LOWER KANKAKEE WATERSHED INITIATIVE

2022

Lower Kankakee River Watershed Management Plan

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APPENDIX LIST

ACRONYM LIST

BMP	Best management practices
CAFO/CFO	Concentrated Animal Feeding/Confined Feeding Operations
CCA	Certified Crop Advisor
CLA	Critical Loading Area
CMIBI	Citizen Macro Invertebrate Impaired Biological Index
CQHEI	Citizen Quality Habitat Evaluation Index
CSO	Combined Sewer Outfalls
DNR	Department of Natural Resources
DO	Dissolved Oxygen
E. coli	Escherichia coli
EPA	Environmental Protection Agency
FSA	Farm Service Agency
HEL	Highly erodible land
HES	Highly erodible soils
HUC	Hydrologic Unit Code
IBI	Impaired Biotic Index
IDEM	Indiana Department of Environmental Management
IDNR	Indiana Department of Natural Resources
IRCD	Iroquois River Conservancy District
ISDA	Indiana State Department of Agriculture
ISDH	Indiana State Department of Health
JCEDO	Jasper County Economic Development Organization
JSWCD	Jasper County Soil and Water Conservation District
LID	Low Impact Development
LKWI	Lower Kankakee Watershed Initiative
MIBI	Macro Invertebrate Index of Biotic Integrity
NICHES	Northern Indiana Citizens Helping Ecosystems Survive
NLI	Nitrate Leaching Index
NPS	Non-Point Source
NPDES	National Pollution Discharge Elimination System
NRCS	Natural Resources Conservation Service
PCB	Polychlorinated biphenyls
PPA	Priority Protection Area
QAPP	Quality Assurance Protection Plan
QHEI	Quality Habitat Evaluation Index
RWA	Rapid Watershed Assessment
SWCD	Soil and Water Conservation District
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
TSS	Total Suspended Solids
UIWI	Upper Iroquois Watershed Initiative
USGS	United States Geological Service
UST	Underground Storage Tanks
WASCOB	Water and Sediment Control Outlet Basin
WEG	Wind Erodibility group
WLA	Waste load allocations

WMP	Watershed Management Plan
WQ	Water Quality
WQS	Water Quality Standard
WWH	Warm Water Habitat
WWTP	Wastewater Treatment Plant

1.0 WATERSHED COMMUNITY INITIATIVE

Everyone lives in a watershed. According to the Center for Watershed Protection, a watershed is defined as an area of land that drains to a common body of water, such as a stream, river, or even the ocean. Watersheds play a vital role in our ecosystems and include the water that we drink, the habitat for wildlife, soils that grow our food, and places that we live and recreate. In essence, protecting watershed resources is vital to a healthy life. Additionally, all the activities that take place in a watershed have the potential to impact the health and quality of those services we all enjoy. Whether we are constructing buildings, growing row crops, or fertilizing our lawns, the watershed is impacted in some way. Therefore, it is imperative to be mindful of how we impact the landscape. Planning for and monitoring how we use a watershed becomes vitally important to the health and well-being of its communities, wildlife, and residents both now and into the future.

According to the USGS "the United States is divided and sub-divided into successively smaller hydrologic units which are classified into four levels: regions, sub-regions, accounting units, and cataloging units. The hydrologic units are arranged or nested within each other, from the largest geographic area (regions) to the smallest geographic area (cataloging units). As the digits of the HUC increases, the geographic area associated with the HUC decreases. The Lower Kankakee Watershed Initiative focuses on three HUC-10 watersheds that extend between Newton and Jasper Counties in northwestern Indiana, and which drains 186,927 acres (Figure 1).

The Lower Kankakee River Basin in northwest Indiana is consistently a topic of discussion by local leaders and stakeholders. In fact, this region, or watershed, has been under review for decades due to concerns related to excess water, silt, and sand, as well as water quality impacts caused from anthropogenic (human) activity. Despite having continuous concerns among stakeholders there are still three HUC 10 watersheds that drain into the Kankakee River that do not have a watershed management plan (WMP; Figure 2). Therefore, the Jasper County Soil and Water Conservation District determined that it would take a locally led watershed approach to assess needs, set goals, and identify programs and resources that would address the needs and ultimately measure success. That entails research, analysis, and the creation of a WMP for the Lower Kankakee River in order to best serve the common good of this area.

Figure 1- HUC 10 Watersheds in the Lower Kankakee Watershed

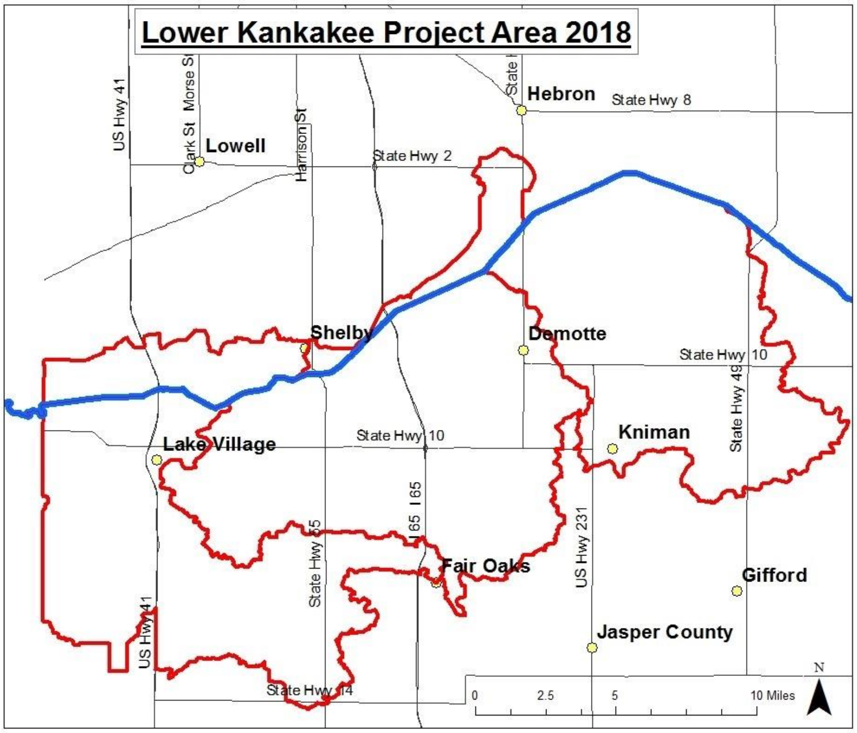
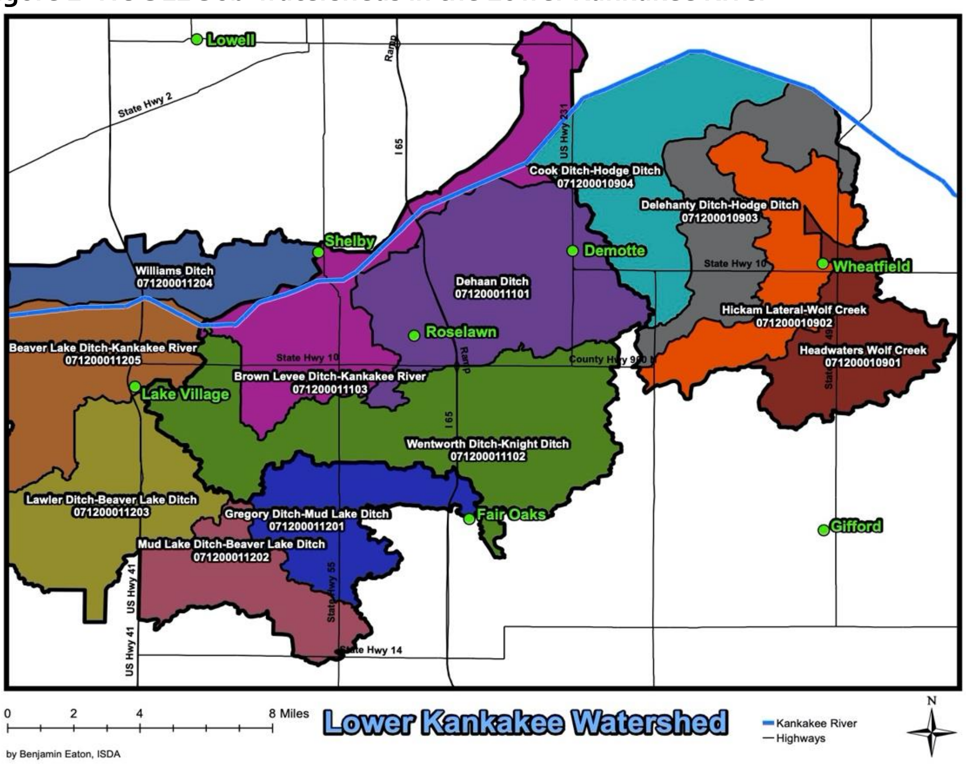


Figure 2- HUC 12 Sub-watersheds in the Lower Kankakee River



Our Partners
Partners of the project include:

- Jasper and Newton County Surveyors and Health Departments
- Jasper County Council Members
- Jasper, Newton, Porter, and Lake County Soil & Water Conservation Districts
- NICHES Land Trust
- Indiana State Department of Agriculture
- Natural Resources Conservation Service and other state agencies
- Ag Conservation Solutions
- Vision Ag, LLC
- The Law Office of Riley & Ahler, P.C.
- area farmers
- area stakeholders

Funding Source
This project was funded in March 2019 by a three-year grant from Indiana Department of Environmental Management (IDEM).

1.1 Project History

The Jasper County Soil and Water Conservation District (JCSWCD) has been studying the Lower Kankakee River in Jasper County since 2007, when they undertook groundwater and surface water testing at the request of local citizens. Those results indicated impairments in nearly all the stream sites and many groundwater tests. In 2008, the IDEM 303d list of impaired streams cited that 83% of the first- and second-order streams entering the Kankakee River, and the river itself, were classified as 5A impaired. In 2008, the Kankakee/Iroquois Watersheds TMDL documents confirmed those findings. The US Environmental Protection Agency has identified this region within the top 25% of the contributors to the hypoxia zone in the Gulf of Mexico.

According to Bob Barr, a research scientist from Purdue University School of Science at Indiana University-Purdue University Indianapolis (IUPUI) and expert on the Kankakee River Basin, the watershed is considered to be one of the most highly modified watersheds in Indiana. The Kankakee River Basin's hydrology and ecosystems have been studied extensively since it was first fully dredged in 1917 by the Indiana Department of Natural Resources (IN DNR). However, the impact of anthropogenic activities on water quality has yet to be fully studied on three HUC 10 watersheds within the Lower Kankakee Basin Jasper and Newton Counties.

Much of the anthropogenic activities impacting water quality in the Lower Kankakee watershed are related to land use. Approximately 73% of the land in the watershed is used for agriculture. In addition to row crops, there are more than 47 confined animal feeding operations (CAFOs) and confined feeding operations (CFOs) and a number of small, unregulated farms in Jasper and Newton counties. Outside of agricultural land use, there is a high amount of infrastructure and poorly planned residential developments along the I-65 corridor due to its proximity to the Chicagoland area.

Hydromodification and soil type within the watershed both impact water quality. The Natural Resources Conservation Service has classified soils into hydrologic groups according to soil's ability to absorb rainfall and thus reduce runoff. Soils in the targeted watersheds range from eolian sands and gravels formed by outwash deposits with high infiltration and transmission rates to those formed by sandy, loamy lacustrine and outwash deposits. The latter soils are poorly drained on nearly level ground and found primarily in the main valleys of the river and its major tributaries. Since this area was previously marshland, high water tables exist. With this unique set of soils and hydrologic conditions, a wide variety of modifications have been employed to facilitate agriculture, all of which make watershed management very challenging and can contribute heavily to nonpoint source pollution. While there are few subterranean tiles due to a high-water table and sandy soils, other irrigation and drainage techniques, such as surface irrigation, ditch pumps, levees, dikes, and irrigation ditches, have been utilized. High water tables, sandy soils, dairies that apply manure to farm fields, septic systems in the developed areas, and small, unregulated farms (pasture areas) all contribute to nonpoint source pollution consisting of *E.coli*, sediment loading, and nutrient runoff are potential problems that have a direct impact on the quality of life in the watershed.

Considering the list of concerns identified above, the JCSWCD submitted a Section 205j Nonpoint Source Program Grant Application to the IDEM Watershed Planning and Restoration Section. It was entitled the Lower Kankakee Watershed Initiative (LKWI). The LKWI was a joint venture of the Jasper and Newton County Soil and Water Conservation Districts, along with local stakeholders, to create a watershed management plan for the Lower Kankakee River, which consisted of three HUC 10 watersheds. The project had four goals: 1) To create a baseline inventory that compiled existing water quality data, 2) To conduct a windshield survey of the region to help identify relevant concerns, 3) To conduct a social indicator survey to gauge stakeholder concerns and gain their support of the LKWI. This goal also included education and outreach relative to the project. 4) To develop a WMP guided by a stakeholder steering committee that would include specific action items connected to stakeholder concerns and which addressed the problems identified in scientific data and related field studies. The grant was approved to begin in March of 2019.

As part of the 205j grant, Arion Consultants was contracted to complete goals one and two, which included compiling existing water quality data on the three HUC 10 watersheds and the completion of the windshield survey. All accessible road-stream crossings were inventoried. The watershed inventory identified issues that fell into five main categories: stream buffers limited in width or lacking altogether; areas of livestock access; streambank erosion; dumping areas; and unregulated farms. Much of the watershed was not visible from the road; therefore, those issues identified in the windshield survey should not be considered exhaustive. More than 796 miles of streams possessed limited buffers, nearly 26.6 miles of stream bank were eroded, and livestock had access to nearly 1.7 miles of streams. Additionally, 8.8 miles of recently clean legal drains were observed in the spring of 2019.

Summaries from the various agencies yielded the following data:
USGS 2019

- Phosphorus exceeded targets in 93% samples
- Nitrates exceeded targets in 68% samples
- Turbidity (soil suspended in water) exceeded target concentrations in 94% of collected samples
- The entire region is not well suited to traditional septic systems due to high water table or unsuitable soil types

IDEM 2018

- Elevated levels of *E.coli* (bacteria), nitrates, phosphorus in 41% of samples
- High turbidity in 93% of samples
- Index of biological integrity (IBI) below targets in 8 of 13 sites
- Habitat for organisms below targets in 7 of 9 sites

JCSWCD 2010

- High *E.coli* levels in 11 of 14 samples
- One round of water testing has been done in 2019, which supports earlier data

IDNR - Hoosier Riverwatch

- Elevated nitrates in 23 of 33 samples
- High turbidity
- Elevated *E.coli* in 3 of 23 samples
- Pollution Tolerance Index (related to life in the streams) showed reach rate to river from fair to good

A stakeholder group, which was composed of individuals who lived and worked within the watershed, was identified in order to facilitate the grant and watershed planning process. The initial stakeholder group meeting held in March 2019 identified the following list of concerns related to the watershed and water quality, which are ranked by highest concern:

1) capacity of stream and soils to retain water
2) groundwater protection
3) flooding, quantity of water is periodically high
4) elevated nutrient levels
5) fishing/fish are not safe to eat
6) farmers are perceived as polluters

Once Arion Consultants completed the watershed inventory, the list of resource concerns was revised to include two additional concerns:

- Elevated bacteria concentrations (high *E. coli*)
- Elevated turbidity or suspended solids concentrations

The following sections of this WMP detail the stakeholder committee and work groups that were created for this project, and the outcomes that were developed to guide future work within the watershed. Input from the watershed stakeholder group and the mechanisms in which input was generated also are included in the following sections. Those efforts were guided by the following mission and vision.

Vision: To ensure an ecological and economically healthy Lower Kankakee River watershed for today and generations to come.

Mission: To connect people for watershed improvement by creating a watershed management plan (WMP) which prioritizes areas of concern followed by implementing the WMP for ongoing improvement in the health of the watershed.

1.2 Steering Committee

The Lower Kankakee Watershed Initiative is a group of citizens and organizations who are working together to develop a WMP that will help them achieve the goal of improving water quality across the watershed.

The steering committee was formed by both the Jasper and Newton SWCD's staff and board members submitting names of local leaders and decision makers who would be important to have on a steering committee and drawing from existing partnerships. Individual citizens representing farmers, businesses, the cities, towns, and counties within the watershed; neighborhood associations; environmental groups; natural resource and engineering professionals; and industrial and educational entities comprised the steering committee. Many of these names came from partnering organizations and stakeholders who had supported the Upper Iroquois Watershed Initiative. Steering Committee Members then voiced their concerns for the Lower Kankakee River, and the list of Stakeholder Concerns was made (Figure 3). Table 1 identifies the current list of members which is subject to change throughout the planning process.

Table 1- Steering Committee Members and their Affiliation

Last	First	Affiliation
Ahler	Carolyn	Jasper Co. SWCD Watershed Outreach Coordinator
Boezeman	Sig	Newton Co. Farmer
Carty	Derek	Jasper Co. SWCD District Program Manager
Ciara	Bri	Newton Co. SWCD Director
Deyoung	Zack	Indiana DNR
Duttlinger	Dave	Jasper Co. Citizen
Hannon	Clayton	Jasper Co. Farmer
Keys	Shelby	Jasper SWCD Treasurer
Kingma	Mark	Jasper SWCD Supervisor
Knochel	Chris	Newton County Surveyor
Luchik	Derek	Jasper SWCD Supervisor
Magiera	Chester	Jasper Co. Farmer
Misch	Jacob	Jasper Co. Farmer
Sipkema	Austin	Jasper Co. Farmer
Styck	Cody	Newton Co. Farmer
Woolever	Zach	Jasper Co. Farmer
Zimmer	Lana	Jasper SWCD Supervisor

1.2.1 Water Quality Work Group

The water quality work group was responsible for sample site identification, historic water quality data identification, and data review and recommendation development. It was decided at the April 10, 2019 Steering Committee meeting that a subgroup would meet to decide on the sampling sites and would report back to the steering committee. This group met in April 2019 to identify sites where surface water was to be monitored for the next twelve months. Once sample collection began, this group met on a quarterly basis to review current and historic data, identify water quality targets, complete data analysis, and to begin prioritization of areas of concern in order to identify the critical areas for remediation. Table 2 identifies the water quality work group members and their affiliation.

Table 2- Water Quality Work Group

Last	First	Affiliation
Ahler	Carolyn	Jasper Co. SWCD Watershed Outreach Coordinator
Eaton	Ben	ISDA
Jordan	Mark	Jasper SWCD Supervisor
Schroeder	Sheila	CCSI
Shide	Kevin	Newton & Jasper NRCS
Zimmer	Lana	Jasper SWCD Supervisor

1.3 Stakeholder Concerns List

Stakeholder concerns were initially gathered during the first stakeholder and steering committee meeting held on March 13, 2019 at the Wheatfield Library. There were 24 people in attendance and each person was asked to place a sticky note on a watershed map of where they lived. The watershed was well represented. Attendees were invited to voice their concerns and all comments were recorded on a dry erase board and in the survey tool, Slido. Each person then voted on their highest priorities using Slido. A score of 10 indicated the respondent was "most concerned" and a score of 1 indicated the respondent was "least concerned (Table 3).

Table 3- Initial Stakeholder Concerns List

Concern	Voting Results
Capacity of Stream and Soils to Retain Water	8.8
Groundwater Protection	7.9
Flooding: Quantity of Water is Periodically High	7.5
Nutrients	7.1
Fishing/Fish Safe to Eat	5.1
Farmers are Perceived as Polluters	4.3

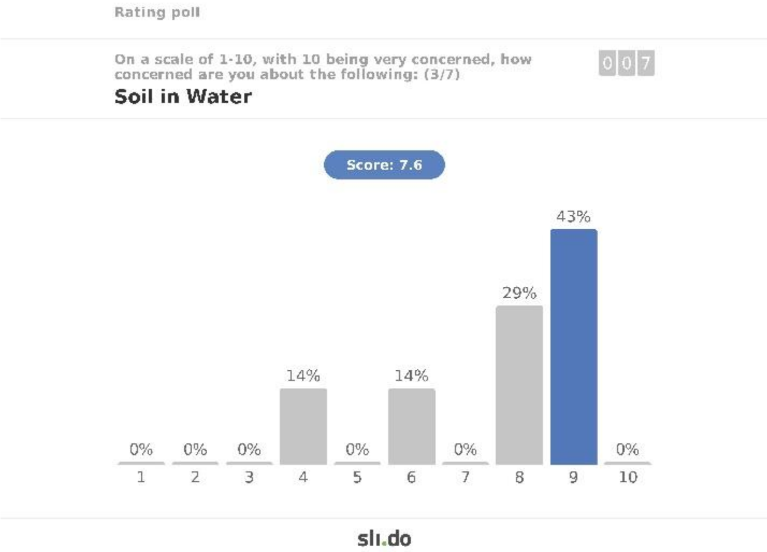
After the initial steering committee meeting, Arion Consultants completed the windshield survey and developed a watershed inventory. After receiving the results of these efforts, the steering committee reviewed their concerns list and added two items to the concerns list: elevated bacteria levels (high *E. coli*) and elevated turbidity or suspended solids levels. During the July 13, 2019 steering committee meeting, the committee voted to reprioritize concerns. Table 4 and Figure 3 details the concerns list ranking following the July 2019 meeting.

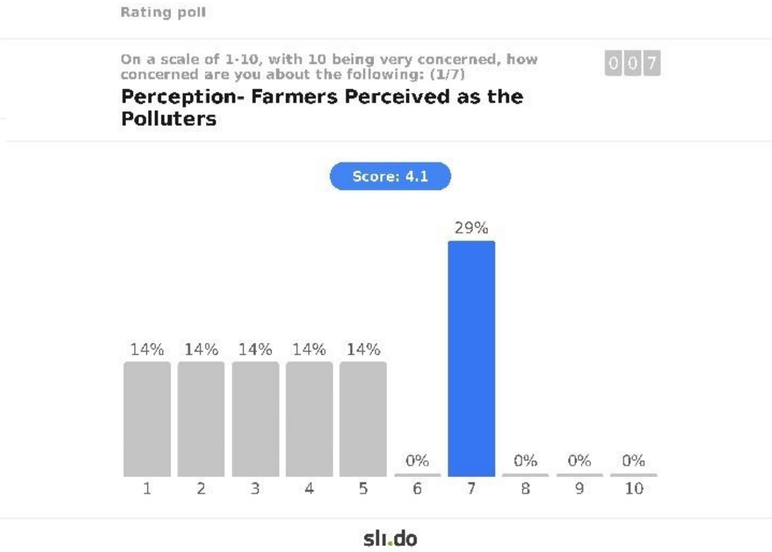
Table 4 - Revised Stakeholder Concerns List

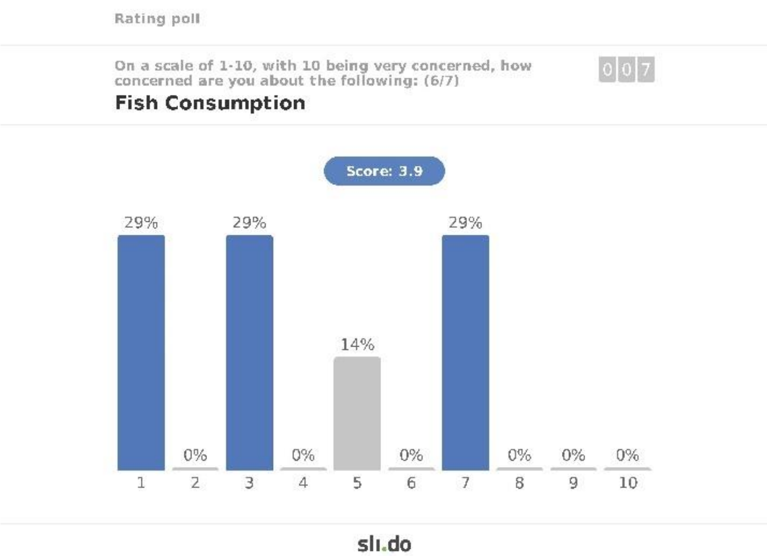
Concern	Voting Results
Capacity of Stream and Soils to Retain Water	9.1
Elevated Bacteria levels	8.6
Nutrients	8.3
Flooding: Quantity of Water is Periodically High	7.9
Soil in water (elevated turbidity)	7.6
Farmers are Perceived as Polluters	4.1
Fishing/Fish Safe to Eat	3.9
Groundwater Protection	Not scored
Low dissolved oxygen levels	Not scored

Figure 3 - Final Stakeholder Concern List Ranking

Final Stakeholder Concern List Ranking (continued)







1.4 Social Indicator Surveys

The ability of the Lower Kankakee River Watershed steering committee and other stakeholders to conduct effective education and outreach depends on the following:

- understanding how people feel about local water resources,
- how much they know about water quality concerns,
- the types of practices they adopt on the land they manage, and
- what factors affect their land management decisions.

Social indicator surveys provide one way to analyze these attitude, awareness, behavior, and constraint measures. The data obtained provide a snapshot of a given time, helping to direct outreach efforts, and allowing for measurement of temporal change observed during future assessments.

1.4.1 Survey Methods

The Lower Kankakee River Watershed is primarily comprised of agricultural land uses, but has some urban land use, so two surveys were deployed. The 10-page urban survey was sent to 11,057 individuals and businesses within the watershed. In total, 1,077 urban surveys were returned for a response rate of 9.7%. The 11-page agricultural survey was sent to 389 addresses in the watershed. In total, 29 agricultural surveys were returned for a response rate of 7.5%. The 2019 surveys are detailed in Appendix A.

A standardized delivery and collection method were used. In August 2019, the first mail survey was sent to collect urban and agricultural data. This survey provided instructions for completing the survey online, along with a summary of the survey's purpose. A follow up postcard was sent in January 2020 to non-responsive agricultural members asking them to participate. This postcard included instructions on how to complete the survey online.

The survey covered the social indicators developed for use in 319-funded watershed projects. The indicators are grouped into four categories: awareness, attitudes, constraints, and behaviors. Socio-demographic information was also collected. Descriptive summaries for the survey are included below. Detailed results are included in Appendix A.

1.4.2 Survey Respondents

1.4.2.1 General Background Information

Urban respondents were 69% male, 31% female, with 40% having a high school diploma/GED and 15% with a 4-year college degree. Respondents that own a home made up 99% of those surveyed, with 28% of the respondents owning lot greater than five acres, 40% owning between 1 to 5 acres, 19% owning between one-quarter to one acre, and 14% owning less than one-quarter acre. On average, respondents have lived at their current residence for nearly 30 years, with 36% living in a rural subdivision, 31% in a rural residence, and 23% living in a community. In total, 77% of respondents do not own or manage an agricultural operation, forested land, or recreational property. Additionally, 77% of respondents do not use a professional lawn care service, but 16% use a professional lawn care service for fertilizing and pest control. Overwhelmingly, respondents use the internet, conversations with others, and newsletter/brochure/fact sheets to seek information about water quality issues.

Agricultural respondents were 81% male, 19% female, with 46% having a high school diploma/GED and 14% with a 4-year college degree. On average, respondents have lived at their current residence for nearly 38 years, with 69% living on a farm, 10% living in a rural subdivision, 17% in a rural residence, and 3% living in a community. In total, 74% of respondents own or manage an agricultural operation, along with 7% owning or managing forested land. Nearly, 30% of respondents worked greater than 200 days in farm operations, with 54% not working in farm operations at least 4 hours per day. Overwhelmingly, respondents use newsletter/brochure/fact sheets, conversations with others, and workshops/ demonstrations/meetings to seek information about water quality issues.

1.4.2.2 Farm Operations

This section of the survey applies only to agricultural respondents. In total, 39% of respondents make farm management decisions alone or with a spouse, while 32% make these decisions with a tenant and 11% make these decisions with family partners (siblings, parents, children). On average, respondents own or rent 600 acres of tillable acreage for their farming operations and have been farming for average of 37 years. Additional averages include 408 acres of corn, 150 acres of soybeans, 14 acres of small grains, and nearly 8 acres of pasture.

Nearly, 73% of respondents state that family members owned and operated the farm before they [respondent) did, and 37% felt that family members will continue to operate the farm when they retire/quit farming. Only 19% felt that family members would not continue to operate their farm. 43% noted that in 5 years, they felt their farm would be about the same as it is today and 40% did not know.

More than 71% noted that their property being managed touches a stream, river, lake, or wetland. 82% of respondents stated their property has a nutrient management plan, with 54% having created their own plan and 39% received assistance from a private sector agronomist or crop consultant. Commercial nutrients and livestock manure are the primary items included in their nutrient management plan.

1.4.3 Survey Results

As detailed above, the agricultural survey was sent to 389 producers and resulted in a 7.5% return rate, while urban surveys were sent to 11,057 individuals with a response rate of 9.7%.

1.4.3.1 Water as a Resource

Respondents were asked to rank the importance of a number of water-related activities. Agricultural survey respondents ranked "for canoeing, kayaking and other boating activities", "for eating fish caught in the water", and "for scenic beauty" as their highest importance, while urban respondents ranked "for scenic beauty", "for canoeing and kayaking and other boating", and "for fish habitat" as their highest qualities. The vast majority of respondents stated that they know where the rainwater goes when it leaves their property and were able to name that body of water.

1.4.3.2 Water Quality Attitudes

Respondents were asked to rank their level of agreement with a number of statements related to their attitudes toward water quality, including its importance to the community, the financial ramifications of management practices, and levels of personal responsibility. This section assessed a baseline set of attitudes towards water quality that can be used as a basis for comparison in future social indicator surveys once practices, education, and outreach have been implemented. A 1-to-5 "strongly disagree" to "strongly agree" scale was used. Agricultural respondents recognize that using recommended management practices on their farm improves water quality and that it is their personal responsibility to protect water quality. They are less supportive of protecting water quality if it cost them more and appear somewhat willing to change management practices to improve water quality. In general, urban respondents believe it is their personal responsibility to help protect water quality and that it is important to protect water quality even if it slows economic development. They are supportive of the ideas that lawn and yard care impacts water quality, what they do on their land makes a difference in overall water quality. However, they are less supportive of paying more to improve water quality.

1.4.3.3 Familiarity with Impairments

Respondents were asked to rate the severity of numerous water impairments. Agricultural respondents demonstrated awareness of "trash and debris" and "sedimentation" as problematic water quality issues, rating both between slight and moderate problems. Respondents were less aware of water quality problems due to "atrazine" and "heavy metals", with around 40% of respondents indicating that they "don't know" about the severity these issues. These responses suggest that the most visible water quality problems are the ones readily identified by the respondent community. Urban respondents noted "sedimentation", "algae in the water", and "pesticides" rated between slight and moderate problems. Additionally, "nitrogen", "phosphorus", and "toxic materials in the water" were known to be problems. Like agricultural respondents, all other water quality problems rated over 30% do not know.

1.4.3.4 Sources of Water Pollution

Respondents were asked to rate the sources of water pollution. Agricultural respondents demonstrated the highest concern regarding "land development" and "stormwater runoff from streets/highways" as sources of water pollution. It should be noted that these two top responses, and the majority of the other responses, rated only as a slight problem. Respondents were less concerned of pollution from "irrigated crop production", "dredging of streams", and "streambank destabilization". Urban respondents demonstrated awareness of "excessive use of fertilizers and/or pesticides" and "excessive use of fertilizers for crop production" as problematic water quality issues, rating both as moderate problems. Respondents were less concerned of pollution from "sewage treatment plants", "grass clippings and leaves entering storm drains", and "storm water runoff from rooftops and/or parking lots".

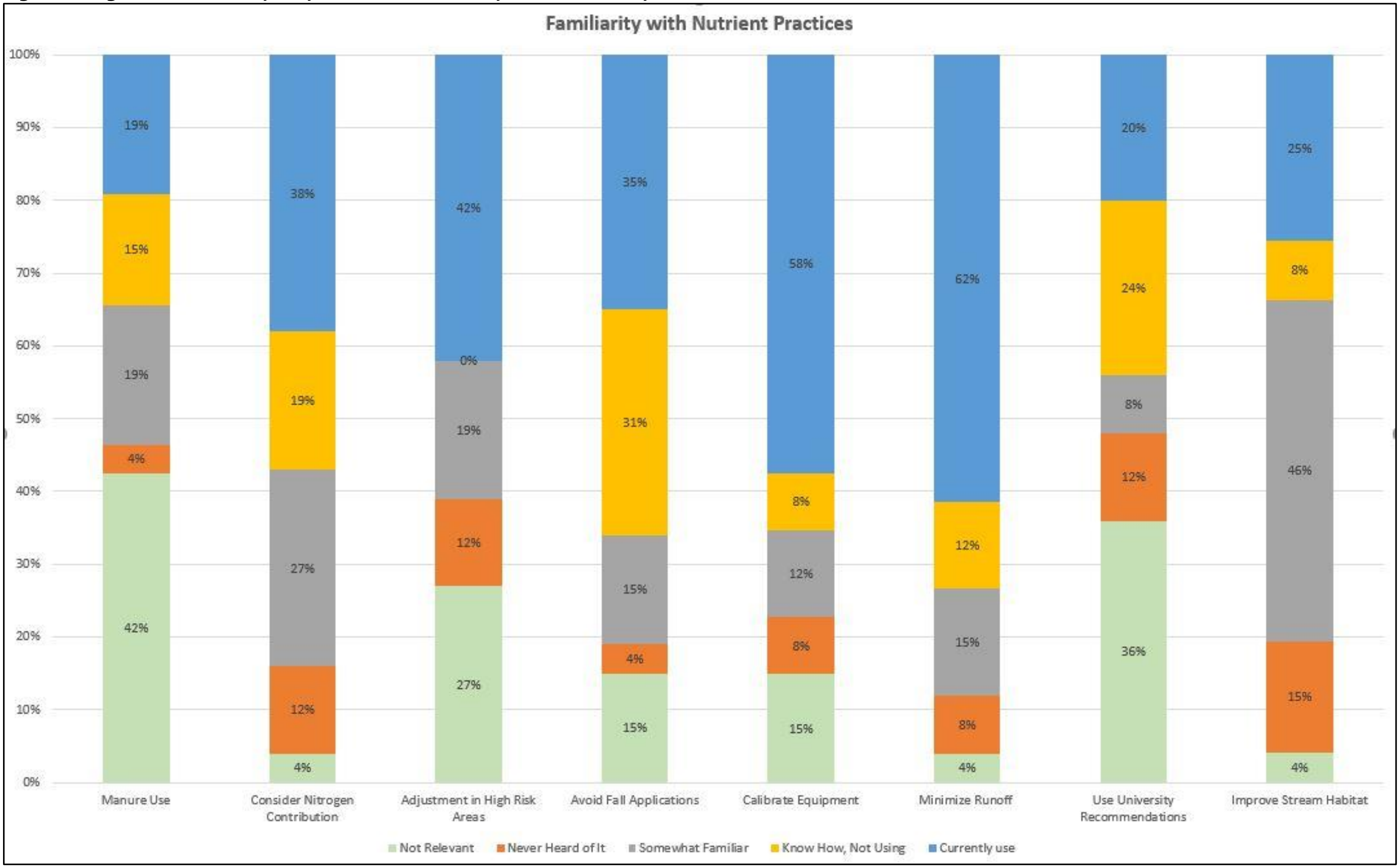
1.4.3.5 Consequences of Poor Water Quality

Respondents were asked to evaluate the consequences of poor water quality. Agricultural respondents noted "loss of desirable fish species" and "reduced opportunities for water recreation" as slight problems. For urban respondents, "excessive aquatic plants", "loss of desirable fish species", and "reduced beauty of lakes or streams" rated as slight to moderate problems. These responses suggest that respondents are most aware of visible and recreational-related issues, but for those that are aware of other issues, fish and algae blooms are the most serious issues.

1.4.3.6 Agricultural Practices to Improve Water Quality

Agricultural respondents were asked questions about their familiarity with specific conservation practices to improve water quality. Responses are noted below (Figure 4). Respondents currently use the practices of "Consider location and soil characteristics to minimize leaching or runoff" (62%) and "Maintain the calibration of fertilizer application equipment" (58%) the most. Practices used the least, or considered not relevant, include "Apply manure so that nutrients are being applied within university recommendations" (20%) and Use manure in accordance with its nutrient content" (19%).

Figure 4- Agricultural survey respondents' familiarity with nutrient practices



1.4.3.7 Urban Practices to Improve Water Quality

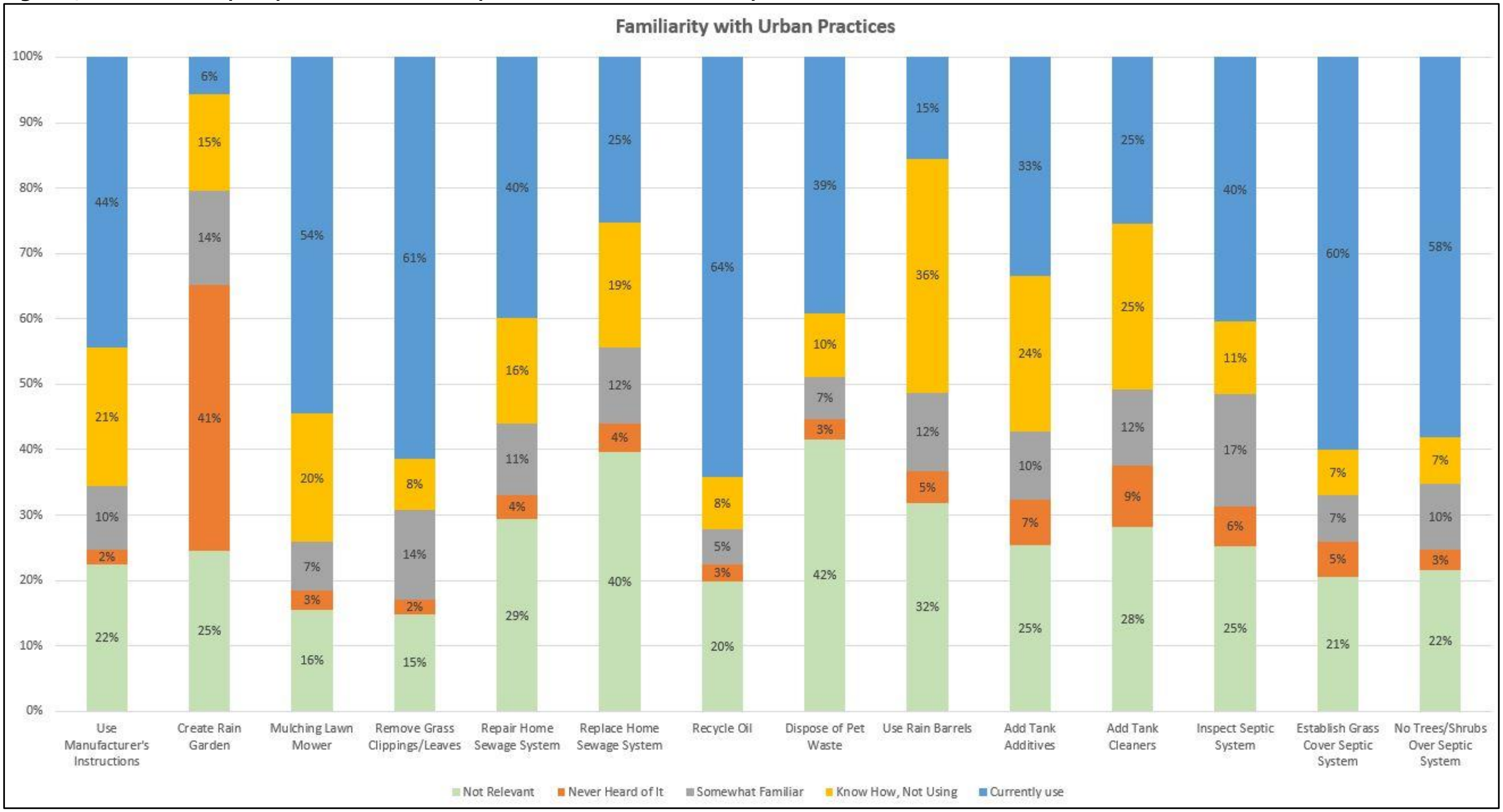
Urban respondents were asked questions about their familiarity with specific conservation practices to improve water quality. Responses are noted below (Figure 5). Respondents appear to currently use several practices, including "recycle automotive oil" (64%), "keep grass clippings and leaves out of roads, ditches, and gutters" (61%), "establish grass cover for septic system" (60%), "not planting trees and shrubs over septic system" (58%), "use a mulching lawn mower" (54%), and "follow manufacturer's instructions when fertilizing lawn or garden" (44%).

Respondents found multiple practices to be not relevant. These practices include "properly dispose of pet waste" (42%), "replace home sewage treatment system" (40%), and "use rain barrels" (32%).

Respondents had overwhelmingly never heard of a single practice, with 41% of respondents unfamiliar with "create a rain garden".

As shown later in this survey, respondents note that their lack of awareness about a practice, its cost, how to implement it and insufficient proof of its ability to impact water quality as the main barriers to implementing a practice.

Figure 5- Urban survey respondents' familiarity with urban conservation practices.



1.4.4 Specific Constraints of Agricultural Practices

Respondents were asked about several different categories of conservation practices and the factors that limit their ability to implement these practices. This section identifies the responses for each respective practice.

1.4.4.1 Soil Tests

Respondents were asked about following conducting regular soil tests for pH, phosphorus, nitrogen, and potassium levels to determine appropriate application levels. More than 78% stated they currently do this, with 0% stating it is not relevant. Nearly 80% of respondents state they are willing to try the practice or already do soil testing. Respondents noted that "cost", "time required", and "insufficient proof of water quality benefit" are the primary factors that limit their ability to implement this practice.

1.4.4.2 Variable Rate Fertilizer Application

Respondents were asked about using variable rate application management units to minimize fertilizer waste and achieve more precise crop production. More than 73% stated they currently do this, with 15% somewhat familiar, and 0% stating it is not relevant. In total, 83% state they are willing to try to the practice or already do this. Respondents noted that "cost", "time required", "lack of equipment", and "insufficient proof of water quality benefit" are the primary factors that limit their ability to implement this practice.

1.4.4.3 Pest Management Record Keeping

Respondents were asked keeping records of crops, pests, and pesticide use to help develop pest control strategies. Nearly 56% of respondents stated they currently do this, with 16% somewhat familiar, and 8% stating it is not relevant. More than 67% of respondents state they are willing to try to the practice or already do this, with 25% stating maybe. Respondents noted that "cost", "time required", "lack of equipment", "hard to use with my farming system", and "insufficient proof of water quality benefit" are the primary factors that limit their ability to implement this practice.

1.4.4.4 Wetland Restoration/Enhancement

Respondents were asked about reestablishing or improving a low-lying area of land that is saturated with moisture especially when regarded as the natural habitat of wildlife. About 13% stated they currently do this, with 48% somewhat familiar with it, and 30% state it is not relevant. Nearly 40% state they are willing to try the practice or already do this, with 35% stating maybe and 25% stating no. Respondents noted that "don't know how to do it", "lack of equipment", and "cost" are the primary factors that limit their ability to implement this practice.

1.4.5 Specific Constraints of Urban Practices

Respondents were asked about several different categories of conservation practices and the factors that limit their ability to implement these practices.

1.4.5.1 Pesticide Application

Respondents were asked about following pesticide application instructions for lawn and gardens according to the guidelines from the manufacturer. 49% stated they currently use the guidelines, with 21% stating they know about it; not using and 18% note it is not relevant. In total, 70% state they are willing to try the practice or already follow the guidelines. Respondents noted that "cost", "desire to keep things the way they are", and "physical or health limitations" are the primary factors that limit their ability to implement this practice.

1.4.5.2 Regular Septic System Maintenance

Respondents were asked about having their septic system cleaned every 3-5 years to remove all the sludge, effluent, and scum from the tank. Nearly 56% stated they currently do this, with 19% somewhat familiar, and 12% stating it is not relevant. In total, 77% state they are willing to try to the practice or already do this. Respondents noted that "cost" and "desire to keep things the way they are" are the primary factors that limit their ability to implement this practice.

1.4.5.3 Proper Household Cleaner Disposal

Respondents were asked about taking hazardous waste, such as batteries, paint, car fluids, and solvents to a hazardous waste facility. More than 73% stated they currently do this, with 14% somewhat familiar, and 2.5% stating it is not relevant. Nearly 90% of respondents state they are willing to try to the practice or already do this. Respondents noted that "time required", "cost" and "don't know how to do it" are the primary factors that limit their ability to implement this practice.

1.4.5.4 Native Plant Community Restoration

Respondents were asked about restoring plan species in a manner designed to produce plant communities comprised of native species. In total, 19% stated they currently do this, with 40% somewhat familiar with it, and 29% had never heard of it. More than 41% state they are willing to try the practice or already do this, with 46% stating maybe. Respondents noted that "don't know how to do it", "time required", and "cost" are the primary factors that limit their ability to implement this practice.

Respondents were asked to rate how much each issue limits their ability to change management practices. Agricultural respondents stated that "personal out-of-pocket expense", "lack of government funds for cost share", and "not having access to the equipment that I need" were the largest issues that limit their ability to make changes. Respondents were not as concerned about "I do not own the property", "environmental damage caused by practice", and "approval of my neighbors".

Urban respondents noted "personal out-of-pocket expense", "not having access to the equipment that I need", and "lack of available information about a practice" were the largest factors. Respondents did not know about "legal restrictions on my property" and "environmental damage caused by practice" and were less concerned about "approval of my neighbors" and "my own physical abilities.

It appears the limiting factors for all respondents is expense and lack of equipment.

1.4.6 Making Decisions for my Property

People get information about water quality from a number of different sources. Agricultural respondents were asked to what extent do they trust various sources for information about soil and water (Figure 6). Overall, respondents were fairly equal in which entity or organization was trusted. Respondents slightly favored SWCDs and landowners/friends as the most trusted sources of information

1.4.7 Information Sources (Urban)

People get information about water quality from a number of different sources. Urban respondents were asked to what extent do they trust various sources for information about soil and water (Figure 7). Respondents stated that University Extensions, State Natural Resources Agency, Local Watershed Projects, and the County Health Department are the most trusted sources of information. Respondents are not as familiar with land trusts.

Figure 6- Agricultural survey respondents' trust in information sources for soils and water quality

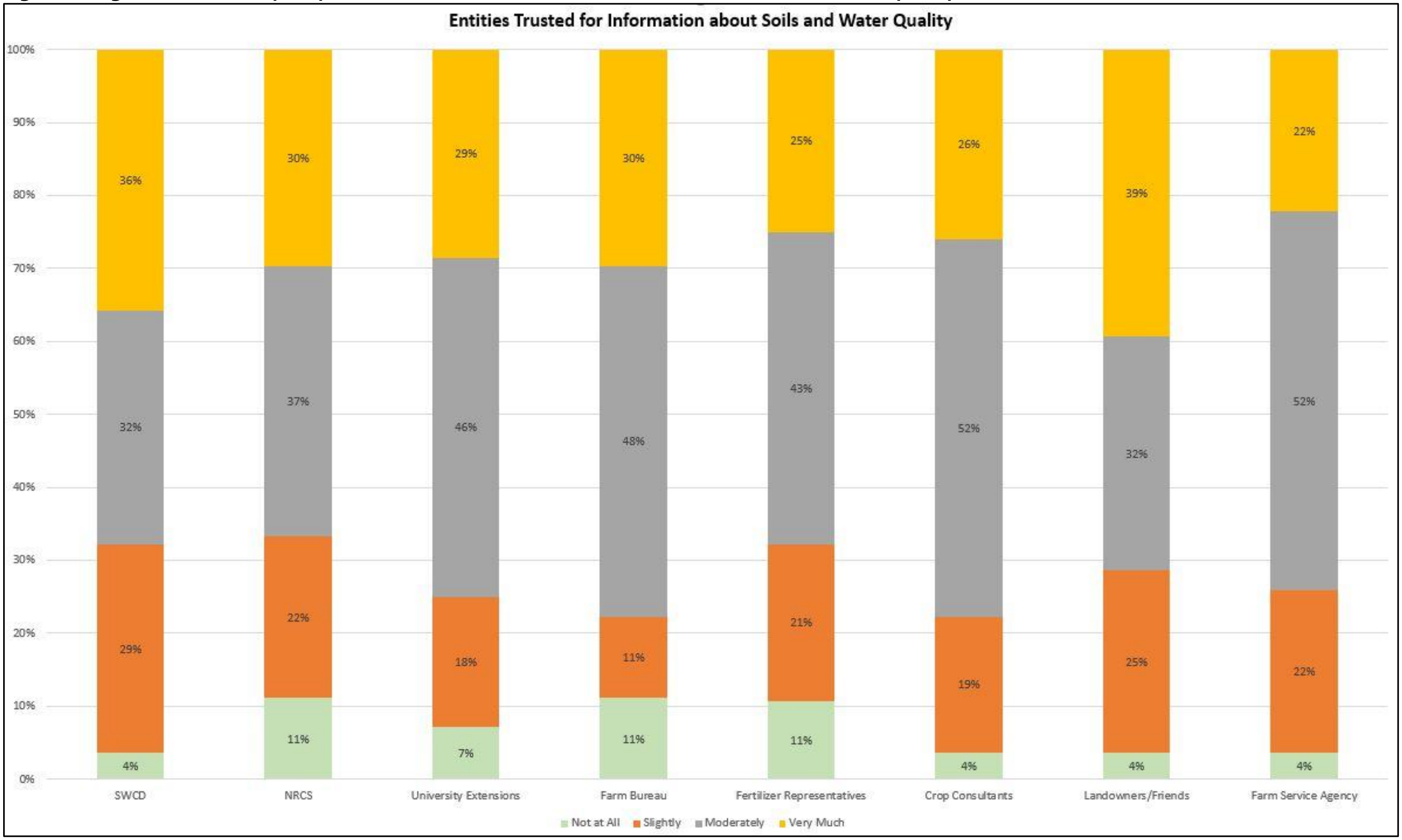
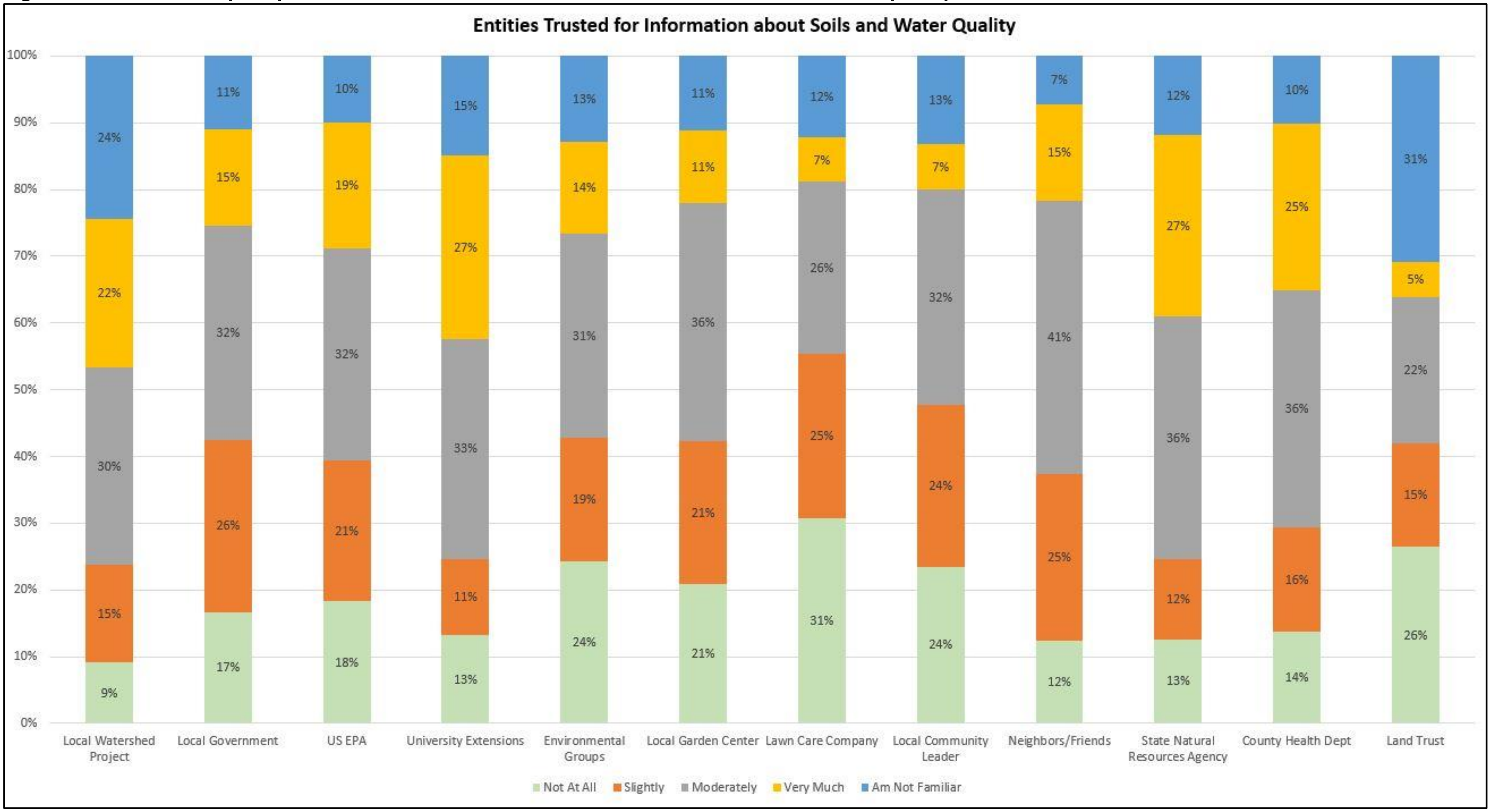


Figure 7- Urban survey respondents' trust in information sources for soils and water quality



1.4.8 Septic Systems

Respondents were asked general questions about their septic systems. Nearly 89% of agricultural respondents stated that they have a septic system. More than 83% have not had any issues in the last 5 years, but 22% have had slow drains, 4% have had bad smells near the tank or drain field, 4% have had sewage on the surface, and 4% have had a sewage backup in the house. In total, 83% are not interested in a reminder from the local health department regarding septic system maintenance. Additionally, 86% of respondents know that their system has an absorption field (finger system), while 9% do not know. Common answers to determine if the septic system was not working properly include slow drains, sewage backup, bad smells, toilet backup, and wet spots in the lawn. Nearly 17% do not know if their septic system is designed to treat sewage or get rid of waste, while 33% stated both.

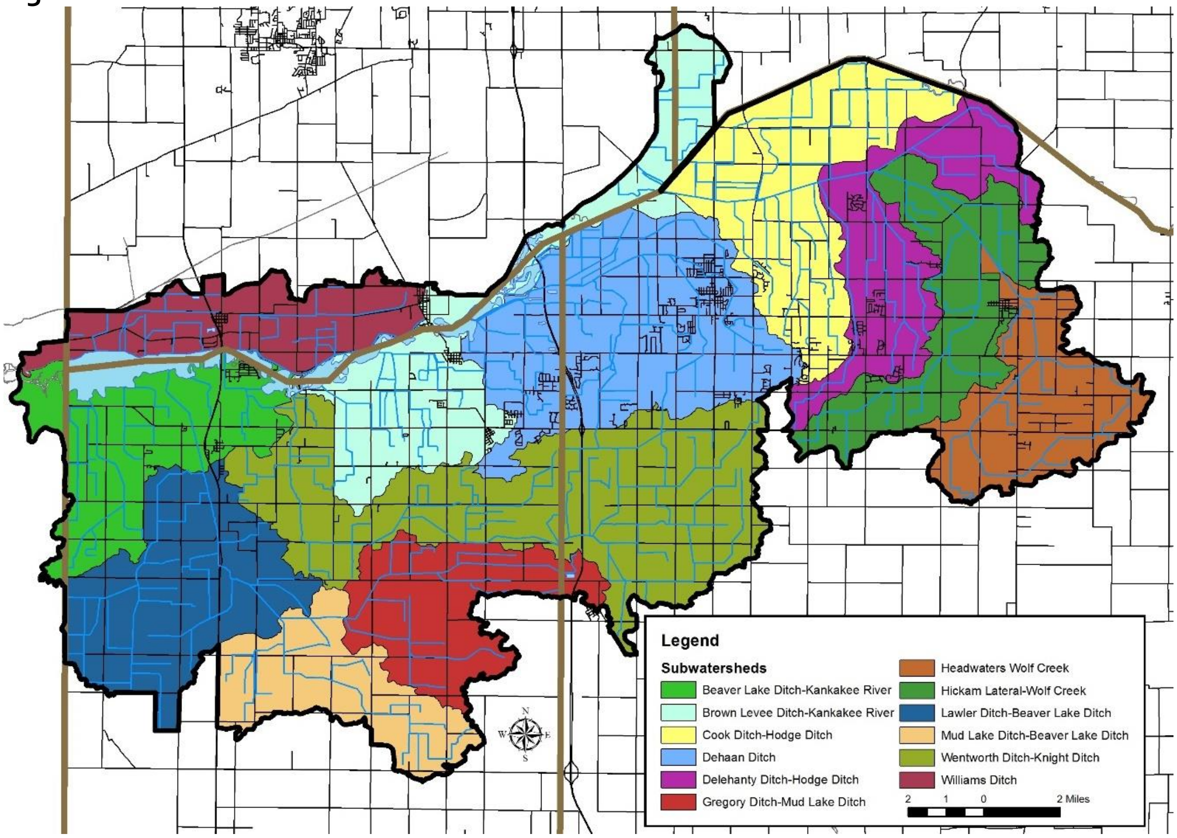
More than 82% of urban respondents stated they have a septic system, with 3% that do not know. On average, the septic system was installed in 1977. Nearly 81% have not had any issues in the last 5 years, but 11% have had slow drains, 4% have had bad smells near the tank or drain field, and 3% have had a sewage backup in the house. Nearly 72% are not interested in a reminder from the local health department regarding septic system maintenance. Additionally, 79% do not have a garbage disposal; 10% have a disposal that is used daily. Nearly 72% of respondents know that their system has an absorption field (finger system), while 18% do not know. Common answers to determine if the septic system was not working properly include slow drains, sewage backup, bad smells, toilet backup, and wet spots in the lawn. More than 37% do not know if their septic system is designed to treat sewage or get rid of waste, while 24% stated both. In total, 58% of respondents do not think a local government agency should handle inspection and maintenance of their septic system, while 19% said a local government agency should do this.

2.0 WATERSHED INVENTORY PART 1 – WATERSHED DESCRIPTION

2.1 Location

The Lower Kankakee River Watershed is part of the Illinois River basin and covers portions of Jasper and Newton counties with small areas of Lake and Porter counties (Figure 8). The Kankakee River basin drains 5,165 square miles of which 2,989 square miles are located within the state of Indiana. The Lower Kankakee River Watershed drains 186,927 acres and is comprised primarily of the Kankakee River. The Kankakee River starts near South Bend, Indiana and flows southwesterly through the northern section of Jasper County into the northern section of Newton County. The stream continues westerly through Newton County, leaving the watershed just past the Indiana and Illinois state border, continuing onward to eventually form the Illinois River.

Figure 8- Subwatersheds in the Lower Kankakee River Watershed



2.2 Climate

In general, Indiana has a temperate climate with warm summers and cool or cold winters. Climate in the Lower Kankakee River Watershed is no different from the rest of the state. There are four seasons throughout the year. The average temperatures measure approximately 84°F in the summer, while low temperatures measure below freezing (16°F) in the winter. The growing season typically extends from April through October. On average, 39.3 inches of precipitation occurs within the watershed per year; approximately 68% of this precipitation falls during the growing season (US Climate Data, 2018).

2.3 Historic Modifications of the Kankakee River

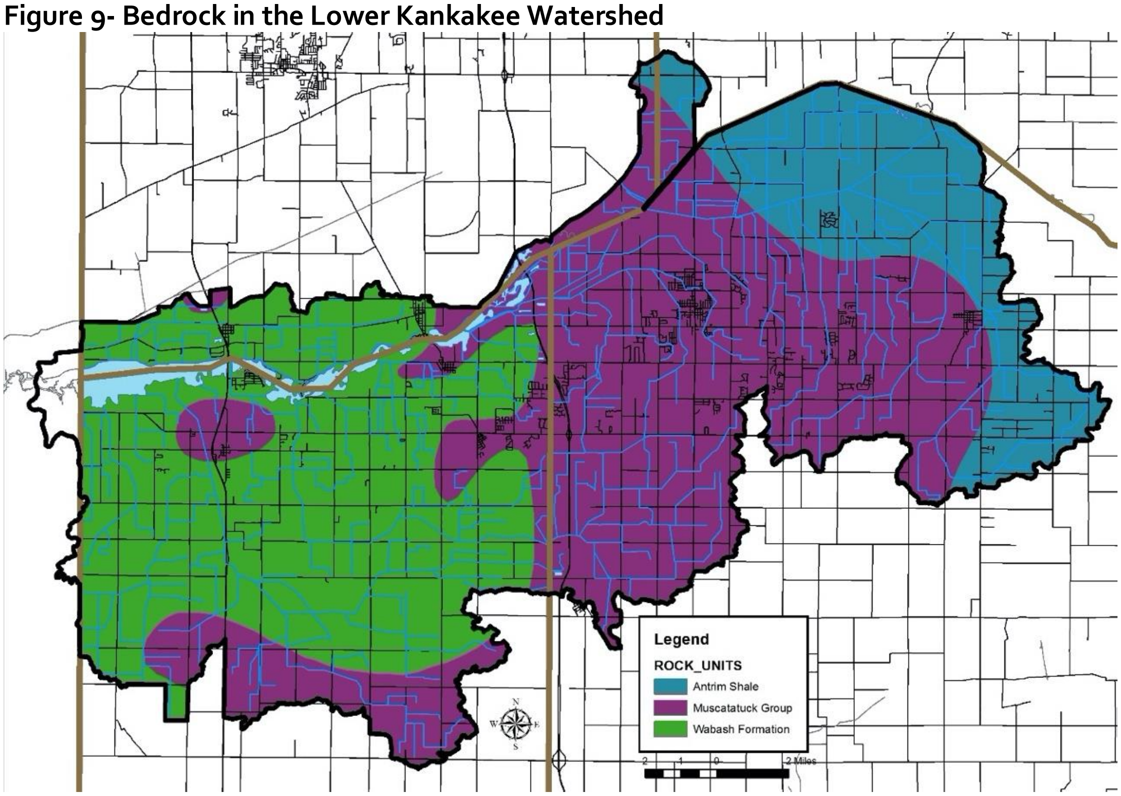
The Kankakee River basin is often referred to as the Everglades of the North and was once a vast, low marshland located on sandy outwash plains. The basin was subsequently drained through extensive dredging and channel straightening in the early 1900s to lessen flooding and rain swampland area for agriculture (U.S. House of Representatives, 1916, 1931). The marsh ranged from 3 to 5 miles in width and averaged 1 to 4 feet deep. The slope of the river was estimated at 0.45 feet per mile (Ivens et al, 1981).

The main channel of the Kankakee River was extensively channelized through a series of projects which started in the late 19th century and concluded in 1918. Ivens et al (1981) and IDNR (1990) detail the modifications to the river documenting the primary mechanisms of channelizing: cut from meander to meander and connect the straight sections. Additional lateral ditches drained the swampland and decreased localize flooding. This process left the river platform largely intact but reduced sinuosity and disconnected the river from its floodplain. Through this effort, the Kankakee River was shorted from 250 miles to 82 miles and the channel slope was increased from 0.45 feet/mile to 0.83 feet/mile (Ivens et al, 1981). These efforts increased the rate of discharge and the transportation of sediment. Much of the surrounding marsh was extensively ditched and dredged which increased the rate of runoff and sediment flow into the Kankakee River from its tributaries as well. Based on these modifications, the Kankakee River is a source of suspended sediments (Terrio and Nazimek, 1997; Holmes, 1997) and nutrients (Murphy et al., 2013; Smith et al., 2003). The Kankakee River bed and banks are largely composed of muck, sand, gravel, cobble, or dense till. Windblown sand dominates the lower the portion of the Kankakee River Basin in which the Lower Kankakee River Watershed is located. These sands are found in spoils piles which were cast to the sides of the river during channel management and straightening activities. Many of these spoil piles are now eroding due to wind and water during high discharge events (CBBEL, 2019).

2.4 Geology and Topography

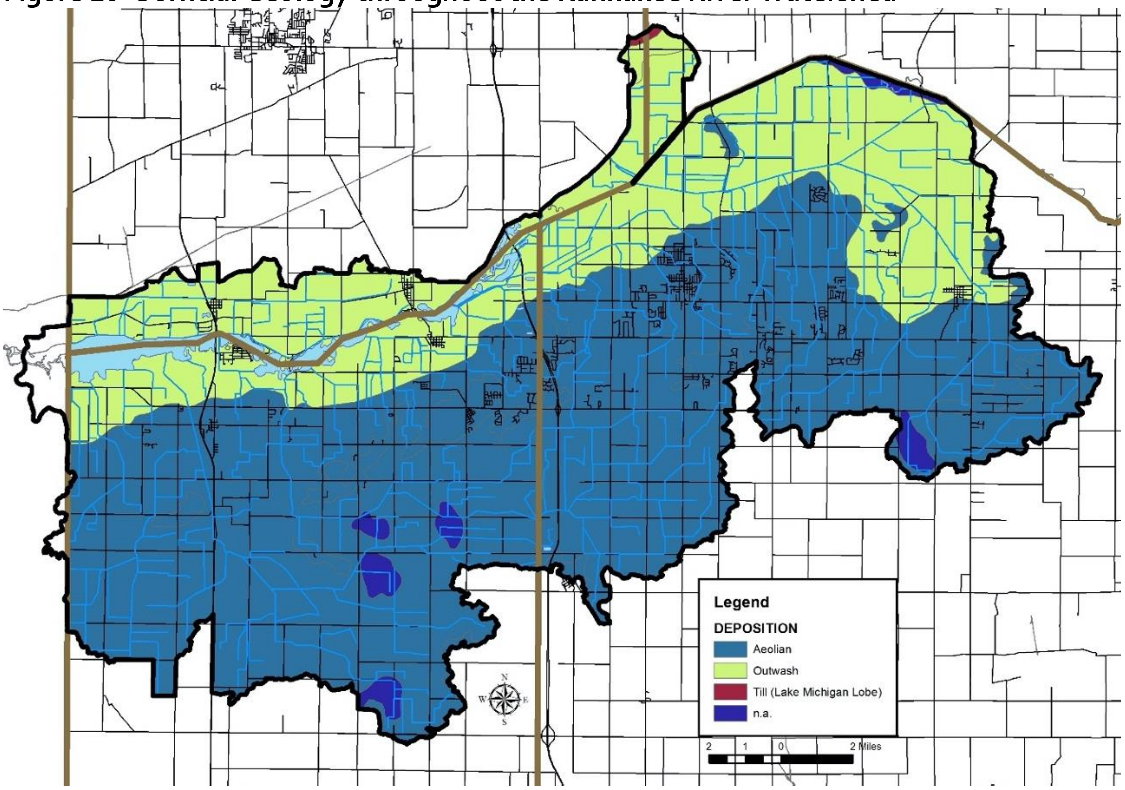
Bedrock deposits (Figure 9) within much of the Lower Kankakee River Watershed are nearly flat, being near the top of the Kankakee Arch. Silurian rocks (Wabash formation) are along the western edge of the watershed. The Silurian rocks are composed of 400 to 600 ft. of dolomite and some limestone (Fenelon et al., 1994) and consist of a wide range of carbonate rocks ranging from shaley to pure and fine coarse-grained carbonate rocks. Mississippian bedrock in the watershed consists of several hundred feet of dolomite and limestone overlain by shale. Muscatatuck Group bedrock covers most of the central portion of the Lower Kankakee River Watershed and overlies the Silurian rocks, consisting mostly of dolomite and contains granular and fibrous anhydrite and gypsum. Additionally, there are minor areas of Atrium Shale that lie within the eastern portion of the watershed, a brownish black, noncalcareous shale overlying the Devonian carbonate rocks (Shaver et al, 1986).

Figure 9- Bedrock in the Lower Kankakee Watershed



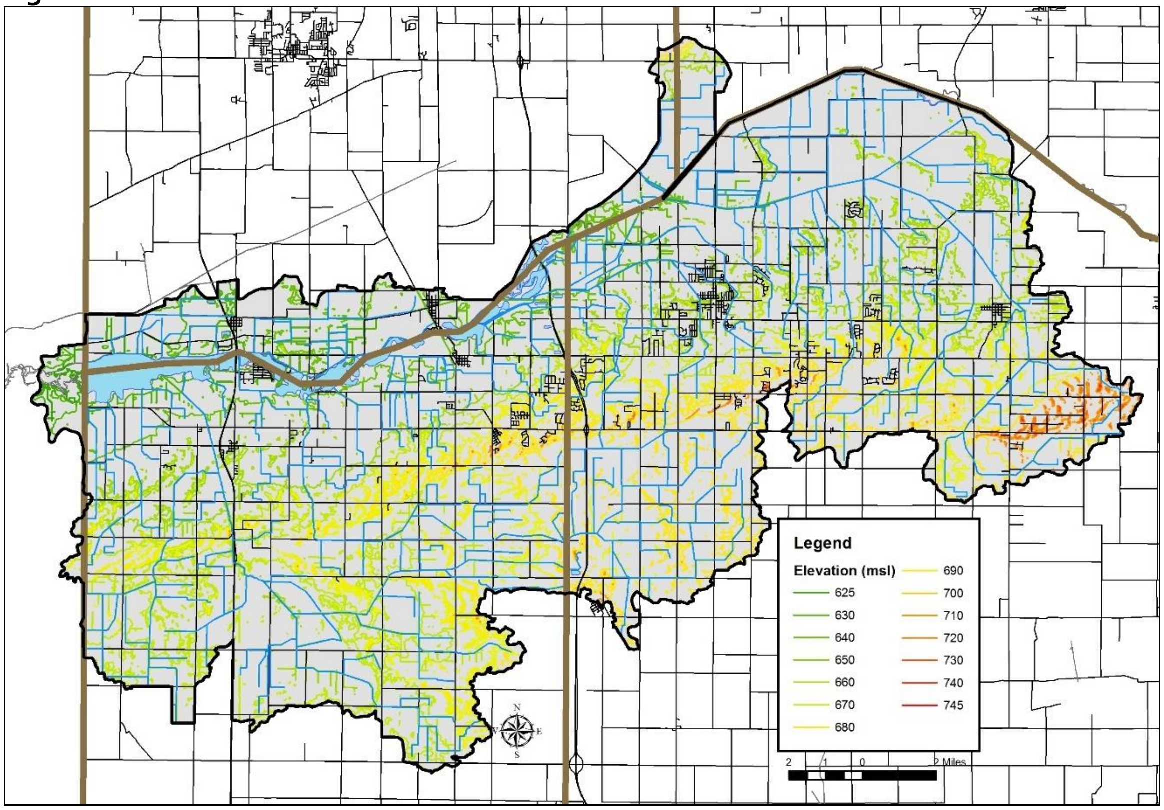
The Lower Kankakee River Watershed is part of the Kankakee Outwash and Lacustrine Plain and is covered by glacial outwash, with deeper drift filling preglacial drainageways (Schneider, 1963). Along and south of the Kankakee River floodplain, fine grained outwash sediments have been sorted by wind to form a broad eolian-sand sheet with scattered dunes and dune ridges. The most recent drift was deposited by the Lake Michigan Lobe of the Wisconsinan glacier (Wayne, 1963). Large parts of the original topography have been heavily modified, but are generally broad, flat, and poorly drained (Figure 10). Extensive drainage work was completed by the early 1900's.

Figure 10- Surficial Geology throughout the Kankakee River Watershed



The topography of the Lower Kankakee River Watershed ranges from nearly level agricultural fields to gently undulating hills and valleys towards the river basin, with an average elevation of 685 feet msl (Figure 11). The relatively flat lake covering much of Jasper and Newton counties shows limited topographic elevation changes. The Lower Kankakee River Watershed elevation is highest near Shrader Ditch in Newton County, measuring 745 feet msl. The lowest elevation (625 feet msl) occurs near the Illinois/Indiana border along the river, with lower elevations typical in the floodplain area along the river. The elevation is the lowest surrounding the Kankakee River, which could be contributing to the stakeholder concerns. Runoff from the higher elevations could be carrying excess water, nutrients, sediment, *E.coli* and other pollutants into the Kankakee River.

Figure 11- Surface Elevation in the Lower Kankakee River Watershed



2.5 Soil Characteristics

There are hundreds of different soil types located within the Lower Kankakee River Watershed. These soil types are delineated by their unique characteristics. The types are then arranged by relief, soil type, drainage pattern, and position within the landscape into soil associations. These associations provide the overall characteristics across the landscape. Soil associations are not used at the individual field level for decision-making. Rather, the individual soil types are used for field-by-field management decisions. Some specific soil characteristics of interest, including septic limitations and soil erodibility, for watershed and water quality management are detailed below.

2.5.1 Soil Associations

The United States Department of Agriculture Natural Resources and Conservation Service (USDA NRCS) publishes soil surveys that identify soils in an area. The survey has maps with soils boundaries and photos, descriptions, and tables of soil properties and features. This information is used by farmers, the real estate industry, land use planners, engineers, and more. Typically, more than one soil occurs together in a landscape and this forms a soil association. This watershed is covered by eight soil associations (Figure 12) with the seven predominant associations described below.

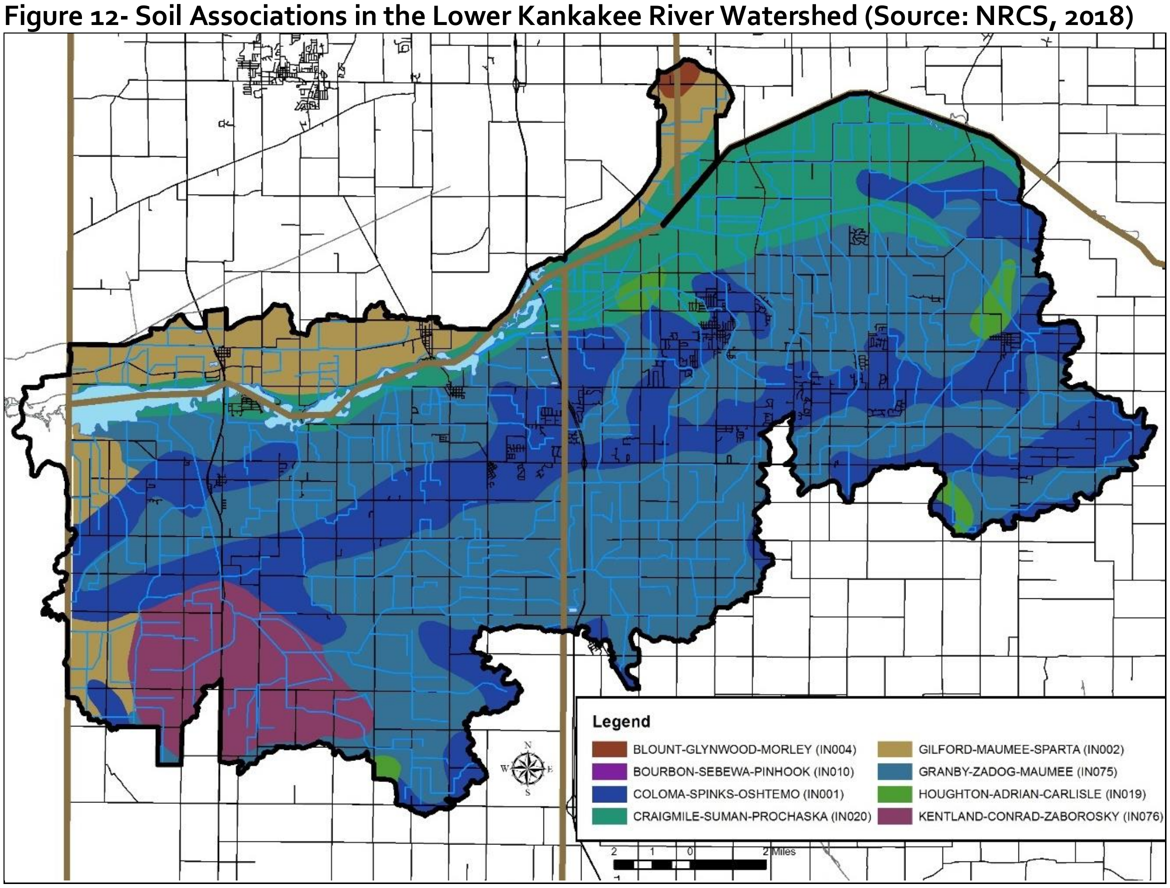
The Granby-Zadog-Maumee association covers much of the central portion of the watershed throughout Jasper and Newton counties. Granby-Zadog-Maumee soils are nearly level and consist of deep, poorly drained soils formed in glacial outwash. Specifically, the Zadog series is notable for the accumulations of iron in the soil. The Coloma-Spinks-Oshtemo soil association covers some of the central portion of the watershed throughout Jasper and Newton counties. These soils are also nearly level, well drained soils that have a sandy or sandy and loamy subsoil and were formed in glacial outwash.

