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UPPER IROQUOIS WATERSHED INITIATIVE
CONNECTING PEOPLE FOR WATERSHED IMPROVEMENT

2013

Upper Iroquois River Watershed Management Plan

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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
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	Waste Water Treatment Plant

0.0 Executive Summary

According to the Upper Iroquois Watershed Initiative (UIWI) 2012 Social Indicators Survey (UIWI-SIS), the top two most important activities in the Iroquois watershed related to local streams are scenic beauty and fishing. The Indiana Department of Natural Resources (IDNR) considers the Iroquois River a navigable waterway and part of the state canoe trail system. Despite these local values and designations, a number of water quality problems are apparent. The water quality problems are directly connected to concerns in the UIWI watershed management plan (UIWI-WMP) which includes flashiness and flooding, loss of fish habitat, excessive sediment, lack of recreation access, elevated E.coli levels, excess nutrients, and impaired biological communities.

The Upper Iroquois Watershed (Jasper, Newton, Benton, White, Pulaski, and Starke Counties) is made up of 438,332 acres; 368,198 acres (84%) of that is agricultural land, with approximately 75% of that land in corn and soybean production. A majority of the rural areas are farmland, which is extensively drained due to the fact that the area was part of the former "Grand Kankakee Marsh," once the second largest wetland in the nation. Developed and forested lands make up 6 % or 53,872 acres of the total watershed area. Land use in the remaining 10% of the watershed is split between pasture, grassland, wetland, and open water. Being largely agricultural, non-point source pollution is a major concern from row crop and animal farmland, including sediment loading, E.coli, and nutrient runoff.

Water quality problems associated with rural areas are very evident by the large number of impaired streams. According to the 303d list, 83% of the first and second order tributaries into the Iroquois River and the Iroquois River itself are listed on the 303d list and many of these streams are in the TMDL classed as 4A and/or 5A. UIWI-WMP efforts calculated from 2010-2012 UIWI water quality testing confirmed these impairments as well, because on average, all sampling sites exceeded water quality targets more than 50% of the time (sampled for orthophosphates, nitrates, turbidity, and E.coli). UIWI-WMP efforts discovered that according to the EPA, this region is in the top 25% of contributors to the zone of hypoxia in the Gulf of Mexico. Also discovered, that Indiana NRCS State Resource Assessment Report from 2011 ranks the Iroquois watershed as the 4th highest in untreated or at risk acres of contributing excess nutrients to surface and groundwater in the state. According to the 2012 UIWI-SIS, the top perceived source of pollution are soil erosion from farm fields and manure from farm animals. The reasons behind these impairments and concerns are complex, interrelated and will take a similar approach to address the problems. The Action Register in the UIWI-WMP outlines such an approach based on some of the possible sources of water quality problems.

According to the 2011 Conservation Tillage Survey for Jasper and Newton Counties (these counties cover a majority of watershed), approximately 9.5% of corn and 48.5% of soybean acres are practicing no-till production. No-till is well documented to have less negative impact on water quality than conventional tillage. This indicates many farmers have yet to implement a conservation tillage system. With current trends in crop prices (more corn after corn) and farms becoming larger, an increase in conventional tilled fields is evident. This means more wind erosion (UIWI-WMP observed that 40% of the acres in the watershed have soils that are of high concern for wind erosion) and water erosion resulting in sediment and nutrient loading. Extensive tile drainage in the critical areas is greater than 46% as identified by the UIWI-WMP. Artificially drainage and sandy soils are vulnerable to leaching (UIWI-WMP calculated 30% of watershed soil acres are high concern for nitrate leaching). Many non-buffered tile risers create a direct conduit for excess nutrients and sediments to travel into streams. Within the last five years, 30,000+ dairy cows have been added to the watershed, with a total of 47 CFOs operating in the watershed. This intensive land use combined with vulnerable soil types could present a significant threat to water quality, if the amount of manure exceeds the available land to spread it on, or if it is mismanaged. This increases the risk of manure spills, such as occurred on Curtis Creek in 2003. Farmland is often left bare during the non-growing season, which increases overland flow and erosion. This leads to excessive run-off and leaching of nutrients, especially where manure has been applied. This runoff and leaching could be significantly addressed by the use of cover crops. Cover crops are not widely adopted. According to the 2013 Conservation Tillage Transect and the 2012 Clean Water Indiana NW Indiana Cover Crop Program. Cover crops would help mitigate the negative impact of wind, water, and nitrate leaching upon water quality associated with farming.

Establishment and protection of wetlands and riparian buffers is lacking. UIWI-WMP efforts calculated the average area of wetlands is less than 1.5% across the watershed and riparian areas is less than 20% across the watershed. This lack of riparian buffers in low lying areas adjacent to streams and directly along streams has allowed sediment, E.coli, and nutrients to move into streams. The UIWI-WMP reveals 48 direct cattle access points exist which have allowed rapid runoff with the water carrying E. coli and increased sedimentation into streams. Also discovered were 48 active erosion sites (separate from livestock sites) which are likely contributing to elevated turbidity levels during storm events. UWI-WMP 2010 and 2013 citizen level habitat and biological evaluations across the watershed show “fair to unhealthy” rankings that are dominated by low diversity macro invertebrates and poor quality fish habitat, which are indicators of poor water quality. In addition, a 14 year on-going study of amphibians by Dr. Brodman from Saint Joseph's College suggests that amphibian numbers and key habitats are in decline in the watershed. Several key areas for restoration have been identified within the Upper Iroquois watershed. A 2003 LARE study of Curtis Creek confirms the UIWI-WMP findings that the biotic Integrity (mIBI) was rated at “moderately impacted to slightly impaired” and the habitat rating (QHEI) was less than optimal for aquatic life. All the above are contributing to the current problems of elevated levels of E.coli, which limits bodily contact for recreational purposes, decreased dissolved oxygen levels, and excess nutrients which have negatively impacted the biological communities and aesthetics of the watershed streams.

Water quality problems associated with urban non-point source pollution are also contributing to the impaired waterways. Rapid unplanned urban development is a concern as growth in the region is twice the rate of the statewide average since the last census. Jasper County is ranked 7th in the state for growth by population. This will lead to more impervious surfaces and sources of non-point pollution. Increasing the use of low impact design could address some of the negative impacts of this rapid growth. The 2003 LARE study of Curtis Creek found water quality samples taken during storm events exceeded state standards for some chemical parameters and E.coli at many of the sample sites, confirmed by UIWI-WMP water quality testing as discussed above. According to the 303d list, of the 208 miles of streams, 72 miles of the 208 miles are E. coli impaired in the project area. The main branch of the Iroquois flows through Rensselaer. Rensselaer has 9 combined sewer overflow (CSO) sites, but is not a MS4 community. A long term control plan (LTCP) does exist to separate the CSO, but lacks adequate funding. According to Tony Carroll, Wastewater Treatment plant foreman, it is not uncommon for a 1/2 inch rain to result in overflow, which adds to the E.coli and nutrient loading on the Iroquois (T.Carroll, pers. comm. June 30th, 2012). Many unsewered communities exist in the watershed, so septic systems that are improperly designed, installed and/or maintained could be allowing untreated or improperly treated effluent to reach streams and groundwater supplies. According to the 2012 UIWI-SIS, 40% of respondents were not willing to service their septic systems. Many of the soil types in the watershed have severe limitations for septic suitability as cited in the UIWI-WMP and the 2003 LARE study of Curtis Creek Watershed. According to Sandra Parks, former Jasper County Health Sanitarian, septic systems have been found to be directly tiled into field drains or discharge directly into streams (S.Parks, pers. comm. July 29, 2009). In addition, numerous abandoned wells have not been properly sealed in the area. This presents a contamination risk to surface water and groundwater supplies, which is a public health risk.

The Upper Iroquois Watershed has significant water quality problems from non-point rural and urban sources. Stakeholders' concerns as identified in the UIWI-WMP are directly connected to these water quality problems and must be addressed to improve water quality. The UIWI-WMP, the Iroquois TMDL and 303d list will serve as a guide as the UIWI-WMP is implemented. High E.coli counts, excess nutrients, and excessive sediment loading must be addressed if water quality is to be improved. Farmers, homeowners, land owners, county and town leaders, and developer involvement in implementing BMPs and educational outreach will be critical to improving overall water quality. In general, a lack of knowledge and information and actual use of BMPs to address the water quality issues exists and needs to be addressed to ensure an ecological and economically healthy watershed for today and generations to come.

1.0 WATERSHED COMMUNITY INITIATIVE

In early 2000, Jasper County local leaders and stakeholders expressed protecting water quality as important during the updating and formation of local ordinances and county wide planning initiatives. A sub-committee was formed to address this specific issue. A lot of good dialogue occurred, but no direct action occurred. However, key outcomes of the sub-committee were the acknowledgement that little data and awareness of local water quality existed, and that to protect water quality planning should occur at the water shed level. A watershed is the land area that drains to a common point, such as a location on a river. All of the water that falls on a watershed will move across the landscape collecting in low spots and drainage ways until it moves into the water body of choice. All activities that take place in a watershed can impact the water quality of the river that drains it. What we do on the land, such as constructing new buildings, fertilizing lawns, or growing crops, affects the water and the ecosystem that lives in it. A healthy watershed is vital for a healthy river, and a healthy river can enhance the community and help maintain a healthy local economy. Watershed planning is especially important in that it will help communities and individuals determine how best to preserve water functions, prevent water quality impairment, and produce long-term economic, environmental, and social health.

The Upper Iroquois Watershed Initiative project is located in Northwestern Indiana. The entire watershed crosses two states, but this plan focuses on the Indiana side of the Iroquois watershed. The project area is five watersheds that drain 651 square miles and covers mostly Jasper, Newton, and small portions of Pulaski, White, and Benton Counties in Indiana. It forms the majority of the headwaters for the Iroquois River.

Figure 1 Iroquois Watershed Overview

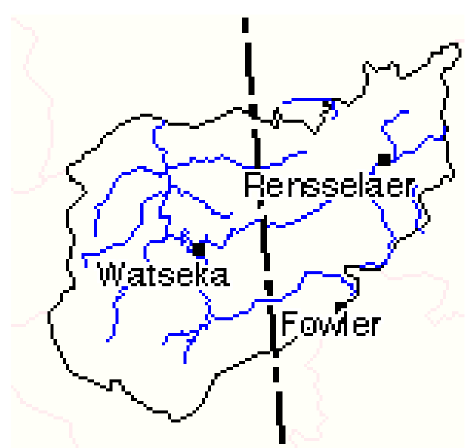
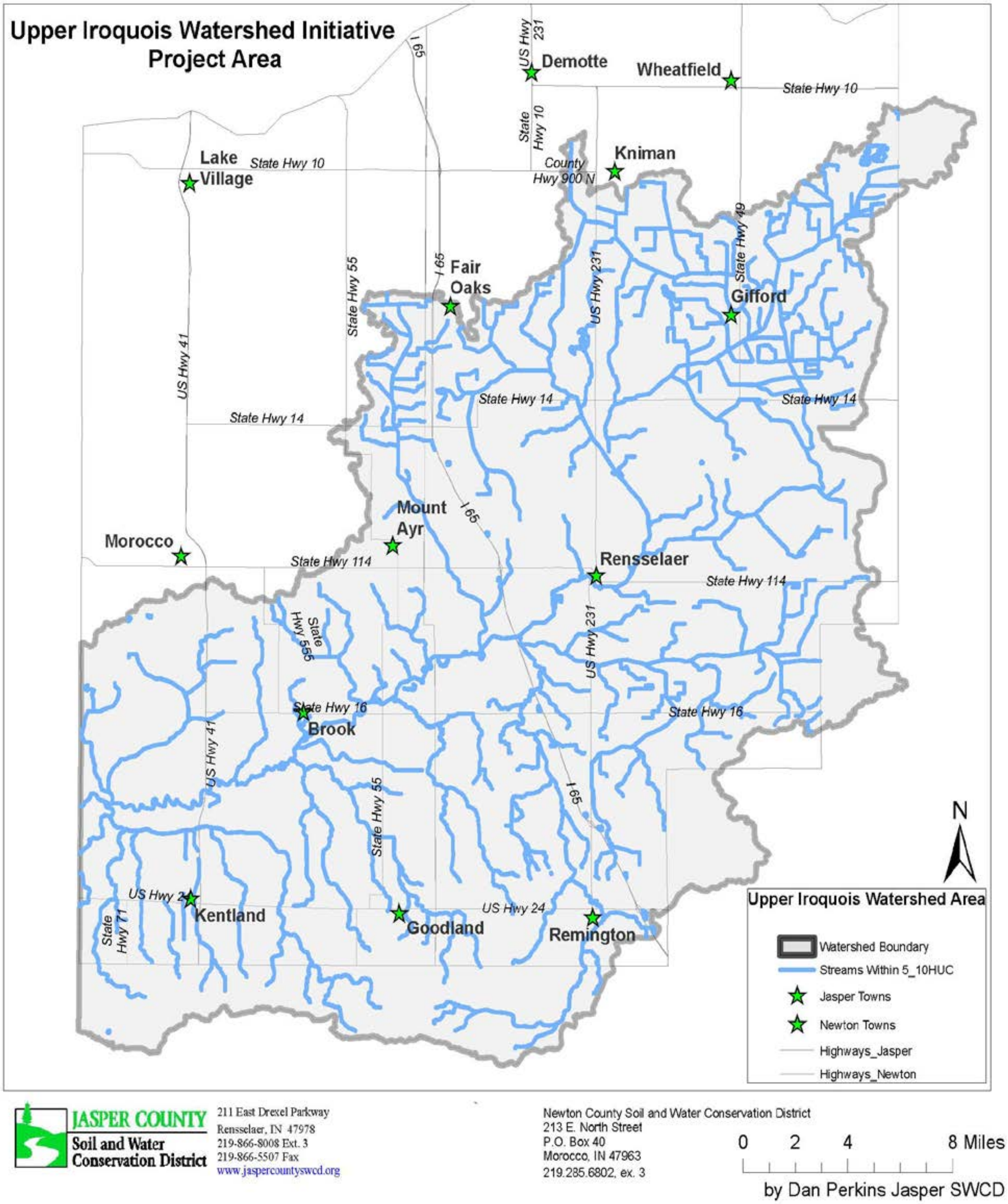


Figure 2 Zoomed In Iroquois Watershed

Figure 3 Upper Iroquois Watershed Area.



1.1 Project History

After the initial 2000 meetings raised the issue of water quality, the Jasper County Soil and Water Conservation District (JCSWCD) board initiated the hiring of a watershed specialist, in 2008 to carry out the goals and mission of the JSWCD and to protect and improve local water quality via watershed planning. Upon hiring the watershed specialist a Section 319 Non-point Source Program grant application was submitted to the Indiana Department of Environmental Management (IDEM) watershed planning section. The grant's purpose was four-fold:

1. Locate the major contributing non-point pollution for bacteria, nutrients, and sediment loading.
2. Characterize each sub-watershed's water quality and where future water quality improvement efforts should be placed.
3. Educate to encourage implementation of best management practices (BMP), focus education efforts by area of need, and promote conservation practices.
4. Facilitate partnerships and educational efforts among all strategic partners to develop and implement the watershed plan.

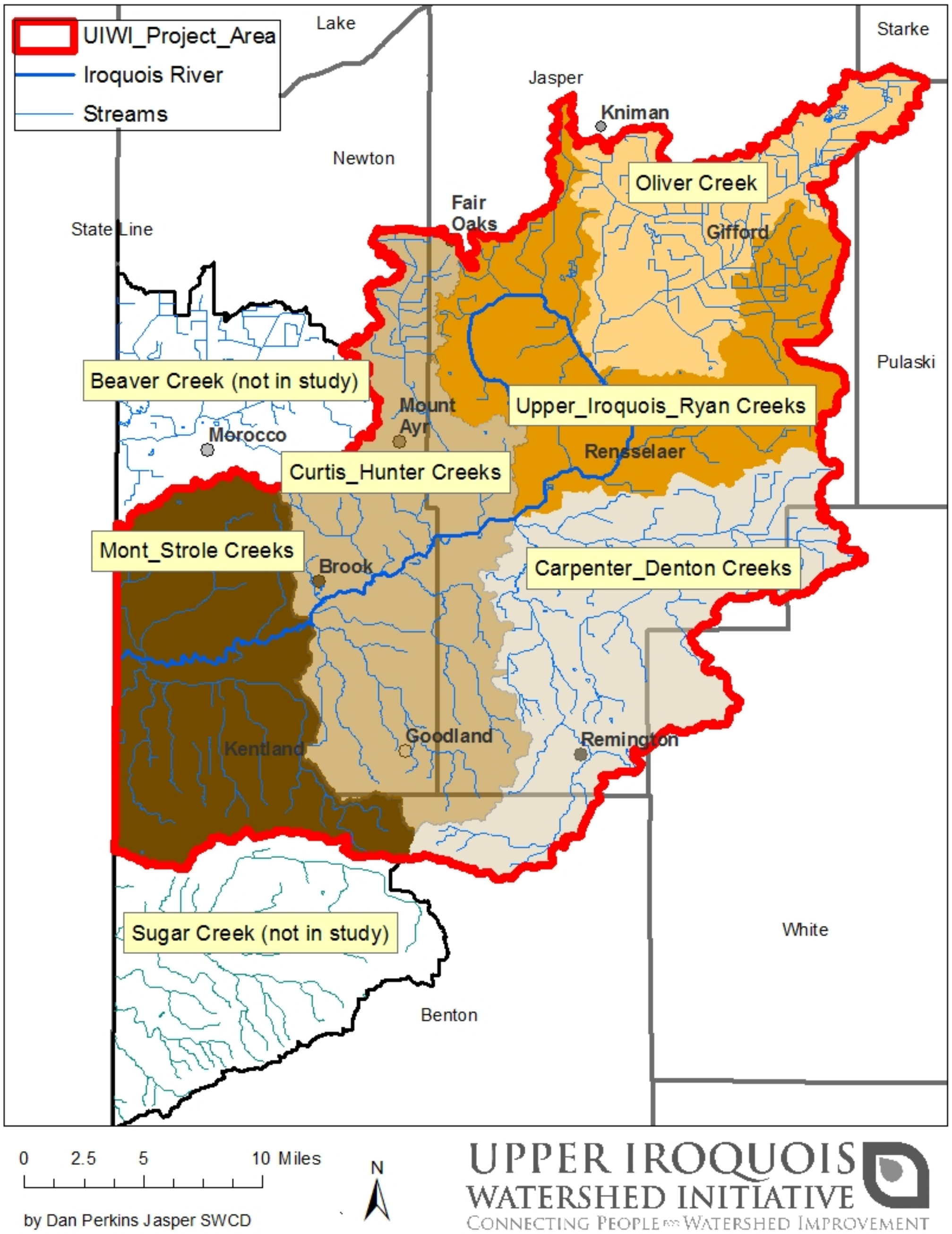
Concurrent with grant submission, identification of watershed partners occurred. Significant amounts of outreach occurred to generate support of the grant and watershed planning process. This occurred via newspaper articles, radio interviews, and 2 public meetings to garner stakeholder involvement. Much of this outreach resulted in partners signing on to the grant and also became part of the project steering committee and work groups. The grant application was approved in fall of 2010.

The following sections detail the committee and work groups created as part of this project, the work these committees completed, and the outcomes developed by the committees and work group. Additionally, input from watershed stakeholders and the mechanisms in which this input was generated are also included in the following sections. All of these efforts were guided by the following mission and vision developed by public participants and committee members:

Vision: Ensure an ecological and economically healthy Iroquois River watershed for today and generations to come.

Mission: Connecting people for watershed improvement by developing a watershed plan which prioritize areas of concern and then implement the plan for ongoing water quality improvements.

Figure 4 Five HUC 10 Sub watersheds



Two HUC 10 sub watershed “Beaver Creek” and “Sugar Creek” located North and South of Mont-Strole Creeks were excluded due to draining into the Iroquois River on the Illinois side and the need to plan on a smaller scale to make the project more manageable and feasible.

1.2 Steering Committee

The Upper Iroquois River Watershed Initiative is a group of citizens and organizations who cooperated to develop a watershed management plan (WMP) that will build capacity to accomplish the goal of improving water quality across the watershed.

The steering committee was formed by both the Jasper and Newton SWCD's board members submitting names of local decision makers who would be important to have on a steering committee and drawing from existing partnerships. Individuals 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 initial grant application. Each steering committee member was then asked to chair a specific work group to address the concerns listed in Table 6 Complete list of Stakeholder Concerns. Work group members were recruited by steering committee members, Jasper and Newton SWCD boards and through public outreach efforts in the watershed. This is a list of founding members, some of which have changed as is the nature of this type of multi-year planning effort.

Table 1 Steering Committee Members and their Affiliation

Last	First	Affiliation
Davisson	Mark	Citizen
Kosanovich	Larry	Local Business
Babcock	Mike	Remington Parks
Kaper	Bob	Kaper's Building Supply
Korniak	Kent	Con Agra, Farmer
Laird	Kyler	Farmer
Veld	Kyle	Newberry Farms
Zimmer	Lana	Jasper SWCD
Collins	Russ	Newton Commissioner
Holderly	Larry	Newton County Engineer
Johnson	Brian	Newton SWCD/Farmer
Knochel	Chris	Newton County Surveyor
Nyberg	Gus	NICHES Land Trust
Smith	Randy	Newton Farmer
Eilers	Steve	Newton Farmer

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. This group met in the spring of 2011 to identify sites where water was to be monitored for the next several years. Once sample collection began, this group met on a roughly quarterly basis to review current and historic data, identify water quality targets, complete data analysis, and begin prioritization of concern areas. Table 2 identifies the water quality work group members and their affiliation.

Table 2 Water Quality Work Group

Last	First	Organization
Davisson	Mark	Citizen
Nyberg	Gus	NICHES Land Trust
Osterholz	Larry	Soil Scientist
Veld	Kyle	Newberry Farms
Harmon	Scott	Earthwise, Inc.

1.2.2 Education and Outreach Work Group

The Education and Outreach work group developed the education programs. This group determined the education priorities and goals, and developed and identified educational materials, such as the logo, brochures, newsletters, and the website, as well as target programs to achieve the goals. Additionally, they determined opportunities to provide this message, identified individuals to carry the message, and completed educational program development and staffing. Table 3 identifies the education and outreach committee members and their affiliation.

Table 3 Education and Outreach

Last	First	Organization
Zimmer	Lana	Jasper SWCD
Morgan	Rose	Newton County SWCD
Wilson	Jody	Jasper SWCD Staff
Osterholz	Larry	Soil Scientist
Seger	Jordan	ISDA Resource Specialist
Wolf	Sarah	ISDA Resource Specialist

1.2.3 Outdoor Recreation Work Group

The Outdoor Recreation work group works to address the concern of lack of recreation access and opportunities in the watershed. They exist to raise awareness about the Iroquois river and create a plan of increasing access to the river. Table 4 identifies the outdoor recreation work group members and their affiliation.

Table 4 Outdoor Recreation Work Group

Last	First	Organization
Laird	Kyler	Farmer
Eilers	Steve	Farmer
Kaper	Bob	Kaper's Building Supply
Urbano	Vince	Jasper Surveyor
Porch	Bob	Wildlife Biologist DNR
Kingman	Connie	Park Board
Bailey	Josh	Friends of the Iroquois

1.2.4 Agriculture Work Group

The Agriculture work group works on two levels: the first completing the watershed inventory for their respective area and the second identifying specific best management practices (BMPs) and implementation areas for the implementation phase of the project. Table 5 identifies the agriculture work group members and their affiliation.

Table 5 Agricultural Work Group

Last	First	Organization
Strole	Larry	Newton SWCD
Laird	Kyler	Jasper Farmer
Korniak	Kent	Con Agra, Farmer
Eilers	Steve	Newton Farm
Bussmon	Lyle	Fair Oaks Dairy
Johnson	Brian	Newton SWCD/Farmer
Veld	Kyle	Newberry Dairy

1.3 Stakeholder Concerns List

Stakeholder concerns were initially gathered during the first stakeholder and steering committee meeting held January 21, 2011. There were 24 people in attendance and each person was asked to place a tack 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 flip chart. Each person was then given three sticky notes to vote for their highest priority.

Every steering committee meeting and work group meeting since then has been a public meeting and we always ask for new concerns to be listed, see Table 6 Complete list of Stakeholder Concerns. These meetings, along with newspaper articles and personal conversations have been the secondary mechanism for stakeholder concerns to be recorded. Concerns were grouped and summarized by the steering committee into problem statements in Table 7 Problems List based on Concerns.

Table 6 Complete List of Stakeholder Concerns

Concerns	
dead trees-log jams	link to Rensselaer trail system
lack of recreation opportunities on river	lack of organizations working together
flashiness of river	sediment loading
excessive nutrients	high e.coli levels
excessive sediments	how do we fix the problems?
access to river	flooding
lack of bike/walk routes	flashiness of river
Kentland lack of walk/bike path	lack of healthy fish habitat
Lack of drainage	Altering natural hydrology
farming right along waterways	stream bank erosion
is the water safe to touch	beaver dams slowing water
Can we eat the fish?	livestock in creeks
lack of riparian corridor	CSO's
dirty/fertilizer filled water	Failing and not maintained septic systems
lack of ag land using BMPs	urban run-off
loss of native fish and mussels	over channelization and ditch cleaning
no trail system	lack of public knowledge about WQ
poor fishing	bare ground on ag ground over winter
lack of crop residue	tile drainage bypassing filter strips

Table 7 Problems List based on Concerns

Concerns	Problem
Flashiness and flooding of the Iroquois	The Iroquois River has undesirable high and low levels and flows of water that threaten our towns, agricultural land, and health of the river.
dead treeslLog jams	
Beaver dams slowing water	
Too much sediment	
Altering of natural hydrology/over ditching	
Lack of drainage in areas	
Tile drainage negatively impacts water quality and water flow	
lack of healthy fish habitat	The desirable native fish populations in the Iroquois River and surrounding waterways are suspected to be in decline.
Farming right along streams/ lack of riparian corridor	
Loss of native fish/mussel populations	
Channelization/Ditch cleaning that results in loss of fish habitat = altered hydrology	
Fish are unhealthy to eat because of contamination	
Excessive sediments in water	Area streams within the watershed are very cloudy and turbid.
Agriculture BMPs should be utilized more	
Locals unaware of Ag and Urban BMP options	
Too many locations where cattle have direct access to watershed streams	
Too much Fertilizer entering the water	
Lack of crop residue on fields	
Surface and soil erosion contributes to scouring and sloughing of stream banks	
Access to river limited	Widespread recreational use is prevented.
Lack of recreational opportunities on river	
Lack of bike/walk routes or trail system	
Kentland/Rensselaer lack of walking/bike paths	
High E.coli levels within watershed streams	
Public lacks knowledge about the river and its tributaries' water quality	
Perceived poor fishing	
dirty/fertilizer filled water	The Iroquois River and its tributaries are listed on IDEM's 303(d) list for "excessive nutrients, e.coli, and IBC."
Septic systems not efficient enough and/or not properly maintained	
Excessive nutrients in water	
Urban run-off	
Surface and soil erosion contributes to scouring and sluffing of stream banks	
CSO's	
Agriculture BMPs should be utilized more	
Tile drainage bypassing filter strips	
Lack of ag land using BMPs	
Nothing actively growing during non cash crop season to prevent nutrient loss	

1.3.1 Preliminary Problem Statements

The steering committee and work groups then took the concerns and problems list and developed problem statements to bridge the gap from obtaining information to setting concrete goals. These statements helped to clarify our thinking and move forward in the planning process. These will continue to be updated and be used as a guide for the final goals and action plan.

> **Problem Statement 1:** *The Iroquois River has undesirable high and low levels (flashiness) and flows of water that could negatively impact our towns, agricultural land, water quality, and fish habitat; we think this is because of channelization, sedimentation and increased water inputs (tile outlets, impervious surfaces, loss of upstream water holding capacity), resulting in increased velocity of in-stream water.*

What we want: Ensure flow of water is not hindered via log jams and cleaning areas where needed, while at the same time slowing water down in upper headwater areas to even out the high and low flows (Dunne and Leopold 1978). Explore and identify sites for 2-stage ditches and wetland creation (slow release of water). Reduce stream bank erosion. Increase capacity, decrease velocity, expand existing wetland areas and/or create new wetland areas in old oxbows and low lying areas, raise public awareness, and create and promote honest and open discussion between various points of view.

What information is missing: Public awareness; studies on hydrology; flow rates data and levels, and information on river bank status; identify sites for two stage ditch projects in upper headwaters; model results for “x” feet of 2-stage ditches to offset/reduce “x” amount of flash flooding downstream; information on how to prevent log jams, but still protect fish and wildlife habitat along streams is needed. Additional sites for wetland creation that will hold water during storm events are needed. Any information on other BMP’s is needed.

> **Problem Statement 2:** *The desirable native fish populations in the Iroquois River and surrounding waterways are suspected to be in decline; we think it’s because of poor water quality and lack of good breeding habitat.*

What we want: Appropriate and healthy populations of native species, protection of existing fish habitat and known fishing spots and creation of more favorable fish habitat, which will result in improvement of water quality. Open sealed backwaters and bayous, increase forested riparian buffer zones, establish water quality data baseline.

What information is missing? What activities impact fish habitat and how so (ditch cleaning, discharge pipes, etc.); what types of fish should we see; level of water quality good enough, what indicators do we use? Are there other reasons for decline, other BMPs to encourage habitat? What county and town policies/ ordinances exist that protect habitat? Is there a review of fish population survey data?

Problem Statement 3: Soil erosion (both water and wind) are contributing to the scouring and sloughing of stream banks which *appear to be negatively impacting water quality and reducing water capacities. We think preventing sediment from reaching the water and reducing stream flashiness may help.*

What we want: We want to see our toes when standing in the water! To do this we must prevent soil from reaching river via encouraging conservation tillage practices, installation of waterways, cover cropping, preserving riparian areas and encouraging other BMPs.
What information is missing: Where is soil coming from: in-stream, from fields, during high rain events? Would 100% no till and cover crops solve the problem? Joint maintenance fund – Jasper/Newton. What is a realistic goal for reducing sediment? What level of sediments in the water is acceptable for wildlife, fish, and mussels? Will slowing the water down help?

Problem Statement 4: *Recreational use of the whole Iroquois River watershed is desirable; however lack of awareness, log jams, poor water quality, perceived poor fishing and eating quality, and lack of public access points prevent widespread recreational use.*

What we want: Increase variety of uses of river. Increase number and better access points, clear log jams, verification of safety of eating fish, create map of access points, area map, report of water quality, increase public use.
What information is missing: Map of current and potential access points, water levels, log jam removal, water quality reports, and land use maps. How to increase late summer flow? List of game species and index of abundance.

Problem Statement 5: *The Iroquois river and its tributaries are listed on the 303(d) list for "excessive nutrients", which negatively impact aquatic wildlife and potentially can impact groundwater drinking supplies. We think failing septic systems, manure mismanagement, field soil erosion, nitrogen loss out of tile drains and lawn fertilizer, bare ground during the winter, stream access by livestock, lack of conservation tillage, and geological based hotspots may be significant sources of nutrients.*

What we want: Waterways delisted from 303(d) list, reduce nutrients reaching waterways, more acres in conservation tillage, use of cover crops, funding sources, filter strips, septic management issues.
What information is missing: What are current nitrate and phosphorus levels in surface waters and groundwater? What is normal background? Trends over time, highs and lows, what can and is being done to reduce nitrogen/phosphorus losses? Are there hotspots? What are the locations of septic's? What are the conservation tillage numbers, cover crop acres? Locate septic systems without leach fields (tied directly to tile drains. Public awareness.

> **<u>Problem Statement 6:</u>** *Elevated levels of E.coli in the waterways may make it unsafe to swim, fish, recreate, and impact other downstream uses. We know failing septics, combined sewer overflows, and other possible sources such as stream access by livestock, pet wastes, wildlife, and improper manure management may be key sources.*

<u>What we want:</u> Reduce E.coli levels. Establish facts about septic systems and livestock access points, funding options to address septics, trends, policy changes to promote improved systems, cluster development for new subdivisions, reduce over- application of manure.

<u>What information is missing:</u> Public awareness about sources of E.coli, impact to environment, recent data, strains and species links, prioritize areas, location stream reaches that are impaired, number of failing septics and “no-fail connections”, where are they and why failing, cattle having unlimited stream access ,existing BMP’s.

1.4 Social Indicators Survey

The purpose of the social indicator survey was to identify the concerns citizens have regarding water quality in the Upper Iroquois Watershed. The steering committee identified two critical sub watershed areas (Figure 87 Top Two Contributing HUC 10 Subwatersheds) that received the survey. The choosing of these two watersheds was based on 2008 and 2010 303(d) waterway impairment listings along with preliminary desktop and windshield survey information. The results of the survey will serve to guide education efforts and verify and add to the current concerns list and problem statements. Relevant survey results are summarized by problem statement in Table 8 Social Indicator Results by Problem Statement.

Conducted in January and February of 2012, the target audience was divided into two groups. Landowners owning more than 2 acres were given a survey focused on agricultural practices and landowners owning less than 2 acres were given a survey focused on urban management practices, see Appendix 1 and 2 for surveys. A randomized mailing list was created, with each landowner being identifiable only by a response code in order to insure confidentiality. A total of 5,322 landowners from the Carpenter Creek and Curtis Creek watersheds were used to make up our total target audience, with 3,817 residents equaling urban and 1,505 residents equaling our Ag audience. Based off of these numbers a total of 349 urban respondents and 306 Ag respondents were needed to be statistically representative.

All of the information gathered from this social survey will help direct future planning towards education and outreach strategies. The interpretation of the survey results will enable us to:

- Use our analysis to refine our target audiences, finalize the management practices to promote, and develop social outcomes.
- Develop outreach and implementation strategies based on our environmental goals and social outcomes.
- Find out how much is already known about the practices, as well as identify the characteristics that will both facilitate or hinder practice adoption.

1.4.1 Agricultural Survey Summary Results

- 57.7% are Willing to Change Management Practices to Improve Water Quality
- Most Important Activities: Scenic Beauty, 40.3%, and Fish Habitat/eating locally caught fish, 18.9%
- Top Perceived Water Impairments: Trash or Debris and Sedimentation
- Top Perceived Sources of Pollution: Soil Erosion from Farm Fields and Manure from Farm Animals
- Lack of Information: 38.6% Don’t Know if Combined Sewer Overflow is an issue, 34.8% Don’t Know if Channelization is an issue, 35.9% Don’t know about Improper disposal of used motor oil/and or antifreeze
- Top Constraint to Regular Septic System Servicing, Cover Crops and Riparian Fencing: Cost

- 78.6% of respondents have a septic system. 27% of them were installed in the 2000's and 11% were installed in the 1950's
- Septic System Servicing: 52.4% Already or Willing to adopt, 28.6% May be Willing
- Cover Crops: 44% Already or Willing to adopt, 31.5% May be willing
- Riparian Fencing: 50.6% Not Willing to adopt, 26.1% Already or Willing to adopt
- Conservation Tillage: 58% Already or Willing to adopt, 23.8% Not Willing to adopt
- Top two forms of information used: Newsletters/brochures/fact sheets 57.5%, Conversations with others 49.4%
- 67.2% regularly read the local newspaper

1.4.2 Urban Survey Summary Results

- 50.2% are Willing to Change Lawn and Yard Practices to Improve Water Quality
- Most Important Activities: Scenic Beauty, 41%, and Fish Habitat, 17.6%
- Top Perceived Water Impairments: Sedimentation and Pesticides
- Top perceived Sources of Pollution: Littering/Illegal Dumping of Trash and Soil Erosion from Farm Fields
- Lack of Information: 49.6% Don't Know if Channelization is an issue, 46.9% Don't Know about Dredging of streams
- Top Constraint to Porous Pavement, Regular Septic System Servicing, and Roof Run-off Management: Cost
- Top Constraint to Grass Clipping Management: Time required
- Septic System Servicing: 37.1% Already or Willing to adopt, 40.7% Not willing to adopt
- Grass Clipping Management: 71.9% Already or Willing to adopt
- Porous Pavement: 45.7% May be willing, 28.1% Already or Willing to adopt
- Roof Run-off Management: 41.1% May be willing, 36.4% Already or Willing to adopt
- Top two forms of information used: Newsletter/brochures/factsheets 48.6%, Conversations with others 35.8%

The majority of respondents are elderly men.

