# SCHOOL BRANCH WATERSHED MASTER PLAN

**Hendricks County, Indiana**

Prepared for


**Hendricks County Surveyor's Office**
355 South Washington Street #214
Danville, IN 46122


*March 2013*

Prepared by


**Christopher B. Burke Engineering, LLC**
**115 West Washington Street, Suite 1368 South**
**Indianapolis, Indiana 46204**


CBBEL Project No. 00-0346 A6

*This page is intentionally left blank*

# TABLE OF CONTENTS

# LIST OF FIGURES

## LIST OF TABLES

# LIST OF APPENDICES

*This page is intentionally left blank*

# CHAPTER 1 INTRODUCTION

The School Branch Watershed in Hendricks County, Indiana has experienced some growth over the past two decades as the Town of Brownsburg and the City of Indianapolis continue to expand. In an effort to render more effective options regarding environmental and flooding concerns due to urbanization, the Hendricks County Surveyor's Office retained Christopher B. Burke Engineering, LLC to develop the School Branch Master Plan. This master plan can assist Hendricks County and the Town of Brownsburg by identifying and analyzing stormwater management concerns as the watershed continues to develop, and provide a recommended plan to manage those concerns so that new stormwater problems are not created and existing problems can be understood and addressed.

## 1.1 WATERSHED LOCATION

The School Branch Watershed is located in the northeast corner of Hendricks County and extends north into Boone County as shown in **Figure 1-1**. This approximately 10-square mile watershed is one of

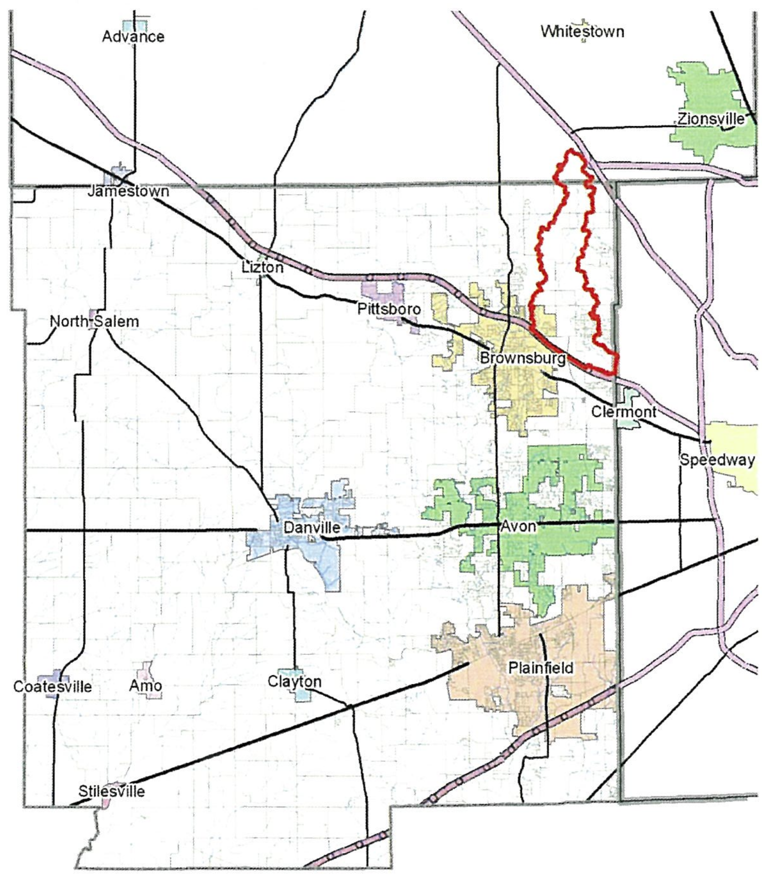


*Figure 1-1: School Branch Watershed Location in Hendricks County*

several watersheds that drain into Eagle Creek Reservoir, a source of drinking water for the City of Indianapolis. In addition to School Branch, which is known locally as William Batz Drain along the upper half of the stream, several other streams are located in this watershed. They include: William Hart Drain, Martin Hogan Drain, Kate Lee Drain, Joseph Jordon Drain, David Beck Drain, and John Green Drain. School Branch drains into Eagle Creek Reservoir less than a mile downstream (east) of the Hendricks-Marion County line.

## 1.2 PURPOSE AND SCOPE

The primary purpose of this Master Plan is to identify and analyze current and future stormwater management concerns for the School Branch Watershed and to provide a specific plan to manage stormwater. This Master Plan has been developed for long term use by Hendricks County and the Town of Brownsburg for assistance with stormwater regulatory decisions, zoning decisions, and other decisions relating to development in the watershed as it affects the open drainage system. It is intended that this plan help guide proper stormwater management as development continues to occur within the watershed in order to preserve natural and beneficial functions of the natural drainage system and preserve and enhance stormwater quality.

The computer modeling of the School Branch Watershed, developed as part of this Master Plan, can be revised and re-simulated in the future to understand the impacts of changes in the watershed that might arise other than those covered by this Master Plan.

This Master Plan includes:

- Identification of existing conditions of the wetlands, floodplains, stream channels, runoff volumes, and water quality of the watershed;
- Identification of existing problems and potential future concerns associated with wetlands, floodplains, stream channels, runoff volumes, and water quality in the watershed;
- Evaluation of potential solutions to identified problems;
- Recommendation of a plan to address the problems;
- Implementation steps needed to carry out the recommendations.

## 1.3 ORGANIZATION OF THIS DOCUMENT

This report is divided into several chapters with appendices of backup data. A brief summary of the contents of each chapter is presented below:

- Chapter 1: Introduction – provides a brief background regarding the location of the watershed, purpose and scope of the Master Plan, and how it is organized.
- Chapter 2: Existing Conditions – describes the current condition of the watershed and summarizes the extent and severity of surface water quantity and quality concerns based on information gathered from public input, local agency input, review of previous studies, data collection, and further analysis. This Chapter also includes an examination of impacts of land use and its changes over time, regulations, regulated drain projects or maintenance activities, and general activities in the watershed on wetlands, floodplains, stream channel morphology, and stormwater runoff quality and quantity.
- Chapter 3: Future Conditions – describes anticipated future land uses, regulations, and the expected impacts on flooding and water quality.
- Chapter 4: Watershed Goals and Performance Criteria – describes the goals for the watershed in terms of water quality improvement, flood reduction or prevention and also discusses the criteria used to evaluate potential solutions.
- Chapter 5: Prioritization of Problems/Concerns and Initial Screening of Potential Solutions – explains the process to catalogue identified problems and the screening of potential solutions.
- Chapter 6: Detailed Evaluation of Promising Solutions – a detailed analysis of the most promising solutions to determine their suitability for potential inclusion as a Master Plan component.
- Chapter 7: Recommended Master Plan Components –includes a list and description of the recommended Master Plan components.

- Chapter 8: Implementation Plan – provides a summary of conclusions of the study and a list of actions to implement the recommended plan components.

- Chapter 9: References – lists information sources.

# CHAPTER 2 EXISTING CONDITIONS

## 2.1 INTRODUCTION

Identifying effective solutions to stormwater problems depends on a thorough understanding of the existing conditions and concerns within the watershed. The resources, problems, concerns, and impacts of land development within a watershed are often interrelated. Water that falls on the School Branch watershed absorbs into plants, evaporates, ponds, soaks into the ground, or runs off of roofs, roads, parking lots, driveways, and yards, and flows overland, down driveways and streets, through swales and storm pipes, to tributaries and then to School Branch and into Eagle Creek Reservoir in Marion County. Therefore, the condition of the land within the watershed affects the quality and quantity of the water that travels through the watershed and also affects drinking water downstream.

This chapter describes the current conditions in the School Branch watershed. Descriptions of the land use, wetlands, flood risk areas, and quality and quantity aspects of stormwater are included. Regulations and existing studies and projects related to the water resources in the watershed are also described. This data was gathered using available mapping, computer modeling, water sampling and analysis, discussions with local officials and the public, and a review of previous studies.

*Figure 2-1: Aerial View of the School Branch Watershed*

## 2.2 LAND USE

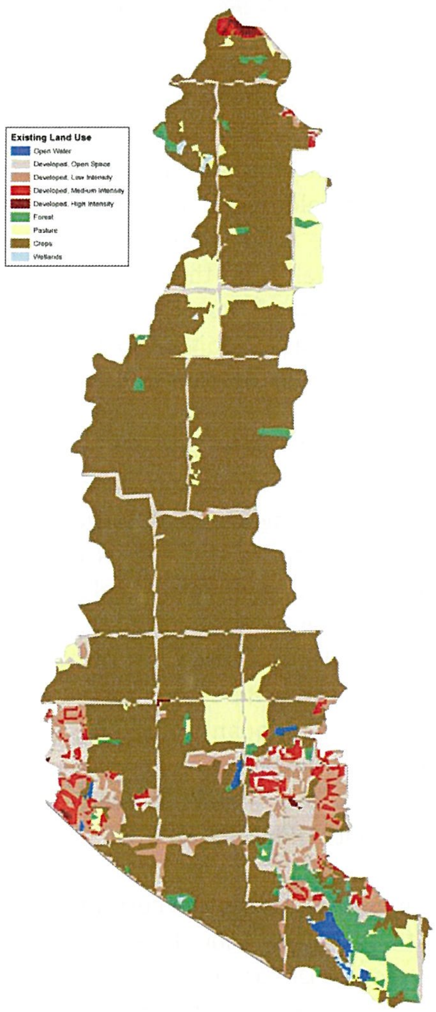


*Figure 2-2: Existing Land Use*

Although the School Branch Watershed has been developing, approximately 65% of the watershed is still agricultural land. Development has been mostly of a lower intensity (or imperviousness) thus far. Lower intensity development makes up approximately 20% of the watershed, while higher intensity development is less than 3% of the watershed area. The current land use in the watershed is presented in **Table 2-1**.

***Table 2-1: Land Use within the School Branch Watershed***

| Land Use | Area (acres) | Percentage |
|---|---|---|
| Open Water | 38 | 0.8% |
| Developed, Open Space | 608 | 12.0% |
| Developed, Low Intensity | 322 | 6.4% |
| Developed, Medium Intensity | 130 | 2.6% |
| Developed, High Intensity | 16 | 0.3% |
| Forest | 216 | 4.3% |
| Pasture | 437 | 8.7% |
| Crops | 3,268 | 64.7% |
| Wetlands | 17 | 0.3% |
| **Total** | **5,053** | **100.00%** |

Most of the development has occurred in the southern portion of the watershed, near Brownsburg and Indianapolis as shown in **Figure 2-2**. There is also a small amount of development at the north end of the watershed in Boone County.

Land use is important to stormwater management because it affects both water quality and quantity. With the use of fertilizer and pesticides, agricultural runoff can potentially be detrimental to wetlands and water quality. Land development generally increases impervious areas which increases runoff volume and decreases the time it takes for stormwater to enter streams. These both can result in increased riverine flooding. Water quality and general stream health can also be adversely impacted due to increases in nutrient, sediment, bacteria, and pathogen-loading.

## 2.3 WETLANDS

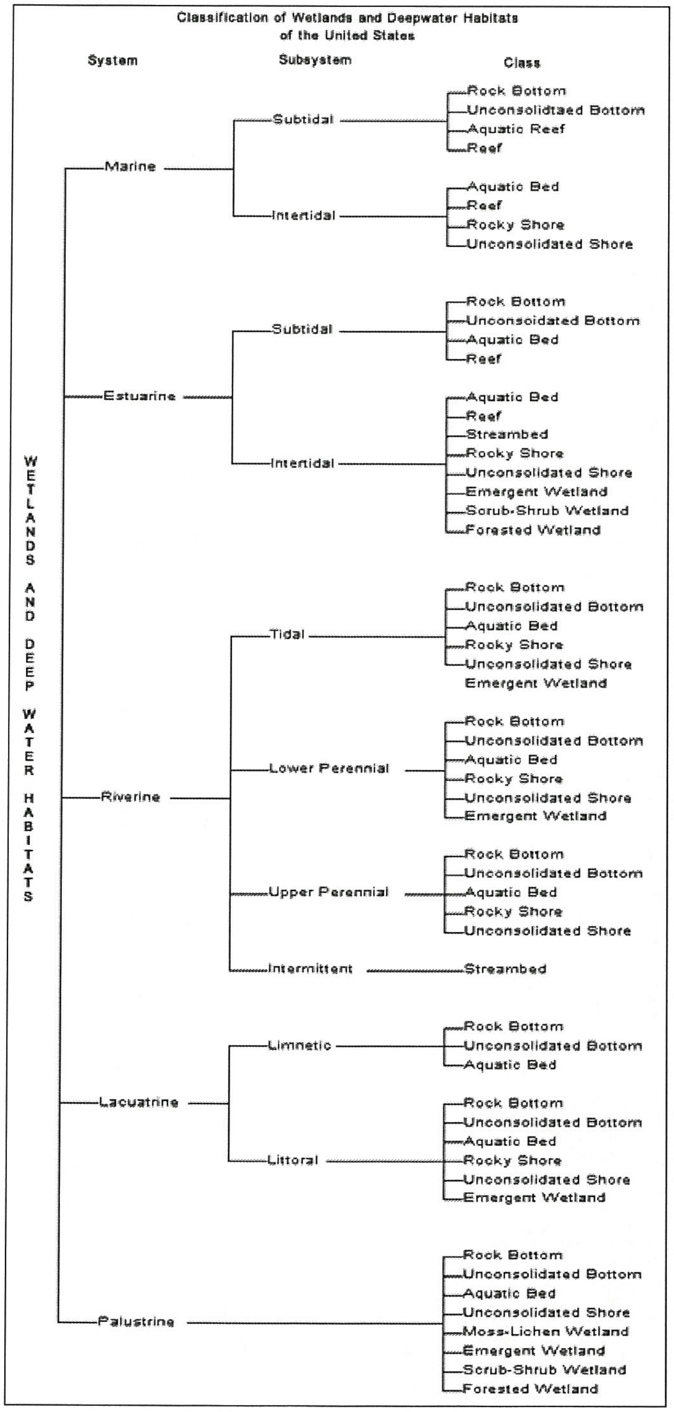


*Figure 2-3: Cowardin Classification System*

The School Branch Watershed is located in the Central Till Plain Natural Region of Indiana, a region that, in pre-settlement times, was dominated by poorly drained, hydric soils, flatwood forests, mesic forests, and seasonally wet depressions. The topography in this region is level to gently undulating and was heavily forested. Wetland communities predominated along river valleys.

The watershed is primarily cropland with approximately 2/3 of the area being in agricultural production. The southern third of the watershed, near I-74 is becoming more residential. The natural hydrology of the entire county has been drastically altered by the construction of extensive tile systems and regulated drains to quickly transport water away from agricultural fields. There are very few natural wetlands remaining in the watershed. Most of the identified wetland areas are open water, which, compared to other types (forested, scrub-shrub, and emergent) provide lower habitat value.

With so few wetlands remaining, particularly in urban areas, it is important to recognize the type and quality of the existing wetland communities. Traditionally, wetland areas are classified based upon the Cowardin Classification System (see **Figure 2-3**).

Several notable wetland areas within the School Branch Watershed were identified using 1992 National Wetland Inventory (NWI) data, 2009 NWI Update, 2009 aerial photography, NRCS soil maps, USGS topographic maps, and other available studies. No onsite wetland evaluations were conducted; however detailed field work would be beneficial to further determine the wetland community types and quality of the sites. Significant Wetland Sites are shown in **Figure 2-4**.

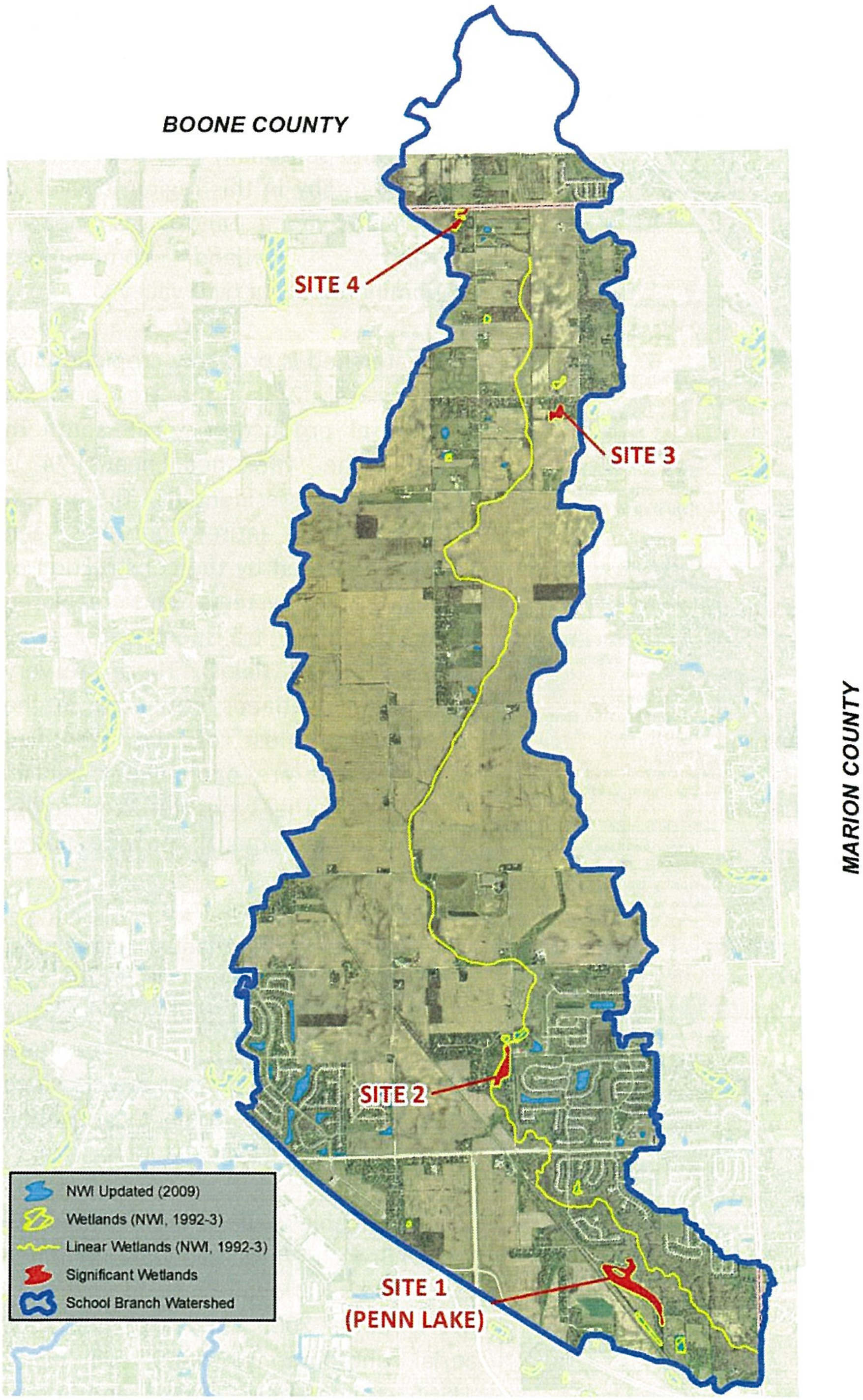


*Figure 2-4: Significant Wetlands*

**Wetland Site 1 – Penn Lake:** This site is a large open water complex which was likely an old borrow pit from the construction of I-74. Although this site is open water, it is the largest mapped wetland in the watershed and likely has some level of wetland habitat around its shoreline. It is located adjacent to and within the floodplain of School Branch. This site is classified as PUBG, which is a palustrine (pond and marsh) wetland with a silty bottom and limited vegetation.

