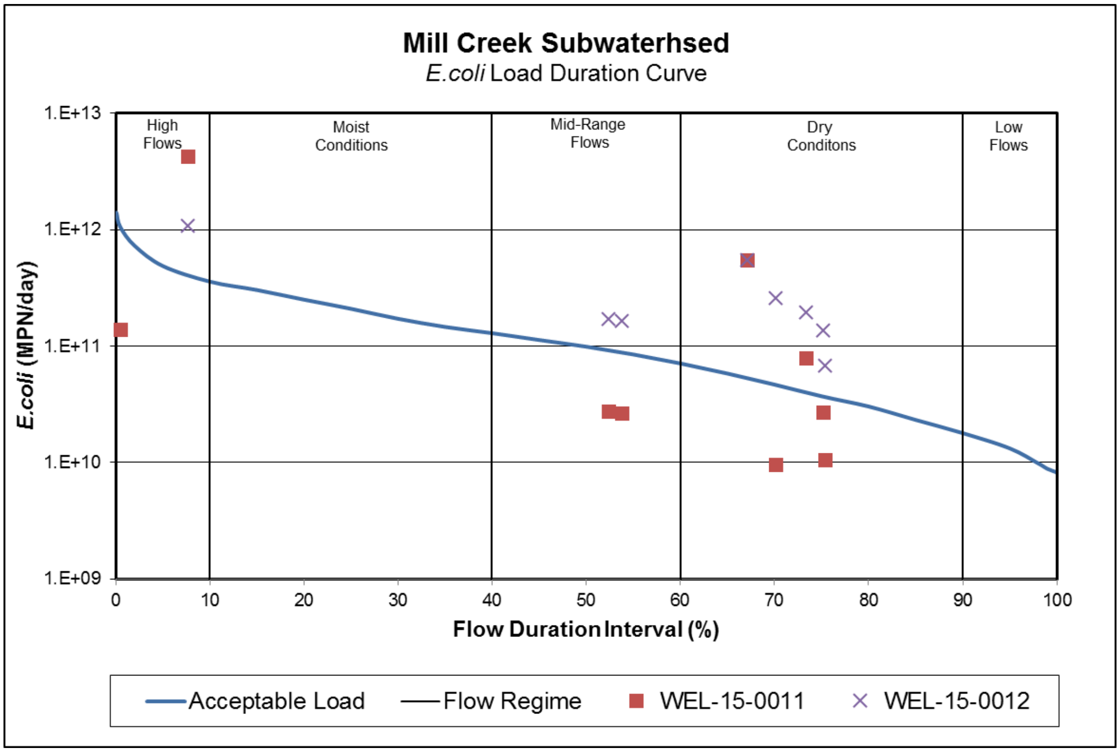

Figure 29: Load Duration Curve for Mill Creek Subwatershed.

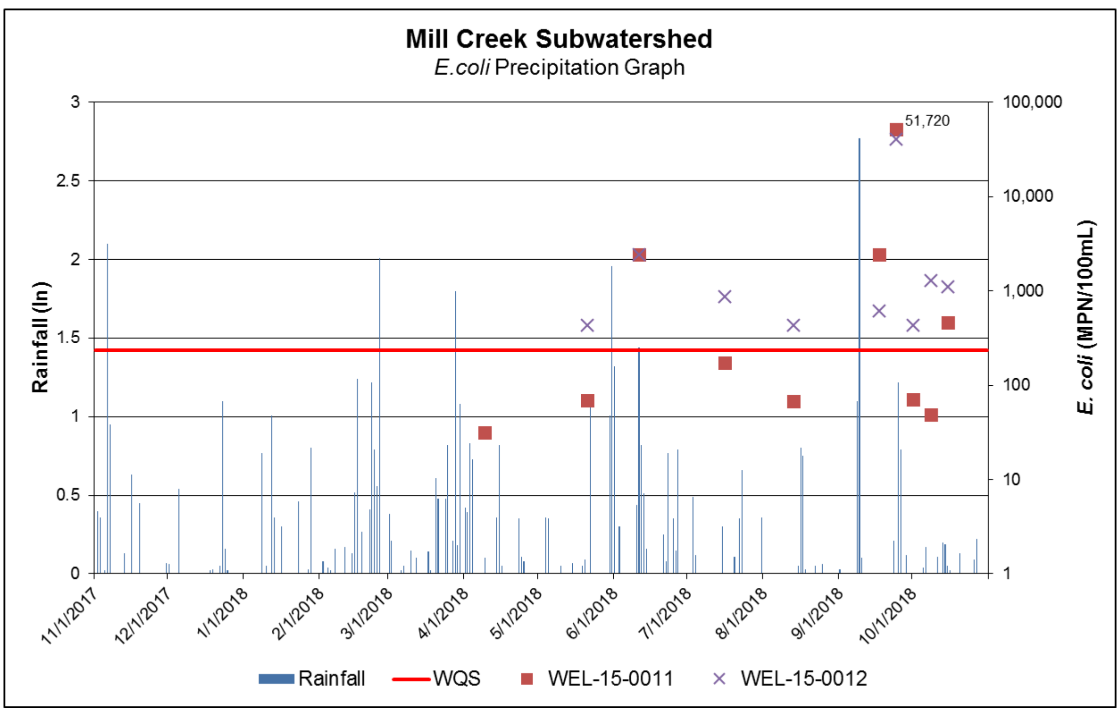

Figure 30: Graph of Precipitation and *E.coli* Data Mill Creek Subwatershed

4.3 Hoffman Run

The Hoffman Run subwatershed drains approximately 5,557 square miles with an actual land area of approximately 22 square miles. Water drains into the East Fork White River and continues flowing east to west throughout the subwatershed. The land use is primarily forest land (52%), followed by agriculture (35%) and hay and pasture land (7%). There are no NPDES permitted dischargers in the subwatershed. The majority of the subwatershed is rural indicating homes pump to on-site septic systems. Based on the septic suitability of the soil, this entire subwatershed is very limited. Maintenance and inspections of septic systems in the area is important to ensure proper function and capacity. The landscape in the area is relatively flat leading to its intense conversion to agricultural production and use. In many areas of the subwatershed there are little to no remaining riparian buffers along the streambanks due to agricultural practices. Despite its flat nature the subwatershed does contain significant amounts of highly erodible soil types. These soil types can be susceptible to sheet, rill, and isolated gully erosion and can contribute to sediment loss from agricultural lands, as well as lands from high gradient slopes.

Many of the waterways in this subwatershed are identified as having hydric soil types in their riparian zones. These areas could be potential locations for wetland restoration or high functioning two-stage ditch implementation. With a land use of 7 percent pasture land a heavy presence of pasture animals is not expected. There are 5 permitted CFOs in the watershed.

Due to local constraints including accessibility, there were no sample sites located directly in this subwatershed. However, site WEL-14-0003 (T01) was sampled directly upstream of the subwatershed on the East Fork White River in order to better characterize incoming contributions from upstream sources. Additionally, site WEL-15-0010 (T07) on the East Fork White River is located within the Sugar Creek subwatershed directly downstream of the Hoffman Run subwatershed. These two sampling locations were used to characterize both inflowing and outflowing pollutants in the subwatershed. In 2017-2018 T01, the upstream site, was sampled 15 times, and T07, the downstream site, was sampled 16 times which resulted in both sites meeting the WQS for *E. coli*. The *E. coli* geomean for T01 on the East Fork White River was 41.46 MPN with 1/9 samples in exceedance of the single sample max. Site T07 had a geomean of 75.46 with 2/10 samples in exceedance of the single sample max. The geomeans from sites T01 and T07 were taken on the same day approximately one hour apart for five consecutive weeks. High *E. coli* levels are reflective of high animal concentration and land application of waste. Although some samples were in exceedance of the single sample maximum value, calculated geometric means used for assessments were meeting water quality standards in Hoffman Run.

The fish community IBI score for site T01 was 16 (very poor) and the QHEI was 60 (good). The macro community mIBI score was 26 (poor) and the QHEI was 51 (good). Load Duration curves were developed for the subwatershed and are summarized in Table 34.

TSS concentrations ranged from 3 mg/L to 160 mg/L across 11 sampling events at the upstream site (T01) of the main stem of the East Fork White River, and exceeded the target value 9/11 times. At the downstream site (T07) of the East Fork White River, concentrations ranged from 4.5 to 550 mg/L across 12 sampling events, and exceeded the target value 10/12 times. Given that targets for TSS were violated in excess at sites immediately located upstream and downstream of the subwatershed, it is reasonable to believe that TSS is a prevalent pollutant in the main stem of the East Fork White River throughout

Hoffman Run subwatershed. Therefore, a TSS TMDL was developed to address impaired biological communities in this subwatershed.

Based on the water quality duration graphs, it can be concluded that the majority of sources of TSS in this watershed are nonpoint sources that include agricultural practices, streambank erosion, and stormwater run-off. There are approximately 47 miles of stream in the subwatershed. Based on IDEM data collected in 2017-2018 there will be 18 stream miles impaired for biotic communities listed on the 2020 303(d) List of Impaired Waters.

Table 34: Summary of Hoffman Run Subwatershed Characteristics

Hoffman Run (051202081502)					
Drainage Area	5,556.86 square miles				
Surface Area	22.42 square miles				
TMDL Sample Site	WEL-14-0003 (US), WEL-15-0010 (DS)				
Listed Segments	INW08F2_02, INW08F2_03				
Listed Impairments [TMDL(s)]	Impaired Biotic Communities [TSS]				
Land Use	Agricultural Land: 35% Forested Land: 52% Developed Land: 3% Open Water: 2% Pasture/Hay: 7% Grassland/Shrubs: <1% Wetland: <1%				
NPDES Facilities	NA				
CAFOs	NA				
CFOs	Ronald D Divine (Farm ID: 880), Deer Run (Farm ID: 2794), Wabash Valley Produce Inc. Sky View Farm (Farm ID:3745), D C Poultry Inc. (Farm ID: 3749), Farbest Farms Brooder 1 (Farm ID: 6446)				
TMDL Total Suspended Solids Allocations (Lbs/day)					
Allocation Category **Duration Interval (%)**	**High Flows** **5%**	**Moist Conditions** **25%**	**Mid-Range Flows** **50%**	**Dry Conditions** **75%**	**Low Flows** **95%**
LA	12,666.76	5,435.16	2,568.87	963.32	343.63
WLA (Total)	0.00	0.00	0.00	0.00	0.00
MOS (10%)	1,583.34	679.40	321.11	120.42	42.95
Future Growth (10%)	1,583.34	679.40	321.11	120.42	42.95
Upstream Drainage Input (East Fork White River)	3,889,369.88	1,668,885.00	788,778.75	295,792.03	105,512.79
TMDL = LA+WLA+MOS	**3,905,203.32**	**1,675,678.95**	**791,989.83**	**296,996.19**	**105,942.33**

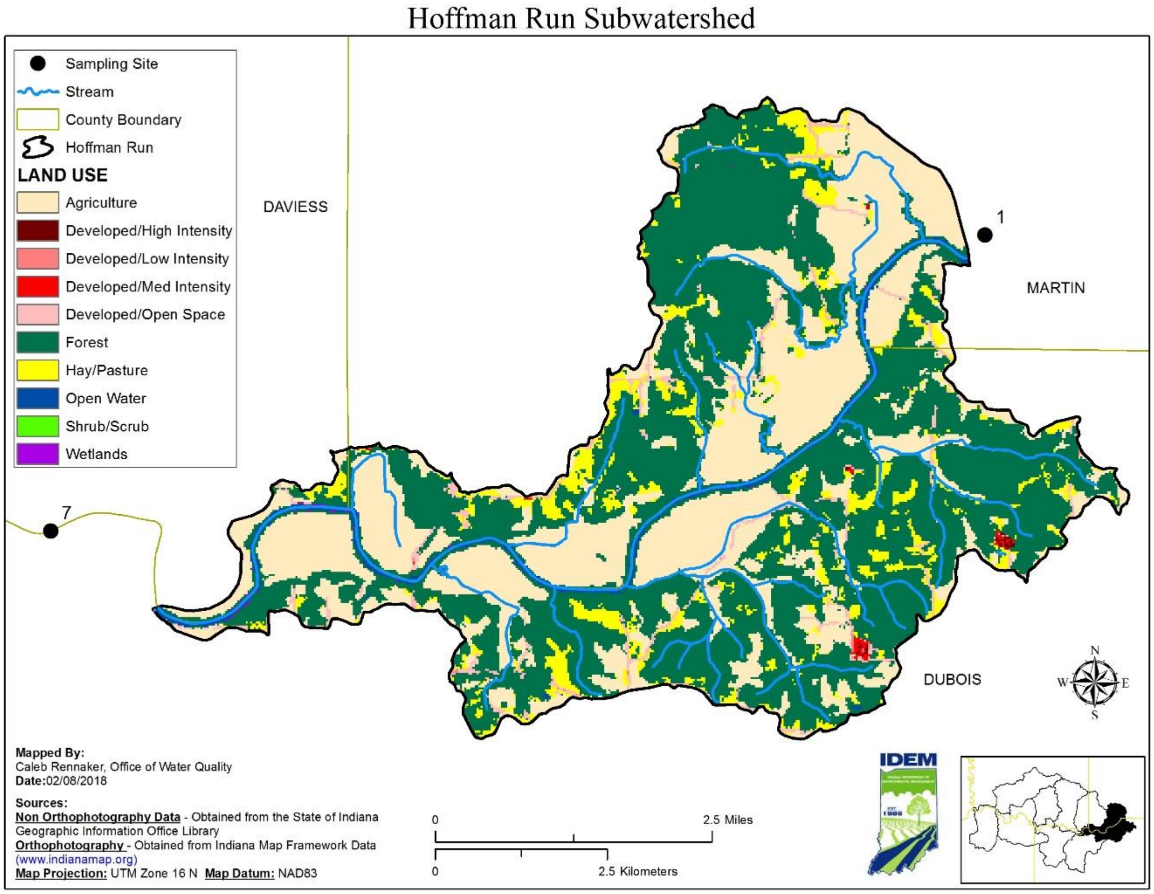

Figure 31: Sampling stations in Hoffman Run Subwatershed

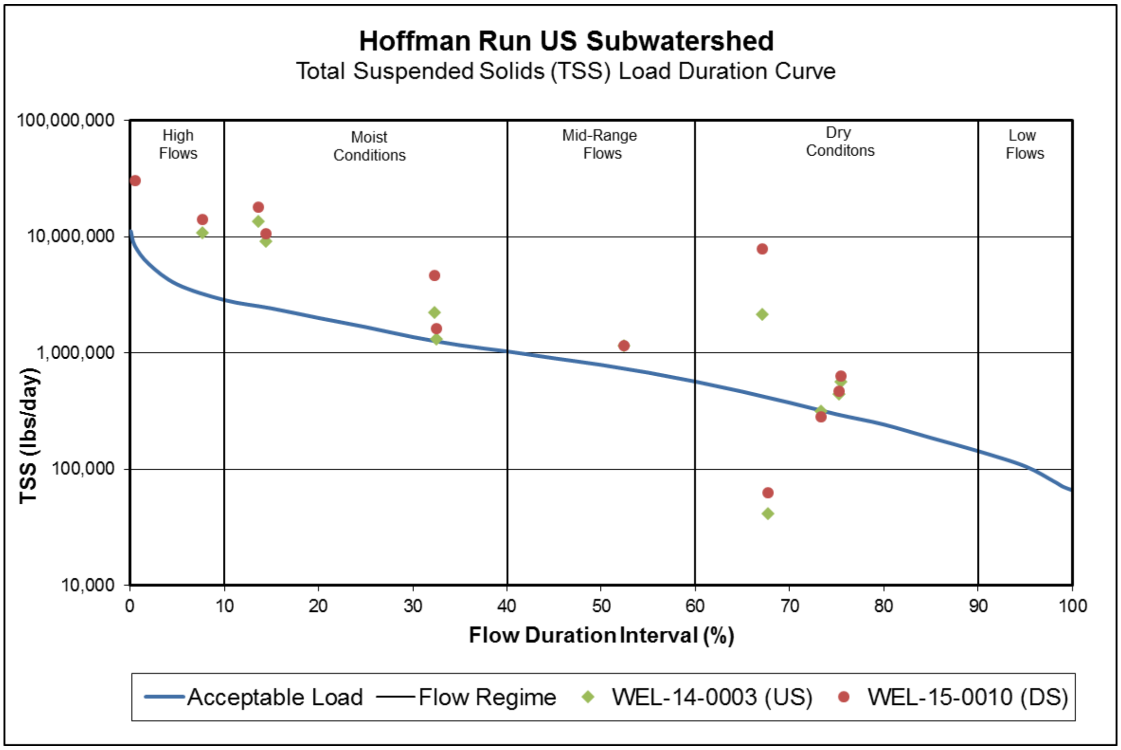

Figure 32: Total Suspended Solids Load Duration Curve for Hoffman Run Subwatershed for Upstream (US) and Downstream (DS) sampling locations.

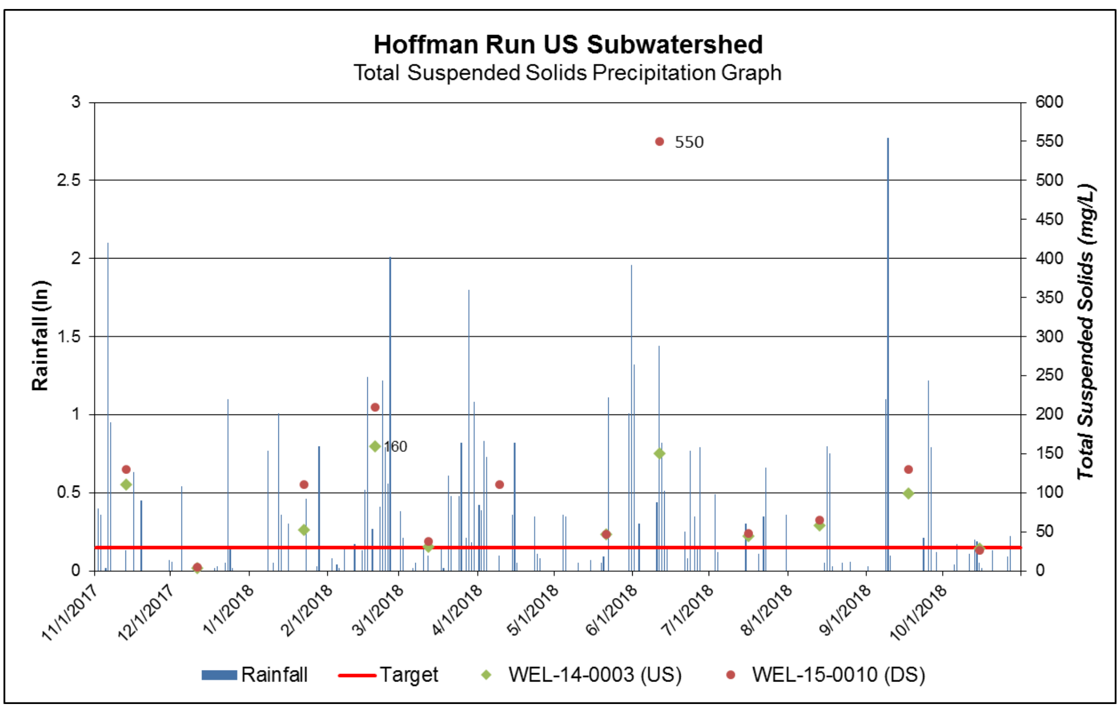

Figure 33: Graph of Precipitation and Total Suspended Solids Data in Hoffman Run Subwatershed Upstream (US) and Downstream (DS) sampling locations.

The precipitation graph for these sites shows the stream is susceptible to high loads of TSS from run-off. The stream is consistently in violation of water quality targets even during drier conditions on the chart. This indicates point sources may be contributing along with nonpoint sources, however there are no permitted dischargers for TSS within the watershed. Water quality duration graphs are presented in Appendix D.

4.4 Slate Creek

The Slate Creek subwatershed drains approximately 19 square miles. The subwatershed drains directly into the mainstem of the East Fork White River just north of Jasper, IN. The land use is primarily agriculture (44%), followed by forested land (34%) and hay and pasture land (16%). There are no NPDES permitted facilities in the subwatershed. The majority of the subwatershed is rural indicating homes pump to on-site septic systems. Based on the septic suitability of the soil, this entire subwatershed is very limited. Maintenance and inspections of septic systems in the area is important to ensure proper function and capacity. The landscape in the area is relatively flat leading to its intense conversion to agricultural production and use. In many areas of the subwatershed, there are little to no remaining riparian buffers along streambanks due to agricultural practices. Despite its flat nature the subwatershed does contain significant amounts of highly erodible soil types. These soil types can be susceptible to sheet, rill, and isolated gully erosion and can contribute to sediment loss from agricultural lands, as well as lands from high gradient slopes.

Many of the waterways in this subwatershed are identified as having hydric soil types in their riparian zones. These areas could be potential locations for wetland restoration or high functioning two-stage ditch implementation. With a land use of 16 percent pasture land a heavy presence of pasture animals is not expected. There are 10 permitted CFOs in the watershed.

There are three monitoring sites located in this subwatershed, WEL-15-0008(T02) and WEL-15-0007(T04) on Slate Creek and WEL-15-0021(T03) on a tributary of Slate Creek. In 2017-2018 this watershed was sampled 38 times between the three sites resulting in all three failing WQS for *E.coli*. These stream reaches will be placed on the 2020 303(d) List of Impaired Waters. The *E. coli* geomean for T02 was 431.86 MPN with 6/10 samples in exceedance of the single sample max. Site T04 had a geomean of 262.8 with 5/10 samples in exceedance of the single sample max. Finally, site T03 had a geomean of 235.03 with 3/9 samples in exceedance of the single sample max. The geomeans from sites T02, T04, and T03 were taken on the same day approximately one hour apart for five consecutive weeks. High *E. coli* levels are reflective of high animal concentration and land application of waste.

The fish community IBI score for site T02 was 40 (fair) and the QHEI was 52 (good). The macro community mIBI score was 30 (poor) and the QHEI was 39 (Poor). The fish community IBI score for site T04 was 34 (poor) and the QHEI was 38 (poor). The macro community mIBI score was 38 (fair) and the QHEI was 48 (poor). The fish community IBI score for site T03 was 30 (poor) and the QHEI was 26 (poor). The macro community mIBI score was 38 (fair) and the QHEI was 38 (poor). Load Duration curves for the subwatershed were developed and are summarized in Table 35.

TSS concentrations ranged from 2 mg/L to 2,200 mg/L across 25 sampling events within the watershed, and exceeded the target value four times. Total phosphorus concentrations ranged from 0.026 mg/L to 0.97 mg/L across 25 sampling events within the watershed, and exceeded the target value three times. All stream segments within the watershed were determined to be impaired for nutrients with total phosphorus being consistently over the target value in those determinations. Additionally, dissolved oxygen was found below water quality standards on multiple occasions on Slate Creek (T04). Given that targets for total phosphorus and TSS were sporadically violated throughout the watershed, TMDLs were developed to address the biological communities and dissolved oxygen impairments within the watershed. Additionally, high total phosphorus values are also believed to be a primary linkage to the nutrients impairments within the watershed. Therefore, a TMDL for total phosphorus will also serve to address nutrients impairments in this subwatershed.

Based on the water quality duration graphs, it can be concluded that the majority of sources of *E. coli*, TSS, and total phosphorus 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; streambank erosion; and agricultural practices.

There are approximately 36 miles of stream in the subwatershed. Based on IDEM data collected in 2017-2018 there will be 36 stream miles impaired for *E. coli*, 21 miles impaired for biological communities, 4 miles impaired for dissolved oxygen, and 36 miles impaired for nutrients listed on the 2020 List of Impaired Waters. Therefore, *E. coli* TMDLs were developed to address all *E. coli* impairments, TSS TMDLs were developed to address all impaired biotic communities, and TP TMDLs were developed to address all nutrients impairments. Additionally, both TP and TSS TMDLs will be used to address all DO impairments in the subwatershed.