The Craigmile-Suman-Prochaska associations are situated along the Kankakee River and consists of deep, very poorly drained soils in the floodplains. The soils formed in loamy alluvium over sandy deposits. Gilford-Maumee-Sparta associations are also in the vicinity of the Kankakee River. This association consists of nearly level, deep, poorly drained soils formed in loam over sandy sediments on outwash plains, glacial drainage channels, and floodplain steps.

Found in the southwest corner of the watershed in Newton County, the Kentland-Conrad-Zaborosky association consists of very deep, nearly level, very poorly drained, coarse textured soils and formed in sandy sediments on lake beds or lake plains. The Houghton-Adrian-Carlisle association covers a small portion of the watershed is notable for severe wetness and ponding problems.

As should be noted in the descriptions, a common theme is that these soil associations are poorly drained. This theme directly relates to stakeholder concerns with regards to flooding. In the landscape of this watershed, the soils that are the most poorly drained will generally occupy the centers of large flats and will be surrounded by somewhat poorly drained soils. Farmers have improved the surface drainage for their fields by installing surface and subsurface drainage systems which consist of tile drains and open ditches. These drainage systems have heavily impacted this watershed; the modifications are some of the most extensive in Indiana. Sediment and chemicals, such as fertilizers, used in the farming industry can actively be transported through the drainage systems and impair waterways.

Figure 12- Soil Associations in the Lower Kankakee River Watershed (Source: NRCS, 2018)

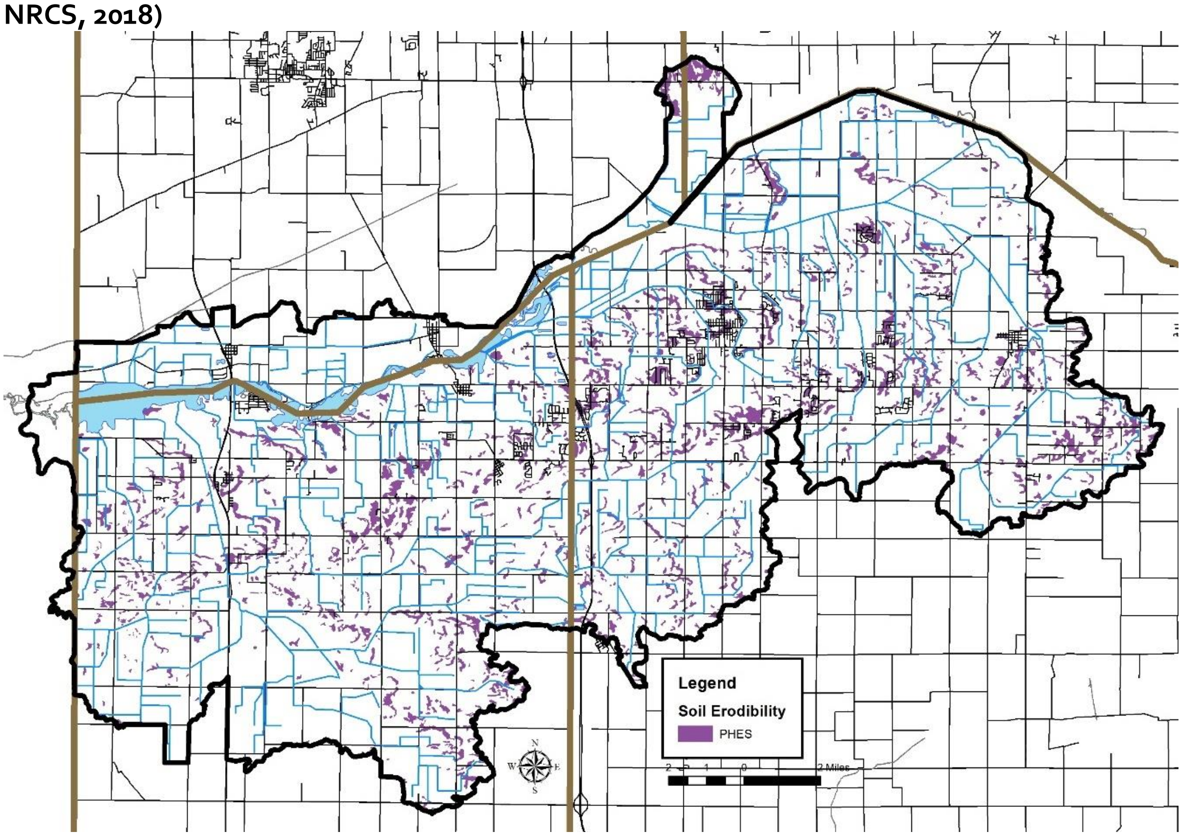


2.5.2 Soil Erodibility

Soils that move from the landscape to adjacent waterbodies result in degraded water quality, limited recreational use, and impaired aquatic habitat and health. Soils carry attached nutrients and pesticides, which can result in impaired water quality by increasing plant and algae growth or even killing aquatic life. The ability and/or likelihood for soils to move from the landscape to waterbodies are rated by the Natural Resources Conservation Service (NRCS). The NRCS uses soil texture and slope to classify soils into those that are considered highly erodible, potentially highly erodible, and not highly erodible. The classification is based on an erodibility index which is determined by dividing the potential average annual rate of erosion by the soil unit's soil loss T value or tolerance value. The T value is the maximum annual rate of erosion that can occur for a particular soil type without causing a decline in long-term productivity. Potentially highly erodible soil determinations are based on the slope steepness and length in addition to the erodibility index value.

Watershed stakeholders are concerned about soil erosion as indicated by their "soil in water (elevated turbidity)" and "elevated nutrients concerns". As detailed above, soils which have high erodibility index values are those that are located on steep slopes and are easily moved by wind, water, or land uses. These soils and the associated sediment-attached nutrients often end up in adjacent waterbodies including rivers and streams. Figure 13 details locations of potentially highly erodible soils within the Lower Kankakee River watershed. Potentially highly erodible soils cover 7.8% of the watershed or 14,730 acres. There are no highly erodible soils in the watershed.

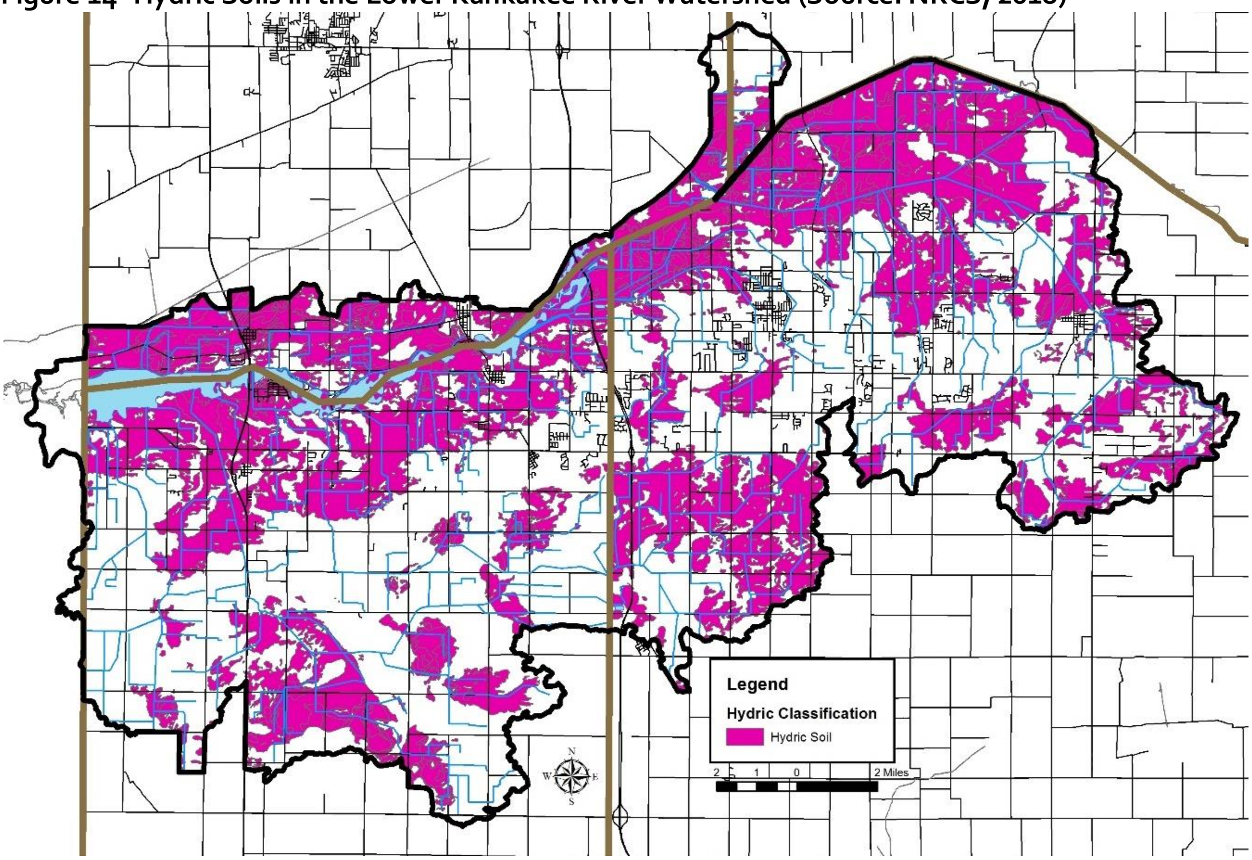
Figure 13- Potentially High Erodible Soils (PHES) in the Lower Kankakee River Watershed (Source: NRCS, 2018)



2.5.3 Hydric Soils

Hydric soils are those that remain saturated for a sufficient period of time to generate a series of chemical, biological, and physical processes. The oxidation and reduction of iron in the soil causes color changes characteristic of prolonged fluctuations in the water table. After undergoing these processes, the soils maintain the resultant characteristics even after draining or use modification occurs. Watershed stakeholders are concerned about flooding specifically noting "the conversion of wetlands into agricultural and urban land uses" is one mechanism by which flooding occurs. This conversion also reduces the capacity for watershed soils to hold water. Historically, approximately 84,286 acres (45.1%) of the watershed was covered by hydric soils (Figure 10). Hydric soils are concentrated in the northern portion of the watershed. As these soils are considered to have developed under wetland conditions, they are a good indicator of historic wetland locations and therefore will be revisited in the land use section. Many of these soils have been drained for agricultural production.

Figure 14- Hydric Soils in the Lower Kankakee River Watershed (Source: NRCS, 2018)



2.6 Potential Sources of Wastewater Pollution

Wastewater from humans contains various pollutants, but high bacteria counts from *E.coli* and Fecal Coliform are two of the primary pollutants of concern. Untreated sewage from failing septic systems, wastewater treatment facility overflows, and unsewered areas can contribute to unhealthy levels of potentially disease carrying bacteria to waterways and drinking water supplies.

Wastewater carrying harmful bacteria can be transported via surface and groundwater. Stormwater runoff can quickly transport wastewater to surface waterways. When pollutants are released into the ground the groundwater can become contaminated. Failing septic systems are an example of a potential source of groundwater contamination (see Section 2.5.1). This contamination can make aquifers, or underground layers of permeable rock containing water, unusable for private wells or drinking water systems. Groundwater contamination is difficult and expensive to clean up. However, groundwater moves more slowly than surface runoff with the contamination typically in a more concentrated area. Building codes generally specify that drinking water wells and septic systems must remain a certain distance apart to prevent contamination.

Clean water is critical to aquatic organisms and wildlife habitats, along with our desire to use water for recreational activities. The goal of wastewater treatment using facilities or septic systems is to reduce the level of pollutants in the water to a level that nature can manage.

2.6.1 Soil Septic Tank Suitability

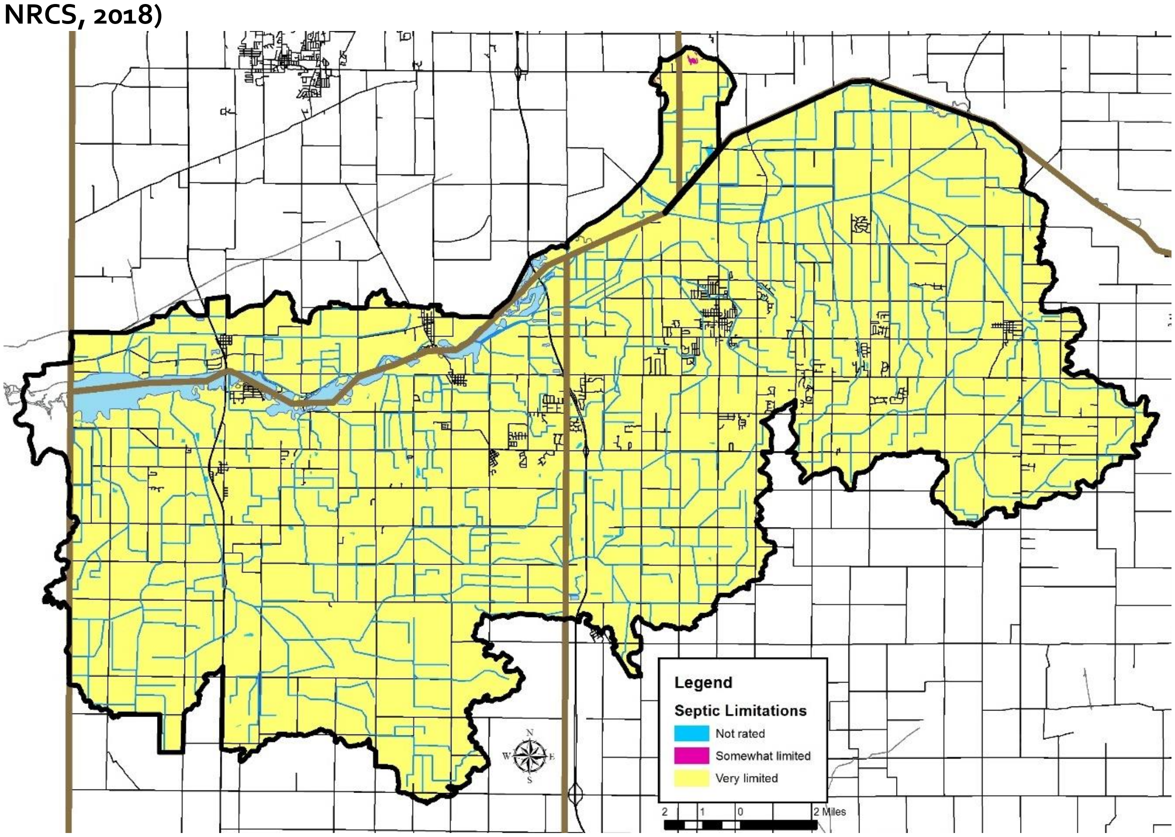
Throughout Indiana, households depend upon septic tank absorption fields to treat wastewater. Seven soil characteristics, including position in the landscape, soil texture, slope, soil structure, soil consistency, depth to limiting layers, and depth to seasonal high-water table, are utilized to determine suitability for on-site septic treatment. Septic tanks require soil characteristics that allow for gradual movement of wastewater from the surface into the groundwater. A variety of characteristics limit the ability for soils to adequately treat wastewater. High water tables, shallow soils, compact till, and coarse soils all limit soils abilities in their use as septic tank absorption fields. Specific system modifications are necessary to adequately address soil limitation; however, in some cases, soils are too poor for treatment and therefore prove inadequate for use in septic tank absorption fields.

Until 1990, residential homes located on 10 acres or more and occurring at least 1,000 feet from a neighboring residence were not required to comply with any septic system regulations. In 1990, a new septic code corrected this loophole. Current regulations address these issues and require that individual septic systems be examined for functionality. Additionally, newly constructed systems cannot be placed within the 100-year floodplain and systems installed at existing homes must be placed above the 100-year flood elevation. However, many residences grandfathered into this code throughout the state have not upgraded or installed fully functioning systems (Krenz and Lee, 2005). In these cases, septic effluent discharges into field tiles or open ditches and waterways and will likely continue to do so due to the high cost of repairing or modernizing systems ($4,000 to $15,000; ISDH, 2001). Lee et al. (2005) estimates that 76,650 gallons of untreated wastewater per failing septic system is expelled in the state of Indiana annually. The true impact of these systems on the water quality in the watershed cannot be determined without a complete survey of systems.

The NRCS ranks each soil series in terms of its limitations for use as a septic tank absorption field. Each soil series is placed in one of three categories: severely limited, moderately limited, and slightly limited. Some soils are also unranked. Severe or very limited limitations delineate areas whose soil properties present serious restrictions to the successful operation of a septic tank tile disposal field. Using soils with a severe limitation increases the probability of the system's failure and increases the costs of installation and maintenance. Areas designated as having moderate or somewhat limited limitations have soil qualities which present some drawbacks to the successful operation of a septic system; correcting these restrictions will increase the system's installation and maintenance costs. Slight limitations delineate locations whose soil properties present no known complications to the successful operation of a septic tank tile disposal field. Soils that are rated moderately or severely limited generally require special design, planning, and/or maintenance to overcome limitations and ensure proper function.

Watershed stakeholders are concerned about elevated nutrient and bacteria (pathogen) concentrations. The lack of maintenance associated with septic tanks, the use of soils that are not suited for septic treatment, and the presence of straight pipe systems within the watershed can lead to elevated nutrient and pathogen levels in surface waterbodies. These concerns are exacerbated by the fact that severely limited soils cover essentially the entire watershed (Figure 15). Nearly 183,602 acres or 98.2% of the watershed is covered by soils that are considered very limited for use in septic tank absorption fields. The remaining 3,324 acres (1.8%) are not rated for septic usage as it is not generally industry standard to install a septic system in these geographic locations.

Figure 15- Suitability of Soils for Septic Tank Usage in the Lower Kankakee River Watershed (Source: NRCS, 2018)



2.6.2 Wastewater Treatment and Solids Disposal

Several facilities which treat wastewater and are permitted to discharge the treated effluent are located within the watershed. These facilities are regulated by National Pollutant Discharge Elimination System (NPDES) permits. These include several wastewater treatment plants ranging in size from small, local plants to larger, publicly owned facilities, and school facilities. In total, five NPDES-regulated facilities are located within the watershed (Figure 16). Table 5 details the NPDES facility name, activity, and permit number. More detailed information for each facility will be discussed on a subwatershed basis in subsequent sections. No municipal wastewater sludge is applied in the Lower Kankakee River Watershed.

Figure 16- NPDES-Regulated Facilities in the Lower Kankakee River Watershed

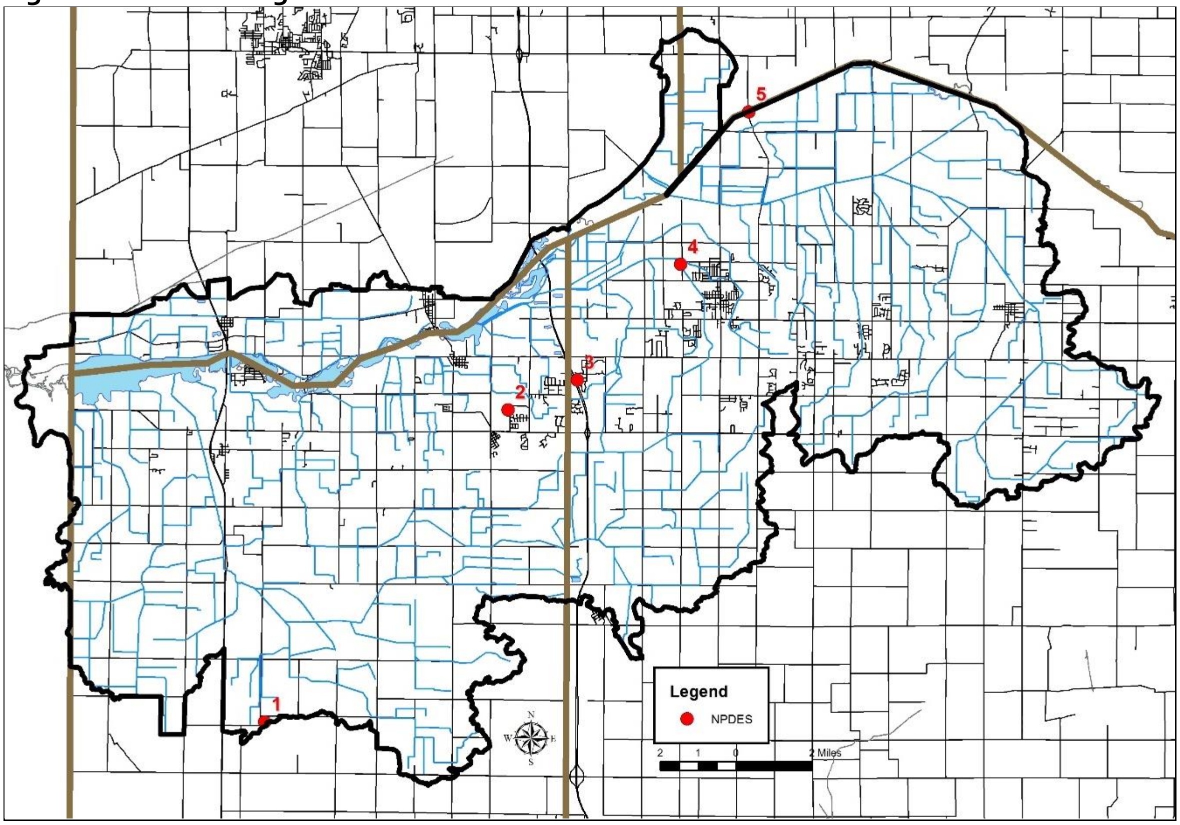


Table 5- NPDES-Regulated Facility Information

Map ID	NPDES ID	Facility Name	Activity
1	IN0031143	North Newton Jr-Sr High School	Elementary or Secondary School
2	IN0030503	Lincoln Elementary School	Elementary or Secondary School
3	IN0031275	Kankakee Rest Area at I-65	INDOT Rest Area
4	IN0039926	DeMotte Municipal WWTP	Municipal Sewer System
5	IN0058823	Marti's Place-Bomars River Lodge	Lodge, Restaurant

2.6.3 Municipal Wastewater Treatment and Combined Sewer Overflows

In the relatively rural Lower Kankakee River Watershed, there are five wastewater treatment facilities located within and discharging to Lower Kankakee River or a tributary. These include the DeMotte Municipal Wastewater, North Newton Jr-Sr High School, Lincoln Elementary School, the Kankakee rest area, and one corporate discharger (Table 5).

The North Newton Jr-Sr High School operates a wastewater treatment plant which serves the school. The plant is a Class I facility with a design flow of 0.030 MGD of wastewater and is comprised of 100% separate sanitary sewers, with no overflow or bypass points. The plant consists of an extended aeration treatment facility with bar screens, aerobic digestion, a final clarifier, effluent chlorination /dechlorination, and an effluent flow meter. Bio-solids are stored in a sludge holding tank before being hauled off-site. The effluent discharges into an unnamed Ditch to Beaver Creek.

The Lincoln Elementary School operates a wastewater treatment plant which serves the school. The plant is a Class I facility with a design flow of 0.0342 MGD of wastewater and is comprised of 100%

separate sanitary sewers, with no overflow or bypass points. The plant consists of an extended aeration treatment facility with a manual bar screen, a totalizing flow meter, and effluent chlorination/ dechlorination facilities. Sludge is treated in an aerobic digester and is hauled off-site. The effluent discharges to Hibler Ditch.

The Kankakee I-65 INDOT rest area has a wastewater treatment plant which serves an unknown number of customers. The plant is a Class I facility with a design flow of 0.0495 MGD of wastewater and is comprised of 100% separate sanitary sewers, with no overflow or bypass points. The plant consists of an extended aeration treatment facility consisting of flow equalization, a sludge digester, and drying beds, two aeration tanks, two stabilization ponds, a flow meter, and UV disinfection. The effluent discharges to Otis-Boyle Ditch.

The Town of DeMotte operates a municipal wastewater treatment plant for the community. The plant is a Class II facility with a design flow of 0.496 MGD of wastewater and is comprised of 100% separate sanitary sewers, with no overflow or bypass points. The plant is an extended aeration treatment facility consisting of a fine screen, two oxidation ditches, two secondary clarifiers, UV disinfection, an effluent flow meter, and post aeration. Bio-solids are treated in two aerobic sludge digestion tanks and hauled off-site. The effluent discharges to Evers Ditch, which flows into the Kankakee River. The boundary for this treatment plant is shown in Figure 13.

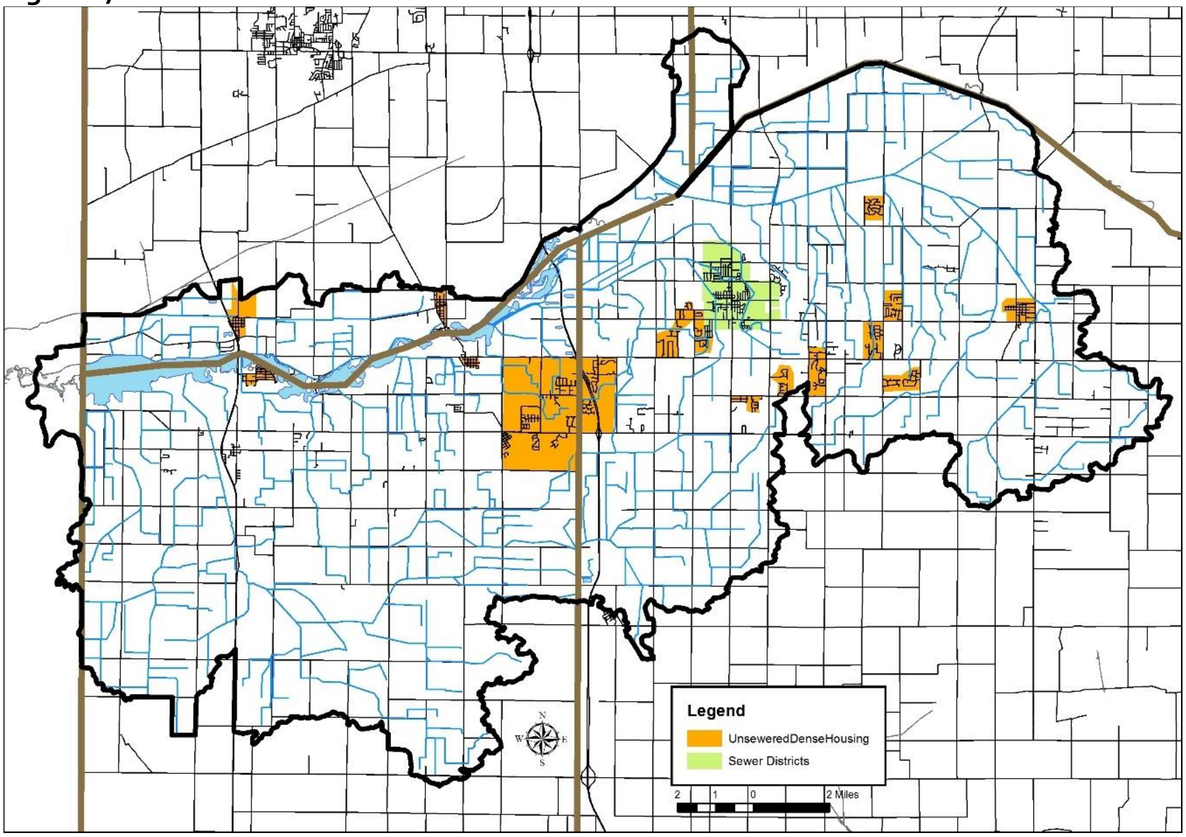
Marti's Place-Bomars River Lodge (Jasper County) operates a private wastewater treatment plant. The plant is a Class I facility with a design flow of 0.0075 MGD of wastewater and is comprised of 100% separate sanitary sewers, with no overflow or bypass points. The plant is an extended aeration facility consisting of a grease interceptor, one flow equalization tank, one aeration tank, one clarifier, one aerobic digester, chlorination/dechlorination facilities, and an effluent flow meter. Final solids are hauled off-site for disposal.

2.6.4 Unsewered Areas

Approximately 11 unsewered areas were identified within the watershed (Figure 17). Areas that have at least 25 houses within a square mile outside of the sanitary district boundaries were classified as dense, unsewered areas.

Due to the watershed having a low number of permitted wastewater treatment facilities and zero Combined Sewer Overflow areas, it seems reasonable that the primary source for *E.coli* and Fecal Coliform contamination will be from the unsewered areas. As noted, over 98% of the watershed is rated as very limited for the use of septic systems. It is likely that multiple septic systems in the watershed are not providing adequate treatment of wastewater before release into the environment.

Figure 17- Sewer Districts and Unsewered Areas in the Lower Kankakee River Watershed



2.7 Hydrology

Watershed streams, reservoirs, legal drains, floodplains, wetlands, storm drains, groundwater, subsurface conveyances, and manmade drainage channels all contribute to the watershed's hydrology. Each component moves water into, out of, or through the system. Their contributions will be covered in further detail in subsequent sections. The unique hydrological conditions of the area such as sub surface irrigation, ditch pumps, levees, dikes, high water tables, and highly altered stream channels and ditches can make watershed management challenging. These conditions, combined with the added pressure of increased agricultural land use intensity, create the potential for increased water quality problems. Public perception of the water quality problems needs to be addressed, such as nutrients leaching into surface water and groundwater and sedimentation of the river.

2.7.1 Watershed Streams

The Lower Kankakee River Watershed includes 1026 miles of streams and ditches (Table 6) and drains 186,927 acres. The Kankakee River originates near South Bend, Indiana and flows westward into Illinois. The Lower Kankakee River Watershed begins on the border of Jasper and Porter counties and continues westward through Newton and Lake counties, eventually reaching the Illinois/Indiana state line. Numerous ditches (named and unnamed) exist throughout the watershed, as a result of dredging and channelization (Table 6).

Table 6- Major Stream and Ditch Segments in the Lower Kankakee River Watershed

Waterbody Name	Regulated Drain	Length (miles)
Unnamed	Unknown	925.7
Beaver Lake Ditch	yes	1.2
Best Ditch	yes	2.9
Bogus Island Ditch	yes	0.6
Bosma Ditch	yes	2.5
Boyle Ditch	yes	0.3
Bradbury Ditch	yes	1.2
Carlson Ditch	yes	1.5
Cook Ditch	yes	1.0
David Ditch	yes	1.4
Defries Ditch	yes	0.3
Delehanty Ditch	yes	5.9
Evers Ditch	yes	3.2
Gregory Ditch	yes	0.6
Hanley Ditch	yes	1.9
Heilsher Ditch	yes	0.8
Hibler Ditch	yes	0.2
Hobbs Ditch	yes	0.8
James Ditch	yes	4.3
Johnson Ditch	yes	1.1
Kankakee River	no	19.6
Krucek Ditch	yes	0.3
Lawler Ditch	yes	1.3
Moffitt Ditch	yes	0.3
Mud Lake Ditch	yes	1.9
Myers Ditch	yes	0.3
Otis-Boyle Ditch	yes	0.6
Otis Ditch	yes	2.3
Rich Ditch	yes	0.5
Ryan Kraisinger Ditch	yes	0.3
Sargent Ditch	yes	3.5
Schatzley Ditch	yes	8.0
Schlatzley Ditch	yes	1.0
Schrader Ditch	yes	3.1
Stover Ditch	yes	1.0
Templeton Ditch	yes	2.9
Tyler Ditch	yes	5.6
Wedelburg Ditch	yes	0.3
Wentworth Ditch	yes	1.8

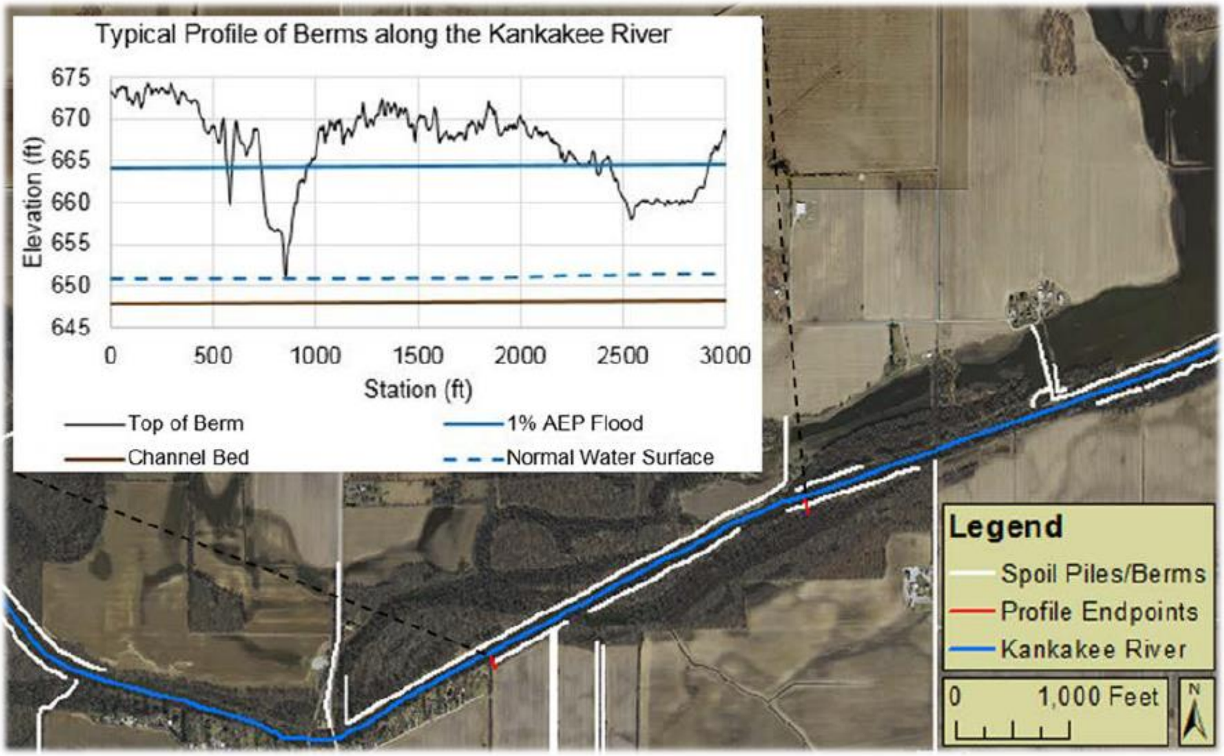
Waterbody Name	Regulated Drain	Length (miles)
Wesner Ditch	yes	0.4
Williams Ditch	yes	2.9
Wolf Creek	no	10.6
Total Length		**1025.9**

In the eastern portion of the watershed, the following larger waterways flow towards the Kankakee River: Wolf Creek, Cook Ditch, Delehanty Ditch, Hickam Lateral Ditch, Hodge Ditch, James Ditch, and Schrader Ditch. In the central portion of the watershed, the following waterways flow towards the Kankakee River: Brent Ditch, Brown Levee Ditch, Dehaan Ditch, Evers Ditch, Hibler Ditch, and Otis Ditch. In the western portion of the watershed, the following waterways flow towards the Kankakee River: Beaver Lake Ditch, Best Ditch, Gregory Ditch, Lawler Ditch, Mud Lake Ditch, Williams Ditch, and Wentworth Ditch.

The Lower Kankakee River Watershed contains approximately 1026 miles of perennial streams and regulated drains. Of these, only the Kankakee River (19.6 miles) and Wolf Creek (10.6 miles) are unregulated streams. Regulated drains cover 995 miles in the Lower Kankakee River Watershed. The larger unregulated streams are used for canoeing, kayaking, fishing, and aesthetic enjoyment, while smaller streams and regulated drains are used for water conveyance and provide wildlife habitat.

As documented above (Section 2.3), the main channel of the Kankakee River and its surround marsh were extensively channelized by a series of projects from the late 1800s through 1918 (Ivens et al, 1981). Based on assessments completed in 1882 (Campbell), the Kankakee River at the Indiana-Illinois state line largely stable possessing a cross section of 543 square feet and a hydraulic depth of 4.5 feet. Robinson (2013) noted that measurements completed in 2018 are nearly identical and that the Kankakee River is in a state of equilibrium meaning that the sediment supply is fairly stable following dredging. Observations by CBBEL (2019) note that streams do not show extensive erosion, rather erosion is occurring from spoils piles placed adjacent to streambanks within the floodplain in a haphazard manner. Deposition of these soils are occurring in the Kankakee River channel near the Illinois-Indiana line. CBBEL (2019) noted only three locations where the Kankakee River channel is migrating, which is likely keeping the volume of sediment due to instream erosion within the stream system low. However, spoils piles and berms placed adjacent to the Kankakee River are providing sediment to the river. These discontinuous and inconsistent soil piles do not provide flood protection nor a consistent elevation along the river. These piles are unconsolidated and porous, are often breached during flood events and are do not provide reliable or adequate flood risk reduction measures (CBBEL, 2019). Further, these berms provide an impediment to flood water receding back into the channel often holding water on the land longer than if the berms were absent.

Figure 18- Representative Discontinuous Berm Adjacent to the Kankakee River from CBBEL (2019)



The drainage and land use practices of an area can have a dramatic effect on the amount of runoff created during storm events and the amount of sediment that washes off the land and enters the river system. Since much of the drainage area is agriculturally based, the following discussion of drainage and land use practices is approached entirely from the viewpoint that drainage is one of, if not the most critical, elements of agricultural production in the Kankakee system. Much of the prime farmland in the area is subject to high groundwater levels and the flat topography makes efficient drainage difficult. An extensive network of drainage ditches, dikes, pumps, and pervasive tiling have been employed to provide drainage for these areas. In some particularly low-lying areas, the drainage network is used to artificially depress the groundwater to prevent surface ponding. The intensity of runoff entering the Kankakee is heavily affected by the density of this drainage network; the higher the network density, the higher the intensity as the runoff is collected and conveyed to the Kankakee much faster. Drainage networks throughout northern Indiana range from 1.6 miles of stream/square mile of drainage in the Iroquois River to 2.3 miles of stream/square mile of drainage in the Upper Maumee with an average of 1.9 miles/square mile of drainage. Table 7 reveals that for each square mile of drainage area, there is approximately 1.5 times as many miles of drainage infrastructure in the Kankakee River system.

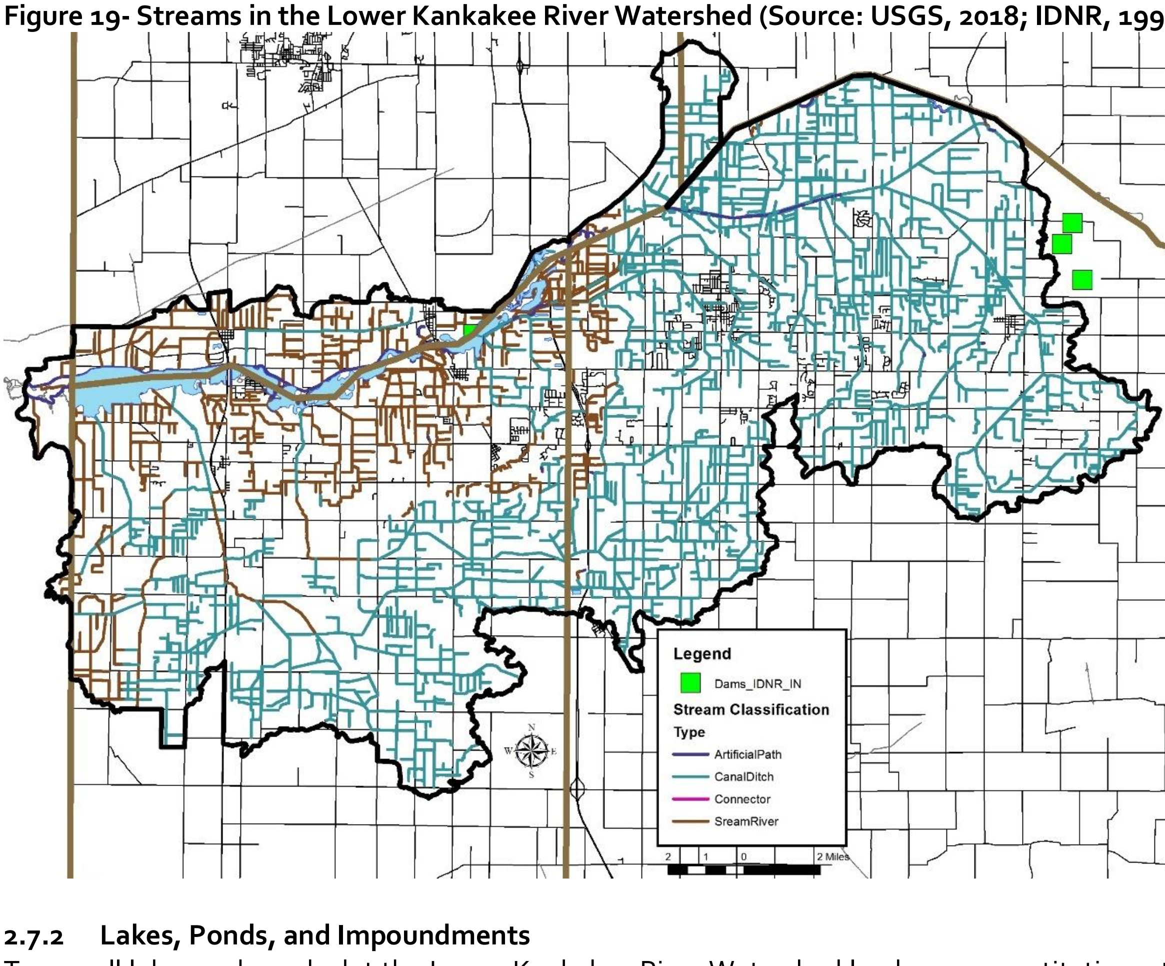
Table 7- Kankakee System Drainage Density for Lower Kankakee River Watershed Counties

County	Total Drainage Area (sq mile)	Total Drainage Network Length (mi)	Drainage Density (mi/sq mi)
Lake	237.2	797.5	3.4
Porter	221.8	665.9	3.0
Jasper	161.8	790.0	4.9
Newton	124.2	602.5	4.9

The Kankakee River from the Kingsbury Fish and Wildlife Area to the Illinois-Indiana state line, or its entire length within the Lower Kankakee River Watershed is recognized as an outstanding river. The Kankakee River is: 1) one of 1,524 river segments identified by the National Park Service as part of the 1982 Nationwide River Inventory; 2) an outstanding river identified as part of a state assessment; 3) considered a state heritage program site; 4) a state-designated canoe/boating route; 5) Considered a national landmark river as designated by the National Natural Landmarks; and 6) a state study river proposed for state protection or designation (NRCS, 1997; Figure 19). The Kankakee River is a large, unregulated stream important to stakeholders for its recreation potential. Stakeholders are concerned with maintaining the recreational value of the river and have some concerns because portions of the watershed have been designated as impaired by IDEM for *E. coli*, nutrients, impaired biotic communities, mercury, and PCBs.

The Kankakee River is a navigable waterway for 86.3 river miles. In 2016, the Kankakee River was designated a National Water Trail. Each of these areas attracts outdoor recreation enthusiasts that swim, canoe, hunt, and fish. Game fish are found in the Kankakee River. Most sportsmen and locals consume what they catch, so there is a concern about the pollutants that may be present in these fish and in the water.

Figure 19- Streams in the Lower Kankakee River Watershed (Source: USGS, 2018; IDNR, 1999)



2.7.2 Lakes, Ponds, and Impoundments

Ten small lakes and ponds dot the Lower Kankakee River Watershed landscape, constituting a total of 157.7 acres. Additionally, the South Marsh Dam (State ID 56-2) is the only dam in Newton County and this lake has a drainage area of 36.6 sq. miles. These waterbodies are used as farm ponds, fishing, aesthetic enjoyment, and personal swimming holes. No publicly available beaches are present in the watershed.

2.7.3 Impaired Waterbodies (303(d) List)

The impaired waterbodies, or 303(d), list is prepared biannually by the Indiana Department of Environmental Management. Waterbodies are included on the list if water quality assessments indicate that they do not meet their designated use. More information on the listing process is included in section 3.2.1. Forty-eight stream segments (Figure 20) within the Lower Kankakee River Watershed are included on the draft list of impaired waterbodies (IDEM, 2018).

Table 8 details the listings in the watershed, while Figure 15 maps the segments and their locations within the watershed. Waterbodies are listed as impaired for *E. coli*, dissolved oxygen, nutrients, impaired biotic communities, mercury, and PCBs.

Figure 20- Impaired Waterbody Locations in the Lower Kankakee River Watershed (Source: IDEM, 2016)

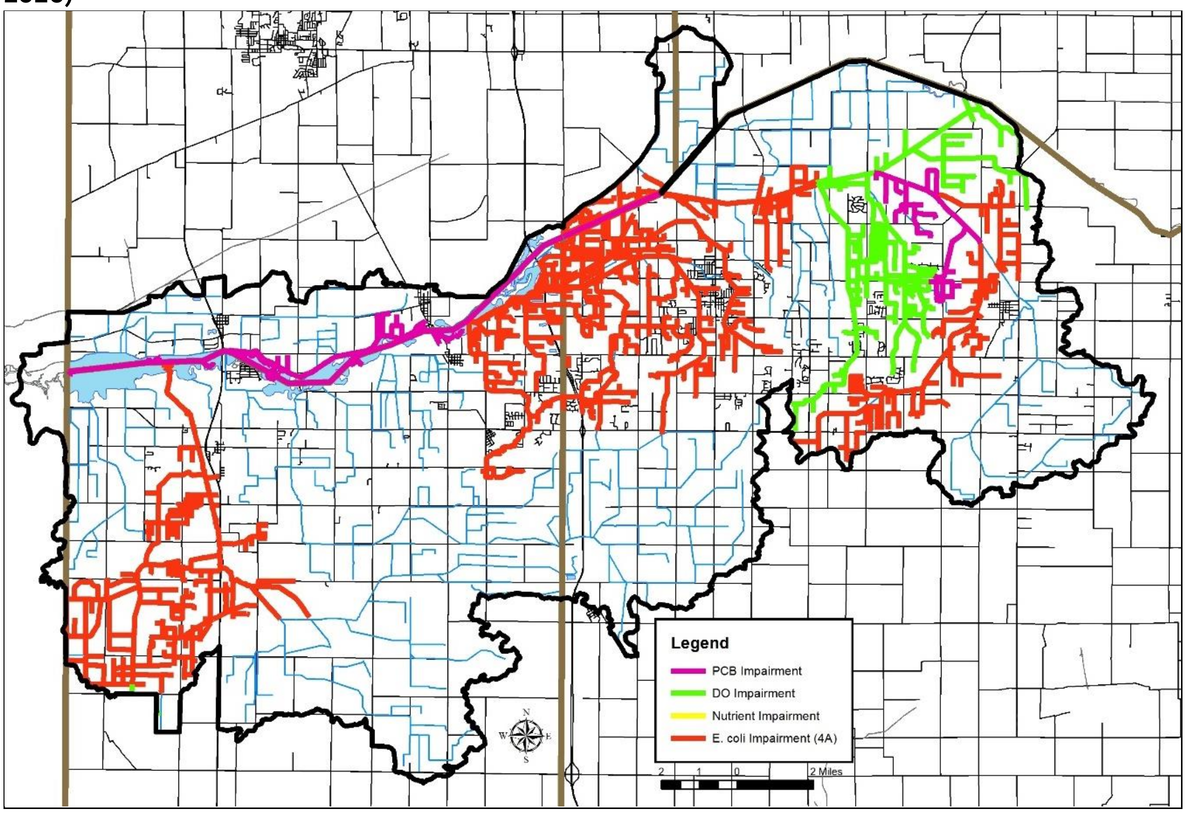


Table 8- Impaired Waterbodies in the Lower Kankakee River Watershed 2018 IDEM 303(d) List

HYDROLOGIC UNIT CODE	COUNTY	ASSESSMENT UNIT ID	ASSESSMENT UNIT NAME	CAUSE OF IMPAIRMENT
071200010901	JASPER	INK0191_01	WOLF CREEK	PCBS (FISH TISSUE)
071200010901	JASPER	INK0191_02	WOLF CREEK	PCBS (FISH TISSUE)
071200010901	JASPER	INK0191_03	WOLF CREEK	PCBS (FISH TISSUE)
071200010901	JASPER	INK0191_04	WOLF CREEK	PCBS (FISH TISSUE)
071200010901	JASPER	INK0191_05	WOLF CREEK	PCBS (FISH TISSUE)

HYDROLOGIC UNIT CODE	COUNTY	ASSESSMENT UNIT ID	ASSESSMENT UNIT NAME	CAUSE OF IMPAIRMENT
071200010901	JASPER	INK0191_06	WOLF CREEK	PCBS (FISH TISSUE)
071200010901	JASPER	INK0191_T1004	WOLF CREEK - UNNAMED TRIB	PCBS (FISH TISSUE)
071200010902	JASPER	INK0192_01	WOLF CREEK	DISSOLVED OXYGEN
071200010902	JASPER	INK0192_01	WOLF CREEK	PCBS (FISH TISSUE)
071200010902	JASPER	INK0192_02	WOLF CREEK	DISSOLVED OXYGEN
071200010902	JASPER	INK0192_02	WOLF CREEK	PCBS (FISH TISSUE)
071200010902	JASPER	INK0192_03	WOLF CREEK	DISSOLVED OXYGEN
071200010902	JASPER	INK0192_03	WOLF CREEK	PCBS (FISH TISSUE)
071200010902	JASPER	INK0192_T1007	MARBLE DITCH	DISSOLVED OXYGEN
071200010902	JASPER	INK0192_T1007	MARBLE DITCH	PCBS (FISH TISSUE)
071200010902	JASPER	INK0192_T1008	WOLF CREEK - UNNAMED TRIB	DISSOLVED OXYGEN
071200010902	JASPER	INK0192_T1008	WOLF CREEK - UNNAMED TRIB	PCBS (FISH TISSUE)
071200010902	JASPER	INK0192_T1009	MYERS DITCH	DISSOLVED OXYGEN
071200010902	JASPER	INK0192_T1009	MYERS DITCH	PCBS (FISH TISSUE)
071200010903	JASPER	INK0193_01	HODGE DITCH	DISSOLVED OXYGEN
071200010903	JASPER	INK0193_02	HODGE DITCH	DISSOLVED OXYGEN
071200010903	JASPER	INK0193_03	HODGE DITCH	DISSOLVED OXYGEN
071200010903	JASPER	INK0193_04	HODGE DITCH	DISSOLVED OXYGEN
071200010903	JASPER	INK0193_T1001	JAMES DITCH	DISSOLVED OXYGEN
071200010903	JASPER	INK0193_T1002	DELEHANTY DITCH	DISSOLVED OXYGEN
071200010903	JASPER	INK0193_T1003	JAMES DITCH	DISSOLVED OXYGEN
071200010903	JASPER	INK0193_T1003	JAMES DITCH	IMPAIRED BIOTIC COMMUNITIES
071200010903	JASPER	INK0193_T1004	DELEHANTY DITCH	DISSOLVED OXYGEN
071200010903	JASPER	INK0193_T1005	DELEHANTY DITCH	DISSOLVED OXYGEN
071200010903	JASPER	INK0193_T1006	DELEHANTY DITCH	DISSOLVED OXYGEN

HYDROLOGIC UNIT CODE	COUNTY	ASSESSMENT UNIT ID	ASSESSMENT UNIT NAME	CAUSE OF IMPAIRMENT
071200010903	JASPER	INK0193_T1006	DELEHANTY DITCH	IMPAIRED BIOTIC COMMUNITIES
071200010903	JASPER	INK0193_T1007	SCHATZLEY DITCH	DISSOLVED OXYGEN
071200010903	JASPER	INK0193_T1007	SCHATZLEY DITCH	IMPAIRED BIOTIC COMMUNITIES
071200010903	JASPER	INK0193_T1008	SCHATZLEY DITCH	DISSOLVED OXYGEN
071200010903	JASPER	INK0193_T1008	SCHATZLEY DITCH	IMPAIRED BIOTIC COMMUNITIES
071200011103	NEWTON	INK01B3_01	KANKAKEE RIVER	PCBS (FISH TISSUE)
071200011103	NEWTON	INK01B3_02	KANKAKEE RIVER	PCBS (FISH TISSUE)
071200011103	NEWTON	INK01B3_03	KANKAKEE RIVER	PCBS (FISH TISSUE)
071200011103	NEWTON	INK01B3_04	KANKAKEE RIVER	PCBS (FISH TISSUE)
071200011103	NEWTON	INK01B3_05	KANKAKEE RIVER	PCBS (FISH TISSUE)
071200011103	NEWTON	INK01B3_M1010	KANKAKEE RIVER	PCBS (FISH TISSUE)
071200011204	LAKE	INK01C4_06	WILLIAMS DITCH	PCBS (FISH TISSUE)
071200011204	LAKE	INK01C4_08	WILLIAMS DITCH	PCBS (FISH TISSUE)
071200011205	NEWTON	INK01C5_01	KANKAKEE RIVER	PCBS (FISH TISSUE)
071200011205	NEWTON	INK01C5_02	KANKAKEE RIVER	PCBS (FISH TISSUE)
071200011205	NEWTON	INK01C5_03	KANKAKEE RIVER	PCBS (FISH TISSUE)
071200011205	NEWTON	INK01C5_M1011	KANKAKEE RIVER	PCBS (FISH TISSUE)
071200011205	NEWTON	INK01C5_T1006	BEST DITCH	PCBS (FISH TISSUE)

2.7.4 Floodplains

Flooding is a common hazard that can affect a local area or an entire river basin. Increased imperviousness, encroachment on the floodplain, deforestation, stream obstruction, tiling, or failure of a flood control structure can contribute to increased flooding. Impacts of flooding include property and inventory damage, utility damage and service disruption, bridge or road impasses, streambank erosion and riparian vegetation loss, water quality degradation, and channel or riparian area modification.

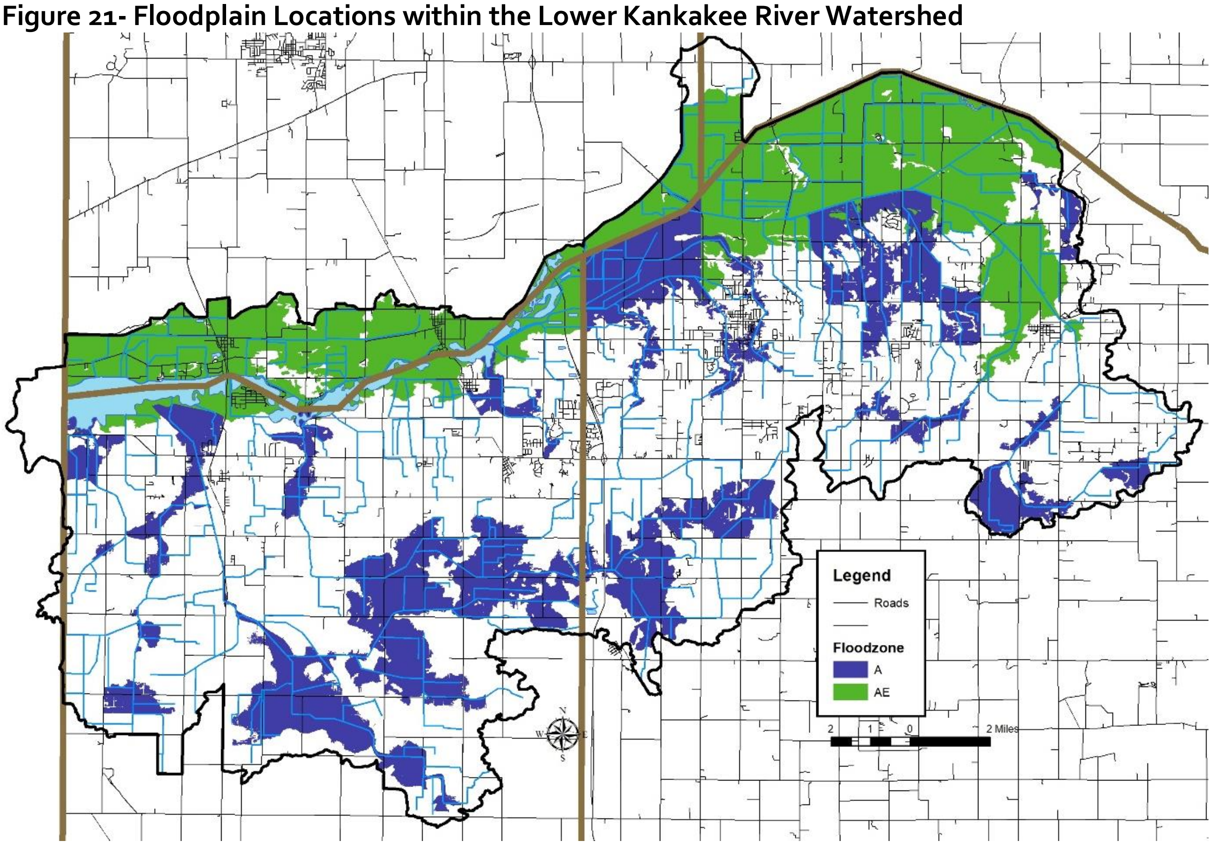
Floodplains are lands adjacent to streams, rivers, and other waterbodies that provide temporary storage for water. These systems act as nurseries for wildlife, offer green space for humans and wildlife, improve water quality, and buffer the waterbody from adjacent land uses. Local stakeholders are concerned about impacts to floodplains from development, lack of landowner maintenance, and soil erosion and deposition within the floodplain.

Figure 21 details the locations of floodplains within the Lower Kankakee River Watershed. The widest floodplain area (primarily Zone A) lies in the northeast section of the watershed in Jasper County. This area is south of the Kankakee River and includes Brent Ditch, Cook Ditch, Dehaan Ditch, Hodge Ditch, James Ditch, and some portions of Wolf Creek. A small area of Zone AE lies in Porter County, directly across the Kankakee River from Jasper County. The floodplain narrows downstream along the Kankakee River and includes Williams Ditch and Hibler Ditch.

Approximately 17% (31,442 acres) of the Lower Kankakee River Watershed lies within the 100-year floodplain. This 100-year floodplain is composed of three regions:

- Zone A is the area inundated during a 100-year flood event for which no base flood elevations (BFE) have been established. Zone A covers 26,841 acres (19.5% of the watershed).
- Zone AE is the area inundated during a 100-year flood event for which BFEs have been determined. The chance of flooding in Zone AE is the same as the chance of flooding in Zone A; however, floodplain boundaries in Zone A are approximated, while those in Zone AE are based on detailed hydraulic models which allows Zone AE floodplains to be more accurate. The majority of the Lower Kankakee River Watershed floodplain is in zone AE or nearly 39,696 acres (21.4%).
- Zone X includes areas outside the 100-year and 500-year floodplains which have a 1% chance of flooding to a depth of one foot of water. No BFEs are available for these areas and no flood insurance is required. The remainder of the watershed is classified as Zone X. The majority of the Lower Kankakee River Watershed is in Zone X.

Figure 21- Floodplain Locations within the Lower Kankakee River Watershed



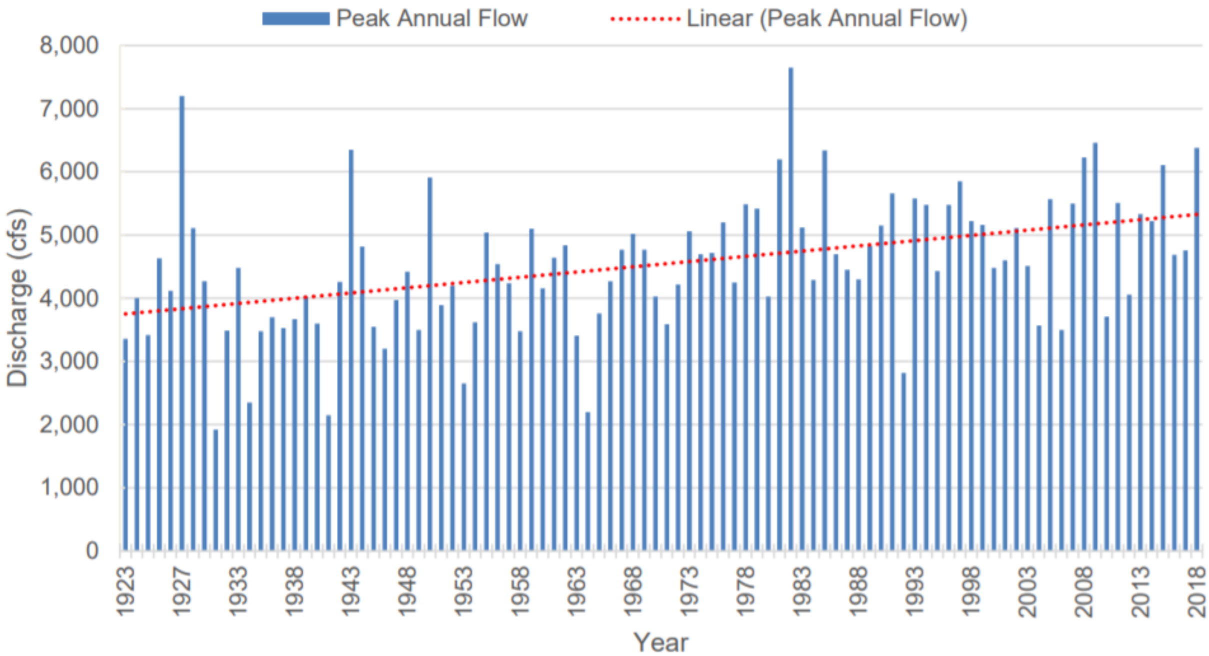
Flooding experienced in the Kankakee River Basin in February and March 2018 produced the highest flood elevations on record in the basin (CBBEL, 2019). FEMA developed maps showing areas that are of high risk of flooding, or special flood hazard areas. These special flood hazard areas have a 1% AEP or annual probability of occurring. CBBEL completed several flooding scenarios which estimate flood inundations. Table 9 details the gaging station stage and flow for the Shelby station under various annual flow occurrences and includes the 2018 flooding data.

Table 9- Existing condition flow rates and flood elevations at the Shelby USGS gage

Event		**Shelby USGS Gage**
Drainage Area		1,779 sq miles
Gage Datum		627.94
50% AEP	Flow	4,440
	Stage	638.69
10% AEP	Flow	5,880
	Stage	640.64
2% AEP	Flow	7,000
	Stage	641.94
1% AEP	Flow	7,450
	Stage	--
0.2% AEP	Flow	7,090
	Stage	--
2018 Flood	Flow	6,380
	Stage	641.24

The extent of flooding continues to increase over historic peak flood events and the future flooding risk is higher than the current flooding risk. This trend is visible using peak annual flow data from the Shelby USGS gage (Table 9). This figure details the clear increase in flooding occurring over the gage's 95 years of operation. CBBEL (2019) note that the major factors contributing to peak discharge increases along the Kankakee are increased frequency, intensity, and depth of precipitation resulting from climate change, increasing volume and intensity of runoff resulting from urban development and agricultural drainage practices, and encroachment and loss of floodplain storage within the river corridor. In total, the Shelby USGS gage documents a change in peak annual flow rate from 2,800 cfs in 1923 to 5,300 in 2018 or a 39% increase during the gaging record. Hamlet et al (2017) note that this trend is likely to continue or worsen in the future as changes in temperature and rainfall patterns continue. The current 1% AEP will likely occur twice as often in the future and the 0.2% AEP is expected to occur five times as likely during any given year. Essentially, the 1% AEP (100-year event) is expected to be similar to a 0.2% AEP event (500-year event). CBBEL also notes that while the highest flood stage recorded at the Shelby gage occurred during the 2018 event, this flow rate was produced twice in the past decade and four times in the 95 years of gage record.

Figure 22- Peak annual flow rate trend at the USGS gage near Shelby, Indiana (CBBEL, 2019)



2.7.5 Wetlands

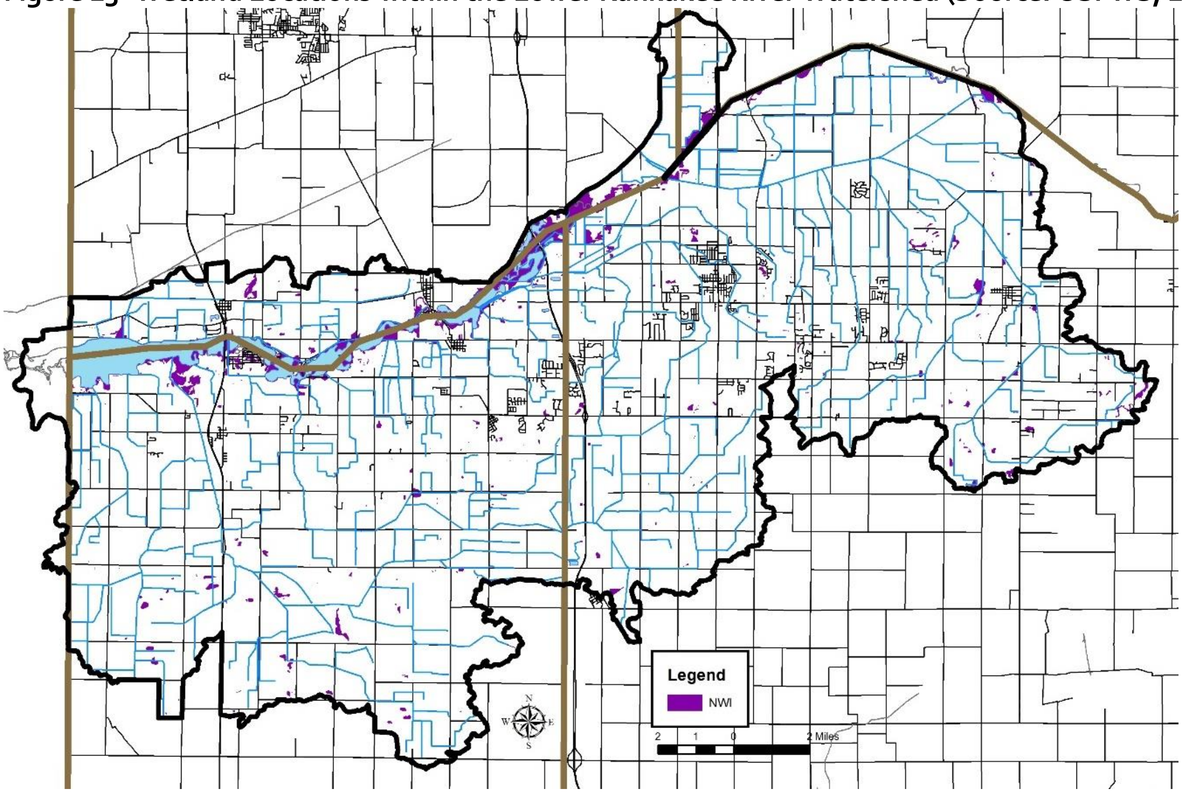
Approximately 25% of Indiana was covered by wetlands prior to European settlement (IDEM, 2007). Overall, 85% of wetlands have been lost resulting in Indiana ranking fourth in the nation in terms of percentage of wetland loss. Wetlands provide numerous valuable functions that are necessary for the health of a watershed and waterbodies. Wetlands play critical roles in protecting water quality, moderating water quantity, and providing habitat. Wetland vegetation adjacent to waterways stabilizes shorelines and streambanks, prevents erosion, and limits sediment transport to waterbodies. Additionally, wetlands have the capacity to increase stormwater detention capacity, increase stormwater attenuation, and moderate low water levels or flow volumes by allowing groundwater to slowly seep back into waterbodies. These benefits help to reduce flooding and erosion. Wetlands also serve as high quality natural areas providing breeding grounds for a variety of wildlife. They are typically diverse ecosystems which can provide recreational opportunities such as fishing, hiking, boating, and bird watching. It should be noted that natural wetlands are regulated through the IDEM and the U.S. Army Corps of Engineers while USDA has jurisdiction over wetlands on agricultural fields. Any modification to wetlands requires permits from these agencies.

Wetlands cover 7,746 acres, or 4.1%, of the watershed. When hydric soil coverage (Figure 23) is used as an estimate of historic wetland coverage, it becomes apparent that more than 90% of wetlands have been modified or lost over time. This represents greater than 76,540 acres of wetland loss within the Lower Kankakee River Watershed. As commodity prices continue to go up and down, area land values remain high, and as a result, individuals are spending a great deal of money to drain small natural wetlands in their fields in order to be able to farm that additional couple acres of land as it is cheaper to tile it than to buy ground already in production.

Figure 23 shows the current extent of wetlands within the Lower Kankakee River Watershed. Wetlands displayed are the result of compilation efforts by the U.S. Fish and Wildlife Service as part of the National

Wetland Inventory (NWI). The NWI was not intended to map specific wetland boundaries that would compare exactly with boundaries derived from ground surveys. As such, NWI boundaries are not exact and should be considered to be estimates of wetland coverage. Using this map will help us to identify which portions of the watershed would make ideal candidates for wetland restoration efforts which would reduce the amount of sediment and nutrients reaching the creek, as well as helping to restore the natural hydrology of the area which could help to reduce flooding impacts locally.

Figure 23- Wetland Locations within the Lower Kankakee River Watershed (Source: USFWS, 2017)



2.7.6 Stormwater and Storm Drains

Under natural conditions, most precipitation is allowed to infiltrate the soil and recharge groundwater resources. The volume of infiltration and groundwater recharge diminishes as development increases. To handle the large volume of precipitation falling in urban or developed areas, stormwater systems are constructed to prevent flooding of property and promote public safety on roadways. However, stormwater runoff can pick up and carry pollutants into local rivers and streams. Examples of pollutants can include sediment from construction sites, litter, plastic bottles, pesticides from lawns, and oil on roadways. When pollutants are deposited into the local waterway, these pollutants can cause impairments ranging from degraded habitat for aquatic organisms to contaminated drinking water supplies. Additionally, the increased volume and velocity of stormwater runoff into the local waterway can cause an increase in bank erosion and scouring of the stream bed.

In some developed areas, the EPA enrolls a community or entity into the Municipal Separate Storm Sewer System (MS4) program. This is a national stormwater management program that focuses on reducing the quantity of pollutants that stormwater runoff transports through storm sewer systems to local waterways. This program serves larger communities with significant amounts of impervious surfaces; no MS4 entities are in this watershed. Storm drain systems are not prevalent in this watershed because there is an overall low level of impervious surfaces that would require the construction of storm sewers. Further, there are not storm sewer overflows within the watershed.

2.7.7 Wellfields/Groundwater

In general, municipal water which supplies the Northwest Jasper, Hebron, Lowell, and Schneider Water Districts and the Water Service Company is taken from the carbonate bedrock aquifer, which is generally 500-600 ft. thick. The upper part of the aquifer is highly permeable because of the enlargement of fractures, joints, and bedding by pre-Pleistocene weathering. Fractures in the bedrock are excellent conduits for groundwater. This type of bedrock can yield 52,000 gallons per minute of groundwater. Areas with Atrium Shale are utilized as minor aquifers where unconsolidated aquifers are absent and more productive carbonate aquifers are far beneath the bedrock surface. Wells can yield 15-20 gallons per minute, but the occurrence of dry holes is more prevalent in the shale (IDNR, 1990).

Recharge to the bedrock aquifer occurs at bedrock outcrops where precipitation enters the aquifer directly or indirectly via unconsolidated deposits. Table 10 lists wellhead protection areas within and adjacent to the Lower Kankakee River Watershed. The wellhead protection areas and wellhead protection plans associated with each area will be discussed in additional detail in subsequent sections. Potential pollution from construction, sewage outfalls or overflows, illegal dumping, agriculture, and storm water runoff must be avoided or controlled due to the recharge of these aquifers from runoff and river water. The sensitivity to surface contamination is shown in Figure 24. Small areas of high aquifer sensitivity include two locations in the western section and one small area in the central section of the watershed.

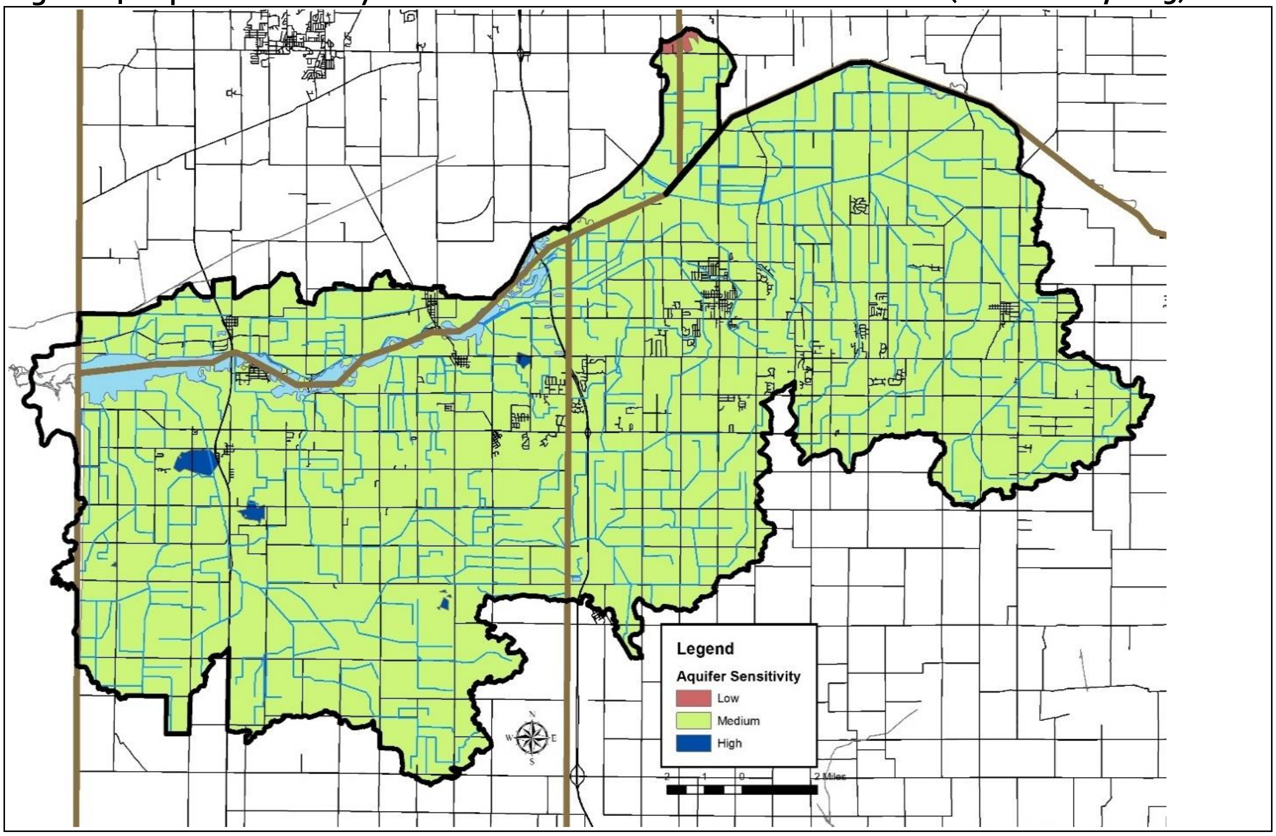
Contamination of private wells was noted as a concern as many wells are shallow driven wells less than 20 feet deep, often located near tiled fields. The Jasper County SWCD has collected relevant groundwater data on this region for the past fifteen years. Private well water testing for nitrate-nitrogen in 2007, which was analyzed by Heidelberg University Labs, revealed that 5% of the wells in the region tested over the 10mg/L drinking standard, and that wells in the range of 3.0 mg/l to 10 mg/l doubled their rate compared to previous years. Additionally, with a high perched water table, excess nutrients and bacteria could lead to significant public health concerns as these contaminants could be reaching public drinking water supplies for the town of DeMotte, and private wells in Wheatfield, Lake Village, and Roselawn.