**Wetland Site 2:** This wetland is also an open water area, but in a watershed with so few natural wetlands, this site provides some level of habitat and water quality benefits. It is located directly abutting School Branch and likely exchanges flow with the stream on a regular basis. This site is classified as PUBGx, which is a also palustrine, wetland with a silty bottom and limited vegetation.

**Wetland Site 3:** This site

is an emergent wetland complex that is likely connected to School Branch via unnamed tributary. Headwater wetlands are very important for filtering pollutants and providing other water quality benefits before these items enter the stream. This site is classified as PEMC, which is a palustrine, seasonally flooded wetland with emergent vegetation.

**Wetland Site 4:** This wetland complex is a series of three wetlands, the northern two being open water and the southernmost one being scrub-shrub. This wetland is also likely connected to School Branch via unnamed tributary or agricultural drain tile. These sites are classified as PUBG and PSS1C, which is a palustrine, seasonally flooded wetland with short woody vegetation.

The wetland sites above are listed in order of significance to the aquatic health of the watershed. Wetlands located along stream corridors (Wetland Sites 1 and 2) are particularly important because they provide crucial flood storage and they filter pollutants before they enter the stream channels. Additionally, continuity of these floodplain wetlands is important for wildlife travel corridors. Wetland Sites 2 and 3 have significant size and are therefore are more valuable than smaller fragmented wetlands.

Wetland sites 3 and 4 are emergent and open water/scrub shrub respectively. Scrub shrub wetlands in particular have multiple vegetative layers and herbaceous plants, and are generally more diverse than open water or emergent wetlands. Because of this, they can provide habitat to a wider range of species. Wetland Sites 3 and 4 are significant in size compared to other wetlands in the watershed. The greater the acreage of a wetland, the more habitat value, flood storage, and pollutant filtration it will provide. This is why larger wetland mitigation banks are preferred by the regulatory agencies over smaller, permittee-owned wetland mitigation at separate sites.

## 2.4 STORMWATER QUALITY

In 1999, the US Environmental Protection Agency (US EPA) issued regulations related to the National Pollutant Discharge Elimination System (NPDES) Storm Water Phase II program whereby discharges from small Municipal Separate Storm Sewer Systems (MS4s) in "urbanized areas" serving populations of less than 100,000 and stormwater discharges from construction activities that disturb more than 1 acre of land. These regulations are referred to as the NPDES Phase II Storm Water Program.

In the State of Indiana, the Indiana Department of Environmental Management (IDEM) is responsible for the development and oversight of the NPDES Phase II Program. The IDEM initiated the adoption of the Phase II Rules that were ultimately codified as 327 IAC 15-13 (Rule 13). Rule 13 requires designated MS4 entities to apply for permit coverage by submitting a Notice of Intent (NOI) and developing Storm Water Quality Master Plans (SWQMPs) through a phased submittal process. The SWQMP is the foundation of a MS4 entity's Stormwater Program. The IDEM's phased submittal requirements for the SWQMP include the following 3 components:

Part A: Initial Application
Part B: Baseline Characterizations Report
Part C: Program Implementation Plan

Part B of the SWQMP required communities to conduct an initial investigation of water quality within their communities. At a minimum, Part B submittals were required to include the following information:

- An investigation and assessment of the impacts of existing land uses on stormwater runoff within the MS4 Area,
- An identification of sensitive areas within the MS4 Area,
- A review of known existing and available water quality monitoring data for the MS4 Area,
- An identification and assessment of structural and non-structural Best Management Practices (BMPs) within the MS4 Area, and
- An identification of priority areas for the implementation of BMPs.

As stated in Rule 13, "Ongoing data collection related to the SWQMP Part B: Baseline Characterization Report must be submitted to the Indiana Department of Environmental Management (IDEM) with the corresponding Annual Report." Rule 13 is not prescriptive in terms of how Municipal Separate Storm Sewer Systems (MS4s) should go about completing ongoing characterizations, and a variety of characterization options, ranging from reviewing existing water quality data to collecting new biological, chemical, and physical data is generally considered acceptable. In past annual reports, Hendricks County has typically reviewed IDEM's 303(d) List of Impaired Waters to determine if there have been changes to the list that may be associated with Stormwater Programs. However, the collection of additional biological, chemical, and physical water quality data provides the County, and other MS4 entities within Hendricks County, with useful baseline information that will serve as a tool in evaluating the long-term water quality impacts of their individual Stormwater Programs.

Biological, chemical, and physical water quality assessments were utilized to better characterize the overall ecological health of the School Branch watershed and tributary streams. Assessments such as these assist water resource planners by serving as a baseline for comparing any future data collected. This is useful in establishing long-term trends in water quality; identifying water quality problems and potential sources of pollution; prioritizing water management decisions based on the positive or negative impacts to water quality; and educating watershed residents and stakeholders of the associations of their everyday activities and stream health.

In all, 2 sites in the School Branch Watershed were selected to be evaluated and are shown in **Figure 2-5**. These sites were selected based on available public access points and their general location within the watershed.

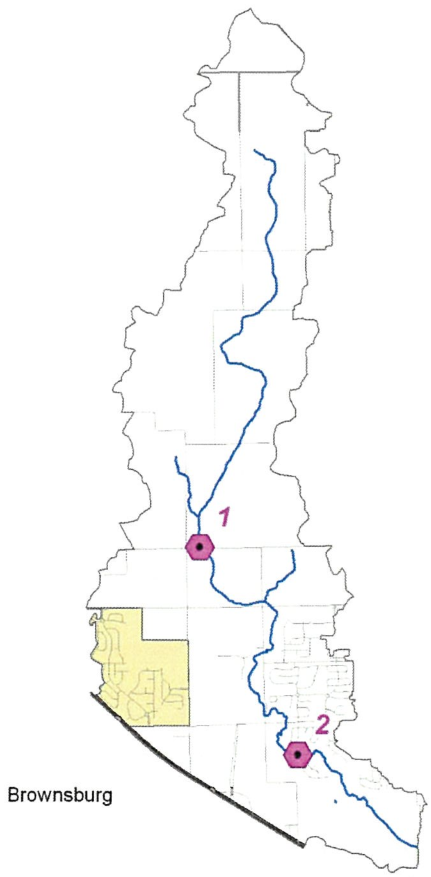


***Figure 2-5: Sampling Sites in the School Branch Watershed***

### 2.4.1 **Biological Assessment**

Biological assessments of School Branch Watershed were completed by sampling the macroinvertebrate communities at each site in July 2010. Macroinvertebrate communities are indicative of the overall health of an aquatic system, and provide a long term view of the water quality in a particular watershed or stream. Macroinvertebrate organisms serve as pollution indicators as some organisms (stoneflies, mayflies, and caddis flies) are considered to be "pollution sensitive" while others (midges, leeches, and worms) are considered more "pollution tolerant". As a stream becomes more polluted, various high quality pollution sensitive organisms will be less prevalent and lower quality pollution tolerant organisms will dominate the community.

The Pollution Tolerance Index (PTI) is one method utilized to rapidly assess a stream's health as it relates to macroinvertebrate richness. This index, adapted from protocols developed for many monitoring programs throughout the United States, utilizes weighted values on 4 pollution Tolerance Groups (shown in **Table 2-2**), to determine an overall rating of the pollution tolerance of the stream being sampled.

For example, the total number of taxa (not organisms) present in the sample for each Tolerance Group is recorded. This sum is then multiplied by the appropriate weighted value as shown in the table. The new values for each Tolerance Group are then added to determine the individual PTI for that sampling area. The PTI was utilized to assess the biological richness of the School Branch Watershed.

*Table 2-2: Pollution Tolerance Groups and Representative Taxa*

| GROUP 1 Intolerant | GROUP 2 Moderately Intolerant | GROUP 3 Fairly Intolerant | GROUP 4 Very Intolerant |
|---|---|---|---|
| *Weighted Value = 4* | *Weighted Value = 3* | *Weighted Value = 2* | *Weighted Value = 1* |
| Stonefly | Damselfly | Midge | Left-Handed Snail |
| Mayfly | Dragonfly | Black Fly | Aquatic Worm |
| Caddis Fly | Sowbug | Planaria | Blood Midge |
| Dobsonfly | Scud | Leech | Rat-Tailed Maggot |
| Riffle Beetle | Crane Fly | | |
| WaterPenny | Clams/Mussels | | |
| Right Handed Snail | | | |

A total sum of 58 is possible using these groups and weighted values. Streams with values of 23 or better are considered to be in "excellent" condition based on this metric while those with score of 10 or less are considered "poor". The ranges of scores and the associated ratings for the PTI are as follows:

- 23 and above – Excellent
- 17-22 – Good
- 11-16 – Fair
- 10 and below – Poor

Based on these results, the sites within the School Branch Watershed both scored a "Poor" rating of 10. **Figure 2-6** represents the PTI scores as follows: Red = Poor; Orange = Fair; Green = Good; Blue = Excellent. Raw data sheets for the macroinvertebrate sampling events are located in Appendix 1.

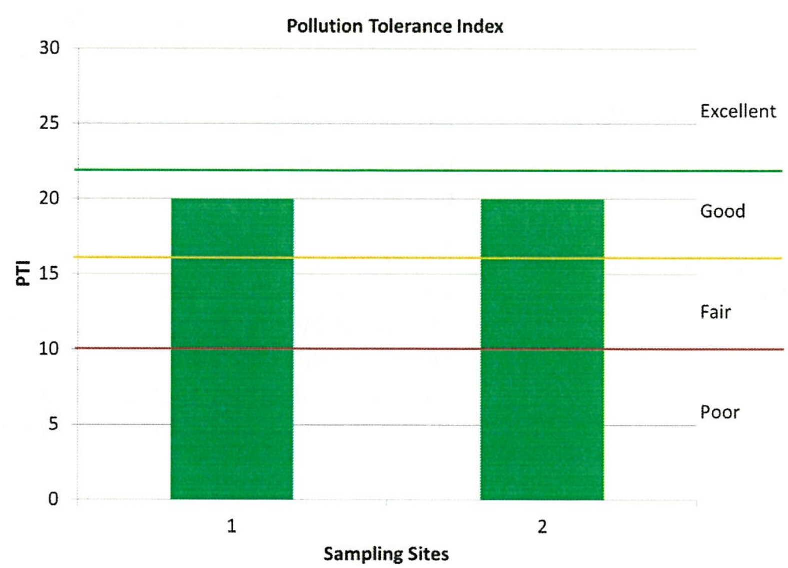


*Figure 2-6: Pollution Tolerance Index Scores*

### 2.4.2 Chemical Assessment

Parameters sampled at each site included pH, temperature, dissolved oxygen, conductivity, turbidity, nitrate/nitrite, organic nitrogen, ammonia, total and dissolved phosphorus, and *E. coli*. Samples were collected once per month May through November 2010. To ensure the integrity of the sampling protocol, duplicate samples and analyses were performed during each sampling event. **Table 2-3** provides the target concentrations for the parameters sampled as recommended by the Indiana State Water Quality Standards, the Indiana Department of Environmental Management (IDEM) Total Daily Maximum Load (TMDL) Reports, the Ohio Environmental Protection Agency (OEPA), and the US EPA.

***Table 2-3: Target and Reference Information for Chemical Sampling***

| Parameter | Target | Reference |
|---|---|---|
| Ammonia | 0.0 – 0.21 mg/L * | Indiana Administrative Code |
| Conductivity | *NA* | *NA* |
| Dissolved Oxygen | Min: 4.0 mg/L<br>Max: 12.0 mg/L | Indiana Administrative Code |
| Dissolved Phosphorus | *NA* | *NA* |
| *E. coli* | Max: 235 CFU/100 mL<br>in a single sample | Indiana Administrative Code |
| Nitrate-Nitrite | Max: 10 mg/L<br>in drinking water | Indiana Administrative Code |
| Organic Nitrogen | *NA* | *NA* |
| Total Phosphorus | Max: 0.3 mg/L | IDEM draft TMDL target |
| | Max: 0.08 mg/L | Ohio EPA recommendation to protect aquatic biotic integrity in warm water habitats |
| Turbidity | Max: 10.4 NTU | US EPA recommendation |

It is important to note that chemical sampling results provide a "snapshot" of the water quality at the precise time of sample collection. Chemical composition of the water column or water body can change quickly with changes in temperature, precipitation, adjacent land disturbances, and changes in velocities and flow within the stream. These results, however, are an integral component in better understanding sources and impacts of pollution within the watershed.

Long term trends can be analyzed to provide comparisons between water quality at the sampling locations and land use changes, stream maintenance, precipitation, seasonality, etc. within the watershed. Raw water quality data is available in Appendix 2.

#### 2.4.2.1 Nutrients

Nutrients such as nitrogen and phosphorus, while essential to the growth of beneficial aquatic plants, can become detrimental to the water system by enhancing the growth of algae. Increases in algal growth can lead to eutrophication in lakes and ponds and can alter the balance of the stream ecosystem. Heightened levels of such nutrients may also lead to detrimental fluctuations of dissolved oxygen levels, decreased sunlight penetration, alterations in the fish and macroinvertebrate assemblages, and even fish kills.

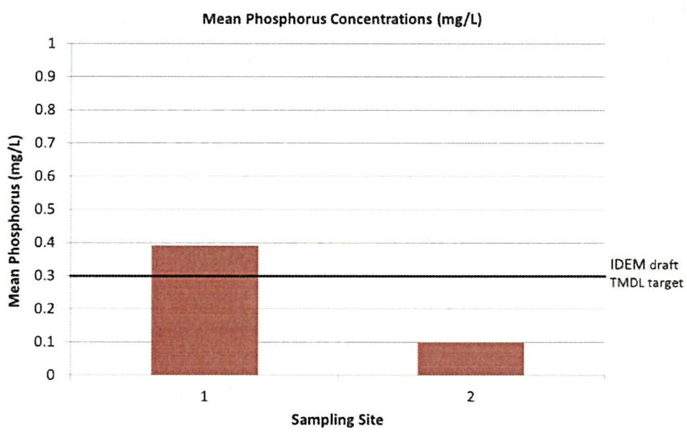


*Figure 2-7: Mean Phosphorous Concentrations*

Field crews collected grab samples at each site on a monthly basis during the sampling period as described above. These samples were delivered to a local water quality laboratory and each sample was analyzed for ammonia, nitrate/nitrite, organic nitrogen, and total and dissolved phosphorus. Within the School Branch Watershed, ammonia levels were mostly below 0.35 mg/L. Total phosphorus levels, were below the IDEM TMDL target recommendation of 0.3 mg/L at Site #2-School Branch at 1000 East while 4 of 7 samples were above IDEM's target at Site #1-School Branch at 950N. **Figure 2-7** shows the mean phosphorus concentrations within the School Branch Watershed during the sampling period.

#### 2.4.2.2 DO, Conductivity, pH, and Temperature

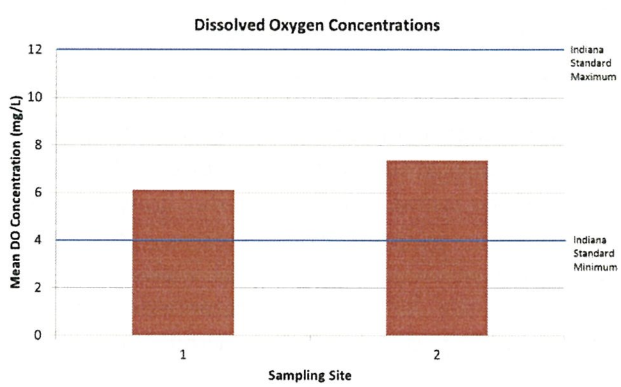


*Figure 2-8: Mean Dissolved Oxygen Concentrations*

Field crews sampled dissolved oxygen, conductivity, pH, and temperature at each sampling location using hand held data collection devices. Temperature and pH levels were collected as these parameters are utilized to determine the appropriate levels of other important parameters such as dissolved oxygen (DO) concentrations, DO percentages, and total ammonia concentrations. Several literature sources suggest that conductivity levels below 800 µS (micro-Siemens) are indicative of background levels and suggest that when levels of 1,000 µS or greater are observed, investigations into sources of such pollution should be completed. Mean conductivity results at both sites did not exceed 1,000 µS.

DO is necessary for the fish and aquatic macroinvertebrate populations to function properly and even to survive. As these levels may fluctuate significantly with diurnal cycles (daytime vs. nighttime), it is suggested that minimum levels should not drop below 4.0 mg/L and maximum levels of DO not exceed 12.0 mg/L. For the School Branch Watershed, the DO mean concentrations (and all individual concentrations) were between 4.0 mg/L and 12.0 mg/L. **Figure 2-8** shows the dissolved oxygen concentrations within the School Branch Watershed during the sampling period.

#### *2.4.2.3 E. coli*

These bacteria associated with the intestinal tract of warm blooded animals are widely used as an indicator of fecal pollution in water bodies. Among other sources, *E. coli* bacteria commonly enter streams from failing septic systems and pet and wildlife waste. As referenced in Table 2-3, water quality standards for *E. coli* have been established for Indiana at 235 CFU/100 mL for a single sample. These levels can be difficult to reach due to wildlife inputs and the high cost of sewer infrastructure and improvements.