- Ag Survey: Mean Age of Respondents: 61 Max Age of Respondents: 97
  Male: 75.9% Female: 24.1%
- Urban Survey: Mean Age of Respondents: 59
- Max Age of Respondents: 92 Male: 61.7% Female: 38.3%
- 7.6% of Jasper County Residents are 45-49 years old, only 5.8% between 60-64 years old (2010 US Census)
- 8.3% of Newton County Residents are 45-49 years old, only 6.0% between 60-64 (2010 US Census)

Figure 5 Social Indicators Survey Area

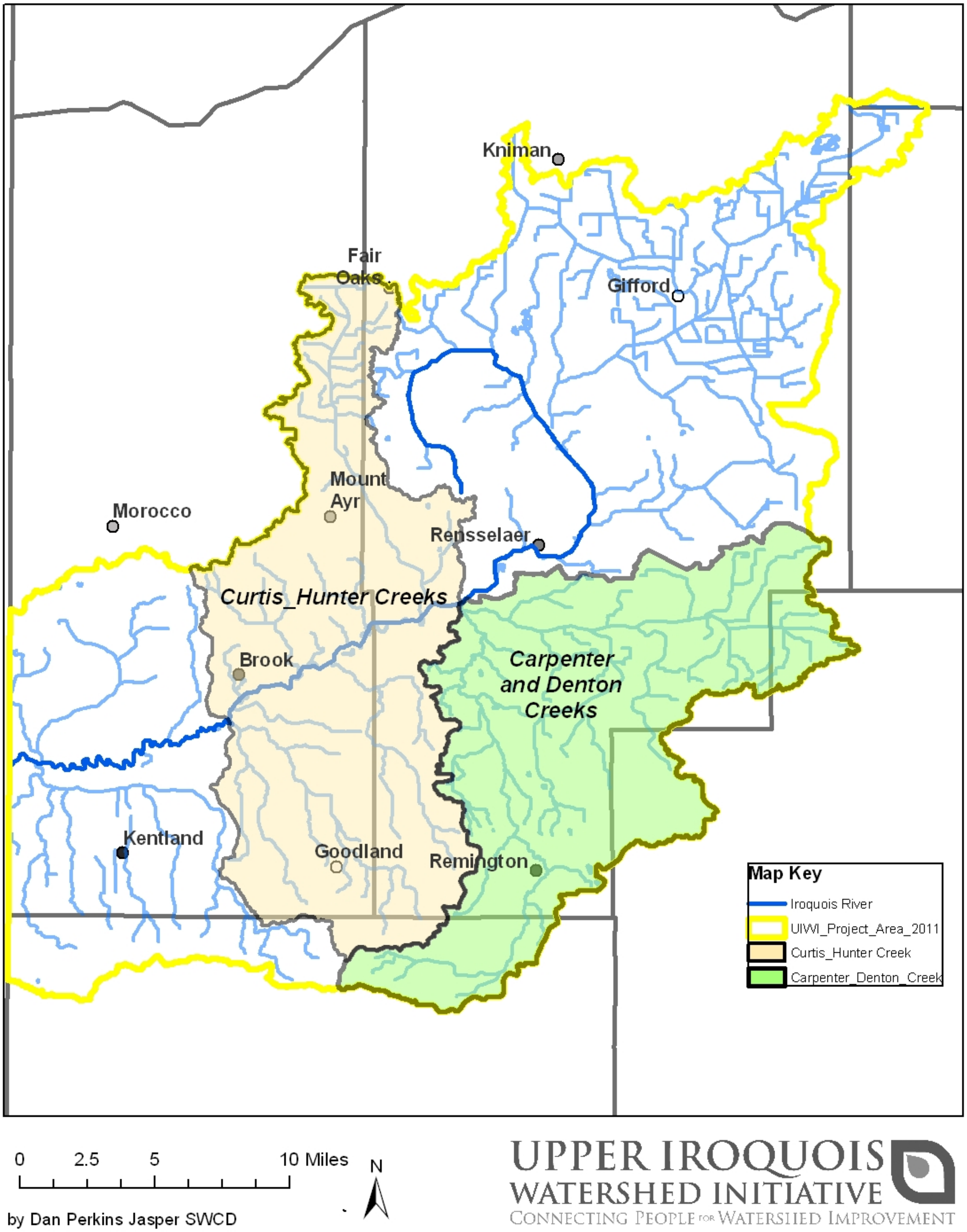


Table 8 Social Indicator Results by Problem Statement

Social Indicators Survey Summary by Problem Statement

Problem	Survey	Results
The Iroquois River has undesirable high and low levels and flows of water that threaten our towns, agricultural land, and health of the river.	Ag	34.8% Don't Know if Channelization is an issue
	Ag	Top Constraint to Cover Crops and Riparian Fencing =Cost
	Ag	Cover Crops: 44% Already or Willing to adopt, 31.5% May be willing
	Urb	Top perceived Sources of Pollution: Littering/Illegal Dumping of Trash and Soil Erosion from Farm Fields
	Urb	Lack of Information: 49.6% Don't Know if Channelization is an issue, 46.9% Don't Know about Dredging of streams
The desirable native fish populations in the Iroquois River and surrounding waterways are suspected to be in decline.	Ag	Scenic Beauty, 40.3%, and Fish Habitat/eating locally caught fish, 18.9%
	Ag	Top Constraint to Cover Crops and Riparian Fencing =Cost
	Urb	50.2% are Willing to Change Lawn and Yard Practices to Improve Water Quality
	Urb	Most Important Activities: Scenic Beauty, 41%, and Fish Habitat, 17.6%
	Urb	Top perceived Sources of Pollution: Littering/Illegal Dumping of Trash and Soil Erosion from Farm Fields
	Urb	Lack of Information: 49.6% Don't Know if Channelization is an issue, 46.9% Don't Know about Dredging of streams
Area streams within the watershed are very cloudy and turbid.	Ag	Top Constraint to Cover Crops and Riparian Fencing =Cost
	Ag	Cover Crops: 44% Already or Willing to adopt, 31.5% May be willing
	Ag	Riparian Fencing: 50.6% Not Willing to adopt, 26.1% Already or Willing to adopt
	Ag	Conservation Tillage: 58% Already or Willing to adopt, 23.8% Not Willing to adopt
	Urb	50.2% are Willing to Change Lawn and Yard Practices to Improve Water Quality
	Urb	Top Perceived Water Impairments: Sedimentation and Pesticides
	Urb	Top perceived Sources of Pollution: Littering/Illegal Dumping of Trash and Soil Erosion from Farm Fields
	Urb	Lack of Information: 49.6% Don't Know if Channelization is an issue, 46.9% Don't Know about Dredging of streams
Widespread recreational use is prevented.	Ag	Scenic Beauty, 40.3%, and Fish Habitat/eating locally caught fish, 18.9%
	Ag	Top Constraint to Regular Septic System Servicing= cost
	Ag	Top Constraint to Cover Crops and Riparian Fencing =Cost
	Urb	50.2% are Willing to Change Lawn and Yard Practices to Improve Water Quality
	Urb	Most Important Activities: Scenic Beauty, 41%, and Fish Habitat, 17.6%
	Urb	Top perceived Sources of Pollution: Littering/Illegal Dumping of Trash and Soil Erosion from Farm Fields

Social Indicators Survey Summary by Problem Statement

Problem	Survey	Results
The Iroquois River and its tributaries are listed on IDEM's 303(d) list for "excessive nutrients, e.coli, and IBI."	Ag	57.7% are Willing to Change Management Practices to Improve Water Quality
	Ag	Top Perceived Water Impairments: Trash or Debris and Sedimentation
	Ag	Top Perceived Sources of Pollution: Soil Erosion from Farm Fields and Manure from Farm Animals
	Ag	38.6% Don't Know if Combined Sewer Overflow is an issue
	Ag	35.9% Don't know about Improper disposal of used motor oil/and or antifreeze
	Ag	Top Constraint to Regular Septic System Servicing= cost
	Urb	Top Constraint to Cover Crops and Riparian Fencing =Cost
	Urb	Cover Crops: 44% Already or Willing to adopt, 31.5% May be willing
	Urb	Riparian Fencing: 50.6% Not Willing to adopt, 26.1% Already or Willing to adopt
	Urb	Conservation Tillage: 58% Already or Willing to adopt, 23.8% Not Willing to adopt
	Urb	50.2% are Willing to Change Lawn and Yard Practices to Improve Water Quality
	Urb	Top Perceived Water Impairments: Sedimentation and Pesticides
	Urb	Top perceived Sources of Pollution: Littering/Illegal Dumping of Trash and Soil Erosion from Farm Fields
General Notes of Importance		
Ag	• Top two forms of information used: Newsletters/brochures/factsheets 57.5%, Conversations with others 49.4% • 67.2% regularly read the local newspaper	
Urban	Top two forms of information used: Newsletter/brochures/factsheets 48.6%, Conversations with others 35.8%	

Ag BMP Willingess to Adopt

- Top Constraint to Regular Septic System Servicing, Cover Crops and Riparian Fencing: Cost
- Cover Crops: 44% Already or Willing to adopt, 31.5% May be willing
- Riparian Fencing: 50.6% Not Willing to adopt, 26.1% Already or Willing to adopt
  Conservation Tillage: 58% Already or Willing to adopt, 23.8% Not Willing to adopt

Urban BMP Willingess to Adopt

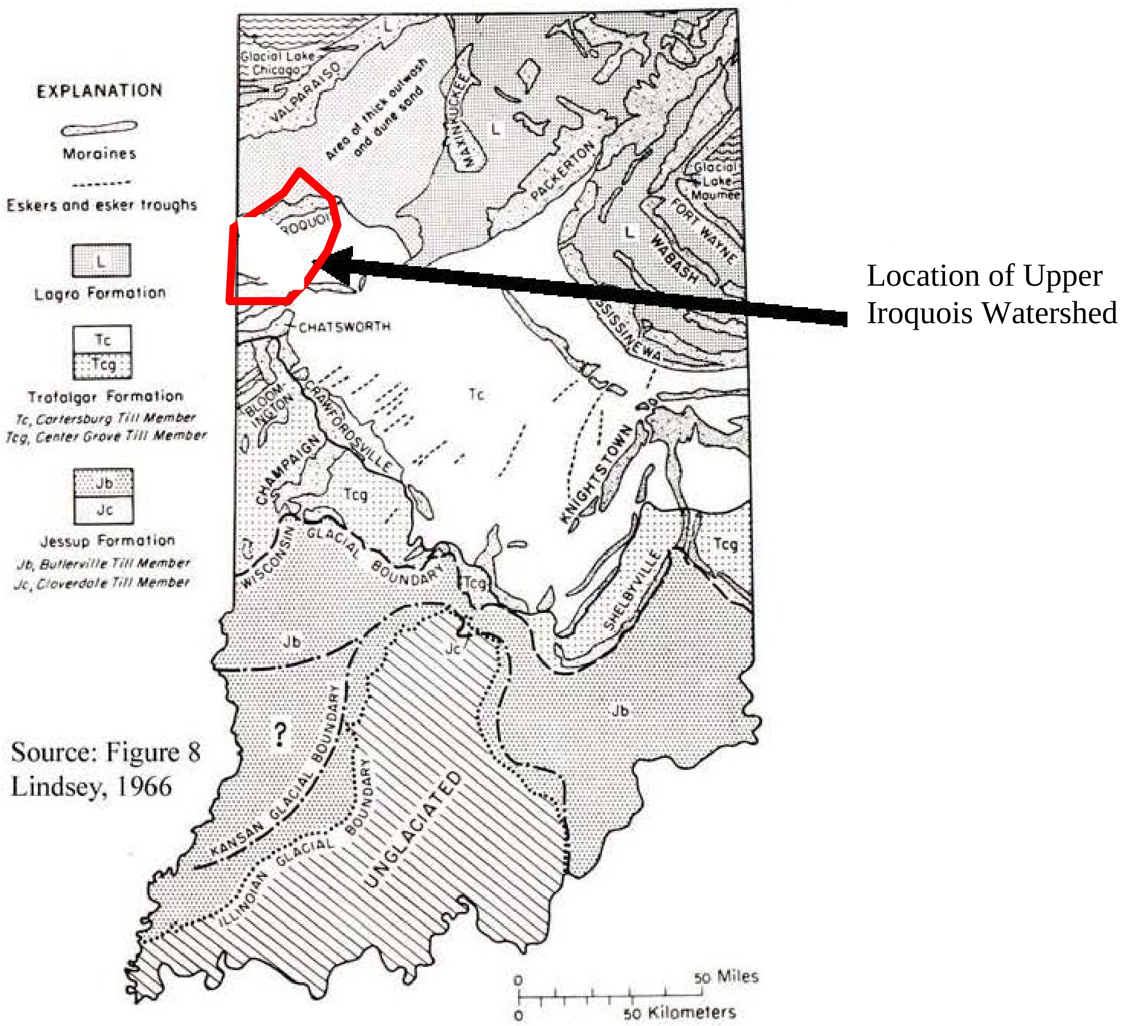
- Top Constraint to Porous Pavement, Regular Septic System Servicing, and Roof Runoff Management: Cost
- Top Constraint to Grass Clipping Management: Time required
- Septic System Servicing: 37.1% Already or Willing to adopt, 40.7% Not willing to adopt
- Grass Clipping Management: 71.9% Already or Willing to adopt
- Porous Pavement: 45.7% May be willing, 28.1% Already or Willing to adopt
- Roof Runoff Management: 41.1% May be willing, 36.4% Already or Willing to adopt

2.0 WATERSHED INVENTORY I

2.1Geology/Topography

The Wisconsinan Age is the most recent glacial period to impact this area. The first two retreats of the Lake Michigan and Lake Erie Lobes of the Wisconsinan Age glaciers deposited the Iroquois, Shelbyville and Crawfordsville/Chatsworth Moraines and established the current topography of the watershed about 20,000 years ago. A glaciated plain was created where a variety of unconsolidated deposits are present including dune sand in the northern part of the watershed, lacustrine sediments, outwash plain sediments (sand and gravel) in the central area, and till in the southern portion (Homoya, 1985).

Figure 6 Moraine Deposits in Northern Indiana from Wisconsin Glacial Period.



(Lindsey, 1996)

The Iroquois River basin lies within the Interior Plains, in the Eastern Lake section of the Central Lowland province. The Iroquois lacustrine plain is oriented in a northeast – southwest direction (Schneider, 1966). The topography is generally undulating to nearly level, but there are narrow steep slopes adjacent to the Iroquois River and its small tributary streams and occasional low sand ridges that rise a few feet above the general ground level. Bedrock is at or near the surface in many areas on this plain. Of note, is a 1-2 mile stretch of the Iroquois River running through Rensselaer that has a very high bedrock level. It appears the bedrock elevation is 2' or less below the ground surface of the floodplain, and the rock itself forms the sides and bottom of the river. The Hydrogeological Atlas of Aquifers in Indiana shows the bedrock in Rensselaer.

Except for a narrow wooded belt adjacent to the Iroquois River and small isolated wooded areas, the area is in the prairie grassland region (EcoIndiana).

The topography throughout the watershed is relatively flat to gently rolling. Elevations in the upper reaches of Jasper County are 710 feet. The lower reaches in Newton County are near 625 feet. Approximately 55 miles are between the upper reaches and the Indiana/Illinois border, the average slope is approximately 1.5 feet per mile (Banning Engineering, P.C., 2010).

2.2 Hydrology

2.2.1 Overview

The hydrology and groundwater function of the Iroquois River is unique to Indiana. The upper reaches of the watershed north of Rensselaer (see Figure 7 Upper Iroquois Stream Names) are dominated by pockets of sand and muck that tend to slow flows downstream. As you get close to Rensselaer, the hydrology of the watershed becomes more defined and the typical clay till found in much of Indiana becomes the controlling soil type (Banning Engineering, P.C., 2010)

The Upper Iroquois watershed study area is comprised of five 10-digit hydrologic unit codes (HUC) and a total of 27 HUC 12 watersheds within these five 10-digit HUC. Figure 8 and Figure 9 outline the HUC 10 and HUC 12 watersheds. These divisions are helpful for planning and determining nonpoint pollution sources.

Figure 7 Upper Iroquois Stream Names

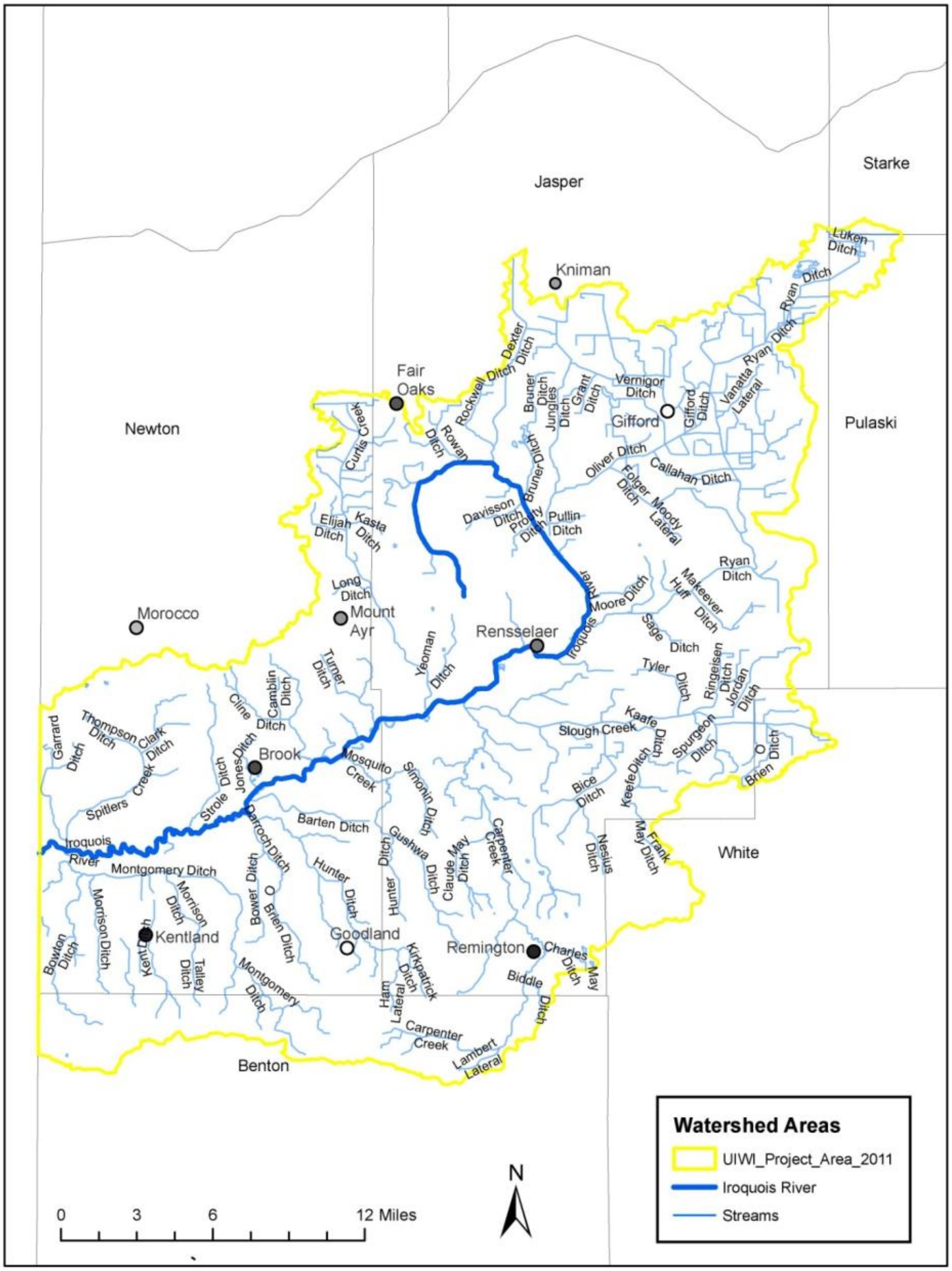


Figure 8 HUC 10 watersheds for Upper Iroquois

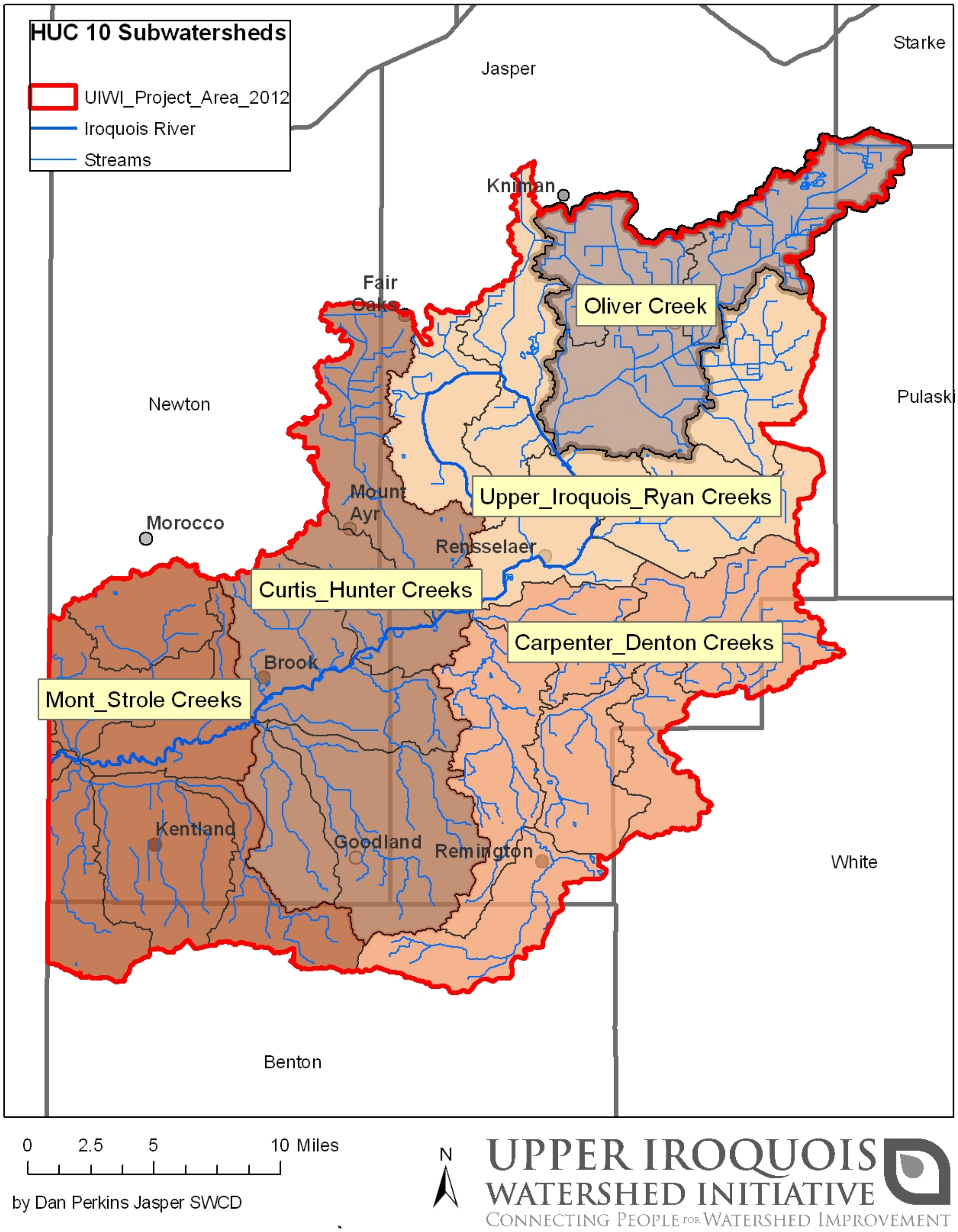
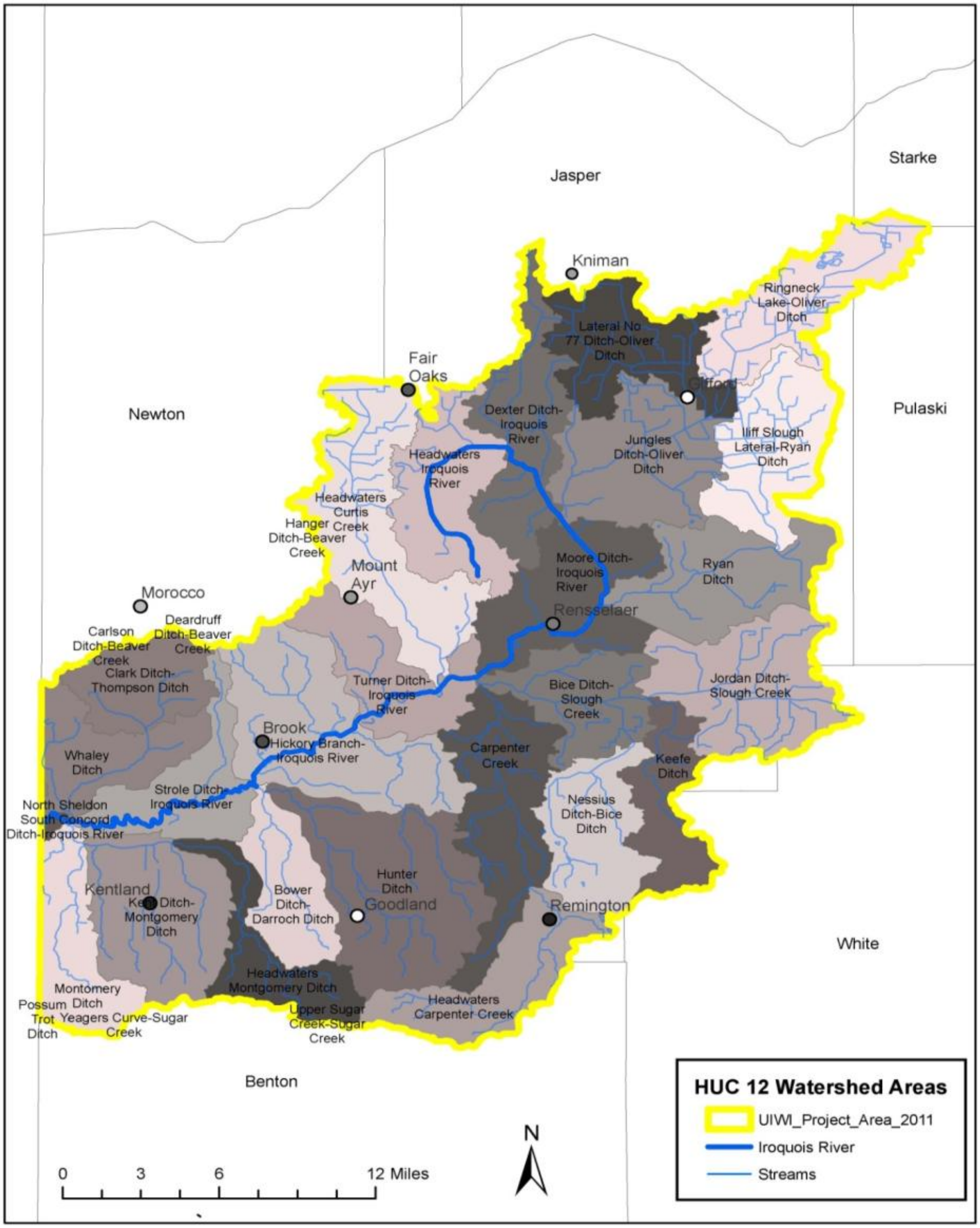


Figure 9 HUC 12 watersheds for Upper Iroquois



Each of the 12-Digit HUC watersheds will be discussed in further detail under Watershed Inventory II.

2.2.2 Streams, Wetlands, and Legal Drains

The upper reaches of the Iroquois River watershed were at one time home to the largest marsh area in the mid-west; "the Everglades" of the Midwest is how one stakeholder put it. Much of the area has now been drained and cleared for agricultural production, resulting in tremendous crop land, but also the loss of wetland function and value to the areas hydrology. The "sponges" for flood storage and slowing water flow have been lost. Hence, the main concern of flashiness and flooding of the river. An extensive system of open ditches and tiling provide drainage for the cropland. Some areas of wetland do exist, see Figure 11 and are largely used for hunting and wildlife watching.

Of note, Carpenter and Curtis Creek HUC 10's have the most stream miles, but the Olive Creek and Upper Iroquois HUC 10's are the most heavily drained.

Table 9 HUC 10 Streams, Wetlands, and Legal Drains

HUC 10 Code	HUC 10 Name	Acres	Sq. Miles	HUC 10 Stream Miles (overlap drains)	**HUC 10 Wetland Acres	% of Land area In Wetland	HUC 10 Regulated Drain Miles	HUC 10 Private Drain Miles	HUC 10 Regulated Tile (miles)	Artifical Drain miles as percent of Total Watershed Area	Total Artifical drainage miles	Regulated Drainage as % total drainage miles
201	Oliver Ditch	52,685	82	124	3401	6.5%	88.30	200.00	30	35%	230	65%
202	Carpenter-Denton Creeks	92,875	145	160	969	1.0%	128.90	68.22	68	21%	136	46%
203	Upper Iroquois-Ryan Creek	86,768	136	136	2156	2.5%	126.85	123.34	119	37%	242	64%
204	Curtis-Hunter Creek	103,490	162	153	1430	1.4%	115.76	60.00	51	17%	111	42%
205	Montgomery Ditch-Spitlers Creek	102,652	127	106	620	0.6%	78.58	60.00	43.80	16%	104	49%
	Totals	438,470	651	679	8,576		538.39	511.56	311.77			

** According to NWI Map

Table 10 HUC 12 Streams, Wetlands and Legal Drains.

HUC 10 Name	HUC 12 Code	HUC 12 Name	Area (sq. miles)	Acres	Huc 12 Stream Miles	HUC 12 Wetland Acres	HUC 12 % of Land in Wetland	HUC 12 Regulated Drain Miles	HUC 12 Private Drain Miles	Total Artifical Drain Miles	Regulated Drainage as % total drainage miles
Oliver Ditch	101	Ringneck Lake-Oliver Ditch	26.58	17011	49.90	2714	0.16	28.50	81.49	110	69%
	101	Lateral No 77 Ditch-Oliver Ditch	25.47	16301	37.30	270	0.02	29.21	66.26	95	72%
	103	Jungles Ditch-Oliver Ditch	30.32	19405	37.17	418	0.02	26.71	49.61	76	67%
Carpenter-Denton Creeks	201	Keefe Ditch	17.00	10880	10.57	42	0.00	9.89	8.79	19	64%
	202	Jordan Ditch-Slough Creek	32.67	20909	42.63	337	0.02	33.50	28.23	62	59%
	203	Nessius Ditch-Bice Ditch	21.84	13978	18.95	90	0.01	18.87	5.62	24	56%
	204	Headwaters Carpenter Creek	23.47	15021	22.50	84	0.01	8.20	2.09	10	31%
	205	Carpenter Creek	30.67	19629	40.30	205	0.01	30.90	6.67	38	48%
	206	Bice Ditch-Slough Creek	19.55	12512	25.20	211	0.02	24.17	16.75	41	62%
Upper Iroquois-Ryan Creek	301	Headwaters Iroquois River	25.86	16550	21.44	488	0.03	24.79	20.14	45	68%
	302	Iliff Slough Lateral-Ryan Ditch	25.70	16448	36.86	221	0.01	29.27	36.30	66	64%
	303	Dexter Ditch-Iroquois River	27.06	17318	33.62	633	0.04	29.43	40.09	70	67%
	304	Ryan Ditch	28.18	18035	21.61	124	0.01	21.36	12.75	34	61%
	305	Moore Ditch-Iroquois River	28.82	18445	22.86	691	0.04	14.00	14.06	28	55%
Curtis-Hunter Creek	401	Headwaters Curtis Creek	38.65	24736	41.89	443	0.02	11.56	16.19	28	40%
	402	Turner Ditch-Iroquois River	21.95	14048	17.79	382	0.03	13.76	9.47	23	57%
	403	Hunter Ditch	42.71	27334	35.95	51	0.00	14.55	4.74	19	35%
	404	Bower Ditch-Darroch Ditch	17.13	10963	13.39	30	0.00	28.62	0.00	29	68%
	405	Hickory Branch-Iroquois River	41.34	26458	42.08	524	0.02	30.62	0.23	31	42%
Montgomery Ditch-Spitlers Creek	501	Clark Ditch-Thompson Ditch	17.54	11226	8.85	113	0.01	11.77	2.19	14	61%
	502	Whaley Ditch	21.39	13690	13.56	140	0.01	13.20	2.74	16	54%
	503	Strole Ditch-Iroquois River	20.27	12973	15.03	214	0.02	9.92	0.00	10	40%
	504	Headwaters Montgomery Ditch	17.67	11309	18.69	13	0.00	9.92	0.00	10	35%
	505	Kent Ditch-Montgomery Ditch	31.50	20160	35.63	15	0.00	23.72	0.00	24	40%
	506	Montgomery Ditch	26.25	16800	14.81	114	0.01	14.07	0.00	14	49%
	507	Concord Ditch- Iroquois River	11.72	7501	1.60	10	0.00	0.00	0.00	0	0%
	508	Blackstone Branch-Iroquois River	14.14	9050	0.00	0	0.00	0.00	0.00	0	0%
		Totals	685.45	438,688	680.18	8578		510.51	424.41	935	

There are no large lakes within the watershed. A few man-made ponds, filled quarries, and backwater areas scattered throughout the watershed are used for recreation by local stakeholders. Two access points along the Iroquois River are used by local canoeists and anglers for fishing and recreation. The IDNR recommends a boat launch every 5-10 miles to make a river accessible. The Iroquois doesn't meet this criteria, more points of access are needed. Keeping fish populations healthy by protecting fish habitat will be key to increase recreational opportunities, and keeping the water safe for bodily contact are all related to stakeholder concerns.