Table 10- Wellhead Protection Areas in and Adjacent to the Lower Kankakee River Watershed

County	PWSID	System name	Type	Population Served
Jasper	5237001	Country Place Apartments - DeMotte	Mobile Home Park	25
Jasper	5237002	Water Service Company	Private Utility	654
Jasper	5237007	DeMotte Mobile Home Park – Stamac II	Mobile Home Park	95
Jasper	5237008	Heritage Park Apartments	Mobile Home Park	47
Jasper	5237009	Pines Apartments of DeMotte	Residential Area	33
Jasper	5237012	Oak Grove Christian Retirement Village	Nursing Home	179
Jasper	5237013	Whites Residential – North Campus	Nursing Home	105
Jasper	5237015	NW Jasper Regional Water District	Municipal Utility	3815
Newton	5256008	Ten Oaks MHP	Mobile Home Park	270
Newton	5256011	River Bend Manor MHP	Mobile Home Park	44
Lake	5245001	Apple Valley Utilities	Mobile Home Park	712

County	PWSID	System name	Type	Population Served
Lake	5245029	Lowell Water Department	Municipal Utility	9276
Lake	5245042	Schneider Water Department	Municipal Utility	277
Porter	5264009	Hebron Water Department	Municipal Utility	3724

Figure 24- Aquifer Sensitivity within the Lower Kankakee River Watershed (Source: IGS, 2015)



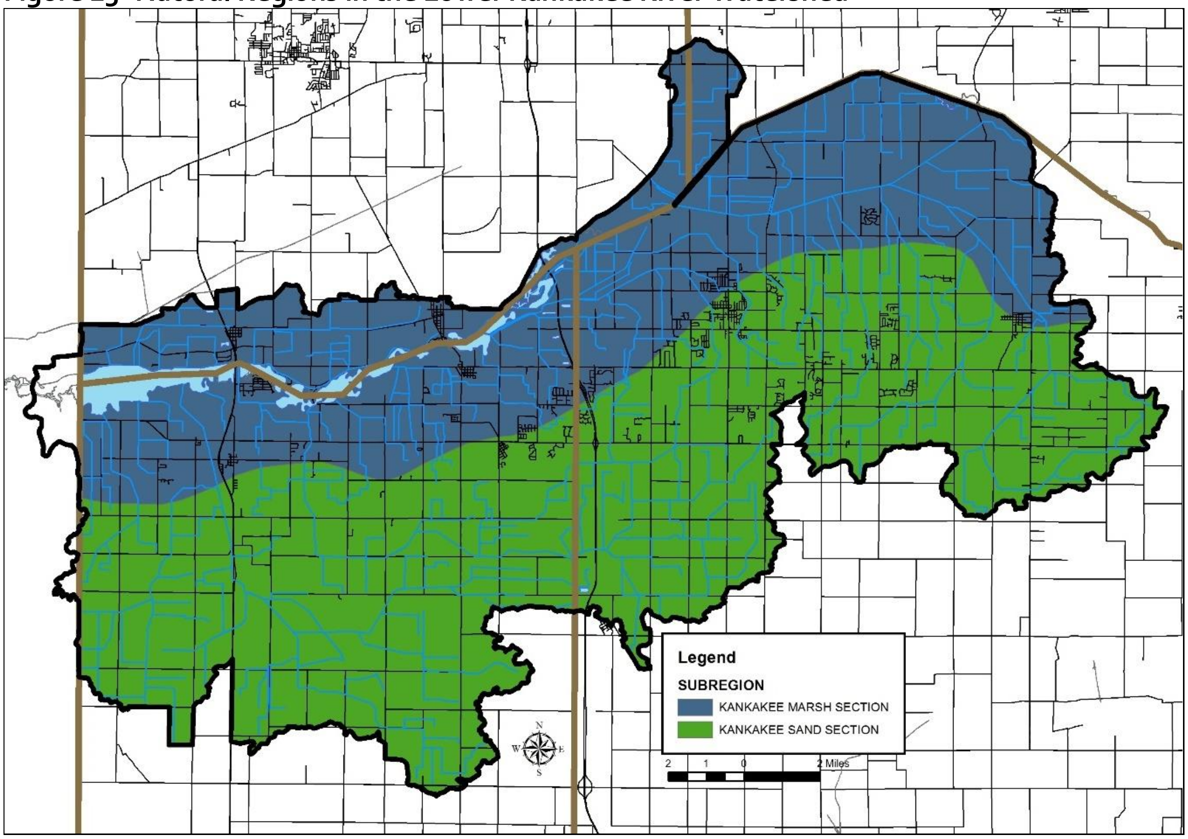
2.8 Natural History

Geology, climate, geographic location, and soils all factor into shaping the native flora and fauna which occurs in a particular area. Categorization of these floral and faunal communities has been completed by a number of ecologists since the earliest efforts by Coulter in 1886. Since this time, Petty and Jackson (1966) identified regional communities; Homoya et al. (1985) classified Indiana into natural regions, while Omernik and Gallant (1988) categorized Indiana into ecoregions.

2.8.1 Natural and Ecoregion Descriptions

According to Homoya et al.'s (1985) classification of natural regions in Indiana, the Lower Kankakee River Watershed lies within two regions: the Kankakee Sand Section and the Kankakee Marsh Section (g). The Kankakee Sand Section formed when glacial meltwaters flushed large amounts of sand down the valley of the Kankakee where the material was later pushed by the wind into ridges, dunes, and hills. Glacial Lake Kankakee formed more than 14,000 years ago from the outwash of the Michigan, Saginaw and Huron-Erie lobes of the Wisconsinan Era glaciation. The outcropping of limestone created by the receedence of the glaciers formed an artificial base level upon which the Grand Kankakee Marsh was formed. This area was transitional, with communities of wetlands, prairies, timber, and savannas mixed together. Unique communities exist, such as the sand savanna and pocket wetlands not typical for the area. These wetlands were hydrologically connected to the marshes along the Kankakee River. The Kankakee Marsh Section was originally one of the largest freshwater marshes in the country. Trapping, fishing, and hunting were prevalent, with farming being nearly impossible. Vegetation was equally diverse. Due to the extensive draining for agricultural purposes, this area only has small, scattered remnants of prairie.

Figure 25- Natural Regions in the Lower Kankakee River Watershed



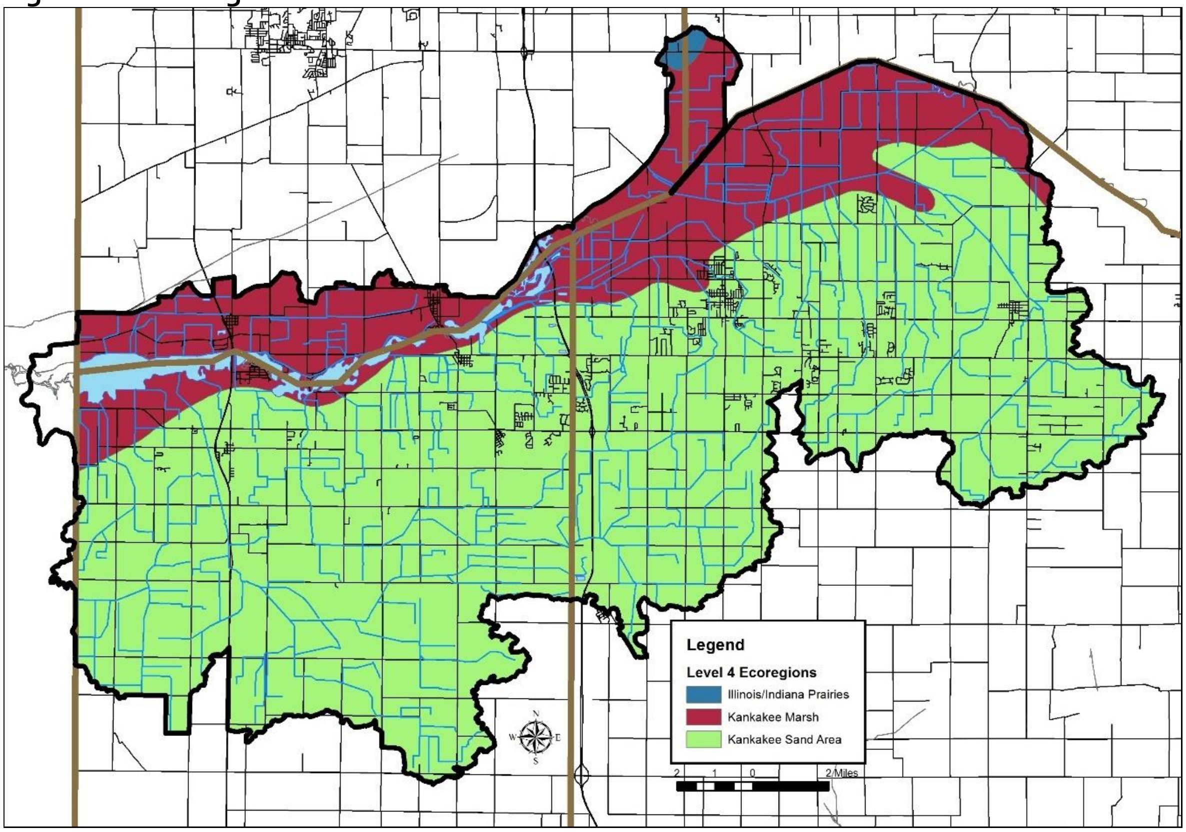
The Lower Kankakee River Watershed is mostly covered by the Kankakee Sand Area (south of the Kankakee River). Along the river, the Kankakee Marsh region is dominate. At the northern tip of watershed is the Illinois/Indiana Prairies ecoregion (Figure 26).

The Kankakee Sand Area ecoregion is distinguished from adjacent ecoregions by its extensive sand plains and relict dunes. Natural soil drainage properties and vegetation were distinctive; dry prairies and mixed oak savannas occurred on well-drained sites while northern swamp forests, marshes, or wet prairies grew on moister soils. Today, the dunes remain wooded.

The Kankakee Marsh Area ecoregion was once covered by extensive northern swamp forests, wet prairies, and bulrush-cattail marshes (Figure 20). Today, most of these distinctive communities are gone and only a narrow-wooded corridor remains along the Kankakee River. Elsewhere, corn, soybean, and livestock farming are dominant on artificially drained soils that were derived from outwash deposits.

The Illinois/Indiana Prairies ecoregion is undulating and characterized by dark, very fertile soils. Today, corn, soybean, and livestock farming has replaced the original prairie and oak-hickory forest; woodland is largely confined to riparian areas.

Figure 26- Eco-Regions in the Lower Kankakee River Watershed



2.8.2 Endangered Species

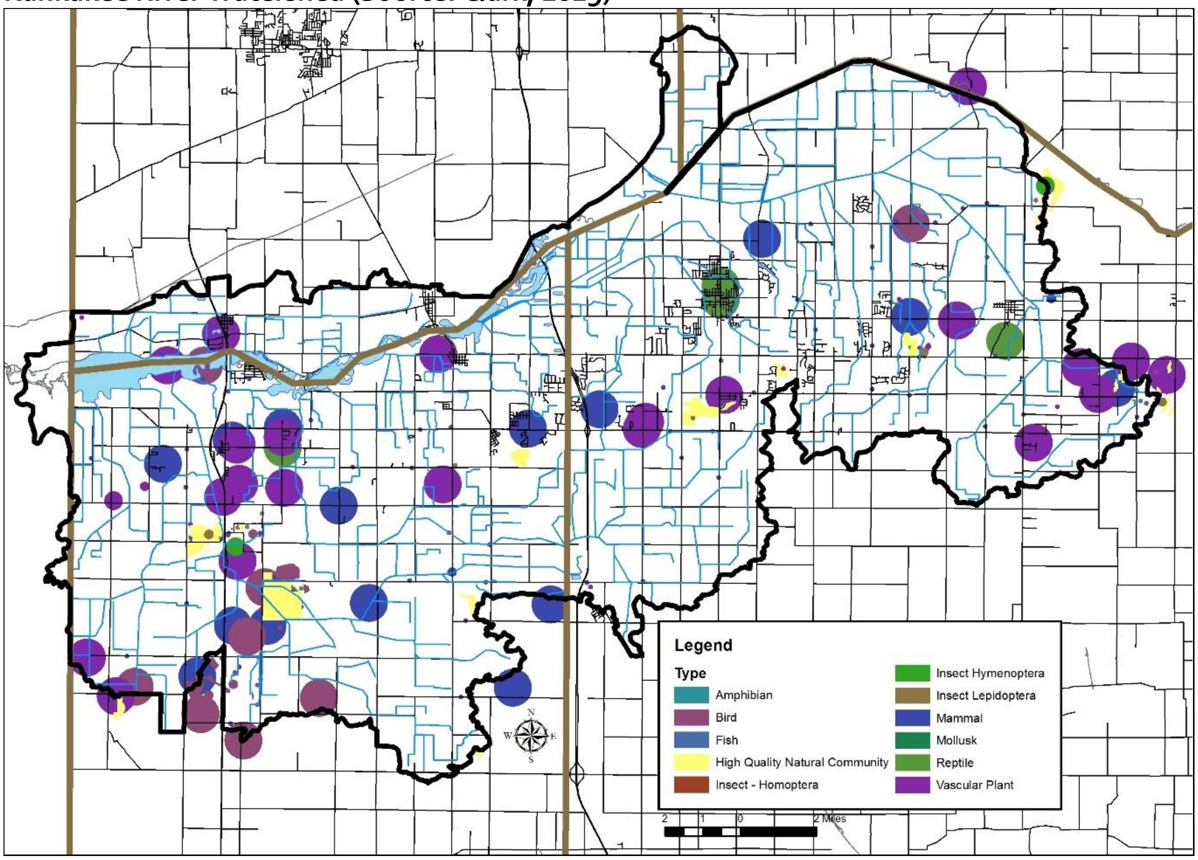
The Indiana Natural Heritage Data Center, part of the Indiana Department of Natural Resources, Division of Nature Preserves, maintains a database documenting the presence of endangered, threatened, or rare species; high quality natural communities; and natural areas in Indiana. The database originated as a tool to document the presence of special species and significant natural areas and to assist with management of said species and areas where high quality ecosystems are present. The database is populated using individual observations which serve as historical documentation or as sightings occur; no systematic surveys occur to maintain the database.

The state of Indiana uses the following definitions to list species:

- *Endangered*: Any species whose prospects for survival or recruitment with the state are in immediate jeopardy and are in danger of disappearing from the state. This includes all species classified as endangered by the federal government which occur in Indiana. Plants currently known to occur on five or fewer sites in the state are considered endangered.
- *Threatened*: Any species likely to become endangered within the foreseeable future. This includes all species classified as threatened by the federal government which occur in Indiana. Plants currently known to occur on six to ten sites in the state are considered threatened.
- *Rare*: Plants and insects currently known to occur on eleven to twenty sites.

In total, 316 observations of listed species and/or high-quality natural communities occurred within the Lower Kankakee River Watershed (Figure 27; Clark, personal communication). These observations include five amphibians, 18 birds, nine mammals, one mollusk, three reptiles, 44 plants, 36 insects, and 31 high quality natural communities. Many of these species were historically located adjacent to Lower Kankakee River or a tributary or within their riparian habitats.

Figure 27- Locations of Special Species and High-Quality Natural Areas Observed in the Lower Kankakee River Watershed (Source: Clark, 2019)



State endangered species include the American Bittern, Black Rail, Blanding's Turtle, Bristly Sarsaparilla, Carolina Woollywhite, Cattail Gay-feather, Climbing Hempweed, Creeping St. John's-wort, Downy Gentian, Drummond Hemicarpha, Elk Sedge, Evening Bat, Franklin's Ground Squirrel, Globe-fruited False-loosestrife, Helianthus Leafhopper, Henslow's Sparrow, Hill's Thistle, Houghton's Nutsedge, Indiana Bat, Least Bittern, Little Brown Bat, Loggerhead Shrike, Marsh Wren, Northern Brook Lamprey, Northern Harrier, Ornate Box Turtle, Pale Corydalis, Prairie Fame-flower, Prairie Parsley, Regal Fritillary, Rings' Cochylid Moth, Rusty-patched Bumble Bee, Sedge Wren, Shaggy False-gromwell, Sheepnose, Small Bristleberry, The Four-lined Cordgrass Borer, The Kansas Prairie Leafhopper, The Leadplant Underwing Moth, The Nebraska Silver Bordered Fritillary, Tricolored Bat, Tube Penstemon, Upland Sandpiper, Virginia Rail, and the Yellow-fringe Orchis.

State threatened species include Noctuid Moth, Beer's Blazing Star Borer Moth, Big Broad-winged Skipper, Bunchgrass Skipper, Carey's Smartweed, Crawe Sedge, Curved Halter Moth, Deep-root Clubmoss, Great St. John's-wort, Louisiana Macrochilo, Northern Bog Clubmoss, Reticulated Nutrush, The Pink Streak, The Starry Campion Moth, Two-spotted Skipper, Warty Panic-grass, Western Rockjasmine, and Western Silvery Aster.

High quality natural communities include the Kankakee Sands and Marsh Megasite, Fair Oaks Savanna Site, Stoutsburg Savanna Site, Colfax Township Savanna Site, DeMotte Savanna Site, Kankakee Sands Macrosite, Willow Slough Macrosite, Nipsco Savanna Site, Fame Savanna Site, and the Beaver Lake Site.

Appendix B includes the database results for the Lower Kankakee River Watershed, as well as county-wide listings for Jasper, Newton, Lake, and Porter Counties.

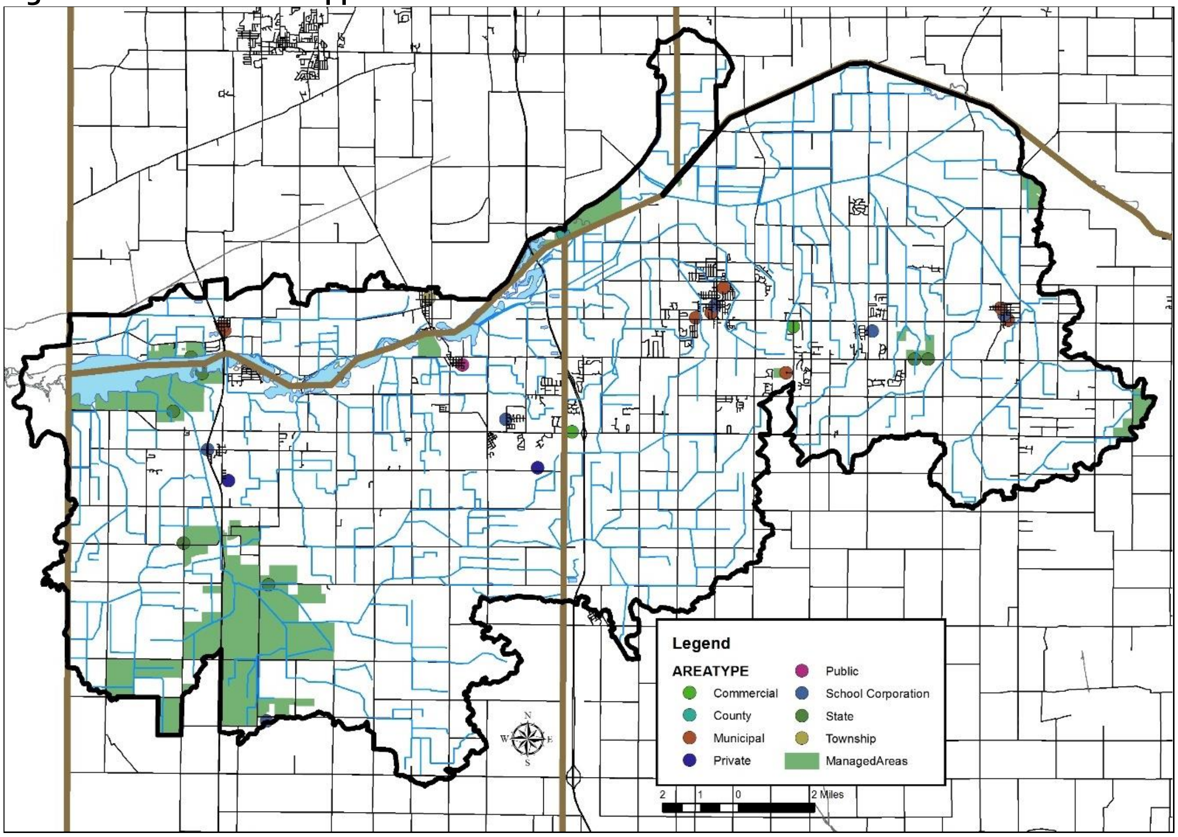
2.8.3 Recreational Resources and Significant Natural Areas

A variety of recreational opportunities and natural areas exist within the Lower Kankakee River Watershed. Recreational opportunities include parks, fish and wildlife areas, and nature preserves (Table 11, Figure 28). There are several significant natural areas located within the Lower Kankakee River Watershed. The Indiana DNR, The Nature Conservancy, counties, and local communities maintain, preserve, and protect these properties.

Table 11- Natural Managed Areas in the Lower Kankakee River Watershed

Natural Area	County	Organization
Aukiki Wetland Conservation Area	Jasper	IDNR/TNC
Ciurus Park Nature Preserve	Jasper	Town of DeMotte
Kankakee River Swampland	Jasper	IDNR
NIPSCO Savanna	Jasper	TNC
Tefft Savanna Nature Preserve	Jasper	IDNR
Spencer Park	Jasper	Town of DeMotte
Stoutsburg Savanna Nature Preserve	Jasper	IDNR
Jasper-Pulaski FWA	Jasper	IDNR
Badal Trust Area	Lake	IDNR
Grand Kankakee Marsh	Lake	Lake County
LaSalle FWA	Lake/Newton	IDNR
Beaver Lake Nature Preserve	Newton	IDNR
Conrad Savanna Nature Preserve	Newton	IDNR
Kankakee Sands	Newton	TNC
Willow Slough FWA	Newton	IDNR

Figure 28- Recreational Opportunities and Natural Areas in the Lower Kankakee River Watershed



Aukiki Wetland Conservation Area, located in Jasper County (650 acres), conserves a mix of wetlands, black oak barrens, and sand prairie, offering wildlife viewing, hiking, and hunting. Jointly owned by the TNC and IDNR, this area is part of the Indiana Grand Kankakee Marsh Restoration Project.

Ciurus Park Nature Preserve, located in the Town of DeMotte, is a 40 acre preserve containing many plants and animals typical of the sandy hills of the Kankakee Valley. Two rare plants are in the preserve: the bristly sarsaparilla and the cream wild indigo. A 0.7-mile trail enables one to experience a change in topography while viewing the wildflowers and grasses that grow there. Among these are the early blooming cleft phlox, rough blazing star, and the showy butterfly weed.

NIPSCO Savanna in Jasper County is a diverse mix of savanna, prairie, and wetland communities. In 1995, as part of the North American Waterfowl Plan, NiSource generously donated 650 acres to The Nature Conservancy. The TNC retained 221 acres of the savanna in hopes of restoring and enhancing the black oak barren and sand prairie communities. The remaining 429 acres were transferred to the DNR's Division of Fish and Wildlife; the primarily agricultural field is now called Aukiki Wetland Conservation Area.

Tefft Savanna Nature Preserve, located in Jasper County (480 acres), supports a complex of community types which are now rare in Indiana. Sand dunes support black oak savannas, some of which have prairie openings. Between the dunes are acid flats and depressions. The flats have a black and pin oak overstory, with an understory of blueberry, huckleberry, and a variety of herbaceous species. The depressions are a complex of sedge meadows, wet prairies, and marshes. Tefft also contains several unusual reptiles and mammals, and numerous rare plants. Many of the plants are also found in Atlantic Coastal Plain Disjuncts.

Spencer Park, located in the Town of DeMotte, is a local community park with a pool, playground, etc.

Stoutsburg Savanna Nature Preserve, located in Jasper County (235 acres), protects a unique habitat of a black oak sand savanna. At this site you will see open-grown black oak trees and high dry sandy soils that are old sand dunes. The 1.5-mile Dunes & Prairie trail allows hikers to experience wetland, prairie, and high-quality oak savanna.

Jasper-Pulaski Fish and Wildlife Area, located in Jasper County, is dedicated to providing quality hunting and fishing opportunities while maintaining 8,142 acres of wetland, upland, and woodland game habitat. The property's suitable habitat provides an ideal stopover for migratory birds. More than 10,000 sandhill cranes stop during fall migration.

Badal Trust Area, located in Lake County (29.79 acres), is open to the public for hunting.

Located on the historic Kankakee River, the 1,952-acre Grand Kankakee Marsh County Park is a natural habitat for deer herds, many duck species, and other wildlife. There are many recreation opportunities at the Marsh like hunting, fishing, and birding. Additionally, the levees make excellent equestrian trails for the public to ride horses.

LaSalle Fish and Wildlife Area, located in Newton and Lake Counties, is a protected area that covers 3,797 acres dedicated to providing hunting and fishing opportunities. The park is open to the public and offers numerous activities and programs throughout the year. It also provides boat access to Kankakee River.

Beaver Lake Nature Preserve, located in Newton County (640 acres), offers hiking and is open to the public.

Conrad Savanna Nature Preserve, located in Newton County (453 acres), preserves an example of the landforms and associated plant communities that were characteristic of the area south of the Kankakee River at the time of settlement. Fine quartz sand is the common soil in this region (as well as in the nature preserve), and it occurs in both broad flats and rolling hills. Oak savanna is the predominant plant community on these droughty sands, with black and white oaks being by far the most common trees.

The Nature Conservancy, in partnership with the Division of Fish & Wildlife, Division of Nature Preserves, Indiana Department of Environmental Management, Indiana Heritage Trust, Indiana Grand Company, Lilly Endowment, National Fish & Wildlife Foundation, Natural Resources Conservation Services, is restoring 7,000+ acres in Newton County. Known as the Efroymson Restoration at Kankakee Sands, this project supports such rare species as red-headed woodpeckers, plains pocket gophers, Henslow's sparrows, old plainsman, and glass lizards as well as more common species such as blue joint grass, blazing star, sawtooth sunflower, and grassland birds.

Willow Slough Fish and Wildlife Area is dedicated to providing quality hunting and fishing opportunities while maintaining 9,956 acres, which includes 1,200 acres of open water, marshes, and flooded crop land.

2.8.4 Wildlife Populations

Local wildlife populations can impact pathogen levels. With these concerns in mind, wildlife density can be estimated from a variety of sources. The Indiana Department of Natural Resources (IDNR) is tasked with managing wildlife populations throughout the state. To complete this task, the IDNR must have an idea of the population density within specific areas, counties, or regions. The most recent survey of wildlife populations for which data are publicly available occurred in 2005. Those densities are shown in Table 12 with deer, squirrels and turkey being the most common wildlife present within the region. It should be noted that these numbers could both underestimate and overestimate populations within the watershed. Densities are recorded based on animal observations per 1000 hours of overall observation. If observations areas are not equally spread throughout the region, over or underestimates of the populations could occur. Likewise, animals are not likely equally distributed throughout the region; therefore, the regional density may again over or underestimate the true density of the animal in question. Nonetheless, these estimates provide the best guess at wildlife densities.

Table 12 - Surrogate estimates of wildlife density in the IDNR northwest region, which includes the Lowe Kankakee River Watershed.

Animal	2005 Population Observation (per 1000 hrs of observation)
Beaver	0.7
Bobcat	1.2
Bobwhite	66.2
Coyote	20.7
Deer	946.5
Fox squirrel	549.5
Gray fox	1.5
Gray squirrel	102.5
Grouse	8.4
Domestic cat	24.9
Muskrat	1.2
Opossum	13.0
Rabbit	42.1
Raccoon	43.2
Red fox	7.7
Skunk	6.9
Turkey	157.6

Source: Plowman, 2006.

2.9 Land Use

Water quality is greatly influenced by land use both past and present. Different land uses contribute different contaminants to surface waters. As water flows across agricultural lands it can pick up pesticides, fertilizers, nutrients, sediment, pathogens, and manure, to name a few. However, when water flows across parking lots or from roof tops it not only picks up motor oil, grease, transmission fluid, sediment, and nutrients, but it reaches a waterbody faster than water flowing over natural or agricultural land. Hard or impervious surfaces present in parking lots or on rooftops create a barrier between surface and groundwater. This barrier limits the infiltration of surface water into the groundwater system resulting in increased rates of transport from the point of impact on the land to the nearest waterbody.

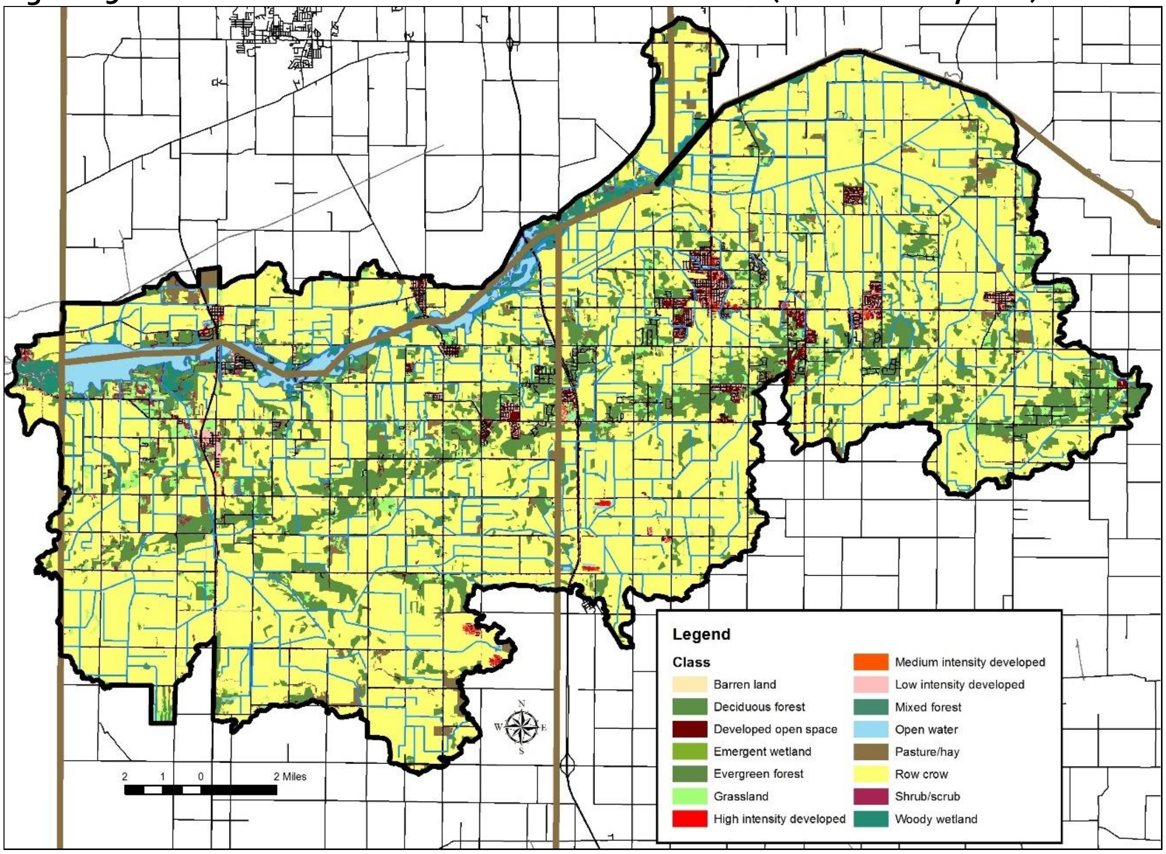
2.9.1 Current Land Use

Today, the majority of the Lower Kankakee River Watershed is covered by row crop agriculture and pasture (70%) (Table 13, Figure 29). Over 13% of the watershed is mapped in forestland, while 8% of the watershed is covered by developed open space or is in low, medium, or high intensity developed areas. Grassland, evergreen forest, open water, and wetlands cover the remaining 9% of the watershed.

Table 13- Detailed Land Use in the Lower Kankakee River Watershed (Source: USGS, 2011)

Classification	Area (acres)	Percent of Watershed
Pasture/hay	67,291	36.0%
Row crop	63,303	33.9%
Deciduous forest	24,997	13.4%
Low intensity developed	7,722	4.1%
Woody wetland	6,294	3.4%
Developed open space	5,150	2.8%
Shrub/scrub	4,700	2.5%
Grassland	4,325	2.3%
Medium intensity developed	1,029	0.6%
Open water	799	0.4%
Emergent wetland	586	0.3%
Evergreen forest	265	0.1%
High intensity developed	258	0.1%
Mixed forest	149	0.1%
Barren land	55	0.03%
Entire Watershed	**186,927**	**100.0%**

Figure 29- Land Use in the Lower Kankakee River Watershed (Source: NLCD, 2011)



2.9.2 Agricultural Land Use

Individuals are concerned about the impact of agricultural practices on water quality. Specifically, the volume of sediment entering adjacent waterbodies, the prevalence of tiled fields and thus the of chemicals into waterbodies, the use of agricultural chemicals, and the volume of manure applied via small animal farms and through confined animal feeding operations are concerning to local residents. Each of these issues will be discussed in further detail below.

2.9.2.1 Tillage Transect

Tillage transect information data for Jasper, Newton, Lake, and Porter counties was compiled for 2018 (Table 14). As reported by ISDA, members of Indiana's Conservation Partnership (ICP) conduct a field survey of tillage methods and cover crop implementation status. A tillage transect is an on-the-ground survey that identifies the types of tillage systems farmers are using and long-term trends of conservation tillage adoption using GPS technology, plus a statistically reliable model for estimating farm management and related annual trends. Table 14 provides the number of acres and percent of acres on which no-till and conservation tillage was utilized for each county by corn and soybeans. Table 15 details cover crop use by corn and soybeans for each county. Conservation tillage and cover crop planting reduces soil disturbance and holds soil in place reducing compaction and sediment and nutrient runoff to adjacent streams. The low usage of these conservation practices is particularly detrimental to the amount of sediment dislodged from the watershed in areas with fine-grained soils; silts and clays are easily detached and kept in suspension by the rainfall and runoff.

Table 14- Conservation Tillage Data by County for Corn and Soybeans (ISDA, 2018)

County	Corn (acres)	Corn (%)	Soybeans (acres)	Soybeans (%)
Jasper	147,828	20%	102,884	20%
Newton	96,788	26%	79,646	26%
Lake	55,044	26%	51,978	26%
Porter	60366	21%	52,352	21%

Table 15- Cover Crop Data by County for Corn and Soybeans (ISDA, 2018)

County	Corn (acres)	Corn (%)	Soybeans (acres)	Soybeans (%)
Jasper	15,895	10%	5,249	5%
Newton	9,876	10%	4,105	5%
Lake	1,757	3%	2,652	5%
Porter	1,848	3%	2,876	5%

2.7.2.2 Agricultural Chemical Usage

Agricultural pesticides and fertilizers are commonly applied to row crops in Indiana. These chemicals can be carried into adjacent waterbodies through surface runoff and via tile drainage. This is especially an issue if a storm occurs prior to the chemicals being broken down and used by the crops.

Data for chemical usage on an individual county or watershed level are not currently collected. Rather, data is collected for the state as a whole in two forms. First, the National Agricultural Statistics Survey (NASS) collects information on chemical usage, number of applications per year, type of chemical applied, and the application rate. These data were last collected in 2006 (NASS, 2006). Additionally, NASS collects farmland data for the number of acres in agricultural production by type (i.e., corn, soybeans, grains) by county (NASS, 2018). These data indicate that corn (315,000 acres in Jasper, Newton, and Porter counties) and soybeans (286,500 acres in Jasper, Newton, Lake, and Porter counties) are the two primary crops grown in the watershed.

Nitrogen fertilizers are typically applied to corn rather than to soybeans. Soybeans have symbiotic bacteria on their roots that act as nitrogen fixers, which means that they pull the nitrogen that they need from the atmosphere then convert it into a form which they can use. Corn does not fix nitrogen; therefore, nitrogen needs to be applied. Nitrogen is typically applied twice in Indiana – once at or before planting and a second time when corn reaches approximately one foot in height (NASS, 2007). Fall application of nitrogen also occurs within the watershed. Fall application is particularly problematic as nitrogen is not used by a crop before winter freeze-thaw and any potential fall or winter flooding. NASS agricultural data indicate that approximately 81% of the total crops planted were fertilized in 2017. Based on these data, it is estimated that 37,826 tons of nitrogen and 20,119 tons of phosphorus are applied annually within the Lower Kankakee River Watershed counties (Table 16). If fertilizers are over applied, nitrogen and phosphorus can be leached to adjacent waterbodies through tile drainage or via overland runoff attached to sediment.

Table 16- Agricultural Nutrient Usage for Crops in the Lower Kankakee River Watershed Counties (Source: NASS, 2017)

Nutrient	Acres of Crops	% of Area Applied	Applications (#/year)	Rate/Application (lb/acre)	Total Applied/ Year (tons)
Nitrogen	633,637	81	2.2	67	37,826
Phosphorus	633,637	81	1.4	56	20,119

Pesticides are also used on crops grown in Indiana. The Office of the Indiana State Chemist indicates that the two predominant herbicide active ingredients applied are atrazine and glyphosate. Atrazine is most commonly applied as a corn herbicide, while glyphosate is used on both corn and soybean fields as an herbicide. NASS indicates that in 2005, an average of 1.24 pounds of atrazine and 0.6 pounds of glyphosate were applied per acre of corn, and 0.73 pounds of glyphosate were applied per acre of soybeans (NASS, 2006). Using these rates, we estimated that a little over 195 tons of atrazine and approximately 199 tons of glyphosate are applied to cropland in the Lower Kankakee River Watershed counties annually (Table 17).

Table 17- Agricultural Herbicide Usage in the Lower Kankakee River Watershed Counties (Source: NASS, 2006; ISDA, 2017A-C)

Crop	Acres	Application Rate (lb/acre)	Total Applied (lbs)	Total Applied/Year (tons)
Corn (Atrazine)	315,000	1.24	390,600	195.3
Corn (Glyphosate)	315,000	0.60	189,000	94.5
Soybeans (Glyphosate)	286,500	0.73	209,145	104.5

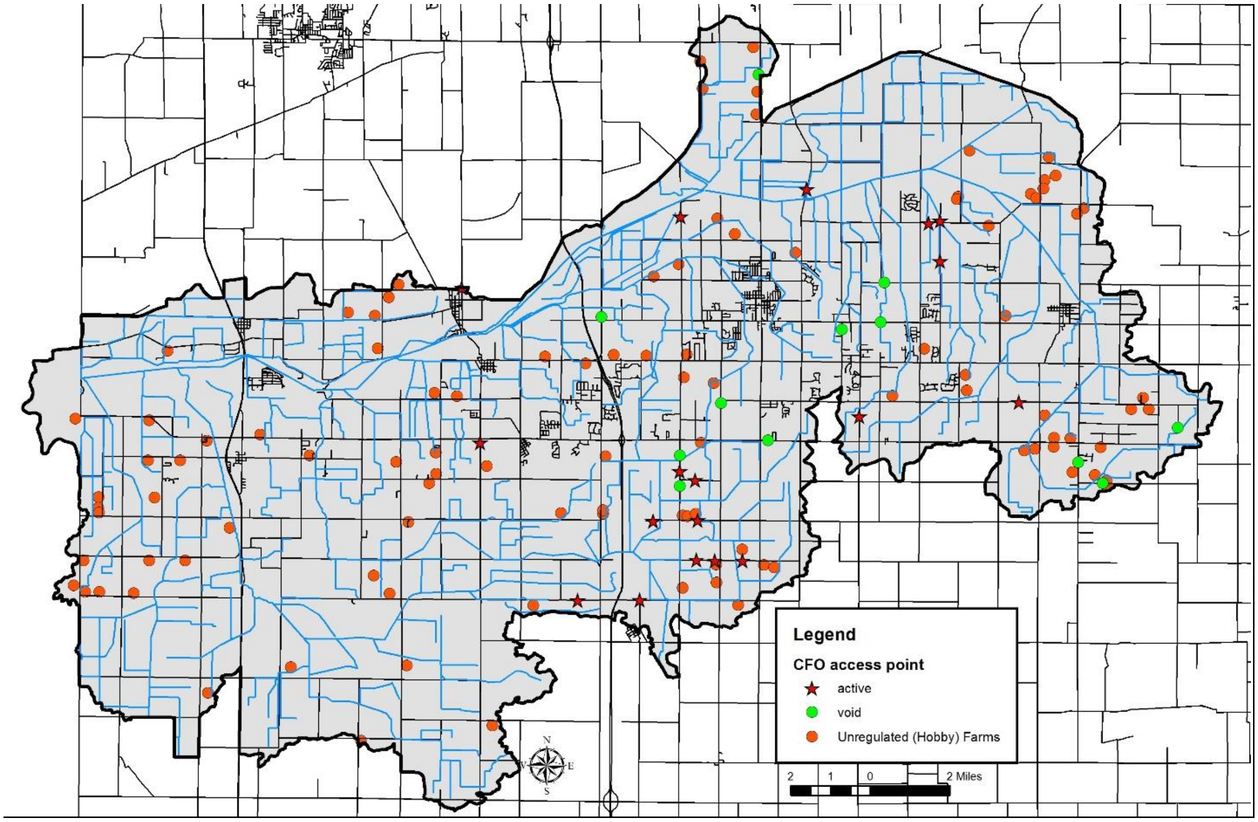
2.7.2.3 Confined Feeding Operations and Hobby Farms

A mixture of small, unregulated, and larger, regulated livestock operations (confined feeding operations) is found within the Lower Kankakee River Watershed. Small farms are those which house small numbers of animals for any period throughout the year, while farms that house large numbers of animals for longer than 45 days per year are regulated by IDEM. These regulations are based on the number and type of animals present. IDEM requires permit applications which document animal housing, manure storage and disposal, and nutrient management plans for farms which maintain 300 or more cows, 600 or more hogs, or 30,000 or more fowl. These facilities are considered confined feeding operations (CFO). There are 19 active confined feeding operations (Figure 30) located in seven subwatersheds. There are an additional 12 voided CFOs that historically operated within the watershed. The facilities house hogs with a combined total of 8,933 gestating sows or sows with litters, 13 boars, 7,554 finishing hogs, and an additional 9,060 farrowing hogs. Additionally, 3,609 beef cattle and 15,071 dairy cattle are housed in confined feeding operations.

Additionally, 104 small, unregulated animal farms containing nearly 1,177 animals were identified during the windshield survey, which is most likely an underestimate of the actual number. These small "mini farms" contain small numbers of cattle, horses, llamas, poultry, or goats, which could be sources of nutrients and *E.coli* as these animals exist on small acreage lots with limited ground cover.

In total, approximately 44,227 animals per year are housed in CFOs and more than 1,075 animals are housed on hobby farms in the watershed. In total, animals in the Lower Kankakee River Watershed generate approximately 494,975 tons of manure per year which is spread over the watershed. This volume of manure contains approximately 551,571 pounds of nitrogen, 362,110 pounds of phosphorus and 2.45xe1016 colonies of *E. coli*. Calculations are based on data from Baker and Walls, 2002; Crane et al., 1983; Texas A&M, 2009; and Georgia DNR, 2014.

Figure 30- Confined Feeding Operation and Unregulated Animal Farm Locations Within the Lower Kankakee River Watershed



2.9.3 Natural Land Use

Natural land uses including forest, wetlands, and open water cover approximately 22.5% of the watershed. Approximately 25,411 acres or 13.5% of the watershed are covered by trees. Forest cover occurs adjacent to waterbodies throughout the watershed, with the extent of forests mostly centered throughout the center of the watershed. Generally, the forested tracts in the center of the watershed are contiguous, with only some lengths of the watershed streams containing intact riparian buffers. Many of the high-quality forested areas are protected by the Indiana DNR and/or The Nature Conservancy. Natural land uses, included forest and wetland areas, can assist with water retention which may address the stakeholder concern of flooding. Additionally, natural land uses can retain nutrients and pathogens and reduce sediment runoff.

2.9.4 Urban Land Use

Urban land uses cover approximately 7.5% of the watershed. Although this is only a very small portion of the watershed, there are some significant issues related to the developed areas. Especially troublesome are issues related to failing septic systems, impervious surfaces, flooding, fertilizer use, pet waste and stormwater runoff that allow untreated sewage and stormwater to flow into the watershed during heavy rain events. The use of fertilizer on urban and suburban land is a potential concern; however, data to quantify this use is not available. Model predictions from the Chesapeake Bay suggest that urban residents typically apply 43 lb of nitrogen and 1.3 lb of phosphorus per year (Sweeney, 2016).

Pet populations can affect pathogen levels. While a count of pets for the Lower Kankakee River Watershed was not completed, dog and cat populations were estimated for the Watershed using statistics reported in the 2012 U.S. Pet Ownership & Demographics Sourcebook. Specifically, the Sourcebook reports that on average 37.4 percent of households own dogs and 32.9 percent of households own cats. Typically, the average number of pets per household is 1.7 dogs and 2.2 cats. However, pets are likely only a significant source of E. coli in population centers. The estimated number of domestic pets in cities and towns in the Lower Kankakee River Watershed is based on the average number of pets per household multiplied by the population of the watershed resulting in a suggested population of 6,627 cats and 4,023 dogs. While pet waste cannot be quantified in the urban communities in the Lower Kankakee River Watershed, their impact is negligible when compared with impact from agricultural manure produced and applied within this watershed.

2.9.4.1 Impervious Surfaces

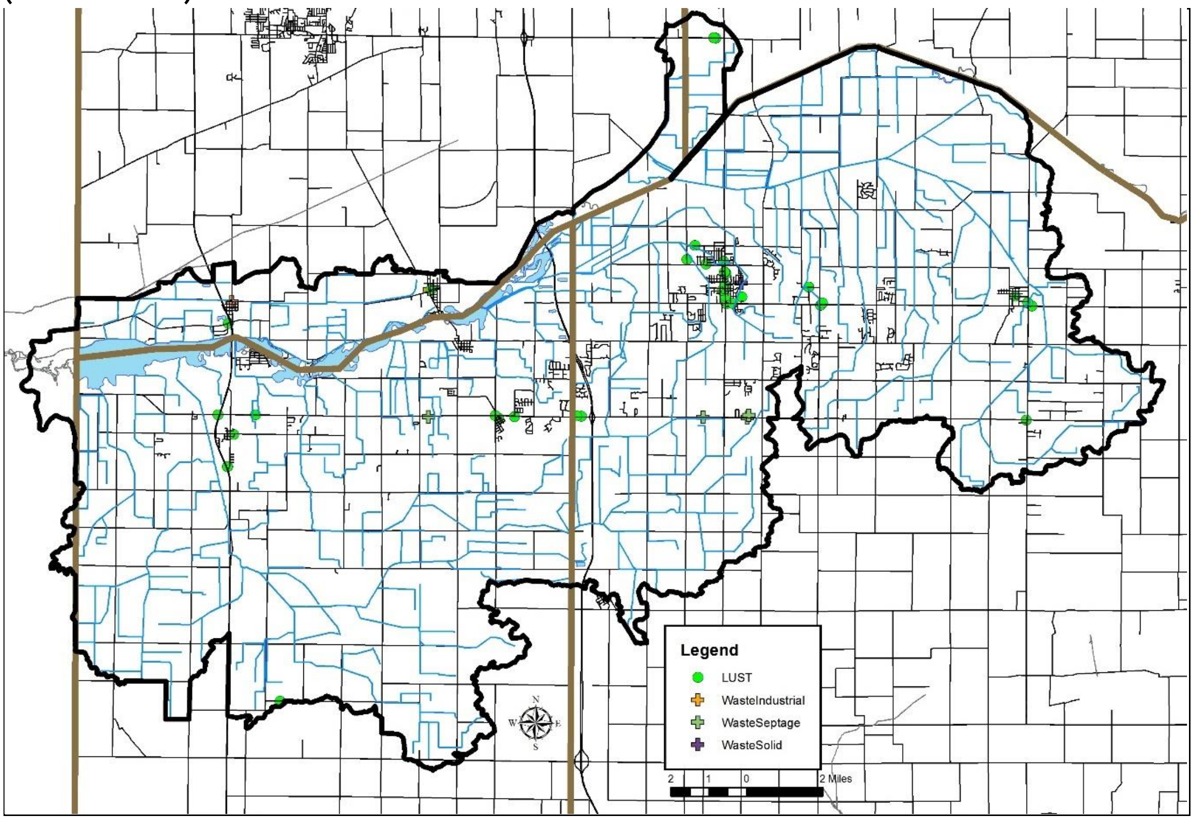
Impervious surfaces are hard surfaces which limit surface water from infiltrating into the land surface to become groundwater thereby creating high overland flow rates. Hard surfaces include concrete, asphalt, compacted soils, rooftops, and buildings or structures. In developed areas, land which was once permeable has been covered by hard, impervious surfaces. This results in rain which once absorbed into the soil running off rooftops and over pavement to enter the stream with not only higher velocity but also higher quantities of pollutants.

Overall, the watershed is covered by low levels of impervious surfaces. However, pockets of high impervious densities are present in DeMotte, Wheatfield, and along roads throughout the watershed (US 231, I-65, etc.). Estimates indicate that 6,540 acres (3.4%) of the watershed is covered by hard surfaces. Elvidge et al. (2004) indicated that streams in watersheds with greater than 10% impervious surfaces clearly exhibited degradation. The Center for Watershed Protection (CWP) identified similar impacts from impervious surface density on water quality. The CWP study indicates that stream ecology degradation begins with only 10% impervious cover in a watershed. Higher impervious surface coverage results in further impairments including water quality problems, increased bacteria concentrations, higher levels of toxic chemicals, high temperatures, and lower dissolved oxygen concentrations (CWP, 2003). Due to the watershed having a level of impervious surface below 10% and only a minor amount of storm sewers, it is anticipated that this issue is not significantly impacting the watershed.

2.9.4.1 Remediation Sites

Remediation sites including industrial waste, leaking underground storage tanks (LUST), open dumps, and brownfields are present throughout the Lower Kankakee River Watershed (Figure 31). Most of these sites are located within the developed areas of the watershed. In total, one industrial waste site, 42 LUST facilities, one solid waste, and one septage sites are present within the watershed. There are no Superfund sites within the watershed.

Figure 31- Industrial Remediation and Waste Sites Within the Lower Kankakee River Watershed (Source: IDEM)



2.10 Population Trends

The Lower Kankakee River Watershed is relatively a sparsely populated area in general. Several incorporated towns, including Schneider, Wheatfield, DeMotte, and multiple unincorporated areas including Roselawn, Lake Village, Thayer, and others are present throughout the watershed. The Fair Oaks and Rensselaer areas are just to the south.

Tracking population changes within a watershed is challenging as data is published by counties and townships rather than watershed boundaries. Changes in watershed population and the associated land use changes and infrastructure impacts were noted by watershed stakeholders. Estimates of the population of the watershed are derived by calculating percentage of the watershed within a county and extrapolating from county-wide data. The Lower Kankakee River Watershed mainly lies within Jasper and Newton counties. It drains 24.5% of Jasper County, 30% of Newton County, 3.7% of Lake County, and 0.7% of Porter County. Population trends for these counties derived from the most recently completed census (2010) are shown in Table 18 while Table 19 displays estimated populations for the portion of each county located within the watershed (StatsIndiana, 2018). The data indicate no growth in Jasper and Newton counties over the past decade. Due to the large population in Lake County, it is suspected that the estimated population for this county in the watershed is high; therefore, township populations were scaled for the three Lake County Townships located within the Lower Kankakee River Watershed.

Table 18- County Demographics for Counties Within the Lower Kankakee River Watershed

County	Area (acres)	Population (2010)	Population Growth (2000-2010)	Pop. Density (#/sq. mi)
Jasper	359,289	33,478	+3,435	59.8
Newton	258,201	14,244	-322	35.5
Lake	400,960	496,005	+11,441	994
Eagle Creek Township		1,668		
West Creek Township		6,826		
Cedar Creek Township		12,097		
Porter	333,952	164,343	+17,545	393

Table 19- Estimated Watershed Demographics for the Lower Kankakee River Watershed

County	Acres of County in Watershed	Percent in Watershed	Population
Jasper	87,984	24.5%	8,202
Newton	79,274	30.7%	4,372
Lake			
Eagle Creek Township	3371.6	1.8%	30
West Creek Township	5537.2	2.9%	198
Cedar Creek Township	6219.6	3.0%	362
Porter	2,272	0.7%	1,117
Total Estimated Population			14,281

2.11 Planning Efforts in the Watershed

The overall Kankakee River Basin has been the subject of in-depth review over the years by different organizations. Examples include:

- "Report upon the Improvement of the Kankakee River and the Drainage of the Marsh Lands in Indiana" by John L. Campbell, 1883.
- "Kankakee River Basin Indiana" by Indiana Department of Natural Resources, 1976.
- "Kankakee River Master Plan" by the Kankakee River Basin Commission, 1989.
- "Water Resource Availability in the Kankakee River Basin, Indiana" by Indiana Department of Natural Resources, 1990.

More recently, several larger plans have encompassed portions of the Lower Kankakee River Watershed or areas which it drains or outlets into. Current planning efforts include organizations such as the Kankakee River Basin Commission (now the newly created Kankakee River Basin and Yellow River Basin Development Commission as of 2019), Jasper, Newton, Lake and Porter County SWCDs, and others.

2.11.1 Kankakee River Flood and Sediment Management Work Plan (2019)

The Kankakee River Basin and Yellow River Basin Development Commission in partnership with the city of Watseka and Iroquois and Kankakee counties, Illinois hired Christopher B. Burke Engineering to review flooding and sediment movement through the Kankakee River Basin (CBBEL, 2019). The report highlights field observations, available data, dredging and straightening history and other modifications to the Kankakee River and its drainage system since 1990. The study identified several key factors that affect channel stability and flow capacity (flooding) of the system including the following:

- Spoil piles and berms: Spoils materials from dredging and straightening the Kankakee River and its tributaries were cast to the sides of the river. While this is perceived as providing flood protection, this is generally not the case as berms are discontinuous, inconsistent, and unstable with placement occur in a disorganized fashion. CBBEL recommends removing some berms and terminating maintenance of others to improve stability and system capacity.

- Increased flooding: Storm events are becoming more frequent and intense in the Kankakee River Basin based on rainfall data, climate studies and stream gaging data. CBBEL recommends 1) removal/replacement of abandoned or deficit bridges to eliminate obstructions; 2) improvement to existing stormwater ordinances and technical standards to offset impacts of future development, drainage efforts and anticipated continued stormwater runoff increases; and 3) the implementation of strategic flood protection measures to protect critical infrastructure and facilities.
- Heavy sediment and low loading from the Yellow and Iroquois Rivers: These rivers have long been identified as critical issues in the Kankakee River system. The Yellow provides a disproportionate volume of sand and flow during signification flow events while the Iroquois provides a large volume of fine silts and clays. Both inputs occur outside of the Lower Kankakee River Basin.

Specific active and passive recommendations which impact the Lower Kankakee River Watershed within the Kankakee River Basin are as follows:

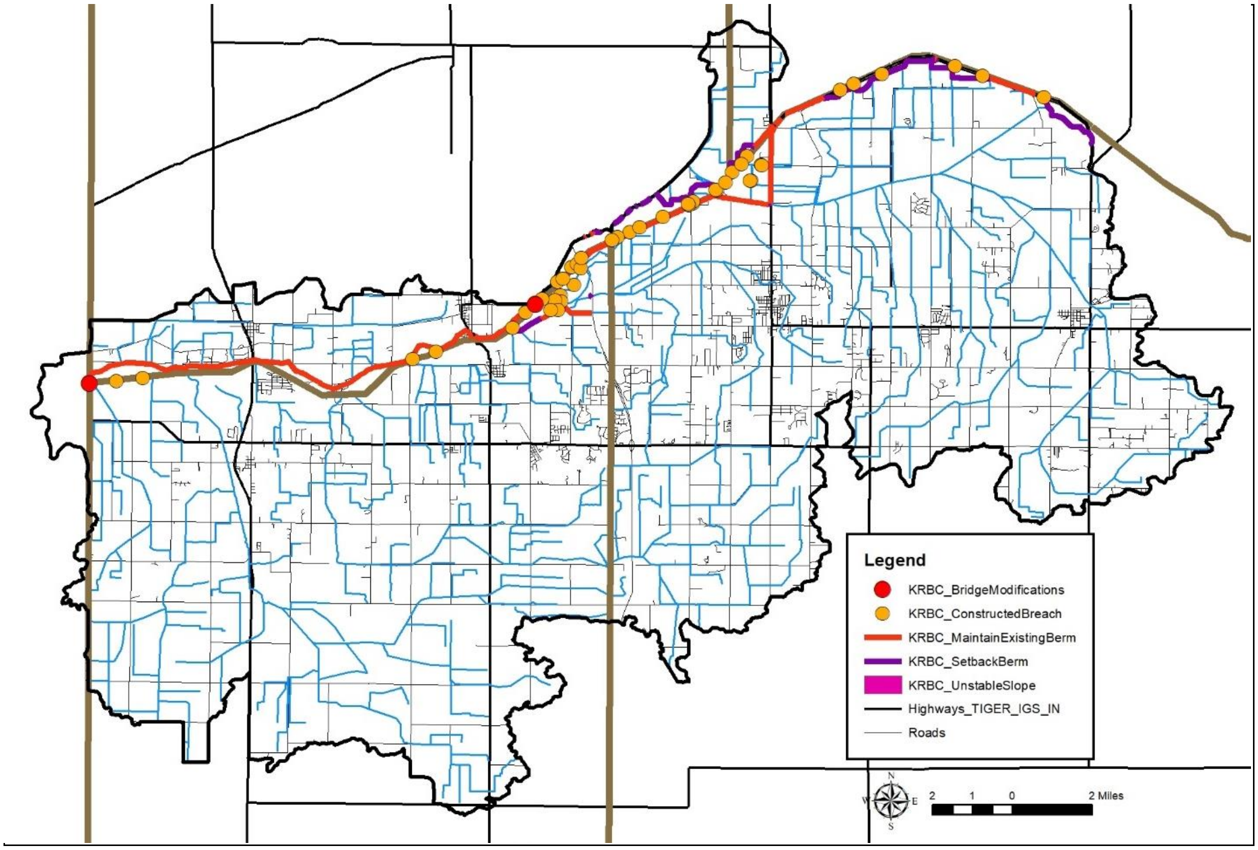
- Reduce sediment supply from severely eroded Kankakee slopes
- Implement zone specific access and manage logjams
- Selective and temporary berm maintenance
- Strategically remove berms and mitigate flooding using setback berms
- Bridge removal and replacement
- Construct storage along laterals to offset increased runoff
- Implement strategic flooding measures
- Reduce sediment supply from the Yellow River
- Remove large woody material in the most downstream reach of the Yellow River
- Yellow River restoration downstream of Knox

Specific passive management recommendations which impact the Lower Kankakee River Watershed include the following:

- Update stormwater ordinances and technical standards
- Mitigate agricultural and county drainage project impacts
- Incentivize cover crop planting
- Address rill and gully erosion
- Develop flood response plans
- Develop flood resilience plans
- Strategically relocate infrastructure from berm-reliant areas.

The plan identifies more than $134 million in basin improvements and identifies an implementation strategy from 2020 through 2060. Figure 32 highlights projects recommended by the master plan within the Lower Kankakee River Watershed. Specifically, the plan calls for two bridge modifications including replacing one bridge and realigning the piers of another; 45 constructed levee breaches including berms 10, 11, 13, 14 and 17; 10 locations where perm maintenance is needed; 10 locations where berm setbacks should occur along berms 9 to 17, and 13.6 acres of unstable slopes which should be addressed. Most of this acreage occurs in Jasper County (10.5 acres). Appendix C details the work plan items which occur within Jasper, Newton, Lake and Porter Counties and documents their locations in more detail.

Figure 32- Kankakee River Flood and Sediment Work Plan project locations in the Lower Kankakee River Watershed.



2.11.2 Kankakee River Watershed Restoration Action Strategy (2001)

The Indiana Department of Environmental Management, Office of Water Quality, working with the Elkhart County, Jasper County, Kosciusko County, Lake County, LaPorte County, Newton County, Porter County, Pulaski County, Starke, and St. Joseph County SWCD's, along with the Kankakee River Basin Commission, prioritized the natural resources needs and concerns for each county. This document describes the impaired waterbodies and describes the priority issues with recommended management strategies. Overall issues evaluated include:

- Data/Information and targeting;
- Streambank erosion and stabilization;
- Failing septic systems and straight pipe discharges;
- Fish consumption advisories;
- General nonpoint source pollution issues that include TMDLs, education and outreach;
- General point source pollution issues that include NPDES permit dischargers etc.

2.11.3 Watershed Management Plan for Lake, Porter, and LaPorte Counties (2005)

The Northwest Indiana Regional Watershed Plan developed a framework for water quality improvements and planning within Northwestern Indiana Regional Planning Commission's (NIRPC) planning area. The plan focuses on two watersheds, one of which is the Kankakee River Basin.

Several critical areas with regards to water quality were identified for the watershed:

- Reduce sedimentation;
- Preserve natural areas;
- Protect natural drainage systems and limit disturbance of natural features;
- Limit increases in impervious areas;
- Preserve, enhance, establish riparian buffers;
- Ensure on-site sewage disposal systems function properly;
- Minimize the discharge of contaminants from agricultural, wastewater, and stormwater runoff;
- Limit hydromodifications, such as channelization.

The watershed management plan calculates loading rates for each of the Kankakee River Basin's 12 digit HUCs. Subwatershed pollutant loading was determined by NIRPC using the EPA's Spreadsheet Tool for Estimating Pollutant Load (STEPL). STEPL uses simple algorithms to calculate nutrient and sediment loads from different land uses. The results are presented as total load (nitrogen, phosphorus, biochemical oxygen demand (BOD), and sediment) by subwatershed and land use. The user inputs land use area (acres), agricultural animals (number), septic system data, and has the option to modify the Universal Soil Loss Equation (USLE) parameters for each land use. Data to help fill in these fields is available from the STEPL Data Server. Additionally, the user can provide optional/modify input data including average soil hydrologic group, reference runoff curve number, nutrient concentration, urban land use distribution, and irrigation data. NIRPC used the 2006 NOAA CCAP land cover data, estimated the average soil hydrologic group for each subwatershed, and downloaded soil total nitrogen and phosphorus data from the STEPL website for the region. Target concentrations are 10 mg/L for nitrogen, 0.3 mg/L for phosphorus and 30 mg/L for sediment. Loading rates and reductions needed to meet water quality targets are detailed in Table 20 with nitrogen and phosphorus loading rates in pounds per year and sediment in tons/year.

Table 20- STEPL Loading Rates Calculated for the Lower Kankakee River 12-digit HUCs

	Current Load			Target Load			Reduction Needed		
Subwatershed Name	**Total N**	**Total P**	**Sediment**	**Total N**	**Total P**	**Sediment**	**Total N**	**Total P**	**Sediment**
Headwaters Wolf Creek	43,885	19,075	1,950	174,458	5,234	262	None	13,841	1,688
Hickam Lateral-Wolf Creek	37,533	22,271	2,596	94,817	2,845	142	None	19,426	2,454
Delehanty Ditch-Hodge Ditch	55,533	23,672	2,426	212,274	6,368	318	None	17,304	2,108
Cook Ditch-Hodge Ditch	49,404	28,814	3,341	127,467	3,824	191	None	24,990	3,150
Dehaan Ditch	54,604	28,741	3,333	163,457	4,904	245	None	23,837	3,088
Wentworth Ditch-Knight Ditch	98,232	45,141	4,739	345,004	10,350	518	None	34,791	4,221
Brown Levee Ditch-Kankakee River	38,318	21,663	2,505	102,320	3,070	153	None	18,593	2,352
Gregory Ditch-Mud Lake Ditch	33,832	20,125	2,355	83,844	2,515	126	None	17,610	2,229
Mud Lake Ditch-Beaver Lake Ditch	31,144	18,806	2,209	31,144	2,269	113	None	16,537	2,096
Lawler Ditch-Beaver lake Ditch	59,356	29,109	3,151	59,356	5,889	294	None	23,220	2,857
Williams Creek	49,025	20,911	2,134	49,025	5,106	255	None	15,805	1,879
Beaver Lake Ditch-Kankakee River	28,708	16,564	1,945	28,708	2,291	115	None	14,273	1,830

2.11.4 Jasper County Comprehensive Plan (2008)

The Jasper County Comprehensive Plan highlights the need to focus on preserving and enhancing the County's natural resources and environmental features and protect these features from the impacts of development. Objectives relevant to the Lower Kankakee River Watershed include:

- Protect the water volume and quality in lakes, streams, and their watersheds, including underground aquifers;
- Minimize conflicts between the built environment and the natural environment;
- Conserve existing natural areas including woodlots, wildlife habitats, riparian corridors, littoral corridors, open space, wetlands, and floodplains;
- Encourage the proper use of land application methods and practices;
- Preserve and enhance historical and culturally significant amenities.

2.11.5 Lake County, Indiana Multi-Hazard Mitigation Plan (2010)

Developed in coordination with The Polis Center (IU), the hazard mitigation plan evaluates disasters and strategies to reduce or eliminate long-term risk to human life and property from hazards. Hazard mitigation planning is a primary goal of the Federal Emergency Management Agency. The plan notes that one of the primary sources of flooding within Lake County is due to the Kankakee River. With regards to the Lower Kankakee River Watershed, this plan discusses the Town of Schneider and recommends:

- Conduct a sewer upgrade to separate stormwater and sanitary sewer lines;
- Improve stormwater drainage throughout the community, specifically along U.S. Hwy 41;

Ideally, community projects that involve drainage and flood protection would be coordinated with other agencies to ensure that projects do not increase flooding or increase water quality issues elsewhere in the watershed.

2.11.6 Kankakee-Iroquois Regional Planning Commission (2010)

This Commission developed the Comprehensive Economic Development Strategy for the eight-county region it serves. A primarily rural area in the state, the commission evaluated the region and its economy, infrastructure, population, labor force, and potentials for economic development. Items of interest include:

- In 2008, the overall population of the area had decreased by 0.25% as compared to the 2000 Census;
- Vital regional projects include connecting utilities to all five I-65 interchanges in Jasper County and fast-growing unincorporated areas of the county, region-wide railroad development;
- Continue to attract wind farms to the region and expand into Jasper and Newton Counties;
- Continue to promote transportation and infrastructure upgrades (e.g., sanitary sewer, drainage etc.)

2.11.7 Jasper County SWCD Plan of Business

The Jasper County SWCD Business Plan highlights four critical issues for Jasper County: 1) healthy soils (e.g., soil erosion), 2) healthy water (e.g., water quality degradation), 3) land use and development (e.g., habitat degradation), and 4) district development (e.g., education). The following goals are highlighted for completion in 2019:

- Healthy Soils: Addressing Soil Erosion
  - Establish 5000 new cover crop acres
  - Increase no till bean practices based on tillage transect data
  - Increase no till/strip till corn practices based on tillage transect data
- Healthy Soils: Addressing Soil Quality Degradation
  - Enroll more farmers to participate in INfield Advantage
  - Establish 1000 acres of new cover crop acres
  - Perform three soil health demonstrations across the watershed
  - Promote the use of soil health testing and monitoring
- Water Management: Addressing Water Quality Degradation
  - The SWCD will increase septic system awareness/education
  - Continue to develop the Lower Kankakee Watershed Initiative
  - Reduce excess nutrients in ground water
  - Reduce excess nutrients in surface water
- Land Use and Development: Addressing Habitat Degradation/Fragmentation
  - Educate landowners about benefits of native plants and the negative impact of invasive plants on the environment
  - 100 acres of wildlife habitat will be installed in Jasper County by 2020
  - 100 acres of wildlife habitat will be protected in Jasper County by 2020
- Land Use and Development: Addressing Inadequate Livestock Water
  - Reduce number of livestock access sites by 50% in key critical areas

2.12 Watershed Summary: Parameter Relationships

Several relationships among watershed parameters become apparent when watershed-wide data are examined. These relationships are discussed here in general, while relationships within specific subwatersheds are discussed in more detail in subsequent sections.

2.12.1 Topography, Soils and Hydrologic Modification

Much of the topography and terrain characteristics within the Lower Kankakee River Watershed have a direct correlation to water quality. Topography within the watershed is generally flat, with the watershed once being a large area known as the Grand Kankakee Marsh. As noted, it is estimated that approximately 90% of the wetlands have been lost in the watershed due to an extensive network of drainage ditches. Due to these ditches, many areas of the watershed are well suited to agriculture. As a result, approximately 70% of the watershed is in agricultural row crop or pasture/hay production. Because of the low slope and poor drainage, tile drains are extensively used throughout the watershed. Approximately 8% of the Lower Kankakee River Watershed is mapped in potentially highly erodible soils. Potentially highly erodible soils are very susceptible to erosion. Nutrients, such as phosphorus, and sediment erode easily when these soils are not covered. Sediments and nutrients that reach Lower Kankakee River waterbodies are likely to degrade water quality. Potentially highly erodible soils that are used for animal production or are located on cropland are more susceptible to soil erosion. Low soil erodibility is a positive for the Lower Kankakee River Watershed. It will be important to address the impacts of row crop agriculture and tile-drained systems, by promoting practices to reduce nutrients transported through tiles in order to improve water quality in the watershed.

2.12.2 Development and Population Centers

Much of the watershed's population is located within small, incorporated areas, such as the Town of DeMotte. Overall, the population is sparse, but there are some unsewered, dense housing areas located throughout the watershed with small subdivisions and roadside housing developments occurring. All other residences utilize septic systems. This is a concern because adequate filtration may not occur, and pollutants in this water may easily reach water sources and groundwater. Most soils are poorly to very poorly drained, indicating ponding and seasonal high-water tables. Therefore, there is a Very Limited rating for the use of septic systems (Figure 12) throughout the entire watershed. The USDA NRCS notes that some of the soil associations are unsuitable for building site development and sanitary facilities.

With a lack of natural filtration of septic fields to groundwater, degradation of water quality is likely if septic systems are not maintained. There is a low impervious surface density and few NPDES-regulated facilities occurring within the watershed. This indicates a low concentration of urban pollution issues, which is a positive for the Lower Kankakee River Watershed.

2.12.3 High Quality Habitat and ETR Species

Many high-quality communities occur along the Kankakee River and throughout the watershed. Due to the extensive efforts of organizations such as The Nature Conservancy, the Indiana Department of Natural Resources, and others, the savanna, marsh, and wetland complexes are being reconstructed and provide unique habitats which house several endangered, threatened, or rare communities and species. Many of the endangered, threatened, and rare species and high-quality natural communities in the watershed are found along the stream corridor, making this an important area to focus habitat preservation and restoration efforts.

3.0 WATERSHED INVENTORY PART 2A – WATER QUALITY AND WATERSHED ASSESSMENT

In order to better understand the watershed, an inventory and assessment of the watershed and existing water quality studies conducted within the watershed is necessary. Examining previous efforts allowed the project participants to determine if sufficient data was available or if additional data needed to be collected to characterize water quality problems. Once the water quality data assessment occurred, the watershed was then characterized to determine potential sources of any water quality issues identified by the data review. Subsequently, pollutant sources could then be tied to stakeholder concerns and collected data could be used to estimate pollutant loads from each identified source location. The following sections detail the water quality and watershed assessment efforts on both the broad, watershed-wide scale and in a focused manner looking at each subwatershed within the Lower Kankakee River Watershed.

3.1 Water Quality Targets

Many of the historic water quality assessments occurred using different techniques or goals. Several sites were sampled only one time and for a limited number of parameters. Monitoring committee members were reluctant to draw too many conclusions based on a single sampling event. Nonetheless, the available data are detailed below and compared in general with water quality targets. To compare the results of these assessments, the monitoring committee identified a standard suite of parameters and parameter benchmarks. Table 21 details the selected parameters and the benchmark utilized to evaluate collected water quality data.