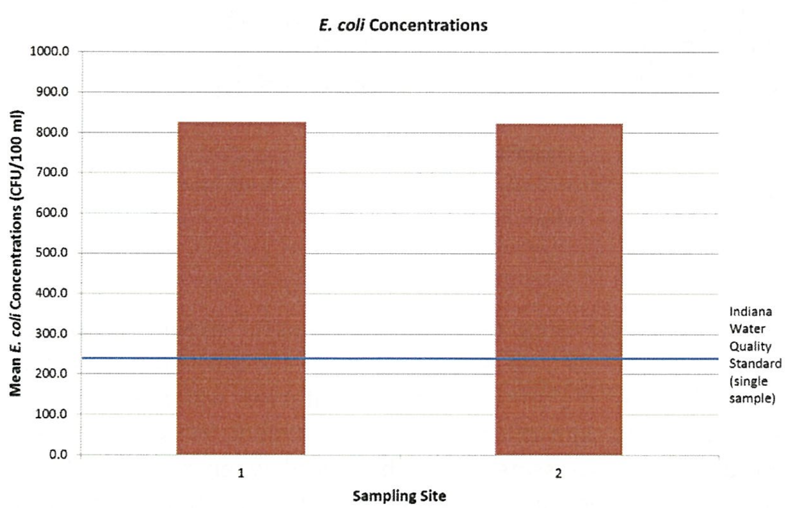


*Figure 2-9: Mean E. coli Concentrations*

During the chemical sampling events within the School Branch Watershed, the *E. coli* concentrations exceeded this standard in the majority (57%) of individual samples, as shown in **Figure 2-9**. Mean concentrations in excess of 800 CFU/100mL were observed at both sites, which is above the single sample Indiana Water Quality Standard for *E. coli*. June sampling results for both locations resulted in *E. coli* concentrations above 3,000 CFU/100 mL.

#### 2.4.2.4 Turbidity

Turbidity measures the "cloudiness" of the water. This cloudiness is due to the individual suspended solids (primarily clay and silt particles and/or algae) that are present within the water column. Many times, suspended solids such as soil particles are delivered to the stream via runoff from disturbed lands such as construction sites. Streambank erosion due to high velocities and volumes of water within the stream also is a source of these particles. During the sampling period, mean NTU levels exceeded the US EPA recommendation of 10.4 NTU at Site #1 with a mean level of 10.86 NTU. Mean turbidity levels are shown in **Figure 2-10**.

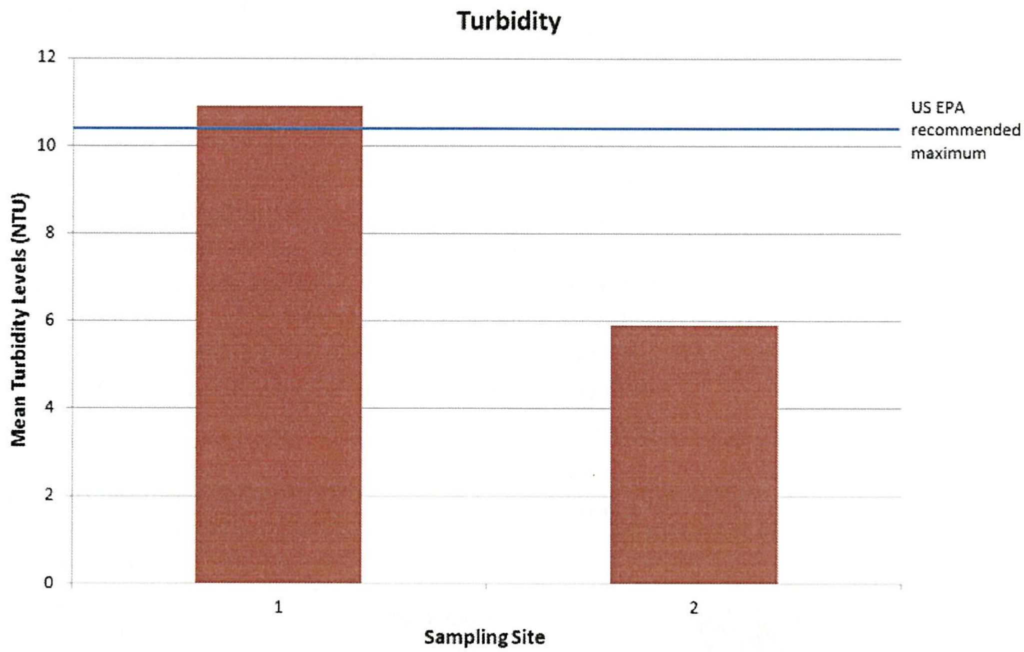


*Figure 2-10: Mean Turbidity Levels*

### 2.4.3 Physical Assessment

Physical characteristics regarding the general stream morphology of each site were collected and recorded. The width of the stream as well as the depth of the stream at regular intervals was measured. At the same time, any signs of significant erosion along the streambanks were noted. These assessments are beneficial when tracking changes in stream morphology and streambank stability over time. The Qualitative Habitat Evaluation Index (QHEI) was utilized to establish baseline data in regard to stream morphology as well as the evaluation of the in-stream characteristics and the correlation of those characteristics to the ability to support aquatic fauna.

The QHEI was developed by the OEPA to assist with relating stream habitat and the biological ability of a stream. The QHEI provides an overall quantitative metric that can generally correspond to the ability of a stream to support fish or other invertebrate communities. Individual metrics for substrate, instream cover, channel morphology, riparian and bank condition, pool and riffle quality, and gradient are summed to provide the total QHEI score. It is important to note that QHEI score are indicative of the 200 foot stream reach segment that was assessed. Significant changes in any of the aforementioned metrics could be observed upstream or downstream of these areas.

This score, with a total possible score of 100 points has been correlated such that generally speaking, a stream segment with a score of 60 or more is conducive to the existence of warmwater fauna. In addition, scores ranging between 45 and 60 indicate areas where some modifications have been made and that the biology may or may not be supported in these streams. Scores under 45 are indicative of many man-made modifications or impacts and that the biological communities will generally not be supported in these waters. These scores can be utilized to compare changes in habitat at one site over time, or to compare different stream segments.

The School Branch Watershed QHEI assessments were completed in August of 2010 at each sampling location.

At Site #1, the factors having an effect on the overall QHEI score were bank erosion and riparian zone (2 of 10 points) and pool/glide and riffle/run quality (3 of 20 points). Bank erosion is an estimate of the severity of erosion occurring along both streambanks while the riparian zone assessment considers the amount of vegetation along the streambanks and the width of the established riparian area. The pool/glide and riffle-run metric places importance on the quality of the pool, glide, and/or riffle-run habitats. Aspects such as the pool depth, water

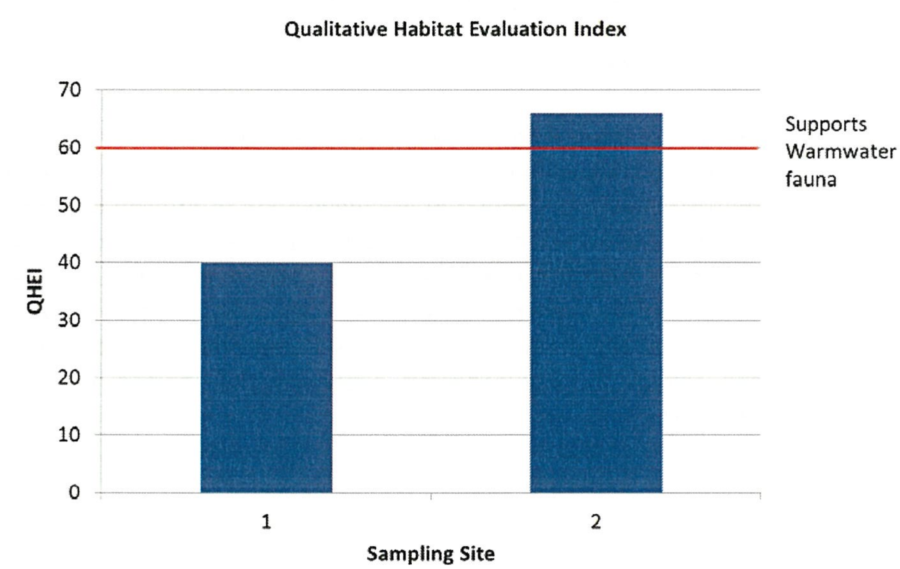


*Figure 2-11: Qualitative Habitat Evaluation Scores*

velocities, substrates in the riffle area, and the pool morphology are considered during scoring. Site #1 had limited morphological characteristics with little discrepancy between the pools and riffles throughout the streambed resulting in low scores.

The highest overall QHEI score (66) was observed at Site #2 and Site #1 received an overall QHEI score of 40. **Figure 2-11** shows the QHEI scores for the School Branch sampling locations. Raw data sheets for the QHEI assessments are located in Appendix 3.

### 2.4.4 Other Water Quality Studies/Data

It is important to review other studies related to water quality in order to validate current sampling results, show longer historical trends, or to determine potential time periods where significant changes took place within the watershed to cause a change, either positive or negative, in the biological, chemical, or physical integrity of the stream segments.

Between 1997 and 2003, the Eagle Creek Watershed Task Force maintained a bi-weekly monitoring regime within the Eagle Creek Watershed, including one monitoring location along School Branch. Mean water quality values for this sampling location during this monitoring period indicate:

- Turbidity: 18.1 NTU (mean) exceeds US EPA recommendation of 10.4 NTU
- Ammonia: 0.10 mg/L within the acceptable range per the Indiana Administrative Code
- Nitrate: 5.4 mg/L is below the maximum allowable for drinking water per the Indiana Administrative Code

### 2.4.5 Water Quality Assessment Summary

To better understand the biological, chemical, and physical assessments discussed above and how they relate to each other, a prioritization matrix (shown in **Table 2-4**) was developed to provide a review of the individual metric scores, individual metric rankings, and a total score and rank. QHEI scores are those achieved through the assessment completed in August 2010 and the PTI scores are those resulting from the July 2010. *E. coli* was selected as an individual metric as nearly all of the single samples collected exceeded the Indiana Water Quality Standard.

***Table 2-4: Water Quality Assessment Summary***

| Site | QHEI | | PTI | | *E. coli* | | Site Score | Overall Rank |
|---|---|---|---|---|---|---|---|---|
| | Score | Rank | Score | Rank | Score | Rank | | |
| 1 | 40 | **2** | 10 | **1** | 825.3 | **2** | 5 | **2** |
| 2 | 66 | **1** | 10 | **1** | 822.3 | **1** | 3 | **1** |

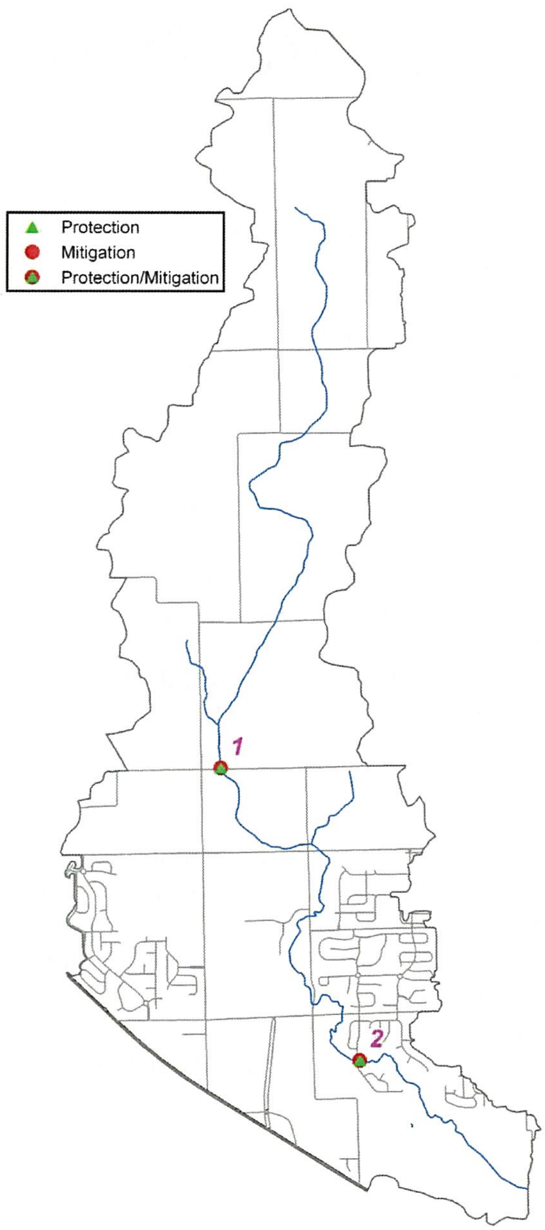


***Figure 2-12: Priority for Mitigation Efforts at Sampling Sites***

The shaded cells in Table 2-4 indicate those areas where observed scores were below ideal situations for each assessment. For example, as stated earlier, QHEI scores above 60 were indicative of areas that are most likely to support aquatic fauna. Therefore, the shaded boxes are those sites where the QHEI scores were below 60. Scores above 17 for the PTI are considered good indicating streams that support a range of macroinvertebrate populations and varied tolerances to pollution. Within the table, the sites where PTI scores were below 17 are shaded. Similarly, *E. coli* mean concentrations that exceed the Indiana Water Quality Standard for a single grab sample (235 cfu/100 ml) are shaded. While these mean scores are not a single grab sample, it provides a baseline data set that can be valuable for comparing sites over a length of time. Single grab sample concentrations did range from acceptable to greatly exceeding the Indiana Water Quality Standard at individual sites and these ranges can be viewed in the raw data sheets in Appendix 2.

For the individual metrics a rank of 1 indicates the higher water quality and a score of 10 indicates potentially lower water quality. The numerical ranks were summed to determine the overall site score. To determine the overall site rank, the lowest overall site score received the highest rank (1) in terms of protection efforts. Conversely, the highest site rank (2) is prioritized for mitigation efforts to enhance the biological, chemical, and/or physical components of the stream system. **Figure 2-12** indicates the overall rank associated with the sampling sites within the School Branch Watershed along with the site's priority for mitigation efforts.

## 2.5 GENERAL FLOOD CHARACTERISTICS

To investigate stormwater flows in response to various frequency rainfalls, a hydrologic model of the watershed was developed as part of this study. The model takes information about the watershed in terms of runoff potential, how long it takes rainfall to reach certain points in the watershed, and the intensity and duration of rainfall, and calculates expected peak flows and volumes at specified locations within the watershed. Details and digital copies of the model are provided in a separate report titled "School Branch Hydrologic Analysis".

### 2.5.1 Peak Flows

In 2001, as part of the update to the County's Technical Stormwater Standards, a default countywide maximum allowable release rate (peak discharge per acre) was established to regulate the flood discharges from development. Presently, these standards state that the allowable post-developed peak discharge from a site shall be no greater than 0.2 cfs/acre for the 0-10 year return interval storms and 0.4 cfs/acre for the 11-100 year return interval storms. The standards allow for establishment of smaller (more restrictive) values if the results from site-specific studies warrant such a reduction.

A two-step process was used to confirm whether lower release rates would be necessary in the School Branch watershed. First, the current unit peak flow rates were calculated in cfs/acre for each subwatershed using the results from a calibrated hydrologic model of the watershed's existing conditions. **Table 2-5** shows the calculated unit peak flow rates for the 2-, 10-, and 100-year storms for various subbasins in the calibrated hydrologic model of the School Branch watershed.

***Table 2-5: Unit Peak Flow Rates***

| Subbasin | Location Description | 2-Year Release Rate (cfs/ac) | 10-Year Release Rate (cfs/ac) | 100-Year Release Rate (cfs/ac) |
|---|---|---|---|---|
| SB1 | School Branch, Downstream of Martin Hogan Drain | 0.014 | 0.078 | 0.099 |
| SB2 | School Branch, Upstream of Martin Hogan Drain | 0.026 | 0.130 | 0.164 |
| SB3 | School Branch, Upstream of Joseph Jordon Drain | 0.030 | 0.154 | 0.195 |

Second, the unit peak flow rates were set as the proposed maximum allowable release rate using the criteria that post-development 100-year and 10-year flow rate not exceed pre-development 10-year and 2-year flow rates, respectively. These criteria have been used in many communities throughout Indiana. The proposed regulatory release rates based on these criteria are shown in **Table 2-6**.

***Table 2-6: Potential Proposed Maximum Allowable Release Rates***

| Subbasin | Location Description | 10-Year Release Rate (cfs/ac) | 100-Year Release Rate (cfs/ac) |
|---|---|---|---|
| SB1 | School Branch, Downstream of Martin Hogan Drain | 0.014 | 0.078 |
| SB2 | School Branch, Upstream of Martin Hogan Drain | 0.026 | 0.130 |
| SB3 | School Branch, Upstream of Joseph Jordon Drain | 0.030 | 0.154 |

**Figure 2-13** shows the location within the watershed of the potential proposed maximum allowable release rates discussed in Table 2-6. A comparison of these proposed allowable release rates with the current countywide default maximum allowable release rates reveals that the proposed rates are lower than the rates currently used. Therefore, the current countywide default rates are inadequate in controlling the impacts of development in the School Branch Watershed because use of the current rates is increasing runoff as development occurs within the watershed.