Figure 10 Legal and Private Drains in Iroquois Watershed

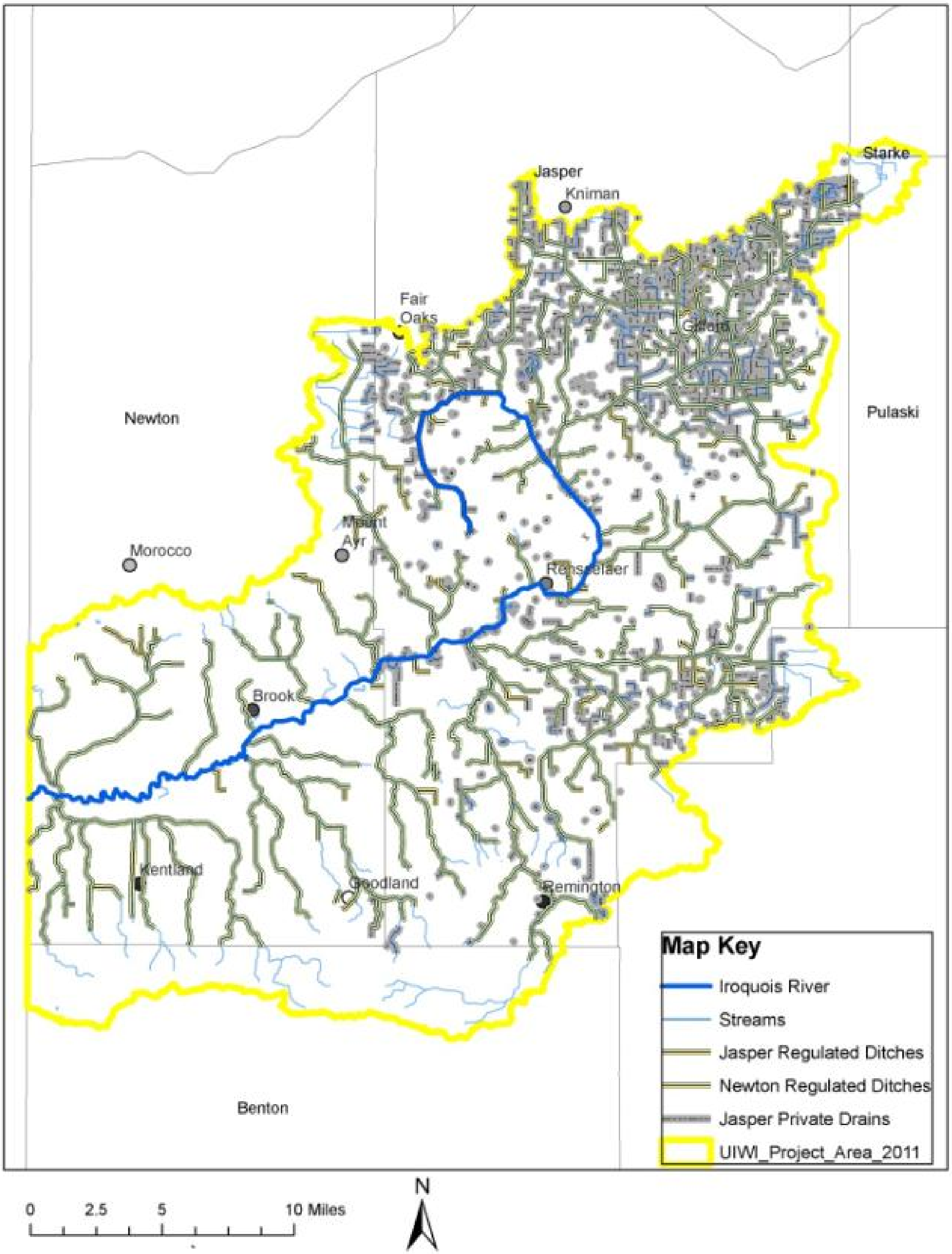
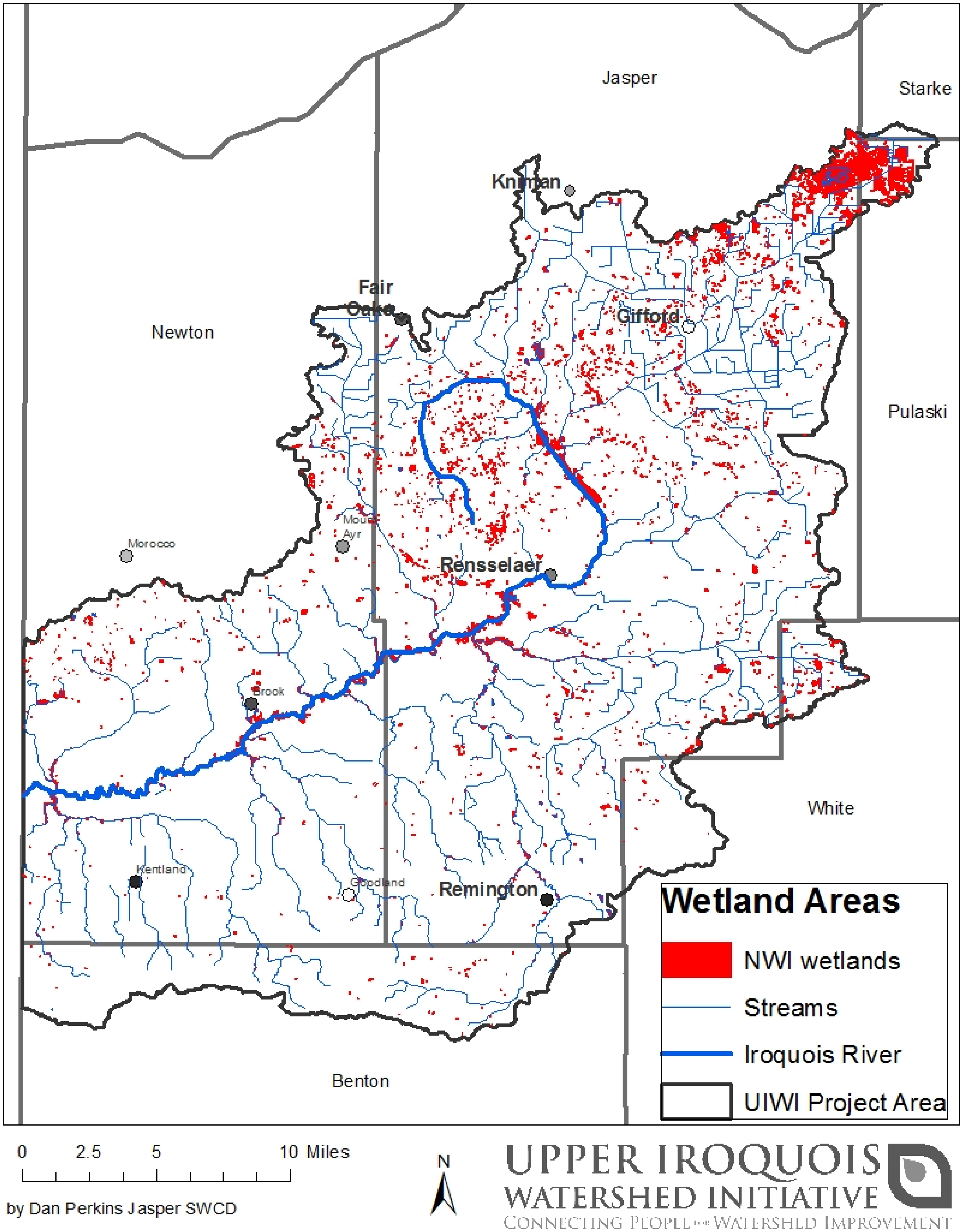


Figure 11 National Wetlands Inventory Map



2.3 Soils

General soil map associations and descriptions for the watershed will be described first by Newton County and then Jasper County. Each soil association has a distinctive pattern of soils, relief, and drainage as well as a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soil types within the association. The soils making up one association can occur in another but in a different pattern.

In Newton County the predominant soil associations in the watershed are Swygert-Bryce-Swygert Variant; Selma, till substratum-Darroch, till substratum-Foresman, till substratum; Selma-Darrock-Foresman; and Selma, till substratum-Barce-Gilboa. These soil associations consist of dominantly nearly level to strongly sloping, very poorly drained to moderately well drained, very deep, fine to medium textured soils on upland glacial till plains and moraines. Most of the soils in these associations are well suited for agricultural production, if drained. The main management concerns are wetness, ponding, and erosion.

The portion of the watershed in Jasper County consists of several soil associations. The lower reaches of the watershed have similar characteristics as those shown for Newton County. The upper reaches of the watershed, predominately north of State Road 14, consist of dominantly nearly level to strongly sloping, very poorly drained to excessively drained, very deep, coarse textured and organic soils on upland outwash plains and bottomlands. Most of the soils in the Jasper County portion of the watershed are well suited for agricultural production. The main management concerns in the southern portion of the watershed are wetness, ponding, and erosion. The main concerns in the northern portion of the watershed are wetness, ponding, flooding and wind erosion. These associations are typically well suited for agricultural production, but have limitations due to flooding (Banning Engineering, P.C., 2010).

Water quality can be impacted in several different ways because of soil type. Due to high perched water tables throughout the watershed and sandy soils in the northern parts of the watershed leaching of nutrients, herbicides, and pesticides into ground water and into surface water via tile drains is a significant concern. The nitrate leaching index section will discuss this reality in more detail.

2.3.1 Highly Erodible Soil

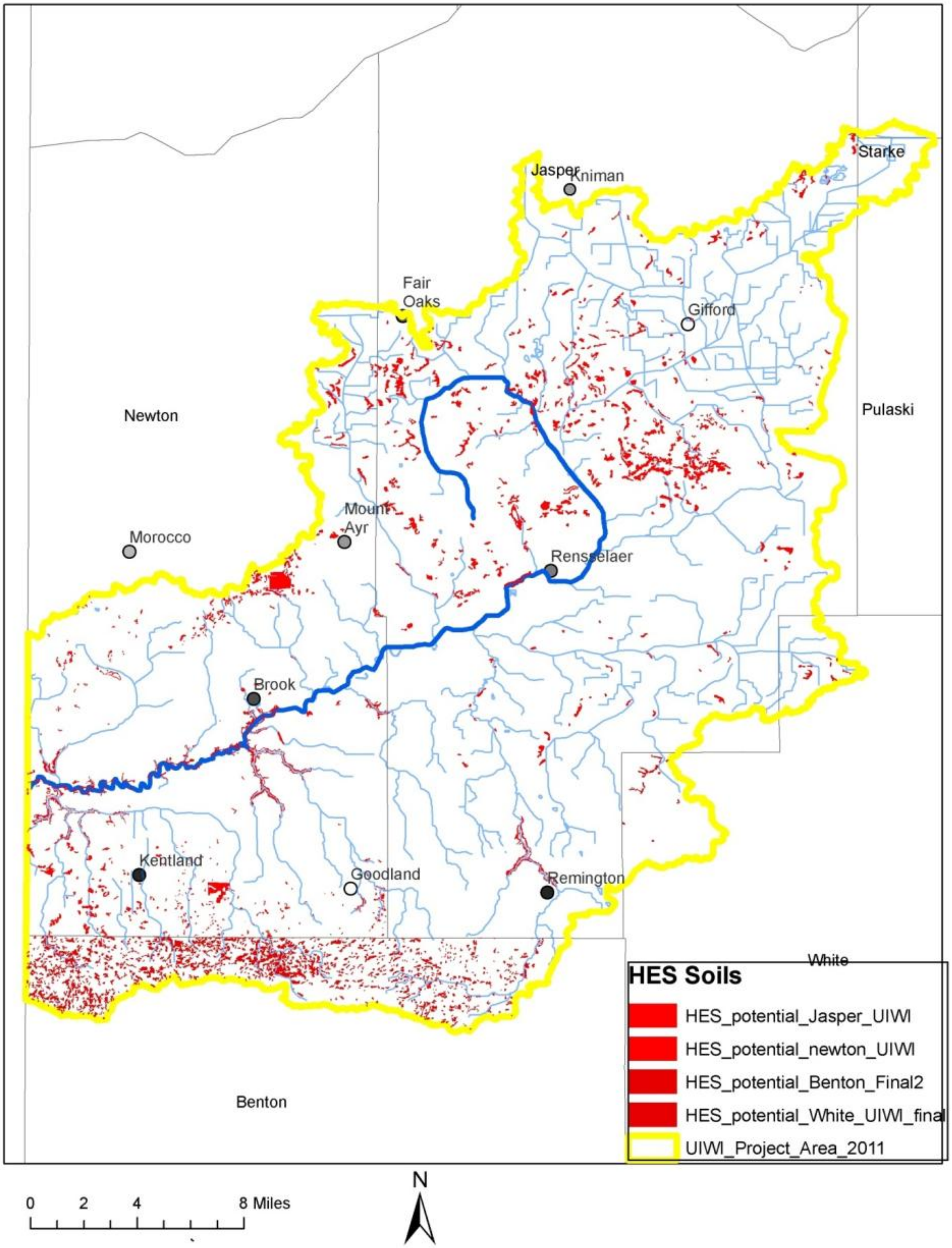
Water quality of the watershed can be impacted by the soils which exist within the watershed and their ability to erode or sustain certain land use practices. Highly erodible soils (HES) are easily transported to waterways where they degrade water quality, interfere with recreational uses, impair aquatic habitat and health, and contribute to excess nutrients all of which are concerns formulated by the steering committee found in Table 6. Within Jasper County four HES units exist, while 15 HES units are found within Newton County (JFNew, 2003). Table 11 identifies highly erodible soil map units within the Iroquois Watershed, followed by the map location of these units.

Highly erodible land (HEL) determined by the Farm Service Agency specifies a field or tract of land needs to have at least one-third of the parcel situated on HES and the soils are used for agricultural production. HES in Jasper and Newton Counties field checked by NRCS personnel have determined that most of these tracts do not meet HEL requirements; therefore, HEL is not a concern for the two counties. Still, HES soils may be a concern and are therefore listed and mapped. Especially, in lighter sand soil that is subject to wind erosion.

Table 11 Watershed Soils With High Erodibility Potential

County	Soil Unit	Soil Name	Soil Description	Acres	% of Total Watershed
Jasper	LuB2	Lucas silty clay loam	2-6% slopes, eroded	261	0.06%
Jasper	OaC	Oakville fine sand	6-15% slopes	8405	2%
Newton	OaC	Oakville fine sand	6-15% slopes	437	0.1%
Newton	MnC2	Miami loam	6-12% slopes	220	0.05%
Newton	MnE	Miami loam	15-25% slopes	312	0.07%
Newton	OcC2	Octagon loam	6-12% slopes, eroded	300	0.07
Newton	SzB2	Swygert variant	2-6% slopes	635	0.15%
Newton	SzC2	Swygert variant	6-15% slopes, eroded	100	0.02%
Benton	AyB2	Ayr variant fine sandy loam	2 to 6 percent slopes, eroded	120	0.02%
Benton	BaB2	Barce loam	2 to 6 percent slopes, eroded	899	0.2%
Benton	CsB2	Corwin silt loam	2 to 6 percent slopes, eroded	1812	0.43%
Benton	FoB2	Foresman silt loam	1 to 5 percent slopes, eroded	17	0.004%
Benton	FpB2	Foresman silt loam	1 to 5 percent slopes, eroded	616	0.14%
Benton	FrB2	Foresman loam	1 to 5 percent slopes, eroded	125	0.03%
Benton	MbB2	Markham silt loam	2 to 6 percent slopes, eroded	159	0.03%
Benton	MmC3	Miami clay loam	6 to 12 percent slopes, severely eroded	52	0.012%
Benton	MxB2	Montmorenci silt loam	2 to 6 percent slopes, eroded	1429	0.34%
Benton	VaB2	Varna silt loam	1 to 5 percent slopes, eroded	488	0.11%
White	AsB	Alvin fine sandy loam	2 to 6 percent	7	0.0017%
White	ChC	Chelsea fine sand	6-15 percent slope	205	0.049%
White	OcB	Octagon silt loam	2 to 6 percent slope	9	0.0022%
Starke and Pulaski	None	N/A	N/A	N/A	0%

Figure 12 Watershed Soils with High Erodibility Potential.



2.3.2 Hydric Soils

Hydric soils are defined as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register, July 13, 1994). Hydric soils are one of three criteria used to define and identify a wetland. Wetland ecosystems function as natural wastewater treatment plants. They remove water pollutants and help remove excess nutrients which have been identified as stakeholder concerns in Table 6. Wetlands also serve as “sponges” absorbing storm water run-off and are extremely important for wildlife habitat and supporting healthy amphibian and fish ecosystems, another stakeholder concern identified in Table 6. Although many of the hydric soils in the Iroquois Watershed have been artificially drained over the years, they still retain their hydric soil capabilities and are excellent candidates for the restoration of wetlands, which is one tool that can be used to address stakeholder concerns.

In summary, 41% of the soils in the watershed are classified as hydric. A closer investigation of hydric soil locations will be discussed by smaller watershed areas later in this report.

Figure 13 Hydric Soils in Iroquois Watershed

2.3.3 Wind Erodibility

Wind Erodibility groups (WEG) are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. Soils are grouped into one of eight groups. Soils in Group 1 are the most susceptible to wind erosion, so much so they are generally not farmed. Groups 2-4L crops can be grown if "intensive measures" are used to control wind erosion, such as cover crops and conservation tillage. Groups 4-5 crops can be grown if "measures to control wind erosion are used." Groups 6-7 crops can easily be grown with minimal soil loss to wind erosion, and group 8 is stony or gravelly (Nelson, 2012)

For planning purposes, group 1 and 8 (Figure 14 General Wind Erodibility Groups) were not factored in since they are not farmed. Groups 2-4L were categorized under the headings of "High Concern", groups 4-5 under the heading of "Concern", and groups 6-7 under the heading of "Slight Concern". Table 12 Wind Erobility Acres by HUC 10 is a summary of these groupings by watershed and acreage. Figure 15 Wind Erodibility Grouping shows the groupings by watershed and wind erodibility concern. A more detailed discussion of each HUC 10 will occur in the Watershed Inventory II section. For planning purposes, group 1 and 8 was not factored in mapping, since they are not farmed. Groups 2-4 L were grouped and called "high concern", groups 4-5 were grouped and called "concern" and groups 6-7 were grouped and called "slight concern"

Wind Erodibility is an important factor in addressing sediment and nutrient loading in the watershed and prioritizing implementation of best management practices in specific areas.

Table 12 Wind Erodibility Acres by HUC 10

Wind Erodability Group HUC 10		Acres in Group			% of total acres in		
HUC 10	HUC 10 Acres	High Concern	Concern	Slight Concern	High	Concern	Priority
Oliver Ditch	52,685	42,292	739	-	80%	1%	1
Carpenter-Denton Creeks	92,875	39,252	9,140	33,273	42%	10%	3
Upper Iroquois-Ryan Creek	86,768	47,828	9,358	20,072	55%	11%	2
Curtis-Hunter Creek	103,490	39,867	18,096	38,163	39%	17%	4
Montgomery Ditch- Spitlers Creek	81,048	16,760	27,946	35,474	21%	34%	5

Figure 14 General Wind Erodibility Groups

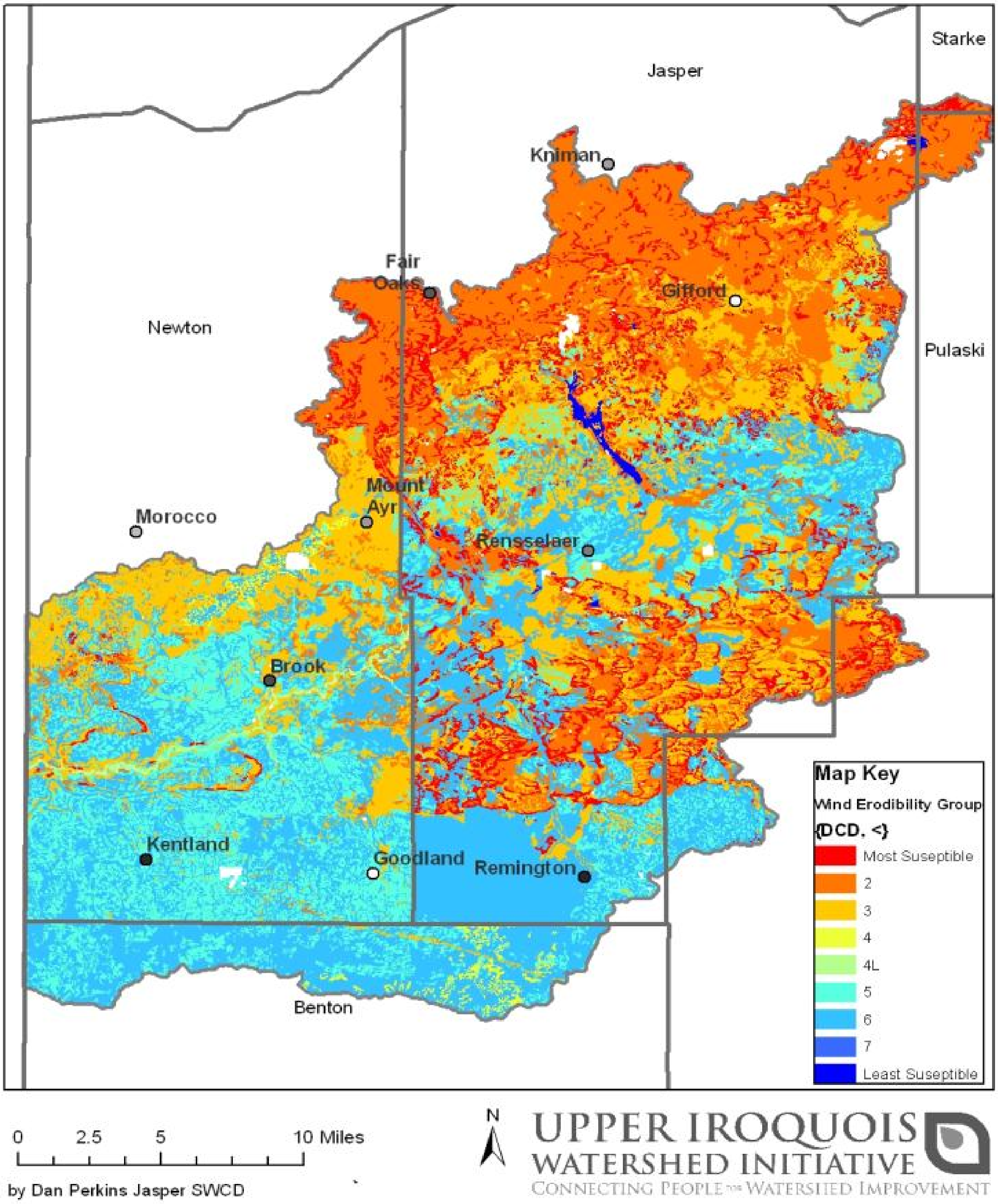
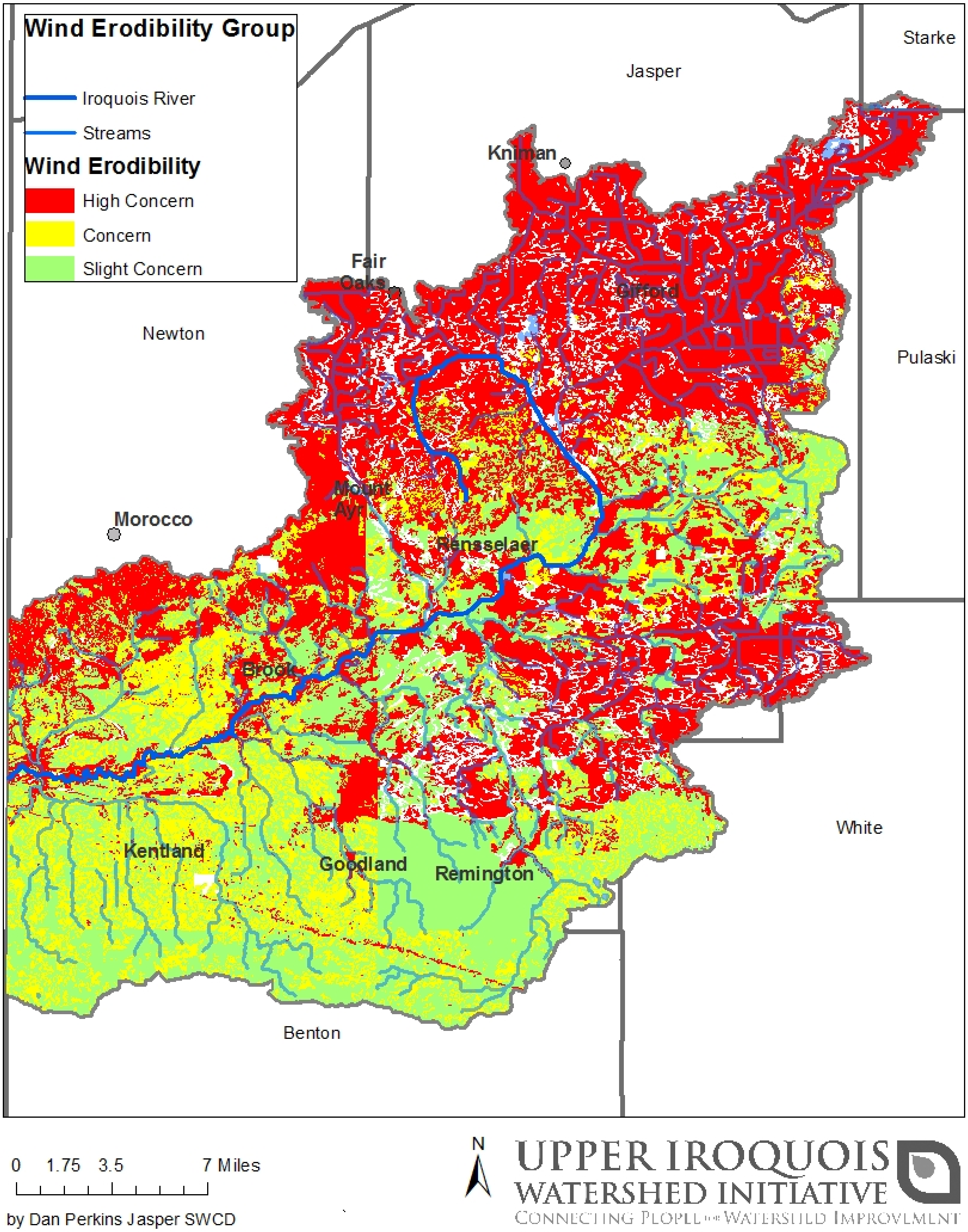


Figure 15 Wind Erodibility Grouping



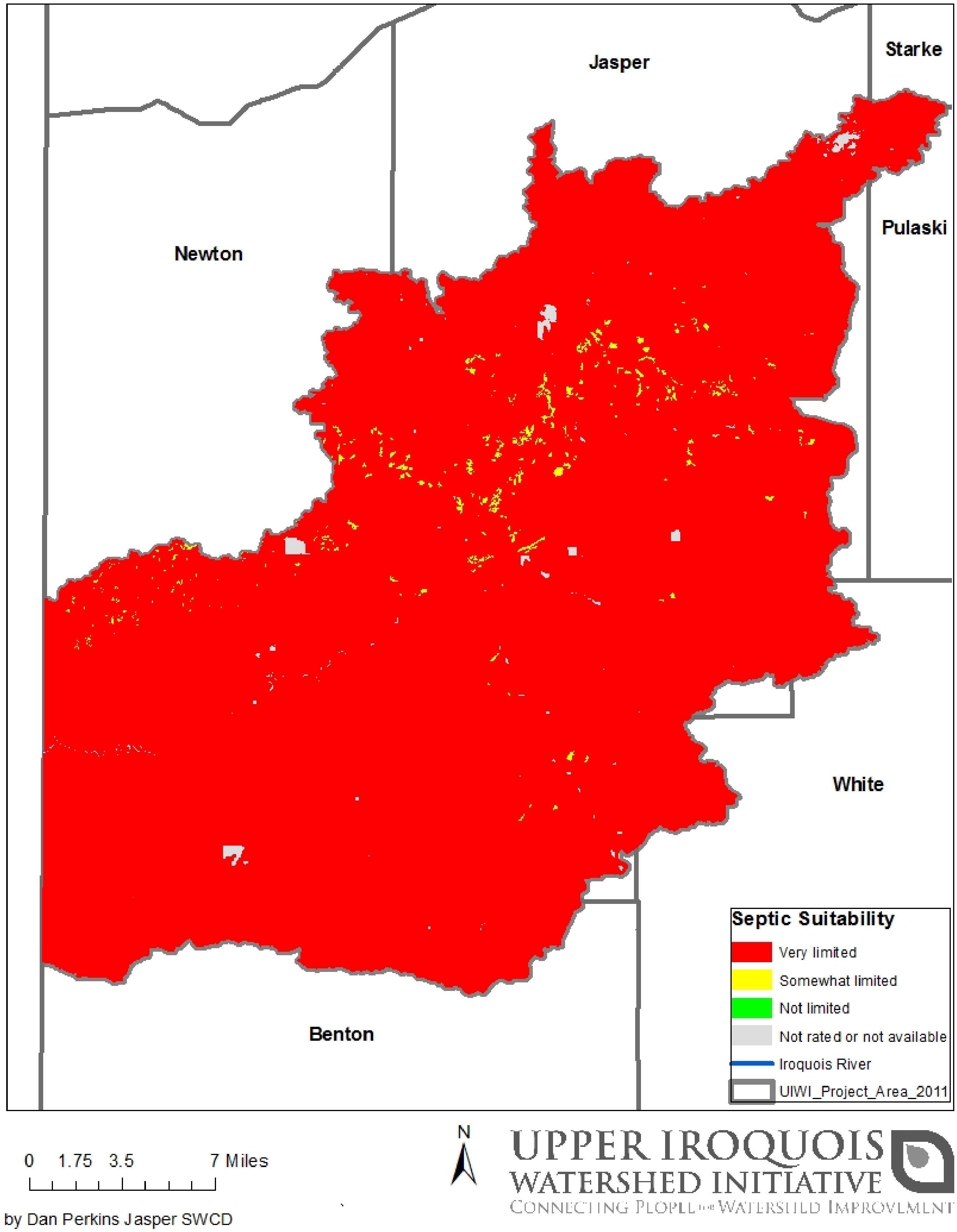
UPPER IROQUOIS WATERSHED INITIATIVE
CONNECTING PEOPLE to WATERSHED IMPROVEMENT

2.3.5 Septic System Suitability

Nearly half of Indiana's residences utilize private or on-site waste disposal systems. For the majority of people using on-site private wastewater treatment systems, septic tanks and septic tank absorption fields are used. A variety of factors can affect a soil's ability to function as a septic absorption field. Soil suitability for on-site sewage disposal systems is determined from seven soil characteristics: position in the landscape, slope, soil texture, soil structure, soil consistency, depth to limiting layers, and the depth to seasonal high water table (Thomas, 1996). The ability of a soil to treat effluent depends on four factors: the amount of accessible soil particle surface area, the chemical properties of soil surfaces, soil conditions (temperature, moisture, oxygen content, etc), and the type of pollutants present in the effluent (Cogger, 1989). Each soil series is ranked by the NRCS in terms of its limitations for use as a septic tank absorption field: slightly limited, moderately limited, or severely limited.

As shown in Figure 16 Septic Suitability, nearly the entire watershed is somewhat limited or very limited for septic tank absorption fields. Use of septic tanks and septic tank absorption fields in these areas generally requires special designs, planning and maintenance to minimize or overcome the soil limitations. Stakeholders have identified fish habitat, recreational use, excess nutrients, and high Escherichia coli bacteria (E. coli) levels as watershed concerns. Failing and mismanaged septic systems can contribute to and/or have a direct impact on each of these concerns. Pollution from septic tank effluent can contribute to eutrophication and water quality impairment of the watershed. Potential health concerns exist for swimmers, fishermen and boaters who come in contact with contaminated water.

Figure 16 Septic Suitability



2.3.5 Nitrate Leaching Index

Due to high perched water tables throughout the watershed and sandy soils in the northern parts of the watershed leaching of nutrients, herbicides, and pesticides into ground water and into surface water via tile drains is a stakeholder concern. Based on recommendations of the Water Quality work group, the steering committee decided to use the soil survey to create a map of areas most vulnerable to leaching based on soil type.

The range of nitrate leaching index (NLI) values is 0 to 24 when you look across the state (Nelson, 2012). General rule of thumb is 10 and over will contribute to nutrient leaching below root zone, an index of 3-9 may contribute, 0-2 will not contribute. The areas that are mapped below are “concern” areas with a rating of 3-9 and “high concern” with any rating over 10. See Summary Table 13 Nitrate Leaching Index Summary by HUC 10 and Table 14 Nitrate Leaching Index By HUC 12 in Critical Areas. See Figure 17 Nitrate Leaching Index Map as well. More detailed analysis is discussed in each sub watershed section.

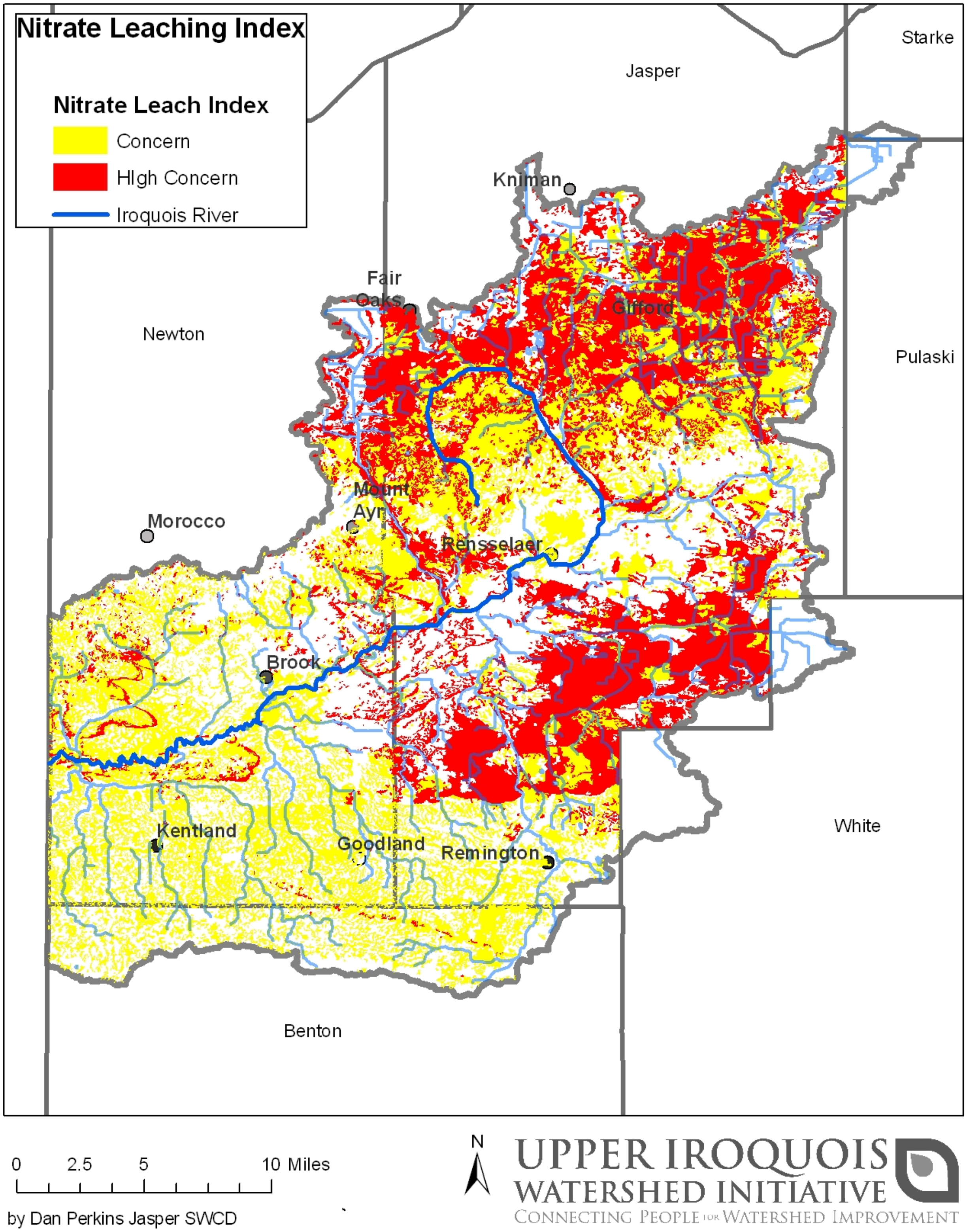
Table 13 Nitrate Leaching Index Summary by HUC 10

HuC 10 Nitrate Leaching Index Summary		Acres in N Index		% of HUC 10 Soil Acres		Total Acres		% of Total HUC 8 Acres		*HUC 10 Ranking	
HUC 10 Watershed	Total Soil Acres	High	Concern	High	Concern	Total High + Concern	high+concern	High	Concern	High	Concern
Oliver Creek	52,685	23057	12415	44%	24%	35,472	67%	6%	3%	5	1
Upper Iq_Ryan Creek	86,768	20283	36687	23%	42%	56,970	66%	5%	9%	3	3
Curtis Creek_Hunter Creeks	103,490	14260	53949	14%	52%	68,209	66%	3%	13%	2	4
Carpenter_Denton Creeks	92,875	28818	24572	31%	26%	53,390	57%	7%	6%	4	2
Mont_Spitlers Creek	81,048	2901	53931	4%	67%	56,832	70%	1%	13%	1	5
Total Acres	416,866										
* 5 = Most leaching potential											

Table 14 Nitrate Leaching Index By HUC 12 in Critical Areas.