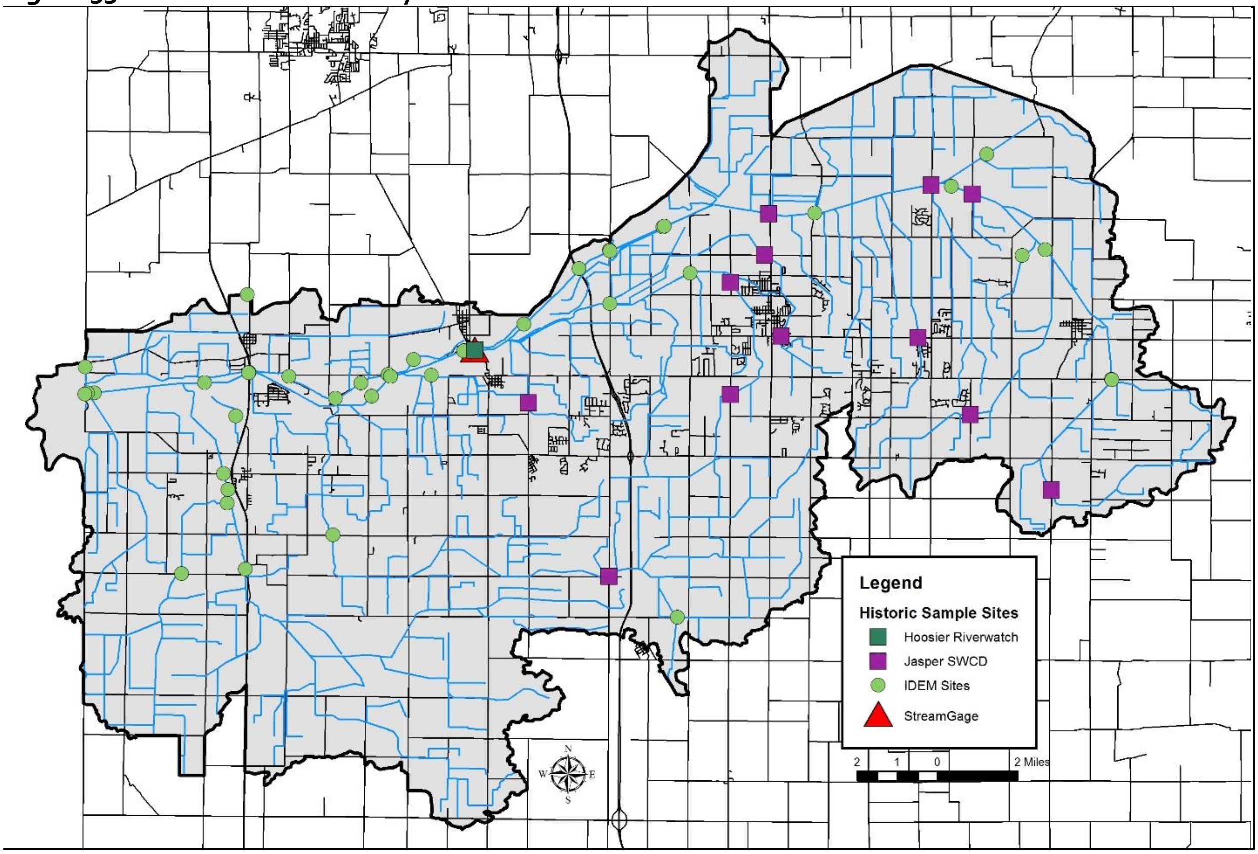
Table 21- Suggested Water Quality Benchmarks Used to Assess Water Quality from Historic and Current Water Quality Assessments

Parameter	Water Quality Benchmark	Source
Dissolved oxygen	>4 or <12 mg/L	Indiana Administrative Code
pH	>6 or <9	Indiana Administrative Code
Temperature	Monthly standard	Indiana Administrative Code
E. coli	<235 CFU /100 mL	Indiana Administrative Code
Nitrate-nitrogen	<0.5 mg/L	Dodds et al. (1998)
Ammonia-nitrogen	0.0 – 0.21 mg/L	Indiana Administrative Code
Total phosphorus	<0.08 mg/L	Dodds et al. (1998)
Orthophosphorus	<0.05 mg/L	Dunne and Leopold (1978)
Total suspended solids	<15 mg/L	Waters (1995)
Turbidity	<5.7 NTU	USEPA (2001)
Qualitative Habitat Evaluation Index	>51 points	IDEM (2008)
Index of Biotic Integrity	>36 points	IDEM (2008)
Macroinvertebrate Index of Biotic Integrity	>2.2 points (old) >36 points (new)	IDEM (2008)

3.2 Historic Water Quality Sampling Efforts

A variety of water quality assessment projects have been completed within the Lower Kankakee River Watershed (Figure 33). Statewide assessments and listings include the integrated water monitoring assessment, the impaired waterbodies assessment, and fish consumption advisories. The Indiana Department of Environmental Management (IDEM) and U.S. Geological Survey (USGS) have both completed assessments within the watershed. The Jasper County SWCD completed water quality assessments as part of their Clean Water Indiana grant in 2007 and 2008. Additionally, the volunteer-based, Hoosier Riverwatch monitoring program also provides water quality data with which the watershed can be characterized. A summary of each assessment methodology and general results are discussed below. Specific data results are detailed within subwatershed discussions in the subsequent section.

Figure 33- Historic Water Quality Assessment Locations



3.2.1 Integrated Water Monitoring Assessment (305(b) Report)

The Indiana Department of Environmental Management (IDEM) is the primary agency tasked with monitoring surface water quality within the state of Indiana. Chapter 305(b) of the Clean Water Act requires that the state report on the quality of waterbodies throughout the state on a biennial basis. These assessments are known as the Integrated Water Monitoring and Assessment Report (IR) and integrates the 305(b) report and 303(d) list. The most recent report was delivered to the USEPA and underwent public comment in 2018 (IDEM, 2018). There is a published 2018 report, and the 2020 report will soon be available for public comment. To complete this report, the 305(b) coordinator reviews all data collected by IDEM and selected high-quality data collected by other organizations on a waterbody basis. Each assessed waterbody is then assigned a water quality rating based on its ability to meet Indiana's water quality standards (WQS). WQS are set at a level to protect Indiana waters' designated uses of swimmable, fishable, and drinkable. Waterbodies that do not meet their designated uses are proposed for listing on the impaired waterbodies list, which is discussed in more detail below. The 2016 IWMA includes 27 waterbody reaches in the Lower Kankakee River Watershed (IDEM, 2016). Listings include the following:

- One segment of Hodge Ditch, one segment of Delehanty Ditch, and two segments of James Ditch are listed for impaired recreational use due to elevated E. coli concentrations and as impaired for aquatic life use due to low dissolved oxygen levels.
- One segment of Hodge Ditch is listed as impaired for aquatic life use due to low dissolved oxygen levels.
- One segment of Evers Ditch, one segment of Hibler Ditch, and two segments of Boyle Ditch are listed for impaired recreational use due to elevated E. coli concentrations.

- Three segments of Wolf Creek, one segment of Hodge Ditch, one segment of Tyler Ditch, two segments of Brown Levee Ditch, two segments of Bogus Island Ditch and two segments of tributaries to Bogus Island Ditch, one segment of Lawler Ditch, one segment of Redden Ditch and two segments of the Kankakee River are listed as impaired for recreational uses due to elevated E. coli concentrations. However, a TMDL has been written for these stream segments, which addresses these E. coli impairments.
- One segment of Williams Ditch, one segment of Wolf Creek, and two segments of the Kankakee River are listed as impaired for fish consumption due to PCBs.

3.2.2 U.S. Geological Survey Assessments (1963-present)

From 1963-1968, 1976-1979, 1989, 1999, 2004, and 2009-2019, the U.S. Geological Survey (USGS) sampled water chemistry at five stream locations in the Lower Kankakee River Watershed. The State Road 55 site was regularly monitored, and results collected since 2004 are summarized below. Table 16 details water quality targets. Based on the water chemistry assessments, the following conclusions can be drawn:

- Dissolved phosphorus (orthophosphorus) concentrations measured higher than target concentrations in 9% of samples collected.
- Total phosphorus concentrations exceeded target concentrations in 93% of samples collected in the Lower Kankakee River Watershed ranging from 0.045 to 0.308 mg/L.
- Nitrate-nitrogen concentrations exceeded target concentrations in 68% of samples collected in the Lower Kankakee River Watershed ranging from 1.41 to 4.32 mg/L.
- Turbidity levels exceeded targets in 94% of samples collected in the Lower Kankakee River Watershed.
- Suspended sediment concentrations ranged from 18 to 195 mg/L in the Lower Kankakee River Watershed exceeding targets in 100% of samples.

The USGS deployed a continuous monitor (super gage) at the USGS gaging station near Shelby in 2015. The monitor collects temperature, conductivity, pH, dissolved oxygen, turbidity, and nitrate. Lathrop (219) reports the following ranges from December 2015 through May 2018:

- Temperatures ranged from -0.2 to 29.0 degrees Celsius.
- Conductivity ranged from 359 to 693 mS/cm all of which fall below WMP target concentrations.
- Dissolved oxygen ranged from 5.2 to 13.6 mg/L
- pH ranged from 7.0 to 8.3 all of which fall below WMP target ranges.
- Turbidity ranged from 0.0 to 229 NTU. Turbidity data were used to calculate suspended sediment concentrations.
- Nitrate ranged from 0.76 to 7.27 mg/L.

Figure 34 details monthly loading rates at the Kankakee River at Shelby gaging station for January 2016 through May 2018 (Lathrop, 2019). Figure 22 documents annual loading rates and yields (loading rate per acre of drainage) calculated by USGS using continuous flow data. Annual loading rates range from 77,800 tons/year to 105,000 ton/s year for sediment, from 4,4400 tons/year to 8,890 tons/year for nitrogen and from 167 to 265 tons per year for phosphorus.

Figure 34- Estimated Monthly Loads at the Gaging Station at Kankakee River at Shelby, Indiana (U.S. Geological Survey station 05518000), for January 2016 through May 2018 Computed from Combined Regression and rLoadest Models with Monthly 90 Percent Prediction Intervals

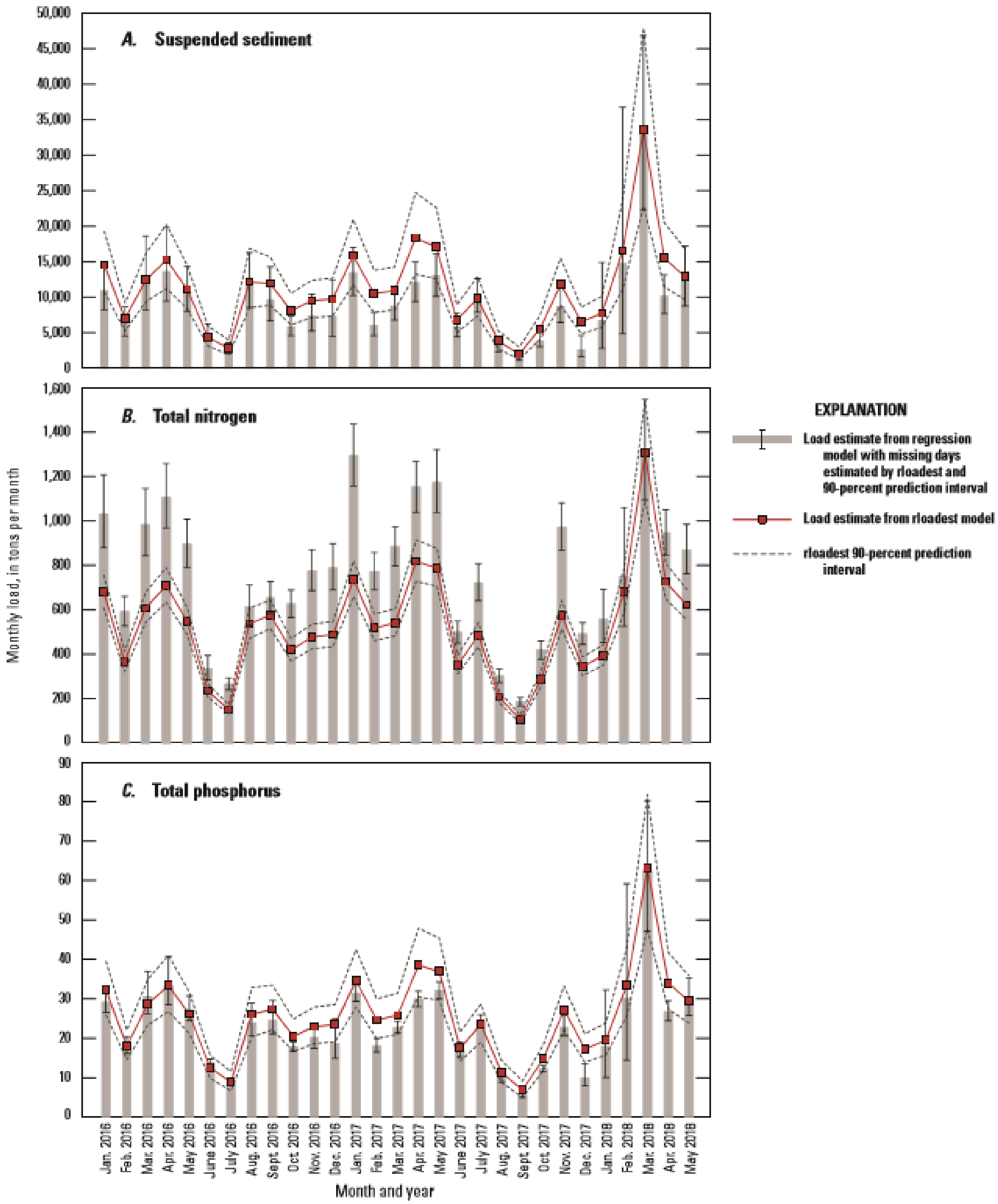


Table 22- Estimated Annual Loads and Yields for Suspended Sediment, Total Nitrogen and Total Phosphorus Computed from Daily Loads of Regression and rLoadest Models for the Gaging Station at the Kankakee River at Shelby (USGS 05518000)

Constituent	Period	Load (ton)	Load (ton), 90-percent prediction interval	Yield (ton per square mile per year)	Days estimated by rloadest models
Suspended sediment	1/1/2016–12/31/2016	105,000	74,900 to 147,000	58.8	42
	1/1/2017–12/31/2017	91,000	68,800 to 116,000	50.9	14
	1/1/2018–5/31/2018	77,800	46,800 to 129,000	—	69
	Total	274,000	190,000 to 392,000	—	125
Total nitrogen, as N	1/1/2016–12/31/2016	8,690	7,610 to 9,880	4.9	43
	1/1/2017–12/31/2017	8,890	7,950 to 9,850	5.0	9
	1/1/2018–5/31/2018	4,440	4,140 to 4,890	—	65
	Total	22,000	19,700 to 24,600	—	117
Total phosphorus, as P	1/1/2016–12/31/2016	265	233 to 311	0.15	43
	1/1/2017–12/31/2017	236	217 to 260	0.13	19
	1/1/2018–5/31/2018	167	122 to 236	—	71
	Total	669	572 to 808	—	133

3.2.3 IDEM Rotational Basin Probabilistic Monitoring and Fixed Station Assessments (1992-2018)

From 1990 to present, IDEM sampled water chemistry, macroinvertebrates, fish, and habitat at several locations in the Lower Kankakee River Watershed via their probabilistic and targeted monitoring programs. Additionally, one site – the Kankakee River at State Road 55 - is sampled monthly as part of IDEM's fixed station monitoring program. Sampling occurred in the Beaver Lake Ditch at CR 700 N and CR 950 N; in Dehaan Ditch at CR 1000 W and CR 600 E; in Hodge Ditch at CR 300 W and CR 700 W; in the Kankakee River at County Line Road, Clay Street, CR 1200 N, CR 1200 W, CR 1500 N, at SR 55 (Shelby), at the LaSalle Fish and Wildlife Area, at US 41, at Whitcomb Street, and at the State Line Bridge; in Knight Ditch at CR 800 N; in Lawler Ditch at CR 400 W and CR 100 N; in Schatzley Ditch at SR 10; at the Schneider wastewater treatment plant; in Williams Ditch at 125th Ave;, King Drive, Whitcomb Street; Wolf Creek at CR 100 N, CR 1100 N, and CR 300 W; and in tributaries of Duke Ditch, Wolf Creek and the Kankakee River.

A few of the assessments, which occurred via various IDEM assessment programs, included a single sample event. Most assessments included a minimum of five sample events and a few assessments included up to 12 events. Fixed station monitoring occurred monthly. Table 17 details water quality targets. Based on the water chemistry assessments, the following conclusions can be drawn:

- *E. coli* concentrations exceeded the state standard in 26% of fixed station samples and in 35% of all samples collected in the Lower Kankakee River Watershed.
- Nitrate-nitrogen concentrations exceeded target concentrations in 97% of fixed station samples and in 46% of all samples collected in the Lower Kankakee River Watershed.
- Total phosphorus concentrations exceeded the recommended criteria in 38% of fixed station samples and in 38% of all samples collected in the Lower Kankakee River Watershed.
- Total suspended solids concentrations exceeded the recommended criteria in 37% of fixed station and in 56% of all samples collected in the Lower Kankakee River Watershed.
- Turbidity levels routinely exceed the recommended standard in more than 97% of fixed station and 82% of all samples collected in the Lower Kankakee River Watershed.
- Macroinvertebrate community assessments indicate that the Kankakee River and its tributaries rate below target scores in 6 of 9 multihabitat assessments, while all four assessments rate better than target scores using the kicknet assessment method.

- Fish community assessments indicate that the Kankakee River and its tributaries rate as poor (32) to good (48). Headwaters Wolf Creek (48), Beaver Lake Ditch (46), and Brown Levee Ditch (46) scored good or measured above target levels while the eight (8) other sites scored below target levels (poor).
- In total, 8 of 13 habitat assessments completed as part of fish community assessment and 7 of 9 habitat assessments completed as part of macroinvertebrate community assessments scored below target levels (51) with scores as low as 32.

3.2.4 Kankakee/Iroquois Watershed TMDL

Water quality data collected by IDEM within the Lower Kankakee River Watershed in 2008 indicated that 3 of 3 sites meet the *E. coli* state standard historically; however, historically elevated *E. coli* concentrations have been observed in the Lower Kankakee River Watershed. Required *E. coli* reductions range from 0 to 99%. The Kankakee/Iroquois Watershed TMDL (Tetra Tech, 2009) addressed *E. coli* throughout the Lower Kankakee River Watershed.

Data collected by IDEM and used for TMDL calculation generate the following conclusions:

- A 79% reduction is needed in *E. coli* loading in Dehaan Ditch.
- A 44% reduction is needed in *E. coli* loading in the Beaver Lake Ditch in the Beaver Lake Ditch-Kankakee River subwatershed and a 78% reduction is needed in *E. coli* loading in the Beaver Lake Ditch in the Lawler Ditch subwatershed.
- A 42% reduction is needed in *E. coli* loading in the Hickam Lateral Ditch.
- A 39% reduction is needed in *E. coli* loading in Lawler Ditch.
- A 37% reduction is needed in *E. coli* loading in Brown Levee Ditch.
- A 36% reduction is needed in *E. coli* loading in Cook Ditch.
- A 29% *E. coli* load reduction is needed in the Kankakee River in the Beaver Lake Ditch-Kankakee River subwatershed.
- Subwatersheds listed were not assessed as part of the TMDL process.

IDEM recommended addressing the following contributing sources:

- Wastewater treatment plants, livestock access to streams, wildlife access to streams, and onsite wastewater/unsewered areas.
- The above areas as well as impervious surfaces and riparian areas during dry conditions.
- The above areas as well as Combined Sewer Overflows, field drainage, and upland stormwater issues during mid-range flows.
- The above as well as natural condition field drainage and bank erosion during moist conditions.
- On-site wastewater, abandoned mines, combined sewer overflows, stormwater inputs, field drainage from tiled and non-tiled files and bank erosion during high flow conditions.

3.2.5 Clean Water Indiana Water Quality Assessment (2007-2008)

The Jasper County SWCD collected three sets of water quality data from 12 watershed sites as part of their Clean Water Indiana grant project in 2007 and 2008. Samples were collected from fourteen locations and analyzed by Heidelberg Labs. Table 17 details water quality targets. The following conclusions can be drawn:

- Nitrate-nitrogen concentrations measured below target concentrations in nearly all samples. In total, only 3 of 42 collected samples measured above the target.
- Total phosphorus concentrations exceeded target concentrations in 2 of 14 samples.
- *E. coli* concentrations exceed targets in 11 of 42 collected samples with concentrations measuring as high as 110,000 col/100 mL.

3.2.6 Hoosier Riverwatch Sampling (2004 to 2018)

From 2004 to 2018, volunteers trained through the Hoosier Riverwatch program assessed one site in the Lower Kankakee River Watershed – the Kankakee River at State Road 55. Volunteers monitored stream stage, flow rate, and discharge; collected water chemistry samples for analysis using HACH test kits; assessed instream habitat using the Citizen's QHEI; and surveyed the stream's macroinvertebrate community. Using the chemical data, the Water Quality Index (WQI) was calculated. Volunteers calculated a Pollution Tolerance Index (PTI) using the biological data. Table 17 details water quality targets. Based on these data, the following conclusions can be drawn:

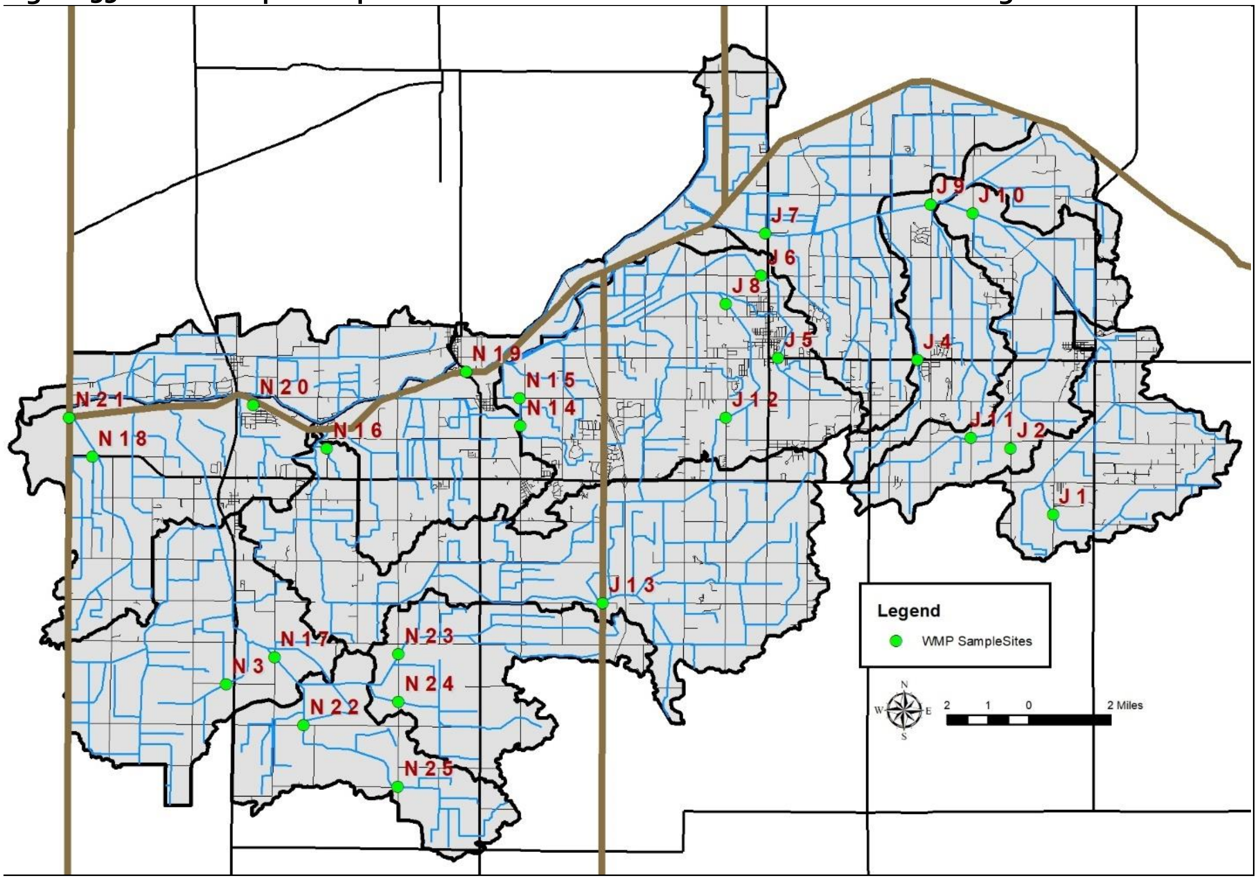
- In the Lower Kankakee River Watershed, nitrate-nitrogen concentrations were elevated measuring as high as 15.4 mg/L. Concentrations exceeded targets in 23 of 33 collected samples.
- Dissolved phosphorus concentrations typically were below target levels while pH, dissolved oxygen and temperature concentrations measured within state standards at all sites.
- Turbidity levels exceed targets in all samples collected measuring as high as 71 NTU.
- E. coli concentrations typically measured low; however, concentrations exceeded state standards in 3 of 23 collected samples.
- The pollution tolerance index ranged from 18 to 42 indicating that this Kankakee River reach rates as fair to good.

3.3 Current Water Quality Assessment

3.3.1 Water Quality Sampling Methodologies

As part of the current project, the Lower Kankakee River Project implemented a one-year professional water quality monitoring program. The program was augmented with additional sample collection for Total Suspended Solids and additional sample sites were added. The program included water chemistry and habitat assessments. Additionally, the project implemented a volunteer monitoring program to assess water chemistry and macroinvertebrate communities. The program is detailed below and in the Quality Assurance Project Plan for the Lower Kankakee River Watershed Management Plan, dated May 28, 2019. Sites sampled through this program are displayed in Figure 35. Sample sites were selected based on land use and watershed drainage and correspond with sites sampled by IDEM. The sampling regimen was enacted to create a baseline of water quality data.

Figure 35- Sites sampled as part of the Lower Kankakee River Watershed Management Plan



Stream Flow

Stream flow was measured *in situ* when grab samples were collected. Due to varying levels of flow, only six sites were sampled regularly for stream flow.

Field Chemistry Parameters

The Lower Kankakee River Project established 25 chemistry monitoring locations as part of the monitoring program. Temperature, dissolved oxygen, pH, turbidity, conductivity, were measured approximately monthly at the sampling locations. Sites 1-20 were monitored monthly from June 2019 to August 2020 for all parameters. Sites 21-25 were monitored from September 2020-August 2021 for all parameters. Appendix D contains data collected through this project.

Laboratory Chemistry Parameters

Like the field parameters, monthly laboratory sample collection and analysis occurred throughout the one-year sampling program. Samples were analyzed for total phosphorus, nitrate-nitrogen, total suspended solids, and *E. coli*. Sites 1-20 were monitored monthly from June 2019 to August 2020 for all parameters except Total Suspended Solids. TSS sample collection occurred from through February 2021 to complete the annual sampling run. Sites 21-25 were monitored from September 2020-August 2021 for all parameters. Appendix D details data collected through this project.

Habitat

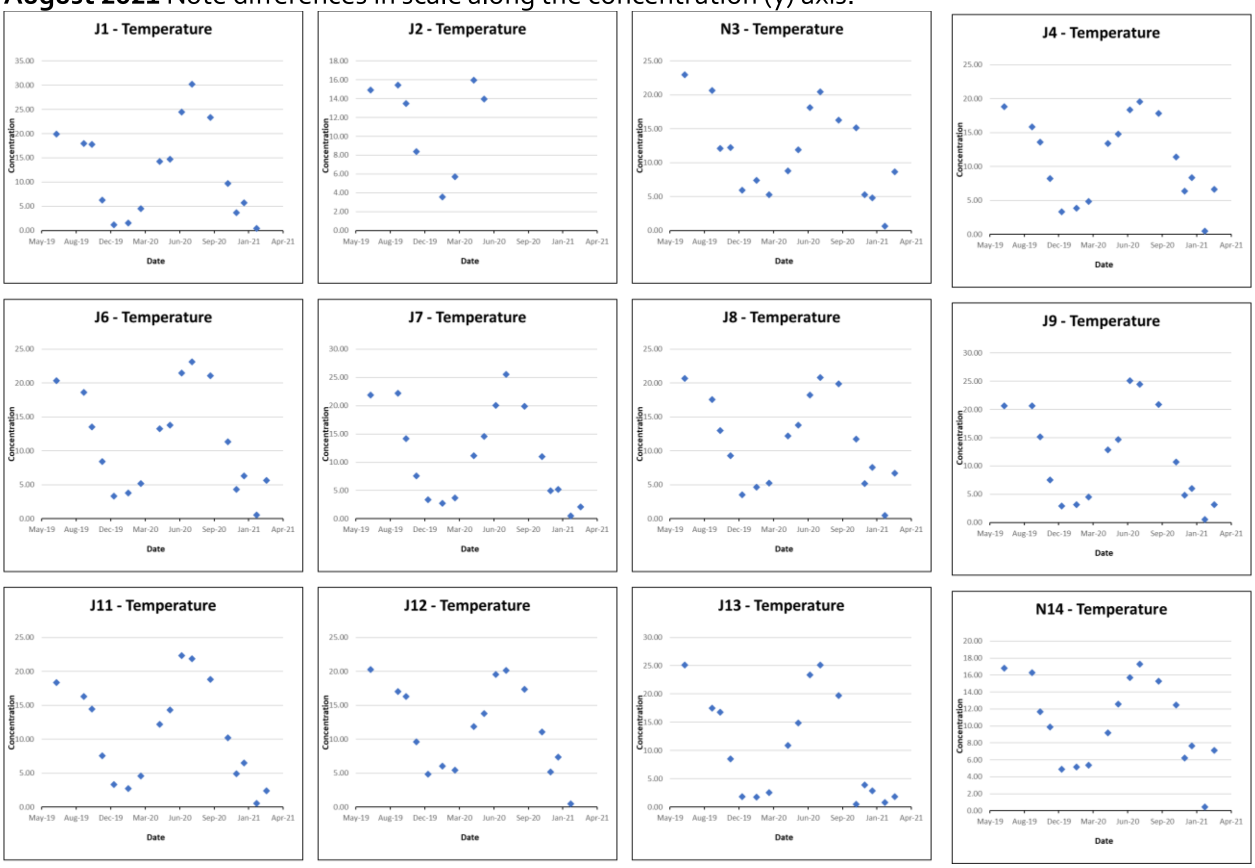
The physical habitat at each of the biological sample sites was evaluated using the Citizens Qualitative Habitat Evaluation Index (CQHEI). Hoosier Riverwatch uses the CQHEI to assess habitat in concert with macroinvertebrate community sampling. Jasper County SWCD assessed habitat at five sites in the summer of 2019.

3.3.2 Field Chemistry Results

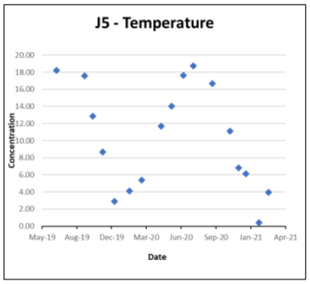
3.3.2.1 Temperature

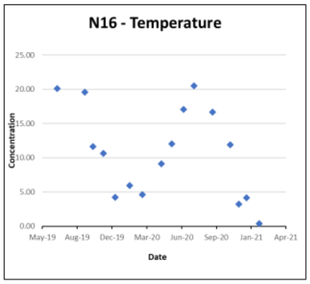
Figure 36 illustrates the monthly temperature measurements in Lower Kankakee River Watershed streams. As shown, temperatures measure approximately the same at each of the stream sites with seasonal changes in temperature creating major differences in temperature throughout the sampling period. Temperatures measured near 0 °C in all streams from December 2019 through March 2020 sampling events. The highest temperatures occurred during the June and July assessments depending on riparian cover and stream depth present at each location.

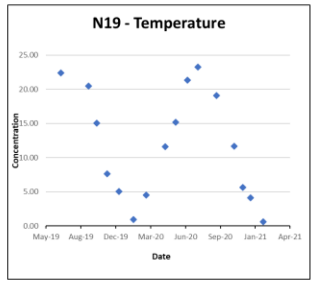
Figure 36- Temperature measurements in Lower Kankakee River samples sites from June 2018 to August 2021 Note differences in scale along the concentration (y) axis.

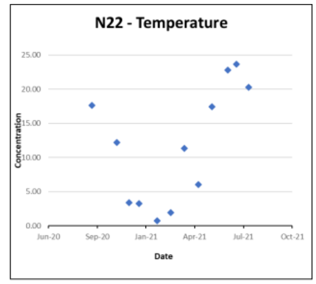


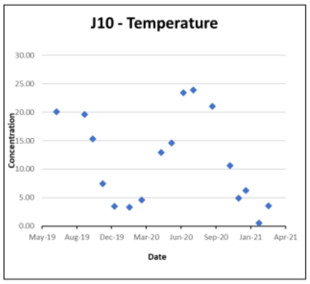
Temperature measurements in Lower Kankakee River samples sites from June 2018 to August 2021 (Continued) Note differences in scale along the concentration (y) axis.

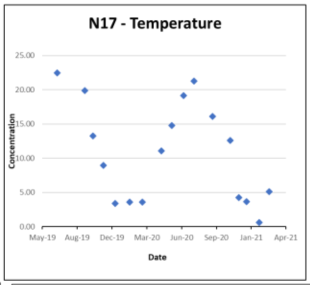


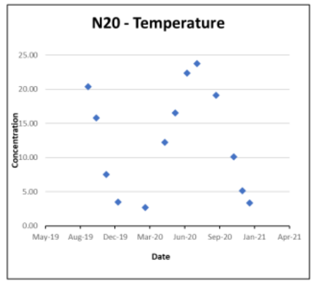


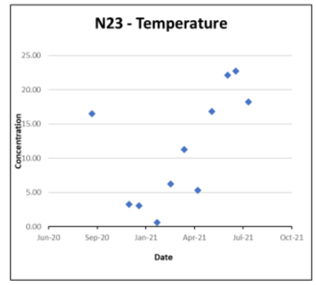


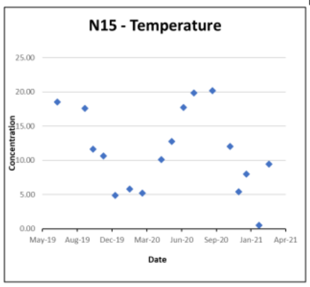


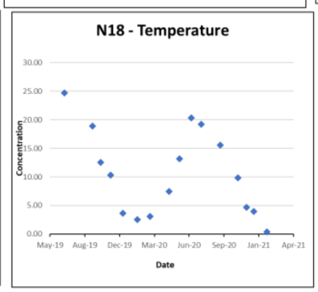


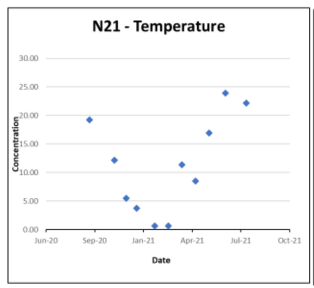


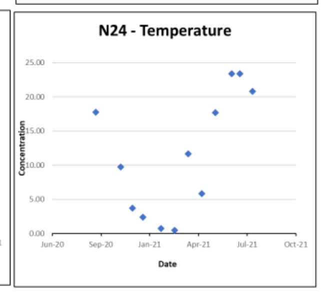


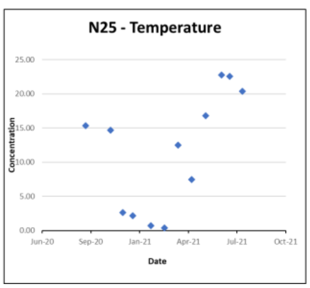








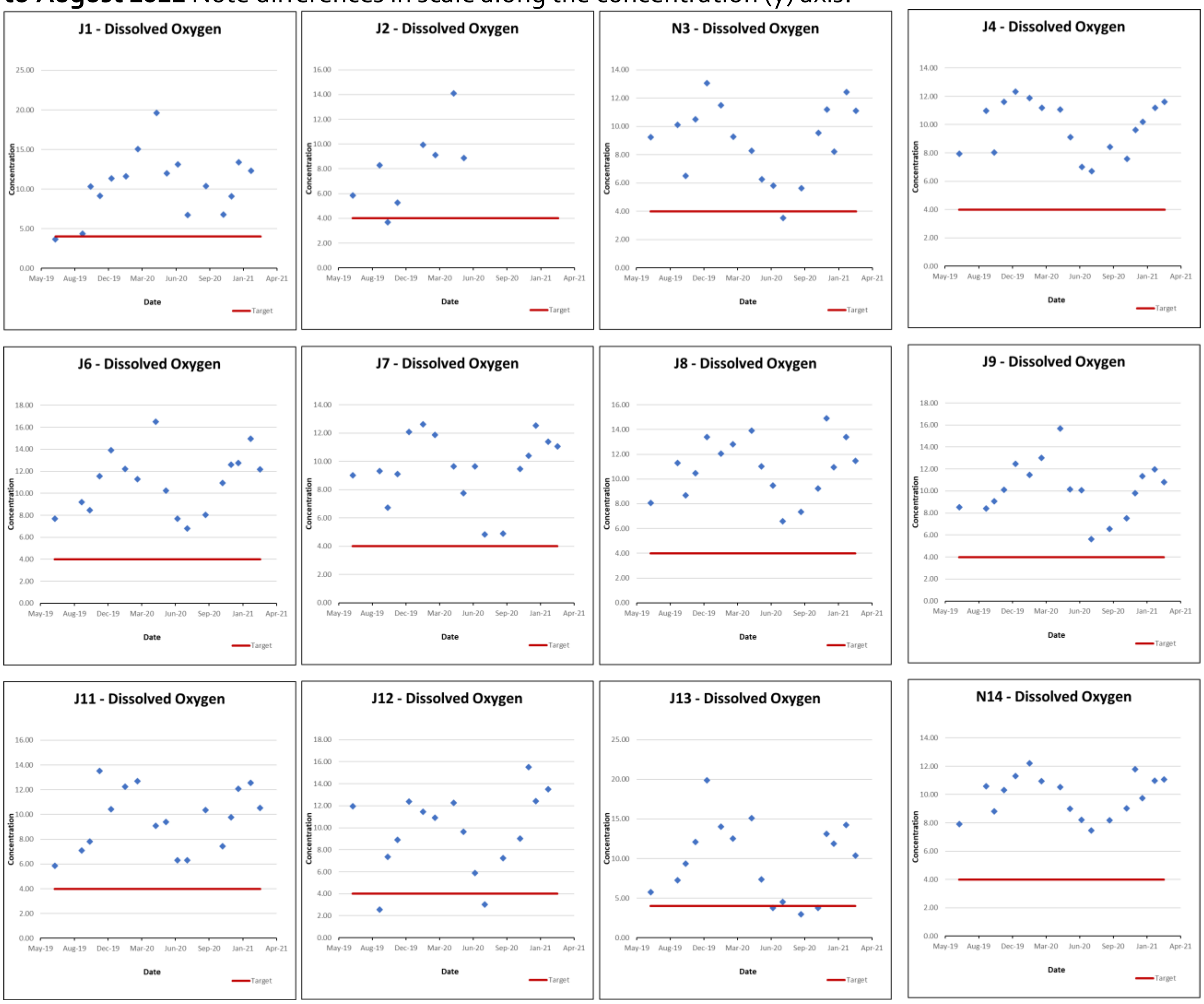




3.3.2.2 Dissolved Oxygen

Dissolved oxygen concentrations also display seasonal changes like those observed for temperature. However, as shown in Figure 37, dissolved oxygen concentrations are opposite those measured for temperature. This is as expected as colder water holds more dissolved oxygen than warmer water; therefore, when water temperatures are low, dissolved oxygen concentrations are high and vice-versa. All streams display variation in dissolved oxygen concentration due to individual conditions present within each system. In total, 27 sample sites contained DO concentrations which measured below the lower state standard (4 mg/L) or aboe the upper state standard (12 mg/L) All sites' DO concentrations exceeded the upper state standard (12 mg/L) during at least one sampling event. In total, 7% of samples exceeded the state standard range.

Figure 37- Dissolved oxygen measurements in Lower Kankakee River samples sites from June 2018 to August 2021 Note differences in scale along the concentration (y) axis.

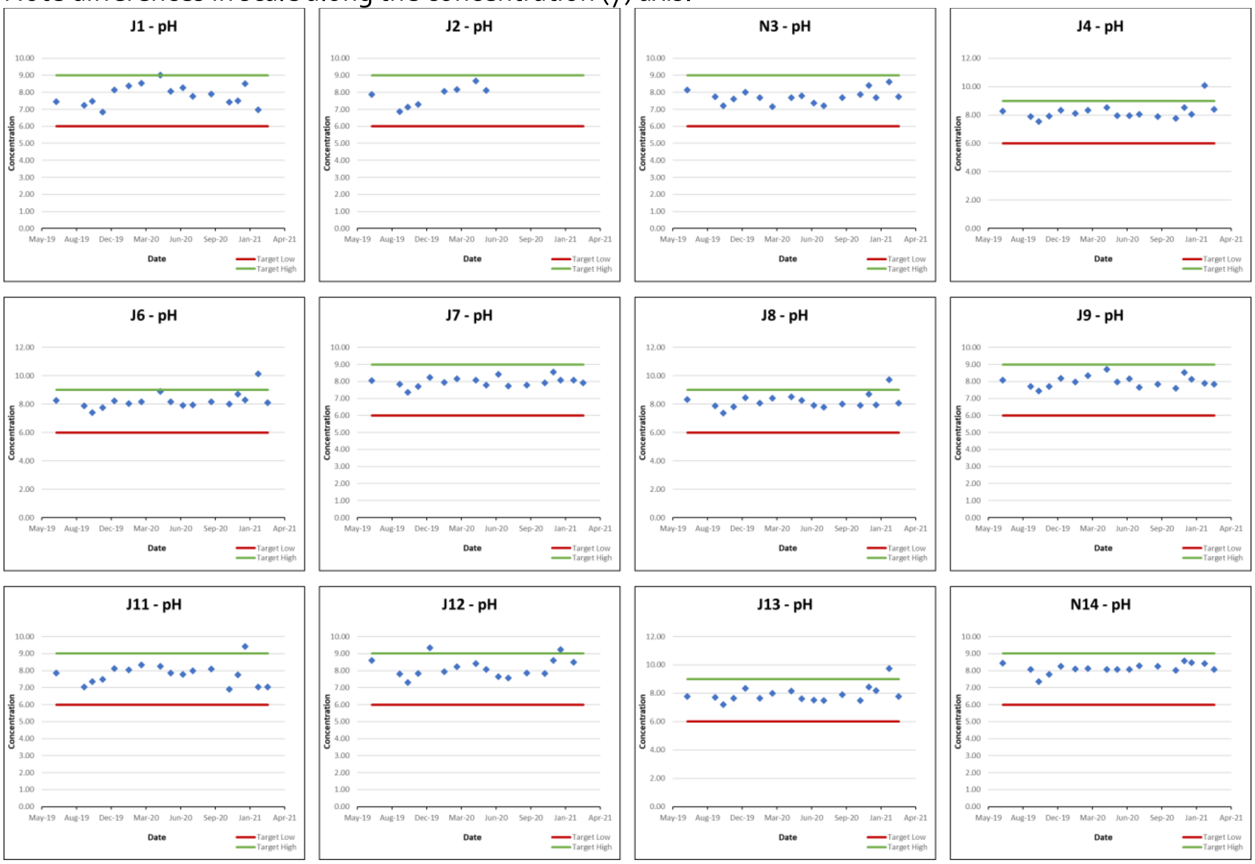


Dissolved oxygen measurements in Lower Kankakee River samples sites from June 2018 to August 2021 (continued) Note differences in scale along the concentration (y) axis.

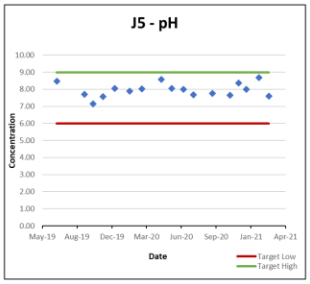
3.3.2.3 pH

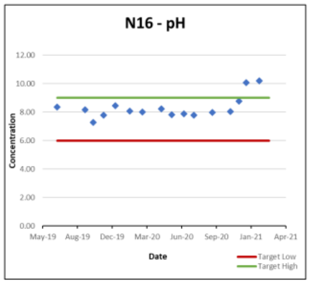
Throughout the sampling period, pH generally remained in an acceptable range in all watershed streams. No discernible pattern can be found in pH levels in any of the monitored streams (Figure 38Figure 37). In total, 15 samples measured above 9 or below 6 during a sampling event. Elevated pH levels can indicate that algae are active within the stream.

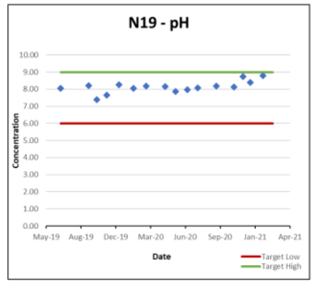
Figure 38- pH measurements in Lower Kankakee River samples sites from June 2018 to August 2021
Note differences in scale along the concentration (y) axis.

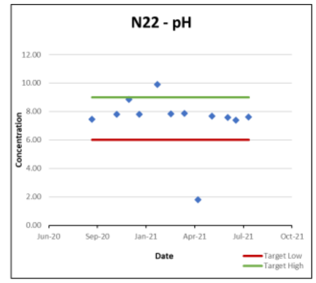


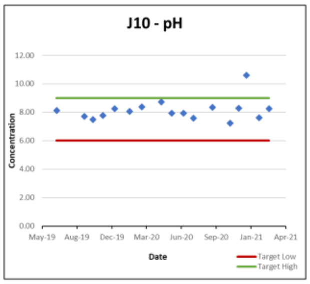
pH measurements in Lower Kankakee River samples sites from June 2018 to August 2021 (continued)
Note differences in scale along the concentration (y) axis.

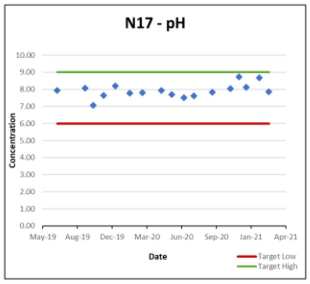


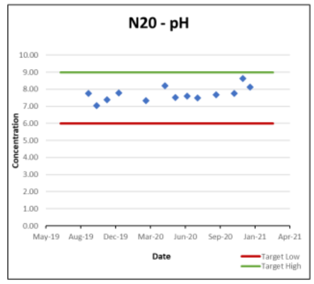


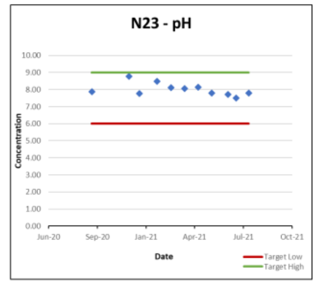


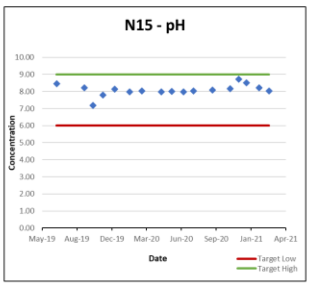


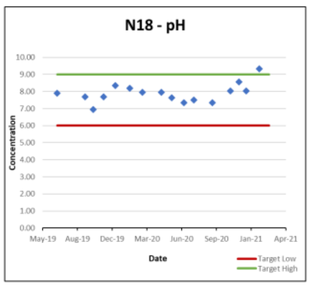


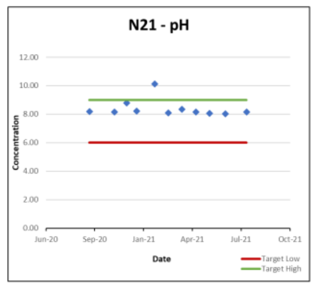


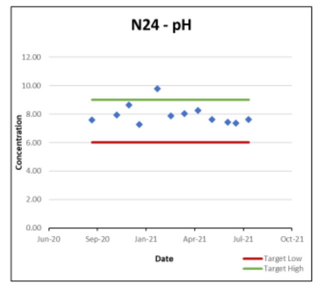


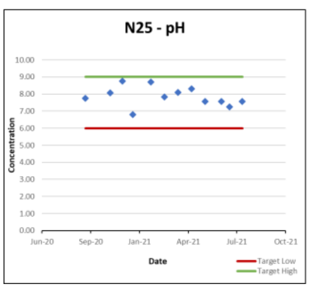








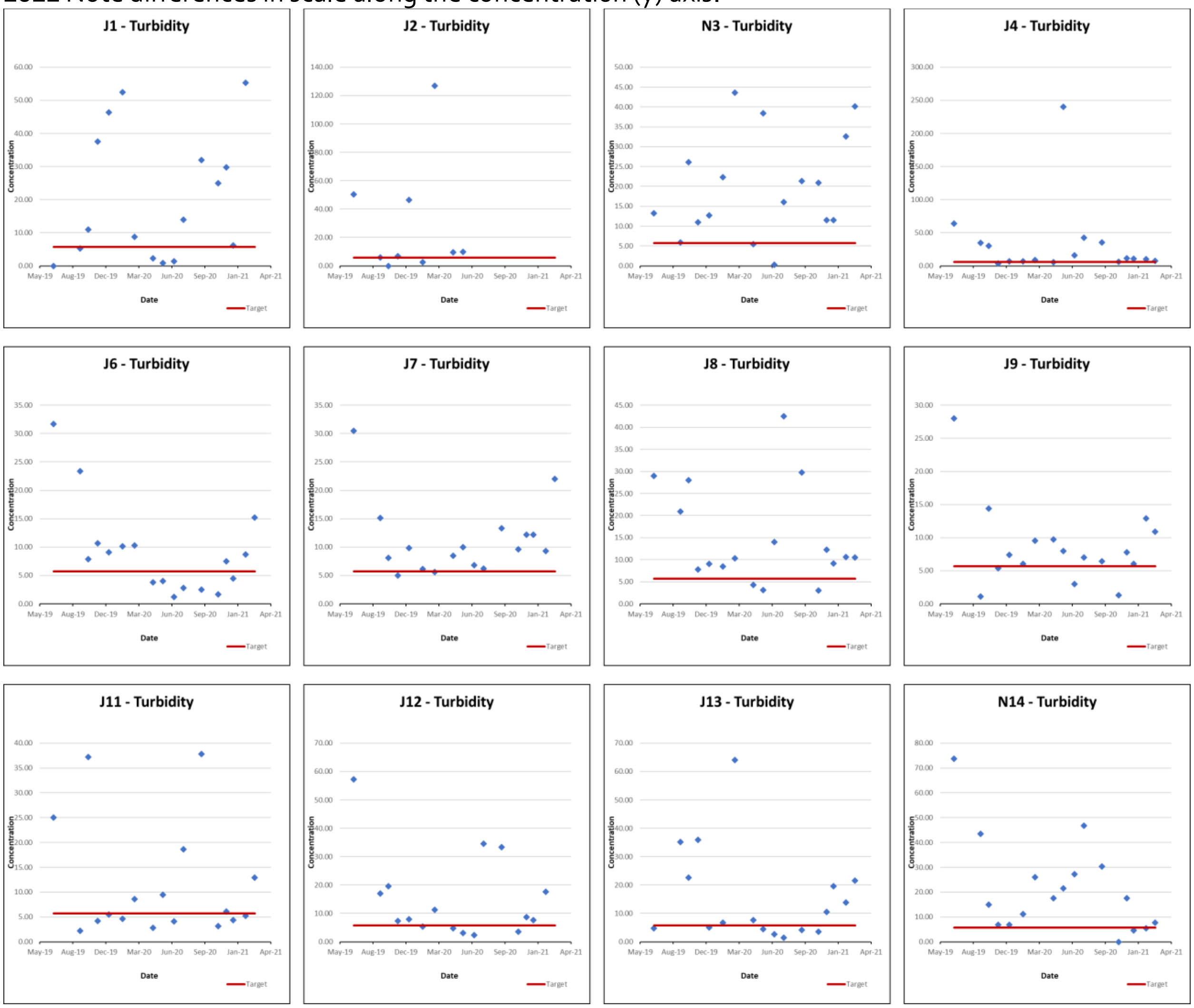




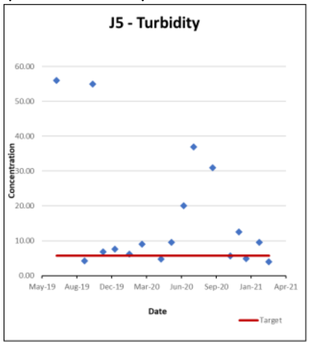
3.3.2.4 Turbidity

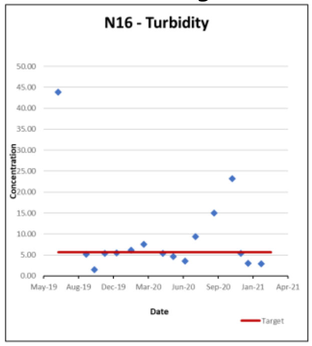
Turbidity measurements for Lower Kankakee River Watershed streams are displayed in Figure 39. Turbidity concentrations exceeded the target in the majority of collected samples. Turbidity tends to spike during high flow events. Turbidity concentrations exceed target concentrations in 70% of samples. The highest turbidity levels occurred in Site J4 with turbidities as high at 240 NTU observed in May 2020.

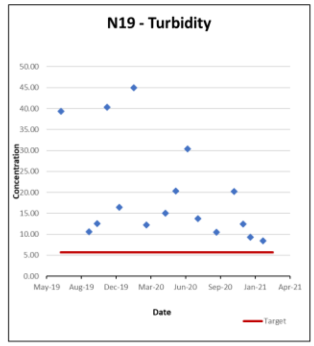
Figure 39- Turbidity measurements in Lower Kankakee River samples sites from June 2018 to August 2021 Note differences in scale along the concentration (y) axis.

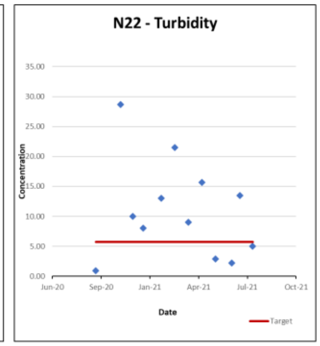


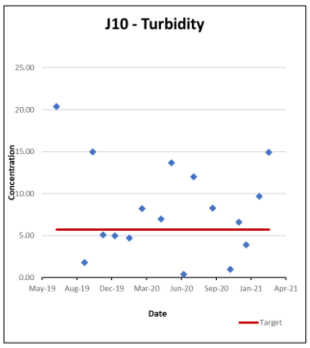
Turbidity measurements in Lower Kankakee River samples sites from June 2018 to August 2021 (continued) Note differences in scale along the concentration (y) axis.

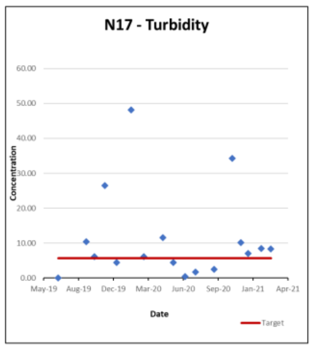


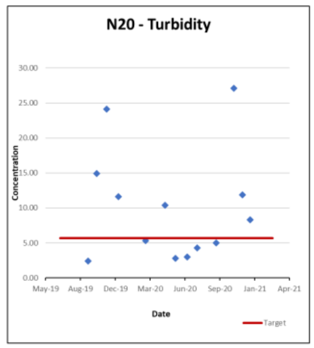


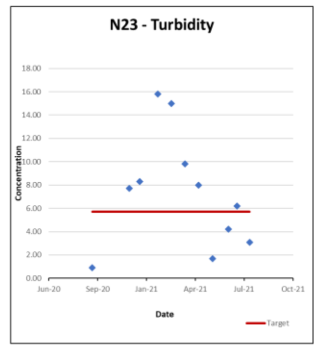


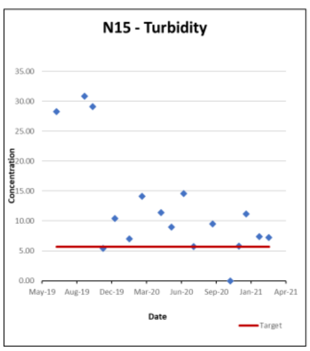


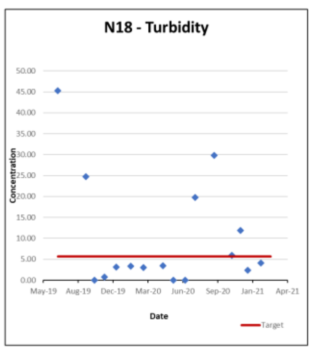


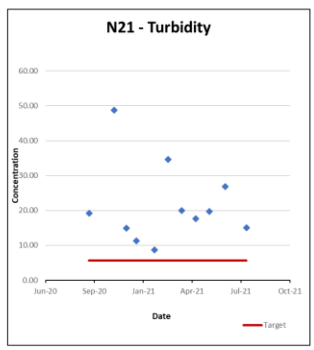


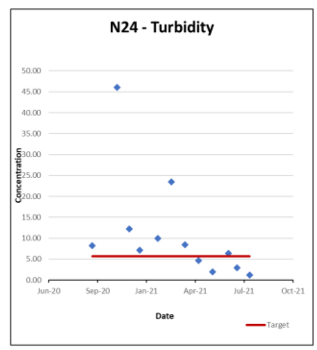


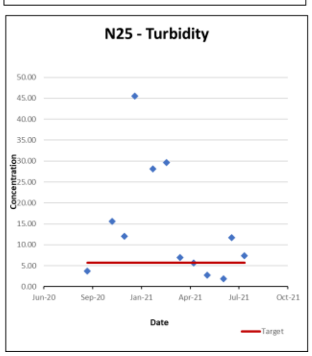










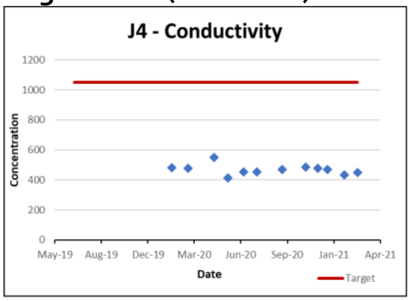


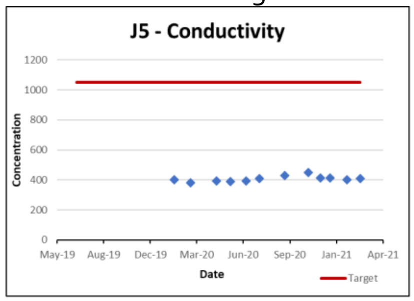
3.3.2.5 Conductivity

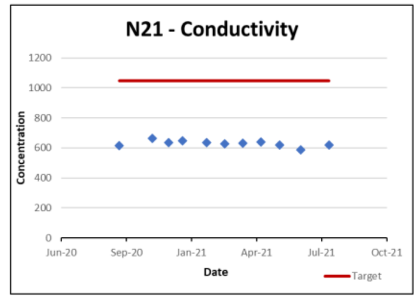
Figure 40 displays conductivity measurements in Lower Kankakee River Watershed streams. Conductivity measurements varied moderately over the sampling period. Conductivity did not exceed state standards any sites.

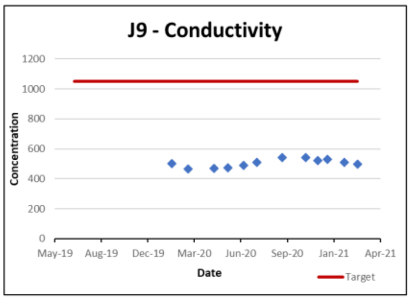
Figure 40- Specific conductivity measurements in Lower Kankakee River samples sites from June 2018 to August 2021 Note differences in scale along the concentration (y) axis.

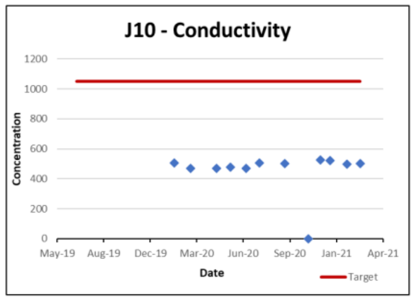
Specific conductivity measurements in Lower Kankakee River samples sites from June 2018 to August 2021 (continued) Note differences in scale along the concentration (y) axis.

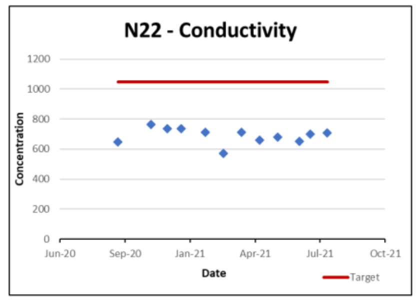


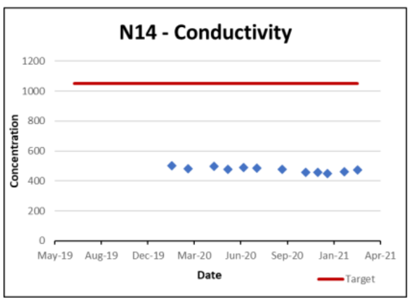


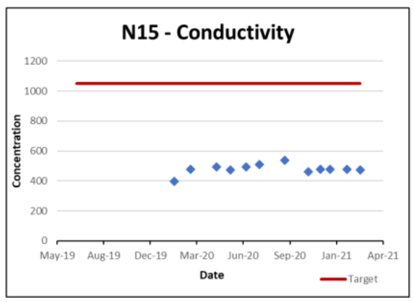


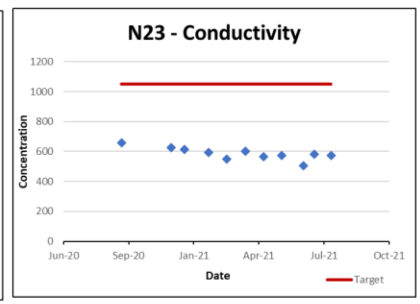


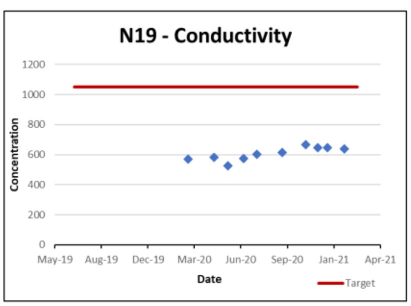


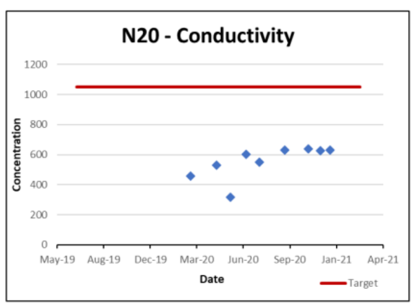


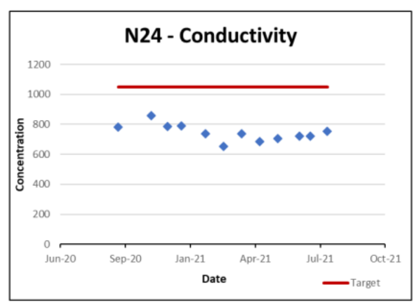


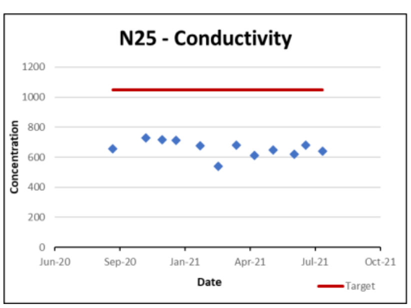












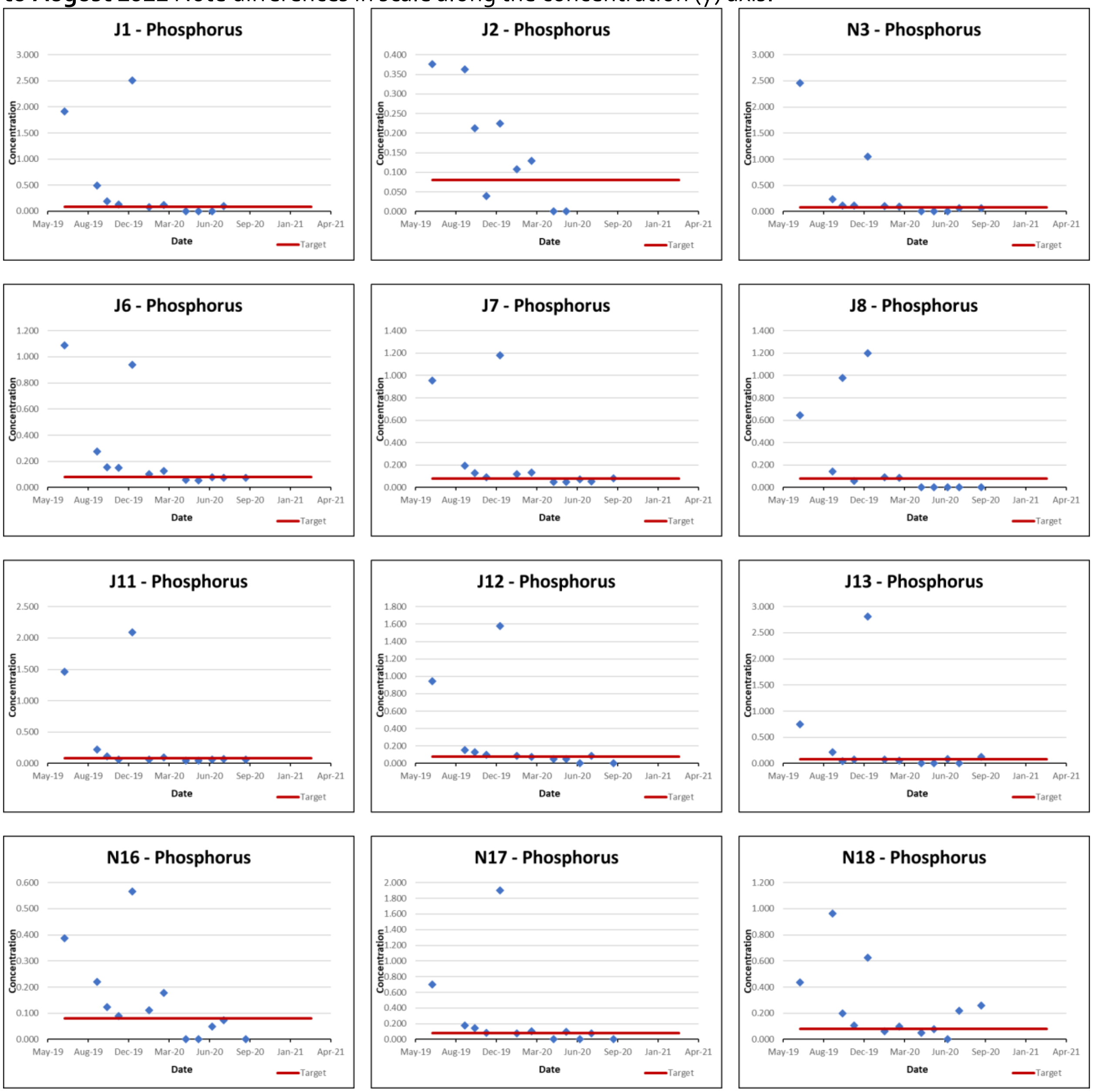
3.3.3 Water Chemistry Results

Figure 41 to Figure 44 display results for total phosphorus, nitrate-nitrogen, total suspended solids, and *E. coli*., which were collected monthly from twenty locations in the Lower Kankakee River Watershed. Data are displayed in comparison to target concentrations. Appendix D details individual measurements collected throughout the sampling period.

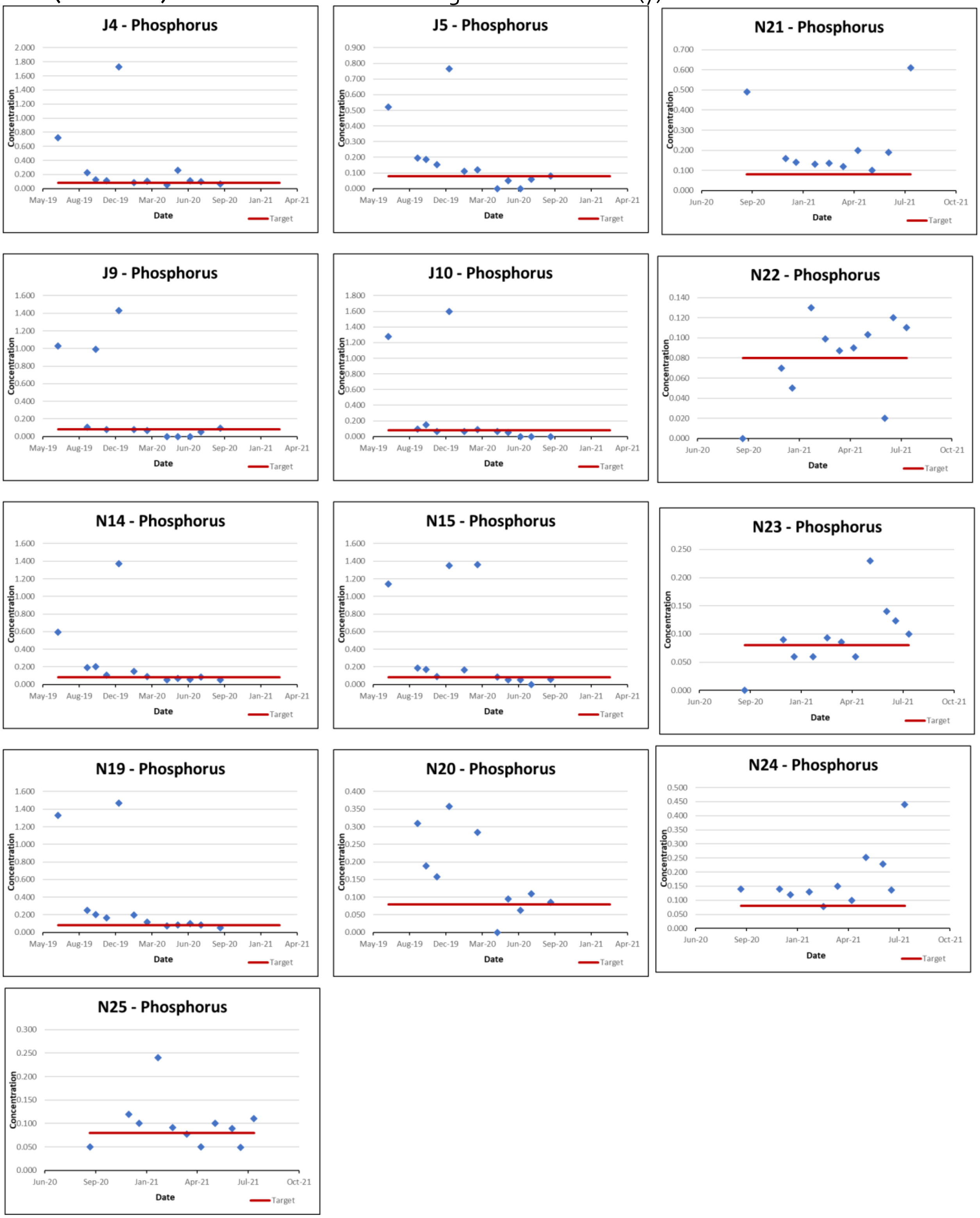
3.3.3.1 Total Phosphorus

Total phosphorus concentrations exceed target concentrations in 72% of samples (Figure 41). The highest concentration (2.81 mg/L) occurred during the December 2019 monitoring event. Concentrations measured in excess of 35 times that target concentration (0.08 mg/L). Concentrations measured throughout the watershed measured in excess of the level at which total phosphorus concentrations impair biological communities (0.08 mg/L). Site N19 contains the highest average concentration (0.195 mg/L).

Figure 41- Total phosphorus measurements in Lower Kankakee River samples sites from June 2018 to August 2021 Note differences in scale along the concentration (y) axis.



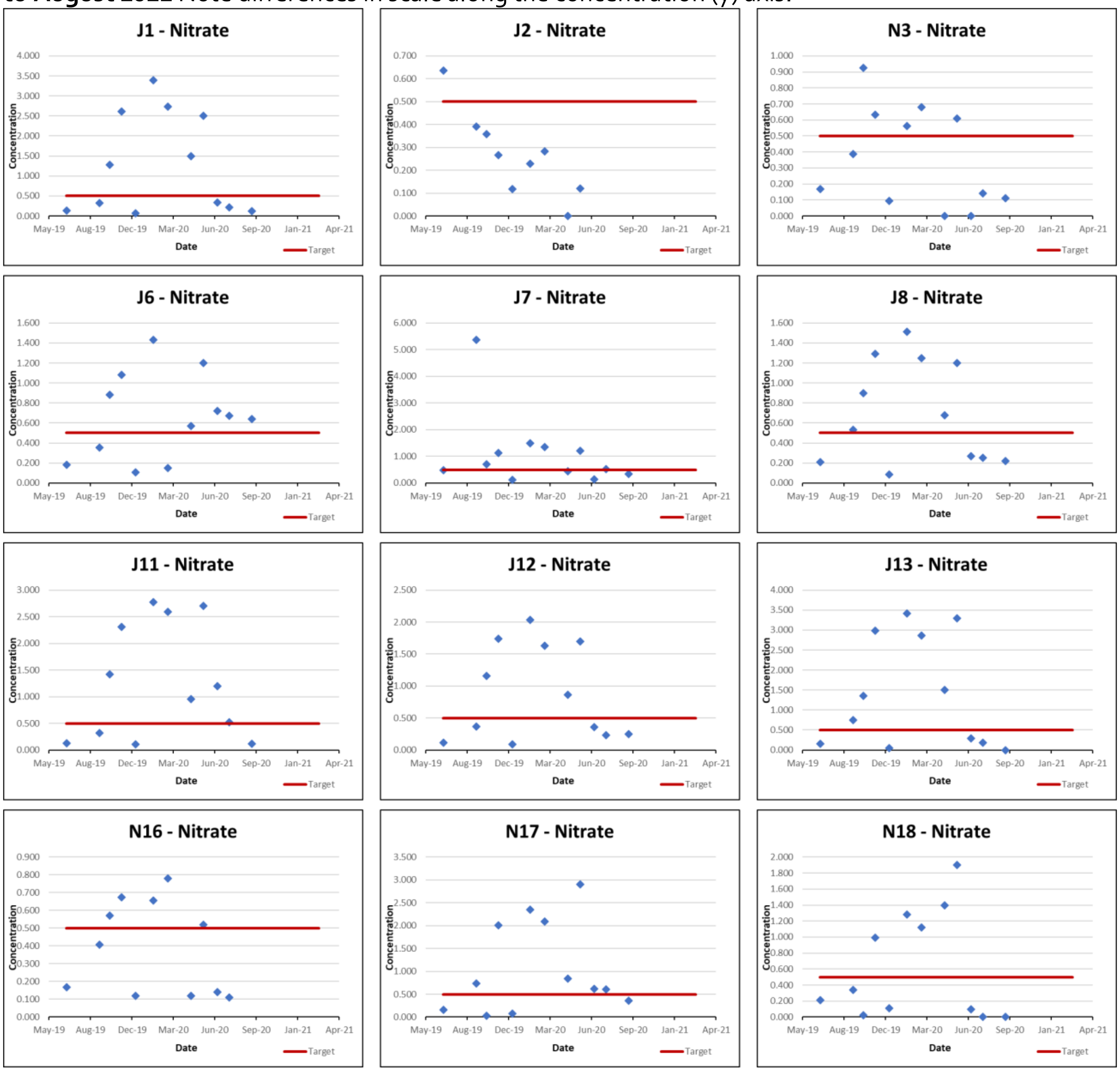
Total phosphorus measurements in Lower Kankakee River samples sites from June 2018 to August 2021 (continued) Note differences in scale along the concentration (y) axis.



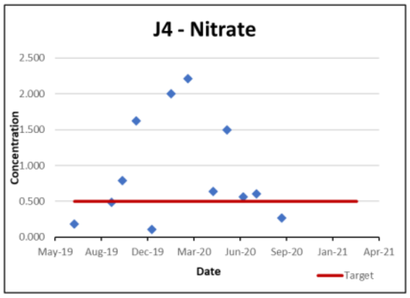
3.3.3.2 Nitrate-nitrogen

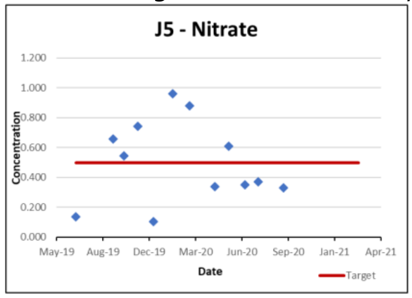
Figure 42 displays nitrate-nitrogen concentrations compared to target levels (0.5 mg/L). As shown below, nitrate-nitrogen concentrations exceed target concentrations in 60% of samples. Nitrate-nitrogen concentrations measured the highest during the spring, falling throughout the summer. The highest concentration occurred at Site J13, with concentrations measuring 3.42 mg/L. In total, 24 of 25 sites averaged nitrate-nitrogen concentrations higher than the median concentration at which biological communities are impaired (1.5 mg/L).