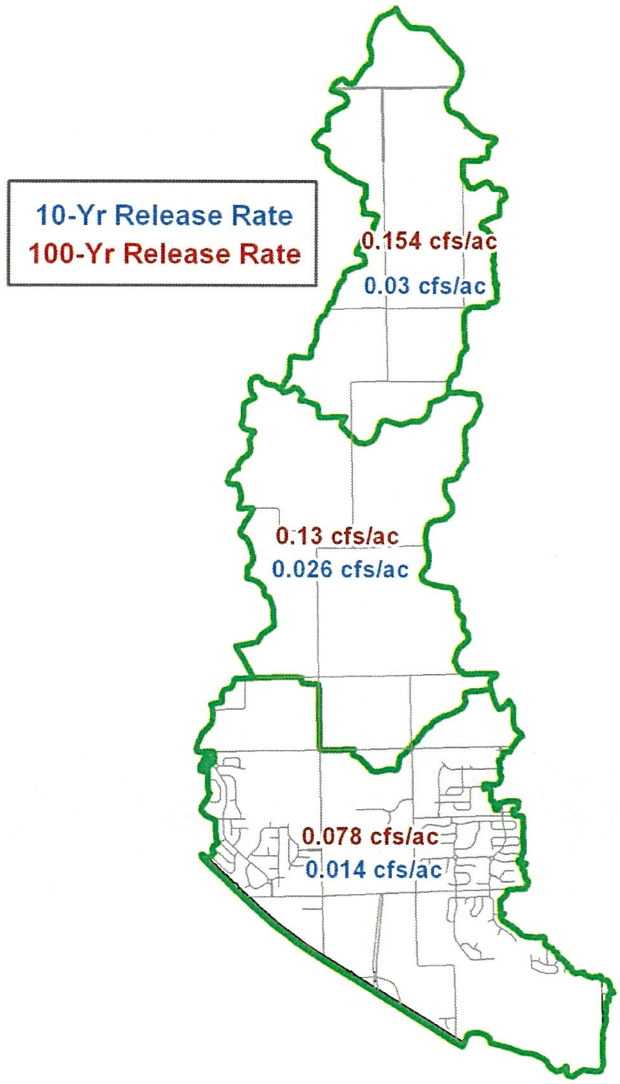


***Figure 2-13: Potential Proposed Maximum Allowable Release Rates***

### 2.5.2 Existing Floodplain Delineations

Each of the creeks, streams, regulated drains, and other water courses within the watershed has some degree of flood risk associated with it. Some of those risks are identified on the Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS) mapping and some are not. Flood risk areas within the watershed have been shown on the FEMA's Flood Insurance Rate Maps (FIRM) since the county joined the Flood Insurance Program in 1980. Recently, the maps for the county and surrounding communities have been condensed into one countywide map by FEMA. As of the writing of this report, the latest FEMA published version of floodplain mapping in Hendricks County is September 25, 2009. A sample of a portion of this mapping is provided in **Figure 2-14**.

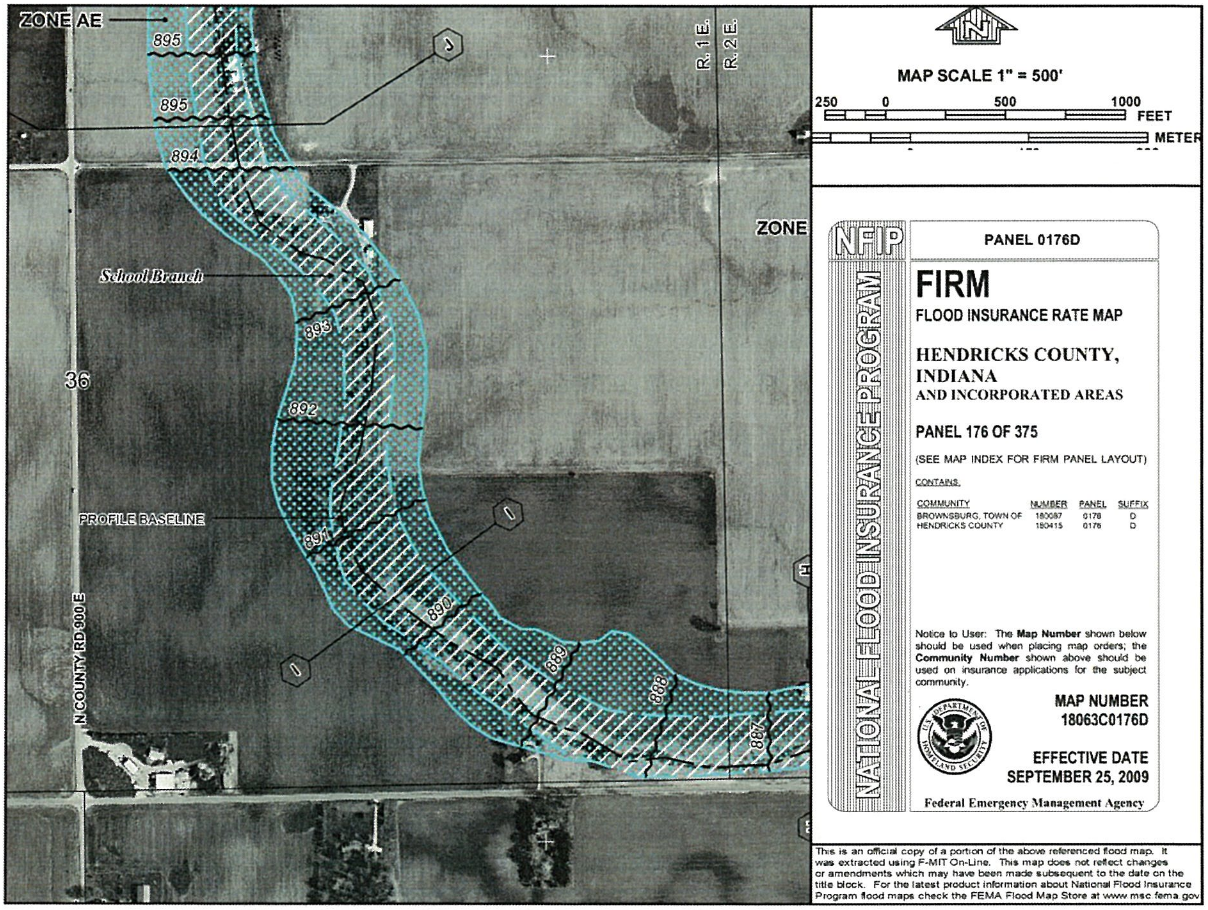


*Figure 2-14: Portion of Hendricks County FIRM Panel 176*

mapping. It has detailed Zone AE delineations (1% (100-year) annual chance floodplain delineation with floodway and Base Flood Elevation determinations). This study reach is shown in **Figure 2-15**.

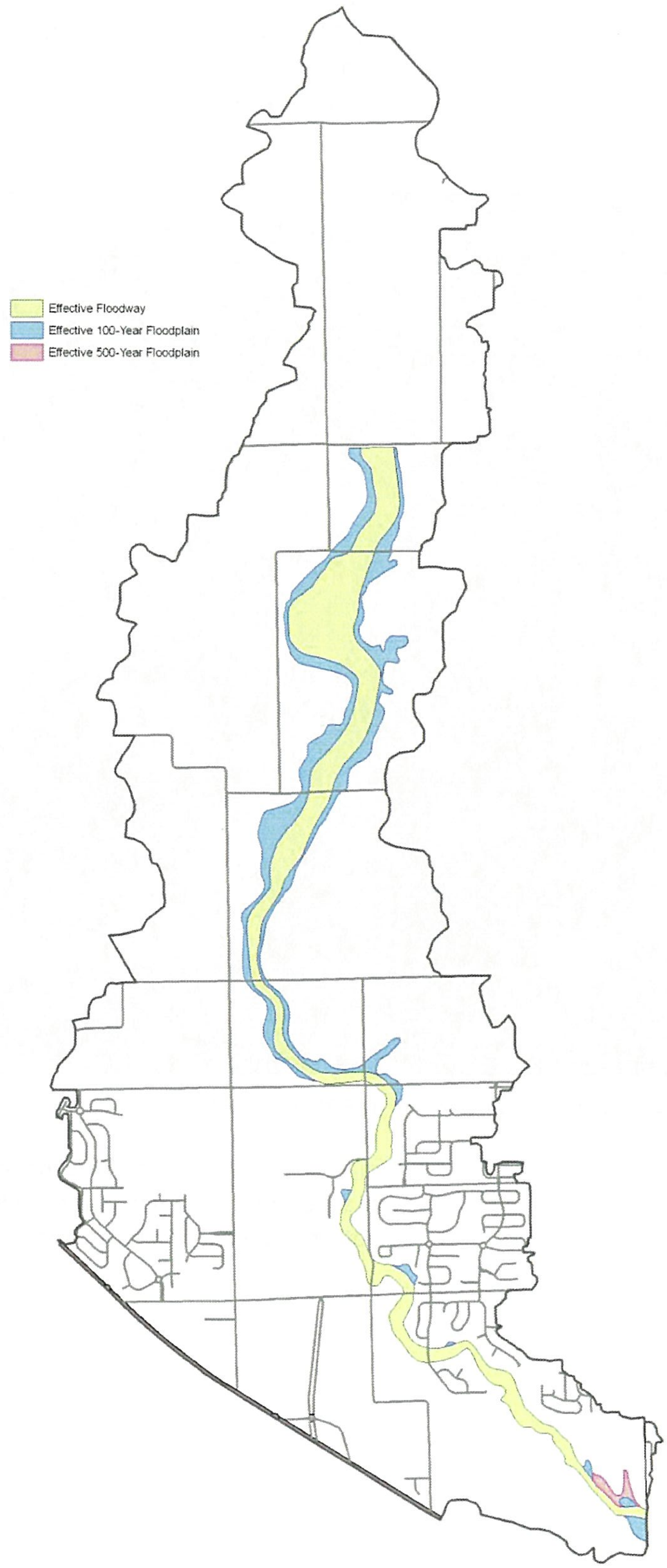


*Figure 2-15: Effective FIS Zones*

### 2.5.3 Proposed Revised FIS Floodplain Delineations

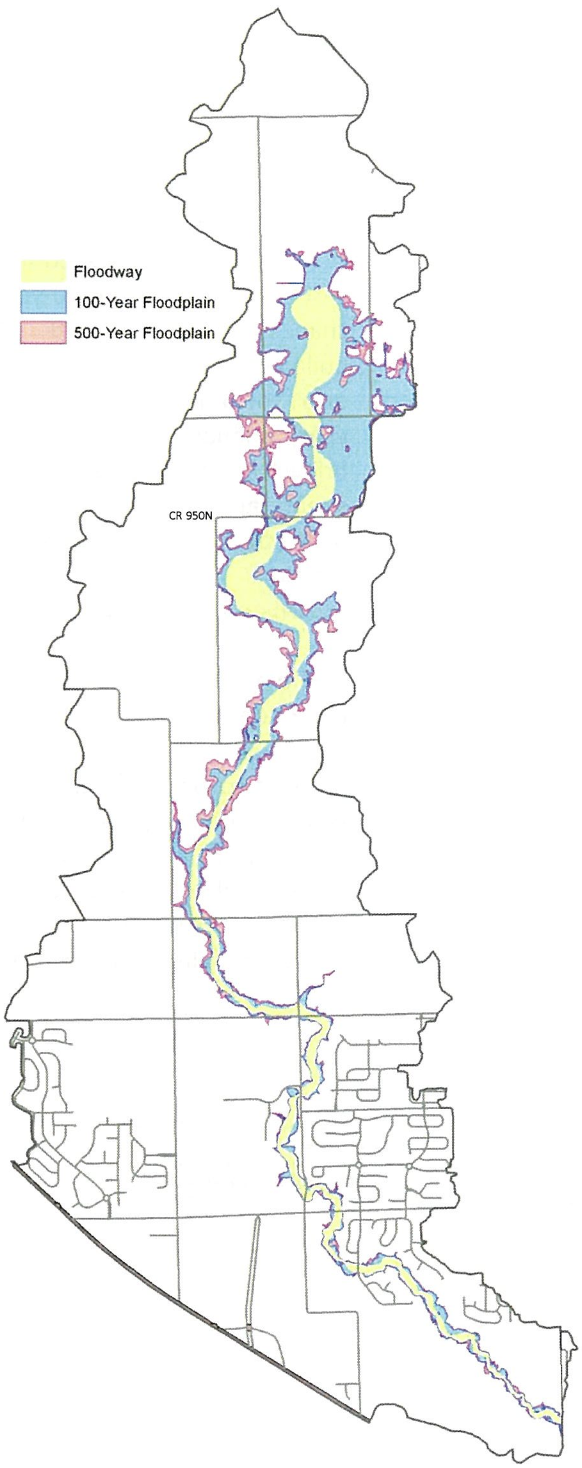


*Figure 2-16: Proposed Floodplain Delineation*

Since the initial delineation, more detailed topographic information has become available. Some bridge structures and associated road approaches have also been replaced. The hydraulic models used in the Hendricks County FIS have not been updated to reflect these changes, so the published FIS mapping may not reflect accurate inundation areas.

As part of this Master Plan; however, a new hydraulic model of School Branch has been created based on the updated topography, bridge data, and a new hydrologic model with revised discharges. The length of stream studied and floodplain delineated was extended on by approximately one mile. A description of the modeling methodology and data used for these calculations is provided in a separate report titled "School Branch Hydraulic Analysis". The revised 1% (100-year) annual chance floodplain along with the 0.2% (500-year) annual chance floodplain resulting from this updated modeling are provided in **Figure 2-16**.

A comparison of the updated flood risk areas to the current effective maps show that overall, the updated delineation is narrower than the current effective FIS mapping. A large exception to that is upstream of CR 950N, where the proposed floodplain is significantly wider. There are other instances where the updated delineation is wider than the existing mapping, but it appears that this is mostly due to the differences in the detail of topographic data used for the mapping. The floodway is also generally narrower in the updated analysis, but some new areas are shown due to the floodway shifting either left or right along the stream.

The updated flood risk mapping provided here for School Branch cannot be used for regulatory or flood insurance purposes until it is approved by IDNR and incorporated into the Flood Insurance Study maps by FEMA.

### 2.5.4 Flooding Concerns

Overlaying the floodplain delineations shown in Figure 2-16 on the 2010 aerial photography shows 48 buildings that appear to be located in or at the very edge of the 1% (100-year) annual chance floodplain and 28 other buildings that appear to be located in or at the very edge of the 0.2% (500-year) annual chance floodplain. 18 bridges are overtopped in the 100-year event, and 4 additional bridges are overtopped in the 500-year event. The locations of these structures are shown on **Figure 2-17**.

One major area of flooding concern is upstream of CR 950N. According to the proposed floodplain, this bridge appears to be undersized and causes water to pond upstream. Farm fields are primarily affected; however, there are several residential structures also in the floodplain. This includes almost half of the Wing Meadows subdivision.

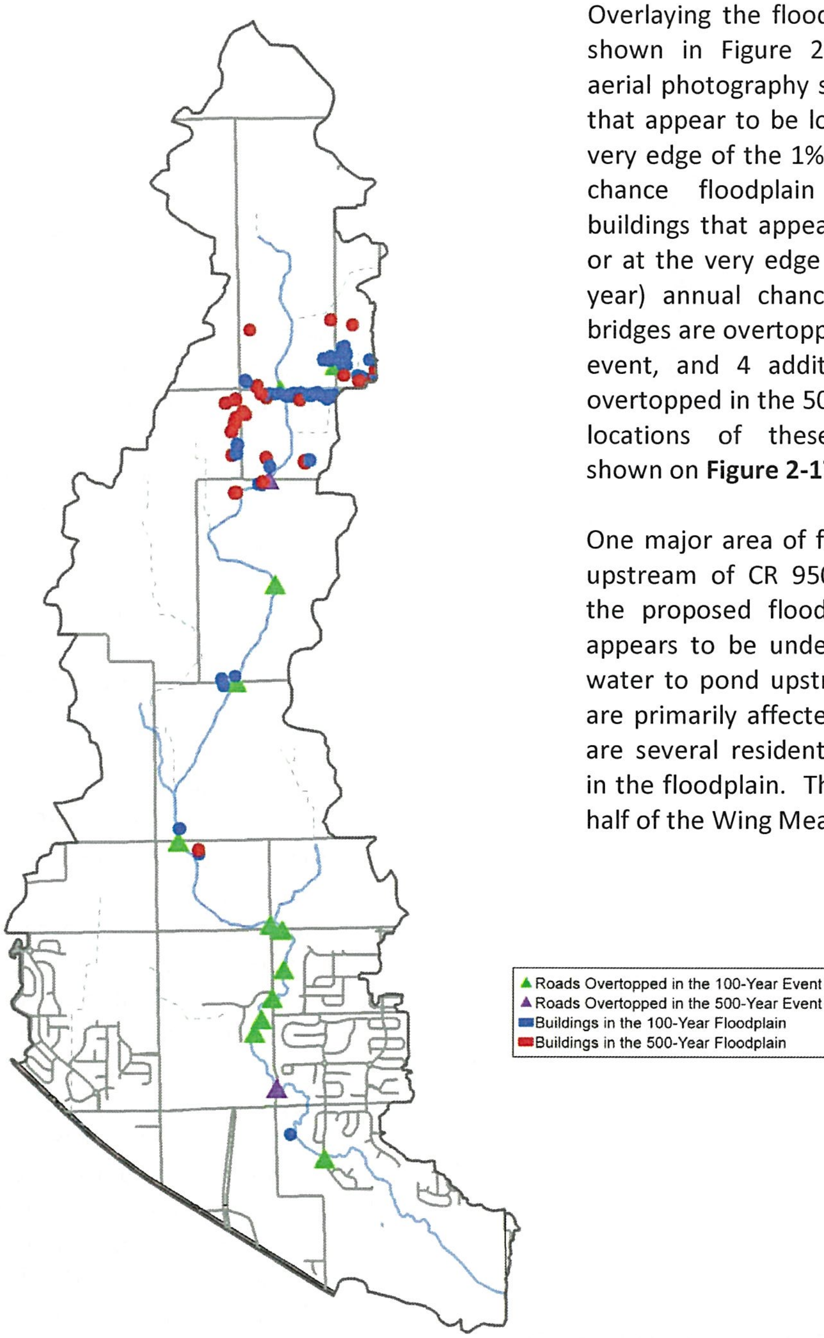


*Figure 2-17: Buildings and Bridges Located in the 1% and 0.2% Annual Chance Floodplains*

## 2.6 REGULATIONS

### 2.6.1 General Description of Regulatory Jurisdictions within the Watershed

Hendricks County and the Town of Brownsburg are the local governmental entities with jurisdictions within the watershed. Current jurisdictional limits in the watershed are shown in **Figure 2-18**. The Town of Brownsburg has its own regulations which supersede Hendricks County regulations, though regulated drains within the watershed will remain under the jurisdiction of the Hendricks County Surveyor. In addition, the Indiana Department of Natural Resources, US Army Corps of Engineers, US Environmental Protection Agency, and Indiana Department of Environmental Management also have stormwater related requirements that the communities and county are responsible for seeing are met.