Table 35: Summary of Slate Creek Subwatershed Characteristics

Slate Creek (051202081503)					
Drainage Area	18.73 square miles				
Surface Area	18.73 square miles				
TMDL Sample Site	WEL-15-0008, WEL-15-0007, WEL-15-0021				
Listed Segments	INW08F3_01; INW08F3_02; INW08F3_03; INW08F3_T1002; INW08F3_T1003; INW08F3_T1004; INW08F3_T1005				
Listed Impairments [TMDL(s)]	*E. coli* [*E. coli*], Impaired Biotic Communities [TSS], Nutrients [TP], Dissolved Oxygen [TP & TSS]				
Land Use	Agricultural Land: 44% Forested Land: 34% Developed Land: 6% Open Water: <1% Pasture/Hay: 16% Grassland/Shrubs: 0% Wetland: <1%				
NPDES Facilities	NA				
CAFOs	NA				
CFOs	Josh & Kristi Ausbrooks (Farm ID: 3207), NSL Farms Incorporated (Farm ID: 3554), Matheis Poultry 1 (Farm ID: 3648), Lottes Farms Incorporated (Farm ID: 3930), Slate Creek Farms (Farm ID: 4020), Matheis Poultry 2 (Farm ID: 4447), Zach Taylor (Farm ID: 4856), Kopps Turkey Sales Inc. Caleb Ridge (Farm ID: 6244), White River, LLC Eagle Farms (Farm ID: 6432), Farbest Farms Brooder Hub 2 (Farm ID: 6539)				
TMDL *E. coli* Allocations (MPN/day)					
Allocation Category **Duration Interval (%)**	**High Flows** **5%**	**Moist Conditions** **25%**	**Mid-Range Flows** **50%**	**Dry Conditions** **75%**	**Low Flows** **95%**

LA	3.976E+11	1.706E+11	8.063E+10	3.024E+10	1.079E+10
WLA (Total)	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
MOS (10%)	4.677E+10	2.007E+10	9.486E+09	3.557E+09	1.269E+09
Future Growth (5%)	2.339E+10	1.003E+10	4.743E+09	1.779E+09	6.344E+08
TMDL = LA+WLA+MOS	**4.677E+11**	**2.007E+11**	**9.486E+10**	**3.557E+10**	**1.269E+10**

TMDL Total Suspended Solids Allocations (Lbs/day)					
Allocation Category	**High Flows**	**Moist Conditions**	**Mid-Range Flows**	**Dry Conditions**	**Low Flows**
LA	10,530.33	4,518.45	2,135.59	800.85	285.67
WLA	0.00	0.00	0.00	0.00	0.00
MOS (10%)	1,316.29	564.81	266.95	100.11	35.71
Future Growth (10%)	1,316.29	564.81	266.95	100.11	35.71
TMDL = LA+WLA+MOS	**13,162.91**	**5,648.06**	**2,669.49**	**1,001.06**	**357.09**

TMDL Total Phosphorus Allocations (Lbs/day)					
Allocation Category	**High Flows**	**Moist Conditions**	**Mid-Range Flows**	**Dry Conditions**	**Low Flows**
LA	111.88	48.01	22.69	8.51	3.04
WLA	0.00	0.00	0.00	0.00	0.00
MOS (10%)	13.16	5.65	2.67	1.00	0.36
Future Growth (5%)	6.58	2.82	1.33	0.50	0.18
TMDL = LA+WLA+MOS	**131.63**	**56.48**	**26.69**	**10.01**	**3.57**

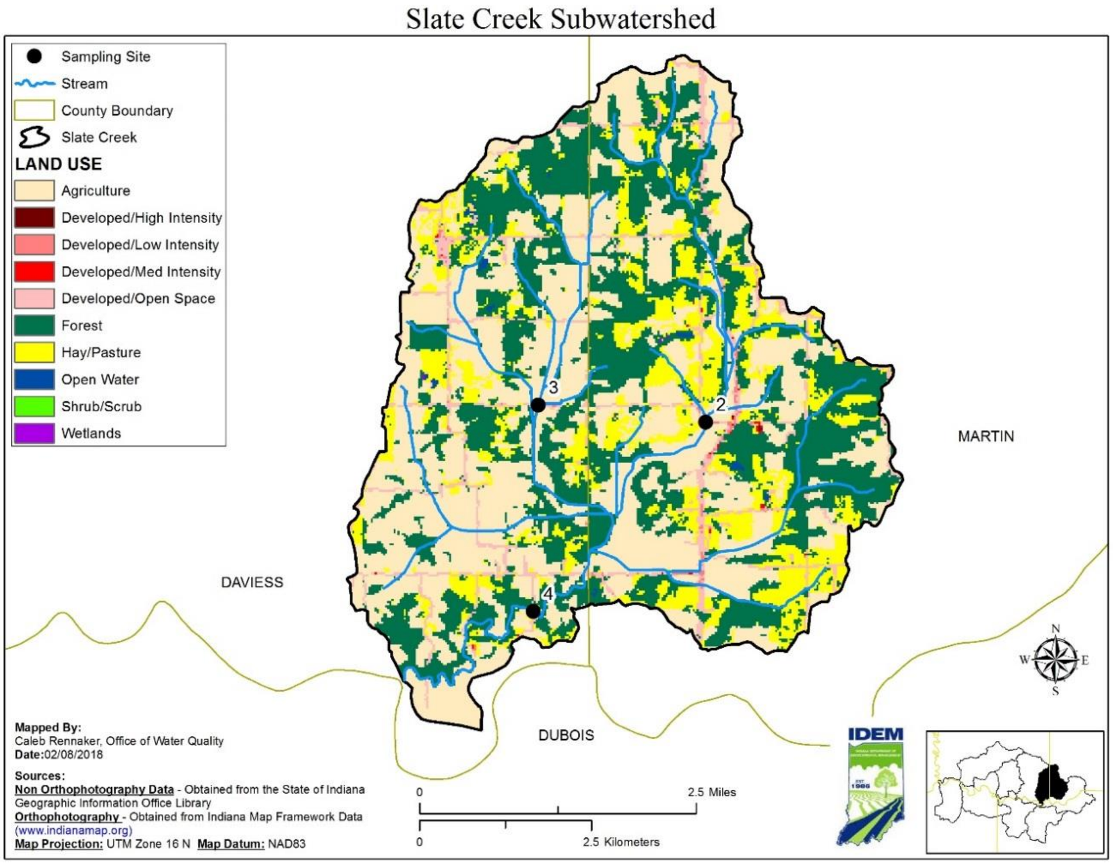

Figure 34: Sampling stations in Slate Creek Subwatershed

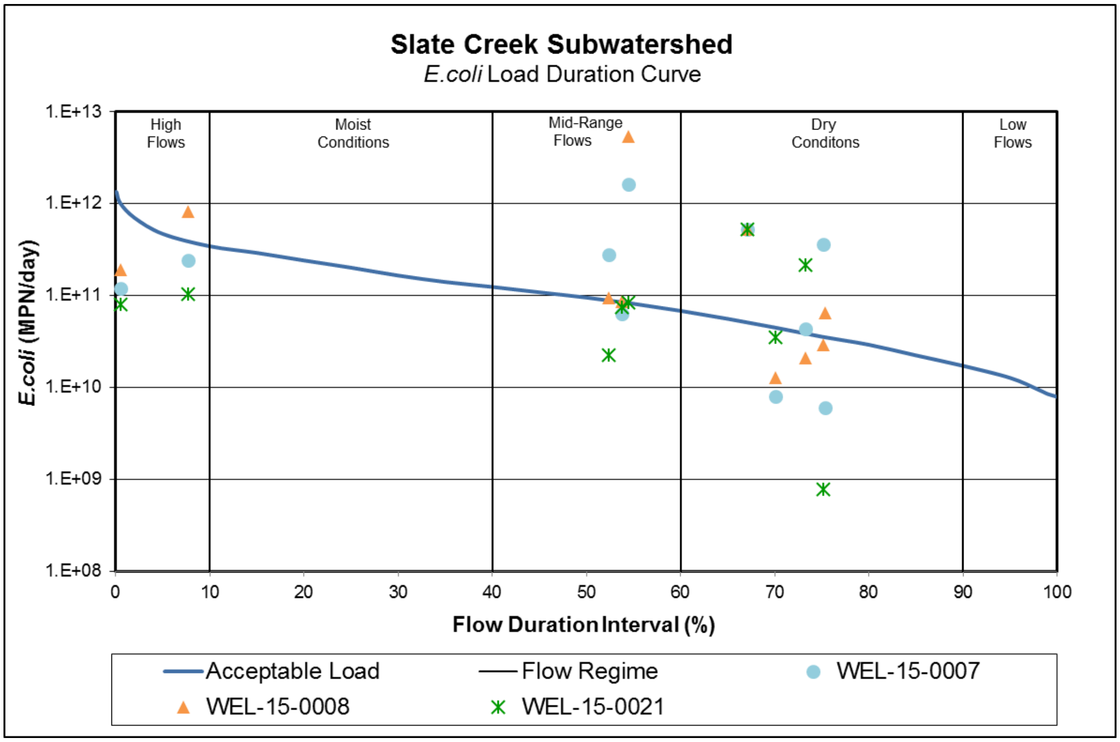

Figure 35: *E. coli* Load Duration Curve for Slate Creek Subwatershed

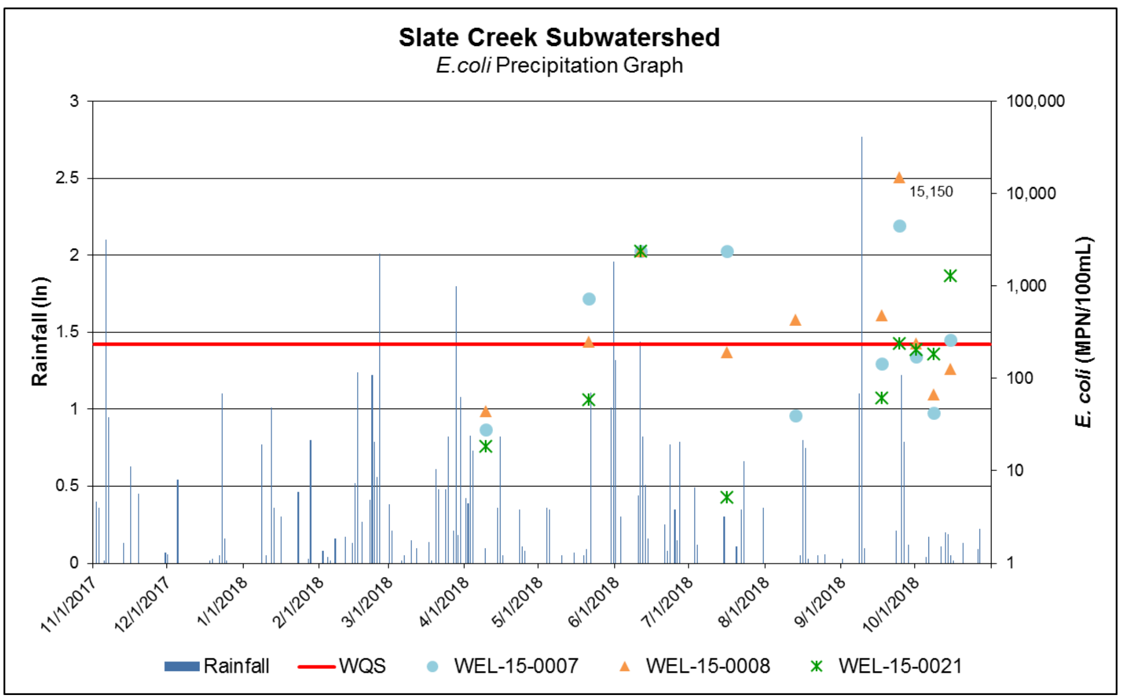

Figure 36: Graph of Precipitation and *E.coli* Data at Slate Creek Subwatershed

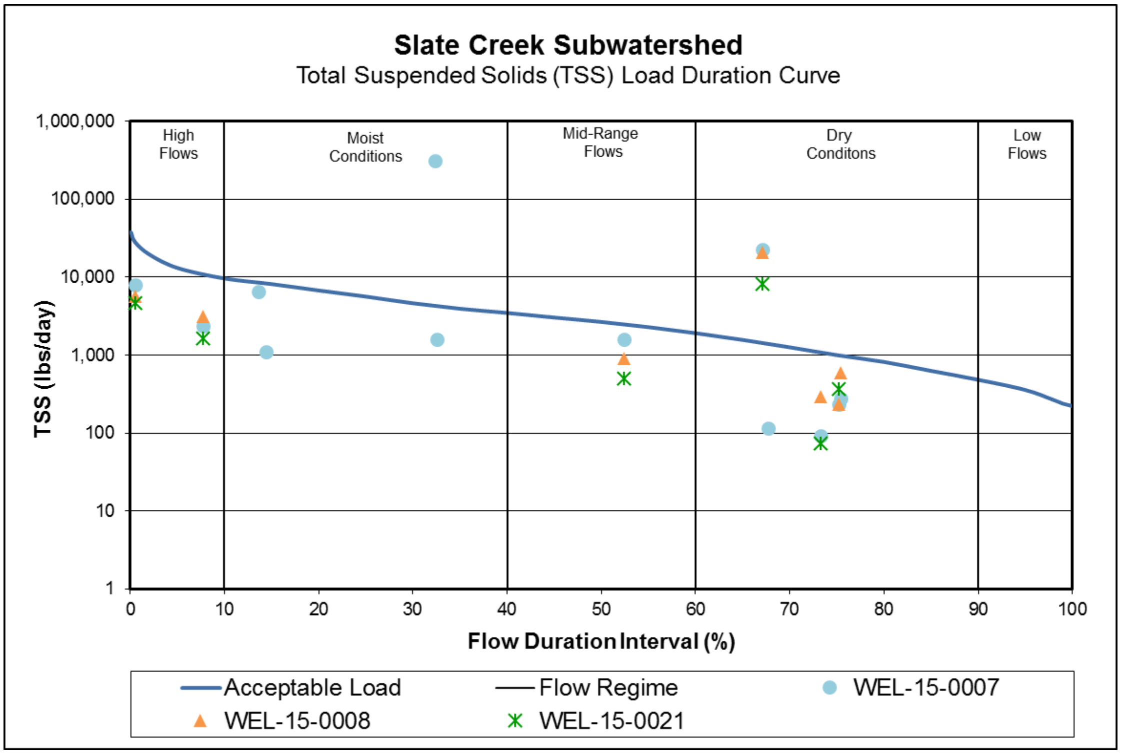

Figure 37: Total Suspended Solids Load Duration Curve for Slate Creek Subwatershed

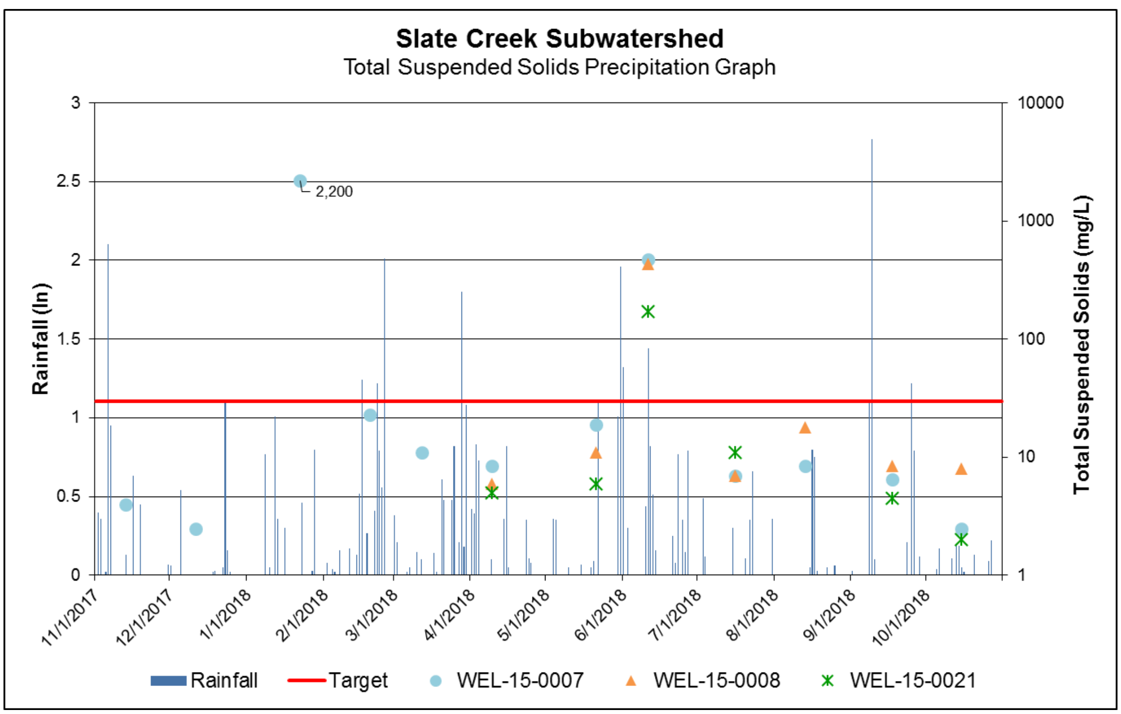

Figure 38: Graph of Precipitation and Total Suspended Solids Data at Slate Creek Subwatershed

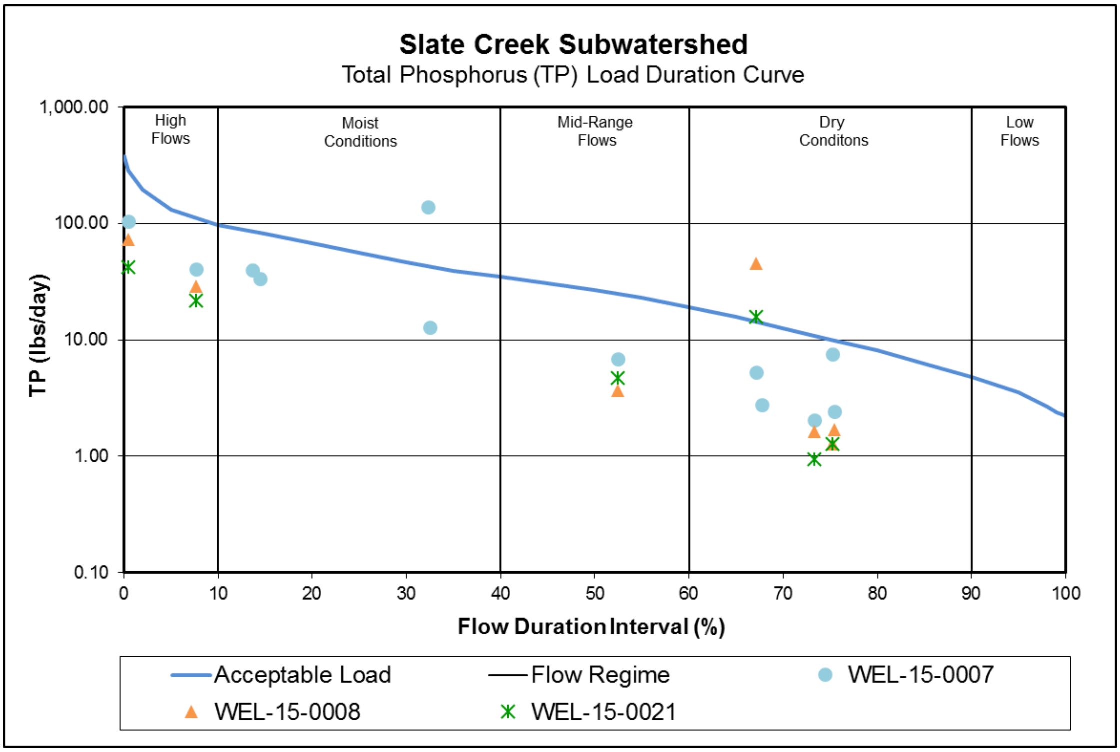

Figure 39: Total Phosphorus Load Duration Curve for Slate Creek Subwatershed

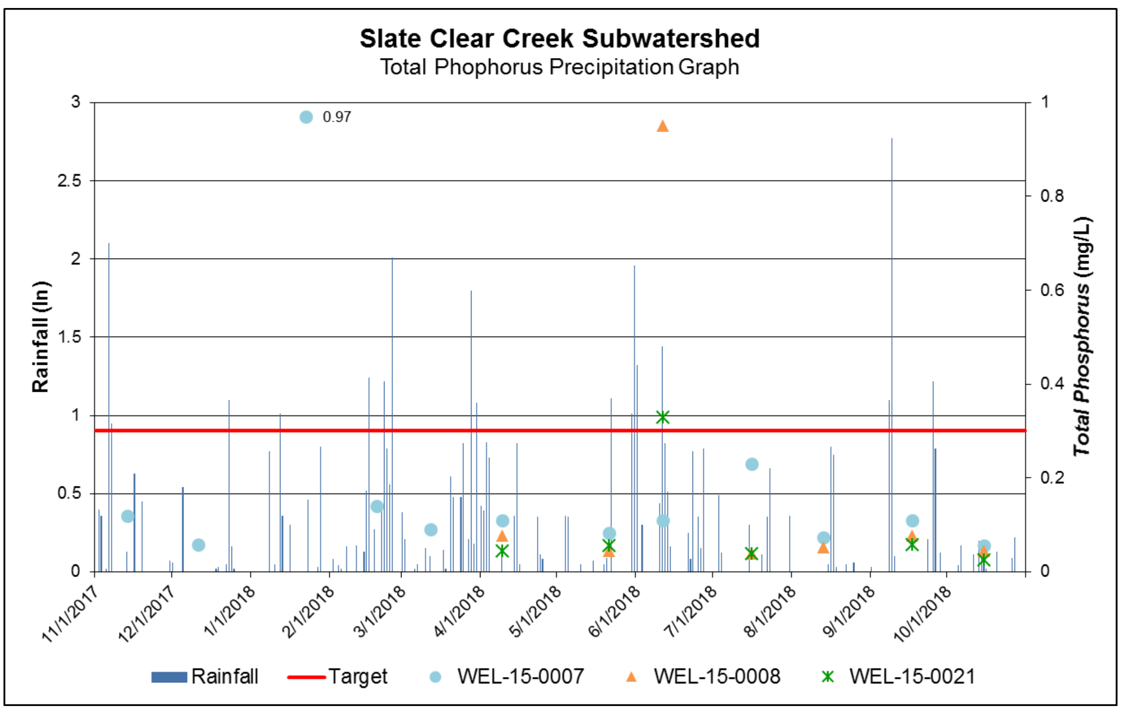

Figure 40: Graph of Precipitation and Total Suspended Solids Data at Slate Creek Subwatershed

The precipitation graph for these sites shows the stream is susceptible to high loads of *E. coli*, TSS, and total phosphorus from run-off. The streams are consistently in violation of water quality standards/targets even during drier conditions on the chart. This indicates point sources may be contributing along with nonpoint sources, however there are no permitted dischargers for *E. coli*, TSS, or total phosphorus within the watershed. Water quality duration graphs are presented in Appendix D.

4.5 Sugar Creek

The Sugar Creek subwatershed drains approximately 5,619 square miles with an actual land area of approximately 24 square miles. Water drains into the East Fork White River in the southern portion of the watershed and continues flowing from east to west. The land use is primarily agriculture (43%), followed by forested land (35%) and hay and pasture land (14%). There are two NPDES permitted facilities in the subwatershed which are both coal surface mining operations. Portions of the Peabody Midwest Mining – Viking Mine Corning Pit mine discharge intermittently through outfalls in the northern portion of the watershed. Trust Resources – Vigo Captain Daviess mine maintains a NPDES permit. However, mining operations have not begun at the time of this document's development, and plans for future mining are still unknown. A list of proposed outfall locations in the current permit indicate discharges to the East Fork White River in portions of this subwatershed. The majority of the subwatershed is rural indicating homes pump to on-site septic systems. Based on the septic suitability of the soil, this entire subwatershed is very limited. Maintenance and inspections of septic systems in the area is important to ensure proper function and capacity. The landscape in the area is relatively flat leading to its intense conversion to agricultural production and use. In many areas of the subwatershed there are little to no remaining riparian buffers along the streambanks due to agricultural practices. Despite its flat nature the subwatershed does contain significant amounts of highly erodible soil types. These soil types can be susceptible to sheet, rill, and isolated gully erosion and can contribute to sediment loss from agricultural lands, as well as lands from high gradient slopes.

Many of the waterways in this subwatershed are identified as having hydric soil types in their riparian zones. These areas could be potential locations for wetland restoration or high functioning two-stage ditch implementation. With a land use of 14 percent pasture land a heavy presence of pasture animals is not expected. There are 3 permitted CFOs in the watershed.

There are four sites located in this subwatershed, WEL-15-0010 (T07) on the East Fork White River, WEL-15-0018 (T08) and WEL-15-0009 (T10) on Sugar Creek, and WEL-15-0022 (T09) on West Fork Sugar Creek. In 2017-2018 this watershed was sampled 53 times between the four sites resulting in three or the four sites failing WQS for *E.coli*. These stream reaches will be placed on the 2020 303(d) list of impaired waters. The *E. coli* geomean for T07 on the East Fork White River was 75.46 MPN with 2/10 samples in exceedance of the single sample max, and was the only site which did not violate the WQS for *E. coli*. Site T08 had a geomean of 320.16 with 6/9 samples in exceedance of the single sample max, site T09 had a geomean of 233.28 with 4/10 samples in exceedance of the single sample max, and site T10 had a geomean of 446.89 with 4/9 samples in exceedance of the single sample max. The geomeans from sites T07, T08, T09, and T10 were taken on the same day approximately one hour apart for five consecutive weeks. High *E. coli* levels are reflective of high animal concentration and land application of waste.

The fish community IBI score for site T07 was 38 (fair) and the QHEI was 61 (good). The macro community mIBI score was 34 (poor) and the QHEI was 46 (poor). The fish community IBI score for site T08 was 34 (poor) and the QHEI was 57 (good). The macro community mIBI score was 34 (fair) and the QHEI was 56 (good). The fish community IBI score for site T09 was 46 (fair) and the QHEI was 47 (poor). The macro community mIBI score was 38 (fair) and the QHEI was 44 (poor). The fish community IBI score for site T10 was 42 (fair) and the QHEI was 51 (good). The macro community mIBI score was 38 (fair) and the QHEI was 63 (good). Load Duration curves for the subwatershed were developed and are summarized in Table 36.

TSS concentrations ranged from 2 mg/L to 2,100 mg/L across 36 sampling events within the watershed, and exceeded the target value 14 times. Given that targets for TSS were sporadically violated throughout the watershed a TSS TMDL was developed to address the impaired biological communities within the subwatershed.

Based on the water quality duration graphs and lack of permitted sources, it can be concluded that the majority of sources of pollutants in this watershed are nonpoint sources with some potential inputs from point sources. There are approximately 36 miles of stream in the subwatershed. Based on IDEM data collected in 2017-2018 there will be 38 stream miles impaired for *E. coli* and 20 miles impaired for biological communities listed on the 2020 303(d) List of Impaired Waters. Therefore, *E. coli* TMDLs were developed to address all *E. coli* impairments, and TSS TMDLs were developed to address all impaired biotic communities in the subwatershed.