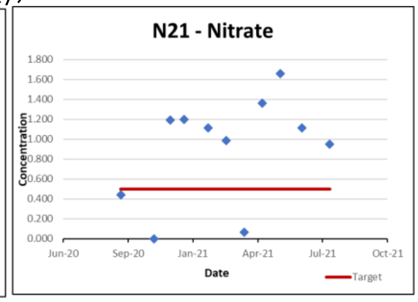
Figure 42- Nitrate-nitrogen measurements in Lower Kankakee River samples sites from June 2018 to August 2021 Note differences in scale along the concentration (y) axis.

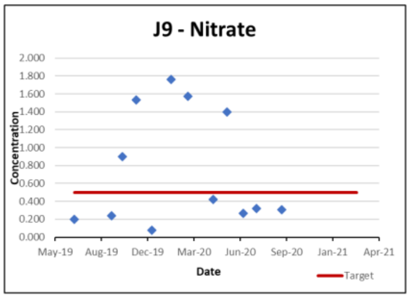


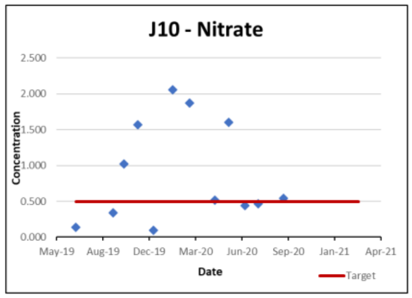
Nitrate-nitrogen measurements in Lower Kankakee River samples sites from June 2018 to August 2021 (continued) Note differences in scale along the concentration (y) axis.

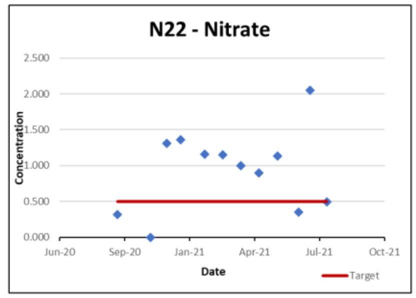


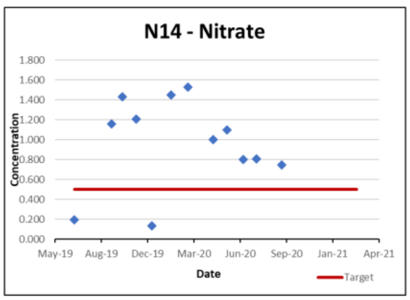


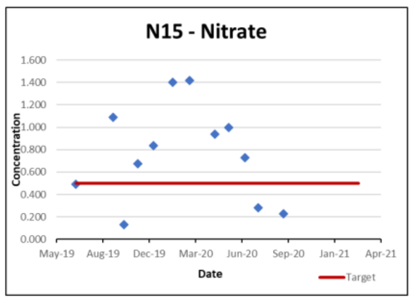


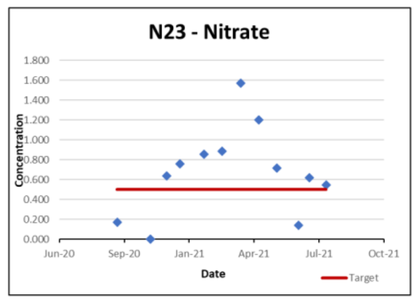


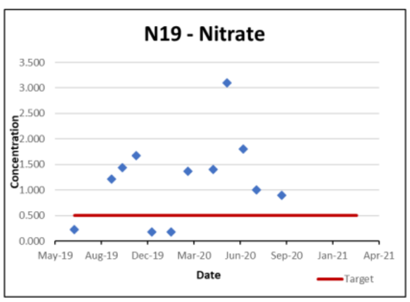


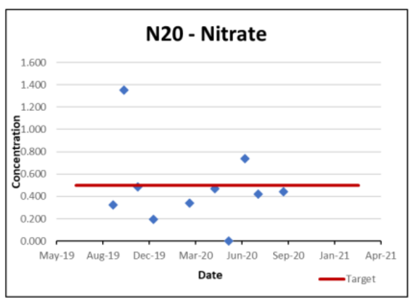


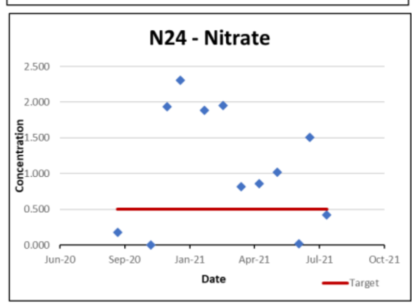


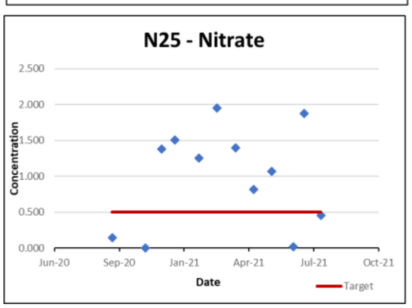








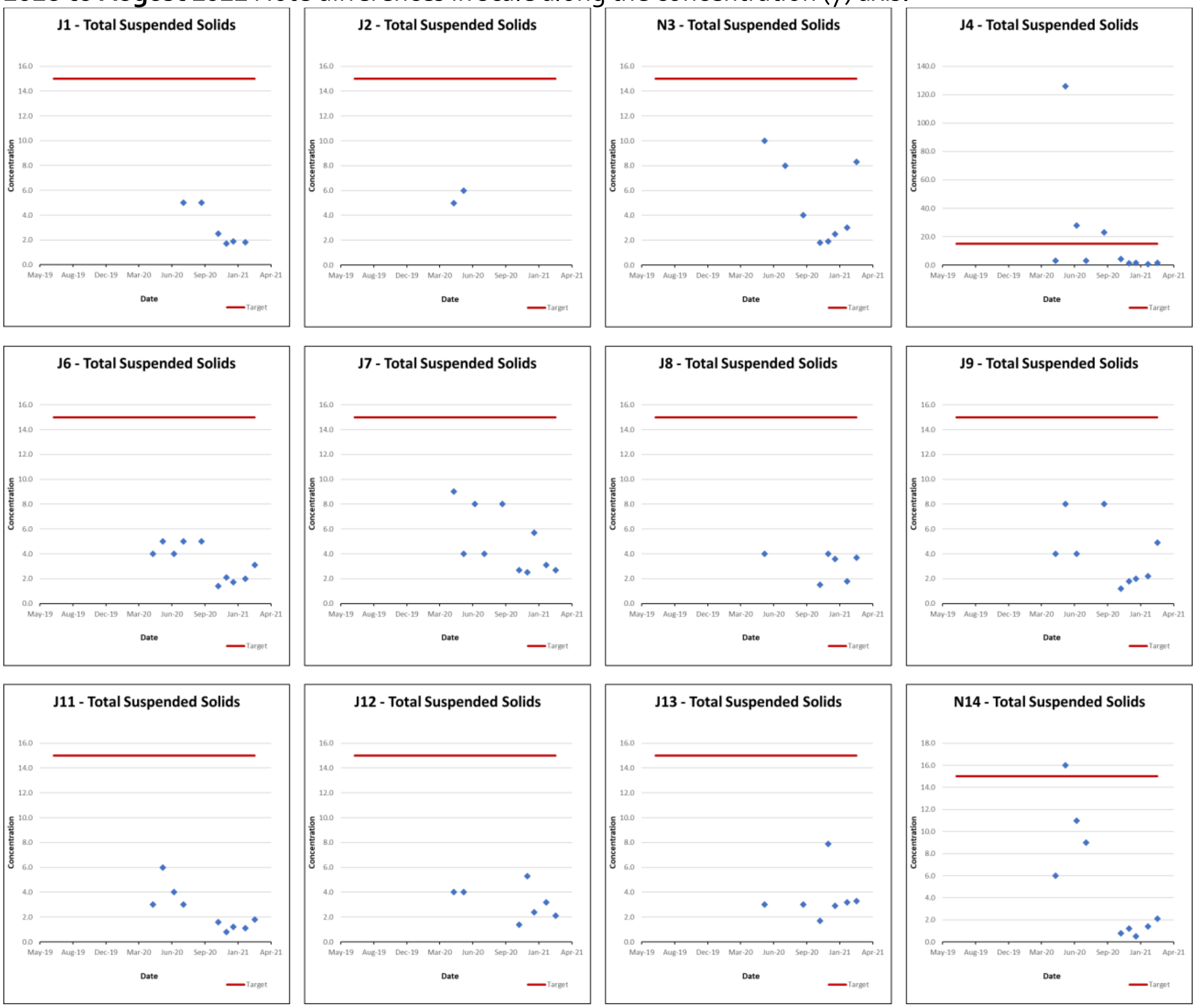




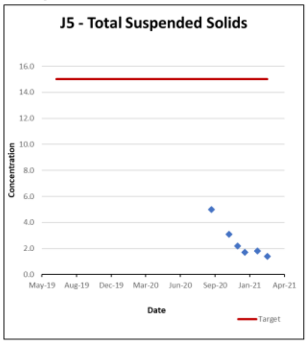
3.3.3.3 Total Suspended Solids

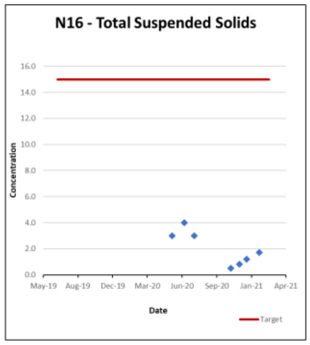
Figure 43 displays total suspended solids (TSS) concentrations compared to target levels (15 mg/L). Only 4% of samples exceeding target concentrations. Many of the samples contained TSS concentrations below the laboratory detection limit. Based on stakeholder input, there were a limited number of storm events during the sampling period resulting in fewer than normal runoff events.

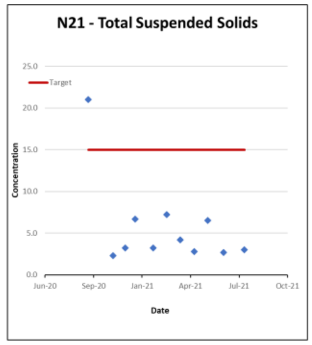
Figure 43- Total suspended solids measurements in Lower Kankakee River samples sites from June 2018 to August 2021 Note differences in scale along the concentration (y) axis.

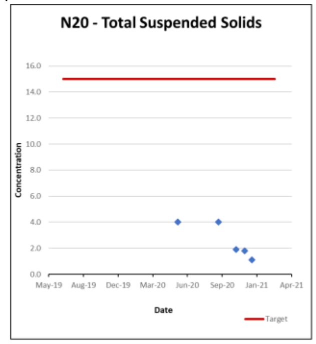


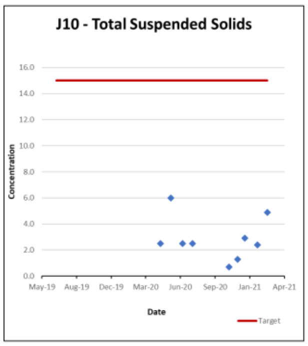
Total suspended solids measurements in Lower Kankakee River samples sites from June 2018 to August 2021(Continued) Note differences in scale along the concentration (y) axis.

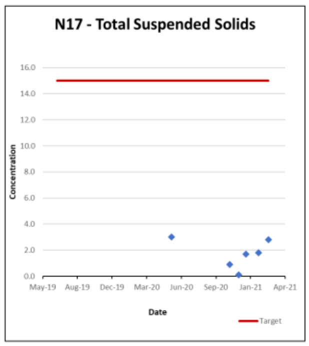


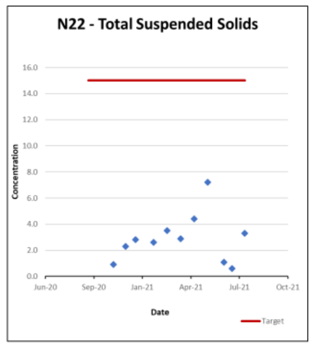


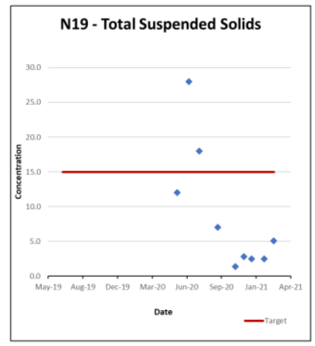


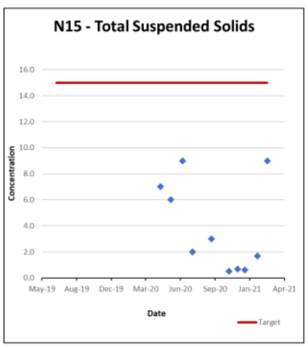


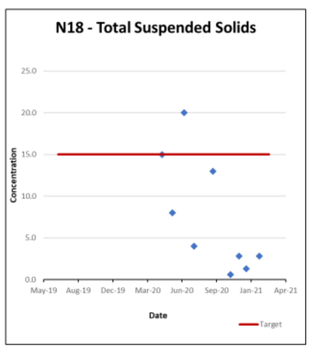


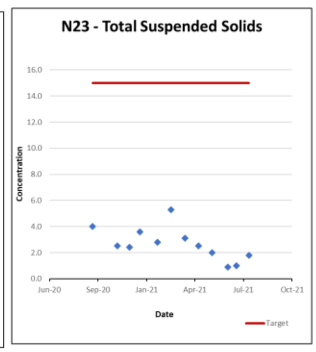


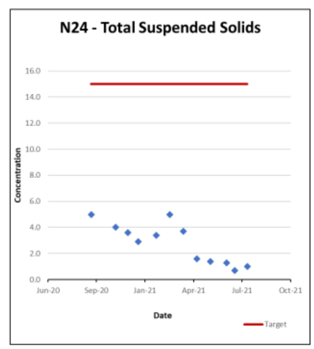


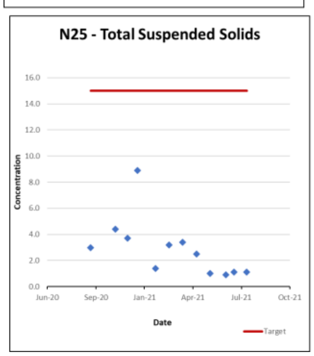








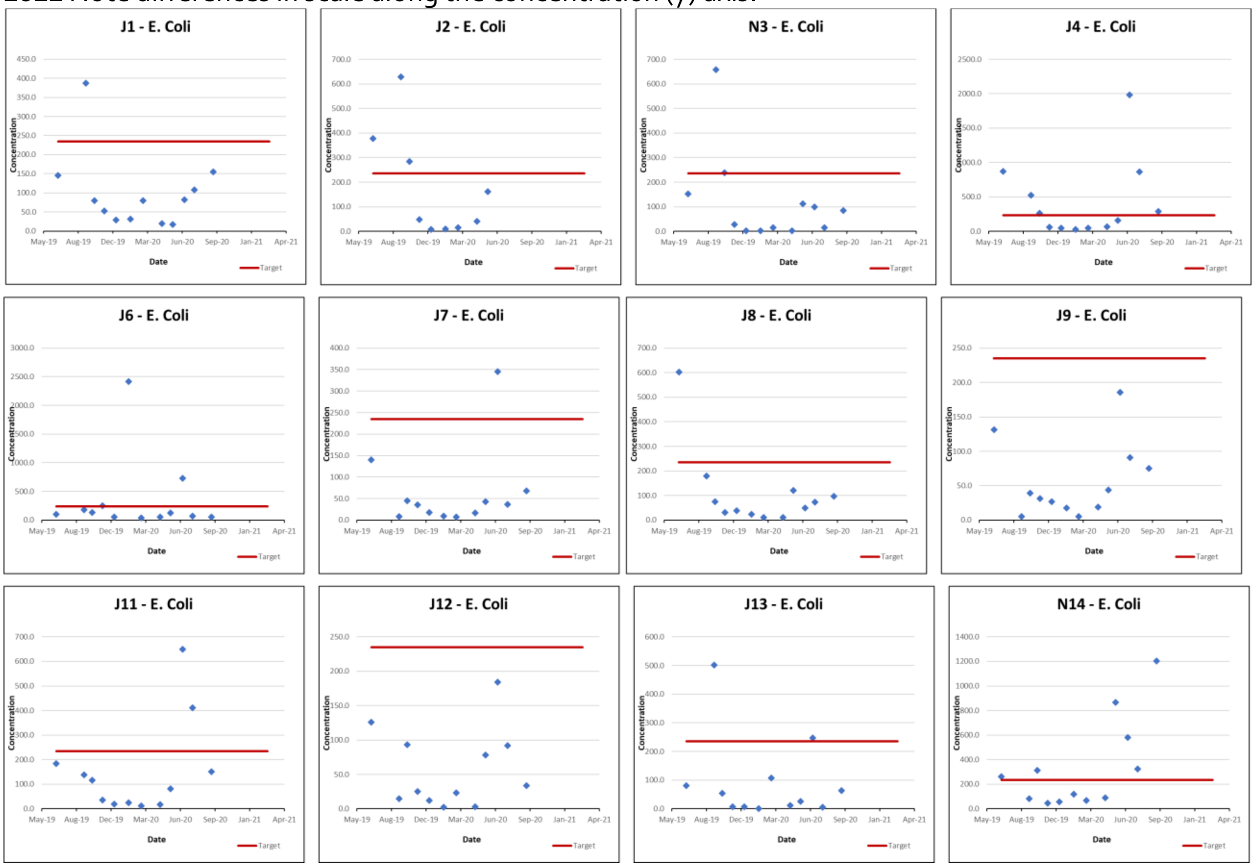




3.3.3.4 E. coli

E. coli concentrations observed at Lower Kankakee River Watershed sites are shown in Figure 44. *E. coli* concentrations exceed state standards in approximately 16% of collected samples. None of the Lower Kankakee River Watershed sites possessed average *E. coli* concentrations in excess of state standards (235 col/100 mL). Site J6 contained the highest *E. coli* concentration with 2,419.6 col/100 mL in January 2020.

Figure 44- *E.coli* measurements in Lower Kankakee River samples sites from June 2018 to August 2021 Note differences in scale along the concentration (y) axis.



***E.coli* measurements in Lower Kankakee River samples sites from June 2018 to August 2021 (Continued)** Note differences in scale along the concentration (y) axis.

3.3.3.5 Habitat Data

Stream water quality and available habitat influence the quality of a biological community in a stream. In 2019, volunteers trained through the Hoosier Riverwatch program assessed instream habitat using the Citizen's QHEI. Table 23 presents the results of the CQHEI assessments at five stream sites. The lowest scores occurred at Sites J6, J12, and N3 and are yellow highlighted. These sites are representative of ditched streams present throughout Indiana. With high banks, narrow riparian zones, and limited pool and riffle development, it is not surprising that these sites scored poorly relative to other stream sites.

Table 23. Citizen's Qualitative Habitat Evaluation Index (CQHEI) scores measured in the Lower Kankakee River Watershed. Those marked in orange measure below the habitat target score.

Site	Date	Total Score
J4	10/06/2019	61
J6	10/06/2019	27
J11	10/06/2019	59
J12	10/06/2019	23
N3	10/07/2019	14

3.4 Watershed Inventory Assessment

3.4.1 Watershed Inventory Methodologies

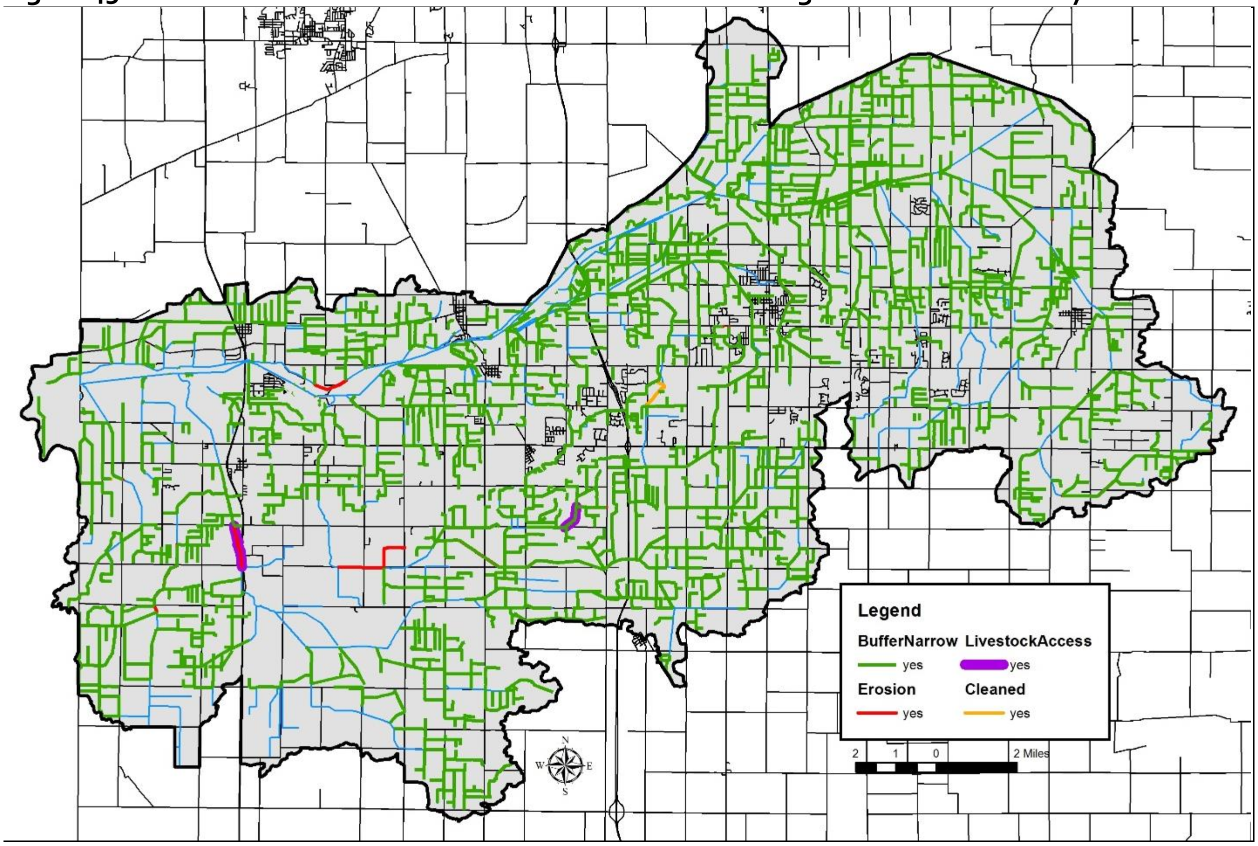
Volunteers completed windshield surveys throughout the Lower Kankakee River Watershed in spring 2018. Volunteers conducted surveys by driving all accessible roads throughout the watershed. Large maps with aerial photographs, road and stream names, and public property labels were provided to each volunteer group. Volunteers recorded observations on the provided maps and data sheets, documented field conditions with photographs, and provided all notes to the Project Coordinator for review. The windshield surveys were also used to confirm GIS map layer data throughout the watershed. Items targeted during the surveys included, but were not limited to the following:

- Aerial land use category
- Field or gully erosion
- Pasture locations and condition
- Livestock access and impact to streams
- Buffer condition and width
- Bank erosion or head-cutting
- Logjams located within the stream
- Dumping areas or areas where trash or debris accumulate
- Small, unregulated farms
- Environmental site confirmation (NPDES, CFO, open dump, Superfund, etc.)

3.4.2 Watershed Inventory Results

All accessible road-stream crossings were inventoried. Most issues identified fall into five categories: stream buffers limited in width or lacking altogether, areas of livestock access, streambank erosion, dumping areas, and unregulated farms. Figure 45 details locations throughout Lower Kankakee River Watershed where problems were identified. Much of the watershed is not visible from the road; therefore, those identified in Figure 3 should not be considered exhaustive. More than 796 miles of streams possessed limited buffers, nearly 26.6 miles of streambank were eroded, and livestock had access to nearly 1.7 miles of streams. Additionally, 8.8 miles of recently cleaned legal drains were observed in the spring of 2019.

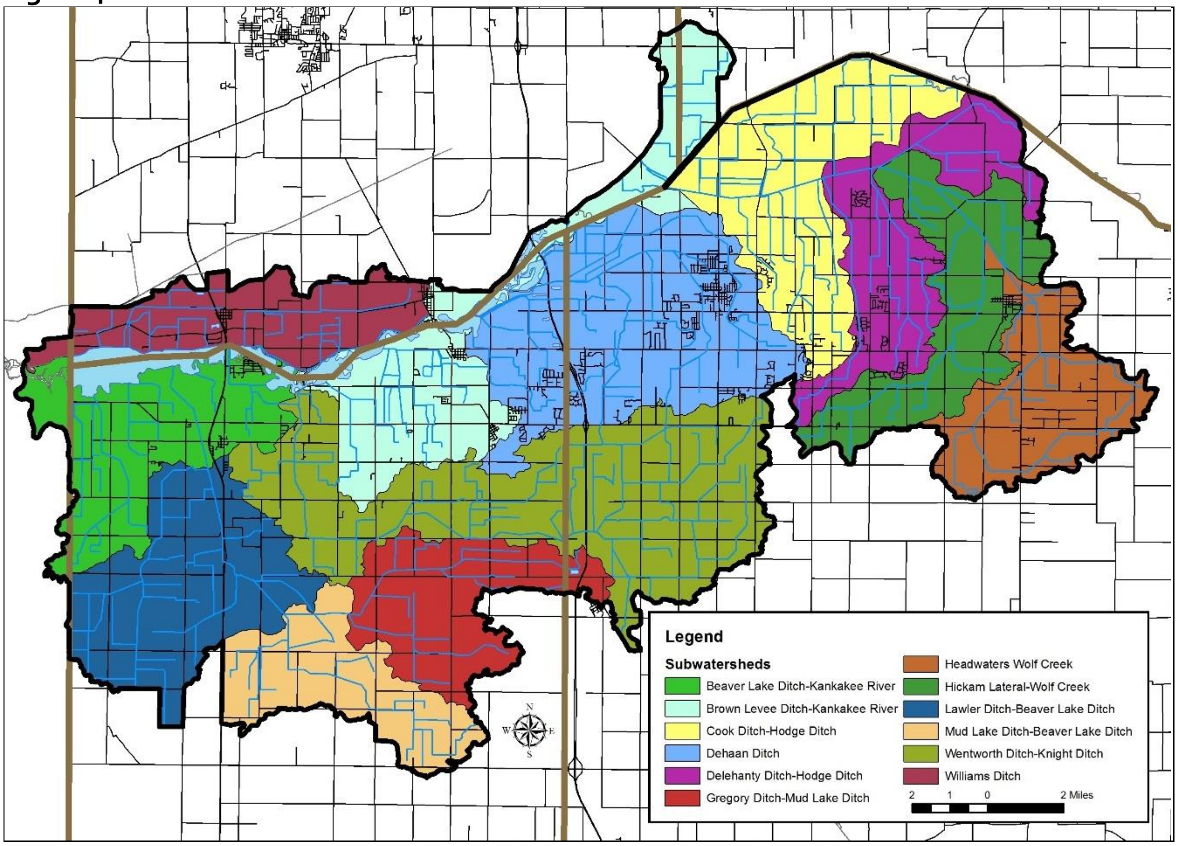
Figure 45- Stream-related Watershed Concerns Identified during Watershed Inventory Efforts



4.0 WATERSEHD INVENOTRY PART 2b – SUBWATERSHED DISCUSSIONS

To gather more specific, localized data, the Lower Kankakee River Watershed was divided into sixteen (16) subwatersheds with each subwatershed reflecting one 12-digit Hydrologic Unite Code (HUC; Figure 46). These subwatersheds reflect specific tributary drainages and similar land uses and hydrology. Land use, point and non-point source watershed concern areas, and historic water quality sampling locations and results are discussed in detail below for each subwatershed.

Figure 46- Subwatersheds in the Lower Kankakee River Watershed



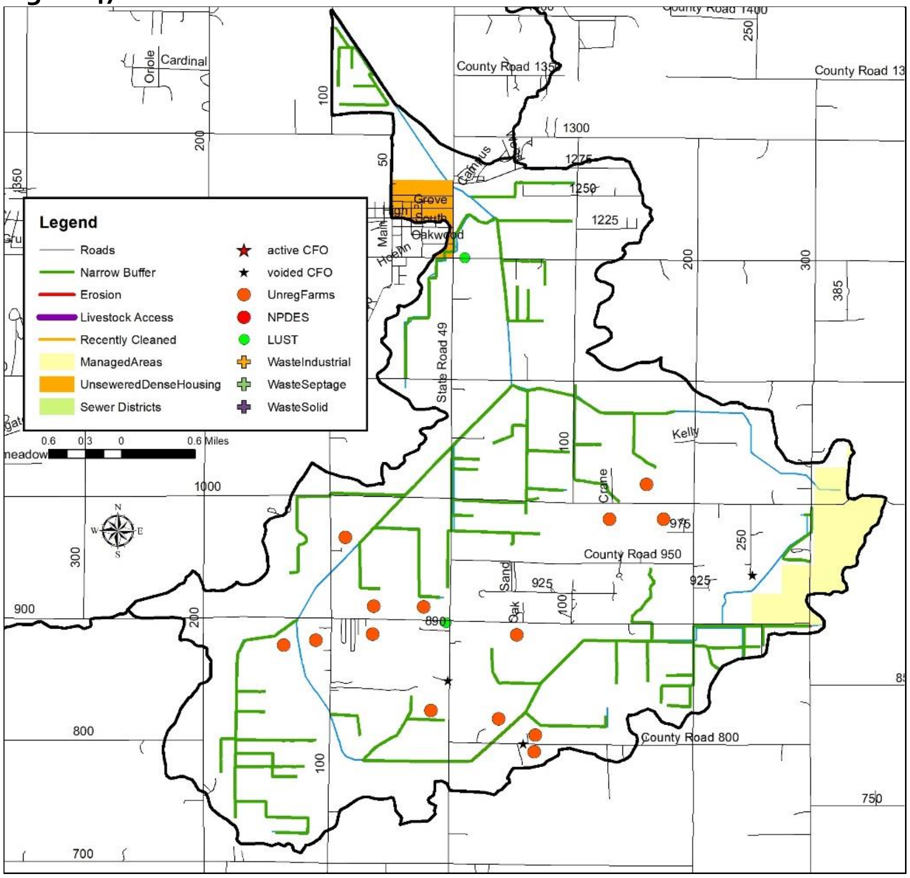
4.1 Headwaters Wolf Creek Subwatershed

The Headwaters Wolf Creek Subwatershed forms part of the southeastern boundary of the Lower Kankakee River Watershed, including the community of Wheatfield as well as portions of Jasper-Pulaski Fish and Wildlife Area and Tefft Nature Preserve and lies within Jasper County. It encompasses one 12-digit HUC watershed: 071200010901. This subwatershed drains 11,523 acres and accounts for 6.2% of the total watershed area. There are 47.7 miles of stream. None of the Headwaters Wolf Creek streams are classified by IDEM as impaired. Potentially highly erodible soils are present in the subwatershed, covering 10.8% of the subwatershed. Nearly the entire subwatershed (99.9%) has soils which are severely limited for septic use. Agricultural land use dominates the Headwaters Wolf Creek subwatershed with 61% (7,010 acres) in agricultural land uses, including row crop and pasture and 24% (2,819 acres) in forested land use. Wetlands, open water, and grassland cover just 895 acres, or 7.8%, of the subwatershed. A portion of Wheatfield lies within the Headwaters Wolf Creek Subwatershed. Additionally, the State Road 39 and State Road 10 corridors bisect the Headwaters Wolf Creek Subwatershed accounting for much of the urban land use within the subwatershed. In total, 799 acres or 6.9% of the subwatershed are in urban land uses.

4.1.1 Point Source Water Quality Issues

There are few point sources of water pollution in the subwatershed. There are four (4) leaking underground storage tanks (LUST) located along the State Road 10 and State Road 49 corridors or within the Town of Wheatfield (Figure 47). No open dumps, brownfields, corrective action sites, voluntary remediation sites, industrial waste facilities, or NPDES-permitted facilities are located within the Headwaters Wolf Creek Subwatershed.

Figure 47- Point and Non-Point Sources of Pollution in the Headwaters Wolf Creek Subwatershed



septic

4.1.2 Non-Point Source Water Quality Issues

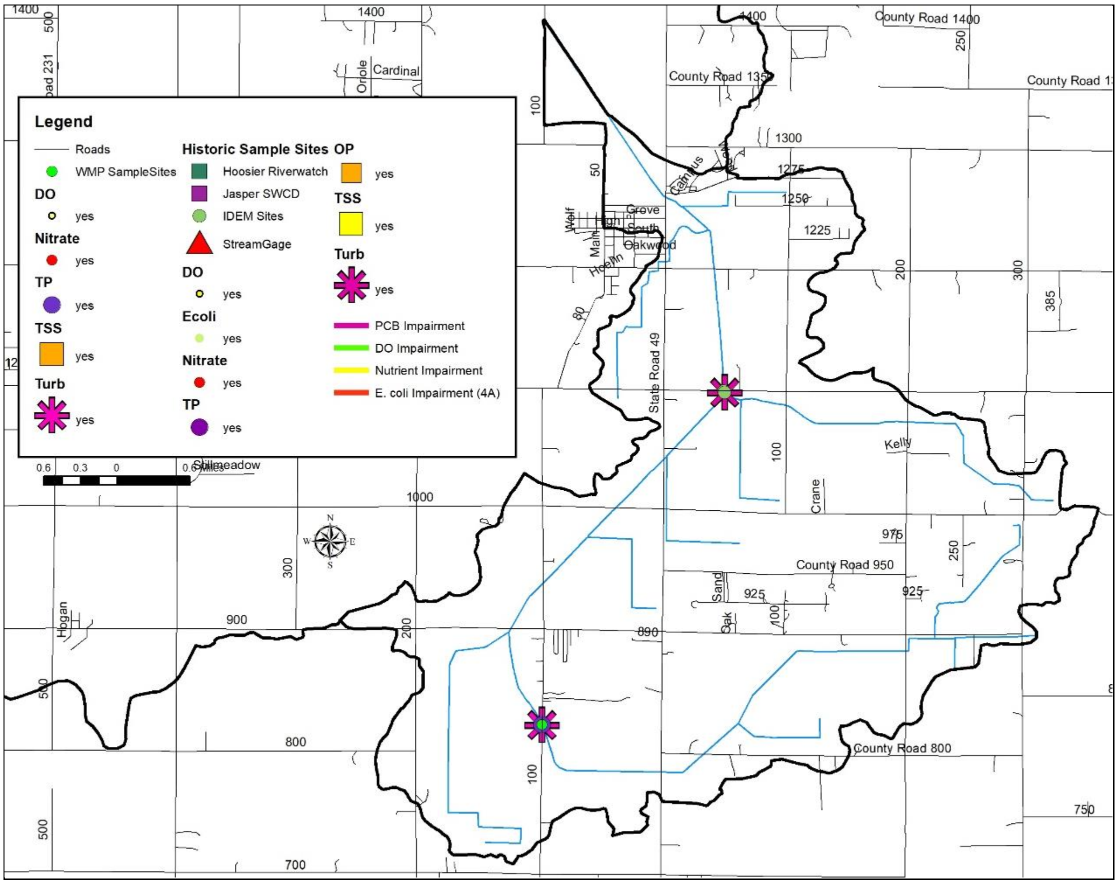
Agricultural land uses are the predominant land use in the Headwaters Wolf Creek Subwatershed. Additionally, a number of small animal operations and pastures are also present. Fourteen unregulated animal operations housing more than 58 cows, horses, and goats were identified during the windshield survey. Livestock access points were not observed in Headwaters Wolf Creek Subwatershed streams. Three voided confined feeding operations (CFO) historically operated within the Headwaters Wolf Creek Subwatershed which housed up to 2,596 animals. Streambank erosion and lack of buffers are a concern in the subwatershed. Approximately 39.7 miles of insufficient stream buffers and 2.4 miles of streambank erosion were identified within the subwatershed.

4.1.3 Water Quality Assessment

Waterbodies within the Headwaters Wolf Creek subwatershed have been sampled at 3 locations for water chemistry (Figure 48) and one location for fish community assessment. Assessments include collection of water chemistry data by IDEM (1 site) and by the Jasper County SWCD as part of their Clean Water Indiana project (1 site). No stream gages are in the Headwaters Wolf Creek subwatershed. Table 21 details water quality targets.

Historic water quality data: Dissolved oxygen, pH, and total phosphorus concentrations did not exceed target concentrations during any of the sampling events. Turbidity samples exceed targets in 67% of IDEM samples collected, while nitrate-nitrogen exceeded targets in 100% of samples and total suspended solids exceed targets in 33% of IDEM samples collected. *E. coli* concentrations exceed state standards in 64% of collected samples. Fish and macroinvertebrate community assessments conducted in Wolf Creek rated higher than target scores during historic assessments. Habitat assessments rated lower than the target QHEI score.

Figure 48- Locations of Current and Historic Water Quality Data Exceedances and Impairments in the Headwaters Wolf Creek Subwatershed



Current water quality data: Table 24 shows the current water quality data. As shown in the table, dissolved oxygen exceeded water quality targets in 45% of samples, turbidity exceeded targets in 60% of samples, total phosphorus exceeded targets in 64% of samples, and nitrate exceeded targets in 55% of samples. pH and TSS did not exceed any targets and *E. coli* only had one sample exceed the target.

Table 24- Water quality data collected in the Headwaters Wolf Creek Subwatershed, June 2019 to February 2021

Site		Temp (C)	DO (mg/L)	pH	Turb (NTU)	Cond	TP (mg/L)	Nitrate (mg/L)	TSS (mg/L)	*E.coli* (col/100 ml)
J1	Min	1.21	3.68	6.85	0.8	401	0.05	0.072	1.70	17
	Median	14.72	11.33	8.06	9.85	461.5	0.115	1.28	2.20	79.4
	Max	30.17	19.63	9	52.5	493	2.51	3.39	5.00	387.7
	Count	11	11	11	10	6	11	11	6	11
	Exceed	--	5	0	6	0	7	6	0	1
	% Exceed	0%	45%	0%	60%	0%	64%	55%	0%	9%

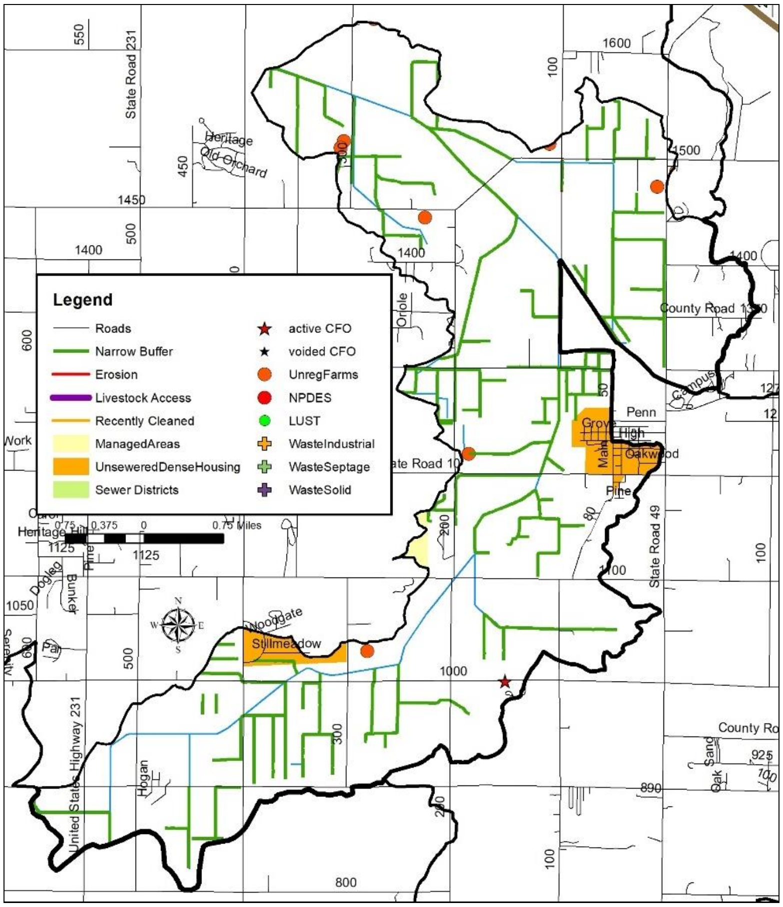
4.2 Hickam Lateral-Wolf Creek Subwatershed

The Hickam Lateral-Wolf Creek Subwatershed forms portions of the southern and eastern including a portion of the Town of Wheatfield and lies within Jasper County. It encompasses one 12-digit HUC watershed: 071200010902. This subwatershed drains 12,686 acres, and accounts for 6.8% of the total watershed area. The Hickam Lateral-Wolf Creek Subwatershed receives water from the Headwaters Wolf Creek Subwatershed. There are 62.9 miles of streams in the Hickam Lateral-Wolf Creek Subwatershed. IDEM has classified 61.6 miles of stream as impaired for *E. coli*, 15. 2 miles of streams as impaired for dissolved oxygen, and 15.2 miles of streams as impaired for PCBs in fish tissue. Potentially highly erodible soils are present within the subwatershed, covering 6.3% of the subwatershed. Much of the subwatershed (99.9%) has soils which are severely limited for septic use. Agricultural land use dominates the Hickam Lateral-Wolf Creek subwatershed with 61% (9,958 acres) in agricultural land uses, including row crop and pasture. Nearly 11.4% (1,451 acres) of the subwatershed are in forested land use. Wetlands, open water, and grassland cover just over 577 acres, or 4.6 %, of the subwatershed. The Town of Wheatfield lies within, and the State Road 10 and 49 corridors bisect the Hickam Lateral-Wolf Creek Subwatershed accounting for much of the urban land use within the subwatershed. In total, 799 acres or 5.5% of the subwatershed are in urban land uses.

4.2.1 Point Source Water Quality Issues

There are few point sources of water pollution in the Hickam Lateral-Wolf Creek subwatershed. There is one LUST site, which is in the Town of Wheatfield (Figure 49). There are no NPDES-permitted facilities in the subwatershed. Additionally, there are no open dumps, brownfields, corrective action sites, voluntary remediation sites, or industrial waste facilities located within the Hickam Lateral-Wolf Creek Subwatershed.

Figure 49- Point and Non-Point Sources of Pollution and Suggested Solutions in the Hickam Lateral-Wolf Creek Subwatershed



4.2.2 Non-Point Source Water Quality Issues

Agricultural land uses are the predominant land use in the Hickam Lateral-Wolf Creek Subwatershed. Additionally, a number of small animal operations and pastures are also present. Seven unregulated animal operations housing more than 31 cows, horses, and goats were identified during the windshield survey. Livestock access points were not observed during the windshield survey. One active CFO housing 2,000 animals is located within the subwatershed. In total, manure from small animal operations and CFOs total over 15,375 tons per year; this contains approximately 44,586 pounds of nitrogen and 33,624 pounds of phosphorus. Streambank erosion and lack of buffers are a concern in the subwatershed. Approximately 51.7 miles of insufficient stream buffers and 1.6 miles of streambank erosion were identified within the subwatershed.

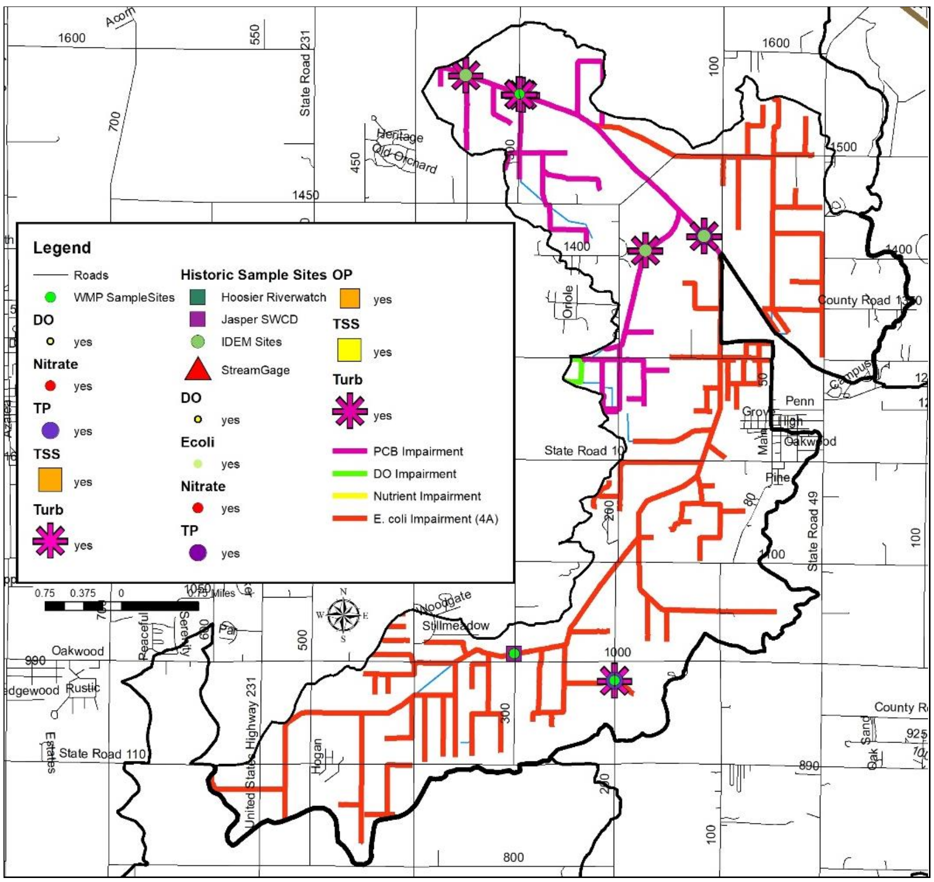
4.2.3 Water Quality Assessment

Waterbodies within the Hickam Lateral-Wolf Creek subwatershed have been sampled at 5 locations (Figure 50). Assessments include collection of water chemistry data by IDEM (5 sites) and for macroinvertebrate community assessments (3 sites) as well as CWI sampling by the Jasper SWCD (2 sites). No stream gages are in the Hickam Lateral-Wolf Creek subwatershed. Table 21 details water quality targets. pH, and total phosphorus concentrations did not exceed target concentrations during any of the sampling events. This means these potential pollutants are not a significant concern in this subwatershed.

Historic water quality data: Dissolved oxygen concentrations exceeded targets in 19% of collected samples. Turbidity samples exceed targets in 87% of samples collected, while total suspended solids exceed targets in 17% of samples collected. Nitrate-nitrogen exceeded target concentrations in 42% of samples. *E. coli* concentrations exceed state standards in 57% of collected samples. This means these potential pollutants may be causing issues in this subwatershed.

A macroinvertebrate community assessment was conducted in the subwatershed in October 2019. The assessment rated excellent with a pollution tolerance index (PTI) score of 31. Flow during this assessment was recorded as 101.0 cfs. Habitat assessments rated lower than the target QHEI score.

Figure 50- Locations of Current and Historic Water Quality Data Exceedances and Impairments in the Hickam Lateral-Wolf Creek Subwatershed



Current water quality data: Table 25 shows the current water quality data for the Hickam Lateral-Wolf Creek Subwatershed where three sample sites were located. It should be noted that site J2 was dry during most sampling events. As shown in the table, dissolved oxygen exceeded water quality targets in 13-36% of samples, turbidity exceeded targets in 45-78% of samples, total phosphorus exceeded targets in 45-67% of samples, and nitrate exceeded targets in 11-73% of samples. pH and TSS did not exceed any targets and *E. coli* exceeded state standards in 18-33% of samples.

Table 25. Water quality data collected in the Hickam Lateral-Wolf Creek Subwatershed, June 2019 to February 2021

Site		Temp (C)	DO (mg/L)	pH	Turb (NTU)	Cond	TP (mg/L)	Nitrate (mg/L)	TSS (mg/L)	*E.coli* (col/100 ml)
J2	Min	3.55	3.68	6.87	0	292	0.04	0.1	5	8
	Median	13.725	8.58	7.97	9.4	297.5	0.13	0.267	5.5	48.7
	Max	15.95	14.1	8.67	127	303	0.376	0.636	6	629.4
	Count	8	8	8	9	4	9	9	2	9
	Exceed		1	0	7	0	6	1	0	3
	% Exceed	0%	13%	0%	78%	0%	67%	11%	0%	33%
J10	Min	3.29	5.24	7.49	0.4	468	0.052	0.096	0.70	13.2
	Median	14.61	10.69	7.93	7	473.5	0.087	0.52	2.50	33.2
	Max	23.91	16.09	8.72	20.4	505	1.6	2.06	6.00	248.9
	Count	11	11	11	11	6	11	11	9	11
	Exceed		4	0	6	0	5	6	0	2
	% Exceed	0%	36%	0%	55%	0%	45%	55%	0%	18%
J11	Min	2.69	5.84	7.04	2.2	457	0.05	0.103	0.80	12.1
	Median	14.29	9.09	7.86	5.5	483.5	0.071	1.2	1.80	81
	Max	22.35	13.53	8.33	37.2	498	2.09	2.77	6.00	649
	Count	11	11	11	11	6	11	11	9	11
	Exceed		3	0	5	0	5	8	0	2
	% Exceed	0%	27%	0%	45%	0%	45%	73%	0%	18%

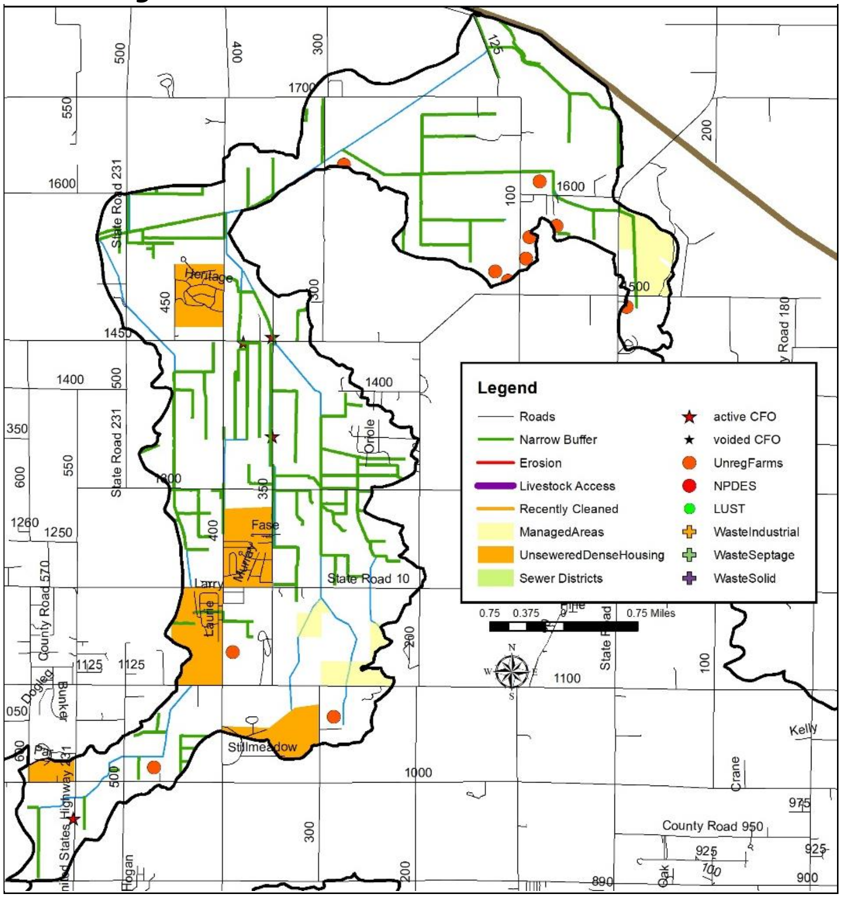
4.3 Delehanty Ditch-Hodge Ditch Subwatershed

The Delehanty Ditch-Hodge Ditch Subwatershed forms part of the southern and eastern boundaries of the Lower Kankakee River Watershed, including the community of Stoutsburg as well as portions of Aukiki Wetland Conservation Area and Stoutsburg Savanna Nature Preserve, and lies within Jasper County. It receives drainage from the Headwaters Wolf Creek and Hickam Lateral-Wolf Creek Subwatersheds. It encompasses one 12-digit HUC watershed: 071200010903. This subwatershed drains 12,610 acres and accounts for 6.7% of the total watershed area. There are 62.8 miles of stream. IDEM has classified 58.5 miles of stream as impaired for *E. coli* and 62.8 miles as impaired for dissolved oxygen. Potentially highly erodible soils are present throughout the subwatershed, covering 8.8% of the subwatershed. Nearly the entire subwatershed (99.7%) has soils which are severely limited for septic use. Agricultural land use dominates the Delehanty Ditch-Hodge Ditch subwatershed with 71% (8,943 acres) in agricultural land uses, including row crop and pasture. An additional 2,004 acres (15.9%) of the watershed is in forested land use. Wetlands, open water, and grassland cover just over 563 acres, or 4.5%, of the subwatershed. Stoutsburg lies within and the State Road 10 corridor bisects the Delehanty Ditch-Hodge Ditch Subwatershed accounting for much of the urban land use within the subwatershed. In total, 1,099 acres or 8.7% of the subwatershed are in urban land uses.

4.3.1 Point Source Water Quality Issues

There are no point sources of water pollution in the subwatershed (Figure 51). There are no open dumps, brownfields, corrective action sites, voluntary remediation sites, NPDES, LUST, or industrial waste facilities located within the Delehanty Ditch-Hodge Ditch Subwatershed.

Figure 51- Point and Non-Point Sources of Pollution and Suggested Solutions in the Delehanty Ditch-Hodge Ditch Subwatershed



4.3.2 Non-Point Source Water Quality Issues

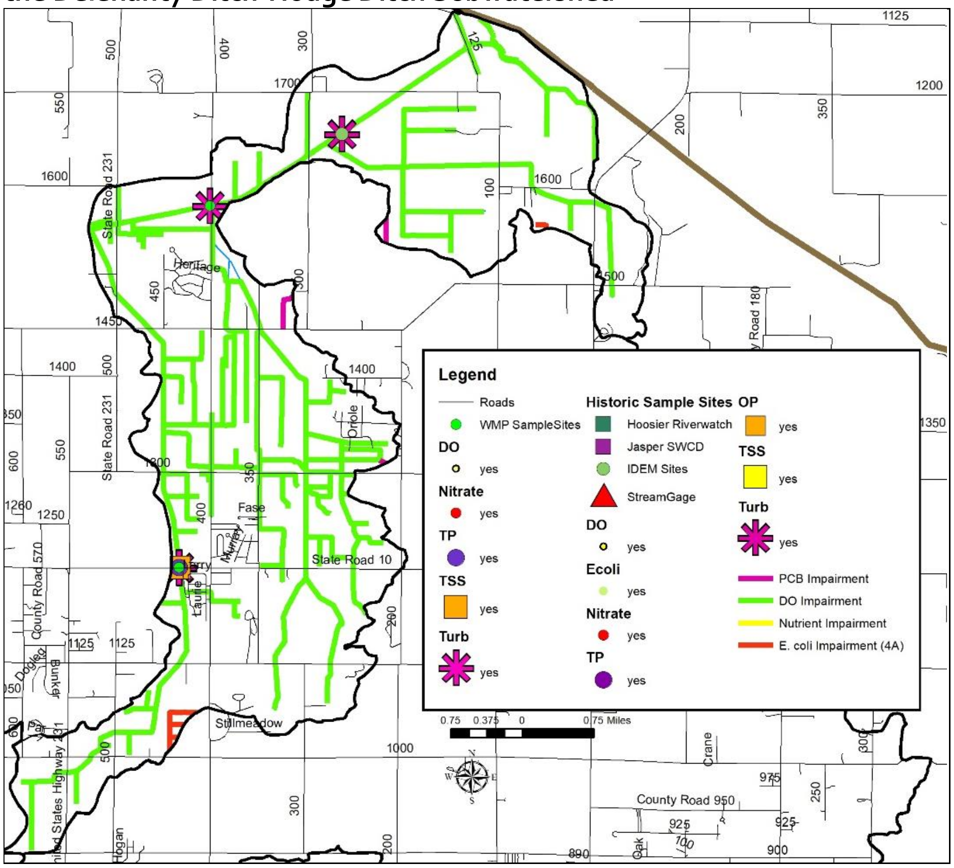
Agricultural land uses are the predominant land use in the Delehanty Ditch-Hodge Ditch Subwatershed. Additionally, a number of small animal operations and pastures are also present. Ten unregulated animal operations housing more than 145 cows, horses, and goats were identified during the windshield survey. Livestock access points were not identified during the windshield survey. Four active CFOs are located within the Delehanty Ditch-Hodge Ditch Subwatershed housing more than 42,200 animals. In total, manure from small animal operations and CFOs total over 42,198 tons per year, containing 118,897 pounds of nitrogen and 89,494 pounds of phosphorus. Streambank erosion and lack of buffers are a concern in the subwatershed. Approximately 46.6 miles of insufficient stream buffers and 0.7 miles of streambank erosion were identified within the subwatershed.

4.3.3 Water Quality Assessment

Waterbodies within the Delehanty Ditch-Hodge Ditch Subwatershed have been sampled at three locations (Figure 52). Assessments include collection of water chemistry data by IDEM (2 sites) and two sites by the Jasper SWCD. No stream gages are in the Delehanty Ditch-Hodge Ditch subwatershed. Table 21 details water quality targets.

Historic water quality data: Dissolved oxygen concentrations exceeded targets in 17% of collected samples. pH, nitrate-nitrogen, and total phosphorus concentrations did not exceed target concentrations during any of the sampling events. Turbidity samples exceed targets in 82% of samples collected, while total suspended solids exceed targets in 33% of samples collected. *E. coli* concentrations exceed state standards in 82% of collected samples.

Figure 52- Locations of Current and Historic Water Quality Data Exceedances and Impairments in the Delehanty Ditch-Hodge Ditch Subwatershed



Current water quality data: Table 26 shows the current water quality data for the Delehanty Ditch-Hodge Ditch Subwatershed where two sample sites were located. As shown in the table, dissolved oxygen exceeded water quality targets in 9-27% of samples, turbidity exceeded targets in 73-82% of samples, total phosphorus exceeded targets in 36-91% of samples, and nitrate exceeded targets in 45-73% of samples. TSS exceeded target concentrations in 30% of samples at J4 and did not exceed at the other site (J9). pH did not exceed any targets and *E. coli* exceeded state standards in 45% of samples at J4 but did not exceed standards at J9.

Table 26- Water quality data collected in the Delehanty Ditch-Hodge Ditch Subwatershed, June 2019 to February 2021

Site		Temp (C)	DO (mg/L)	pH	Turb (NTU)	Cond	TP (mg/L)	Nitrate (mg/L)	TSS (mg/L)	*E.coli* (col/100 ml)
J4	Min	3.31	6.71	7.53	3.5	413	0.05	0.105	0.60	27.2
	Median	13.6	10.98	8.05	16.1	466.5	0.114	0.64	3.00	159
	Max	19.54	12.32	8.54	240	549	1.73	2.21	126.00	1986
	Count	11	11	11	11	6	11	11	10	11
	Exceed		1	0	9	0	10	8	3	5

	% Exceed	0%	9%	0%	82%	0%	91%	73%	30%	45%
J9	Min	2.95	5.63	7.43	1.1	466	0.05	0.075	1.20	5.2
	Median	14.71	10.1	7.97	7.4	480.5	0.0775	0.42	4.00	31.3
	Max	25.12	15.69	8.72	28	510	1.43	1.76	8.00	186
	Count	11	11	11	11	6	11	11	9	11
	Exceed		3	0	8	0	4	5	0	0
	% Exceed	0%	27%	0%	73%	0%	36%	45%	0%	0%

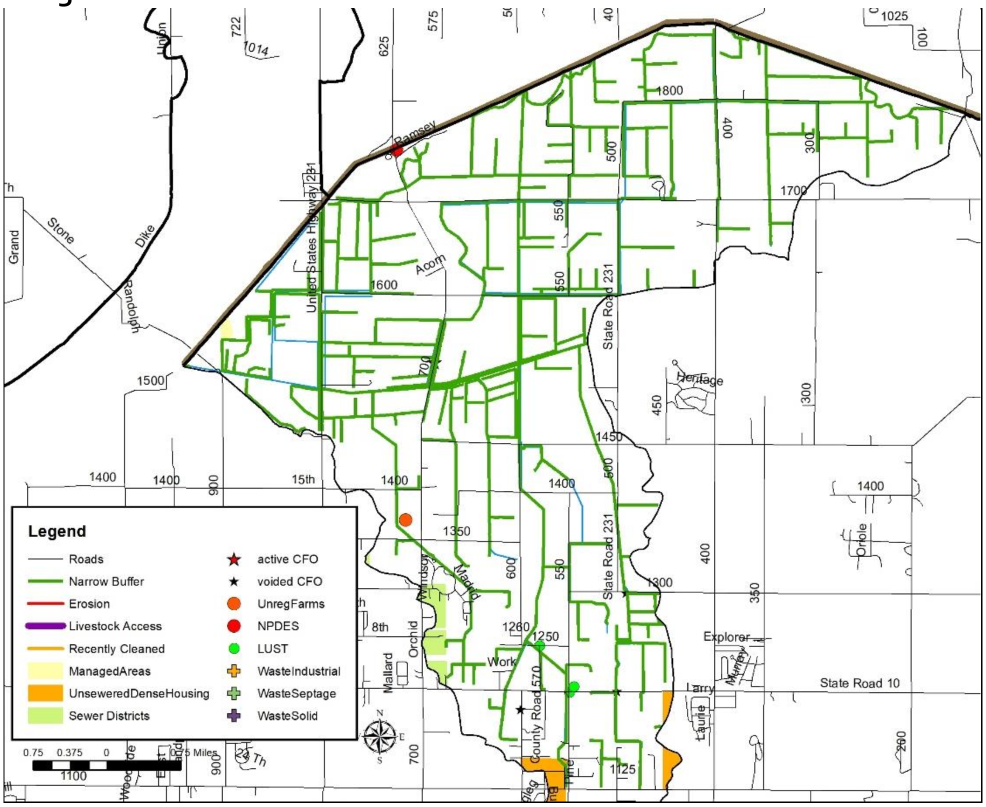
4.4 Cook Ditch-Hodge Ditch Subwatershed

The Cook Ditch-Hodge Ditch Subwatershed forms part of the northern boundary of the Lower Kankakee River Watershed and lies within Jasper County. It encompasses one 12-digit HUC watershed: 071200010904. It receives drainage from the Headwaters Wolf Creek, Hickam Lateral-Wolf Creek, and Delehanty Ditch-Hodge Ditch subwatersheds. This subwatershed drains 17,074 acres and accounts for 9.1% of the total watershed area. There are 116.4 miles of stream. IDEM has classified 21.2 miles of stream as impaired for *E. coli*. Potentially highly erodible soils are present throughout the subwatershed, covering 7.1% of the subwatershed. Nearly the entire subwatershed (99.6%) has soils which are severely limited for septic use. Agricultural land use dominates the Cook Ditch-Hodge Ditch subwatershed with 81% (13,844 acres) in agricultural land uses, including row crop and pasture. Nearly 6.9% of the watershed (1,180 acres) is in forested land use. Wetlands, open water, and grassland cover just over 886 acres, or 5.1%, of the subwatershed. The US Highway 231 corridor bisects the Cook Ditch-Hodge Ditch Subwatershed accounting for much of the urban land use within the subwatershed. In total, 1,182acres or 6.9% of the subwatershed are in urban land uses.

4.4.1 Point Source Water Quality Issues

There are few point sources of water pollution in the subwatershed. There are four (4) LUST sites (Figure 53) and one (1) NPDES-permitted facility (Marti's Place-Bomars River Lodge). No open dumps, brownfields, correction action sites, or industrial waste facilities are located within the Cook Ditch-Hodge Ditch Subwatershed.

Figure 53- Point and Non-Point Sources of Pollution and Suggested Solutions in the Cook Ditch-Hodge Ditch Subwatershed



4.4.2 Non-Point Source Water Quality Issues

Agricultural land uses are the predominant land use in the Cook Ditch-Hodge Ditch Subwatershed. Additionally, a number of small animal operations and pastures are also present. One unregulated animal operation housing approximately 15 cows and horses were identified during the windshield survey. Livestock access points were not identified during the windshield survey. Three CFOs are located in the Cook Ditch-Hodge Ditch Subwatershed. Based on steering committee knowledge, only one CFO is active, and it houses nearly 3,000 animals. In total, manure from small animal operations and CFOs total over 12,534 tons per year, containing almost 36,773 pounds of nitrogen and almost 27,763 pounds of phosphorus. Streambank erosion and lack of buffers are a concern in the subwatershed. Approximately 124.2 miles of insufficient stream buffers and 1.6 miles of streambank erosion were identified within the subwatershed.

4.4.3 Water Quality Assessment

Waterbodies within the Cook Ditch-Hodge Ditch Subwatershed have been sampled at 2 locations (Figure 54). Assessments include collection of water chemistry data by IDEM (1 site) and by the Jasper County SWCD as part of their Clean Water Indiana project (1 site). No stream gages are in the Cook Ditch-Hodge Ditch subwatershed. Table 21 details water quality targets.

Historic water quality data: Dissolved oxygen, pH, nitrate-nitrogen, and total phosphorus concentrations did not exceed target concentrations during any of the IDEM sampling events. Turbidity samples exceed targets in 82% of samples collected by IDEM, while total suspended solids exceed targets in 33% of IDEM samples collected. *E. coli* concentrations exceed state standards in 44% of IDEM-collected samples.

Current water quality data: Table 27 shows the current water quality data for the Cook Ditch-Hodge Ditch Subwatershed where one sample site was located. As shown in the table, dissolved oxygen exceeded water quality targets in 18% of samples, turbidity exceeded targets in 82% of samples, total phosphorus exceeded targets in 64% of samples, and nitrate exceeded targets in 64% of samples. pH and TSS did not exceed any targets and *E. coli* exceeded state standards in 9% of samples.

A macroinvertebrate community assessment was conducted in the subwatershed in October 2019. The assessment rated excellent with a pollution tolerance index (PTI) score of 37. Flow during this assessment was recorded as 24.36 cfs.

Figure 54- Locations of Historic Water Quality Data Exceedances and Impairments in the Cook Ditch-Hodge Ditch Subwatershed

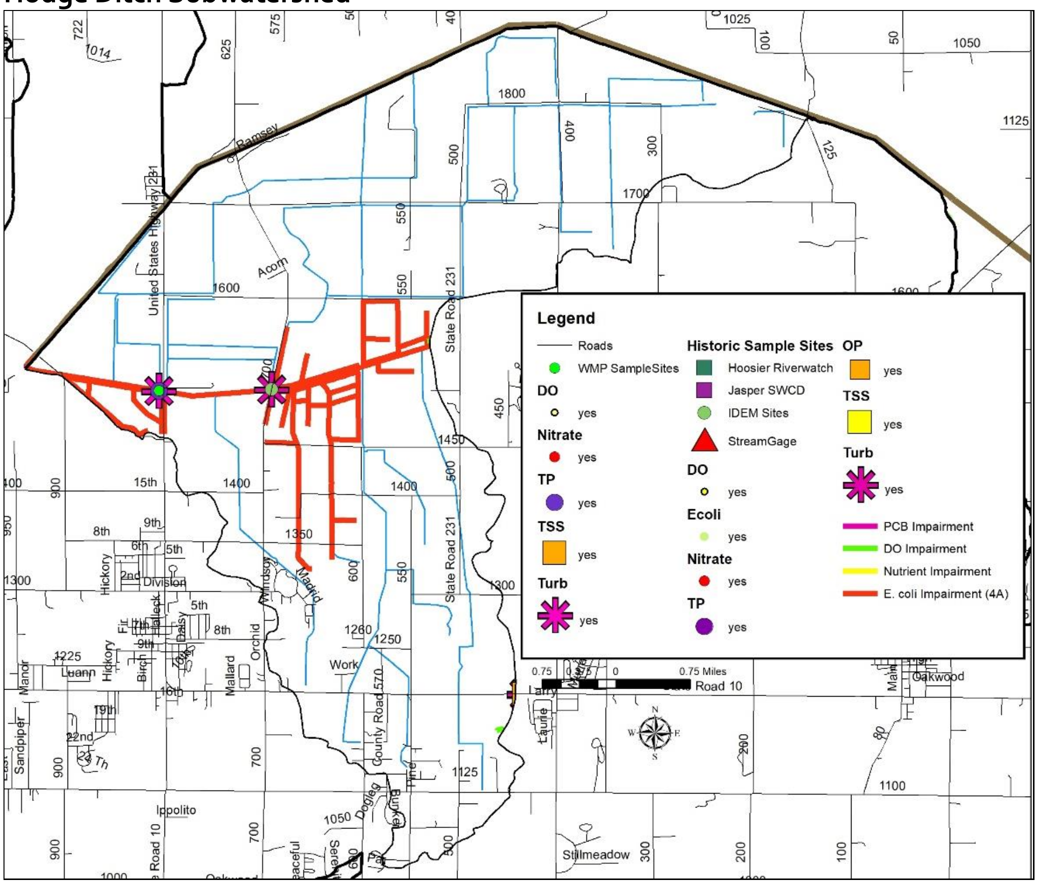


Table 27- Water quality data collected in the Cook Ditch-Hodge Ditch Subwatershed, June 2019 to February 2021

Site		Temp (C)	DO (mg/L)	pH	Turb (NTU)	Cond	TP (mg/L)	Nitrate (mg/L)	TSS (mg/L)	*E.coli* (col/100 ml)
J7	Min	2.75	4.83	7.36	5	466	0.05	0.107	2.50	7.3
	Median	14.16	9.32	7.94	8.1	504.5	0.12	0.696	4.00	35
	Max	25.54	12.61	8.42	30.5	547	1.18	5.37	9.00	345
	Count	11	11	11	11	6	11	11	10	11
	Exceed		2	0	9	0	7	7	0	1
	% Exceed	0%	18%	0%	82%	0%	64%	64%	0%	9%

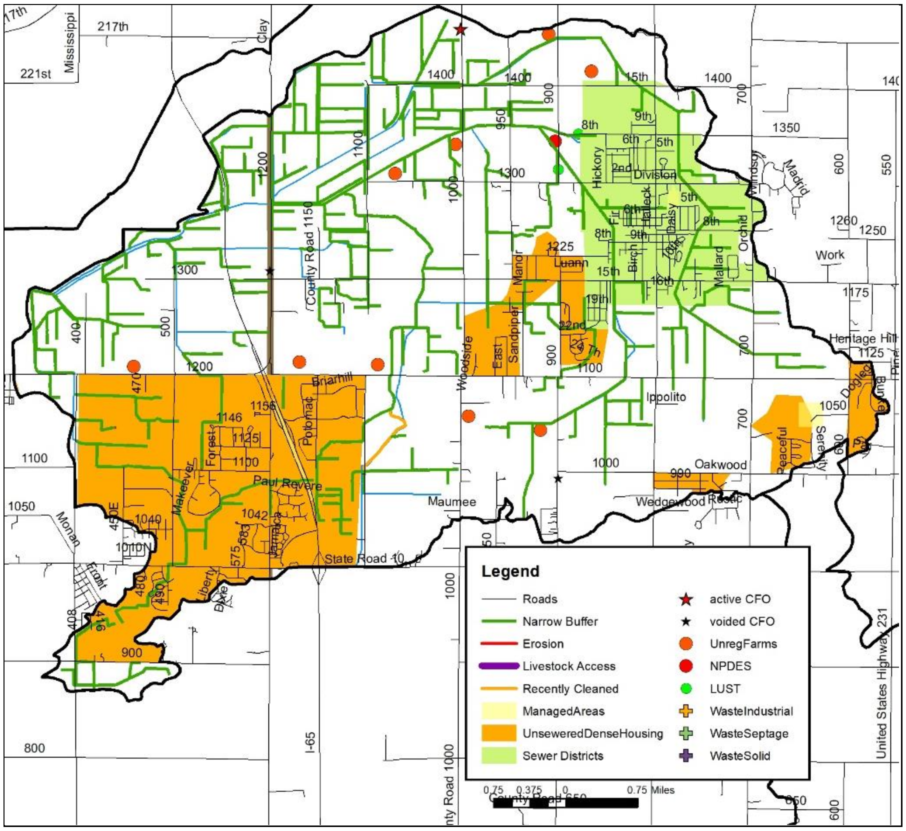
4.5 Dehaan Ditch Subwatershed

The Dehaan Ditch Subwatershed forms part of the southern boundary of the Lower Kankakee River Watershed, including the Town of DeMotte, and lies within Newton and Jasper Counties. It encompasses one 12-digit HUC watershed: 071200011102. This subwatershed drains 23,353 acres and accounts for 12.5% of the total watershed area. There are 125.7 miles of stream. IDEM has classified 0.58 miles of stream as impaired for *E. coli*. Potentially highly erodible soils are present within the subwatershed covering 11.4% of the subwatershed. Nearly the entire subwatershed (99.6%) has soils which are severely limited for septic use. Agricultural land use dominates the Dehaan Ditch subwatershed with 59% (13,750 acres) in agricultural land uses, including row crop and pasture. Nearly 18% of the Dehaan Ditch Subwatershed is in forested land uses (4,328 acres). Wetlands, open water, and grassland cover just over 1,883 acres, or 8.1%, of the subwatershed. DeMotte and the State Road 10 and U.S. Highway 231 corridors account for much of the urban land use within the subwatershed. In total, 3,392 acres or 14.5% of the subwatershed are in urban land uses.

4.5.1 Point Source Water Quality Issues

There are few point sources of water pollution in the subwatershed; however, the Dehaan Ditch Subwatershed contains more point sources than other subwatersheds. There are 22 LUST sites located within or near DeMotte and the U.S. Highway 231 corridor (Figure 55). Additionally, there are three NPDES-permitted facilities (DeMotte Municipal sewer treatment plant, Kankakee Rest Area at I-65, and Lincoln Elementary School). No open dumps, brownfields, corrective action sites, voluntary remediation sites, industrial waste facilities, or industrial waste facilities are located within the Dehaan Ditch Subwatershed.

Figure 55- Point and Non-Point Sources of Pollution and Suggested Solutions in the Dehaan Ditch Subwatershed



4.5.2 Non-Point Source Water Quality Issues

Agricultural land uses are the predominant land use in the Dehaan Ditch Subwatershed. Additionally, a number of small animal operations and pastures are also present. Eleven unregulated animal operations housing more than 145 cows, horses, and goats were identified during the windshield survey. Livestock access points were not identified during the windshield survey. One active and two voided CFOs are located within the Dehaan Ditch Subwatershed housing more than 1,250 animals. In total, manure from small animal operations and CFOs total over 8,222 tons per year; this contains almost 17,062 of nitrogen and almost 12,496 pounds of phosphorus. Streambank erosion and narrow buffers are a concern in the subwatershed. Approximately 7.4 miles of streambank erosion and 109.7 miles of narrow buffers were identified within the subwatershed.

4.5.3 Water Quality Assessment

Waterbodies within the Dehaan Ditch Subwatershed have been sampled at 5 locations (Figure 56). Assessments include collection of water chemistry, fish, macroinvertebrates, and habitat data by IDEM (1 site) and at five sites as part of the Jasper County SWCD's Clean Water Indiana project. No stream gages are in the Dehaan Ditch subwatershed. Table 21 details water quality targets.

Historic water quality data: Dissolved oxygen concentrations did not exceed target concentrations during any of the sampling events. Turbidity samples exceed targets in 100% of samples collected, while *E. coli* concentrations exceed state standards in 90% of collected samples. Fish and macroinvertebrate community assessments conducted in the Kankakee River rated higher than target scores during historic assessments. Habitat assessments rated higher than the target QHEI score.