Nitrate Leaching Index Summary HUC 12 Critical Area				Acres in N Index		% of HUC 12 Soil Acres		Total	% of Total HUC 10 Acres		*HUC 12 Ranking	
HUC 10	HUC 10 Acres	HUC 12 Watershed	Total Soil Acres	High	Concern	High	Concern	High + Concern	High	Concern	High	Concern
Carpenter-Denton Creeks	92,875	Keefe Ditch	10880	2957	2274	27%	21%	5,231	3%	2%	3	3
		Jordan Ditch-Slough Creek	20909	10098	2816	48%	13%	12,914	11%	3%	6	1
		Nessius Ditch-Bice Ditch	13978	4690	4092	34%	29%	8,782	5%	4%	4	4
		Headwaters Carpenter Creek	15021	36	7786	0%	52%	7,822	0%	8%	2	5
		Carpenter Creek	19629	5330	5632	27%	29%	10,962	6%	6%	3	4
		Bice Ditch-Slough Creek	12512	5707	1972	46%	16%	7,679	6%	2%	5	2
Curtis-Hunter Creek	103,490	Headwaters Curtis Creek	24736	7808	6157	32%	25%	13,965	8%	6%	5	1
		Turner Ditch-Iroquois River	14048	1958	6046	14%	43%	8,004	2%	6%	4	3
		Hunter Ditch	27334	1493	14750	5%	54%	16,243	1%	14%	2	4
		Bower Ditch-Darroch Ditch	10963	86	3806	1%	35%	3,892	0%	4%	1	2
		Hickory Branch-Iroquois River	26458	2560	14922	10%	56%	17,482	2%	14%	3	5

Figure 17 Nitrate Leaching Index Map

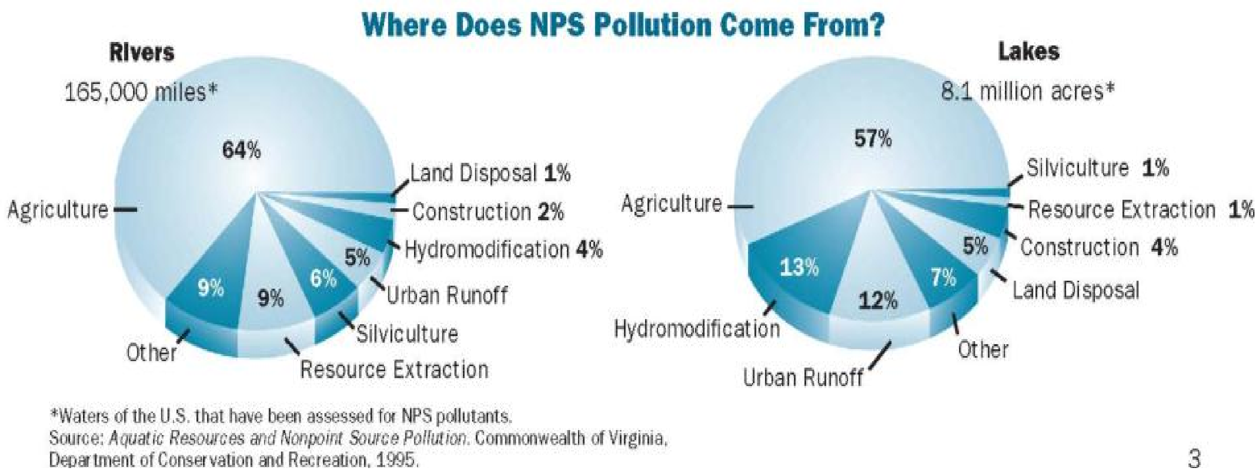


2.4 Land Use

Land use for the watershed is predominantly agricultural with over 84% of it being covered by agricultural vegetation. Developed and forested lands each account for a little over 6% of the total watershed area. A complete list of land uses in the Upper Iroquois Watershed can be found in Table 15 Land Use/Land Cover (Tetra Tech, 2009). In general, there are isolated pockets of urban and forested/wetland land use with a corridor of forested vegetation adjacent to the Iroquois River (Banning Engineering, P.C., 2010).

The impact of agricultural practices on water quality is of concern to the stakeholders. As can be seen in Figure 18 Where Does NPS Come From?, agricultural land use is generally responsible for 64% of non-point pollution, which would be the nutrients, sediments, and E.coli stakeholder concerns. Specifically, the volume of exposed soil entering adjacent water bodies, the prevalence of tiled fields and thus the transport of chemicals into water bodies, the use of agricultural chemicals, and the volume of manure applied via small animal farms and confined animal feeding operations are possible sources of non-point pollution in the watershed (WREC, 2010). Cultivated areas can be seen in Figure 19 below.

Figure 18 Where Does NPS Come From?



The amount of impervious surface within a watershed is important. Surfaces such as pavement, sidewalks, roof tops, and compacted earth (lawns and some agricultural ground) prevent natural infiltration of water into the ground and disrupt the natural water cycle which helps maintain adequate levels of clean water in the watershed. It is well documented that with a greater percent of impervious surfaces higher loads of pollutants such as excess nutrients, chemicals, sediment, and waste via stormwater run-off enter watershed streams. Normally, this wouldn't occur as filtration and infiltration would prevent the pollutants from reaching streams. A direct relationship between the amount of impervious surface in a watershed and the quality and quantity of water exists. Generally, where less than 10% of a watershed is covered in impervious surfaces, the streams are generally protected; where 11-25% is impervious, the streams are most likely impacted;

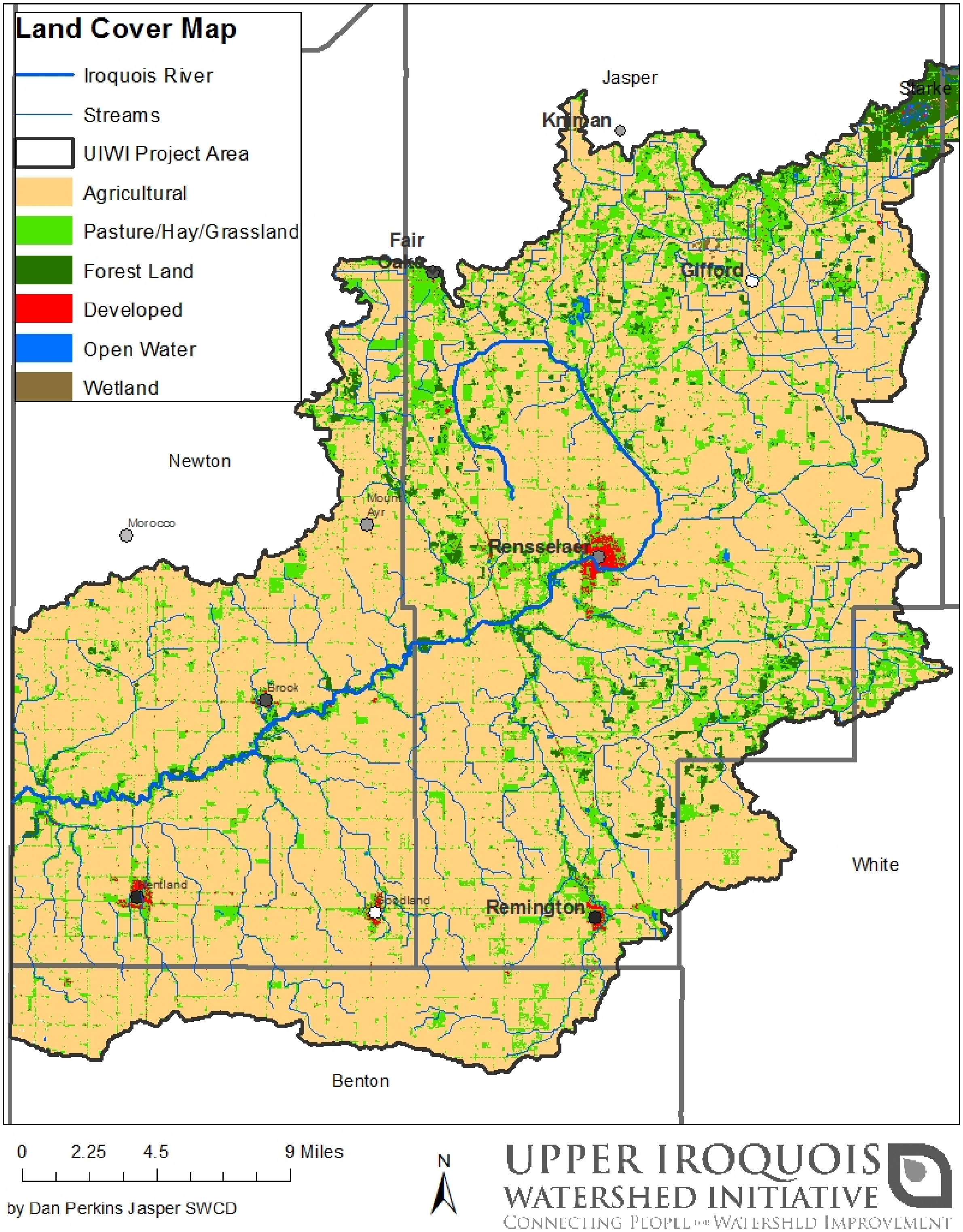
where more than 25% is impervious, the streams are most likely degraded. Development across the Iroquois watershed has not reached these levels, but as development increases and we further focus on areas of concentrated growth such as Rensselaer, Remington, Brook, Kentland then we must weigh the impact on local streams in those particular watersheds.

Continual development within the Iroquois Watershed is likely to increase impervious surfaces and therefore further degradation of streams unless conscious efforts are made to plan and develop with water resources in mind.

Table 15 Land Use/Land Cover

Land Use/Land Cover	**Watershed Area**		
	Acres	**Square Miles**	**Percent**
Agricultural Land	368,676	576.06	84.11
Forested Land	27,192	42.49	6.20
Developed Land	26,680	41.69	6.09
Pasture/Hay	10,636	16.62	2.43
Grassland and Shrubs	2,344	3.66	0.53
Wetland	1,722	2.69	0.39
Open Water	1,082	1.69	0.25
Total	438,332	684.90	100.00

Figure 19 Land Use



2.4.1 Unsewered Areas

Unsewered areas that operate without modern treatment systems can have significant impacts on water quality and be a significant source of non-point pollution. A number of communities within the watershed are unsewered (Figure 21 Unsewered Areas with Significant Populations. This map also includes subdivisions that have 50+ homes on septic as these could be a possible source of pollutants if systems are failing. It needs to be determined if these areas are operating on old and outdated septic systems or even a "no-fail" system (i.e. a system with no absorption field and the septic tank piped directly to an open waterway or a subsurface drainage tile that discharges into an open waterway). Many of these concerns can be addressed with the creation of regional sewer districts such as the district serving the area around State Road 114/I-65 Interchange and the Yeomen Ditch, which has shown significant impairment based on high E-coli levels.

One combined sewer overflow (CSO) community does exist within the watershed and is possibly a significant source of water quality pollutants. The city of Rensselaer has nine (9) CSOs that discharge directly into the Iroquois River. Figure 20 Combined Sewer Outfalls (CSO) and Delineated Drainage Areas shows the location of each outfall and the approximate contributing drainage area for each outfall. These should be addressed to improve water quality.

Figure 20 Combined Sewer Outfalls (CSO) and Delineated Drainage Areas

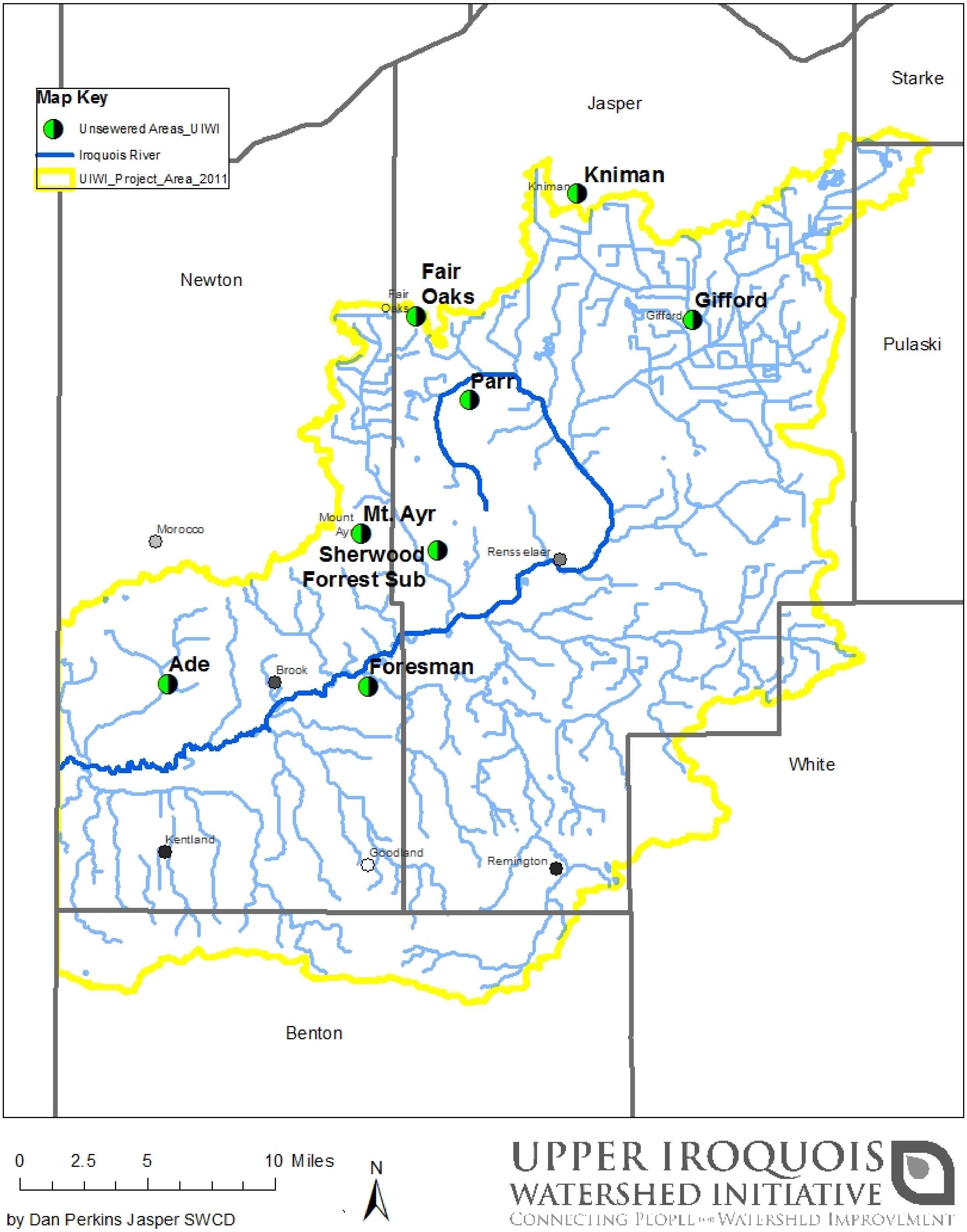


Figure 21 Unsewered Areas with Significant Populations

2.4.2 Tillage Transect

The largest land use in the watershed is agriculture at 84% of the acreage and therefore has the most potential to negatively or positively impact water quality. Four of the six stakeholder concerns- flashiness of river, too much sediment, too much nutrients, and high E.coli levels can be associated with agricultural land use.

Tillage transects are county level windshield surveys that collect data on current crop use, tillage practice and various soil loss factors. Data from these yearly to biannual surveys provide valuable information on trends in crop use and acceptance of conservation practices such as conservation tillage and cover crops.

Common tillage types include no-till, strip-till, ridge-till, mulch-till, reduced-till, and conventional-till. According to the Indiana State Department of Agriculture (ISDA) by definition no-till is any direct seeding system, including site preparation, with minimal soil disturbance (includes strip and ridge till). Mulch-till is any tillage system leaving 30%-75% residue cover after planting, excluding no-till. Reduced-till is any tillage system leaving 16%-30% residue cover after planting and conventional-till is any tillage system leaving less than 15% residue cover after planting. No-till, ridge-till, strip-till, and mulch-till are all examples of conservation tillage. 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 run-off volume **(WREC, 2010)**. Conservation tillage positively impacts water quality for these reasons. The more conservation tillage acres we have the better protected the soil surface is from erosion, which should result in local water quality improvements**.**
Appendix 1 lists the acres used for bean and corn production in 2009 versus 2011 for each tillage practice according to the ISDA Conservation Tillage Summary Reports.

Key observations 2009-2011:

1. Decreasing reduced till acres to more mulch till acres for both corn and soybeans = more residue on soil, a positive for water quality
2. Decreasing no-till acres for soybeans = less residue on the surface, a negative for water quality.

Table 16 Tillage Practices in UIWI Area

County	Total Acres	No Till		Mulch Till		Reduced Till		Conventional Till	
		Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres
Corn									
Jasper	156,000	12%	18,700	31%	48,400	16%	2,500	40%	62,400
Newton	118,000	7%	8,300	49%	57,800	15%	17,700	29%	34,200
Benton	156,000	12%	18,700	31%	48,400	16%	25,000	40%	62,400
Pulaski	106,000	29%	30,700	21%	22,300	32%	33,900	19%	20,100
White	150,000	7%	10,500	42%	63,000	21%	31,500	30%	4,500
Totals									
Soybean									
Jasper	99,900	38%	38,000	41%	41,000	8%	8,000	13%	13,000
Newton	673,000	59%	39,700	27%	18,200	6%	4,000	9%	6,100
Benton	100,500	68%	68,300	27%	27,100	3%	3,000	2%	2,000
Pulaski	77,300	64%	49,500	16%	12,400	15%	11,600	5%	3,900
White	95,700	46%	44,000	40%	38,300	9%	8,600	5%	4,800

A historic view of tillage transects data for Jasper and Newton was conducted and is summarized in Table 17 Historic Tillage Transect No Till Acres in Jasper and Newton. It appears no-till acres for corn reached an all-time high in 1996, and for soybeans in 2007. Again the downward trend in no-till acres is not positive for water quality protection.

Table 17 Historic Tillage Transect No Till Acres in Jasper and Newton

Historic Tillage Transect for No-till Corn and Soybean Acres				
No-Till Year	Jasper No till Corn (% of Corn)	Newton No till Corn (% of Corn)	Jasper No till Soybeans(% of Soybeans)	Newton No till Soybeans(% of Soybean Acres)
1990	16%	15%	10%	15%
1996	26%	17%	47%	45%
2000	20%	No Data	41%	No Data
2002	13%	23%	48%	55%
2004	9%	17%	35%	67%
2007	17%	20%	54%	74%
2009	8%	14%	52%	71%
2011	12%	7%	38%	59%
Summary Data	**Jasper Corn**	**Newton Corn**	**Jasper Soybean**	**Newton Soybean**
Recorded High	26%	23%	54%	74%
2011	12%	7%	38%	59%
Loss (High to current)	14%	16%	16%	15%

2.4.3 Fertilizer Use on Urban and Suburban Land

Fertilizers are commonly applied to urban and suburban land in Indiana. These chemicals can be carried into adjacent water bodies through surface run-off and via storm water drainage systems. This is especially an issue if a storm occurs prior to the chemicals being broken down and used. Given that 6% of the land area is developed and would be considered urban/suburban land use, the overall impact on water quality and concerns of stakeholders would be minimal. However, given that several of the towns have significant streams flowing directly through them more study is needed to determine if this is an issue in these areas. This is especially true in the City of Rensselaer since most of their CSOs discharge directly into the Iroquois River and currently the city offers grass clipping pickup so piles of grass clippings are often piled on the street and can leach nutrients directly into the sewer system.

2.5 Other Planning Efforts

The Upper Iroquois Watershed is an area of concern for many agencies and organizations. Many planning efforts have occurred or are occurring within the watershed. The following is a summary of known efforts and their relevance to this watershed planning effort.

In general, Jasper and Newton County receive less than 4 Rule 5 plans a year, so no formal enforcement/program exists at this time. If development increases and the number of Rule 5 plans go up then a program of enforcement should be considered. Currently, IDEM’s Rule 5 Section can handle the workload. No known sprawl issue exist within the watershed

2.5.1 County Comprehensive Plans

Comprehensive plans function to communicate a unified vision and purpose across each county in regards to plans for land use and development. From a watershed planning perspective, the plans value is that they create a common language and vision as well as a basic roadmap and policy making structure to what development will look like in the county in the future, or depending on the extent of the plan they can clearly communicate what is not being planned and valued. The following is a summary of known plans and their relevance to this watershed planning effort.

<u>Jasper County (2008)</u>

The Jasper County Comprehensive Plan states as one of its goals, “Preserve and enhance the County’s natural resources and environmental features, and protect these features from the impact of development.” Within that goal; objectives 1-4 are applicable to concerns that may impact water quality.

Objective 1: “Protect the water volume and quality in lakes, streams, and their watersheds, including aquifers.”

Objective 2: "Minimize conflicts between the built environment and the natural environment."

Objective 3: "Conserve existing natural areas including woodlots, wildlife habitats, riparian corridors, littoral corridors, open space, wetlands, and floodplains. "

Objective 4: "Encourage the proper use of land application methods and practices."

Under each of the above 4 objectives are 5-7 fairly specific strategies to try and meet the objectives. Plenty of good recommendations are given, many of which would start addressing the concerns of stakeholders, but few specifics are given that determine exactly <u>how</u> and by <u>whom</u> and a <u>timeline</u> of how the goals and objective would be achieved or how to determine if an area is in need of protection. Ultimately, the Upper Iroquois watershed plan will provide the how and by whom and the timeline that is not found within the comprehensive plan.

<u>Newton County (2006)</u>

The Newton County Comprehensive Plan states as one of its goals: "provide a healthful and attractive environment to live and raise a family." Specifically mentioned is the "significant acreage" of designated state and private nature preserves within the county and the need to take advantage of such resources by promoting the use by sportsmen and nature lovers, which will encourage businesses servicing such tourism.

This certainly relates to the stakeholder concern of "increasing recreational activity and protecting fish habitat." Again, the missing information is the how and by who part of this objective; beyond just saying the "zoning and drainage ordinances will implement these policies" or "work with DNR and The Nature Conservancy". Ultimately, the Upper Iroquois watershed plan will provide the <u>how and by whom and timeline</u> that is not part of this comprehensive plan.

Benton County currently has no comprehensive county plan.

<u>White County</u>

- The White County Comprehensive Plan has overall goals and selected objectives and projects to meet those goals. The following goals and projects might be utilized to address stakeholder concerns.

Overall goal = "To Encourage the protection of sensitive areas and protection of natural resources." Within the section on "Park and Open Space Development." The following statements are made that may address stakeholder concerns:
"Encourage the development of recreational corridors along rivers and abandoned railroad rights of way." This would fit right into lack of recreational access.
"Encourage the preservation and/or restoration of areas of special natural features such as lakefronts, beaches, wetlands, lakes, rivers, nature preserves, and/or natural drainage areas." This would help address flashiness and flooding by keeping water on site.

"Encourage environmentally sensitive lands to be used as open space or passive recreational areas." Strategically placed these lands may be able to address multiple stakeholder concerns.
"Improve and control stormwater drainage and upgrade sewer and water lines." A great thing, but no specific plan of action.

2.5.2 Watershed Management Plans

The Iroquois River Watershed Restoration Action Strategy (2001) was written by Indiana Department of Environmental Management (IDEM) to assist restoration and protection efforts of stakeholders in the watershed of the Upper Iroquois River. The strategy broadly covers the entire watershed; therefore, it is intended to be an overall strategy and does not dictate management and activities at the stream site or segment level, hence the need for this UIWI-WMP. The following information drawn from this report will be important to consider:

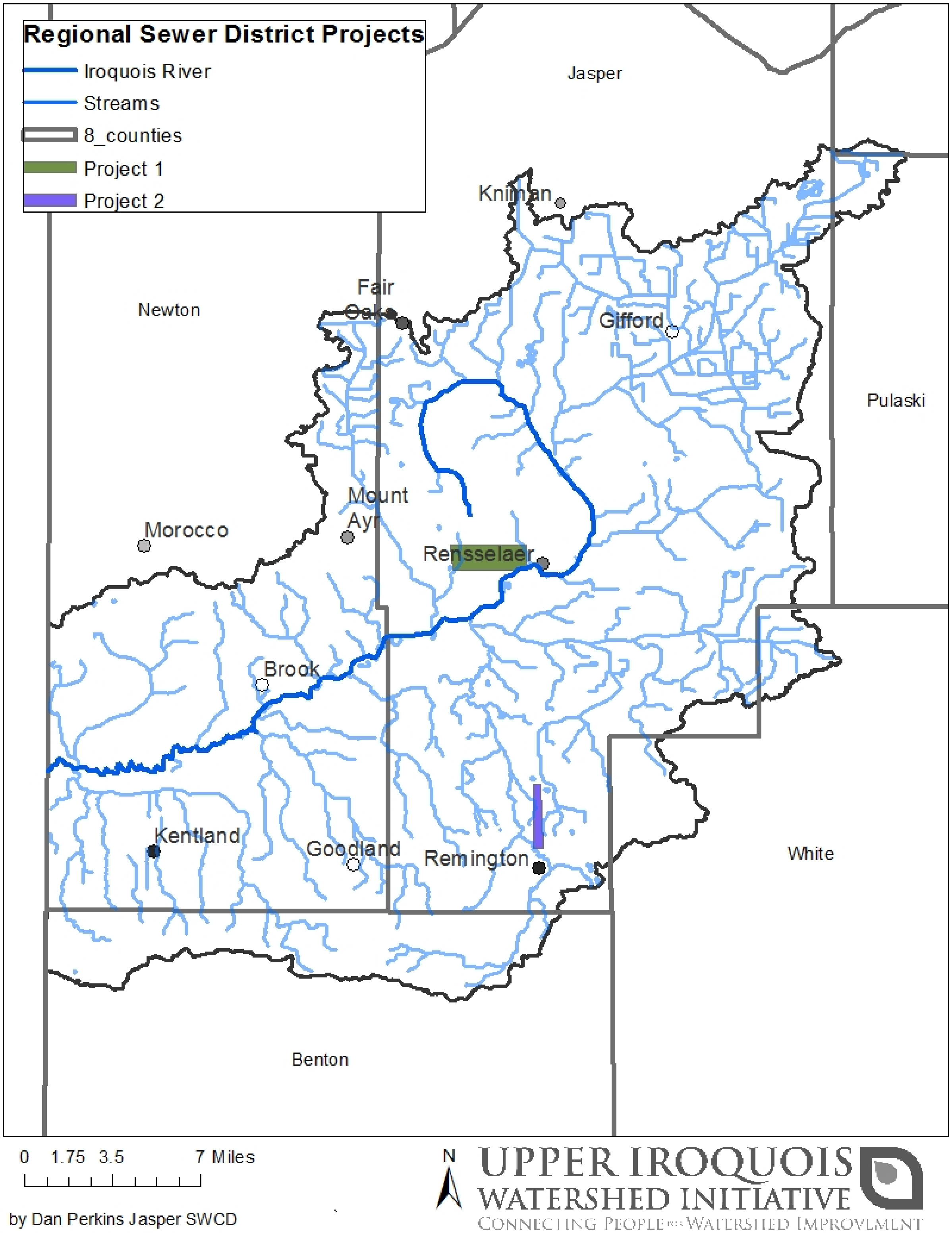
- According to the 1998 Clean Water Indiana Act Section 303d list only the Iroquois River is impaired, and only for FCA and PCBs. Current WQ data and 303d lists show many more impairments on the Iroquois River as well as it's tributaries
- Land use has shifted from 92% Agricultural to 84%, and Urban from 1% to 6% Urban.
- Confirmation that the Iroquois River from State Road 16 to State Line is on the state "Outstanding Rivers" lists, and that the river is designated in the "Roster of Indiana Waterways Declared Navigable." This means regulatory standards and permitting is required for construction in the floodplain and that all stream segments in the watershed must meet surface water use designations.
- Remington use to be a CSO community. Our data confirms it no longer has any CSO outlets. Rensselaer still has CSO outlets, but has reduced the total number of CSOs.
- Within this report, the 1998 and 2001 Unified Watershed Assessment (UWA) for the Iroquois River Watershed is referenced and confirms many of the current concerns listed in this plan, such as stream bank erosion, failing septic systems, and nonpoint pollution sources. The UIWI-WMP data supports these concerns, adds additional concerns and further explores their severity and opportunities to address the concerns.
- All the stakeholders identified are part of current efforts, as well add many more stakeholders.

2.5.3 Other Planning Efforts

<u>Regional Water and Sewer District Engineering Report</u>

The Jasper County Regional Water and Sewer District plan, prepared by RQAW Corporation for submission to IDEM was issued June 8, 2009. By providing water supply and sewage disposal systems it was hoped that Jasper County would experience potential economic benefits and provide economic opportunities for its citizens. It was also believed that such facilities would be conducive to the public health, safety, convenience, and welfare by ensuring that the potable water complied with the Safe Drinking Water Act and sewage disposal in accordance with the Clean Water Act and the National Pollutant Discharge Elimination System Program. Historically the proposed area relied on individual septic systems, many of which have failed. As discussed in Section 2.3.3 Septic System Suitability approximately 98.7% of the soils in Jasper county are rated as “very limited” for septic tank adsorption fields. According to the Indiana Department of Natural Resources (DNR) 2,985 wells exist within Jasper County, many of which have not been replaced and have unsatisfactory water quantity and quality. Currently three projects are being focused on, with two falling within the Upper Iroquois Watershed. Project 1, from State Road 114 to Rensselaer includes the installation of new sanitary sewers and a new water system from the City of Rensselaer to I-65 along Rt.114. This project is currently underway and specifics are discussed in Part Two of the Watershed Inventory under the appropriate subwatershed section. Project 2, from State Road 231 to Remington proposes the extension of both sanitary sewer and domestic water from the City of Remington’s existing water and sewer service territory, north along SR 231, to Exit 205 on I-65, which is on the 303(d) list for E.coli impairment. See Figure 22 Regional Sewer District Project Sites.

Figure 22 Regional Sewer District Project Sites



Environmental Impact Review for the Iroquois River Conservancy District

The Iroquois River Conservancy District along with JF New and Banning Engineering completed an environmental impact review in January 2010. The study area for this project was the Iroquois river corridor extending from Parr in Jasper County, through Newton County, to the Illinois border. The project was carried out to document natural resources in the study area, and to outline potential permitting challenges associated with those resources. Many of the proposed projects and associated benefits directly relate to the stakeholders concerns list; such as obstruction removal (logjams), eroded stream bank repair, two-stage ditch construction, enhancement of floodway conveyance, and upstream flood storage management. All of the recommended projects directly affect flashiness and flooding of the river and/or the amount of sediment in the water. Obstruction removal and treatment of stream bank stabilization projects are noted as maintenance projects which are ongoing and are budgeted for annually.

Department of Natural Resources (DNR) Fish Survey Iroquois River

In 1971, the Iroquois River was surveyed by DNR as part of the Kankakee River to assess the status of the current fish populations. A total of 383 fish representing 19 species were collected. In contrast, downstream on the Illinois portion of the watershed, 69 species in 2000, and 63 species in 2005 where counted. (Lutterbie, 2000) (LutterBie, 2005). Game fish collected included smallmouth bass, largemouth bass, rock bass, channel catfish, northern pike, bluegill and black crappie. Game fish only made up a small percentage of the fish collected. Relative abundance of the major species by number collected was quillback 38%, carp 29%, shorthead redhorse 8%, bluntnose minnow 6%, bigmounting buffalo 6%, and golden redhorse 4%. The presence of game and native fish species, along with healthy fish habitat are among the list of stakeholder concerns. In 1989, it was recommended that the reduction of soil run-off through improved land management practices would help improve water quality and game fish populations. Improvement structures, such as gabions, might also enhance game fish reproduction and survival.

Jasper County Trails Initiative

The National Park Service, Northwest Indiana Regional Plan Commission, and the Jasper County Economic Development Organization are working together to develop a trails system throughout Jasper County. This project is currently ongoing and hopes to provide hiking, biking, walking, and water trails to area residents. The purpose of these trails is to enhance tourism, promote healthy lifestyles, and help boost economic development along the corridors and in surrounding communities. This project addresses the stakeholder concerns regarding recreation.

2008 Total Maximum Daily Load (TMDL) Report for the Kankakee/Iroquois Watershed (Tetra Tech, 2009)

The TMDL Report finalized on October 23, 2009 was prepared for the U.S. Environmental Protection Agency (EPA) Region 5, Illinois EPA, and IDEM by Tetra Tech, Inc. A TMDL is the total amount of a pollutant that can be assimilated by the receiving water while still achieving water quality standards. They are composed of the sum of individual waste-load allocations for regulated sources and load allocations for unregulated sources and natural background levels. TMDL studies are performed on waterways that have been previously listed on the state's 303(d) list. These studies look to identify more specifically what types of pollutants are leading to impairments and what needs to be done to address those threats so that state water quality goals would be achieved. Data compiled for the Upper Iroquois in the summer of 2008 indicate that there are *E. coli* exceedances throughout the Indiana portion; therefore, this study looked specifically to address high levels of E. coli. Numeric criteria for E.coli were used as a basis of the TMDLs. The Indiana Administrative Code designates all surface waters of the state for full body contact recreation uses. Water Quality Standards (WQS) for all waters in the non-Great Lakes system states that E.coli bacteria shall not exceed 125 counts per 100ml as a geometric mean based on not less than 5 samples equally spaced over a 30 day period. Some of the recommended solutions to address the impairments include storm water controls, point source controls, manure management and habitat improvements. A more detailed review of the water quality data is included in the subwatershed descriptions.

<u>Rensselaer Riverfront Project</u> (Iroquois River Conservancy District, 1988)

In 1988, the Jasper County Soil Conservation Service (now NRCS) and the Jasper County SWCD worked with the Rensselaer Chamber of Commerce, Rensselaer Rotary and other local agencies to develop an Iroquois River improvement plan within the boundaries of Rensselaer, IN. The project consisted of three phases: Phase 1 was the construction of the canoe/boat access point at Lairds Landing; Phase 2 consisted of the installation of gabion, rock-filled baskets, to be placed into the river to improve canoe and boat access during times of low flow; and Phase 3 consisted of the construction of walkways through the downtown area to promote winter and summer recreation activities. Phase 1 was completed; however, phases 2 and 3 were never started. During the late summer months when rainfall is low and consequently run-off into the river is low, the depth of water flow over the rock ledges is not enough to allow passage of boats and canoes. The deep water pools become stagnant and depleted of oxygen and therefore do not provide livable fish habitat. Gabions would maintain a flow depth over the rock ledges so that small boats and canoes may pass at least 90% of the time. In addition to providing for the passage of small boats and canoes, these structures would also help aerate the water for better fish habitat. While this is a dated project, it still proves relevant to stakeholder concerns for fish habitat and recreational access. Much support for this project existed and preliminary engineering plans and cost estimates were completed, however due to landowner concerns of basement flooding the project was abandoned. Not sure if the concern was ever validated as a true concern, or just a rumor.

2.6 Endangered and Threatened Species

The Indiana Natural Heritage Data Center, part of the Indiana DNR, maintains a database which provides information on the presence of endangered, threatened and rare species; high quality natural communities; and natural areas in Indiana. The database relies on observations from individuals rather than systematic field surveys. Due to this, not every occurrence is documented and it is not guaranteed that each listed species is present at this time or that the listed area is in pristine condition (JFNew, 2003).

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 from eleven to twenty sites.

On a state listing basis, 45 species which are listed in the Natural Heritage Database as state endangered have been observed within the watershed including:

- Mussels: Sheepnose
- Insects: Aethes patricia, Frosted Elfin, Cochylis ringsi, and Ottoe Skipper
- Fish: Greater Redhorse
- Reptiles: Spotted Turtle, Blanding's Turtle, Eastern Mud Turtle, Smooth Green Snake, Eastern Massasauga, and Ornate Box Turtle
- Birds: Upland Sandpiper, Northern Harrier, Marsh Wren, Sedge Wren, Peregrine Falcon, Least Bittern, Loggerhead Shrike, Virginia Rail, and Golden-winged Warbler
- Mammals: Indiana Bat, Franklin's Ground Squirrel
- Vascular Plants: Bristly Sarsaparilla, Lake Cress, Hill's Thistle, Toothed Sedge, Small-fruited Spike-rush, Carolina Fimbry, Creeping St. John's-Wort, Brown-fruited Rush, Sand plain Flax, Globe-fruited False-loosestrife, Northern Bog Club moss, Sessile-leaved Bugleweed, Cutleaf Water-milfoil, Eastern Eulophus, Yellow-fringe Orchids, Prairie Parsley, Snail-seed Pondweed, Spotted Pondweed, Globe Beaked-rush, Torrey's Bulrush, Muhlenberg's Nutrush, Hidden-fruited Bladderwort, and Small Swollen Bladderwort.

Three amphibian species are listed as state species of special concern: Blue-spotted Salamander, Plains Leopard Frog, and Northern Leopard Frog. All three species have a G5 ranking, stating them to be widespread and abundant globally. The Plains Leopard Frog is ranked as S1 and to be critically imperiled in the state. The Blue-spotted Salamander and Northern Leopard Frog have an S2 ranking of being imperiled in the state.