Table 36: Summary of Sugar Creek Subwatershed Characteristics

Sugar Creek (051202081504)					
Drainage Area	5,619.3 square miles				
Surface Area	24.13 square miles				
TMDL Sample Site	WEL-15-0010, WEL-15-0009, WEL-15-0018, WEL-15-0022				
Listed Segments	INW08F4_01; INW08F4_T1002; INW08F4_T1003; INW08F4_T1004; INW08F4_T1005; INW08F4_T1006				
Listed Impairments [TMDL(s)]	*E. coli* [*E. coli*], Impaired Biotic Communities [TSS]				
Land Use	Agricultural Land: 43% Forested Land: 35% Developed Land: 5% Open Water: 2% Pasture/Hay: 14% Grassland/Shrubs: <1% Wetland: <1%				
NPDES Facilities	Trust Resources – Vigo Captain Daviess Mine (ING040277); Peabody Midwest Mining – Viking Mine Corning Pit (ING040154)				
CAFOs	NA				
CFOs	Mehne Farms Inc. (Farm ID: 132), Armes Boys (Farm ID: 4071), For Him Farms (Farm ID: 6832)				
TMDL *E. coli* Allocations (MPN/day)					
Allocation Category **Duration Interval (%)**	**High Flows** **5%**	**Moist Conditions** **25%**	**Mid-Range Flows** **50%**	**Dry Conditions** **75%**	**Low Flows** **95%**
LA	5.124E+11	2.199E+11	1.039E+11	3.897E+10	1.390E+10
WLA (Total)	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
MOS (10%)	6.028E+10	2.587E+10	1.223E+10	4.585E+09	1.635E+09
Future Growth (5%)	3.014E+10	1.293E+10	6.113E+09	2.292E+09	8.177E+08

Upstream Drainage Input (Slate, Hoffman, Mill)	**1.397E+14**	**5.995E+13**	**2.834E+13**	**1.063E+13**	**3.790E+12**
TMDL = LA+WLA+MOS	**1.403E+14**	**6.021E+13**	**2.846E+13**	**1.067E+13**	**3.807E+12**
TMDL Total Suspended Solids Allocations (Lbs/day)					
Allocation Category	**High Flows**	**Moist Conditions**	**Mid-Range Flows**	**Dry Conditions**	**Low Flows**
LA	11,219.53	4,814.17	2,276.16	853.56	304.48
WLA	2,352.39	1,009.39	476.28	178.60	63.71
MOS (10%)	1,696.49	727.95	344.05	129.02	46.02
Future Growth (10%)	1,696.49	727.95	344.05	129.02	46.02
Upstream Drainage Input (Slate, Hoffman, Mill)	**3,932,119.47**	**1,687,228.37**	**797,448.53**	**299,043.20**	**106,672.52**
TMDL = LA+WLA+MOS	**3,949,084.38**	**1,694,507.82**	**800,889.08**	**300,333.40**	**107,132.75**
WLA (Individual)					
Trust Resources – Vigo Captain Daviess Mine	1,874.65	804.39	380.19	142.57	50.86
Peabody Midwest Mining – Viking Mine Corning Pit	473.82	203.31	96.09	36.03	12.85
Construction WLA	3.92	1.68	0.00	0.00	0.00

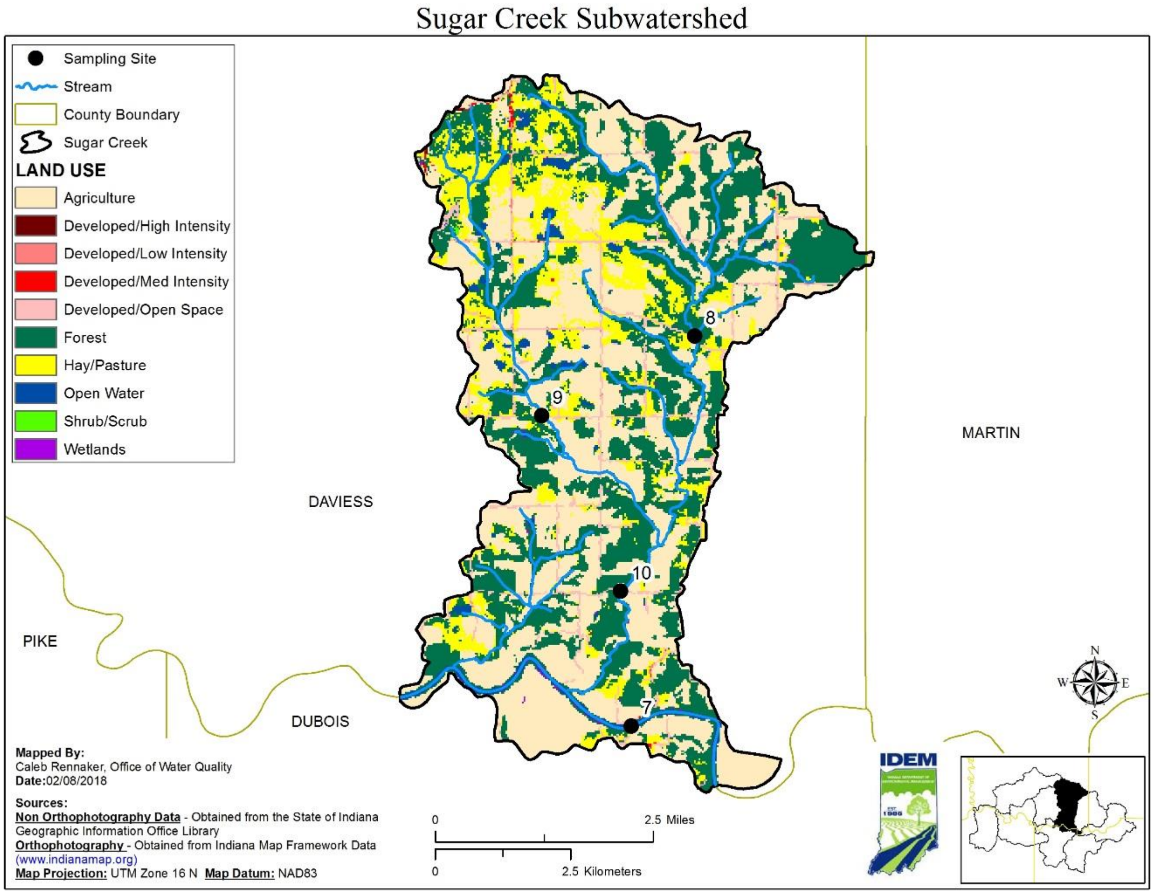

Figure 41: Sampling stations in Sugar Creek Subwatershed

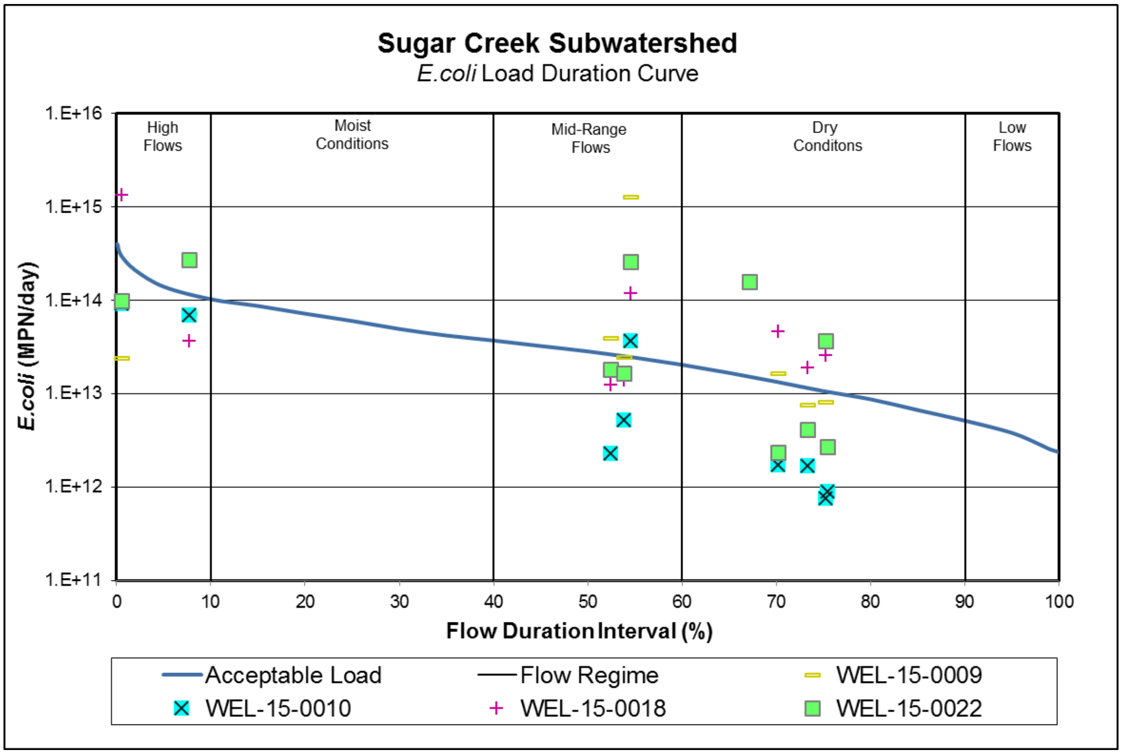

Figure 42: *E. coli* Load Duration Curve for Sugar Creek Subwatershed

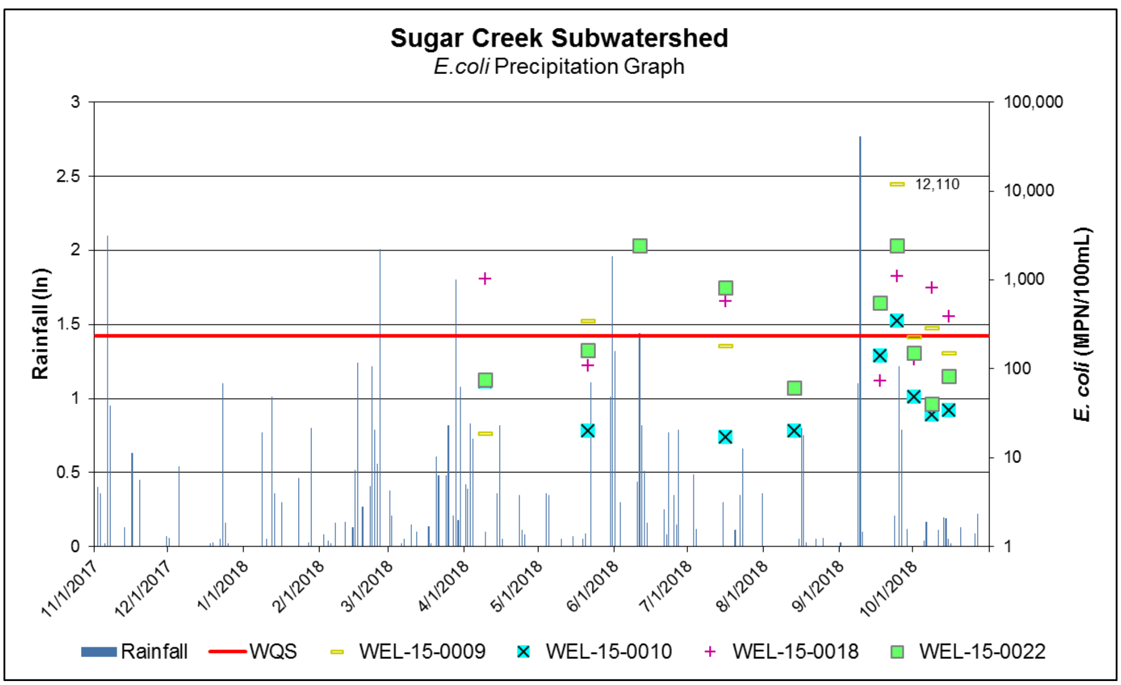

Figure 43: Graph of Precipitation and *E.coli* Data at Sugar Creek Subwatershed

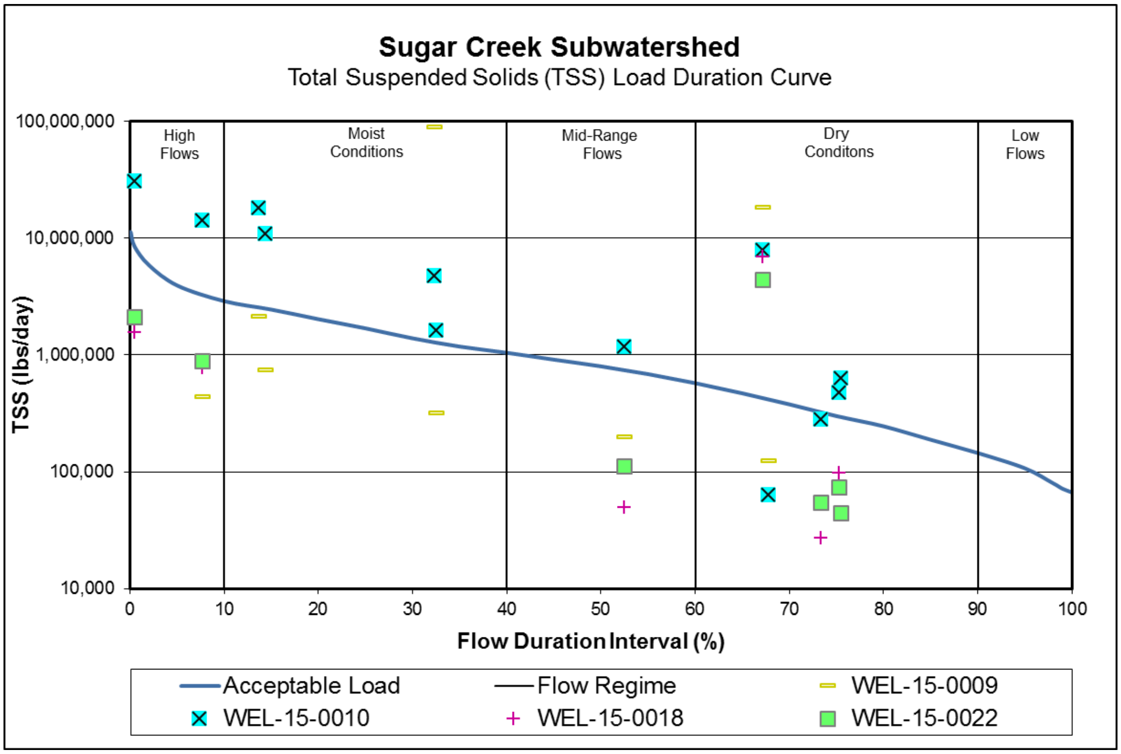

Figure 44: Total Suspended Solids Load Duration Curve for Sugar Creek Subwatershed

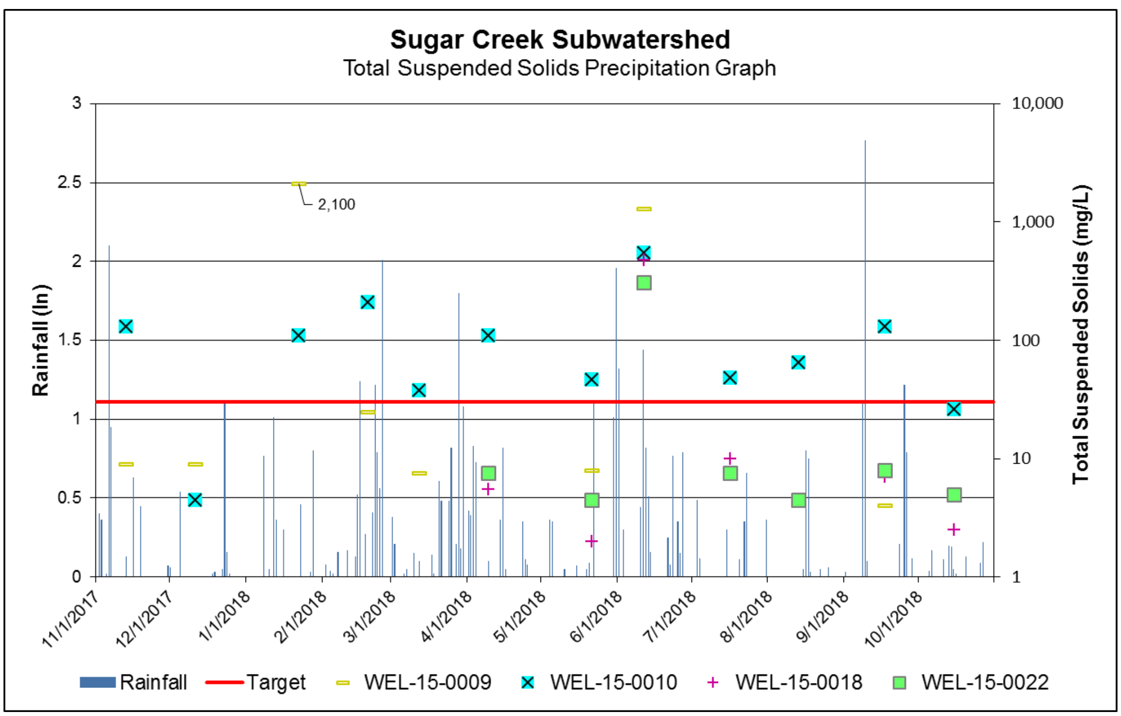

Figure 45: Graph of Precipitation and *E.coli* Data at Sugar Creek Subwatershed

The precipitation graph for these sites shows the stream is susceptible to high loads of *E. coli* and TSS from run-off. The streams are consistently in violation of water quality standards/targets even during drier conditions on the chart. This indicates point sources may be contributing along with nonpoint sources. Water quality duration graphs are presented in Appendix D.

4.6 Dogwood Lake

The Dogwood Lake subwatershed drains approximately 17 square miles. Dogwood Lake encompasses the majority of the watershed and eventually drains into the East Fork White River in the southern portion of the watershed. The land use is primarily forest (54%), followed by agriculture (24%) and open water (12%). There are two NPDES permitted facilities in the subwatershed which are both coal surface mining operations. Portions of the Peabody Midwest Mining – Viking Mine Corning Pit mine discharge intermittently through outfalls in the northern portion of the watershed. Trust Resources – Vigo Captain Daviess mine maintains a NPDES permit. However, mining operations have not begun at the time of this document's development, and plans for future mining are still unknown. A list of proposed outfall locations in the current permit indicate discharges to the East Fork White River in portions of this subwatershed. The majority of the subwatershed is rural indicating homes pump to on-site septic systems. Based on the septic suitability of the soil, this entire subwatershed is very limited. Maintenance and inspections of septic systems in the area is important to ensure proper function and capacity. The landscape in the area is relatively flat leading to its intense conversion to agricultural production and use. In many areas of the subwatershed there are little to no remaining riparian buffers along the streambanks due to agricultural practices. Despite its flat nature the subwatershed does contain significant amounts of highly erodible soil types. These soil types can be susceptible to sheet, rill, and isolated gully erosion and can contribute to sediment loss from agricultural lands, as well as lands from high gradient slopes.

Many of the waterways in this subwatershed are identified as having hydric soil types in their riparian zones. These areas could be potential locations for wetland restoration or high functioning two-stage ditch implementation. With a land use of 8 percent pasture land a heavy presence of pasture animals is not expected. There are no permitted CFOs in the watershed.

Due to watershed characteristics and accessibility, there were no sampling sites within this subwatershed. There are currently no known impairments within the subwatershed, therefore no segments are listed on the 303(d) list requiring the development of a TMDL. The majority of the subwatershed is being managed through the Indiana Department of Natural Resources (IDNR) as part of the Glendale Fish and Wildlife Area. As no segments are listed as impaired, no TMDLs were developed for this subwatershed at this time.

Table 37: Summary of Dogwood Lake Subwatershed Characteristics

Dogwood Lake (051202081505)	
Drainage Area	16.75 square miles
Surface Area	16.75 square miles
TMDL Sample Site	NA
Listed Segments	NA
Listed Impairments [TMDL(s)]	NA
Land Use	Agricultural Land: 24% Forested Land: 51% Developed Land: 5% Open Water: 12% Pasture/Hay: 8% Grassland/Shrubs: <1% Wetland: <1%
NPDES Facilities	Peabody Midwest Mining – Viking Mine Corning Pit (ING040154); Trust Resources – Vigo Captain Daviess Mine (ING040277)
CAFOs	NA
CFOs	NA

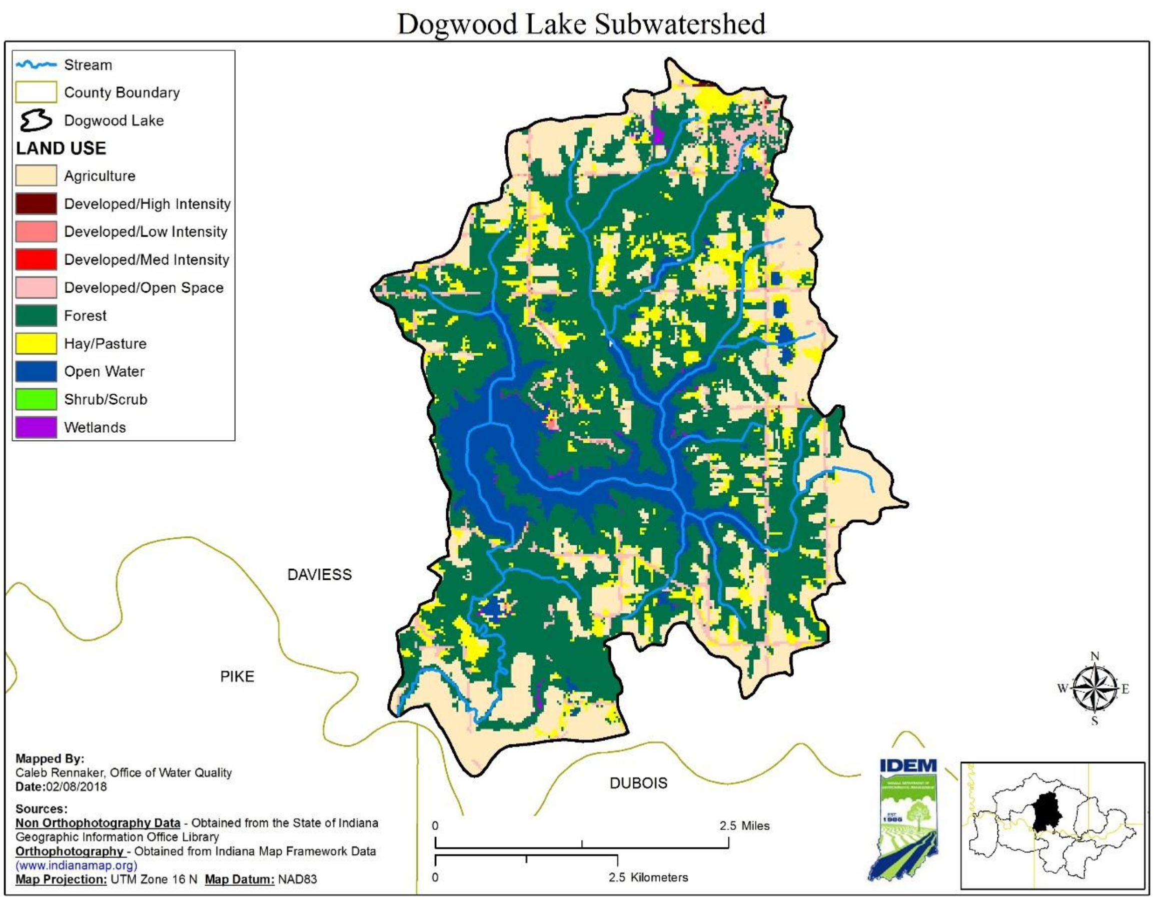

Figure 46: Land use and location of the Dogwood Lake subwatershed

4.7 Birch Creek

The Birch Creek subwatershed drains approximately 5,641 square miles with a land area covering approximately 22 square miles. The subwatershed drains into the mainstem of the East Fork White River just north of Ireland, IN. The land use is primarily agriculture (69%), followed by forested land (17%) and hay and pasture land (7%). There are two NPDES facilities located within the subwatershed including Solar Sources Shamrock Mine (ING040210) and Trust Resources – Vigo Captain Daviess Mine (ING040277). The majority of the subwatershed is rural indicating homes pump to on-site septic systems. Based on the septic suitability of the soil, this entire subwatershed is very limited. Maintenance and inspections of septic systems in the area are important to ensure proper function and capacity. The landscape in the area is relatively flat leading to its intense conversion to agricultural production and use. In many areas of the subwatershed there are little to no remaining riparian buffers along streambanks due to agricultural practices. Despite its flat nature the subwatershed does contain significant amounts of highly erodible soil types. These soil types can be susceptible to sheet, rill, and isolated gully erosion and can contribute to sediment loss from agricultural lands, as well as lands from high gradient slopes.

Many of the waterways in this subwatershed are identified as having hydric soil types in their riparian zones. These areas could be potential locations for wetland restoration or high functioning two-stage ditch implementation. With a land use of less than 10 percent pasture land a heavy presence of pasture animals is not expected. There are 3 permitted CFOs in the watershed.

There are two monitoring sites located in this subwatershed, WEL-15-0013 (T11) and WEL-15-0014 (T12), both established on Birch Creek. In 2017-2018 this watershed was sampled 19 times between the two sites resulting in both failing WQS for *E.coli*. These stream reaches will be placed on the 2020 303(d) List of Impaired Waters. The *E. coli* geomean for T11 was 767.69 MPN with 8/9 samples in exceedance of the single sample max; while T12 had a geomean of 279.24 with 3/10 samples in exceedance of the single sample max. The geomeans from sites T11 and T12 were taken on the same day approximately one hour apart for five consecutive weeks. High *E. coli* levels are reflective of high animal concentration and land application of waste.

The fish community IBI score for site T11 was 40 (fair) and the QHEI was 32 (poor). The macro community mIBI score was 32 (poor) and the QHEI was 41 (poor). The fish community IBI score for site T12 was 44 (fair) and the QHEI was 54 (good). The macro community mIBI score was 38 (fair) and the QHEI was 62 (good). Load Duration curves for the subwatershed were developed and are summarized in Table 38.

TSS concentrations ranged from less than 5 mg/L to 1,300 mg/L across 19 sampling events within the watershed, and exceeded the target value seven times. Given that targets for TSS were sporadically violated throughout the subwatershed a TSS TMDL was developed to address the impaired biological communities within the subwatershed.

Based on the water quality duration graphs and limited permitted sources, it can be concluded that the majority of sources of pollutants in this watershed are nonpoint sources. There are approximately 54 miles of stream in the subwatershed. Based on IDEM data collected in 2017-2018 there will be 29 stream miles impaired for *E. coli* and 13 miles impaired for biotic communities listed on the 2020 303(d) List of

Impaired Waters. Therefore, *E. coli* TMDLs were developed to address all *E. coli* impairments, and TSS TMDLs were developed to address all impaired biological communities in the subwatershed.