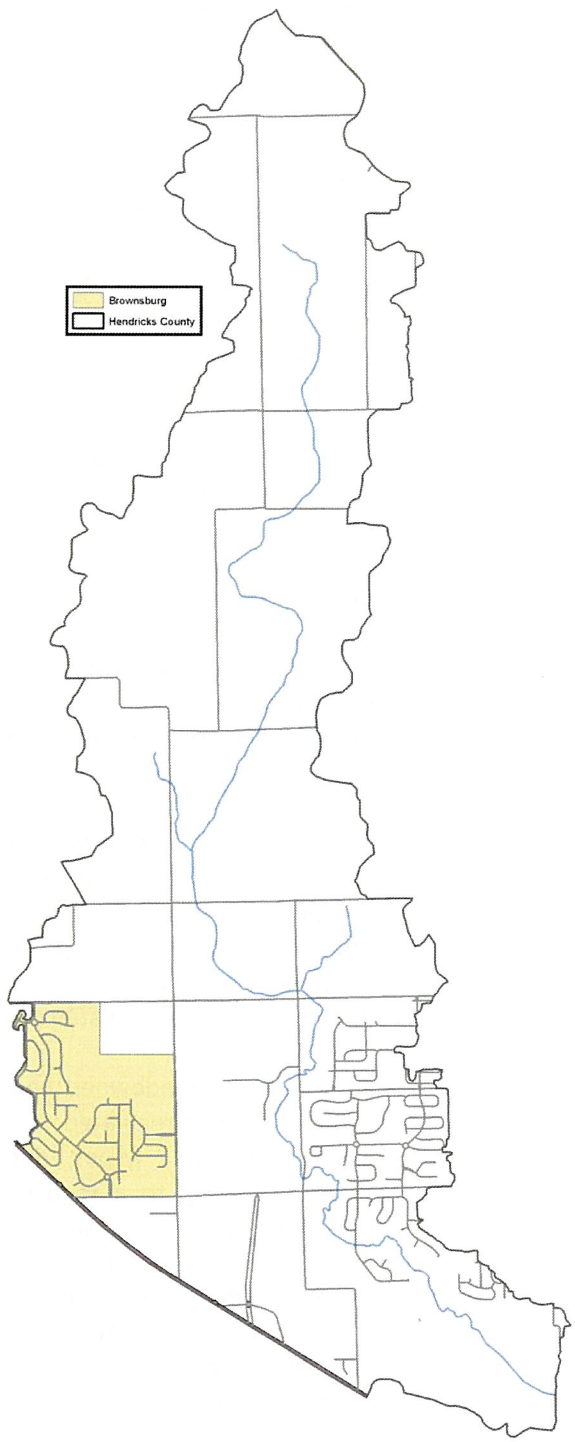


*Figure 2-18: Corporate Limits in the School Branch Watershed*

### 2.6.2 Regulated Drains

Regulated drains are viewed as utilities that are in place with the main purpose of providing drainage and are therefore regulated and maintained accordingly. For the regulated drains within the county, the County Surveyor's office has certain responsibilities and authority. A map of the additional regulated drains within the School Branch watershed is shown in **Figure 2-19**.

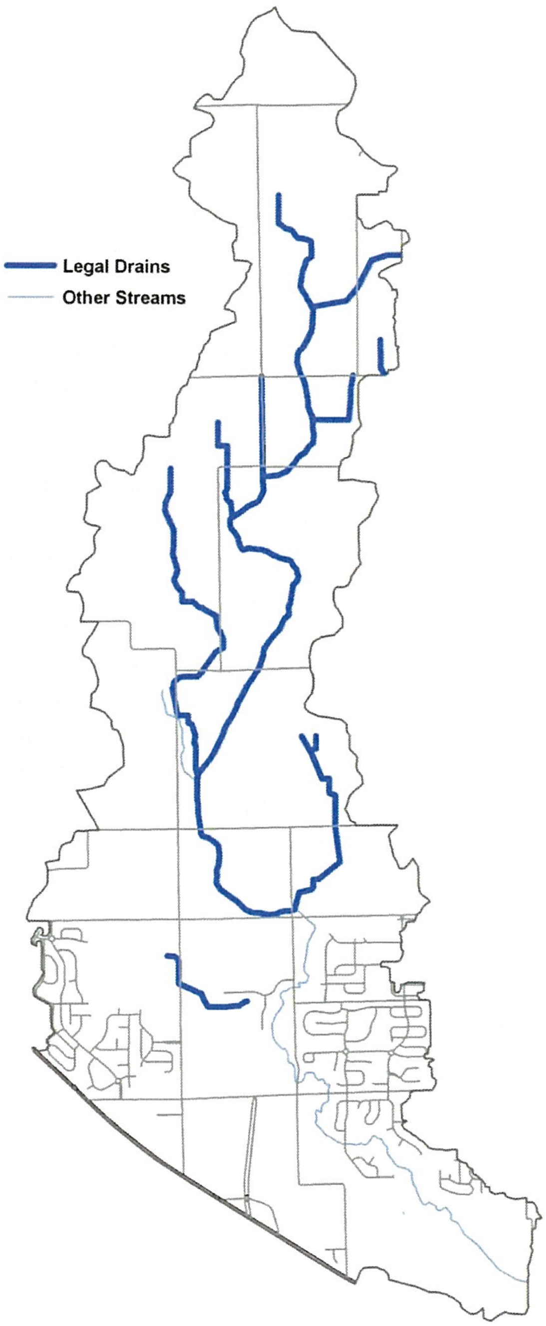


*Figure 2-19: Regulated Drains in the School Branch Watershed*

The responsibilities of the County Surveyor regarding regulated drains include:

- The Hendricks County Drainage Board has the authority, per Indiana Code, to establish, construct, reconstruct, and maintain regulated drains within Hendricks County.
- The Hendricks County Drainage Board evaluates all proposed connections to regulated drains within the county. Any and all connections to regulated drains must be approved by the Drainage Board.
- Anyone wishing to directly or indirectly connect to a regulated drain in Hendricks County must file a formal application with the Drainage Board and pay appropriate fees.
- If the regulated drain does not have adequate capacity to accommodate the proposed connection, the petitioner must make provisions to reconstruct, upgrade, or otherwise improve the drain or limit the discharge to an acceptable amount prior to discharging to the regulated drain.
- If the landowner benefited by a permitted connection to a regulated drain fails to maintain the drainage facilities (pipes, detention ponds, swales, etc.) connecting to a regulated drain, it is lawfully presumed that the failure is a request by the landowner for the drainage facilities to become a regulated drain pursuant to Indiana Code. The Drainage Board may then impose a maintenance or reconstruction assessment on all real estate benefited by the issuance of the particular outlet permit.

- A single owner or all owners affected by a private or mutual drain may petition the Hendricks County Drainage Board to assume jurisdiction over the drain per Indiana Code (36-9-27-18). The Board will then defer to the County Surveyor to determine whether or not the drain meets the standards of design and construction as defined by Indiana Code. If it does meet the standards, the Board shall grant the request. Otherwise, the request will be denied.

Property owners within each regulated drain watershed can be required to pay an assessment. The collected funds from these assessments are then used by the County Surveyor's Office to prevent future problems or to take care of existing problems along the drain. Landowners can petition to have old infrastructure replaced or to do activities to maintain the current infrastructure.

### 2.6.3 Indiana Department of Environmental Management (IDEM)

IDEM is responsible for maintaining, protecting, and improving the physical, chemical, and biological integrity of Indiana's waters. IDEM administers the Section 401 Water Quality Certification (WQC) Program, and draws its authority from the federal Clean Water Act and from Indiana's Water Quality Standards. Any person who wishes to place fill materials, excavate or dredge, or mechanically clear (use of heavy equipment) within a wetland, lake, river, stream, or other Water of the State must first apply to the USACE for a Clean Waters Act Section 404 permit. If the USACE determines that a permit is necessary, then the person must also apply for, and obtain, a Section 401 Water Quality Certification from IDEM. A Section 404 permit cannot be granted without a Section 401 permit.

As discussed in Section 2.4 of this Master Plan, IDEM is also responsible for the NPDES Phase II program in Indiana. MS4 entities are required by IDEM's Rule 13 to apply for NPDES permit coverage because their storm water discharges are considered point sources of pollution. More on MS4 entities can be found in the following section.

### 2.6.4 Municipal Separate Storm Sewer Systems (MS4s) Entities

MS4 entities are required to regulate stormwater quality management. Most of the School Branch Watershed is in an MS4 boundary (regulated by either Hendricks County, or the Town of Brownsburg) with the exception of an area north of CR 1000N and west of CR 950E. As MS4s, Hendricks County and the Town of Brownsburg regulate:

- Discharges of prohibited non-stormwater flows into the stormwater drainage system.

- Stormwater drainage improvements related to development of lands.
- Drainage control systems installed during new construction and grading of lots and other parcels of land.
- Erosion and sediment control systems installed during new construction and grading of lots and other parcels of land.
- The design, construction, and maintenance of stormwater drainage facilities and systems.
- The design, construction, and maintenance of stormwater quality facilities and systems.
- Land-disturbing activities affecting wetlands.

More details can be found in the Stormwater Management Ordinances of Hendricks County and the Town of Brownsburg.

### 2.6.5 Indiana Department of Natural Resources (IDNR) Jurisdiction

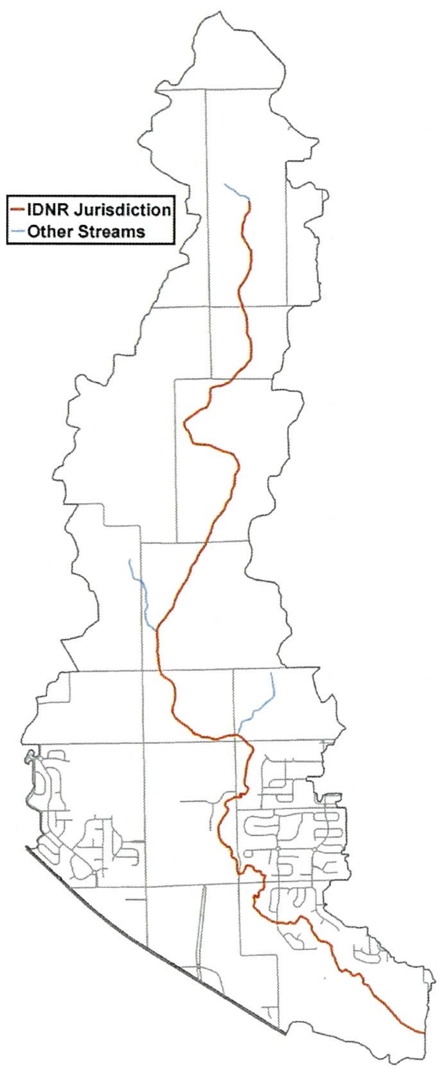


*Figure 2-20: IDNR Jurisdiction Limits*

The IDNR jurisdiction is limited to the floodway portion of the stream reaches with a drainage area greater than one square mile and dams that exceed 20 feet in height or impound a volume of more than 100 acre-feet of water. To assist in alerting residents and the governmental entities to the reaches where the requirement exists, a map of the one square mile drainage area jurisdiction limits was created and approved by IDNR. As shown in **Figure 2-20**, School Branch is the only stream in the watershed where IDNR has jurisdiction.

### 2.6.6 Summary

With multiple jurisdictions in the watershed that deal with stormwater related issues, it can become confusing as to who has authority for what problems. **Table 2-7** was developed to provide a summary of jurisdictions within the watershed. In some cases, an entity has regulatory but not maintenance responsibilities or vice versa so these are noted separately in the table. More specific information regarding regulatory and maintenance responsibilities and procedures can be found in the Stormwater Ordinances of Hendricks County and the Town of Brownsburg.

***Table 2-7: Summary of Jurisdictional Responsibilities in the School Branch Watershed***

| | JURISDICTION (M=Maintenance, R=Regulatory) | | | | | | |
|---|---|---|---|---|---|---|---|
| **Drainage System Component** | **Land-owner** | **H.O.A.** | **Town/ MS4 Entity** | **County Highway** | **County Surveyor** | **State Highway** | **Other** |
| Rear/side yard drainage swales | M | R | R | | R | | |
| Sump pump | M | | R | | R | | |
| Downspouts | M | | R | | R | | |
| Storm pipe inlets | | | M*, R | | M**, R | | |
| Storm pipes | | | M*, R | | M**, R | | |
| Storm pipe outfalls (wet/dry flows) | | | M*, R | | M**, R | | IDEM |
| Pond berm & emergency spillway | | M | R | | M**, R | | |
| Pond principal outlet | | M | R | | M**, R | | |
| Swale, <6 cfs | M | | R | | R, ** | | |
| Swale, >6 cfs | M | | M,R | | M**, R | | |
| Swale, road ROW | M | | R | | | | |
| Drain, stream – 1% floodplain | M | | R | | R | | IDNR*** |
| Regulated drain, incl. easement & 1% floodplain | | | | | M(of drain & access),R | | IDNR*** |
| Culverts (for drainage under roads) | | | M,R | | M,R | | |
| Bridges/culverts for stream/drain | | | M,R | | M,R | | IDNR*** |
| Tile (regulated drain) | | | | | M,R | | |
| Tile (non-regulated drain) | M | | R | | R | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I-74 | | | | | | M,R | |
| Main N/S & E/W streets drainage | | | M,R | | | | |
| Subdivision streets drainage | | | M,R | | | | |
| Private streets drainage | | M | R | | | | |
| Wetland or below stream Ordinary High Water Mark | | | | | | | USACE, IDEM |
| Water Quality Indicator (odor, color, floatables) | | | R* | | R* | | IDEM |
| BMP maintenance | M | M | M*, R* | | M*, R* | | |

**Unless a private system or regulated subdivision (most commercial properties and some subdivisions)*

***applies if is part of regulated drain*

**** applies if drainage area of stream at point of interest is greater than one square mile*

## 2.7 SUMMARY OF CONCERNS

As noted in the previous sections, various areas of concern in the watershed have been identified. The locations of these areas are summarized in **Figure 2-21**. Table **2-8** then follows, identifying these areas of concern in more detail. All concerns that were identified have been shown on the table and map, but not all of these concerns are within the scope of the issues this master plan is designed to address. Examples of concerns which are beyond the master plan scope are improper sump discharges, sedimentation of or breaking of non-regulated drain tile, springs that surface in new locations, etc. These issues are not typically the responsibility of a town or county.

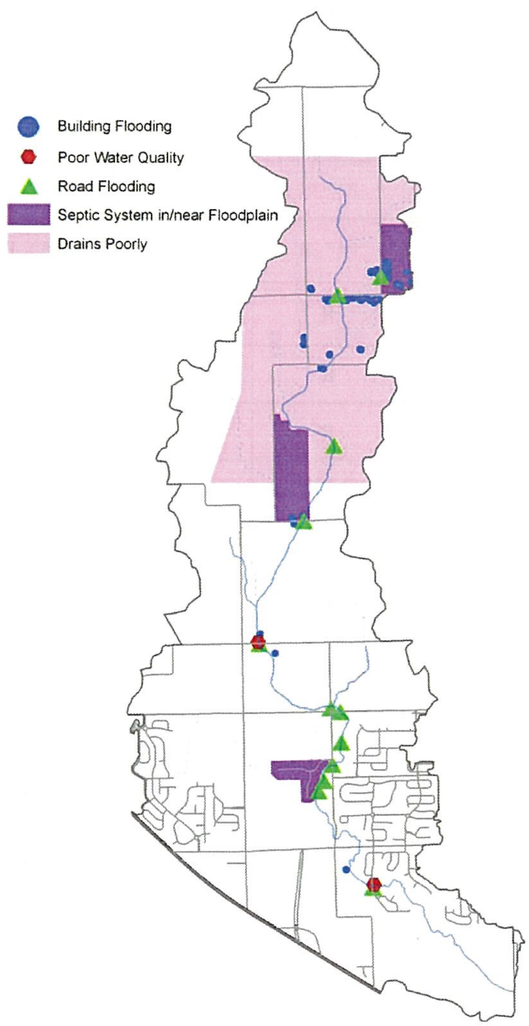


***Figure 2-21: Areas of Concern in the School Branch Watershed***

***Table 2-8: Areas of Concern in the School Branch Watershed***

| Location Description | Community | Regulated Drain | Description of Concern | Source of Concern Identification |
|---|---|---|---|---|
| School Branch between CR 950N & Boone County line | Hendricks Co. | William Batz | Flooding upstream of CR 950N | CBBEL |
| Wing Meadows | Hendricks Co. | William Batz | Septic system in proposed floodplain | County Surveyor & CBBEL |
| Maloney Rd. & CR 925E | Hendricks Co. | William Batz | Septic system in/on edge of proposed floodplain | County Surveyor & CBBEL |
| Shoal Creek Estates | Hendricks Co. | William Batz | Septic system in/on edge of proposed floodplain | County Surveyor & CBBEL |
| School Branch watershed, north of CR 950N | Hendricks Co. | William Batz | Roadside ditches don't have grading to drain well do to gaslines limiting depth | County Surveyor |
| School Branch, between Maloney Rd & CR 950N | Hendricks Co. | William Batz | Flat area, drains poorly | County Surveyor |
| School Branch at CR 700N | Hendricks Co. | William Batz | Poor water quality site | CBBEL |
| School Branch at Noble Dr. | Hendricks Co. | N/A | Poor water quality site | CBBEL |

*This page is intentionally left blank*

# CHAPTER 3 FUTURE CONDITIONS

## 3.1 INTRODUCTION

Identifying effective solutions to stormwater problems depends on a thorough understanding of not only the existing stormwater conditions but also the future stormwater conditions and associated concerns. As land use, regulations, and activities in the watershed change, so potentially do the impacts on stormwater quantity and quality. Chapter 2 described current conditions and impacts from changes that have already occurred. This chapter describes expected changes from conditions that are expected to occur in the future. Included are descriptions of the land use, wetlands, flood risk areas, and quality and quantity aspects of stormwater. This data has been gathered from available mapping, computer modeling for the watershed, discussions of expected future land use with local officials, and review of studies regarding expected future conditions.

## 3.2 LAND USE

The expected future use of land in the watershed was identified based on a review of the 2006 Hendricks County Comprehensive Plan. The land use intensity map from the Comprehensive Plan is shown below in Figure 3-1.