Current water quality data: Table 28 shows the current water quality data for the Dehaan Ditch Subwatershed where six sample sites were located. As shown in the table, dissolved oxygen exceeded water quality targets in 9-36% of samples, turbidity exceeded targets in 64-100% of samples, total phosphorus exceeded targets in 55-73% of samples, and nitrate exceeded targets in 55-82% of samples. pH did not exceed any targets. TSS exceeded 11% of samples at N14 but did not exceed at other sites. *E. coli* exceeded state standards in 9-45% of samples.

Two macroinvertebrate community assessments were conducted in the subwatershed in October 2019. Both assessments rated excellent with the pollution tolerance index (PTI) scores ranging from 27 – 28. Flows during this assessment were recorded as 94.97 cfs and 67.12 cfs, respectively.

Figure 56- Locations of Current and Historic Water Quality Data Exceedances and Impairments in the Dehaan Ditch Subwatershed

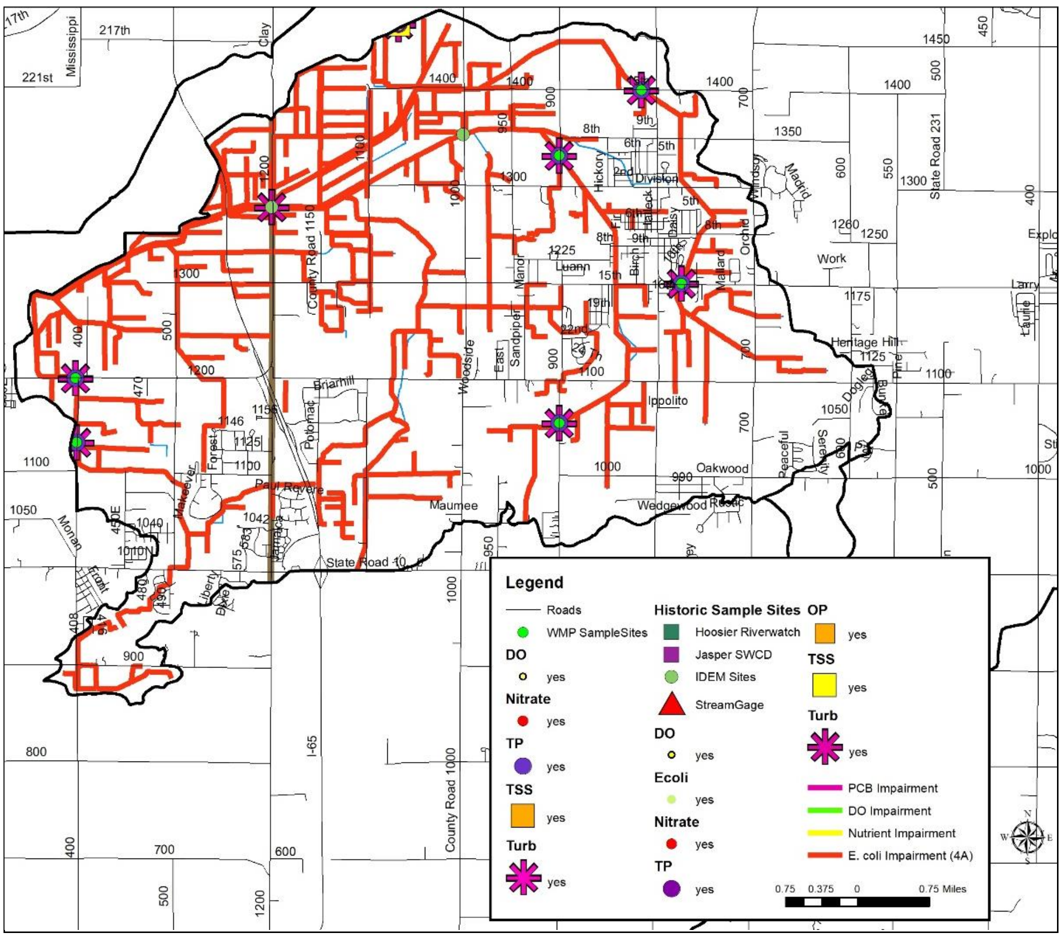


Table 28- Water quality data collected in the Dehaan Ditch Subwatershed, June 2019 to February 2021

Site		Temp (C)	DO (mg/L)	pH	Turb (NTU)	Cond	TP (mg/L)	Nitrate (mg/L)	TSS (mg/L)	*E.coli* (col/100 ml)
J5	Min	2.9	5.97	7.15	4.2	380	0.05	0.106	1.40	24
	Median	12.87	10.24	8	9.1	393.5	0.1365	0.543	2.00	142.1
	Max	18.74	19.65	8.58	56	409	0.764	0.959	5.00	537
	Count	11	11	11	11	6	11	11	6	11
	Exceed		2	0	9	0	7	6	0	4
	% Exceed	0%	18%	0%	82%	0%	64%	55%	0%	36%
J6	Min	3.31	6.81	7.41	1.2	428	0.053	0.106	1.40	35
	Median	13.56	10.26	8.04	9.1	448.5	0.127	0.67	3.55	122
	Max	23.14	16.51	8.91	31.7	586	1.09	1.43	5.00	2419.6
	Count	11	11	11	11	6	11	11	10	11
	Exceed		3	0	7	0	7	7	0	3
	% Exceed	0%	27%	0%	64%	0%	64%	64%	0%	27%
J8	Min	3.54	6.58	7.37	3.1	44	0.05	0.087	1.50	10
	Median	13.01	11.01	8.06	10.3	493	0.09	0.68	3.65	50
	Max	20.82	13.9	8.53	42.5	512	1.2	1.51	4.00	601.5
	Count	11	11	11	11	6	11	11	6	11
	Exceed		4	0	9	0	6	7	0	1
	% Exceed	0%	36%	0%	82%	0%	55%	64%	0%	9%
J12	Min	4.85	2.57	7.3	2.3	373	0.05	0.093	1.40	2
	Median	13.78	9.64	7.94	8	437	0.094	0.86	3.20	24.9
	Max	20.26	12.38	9.35	57.3	775	1.58	2.03	5.30	184
	Count	11	11	11	11	6	11	11	7	11
	Exceed		4	1	7	0	7	6	0	0
	% Exceed	0%	36%	9%	64%	0%	64%	55%	0%	0%
N14	Min	4.91	7.45	7.34	6.8	478	0.05	0.138	0.50	57.7
	Median	11.7	9.61	8.08	21.5	488.5	0.146	1.1	2.10	209.8
	Max	17.28	12.21	8.43	73.8	500	1.37	1.53	16.00	866
	Count	11	11	11	11	6	11	11	9	11
	Exceed		1	0	11	0	8	9	1	5
	% Exceed	0%	9%	0%	100%	0%	73%	82%	11%	45%
N15	Min	4.88	7.93	7.18	5.7	396	0.05	0.133	0.50	28.2
	Median	11.61	10.29	8	11.4	485.5	0.1685	0.94	2.50	93
	Max	19.87	12.09	8.45	73.8	500	1.37	1.53	9.00	613
	Count	11	11	11	11	6	11	11	10	11
	Exceed		1	0	10	0	8	8	0	2
	% Exceed	0%	9%	0%	91%	0%	73%	73%	0%	18%

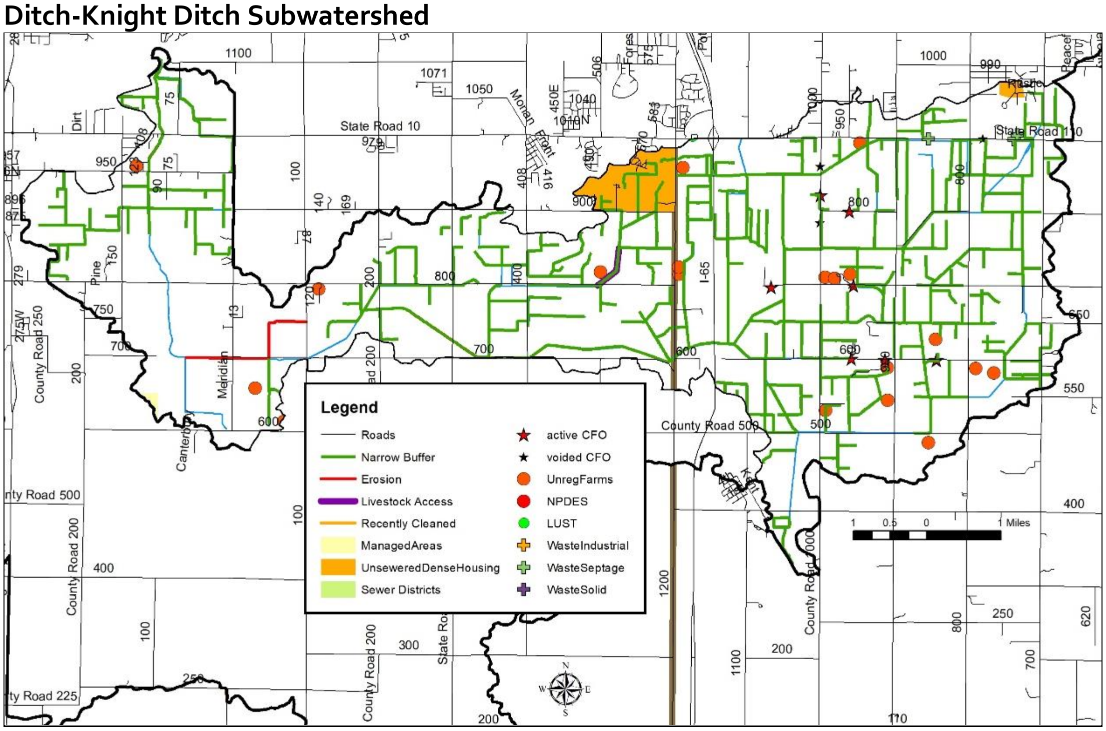
4.6 Wentworth Ditch-Knight Ditch Subwatershed

The Wentworth Ditch-Knight Ditch Subwatershed forms part of the southern boundary of the Lower Kankakee River Watershed and includes the community of Lake Station as well as a small portion of the State Road 10 and State Road 55 corridors and lies within Newton and Jasper Counties. It encompasses one 12-digit HUC watershed: 071200011102. This subwatershed drains 28,835 acres and accounts for 15.4% of the total watershed area. There are 156.3 miles of stream, none of which have been classified as impaired by IDEM. Potentially highly erodible soils are present within the subwatershed, covering 8% of the subwatershed. Nearly the entire subwatershed (99.8%) has soils which are severely limited for septic use. Agricultural land use dominates the Wentworth Ditch-Knight Ditch subwatershed with 76% (21,931 acres) in agricultural land uses, including row crop and pasture. Nearly 14% (4,216 acres) of the subwatershed is in forested land use. Wetlands, open water, and grassland cover just over 1,080 acres, or 3.7%, of the subwatershed. In total, 1,608 acres or 5.6% of the subwatershed is in urban land uses.

4.6.1 Point Source Water Quality Issues

There are few point sources of water pollution in the subwatershed. No LUST, open dumps, brownfields, corrective action sites, voluntary remediation sites, NPDES permitted locations, or industrial waste facilities are located within the Wentworth Ditch-Knight Ditch Subwatershed (Figure 57).

Figure 57- Point and Non-Point Sources of Pollution and Suggested Solutions in the Wentworth Ditch-Knight Ditch Subwatershed



4.6.2 Non-Point Source Water Quality Issues

Agricultural land uses are the predominant land use in the Wentworth Ditch-Knight Ditch Subwatershed. Approximately 18 small animal operations are present housing more than 250 cows, horses, and goats were identified during the windshield survey. Livestock have access to 1.2 miles of Wentworth Ditch-Knight Ditch Subwatershed streams. Eight active and three voided confined feeding operations are located within the Wentworth Ditch-Knight Ditch Subwatershed. The active CFOs house more than 15,530 animals. In total, manure from small animal operations and CFOs total over 166,147 tons per year, this contains almost 188,947 pounds of nitrogen and almost 119,235 pounds of phosphorus. Streambank erosion and narrow buffers are of concern in the subwatershed. Approximately 7.4 miles of streambank erosion and 136.8 miles of narrow buffers were identified within the subwatershed.

4.6.3 Water Quality Assessment

Waterbodies within the Wentworth Ditch-Knight Ditch Subwatershed was sampled one time each at two sites by IDEM and was sampled by the Jasper SWCD (Figure 58). Table 21 details water quality targets.

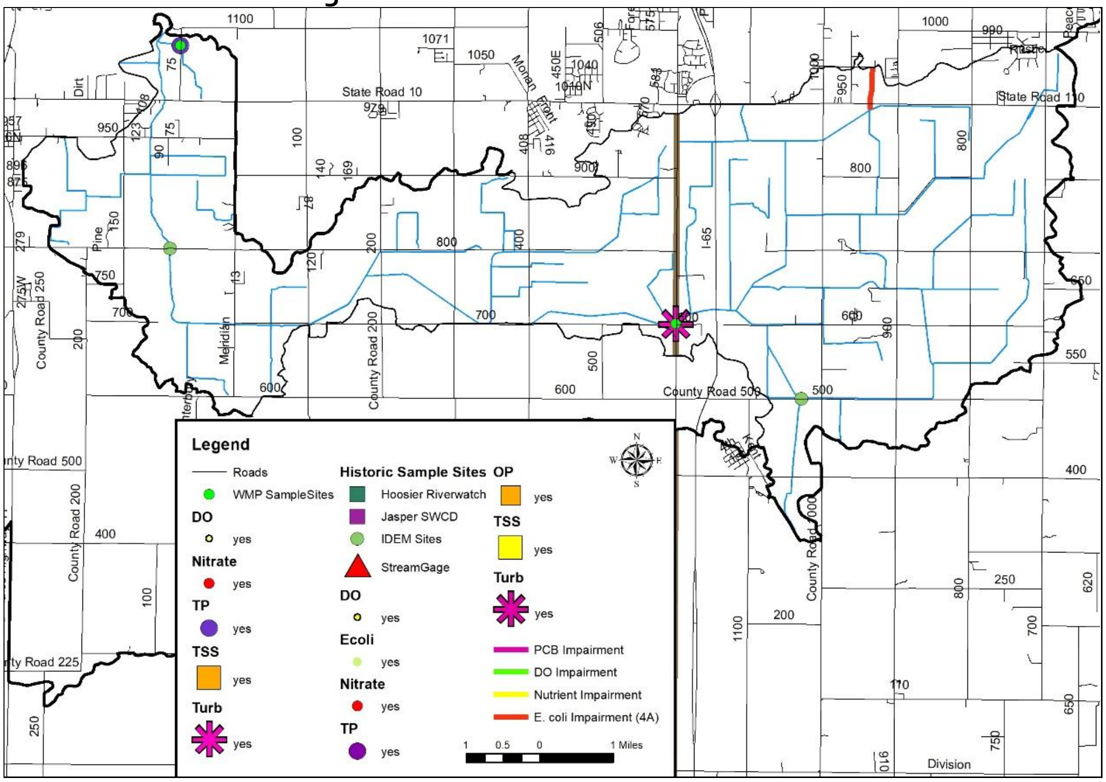
Historic water quality data: *E. coli* concentrations exceed targets in 2 of 3 samples collected by the Jasper SWCD. None of the other water quality data collected exceeded target concentrations.

Current water quality data: Table 29 shows the current water quality data for the Wentworth Ditch Subwatershed where two sample sites were located. As shown in the table, dissolved oxygen exceeded water quality targets in 36-55% of samples, turbidity exceeded targets in 36-55% of samples, total phosphorus exceeded targets in 36-64% of samples, and nitrate exceeded targets in 45-64% of samples. pH and TSS did not exceed any targets and *E. coli* exceeded state standards in 9-18% of samples.

Table 29- Water quality data collected in the Wentworth Ditch Subwatershed, June 2019 to February 2021

Site		Temp (C)	DO (mg/L)	pH	Turb (NTU)	Cond	TP (mg/L)	Nitrate (mg/L)	TSS (mg/L)	*E.coli* (col/100 ml)
J13	Min	1.77	3.75	7.21	1.5	506	0.047	0.052	1.70	1
	Median	14.85	9.37	7.66	6.7	683.5	0.075	1.35	3.00	26
	Max	25.15	19.86	8.36	64.1	739	2.81	3.42	7.90	501.2
	Count	11	11	11	11	6	11	11	7	11
	Exceed		6	0	6	0	4	7	0	2
	% Exceed	0%	55%	0%	55%	0%	36%	64%	0%	18%
N16	Min	4.2	3.19	7.29	1.5	380	0.05	0.11	0.50	14.3
	Median	11.62	9.44	8.02	5.4	393	0.112	0.406	1.70	72
	Max	20.48	14.15	8.45	43.9	625	0.566	0.781	4.00	248.9
	Count	11	11	11	11	6	11	11	7	11
	Exceed		4	0	4	0	7	5	0	1
	% Exceed	0%	36%	0%	36%	0%	64%	45%	0%	9%

Figure 58- Locations of Current and Historic Water Quality Data Exceedances and Impairments in the Wentworth Ditch-Knight Ditch Subwatershed



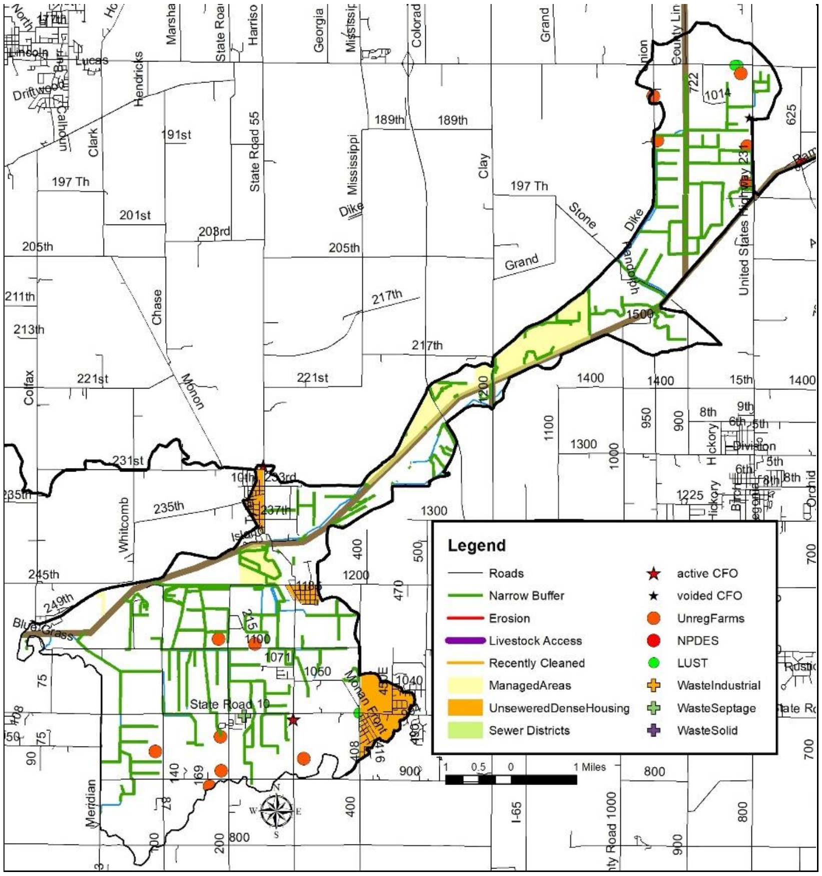
4.7 Brown Levee Ditch-Kankakee River Subwatershed

The Brown Levee Ditch-Kankakee River Subwatershed forms part of the northern boundary of Lower Kankakee River Watershed. The subwatershed includes the communities of Shelby, Roselawn and Thayer and lies within Lake, Porter, Jasper, and Newton Counties. Portions of the Grand Kankakee Marsh lie within the Brown Levee Ditch-Kankakee River subwatershed. It encompasses one 12-digit HUC watershed: 071200011103. This subwatershed drains 17,698 acres and accounts for 9.5% of the total watershed area. There are 125.5 miles of stream. IDEM has classified 122.1 miles of stream as impaired for *E. coli*. Potentially highly erodible soils are present within the subwatershed covering 6.2% of the subwatershed. Nearly the entire subwatershed (97.9%) has soils which are severely limited for septic use. Agricultural land use dominates the Brown Levee Ditch-Kankakee River subwatershed with 54.7% (9,682 acres) in agricultural land uses. Forested land uses cover 2,405 acres (13.6%) of the subwatershed. Wetlands, open water, and grassland cover just over 4,256 acres, or 24.1%, of the subwatershed. In total, 1,354 acres or 7.7% of the subwatershed are in urban land uses.

4.7.1 Point Source Water Quality Issues

There are few point sources of water pollution in the subwatershed. There are three LUST sites (Figure 59) and one waste septage site in the subwatershed. There are no open dumps, brownfields, corrective action sites, voluntary remediations sites, or industrial waste facilities located within the Brown Levee Ditch-Kankakee River Subwatershed.

Figure 59- Point and Non-Point Sources of Pollution and Suggested Solutions in the Brown Levee Ditch-Kankakee River Subwatershed



4.7.2 Non-Point Source Water Quality Issues

Agricultural land uses are the predominant land use in the Brown Levee Ditch-Kankakee River Subwatershed. Additionally, 12 unregulated animal operations housing more than 90 cows, horses, goats, and sheep were identified during the windshield survey. Livestock access points were not identified in the Brown Levee Ditch-Kankakee River Subwatershed during the windshield survey. Two active and one voided confined feeding operations are located within the Brown Levee Ditch-Kankakee River Subwatershed. The voided CFO was closed at the request of the owner/operator. These facilities house approximately 2,500 animals. In total, manure from small animal operations and CFOs total over 3,964 tons per year; this contains almost 1,958 pounds of nitrogen and almost 970 pounds of phosphorus. Streambank erosion and lack of buffers are a concern in the subwatershed. Approximately 81.5 miles of insufficient stream buffers and 0.5 miles of streambank erosion were identified within the subwatershed.

4.7.3 Water Quality Assessment

Waterbodies within the Brown Levee Ditch-Kankakee River Subwatershed have been sampled at 9 locations (Figure 60). Assessments include collection of water chemistry data by IDEM (9 sites, including one site that is sampled monthly), the U.S. Geological Survey (1 site), and Hoosier Riverwatch volunteers (1 site). Additionally, fish community assessments occurred at four sites. One U.S. Geological Survey-maintained stream gage is located at the intersection of the Kankakee River with State Road 55 in the Brown Levee Ditch-Kankakee River subwatershed. Table 21 details water quality targets.

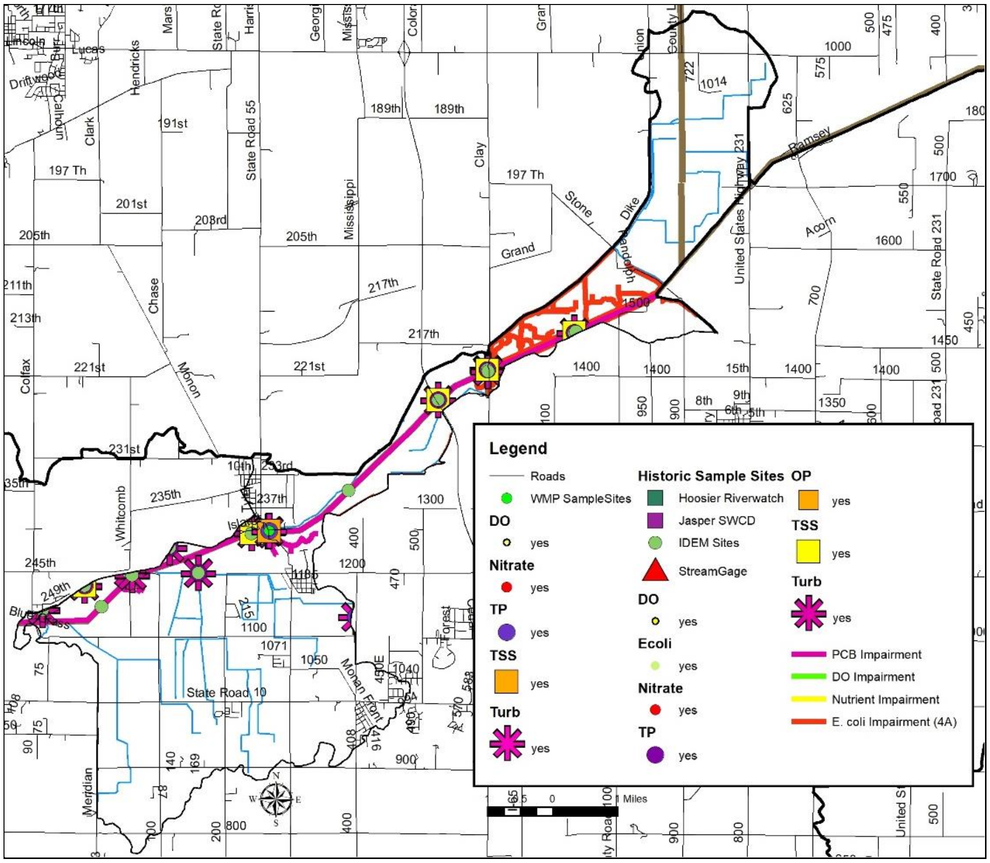
Historic water quality data: Dissolved oxygen concentrations exceeded targets in 8% of IDEM and USGS-collected samples. pH did not exceed target concentrations during any of the sampling events. Nitrate-nitrogen concentrations exceeded targets in 88% of IDEM and USGS-collected samples and in 69% of Hoosier Riverwatch samples, while total phosphorus and orthophosphorus concentrations exceed targets in 44% and 61% of IDEM and USGS collected samples, respectively. Turbidity samples exceed targets in 97% of IDEM and USGS collected samples and in 100% of Hoosier Riverwatch collected samples, while total suspended solids exceed targets in 58% of IDEM samples collected. *E. coli* concentrations exceed state standards in 15% of IDEM collected samples and in 10% of Hoosier Riverwatch collected samples.

Current water quality data: Table 30 shows the current water quality data for the Brown Levee Ditch-Kankakee River Subwatershed where three sample sites were located. As shown in the table, dissolved oxygen exceeded water quality targets in 18-56% of samples, turbidity exceeded targets in 44-100% of samples, total phosphorus exceeded targets in 78-91% of samples, and nitrate exceeded targets in 22-73% of samples. pH did not exceed any targets. TSS exceeded targets in 22% of sample at N19 but did not exceed targets at J20. *E. coli* exceeded state standards in less than 9% of samples.

Table 30- Water quality data collected in the Brown Levee Ditch-Kankakee River Subwatershed, June 2019 to February 2021

Site		Temp (C)	DO (mg/L)	pH	Turb (NTU)	Cond	TP (mg/L)	Nitrate (mg/L)	TSS (mg/L)	*E.coli* (col/100 ml)
N19	Min	0.93	5.91	7.38	10.6	525	0.071	0.181	1.40	23
	Median	15.09	9	8.04	16.4	575	0.162	1.37	5.10	85.7
	Max	23.3	12.36	8.25	45	603	1.47	3.1	28.00	816
	Count	11	11	11	11	5	11	11	9	11
	Exceed		2	0	11	0	10	8	2	1
	% Exceed	0%	18%	0%	100%	0%	91%	73%	22%	9%
N20	Min	2.7	1.21	7.03	2.4	315	0.05	0.192	1.10	3.1
	Median	15.8	4.29	7.51	5.3	531	0.158	0.445	1.90	52
	Max	23.74	13.05	8.2	24.1	603	0.358	1.35	4.00	116.2
	Count	9	9	9	9	5	9	9	5	9
	Exceed		5	0	4	0	7	2	0	0
	% Exceed	0%	56%	0%	44%	0%	78%	22%	0%	0%

Figure 60- Locations of Current and Historic Water Quality Data Exceedances and Impairments in the Brown Levee Ditch-Kankakee River



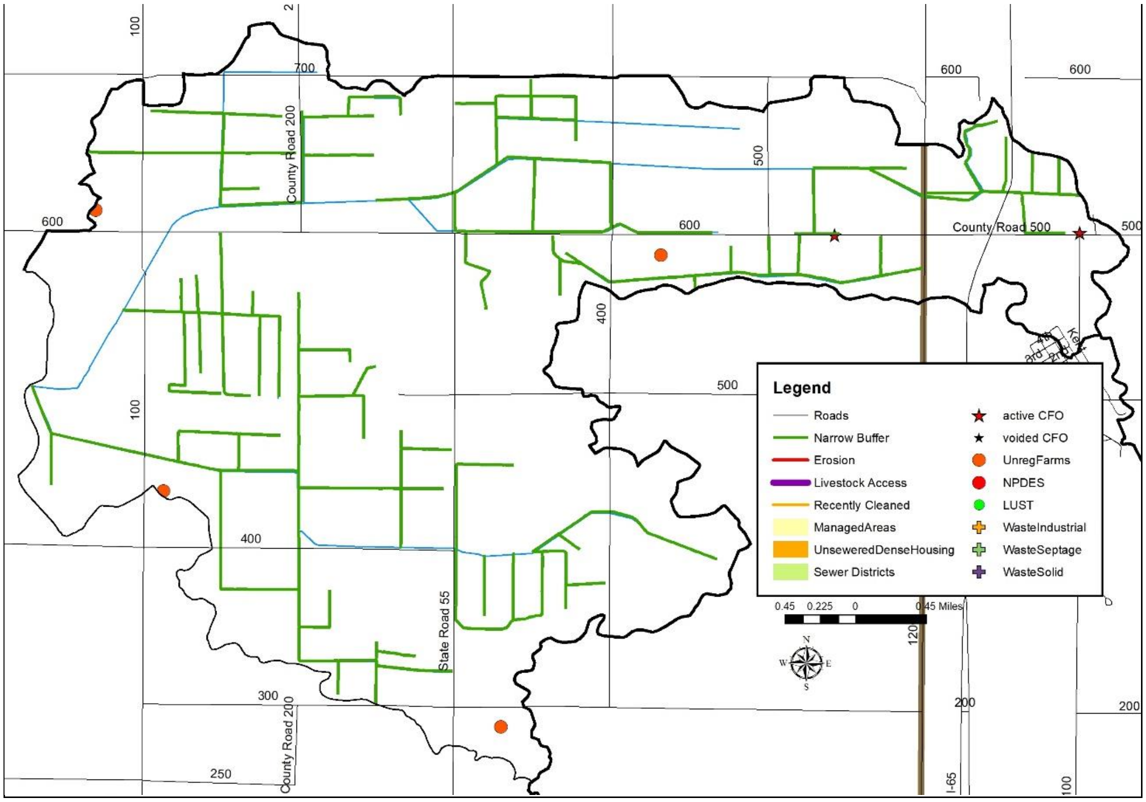
4.8 Gregory Ditch-Mud Lake Ditch Subwatershed

The Gregory Ditch-Mud Lake Ditch Subwatershed forms part of the southern boundary of Lower Kankakee River Watershed and lies within Jasper and Newton Counties. It encompasses one 12-digit HUC watershed: 071200011201. This subwatershed drains 10,977 acres and accounts for 9.5% of the total watershed area. There are 54.1 miles of stream in the watershed. IDEM has classified 30.7 miles of stream as impaired for *E. coli* and 14.2 miles as impaired for PCBs in fish tissue. Potentially highly erodible soils are present within the subwatershed covering 10.1% of the subwatershed. Nearly the entire subwatershed (99.6%) has soils which are severely limited for septic use. Agricultural land use dominates the Gregory Ditch-Mud Lake Ditch subwatershed with 79% (17,698 acres) in agricultural land uses, including row crop and pasture, and 10.3% (6,671 acres) in forested land use. Wetlands, open water, and grassland cover just over 482 acres, or 4.4%, of the subwatershed, while 691 acres or 6.3% of the subwatershed are in urban land uses.

4.8.1 Point Source Water Quality Issues

There are no point sources of water pollution in the Gregory Ditch-Mud Lake Ditch subwatershed (Figure 61). No brownfields, corrective action sites, voluntary remediations sites, or industrial waste facilities are located within the Gregory Ditch-Mud Lake Ditch Subwatershed.

Figure 61- Point and Non-Point Sources of Pollution and Suggested Solutions in the Gregory Ditch-Mud Lake Ditch Subwatershed



4.8.2 Non-Point Source Water Quality Issues

Agricultural land uses are the predominant land use in the Gregory Ditch-Mud Lake Ditch Subwatershed. Four unregulated animal operations housing more than 40 cows, horses, and goats were identified during the windshield survey. Livestock have access to 1.2 miles of Gregory Ditch-Mud Lake Ditch Subwatershed streams. Two active confined feeding operations are located within the Gregory Ditch-Mud Lake Ditch Subwatershed housing 10,470 animals. In total, manure from small animal operations and CFOs total over 230,188 tons per year; this contains almost 109,342 pounds of nitrogen and almost 53,623 pounds of phosphorus. Streambank erosion and livestock access points were not identified during the windshield survey. Approximately 43.7 miles of insufficient stream buffers were identified within the subwatershed.

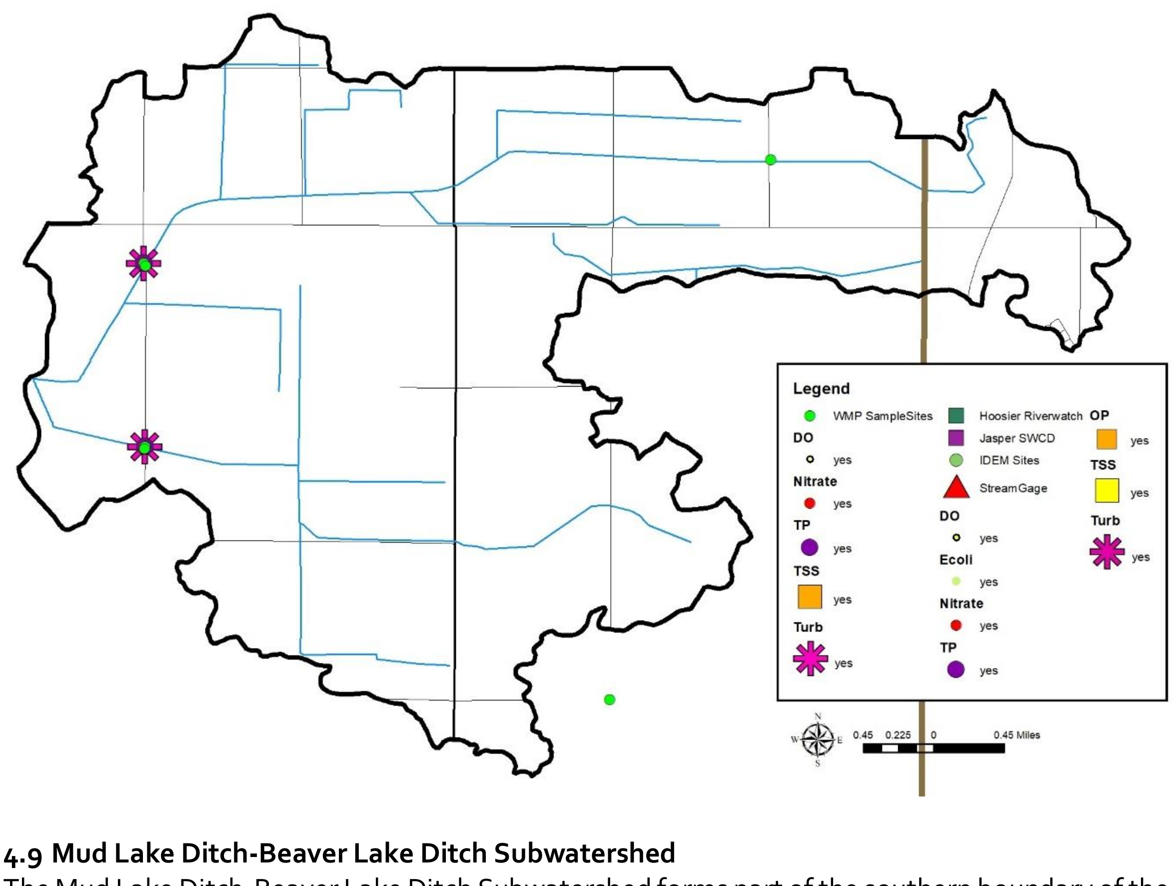
4.8.3 Water Quality Assessment

Current water quality data:Table 31 shows the current water quality data for the Gregory Ditch-Mud Lake Ditch Subwatershed where two sample sites were located. As shown in the table, dissolved oxygen exceeded water quality targets in 0-33% of samples, turbidity exceeded targets in 64-67% of samples, total phosphorus exceeded targets in 64-91% of samples, and nitrate exceeded targets in 67-75% of samples. pH and TSS did not exceed any targets. *E. coli* did not exceed state standards in at either site..

Table 31- Water quality data collected in the Gregory Ditch-Mud Lake Ditch Subwatershed, September 2020 to August 2021

Site		Temp (C)	DO (mg/L)	pH	Turb (NTU)	Cond	TP (mg/L)	Nitrate (mg/L)	TSS (mg/L)	*E.coli* (col/100 ml)
N23	Min	0.59	5.47	7.51	0.90	506.00	0.06	0.14	0.90	3.00
	Median	11.29	9.08	7.87	7.70	580.00	0.09	0.72	2.50	49.00
	Max	22.72	14.60	8.78	15.80	658.00	0.23	1.57	5.30	165.00
	Count	11	11	11	11	11	11	12	12	12
	Exceed		0	0	7	0	7	9	0	0
	% Exceed	0%	0%	0%	64%	0%	64%	75%	0%	0%
N24	Min	0.49	0.89	7.27	1.20	654.00	0.08	0.02	0.70	6.00
	Median	10.70	8.66	7.75	7.65	736.50	0.14	1.02	3.15	41.50
	Max	23.42	14.77	9.77	46.10	858.00	0.44	2.31	5.00	219.00
	Count	12	12	12	12	12	11	12	12	12
	Exceed		4	1	8	0	10	8	0	0
	% Exceed	0%	33%	8%	67%	0%	91%	67%	0%	0%

Figure 62- Locations of Current and Historic Water Quality Data Exceedances and Impairments in the Gregory Ditch-Mud Lake Ditch Subwatershed



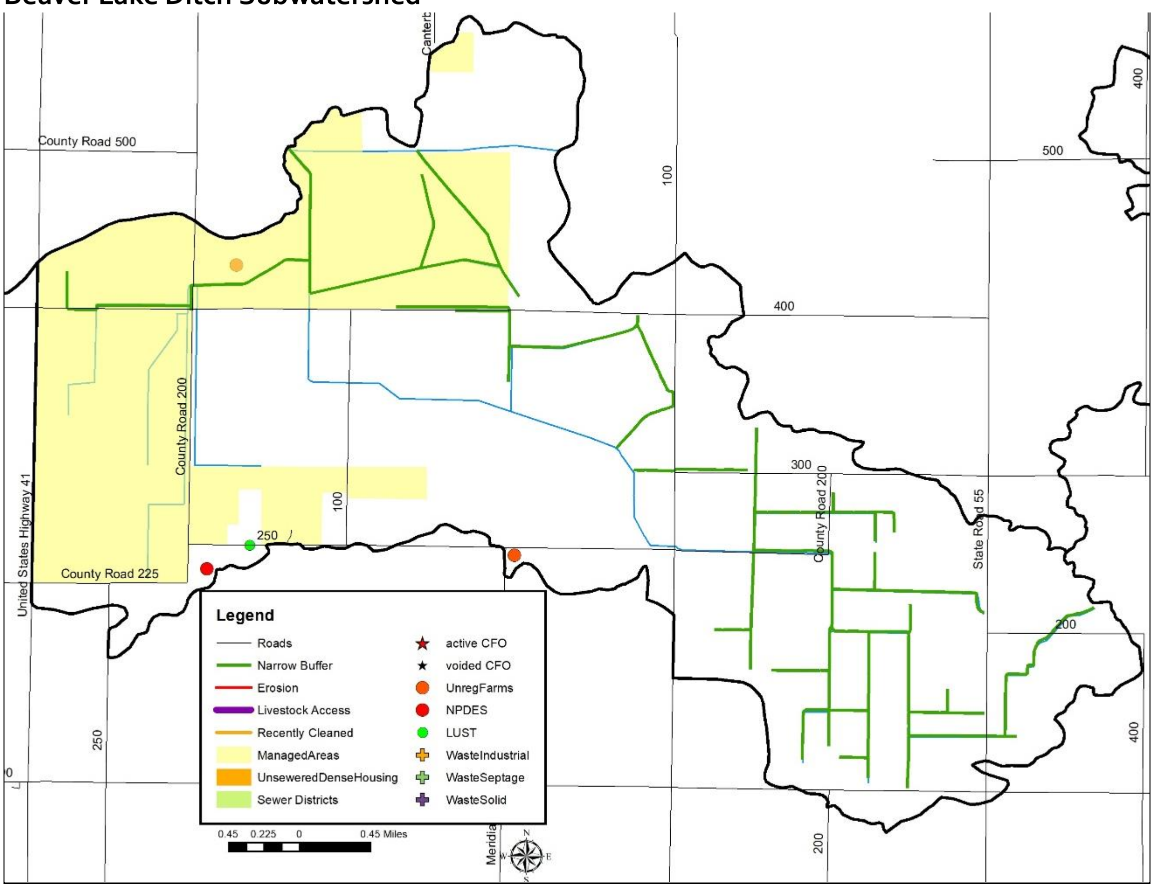
4.9 Mud Lake Ditch-Beaver Lake Ditch Subwatershed

The Mud Lake Ditch-Beaver Lake Ditch Subwatershed forms part of the southern boundary of the Lower Kankakee River Watershed and lies within Newton County. The subwatershed includes portions of the Kankakee Sands Nature Preserve and Beaver Lake Nature Preserve. It encompasses one 12-digit HUC watershed: 071200011202. This subwatershed drains 10,097 acres and accounts for 5.4% of the total watershed area. There are 44.4 miles of streams in this subwatershed, none of which have been impaired. Potentially highly erodible soils are present within the subwatershed covering 5.3% of the subwatershed. Nearly the entire subwatershed (99.9%) has soils which are severely limited for septic use. Agricultural land use dominates the Mud Lake Ditch-Beaver Lake Ditch subwatershed with 84.4% (8,518 acres) in agricultural land uses, including row crop and pasture. Nearly 1,024 acres (10%) of the subwatershed is in forested land use. Wetlands, open water, and grassland cover just over 94 acres, or 0.9%, of the subwatershed. Nearly 460 acres or 4.6% of the subwatershed are in urban land uses.

4.9.1 Point Source Water Quality Issues

There are few point sources of water pollution in the subwatershed. There is one LUST site and one NPDES facility (North Newton Junior-Senior High School; Figure 63. There are no open dumps, industrial waste, brownfields, corrective action sites, voluntary remediation sites, or NPDES permitted locations located within the Mud Lake Ditch-Beaver Lake Ditch Subwatershed. Cattle are grazed on the pasture operated on managed land.

Figure 63- Point and Non-Point Sources of Pollution and Suggested Solutions in the Mud Lake Ditch-Beaver Lake Ditch Subwatershed



4.9.2 Non-Point Source Water Quality Issues

Agricultural land uses are dominant in the Mud Lake Ditch-Beaver Lake Ditch Subwatershed. Two unregulated animal operations housing more than 60 cows, horses, goats, and sheep were identified during the windshield survey. Livestock access points were not identified during the windshield survey.

No active confined feeding operations are located within the Mud Lake Ditch-Beaver Lake Ditch Subwatershed. In total, manure from small animal operations total over 1,300 tons per year, which contains almost 624 pounds of nitrogen and almost 306 pounds of phosphorus. Narrow buffers were identified along 22.7 miles of streambanks.

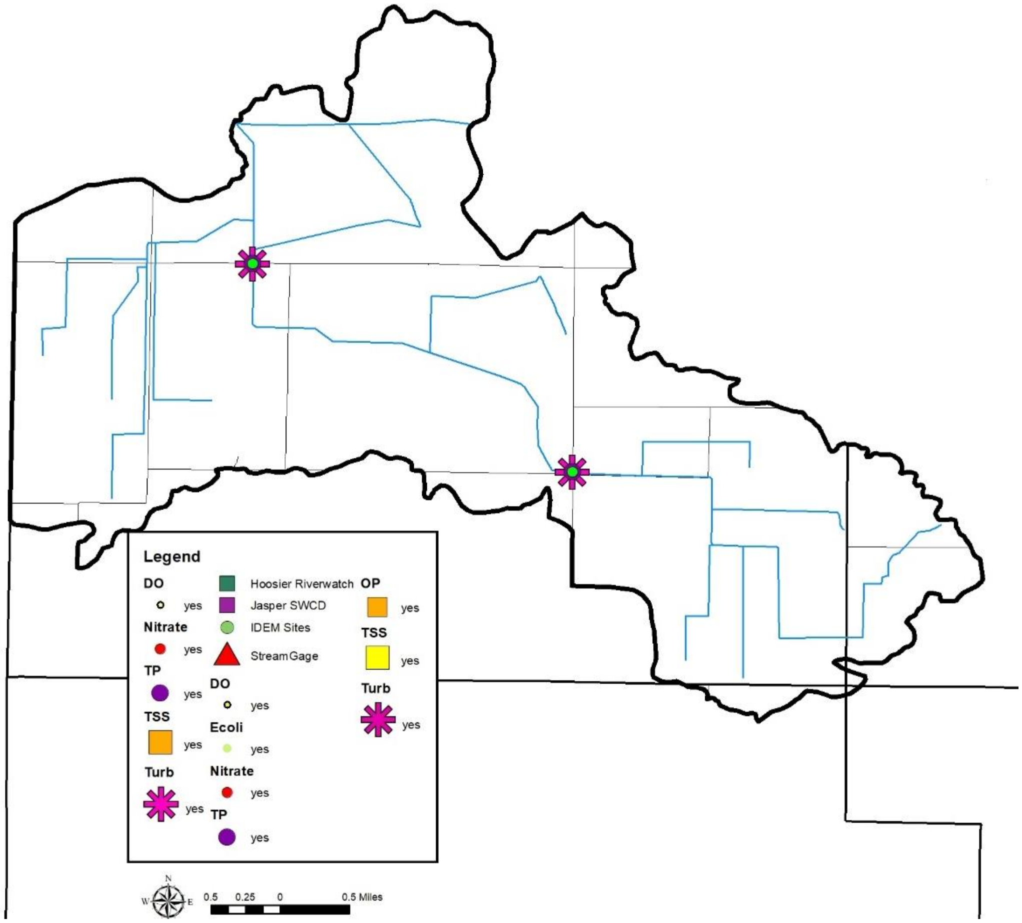
4.9.3 Water Quality Assessment

Current water quality data: Table 32 shows the current water quality data for the Mud Lake Ditch-Beaver Lake Ditch Subwatershed where two sample sites were located. As shown in the table, dissolved oxygen exceeded water quality targets in 8-17% of samples, turbidity exceeded targets in 67% of samples, total phosphorus exceeded targets in 64% of samples, and nitrate exceeded targets in 67% of samples. pH exceeded state standards in 0-17% of samples. TSS did not exceed any targets. *E. coli* exceeded state standards in 0-17% of samples.

Table 32- Water quality data collected in the Mud Lake Ditch-Beaver Lake Ditch Subwatershed, September 2020 to August 2021

Site		Temp (C)	DO (mg/L)	pH	Turb (NTU)	Cond	TP (mg/L)	Nitrate (mg/L)	TSS (mg/L)	*E.coli* (col/100 ml)
N22	Min	0.71	2.21	1.79	0.90	570.00	0.02	0.32	0.60	2.00
	Median	11.78	7.62	7.74	9.50	706.00	0.09	1.13	2.80	26.50
	Max	23.62	14.92	9.91	28.69	765.00	0.13	2.05	7.20	109.00
	Count	12	12	12	12	12	11	12	11	12
	Exceed		1	2	8	0	7	8	0	0
	% Exceed	0%	8%	17%	67%	0%	64%	67%	0%	0%
N25	Min	0.37	2.45	6.79	1.90	538.00	0.05	0.02	0.90	2.00
	Median	13.59	10.04	7.80	9.55	665.00	0.09	1.25	2.75	82.00
	Max	22.75	16.07	8.75	45.50	729.00	0.24	1.95	8.90	548.00
	Count	12	12	12	12	12	11	12	12	12
	Exceed		2	0	8	0	7	8	0	2
	% Exceed	0%	17%	0%	67%	0%	64%	67%	0%	17%

Figure 64- Locations of Current and Historic Water Quality Data Exceedances and Impairments in the Mud Lake Ditch-Beaver Lake Ditch Creek Subwatershed



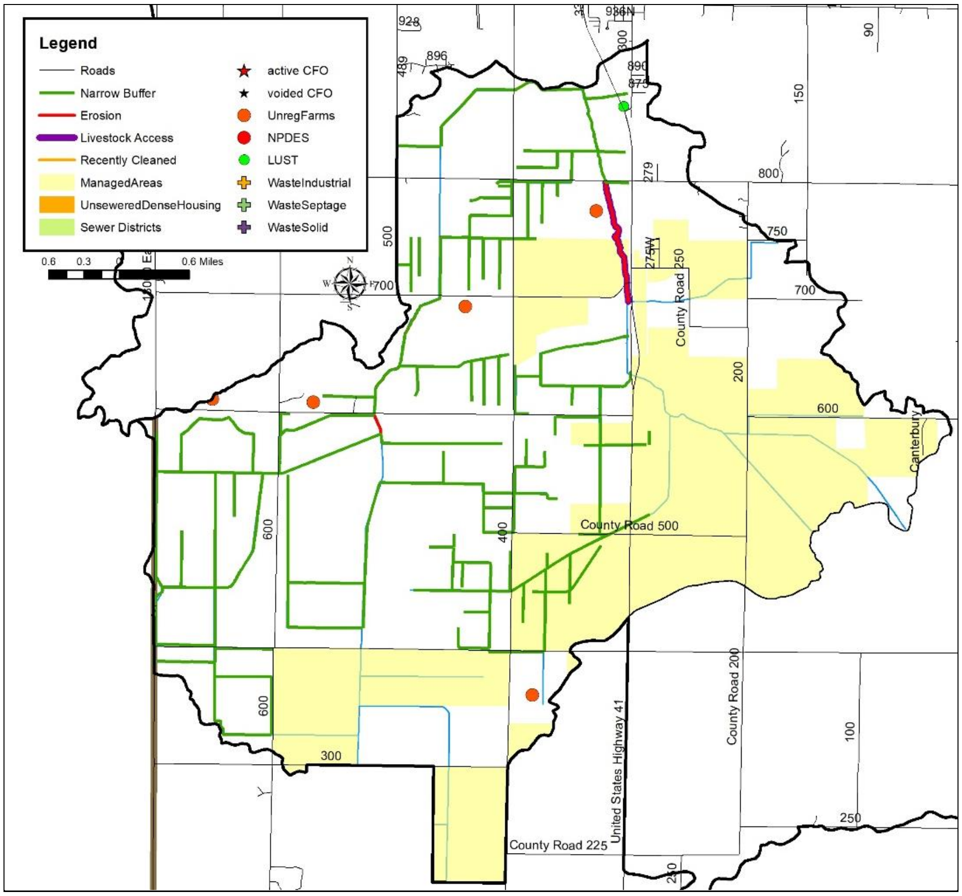
4.10 Lawler Ditch-Beaver Lake Ditch Subwatershed

The Lawler Ditch-Beaver Lake Ditch Subwatershed forms part of the southwestern boundary of the Lower Kankakee River Watershed and includes portions of the U.S. Highway 41 corridor and the Town of Conrad. This subwatershed lies entirely within Newton County and includes portions of Willow Slough Fish and Wildlife Area, Kankakee Sands Nature Preserve, Conrad Station Nature Preserve, Conrad Savanna Managed Area and Beaver Lake Nature Preserve. The Lawler Ditch-Beaver Lake Ditch subwatershed receives water from the Mud Lake Ditch-Beaver Lake Ditch subwatershed. It encompasses one 12-digit HUC watershed: 071200011203. This subwatershed drains 15,988 acres and accounts for 8.6% of the total watershed area. There are 79.3 miles of stream in the subwatershed. IDEM has classified 76.4 miles of stream as impaired for *E. coli*. Potentially highly erodible soils are present within the subwatershed, covering 5.8% of the subwatershed. Nearly the entire subwatershed (99.7%) has soils which are severely limited for septic use. Agricultural land use dominates the Lawler Ditch-Beaver Lake Ditch subwatershed with 78% (12,414 acres) in agricultural land uses, including row crop and pasture. Nearly 13.5% of the subwatershed (3,088 acres) is in forested land use. Wetlands, open water, and grassland cover just over 569 acres, or 3.6%, of the subwatershed. Nearly 844 acres or 5.3% of the subwatershed are in urban land uses.

4.10.1 Point Source Water Quality Issues

There are few point sources of water pollution in the Lawler Ditch-Beaver Lake Ditch subwatershed. There are no open dumps, brownfields, corrective action sites, voluntary remediations sites, NPDES permitted locations, or industrial waste facilities located within the Lawler Ditch-Beaver Lake Ditch Subwatershed. One LUST location is located within the Lawler Ditch-Beaver Lake Ditch subwatershed (Figure 65).

Figure 65- Point and Non-Point Sources of Pollution and Suggested Solutions in the Lawler Ditch-Beaver Lake Ditch Subwatershed



4.10.2 Non-Point Source Water Quality Issues

Agricultural land uses are the predominant land use in the Lawler Ditch-Beaver Lake Ditch subwatershed. Five unregulated animal operations housing more than 60 cows, horses, and goats were identified during the windshield survey. Livestock have access to 2.2 miles of Lawler Ditch-Beaver Lake Ditch subwatershed streams. No active confined feeding operations are located within the Lawler Ditch-Beaver Lake Ditch subwatershed. In total, manure from small animal operations total over 760 tons per year, which contains almost 447 pounds of nitrogen and almost 241 pounds of phosphorus. Streambank erosion and lack of buffers are a concern in the subwatershed. Approximately 52.4 miles of insufficient stream buffers and 3.1 miles of streambank erosion were identified within the subwatershed.

4.10.3 Water Quality Assessment

Waterbodies within the Lawler Ditch-Beaver Lake Ditch subwatershed have been sampled at 3 locations (Figure 66). Assessments include collection of water chemistry data (3 sites), fish community (1 site) and macroinvertebrate community (3 sites) data by IDEM. No stream gages are in the Lawler Ditch-Beaver Lake Ditch subwatershed. Table 21 details water quality targets.

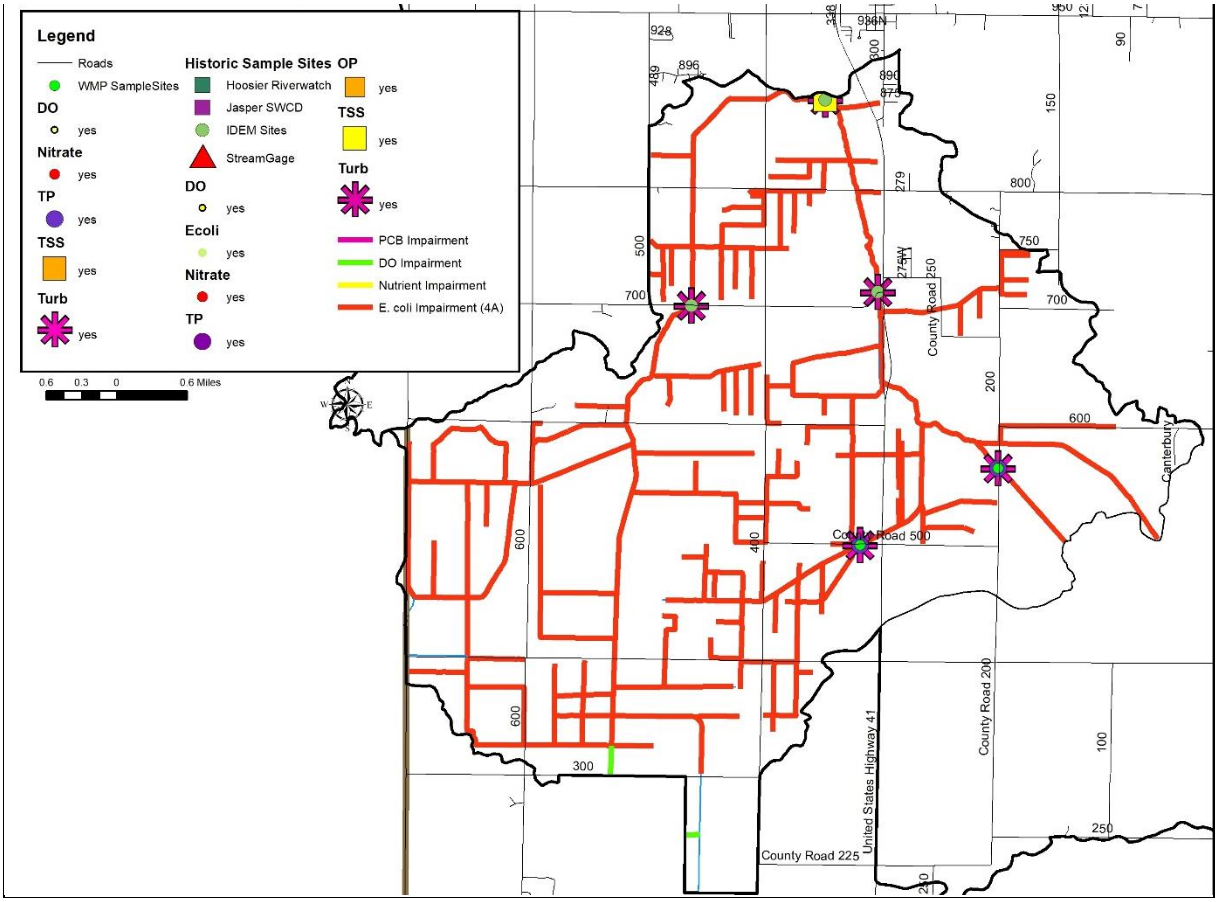
Historic water quality data: Dissolved oxygen concentrations exceeded targets in 5% of collected samples. Nitrate-nitrogen concentrations did not exceed target concentrations during any of the sampling events. Total phosphorus concentrations exceed targets in 84% of collected samples. Turbidity samples exceed targets in 87% of samples collected, while total suspended solids exceed targets in 67% of samples collected. *E. coli* concentrations exceed state standards in 60% of collected samples. Fish community assessments rated higher than target scores, while macroinvertebrate community assessment scores rated higher than target scores during historic assessments. Habitat assessments rated lower than the target QHEI score.

Current water quality data: Table 33 shows the current water quality data for the Lawler Ditch-Beaver Lake Ditch Subwatershed where two sample sites were located. As shown in the table, dissolved oxygen exceeded water quality targets in 18-27% of samples, turbidity exceeded targets in 55-82% of samples, total phosphorus exceeded targets in 64% of samples, and nitrate exceeded targets in 45-73% of samples. pH and TSS did not exceed any targets and *E. coli* exceeded state standards in 0-18% of samples.

Table 33- Water quality data collected in the Lawler Ditch-Beaver Lake Ditch Subwatershed, June 2019 to February 2021

Site		Temp (C)	DO (mg/L)	pH	Turb (NTU)	Cond	TP (mg/L)	Nitrate (mg/L)	TSS (mg/L)	*E.coli* (col/100 ml)
N17	Min	3.41	3.93	7.07	0	345	0.05	0.029	0.12	6.3
	Median	13.27	9.31	7.77	6.1	572.5	0.1015	0.735	1.75	44.1
	Max	22.47	14.09	8.21	48.1	604	1.9	2.9	3.00	125.9
	Count	11	11	11	11	6	11	11	6	11
	Exceed		3	0	6	0	7	8	0	0
	% Exceed	0%	27%	0%	55%	0%	64%	73%	0%	0%
N3	Min	5.29	3.52	7.16	0.3	589	0.05	0.094	1.80	2
	Median	12.08	9.25	7.69	13.2	622.5	0.102	0.474	3.50	26.9
	Max	22.95	13.07	8.14	43.6	653	2.46	0.926	10.00	658.6
	Count	11	11	11	11	6	11	11	8	11
	Exceed		2	0	9	0	7	5	0	2
	% Exceed	0%	18%	0%	82%	0%	64%	45%	0%	18%

Figure 66- Locations of Historic Water Quality Data Exceedances and Impairments in the Lawler Ditch-Beaver Lake Ditch Subwatershed



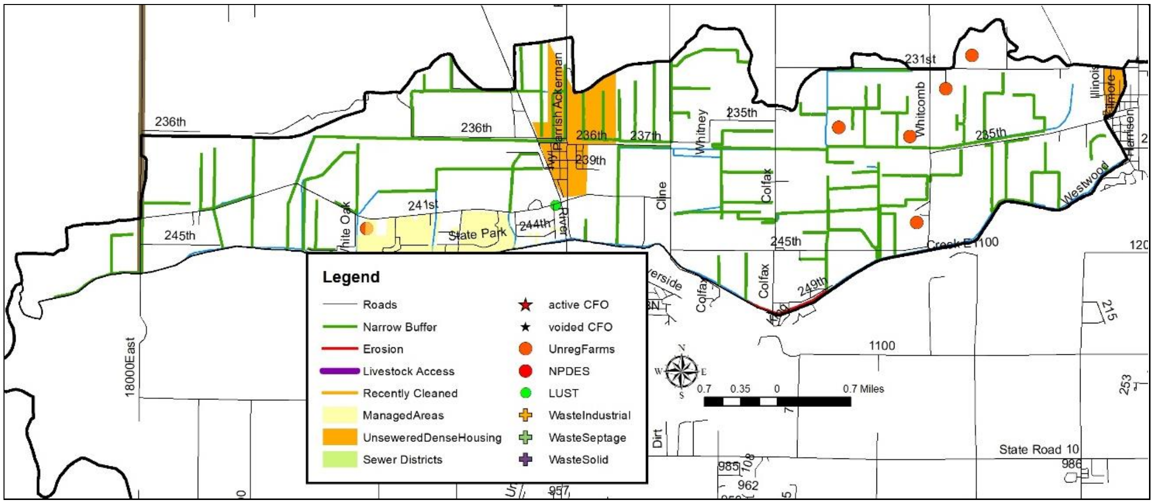
4.11 Williams Creek Subwatershed

The Williams Creek Subwatershed forms part of the northern boundary of the Lower Kankakee River Watershed, includes the town of Schneider and lies entirely within Lake County. It encompasses one 12-digit HUC watershed: 071200011204. This subwatershed drains 10,439 acres and accounts for 8.4% of the total watershed area. There are 67.2 miles of stream in this subwatershed. IDEM has classified 9.4 miles of stream as impaired for PCBs in fish tissue. Nearly the entire subwatershed (96%) has soils which are severely limited for septic use. Agricultural land use dominates the Williams Creek subwatershed with 78% (10,438 acres) in agricultural land uses, including row crop and pasture. Wetlands, open water, and grassland cover 759 acres, or 7.3%, of the subwatershed, while forested land uses cover 703 acres (6.7%) of the subwatershed. In total, 776 acres or 7.4% of the subwatershed are in urban land uses.

4.11.1 Point Source Water Quality Issues

There are few point sources of water pollution in the subwatershed. There are no open dumps, brownfields, corrective action sites, voluntary remediation sites, NPDES permitted locations, or industrial waste facilities located within the Williams Creek subwatershed. One LUST facility is present in the Williams Creek subwatershed (Figure 67).

Figure 67- Point and Non-Point Sources of Pollution and Suggested Solutions in the Williams Creek Subwatershed



4.11.2 Non-Point Source Water Quality Issues

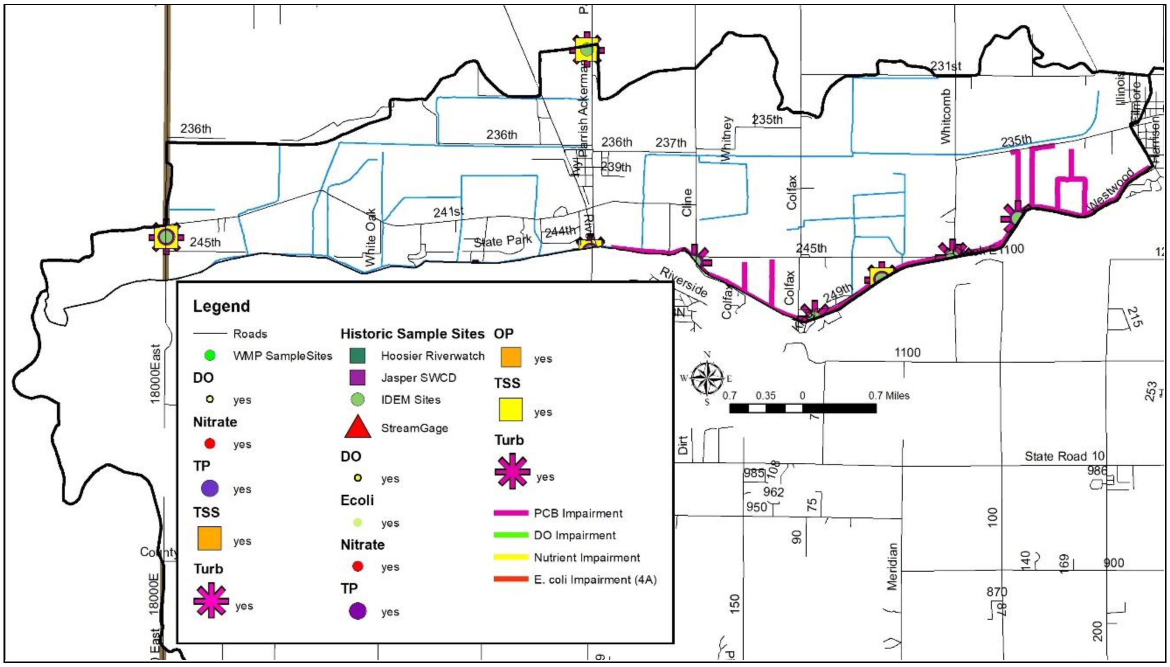
Agricultural land uses are a significant land use in the Williams Creek Subwatershed. Six unregulated animal operations housing more than 95 cows, horses, goats, and bison were identified during the windshield survey. Livestock access points were not identified during the windshield survey. No active confined feeding operations are located within the Williams Creek Subwatershed. In total, manure from small animal operations total over 1,972 tons per year, which contains almost 977 pounds of nitrogen and almost 486 pounds of phosphorus. Streambank erosion and narrow buffers are of concern in the subwatershed. Approximately 1.0 miles of streambank erosion and 52.5 miles of narrow buffer were identified within the subwatershed.

4.11.3 Water Quality Assessment

Waterbodies within the Williams Creek subwatershed have been sampled at 7 locations (Figure 68). Assessments include collection of water chemistry data by IDEM (7 sites), fish (3 sites), and macroinvertebrates (1 site). No stream gages are in the Hickam Lateral-Wolf Creek subwatershed. Table 21 details water quality targets.

Historic water quality data: Dissolved oxygen concentrations exceeded targets in 11% of collected samples. Nitrate-nitrogen concentrations exceeded target concentrations in 88% of collected samples. Total phosphorus concentrations exceed targets in 63% of samples. Turbidity samples exceed targets in 74% of samples collected, while total suspended solids exceed targets in 25% of samples collected. *E. coli* concentrations exceed state standards in 10% of collected samples. Fish and macroinvertebrate community assessments conducted on Williams Creek and the Kankakee River rated higher than target scores during historic assessments. Habitat assessments rated higher than the target QHEI score.

Figure 68- Locations of Historic Water Quality Data Exceedances and Impairments in the Williams Creek Subwatershed



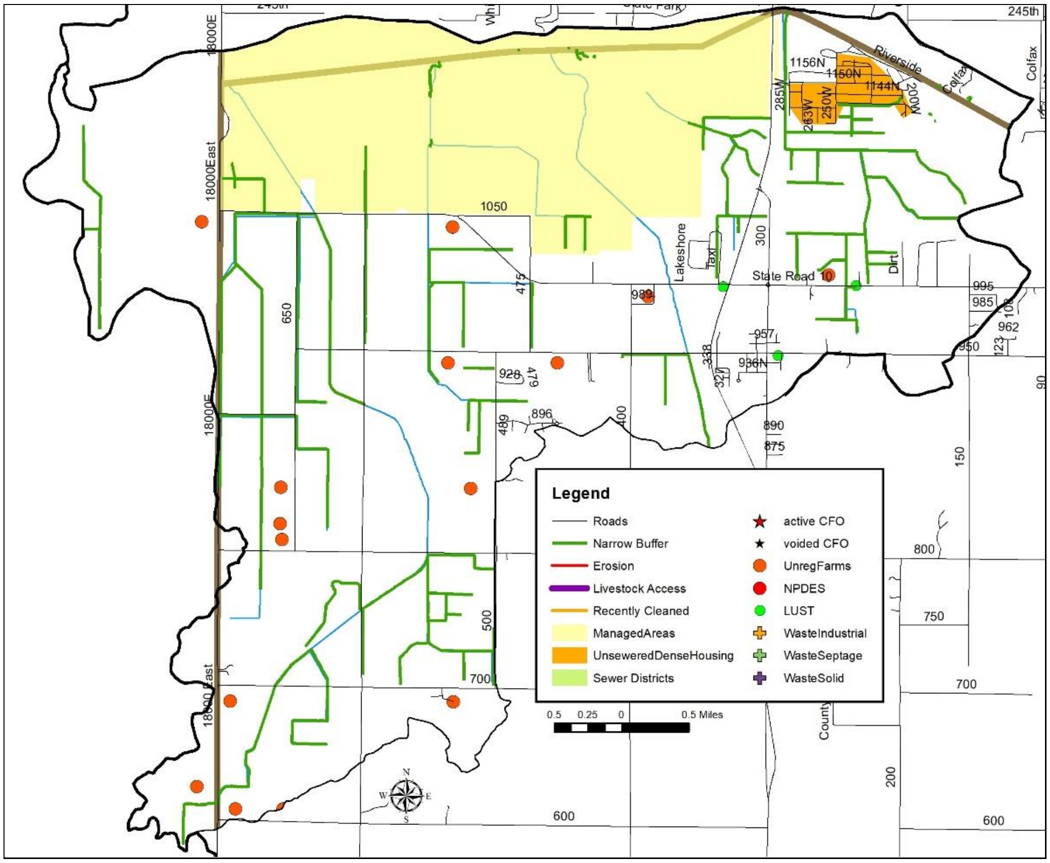
4.12 Beaver Lake Ditch-Kankakee River Subwatershed

The Beaver Lake Ditch-Kankakee River Subwatershed forms part of the western boundary of the Lower Kankakee River Watershed and includes the Town of Lake Station as well as Sumava Resorts. The subwatershed lies within Newton County. It encompasses one 12-digit HUC watershed: 071200011205. This subwatershed drains 15,647 acres and accounts for 7.3% of the total watershed area. The Beaver Lake Ditch-Kankakee River Subwatershed received water from the Lawler Ditch-Beaver Lake Ditch and Mud Lake Ditch-Beaver Lake Ditch subwatersheds. There are 42.6 miles of stream. IDEM has classified 14.4 miles of stream as impaired for *E. coli*, while an additional 9.2 miles of streams are classified as impaired for PCBs in fish tissue. Potentially highly erodible soils are present within the subwatershed covering 6.3% of the subwatershed. Nearly the entire subwatershed (86%) has soils which are severely limited for septic use. Agricultural land use dominates the Beaver Lake Ditch-Kankakee River subwatershed with 49% (15,647 acres) in agricultural land uses, including row crop and pasture. Wetlands, open water, and grassland cover nearly 30% of the subwatershed (4,736 acres), while nearly 7,672 acres (13%) of the subwatershed is in forested land use. More than 1,252 acres or 8% of the subwatershed are in urban land uses.

4.12.1 Point Source Water Quality Issues

There are minimal point sources of water pollution in the subwatershed. There are three LUST sites located in the subwatershed (Figure 69). There are no open dumps, brownfields, corrective action sites, NPDES permitted facilities, industrial waste, waste septage, or voluntary remediations sites located within the Beaver Lake Ditch-Kankakee River subwatershed.

Figure 69- Point and Non-Point Sources of Pollution and Suggested Solutions in the Beaver Lake Ditch-Kankakee River Subwatershed



4.12.2 Non-Point Source Water Quality Issues

Agricultural land use dominates the Beaver Lake Ditch-Kankakee River subwatershed. Fourteen unregulated animal operations housing more than 185 cows, horses, and sheep were identified during the windshield survey. Livestock access points were not identified during the windshield survey. No active confined feeding operations are located within the Beaver Lake Ditch-Kankakee River subwatershed. In total, manure from small animal operations total over 1,482 tons per year, which contains almost 966 pounds of nitrogen and almost 534 pounds of phosphorus. Streambank erosion and narrow buffers are a concern in the subwatershed. Approximately 0.6 miles of streambank erosion and 76.2 miles of narrow buffers were identified within the subwatershed.

4.12.3 Water Quality Assessment

Waterbodies within the Beaver Lake Ditch-Kankakee River subwatershed have been sampled at 8 locations (Figure 70). Assessments include collection of water chemistry data (8 sites), fish (1 site) and macroinvertebrates (1 site) by IDEM. No stream gages are in the Beaver Lake Ditch-Kankakee River subwatershed.

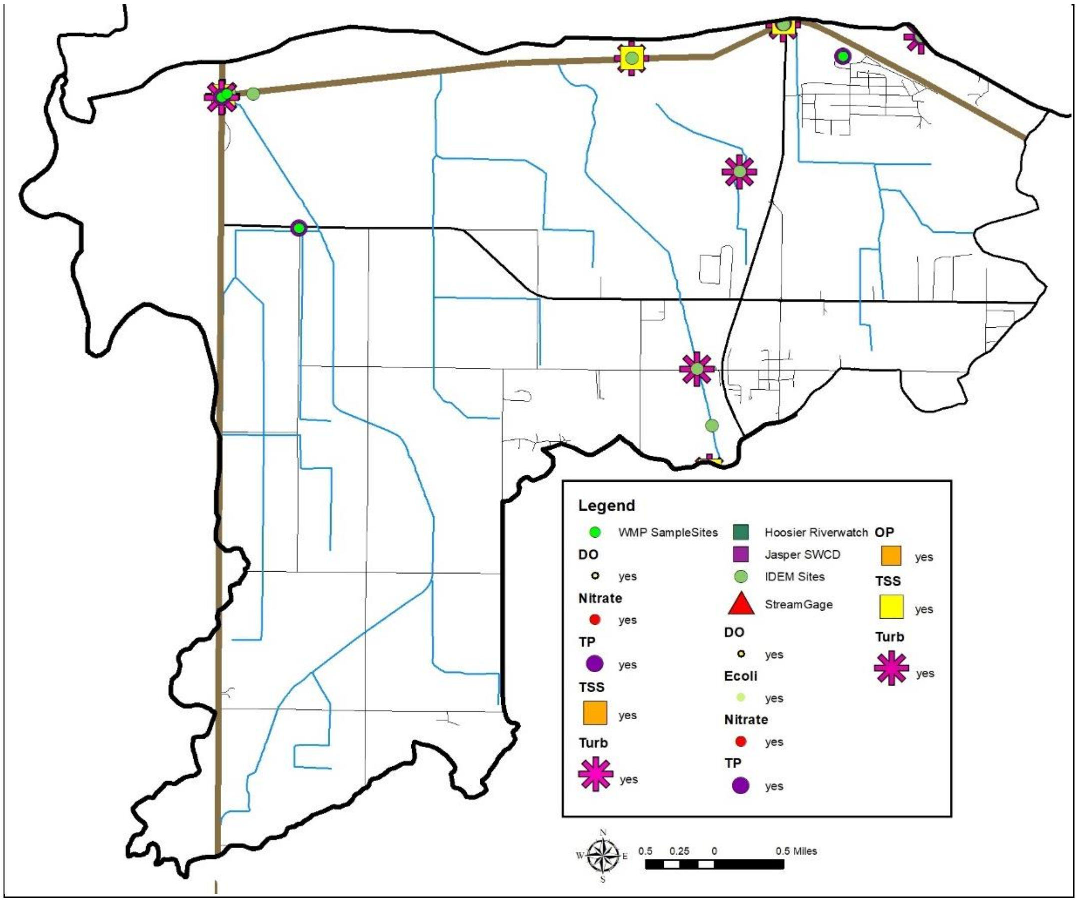
Historic water quality data: Dissolved oxygen concentrations did not exceed target concentrations during any of the sampling events. Nitrate-nitrogen concentrations exceed targets in 70% of samples, while total phosphorus concentrations exceed targets in 40% of samples. Turbidity samples exceed targets in 84% of samples collected, while total suspended solids exceed targets in 50% of samples collected. *E. coli* concentrations exceed state standards in 33% of collected samples. Fish and macroinvertebrate community assessments conducted in the Kankakee River rated higher than target scores during historic assessments. Habitat assessments rated lower than the target QHEI score.