Table 38: Summary of Birch Creek Subwatershed Characteristics

Birch Creek (051202081506)					
Drainage Area	5,641.14 square miles				
Surface Area	21.84 square miles				
TMDL Sample Site	WEL-15-0014, WEL-15-0013				
Listed Segments	INW08F6_T1003, INW08F6_T1006				
Listed Impairments [TMDL(s)]	*E. coli* [*E. coli*], Impaired Biotic Communities [TSS]				
Land Use	Agricultural Land: 69% Forested Land: 17% Developed Land: 5% Open Water: 2% Pasture/Hay: 7% Grassland/Shrubs: <1% Wetland: <1%				
NPDES Facilities	Solar Sources Shamrock Mine (ING040210); Trust Resources – Vigo Captain Daviess Mine (ING040277)				
CAFOs	NA				
CFOs	Schnarr Farms (Farm ID: 2723), Edward G Barley (Farm ID: 3025), Luther R Mann (Farm ID: 6221)				
TMDL *E. coli* Allocations (MPN/day)					
Allocation Category **Duration Interval (%)**	**High Flows** **5%**	**Moist Conditions** **25%**	**Mid-Range Flows** **50%**	**Dry Conditions** **75%**	**Low Flows** **95%**
LA	4.636E+11	1.989E+11	9.402E+10	3.526E+10	1.258E+10
WLA	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
MOS (10%)	5.454E+10	2.340E+10	1.106E+10	4.148E+09	1.480E+09
Future Growth (5%)	2.727E+10	1.170E+10	5.530E+09	2.074E+09	7.398E+08
Upstream Drainage Input (Sugar)	**1.403E+14**	**6.021E+13**	**2.846E+13**	**1.067E+13**	**3.807E+12**
TMDL = LA+WLA+MOS	**1.409E+14**	**6.045E+13**	**2.857E+13**	**1.071E+13**	**3.822E+12**
TMDL Total Suspended Solids Allocations (Lbs/day)					
Allocation Category	**High Flows**	**Moist Conditions**	**Mid-Range Flows**	**Dry Conditions**	**Low Flows**
LA	7,534.00	3,232.75	1,527.92	572.97	204.39
WLA	4,744.83	2,035.95	962.27	360.85	128.72
MOS (10%)	1,534.85	658.59	311.27	116.73	41.64
Future Growth (10%)	1,534.85	658.59	311.27	116.73	41.64
Upstream Drainage Input (Sugar)	**3,949,084.38**	**1,694,507.82**	**800,889.08**	**300,333.40**	**107,132.75**
TMDL = LA+WLA+MOS	**3,964,432.91**	**1,701,093.70**	**804,001.81**	**301,500.68**	**107,549.14**
WLA (Individual)					
Solar Sources Shamrock Mine	4,124.94	1,769.96	836.55	313.71	111.90
Trust Resources – Vigo Captain Daviess Mine	619.89	265.99	125.72	47.14	16.82

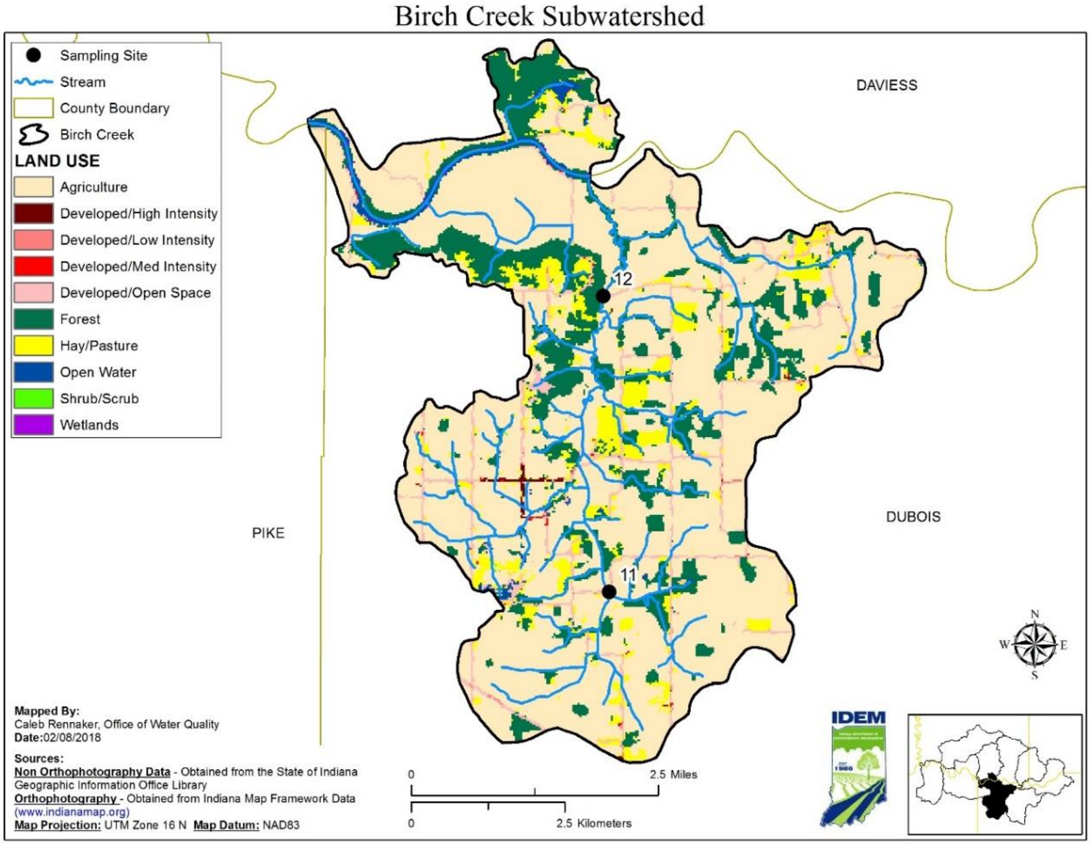

Figure 47: Sampling stations in Birch Creek Subwatershed

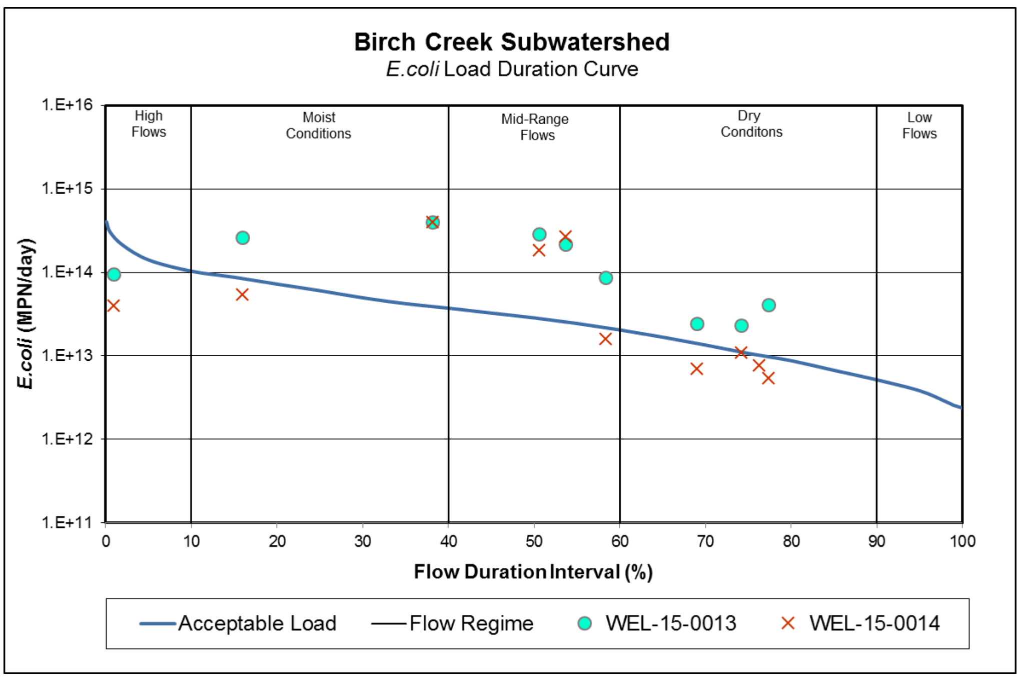

Figure 48: *E. coli* Load Duration Curve for Birch Creek Subwatershed

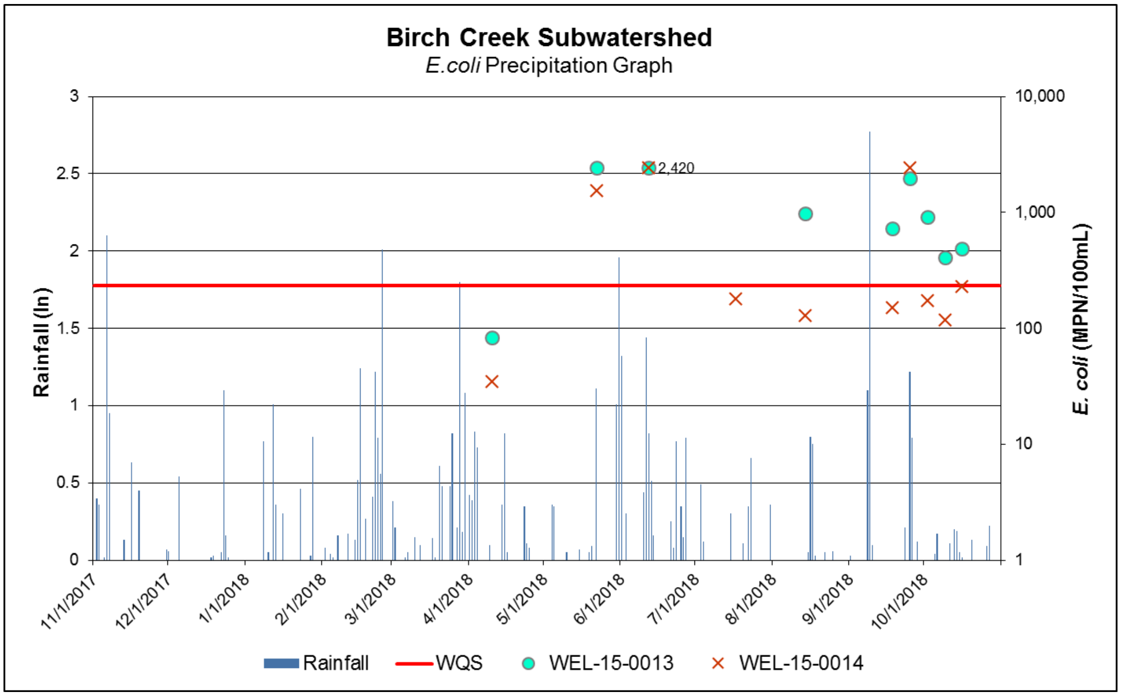

Figure 49: Graph of Precipitation and *E.coli* Data at Birch Creek Subwatershed

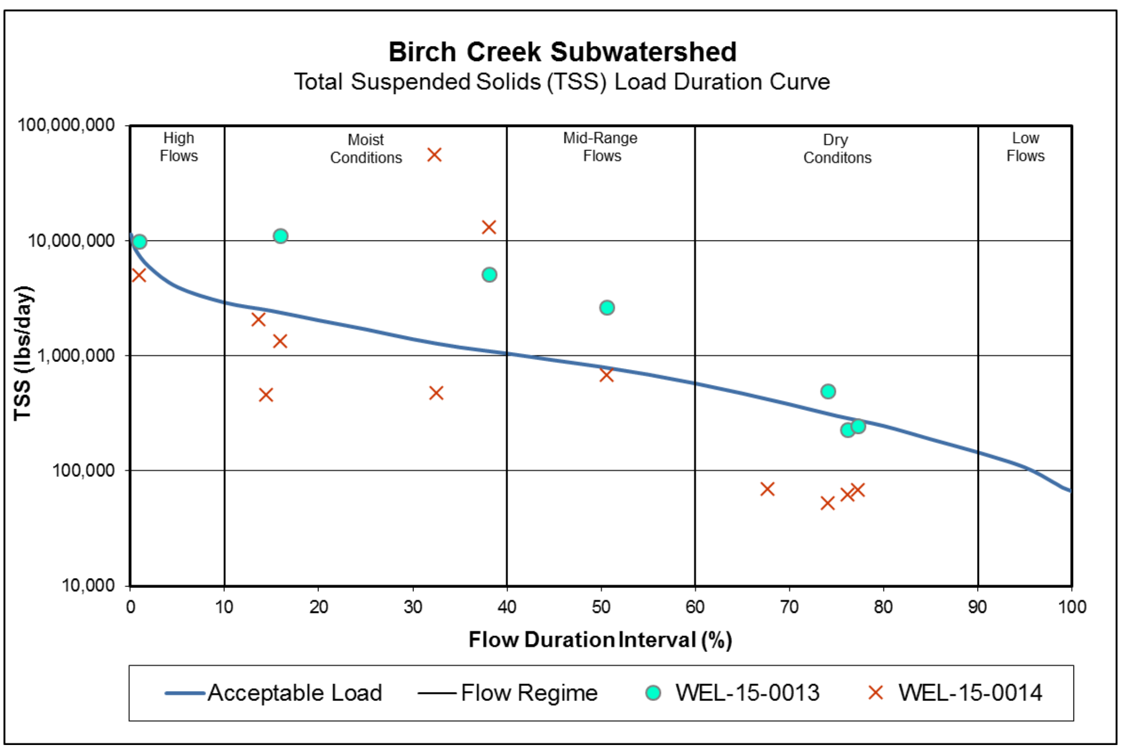

Figure 50: Total Suspended Solids Load Duration Curve for Birch Creek Subwatershed

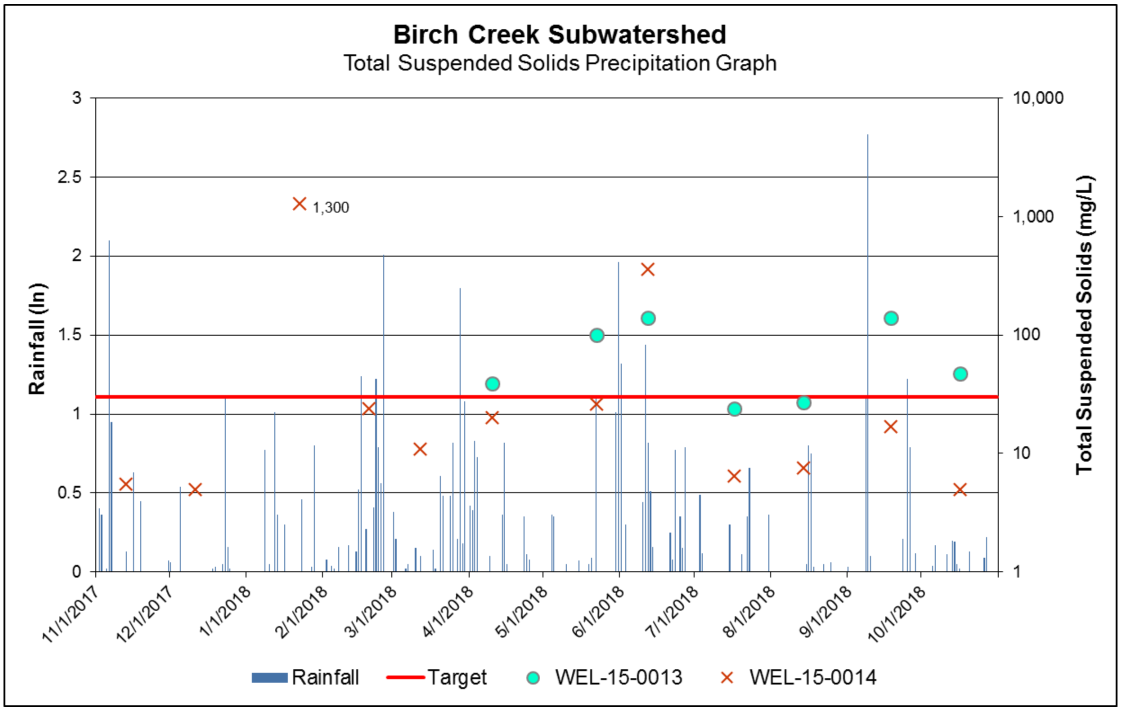

Figure 51: Graph of Precipitation and Total Suspended Solids Data at Birch Creek Subwatershed

The precipitation graph for these sites shows the stream is susceptible to high loads of *E. coli* and TSS from run-off. The streams are consistently in violation of water quality standards/targets even during drier conditions on the chart. This indicates point sources may be contributing along with nonpoint sources. Water quality duration graphs are presented in Appendix D.

4.8 Aikman Creek

The Aikman Creek subwatershed drains approximately 30 square miles. The subwatershed drains into the mainstem of the East Fork White River southeast of Washington, IN. The land use is primarily agriculture (54%), followed by forested land (28%) and hay and pasture land (11%). There are two NPDES facilities located within the subwatershed including Peabody Midwest Mining – Viking Mine Corning Pit (ING040154) and Solar Sources Cannelburg Mine (ING040026). The majority of the subwatershed is rural indicating homes pump to on-site septic systems. Based on the septic suitability of the soil, this entire subwatershed is very limited. Maintenance and inspections of septic systems in the area are important to ensure proper function and capacity. The landscape in the area is relatively flat leading to its intense conversion to agricultural production and use. In many areas of the subwatershed there are little to no remaining riparian buffers along the streambanks due to agricultural practices. Despite its flat nature the subwatershed does contain significant amounts of highly erodible soil types. These soil types can be susceptible to sheet, rill, and isolated gully erosion and can contribute to sediment loss from agricultural lands, as well as lands from high gradient slopes.

Many of the waterways in this subwatershed are identified as having hydric soil types in their riparian zones. These areas could be potential locations for wetland restoration or high functioning two-stage ditch implementation. With a land use of 11 percent pasture land a heavy presence of pasture animals is not expected. There are 3 permitted CFOs in the watershed.

There is one monitoring site located in this subwatershed which is situated on Aikman Creek, WEL-170-0008 (T16). In 2017-2018 this watershed was sampled at this site 12 times resulting in WQS failures for *E.coli*. The *E. coli* geomean for T16 was 360.95 MPN with 6/10 samples in exceedance of the single sample max. The geomean from site T16 was taken on the same day approximately one hour apart for five consecutive weeks. High *E. coli* levels are reflective of high animal concentration and land application of waste. The fish community IBI score for site T16 was 28 (poor) and the QHEI was 41 (poor). The macro community mIBI score was 40 (fair) and the QHEI was 44 (poor). Load Duration curves for the subwatershed were developed and are summarized in Table 39.

TSS concentrations ranged from 2 mg/L to 2,200 mg/L across 12 sampling events within the watershed, and exceeded the target value three times. Total phosphorus concentrations ranged from 0.086 mg/L to 0.97 mg/L across 12 sampling events within the watershed, and exceeded the target value two times. A stream segment on Aikman Creek (INW08F7_04) within the watershed was in excess of nutrients with total phosphorus being consistently over the target value. Additionally, dissolved oxygen was found below water quality standards on multiple occasions on the same segment. Given that targets for total phosphorus and TSS were sporadically violated throughout the subwatershed TMDLs were developed to address impaired biological communities and dissolved oxygen impairments within the watershed. Additionally, excessive total phosphorus values are also believed to be a primary linkage to the nutrients impairment within the watershed. Therefore, a TMDL for total phosphorus will also serve to address nutrients impairments in this subwatershed.

Based on the water quality duration graphs and limited, it can be concluded that the majority of sources of *E. coli*, TSS, and total phosphorus 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, streambank erosion, and agricultural practices.

Based on the water quality duration graphs and limited permitted sources, it can be concluded that the majority of sources of pollutants in this watershed are nonpoint sources with some potential inputs from point sources. There are approximately 51 miles of stream in the subwatershed. Based on IDEM data collected in 2017-2018 there will be 51 stream miles impaired for *E. coli*, and 11 miles impaired for biological communities, dissolved oxygen, and nutrients listed on the 2020 List of Impaired Waters. Therefore, *E. coli* TMDLs were developed to address all *E. coli* impairments, TSS TMDLs were developed to address all impaired biotic communities, and TP TMDLs were developed to address all nutrients impairments. Additionally, both TP and TSS TMDLs will be used to address all DO impairments in the subwatershed.

Table 39: Summary of Aikman Creek Subwatershed Characteristics

Aikman Creek (051202081507)	
Drainage Area	30.41 square miles
Surface Area	30.41 square miles

TMDL Sample Site	WEL170-0008				
Listed Segments	INW08F7_02, INW08F7_03, INW08F7_04, INW08F7_05, INW08F7_T1001, INW08F7_T1002, INW08F7_T1003, INW08F7_T1004, INW08F7_T1005, INW08F7_T1006, INW08F7_T1007, INW08F7_T1008, INW08F7_T1009				
Listed Impairments [TMDL(s)]	*E. coli* [*E. coli*], Impaired Biotic Communities [TSS], Nutrients [TP], Dissolved Oxygen [TP & TSS]				
Land Use	Agricultural Land: 54% Forested Land: 28% Developed Land: 6% Open Water: 1% Pasture/Hay: 11% Grassland/Shrubs: <1% Wetland: <1%				
NPDES Facilities	Peabody Midwest Mining – Viking Mine Corning Pit (ING040154); Solar Sources Cannelburg Mine (ING040026)				
CAFOs	-				
CFOs	Don Kendall 4 K Swine Inc. Jones Farm (Farm ID: 3961), Mitchell Barber (Farm ID: 6534), Heartland Turkey Farms, LLC (Farm ID: 6965)				
TMDL *E. coli* Allocations (MPN/day)					
Allocation Category Duration Interval (%)	**High Flows 5%**	**Moist Conditions 25%**	**Mid-Range Flows 50%**	**Dry Conditions 75%**	**Low Flows 95%**
LA	6.455E+11	2.770E+11	1.309E+11	4.909E+10	1.751E+10
WLA (Total)	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
MOS (10%)	7.594E+10	3.259E+10	1.540E+10	5.775E+09	2.060E+09
Future Growth (5%)	3.797E+10	1.629E+10	7.701E+09	2.888E+09	1.030E+09
TMDL = LA+WLA+MOS	**7.594E+11**	**3.259E+11**	**1.540E+11**	**5.775E+10**	**2.060E+10**
TMDL Total Suspended Solids Allocations (Lbs/day)					
Allocation Category	**High Flows**	**Moist Conditions**	**Mid-Range Flows**	**Dry Conditions**	**Low Flows**
LA	14,218.01	6,100.79	2,883.87	1,081.45	385.77
WLA	2,879.02	1,235.35	583.47	218.80	78.05
MOS (10%)	2,137.13	917.02	433.42	162.53	57.98
Future Growth (10%)	2,137.13	917.02	433.42	162.53	57.98
TMDL = LA+WLA+MOS	**21,371.28**	**9,170.18**	**4,334.18**	**1,625.32**	**579.77**
WLA (Individual)					
Peabody Midwest Mining – Viking Mine Corning Pit	1,119.48	480.36	227.03	85.14	30.37
Solar Sources Cannelburg Mine	1,757.52	754.13	356.43	133.66	47.68
Construction WLA	2.02	0.86	0.00	0.00	0.00
TMDL Total Phosphorus Allocations (Lbs/day)					
Allocation Category	**High Flows**	**Moist Conditions**	**Mid-Range Flows**	**Dry Conditions**	**Low Flows**
LA	181.66	77.95	36.84	13.82	4.93
WLA (Total)	0.00	0.00	0.00	0.00	0.00
MOS (10%)	21.37	9.17	4.33	1.63	0.58
Future Growth (5%)	10.69	4.59	2.17	0.81	0.29
TMDL = LA+WLA+MOS	**213.71**	**91.70**	**43.34**	**16.25**	**5.80**