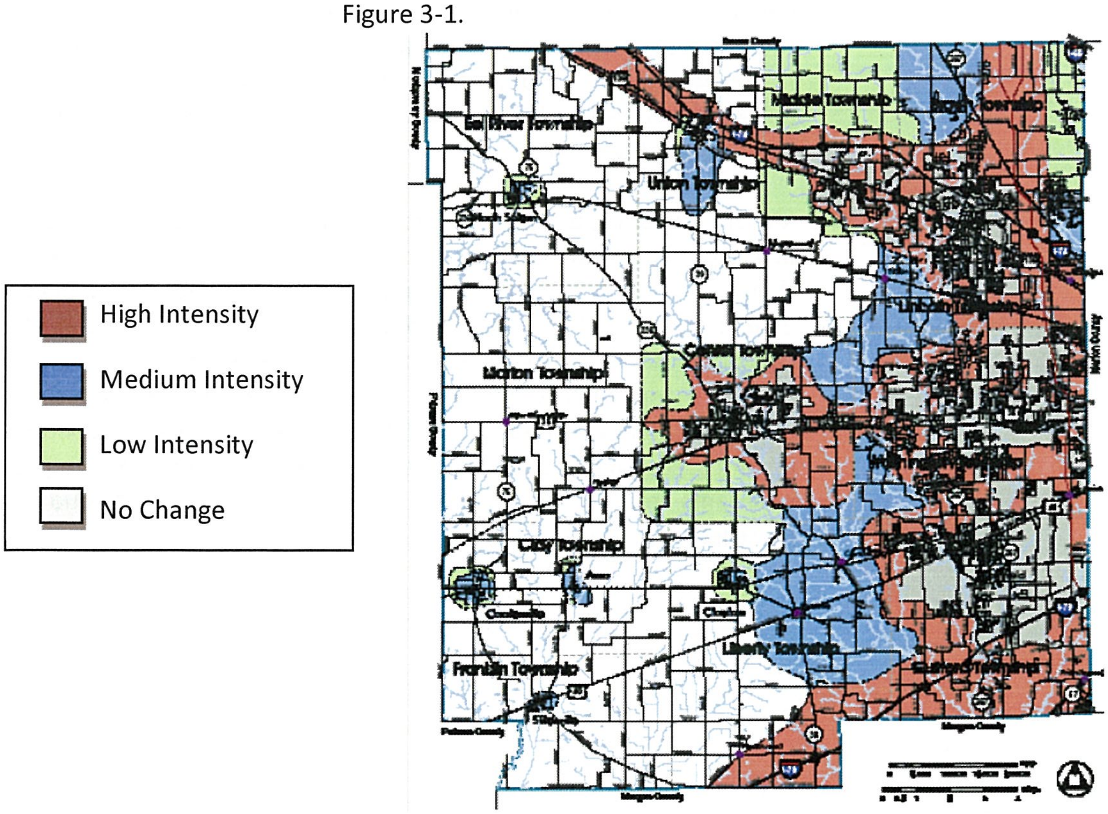


*Figure 3-1: Future Land Use in Hendrcks County (from the 2006 Hendricks County Comprehensive Plan)*

The School Branch Watershed is expected to develop primarily with high intensity. Small amounts of medium and low intensity development are also expected on the eastern boundary of the watershed. High intensity development, which consists of commercial, industrial, and urban residential land uses, is expected to occur mainly around the existing Town of Brownsburg, and also along CR 900N, 925N, and 950N. Medium intensity development, which consists of suburban residential subdivisions, is expected in the southeast corner of the watershed. Some low intensity development, such as scattered subdivisions, is likely to occur near the northeast boundary of the watershed.

## 3.3 WETLANDS

The wetland sites discussed in Chapter 2 (existing conditions) are some of the few remaining in the School Branch Watershed. As the watershed develops or agricultural practices become more extensive, these wetlands may be in jeopardy or direct or indirect alteration. Protection of these wetlands and expansion and creation of new wetland areas is needed wherever feasible.

Additional wetlands not identified on the NWI mapping may also exist in developed or un-developed areas because often the NWI predates the development of newer wetland areas. The 2009 NWI Update conducted by Ducks Unlimited somewhat alleviates this issue; however there are still some wetland areas that may not be included in either mapping data set. Additionally, the NWI serves only as a large scale guide, therefore it is important to require wetland delineations on any site prior to development.

Mature wetlands, particularly forested riparian sites, take many years to develop. Forested wetlands provide a higher flood storage capacity than emergent sites, and also contain a larger diversity of plant and animal species. When forested wetlands are located along stream corridors, they are of particular importance because they provide travel corridors for wildlife through otherwise heavily developed areas. Buffering stream corridors and wetland areas with undeveloped native upland areas and/or additional wetland habitat is important to prevent pollutants from disrupting these areas and to provide transition areas for wildlife.

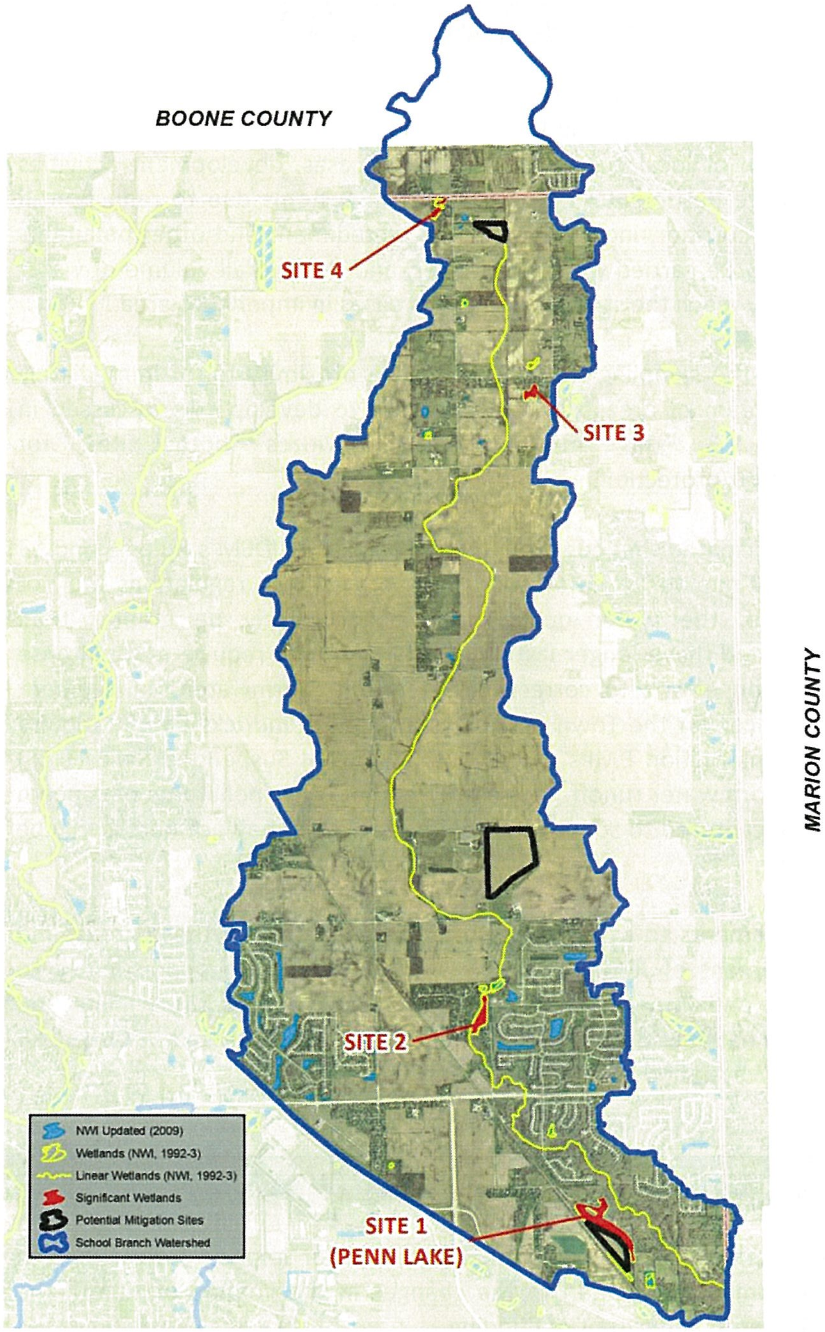


***Figure 3-2: Significant Wetlands and Potential Mitigation Sites***

Efforts to preserve these limited resources are important because wetland mitigation will not replace the habitat, value, and function of these existing sites for ten to twenty years to come, even if the mitigation is constructed properly. Mitigation ratios required by IDEM and the USACE have been used to make up for the lack of success of many wetland mitigation sites. The goal of this is to ensure that there is “no net loss” of wetland acreage. Even the required wetland acreage replacement ratios often don’t succeed with this. In addition, there is currently no regulation prohibiting draining or altering the hydrology of existing wetlands. This results in indirect “impacts” to wetland sites decreasing their value and function.

It has been shown through years of research that larger (50 acres plus), third party controlled, wetland sites provide more benefit to wildlife and have a higher probability of being successful than isolated wetland mitigation sites interspersed throughout urban areas. It is very difficult for wildlife, particularly reptiles and amphibians to inhabit sites that are surrounded by development and not connected to other natural areas. Potential large scale wetland mitigation sites within the School Branch watershed have therefore been identified as shown in **Figure 3-2**.

## 3.4 STORMWATER QUALITY

As the School Branch Watershed continues to develop, it is important to consider the relationship between land use and the overall health and condition of local waterways. In many cases, development activities may have detrimental effects on stream systems due to reduction in riparian corridor, increased amounts of sediment and other pollutants that may be carried with stormwater, and the overall volume of water that may reach the streams due to increases in impervious area.

Both of the sampling sites are within, in proximity to, or immediately downstream of areas that are expected to develop. As discussed in Chapter 2, this master plan prioritizes both sites for mitigation/protection.

It is anticipated that current regulations such as IDEM's Rules 5 and 13 will continue to be enforced. However, if these regulations are not enforced, the water quality impacts will likely be greater than anticipated, have longer lasting effects, and may require more intense mitigation efforts to correct. The current Stormwater Management Ordinances for the Town of Brownsburg and Hendricks County require post-construction BMPs to remove 80% Total Suspended Solids (TSS) from stormwater runoff. It is assumed that other pollutants of concern will be captured to some extent with TSS which may not necessarily be the case.

Enhancements to existing land uses, development of these areas, and enforcement of IDEM's Rules 5 and 13 will create opportunities to protect and improve local water quality as well as the wildlife and aquatic habitat. Specific recommendations are discussed in Chapter 5 of this Watershed Master Plan.

## 3.5 GENERAL FLOOD CHARACTERISTICS

This section describes additional potential for impacts from expected development in relation to the changes in the volume of runoff, the peak runoff, and extent of flooding.

Every 10-15 years or after a major rainfall event (2% annual chance/50-year or larger), the hydrologic model could be revisited to evaluate whether conditions have changed in the watershed and the conclusions reached are valid.

### 3.5.1 Runoff Volumes

Runoff volume can be greatly impacted by the land use. As imperviousness increases with development, less stormwater is able to soak into the ground. While the existing peak flow control requirements in the form of detention ponds would control the peak flow for larger events, the smaller than 2-year peak flows and their associated runoff volumes are currently not controlled either with regards to peak flow or runoff volume. Without proper mitigation for such an increase in runoff volume, usually in the form of retention of the "Channel Protection Volume" through Conventional or LID/green distributed storage approaches, this increased runoff will flow directly into the receiving storm sewers and streams, causing increased channel bank erosion. Therefore, new regulation of runoff volumes resulting from smaller storms for new development is critical.

### 3.5.2 Peak Flows

Since 2001, a default maximum allowable release rate (peak discharge per developed acre) has been used to regulate the peak flood discharges from development. Presently, in the School Branch watershed, these standards state that the allowable post-developed peak discharge from a site shall be no greater than 0.2 cfs/acre for the 0-10 year return interval storms and 0.4 cfs/acre for the 11-100 year return interval storms. As stated in Chapter 2, it is recommended that these standards be changed to match the potential proposed maximum allowable release rates presented in Table 2-6 to help ensure flooding does not increase with future land development.

### 3.5.3 Future Floodplain Delineations

Each of the creeks, streams, regulated drains, and other water courses within the watershed has some degree of flood risk associated with it. The current County and Town regulations requires that compensatory floodplain storage is provided when existing floodplain storage is proposed to be eliminated or reduced as part of proposed development/redevelopment. This should help keep the peak flow rates from increasing within the floodplain corridor due to loss of floodplain storage. There are also regulations in place to protect future buildings from being constructed below the current 1% annual chance flood elevation. However, if development continues with the current allowable release rates, the runoff volumes and peak flows can be expected to increase within the watershed. An increase the amount of rainwater that runs off of new development will likely increase flood elevations and widen the current floodplains. This means there is the potential for buildings that are currently built according to regulations to end up in future revisions to the floodplain delineations.

In addition to increases in runoff and flows, poor channel maintenance has the potential to increase flood elevations and widen floodplain delineations. To determine the sensitivity to channel maintenance on floodprone status, the hydraulic model of School Branch was run with a channel roughness coefficient of 0.09 representing very overgrown channel banks and growth or debris within the channel itself. Resulting flood elevations were increased by up to 2 feet on School Branch. On stream reaches with steep overbank slopes, this may means small changes in floodplain width. This is the case near the downstream end of School Branch. However, on reaches with flat overbank slopes, like much of the upstream end of School Branch, floodplain widths can increase dramatically.

### 3.5.4 Flooding Concerns

As discussed above, channel maintenance can have a significant impact on flood elevations. Figure 3-3 shows the additional buildings that would susceptible to flooding. For most of the stream reach there currently isn't a large number of additional buildings, because there hasn't been significant development near the stream corridor. However, if buildings are built near the current floodplain in the future, those potential future structures could be impacted by a lack of channel maintenance. Similar conclusions can be drawn for streams without hydraulic models and floodplain mapping. If the stream with a computer model can experience a flood elevation difference of 2 feet at some locations, it stands to reason that this can be expected for other streams in the watershed.

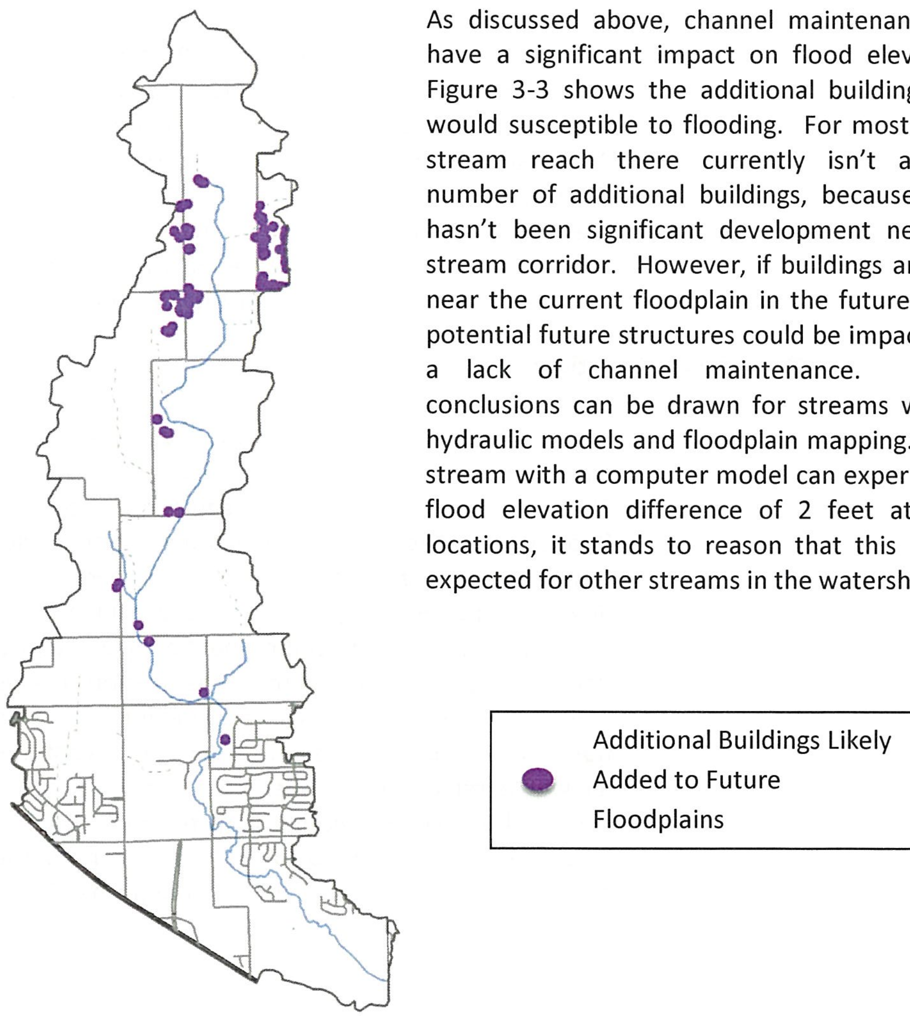


*Figure 3-3: Additional Buildings Likely Added to Future Floodplains*

## 3.6 SUMMARY OF CONCERNS

As noted in the previous sections, various concerns related to the future condition of the watershed have been identified beyond those noted for existing conditions. These concerns are listed below:

- Wetland preservation and enhancement
- Stormwater quality improvement
- Increases in runoff peak discharge due to insufficient current release rate regulations
- Increase in runoff volume for smaller floods due to insufficient volume control requirements, leading to increased channel bank erosion downstream of new development/urbanized areas
- Increase in flood elevations due to a lack or decrease of channel maintenance

Recommendations to address these stormwater concerns will be discussed in Chapter 5 of this Watershed Master Plan.

*This page is intentionally left blank*

# CHAPTER 4 WATERSHED GOALS AND EVALUATION CRITERIA

In order to address stormwater related issues in the watershed, goals and the preferred level of service to the public had to be determined. While complete protection of the watershed is a good goal, the cost to achieve it in every area is not always a wise use of available resources. A practical level of protection; therefore, needed to be determined so that the activities with the most value would become the focus of this plan. Depending on the magnitude of the problem, goals may be general, specific, long-term, or short-term. Evaluation Criteria are measures that will be used to formulate and/or screen the proposed alternatives to address stormwater concerns to meet the goals. This Chapter defines the goals and performance criteria for the School Branch Watershed Master Plan.

## 4.1 WATERSHED GOALS

- Reduce existing extent of flooding and drainage problems
- Improve water quality of stormwater runoff
- Protect, enhance, and restore natural systems for stormwater conveyance and storage.
- Prevent potential future increases in vulnerability to flooding, drainage, and water quality problems

## 4.2 EVALUATION CRITERIA

Based on the nature and extent of existing and future stormwater conditions and concerns presented in Chapters 2 and 3, the following set of technical, environmental, and economic criteria were developed to aid in the formulation and screening of potential alternatives.

### 4.2.1 Technical Criteria

- Create at least one lane width that is open for road and bridge traffic during a 1% annual chance (100-year) storm
- Provide for at least 2 feet of freeboard for the lowest adjacent grade during the 1% annual chance (100-year) flood for residential and commercial structures
- Prevent development from having an adverse impact on upstream or downstream flood levels
- Address drainage concerns by identification of the cause, clarification of the public or private responsible party, and requirement of that party to solve in a manner that does not

cause additional drainage problems on adjacent, upstream, or downstream properties.