Current water quality data: Table 34 shows the current water quality data for the Beaver Lake Ditch-Kankakee River Subwatershed where two sample sites were located. As shown in the table, dissolved oxygen exceeded water quality targets in 0-55% of samples, turbidity exceeded targets in 27-100% of samples, total phosphorus exceeded targets in 64-100% of samples, and nitrate exceeded targets in 45-73% of samples. pH exceeded state standards in 0-9% of samples. TSS exceeded water quality targets in 9-25% of samples. *E. coli* exceeded state standards in 0-9% of samples.

Table 34- Water quality data collected in the Beaver Lake Ditch-Kankakee River Subwatershed, June 2019 to August 2021

Site		Temp (C)	DO (mg/L)	pH	Turb (NTU)	Cond	TP (mg/L)	Nitrate (mg/L)	TSS (mg/L)	*E.coli* (col/100 ml)
N18	Min	2.55	1.05	6.95	0	355	0.05	0.025	4	2
	Median	12.52	7.43	7.7	3.1	419.5	0.1535	0.337	11.5	47.1
	Max	24.72	15.08	8.35	45.3	568	0.965	1.9	20	228.2
	Count	11	11	11	11	6	11	11	4	11
	Exceed		6	0	3	0	7	5	1	0
	% Exceed	0%	55%	0%	27%	0%	64%	45%	25%	0%
N21	Min	0.64	7.15	8.03	8.70	588.00	0.10	0.06	2.30	4.00
	Median	11.38	10.40	8.15	19.20	631.00	0.15	1.11	3.20	34.00
	Max	23.90	12.83	10.12	48.80	665.00	0.61	1.66	21.00	488.00
	Count	11	11	11	11	11	10	11	11	11
	Exceed		0	1	11	0	10	8	1	1
	% Exceed	0%	0%	9%	100%	0%	100%	73%	9%	9%

Figure 70- Locations of Historic Water Quality Data Exceedances and Impairments in the Beaver Lake Ditch-Kankakee River Subwatershed



5.0 WATERSHED INVENOTRY PART 3

Several important factors and relationships become apparent when the Lower Kankakee River Watershed is observed both as a whole and in part. Many of these were discussed in the individual subwatershed discussions above. An overall summary of water quality impairments and a review of stakeholder concerns and any data which support these concerns are included below.

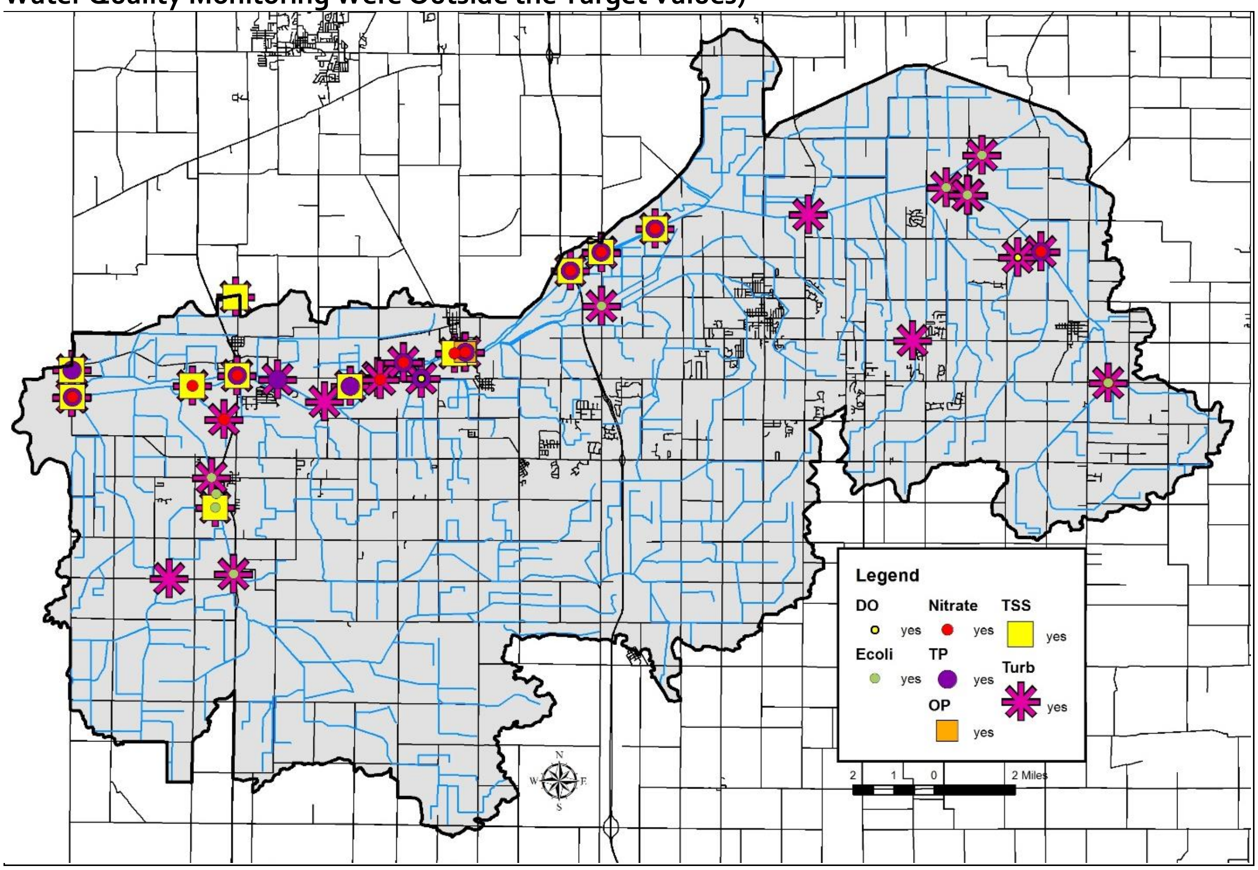
5.1 Water Quality Summary

Based on historic water quality data, several water quality impairments were identified during the watershed inventory process. These impairments include elevated nitrate-nitrogen, total phosphorus, total suspended solids or turbidity, and *E. coli* concentrations; poor fish and macroinvertebrate communities; and poor habitat. Most stream communities were assessed only one time. Conclusions about subwatershed quality in comparison to others are too limited to include. Based on historic data, Table 35 highlights those locations within the Lower Kankakee River Watershed where concentrations of these parameters measured higher than the target concentrations. Sample sites are mapped only if 50% or more of samples collected at those sites were outside the target values. Table 35 summarizes where historic samples were outside the target values and are grouped by subwatershed.

Table 35- Percent of Samples Historically Collected in the Lower Kankakee River Subwatersheds Which Measured Outside Target Values

Subwatersheds	DO (mg/L)	pH	Turbidity (NTU)	Nitrate (mg/L)	OP (mg/L)	TP (mg/L)	TSS (mg/L)	*E. coli* (col/100 mL)
Beaver Lake Ditch-Kankakee River	0%	N/A	84%	70%	N/A	40%	50%	33%
Brown Levee Ditch-Kankakee River	8%	0%	97%	88%	61%	44%	58%	26%
Cook Ditch-Hodge Ditch	0%	0%	94%	N/A	N/A	N/A	0%	44%
Dehaan Ditch	0%	N/A	100%	N/A	N/A	N/A	N/A	90%
Delehanty Ditch-Hodge Ditch	17%	0%	82%	0%	N/A	0%	33%	82%
Gregory Ditch-Mud Lake Ditch	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Headwaters Wolf Creek	0%	0%	67%	100%	N/A	0%	33%	64%
Hickam Lateral-Wolf Creek	19%	0%	87%	42%	N/A	42%	17%	57%
Lawler Ditch-Beaver Lake Ditch	5%	N/A	84%	0%	N/A	33%	67%	60%
Mud Lake Ditch-Beaver Lake Ditch	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Wentworth Ditch-Knight Ditch	N/A	N/A	N/A	N/A	N/A	N/A	N/A	67%
Williams Ditch	11%	N/A	74%	38%	N/A	63%	25%	10%

Figure 71- Sample Sites with Poor Water Quality (50% or More of Samples Collected During Historic Water Quality Monitoring Were Outside the Target Values)



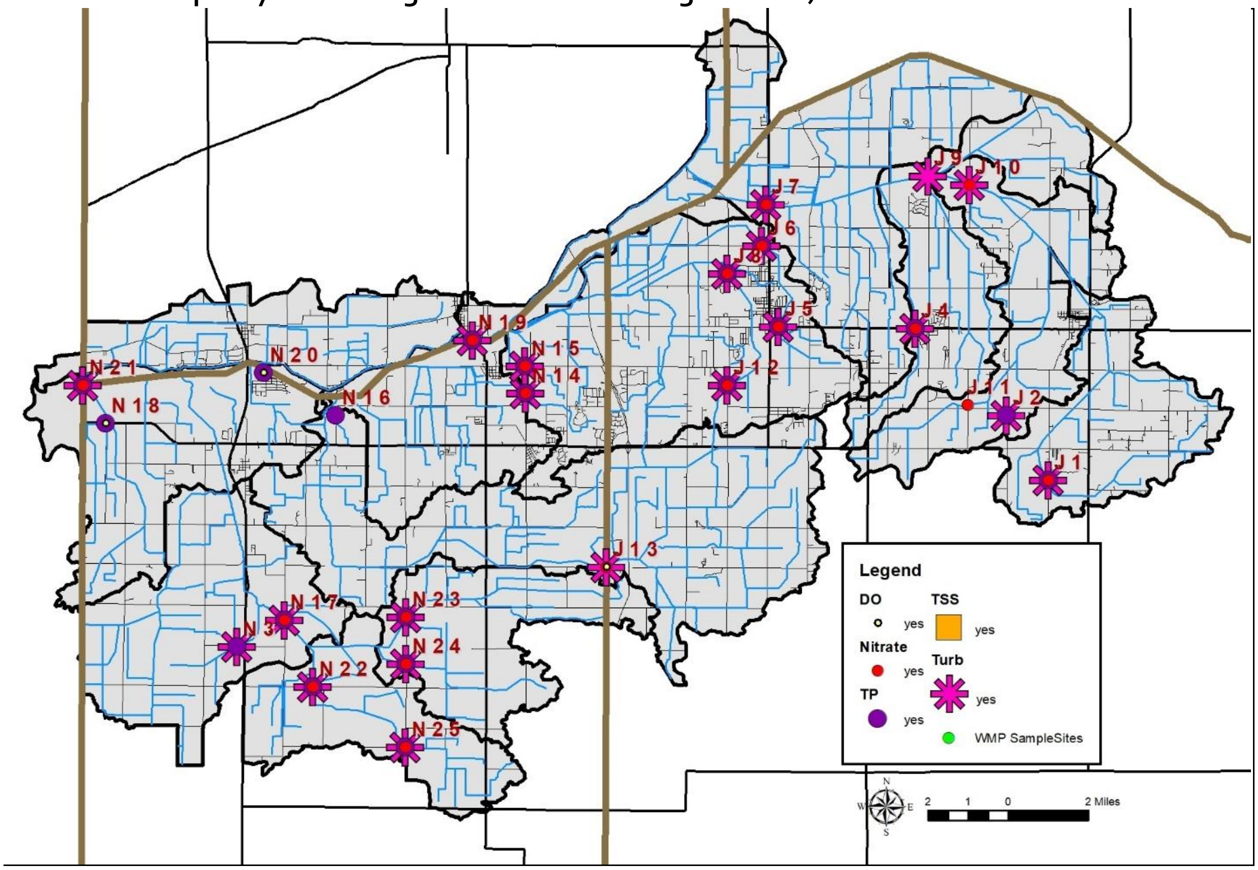
Elevated total phosphorus concentrations were observed at all but one sample site with concentrations exceeding total phosphorus targets during 38% or more of collected samples at all sample sites. Elevated total suspended solids concentrations were observed at nearly half the sample sites. However, elevated TSS concentrations were observed in only 4% of samples. Turbidity concentrations exceeded targets during 70% of collected samples with all but one site exceeding water quality targets. *E. coli* concentrations that exceeded the state grab sample standard were observed in 14% of samples.

Table 36 and Figure 72 summarize current samples which measured outside the target values during the current assessment. Elevated nitrate-nitrogen concentrations were observed at all sample sites with concentrations exceeding targets during 60% of sampling events throughout the Lower Kankakee River Watershed. In total, 19 of 25 sites possessed nitrate-nitrogen concentrations measuring above target concentrations in 50% or more of collected samples. Elevated total phosphorus concentrations were observed at all sample sites with concentrations exceeding total phosphorus targets during 72% of collected samples at all sample sites. In total, 21 of 25 sites possessed total phosphorus concentrations measuring above target concentrations in 50% or more of collected samples. Elevated total suspended solids concentrations were observed at multiple sites with 4% of all samples exceeding targets. No sample sites possessed TSS concentrations measuring above target concentrations in 50% or more of collected samples. Turbidity concentrations exceeded targets in 70% of collected samples at each site. In total, 21 of 25 sites possessed turbidity concentrations measuring above target concentrations in 50% or more of collected samples. *E. coli* concentrations that exceeded the state grab sample standard were measured at 17 sites with 14% of samples exceeding state standards. None of the sites sampled during the current project contained E. coli concentrations which exceeded state standards during 50% or more sampling events. Dissolved oxygen concentrations measured outside of the state standard range (below 4 mg/L or above 12 mg/L) in 7% of collected samples with 3 of 20 sites (J13, N18, N20) possessing 50% or more of samples above or below the state standard. J4, N14, N18, N19 and N21 samples exceeded targets or state standards for four parameters including turbidity, TSS, TP and nitrate. J11 samples exceeded targets or state standards in 50% or more of samples for only one parameter: nitrate-nitrogen, while J8 exceeded targets or state standards in 50% or more of samples for turbidity and nitrate-nitrogen.

Table 36- Percent of samples collected in the Lower Kankakee River Watershed during the 2019-2020 which measured outside target values

Site	DO (mg/L)	pH	Turbidity (NTU)	Conductivity	Total P (mg/L)	Nitrate (mg/L)	TSS (mg/L)	*E. coli* (col/100 ml)
J1	45%	0%	60%	0%	64%	55%	0%	9%
J2	13%	0%	78%	0%	67%	11%	0%	33%
N3	18%	0%	82%	0%	64%	45%	0%	18%
J4	9%	0%	82%	0%	91%	73%	30%	45%
J5	18%	0%	82%	0%	64%	55%	0%	36%
J6	27%	0%	64%	0%	64%	64%	0%	27%
J7	18%	0%	82%	0%	64%	64%	0%	9%
J8	36%	0%	82%	0%	55%	64%	0%	9%
J9	27%	0%	73%	0%	36%	45%	0%	0%
J10	36%	0%	55%	0%	45%	55%	0%	18%
J11	27%	0%	45%	0%	45%	73%	0%	18%
J12	36%	9%	64%	0%	64%	55%	0%	0%
J13	55%	0%	55%	0%	36%	64%	0%	18%
N14	9%	0%	100%	0%	73%	82%	11%	45%
N15	9%	0%	91%	0%	73%	73%	0%	18%
N16	36%	0%	36%	0%	64%	45%	0%	9%
N17	27%	0%	55%	0%	64%	73%	0%	0%
N18	55%	0%	27%	0%	64%	45%	11%	0%
N19	18%	0%	100%	0%	91%	73%	22%	9%
N20	56%	0%	44%	0%	78%	22%	0%	0%
N21	0%	9%	100%	0%	100%	73%	9%	9%
N22	8%	17%	67%	0%	64%	67%	0%	0%
N23	0%	0%	64%	0%	64%	75%	0%	0%
N24	33%	8%	67%	0%	91%	67%	0%	0%
N25	17%	0%	67%	0%	64%	67%	0%	17%

Figure 72- Sample sites with poor water quality (50% or more of samples collected during current or historic water quality monitoring were outside the target values)



5.2 Analysis of Stakeholder Concerns

Following the characterization and inventory of the Lower Kankakee Watershed, stakeholder concerns were analyzed using the information acquired during the characterization and inventory. As part of this analysis, the three HUC10 watersheds were broken down into the twelve HUC12 subwatersheds for deeper analysis. The steering committee reviewed compiled data and determined if each concern was supported by data collected as part of the inventory process. If evidence was available, the steering committee then determined if the evidence provided quantifiable data and whether the concern was within the scope of the watershed planning project. All of the identified concerns generated both from stakeholder input and through water quality and watershed inventory efforts are detailed in Table 37.

Table 37- Analysis of Stakeholder Concerns by Subwatershed

Concerns	Supported by our data?	Evidence	Able to Quantify?	Outside Scope?	Group wants to focus on?
Capacity of streams and soils to retain water Flooding: Quantity of water is periodically high	No	The USGS stream gage details periodic high flows. CBBEL (2019) noted a 39% increase in peak storm flow during gage operation (1923 to 2018) from 3,800 to 5,300 cfs. 53% of the watershed was covered by soils which rate as poorly drained. Approximately 17% of the Lower Kankakee River Watershed lies within the 100-year floodplain.	Yes	No	Yes
Groundwater protection	Yes, Historic data	Many wells are shallow driven wells less than 20 feet deep, often located near tiled fields. Private well water testing for nitrate-nitrogen in 2007 revealed that 5% of the wells in the region tested over the 10mg/L drinking standard, and that wells in the range of 3.0 mg/l to 10 mg/l doubled their rate compared to previous years. Additionally, with a high perched water table, excess nutrients and bacteria could lead to significant public health concerns as these contaminants could be reaching public drinking water supplies for the town of DeMotte, and private wells in Wheatfield, Lake Village, and Roselawn.	Yes	Yes	No
Elevated bacteria levels (high *E. coli*)	Yes	More than 25% of historical samples collected at the fixed station and 45% of samples collected in other watershed locations exceed state standards for *E. coli* in the Lower Kankakee River Watershed. IDEM lists more than 385 stream miles as impaired for *E. coli*. Data collected by IDEM and used for TMDL calculation generate the following conclusions: • A 79% reduction is needed in *E. coli* loading in Dehaan Ditch. • A 44% reduction is needed in *E. coli* loading in the Beaver Lake Ditch in the Beaver Lake Ditch-Kankakee River subwatershed and a 78% reduction is needed in *E. coli* loading in the Beaver Lake Ditch in the Lawler Ditch subwatershed. • A 42% reduction is needed in *E. coli* loading in the Hickam Lateral Ditch.	Yes	No	Yes – includes septic education

Concerns	Supported by our data?	Evidence	Able to Quantify?	Outside Scope?	Group wants to focus on?
		• A 39% reduction is needed in *E. coli* loading in Lawler Ditch. • A 37% reduction is needed in *E. coli* loading in Brown Levee Ditch. • A 36% reduction is needed in *E. coli* loading in Cook Ditch. • A 29% *E. coli* load reduction is needed in the Kankakee River in the Beaver Lake Ditch-Kankakee River subwatershed. *E. coli* concentrations exceeded state standards in 14% of samples collected during WMP development. More than 98% of watershed soils are considered very limited for septic system use. Only four communities use sewer systems, indicating that a majority of these soils are used for septic treatment despite their limitations. More than 494,000 tons of manure are produced within the watershed and spread on agricultural fields throughout the watershed. This manure contains more than 2.46x10e16 *E. coli* colonies/ton of manure.			
High nutrient levels	Yes	More than 97% of historical fixed station and more than 46% of samples collected in other watershed streams exceed nitrate-nitrogen target concentrations. More than 38% of total phosphorus samples collected historically at the fixed station and at other watershed streams exceed target concentrations. 72% of TP and 60% of nitrate-nitrogen samples exceeded water quality targets in samples collected during WMP development.	Yes	No	Yes
Soil in water (elevated turbidity)	Yes	Turbidity levels exceed targets levels in more than 97% of samples collected at the fixed station and more than 83% of samples collected throughout the watershed. TSS levels exceed target concentrations in 57% of fixed station samples and more than 33% of samples collected in other watershed streams historically.	Yes	No	Yes

Concerns	Supported by our data?	Evidence	Able to Quantify?	Outside Scope?	Group wants to focus on?
		70% of turbidity samples and 4% of TSS samples exceeded water quality targets in samples collected during WMP development.			
Unsafe to fish/Fish not safe to eat (High PCBs)	Yes	Elevated PCB and mercury levels are present within Lower Kankakee streams. 48.6 stream miles are listed as impaired for PCBs.	Yes	Yes	No – These are likely from past air pollution sources and cannot be addressed with our current efforts.
Low Dissolved Oxygen levels	Historic data yes; current data no	Historic DO data indicate that 8% of fixed station samples and 4% of samples collected at other sites measured below target concentrations. 79.6 miles of Hickam Laterial-Wolf Creek and Delehanty Ditch-Hodge Ditch streams are listed on the impaired waterbodies list for low dissolved oxygen. 7% of samples exceeded the upper or lower DO state standard in samples collected during WMP development.	Yes	Yes	No – current data do not support these findings
Farmers are perceived as polluters	No	Social indicator survey results indicate that soil erosion from farm fields, manure from farm animals and animal feed operations rate as a slight problem scoring 2.2 (ag)/2.65 (urban), 2.0 (ag)/2.65 (urban), and 2.13 (ag)/2.47 (urban), respectively. However, more than 25% of urban respondents answered this question with a response of "don't know". These results suggest that farm-based sources of pollution are rated as a slight concern and thus this concern will not be carried forward.	Yes	No	No

5.2.1 Concerns Supported by Data That Will Not be Focused On

The following concerns will be outside of the project's focus for the Lower Kankakee River Watershed Management Plan. Each bullet below details why these concerns were set aside for future consideration:

- Unsafe to Fish/Fish Not Safe to Eat (High PCBs) will not be addressed as part of the Lower Kankakee Watershed Management Plan. The steering committee identified that fish consumption concerns originate from historic pollutant sources, including methyl mercury and PCBs, which likely precipitated from past air pollution from outside the watershed. These sources are outside of the current scope of the project and will not be focused on as part of this project.

- Groundwater Protection: Many wells are shallow driven wells less than 20 feet deep, often located near tiled agricultural fields. Private well water testing for nitrate-nitrogen in 2007 revealed that 5% of the wells in the region tested over the 10mg/L drinking standard, and that wells in the range of 3.0 mg/l to 10 mg/l doubled their rate compared to previous years. Additionally, with a high perched water table, excess nutrients and bacteria could lead to significant public health concerns as these contaminants could be reaching public drinking water supplies for the town of DeMotte, and private wells in Wheatfield, Lake Village, and Roselawn. The steering committee noted that *E. coli* contamination may be a concern in areas outside of sewered areas in areas where high densities of septic systems are located (i.e., Town of Wheatland). The steering committee is interested in addressing surface water quality concerns. Further, they noted that while failing septic systems are within the project scope, funding limitations and the potential volume of failing or non-maintained septic systems are simply not possible to address within the lifetime of this project. Rather, the committee will focus septic concerns on education and outreach efforts including hosting septic aware events and mailing septic maintenance fliers. *E. coli* and nitrate-nitrogen concerns with regards to surface waters will be addressed by other concerns.

- Low dissolved oxygen levels: Historically in the Headwaters-Wolf Creek, Hickam Lateral-Wolf Creek, Delehanty Ditch-Hodge Ditch, and Cook Ditch-Hodge Ditch Subwatersheds there was low dissolved oxygen concentrations. Further, nearly 80 miles of watershed streams are listed for dissolved oxygen on the impaired waterbodies list. Current water quality data collected by the Jasper SWCD as part of this grant project, shows that low Dissolved Oxygen is no longer an issue. Based on current conditions, the steering committee will not be focusing on this concern.

- Farmers being perceived as the polluters will also not be included as a concern of focus as social indicator survey data indicate that both urban residents and agricultural respondents consider agricultural sources of pollution as slight concerns. Response rates range from 2.0 to 2.65 all of which fall within the slight concern range. Due to these low scores, farmers being perceived as polluters will not be focused on as part of this project.

5.3 Problems That Reflect the Concerns on Which the Group has Chosen to Focus

After evaluation of stakeholder concerns and completion of the watershed inventory, watershed problems can be summarized as shown in Table 38. Problems represent the condition that exists due to a particular concern or group of concerns. Table 39 details potential causes of problems identified in Table 38.

Table 38- Problems Identified for the Lower Kankakee River Watershed Based on Stakeholder Concerns

Concern	Problem Statement
Capacity of Stream and Soils to Retain Water	The Kankakee River is flashy and has undesirable periodic high levels and flows of water that threaten our towns, agricultural land, and health of the river. There is limited holding capacity for excess water, which also moves sediment and soils which also may contain increased levels of nutrients.
Flooding: Quantity of Water is Periodically High	
Groundwater Protection from Unsafe Levels of Bacteria (*E.coli*)	Area streams are impaired for recreational contact and are included on the IDEM impaired waterbodies list.
High Nutrient Levels in Streams	Area streams' nutrient levels exceed targets set by this project.
High Turbidity in Streams	Area streams are very cloudy and turbid.

5.4 Potential Causes for Each Identified Problem

The initial stakeholder concerns and problem statements (Table 38) were then analyzed to determine potential causes based on historic and current water quality data (Table 39). A cause is defined as an event, agent, or series of actions that produces an effect.

Table 39- Potential Causes for Each Problem

Problem	Potential Cause(s)
Flooding: Quantity of Water is Periodically High/Capacity of Streams and Soils to Retain Water	Flooding occurs within the Lower Kankakee River Watershed.
Areas streams are impaired by IDEM for recreational contact	*E. coli* levels exceed the water quality standard
Area streams have nutrient levels exceeding the targets set by this project	Nutrient levels exceed the target set by this project
Area streams are very cloudy and turbid	Total Suspended Sediment concentrations and turbidity levels exceed the targets set by this project

6.0 SOURCE IDENTIFICATION AND LOAD CALCULATIONS

Nonpoint pollution sources are varied, yet common throughout almost any watershed. Several earlier sections of this document identify potential sources of the pollutants of concern in the Lower Kankakee River Watershed. These and other potential sources of these causes are discussed in further detail in subsequent sections. A summary of potential sources identified in the Lower Kankakee River Watershed for each of our concerns is listed below:

Nutrients (Nitrogen and Phosphorus):

- Conventional tillage cropping practice
- Wastewater treatment discharges
- Gully or ephemeral erosion
- Agricultural fertilizer
- Poor riparian buffers
- Poor forest management

- Streambank and bed erosion
- Animal waste (livestock in streams, poor manure management, domestic and wildlife runoff)
- Confined feeding operations
- Human waste (failing septic systems, package plants, inadequately treated wastewater)
- Stormwater input from urban storm drains and agricultural tiles

Sediment:

- Conventional tillage cropping practice
- Streambank and bed erosion
- Poor riparian buffers
- Gully or ephemeral erosion
- Cropped floodplains
- Livestock access to streams
- Altered hydrology (ditching and draining, altered stream courses)
- Stormwater input from urban storm drains and agricultural tiles

E. coli:

- Human waste (failing septic systems, package plants, inadequately treated wastewater)
- Animal waste (livestock in streams, poor manure management, domestic and wildlife runoff)
- Stormwater input from urban storm drains and agricultural tiles

6.1 Potential Sources for Each Problem

Following the steering committee identifying the potential causes for each problem, the potential sources for each problem were identified for each problem. Table 40 through Table 43 summarize the magnitude of potential sources of pollution for each problem by subwatershed. Watershed Inventory, GIS data, and water quality data were used to characterize and calculate loading of potential sources. A source is defined as an activity, material, or structure that results in a cause of nonpoint source pollution.

Table 40- Potential Sources Causing Flooding Problems

Problem	Flooding: Quantity of Water is Periodically High/Capacity of Streams and Soils to Retain Water
Potential Cause	Flooding occurs within the Lower Kankakee River Watershed.
Subwatershed	Potential Sources
Hickam Lateral-Wolf Creek	• 41% of the watershed is located within floodplain (Zones A or AE).
Delehanty Ditch-Hodge Ditch	• 54% of the watershed is located within floodplain (Zones A or AE).
Cook Ditch-Hodge Ditch	• 72% of the watershed is located within floodplain (Zones A or AE).
Deehan Ditch	• 30% of the watershed is located within floodplain (Zones A or AE).
Brown Levee Ditch-Kankakee River	• 46% of the watershed is located within floodplain (Zones A or AE).
Mud Lake Ditch-Beaver Lake Ditch	• 39% of the watershed is located within floodplain (Zones A or AE).

Beaver Lake Ditch-Kankakee River	• 36% of the watershed is located within floodplain (Zones A or AE).
Williams Ditch	• 88% of the watershed is located within floodplain (Zones A or AE).

Table 41- Potential Sources Causing *E.coli* Problems

Problem	Areas streams are impaired by IDEM for recreational contact
Potential Cause	*E. coli* levels exceed the water quality standard
Subwatershed	Potential Sources
Headwaters-Wolf Creek	• *E. coli* concentrations exceeded state standards in 80% of collected samples by IDEM and Jasper SWCD. • 99% of soils rate as very limited for septic use. • 734 pounds of manure produced on small animal operations which contains 3.66e10x13 colonies of *E.coli*.
Hickam Lateral-Wolf Creek	• 61.6 miles of stream listed as impaired for *E.coli* by IDEM. • 99.9% of the soils are severely limited for septic use. • 7 unregulated animal operations housing more than 31 livestock. • One active CFOs permitted to house up to 7,000 animals. • 15,375 tons of manure from CFOs and small animal operations which contains 1.29e10x13 colonies of *E.coli*. • *E. c*oli concentrations exceeded state standards in 60% of collected samples from IDEM and Jasper SWCD.
Delehanty Ditch-Hodge Ditch	• 58.5 miles of stream listed as impaired for *E.coli* by IDEM. • 99.7% of the soils are severely limited for septic use. • 10 unregulated animal operations housing more than 145 livestock. • Four active CFOs permitted to house up to 9,539 animals. • 42,198 tons of manure from CFOs and small animal operations which contains 7.85e10x13 colonies of *E.coli*. • *E. c*oli concentrations exceeded state standards in 60% of collected samples from IDEM and Jasper SWCD.
Cook Ditch-Hodge Ditch	• 21.2 miles of stream listed as impaired for *E.coli* by IDEM. • 99.7% of the soils are severely limited for septic use. • 1 unregulated animal operations housing more than 15 livestock. • One active CFOs permitted to house up to 2,997 animals. • 12,534 tons of manure from CFOs and small animal operations which contains 9.3310x12 colonies of *E.coli*. • *E. c*oli concentrations exceeded state standards in 20% of collected samples from IDEM and Jasper SWCD.
Deehan Ditch	• 0.58 miles impaired for *E. c*oli by IDEM. • 99.6% of soils severely limited for septic use. • 3 NPDES-permitted facilities. • 1 active and 2 voided CFOs permitted to house up to 1,250 animals. • CFOs and small animal operations create over 8,222 tons of manure per year which contains 8.63e10x13 colonies of *E.coli*. • *E. coli* concentrations exceed state standards in 100% of collected samples by IDEM and Jasper SWCD.

Wentworth Ditch-Knight Ditch	• 99.8% of soils are severely limited for septic use. • Livestock has access to 1.2 miles of this subwatershed. • 11 confined feeding operations exist and house up to 15,530 animals. • 166,147 tons of manure from CFOs and small animal operations which contains 5.26e10x15 colonies of *E.coli*. • *E. coli* concentrations exceed targets in 2 of 3 samples collected by the Jasper SWCD.
Brown Levee Ditch-Kankakee River	• 97.9% of the subwatershed has soils which are severely limited for septic use • Two active CFOs and one voided CFO permitted to house up to 2,459 animals. • 122.1 miles listed as impaired for *E. coli* by IDEM. • 3,964 tons of manure produced per year by CFOs and small animal operations which contains 1.06e10x14 colonies of *E.coli*. • *E. coli* concentrations exceed state standards in 15% of IDEM collected samples and 10% of Hoosier Riverwatch samples.
Gregory Ditch-Mud Lake Ditch	• 30.7 miles of streams classified as impaired for *E. coli* by IDEM. • 99.6% of the subwatershed is severely limited for septic use. • CFOs permitted to house up to 10,471 animals. • 230,188 tons of manure created by CFOs and small animal operations which contains 6.54e10x15 colonies of *E.coli*.
Mud Lake Ditch-Beaver Lake Ditch	• 99.9% of soils are severely limited for septic use. • 1 NPDES permitted facility • 1,300 tons of manure produced per year by small animal operations which contains 3.73e10x13 colonies of *E.coli*.
Lawler Ditch-Beaver Lake Ditch	• 76.4 stream miles classified as impaired for *E. coli* by IDEM. • 99.7% of soils severely limited for septic use. • 2.2 stream miles of livestock access. • 760 tons of manure per year by small animal operations which contains 2.50e10x13 colonies of *E.coli*. • 60% of water samples by IDEM exceeded state standards for *E. coli* concentrations.
William Creek	• 96% of soils severely limited for septic use. • 1,972 tons of manure per year from small animal operations which contains 5.46e10x13 colonies of *E.coli*. • *E. coli* concentrations exceeded state standards in 10% of collected samples by IDEM.
Beaver Lake Ditch-Kankakee River	• 14.4 stream miles classified as impaired for *E. coli* by IDEM. • 86% of soils are severely limited for septic use. • Sumava Resort failing septic systems. • 1,482 tons of manure per year created by small animal operations which contains 1.23e10x16 colonies of *E.coli*. • *E. coli* concentrations exceed state standards in 33% of collected samples by IDEM.

Table 42- Potential Sources Causing Nutrient Problems

Problem	Area streams have nutrient levels exceeding the targets set by this project
Potential Cause	Nutrient levels exceed the target set by this project
Subwatershed	Potential Sources
Headwaters-Wolf Creek	• 10.8% of soils are highly erodible. • 61% of land in agricultural use. • Only 7.8% of land is wetlands, open water, and grassland. • 6.9% urban land use. • SR10 and SR49 in subwatershed. • Town of Wheatfield in subwatershed. • 14 unregulated animal operations. • 3 CFOs. • 32,677 pounds of nitrogen from manure. • 24,607 pounds of phosphorus from manure. • 39.7 miles of insufficient stream buffers. • 2.4 miles of streambank erosion.
Hickam Lateral-Wolf Creek	• 6.3% of soils are highly erodible. • 61% of land in agricultural use. • Only 11.4% of subwatershed in forested land. • Only 4.6% of subwatershed are wetlands, open water, and grassland. • 5.5% urban land use. • SR10 and SR49 in the subwatershed. • Town of Wheatfield in the subwatershed. • 44,586 pounds of nitrogen from CFOs and small animal operations. • 33,624 pounds of phosphorus from CFOs and small animal operations. • 51.7 miles of insufficient stream buffers. • 1.6 miles of streambank erosion. • 42% of TP samples and 19% of nitrate-nitrogen samples collected during historical assessments exceed target concentrations.
Delehanty Ditch-Hodge Ditch	• 8.8% of soils are highly erodible. • 71% of land in agricultural use. • Only 15.9% of land in forested land use. • Only 4.5% of the land is wetlands, open water, and grassland. • 8.7% urban land use. • Town of Stoutsburg • SR10 • 118,897 pounds of nitrogen per year from CFOs and small animal operations. • 89,494 pounds of phosphorus per year from CFOs and small animal operations. • 46.6 miles of insufficient stream buffers • 0.7 miles of streambank erosion.
Cook Ditch-Hodge Ditch	• 7.1% of soils are highly erodible. • 99.6% of soils are severely limited for septic use. • 81% agricultural land use. • Only 6.9% in forested land use. • Only 5.1% in wetlands, open water, and grassland. • US HWY 231 bisect subwatershed.

	• 6.9% urban land use. • 1 NPDES-permitted facility • 55,592 pounds of nitrogen produced by CFOs and small animal operations. • 41,992 pounds of phosphorus produced by CFOs and small animal operations. • 124.2 miles of insufficient stream buffers • 1.6 miles of streambank erosion.
Deehan Ditch	• 11.4% of soils are highly erodible. • 99.6% of soils are severely limited for septic use. • 59% of land in agricultural use. • Only 18% in forested land use. • Only 8.1% in wetlands, open water, and grasslands. • Town of DeMotte • SR10 and US HWY 231. • 14.5% urban land use. • 22 LUST sites. • 3 NPDES permitted facilities. • 17,062 pounds of nitrogen from CFOs and small animal operations. • 12,496 pounds of phosphorus from CFOs and small animal operations. • 7.4 miles of streambank erosion. • 109.7 miles of narrow buffers.
Wentworth Ditch-Knight Ditch	• 8% highly erodible soils. • 76% agricultural use. • Only 14% in forested land. • Only 3.7% in wetlands, open water, and grasslands. • Manure from CFOs and small animal operations contains almost 188,947 pounds of nitrogen and almost 119,235 pounds of phosphorus per year. • There are 7.4 miles of streambank erosion and 136.8 miles of narrow buffers.
Brown Levee Ditch-Kankakee River	• 81.5 miles of insufficient stream buffers. • 0.5 miles of streambank erosion. • 6.2% highly erodible soils. • 54.7% agricultural land use. • 44% of TP and 88% of nitrate-nitrogen samples collected during historic assessments exceed target concentrations
Gregory Ditch-Mud Lake Ditch	• 10.1% highly erodible soils. • 79% agricultural use. • Only 10.3% forested land use. • Only 4.4% in wetlands, open water, and grassland. • 6.3% urban land use. • 109,342 pounds of nitrogen per year produced by CFOs and small animal operations. • 53,623 pounds of phosphorus per year produced by CFOs and small animal operations. • 43.7 miles of insufficient stream buffers.

Mud Lake Ditch-Beaver Lake Ditch	• 1 LUST site • 1 NPDES facility • 5.3% potentially highly erodible soils. • 84.4% agricultural land use. • Only 10% in forested land use. • Only 0.9% in wetlands, open water, and grasslands. • 4.6% urban use. • 624 pounds of nitrogen and 306 pounds of phosphorus produced per year by small animal operations. • 22.7 miles of narrow buffers.
Lawler Ditch-Beaver Lake Ditch	• 5.8% potentially highly erodible soil. • 78% agricultural land use. • Only 13.5% in forested land use. • Only 3.6% in wetlands, open water, and grassland. • 5.3% urban land use. • US HWY 41. • Town of Conrad. • 447 pounds of nitrogen and 241 pounds of phosphorus produced per year by small animal operations. • 52.4 miles of insufficient stream buffers. • 3.1 miles of streambank erosion. • Total phosphorus concentrations exceed targets in 84% of samples from IDEM. • 33% of historic TP samples exceed target concentrations.
William Creek	• 9.4 stream miles classified by IDEM as impaired for PCBs in fish tissue. • 78% agricultural land use. • Only 7.3% in wetlands, open water, and grassland. • Only 6.7% in forested land. • 7.4% urban land use. • Town of Schneider. • 977 pounds of nitrogen and 486 pounds of phosphorus produced by year by small animal operations. • Mile of streambank erosion. • 52.5 miles of narrow buffer. • Total phosphorus concentrations exceed targets in 63% of samples; nitrate-nitrogen concentrations exceed targets in 38% of samples collected historically.

Beaver Lake Ditch-Kankakee River	• Town of Lake Station. • Sumava Resorts. • 6.3% Potentially highly erodible soils. • 49% agricultural use. • Only 13% in forested land use. • 8% urban land use. • 31,212 pounds of nitrogen and 23,408 pounds of phosphorus are produced per year by small animal operations. • Total phosphorus exceeded targets in 40% of historic samples and nitrate-nitrogen concentrations exceed targets in 70% of historic samples. • 76.2 miles of narrow buffers. • 0.6 miles of streambank erosion. • Cattle have direct access to watershed streams at state line and state road 10.

Table 43- Potential Sources Causing Sediment Problems

Problem	Area streams are very cloudy and turbid
Potential Cause	Total Suspended Sediment concentrations and turbidity levels exceed the targets set by this project
Subwatershed	Potential Sources
Headwaters-Wolf Creek	• 10.8% of soils are highly erodible. • 61% of land in agricultural use. • Only 7.8% of land is wetlands, open water, and grassland. • 6.9% urban land use. • SR10 and SR49 in subwatershed. • Town of Wheatfield in subwatershed. • 39.7 miles of insufficient stream buffers. • 2.4 miles of streambank erosion. • Turbidity levels exceed target levels in 67% of historic samples, TSS samples exceed targets in 33% of samples.
Hickam Lateral-Wolf Creek	• 6.3% of soils are highly erodible. • 61% of land in agricultural use. • Only 11.4% of subwatershed in forested land. • Only 4.6% of subwatershed are wetlands, open water, and grassland. • 5.5% urban land use. • SR10 and SR49 in the subwatershed. • Town of Wheatfield in the subwatershed. • 51.7 miles of insufficient stream buffers. • 1.6 miles of streambank erosion. • Turbidity levels exceed targets in 87% of historic samples, TSS samples exceed targets in 17% of samples.

Delehanty Ditch-Hodge Ditch	• 8.8% of soils are highly erodible. • 71% of land in agricultural use. • Only 15.9% of land in forested land use. • Only 4.5% of the land is wetlands, open water, and grassland. • 8.7% urban land use. • Town of Stoutsburg. • SR10. • 46.6 miles of insufficient stream buffers • 0.7 miles of streambank erosion. • Turbidity levels exceed targets in 82% of historic samples, TSS samples exceed targets in 33% of samples.
Cook Ditch-Hodge Ditch	• 7.1% of soils are highly erodible. • 99.6% of soils are severely limited for septic use. • 81% agricultural land use. • Only 6.9% in forested land use. • Only 5.1% in wetlands, open water, and grassland. • US HWY 231 bisect subwatershed. • 6.9% urban land use. • 124.2 miles of insufficient stream buffers • 1.6 miles of streambank erosion. • Turbidity levels exceed targets in 92% of historic samples.
Deehan Ditch	• 11.4% of soils are highly erodible. • 99.6% of soils are severely limited for septic use. • 59% of land in agricultural use. • Only 18% in forested land use. • Only 8.1% in wetlands, open water, and grasslands. • Town of DeMotte. • SR10 and US HWY 231. • 14.5% urban land use. • 7.4 miles of streambank erosion. • 109.7 miles of narrow buffers. • Turbidity levels exceed targets in 100% of historic samples.
Wentworth Ditch-Knight Ditch	• 8% highly erodible soils. • 76% agricultural use. • Only 14% in forested land. • Only 3.7% in wetlands, open water, and grasslands. • There are 7.4 miles of streambank erosion and 136.8 miles of narrow buffers.
Brown Levee Ditch-Kankakee River	• 81.5 miles of insufficient stream buffers. • 0.5 miles of streambank erosion. • Turbidity high in 97% of IDEM and USGS samples and 100% Hoosier River Watch samples. • 6.2% highly erodible soils. • 54.7% agricultural land use. • Turbidity levels exceed targets in 97% of historic samples, TSS samples exceed targets in 58% of samples.

Gregory Ditch-Mud Lake Ditch	• 10.1% highly erodible soils. • 79% agricultural use. • Only 10.3% forested land use. • Only 4.4% in wetlands, open water, and grassland. • 6.3% urban land use. • 43.7 miles of insufficient stream buffers.
Mud Lake Ditch-Beaver Lake Ditch	• 5.3% potentially highly erodible soils. • 84.4% agricultural land use. • Only 10% in forested land use. • Only 0.9% in wetlands, open water, and grasslands. • 4.6% urban use. • 22.7 miles of narrow buffers. • Turbidity levels exceed targets in 84% of historic samples, TSS samples exceed targets in 67% of samples.
Lawler Ditch-Beaver Lake Ditch	• 5.8% potentially highly erodible soil. • 78% agricultural land use. • Only 13.5% in forested land use. • Only 3.6% in wetlands, open water, and grassland. • 5.3% urban land use. • US HWY 41. • Town of Conrad. • 52.4 miles of insufficient stream buffers. • 3.1 miles of streambank erosion. • Turbidity levels exceed targets in 82% of historic samples, TSS samples exceed targets in 33% of samples.
William Creek	• 9.4 stream miles classified by IDEM as impaired for PCBs in fish tissue. • 78% agricultural land use. • Only 7.3% in wetlands, open water, and grassland. • Only 6.7% in forested land. • 7.4% urban land use. • Town of Schneider. • Mile of streambank erosion. • 52.5 miles of narrow buffer. • Turbidity levels exceed targets in 74% of historic samples, TSS samples exceed targets in 63% of samples.
Beaver Lake Ditch-Kankakee River	• Town of Lake Station. • Sumava Resorts. • 6.3% Potentially highly erodible soils. • 49% agricultural use. • Only 13% in forested land use. • 8% urban land use. • 76.2 miles of narrow buffers. • 0.6 miles of streambank erosion. • Cattle have direct access to watershed streams at state line and state road 10. • Turbidity levels exceed targets in 70% of historic samples, TSS samples exceed targets in 50% of samples.

6.2 Load Estimates

Nonpoint source pollution is generated from diffuse sources found on public and private lands. The USEPA notes that sources of nonpoint source pollution include stormwater runoff, construction activities, solid waste disposal, atmospheric deposition, streambank erosion, and more. Inventory data in Table 40 through Table 43 identify potential sources of nonpoint pollution within the watershed. These tables – generated using GIS, water quality data, windshield surveys, local knowledge, and other sources of data – are useful for generally identifying water quality problems. Two methods could be used to understand the loading of nutrients, sediment, and pathogens in waterbodies in the Lower Kankakee River Watershed: 1) measured results from the monitoring regime and 2) modeled results. Each method can estimate both the current load and the reduction in load needed to reach target concentrations. These methods each present advantages and disadvantages for understanding the loading in this watershed in particular. The steering committee considered the monitoring data to draft long term goals and critical areas. These data were used to calculate final goals and set long term goals, short term goals, and define critical areas.

6.2.1 Current Load Estimates

As part of the Lower Kankakee River Watershed project, grab samples and flow measurements were collected monthly at eight locations within the Lower Kankakee River Watershed (J1, J7, J9, J10, J13, N17, N22 and N23) with the goal of collecting 12 monthly grab samples. These grab sample data were combined with Kankakee River at Shelby gaging station data scaled to each subwatershed drainage to generate loading rates for each station (Table 44 to Table 47). Scaled flow rates were compared with flow data collected in the field to confirm data comparability. It should be noted that TSS loading rates were calculated using only four grab samples collected during the initial water quality sampling period. Due to this limited collection, monthly TSS sampling was extended to complete one full year of TSS monitoring. TSS concentrations were overall low with only 3.8% of samples exceeding the selected water quality target (15 mg/L). Based on these samples, the data suggest little need to reduce TSS loading rates (Table 46). Additionally, *E. coli* data typically measured below the state standard, which is the target used to calculate load reductions. Based on grab sampling data, *E. coli* data suggest there is little need to reduce *E. coli* concentrations as only 16% of collected samples exceed the state standard for grab samples. This results in negative reductions for five of the six sample sites (Table 47). These loading rates and the lack of need for *E. coli* loading rate reductions are in direct conflict with the Kankakee River TMDL. As the Lower Kankakee River Watershed Management Plan is required to meet the TMDL loading rate reductions, the *E. coli* reductions calculated for the TMDL will be used instead of the loading rates calculated during the current assessment. The steering committee reviewed E. coli and TSS loading rates and the total watershed area covered by these sample points and determined that while these data are useful to consider as a baseline for future work efforts. Based on discussion of the data, the overall limited precipitation occurring during the sampling period and local observations that instream flows during the sampling period were lower than normal, these data are considered to not represent typical conditions in the Lower Kankakee River Watershed. Rather, these samples occurred during a period of limited rainfall which resulted in limited surface runoff which results in lower instream flows and lower TSS and E. coli sample concentrations than typically occur within a normal climate year for the Lower Kankakee River.

Table 44- Current and target nitrate-nitrogen load reduction needed to meet water quality target concentrations in the Lower Kankakee River Watershed

Site	Current Load (lb/yr)	Target Load (lb/yr)	Reduction Needed (lb/yr)	Percent Reduction
J1	92,941.9	6,082.9	86,859.0	93%
J7	172,158.9	107,943.4	64,215.4	37%
J9	230,319.8	67,944.6	162,375.1	70%
J10	332,196.1	5,280.5	326,915.6	98%
J13	271,351.9	31,430.6	239,921.3	88%
J17	216,623.6	44,700.6	171,923.0	79%
J19	6,784,094.4	2,263,179.4	4,520,915.0	67%

Table 45- Current and target phosphorus load reduction needed to meet water quality target concentrations in the Lower Kankakee River Watershed

Site	Current Load (lb/yr)	Target Load (lb/yr)	Reduction Needed (lb/yr)	Percent Reduction
J1	17,098.7	365.0	16,733.7	98%
J7	73,235.2	6,476.6	66,758.6	91%
J9	217,145.2	4,076.7	213,068.6	98%
J10	60,477.6	316.8	60,160.7	99%
J13	42,860.6	1,885.8	40,974.7	96%
J17	36,136.8	2,682.0	33,454.7	93%
J19	3,254,855.7	135,790.8	3,119,064.9	96%

Table 46- Current and target total suspended solids load reduction needed to meet water quality target concentrations in the Lower Kankakee River Watershed

Site	Current Load (lb/yr)	Target Load (lb/yr)	Reduction Needed (lb/yr)	Percent Reduction
J1	31,563.7	182,488.2	-150,924.5	-478%
J7	290,646.1	3,238,302.7	-2,947,656.6	-1014%
J9	428,916.7	2,038,338.5	-1,609,421.8	-375%
J10	174,333.5	158,415.0	15,918.5	9%
J13	96,919.3	942,917.0	-845,997.7	-873%
J17	117,968.2	1,341,017.0	-1,223,048.8	-1037%
J19	22,035,908.5	67,895,381.3	-45,859,472.8	-208%

Table 47- Current and target E. coli loads in pounds/year and load reduction needed to meet water quality target concentrations in the Lower Kankakee River Watershed

Site	Current Load (lb/yr)	Target Load (lb/yr)	Reduction Needed (lb/yr)	Percent Reduction
J1	1.08E+13	1.30E+13	-2.20E+12	-20%
J7	6.33E+13	2.30E+14	-1.67E+14	-264%
J9	5.42E+13	1.45E+14	-9.07E+13	-167%
J10	4.85E+13	1.13E+13	3.72E+13	77%
J13	4.43E+13	6.71E+13	-2.28E+13	-51%
J17	2.62E+13	9.54E+13	-6.92E+13	-264%
J19	2.98E+15	4.83E+15	-1.84E+15	-62%

After discussing the low flow conditions present in the Lower Kankakee River Watershed streams and the lack of reductions needed to meet TSS target concentrations and E. coli reductions as required by the TMDL, the steering committee discussed other options for calculating loading rates for the watershed. The steering committee identified the IDEM fixed monitoring station and USGS gaging station near Shelby as a better source of watershed wide data as this station 1) represents the entire Lower Kankakee River Watershed and 2) has more long-term data than the data collected at various points throughout the watershed during the current project. With this in mind, load duration curves were developed for the Shelby sampling station. Since this gage includes the entire drainage of the Kankakee River to Shelby, watershed drainage was scaled to remove drainage from the Upper Kankakee and Yellow River watersheds. The stream flow was scaled from the drainage at Shelby to include the entire drainage area of the Lower Kankakee River Watershed. Data collected from the IDEM fixed station at Shelby was used for nitrate-nitrogen, total phosphorus, and total suspended solids load calculations. IDEM collects data at this fixed station monthly for these parameters. The scaled instream flow data were combined with IDEM fixed station grab sample data were used to create load duration curves. These curves represent the current loading rate for each parameter for the entire watershed. Load duration curves were then used to estimate load reductions.

6.2.2 Load Duration Curves Load Reductions

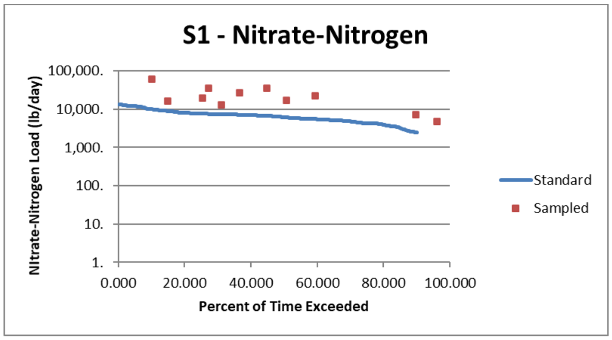
Load duration curves allows for comparison of instream loading with stream flow so that conditions of concern can be identified. The load duration curves present the flow characteristics for the entire Lower Kankakee River drainage during the time of study from April 2019 to March 2020. Data used for the curves were calculated by scaling flow measured at Kankakee River stream gage near Shelby, Indiana and used the monthly data collected by IDEM as part of their fixed station monitoring network.

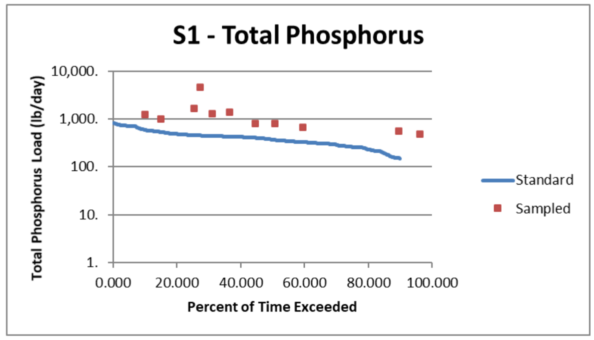
observed flow (cfs)) x (conversion factor) x (target concentration or state criteria) = total load /day

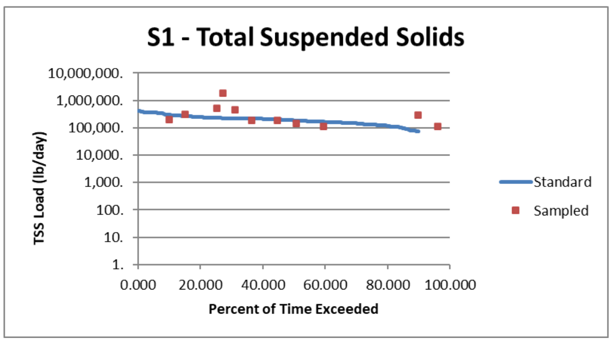
The individual parameter load duration curves, also known as the allowable load curves, for the Kankakee River at Shelby gaging station are displayed below (Figure 72). Appendix E contains load duration curves for the other six subwatershed sampling sites. In the graphs, the total daily load of each contaminant sample result (points) is plotted against the "percent time flow is exceeded" for the day of sampling (curve). Those points above the curve exceed the state criterion or target concentration. Values on a load duration curve can be grouped by hydrologic condition to help identify possible sources and conditions that result in the material being present in the system under those flow conditions. Most often, the flow ranges fall in High (0 to 10), Moist (10-40), Mid-Range (40-60), Dry (60-90), and Low (90-100).

Exceedances falling in the moist range (10-40) are typically associated surface runoff or stormwater loads, while exceedances associated with the dry zone are most often associated with dry conditions. These exceedances are suggested to result from point sources that are the most likely source. The curves shown in Figure 73 represent the current loading rate for each parameter calculated for the entire Lower Kankakee River drainage.

Figure 73- Nitrate-Nitrogen, Total Phosphorus and Total Suspended Solids Load Duration Curves for the Lower Kankakee River







6.2.3 Load Reductions

As discussed in Section 3.1 the steering committee selected water quality benchmarks for nitrate-nitrogen, total phosphorus, and total suspended solids that will significantly improve water quality in Lower Kankakee River (Table 21). Target loads needed to meet these benchmarks were calculated for the entire watershed for each parameter. IDEM fixed station data was used to calculate annual loading rates and load reductions. The current loading rate was calculated using the load duration curves detailed above. Concentration data collected monthly at the fixed station was multiplied by the representative days between sampling events (typically 30 days) and then by the average flow during that period of time. Load reduction targets were calculated using the water quality targets selected by the steering committee for each parameter. These targets were multiplied by the same scaled average continuous flow data used to calculate current loading rates and the number of days between sampling events. All calculations are in lb/year and are shown as percent of the current load (Table 48).

Table 48- Estimated load reductions needed to meet water quality target concentrations in the Lower Kankakee River Watershed

	Nitrate-nitrogen	TP	TSS
Total Current (lb/year)	2,471,085.1	134,795.4	38,291,243.6
Target (lb/year)	707,880.6	42,472.8	21,236,419.2
Reduction (lb/year)	1,763,204.4	92,322.6	17,054,824.4
Percent Reduction	71%	68%	45%

As noted above, the load duration curves and association loading reductions calculated for the six subwatershed sample sites result in negative *E. coli* load reductions for five of the six sample sites. The steering committee noted the overall low flows and few storm events which occurred during the sampling period. This likely resulted in lower than average *E. coli* concentrations in Lower Kankakee River streams. Further, an *E. coli* loading calculation cannot be calculated for the Kankakee River at Shelby gaging station as IDEM does not collect E. coli samples as part of their monthly sampling. Therefore, the Iroquois and Kankakee River *E. coli* TMDL was used to develop *E. coli* reductions needed in the Lower Kankakee River Watershed. The required *E. coli* load reduction was determined using the TMDL for each 12-digit HUC within the Lower Kankakee River Watershed (IDEM, 2014). The TMDL states that between a 0 and 63% reduction in *E. coli* geometric mean concentration (col/100 mL) is needed in order to achieve the state water quality standard, while between a 0 and 93% reduction is needed (billion/day) to achieve loading targets (Table 49).

Table 49- Estimated *E. coli* load reductions needed to meet water quality target concentrations in the Lower Kankakee River Watershed

Subwatershed	TMDL Geomean (col/100 mL)	Target Geomean (col/100 mL)	% Reduction Based on Geomean
Beaver Lake Ditch-Kankakee River	175 560	125	29% (Kankakee River) 78% (Beaver Lake Ditch)
Brown Levee Ditch-Kankakee River	198	125	37%
Cook Ditch-Hodge Ditch	195	125	38%
Dehaan Ditch	602	125	79%
Delehanty Ditch-Hodge Ditch	Not sampled		
Gregory Ditch-Mud Lake Ditch	Not sampled		
Headwaters Wolf Creek	Not sampled		
Hickam Lateral-Wolf Creek	215		42%
Lawler Ditch-Beaver Lake Ditch	202 222	125	39% (Lawler Ditch) 44% (Beaver Lake Ditch)
Mud Lake Ditch-Beaver Lake Ditch	Not sampled		
Wentworth Ditch-Knight Ditch	Not sampled		
Williams Ditch	Not sampled		

7.0 CRITICAL AND PRIORITY AREA DETERMINATION

Critical areas are defined as the areas where sources of water quality problems occur in the highest densities and where restoration measures can improve water quality. These areas indicate locations where best management practices should be targeted to address nonpoint sources of pollution. Priority areas are those areas of the watershed where high quality habitat is found, and the aquatic biological community is classified as good or excellent. Best management practices to protect the higher quality conditions should be targeted to these areas.

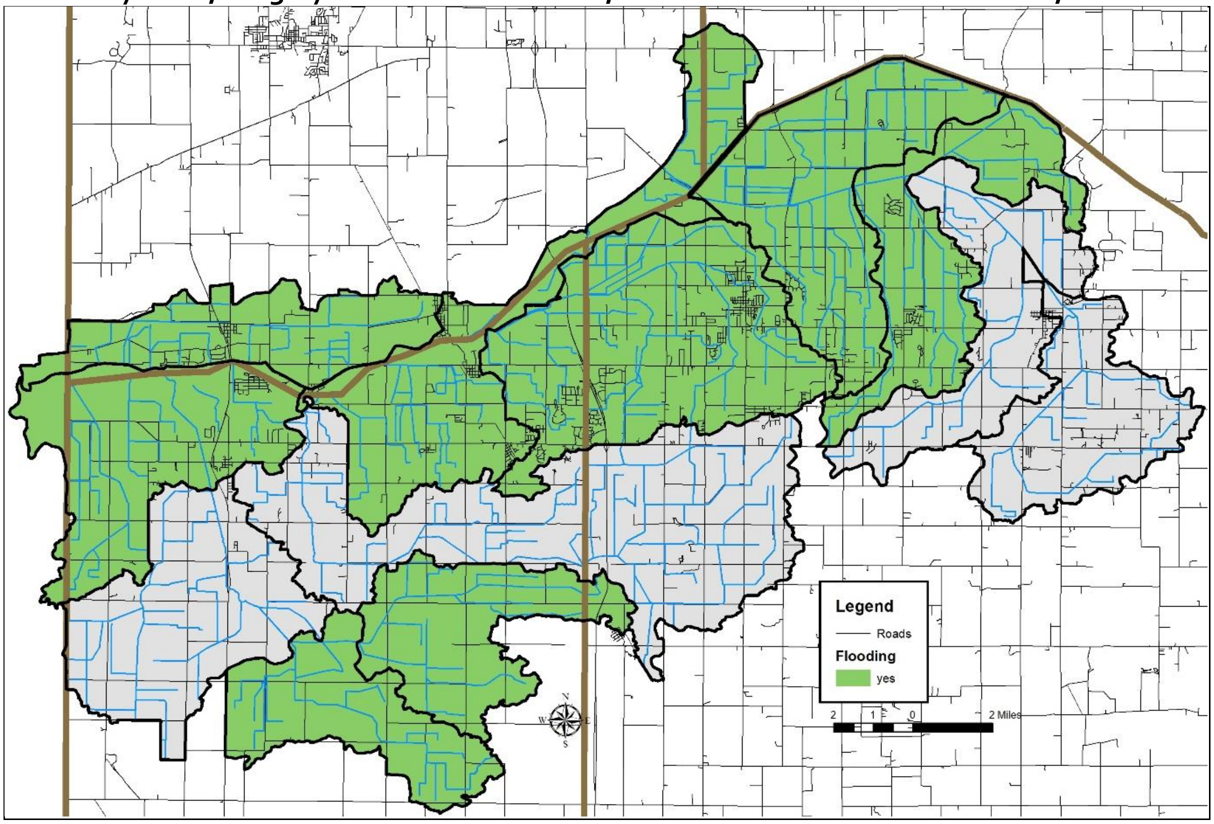
Using the list of potential sources developed for each parameter of concern as a base, the steering committee developed a mechanism for determining critical areas for each parameter. GIS-based mapping data from desktop and windshield survey efforts, loading calculations, and current and historic water quality data were used as a basis for decision-making. Data for each subwatershed are detailed in Appendix F. The steering committee reviewed each subwatersheds' data and developed a criteria list for each parameter (sediment, nitrogen, phosphorus, pathogens, etc). Break points for each factor considered when determining critical areas were identified by the steering committee. These break points are often natural breaks in the data. For example, agricultural land use ranges from 49 to 81% of subwatershed land use. Two natural groups form, those subwatersheds where agricultural land use covers more than 60% of the subwatershed and those that cover less than 60% of the subwatershed. Based on this natural grouping, the steering committee chose to place those subwatershed with more than 60% agricultural land use critical and those below 60% were not considered critical for this factor. Each factor was reviewed for each item deemed important for each critical area determination and a break in data selected based on the data pattern. For each parameter, each subwatershed was evaluated to determine whether it met each criterion developed by the steering committee. Each parameters criterion is detailed in subsequent sections. Each subwatershed was scored based on the total number of criteria that were met (1=yes, 0=no) and the subwatersheds with the highest scores were prioritized as critical areas for each parameter.

The steering committee reviewed the coverage for each parameter once critical area determinations were completed. The committee discussed the large percentage of the watershed covered by each subwatershed and decided they were in favor of proceeding as these areas 1) meet the natural break point of each dataset reviewed for each factor considered; 2) possess the highest percentage of the concern (agricultural land use, samples exceeding targets, etc) and 3) represent the areas of highest concern within the Lower Kankakee River Watershed. The committee discussed reducing the overall coverage and reprioritizing critical areas and but chose to proceed with the critical areas as defined.

7.1 Critical Areas for Flooding

The steering committee identified flooding throughout the watershed as a concern. Based on input from the Kankakee River Sediment Work Plan (CBBEL, 2019) and maps showing the extent of the 2018 Kankakee River Flood, the steering committee used the most recent DNR FIRM maps to set priorities for critical areas for flooding (Figure 74).

Figure 74- Critical Areas for Flooding in the Lower Kankakee Watershed: Beaver Lake Ditch-Kankakee River, Brown Levee Ditch-Hodge Ditch, Cook Ditch-Hodge Ditch, Dehaan Ditch, Delehanty Ditch, Gregory Ditch-Mud Lake Ditch, Mud Lake Ditch-Beaver Lake Ditch, Williams Ditch



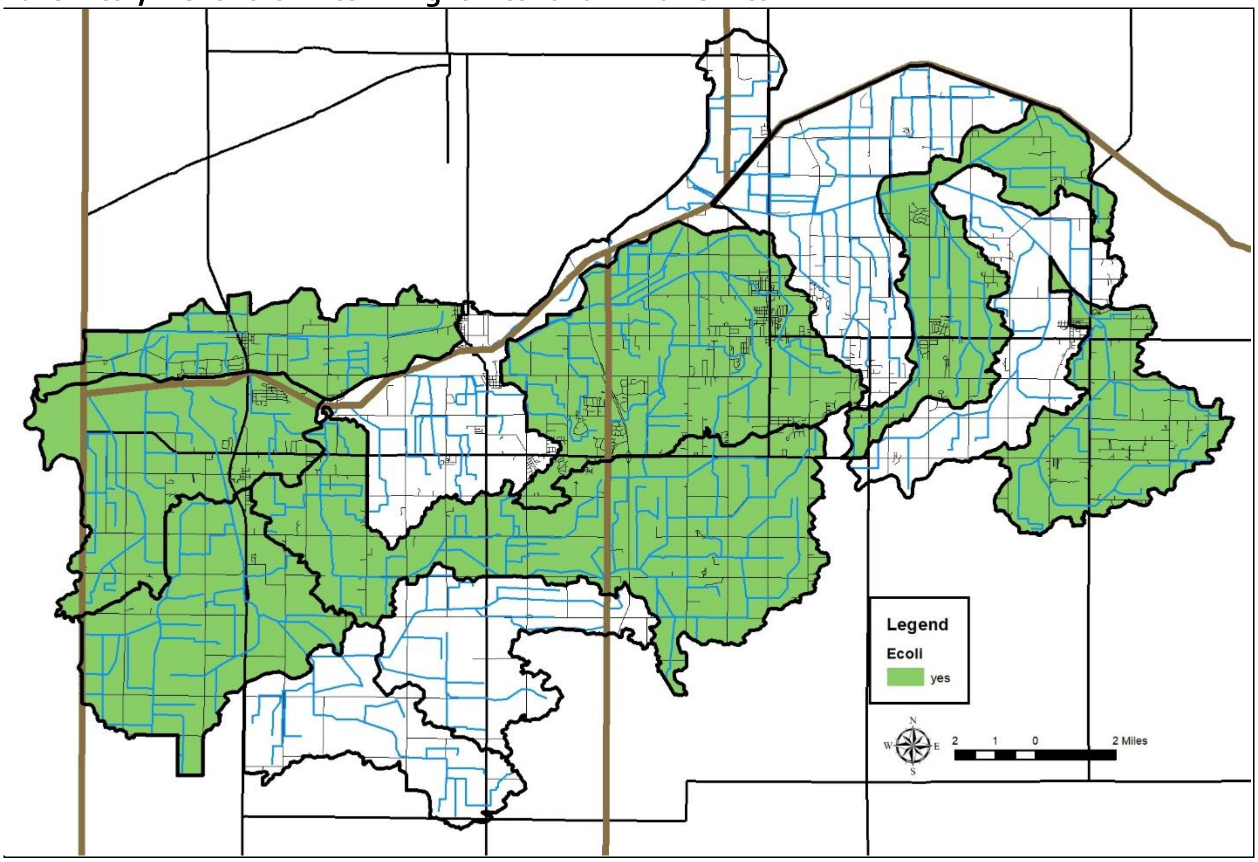
7.2 Critical Areas for *E. coli*

E. coli concentrations were used to determine *E. coli*-based critical areas (Figure 75). *E. coli* enters streams in the Lower Kankakee River Watershed through human and animal waste, livestock access, and infrastructure issues. Additional areas of concern, such as areas with manure management issues or failing septic systems, may also be included. While those areas have not been quantified, dense unsewered areas and knowledge of septic system failures were included as a method for identifying these areas. Under wet weather conditions, the Kankakee/Iroquois TMDL prioritizes *E. coli* reductions for Hickam Lateral-Wolf Creek, Cook Ditch-Hodge Ditch, Deehan Ditch, Brown Levee Ditch-Kankakee River, Lawler Ditch-Beaver Lake Ditch, and Beaver Lake Ditch-Kankakee River. IDEM indicates that this ranking should be considered when determining critical areas as part of this planning process (IDEM, 2013). Additionally, as noted above *E. coli* concentrations measured during the current project are overall low with most samples measuring below the state grab sample standard. While this could be considered an improvement in water quality, the steering committee noted that storm events were limited during the sampling period and thus *E. coli* concentrations were likely undercounted. These suggestions were considered as part of the *E. coli* discussion. Based on the data reviewed by the steering committee, the following targets were priorities for *E. coli* critical areas:

- 30% or greater of *E. coli* samples exceeding target concentrations historic data
- 20 miles or greater of stream listed as impaired for *E. coli* by IDEM
- TMDL recommends *E. coli* reduction based on geometric mean
- Manure volumes as estimated from hobby farm and confined feeding operation data greater than 10,000 pounds

- Percent urban land use greater than 7%
- Miles of observed livestock access greater than 1 mile
- Evidence of septic issues
- NPDES permitted facilities

Figure 75- Critical Areas for *E. coli* in the Lower Kankakee Watershed: Beaver Lake Ditch-Kankakee River, Dehaan Ditch, Delehanty Ditch-Hodge Ditch, Headwaters Wolf Creek, Lawler Ditch-Beaver Lake Ditch, Wentworth Ditch-Knight Ditch and Williams Ditch.