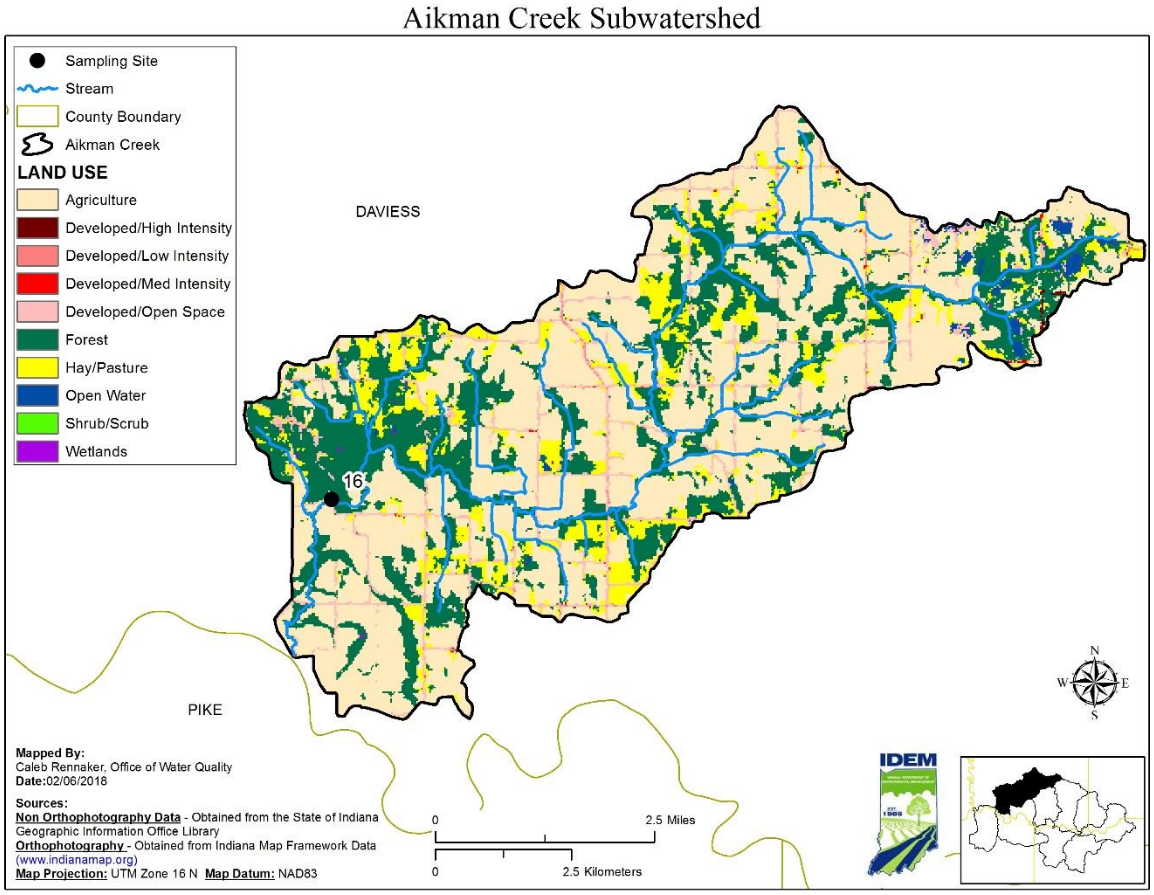

Figure 52: Sampling stations in Aikman Creek Subwatershed

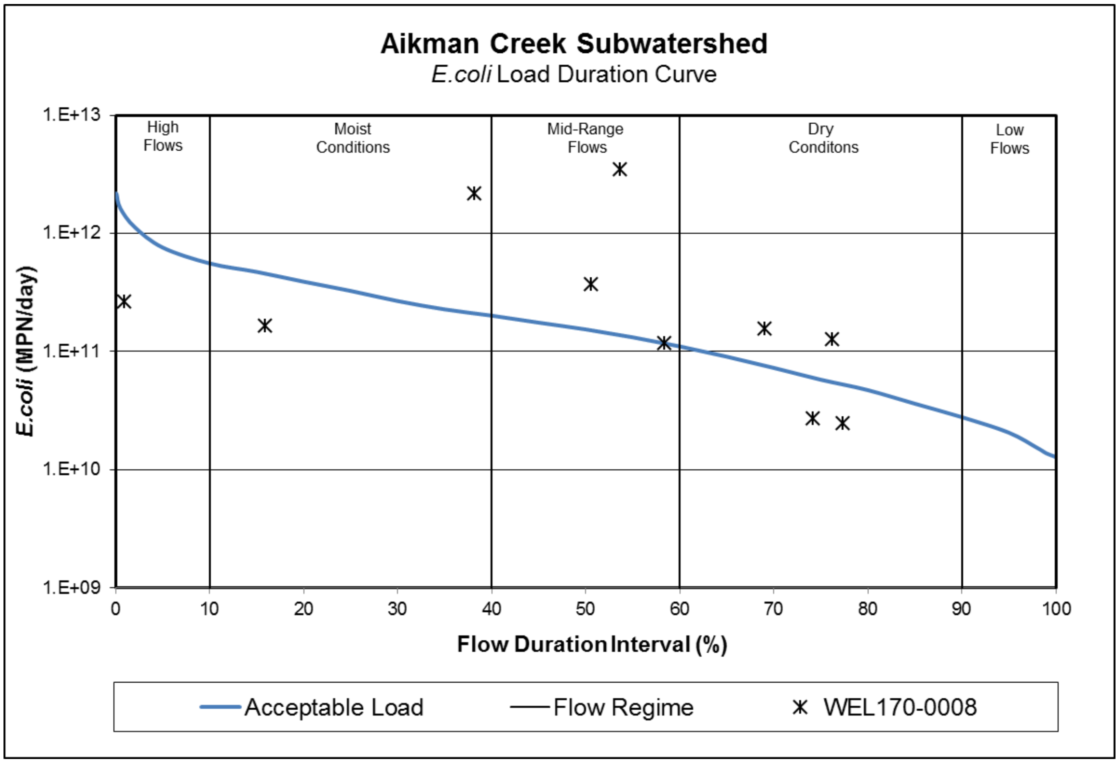

Figure 53: *E. coli* Load Duration Curve for Aikman Creek Subwatershed

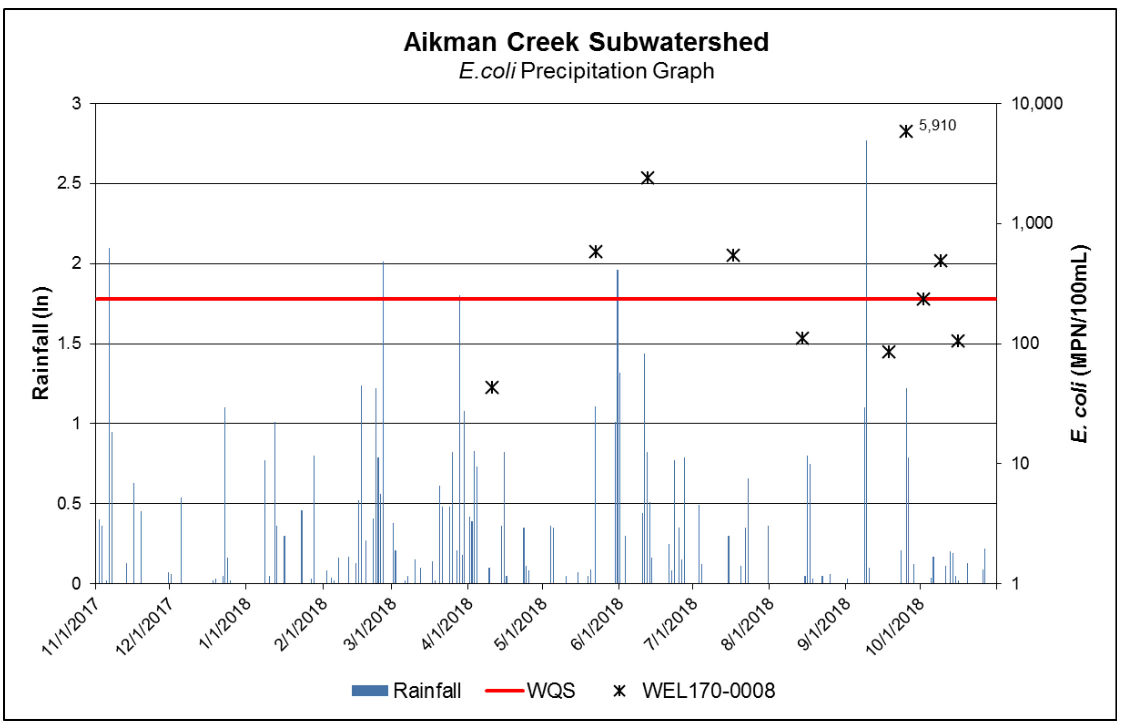

Figure 54: Graph of Precipitation and *E.coli* Data at Birch Creek Subwatershed

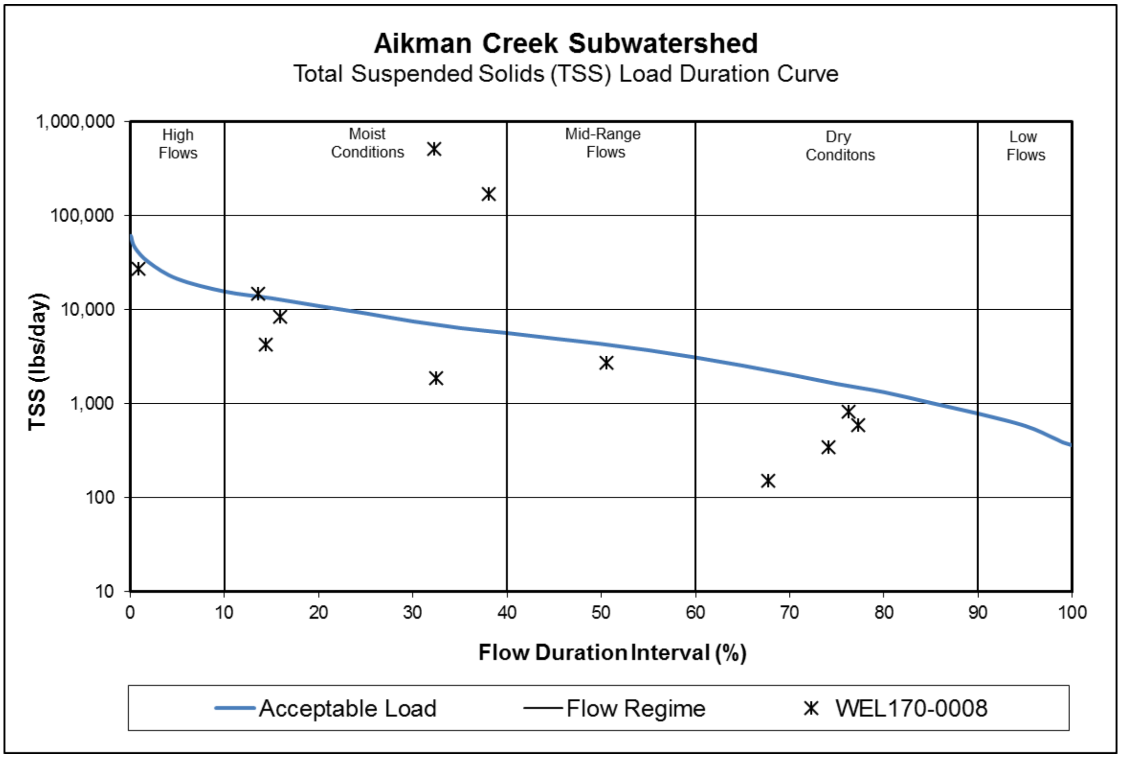

Figure 55: Total Suspended Solids Load Duration Curve for Aikman Creek Subwatershed

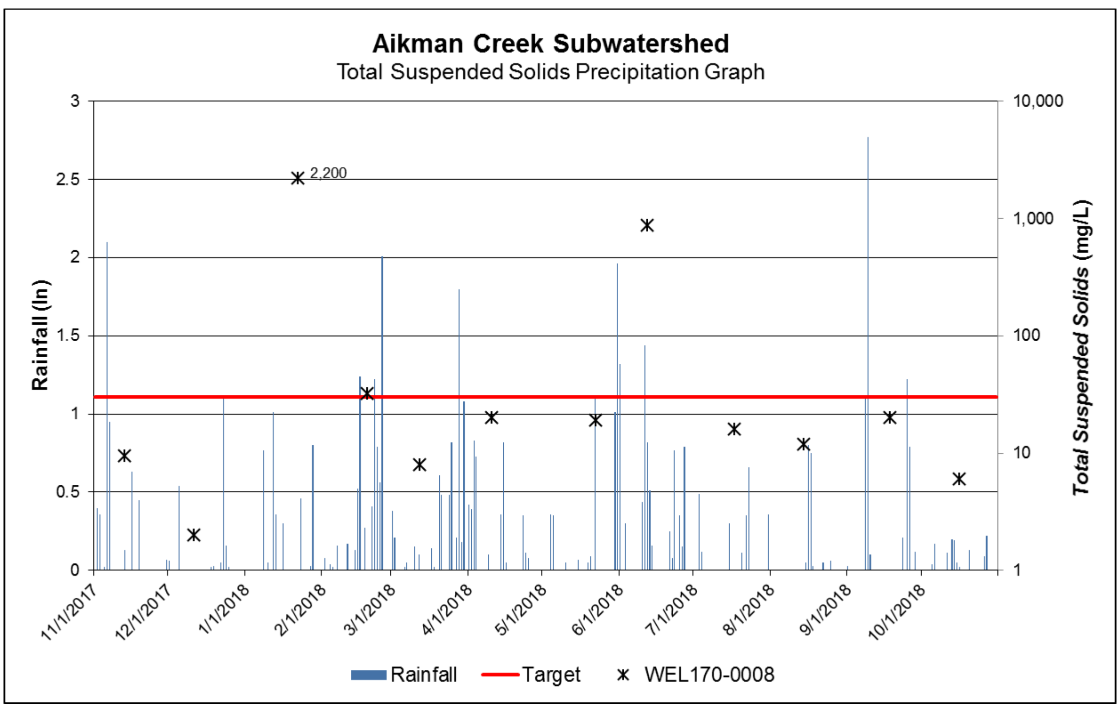

Figure 56: Graph of Precipitation and Total Suspended Solids Data at Birch Creek Subwatershed

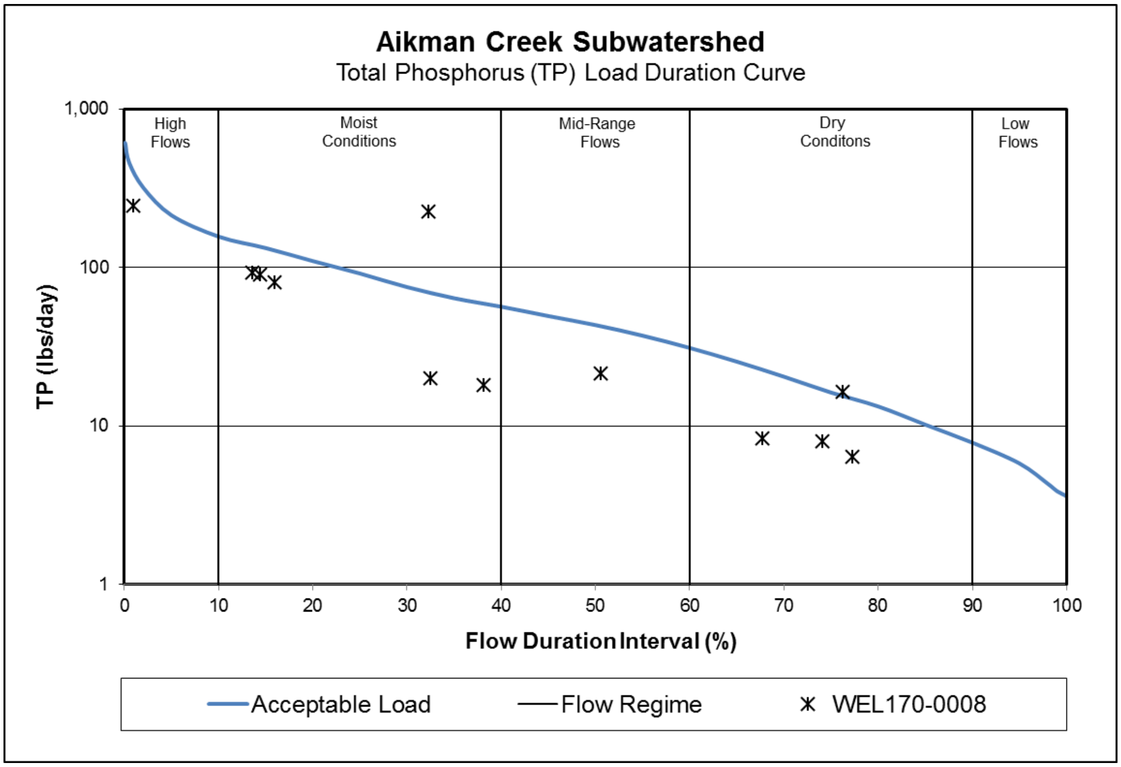

Figure 57: Total Phosphorus Load Duration Curve for Aikman Creek Subwatershed

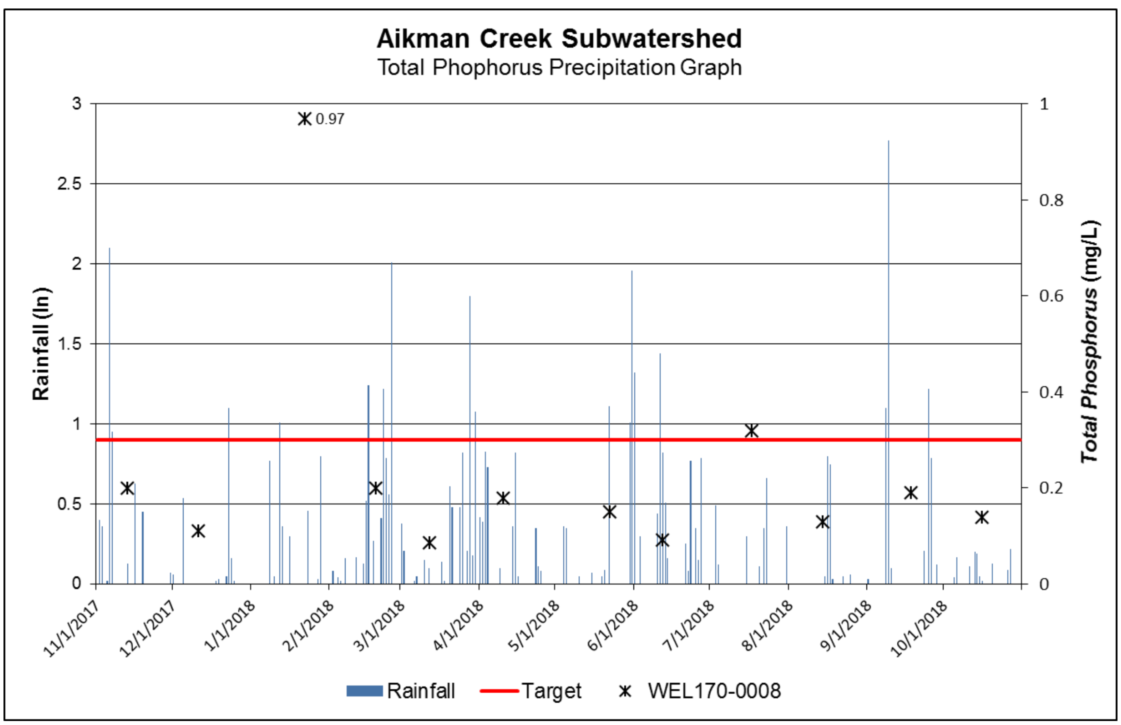

Figure 58: Graph of Precipitation and Total Phosphorus Data at Birch Creek Subwatershed

The precipitation graph for these sites shows the stream is susceptible to high loads of *E. coli*, TSS, and total phosphorus from run-off. The stream is consistently in violation of water quality standards/targets even during drier conditions on the chart. This indicates point sources may be contributing along with nonpoint sources, however there are no permitted dischargers for *E. coli* or total phosphorus within the watershed. Water quality duration graphs are presented in Appendix D.

Along with water quality data collected in Aikman Creek, monitoring staff noted a historic structure located at site WEL170-0008 (T16) which may be impacting stream movement in the subwatershed. Although historical information or ownership of the structure is unknown, it appeared to have a significant impact on flow based on visual observations. During periods of higher flows, the stream was allowed to move over the structure relatively unimpeded. However, periods of lower flow prevented normal flow of the stream as water was forced under the structure. Although the structure contained drainage pipes underneath, they appeared to become blocked easily by debris (i.e., leaves, sticks, etc.) which further impeded water movement (Figure 59 & Figure 60). Potential impacts of this structure on stream flow, along with meeting the TMDL targets for *E. coli*, total phosphorus and TSS, should be considered in future watershed planning efforts.

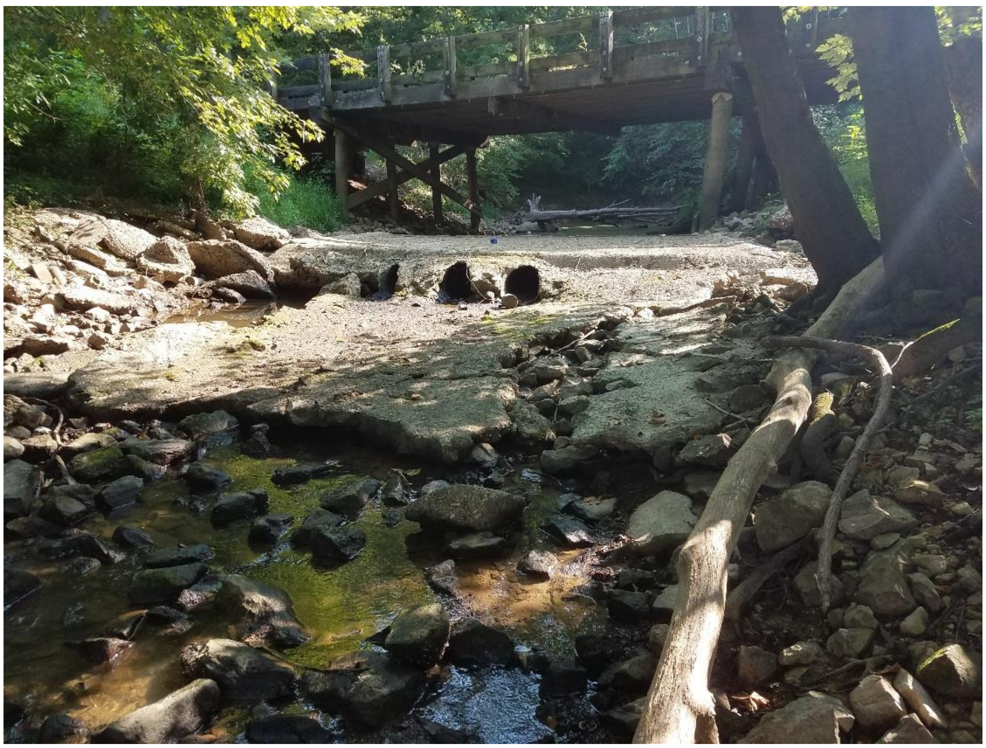

Figure 59: Structure at site WEL170-0008 showing movement of stream at downstream portion.

Figure 60: Structure at site WEL170-0008 showing movement of stream at upstream portion. Buildup of debris further prevented water movement by blocking drainage pipes under structure.

4.9 Bear Creek

The Bear Creek subwatershed drains approximately 5,690 square miles and covers a land area of approximately 33 square miles. The subwatershed drains into the mainstem of the East Fork White River just north of Otwell, IN. The land use is primarily agriculture (59%), followed by forested land (23%) and hay and pasture land (10%). There are two NPDES facilities located within the subwatershed including Otwell Water Corporation Treatment Plant (IN0052086) and Solar Sources Shamrock Mine (ING040210). The majority of the subwatershed is rural indicating homes pump to on-site septic systems. Based on the septic suitability of the soil, this entire subwatershed is very limited. Maintenance and inspections of septic systems in the area are important to ensure proper function and capacity. The landscape in the area is relatively flat leading to its intense conversion to agricultural production and use. In many areas of the subwatershed there are little to no remaining riparian buffers along the streambanks due to agricultural practices. Despite its flat nature the subwatershed does contain significant amounts of highly erodible soil types. These soil types can be susceptible to sheet, rill, and isolated gully erosion and can contribute to sediment loss from agricultural lands, as well as lands from high gradient slopes.

Many of the waterways in this subwatershed are identified as having hydric soil types in their riparian zones. These areas could be potential locations for wetland restoration or high functioning two-stage ditch implementation. With a land use of 10 percent pasture land a heavy presence of pasture animals is not expected. There are 3 permitted CFOs in the watershed.

There are two monitoring sites located in this subwatershed situated on Bear Creek, WEL-15-0015 (T14), and Beech Creek, WEL-15-0016 (T15). In 2017-2018 this watershed was sampled 22 times between the two sites resulting in both failing WQS for *E.coli*. These stream reaches will be placed on the 2020 303(d) List of Impaired Waters. The *E. coli* geomean for T14 was 461.91 MPN with 8/10 samples in exceedance of the single sample max; while T15 had a geomean of 698.56 with 8/10 samples in exceedance of the single sample max. The geomeans from site T14 and T15 were taken on the same day approximately one hour apart for five consecutive weeks. High *E. coli* levels are reflective of high animal concentration and land application of waste.

The fish community IBI score for site T14 was 36 (fair) and the QHEI was 55 (good). The macro community mIBI score was 32 (poor) and the QHEI was 50 (poor). The fish community IBI score for site T15 was 44 (fair) and the QHEI was 52 (good). The macro community mIBI score was 34 (poor) and the QHEI was 41 (poor). Load Duration curves for the subwatershed were developed and are summarized in Table 40.

TSS concentrations ranged from less than 2.5 mg/L to 280 mg/L across 14 sampling events within the watershed, and exceeded the target value four times. Given that targets for TSS were sporadically violated throughout the subwatershed a TMDL for TSS was developed to address the impaired biological communities within the subwatershed.

Based on the water quality duration graphs and limited permitted sources, it can be concluded that the majority of sources of pollutants in this watershed are nonpoint sources. There are approximately 80 miles of stream in the subwatershed. Based on IDEM data collected in 2017-2018 there will be 30 stream miles impaired for *E. coli* and 25 miles impaired for biological communities listed on the 2020 303(d) List of Impaired Waters. Therefore, *E. coli* TMDLs were developed to address all *E. coli* impairments, and TSS TMDLs were developed to address all impaired biotic communities in the subwatershed.

Table 40: Summary of Bear Creek Subwatershed Characteristics

Bear Creek (051202081508)					
Drainage Area	5,690.47 square miles				
Surface Area	32.57 square miles				
TMDL Sample Site	WEL-15-0015, WEL-15-0016				
Listed Segments	INW08F8_T1008, INW08F8_T1009, INW08F8_T1010				
Listed Impairments [TMDL(s)]	*E. coli* [*E. coli*], Impaired Biotic Communities [TSS]				
Land Use	Agricultural Land: 59% Forested Land: 23% Developed Land: 6% Open Water: 2% Pasture/Hay: 10% Grassland/Shrubs: <1% Wetland: <1%				
NPDES Facilities	Otwell Water Corporation Treatment Plant (IN0052086); Solar Sources Shamrock Mine (ING040210)				
CAFOs	NA				
CFOs	Jay Armes Grain & Livestock (Farm ID: 608), Jackle Farms Inc. (Farm ID: 3033), Aikman Creek, LLC (Farm ID: 4582)				
TMDL *E. coli* Allocations (MPN/day)					
Allocation Category **Duration Interval (%)**	**High Flows** **5%**	**Moist Conditions** **25%**	**Mid-Range Flows** **50%**	**Dry Conditions** **75%**	**Low Flows** **95%**
LA	6.916E+11	2.968E+11	1.403E+11	5.261E+10	1.878E+10

WLA (Total)	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
MOS (10%)	8.136E+10	3.491E+10	1.650E+10	6.189E+09	2.209E+09
Future Growth (5%)	4.068E+10	1.746E+10	8.251E+09	3.095E+09	1.104E+09
Upstream Drainage Input (Birch, Dogwood)	**1.413E+14**	**6.063E+13**	**2.865E+13**	**1.075E+13**	**3.833E+12**
TMDL = LA+WLA+MOS	**1.421E+14**	**6.098E+13**	**2.882E+13**	**1.081E+13**	**3.855E+12**
TMDL Total Suspended Solids Allocations (Lbs/day)					
Allocation Category	**High Flows**	**Moist Conditions**	**Mid-Range Flows**	**Dry Conditions**	**Low Flows**
LA	17,561.30	7,535.19	3,561.27	1,335.30	476.14
WLA	756.14	324.84	153.89	58.14	21.18
MOS (10%)	2,289.68	982.50	464.40	174.18	62.16
Future Growth (10%)	2,289.68	982.50	464.40	174.18	62.16
Upstream Drainage Input (Birch, Dogwood)	**3,976,204.33**	**1,706,144.69**	**806,389.10**	**302,395.91**	**107,868.48**
TMDL = LA+WLA+MOS	**3,999,101.13**	**1,715,969.73**	**811,033.06**	**304,137.71**	**108,490.12**
WLA (Individual)					
Otwell Water Corporation	0.67	0.67	0.67	0.67	0.67
Solar Sources Shamrock Mine	755.47	324.17	153.23	57.47	20.51