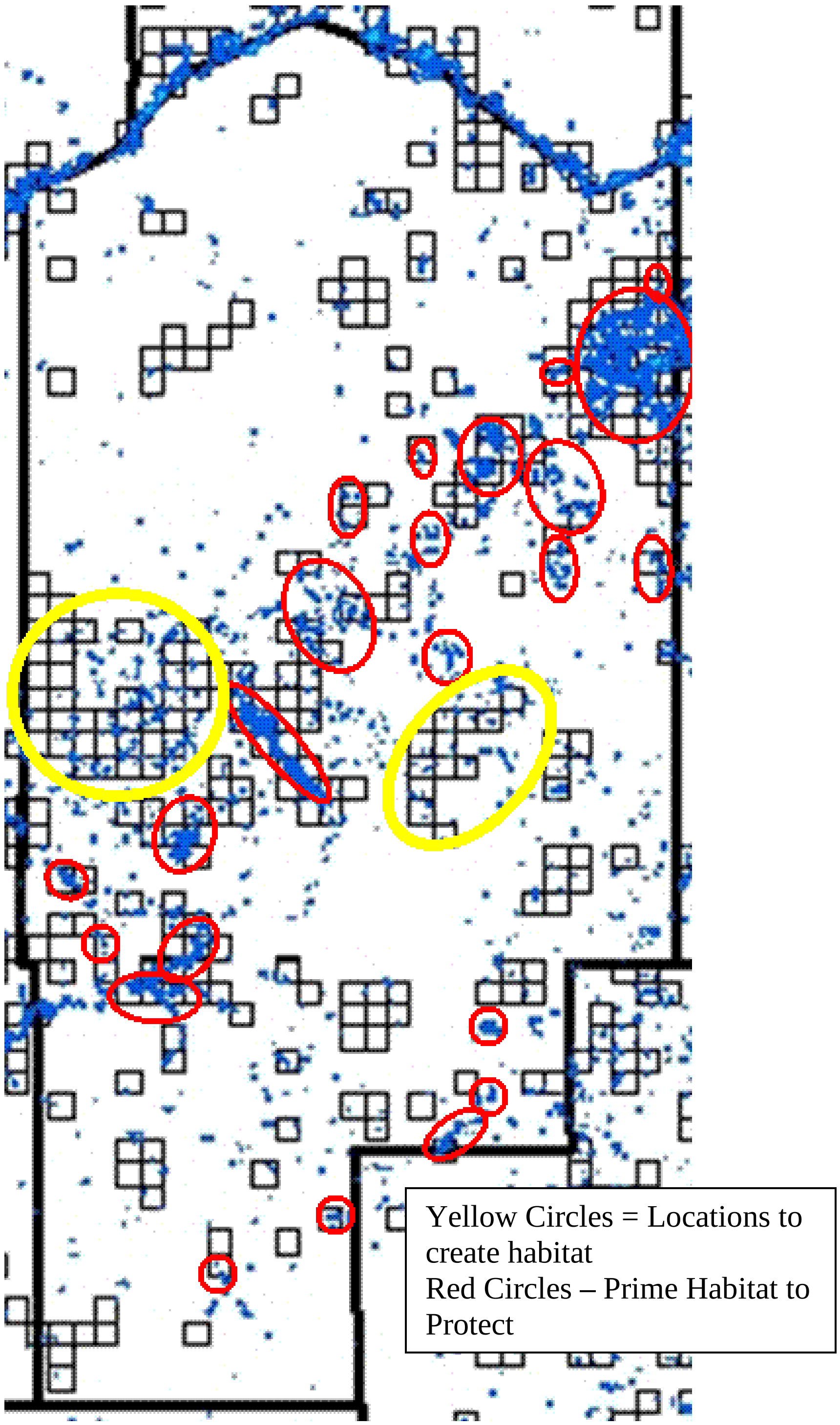
Habitat preferences for the state listed species vary. Warm water temperatures, high turbidity, and loss of habitat can all impact fish and mussel diversity. Deforestation or forest fragmentation likely affect the peregrine falcon and Indiana bat species. These species require large hunting areas where dense forests are present and small stream corridors with well-developed riparian forests. The elimination of these habitats could result in the loss of roost and hunting habitat thus eliminating these species. Other listed species, including Franklin's ground squirrel (found within Newton County), eastern massasauga, smooth green snake, and several bird and vascular plant species rely on prairie habitat. Many live on the border between forested and prairie habitats hunting in one habitat and nesting in the other. The conversion of prairies and forests to agricultural and urban land uses could have resulted in the decline in these populations (WREC, 2010)

A 14 Year Study of Amphibian Populations and Metacommunities

A study of amphibian populations and metacommunities by Dr. Robert Brodman, of the Biology Department at Saint Joseph's College, Rensselaer, IN used data from 14 species of amphibian fauna in Jasper County to detect population and diversity trends. Hypotheses regarding the influence of landscape, climatic, and biotic factors on abundance, occupancy, and diversity were also tested. A total of 11,438 breeding populations were recorded in Jasper County from 1994-2007. An average of 339 sites with amphibian breeding activity and 817 populations were identified. A total of 630 wetland clusters and isolated wetlands were identified. Of these, 94.4% had at least one year with amphibian breeding activity and 81.3% had metacommunities with at least two coexisting species.

The 23 wetland clusters that exhibited the highest abundance were defined as megametacommunities. These megametacommunities are associated with several landscape variables with 78% including upland habitat identified by the IBI conservation tool as km^2 sections with greater than 50% cover by important native plants or core habitat for any of the six species designated for the region as umbrella wildlife species. This association with priority habitats is related to the stakeholder's concerns list, particularly in regards to protecting and creating healthy fish habitat. The megametacommunities are associated with all but two of the large areas in Jasper County that have large numbers of wetlands and important native plant or umbrella animal habitats. Figure 23 Amphibian Megametacommunities shows the location of the 23 megametacommunities. Wetland clusters and isolated wetlands are indicated by the blue, amphibian megametacommunities are indicated by the red circles, and IBI priority habitats are indicated by open squares. Yellow circles indicate areas with wetlands, and priority habitat, but no amphibian megametacommunities (Brodman, 2009).

Figure 23 Amphibian Megametacommunities



2.7 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 specific subwatershed related relationships are discussed in more detail in subsequent sections.

2.7.1 Soils, Topography, and Land Forms

Topography of the watershed is generally undulating to nearly level, but there are narrow steep slopes adjacent to the Iroquois River and its small tributary streams. The steeper slopes adjacent to streams would be characteristic of areas prone to soil loss, especially if they are farmed or lack vegetative cover year round. These would be a potential source of sediments and excess nutrients in the watershed. These areas should be mapped and then targeted for appropriate treatment BMP's based on site conditions.

Most soils occurring on nearly level areas of the watershed are generally classified as prime farmland. These areas can be a significant source of sediment and nutrients if not managed properly. They can also be a source of nitrogen leaching when artificially drained. Conservation tillage and other best management practices are extremely important to minimize or eliminate the deposition of windblown particles in waterways.

As noted earlier, most of the soil types on the nearly level and depressional areas within the watershed are hydric and require the installation of subsurface drainage tile and/or open drainage channels to facilitate farming operations. These extensive drainage networks, as seen in Figure 10 Legal and Private Drains in Iroquois Watershed, often facilitate nitrogen leaching from the soil. Specific watersheds with both extensive tile drain networks and open ditches, plus low use of conservation tillage methods could be significant sources of excess nitrogen to waterways. These areas will be noted in the subwatersheds section.

2.7.2 Development and Population Centers

The largest population center is the City of Rensselaer with 8 CSO outfalls and significant impervious surfaces. In terms of largest urban non-point pollution sources, this is most likely the area, especially given that the Iroquois River flows right through the middle of the city.

Other towns and communities in the area, especially unsewered areas as mapped in Figure 21 Unsewered Areas with Significant Populations could be sources of urban non-point pollution, especially failing septics that could be contributing E.coli and excess nutrients to the waterways. Given that more than 90% of the soils in the watershed are poorly suited for conventional septic systems, alternative wastewater treatment systems and regional sewer districts should be encouraged. Separation of combined sewer overflow (CSO) systems and the use of low impact developments and management practices should also be encouraged.

In urban and suburban areas, water conservation and the use of storm water best management practices should be encouraged.

2.7.3 High Quality Habitat, ETR Species, and Recreational Opportunities

A significant amount of publicly-owned land located within the Upper Iroquois watershed exists, especially in the Oliver Ditch subwatershed. Since increasing recreational access to the river is a stakeholder concern the variety of high quality habitats and endangered, threatened, and rare species in these areas and outside already protected areas creates a unique opportunity in the watershed. Publicly-owned land and non-profit conservation land that is not routinely visited by watershed stakeholders could provide a great opportunity to positively impact water quality. It is clear from the social indicators survey that stakeholders value recreational use of land and if we can connect people to what is in their own back yards is directly connected to water quality, then we can have an impact. People care and protect what they know and are connected too. Enhancement of these areas could serve as demonstration sites which will allow stakeholders to view management options before enacting them on their own property. As stakeholder's love for these areas grows, willingness to protect high quality species and habitat, and their desire to positively impact water quality and the environment will increase the opportunity present in the watershed to improve water quality. Greater efforts need to be made to increase the number of access points along the main stem of the Iroquois River and appropriate tributaries. Hydrology and soil types that are hydric may be the areas to focus on getting more access points, while also looking to protect these areas as high quality habitat.

3.0 Watershed Inventory II: Environmental and Water Quality Data

The following contains three sections. First, are the water quality parameters and target levels for 2013. Second, is a summary of the historical water quality data and studies. Third, a narrative of each individual sub watershed (10 digit HUC) within the Upper Iroquois watershed, with any relevant 12 digit HUC watersheds discussed in detail. Each narrative will include specific water quality information, habitat/Biological information, and land use information.

3.1 Water Quality Targets

Water quality targets for each parameter have been selected based on applicable Indiana Administrative Code, the Upper Iroquois River TMDL, and other standards accepted by the Indiana Department of Environmental Management. Table 18 Water Quality Parameters and Target Levels are used for the Upper Iroquois Watershed to assess the water quality throughout the drainage area.

Table 18 Water Quality Parameters and Target Levels

Parameter	Target Level	Source
pH	> 6 or <9	Indiana Administrative Code Article 2 327-IAC
Temperature	Monthly Standard	Indiana Administrative Code Article 2 327-IAC
Dissolved Oxygen	> 4 mg/L and <100%	Indiana Administrative Code Article 2 327-IAC
E.coli	<235 cfu per 100ml sample	EPA Safe bodily contact limit
Ortho-phosphate	Max: 0.005 mg/L	Wawasee Area Conservancy Foundation recommendation for lake systems, NESWP344
Nitrate-nitrogen (NO3-N)	Max: 1.0 mg/L (20 year goal)	Ohio EPA recommended criteria for Warm Water Habitat (WWH) headwater streams in Ohio EPA Technical Bulletin MAS//1999-1-1 [PDF] (Dodds, 2000)
	1.5 mg/L (10 year goal)	Dividing line between mesotrophic and eutrophic streams (Dodds, W.K. et al., 1998, Table 1, pg. 1459, and in EPA-822-B-00-002 [PDF], p 27.)
	10.0 mg/L (5 year goal)	IDEM draft TMDL target based on drinking water targets
Turbidity	Max: 25.0 NTU	Minnesota TMDL for protection of fish/macroinvertebrate health
	Max: 10.4 NTU	U.S. EPA recommendation
Citizen Habitat Evaluation Index CQHEI	100> High quality Stream	Hoosier River Watch
	> 60 Generally Healthy	Hoosier River Watch
Citizen IBI	>23 Excellent	Hoosier River Watch
	17-22 Good	Hoosier River Watch
	11-16 Fair	Hoosier River Watch
	10< Poor	Hoosier River Watch

3.2 Historical Water Quality Data

Several historical sources of water quality data are available and were reviewed in an effort to determine long term trends in data. A brief review of these data sources is included below. Relevant data and conclusions from the data will be discussed in further detail in the relevant subwatershed descriptions.

Curtis Creek Watershed Diagnostic Study

The Curtis Creek Watershed Diagnostic Study plan was completed in April 2003 by JF New and Indiana University. The study was commissioned by the Newton County SWCD and Indiana Department of Natural Resources Lake and River Enhancement Program. The purpose of the study was to describe the historical and existing conditions of the watershed, identify potential problems, and make prioritized recommendations addressing these issues. Specifics of this study will be discussed under the Curtis Creek subwatershed section.

Fish Consumption Advisory 2010

The Indiana State Department of Health (ISDH), Indiana DNR and IDEM, with support from Purdue University, collaborated to produce the annual Indiana Fish Consumption Advisory for 2010. The Advisory is based on the statewide collection and analysis of fish samples for long-lasting contaminants found in fish tissue, such as polychlorinated biphenyls (PCBs), pesticides, and/or heavy metals (e.g., mercury). Samples were taken from fish that feed at all depths of the water, predatory and bottom-feeding. Fish consumption advisories for Jasper and Newton County are seen in Table 19 Fish Consumption Advisory, 2010 below.

Table 19 Fish Consumption Advisory, 2010

Fish Consumption Advisories for Sensitive Populations*	Species	Length (in)	Contaminant	Maximum Amount of Meals for Adults**
All Indiana Rivers and Streams (unless specified)	Carp	All		0
Iroquois River (Jasper & Newton County)	Carp	Up to 19		8 ounces per wk (1 meal/wk)
		28+	PCBs	0
	Channel Catfish	Up to 18		8 ounces per wk (1 meal/wk)
	Shorthead Redhorse	Up to 12		8 ounces per wk (1 meal/wk)
	Golden Redhorse	Up to 15		8 ounces per wk (1 meal/wk)
	Rock Bass	Up to 6		8 ounces per wk (1 meal/wk)
All Indiana Rivers and Streams (unless specified)	Carp	All		0

*Sensitive populations include: pregnant or nursing women, women that will become pregnant, and children under 6 years of age. These consumers should use caution when eating some types of sportfish.
**The maximum amount for adults to eat is determined by fishing location, species and fish length. For instance, if you eat the maximum amount of one species during a week, you should not eat any other fish which has a consumption limitation until the following week. Example - if you eat the limit (4 ounces) of a 20 inch long Carp from the Easy Catch River, then you should not eat any other sportfish from the list until the following week.

TMDL Report for the Kankakee/Iroquois Watershed 2008

IDEM determined that there is a lack of historical E.coli data needed for a water quality load duration analysis for the Upper Iroquois River Subwatersheds. Table 59 in Section 6.0 of the TMDL document suggests a relationship between potential sources and the resulting water quality. E.coli counts (sampled once a week for five weeks in June 2008) are among the highest in the Upper Iroquois subwatersheds which are characterized by relatively high animal unit densities. It is therefore possible that waste generated by livestock in these subwatersheds is contributing to the elevated bacteria counts. However, it is also possible that some other factor could explain the higher counts. For example, the Upper Iroquois is also made up of headwater subwatersheds and many of the sampled tributaries therefore have a relatively small drainage area. Streams with smaller drainage areas generally have relatively higher *E. coli* counts because there is less opportunity for dilution compared to larger streams. Most NPDES facilities were in compliance in their flow and bacteria limits. It has also been determined by IDEM that there is not any one specific condition that is the “critical” condition. The load duration calculations and other analyses show that exceedances occur under several flow regimes and varied from one major subwatershed to another depending on subwatershed characteristics and contributing sources.

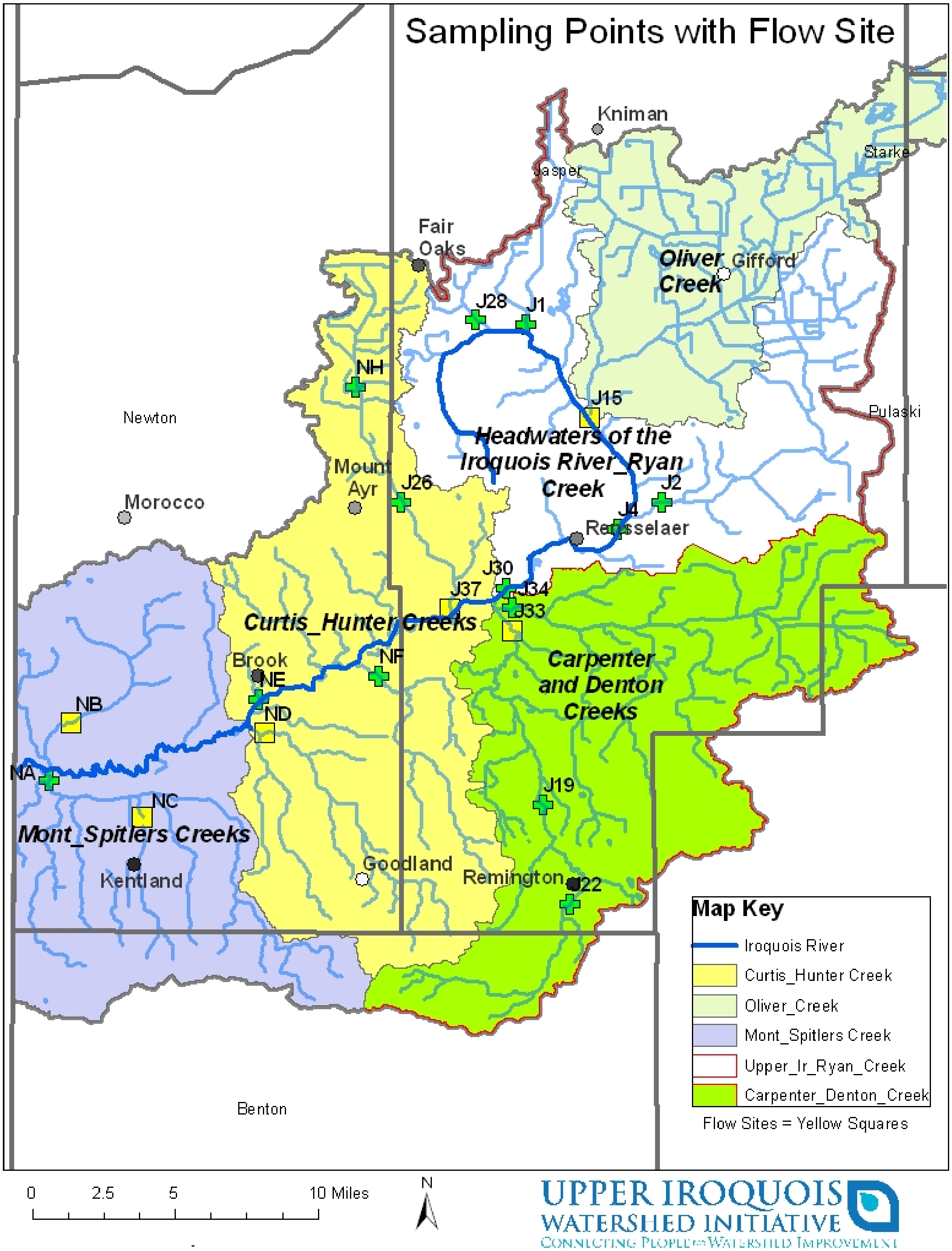
Upper Iroquois Watershed Initiative (UIWI) Water Quality Monitoring

Water quality monitoring has been performed to gain an understanding of existing water quality and to identify potential contributing areas. Monitoring is performed using in-house and partner equipment. Specifically, testing for E.coli levels, nutrient impairment, and sediment problems have been carried out. Monthly chemical and physical testing includes measuring flow using a price flow meter, total dissolved oxygen, pH, temperature, conductivity, and turbidity using a quanta hydro lab probe. Ortho-phosphates are measured with a color comparator. Nitrates are tested using a cadmium reduction method and a Hach Colorimeter II. E.coli testing is done at all sites, monthly April through October with EPA approved methods at the Rensselaer Waste Water Treatment plant.

Yearly habitat and macroinvertebrate assessments are done once at each site in July or August of each year. Currently 18 sites are sampled within the Upper Iroquois Watershed that stretches between Jasper and Newton Counties. At least one high flow event and one low flow event is included.

Results from May 2011 to April 2013 testing are discussed in sub watershed sections and summarized in section 4 of this watershed management plan.

Figure 24 UIWI WQ Sampling Sites



3.3 Watershed Inventories

Land use and other inventories on potential sources of pollutants were analyzed for the 5 HUC 10 subwatersheds in the Upper Iroquois River Watershed. A brief summary of these inventories are included below, with more specifics included in each of the 5 subwatershed descriptions.

Indiana Department of Environmental Management

IDEM is responsible for environmental compliance issues and works in accordance with the EPA. The Office of Land Quality works with such land uses as agricultural and solid waste, auto salvage, confined animal feeding operations (CAFO/CFO), hazardous waste, industrial waste, and underground storage tanks (UST). The goal is to make sure that these developments are meeting their permit requirements.

A survey of areas within the Upper Iroquois Watershed that are under the Office of Land Quality was completed. Various permitted land uses were mapped and are discussed in each subwatershed section as relevant to stakeholder concerns.

Fertilizer Use on non urban/suburban land uses

Fertilizer use is present on almost all land uses, but very little data on exact amounts and use is publically available. For agricultural land use it is important that nutrient management plans are created and that they are utilized along with the latest in precision technologies such as- yield monitors, autoswath control, variable rate- fertilizer, lime, etc. in order to preserve water quality. Likewise, urban use of fertilizer should be better understood and BMPs promoted as a key part of education and outreach efforts.

Hobby Farms and other Animal Feeding Operations (AFOs) The existence and impact of Hobby farms or AFOs on local water quality is not well understood. The windshield survey with documenting livestock access points is the best way we have been able to locate and track impact of AFO's on water quality and are discussed in the windshield survey sections

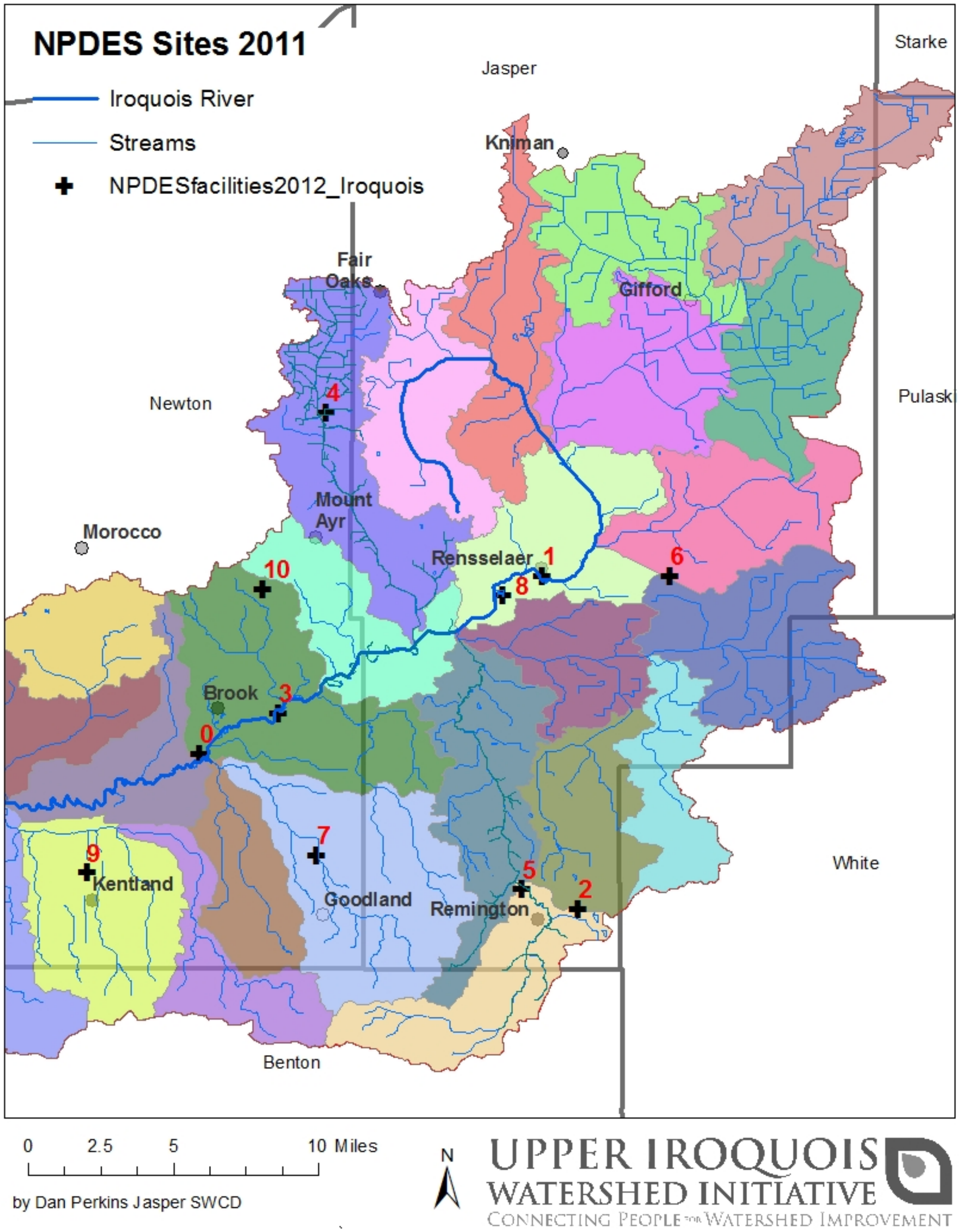
NPDES Facilities

Facilities in the watershed are regulated under the National Pollution Discharge Elimination System (NPDES) program which is administered by IDEM and the U.S. EPA. The NPDES program regulates direct (point source) discharges to waters of the state by establishing, or setting, limits on the type and amount of pollutants that may be discharged from each facility's outfall(s). IDEM issues several different types of NPDES permits: Municipal, Industrial, and Wet Weather (i.e. Storm Water-related and Combined Sewer Overflow). At the time of this writing there were a total of 13 permitted municipal and industrial facilities in the watershed. Table 20 NPDES Sites in Upper Iroquois Watershed lists the name, location, county, receiving waters, and primary discharge type. Each facility's compliance with their NPDES permit(s) will be evaluated in the sub-watershed sections.

Table 20 NPDES Sites in Upper Iroquois Watershed

Site Map #	NPDES Facility Name	Type	Discharge (Million gallons per day) MGD	City	Receiving Water	Discharge Type
0	Brook WWTP, Town	MWD	0.100	Brook	Iroquois River	Sewerage Systems
1	Rensselaer WWTP	CSO		Renselaer	Iroquois	Storm water
4	Fair Oaks Bottling Co	POF	0.450	Fair Oaks	Curtis Creek	Dairy Products
3	George Ade Memorial Health Care Center	MXO	0.000	Brook	Iroquois River	Skilled Nursing Care Facilities
7	Goodland Municipal WWTP	MWD	0.095	Goodland	Hunter Ditch Trib	Sewerage Systems
6	Iroquois Bio-Energy Co, LLC	POF	0.420	Rensselaer	Sage (Pinkamink) Ditch	Industrial Organic Chemicals
9	Kentland WWTP	MWD	0.700	Kentland	Montgomery Via Kent	Sewerage Systems
10	Newton Regional Water and Sewer District	MWD	0.000	Brook	Battleday Ditch	Sewerage Systems
2	Remington I 65 auto Truck Plaza	POF	0.000	Remington	Bice Ditch	Gasoline Service Stations
5	Remington WWTP	MWD	0.429	Remington	Carpenter Creek	Sewerage Systems
1	Rensselaer WWTP	MWD	1.200	Rensselaer	Iroquois River	Sewerage Systems

Figure 25 NPDES Sites 2012



Confined Feeding Operations (CFOs/CAFOs)

Animals raised in confined feeding operations produce manure and wastewater which is collected and stored in pits, tanks, lagoons and other storage devices. The manure is then applied to area fields as fertilizer. When stored and applied properly, this beneficial reuse provides a natural source of nutrients for crop production. It also lessens the need for fuel and other resources that are used in the production of commercial fertilizer.

Confined feeding operations, however, can also pose environmental concerns, including the following:

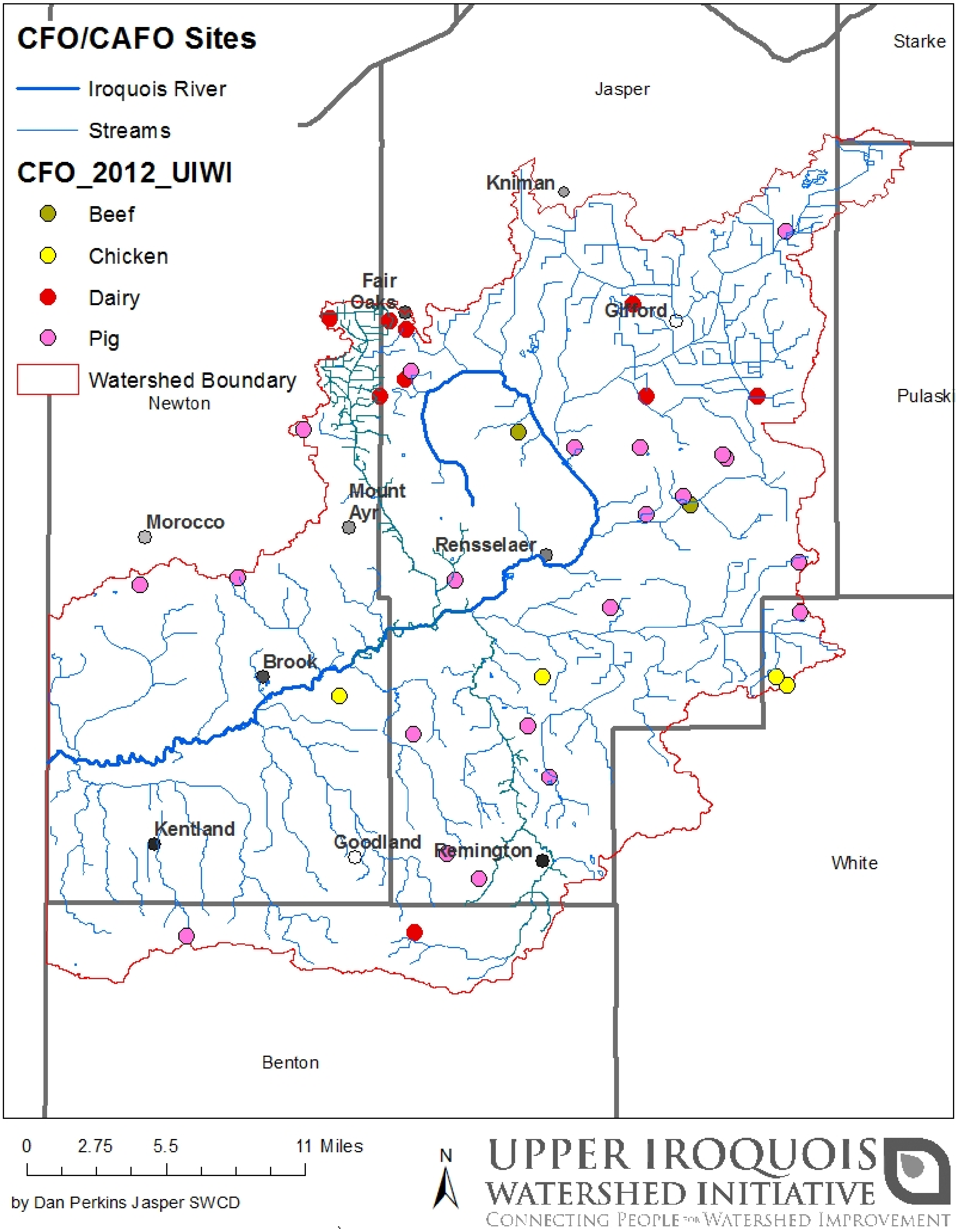
- Manure can leak or spill from storage pits, lagoons or tanks
- Improper application of manure to the land can impair surface or ground water quality

The IDEM CFO/CAFO approval/permit program is based on the Confined Feeding Control Law administered through regulations adopted under the Water Pollution Control Board. CFO/CAFOs will be discussed in more detail in each sub watershed section.

Table 21CFO/CAFOs in UIWI Watershed

FarmID	OperationN	HUC 10	County	PermitProg	PermType	ConstrucAp
6207	SEVEN HILLS DAIRY LLC	Carpenter_Denton	BENTON	CAFO	GENERAL PERMIT	4/8/2010
4390	RONALD HATHAWAY	Carpenter_Denton	JASPER	CFO	CFO APPROVAL	5/29/1998
745	FREY FARM	Carpenter_Denton	JASPER	CFO	CFO APPROVAL	4/8/1997
2689	TIP TOP PIGS INCORPORATED 1	Carpenter_Denton	JASPER	CAFO	GENERAL PERMIT	8/12/1991
3423	WHITE COUNTY PULLETS	Carpenter_Denton	WHITE	CFO	NPDES EXEMPTION	2/13/1985
3506	ROSE ACRE FARMS JASPER COUNTY PULLETS	Carpenter_Denton	JASPER	CFO	NPDES EXEMPTION	3/17/1988
3422	WHITE COUNTY EGG FARM	Carpenter_Denton	WHITE	CAFO	GENERAL PERMIT	8/24/2004
2891	MARK & REBECCA STREITMATTER	Carpenter_Denton	WHITE	CFO	CFO APPROVAL	3/1/2002
516	JACK RODIBAUGH & SONS INCORPORATED	Carpenter_Denton	JASPER	CFO	CFO APPROVAL	1/17/1995
4260	KEITH STREITMATTER	Carpenter_Denton	JASPER	CFO	CFO APPROVAL	12/29/1994
3279	OINKER ACRES	Curtis_Hunter	JASPER	CFO	CFO APPROVAL	5/17/1994
3182	FOXHILL HOG FARM	Curtis_Hunter	JASPER	CFO	CFO APPROVAL	6/2/1980
3372	NEWTON COUNTY EGG FARM	Curtis_Hunter	NEWTON	CAFO	GENERAL PERMIT	10/27/2010
651	KORNIAK FARM	Curtis_Hunter	JASPER	CFO	CFO APPROVAL	12/22/1998
2399	NURSERY FINISHING SITE	Curtis_Hunter	NEWTON	CFO	NPDES EXEMPTION	11/27/2001
3535	CAMBALOT SWINE BREEDERS	Curtis_Hunter	NEWTON	CAFO	GENERAL PERMIT	2/22/2008
6036	FAIR OAKS DAIRY FARM SOUTH SITE 2	Curtis_Hunter	NEWTON	CAFO	GENERAL PERMIT	6/17/2010
3732	CALF LAND LLC	Curtis_Hunter	JASPER	CAFO	GENERAL PERMIT	10/21/2002
6064	FAIR OAKS DAIRY FARM CENTRAL 3	Curtis_Hunter	NEWTON	CAFO	GENERAL PERMIT	10/8/1999
6341	FAIR OAKS DAIRY FARM LLC NORTH CENTRAL 5	Curtis_Hunter	NEWTON	CAFO	GENERAL PERMIT	10/29/2008
6065	FAIR OAKS DAIRY FARM WEST 4	Curtis_Hunter	NEWTON	CAFO	GENERAL PERMIT	2/18/2003
1680	HAROLD & DON GRETENCORD	Mont_Strole	BENTON	CFO	CFO APPROVAL	3/30/1995
669	GARY A CLARK	Mont_Strole	NEWTON	CFO	CFO APPROVAL	7/20/1993
6380	HIDDEN VIEW DAIRY	Oliver	JASPER	CAFO	GENERAL PERMIT	2/23/2007
6083	NEWBERRY FARMS LLC	Oliver	JASPER	CAFO	GENERAL PERMIT	9/14/2006
6383	PEMBROKE OAKS FARM LLC	Oliver	JASPER	CFO	CFO APPROVAL	10/20/2005
4656	GOP FARMS	Upper_Ir_Ryan	JASPER	CFO	CFO APPROVAL	10/9/2001
4337	MOORE FARMS	Upper_Ir_Ryan	JASPER	CFO	CFO APPROVAL	12/29/1994
4235	PARKINSON & RODIBAUGH	Upper_Ir_Ryan	JASPER	CFO	CFO APPROVAL	1/17/1995
4056	HURLEY SWINE ENTERPRISES 1	Upper_Ir_Ryan	JASPER	CAFO	GENERAL PERMIT	12/2/2010
4991	NORTHWIND PORK LLC	Upper_Ir_Ryan	JASPER	CFO	CFO APPROVAL	10/19/1998
652	PULLIN FARMS INCORPORATED	Upper_Ir_Ryan	JASPER	CFO	CFO APPROVAL	9/18/1972
2542	MAX L FARMS LLC	Upper_Ir_Ryan	JASPER	CFO	NPDES EXEMPTION	8/16/2002
876	GROW FARM & FEEDLOTS INC	Upper_Ir_Ryan	JASPER	CAFO	GENERAL PERMIT	6/25/2007
6604	DE JONG FAMILY FARMS LLC	Upper_Ir_Ryan	JASPER	CAFO	GENERAL PERMIT	6/17/2010
6045	WINDY RIDGE DAIRY LLC	Upper_Ir_Ryan	JASPER	CAFO	GENERAL PERMIT	12/3/2009
3700	IROQUOIS VALLEY SWINE	Upper_Ir_Ryan	JASPER	CFO	NPDES EXEMPTION	9/13/1991

Figure 26 CFO/CAFO Sites



UST

Underground storage tanks are not a water quality concerns as long as they are not leaking. 37 Leaking underground storage tanks (LUSTs) do exist across the watershed according to IDEM's LUST August 2009 listing and are mapped in