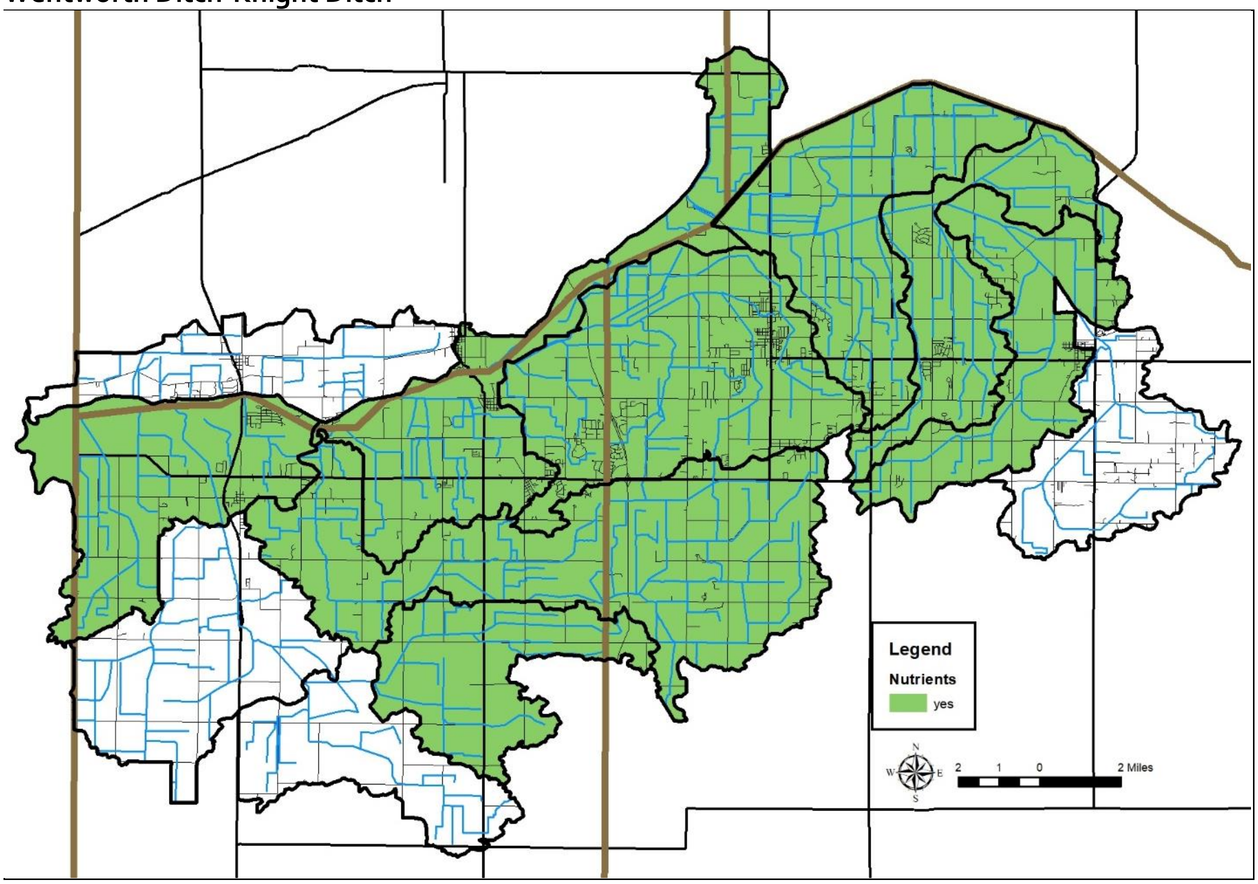
7.3 Critical Areas for Nutrients - Nitrate-Nitrogen and Total Phosphorus

Nitrate-nitrogen was the nitrogen form used to determine our critical areas. Total phosphorus was the form of phosphorus used to determine phosphorus critical areas (Figure 76). Nitrate-nitrogen and total phosphorus are readily available in the Lower Kankakee River Watershed, entering surface water via human and animal waste, fertilizer use, and tile drains on agricultural lands. Phosphorus enters the Lower Kankakee River watershed through streambank and bed erosion, unfiltered runoff, agricultural land use in floodplains, stormwater runoff, and livestock access. Based on the data reviewed by the steering committee, the following criteria were priorities for nutrient critical areas:

- Percent of samples exceeding target concentrations historic data including
  - 70% of nitrate samples exceeding target
  - 40% of total phosphorus and 60% of dissolved phosphorus exceeding targets
- Percent of current water quality samples exceeding target concentrations including
  - 55% of nitrate samples exceeding target
  - 60% of total phosphorus samples exceeding target
- Row crop + pastureland – percent of watershed greater than 60%

- Miles of observed streambank erosion greater than 3 miles
- Miles of observed narrow buffer strips greater than 50 miles
- Miles of observed livestock access greater than 1 mile
- Calculated manure volume greater than 10,000 pounds and associated N and P volumes from observed unregulated farms and permitted confined feeding operations
- Presence of known septic issue

Figure 76- Critical Areas for Nutrients in the Lower Kankakee River Watershed: Beaver Lake Ditch-Kankakee River, Brown Levee Ditch-Kankakee River, Cook Ditch-Hodge Ditch, Dehaan Ditch, Delehanty Ditch-Hodge Ditch, Gregory Ditch-Mud Lake Ditch, Hickam Lateral-Wolf Creek, and Wentworth Ditch-Knight Ditch

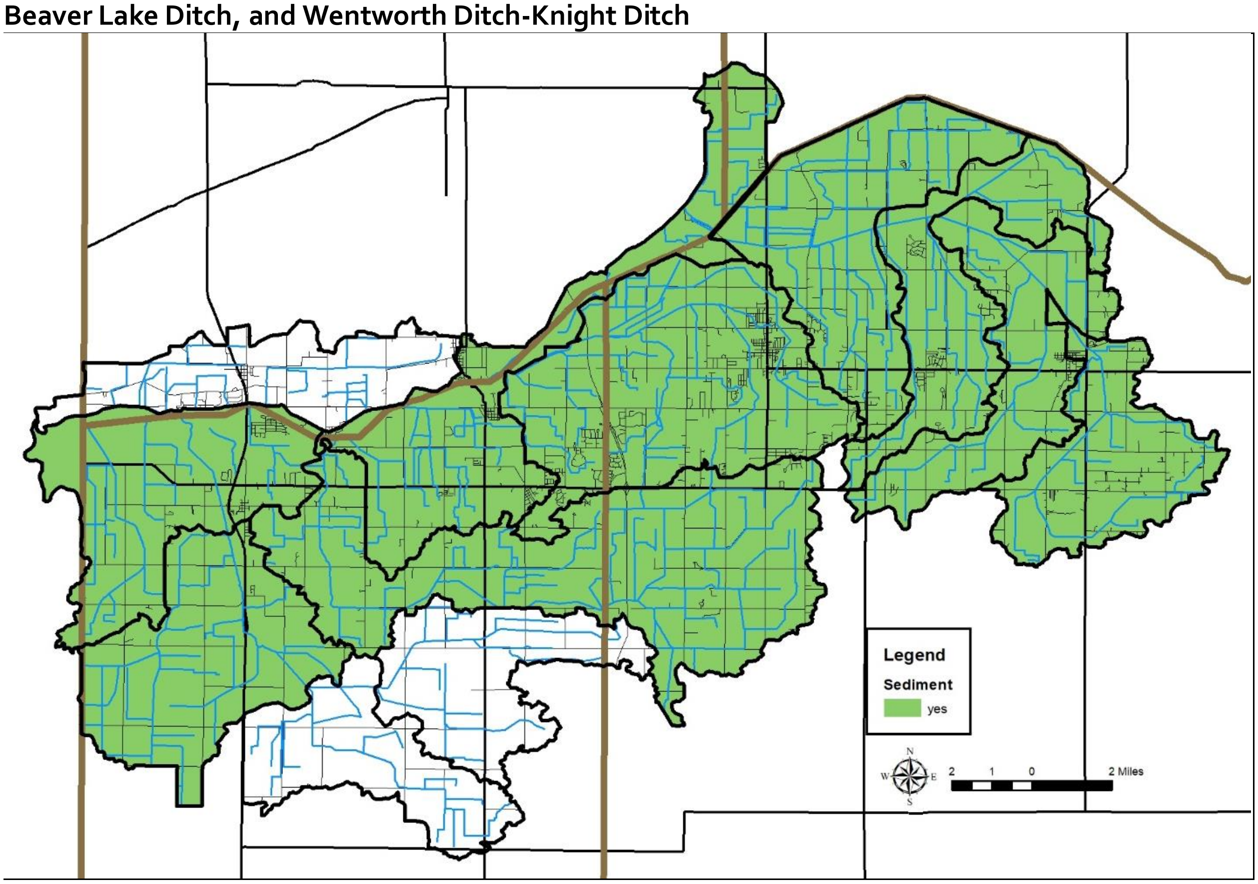


7.4 Critical Areas for Sediment

Total suspended solids concentrations were used to determine sediment-based critical areas (Figure 77). Total suspended solids enter streams in the Lower Kankakee River Watershed through streambank and bed erosion, unfiltered runoff, agricultural land use in floodplains, stormwater runoff, and livestock access. Based on the data reviewed by the steering committee, the following targets were priorities for nutrient critical areas:

- 60% or greater of turbidity samples exceeding target concentrations in historic data
- 50% or greater of TSS samples exceeding target concentrations in historic data
- 70% or greater of turbidity samples exceeding target in current data
- 10% or greater of TSS samples exceeding target concentrations in current data
- Row crop + pastureland – percent of watershed greater than 60%
- Urban land – percent of watershed and/or presence of urban development or corridor greater than 7%
- Miles of observed streambank erosion greater than 3 miles
- Miles of observed narrow buffer strips greater than 50 miles
- Miles of observed livestock access greater than 1 mile

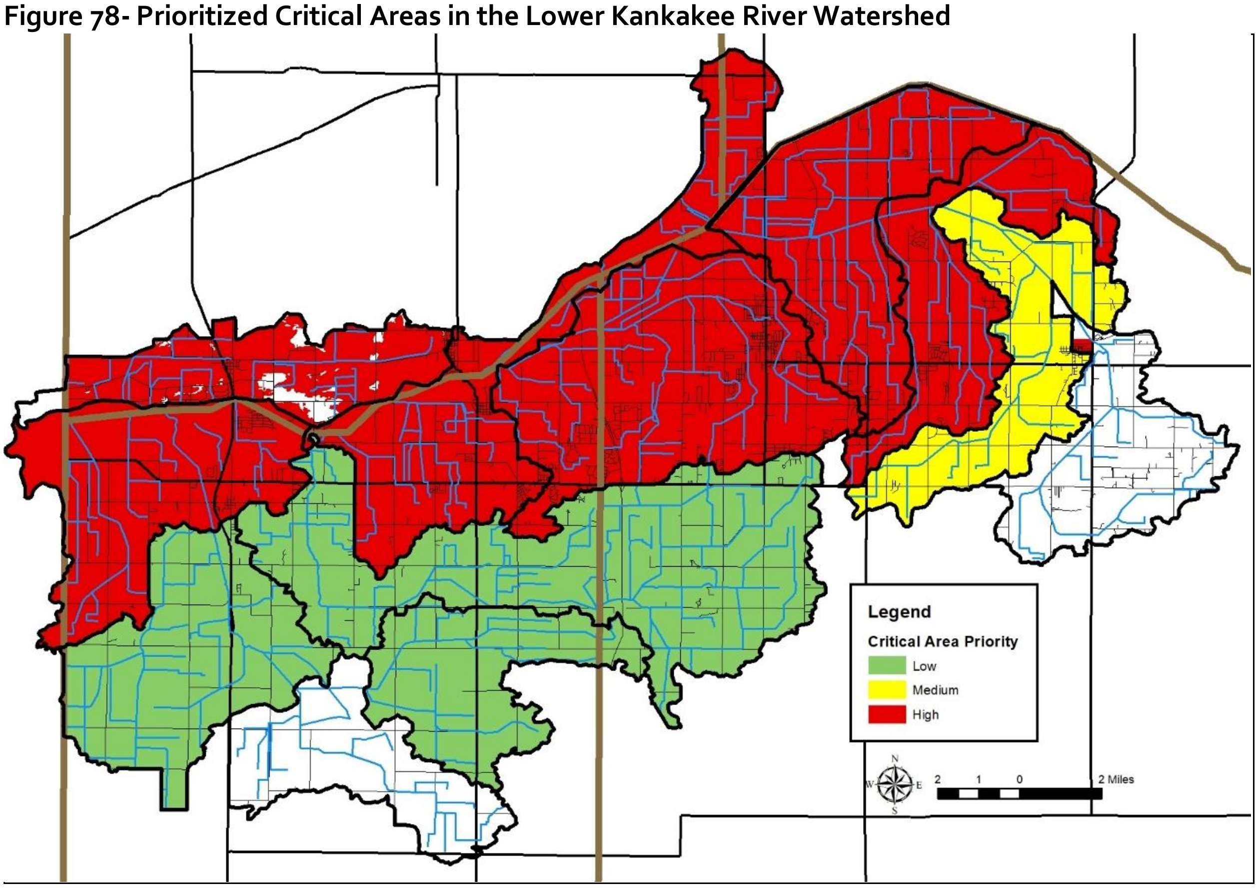
Figure 77- Critical Areas for Sediment in the Lower Kankakee River Watershed: Beaver Lake Ditch-Kankakee River, Brown Levee Ditch-Kankakee River, Cook Ditch-Hodge Ditch, Dehaan Ditch, Delehanty Ditch-Hodge Ditch, Headwaters Wolf Creek, Hickam Lateral-Wolf Creek, Lawler Ditch-Beaver Lake Ditch, and Wentworth Ditch-Knight Ditch



7.5 Critical Areas Summary

The subwatersheds identified as critical areas for each parameter are summarized in Figure 78. To identify the highest priority subwatersheds, the steering committee decided to divide them into three tiers (high, medium and low priority), based on the number of parameters that were determined to be critical. The highest priority subwatersheds are those that were determined to be critical for four parameters of the four potential parameters (flooding, nutrients, sediment, and *E. coli*). The medium priority subwatersheds are those that were determined to be critical for three of four potential parameters. Low priority subwatersheds are those that are priorities for two of four parameters. It is anticipated that implementation efforts will be targeted at these watersheds as part of EPA-funded implementation efforts only after additional monitoring to understand concerns within these areas are completed and after implementation efforts are exhausted in high and medium priority areas. Implementation via other funding sources, via landowner interest in NRCS-based federal funding programs or to mitigate flooding concerns will occur as landowners are interested.

Figure 78- Prioritized Critical Areas in the Lower Kankakee River Watershed



After setting priorities for critical areas based on water quality concerns and flooding, the steering committee reviewed their concerns list. The steering committee noted the need to include urban population centers and the floodplain adjacent to the mainstem of the Kankakee River in their implementation efforts. With this in mind, incorporated areas and those mapped as having a high density of homes are included as high priority critical areas as was area mapped as floodplain within 4 miles of the Kankakee River mainstem (Figure 78). While these areas are mapped as critical areas, the steering committee will target urban best management practices at any residential or commercial property throughout the Lower Kankakee River Watershed.

High priority critical areas (Beaver Lake Ditch-Kankakee River, Brown Levee Ditch-Kankakee River, Cook Ditch-Hodge Ditch, Dehaan Ditch, Delehanty Ditch-Hodge Ditch, floodplain adjacent to the Kankakee River mainstem and urban development) will be targeted for short term goal implementation. Problem areas identified in point and nonpoint sources of pollution figures for each high priority area should be targeted for initial implementation efforts. All high priority critical area subwatersheds will be targeted at the same time. Once high priority critical areas have been fully addressed and implementation moves to medium priority areas of the watershed, portions of the watershed that were identified as medium priority critical areas (Hickam Lateral-Wolf Creek) should be targeted. Gregory Ditch-Mud Lake Ditch, Headwaters Wolf Creek and Wentworth Ditch-Knight Ditch will be targeted as low priority areas. Mud Lake-Beaver Lake Ditch and Williams Ditch will be targeted after all other priority opportunities are exhausted for implementation efforts. It should be noted that implementation of this plan started prior to the plan's completion and approval. When the plan was drafted, the Lower Kankakee Watershed Initiative planned to target all high priority critical areas in the first phase of implementation. However, the Jasper and Newton County Soil and Water Conservation Districts applied for a received Indiana Department of Natural Resources Lake and River Enhancement program funding. These funds target implementation in three of the six high priority critical area subwatersheds selecting subwatersheds that fall within both Newton and Jasper Counties.

8.0 GOAL SETTING

Based on watershed inventory efforts; stakeholder input for concerns, problems, and sources; and watershed loading information, the following goals and strategies were developed.

8.1 Goal Statements

The steering committee wrote goals for each parameter or area of concern based on a goal of meeting the target concentrations identified by the committee. In an effort to scale goals to manageable levels, a forty-year timeframe was used for most goals. Interim goals were set for each 10-year period to allow for milestones against which implementation efforts can be compared. Each 10-year time period targets a 30% reduction in loading across all parameters. The steering committee anticipates targeting high priority critical areas (Beaver Lake Ditch-Kankakee River, Brown Levee Ditch-Kankakee River, Cook Ditch-Hodge Ditch, Dehaan Ditch, Delehanty Ditch-Hodge Ditch, floodplain adjacent to the Kankakee River, and urban development) first, then moving on to address medium priority critical areas (Hickam Lateral-Wolf Creek) before targeting low priority areas (Gregory Ditch-Mud Lake Ditch, Lawler Ditch-Beaver Lake Ditch, Headwaters Wolf Creek) or areas that were not prioritized (Mud Lake Ditch-Beaver Lake Ditch and Williams Ditch).

Based on load reduction calculations, it is anticipated that implementation within the high priority critical areas will meet short term and medium-term goals for nutrients, while implementation targeting medium and low priority critical areas will generate sufficient load reductions to meet long term sediment and nutrient goals. E. coli targets will focus on reducing E. coli concentrations to meet the Kankakee River TMDL targets throughout the watershed to meet the long-term goal. Note that several subwatersheds were not sampled as part of the TMDL.

Reduce Nutrient Loading

Based on IDEM fixed station water quality data and USGS stream gage data collected, the committee set the following goals for nitrate-nitrogen and total phosphorus (Table 50 and Table 51).

Ultimate Goal (30 years): Reduce nitrate-nitrogen from 2,471,085 pounds per year to 707,881 pounds per year (71% reduction) and phosphorus from 134,795 pounds per year to 42,473 pounds per year (68% reduction) in the Lower Kankakee River Watershed by 2051.

10-Year Goal: Reduce nitrate-nitrogen from 2,471,085 pounds per year to 1,883,350 pounds per year (24% reduction) and phosphorus from 134,021 pounds per year to 104,021 pounds per year (23% reduction) in the Lower Kankakee River Watershed by 2031.

20-Year Goal: Reduce nitrate-nitrogen from 1,883,350 pounds per year to 1,295,915 pounds per year (31% reduction) and phosphorus from 104,021 pounds per year to 73,247 pounds per year (30% reduction) in the Lower Kankakee River Watershed by 2041.

30-Year Goal: Reduce nitrate-nitrogen from 1,295,615 pounds per year to 707,881 pounds per year (45% reduction) and phosphorus from 73,247 pounds per year to 42,473 pounds per year (41% reduction) in the Lower Kankakee River Watershed by 2051.

Table 50. Nitrate-nitrogen goal calculations for the Lower Kankakee River Watershed

	Current/Starting Load (lb/year)	Target Load (lb/year)	Reduction Needed (lb/year)	Percent Reduction	Cumulative Percent Reduction
10 Year Goal	2,471,085.1	1,883,350.3	587,734.8	24%	
20 Year Goal	1,883,350.3	1,295,615.4	587,734.8	31%	
30 Year Goal	1,295,615.4	707,880.6	587,734.8	45%	71%

Table 51. Total phosphorus goal calculations for the Lower Kankakee River Watershed

	Current/Starting Load (lb/year)	Target Load (lb/year)	Reduction Needed (lb/year)	Percent Reduction	Cumulative Percent Reduction
10 Year Goal	134,795.4	104,021.2	30,774.2	23%	
20 Year Goal	104,021.2	73,247.0	30,774.2	30%	
30 Year Goal	73,247.0	42,472.8	30,774.2	42%	68%

Reduce Sediment Loading

Based on collected water quality data collected, the committee set the following goals for total suspended solids (Table 52).

Ultimate Goal (30 years): Reduce total suspended solids from 38,291,124 pounds per year to 35,394,032 pounds per year (8% reduction) by 2051.

10-Year Goal: Reduce total suspended solids from 38,291,244 pounds per year to 37,325,506 pounds per year (3% reduction) in the Lower Kankakee River Watershed by 2031.

20-Year Goal: Reduce total suspended solids from 37,325,506 pounds per year to 36,359,769 pounds per year (3% reduction) in the Lower Kankakee River Watershed by 2041.

30-Year Goal: Reduce total suspended solids from 36,359,769 pounds per year to 35,394,032 pounds per year (3% reduction) in the Lower Kankakee River Watershed by 2051.

Table 52. Total Suspended Solids goal calculations for the Lower Kankakee River Watershed

	Current/Starting Load (lb/year)	Target Load (lb/year)	Reduction Needed (lb/year)	Percent Reduction	Cumulative Percent Reduction
10 Year Goal	38,291,243.6	37,325,506.4	965,737.2	3%	
20 Year Goal	37,325,506.4	36,359,769.2	965,737.2	3%	
30 Year Goal	36,359,769.2	35,394,032.0	965,737.2	3%	8%

Reduce *E. coli* Loading

Based on collected *E. coli* data, only 16% of samples exceeded state standards. Once load duration curves were created and loading rates calculated, load reductions were needed at only one subwatershed. As these load reductions will not meet the load reductions detailed in the TMDL, the steering committee chose to use the *E. coli* concentration targets and reductions detailed in the TMDL. The committee set the following goals for *E. coli* (Table 53). The table provides the targeted percent reduction for each subwatershed.

30-Year Goal: Reduce *E. coli* concentrations to current state standards (125 CFU/100 mL) in the Lower Kankakee River Watershed such that the Beaver Lake Ditch-Kankakee River, Brown Levee Ditch-Kankakee River, Cook Ditch-Hodge Ditch, Dehaan Ditch, Hickam Lateral-Wolf Creek, and Lawler Ditch-Beaver Lake Ditch Subwatersheds meet the Iroquois/Kankakee River TMDL load reductions by 2051 (Table 53). Note that *E. coli* data collected during development of the watershed management plan indicate that concentrations measure below the state standard throughout the watershed and additional load reductions are not required.

Table 53. *E. coli* goal calculations from the Iroquois/Kankakee River TMDL for Lower Kankakee River Subwatersheds

Subwatershed	Current Geomean (col/100 mL)	Target Geomean (col/100 mL)	Percent Reduction Based on Geomean
Beaver Lake Ditch-Kankakee River	175 560	125	29% (Kankakee River) 78% (Beaver Lake Ditch)
Brown Levee Ditch-Kankakee River	198	125	37%
Cook Ditch-Hodge Ditch	195	125	38%
Dehaan Ditch	602	125	79%
Delehanty Ditch-Hodge Ditch	Not sampled		
Gregory Ditch-Mud Lake Ditch	Not sampled		
Headwaters Wolf Creek	Not sampled		
Hickam Lateral-Wolf Creek	215		42%
Lawler Ditch-Beaver Lake Ditch	202 222	125	39% (Lawler Ditch) 44% (Beaver Lake Ditch)
Mud Lake Ditch-Beaver Lake Ditch	Not sampled		
Wentworth Ditch-Knight Ditch	Not sampled		
Williams Ditch	Not sampled		

Reduce flooding

Long term: Work in partnership with the Kankakee River Basin and Yellow River Basin Commission to implement their Kankakee River Flood and Sediment Management Work Plan (CBBEL, 2019) which lays out a series of projects and variety of best management practices which could reduce flooding within the Kankakee River Basin. The best management practice-based goals identified in the Kankakee River Flood and Sediment Management Work Plan will be addressed through the sediment and nutrient goas noted above. The KRB/YRB Commission has set an ambitious goal of addressing the structural projects in a 30 year timeframe. The Lower Kankakee Watershed Initiative will target participating in the implementation, promotion and education and outreach activities associated with no less than one structural project implemented annually. Members of the Lower Kankakee River Initiative steering committee regularly attend KRB/YRB commission meetings and will work with the commission to identify opportunities and options for collaboration in the future. The work plan components are detailed in Appendix C.

9.0 IMPROVEMENT MEASURE SELECTION

A wide variety of practices are available for on-the-ground implementation to reduce sediment, nutrient, and *E. coli* loading within the Lower Kankakee River Watershed. A list of potential best management practices was reviewed by the project steering committee. From this list, the practices which were deemed most appropriate to remediate the sources of pollution in the watershed and most likely to successfully meet loading reduction targets were identified. It should be noted that no practice list is exhaustive and that additional techniques may be both possible and necessary to reach water quality goals.

9.1 Agricultural Best Management Practice Descriptions

A list of potential BMPs were reviewed by the Lower Kankakee River steering committee. Committee members reviewed potential practices taking into account the identified resource concerns, watershed land uses, and Lower Kankakee River Watershed Project goals. From the potential practice list, the most appropriate BMPs to remediate sources of pollution and address resource concerns in the Lower Kankakee River Watershed was developed. This practice list is not exhaustive and new and emerging technologies and techniques should be considered as possible and necessary options to meet water quality targets within the Lower Kankakee River Watershed. A combination of practices detailed below aimed at avoiding, controlling, and trapping nutrients and sediment and the implementation of a conservation system could be necessary to make lasting, measurable changes in Lower Kankakee River water quality. Selected practices are appropriate for all critical areas since they all contain agriculture land use and pasture, and crop resource concerns were identified in all subwatersheds. Selected practices with descriptions are listed below. Potential best management practices include the following:

Animal Mortality Facility
Bioreactor
Composting Facility
Conservation Tillage
Cover Crop
Critical Area Planting/Conservation Cover
Drainage Water Management
Field Border/Buffer or Filter Strip
Forage/Biomass Planting

Grade Stabilization Structure
Grassed Waterway/Mulching/Subsurface Drain
Heavy Use Protection Area
Livestock Restriction including Access Control/Prescribed Grazing/Livestock Pipeline/Alternative Watering Facility
Manure Management Planning
Nutrient/Pest Management
Pollinator Habitat
Saturated Buffer
Stream Crossing
Streambank Stabilization
T&E Species Protection (Habitat Improvement)
Tree/Shrub Establishment/Planting
Two Stage Ditch
Waste Storage Facility
Water and Sediment Control Basin
Wetland Creation/Enhancement/Restoration
Windbreak Establishment

Animal Mortality Facility
An animal mortality facility is an on-farm facility for the treatment or disposal of livestock and poultry carcasses for routine and catastrophic mortality events. This practice can reduce impacts to surface and groundwater resources and decrease the spread of pathogens. This practice is applicable to operations where animal carcass treatment or disposal is needed. However, these facilities may not be used for catastrophic mortality resulting from disease. All runoff is diverted away from such facilities, which should be located down gradient from springs and wells and above the 100-year floodplain if possible to prevent contamination (FOTG Code 316).

Bioreactors
Bioreactors use bacteria to digest organic materials including manure, remnant plant material, and woody debris. Bioreactors typically generate energy, water, and fertilizer. Bioreactors use a series of tanks and treatment processes to separate cellulose-based materials from oils and gases. Materials are then broken down into carbon dioxide or methane gas and ethanol.

Composting Facility
A composting facility is a structure to facilitate the controlled anaerobic decomposition of manure or other organic material by microorganisms into a biologically stable organic material that is suitable for use as a soil amendment. It can reduce the pollution potential and improve the handling characteristics of organic waste solids and produce a soil amendment that adds organic matter and beneficial organisms, provides slow-release plant-available nutrients, and improves soil conditions (FOTG Code 317).

Conservation Tillage (No-till)
Conservation tillage refers to several different tillage methods or systems that leave at least 30% of the soil covered with crop residue after planting (Holdren et al., 2001). Tillage methods encompassed by conservation tillage include no-till, mulch-till, ridge-till, and strip till. The purpose of conservation tillage is to reduce sheet and rill erosion, maintain or improve soil organic matter content, conserve soil

moisture, increase available moisture, reduce plant damage, and provide habitat and cover for wildlife. The remaining crop residue helps reduce soil erosion and runoff volume.

Several researchers have demonstrated the benefits of conservation tillage in reducing pollutant loading to streams and lakes. A comprehensive comparison of tillage systems showed that no-till results in 70% less herbicide runoff, 93% less erosion, and 69% less water runoff volume when compared to conventional tillage (Conservation Technology Information Center, 2000). Reductions in pesticide loading have also been reported (Olem and Flock, 1990; FOTG Code 329).

Cover Crops/Critical Area Planting/Conservation Cover

Cover crops include legumes, such as clover, hairy vetch, field peas, alfalfa, and soybean, and non-legumes, such as rye, oats, wheat, radishes, turnips, and buckwheat which are planted prior to or following crop harvest. Cover crops typically grow for one season to one year and are typically grown in non-cropping seasons. Cover crops are used to improve soil quality and future crop harvest by improving soil tilth, reducing wind and water erosion, increasing available nitrogen, suppressing weed cover, and encouraging beneficial insect growth. Cover crops reduce phosphorus transport by reducing soil erosion and runoff. Both wind and water erosion move soil particles that have phosphorus attached. Sediment that reaches water bodies may release phosphorus into the water. Runoff water can wash soluble phosphorus from the surface soil and crop residue and carry it off the field. The cover crop vegetation recovers plant-available nutrients in the soil and recycles them through the plant biomass for succeeding crops (FOTG Codes 327, 340, 342).

Drainage Water Management/Subirrigation

Subsurface tile drainage is an essential water management practice on highly productive fields. As a result of tile drainage, nitrate carried in drainage water enters adjacent surface waterbodies. Drainage water management is necessary to reduce nitrate loads entering adjacent surface waterbodies from tile drainage networks. Drainage water management uses water control structures within lateral drains to vary the depth of tile outlets. Typically, the outlet is raised after harvest to limit outflow from the tile and reduce nitrate transport to adjacent waterbodies; lowered in the spring and fall to allow tile water to flow freely from the field to adjacent waterbodies; and raised in the summer to help store water making it available for crops (Frankenberger et al., 2006). Drainage water management can be used in concert with a suite of other conservation practices including subirrigation, cover crops and conservation tillage to promote a systems approach and be better stewards of water quantity (FOTG Code 554).

Field Border/Buffer Strip/Filter Strip

Installing natural buffers or filters along major and minor drainages in the watershed helps reduce the nutrient and sediment loads reaching surface waterbodies. Buffers provide many benefits including restoring hydrologic connectivity, reducing nutrient and sediment transport, improving recreational opportunities and aesthetics, and providing wildlife habitat. Sediment, phosphorus, nitrogen, and *E. coli* are at least partly removed from water passing through a naturally vegetated buffer. The percentage of pollutants removed depends on the pollutant load, the type of vegetation, the amount of runoff, and the character of the buffer area. The most effective buffer width can vary along the length of a channel. Adjacent land uses, topography, runoff velocity, and soil and vegetation types are all factors used to determine the optimum buffer width.

Many researchers have verified the effectiveness of filter strips in removing sediment from runoff with reductions ranging from 56-97% (Arora et al., 1996; Mickelson and Baker, 1993; Schmitt et al., 1999; Lee et al, 2000; Lee et al., 2003). Most of the reduction in sediment load occurs within the first 15 feet of installed buffer. Smaller additional amounts of sediment are retained, and infiltration is increased by increasing the width of the strip (Dillaha et al., 1989). Filter strips have been found to reduce sediment-bound nutrients like total phosphorus but to a lesser extent than they reduce sediment load itself. Phosphorus predominately associates with finer particles like silt and clay that remain suspended longer and are more likely to reach the strip's outfall (Hayes et al., 1984). Filter strips are least effective at reducing dissolved nutrients like those of nitrate and phosphorus, and atrazine and alachlor, although reductions of dissolved phosphorus, atrazine, and alachlor of up to 50% have been documented (Conservation Technology Information Center, 2000). Simpkins et al. (2003) demonstrated 20-93% nitrate-nitrogen removal in multispecies riparian buffers. Short groundwater flow paths, long residence times, and contact with fine-textured sediments favorably increased nitrate-nitrogen removal rates. Additionally, up to 60% of pathogens contained in runoff may be effectively removed. Computer modeling also indicates that over the long run (30 years), filter strips significantly reduce amounts of pollutants entering waterways.

Filter strips should be designed as permanent plantings to treat runoff and should not be considered part of the annual rotation of adjacent cropland. Filter strips should receive only sheet flow and should be installed on stable banks. A mixture of grasses, forbs, and herbaceous plants should be used. In more permanent plantings, shrubs and trees should be intermingled to form a stable riparian community (FOTG Code 393).

Forage and Biomass Planting

Forage and biomass plantings establish adapted and/or compatible species, varieties, or cultivars of herbaceous species suitable for pasture, hay, or biomass production. Purposes include: Improve or maintain livestock nutrition and/or health; provide or increase forage supply during periods of low forage production; reduce soil erosion; improve soil and water quality; produce feedstock for biofuel or energy production (FOTG 512).

Grade Stabilization

A grade stabilization structure is used to stabilize and control soil erosion in natural and artificial channels. It can prevent the formation or advance of gullies, enhance environmental quality, and reduce pollution hazards. Special attention is given to maintaining or improving habitat for fish and wildlife (FOTG Code 410).

Grassed Waterway

Grassed waterways are natural or constructed channels established for transport of concentrated flow at safe velocities using adequate channel dimensions and proper vegetation. They are generally broad and shallow by design to move surface water across farmland without causing soil erosion. Grassed waterways are used as outlets to prevent rill and gully formation. The vegetative cover slows the water flow, minimizing channel surface erosion. When properly constructed, grassed waterways can safely transport large water flows downslope. These waterways can also be used as outlets for water released from contoured and terraced systems and from diverted channels. The amount of precipitation that runs off the soil surface rather than infiltrating down into the soil profile is increased by tillage and other farming activities that increase soil compaction and decrease soil organic matter and macro-pore content. For these reasons, the establishment or refurbishing of a grassed waterway should, when possible, be coupled with other practices that aim to increase the rate of water infiltration into the soil. This BMP can reduce sediment concentrations of nearby waterbodies and pollutants in runoff. The vegetation improves the soil aeration and water quality due to its nutrient removal through plant uptake and absorption by soil. The waterways can also provide wildlife corridors and allows more land to be natural areas (FOTG Code 412).

Heavy Use Protection Area (HUAP)
HUAP is used to stabilize a ground surface that is frequently used by people, animals, or vehicles and to protect water quality (FOTG Code 561).

Livestock Restriction/Rotational Grazing/Lined Waterway or Outlet
Livestock that have unrestricted access to a stream or wetland have the potential to degrade the waterbody's water quality and biotic integrity. Livestock can deliver nutrients and pathogens directly to a waterbody through defecation. Livestock also degrade stream ecosystems indirectly. Trampling and removal of vegetation through grazing of riparian zones can weaken banks and increase the potential for bank erosion. Trampling can also compact soils in a wetland or riparian zone decreasing the area's ability to infiltrate water runoff. Removal of vegetation in a wetland or riparian zone also limits the area's ability to filter pollutants in runoff. The degradation of a waterbody's water quality and habitat typically results in the impairment of the biota living in the waterbody.

Restoring areas impacted by livestock grazing often involves several steps. First, the livestock in these areas should be restricted from the wetland or stream to which they currently have access. If necessary, an alternate source of water should be created for the livestock. Second, the wetland or riparian zone where the livestock have grazed should be restored. This may include stabilizing or reconstructing the banks using bioengineering techniques. Minimally, it involves installing filter strips along banks or wetland edge and replanting any denuded areas. Finally, if possible, drainage from the land where the livestock are pastured should be directed to flow through a constructed wetland to reduce pollutant loading, particularly nitrate-nitrogen loading, to the adjacent waterbody. Complete restoration of aquatic areas impacted by livestock will help reduce pollutant loading, particularly nitrate-nitrogen, sediment, and pathogens.

A livestock exclusion system is a system of permanent fencing (board, barbed, etc.) installed to exclude livestock from streams and areas not intended for grazing. This will reduce erosion, sediment, and nutrient loading, and improve the quality of surface water. Landowners can additionally section off the pastureland and move the animals from one paddock to the next, ensuring adequate vegetation growth for nutrient removal. Using this system of rotational grazing no one piece of land gets overgrazed and ensures a high-quality food for the livestock and adequate ground cover for nutrient and sediment retention. Education and outreach programs focusing on rotational grazing and exclusionary fencing are important in the success of this BMP (FOTG Code 468, 516).

Manure Management Planning
Large volumes of manure are generated by both small, unregulated animal operations and by confined feeding operations located throughout the Big Pine watershed. Many entities have manure management plans in place and are currently using these plans to manage the volume of manure produced on their facility. Manure management planning includes consideration of the volume and type of manure produced annually, crop rotations by field, the volume of manure and nutrients needed for each crop, field slope, soil type, and manure collection, transportation, storage, and distribution methods. Manure management planning uses similar techniques to nutrient management planning with regards to nutrient budgets.

Animal waste is a major source of pollution to waterbodies. To protect the health of aquatic ecosystems and meet water quality standards, manure must be safely managed. Good management of manure keeps livestock healthy, returns nutrients to the soil, improves pastures and gardens, and protects the environment, specifically water quality. Poor manure management may lead to sick livestock, unsanitary and unhealthy conditions for humans and other organisms, and increased insect and parasite populations. Proper management of animal waste can be done by implementing BMPs, through safe storage, by application as a fertilizer, and through composting. Proper manure management can effectively reduce *E.coli* concentrations, nutrient levels, and sedimentation. Manure management can also be addressed in education and outreach to encourage farmers to participate in this BMP.

Nutrient/Pest Management Planning including Variable Rate Application and Waste Storage Facility

Nutrient management is the management of the amount, source, placement, form, and timing of the application of plant nutrients and soil amendments to minimize the transport of applied nutrients into surface water or groundwater and can be in commercial/non-manure fertilizer or manure-based fertilizers. Nutrient management seeks to supply adequate nutrients for optimum crop yield and quantity, while also helping to sustain the physical, biological, and chemical properties of the soil. A nutrient budget for nitrogen, phosphorus, and potassium is developed considering all potential sources of nutrients including, but not limited to, animal manure, commercial fertilizer, crop residue, and legume credits. Realistic yields are based on soil productivity information, potential yield, or historical yield data based on a 5-year average. Nutrient management plans specify the form, source, amount, timing, and method of application of nutrients on each field in order to achieve realistic production levels while minimizing transport of nutrients to surface and/or groundwater (FOTG Codes 590, 595).

Prescribed Grazing/Fencing/Alternate Watering Systems

Fencing livestock out of stream systems allows for the restoration of the stream channel. Alternative watering systems provide an alternate location for livestock to seek water rather than using a surface water source. This removes the negative impacts of livestock access to streams including direct deposit of manure and bank erosion and destabilization, while improving the health of livestock by providing a clean water source and better footing while drinking. This results in less *E. coli*, phosphorus, nitrogen, and sediment entering a surface waterbody. Alternative watering systems may include pump systems or gravity systems connected to a well or running pipe from a pond or spring (FOTG Code 528).

Saturated Buffer

Saturated buffers are an option in situations where a field is bordered by a riparian buffer. The conventional practice is to extend the tile main line from the field, through the buffer and discharge the water directly into the receiving stream. Subsurface drainage water, therefore, bypasses the buffer and has no opportunity for interaction with the biota in the buffer. Saturated buffers provide a means for distributing some or all of the drainage water through the buffer. For the purpose of utilizing the buffer, a diverter box, or control structure, is installed on the tile main line at the edge between the field and the buffer. The diverter box is used to direct the water into a subsurface distribution pipe running parallel to the stream along the edge of the field. The distribution pipe is regular perforated drainage pipe. The drainage water can then seep out of the distribution pipe and into the soil and make its way down gradient to the stream. The nitrate in the water is removed by the buffer through denitrification, immobilization in bacterial biomass and plant uptake. An overflow discharge pipe to the stream is connected to the diverter box to allow bypass flow during times of high drainage flow rates, thereby ensuring that no water is being backed up in the main tile line.

Streambank Stabilization

Streambank stabilization or stream restoration techniques are used to improve stream conditions so they more closely mimic natural conditions. The most feasible restoration options return many of the stream's natural functions (flood storage, nutrient removal, etc.) without restoring the stream completely to its original condition. However, even a partial restoration of this type is extremely expensive, takes quite a bit of land to accomplish, and is likely unrealistic as a large-scale strategy in this watershed. Our efforts will focus primarily on two-stage ditch construction, which is a cheaper way to incorporate a small floodplain into the ditch itself in the form of benches on either side of the main channel that allow for increased capacity in the ditch resulting in slower moving water along the banks resulting in reduced bank slumping and failure. Restoration and stabilization options are limited by available floodplain, modifications to natural flows, and development structure locations. Reestablishment of riparian buffers, restoration of stream channels, stabilization of eroding stream banks, installation of riffle-pool complexes, and general maintenance can all improve stream function while reducing sediment and nutrient transport into and within the system.

T&E Species Protection (Habitat Improvement)
Threatened and endangered species are those plant and animal species whose survival is in peril. Federally and state listed species identified within the Lower Kankakee River Watershed are highlighted in the Watershed Inventory. Threatened species are those that are likely to become endangered in the foreseeable future. Federally endangered species are those that are in danger of extinction throughout all or a significant portion of their range. A state-endangered species is any species that is in danger of extinction as a breeding species in Indiana.

Protecting threatened and endangered species requires consideration of their habitat including food, water, and nesting and roosting living space for animals and preferred substrate for plants and mussels. Corridors for species movement are also necessary for long-term protection of these species. Protection of habitat can include providing clean water and available food but likely requires protection of the physical living space and associated corridor. Conservation management plans should be developed for each species if they are not already in place. Such plans should consider habitat needs including purchase or protection of adjacent properties to current habitat locations, hydrologic needs, pollution reduction, outside impacts, and other techniques necessary to protect threatened and endangered species.

Tree/Shrub Establishment/Planting or Reforestation including Invasive Control/Timber Stand Improvement
Reforestation is the establishment of forests, usually accomplished through the planting of tree seedlings. It is important to match the species being planted to the site chosen for reforestation. Control of competing vegetation and invasive plants is often necessary to ensure establishment and survival of planted trees. This is usually done through mowing and/or herbicide application. Reforestation can provide many benefits to the landscape. Increasing the amount of forest through tree planting provides more habitat for forest dependent species, improves water quality by reducing erosion, decreases nutrient loading and lowers floodwater velocity (FOTG Code 612).

Two-Stage Ditch

When water is confined to stream or ditch channel it has the potential to cause bank erosion and channel downcutting. Current ditch design generates narrow channels with steep sides. Water flowing through these systems often result in bank erosion, channel scour and flooding. A relatively new technique focuses on mitigating these issues through an in-stream restoration called a two-stage ditch. The design of a two-stage ditch incorporates a floodplain zone, called benches, into the ditch by removing the ditch banks roughly 2-3 feet above the bottom for a width of about 10 feet on each side depending on the size of the channel. This allows the water to have more area to spread out on and decreases the velocity of the water. This not only improves the water quality, but also improves the biological conditions of the ditches where this is located.

The benefits of a two-stage ditch over the typical agricultural ditch include both improved drainage function and ecological function. The two-stage design improves ditch stability by reducing water flow and the need for maintenance, saving both labor and money. It also has the potential to create and maintain better habitat conditions. Better habitats for both terrestrial and aquatic species are a great plus when it comes to the two-stage ditch design. The transportation of sediment and nutrients is decreased considerably because the design allows the sorting of sediment, with finer silt depositing on the benches and coarser material forming the bed. A recent study by the University of Notre Dame found that the average two-stage ditch reduces the amount of sediment transported annually by over 100,000 pounds per half mile of two-stage (Tank, unpublished data).

Waste Storage Facility

A waste storage impoundment made by constructing an embankment and/or excavating a pit or dugout, or by fabricating a structure. The purpose of this practice is to temporarily stores wastes such as manure, wastewater, and contaminated runoff as a storage function component of an agricultural waste management system. (FOTG Code 313).

Water and Sediment Control Basin

A water and sediment control basin is an earthen embankment constructed across the slope of a minor watercourse to form a sediment trap and water detention basin with a stable outlet. This practice can reduce watercourse and gully erosion, trap sediment, and reduce downstream runoff. It is particularly applicable where watercourse or gully erosion is a problem and where sheet and rill erosion is controlled by other conservation practices. It can help in areas where sediment in runoff is severe, though it needs to be placed where adequate outlets can be provided (FOTG Code 638).

Wetland Creation/Enhancement/Restoration

Visual observation and historical records indicate at least a portion of the Lower Kankakee River watershed has been altered to increase its drainage capacity. Riser tiles in low spots on the landscape and tile outlets along the waterways in the watershed confirm the fact that the landscape has been hydrologically altered. This hydrological alteration and subsequent loss of wetlands has implications for the watershed's water quality. Wetlands serve a vital role in storing water and recharging the groundwater. When wetlands are drained with tiles, the stormwater reaching these wetlands is directed immediately to nearby ditches and streams. This increases the peak flow velocities and volumes in the ditch. The increase in flow velocities and volumes can in turn lead to increased stream bed and bank erosion, ultimately increasing sediment delivery to downstream water bodies. Wetlands also serve as nutrient sinks at times. The loss of wetlands can increase pollutant loads reaching nearby streams and downstream waterbodies.

Restoring wetlands in the watershed could return many of the functions that were lost when these wetlands were drained. Through this process, a historic wetland site is restored to its historic status. These restored systems store nutrients, sediment, and *E. coli* while also increasing water storage and reducing flooding. Wetlands also provide additional habitat, stormwater mitigation, and recreational opportunities.

Windbreak/Shelterbelt

Windbreaks or shelterbelts are single or multiple rows of trees or shrubs in linear configurations. The purposes of this practice include: reduce soil erosion from wind; protect plants from wind related damage; alter microenvironment for enhancing plant growth; manage snow deposition; provide shelter for structures, animals, and people; enhance wildlife habitat; provide noise screens; provide visual screens; improve air quality by reducing and intercepting air born particulate matter, chemicals, and odors; delineate property and field boundaries; improve irrigation efficiency; increase carbon storage in biomass and soils; and reduce energy use (FOTG Code 642).

9.2 Urban Best Management Practice Descriptions

Though only 8% of the watershed is classified as urban land use, there are some best management practices which could be considered for helping to improve water quality where development and impervious surfaces are more prevalent. The best way to mitigate the impacts of impervious surfaces is to infiltrate, store, and treat stormwater onsite before it can run off into nearby streams and tributaries.

Bioretention

Bioretention practices use biofiltration or bioinfiltration to filter runoff by storing it in shallow depressions. Bioretention uses plant uptake and soil permeability mechanisms in a variety of manners typically in combination. Potential practices include sand beds, pea gravel overflow structures, organic mulch layers, plant materials, gravel underdrains, and an overflow system to promote infiltration. Bioinfiltration can also be used to treat runoff from parking lots, roads, driveways, and other areas in the urban environment. Bioretention should not be used in highly urbanized areas rather, it should be used in areas where on-site storage space is available.

Infrastructure Retrofits

Typical stormwater infrastructure includes pipe and storm drains, or hard infrastructure, to convey water away from hard surfaces and into the stormwater system. Retrofitting these structures to implement low impact development techniques, use green practices, and introduce plants and filters to reduce sediment and nutrient concentrations contained in stormwater.

Pervious Pavement

Pervious pavement comes in many forms including porous pavement and modular block pavement. Both types of pervious pavement can be installed on most any travel surface with a slope of 5% or less. Pervious pavement has the approximate strength characteristics of traditional pavement with the ability to percolate water into the groundwater system. The pavement reduces sediment and nutrient transmission into the groundwater as water moves through the pores in the pavement. When installed, porous pavement includes a stone layer, filter fabric, and a filter layer covered by porous pavement. Correctly mixed porous pavement eliminates fine aggregates found in typical pavements. Porous asphalt is a type of porous pavement which includes a mix of Portland cement, coarse aggregates, and water that results in the formation of interconnected voids.

Modular pavement consists of individual blocks made of pervious material such as sand, gravel, or sod interspersed with strong structural material such as concrete. The blocks are typically placed on a sand or gravel base and designed to provide a load-bearing surface that is adequate to support personal vehicles, while allowing infiltration of surface water into the underlying soils. They usually are used in low-volume traffic areas such as overflow parking lots and lightly used access roads. An alternative to pervious and modular pavement for parking areas is a geotextile material installed as a framework to provide structural strength. Filled with sand and sodded, it provides a completely grassed parking area.

Rain Barrel
A rain barrel is a container that collects and stores rainwater from your rooftop (via your home's disconnected downspouts) for later use on your lawn, garden, or other outdoor uses. Rainwater stored in rain barrels can be useful for watering landscapes, gardens, lawns, and trees. Rain is a naturally soft water and devoid of minerals, chlorine, fluoride, and other chemicals. In addition, rain barrels help to reduce peak volume and velocity of stormwater runoff to streams and storm sewer systems. Although rain barrels do not specifically reduce nutrient or sediment loading to waterbodies, their presence can reduce the first flush of water reaching storm drains. This impact is great especially in portions of the watershed where combined sewers are still in operation. Although a high percentage of urban residents indicated a general knowledge of rain barrels, only 5% of survey respondents indicate that they have installed a rain barrel.

Rain Garden
Rain gardens are small-scale bioretention systems that be can be used as landscape features and small-scale stormwater management systems for single-family homes, townhouse units, some small commercial development, and to treat parking lot or building runoff. Rain gardens provide a landscape feature for the site and reduce the need for irrigation and can be used to provide stormwater depression storage and treatment near the point of generation. These systems can be integrated into the stormwater management system since the components can be optimized to maximize depression storage, pretreatment of the stormwater runoff, promote evapotranspiration, and facilitate groundwater recharge. The combination of these benefits can result in decreased flooding due to a decrease in the peak flow and total volume of runoff generated by a storm event. Additionally, rain gardens can be designed to provide a significant improvement in the quality of the stormwater runoff.

Septic System Care, Maintenance, and Upgrades
Septic, or on-site waste disposal systems, are the primary means of sanitary flow treatment outside of incorporated areas including most of the small towns and unincorporated areas in the Lower Kankakee River Watershed. Because of the prohibitive cost of providing centralized sewer systems to many areas, septic tank systems will remain the primary means of treatment into the future. Annual maintenance of septic systems is crucial for their operation, particularly the annual removal of accumulated sludge. The cost of replacing failed septic tanks is about $5,000-$15,000 per unit based on industry standards.

Property owners are responsible for their septic systems under the regulation of the County Health Department. When septic systems fail, untreated sanitary flows are discharged into open watercourses that pollute the water and pose a potential public health risk. Septic systems discharging to the ground surface are a risk to public health directly through body contact or contamination of drinking water sources. Additionally, septic systems can contribute significant amounts of nitrogen and phosphorus to the watershed. Therefore, it is imperative for homeowners not to ignore septic failures. If plumbing fixtures back up or will not drain, the system is failing. Funding for this practice is limited. Our efforts will include developing an education plan for homeowners in the watershed and hosting a series of septic system care and maintenance workshops.

9.3 Best Management Practice Selection and Load Reduction Calculations

Table 54 details selected agricultural and urban best management practices and reflect those parameters which NRCS eFOTG indicate can be utilized to impact each parameter. The critical area and the selected best management practices are based on subwatershed characteristics and available water quality data. The steering committee identified BMPs that would be of interest to local producers, while the project coordinator calculated volume of BMPs necessary to meet project goals.

Table 54. Suggested Best Management Practices to address high and medium priority critical areas.

Practice	Nutrients	Sediment	Pathogens
Animal Mortality Facility			X
Bioreactor	X		
Bioretention			X
Composting Facility	X		X
Conservation Tillage	X	X	X
Cover Crop/Critical Area Planting/Conservation Cover	X	X	X
Drainage Water Management	X	X	
Field Border/Buffer Strip/Filter Strip	X	X	X
Forage/Biomass Planting	X	X	X
Grade Stabilization Structure	X	X	
Grassed Waterway	X	X	X
Heavy Use Area Protection	X	X	
Infrastructure Retrofit	X	X	X
Manure Management Planning	X		X
Nutrient/Pest Management	X		
Pervious Pavement	X	X	
Prescribed Grazing (Livestock restriction, alt watering)	X	X	X
Rain Barrel	X	X	
Rain Garden	X	X	
Septic System Care/Maintenance	X		X
Streambank Stabilization	X	X	
Tree/Shrub Establishment/Planting	X	X	
Two Stage Ditch	X	X	X
Variable Rate Application	X		
Waste Storage Facility	X		X
Water and Sediment Control Basin	X	X	
Wetland Creation/Enhancement/Restoration	X	X	X
Windbreak/Shelterbelt	X	X	

The Region V model was used to estimate the approximate load reductions for BMPs unless otherwise noted (Table 55). BMPs with dashes (-) do not have load reductions available using the Region V Model or other identifiable source. The target volumes of BMPs proposed to be installed are not required to be implemented as the quantities suggest. These targets are simply guidelines for achieving goals. Load reductions solely using this model meet the project targets for nitrogen, phosphorus, and sediment goals for short, medium, and long-term goals. If the volume of practices specific in Table 54 is met, then the target loading rates detailed in Table 50 through Table 53 will be achieved for high priority critical areas (Delehanty Ditch-Hodge Ditch, Dehaan Ditch, Brown Levee Ditch-Kankakee River, Headwaters Wolf Creek and Wentworth Ditch-Knight Ditch) and medium priority critical areas (Beaver Lake Ditch-Kankakee River, Cook Ditch-Hodge Ditch, Hickam Lateral-Wolf Creek, Lawler Ditch-Beaver Lake Ditch and Williams Ditch). There is insufficient field water quality data for the low priority critical areas (Mud Lake Ditch-Beaver Lake Ditch and Gregory Ditch-Mud Lake Ditch) to determine if meeting goals for these areas is possible. The steering committee realizes that the model's calculations are only an estimate, and actual reductions could be beyond the model's estimation. The Region V model does not provide estimated reductions for all suggested BMPs; these load reductions cannot be included in the calculations. The steering committee acknowledges that they have set the bar high by establishing ambitious water quality targets that may be difficult to obtain. The group is committed to improve water quality the best that they can, even in the event that the original load reduction goals are not met.

Table 55. Suggested Best Management Practices, target volumes, and their estimated load reduction per practice to meet interim and long-term goals. Numbers in each row represent the volume to be implemented within each ten year target period.

Suggested BMPs:	Short-term (10 year) BMP Targets	Medium-term (20 year) BMP Targets	Long-term (30 year) BMP Targets	Total BMP Target	Unit	Nitrogen (lb/year)	Phosphorus (lb/year)	Sediment (t/year)
Conservation Cover (327)	2,000	2,000	2,000	6,000	acre	23	11	10
Cover Crop (340)	30,000	30,000	30,000	90,000	acre	15	7	7
Drainage Water Management (554)	Education – install demo				acre	10.4	-	-
Fence (382)	5,000	5,000	5,000	15,000	feet	0.4	0.4	0.4
Filter Strip (393)	20,000	20,000	20,000	60,000	sq feet	24	12	10
Forage and Biomass Planting (512)	700	700	700	2,100	acre	23	11	10
Grassed Waterway (412)	40	40	40	120	acre	232.9	116.4	101.3
Livestock Restriction (Alt Watering System, Access Control)	4,000	4,000	4,000	12,000	feet	2.8	0.83	7.52
Nutrient/Pest Management (590)^	30,000	30,000	30,000	90,000	Acre	4.16	6.24	-
Prescribed Grazing (528)	10,000	10,000	10,000	30,000	acre	17	9	8
Residue and Tillage Management (329)	30,000	30,000	30,000	90,000	acres	21	10	11
Streambank Stabilization*	5,000	5,000	5,000	15,000	feet	0	0.83	14
Tree/shrub Establishment (612)	1,000	1,000	1,000	3,000	acre	10	5	5
Water and Sediment Control Basin (638)	10	10	10	30	unit	129.8	64.9	56.4
Windbreak/Shelterbelt Renovation (650)	2,000	2,000	2,000	6,000	feet	10	5	5

^Assumes all nutrient management is non-manure based. Increase to 6.24 lb/ac/yr for N and 8.77 lb/ac/yr P for manure-based nutrient management.
*Assumes average width of 5 feet.

Table 56. Estimated cost for selected Best Management Practices to meet interim and long-term goals.

Suggested BMPs:	**Estimated Cost per Unit**	**Short-term (10 year) Estimated Cost**	**Medium-term (20 year) Estimated Cost**	**Long-term (30 year) Estimated Cost**
Conservation Cover (327)	75	$150,000	$150,000	$150,000
Cover Crop (340)	25	$750,000	$750,000	$750,000
Drainage Water Management (554)	$50	$0	$0	$0
Fence (382)	1	$5,000	$5,000	$5,000
Filter Strip (393)	75	$1,500,000	$1,500,000	$1,500,000
Forage and Biomass Planting (512)	75	$52,500	$52,500	$52,500
Grassed Waterway (412)	$5,000	$200,000	$200,000	$200,000
Livestock Restriction (Alt Watering System, Access Control)	$1,000	$4,000,000	$4,000,000	$4,000,000
Nutrient/Pest Management (590)	$4.00	$120,000	$120,000	$120,000
Prescribed Grazing (528)	$15.00	$150,000	$150,000	$150,000
Residue and Tillage Management (329)	$15	$450,000	$450,000	$450,000
Streambank Stabilization	$1,000	$5,000,000	$5,000,000	$5,000,000
Tree/shrub Establishment (612)	$450	$450,000	$450,000	$450,000
Water and Sediment Control Basin (638)	$2,500	$25,000	$25,000	$25,000
Windbreak/Shelterbelt Renovation (650)	$0.50	$1,000	$1,000	$1,000
Total Cost		**$12,853,500**	**$12,853,500**	**$12,853,500**

9.4 Action Register

All activities to be completed as part of the Lower Kankakee River Watershed management plan are identified in Table 57. The goals set by the steering committee are listed below. Each objective in the action register corresponds to one or more goals and reflects the estimated amount of each BMP that will be needed in order to achieve the target load reductions. Nutrient and sediment removal efficiencies were not available for all BMPs, so the estimated number of BMPs needed was calculated based only on those BMPs that had load reduction estimates. For those BMPs that did not have associated load reduction estimates, the objective was developed with an amount of each BMP that the steering committee determined to be reasonably achievable. Therefore, if all the BMPs listed in all objectives are implemented, the total load reductions achieved will far exceed the load reductions needed to meet the water quality benchmarks.

Table 57. Action Register.

Education and Funding Goals	Objective	Target Audience	Milestones	Cost	Possible Partners (PP) & Technical Assistance (TA)
Fund Raising	Coordinate on-the-ground cost-share program by 2023.	Local farmers, CFO/CAFO owner/operators, rural homeowners, local government, local community residents and business owners	Develop a cost-share program.	$25,000 annually	PP=SWCDs, EDCs, CCAs and ag retailers, Health Departments, ICP Partners, local realtors, TNC, Niches Land Trust, Pheasants Forever, KRBC/YRBC, local media (Rensselaer Republican & Newton County Enterprise) and radio TA=ICP Partners, CCAs and ag retailers, SWCDs, County surveyors
			Implement cost-share program.		
			Identify potential funding sources to augment cost-share program including NWQI, RCPP, LARE, CWA and others.		
Education	Develop an education plan targeting each practice identified above by 2023.		Create mechanism to promote each practice using methods including but not limited to press release; stream clean up; float trip; stream, field, or pasture walk; website creation; local events; county fair booth; educational booth; workshop; field days and public meetings.	$10,000	
			Develop funding mechanism for education efforts.		
Flooding	Work with the KRBC/YRBC to implement their flood reduction strategy		The education program should include educational efforts which includes but is not limited to the following: all agricultural and urban practices identified by the steering committee and noted in tables above; septic system use; maintenance and care; high quality natural areas; wetland protection and preservation and general stream processes.	$25,000 annually	

Nutrient Goal	Objective	Target Audience	Milestones	Cost (includes BMPs, staff and supplies)	Potential Partners/ Technical Assistance
Short term: Reduce nitrate-nitrogen by 24% and TP by 23% in the Lower Kankakee River Watershed by 2032. Medium term: Reduce nitrate-nitrogen by 31% and TP by 30% in the Lower Kankakee River Watershed from 2031 to 2042. Long term: Reduce nitrate-nitrogen by 45% and TP by 42% in the Lower Kankakee River Watershed from 2042 to 2052.	Educate and promote installation of BMPs through field days/workshops	Local producers, CFO/CAFO owner/operators, rural landowners with septic systems, local government, local community residents and business owners, local realtors	Host at least one local event (field day, public meeting, workshop) annually targeting agricultural BMPs and one local event every two years targeting urban or habitat based BMPs.	$5,000 annually	PP=SWCDs, EDCs, CCAs and ag retailers, Health Departments, local realtors, ICP Partners, TNC, Niches Land Trust, Pheasants Forever, KRBC/YRBC, local media (Rensselaer Republican & Newton County Enterprise) and radio TA=ICP Partners, CCAs and ag retailers, SWCDs, County surveyors
	Education through publications, web posts, and press releases		Develop quarterly (4) print materials publications, press releases, web updates, social media posts or other publications annually.		
			Implement one tenth of the short-term practices annually from 2022 to 2032, one tenth of medium-term practice annually from 2032 to 2042 and one tenth of long-term practices annually from 2042 to 2052.	$1,285,350 annually (see Table 56 for cost by practice)	
			Achieve 10-year interim BMP target and load reduction goals: 24% nitrate-nitrogen and 23% total phosphorus reduction in the Kankakee River.		
	Implement 319, MRBI CWI, LARE and other cost-share programs to put nutrient-reducing BMPs in place		Achieve 20-year interim BMP target and load reduction goal: 48% nitrate-nitrogen and 48% total phosphorus reduction in the Kankakee River.		
			Achieve 30-year BMP target and long-term load reduction goal: 71% nitrate-nitrogen and 68% total phosphorus reduction.		

Sediment Goal	Objective	Target Audience	Milestones	Cost (includes BMPs, staff and supplies)	Potential Partners/ Technical Assistance
Short term: Reduce total suspended sediment by 3% the Lower Kankakee River by 2032. Medium term: Reduce total suspended sediment by 3% in the Lower Kankakee River from 2032 to 2042. Long term: Reduce total suspended sediment by 3% in the Lower Kankakee River from 2042 to 2052.	Educate and promote installation of BMPs through field days/workshops	Local producers, CFO/CAFO owner/operators, rural landowners, local government, local developers	Host at least one local event (field day, public meeting, workshop) annually targeting agricultural BMPs and one local event every two years targeting urban or habitat based BMPs.	$5,000 annually	PP=SWCDs, EDCs, CCAs and ag retailers, ICP Partners, TNC, Niches Land Trust, Pheasants Forever, local business owners, KRBC/YRBC, local media (Rensselaer Republican & Newton County Enterprise) and radio TA=ICP Partners, CCAs and ag retailers, SWCDs, County surveyors, soil testing laboratories
	Education through publications/press releases		Develop quarterly (4) print materials publications, press releases, web updates, social media posts or other publications annually.		
	Implement 319, CWI, LARE and other cost-share programs to put erosion-reducing BMPs in place		Implement one tenth of the short-term practices annually from 2022 to 2032, one tenth of medium-term practice annually from 2032 to 2042 and one tenth of long-term practices annually from 2042 to 2052.	$1,285,350 annually (see Table 56 for cost by practice)	
			Achieve 10-year interim BMP target and load reduction goals: 3% reduction		
			Achieve 20-year interim BMP target and load reduction goal: 5% reduction.		
			Achieve 30-year BMP target and long-term load reduction goal: 8% reduction.		

***E. coli* Goal**	**Objective**	**Target Audience**	**Milestones**	**Cost (includes BMPs, staff and supplies)**	**Potential Partners/ Technical Assistance**
Long term: Reduce *E. coli* to meet concentration reductions detailed in the Kankakee-Iroquois River TMDL: 29% reduction in Kankakee River and 78% reduction in Beaver Lake Ditch in Beaver Lake Ditch-Kankakee River, 37% reduction in Brown Levee Ditch-Kankakee River, 38% reduction in Cook Ditch-Hodge Ditch, 79% reduction in Dehaan Ditch, 42% reduction in Hickam Lateral-Wolf Creek and 39% reduction in Lawler Ditch and 44% Reduction in Beaver Lake Ditch in Lawler Ditch-Beaver Lake Ditch subwatersheds.	Educate and promote installation of BMPs through field days/workshops	Local producers, CFO/CAFO owner/operators, rural landowners with septic systems, local government, local community residents and business owners, local realtors	Host at least one local event (field day, public meeting, workshop) annually targeting agricultural BMPs and one local event every two years targeting urban or habitat based BMPs.	$5,000 annually	PP=SWCDs, EDCs, CCAs and ag retailers, Health Departments, local realtors, ICP Partners, TNC, Niches Land Trust, Pheasants Forever, KRBC/YRBC, local media (Rensselaer Republican & Newton County Enterprise) and radio TA=ICP Partners, CCAs and ag retailers, SWCDs, County surveyors, water testing laboratories
	Education through publications/press releases		Develop quarterly (4) print materials publications, press releases, web updates, social media posts or other publications annually.		
	Implement 319, CWI, LARE and other cost-share programs to put *E.coli*-reducing BMPs in place		Implement one tenth of the short-term practices annually from 2022 to 2032, one tenth of medium-term practice annually from 2032 to 2042 and one tenth of long-term practices annually from 2042 to 2052.	$1,285,350 annually (see Table 56 for cost by practice)	
			Achieve 10-year interim BMP target.		
	Educate and promote proper septic maintenance		Achieve 20-year interim BMP target.		
			Achieve 30-year BMP target.		

10.0 FUTURE ACTIVITIES

The next steps for the project include starting implementation of the Lower Kankakee River Watershed Management Plan. The Jasper County SWCD in partnership with the project steering committee and other regional partners will consider options for submitting implementation-focused grant applications for IDEM Section 319 funds, Great Lakes Restoration Initiative Funds, RCPP, DNR LARE, Clean Water Indiana and other funds. If funded, this grant would provide funds for a cost-share program to install BMPs, promotion of the cost-share program, and an education and outreach program. If the grant is awarded, the steering committee will develop a cost-share program that will include steps to meeting the goals and management strategies of this plan. The anticipated cost-share program will use a ranking system to fund applications that will have the most impact in improving water quality. Factors such as location within watershed (priority areas), distance from streams, number of resource concerns addressed, and number of practices planned will be considered as part of the ranking process to further prioritize BMPs. It is anticipated that implementation efforts will target high priority critical areas and focus on the implementation of short-term goals.

10.1 Tracking Effectiveness

Implementation of policies, programs, and practices will improve water quality and watershed conditions within the Lower Kankakee River Watershed, helping reach interim and long-term goals by 2052. For each practice identified, an annual target for the acres or number of each BMP implemented is included in The tracking strategies illustrated in Table 59 will be used to document changes and aid in the plan re-evaluation. Activities to be completed as part of this watershed management plan are identified in the action register in Table 57 identifies the annual target for the number or acres of BMPs to be installed during each implementation phase. Work completed towards each goal/objective documented will include scheduled and completed activities, numbers of individuals attending, or efforts completed toward each objective, and load calculations for each goal, objective, and strategy. Overall, project progress will be tracked by measurable items such as workshops held, BMPs installed, meetings held, number of attendees, etc. Load reductions will be calculated for each BMP installed. These values and associated project details including BMP type, location, dimensions, load reductions, and more will be tracked over time and documented on the Indiana State Department of Agriculture Conservation Tracking sheet. Individual landowner contacts and information will be tracked for both identified and installed BMPs. Volunteer water monitoring results will be documented on the Hoosier Riverwatch website. The Lower Kankakee River Initiative Coordinator/Jasper County SWCD will be responsible for keeping the mentioned records.

Table 58). Measurement of the success of implementation is a necessary part of any watershed project (). Both social indicator and water quality data will be used to measure observable changes following implementation. In order to track the project's progress of reaching goals and improving water quality, information and data will need to be continually collected during implementation.

The tracking strategies illustrated in Table 59 will be used to document changes and aid in the plan re-evaluation. Activities to be completed as part of this watershed management plan are identified in the action register in Table 57 identifies the annual target for the number or acres of BMPs to be installed during each implementation phase. Work completed towards each goal/objective documented will include scheduled and completed activities, numbers of individuals attending, or efforts completed toward each objective, and load calculations for each goal, objective, and strategy. Overall, project progress will be tracked by measurable items such as workshops held, BMPs installed, meetings held, number of attendees, etc. Load reductions will be calculated for each BMP installed. These values and associated project details including BMP type, location, dimensions, load reductions, and more will be tracked over time and documented on the Indiana State Department of Agriculture Conservation Tracking sheet. Individual landowner contacts and information will be tracked for both identified and installed BMPs. Volunteer water monitoring results will be documented on the Hoosier Riverwatch website. The Lower Kankakee River Initiative Coordinator/Jasper County SWCD will be responsible for keeping the mentioned records.

Table 58. Annual targets for short term, medium term, and long-term goals for each best management practice.

Suggested BMPs:	**Short Term (10 year) BMP Targets**	**Medium Term (20 year) BMP Targets**	**Long Term (30 year) BMP Targets**	**Unit**
Conservation Cover (327)	200	200	200	acre
Cover Crop (340)	3,000	3,000	3,000	acre
Drainage Water Management (554)	0	0	0	acre
Fence (382)	500	500	500	feet
Filter Strip (393)	2,000	2,000	2,000	sq feet
Forage and Biomass Planting (512)	70	70	70	acre
Grassed Waterway (412)	4	4	4	acre
Livestock Restriction (Alt Watering System, Access Control)	400	400	400	feet
Nutrient/Pest Management (590)	3,000	3,000	3,000	Acre
Prescribed Grazing (528)	1,000	1,000	1,000	acre
Residue and Tillage Management (329)	3,000	3,000	3,000	acres
Streambank Stabilization	500	500	500	feet
Tree/shrub Establishment (612)	100	100	100	acre
Water and Sediment Control Basin (638)	1	1	1	unit
Windbreak/Shelterbelt Renovation (650)	200	200	200	feet

Table 59. Strategies for and indicators of tracking goals and effectiveness of implementation.

Tracking Strategy	Frequency of Review	Total Estimated Cost (Staff Time Included)	Partners/Technical Assistance
BMP Count	Yearly	$5,000	SWCDs, NRCS, ISDA, MS4
BMP Load Reductions	Yearly	$5,000	SWCDs, NRCS, ISDA, MS4
Attendance at Workshops/Field Days	Yearly	$500/workshop	N/A
Post Workshop Surveys for Effectiveness	Yearly	$250/workshop	SWCD, NRCS, Purdue Extension
Number of Educational Programs/students reached	Yearly	$250/program	N/A
Windshield Surveys	Every 4-5 years	$2,500 annually	SWCDs, Committee, ISDA
Tillage/Cover Crop Transects	Yearly	$20,000 in SWCD and ISDA staff time	SWCDs, NRCS, ISDA Staff
Number of educational publications/press releases	Yearly	$500/release	SWCD
IDEM Fixed Station Monitoring	Monthly on an annual basis	N/A (IDEM provides staff and funding)	IDEM

10.2 Indicators of Success

Water quality, social, and administrative indicators will be used to monitor progress towards successful achievement of the goals for the high and medium priority critical areas. Water quality indicators will include monitoring total phosphorus, nitrate-nitrogen, total suspended solids, and E. coli. Monitoring will occur as part of the Hoosier Riverwatch volunteer program, at a minimum. If local laboratory partners will continue to analyze collected samples as an in-kind service, laboratory data will be utilized as an indicator for each parameter. Additionally, fixed station data collected at the Shelby gaging station will be collected from IDEM and reviewed on the same cycle noted below. Administrative indicators will be listed with each strategy included in the action register.

Reduce Nutrient Loading

Water Quality Indicator: Nitrate-nitrogen and total phosphorus will be measured monthly during the growing season at the sample sites monitored during the current project. After five years of implementation, water quality samples will show a decreasing trend, with more samples annually meeting the target level detailed in Table 21.

Administrative Indicator: The number of BMPs that can reduce nitrate-nitrogen total phosphorus will be tracked annually. The total number of acreage will be compared against annual targets identified in The tracking strategies illustrated in Table 59 will be used to document changes and aid in the plan re-evaluation. Activities to be completed as part of this watershed management plan are identified in the action register in Table 57 identifies the annual target for the number or acres of BMPs to be installed during each implementation phase. Work completed towards each goal/objective documented will include scheduled and completed activities, numbers of individuals attending, or efforts completed toward each objective, and load calculations for each goal, objective, and strategy. Overall, project progress will be tracked by measurable items such as workshops held, BMPs installed, meetings held, number of attendees, etc. Load reductions will be calculated for each BMP installed. These values and associated project details including BMP type, location, dimensions, load reductions, and more will be tracked over time and documented on the Indiana State Department of Agriculture Conservation Tracking sheet. Individual landowner contacts and information will be tracked for both identified and installed BMPs. Volunteer water monitoring results will be documented on the Hoosier Riverwatch website. The Lower Kankakee River Initiative Coordinator/Jasper County SWCD will be responsible for keeping the mentioned records.

- Table 58. Individual load reductions calculated for each BMP will be reviewed to determine if cumulative loading rates for nitrate-nitrogen and phosphorus are sufficient to meet the target reductions.

Reduce Sediment Loading
Water Quality Indicator: Total suspended solids will be measured monthly during the growing season at the sample sites monitored during the current project. After five years of implementation, water quality samples will show a decreasing trend, with more samples annually meeting the target level detailed in Table 21.

- Administrative Indicator: The number of BMPs that can reduce total suspended solids will be tracked annually. The total number or acreage will be compared against annual targets identified in The tracking strategies illustrated in Table 59 will be used to document changes and aid in the plan re-evaluation. Activities to be completed as part of this watershed management plan are identified in the action register in Table 57 identifies the annual target for the number or acres of BMPs to be installed during each implementation phase. Work completed towards each goal/objective documented will include scheduled and completed activities, numbers of individuals attending, or efforts completed toward each objective, and load calculations for each goal, objective, and strategy. Overall, project progress will be tracked by measurable items such as workshops held, BMPs installed, meetings held, number of attendees, etc. Load reductions will be calculated for each BMP installed. These values and associated project details including BMP type, location, dimensions, load reductions, and more will be tracked over time and documented on the Indiana State Department of Agriculture Conservation Tracking sheet. Individual landowner contacts and information will be tracked for both identified and installed BMPs. Volunteer water monitoring results will be documented on the Hoosier Riverwatch website. The Lower Kankakee River Initiative Coordinator/Jasper County SWCD will be responsible for keeping the mentioned records.

- Table 58. Individual load reductions calculated for each BMP will be reviewed to determine if the cumulative loading rate for total suspended solids is sufficient to meet the target reduction.

Reduce *E. coli* Loading

- Water Quality Indicator: *E. coli* will be measured monthly during the growing season at the sample sites monitored during the current project. After five years of implementation, water quality samples will show a decreasing trend, with more samples annually meeting the state standard.
- Administrative Indicator: The number of BMPs that can reduce *E. coli* will be tracked annually. *E. coli* reductions will be calculated using the IDEM *E. coli* load calculator. Individual load reductions calculated for each BMP will be reviewed to determine if the cumulative loading rate for *E. coli* is sufficient to meet the target reduction. The total number or acreage will be compared against annual targets identified in The tracking strategies illustrated in Table 59 will be used to document changes and aid in the plan re-evaluation. Activities to be completed as part of this

watershed management plan are identified in the action register in Table 57 identifies the annual target for the number or acres of BMPs to be installed during each implementation phase. Work completed towards each goal/objective documented will include scheduled and completed activities, numbers of individuals attending, or efforts completed toward each objective, and load calculations for each goal, objective, and strategy. Overall, project progress will be tracked by measurable items such as workshops held, BMPs installed, meetings held, number of attendees, etc. Load reductions will be calculated for each BMP installed. These values and associated project details including BMP type, location, dimensions, load reductions, and more will be tracked over time and documented on the Indiana State Department of Agriculture Conservation Tracking sheet. Individual landowner contacts and information will be tracked for both identified and installed BMPs. Volunteer water monitoring results will be documented on the Hoosier Riverwatch website. The Lower Kankakee River Initiative Coordinator/Jasper County SWCD will be responsible for keeping the mentioned records.

- Table 58.

Increase Public Awareness and Participation

- Administrative Indicator: The number of people who attend education and outreach events will be tracked. The percent of targeted households reached will increase annually.
- Social Indicator: Pre and post surveys of attendees will be conducted at workshops to determine changes in individuals' knowledge of the topic as a result of attending the workshop. It would be expected that 75% of workshop attendees would have a better understanding of the topic after the workshop. Responses will be compared with data collected during this project's social indicator survey.

10.3 Adapting Strategies in the Future

Due to the uncertainty of the watershed management planning, an adaptive management strategy will be implemented to improve the project's success. While much thought and expertise has been put into the planning process, not all scenarios can be foreseen. Oftentimes there are changes such as a shift in community attitude/behavior, changes in resource concerns, development of new information or accomplishing a goal sooner or later than expected. By implementing an adaptive management strategy, the Lower Kankakee River Initiative Steering Committee can adjust the watershed management plan to ensure project success. A four-step adaptive management strategy has been outlined for the Lower Kankakee River Initiative and can be found below.

Step 1: Planning The planning process used to develop Lower Kankakee River WMP follows the IDEM 2009 Watershed Management Checklist. The project coordinator worked in concert with and was guided by the Lower Kankakee River Initiative Steering Committee to develop the WMP using knowledge of the watershed, inputs from stakeholders, new data from water monitoring and windshield surveys, and historical data. This plan includes goals, action register, and schedule outlining how and when to achieve the defined goals.

Step 2: Implementation The action register and schedule will be implemented to achieve the goals of the Lower Kankakee River Watershed Project objectives and goals. Partnering agencies such as NRCS, SWCD, ISDA, and IDEM will carry out the implementation. Implementation will include a cost-share program and education events targeting both for youth and adults. Practices implemented through the cost-share program will follow the NRCS Field Office Technical Guide (FOTG) Practice Standards or other technical standards as detailed in the cost-share program, once developed. The cost-share program will include but will not be limited to practices such as cover crops, watering facilities, fencing, conservation buffers, grassed waterways, and nutrient and pest management plans. Cost-share funding will be implemented in priority areas, addressing high priority areas before the medium priority area. A ranking system will be used to prioritize applications that will have the greatest impact on water quality improvement.

Step 3: Evaluate & Learn Evaluations of indicators identified above and in Table 59 will occur often to check the progress being made toward the project goals. The steering committee will annually review progress and determine if the project is on track to meet interim and project end goals outlined in the Action Register (Table 57) and goals. Factors evaluated will include but will not be limited to numbers of BMPs installed, calculated/estimated load reductions of installed BMPs, number of individuals reach through outreach, evaluation from education and outreach event attendees, etc. The evaluations will be conducted by the Lower Kankakee River Initiative Steering Committee. The group will then provide recommendations that will improve education and outreach event attendance, BMP adoption rates and overall project success. Progress against the watershed management plan will be reviewed no less than every two years (i.e., 2022, 2024, etc.).

Step 4: Alter Strategy The project's implementation and management strategy will be adjusted to improve the project's success. If progress is not made proportionate to the time into the project (i.e., at the end of year 3, approximately 30% (3/10) of 10-year goals should be met), the steering committee will have the opportunity to alter their strategy in order to meet the goals of the project. Adjustments will be based off of recommendations from the Evaluate and Learn step. Once the adjustments are agreed upon by the steering committee, the project will revert back to Implementation (Step 2) to continue with the Adaptive Management strategy (steps 2-4) until all goals have been met or all conservation opportunities have been exhausted.

The Lower Kankakee River Initiative, coordinated by the Jasper County SWCD, are responsible for maintaining records for the project including tracking plan successes and failures and any necessary watershed management plan revisions. The plan will be re-evaluated at the end of Year 5 and every 5 years after that.

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