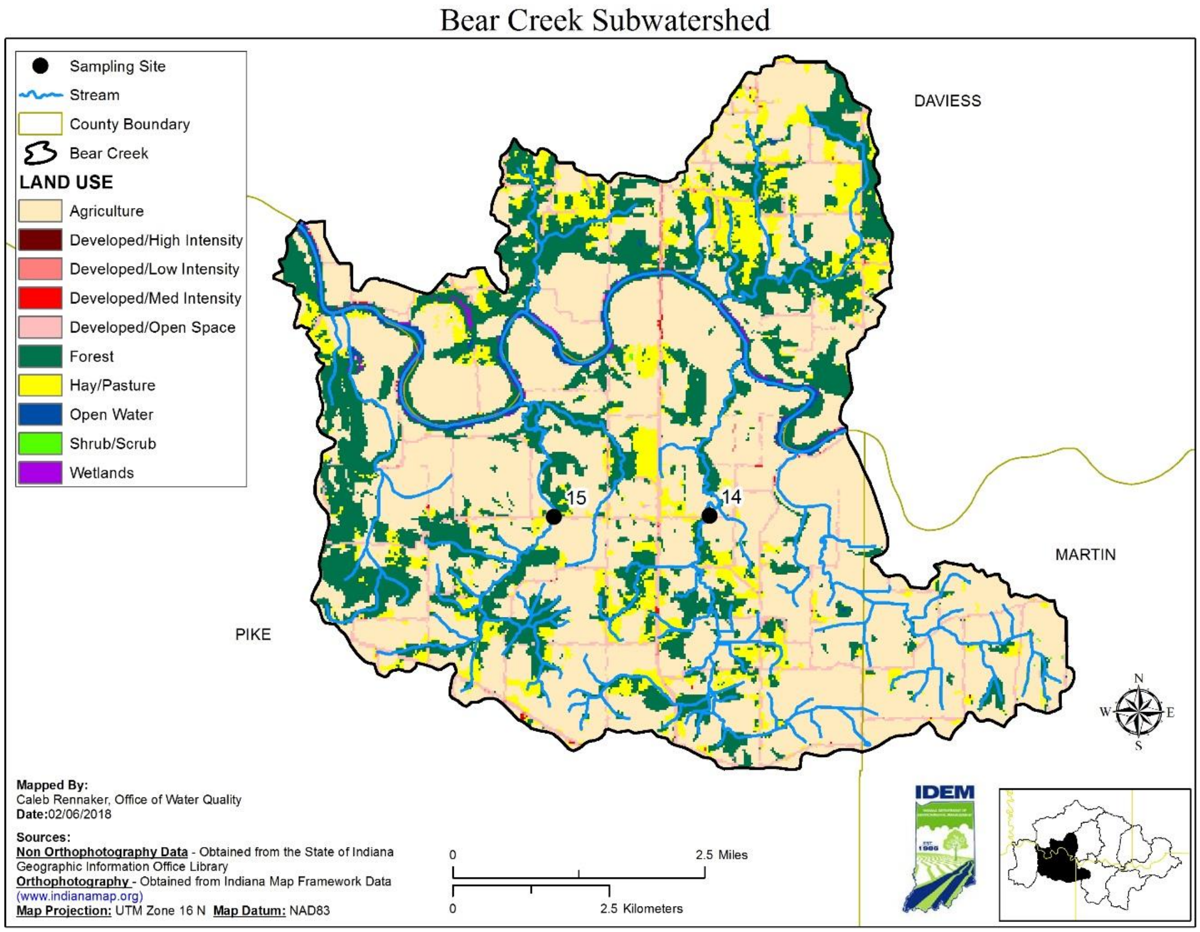

Figure 61: Sampling stations in Bear Creek Subwatershed

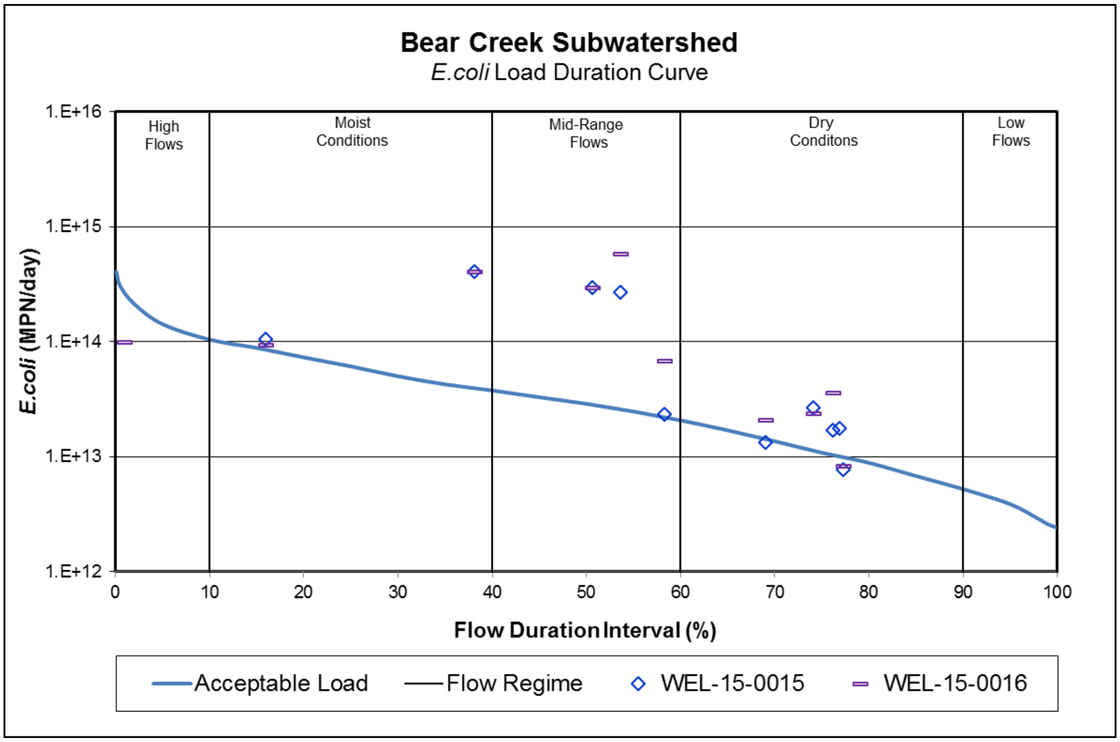

Figure 62: *E. coli* Load Duration Curve the Bear Creek Subwatershed

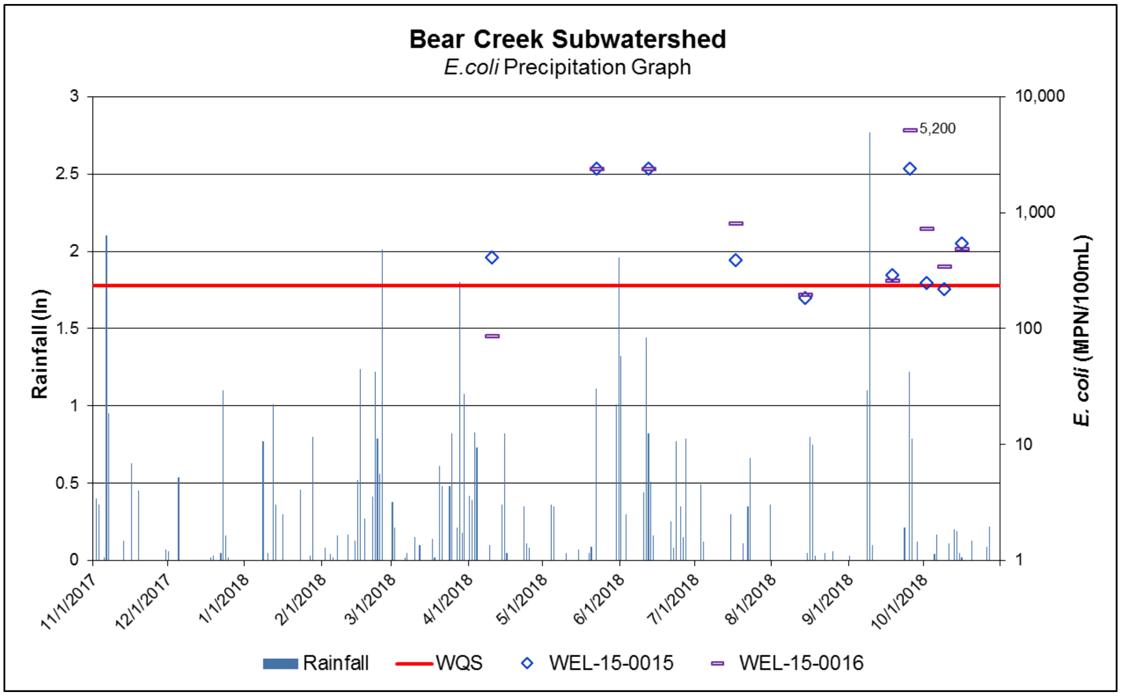

Figure 63: Graph of Precipitation and *E.coli* in the Bear Creek Subwatershed

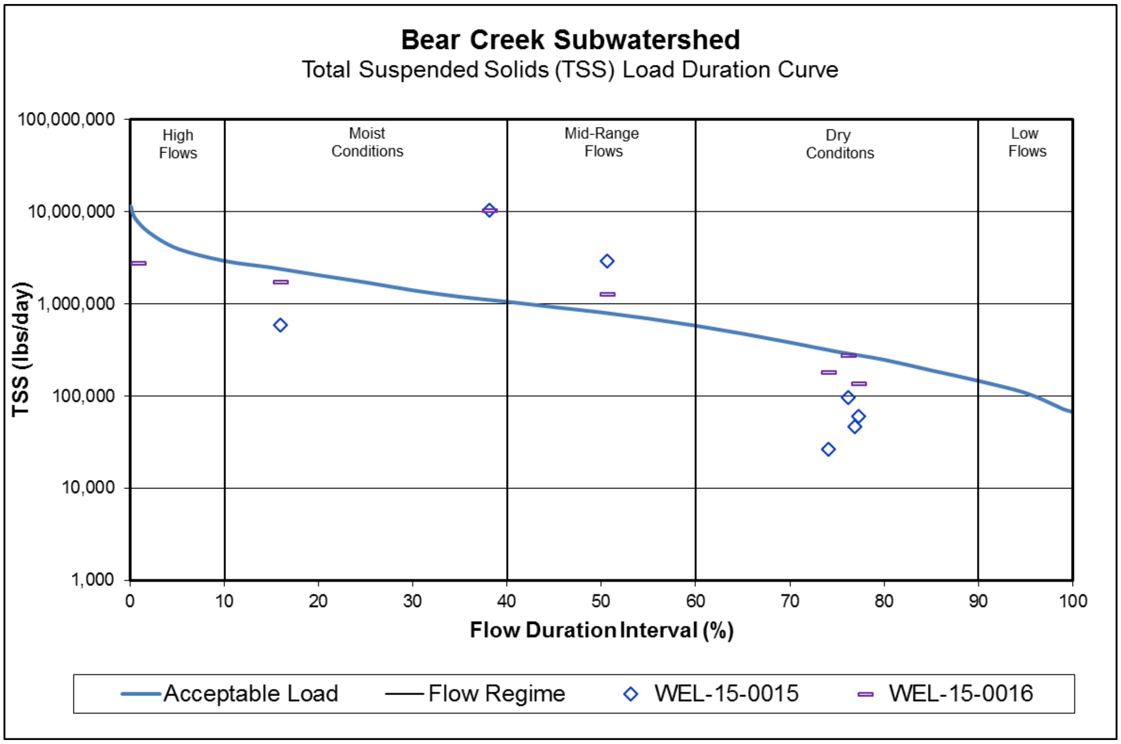

Figure 64: Total Suspended Solids Load Duration Curve the Bear Creek Subwatershed

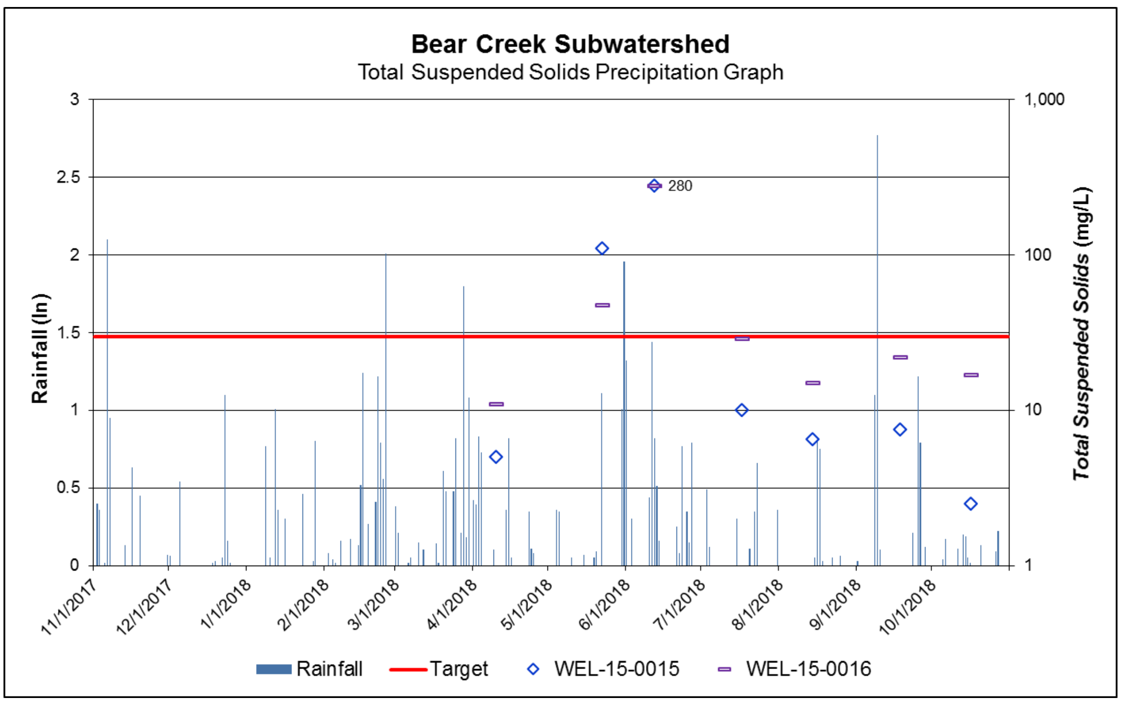

Figure 65: Graph of Precipitation and Total Suspended Solids in the Bear Creek Subwatershed

The precipitation graph for these sites shows the stream is susceptible to high loads of *E. coli* and TSS from run-off. The streams are consistently in violation of water quality standards/targets even during drier conditions on the chart. This indicates point sources may be contributing along with nonpoint sources, however point sources are not believed to be significant contributors. Livestock with direct access to streams may also resemble point source pollution for *E. coli*. Water quality duration graphs are presented in Appendix D.

4.10 Mud Creek

The Mud Creek subwatershed drains approximately 5,742 square miles and covers a land area of approximately 21 square miles. The subwatershed drains into the mainstem of the East Fork White River just east of Petersburg, IN. The land use is primarily agriculture (58%), followed by forested land (25%) and hay and pasture land (7%). Solar Sources Charger Mine (ING040129) is the only NPDES facility located within the subwatershed. The majority of the subwatershed is rural indicating homes pump to on-site septic systems. Based on the septic suitability of the soil, this entire subwatershed is very limited. Maintenance and inspections of septic systems in the area are important to ensure proper function and capacity. The landscape in the area is relatively flat leading to its intense conversion to agricultural production and use. In many areas of the subwatershed there are little to no remaining riparian buffers along the streambanks due to agricultural practices. Despite its flat nature the subwatershed does contain significant amounts of highly erodible soil types. These soil types can be susceptible to sheet, rill, and isolated gully erosion and can contribute to sediment loss from agricultural lands, as well as lands from high gradient slopes.

Many of the waterways in this subwatershed are identified as having hydric soil types in their riparian zones. These areas could be potential locations for wetland restoration or high functioning two-stage ditch implementation. With a land use of less than 10 percent pasture land a heavy presence of pasture animals is not expected. There are no permitted CFOs in the watershed.

There are two monitoring sites located in this subwatershed which are located on East Fork White River, WEL-15-0020 (T18), and Mud Creek, WEL-15-0017 (T17). In 2017-2018 this watershed was sampled 38 times between the two sites resulting in both failing WQS for *E.coli*. These stream reaches will be placed on the 2020 303(d) List of Impaired Waters. The *E. coli* geomean for T18 was 115.82 MPN with 2/10 samples in exceedance of the single sample max; while T17 had a geomean of 258.09 with 4/9 samples in exceedance of the single sample max. The geomeans from sites T17 and T18 were taken on the same day approximately one hour apart for five consecutive weeks. High *E. coli* levels are reflective of high animal concentration and land application of waste. The fish community IBI score for site T18 was 16 (very poor) and the QHEI was 54 (good). The macro community mIBI score was 30 (poor) and the QHEI was 54 (good). The fish community IBI score for site T17 was 38 (fair) and the QHEI was 52 (good). The macro community mIBI score was 40 (fair) and the QHEI was 51 (good). Load Duration curves for the subwatershed were developed and are summarized in in Table 41.

TSS concentrations ranged from 4 mg/L to 2,400 mg/L across 29 sampling events within the watershed, and exceeded the target value 15 times. Given that targets for TSS were sporadically violated throughout the subwatershed a TMDL for TSS was developed to address the impaired biological communities within the subwatershed.

Based on the water quality duration graphs and limited permitted sources, it can be concluded that the majority of sources of pollutants in this watershed are nonpoint sources. There are approximately 50 miles of stream in the subwatershed. Based on IDEM data collected in 2017-2018 there will be 21 stream miles impaired for *E. coli* and 1 mile listed for biological communities on the 2020 List of Impaired Waters. Therefore, *E. coli* TMDLs were developed to address all *E. coli* impairments, and TSS TMDLs were developed to address all impaired biotic communities in the subwatershed.

Table 41: Summary of Mud Creek Subwatershed Characteristics

Mud Creek (051202081509)					
Drainage Area	5,741.76 square miles				
Surface Area	21.0 square miles				
TMDL Sample Site	WEL-15-0020, WEL-15-0017				
Listed Segments	INW08F9_03, INW08F9_T1001				
Listed Impairments [TMDL(s)]	*E. coli* [*E. coli*], Impaired Biotic Communities [TSS]				
Land Use	Agricultural Land: 58% Forested Land: 25% Developed Land: 6% Open Water: 3% Pasture/Hay: 7% Grassland/Shrubs: <1% Wetland: 1%				
NPDES Facilities	Solar Sources Charger Mine (ING040129)				
CAFOs	NA				
CFOs	NA				
TMDL *E. coli* Allocations (MPN/day)					
Allocation Category **Duration Interval (%)**	**High Flows** **5%**	**Moist Conditions** **25%**	**Mid-Range Flows** **50%**	**Dry Conditions** **75%**	**Low Flows** **95%**
LA	4.432E+11	1.902E+11	8.988E+10	3.371E+10	1.202E+10
WLA (Total)	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
MOS (10%)	5.214E+10	2.237E+10	1.057E+10	3.965E+09	1.415E+09
Future Growth (5%)	2.607E+10	1.119E+10	5.287E+09	1.983E+09	7.073E+08
Upstream Drainage Input (Bear, Aikman)	**1.429E+14**	**6.130E+13**	**2.897E+13**	**1.086E+13**	**3.876E+12**
TMDL = LA+WLA+MOS	**1.434E+14**	**6.152E+13**	**2.908E+13**	**1.090E+13**	**3.890E+12**
TMDL Total Suspended Solids Allocations (Lbs/day)					
Allocation Category	**High Flows**	**Moist Conditions**	**Mid-Range Flows**	**Dry Conditions**	**Low Flows**
LA	11,167.94	4,792.04	2,266.69	850.01	303.21
WLA	571.16	245.08	114.04	42.77	15.25
MOS (10%)	1,467.39	629.64	297.59	111.60	39.81
Future Growth (10%)	1,467.39	629.64	297.59	111.60	39.81
Upstream Drainage Input (Bear, Aikman)	4,020,472.42	1,725,139.91	815,367.24	305,763.03	109,069.89
TMDL = LA+WLA+MOS	**4,035,146.29**	**1,731,436.30**	**818,343.15**	**306,878.99**	**109,467.97**
WLA (Individual)					
Solar Sources Charger Mine	562.32	241.29	114.04	42.77	15.25
Construction WLA	8.84	3.79	0.00	0.00	0.00