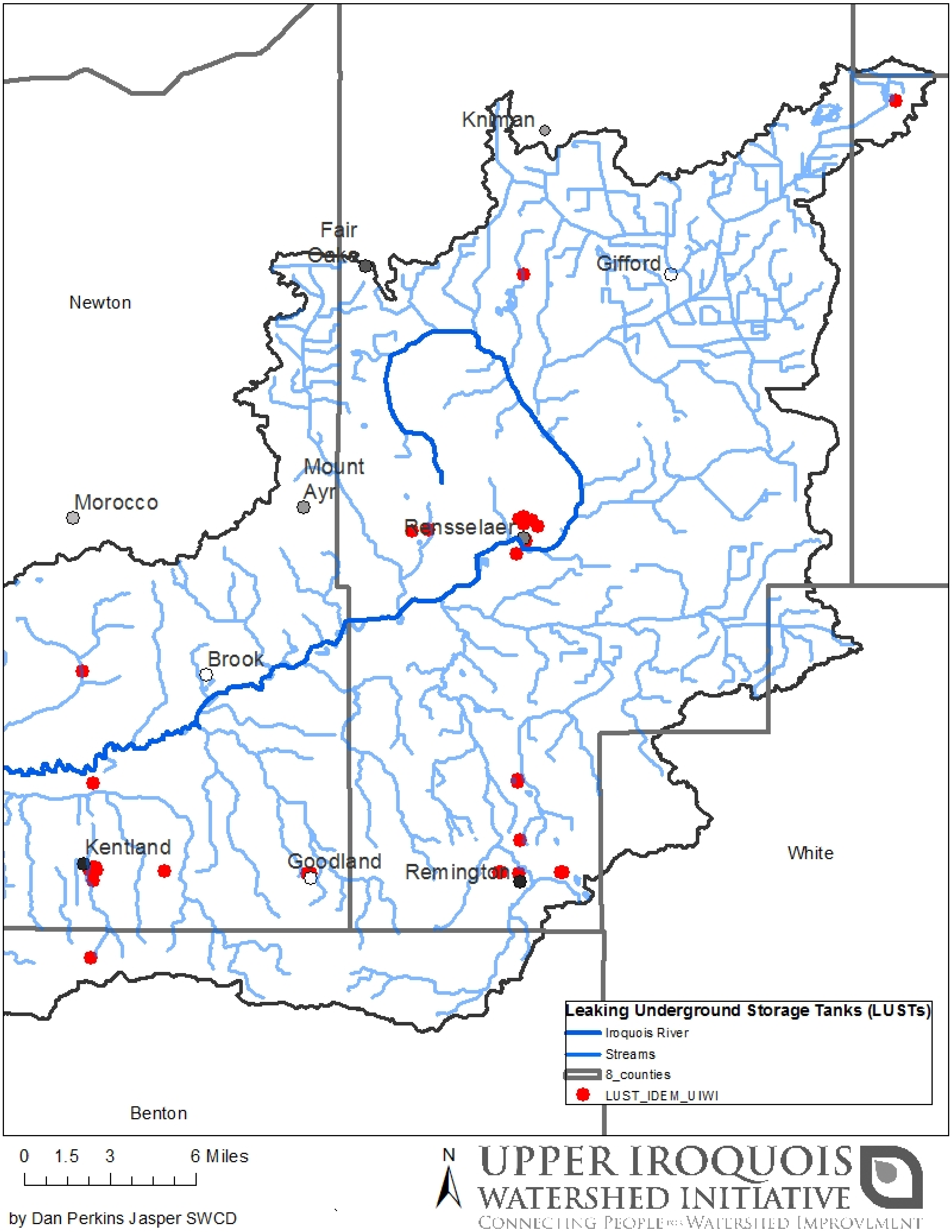
IDEM Site ID	PRIMARY_NA	DATA_COLLE	LOCATION_A
1947	Funk & Sons Inc	1/15/2008	
16936	Kentland Truck Stop	2/21/2002	409 South 7th Street
17780	Family Pantry #7	11/21/2005	23 W Division Hwy 24
12257	Durham's Amoco	11/21/2005	127 W Jasper St/Us 24 W
11592	Goodland Food Shop	3/7/2002	Us 24 & Newton St
15483	Remington Travel Plaza	6/16/2004	
12419	Remington Freight Lines Remington	8/8/2006	
501	Schilli Leasing Inc Remington	1/24/2002	6358 Us 24 West
3526	Pilot Travel Centers #034	2/7/2002	Rr 2 Box 240-C
21045	Newton County Quarry	1/15/2008	
17604	Funk & Sons Inc	11/1/2006	
802 DUNAWAY	REC. AND SHIP.	11/1/2006	
22109	Ford's Automotive & Truck Repair	11/21/2005	504 E Seymour St
15758	Bernie's Amoco Service Inc	9/25/2003	
11566	Kentland Shell	2/21/2002	Us 24 & Us 41
14819	Bernies Kerr Mcgee Dba Bernie 66	2/21/2002	412 E Seymour
15758	Bernie's Amoco Service Inc	11/1/2006	
1476	Dekalb Genetics Corp Remington	7/21/2006	
3739	Kentland Unit	1/15/2008	
11571	Shell Travel Mart	2/7/2002	13766 S Us 231
1204	Midway Marathon	2/7/2002	13702 S Us 231
10606	Jasper Co Farm Bureau Co-Op	11/21/2005	2887 W. & 883 S.
16135	Southside Amoco	11/21/2005	511 S College
14683	Petro Plus Food Mart Iii	11/21/2005	510 S. College Ave.
22991	County Jail & Sheriffs Dept	11/21/2005	202 S Cullen
11570	Trail Tree Truck Stop	8/8/2006	
4140	Family Express #35	2/12/2002	8805 W SR 114
370	Schumacher Electric Corporation	11/21/2005	512 N Melville St
2802	Brooks Motor Sales	11/21/2005	919 N Mckinley Ave
22033	MK Gas Stop	6/11/2004	
22033	MK Gas Stop	3/21/2002	
3741	Rensselaer Sub District	7/21/2006	
10186	** Vacant **	11/21/2005	1136 N Mckinley
6230	Northway Cabinetry Div.	11/21/2005	1133 N. Cullen St.
13016	Davisson Oil Co	7/21/2006	
15738	Fishers Grocery	7/8/2004	
4750	Jasper-Pulaski State Nursery	3/20/2002	15508 W 700 N

Figure 27 and site names and locations below. They should be further investigated as to their remediation status with IDEM.

Table 22 UIWI LUSTs Site Locations

IDEM Site ID	PRIMARY_NA	DATA_COLLE	LOCATION_A
1947	Funk & Sons Inc	1/15/2008	
16936	Kentland Truck Stop	2/21/2002	409 South 7th Street
17780	Family Pantry #7	11/21/2005	23 W Division Hwy 24
12257	Durham's Amoco	11/21/2005	127 W Jasper St/Us 24 W
11592	Goodland Food Shop	3/7/2002	Us 24 & Newton St
15483	Remington Travel Plaza	6/16/2004	
12419	Remington Freight Lines Remington	8/8/2006	
501	Schilli Leasing Inc Remington	1/24/2002	6358 Us 24 West
3526	Pilot Travel Centers #034	2/7/2002	Rr 2 Box 240-C
21045	Newton County Quarry	1/15/2008	
17604	Funk & Sons Inc	11/1/2006	
802 DUNAWAY	REC. AND SHIP.	11/1/2006	
22109	Ford's Automotive & Truck Repair	11/21/2005	504 E Seymour St
15758	Bernie's Amoco Service Inc	9/25/2003	
11566	Kentland Shell	2/21/2002	Us 24 & Us 41
14819	Bernies Kerr Mcgee Dba Bernie 66	2/21/2002	412 E Seymour
15758	Bernie's Amoco Service Inc	11/1/2006	
1476	Dekalb Genetics Corp Remington	7/21/2006	
3739	Kentland Unit	1/15/2008	
11571	Shell Travel Mart	2/7/2002	13766 S Us 231
1204	Midway Marathon	2/7/2002	13702 S Us 231
10606	Jasper Co Farm Bureau Co-Op	11/21/2005	2887 W. & 883 S.
16135	Southside Amoco	11/21/2005	511 S College
14683	Petro Plus Food Mart Iii	11/21/2005	510 S. College Ave.
22991	County Jail & Sheriffs Dept	11/21/2005	202 S Cullen
11570	Trail Tree Truck Stop	8/8/2006	
4140	Family Express #35	2/12/2002	8805 W SR 114
370	Schumacher Electric Corporation	11/21/2005	512 N Melville St
2802	Brooks Motor Sales	11/21/2005	919 N Mckinley Ave
22033	MK Gas Stop	6/11/2004	
22033	MK Gas Stop	3/21/2002	
3741	Rensselaer Sub District	7/21/2006	
10186	** Vacant **	11/21/2005	1136 N Mckinley
6230	Northway Cabinetry Div.	11/21/2005	1133 N. Cullen St.
13016	Davisson Oil Co	7/21/2006	
15738	Fishers Grocery	7/8/2004	
4750	Jasper-Pulaski State Nursery	3/20/2002	15508 W 700 N

Figure 27 Leaking Underground Storage Tanks



<u>Municipal Wastewater Sludge</u>

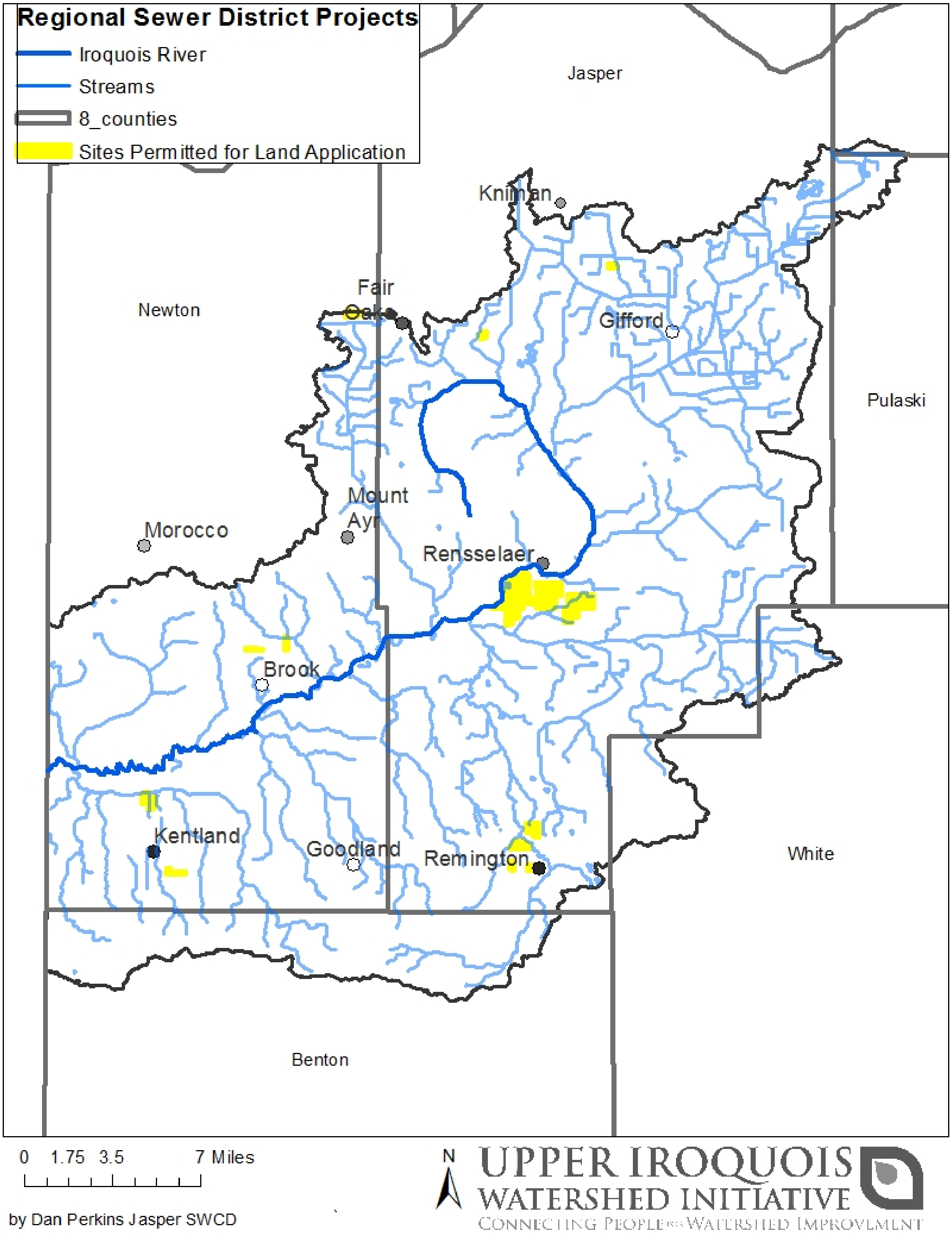
Wastewater sludge land application is not a water quality concerns as long as BMP's and plans are followed by the permitted facility and applicators. 8 facilities across the watershed do have permits to land apply sludge on over 2,312 acres, and are mapped in Figure 28 and site names and locations below in Table 23.

Specific water quality concerns related to land application will be discussed in the appropriate sub watershed section as needed.

Table 23 Municipal Sludge Land Application Permits in UIWI

SITE_ID	PERMITTEE	ACRES_PERM	PERMIT_NO
AP-1	KENTLAND MUNICIPAL STP	18.90	000391
CS-2	SOLAE, LLC	18.00	000112
CS-1	SOLAE, LLC	30.00	000112
S-2	REMINGTON MUNICIPAL STP	8.00	000162
S-4	REMINGTON MUNICIPAL STP	87.50	000162
S-1	REMINGTON MUNICIPAL STP	10.00	000162
S-3	REMINGTON MUNICIPAL STP	117.00	000162
WM-1	KENTLAND MUNICIPAL STP	77.00	000391
WM-2	KENTLAND MUNICIPAL STP	65.00	000391
BLY-101	GEORGIA PACIFIC	10.00	000461
BLY-201	GEORGIA PACIFIC	17.00	000461
04	RENSSELAER MUNICIPAL STP	143.00	000450
08	RENSSELAER MUNICIPAL STP	160.00	000450
06	RENSSELAER MUNICIPAL STP	20.00	000450
STJC-B	RENSSELAER MUNICIPAL STP	243.00	000157
02	RENSSELAER MUNICIPAL STP	80.00	000450
STJC-C	RENSSELAER MUNICIPAL STP	272.00	000157
03	RENSSELAER MUNICIPAL STP	140.00	000450
01	RENSSELAER MUNICIPAL STP	80.00	000450
STJC-A	RENSSELAER MUNICIPAL STP	201.00	000157
FIELD 05	RENSSELAER MUNICIPAL STP	3.26	000450
STJC-D	RENSSELAER MUNICIPAL STP	207.00	000157
07	RENSSELAER MUNICIPAL STP	171.00	000450
T-2	DEMOTTE MUNICIPAL STP	25.70	000029
FOF LEVER	UNILEVER HPC USA	3.51	AP0002
FODF-HQ1	CHESTERTON MUNICIPAL STP	85.00	000225
T3	DEMOTTE MUNICIPAL STP	20.00	000029

Figure 28 Municipal Land Application Fields



Upper Iroquois Watershed- Rapid Watershed Assessment (2008)

The USDA- Natural Resources Conservation Service (NRCS) created Rapid Watershed Assessments (RWA) to provide initial estimates of where conservation practices would best address the concerns of land owners, conservation districts, and the community. A quick review of natural resource data such as soils, topography, and impaired waterways was done to identify broad scale concerns. There were a number of resource concerns as listed in Table 24.

Concern Area	**Summary Information**
Surface Water Quality	2006 data, Approx. 18% (128 miles) of the 769 total miles of streams in the watershed have identified impairments for excessive amounts of sediments, nutrients, and bacteria.
Ground Water Quality	32% (175,140 acres) of soils have high leaching index (>10) which allows contaminants on the land to easily be carried to ground water through infiltration. Additionally, 2% (11,504 acres) are located inside wellhead protection areas. Sub surface drainage exists on 29% of the area.
Air Quality	No known air quality concerns exist.
Threatened and Endangered Species	Over 18% of the 416,866 acres in the watershed contain known ranges of Threatened & Endangered Species.
Soil Quality	Over 29% (161,849) of the watershed soils are at relatively high risk of eroding by wind.

Table 24 Rapid Watershed Assessment Resource Concerns Summary

The value of this data is for initial identification of concerns to be aware of as we look at more detail at the subwatershed level in regards to land use and resource information.

Indiana State Resource Assessment: Water Quality Degradation 2011

NRCS State Resource Assessment report June 2011 (Natural Resource Conservation Service, 2011) utilized an Offsite Risk Index- Soil map units with a surface run-off class of High or Very High and subsurface drainage potential of High or Very High, overlaid with crop land and then determined the percent of untreated crop land = untreated acres. Those areas with 33-50% untreated acres where ranked across the state.

The Upper Iroquois had 41% of its crop acres (224,530) untreated and therefore at risk, 4th in untreated % acres in the state overall. For goal setting and implementation, this was used as a starting point, each HUC 10's cropland acres was assumed to have 41% of its acres untreated with any conservation practice.

Windshield Inventory (2011-2012)

Windshield inventories were conducted during the summer and fall of 2012 using standardized field sheets, see Appendix 1. Windshield Survey Form.

The 2012 inventories were conducted by the watershed coordinator, watershed interns, and accompanying volunteers at every road section that crossed a stream. Summary results can be found in Table 25 Windshield Survey Summary Data. The information was compiled and areas of concern mapped in each HUC 10. The relevant concerns noted were:

1. Water Odor, color or algae
2. Stream Buffer- Present or Absent and % buffer present up and downstream of site. Determined by 100 foot along stream at the NE, NW, SE, SW direction of stream crossing. So if just NE and NW has buffer, it would be considered 50% buffered.
3. Areas of active erosion (stream bank)
4. Areas where livestock had direct access to waterways.
5. Evidence of Channelization

Concerns and maps are discussed in the relevant subwatershed section.

Table 25 Windshield Survey Summary Data

HUC 10 Windshield Survey Summary	Oliver	Upper Ir_Ryan	Carpenter/ Denton	Curtis/ Hunter	Mont/Strole
Windshield Survey Item					
Number Sites Sampled	51	67	80	87	58
# Sites with Buffers Present	39	56	67	64	53
% Sites with 100% Buffer	22%	30%	61%	48%	47%
% Sites with 75% Buffer	14%	9%	5%	1%	9%
% Sites with 50% Buffer	18%	22%	15%	20%	21%
% Sites with 25% Buffer	24%	22%	3%	5%	16%
% Sites with 0% Buffer	24%	16%	16%	26%	9%
# Sites with Active Erosion	1	19	3	11	14
# Sites with Livestock Access	2	7	12	19	8
# Sites with Channelization	40	56	72	62	34

Desktop Inventory

A desktop inventory was conducted by using GIS to analyze water courses in several ways:

1. Using GIS, a 100 foot buffer from the center line of each stream was used to select land-cover data from within 100 foot of the centerline of each stream. The land cover data was reclassification into 4 categories; water, buffered (grassland, pasture, forested, wetland), cropland, and developed (low, med, high) and then percent of each land use per sub-watershed was calculated. This will begin to help locate and characterize areas that lack stream buffers, which are critical to addressing stakeholder concerns of loss of fish habitat, flood retention, and excessive sediments, bacteria, and nutrients.

Table 26 HUC 10 Stream Buffer Land Use within 100 ft Summary

Stream Buffer Land Use with 100 Feet					
HUC 10	Carpenter_Denton	Curtis	Oliver	Mont_Strole	Upper Iroq
100 Ft Acre Total	3,805	3,888	3,323	2,669	3,220
Stream Miles	160	162	124	127	136
Water %	1%	1%	1%	4%	2%
Developed %	5%	5%	5%	6%	6%
Buffered %	20%	23%	18%	20%	18%
Cropland %	74%	71%	76%	70%	74%

2. Watershed areas with high nitrate leaching index mapped by HUC 10 according to the USDA Soil Survey.

Table 27 HUC 10 Nitrate Leaching Index Summary

HuC 10 Nitrate Leaching Index Summary		Acres in N Index		% of HUC 10 Soil Acres		Total Acres		% of Total HUC 8 Acres		*HUC 10 Ranking	
HUC 10 Watershed	**Total Soil Acres**	High	Concern	High	Concern	Total High + Concern	high+concern	High	Concern	High	Concern
Oliver Creek	52,685	23057	12415	44%	24%	35,472	67%	6%	3%	5	1
Upper Iq_Ryan Creek	86,768	20283	36687	23%	42%	56,970	66%	5%	9%	3	3
Curtis Creek_Hunter Creeks	103,490	14260	53949	14%	52%	68,209	66%	3%	13%	2	4
Carpenter_Denton Creeks	92,875	28818	24572	31%	26%	53,390	57%	7%	6%	4	2
Mont_Spitlers Creek	81,048	2901	53931	4%	67%	56,832	70%	1%	13%	1	5
Total Acres	416,866										
* 5 = Most leaching potential											

Each desktop inventory is discussed in the relevant sub watershed section.

3.3.0 Subwatershed Inventory Discussion.

The following section is a detailed discussion and summary of water quality, habitat/biological, land use, windshield and desktop data for each of the 5 HUC 10 subwatersheds in the Upper Iroquois River Watershed. HUC 12 sub watersheds will only be discussed when relevant to critical concerns or sources of non-point pollution and planning efforts.

Figure 29 HUC 10 Subwatersheds

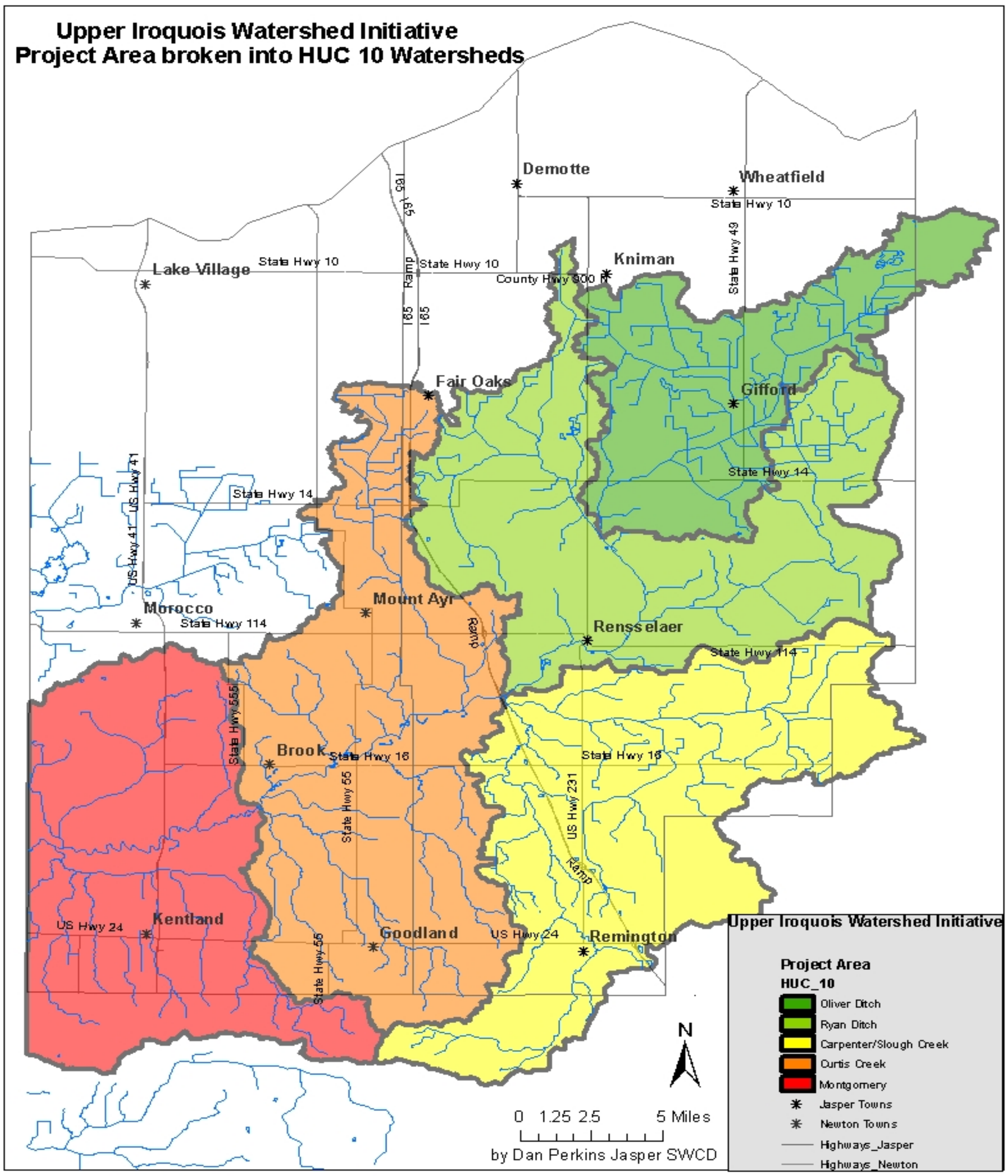
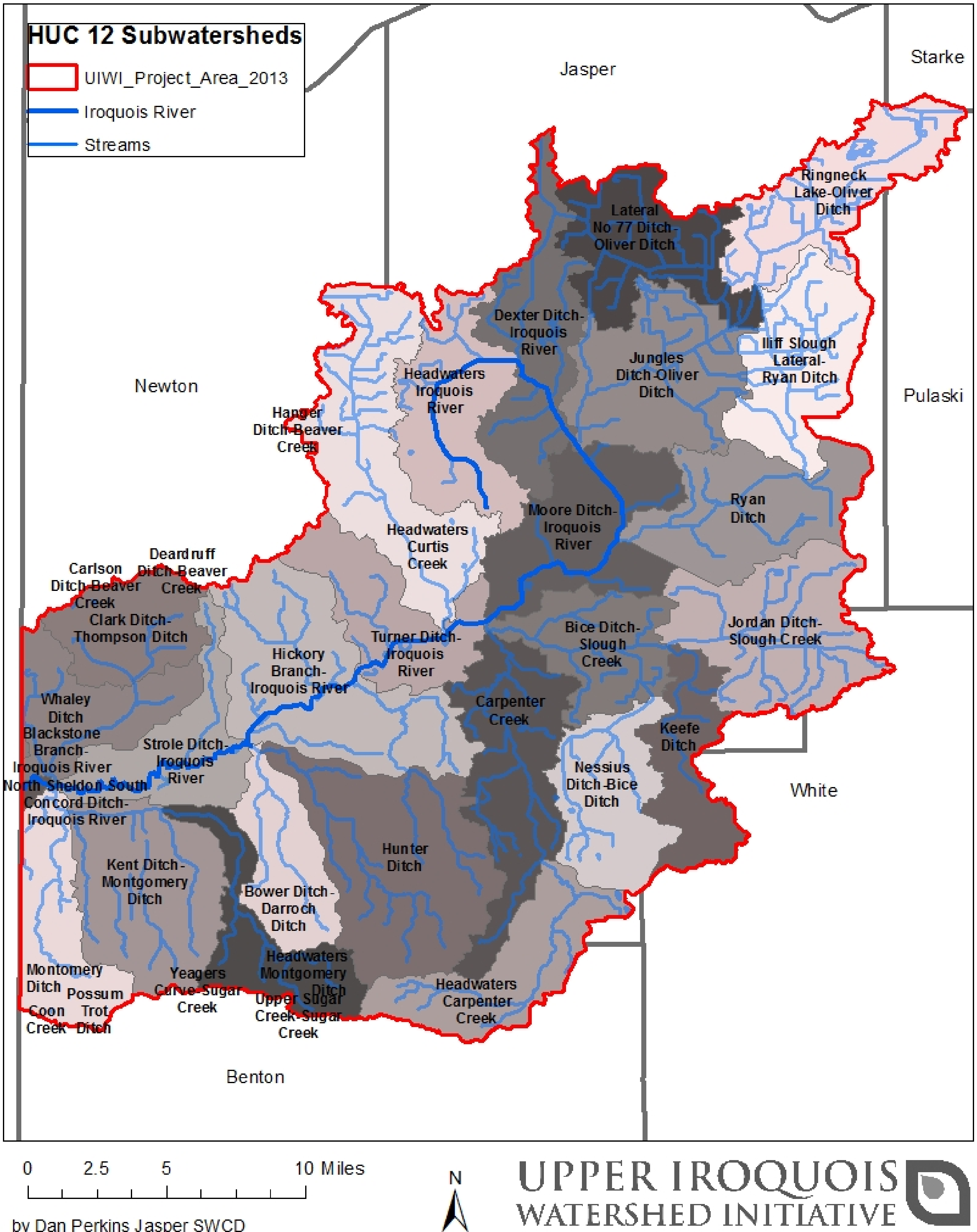


Figure 30 HUC 12 Subwatersheds

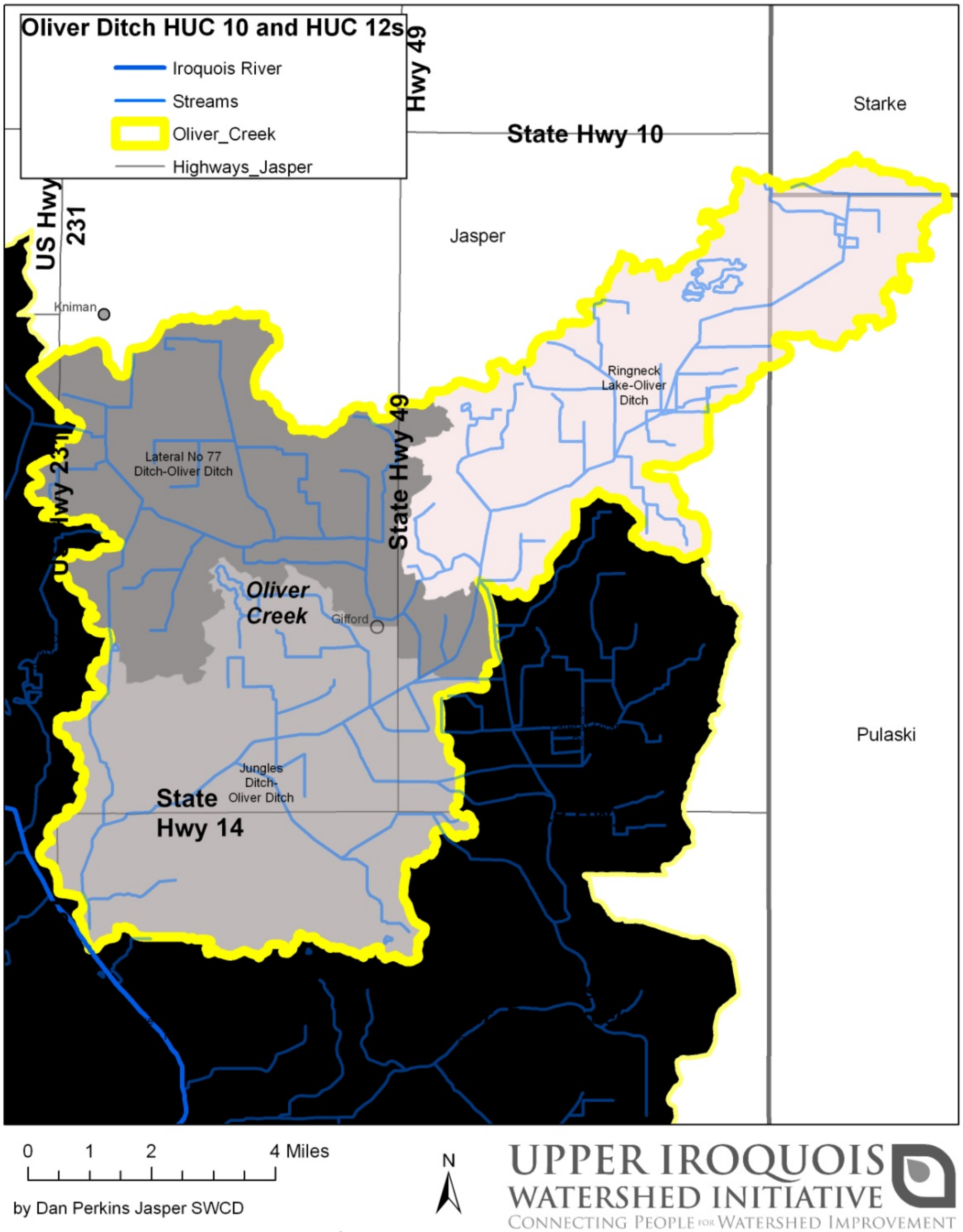


UPPER IROQUOIS WATERSHED INITIATIVE
CONNECTING PEOPLE FOR WATERSHED IMPROVEMENT

3.3.1 HUC 10- Oliver Ditch

The Oliver Ditch subwatershed is the northeastern most portion of the watershed. It has an area of approximately 82 square miles. It contains 3 HUC 12 subwatersheds- Lateral No 77, Ringneck Lake, and Jungles Ditch. It lies in parts of Jasper, Starke and Pulaski counties.

Figure 31 Oliver Creek HUC 10 Overview



i. Oliver Ditch Water Quality Information

<u>IDEM 303(d)</u>

Oliver Ditch has zero miles of impairment according to the 2012, 2010 and 2008 303(d) lists. However, the 2008 TMDL sampling did suggest several streams are impaired for E.coli as the geometric mean of 5 samples exceeded bodily contact limit. Sampling Station #52 is located on the Jungles Ditch and stations #56, 54, 50 on the Oliver Ditch.

Figure 32 Land Use and IDEM 2008 Sampling Sites Oliver Ditch

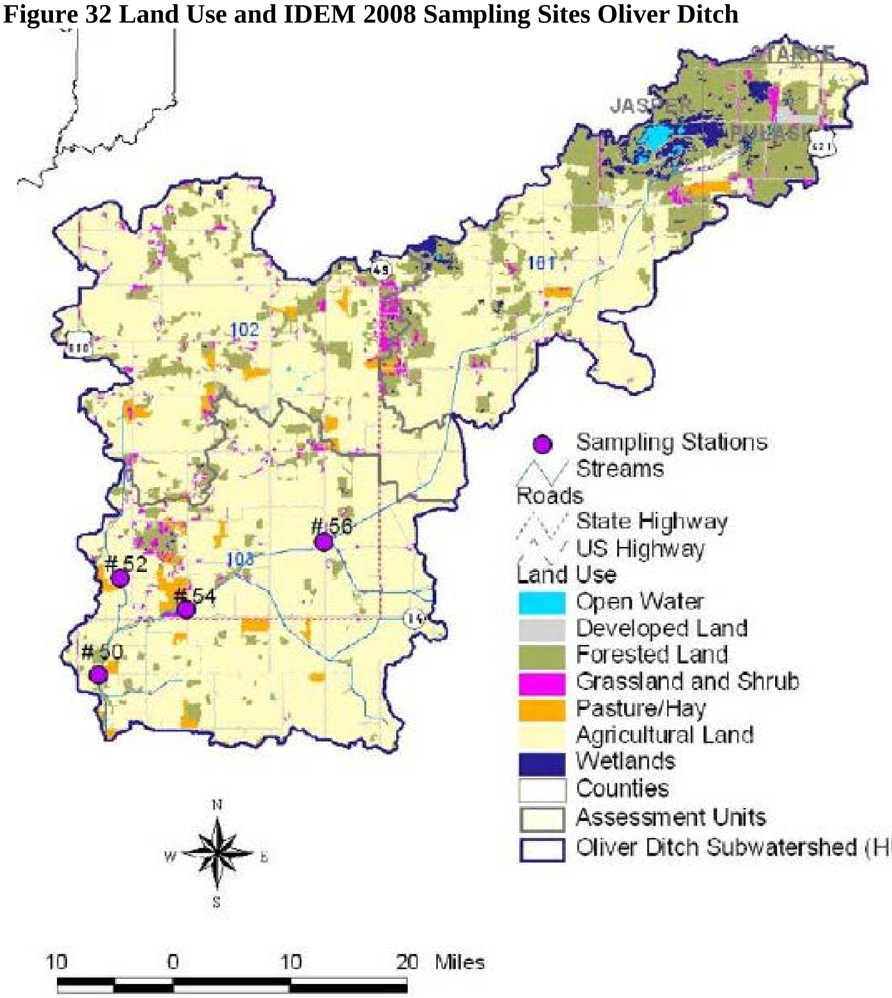


Figure 84. Location of Oliver Ditch Subwatershed (HUC10-201)

UIWI Water Monitoring

Site J15 is at the mouth of the Oliver Ditch, see Figure 33 Oliver Ditch Stream Names and WQ Sample Site. Both water quality chemistry and biological monitoring data was collected from 2011-2013 monthly. See Table 28 Oliver Ditch WQ Data May 2011-April 2013 for summary.