- Prevent an increase in runoff from development sites
- Contradict no codes/policies unless a related revision of the code/policy is also recommended

#### 4.2.2 Economic Criteria

- Select fundable options or those which require no funding
- Reduce economic damages resulting from flood events

#### 4.2.3 Environmental Criteria

- Create no significant and/or permanent negative impacts on the environment, recreational opportunities, and /or fish and wildlife resources
- Maintain or enhance wetland aquatic and terrestrial species based on USFWS/IDEM classification systems (a wetlands classification system used by the U.S. Fish and Wildlife Service to map and inventory wetlands)
- Meet ordinance requirements
- Limit the loss of wetland aquatic/terrestrial species
- Enhance water quality to the point of having a QHEI score of at least 60 when possible. (The qualitative habitat evaluation index (QHEI) represents a measure of the physical and biological conditions of a particular stream site. This comprehensive assessment is critical for evaluating the disturbance and land use practices in the watershed.)

#### 4.2.4 Institutional Criteria

- Choose only recommended improvement plans that will be acceptable to Hendricks County and the Town of Brownsburg officials as well as the affected residents of these communities and incorporated areas.
- Choose only recommended improvement plans that are permittable under existing federal, state, and local permit programs.

# CHAPTER 5 PRIORITIZATION OF PROBLEMS/CONCERNS AND INITIAL SCREENING OF POTENTIAL SOLUTIONS

## 5.1 INTRODUCTION

This Chapter explains the process to catalogue identified problems and the screening of potential solutions based on the performance criteria discussed in Chapter 4.

## 5.2 CATALOGUED PROBLEMS

In an effort to address as many problems as possible and use the resources of this Master Plan to find solutions to the major issues, problems (identified at the end of Chapters 2 and 3) were catalogued by stream/drain into isolated and large scale problem categories. These are defined as:

- Isolated Problems – isolated problem affecting only a few buildings or small stream reaches.
- Large Scale Problems – flooding or drainage issues that affect a large area and may be solved with one or more regional solutions.

**Table 5-1** summarizes the problems identified. The table includes the location description, the type of problem, the source that identified the problem, the probable cause, and scale of the problem. There are also potential future problems throughout the watershed, as discussed in Chapter 3. Potential watershed-wide problems include: increases in flood elevations due to a lack/decrease in channel maintenance, increases in peak flows and runoff volume due to insufficient development requirements, and increases in erosion.

*Table 5-1: Problem Areas Along School Branch*

| Location Description | Description of Concern | Source of Concern Identification | Probable Cause | Problem Scale |
|---|---|---|---|---|
| School Branch between CR 950N & Boone County line | Widespread Building & Roadway Flooding | CBBEL | Restrictive Crossing at CR 950N | Large Scale |
| Wing Meadows | Septic Systems In Floodplain | County Surveyor & CBBEL | -- | Isolated |
| Maloney Rd. & CR 925E | Septic Systems In/Near Floodplain | County Surveyor & CBBEL | -- | Isolated |
| Shoal Creek Estates | Septic Systems In/Near Floodplain | County Surveyor & CBBEL | -- | Isolated |
| School Branch watershed, north of CR 950N | Poor Roadside Ditch Grading | County Surveyor | Gaslines limiting depth of ditches | Large Scale |
| School Branch, between Maloney Rd & CR 950N | Flat area, drains poorly | County Surveyor | Unknown | Large Scale |
| School Branch at CR 700N | Poor Water Quality | CBBEL | Untreated surface water runoff, septic systems in/near floodplain | Large Scale |
| School Branch at Noble Dr. | Poor Water Quality | CBBEL | Untreated surface water runoff, septic systems in/near floodplain | Large Scale |

## 5.3 IDENTIFICATION AND INITIAL SCREENING OF POTENTIAL SOLUTIONS

After reviewing the problems listed in Section 5.2, a list of potential solutions was developed with a focus on larger scale problems. **Table 5-2** summarizes the potential solutions, the locations the solution is applicable in and whether the solution will be carried over to the short list at the end of this Chapter. The promising solutions were further evaluated as discussed in Chapter 6 of this Master Plan.

***Table 5-2: Initial Screening of Potential Solutions***

| Potential Solution | Problem Location(s) | Remarks | Carried to Short-list |
|---|---|---|---|
| Update Ordinance and Technical Standards to set maximum allowable release rate for new development/ redevelopment at 10-year existing and 2-year existing unit peak flow rates, respectively for the 100-year and 10-year post-development conditions | Countywide | Would prevent increased peak flow rates, limit additional flooding problems; would not solve current problems | Yes |
| Update Ordinance and Technical Standards to add requirement for Channel Protection Volume and detailed standards for incorporating LID/Green standards for addressing water quality and channel bank erosion problems | Countywide | Would prevent increase in channel bank erosion downstream of developments and allow the use of state of the art LID/Green practices to eliminate nuisance flooding and water quality issues; would not solve current problems | Yes |
| Update Ordinance and Technical Standards to include removal requirements for nutrients, metals, and *E. coli* | Countywide | Would lessen the impact of development on water quality | Yes |
| Establish and follow a regular drain maintenance plan | Countywide | Would prevent increased flood elevations due debris and brush filled channels; could reduce existing flood elevations on some streams | Yes |

| Potential Solution | Problem Location(s) | Remarks | Carried to Short-list |
|---|---|---|---|
| Floodproof structures currently in the floodplain | Various | May limit or prevent flooding to individual structures; would not lower existing flood elevations or maintain access to properties. Good solution for isolated shallow flooding or where large scale solutions aren't feasible. | Yes |
| Buyout structures currently in the floodplain | Various | Removes flood hazard; does not decrease flood elevations. Best used where flood depths exceed recommended floodproofing depths and no large scale solution is both structurally and economically feasible. All identified flooding in the School Branch watershed is shallow enough for floodproofing, which is much less costly than buyouts. | No |
| Construct a regional detention pond | William Batz Drain/ upstream reach of School Branch | Would prevent increased peak flow rates due to development; has the potential to reduce peak flow rates and current flooding problems | Yes |
| Enlarge existing stream crossings to prevent flooding upstream | CR 950 N & CR 1000N over William Batz Drain | Would improve the existing stream crossings that are overtopped during flood events; has the potential to reduce upstream flood elevations; may increase problems downstream | Yes |
| Construct a 2-stage channel along William Batz Drain | William Batz Drain/ upstream reach of School Branch | Would reduce flood elevations and minimize the amount of sediment and nutrients that are transported by stormwater | Yes |
| Construct a bypass channel on William Batz Drain | William Batz Drain/ upstream reach of School Branch | Could reduce flood elevations upstream; would likely increase flood elevations in other areas | No |
| Plant/maintain vegetative buffers of native plants along William Batz Drain | William Batz Drain/ School Branch | Would filter and trap pollutants carried by stormwater | Yes |
| Connect neighborhoods with septic systems to nearby sewer systems | Wing Meadows, Maloney Rd. & CR 925E, Shoal Creek Estates neighborhoods | Would improve water quality in William Batz Drain/School Branch | Yes |

| Potential Solution | Problem Location(s) | Remarks | Carried to Short-list |
|---|---|---|---|
| Request gas companies move or alter slope of pipelines | School Branch watershed north of CR 950N | Would allow for regrading of road side ditches for better drainage; expensive and gas companies are unlikely to approve request | No |
| Construct a storm sewer system in areas with poor drainage | School Branch watershed north of CR 950N | Expensive; could be implemented slowly as development continues in this area | Yes |

## 5.4 SUMMARY OF SHORT-LISTED PROMISING SOLUTIONS

A summary of short-listed promising solutions to address existing flooding problems and concerns regarding potential worsening of flooding problems in the future is provided in **Table 5-3**. These promising solutions will be further evaluated in detail in Chapter 6.

***Table 5-3: Short-Listed Promising Solutions***

| Solution Number | Potential Solution | Problem Location(s) | Remarks |
|---|---|---|---|
| 1 | Update Ordinance and Technical Standards to set maximum allowable release rate for new development/ redevelopment at 10-year existing and 2-year existing unit peak flow rates, respectively for the 100-year and 10-year post-development conditions | Countywide | Would prevent increased peak flow rates, limit additional flooding problems such as inundation and erosion; would not solve current problems |
| 2 | Update Ordinance and Technical Standards to add requirement for Channel Protection Volume and detailed standards for incorporating LID/Green standards for addressing water quality and channel bank erosion problems | Countywide | Would prevent increase in channel bank erosion downstream of developments and allow the use of state of the art LID/Green practices to eliminate nuisance flooding and water quality issues; would not solve current problems |
| 3 | Update Ordinance and Technical Standards to include removal requirements for nutrients, metals, and *E. coli* | Countywide | Would lessen the impact of development on water quality |

| Solution Number | Potential Solution | Problem Location(s) | Remarks |
|---|---|---|---|
| 4 | Establish and follow a regular drain maintenance plan | Countywide | Would prevent increased flood elevations due debris and brush filled channels; could reduce existing flood elevations on some streams |
| 5 | Floodproof structures currently in the floodplain | Various | May limit or prevent flooding to individual structures; would not lower existing flood elevations or maintain access to properties. Good solution for isolated shallow flooding or where large scale solutions aren't feasible. |
| 6 | Construct a regional detention pond | William Batz Drain/ Upstream reach of School Branch | Would prevent increased peak flow rates due to development; has the potential to reduce peak flow rates and current flooding problems |
| 7 | Enlarge existing stream crossings to prevent flooding upstream | CR 950 N & CR 1000N over William Batz Drain | Would improve the existing stream crossings that are overtopped during flood events; has the potential to reduce upstream flood elevations; may increase problems downstream |
| 8 | Construct a 2-stage channel along William Batz Drain | William Batz Drain/ Upstream reach of School Branch | Would reduce flood elevations and minimize the amount of sediment and nutrients that are transported by stormwater |
| 9 | Plant/maintain vegetative buffers of native plants along William Batz Drain | William Batz Drain/ School Branch | Would filter and trap pollutants carried by stormwater |
| 10 | Connect neighborhoods with septic systems to nearby sewer systems | Wing Meadows, Maloney Rd. & CR 925E, Shoal Creek Estates neighborhoods | Would improve water quality in William Batz Drain/School Branch |
| 11 | Construct a storm sewer system in areas with poor drainage | School Branch watershed north of CR 950N | Expensive; could be implemented slowly as development continues in this area |

# CHAPTER 6 DETAILED EVALUATION OF PROMISING SOLUTIONS

This Chapter includes a detailed analysis of the most promising solutions filtered through the screening process in Chapter 5 to determine their suitability for potential inclusion as a Master Plan component for the School Branch Watershed. Calculation details are provided in **Appendix 4** for promising solutions requiring a hydrologic and/or hydraulic analysis.

## 6.1 PROMISING SOLUTION 1: UPDATE MAXIMUM ALLOWABLE RELEASE RATES IN ORDINANCE AND TECHNICAL STANDARDS

This solution addresses the concern of increases in peak discharges due to insufficient release rate regulations. As discussed in Sections 2.5 and 3.5, the default maximum allowable release rates for Hendricks County are larger than the unit peak flow rates calculated from the detailed hydrologic model of the School Branch Watershed. Decreasing the maximum allowable release rates, by setting them to the values suggested in both Table 2-6 and Figure 2-13, will allow for greater control of future peak flow rates. This is a low-cost solution to increasing peak flow rates and will be included as a recommended Master Plan component.

## 6.2 PROMISING SOLUTION 2: ADD CHANNEL PROTECTION VOLUME REQUIREMENTS AND ALLOWANCE FOR LID/GREEN PRACTICES IN ORDINANCE AND TECHNICAL STANDARDS

Channel protection is typically achieved by matching the post-construction runoff volume and flowrate to the pre-settlement condition for all runoff events up to the bankfull flow. However, due to difficulties in determining the pre-settlement conditions, the net control of runoff resulting from a 1-year, 24-hour storm in the Proposed Condition can be established as the standard for channel protection. The bankfull flow in most Indiana streams correlate with the 1.5 to 2-year flood event. This requirement of Channel Volume Protection will reduce future increase in channel bank erosion due to development and will be included as a recommended Master Plan component. The updated Technical standards should also contain detailed procedures and incentives on the utilization of LID/Green Infrastructure to satisfy the water quality and channel protection volume requirements.

## 6.3 PROMISING SOLUTION 3: UPDATE POLLUTANT REMOVAL REQUIREMENTS IN ORDINANCE AND TECHNICAL STANDARDS

The current Stormwater Management Ordinance and Technical Standards requires post-construction BMPs to remove 80% TSS from stormwater runoff but does not target other pollutants of concern such as nutrients, like nitrogen and phosphorous, metals, and *E. coli*. It is assumed that other pollutants of concern will be captured to some extent with TSS which may not necessarily be the case. Removal of additional pollutants is especially important given that every water quality sampling site has *E. coli* concentrations above the recommended levels. This will be included as a recommended Master Plan component.

## 6.4 PROMISING SOLUTION 4: ESTABLISH AND FOLLOW A REGULAR DRAIN MAINTENANCE PLAN

As discussed in Section 3.5, floodplains may expand if channels are not regularly cleared of debris and excessive weeds are not managed. This is especially important in areas already developed or that are likely to develop with high intensity. This is a low-cost solution to increasing flood depths and will be included as a recommended Master Plan component.

## 6.5 PROMISING SOLUTION 5: FLOODPROOF STRUCTURES CURRENTLY IN THE FLOODPLAIN

Floodproofing existing floodprone structures is usually an economic solution to shallow flooding of structures where there are not large scale problems or large scale solutions are not feasible. However, this solution does not protect access to structures or reduce flood elevations.

Floodproofing may be designed to reduce the number of times the building is flooded or to limit the potential damage to the building and its contents when it's flooded. General approaches to floodproofing range from low cost solutions such as moving or elevating valuables from the area subject to flooding to more expensive solutions including:

1. Implementing measures that prevent basement flooding and sewer backups;
2. Wet floodproofing – modifying the building and relocating the contents to allow floodwaters inside the structure with little or no damage;

3. Dry floodproofing – preventing water from entering the structure by making the building floor and walls watertight;
4. Floodwalls – preventing floodwaters to come near the building by constructing barriers around the building or at the lower elevations on the property; and
5. Elevation – preventing the floodwaters to enter the building by raising the building in place.

Selecting the appropriate floodproofing measure for a structure will depend on the nature of the flood hazard, the physical condition of the site, the function and use of the building, and its structural characteristics.

Typically, flood depths must be less than 3-feet for floodproofing to be effective. There are 28 structures likely eligible for floodproofing, though some may not require floodproofing if other flood protection or reduction measures are taken. Streams without a defined floodplain are not included.

Floodproofing is an economical solution for flood protection in areas with isolated shallow flooding and will be included as a recommended Master Plan component. A typical community-led floodproofing program would involve developing a cost-share grant program, with the County/community matching one to one the expenditure made by the property owner towards floodproofing. The County/community cost-share contribution is typically capped at about $10,000 for each residential and $20,000 for each non-residential structure.

## 6.6 PROMISING SOLUTION 6: CONSTRUCT A REGIONAL DETENTION POND


*Figure 6-1: Regional Pond Site*

The primary reason to construct a regional detention pond in the School Branch watershed is to reduce flooding in the upstream reach north of CR 950N. Since the School Branch watershed is long and narrow with no major tributaries, one single pond was not able to capture enough flow to significantly reduce the amount of flooding north of CR 950N. The first test site for a pond is at the confluence of William Batz and John Green Drains, as shown in **Figure 6-1**. This 150 acre-foot pond barely altered discharges and flood depths. To test if multiple ponds along William Batz Drain/School Branch would reduce discharges and flood depths significantly, a second hypothetical pond was added downstream in the hydrologic model. This hypothetical pond was double the size of the first pond and a suitable site would be difficult to locate. Even with both large ponds, proposed 100-year discharges were only reduced to the existing 50-year rates. To remove structures from the floodplain, the proposed 100-year discharges will have to be reduced to slightly below the 10-year. Since suitable sites for ponds are more difficult to find closer to the mouth of School Branch, and the ponds already attempted did not have a significant enough impact, this alternative was abandoned and this solution will not be included as a recommended Master Plan component. Calculations regarding this alternative are included in **Appendix 4**.

## 6.7 PROMISING SOLUTION 7: ENLARGE EXISTING CROSSINGS TO PREVENT FLOODING UPSTREAM

There are 10 public road crossings that are overtopped in the 100-year event within the watershed, as shown in Figure 2-17. Any crossings that are only slightly overtopped by the 100-year event, do not backup water upstream and would only have a slight benefit for the cost involved in replacing the crossings. These are not recommended for replacement. There are two crossings that, if enlarged, would likely reduce upstream flooding. These are discussed in the following subsections.

### 6.7.1 County Road 950 North

According to revised hydraulic modeling, there is widespread flooding upstream of the CR 950N crossing on William Batz Drain. Most of this flooding is actually north of CR 1000N; however, there are several homes along CR 1000N that are on the downstream side of that road. Enlarging the CR 950N 16-foot wide bridge to twin 14-foot by 8 foot rectangular concrete box culverts removes 3 structures from the floodplain, but does not impact any structures upstream of CR 1000N. Enlarging CR 950N also provides flood-free access in the 100-year event to 7 homes along CR 950N and CR 950E. Since this bridge replacement does remove several structures from the floodplain, it is recommended as a Master Plan component.

### 6.7.2 County Road 1000 North

Since enlarging CR 950N had little effect on flood elevations upstream of CR 1000N, enlarging CR 1000N was also tested. The existing 15-foot wide bridge was modeled as a 34-foot wide bridge, but did not remove any structures from the floodplain. This solution is not recommended as a Master Plan component on its own; however, it is useful combined with other solutions as discussed below.