Mud Creek Subwatershed

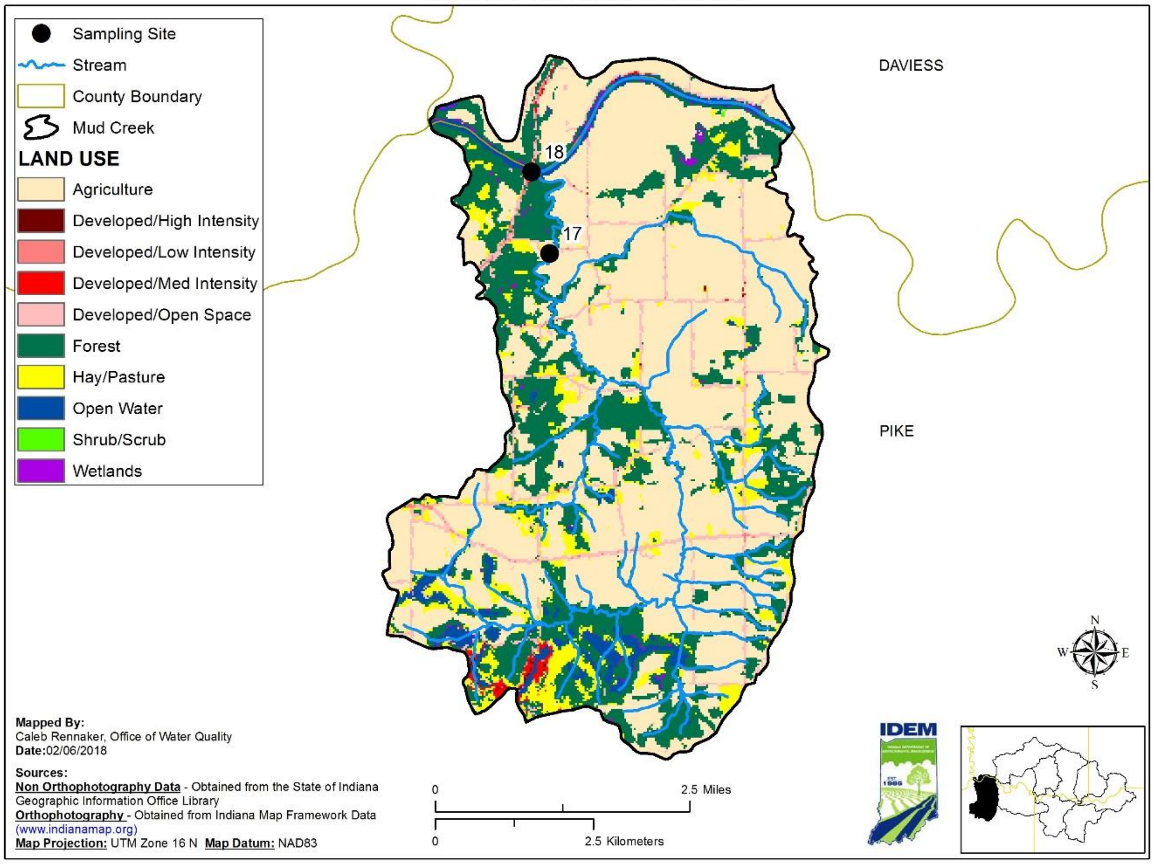

Figure 66: Sampling stations in Mud Creek Subwatershed

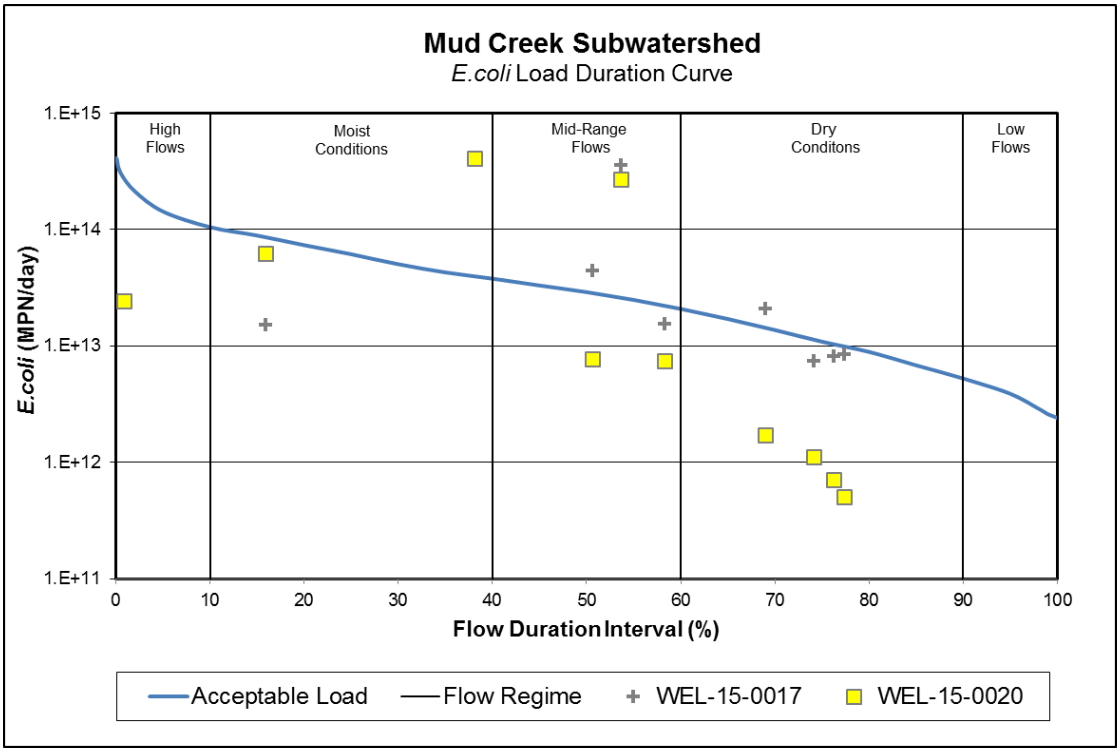

Figure 67: *E. coli* Load Duration Curve for Mud Creek Subwatershed

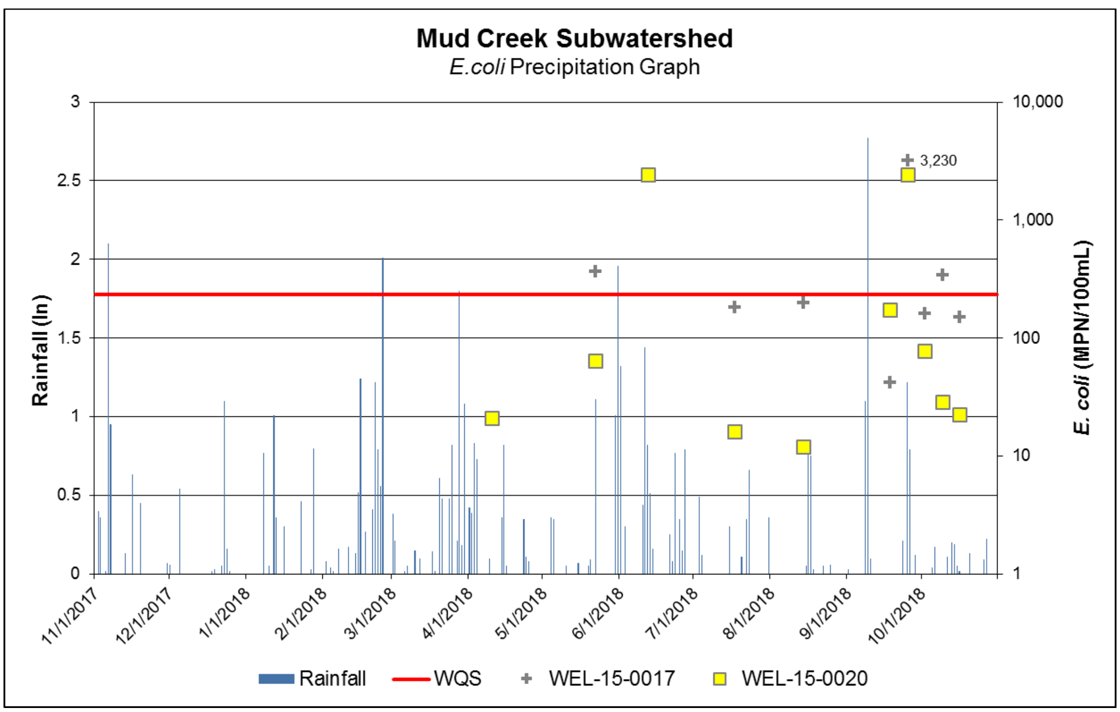

Figure 68: Graph of Precipitation and *E.coli* Data Mud Creek Subwatershed

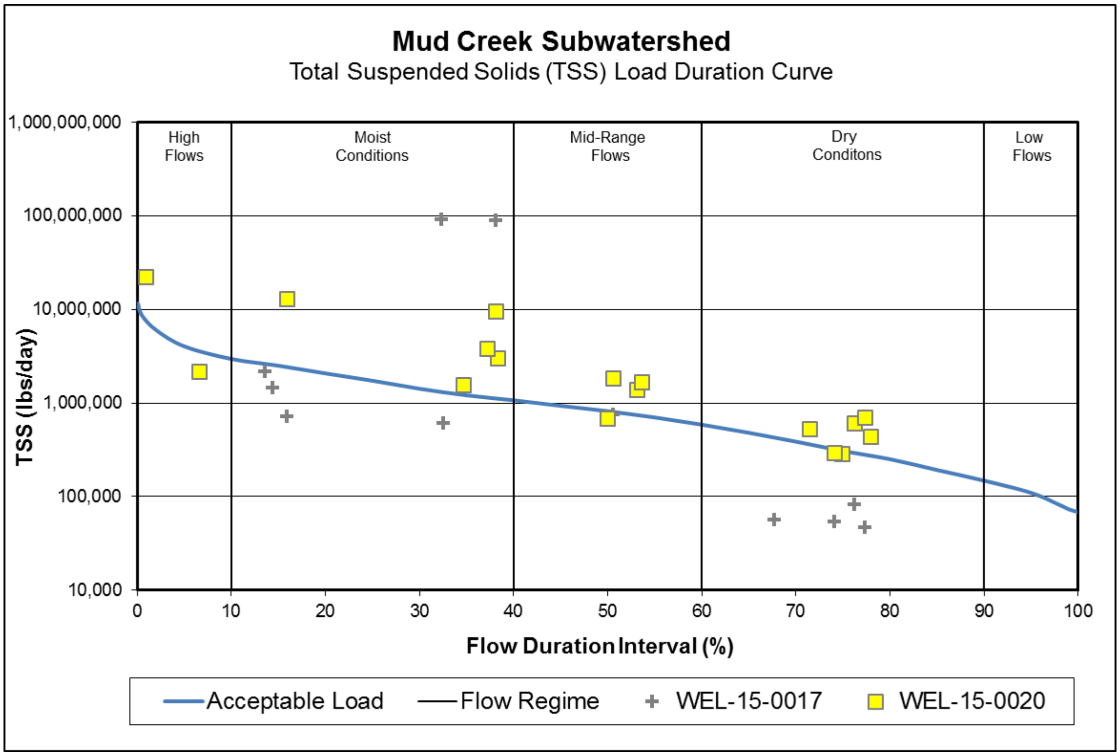

Figure 69: Total Suspended Solids Load Duration Curve for Mud Creek Subwatershed

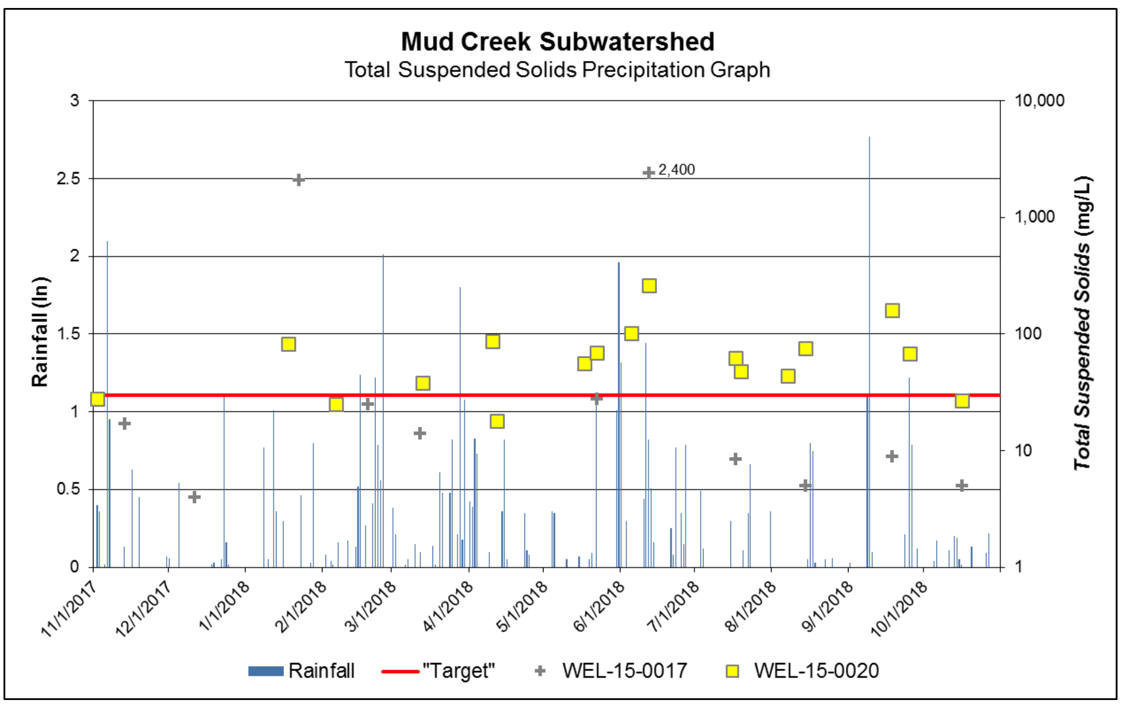

Figure 70: Graph of Precipitation and Total Suspended Solids Data Mud Creek Subwatershed

The precipitation graph for these sites shows the stream is susceptible to high loads of *E. coli* and TSS from run-off. The streams are consistently in violation of water quality standards/targets even during drier conditions on the chart. This indicates point sources may be contributing along with nonpoint sources, however point sources are not believed to be significant contributors. Water quality duration graphs are presented in Appendix D.

5.0 Allocations

A TMDL is the total amount of a pollutant that can be assimilated by the receiving water while still achieving water quality standards. TMDLs are composed of the sum of individual WLAs for regulated sources and LAs for sources not directly regulated by a permit. In addition, the TMDL must include a MOS, either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. Conceptually, this is defined by the equation:

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

5.1 Individual Allocations

The following sections present the allowable pollutant loads and associated allocations for each of the subwatersheds and associated assessment units in the Lower East Fork White River Watershed. Allocations were calculated for each 12-digit HUC. WLAs were calculated based on the design flow or estimated flow of the facility and the TMDL target or applicable permit limit. The following tables presents the individual WLAs for NPDES facilities in the Lower East Fork White River watershed by subwatershed.

Table 42: Individual WLAs for NPDES PWS Facilities in the Lower East Fork White River Watershed

Subwatershed	AUID	Facility Name	Permit ID	Avg Design Flow (MGD)	TSS WLA (lbs/day)	NPDES Permit Limit (daily max)
Bear Creek	INW08F8_T1001	Otwell Water Corporation	IN0052086	0.002	0.67	**40 mg/L**

5.1.1 Approach for Calculating General Permit Waste Load Allocations

A number of permittees in the Lower East Fork White River watershed have general rather than individual permits. An individual permit is site-specific and is developed to address discharges from a specific facility. A general permit is used to cover a category of similar discharges, rather than a specific site. IDEM may issue a general permit when there are several sources or activities involved in similar operations that may be adequately regulated with a standard set of conditions.

Calculating WLAs for facilities with individual permits is straightforward; all of the necessary information regarding allowable flows and effluent limits is contained within the permit. Calculating WLAs for facilities with general permits is more difficult because only limited information is available on historical flow and pollutant concentrations. For example, several of the current mines in the watershed have general permits for treating run-off; discharge is therefore related to precipitation events rather than a “design” flow as is available for WWTPs. WLAs were therefore calculated by using the drainage area of each permittee to estimate run-off flow volumes and using either existing permit limits or the TMDL targets to calculate the allowable loadings. The total performance acres bonded were used to estimate the size of the mine for each subwatershed. As total permitted boundaries and not bonded acreage are typically available for spatial analysis, bonded acreage for each subwatershed was estimated by an area weighted approach using permitted area within each subwatershed. For example, Solar Sources Shamrock Mine is permitted for 2,550 acres of which 2,132 acres or 83.6% of the permitted area is located within the Birch Creek subwatershed. Using the total bonded area reported at 1,925 acres, the estimated bonded acreage within the subwatershed was determined by multiplying 1,925 by 83.6% to result in 1,607 acres. To determine the WLA, 1,607 was divided by the subwatershed area, and multiplied by the corresponding flow values for the subwatershed to determine flow from the facility [(1,607 / 13,978 acres in Birch Creek) * flow (cfs)]. Flow-based WLA were thus calculated by multiplying the flow values by the permit limit of 70 mg/L daily maximum. These permits have varying discharge limits based on dry and wet weather discharge flow rates. Individual WLAs for coal mining facilities are implemented through compliance with their NPDES permit.

Table 43: Individual WLA for NPDES Coal Mining Facilities in the Lower East Fork White River Watershed

Facility Name (NPDES Permit)	Subwatershed	Permitted Area in Subwatershed	Estimated bonded acres	Percent of Subwatershed (bonded acres)	High Flow Regime TSS WLA (lbs/day)	Low Flow Regime TSS WLA (lbs/day)	NPDES Permit Limit (daily max)
Solar Sources Charger Mine (ING040129)	Mud Creek	2,396	220	1.64%	562.32*	15.25*	**70 mg/L**
Solar Sources Shamrock Mine (ING040210)	Birch Creek	2,132	1,609	11.52%	4,124.94*	111.90*	**70 mg/L**
	Bear Creek	390	295	1.41%	755.47*	20.51*	**70 mg/L**
Solar Sources Cannelburg mine (ING040026)	Aikman Creek	2,703	686	3.52%	1,757.52*	47.68*	**70 mg/L**
Peabody Midwest Viking Corning Pit (ING040154)	Sugar Creek	862	185	1.20%	473.82*	12.85*	**70 mg/L**
	Aikman Creek	2,037	437	2.24%	1,119.48*	30.37*	**70 mg/L**
Trust Resources Vigo Captain Daviess Mine (ING040277)	Sugar Creek	731	731	4.74%	1,874.65*	50.86*	**70 mg/L**
	Birch Creek	242	242	1.73%	619.89*	16.82*	**70 mg/L**

Understanding Table 43: Bonded or disturbed acres were used to estimate individual WLAs for each subwatershed. Information on mining activities was obtained from the Indiana Coal Mine Information System maintained by the Indiana Department of Natural Resources Division of Reclamation (https://www.in.gov/dnr/reclamation/9310.htm). *These allocations are not meant to be directly incorporated into the general permit.

The TMDL was calculated using the load duration curve approach discussed in Section 3.0. Stormwater WLAs were calculated by subtracting the MOS, WLA (non-stormwater), and future growth from the TMDL. A moderate MOS of 10 percent was calculated by reserving 10 percent of the total TMDL allocation. The WLAs for MS4 facilities was determined based on the overall area the MS4 has jurisdiction over in the subwatershed.

Table 44: Individual WLAs for MS4 Communities in the Lower East Fork White River Watershed

Subwatershed	MS4 Community	Permit ID	Area in Drainage (Acres)	Percentage of Subwatershed	High Flow Regime *E. coli* WLA (MPN/day)	Low Flow Regime *E. coli* WLA (MPN/day)
Mill Creek	Jasper	INR040067	1245.57	9.95%	4.132E+10	1.773E+10

5.2 Critical Conditions

The CWA requires that TMDLs take into account critical conditions for stream flow, loading, and water quality parameters as part of the analysis of loading capacity. The load duration curve approach helps to identify the sources contributing to the impairment and to roughly differentiate between sources. Exceedances of the load duration curve at higher flows (0-40 percent ranges) are indicative of wet weather sources (e.g., nonpoint sources, regulated stormwater discharges). Exceedances of the load duration curve at lower flows (60 to 100 percent range) are indicative of point sources (e.g., wastewater treatment facilities, livestock in the stream). Table 45 summarizes the general relationship between the five hydrologic zones and potentially contributing sources (the table is not specific to any individual pollutant). Existing loading is calculated as the 90th percentile of measured *E. coli* concentrations under each hydrologic condition class multiplied by the flow at the middle of the flow exceedance percentile. For example, in calculating the existing loading under dry conditions (flow exceedance percentile = 60-90 percent), the 75th percentile exceedance flow is *multiplied* by the 90th percentile of pollutant concentrations measured under 60-90th percentile flows. Through the load duration curve approach it has been determined that load reductions for *E. coli*, TSS, and total phosphorus are needed for specific flow conditions. The critical conditions (the periods when the greatest reductions are required) vary by location and are summarized in Table 46. After existing loading and percent reductions are calculated under each hydrologic condition class, the critical condition for each TMDL is identified as the flow condition requiring the largest percent reduction. For example, impacts from point sources are usually most pronounced during dry and low flow zones because there is less water in the stream to dilute their loads. In contrast, impacts from channel bank erosion is most pronounced during high flow zones because these are the periods during which stream velocities are high enough to cause erosion to occur. The table indicates that critical conditions for pollutants for most locations occur during the dry to moist regimes, and therefore implementation of controls should be targeted for these conditions.

Table 45: Relationship between Load Duration Curve Zones and Contributing Sources

Contributing Source Area	Duration Curve Zone				
	High (0%-10%)	Moist (10%-40%)	Mid-Range (40%-60%)	Dry (60%-90%)	Low (90%-100%)
Wastewater treatment plants (point source)			L	M	H
Livestock direct access to streams			L	M	H
Wildlife direct access to streams			L	M	H
Pasture management	H	H	M		
On-site wastewater systems/Unsewered areas	L	M	H	H	H
Riparian buffer areas	H	H	M	M	
Stormwater: Impervious	H	H	H		
Stormwater: Upland	H	H	M		
Field drainage: Natural condition	H	M			
Field drainage: Tile system	H	H	M	L	
Bank erosion	H	M	L		

Note: Potential relative importance of source area to contribute loads under given hydrologic condition (H: High; M: Medium; L: Low)
(Modified from *EPA, 2007 An Approach for Using Load Duration Curves in the Development of TMDLs*)

Table 46: Critical Conditions for TMDL Parameters

Parameter	Subwatershed (HUC)	Critical Condition				
		High	Moist	Mid-Range	Dry	Low
E. coli (counts/mL)	Mill Creek (51202081501)	89%	--	99%	90%	--
	Hoffman Run US (51202081502)	NA	--	NA	78%	--
	Slate Creek (51202081503)	26%	--	96%	90%	--
	Sugar Creek (51202081504)	66%	--	90%	90%	--
	Dogwood Lake (51202081505)	--	--	--	--	--
	Birch Creek (51202081506)	NA	90%	90%	66%	--
	Aikman Creek (51202081507)	NA	89%	95%	56%	--
	Bear Creek (51202081508)	38%	90%	94%	63%	--
	Mud Creek (51202081509)	NA	90%	92%	4%	--
	Mill Creek (51202081501)	NA	40%	NA	NA	--
	Hoffman Run US (51202081502)	NA	NA	NA	NA	--
	Slate Creek (51202081503)	NA	58%	NA	6%	--

Parameter	Subwatershed (HUC)	Critical Condition				
		High	Moist	Mid-Range	Dry	Low
	Sugar Creek (51202081504)	NA	34%	NA	NA	--
	Dogwood Lake (51202081505)	--	--	--	--	--
	Birch Creek (51202081506)	41%	48%	NA	NA	--
	Aikman Creek (51202081507)	NA	49%	NA	NA	--
	Bear Creek (51202081508)	NA	NA	11%	NA	--
	Mud Creek (51202081509)	3%	41%	NA	NA	--
Total Suspended Solids (mg/L)	Mill Creek (51202081501)	NA	96%	NA	87%	--
	Hoffman Run US (51202081502)	70%	79%	36%	74%	--
	Slate Creek (51202081503)	NA	98%	NA	93%	--
	Sugar Creek (51202081504)	74%	96%	15%	94%	--
	Dogwood Lake (51202081505)	--	--	--	--	--
	Birch Creek (51202081506)	19%	95%	68%	14%	--
	Aikman Creek (51202081507)	NA	98%	NA	NA	--
	Bear Creek (51202081508)	NA	89%	71%	NA	--
	Mud Creek (51202081509)	65%	99%	54%	55%	--

Note: -- = No Data Collected in Flow Regime; NA = No reduction needed

Table 45 and Table 46 provide the foundation necessary to identify subwatersheds that are in need of the most significant pollutant reductions to achieve water quality standards in the Lower East Fork White River watershed. Using these two tables, along with the Linkage Analysis in Section 4.0, watershed organizations will gain a better understanding of which subwatersheds require the most pollutant load reductions. This can assist in future efforts to identify critical areas in the Lower East Fork White River watershed for implementation. The tables above focus on the information and data collected and analyzed through the TMDL development process for percent reduction purposes, whereas critical areas take into account other factors for consideration (e.g., political, social, economic) to help determine implementation feasibility that will affect progress toward pollutant load reductions and, ultimately, attainment of water quality standards. This information can be key to watershed organizations in the process of identifying and selecting critical areas and implementation activities for the purposes of watershed management plan development. IDEM recommends that watershed organizations take the percent reductions into consideration when selecting critical areas for purposes of watershed management planning. By also taking into account different flow regimes, watershed groups will be able to prioritize practices that give them the most efficient load reductions for each critical area that is chosen.

6.0 Reasonable Assurances/Implementation

This section of the Lower East Fork White River watershed TMDL focuses on implementation activities that have the potential to achieve the WLAs and LAs presented in previous sections. The focus of this section is to identify and select the most appropriate structural and non-structural best management practices (BMPs) and control technologies to reduce *E. coli*, TSS, and total phosphorus loads from sources throughout the Lower East Fork White River watershed, particularly in the critical areas identified in Section 5.2. This section also addresses the programs that are available to facilitate implementation of structural and non-structural BMPs to achieve the allocations, as well as current ongoing activities in the Lower East Fork White River watershed at the local level that will play a key role in successful TMDL implementation.

To select appropriate BMPs and control technologies, it is important to review the relevant sources in the Lower East Fork White River watershed.

Point Sources

- PWS
- Industrial facilities
- Illicitly connected straight pipe systems

Nonpoint Sources

- Cropland
- Pastures and livestock operations
- CFOs and AFOs
- Streambank erosion
- Onsite wastewater treatment systems
- Wildlife
- Urban nonpoint source run-off

6.1 Implementation Activity Options for Sources in the Lower East Fork White River Watershed

Keeping the list of significant sources in the Lower East Fork White River watershed in mind, it is possible to review the types of BMPs that are most appropriate for the pollutants and the source type. Table 47: List of Potentially Suitable BMPs for the Lower East Fork White River Watershed provides a list of implementation activities that are potentially suitable for the Lower East Fork White River watershed based on the pollutants and the types of sources. The implementation activities are a combination of structural and non-structural BMPs to achieve the assigned WLAs and LAs. IDEM recognizes that actions taken in any individual subwatershed may depend on a number of factors (including socioeconomic, political and ecological factors). The recommendations in Table 47 are not intended to be prescriptive. Any number or combination of implementation activities might contribute to water quality improvement, whether applied at sites where the actual impairment was noted or other locations where sources contribute indirectly to the water quality impairment.

Table 47: List of Potentially Suitable BMPs for the Lower East Fork White River Watershed

	Pollutant			Point Sources			Nonpoint Sources						
Implementation Activities	Bacteria	Nutrients	Sediment	WWTPs and Industrial Facilities	CAFOs	Illicitly Connected "Straight Pipe" Systems	Cropland	Pastures and Livestock Operations	CFOs	Streambank Erosion	Onsite Wastewater Treatment Systems	Wildlife/Domestic Pets	Urban NPS Run-off
Inspection and maintenance	X	X	X	X	X						X		
Outreach and education and training	X	X	X	X	X	X	X	X	X	X	X	X	
System replacement	X	X				X					X		
Conservation tillage/residue management	X	X	X				X						
Cover crops	X	X	X				X			X			
Filter strips	X	X	X		X		X	X	X	X			
Grassed waterways	X		X		X		X		X	X			
Riparian forested/herbaceous buffers	X	X	X		X		X	X	X	X		X	
Manure handling, storage, treatment, and disposal	X	X			X				X				
Alternative watering systems	X		X		X			X	X	X			
Stream fencing (animal exclusion)	X	X	X		X			X		X			
Prescribed grazing	X	X	X					X		X			
Conservation easements	X	X	X										
Two-stage ditches		X	X										
Rain barrel		X	X										
Rain garden		X	X										
Porous pavement		X	X										
Stormwater planning and management	X	X	X	X						X	X	X	
Comprehensive Nutrient Management Plan	X	X					X		X				
Constructed Wetland	X	X	X	X		X	X					X	
Critical Area Planting			X					X		X			
Drainage Water Management		X					X						
Nutrient Management Plan		X					X			X			
Land Reconstruction of Mined Land			X							X			
Sediment Basin		X	X										
Pasture and Hay Planting	X	X	X				X	X	X	X		X	

Implementation Activities	Pollutant			Point Sources			Nonpoint Sources						
	Bacteria	Nutrients	Sediment	WWTPs and Industrial Facilities	CAFOs	Illicitly Connected "Straight Pipe" Systems	Cropland	Pastures and Livestock Operations	CFOs	Streambank Erosion	Onsite Wastewater Treatment Systems	Wildlife/Domestic Pets	Urban NPS Run-off
Streambank and Shoreline Protection			X				X	X	X	X		X	
Conservation Crop Rotation		X	X				X	X	X				
Field Border	X	X					X	X	X			X	
Conservation Crop Rotation	X	X	X				X			X			

The information provided in Section 5.2 assisted in the development of Table 47, which provides a more refined suite of recommended implementation activities targeted to the critical flow condition identified in Section 5.2. Watershed stakeholders can use the implementation activities identified in Table 47 for each critical flow condition and select activities that are most feasible in the Lower East Fork White River watershed. This table can also help watershed stakeholders to identify implementation activities for critical areas that they select through the watershed management planning process.

6.2 Implementation Goals and Indicators

For each pollutant in the Lower East Fork White River watershed, IDEM has identified broad goal statements and indicators. This information is to help watershed stakeholders determine how to track implementation progress over time and also provides the information necessary to complete a watershed management plan.

***E. coli* Goal Statement:** The waterbodies (or streams) in the Lower East Fork White River watershed should meet the 235 colonies/100 mL daily maximum TMDL target value.

***E. coli* Indicator:** Water quality monitoring by IDEM will serve as the environmental indicator to determine progress toward the *E. coli* target value.

Total Phosphorus Goal Statement: The waterbodies (or streams) in the Lower East Fork White River watershed should meet the 0.30 mg/L TMDL total phosphorus target value.

Total Phosphorus Indicator: Water quality monitoring by IDEM will serve as the environmental indicator to determine progress toward the total phosphorus target value.

Total Suspended Solids Goal Statement: The waterbodies (or streams) in the Lower East Fork White River watershed should meet the 30 mg/L TMDL total suspended solids target value.

Total Suspended Solids Indicator: Water quality monitoring by IDEM will serve as the environmental indicator to determine progress toward the total suspended solids target value.

6.3 Summary of Programs

There are a number of federal, state, and local programs that either require or can assist with the implementation activities recommended for the Lower East Fork White River watershed. A description of these programs is provided in this section. The following section discusses how some of these programs relate to the various sources in the Lower East Fork White River watershed.

6.3.1 Federal Programs

Clean Water Act Section 319(h) Grants

Section 319 of the federal Clean Water Act contains provisions for the control of nonpoint source pollution. The Section 319 program provides for various voluntary projects throughout the state to prevent water pollution and also provides for assessment and management plans related to waterbodies in Indiana impacted by NPS pollution. The Watershed Planning and Restoration Section within the Watershed Assessment and Planning Branch of the Office of Water Quality administers the Section 319 program for the NPS-related projects.

U.S. EPA offers Clean Water Act Section 319(h) grant monies to the state on an annual basis. These grants must be used to fund projects that address nonpoint source pollution issues. Some projects which the Office of Water Quality has funded with this money in the past include developing and implementing Watershed Management Plans (WMPs), BMP demonstrations, data management, educational programs, modeling, stream restoration, and riparian buffer establishment. Projects are usually two to three years in length. Section 319(h) grants are intended to be used for project start-up, not as a continuous funding source. Units of government, nonprofit groups, and universities in the state that have expertise in nonpoint source pollution problems are invited to submit Section 319(h) proposals to the Office of Water Quality.

Clean Water Action Section 205(j) Grants

Section 205(j) provides for planning activities relating to the improvement of water quality from nonpoint and point sources by making funding available to municipal and county governments, regional planning commissions, and other public organizations. For-profit entities, non-profit organizations, private associations, universities, and individuals are not eligible for funding through Section 205(j). The CWA states that the grants are to be used for water quality management and planning, including, but not limited to:

- Identifying most cost effective and locally acceptable facility and nonpoint source measures to meet and maintain water quality standards;
- Developing an implementation plan to obtain state and local financial and regulatory commitments to implement measures developed under those plans;
- Determining the nature, extent, and cause of water quality problems in various areas of the state.

The Section 205(j) program provides for projects that gather and map information on nonpoint and point source water pollution, develop recommendations for increasing the involvement of environmental and civic organizations in watershed planning and implementation activities, and develop watershed management plans.

USDA's Conservation Stewardship Program (CSP)

The Conservation Stewardship Program (CSP) helps landowners build on their existing conservation efforts while strengthening their operation. Whether they are looking to improve grazing conditions, increase crop yields, or develop wildlife habitat, NRCS can custom design a CSP plan to help them meet those goals. NRCS can help landowners schedule timely planting of cover crops, develop a grazing plan that will improve the forage base, implement no-till to reduce erosion or manage forested areas in a way that benefits wildlife habitat. If landowners are already taking steps to improve the condition of the land, chances are CSP can help them find new ways to meet their goals.