Figure 33 Oliver Ditch Stream Names and WQ Sample Site

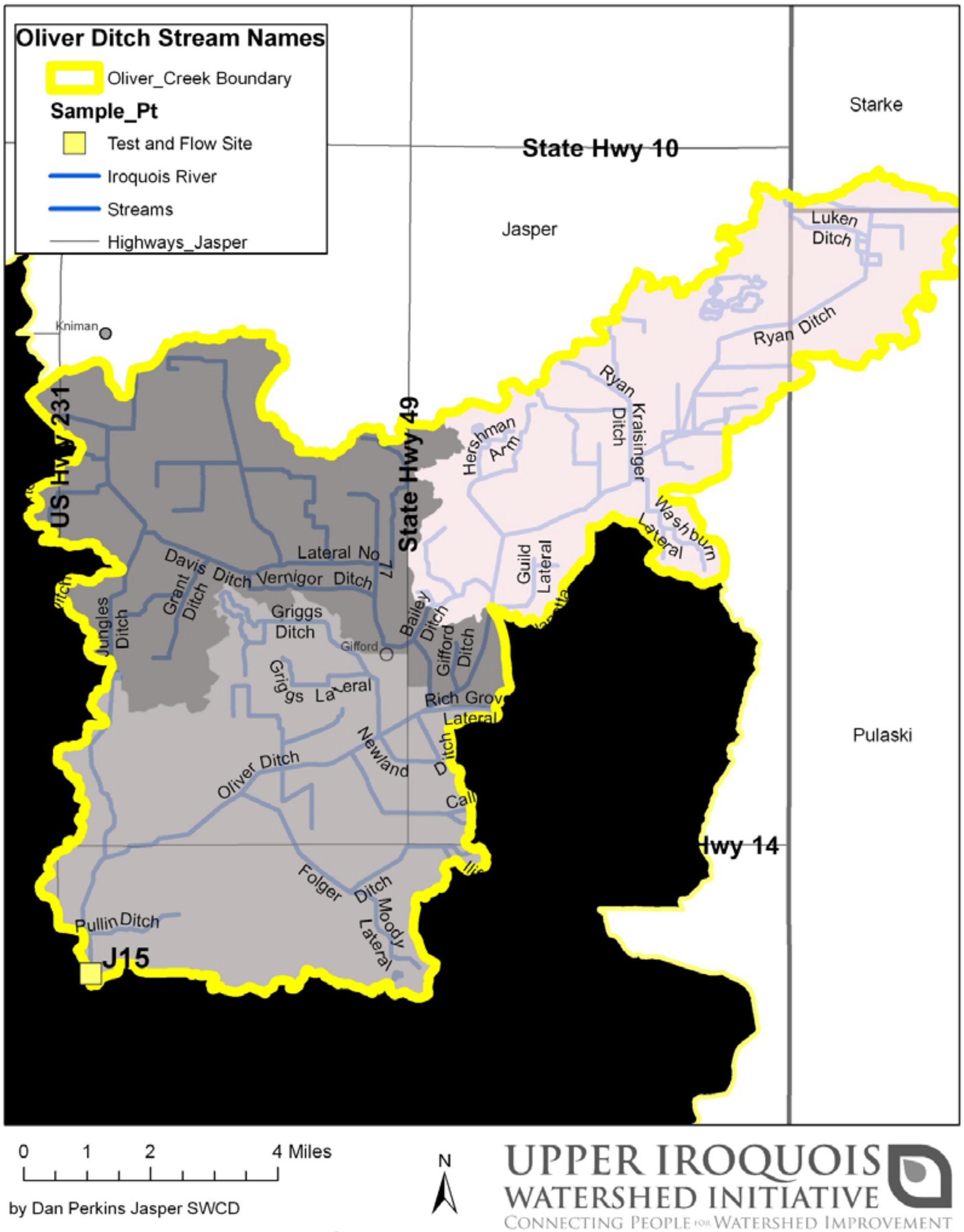


Table 28 Oliver Ditch WQ Data May 2011-April 2013

Subwatershed	Site #	Average Temp°C	Average DO%	Average DO mg/L	Average Turbidity
Oliver Ditch	J15	14.94	116.30	11.06	19.78

Parameter	Oliver Ditch Site #	Target Level	Number of Times Exceeding Target Level Range	Number of Times Exceeding Target Level	Number of Samples (n)
Temperature °C	J15	Monthly Standard	1	1	24
DO %	J15	<100	17	17	24
DO mg/L	J15	>4	0	0	24
pH	J15	<9	0	0	24
Turbidity (NTU)	J15	<10.4 (US EPA)	16	16	24
Orthophosphate (mg/L)	J15	<0.005	18	18	18
Nitrate (mg/L)	J15	<1.5	10	13	17
		<5	1	2	
		<10	1	1	
E.coli (cfu/100mL)	J15	<235	1	3	9
		< 410	0	1	
		<576	1	1	

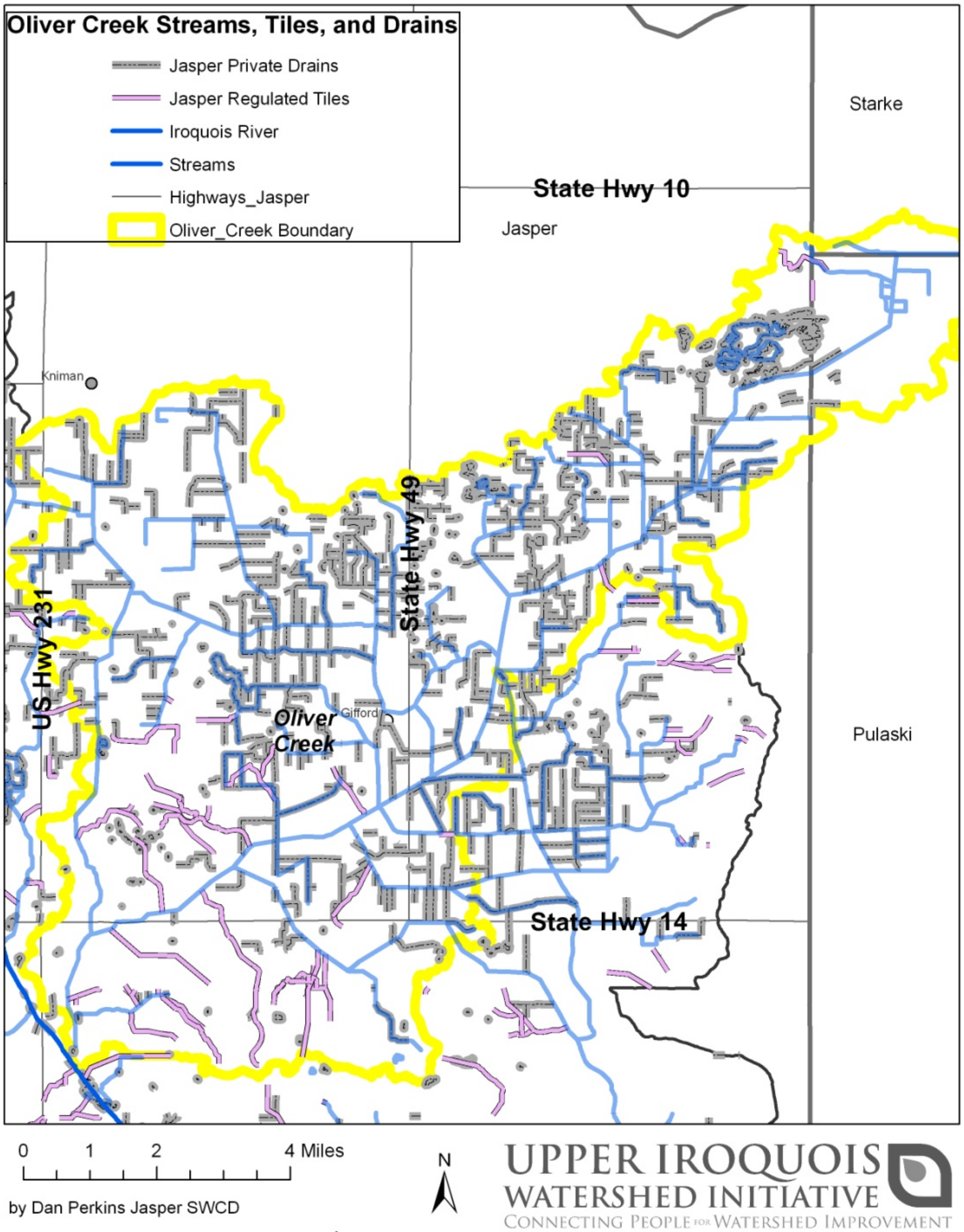
ii. Habitat/Biological Information

Site J15 was used for Citizens Index of Biotic Integrity (CMIBI) and the Oliver Ditch has a rating of 16, which is a fair quality score. The Citizen Quality Habitat Evaluation Index (CQHEI) score was a 44, which is considered unhealthy. Given that this was only one sample site at the outlet of the watershed, it may not be a best indicator of overall stream habitat and biological health.

iii. Land Use Information

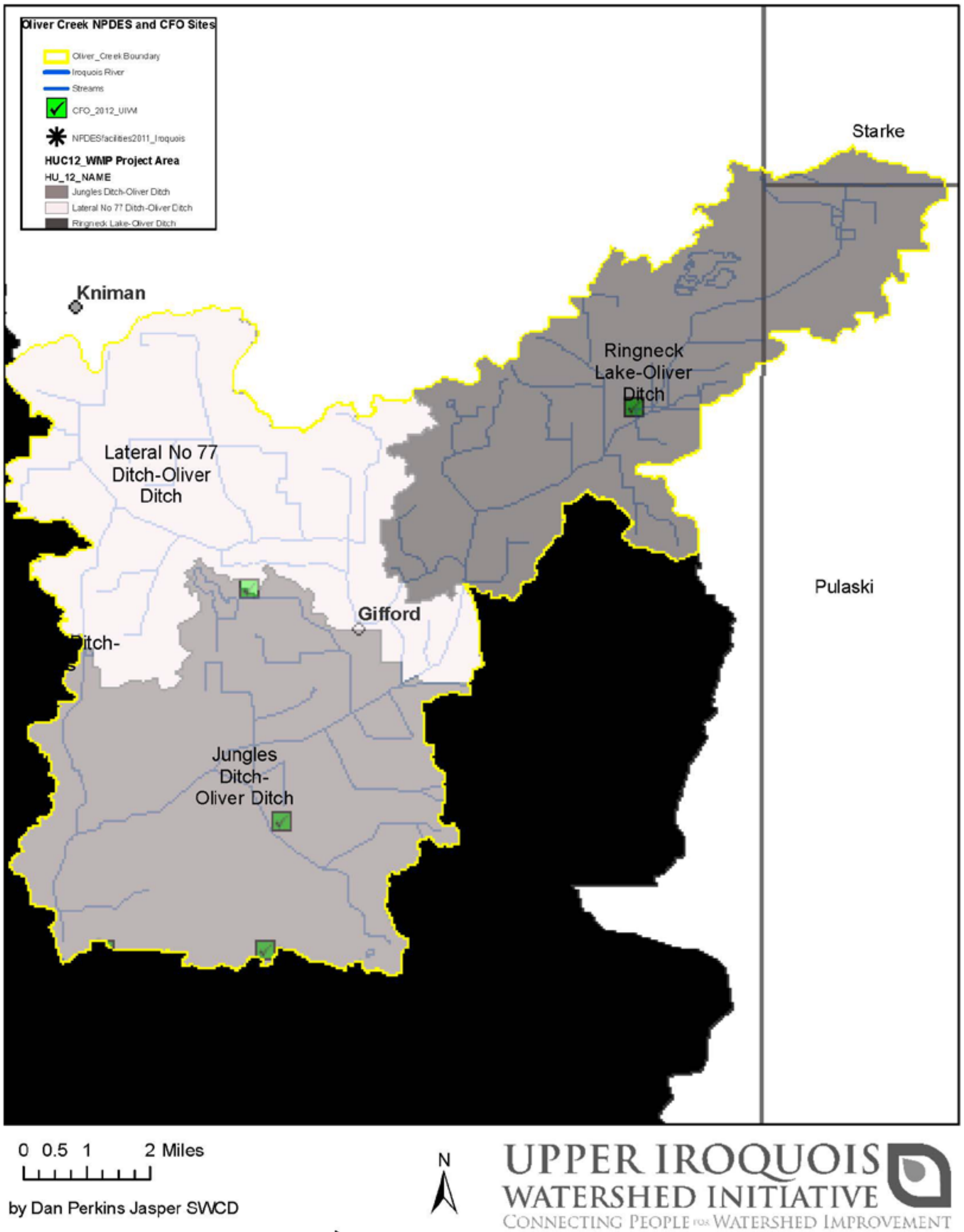
The Oliver Ditch subwatershed is approximately 52,685 acres or 82 square miles and has 124 natural stream miles, 88 miles of regulated drain and 200 miles of private drains. According to the 2008 TMDL one CAFO and one NPDES facility were found within the Oliver ditch subwatershed. As of 2012, 4 CFO facilities – 2 hog and 2 dairy operations exist and zero NPDES facilities are found.

Figure 34 Oliver Creek Drainages



It should be noted that 65% of the total drainage, or 230 miles of artificial drainage, within this subwatershed is regulated. Given the geological and hydrological history of this region and the modern conversion to farmland (70% of total acres) this isn't a surprise.

Figure 35 Oliver Creek_CFO_NPDES Sites



A 2007-2012 review of IDEM's virtual cabinet and EPA's ECHO database for NPDES and CFO permit holders found only 1 out of compliance event. Best management practices should continue to be utilized for all manure applications to ensure these facilities are not contributing to stakeholders concerns of excessive nutrients or E.coli in the water.

Figure 36 Land Us/Land Cover in the Oliver Ditch Subwatershed

Land Use/Land Cover	Subwatershed		
	Area		Percent
	Acres	Square Miles	
Agricultural Land	37139.12	58.03	70.52
Forested Land	9490.44	14.83	18.02
Developed Land	2600.01	4.06	4.94
Grassland and Shrubs	1184.47	1.85	2.25
Pasture/Hay	1161.12	1.81	2.20
Wetland	904.25	1.41	1.72
Open Water	188.59	0.29	0.36
Total	52,668.00	82.29	100.00

It should be noted that the above land-use data (Tetra Tech, 2009) is different in regards to wetland acres. The National Wetlands Inventory map shows 6.5% of the acres is still in wetland, which is a lot higher than the rest of the HUC 10's. This watershed is 18% forested, which is also significantly higher than other HUC 10s. See Table 9 HUC 10 Streams, Wetlands, and Legal Drains for comparison. This area could host a significant area for wetland mitigation acres and wildlife restoration habitat given its geologic and hydric history.

Open space is not needed in this area given its agricultural land use, amount of forest land due to the state wildlife refuges and wetland acres. Areas slated for development follow the county ordinances and codes and town boundary restrictions. No LUST exist or brownfields.

Application of municipal sludge occurs on 22 acres, which is 0.9 % of the total acres that are spread across the entire Upper Iroquois watershed.

iv. Windshield Survey

The Oliver Creek watershed windshield survey had a possible 64 points on roads that intersected a stream; of these we surveyed 51 sites.
Based on the summary data in Table 29 Oliver Creek Windshield Survey Summary, 3 maps of concerns were created based on the following:

1. Stream Buffer- Present or absent, and if present % of area
2. Areas of active erosion (stream bank)
3. Areas where livestock had direct access to water.
4. Evidence of Channelization

Table 29 Oliver Creek Windshield Survey Summary

HUC 10 Windshield Survey Summary	Oliver Creek
Windshield Survey Item	
Number Sites Sampled	51
# Sites with Buffers Present	39
% Sites with 100% Buffer	22%
% Sites with 75% Buffer	14%
% Sites with 50% Buffer	18%
% Sites with 25% Buffer	24%
% Sites with 0% Buffer	24%
# Sites with Active Erosion	1
# Sites with Livestock Access	2
# Sites with Channelization	40

Figure 37 Oliver Creek HUC 12 Windshield % Buffer

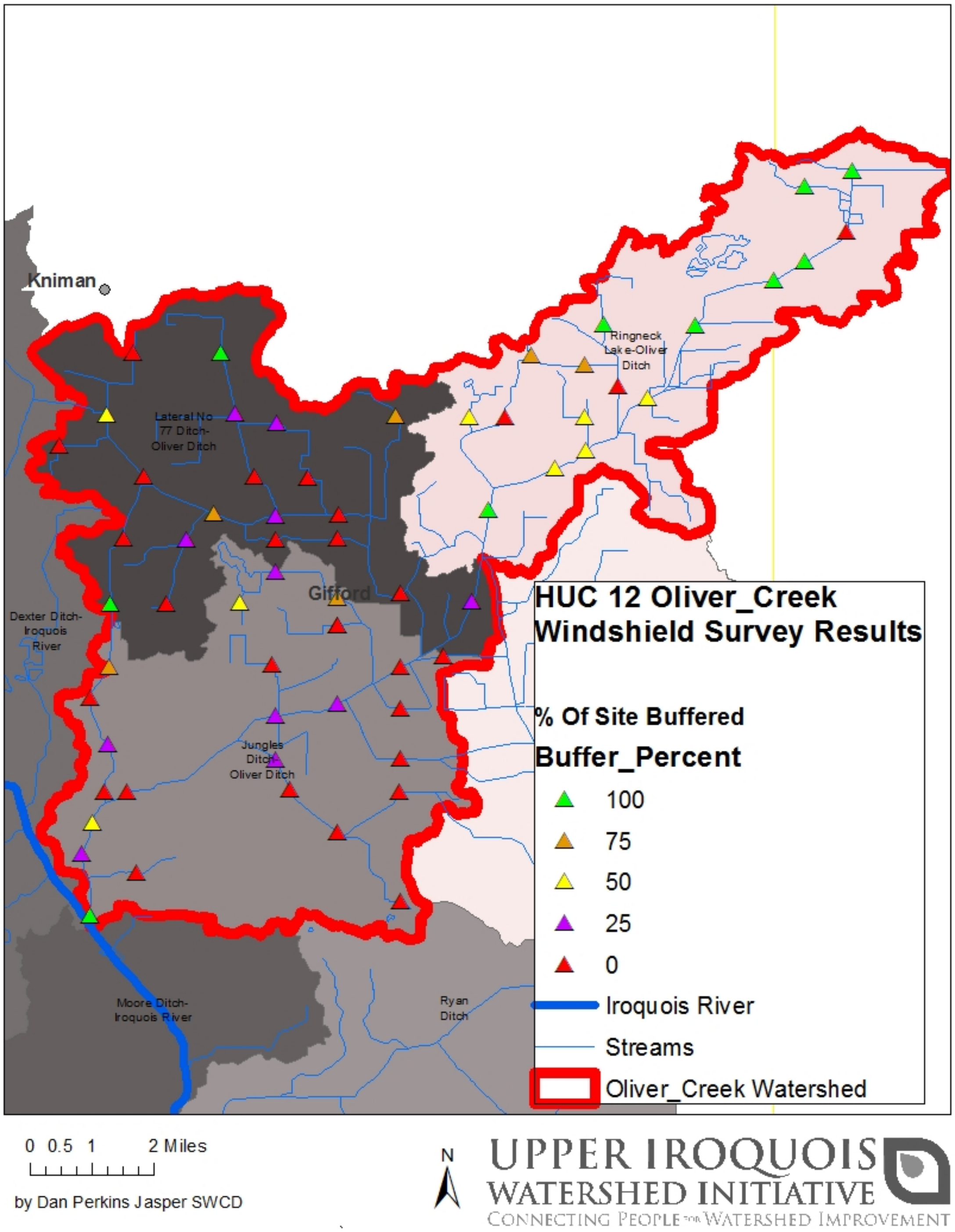
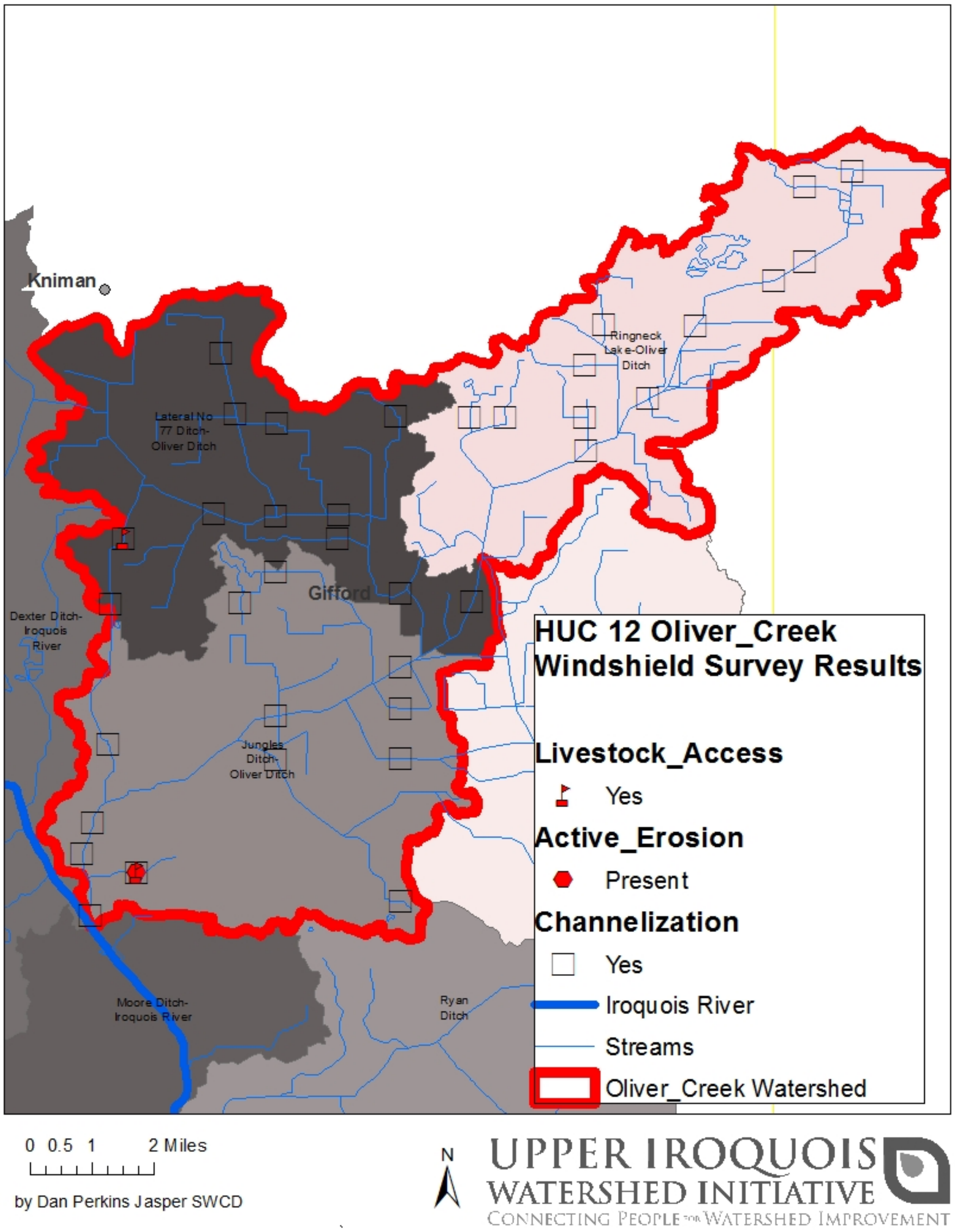


Figure 38 Oliver Creek Livestock, Active Erosion, and Channelization Sites



To address the concern of loss of fish habitat and to protect fish habitat, as well as reduce nutrient, bacteria, and sediment loading it will be important to further investigate the sites with: less than 50% buffer, which equals 48% or 24 of the 59 sites, the two livestock access areas, the one active erosion site, and status of buffer along channelization areas and address these areas with appropriate best management practices.

v. Desktop Survey

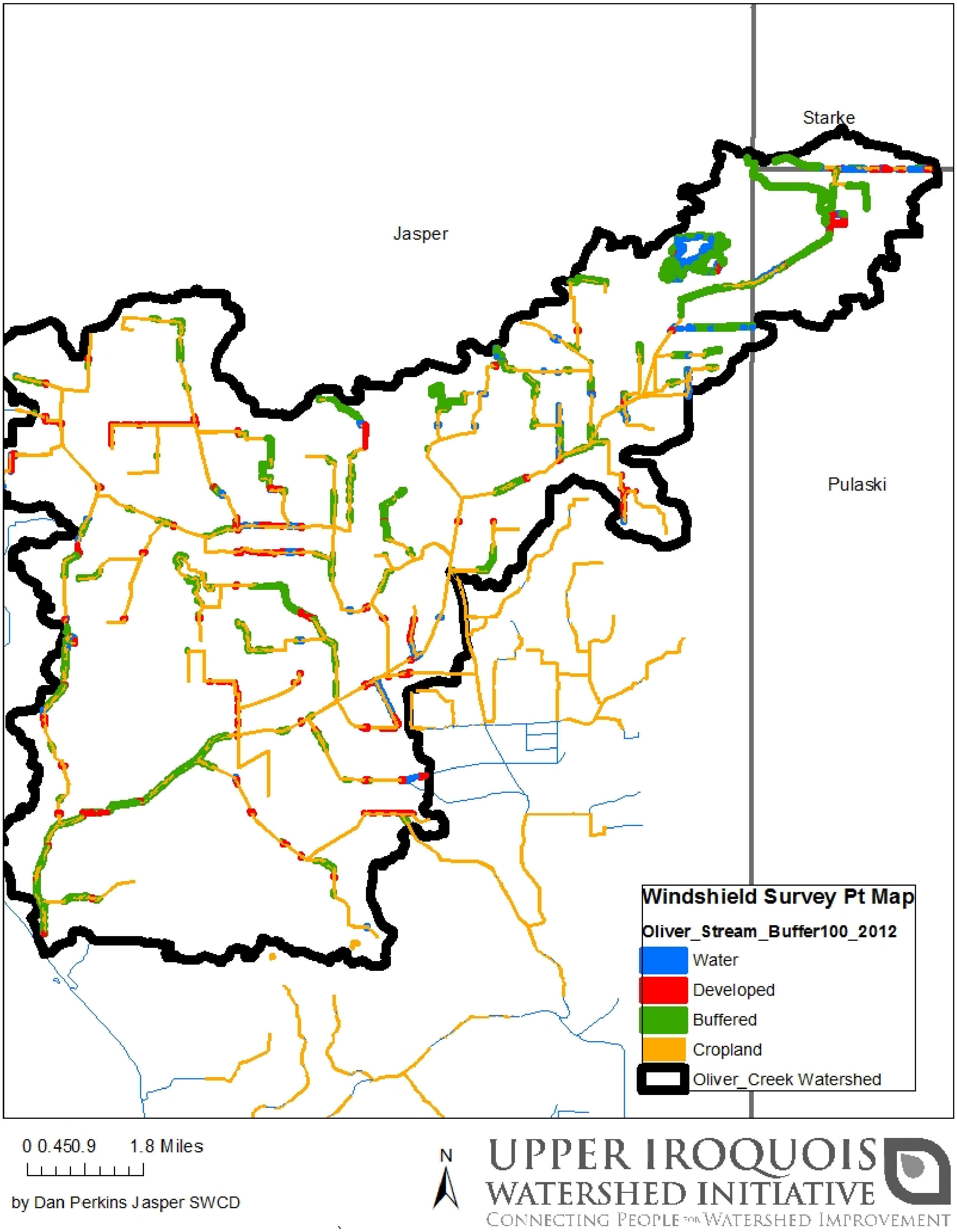
v.i. Stream Buffer Land Use within 100ft

18 % of the land within the 100 foot buffer zone of a stream is buffered. With 76% of the land use along streams being cropland that means potential direct contamination of nutrients and E.coli from manure spreading may be occurring and indirect pollution from chemical fertilizers by run-off may be occurring. The windshield survey map along with the desktop survey map (Figure 39 100 Ft Stream Buffer Oliver Creek) reveals that smaller headwater and tributary streams to Oliver Creek seem to have the least buffered area and would be a good area to target for outreach efforts.

Table 30 Oliver Creek 100 ft of Stream Landuse

HUC 10	Oliver
100 Ft Acre Total	3,323
Stream Miles	124
Water %	1%
Developed %	5%
Buffered %	18%
Cropland %	76%

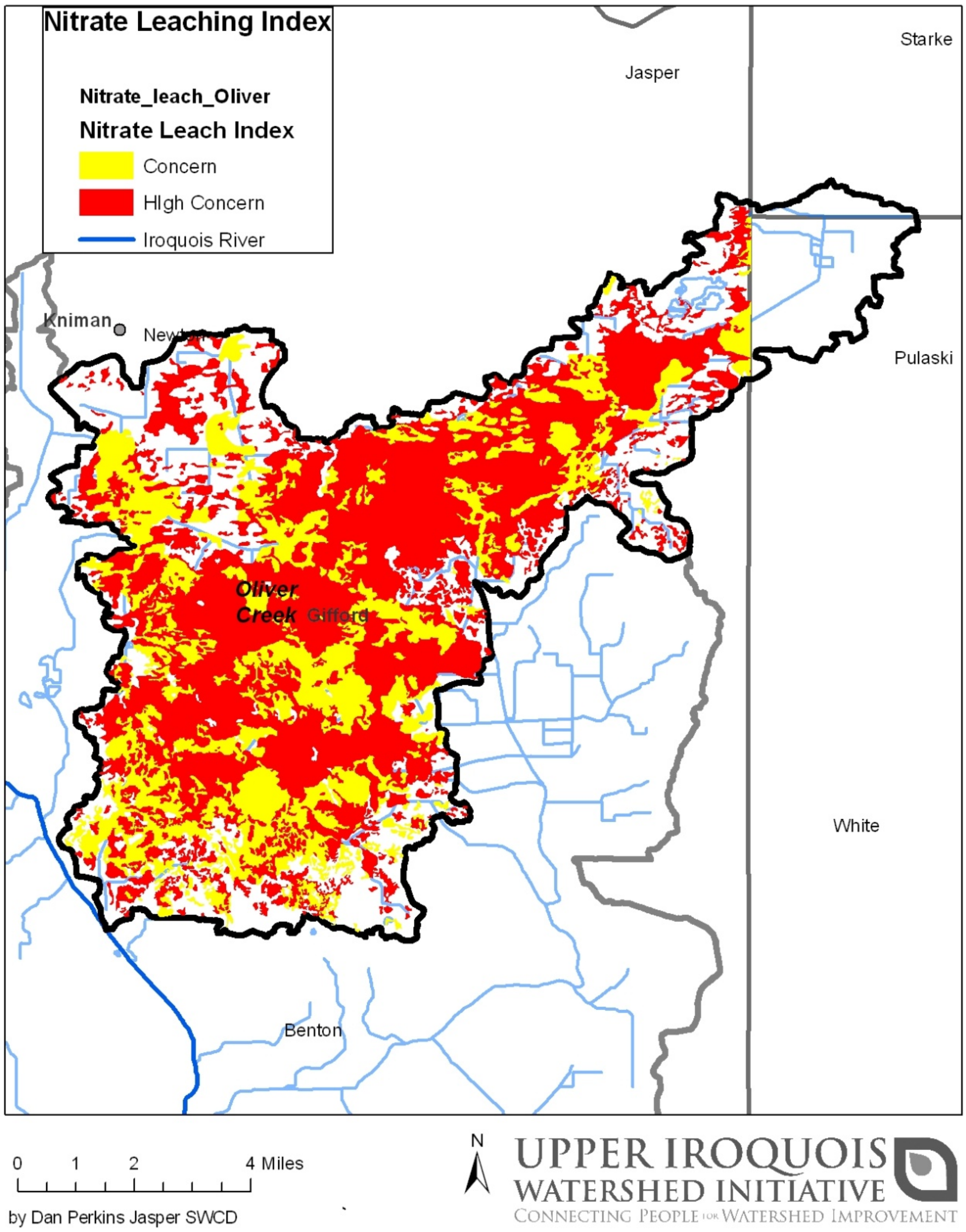
Figure 39 100 Ft Stream Buffer Oliver Creek



v.ii. Nitrate Leaching Index Map

The Olive Creek sub watershed is particularly vulnerable to leaching of pollutants as can be seen with the large amount of "high concern" soil types in the watershed at 44% of total soil acres and 22% of the acres in "concern" index. In prioritizing education and BMP implementation this should be taken into account when prioritizing efforts. Especially if fields are next to housing developments that have shallow wells for drinking water.

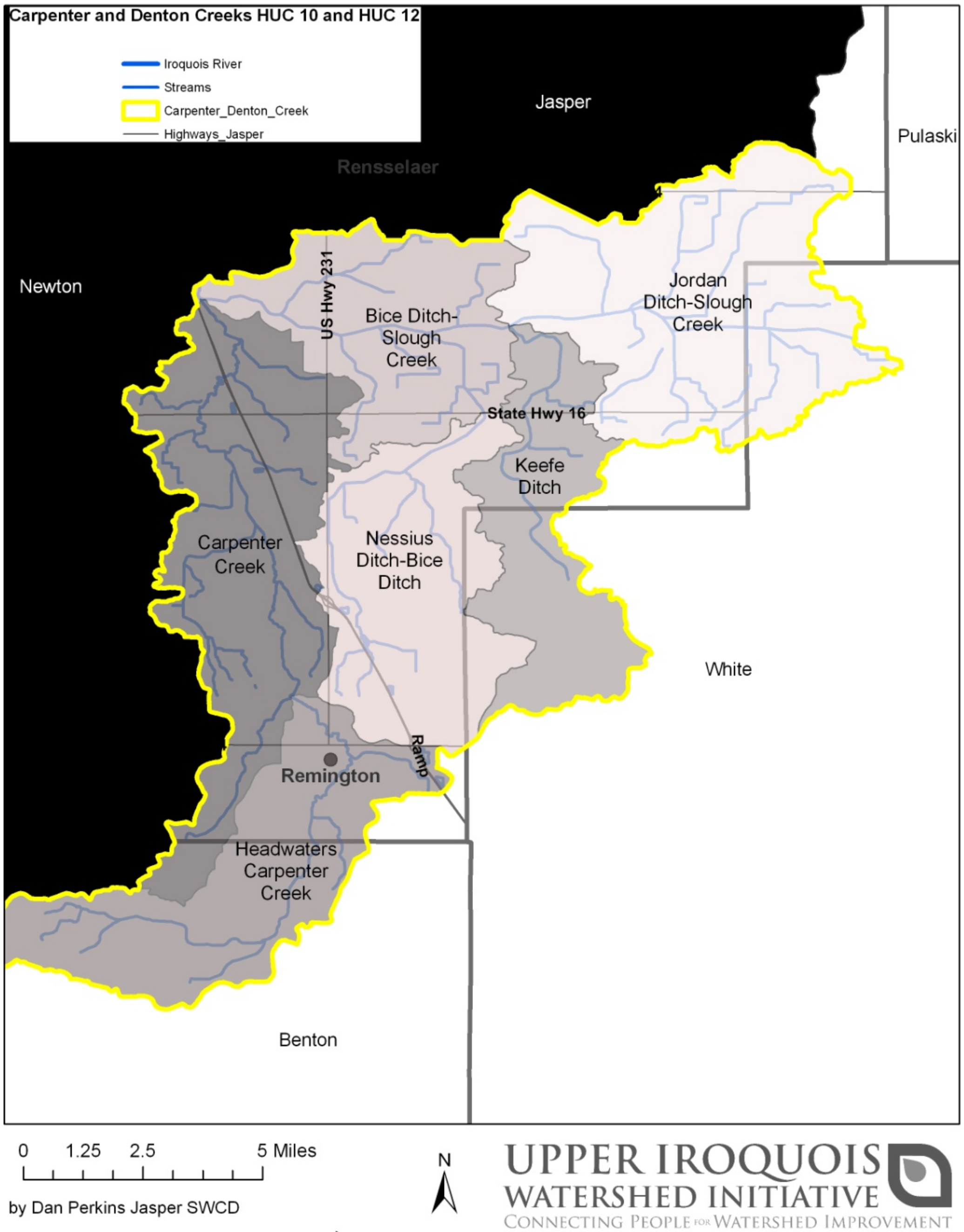
Figure 40 Nitrate Leaching Index Olive Creek



3.3.2 HUC 10- Carpenter and Denton Creeks

The Carpenter and Denton Creeks sub watershed is the southeastern most portion of the watershed. It has an area of approximately 145 square miles. It contains 6 HUC 12 subwatersheds-Jordan Ditch/Slough Creek, Bice Ditch/Slough Creek, Keefe Ditch, Nessius/Bice Ditch, Carpenter Creek, and Headwaters of Carpenter Creek, and lies within Jasper, Benton, White counties.

Figure 41 Carpenter and Denton Creek HUC 10 Overview.