## 6.8 PROMISING SOLUTION 8: CONSTRUCT A 2-STAGE CHANNEL ALONG WILLIAM BATZ DRAIN

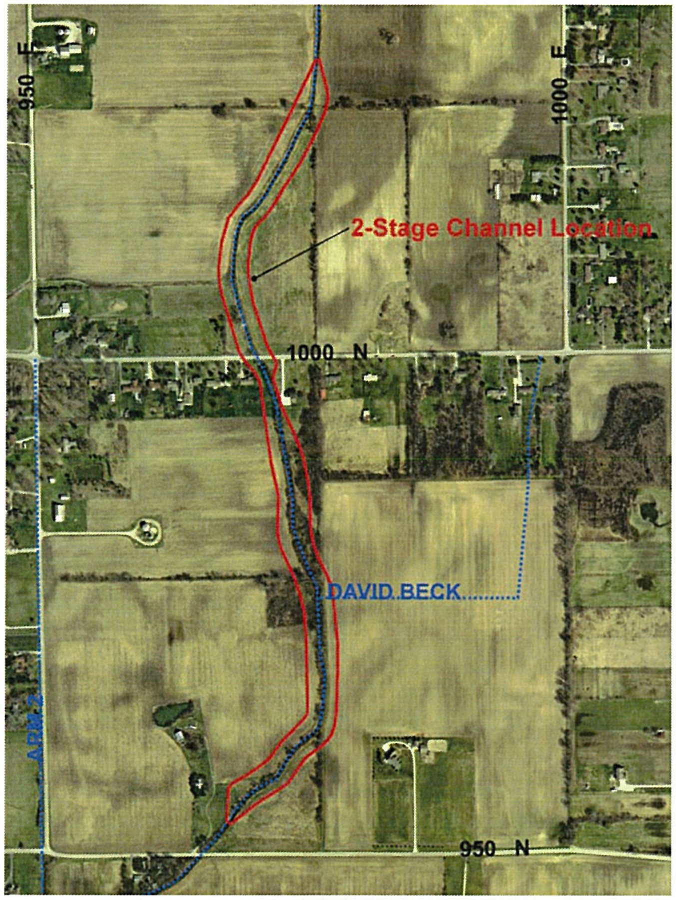


*Figure 6-2: 2-Stage Channel Location*

A 2-stage channel typically would reduce flood elevations and also reduce the amount of nutrients and sediment transported downstream. Since William Batz Drain/School Branch has both water quality and quantity problems, a 2-stage channel should be a good solution for this stream. Most of the water quantity problems are upstream of CR 950N, so a 2-stage channel was modeled just upstream of CR 950N, as shown in **Figure 6-2**. The 2-stage channel is approximately 0.75-miles long and has a total shelf width of 140-feet. The 100-year flood elevation is reduced by approximately 1.2-feet and 20 residences would be removed from the floodplain. If Promising Solutions 7 and 8 are combined, the 100-year flood elevation is reduced by approximately 1.5-feet and a total of 27 residences would be removed, which is all the structures in the floodplain north of CR 950N. Given the water quality and quantity benefits, this solution will be included as a recommended Master Plan component.

## 6.9 PROMISING SOLUTION 9: PLANT/MAINTAIN VEGETATIVE BUFFERS OF NATIVE PLANTS ALONG WILLIAM BATZ DRAIN

Planting vegetation along the overbanks will provide resistance to erosion and reduce the possibility of future stream widening. Planting trees and shrubs inside the buffer will increase bank stabilization by providing a root system that will help keep the bank intact. Similarly, this vegetation will help by filtering sediments and other pollutants out of the stream and provide for overall water quality enhancement.

Using vegetation in a buffer zone or easement filters runoff and reduces pollution, nutrients, and sediment before they enter the stream. Buffers along natural streams consist of a natural and dense network of grasses, shrubs, and trees, while buffers along drainage ditches are mowed cool season grasses regularly maintained to prevent the development of woody plants. A minimum buffer width of 30-feet where possible is advised; however, a larger buffer would provide more filtration benefits to the stream. A buffer zone will also aid in channel maintenance by preserving access to the stream. The primary focus should be along William Batz Drain where the water quality is slightly worse than further downstream on School Branch. Other streams and regulated drains in the watershed would also experience improved water quality if buffers were implemented along those streams, but there currently isn't any water quality data to determine the urgency of improving that water quality in those streams. This solution will improve stream water quality and will be included as a recommended Master Plan component.

## 6.10 PROMISING SOLUTION 10: CONNECT NEIGHBORHOODS WITH SEPTIC SYSTEMS TO NEARBY SEWER SYSTEMS

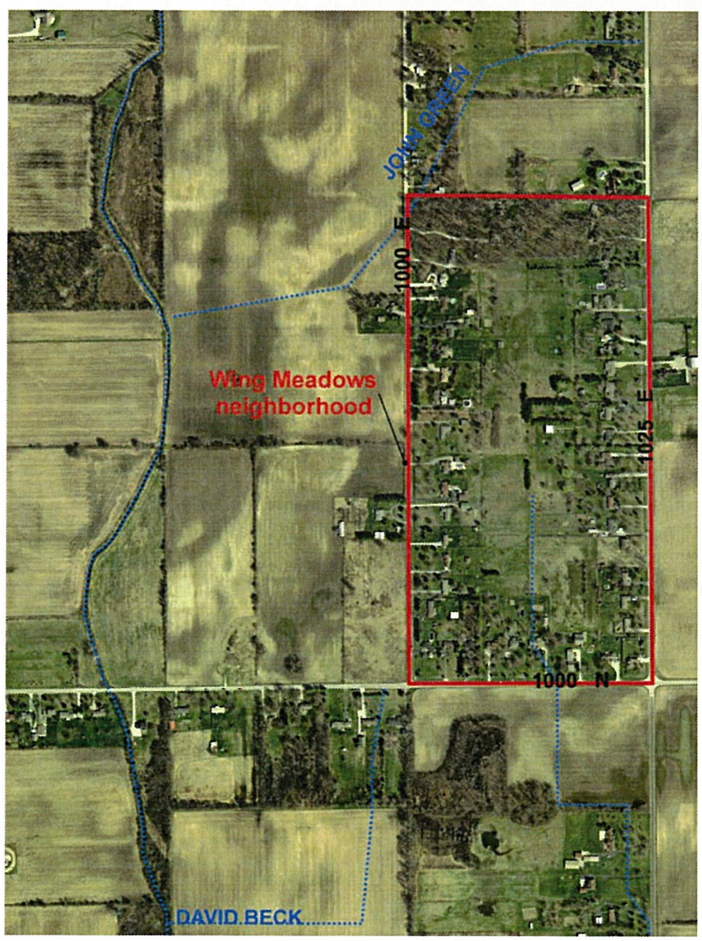


*Figure 6-3: Wing Meadows Neighborhood*

There are 3 known neighborhoods in the School Branch watershed with septic systems in or very near the proposed 100-year floodplain. Their locations and relationship to Williams Batz Drain/School Branch are described below.

The Wing Meadows neighborhood is in the northern portion of the watershed between CR 1000E and CR 1025E, north of CR 1000N as shown in **Figure 6-3**. This neighborhood is connected to John Green Drain to the north and David Beck Drain to the south. Both are regulated drains discharging into William Batz Drain/School Branch less than 0.5 miles downstream.

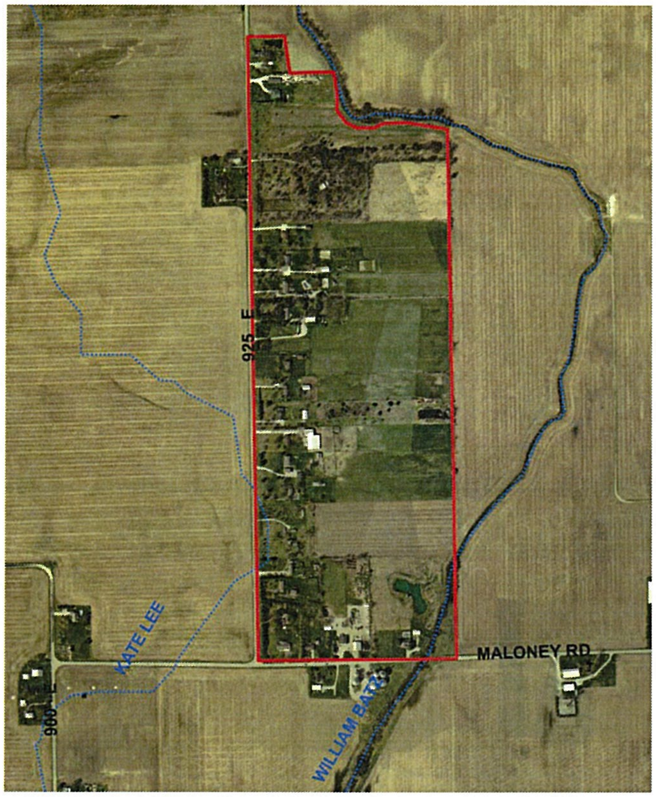


*Figure 6-4: Neighborhood near Maloney Rd. and CR 925E*


*Figure 6-5: Shoal Creek Estates Neighborhood*

Another neighborhood with septic systems is in the middle of the watershed near the intersection of Maloney Road and CR 925E, as shown in **Figure 6-4**. Both William Batz Drain and Kate Lee Drain, which discharges into William Batz about a mile downstream, flow through this neighborhood.

The Shoal Creek Estates neighborhood is near the downstream end of School Branch, just downstream of the William Batz regulated drain portion of School Branch. The neighborhood is located off of CR 1000E, between CR 600N and CR 700N, as shown in **Figure 6-5**. William Hart Drain flows through the neighborhood and into School Branch, which is just to the east.

It is likely that these septic systems are discharging rapidly to these drains. Septic systems this close to surface water should be converted to sewer systems so that the wastewater can be properly treated before entering the stream and prevent *E. coli* concentrations from increasing further. Nearby neighborhoods with sewer systems are not likely oversized to accept additional flows from this neighborhood. However, there are vacant plots of land to the west and east that will likely develop in the future. As these are developed and connected to the sewer system, the design could allow for the additional flows from this neighborhood. This solution will be included as a recommended Master Plan component.

## 6.11 PROMISING SOLUTION 11: CONSTRUCT A STORM SEWER SYSTEM NORTH OF COUNTY ROAD 950 NORTH

There are numerous gas and oil pipelines running below ground in the area north of CR 950N. As reported by the County Surveyor's Office, these pipelines are limiting the grading of roadside drainage ditches. This level of local drainage is outside of the scope of modeling for a Watershed Master Plan, so it is unclear how significant the drainage issues are. The most comprehensive large scale solution to this problem is likely to construct a storm sewer system in the area where the pipelines are most prevalent. However, the cost of such a system would likely be in the millions of dollars. It is recommended that more data be collected on the severity of the local roadside drainage issues in this area to weigh whether the monetary cost of a sewer system is worth the benefits in this location. This solution is not recommended as a Master Plan component at this time. In the meantime, improving and enforcing the Stormwater Ordinance and Technical Standards should prevent any local drainage problems from worsening as development continues in this portion of the watershed.

# CHAPTER 7 RECOMMENDED MASTER PLAN COMPONENTS

This Chapter summarizes the recommended Master Plan components for the School Branch Watershed investigated as solutions to the noted problems and provides information regarding each promising component's expected positive impacts and disadvantages. **Table 7-1** includes a list of the promising solutions discussed in Chapter 6, the problems they are meant to address, their potential impacts, and an estimated cost. Cost data sheets for each recommended Master Plan component are provided in **Appendix 6**.

***Table 7-1: Recommended Master Plan Components***

| Master Plan Component | Problem(s) Addressed | Positive Impacts | Disadvantages | Estimated Cost |
|---|---|---|---|---|
| Update Ordinance and Technical Standards to set maximum allowable release rate for new development/redevelopment at 10-year existing and 2-year existing unit peak flow rates, respectively for the 100-year and 10-year post-development conditions | Current post-development allowable release rates are larger than existing condition unit peak flow rates leading to increasing flooding and erosion | Would prevent increased peak flow rates, limit additional flooding problems such as inundation and erosion | Would not solve current problems | $15,000 |
| Update Ordinance and Technical Standards to add requirement for Channel Protection Volume and detailed standards for incorporating LID/Green standards for addressing water quality and channel protection volume requirements | Streambank erosion, nuisance flooding | Would prevent increase in channel bank erosion downstream of developments, eliminate nuisance flooding and water quality issues | Would not solve current problems | |
| Update Ordinance and Technical Standards to include removal requirements for nutrients, metals, and *E. coli* | High *E. coli* and phosphorus concentrations in most streams | Would lessen the impact of development on water quality | Would not solve current problems | |

| Master Plan Component | Problem(s) Addressed | Positive Impacts | Disadvantages | Estimated Cost |
|---|---|---|---|---|
| Establish and follow a regular drain maintenance plan | Lack of channel maintenance | Would prevent increased flood elevations due debris and brush filled channels; could reduce existing flood elevations on some streams | None | Performed by Surveyor's Office |
| Floodproof 1 structure currently in the floodplain that is not protected by other recommended Master Plan components | Shallow flooding of structures | Limits or prevents flooding to individual structures; economic solution for isolated shallow flooding | Would not lower existing flood elevations or maintain access to properties | Up to $10,000 |
| Enlarge CR 950N over William Batz Drain | Undersized culvert causing upstream flooding | Has the potential to reduce upstream flood elevations and improve upstream drainage | May increase problems downstream | $500,000 |
| Enlarge CR 1000N over William Batz Drain | Undersized culvert causing upstream flooding | Has the potential to reduce upstream flood elevations and improve upstream drainage | May increase problems downstream | $500,000 |
| Construct a 2-stage channel along William Batz Drain | Flooding and drainage issues upstream of CR 950N; Improves water quality along William Batz Drain/ School Branch | Would reduce flood elevations and minimize the amount of sediment and nutrients that are transported by stormwater | Will need to acquire additional land in the overbank area | $2,150,000 |

| Master Plan Component | Problem(s) Addressed | Positive Impacts | Disadvantages | Estimated Cost |
|---|---|---|---|---|
| Plant/maintain vegetative buffers of native plants along William Batz Drain | Improves water quality along William Batz Drain/ School Branch | Would filter and trap pollutants carried by stormwater; reduce erosion; create/preserve access to streams for maintenance | None | $250-$500 per acre |
| Connect neighborhoods with septic systems to nearby sewer systems | Wing Meadows, Maloney Rd. & CR 925E, Shoal Creek Estates neighborhoods | Would improve water quality in William Batz Drain and School Branch | High Cost | Costs will vary depending on future sewer plans; minimum of $250 per linear foot |

*This page is intentionally left blank*

# CHAPTER 8 IMPLEMENTATION PLAN

This Chapter provides a summary of conclusions of the study and a list of actions to be followed in order to implement the recommended plan components.

## 8.1 ORDINANCE AND TECHNICAL STANDARDS UPDATE

- Revise the County's Stormwater Ordinance and Technical Standards with the subbasin-specific post-development maximum allowable release rates proposed in Table 2-6.
- Revise the County's Stormwater Ordinance and Technical Standards to include Channel Protection Volume requirements and include LID standards for water quality and Channel Protection Volume
- Revise the County's Stormwater Ordinance and Technical Standards to include removal requirements for nutrients, metals, and *E. coli*.
- Conduct training for staff reviewers, decision-makers and the development community.
- Adopt and enforce new requirements.

## 8.2 CHANNEL MAINTENANCE

- Determine how frequently debris collects in each regulated drain within the School Branch Watershed
- Establish and follow a regular maintenance plan and schedule for regulated drains
    - Maintenance should be conducted in a way that minimizes natural vegetation disturbance
    - Channels should be inspected soon after major rainfall events for flood debris

## 8.3 FLOODPROOFING

- Develop a floodproofing cost-share program and an associated application form
- Create outreach materials and conduct meetings with interested participants
- Encourage property owners in defined floodplains to obtain a lowest adjacent grade survey to determine more accurate flood depths affecting their structure
- Gather grant funding information for property owners

- Based on flood depth, site layout, etc., determine the best type of floodproofing for use at each location.

## 8.4 ENLARGE UNDERSIZED STREAM CROSSINGS

For both CR 950N and CR 1000N over William Batz Drain, the following steps should be taken:

- Identify funding mechanism
- Develop design and construction documents
- Obtain Construction in a Floodway permit from IDNR
- Obtain USACE water quality permits
- Proceed with construction

## 8.5 PLANT AND MAINTAIN VEGETATIVE BUFFERS

- Determine best locations along School Branch for installation of buffer strips, with a focus on the William Batz Drain portion of School Branch where the water quality is worse
- Conduct a workshop and/or develop educational materials on the benefits of implementing buffer strips along natural streams and drainage ditches to encourage property owners to participate.
- Develop a cost-share program to assist landowners with implementing buffer strips.
- Develop and maintain a GIS database of buffer strips as they are added to the watershed.

## 8.6 CONNECT SEPTIC SYSTEMS TO SEWER SYSTEM

- If connection to a sewer system is not possible in the near future, conduct a septic system maintenance workshop to improve operation of system resulting in improved water quality.
- As development continues in this portion of the watershed, plan sewer mains to accommodate the Wing Meadows, Shoal Creek Estates, and Maloney Road & CR 925E neighborhoods.
- Develop a cost-share program to assist property owners with connecting to the sewer main line.

# CHAPTER 9 REFERENCES

Information sources used in the development of this Master Plan are listed below:


- Christopher B. Burke Engineering, LLC. School Branch Hydraulic Analysis. July 2012.
- Christopher B. Burke Engineering, LLC. School Branch Hydrologic Analysis. July 2012.
- Federal Emergency Management Agency. Effective Flood Zones for Hendricks County. September 25, 2009.
- Federal Emergency Management Agency. "Homeowner's Guide to Retrofitting Second Edition". Publication # FEMA P-312. December, 2009.
- Indiana Department of Environmental Management. Water Quality Targets. http://www.in.gov/idem/6242.htm.
- Indiana Department of Natural Resources. One Square Mile Cutoffs Map.
- Hendricks County. 1-foot contour interval topography, NAVD 1988. 2007.
- Hendricks County. Aerial Photography. 2010.
- Hendricks County. Buildings shapefile.
- Hendricks County. Comprehensive Plan. December 2006.
- Hendricks County. Regulated Drain Map.
- Hendricks County. Stormwater Management Ordinance. 2004.
- Hendricks County. Stormwater Technical Standards Manual. 2004.
- U.S. Fish and Wildlife Service. National Wetlands Inventory. 1992.
- U.S. Fish and Wildlife Service. National Wetlands Inventory Update. 2009.
- U.S. Geological Survey. National Land Cover Database. 2006.
- U.S. Geological Survey. Quadrangle Map of Clermont, Indiana. 1967. Photorevised 1980. Photoinspected 1984.
- U.S. Geological Survey. Quadrangle Map of Zionsville, Indiana. 1966. Photorevised 1988.