USDA's Conservation Reserve Program (CRP)

NRCS provides technical assistance to landowners interested in participating in the Conservation Reserve Program administered by the USDA Farm Service Agency. The Conservation Reserve Program reduces soil erosion, protects the Nation's ability to produce food and fiber, reduces sedimentation in streams and lakes, improves water quality, establishes wildlife habitat, and enhances forest and wetland resources. It encourages farmers to convert highly erodible cropland or other environmentally sensitive acreage to vegetative cover, such as tame or native grasses, wildlife plantings, trees, filter strips, or riparian buffers. Farmers receive an annual rental payment for the term of the multi-year contract. Cost-share funding is provided to establish the vegetative cover practices.

USDA's Conservation Reserve Enhancement Program (CREP)

NRCS provides technical assistance to landowners interested in participating in the Conservation Reserve Program administered by the USDA Farm Service Agency. The Conservation Reserve Enhancement Program (CREP), an offshoot of CRP, targets high-priority conservation concerns identified by a State, and federal funds are supplemented with non-federal funds to address those concerns. In exchange for removing environmentally sensitive land from production and establishing permanent resource conserving plant species, farmers and ranchers are paid an annual rental rate along with other federal and state incentives as applicable per each CREP agreement. Participation is voluntary, and the contract period is typically 10–15 years.

USDA's Environmental Quality Incentives Program (EQIP)

The Environmental Quality Incentives Program provides technical, educational, and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost effective manner. The program provides assistance to farmers and ranchers in complying with Federal, State, and tribal environmental laws, and encourages environmental enhancement. The program is funded through the Commodity Credit Corporation. The purposes of the program are achieved through the implementation of a conservation plan, which includes structural, vegetative, and land management practices on eligible land. Five to ten year contracts are made with eligible producers. Cost-share payments may be made to implement one or more eligible structural or vegetative practices, such as animal waste management facilities, terraces, filter strips, tree planting, and permanent wildlife habitat. Incentive payments can be made to implement one or more land management practices, such as nutrient management, pest management, and grazing land management. Fifty percent of the funding available for the program is targeted at natural resource concerns relating to livestock production. The program is carried out primarily in priority areas that may be watersheds, regions, or multi-state areas, and for significant statewide natural resource concerns that are outside of geographic priority areas.

USDA's Farmable Wetlands Program

NRCS provides technical assistance to landowners interested in participating in the Conservation Reserve Program administered by the USDA Farm Service Agency. The Farmable Wetlands Program (FWP) is designed to restore previously farmed wetlands and wetland buffer to improve both vegetation and water flow. FWP is a voluntary program to restore up to one million acres of farmable wetlands and associated buffers. Participants must agree to restore the wetlands, establish plant cover, and to not use enrolled land for commercial purposes. Plant cover may include plants that are partially submerged or specific types of trees. By restoring farmable wetlands, FWP improves ground water quality, helps trap and break down pollutants, prevents soil erosion, reduces downstream flood damage, and provides habitat for water birds and other wildlife. Wetlands can also be used to treat sewage and are found to be as effective as "high tech" methods. The Farm Service Agency runs the program through the Conservation Reserve Program (CRP) with assistance from other government agencies and local conservation groups.

USDA's Conservation Technical Assistance (CTA)

The purpose of the CTA program is to assist land users, communities, units of state and local government, and other Federal agencies in planning and implementing conservation systems. The purpose of the conservation systems is to reduce erosion, improve soil and water quality, improve and conserve wetlands, enhance fish and wildlife habitat, improve air quality, improve pasture and range condition, reduce upstream flooding, and improve woodlands.

One objective of the program is to assist individual land users, communities, conservation districts, and other units of state and local government and federal agencies to meet their goals for resource stewardship and assist individuals in complying with state and local requirements. NRCS assistance to individuals is provided through conservation districts in accordance with the Memorandum of Understanding signed by the Secretary of Agriculture, the Governor of the State, and the conservation district. Assistance is provided to land users voluntarily applying conservation practices and to those who must comply with local or state laws and regulations.

Another objective is to provide assistance to agricultural producers to comply with the highly erodible land (HEL) and wetland (Swampbuster) provisions of the 1985 Food Security Act, as amended by the Food, Agriculture, Conservation and Trade Act of 1990 (16 U.S.C. 3801 et. seq.), the Federal Agriculture Improvement and Reform Act of 1996, and wetlands requirements of Section 404 of the Clean Water Act. NRCS makes HEL and wetland determinations and helps land users develop and implement conservation plans to comply with the law. The program also provides technical assistance to participants in USDA cost-share and conservation incentive programs.

NRCS collects, analyzes, interprets, displays, and disseminates information about the condition and trends of the Nation's soil and other natural resources so that people can make good decisions about resource use and about public policies for resource conservation. They also develop effective science based technologies for natural resource assessment, management, and conservation.

USDA's Watershed Surveys and Planning

The Watershed and Flood Prevention Act, P.L. 83-566, August 4, 1954, (16 U.S.C. 1001-1008) authorized this program. Prior to fiscal year 1996, small watershed planning activities and the cooperative river basin surveys and investigations authorized by Section 6 of the Act were operated as separate programs. The 1996 appropriations act combined the activities into a single program entitled the Watershed Surveys and Planning program. Activities under both programs are continuing under this authority.

The purpose of the program is to assist Federal, State, and local agencies and tribal governments to protect watersheds from damage caused by erosion, floodwater, and sediment and to conserve and develop water and land resources. Resource concerns addressed by the program include water quality, opportunities for water conservation, wetland and water storage capacity, agricultural drought problems, rural development, municipal and industrial water needs, upstream flood damages, and water needs for fish, wildlife, and forest-based industries.

Types of surveys and plans include watershed plans, river basin surveys and studies, flood hazard analyses, and floodplain management assistance. The focus of these plans is to identify solutions that use land treatment and non-structural measures to solve resource problems.

Agricultural Conservation Easement Program (ACEP)

The Agricultural Conservation Easement Program (ACEP) provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits. Under the Agricultural Land Easements component, NRCS helps American Indian tribes, state and local governments and nongovernmental organizations protect working agricultural lands and limit non-agricultural uses of the land. Under the Wetlands Reserve Easements component, NRCS helps to restore, protect, and enhance enrolled wetlands.

Agricultural Land Easements protect the long-term viability of the nation's food supply by preventing conversion of productive working lands to non-agricultural uses. Land protected by agricultural land easements provides additional public benefits, including environmental quality, historic preservation, wildlife habitat, and protection of open space.

Wetland Reserve Easements provide habitat for fish and wildlife, including threatened and endangered species, improve water quality by filtering sediments and chemicals, reduce flooding, recharge ground water, protect biological diversity, and provide opportunities for educational, scientific, and limited recreational activities.

NRCS provides financial assistance to eligible partners for purchasing Agricultural Land Easements that protect the agricultural use and conservation values of eligible land. In the case of working farms, the program helps farmers and ranchers keep their land in agriculture. The program also protects grazing uses and related conservation values by conserving grassland, including rangeland, pastureland and shrubland. Eligible partners include American Indian tribes, state and local governments and non-governmental organizations that have farmland, rangeland, or grassland protection programs.

Under the Agricultural Land component, NRCS may contribute up to 50 percent of the fair market value of the agricultural land easement. Where NRCS determines that grasslands of special environmental significance will be protected, NRCS may contribute up to 75 percent of the fair market value of the agricultural land easement.

Regional Conservation Partnership Program

The Regional Conservation Partnership Program (RCPP) encourages partners to join in efforts with producers to increase the restoration and sustainable use of soil, water, wildlife, and related natural resources on regional or watershed scales. Through the program, NRCS and its partners help producers install and maintain conservation activities in selected project areas. Partners leverage RCPP funding in project areas and report on the benefits achieved.

Healthy Forests Reserve Program

The Healthy Forests Reserve Program (HFRP) helps landowners restore, enhance, and protect forestland resources on private lands through easements and financial assistance. HRFP aids the recovery of endangered and threatened species under the Endangered Species Act, improves plant and animal biodiversity, and enhances carbon sequestration.

HFRP provides landowners with 10-year restoration agreements and 30-year or permanent easements for specific conservation actions. For acreage owned by an Indian tribe, there is an additional enrollment option of a 30-year contract. Some landowners may avoid regulatory restrictions under the Endangered Species Act by restoring or improving habitat on their land for a specified period of time.

Conservation Innovation Grants (CIG)

Conservation Innovation Grants (CIG) are competitive grants that drive public and private sector innovation in resource conservation. Authorized by the 2002 Farm Bill, CIG uses EQIP funds to award competitive grants to non-Federal governmental or nongovernmental organizations, American Indian Tribes, or individuals. Producers involved in CIG-funded projects must be EQIP eligible. Through the NRCS CIG program, public and private grantees develop the tools, technologies, and strategies to support next-generation conservation efforts on working lands and develop market-based solutions to resource challenges. Grantees leverage the federal investment by at least matching it.

The NRCS understands the importance of supporting historically underserved, new and beginning, and military veteran producers in farming and ranching because these producers are critical to the fabric of American agriculture and to our rural communities. Annually, approximately 10% of CIG funding is set aside to support these farmers and ranchers. CIG projects inspire creative problem-solving that boosts production on farms, ranches, and private forests - ultimately they improve water quality, soil health, and wildlife habitat.

Voluntary Public Access and Habitat Incentive Program (VPA-HIP)

The Voluntary Public Access and Habitat Incentive Program (VPA-HIP) is a competitive grants program that helps state and tribal governments increase public access to private lands for wildlife-dependent recreation, such as hunting, fishing, nature watching, or hiking.

State and tribal governments may submit proposals for VPA-HIP block grants from NRCS. These governments provide the funds to participating private landowners to initiate new or expand existing public access programs that enhance public access to areas previously unavailable for wildlife-dependent recreation. Nothing in VPA-HIP preempts liability laws that may apply to activities on any property related to grants made in this programs.

6.3.2 State Programs

State Point Source Control Program

The purpose of the NPDES permit is to control the point source discharge of pollutants into the waters of the State such that the quality of the water of the State is maintained in accordance with applicable water quality standards. NPDES permit requirements ensure that the minimum amount of control is imposed upon any new or existing point source through the application of technology-based treatment requirements. Control of discharges from WWTPs, industrial facilities, and CSOs consistent with WLAs is implemented through the NPDES program. The Stormwater and Sediment Control Program works primarily with developers, contractors, realtors, property holders, and others to address erosion and sediment concerns on non-agricultural lands, especially those undergoing development.

State Nonpoint Source Control Program

The state's Nonpoint Source Program, administered by the IDEM Office of Water Quality's Watershed Planning and Restoration Section, focuses on the assessment and prevention of nonpoint source water pollution. The program also provides for education and outreach to improve the way land is managed. Through the use of federal funding for the installation of BMPs, the development of watershed management plans, and the implementation of watershed restoration pollution prevention activities, the program reaches out to citizens so that land is managed in such a way that less pollution is generated.

Nonpoint source projects funded through the Office of Water Quality are a combination of local, regional, and statewide efforts sponsored by various public and not-for-profit organizations. The emphasis of these projects has been on the local, voluntary implementation of nonpoint source water pollution controls. The Watershed Planning and Restoration Section administers the Section 319 funding for nonpoint source-related projects, as well as Section 205(j) grants.

To award 319 grants, Watershed Planning and Restoration Section staff review proposals for minimum 319(h) eligibility criteria and rank each proposal. In their review, members consider such factors as: technical soundness; likelihood of achieving water quality results; strength of local partnerships; and competence/reliability of contracting agency. They then convene to discuss individual project merits and pool all rankings to arrive at final rankings for the projects. All proposals that rank above the funding target are included in the annual grant application to U.S. EPA, with U.S. EPA reserving the right to make final changes to the list. Actual funding depends on approval from U.S. EPA and yearly congressional appropriations.

Section 205(j) projects are administered through grant agreements that define the tasks, schedule, and budget for the project. IDEM project managers work closely with the project sponsors to help ensure that the project runs smoothly and the tasks of the grant agreement are fulfilled. Site visits are conducted at least quarterly to touch base on the project, provide guidance and technical assistance as needed, and to work with the grantee on any issues that arise to ensure a successful project closeout.

Indiana State Department of Agriculture Division of Soil Conservation

The Division of Soil Conservation's mission is to ensure the protection, wise use, and enhancement of Indiana's soil and water resources. The Division's employees are part of Indiana's Conservation Partnership, which includes the 92 soil and water conservation districts (SWCDs), the USDA Natural Resources Conservation Service, and the Purdue University Cooperative Extension Service. Working together, the partnership provides technical, educational, and financial assistance to citizens to solve erosion and sediment-related problems occurring on the land or impacting public waters.

The Division administers the Clean Water Indiana soil conservation and water quality protection program under guidelines established by the State Soil Conservation Board, primarily through the local SWCDs in direct service to landusers. The Division staff includes field-based resource specialists who work closely with landusers, assisting in the selection, design, and installation of practices to reduce soil erosion on agricultural land.

Indiana Department of Natural Resources, Division of Fish and Wildlife

The Lake and River Enhancement (LARE) program utilizes a watershed approach to reduce nonpoint source sediment and nutrient pollution of Indiana's and adjacent states' surface waters to a level that meets or surpasses state water quality standards. To accomplish this goal, LARE provides technical and financial assistance to local entities for qualifying projects that improve and maintain water quality in public access lakes, rivers, and streams.

State Revolving Fund (SRF) Loan Program

The SRF is a fixed rate, 20-year loan administered by the Indiana Finance Authority. The SRF provides low-interest loans to Indiana communities for projects that improve wastewater and drinking water infrastructure. The Program's mission is to provide eligible entities with the lowest interest rates possible on the financing of such projects while protecting public health and the environment. SRF also funds nonpoint source projects that are tied to a wastewater loan. Any project where there is an existing pollution abatement need is eligible for SRF funding.

Hoosier Riverwatch

Hoosier Riverwatch, administered by the IDEM OWQ Watershed Assessment and Planning Branch, is a water quality monitoring initiative which aims to increase public awareness of water quality issues and concerns through hands-on training of volunteers, in-stream monitoring, and cleanup activities. Hoosier Riverwatch collaborates with agencies and volunteers to educate local communities about the relationship between land use and water quality and to provide water quality information to citizens and governmental agencies working to protect Indiana's rivers and streams.

6.3.3 Local Programs

Programs taking place at the local level are key to successful TMDL implementation. Partners such as Pike, Martin, Daviess, and Dubois SWCDs are instrumental to bringing grant funding into the Lower East Fork White River watershed to support local protection and restoration projects. This section provides a brief summary of the local programs taking place in the Lower East Fork White River watershed that will help to reduce pollutant loads, as well as provide ancillary benefits to the Lower East Fork White River watershed.

Pike County

Pike County has received the following funding to improve water quality and conservation in 2017:

Local: $40,149
Clean Water Indiana: $11,000
Game Bird Habitat Development Program: $2,505
Wildlife Habitat Cost-Share Program: $4,428
Conservation Reserve Program & Conservation Reserve Enhancement Program: $636,864
Conservation Stewardship Program: $56,879

Environmental Quality Incentives Program: $184,888
Grassland Reserve Program: $1,370

Total: $938,083

Daviess County
Daviess County has received the following funding to improve water quality and conservation in 2017:

Local: $104,425
Clean Water Indiana: $10,000
Conservation Reserve Program & Conservation Reserve Enhancement Program: $389,560
Agricultural Conservation Easement Program: $419,666
Conservation Stewardship Program: $33,527
Environmental Quality Incentives Program: $300,905

Total: $1,258,083

Dubois County
Dubois County has received the following funding to improve water quality and conservation in 2017:

Local: $108,759
Clean Water Indiana: $10,000
Conservation Reserve Program & Conservation Reserve Enhancement Program: $351,149
Agricultural Conservation Easement Program: $64,875
Conservation Stewardship Program: $8,926
Environmental Quality Incentives Program: $249,805
|Grassland Reserve Program: $5,268

Total: $798,782

Martin County
Martin County has received the following funding to improve water quality and conservation in 2017:

Local: $20,174
Clean Water Indiana: $10,000
Conservation Reserve Program & Conservation Reserve Enhancement Program: $129,147
Conservation Stewardship Program: $2,594
Environmental Quality Incentives Program: $207,727

Total: $369,642

6.4 Implementation Programs by Source

Section 6.3 identified a number of federal, state, and local programs that can support implementation of the recommended management or restoration activities for the Lower East Fork White River watershed. Table 48 and the following sections identify which programs are relevant to the various sources in the Lower East Fork White River watershed.

Table 48: Summary of Programs Relevant to Sources in the Lower East Fork White River Watershed

Source	State NPDES program	Local agencies/programs	Section 319 program	Section 205(j) program	ISDA Division of Soil Conservation	IDNR Division of Fish and Wildlife	USDA's Conservation of Private Grazing Land Initiative	USDA's Conservation Reserve Program	USDA's Conservation Technical Assistance	USDA's Environmental Quality Incentives Program	USDA's Small Watershed Program and Flood Prevention Program	USDA's Watershed Surveys and Planning	USDA's Wetlands Reserve Program	USDA's Wildlife Habitat Incentives Program
Regulated Stormwater Sources	X			X										
CAFOs	X			X										
Illicitly Connected "Straight Pipe" Systems	X	X		X										
Cropland		X	X	X	X	X		X	X	X	X	X	X	
Pastures and Livestock Operations		X	X	X	X	X	X	X	X	X	X	X		
CFOs	X			X		X								
Streambank Erosion		X	X	X	X	X	X		X	X	X	X		
Onsite Wastewater Treatment Systems		X		X										
In-stream Habitat	X	X	X											X

6.4.1 Point Source Programs

WWTPs

Discharges from WWTPs are regulated under the NPDES program, with permits that authorize the discharge of substances at levels that meet the more stringent of technology- or water quality-based effluent limits. The NPDES program provides IDEM the authority to ensure that recommended effluent limits are applied to the appropriate permit holders within the watershed.

Industrial Facilities

As with discharges from WWTPs, industrial discharges are regulated under the NPDES program, with permits that authorize the discharge of substances at levels that meet the more stringent of technology- or water quality-based effluent limits. The NPDES program provides IDEM the authority to ensure that recommended effluent limits are applied to the appropriate permit holders within the watershed.

Regulated Stormwater Sources

Regulated MS4s are required to obtain permits administered under IDEM's MS4 general permit. This permit requires a stormwater management program (SWMP) to address six minimum control measures.

CAFOs

CAFOs are point sources regulated through the NPDES Program. Indiana regulations for CAFOs can be found in 327 IAC 15-15 and federal regulations for all CAFOs can be found in 40 CFR Parts 9, 122, and 412. The Effluent Limitations Guidelines and New Source Performance Standards for CAFOs require, in general, zero discharge from these areas and require proper design, construction, operation, and maintenance of the structures to contain all manure, litter, and process wastewater including the run-off and direct precipitation from a 25-year, 24-hour rainfall event. The NPDES general permit also requires that water quality standards shall not be exceeded in the event of an overflow from production areas. There are no CAFOs in the Lower East Fork White River Watershed.

Examples of requirements for CAFO operators include

- weekly inspections of waste storage facilities
- develop a Soil Conservation Practice Plan for all manure application sites controlled by the CAFO
- develop a Stormwater Pollution Prevention Plan for the area immediately around the production barns
- submit an annual report to IDEM
- adjust land application rates based on nitrogen and phosphorus

Illegal straight pipes

Local health departments are responsible for locating and eliminating illicit discharges and illegal connections to the sewer system.

6.4.2 Nonpoint Sources Programs

Cropland

Nonpoint source pollution from cropland areas is typically reduced through the voluntary implementation of BMPs by private landowners. Programs available to support implementation of cropland BMPs, whether through cost-share or technical assistance and education, include:

- Clean Water Act Section 319 program
- Indiana Department of Natural Resources Division of Fish and Wildlife (LARE)
- Indiana State Department of Agriculture Division of Soil Conservation/SWCDs
- USDA’s Conservation Reserve Program (CRP)
- USDA’s Conservation Technical Assistance (CTA)
- USDA’s Environmental Quality Incentives Program (EQIP)
- USDA’s Watershed Surveys and Planning
- USDA’s Wetlands Reserve Program (WRP)

Pastures and livestock operations

Nonpoint source pollution from pasture and livestock areas is typically reduced through the voluntary implementation of BMPs by private landowners. Programs available to support implementation of pasture and grazing BMPs, whether through cost-share or technical assistance and education, include:

- Clean Water Act Section 319 program
- Indiana Department of Natural Resources Division of Fish and Wildlife (LARE)
- Indiana State Department of Agriculture Division of Soil Conservation/SWCDs
- USDA's Conservation of Private Grazing Land Initiative (CPGL)
- USDA's Conservation Reserve Program (CRP)
- USDA's Conservation Technical Assistance (CTA)
- USDA's Environmental Quality Incentives Program (EQIP)
- USDA's Watershed Surveys and Planning

CFOs

While CAFOs are regulated by federal law, CFOs are not. However, Indiana has CFO regulations 327 IAC 16 and 327 IAC 15 that require that operations manage manure, litter, and process wastewater in a manner that "does not cause or contribute to an impairment of surface waters of the state." IDEM regulates CFOs under IC 13-18-10, the Confined Feeding Control Law. The rules at 327 IAC 16, which implement the statute regulating CFOs, were effective on March 10, 2002. IDEM's Office of Land Quality administers the regulatory program, which includes permitting, compliance monitoring, and enforcement activities.

Streambank Erosion

Streambank erosion can be the result of changes in the physical structure of the immediate bank from activities such as removal of riparian vegetation or frequent use by livestock, or it can be the result of increased flow volumes and velocities resulting from increased surface run-off throughout the upstream watershed. Therefore, streambank erosion might be addressed through BMPs and restoration targeted to the specific stream reach, and further degradation could be addressed through the use of BMPs implemented to address stormwater issues throughout the watershed. Programs available to support implementation of BMPs to address streambank erosion, whether through cost-share or technical assistance and education, include:

- Clean Water Act Section 319 program
- Indiana Department of Natural Resources Division of Soil Conservation
- USDA's Conservation Technical Assistance (CTA)
- USDA's Environmental Quality Incentives Program (EQIP)
- USDA's Watershed Surveys and Planning
- Mitigation Funds

Onsite wastewater treatment systems

Indiana State Department of Health (ISDH) Rule 410 IAC 6-8.1 outlines regulations for septic systems, including a series of regulatory constraints on the location and design of current septic systems in an effort to prevent system failures. The rule prohibits failing systems, requiring that:

- No system will contaminate ground water.
- No system will discharge untreated effluent to the surface.

Wildlife/domestic pets

Addressing pollutant contributions from wildlife and domestic pets is typically done at the local level through education and outreach efforts. For wildlife, educational programs focus on proper maintenance of riparian areas and discouraging the public from feeding wildlife. For domestic pets, education programs focus on responsible pet waste maintenance (e.g., scoop the poop campaigns) coupled with local ordinances.

6.5 Potential Implementation Partners and Technical Assistance Resources

Agencies and organizations at the federal, state, and local levels will play a critical role in implementation to achieve the WLAs and LAs assigned under this TMDL. Table 49 identifies key potential implementation partners and the type of technical assistance they can provide to watershed stakeholders.

Table 49: Potential Implementation Partners in the Lower East Fork White River Watershed

Potential Implementation Partner	Funding Source
Federal	
USDA	Conservation of Private Grazing Land Initiative (technical and education assistance only)
USDA	Conservation Reserve Program
USDA	Conservation Technical Assistance (technical assistance only)
USDA	Environmental Quality Incentives Program
USDA	Small Watershed Program and Flood Prevention Program
USDA	Watershed Surveys and Planning
USDA	Wetlands Reserve Program
State	
ISDA	Division of Soil Conservation soil and water conservation districts
IDNR	Division of Fish and Wildlife Lake and River Enhancement program
IDEM	Section 319 program grants
IDEM	Section 205(j) program grants
Local	
Soil and Water Conservation Districts	Local funds
Indiana Karst Conservancy	
County Health Departments	

IDEM has compiled a matrix of public and private grants and other funding resources available to fund watershed implementation activities. The matrix is available on IDEM's website at http://www.in.gov/idem/nps/3439.htm.

7.0 Public Participation

Public participation is an important and required component of the TMDL development process. The following public meetings were held in the watershed to discuss this project:

- A kickoff public meeting was held in Haysville, IN on October 23, 2017 to introduce the project and solicit public input. IDEM explained the TMDL process during these meetings, presented initial information regarding the Lower East Fork White River watershed, and answered questions from the public. Information was also solicited from stakeholders in the area.
- On October 23, 2018, IDEM worked with the Pike County Soil and Water Conservation District (SWCD) to host a water monitoring demonstration. The event was held in a public park along a tributary of Little Creek in Haysville, IN. IDEM staff were on site to explain and/or give demonstrations on their process for collecting water chemistry, fish through electrofishing techniques, and macroinvertebrates. Results were discussed for the 2017-2018 IDEM sampling of the watershed. The details of the partnership between the Pike County SWCD and IDEM were discussed as well.
- On June 5, 2019, a notice was posted to the Indiana Register to inform stakeholders of new impairments discovered during the 2017-2018 watershed characterization study in the Lower East Fork White River watershed. The notice outlined the findings of the study and listed proposed additions/deletions to the 2020 303(d) list of impaired waters. Public comments were solicited through September 3, 2019. IDEM received no comments regarding the notice.
- A Draft TMDL public meeting was held in the watershed at St. Paul's Lutheran Church, 556 W Haysville Rd, Jasper, IN 47546 on November 12, 2019 at 5:00 PM. The draft findings of the TMDL were presented at the meeting and the public had the opportunity ask questions and provide information to be included in the final TMDL report. A representative from the Pike Co SWCD was in attendance and presented information on the progress of the watershed management plan. A public comment period was from November 8, 2019 to December 8, 2019. IDEM received no comments regarding the notice.

Works Cited

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APPENDIX A. WATER QUALITY DATA FOR THE LOWER EAST FORK WHITE RIVER WATERSHED TMDL

APPENDIX B. REASSESSMENT NOTES FOR THE LOWER EAST FORK WHITE RIVER WATERSHED TMDL

APPENDIX C. SAMPLING AND ANALYSIS WORK PLAN FOR THE LOWER EAST FORK WHITE RIVER WATERSHED TMDL

APPENDIX D. WATER QUALITY DURATION GRAPHS FOR THE LOWER EAST FORK WHITE RIVER WATERSHED TMDL