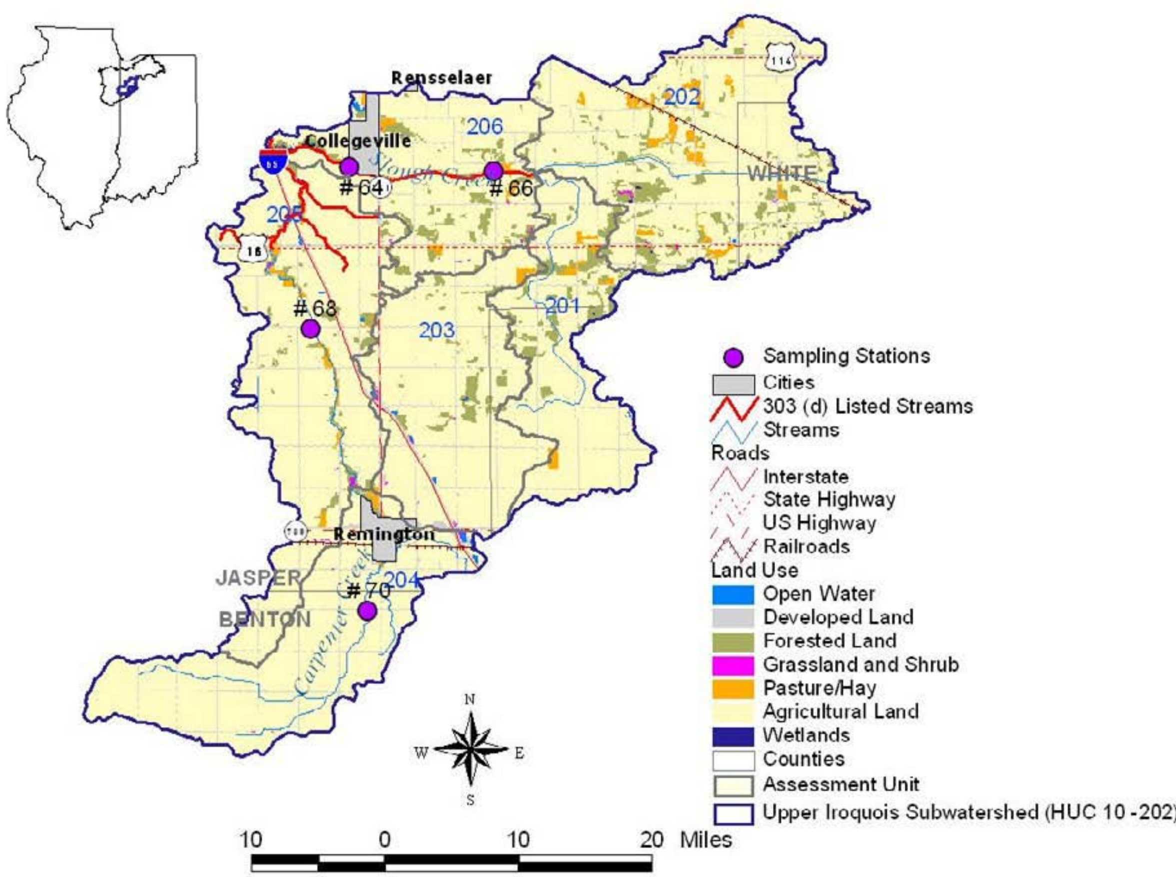


i. Water Quality Information

IDEM 303(d)

The Carpenter-Denton sub watershed had a total of 5 impairments – e.coli, chloride, nutrients, DO, and IBC on the 2008 303(d) list, 4 impairments- Chloride, Nutrients, IBC, and DO on the 303(d) 2010 list and a total of 5 impairments - Chloride, Nutrients, IBC, DO, E.coli on the 303(d) 2012 list. There was a 4% change in miles of impairment from 2008 to 2010, with 66 miles impaired in 2008 and 68.5 miles impaired in 2010 (Tetra Tech, 2009).

Figure 42 Carpenter and Denton Land Use and IDEM TMDL Sample Pts



Iroquois TMDL 2008

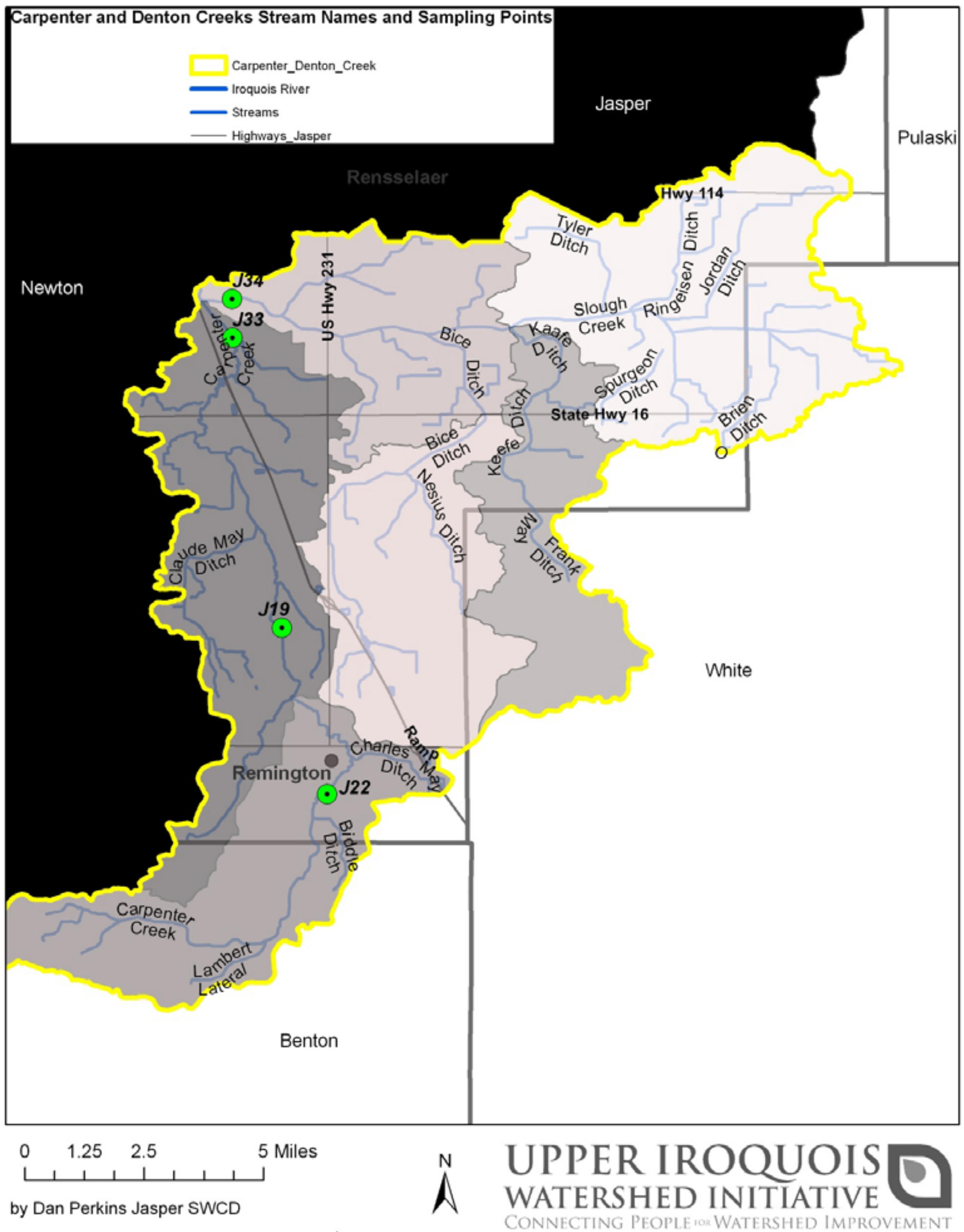
There are two NPDES facilities within this subwatershed and the waste load allocations (WLAs) for the facilities were calculated based on their design flows and E.coli permit limits. There are two CAFOs within this subwatershed. Water quality samples for E.coli were included from four sites. Based on this data, a reduction range from 51 to 86% was required. See Table 31 TMDLs for Carpenter-Denton for TMDL data of the Carpenter-Denton subwatershed.

Station #	Period of Record	Total Number of Samples	Percent of Samples Exceeding *E. coli* WQS (#/100 mL)		Minimum (#/ 100 Ml)	Geomean (#/ 100 Ml)	Average (#/ 100 Ml)	Maximum (#/ 100 Ml)	Percent Reduction Based on Geomean
			125	235					(125/ 100Ml)
70	6/4/2008 – 7/2/2008	5	60	40	76	253	636	2,419	51%
68	6/4/2008 – 7/2/2008	5	100	100	411	919	1,128	2,419	86%
64	6/4/2008 – 7/2/2008	5	100	100	365	711	915	2,419	82%
66	6/4/2008 – 7/2/2008	5	100	60	179	583	994	2,419	79%

Table 31 TMDLs for Carpenter-Denton

UIWI Water Monitoring

Figure 43 Carpenter and Denton Creek Streams and WQ Sample Sites



Four sampling sites are within the Carpenter-Denton sub watershed; see Figure 43 Carpenter and Denton Creek Streams and WQ Sample Sites. Both water quality and biological monitoring data was collected. Based on the Citizen CMIBI all sites had a rating between 11-26, three sites having a quality score of fair, one site scoring excellent, and one site lacking biological data. The overall score for all the HUC 10 is fair. See below for chemical monitoring data of the Carpenter-Denton subwatershed.

Figure 44 Carpenter Creek HUC 10 WQ Data Summary May 2011-April 2013

Subwatershed	Site #	Average Temp°C	Average DO%	Average DO mg/L	Average Turbidity
Carpenter Denton	J33	14.88	112.46	10.44	27.23
	J34	14.79	110.85	10.63	20.33
	J19	14.28	130.32	12.48	24.68
	J22	15.66	116.94	10.69	38.22
	Overall	14.90	94.11	8.85	22.09

Parameter	Carpenter Denton Site #	Target Level	Number of Times Exceeding Target Level Range	Number of Times Exceeding Target Level	Number of Samples (n)	
Temperature °C	J33	Monthly Standard	1	1	16	
	J34		0	0	20	
	J19		1	1	23	
	J22		0	0	21	
DO %	J33	<100	11	11	16	
	J34		13	13	20	
	J19		19	19	24	
	J22		16	16	21	
DO mg/L	J33	>4	0	0	16	
	J34		0	0	20	
	J19		0	0	24	
	J22		0	0	21	
pH	J33	<9	16	16	16	
	J34		20	20	20	
	J19		24	24	24	
	J22		21	**21**	21	
Turbidity (NTU)	J33	<10.4 (US EPA)	16	16	16	
	J34		20	20	20	
	J19		24	24	24	
	J22		21	21	21	
Orthophosphate (mg/L)	J33	<0.005	16	16	11	
	J34		20	20	18	
	J19		24	24	18	
	J22		21	21	14	
Nitrate (mg/L)	J33	>1.5	3	7	J33	13
	J34		4	14		
	J19		4	10		
	J22		1	13	J34	16
	J33	<5.0	3	4		
	J34		3	10		
	J19		2	6	J19	15
	J22		2	**4**		
	J33	<10	1	**1**		
	J34		7	**7**	J22	13
	J19		4	**4**		
	J22		2	2		
E.coli (cfu/100mL)	J33	<235	1	4	J33	8
	J34		4	6		
	J19		2	6		
	J22		10	13	J34	9
	J33	<410	2	3		
	J34		0	2		
	J19		1	4	J19	13
	J22		2	3		
	J33	<576	1	1		
	J34		2	2	J22	10
	J19		3	**3**		
	J22		1	1		

ii. Habitat/Biological Information

Based on the CMIBI, the Carpenter-Denton sampling sites have an average rating of 16 in 2011, a fair quality score and in 2013 a 7.25, a poor quality ranking. The CQHEI average from all sampling sites for the Carpenter-Denton sub watershed in 2011 was 50.3, which is considered unhealthy, but in 2013 scored a 68, which is considered healthy.

The Denton Creek was dredged and trees cleared along one side of the bank in fall of 2011, which would explain the shift of fair to poor CMIBI, as dredging is very disruptive to aquatic organisms. The CQHEI score did improve from unhealthy to healthy because the removal of sediment/silt exposed a rock substrate, improving the score just enough to be called healthy, despite the loss of trees on one side. It will be important to keep sediment from moving back into the stream, which would require dredging again, to protect aquatic organisms and water quality. In that way both CQHEI and CMIBI scores can improve, ultimately, protecting fish habitat.

Among the 4 other HUC 10 for CQHEI this was the highest score overall. Given this fact and its place in the watershed this is a priority protection area for fish and wildlife habitat.

Table 32 Carpenter CMIBI Ratings

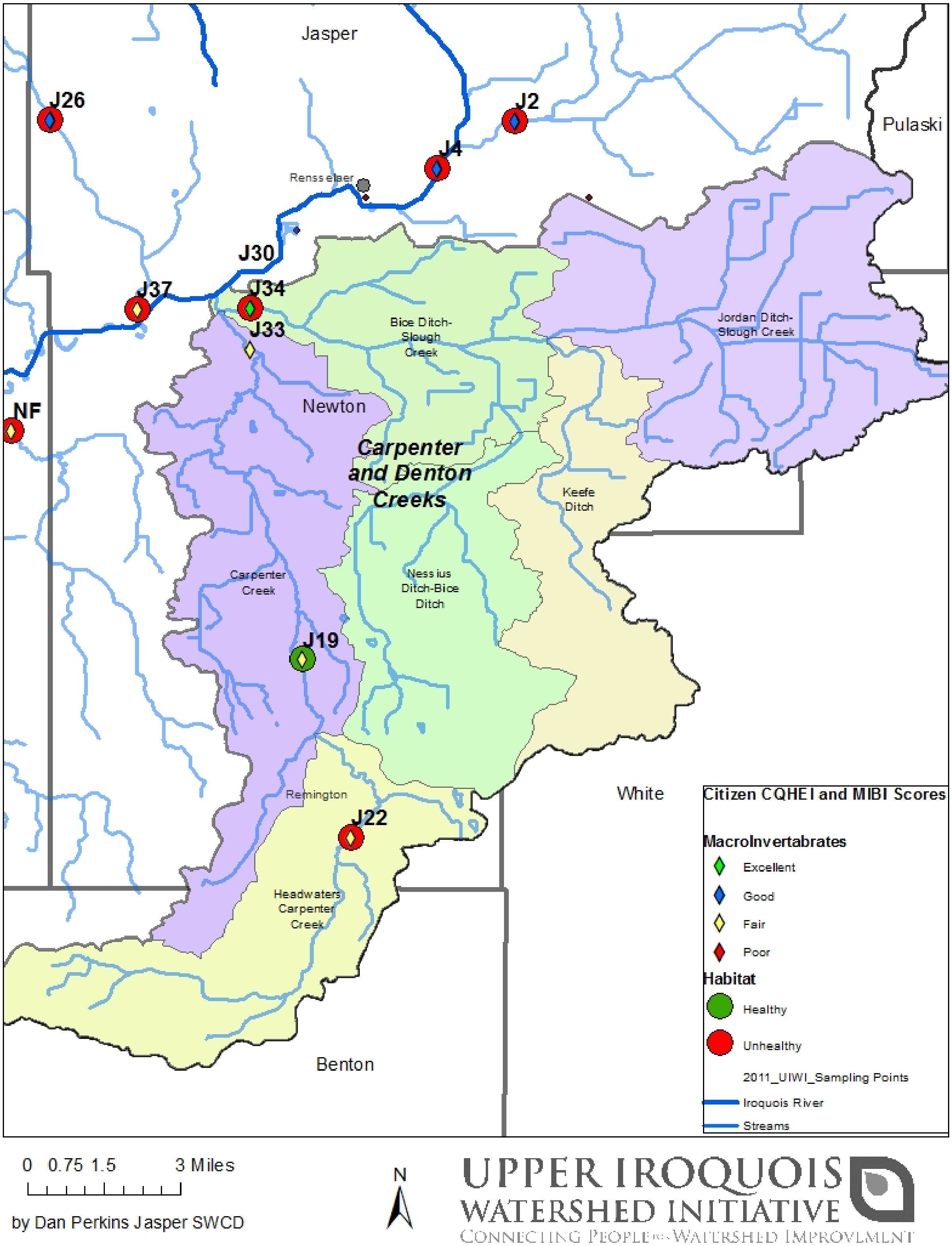
Citizen MIBI									
Sample Site	Rating 2011	2011 Quality Score	Rating 2013	2013 Quality Score	10 HUC_Subwatershed	2011 Average 10 HUC	2013 Average 10 HUC	2011 Overall Score	2013 Overall Score
J22	15	Fair	2	Poor	Carpenter-Denton Creeks	16.00	7.25	Fair	Poor
J33	11	Fair	1	Poor	Carpenter-Denton Creeks				
J34	26	Excellent	16	Fair	Carpenter-Denton Creeks				
J19	12	Fair	10	Poor	Carpenter-Denton Creeks				
Watershed Average	14	Fair	13	Fair					
Scale	**Quality**	**Scale**	**Quality**						
10 or less	Poor	11_16	Fair						
17-22	Good	23 >	Excellent						

Table 33 Carpenter CQHEI Ratings

Citizen Habitat Evaluation index (CQHEI)									
Site	2011 Rating	2011 Quality Score	2013 Rating	2013 Quality Score	HUC 10 Subwatershed	2011 Average Rating	2013 Average Rating	2011 Overall Quality Score	2013 Overall Quality Score
J33*	69	Healthy	46	Unhealthy	Carpenter-Denton Creeks	55	66	Unhealthy	Healthy
J34	48	Unhealthy	73	Healthy	Carpenter-Denton Creeks				
J19	63	Healthy	85	Healthy	Carpenter-Denton Creeks				
J22	40	Unhealthy	60	Healthy	Carpenter-Denton Creeks				
HUC 8	37	Unhealthy	53	Unhealthy					
Citizen Habitat Evaluation Index CQHEI		100>	High Quality Stream						
		> 60	Generally Healthy						
		< 60	Unhealthy						

*Field data sheets could not be found for these sites from 2011, aerial imagery from 2010-2012 was reviewed, and only site J33 had major changes as the 75 right away was cleared on one side.

Figure 45 CMIBI and CQHEI Ratings for Carpenter Creek

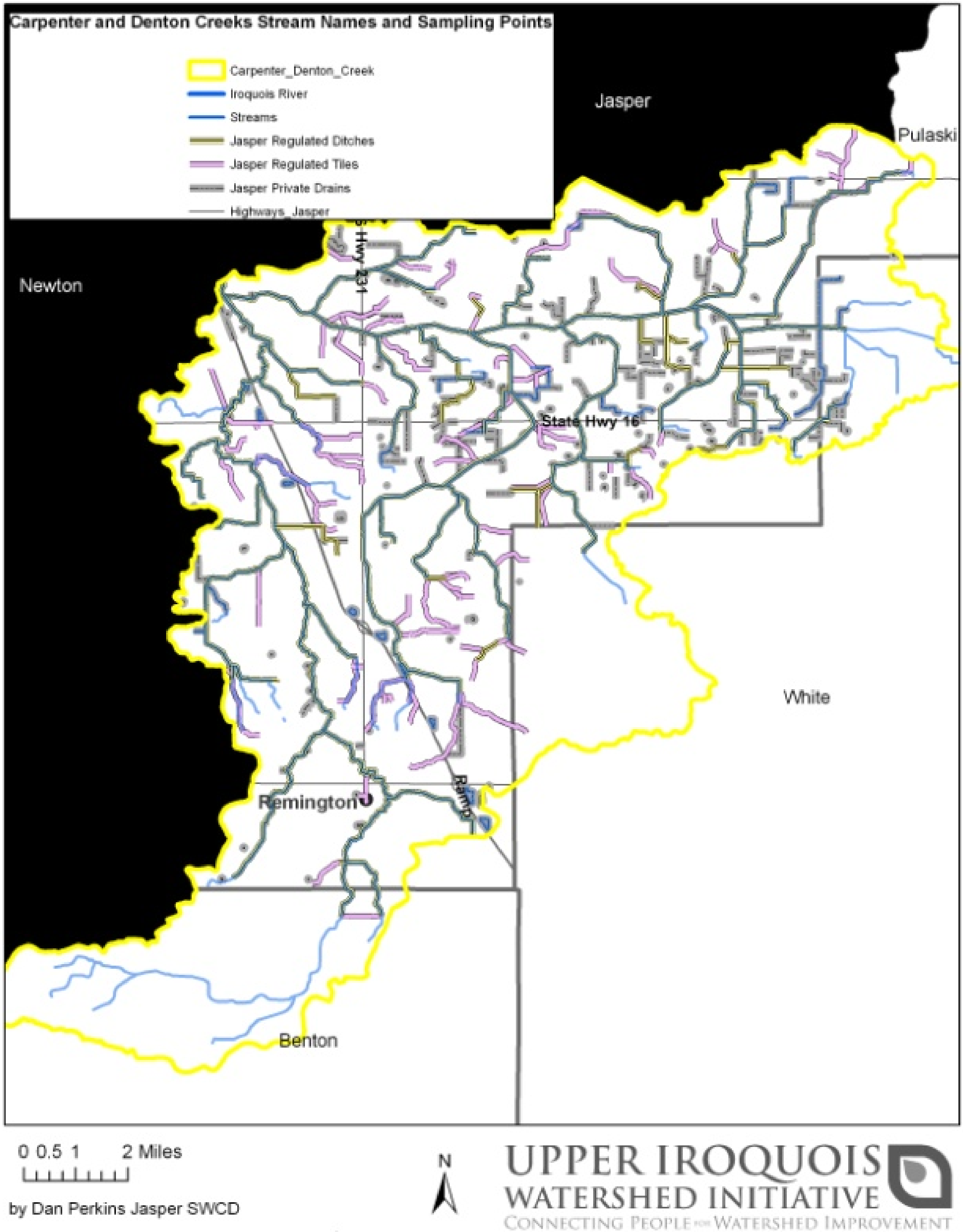


iii. Land Use Information

The Carpenter and Denton Creeks subwatershed is approximately 92,875 acres or 145 square miles and has 160 natural stream miles of which 128 miles are regulated open drains. About 68 miles of private drains are known to exist.

The local drainage board has a 75 ft right of way along all regulated drains and schedules maintenance projects. Working with them to ensure minimal in-stream disturbance and habitat loss will be critical to addressing stakeholder concerns.

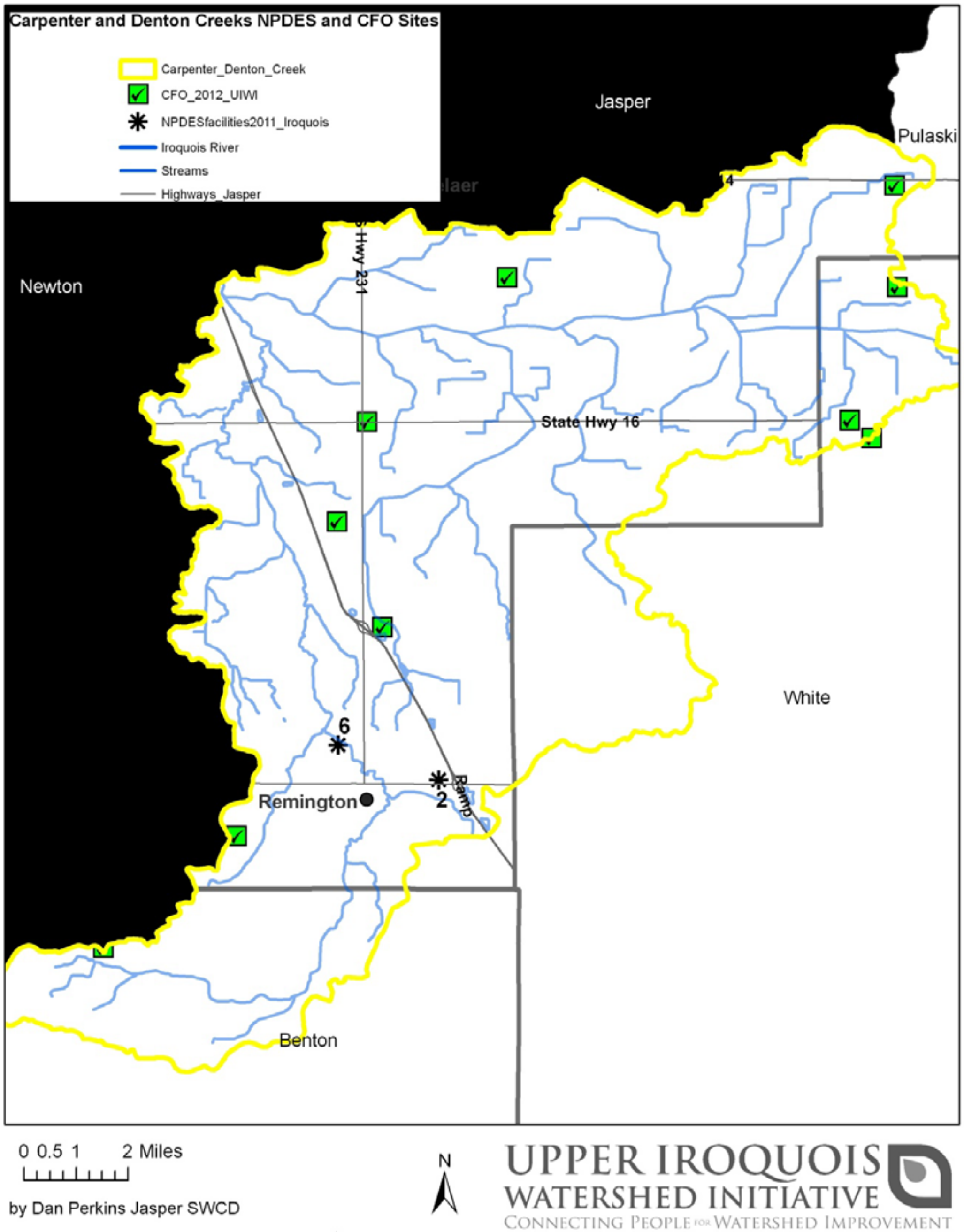
Figure 46 Carpenter and Denton Drainages



As of 2012, 10 CFO facilities – 6 hog , 3 chicken, and 1 dairy operation are in operation. 2 NPDES sites – the town of Remington WWTP and Remington I-65 Truck Stop are in operation.

A 2007-2012 review of IDEM's virtual cabinet and EPA's ECHO database for NPDES and CFO permit holders found 13 out of compliance events, occurring at only 2 of the 10 CFOs. Best management practices should continue to be utilized for all manure applications to ensure these facilities are not contributing to stakeholders concerns of excessive nutrients or E.coli in the water.

Figure 47 Carpenter and Denton NPDES and CFO Sites



Agriculture accounts for 84.77 percent of the total subwatershed area followed by forested (6.73%) and developed land (6.05%).

Table 34 Carpenter and Denton Land Use

Land Use/Land Cover	Subwatershed		
	Area		Percent
	Acres	Square Miles	
Agricultural Land	78,614.71	122.84	84.77
Forested Land	6,242.60	9.75	6.73
Developed Land	5,608.78	8.76	6.05
Pasture/Hay	1,871.89	2.92	2.02
Grassland and Shrubs	171.69	0.27	0.19
Open Water	146.34	0.23	0.16
Wetland	89.18	0.14	0.10
Total	92,745.18	144.91	100.00

Open space is not needed in this area given its agricultural land use. Areas slated for development follow the county ordinances and codes and town boundary restrictions. Of the 37 leaking UST across the entire Iroquois River watershed, 8 of these are in the Carpenter Creek Denton watershed and need further investigation as to their remediation status. See Table 22 UIWI LUSTs Site Locations.

Application of municipal waste does occur on 1,967 acres, largely around the towns of Rensselaer and Remington. This accounts for 81% of all the acres permitted for sludge application across the entire watershed.

vi. Windshield Survey

The Carpenter and Denton Creek watershed windshield survey had a possible 140 points or roads that intersected a stream; of these we surveyed 78 sites.
Based on the summary data in Table 35 Carpenter_Denton Windshield Survey Summary, 2 maps of concerns were created based on each point showing the following:

1. Stream Buffer- Present or absent, and if present % of area
2. Areas of active erosion (stream bank)
3. Areas where livestock had direct access to water.
4. Evidence of Channelization

Table 35 Carpenter_Denton Windshield Survey Summary

HUC 10	Carpenter/Denton Creek
Windshield Survey Item	
Number Sites Sampled	78
# Sites with Buffers Present	64
% Sites with 100% Buffer	62%
% Sites with 75% Buffer	1%
% Sites with 50% Buffer	15%
% Sites with 25% Buffer	4%
% Sites with 0% Buffer	18%
# Sites with Active Erosion	3
# Sites with Livestock Access	12
# Sites with Channelization	70

To address the concern of loss of fish habitat and to protect fish habitat, as well as reduce nutrient, bacteria, and sediment loading it will be important to further investigate the sites with: less than 50% buffer, livestock access particularly the area north of State Road 16, active erosion, and extent of channelization and address these areas with appropriate best management practices.

Figure 48 Carpenter Windshield % Buffer Sites

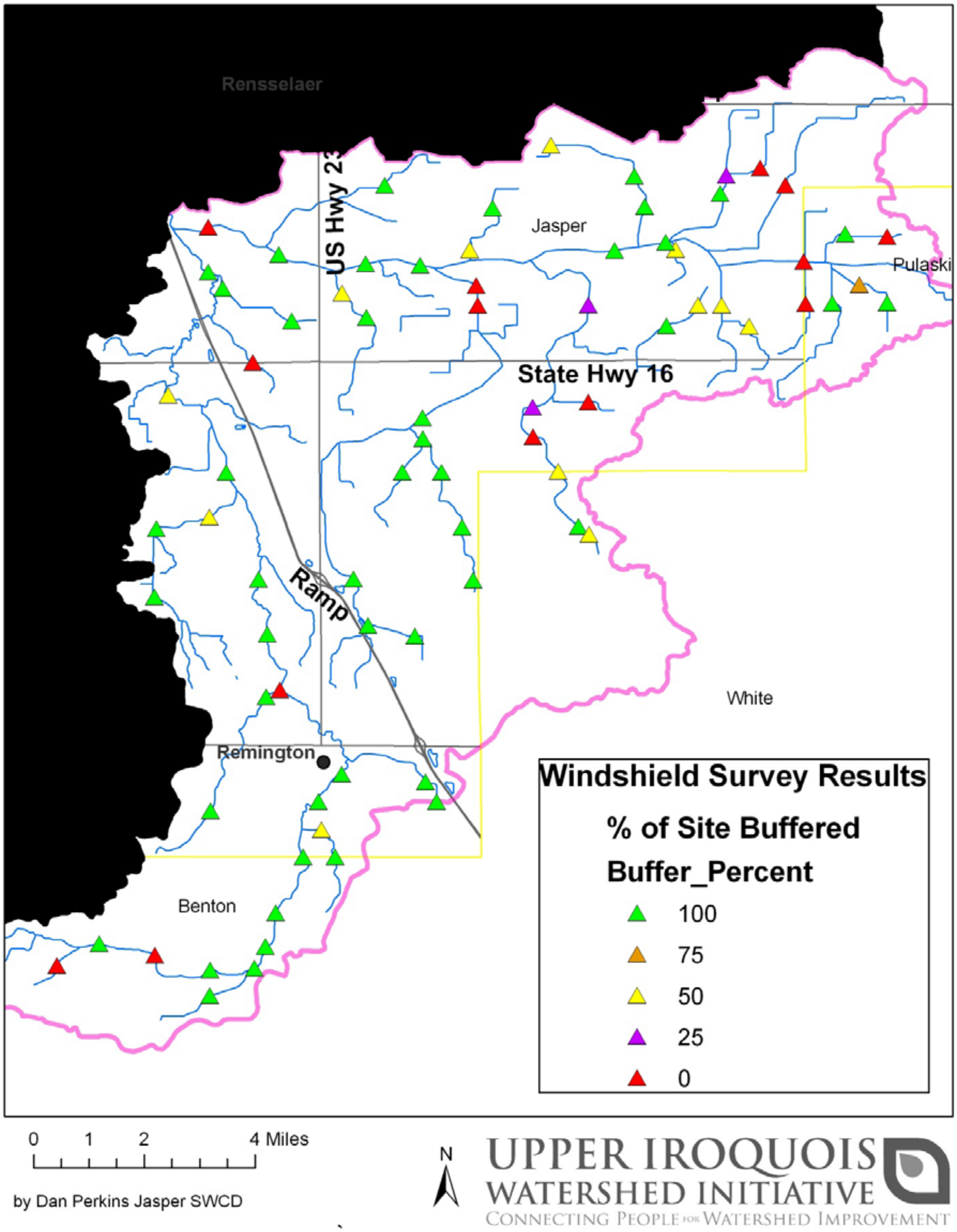
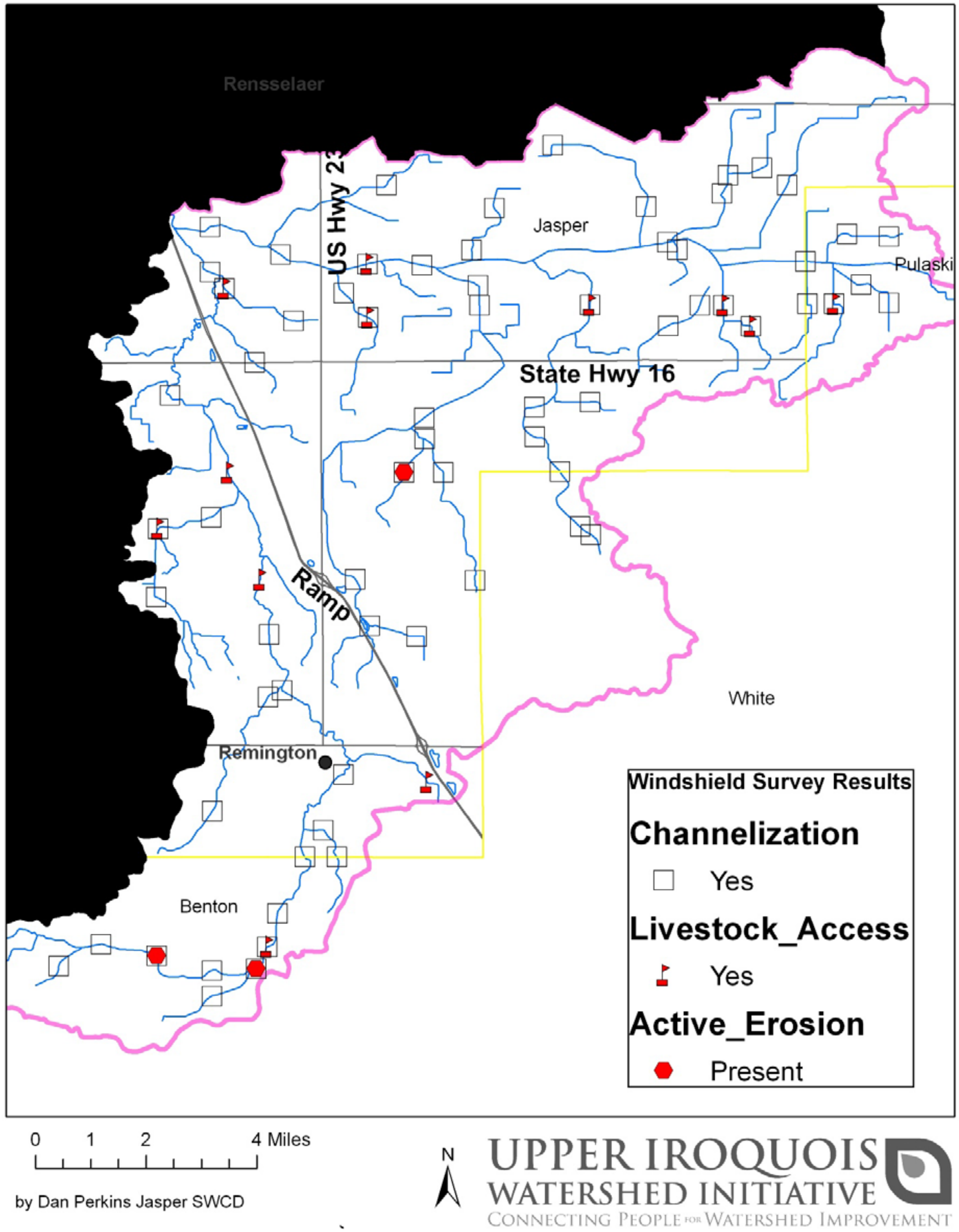


Figure 49 Windshield 3 Factors Summary Map



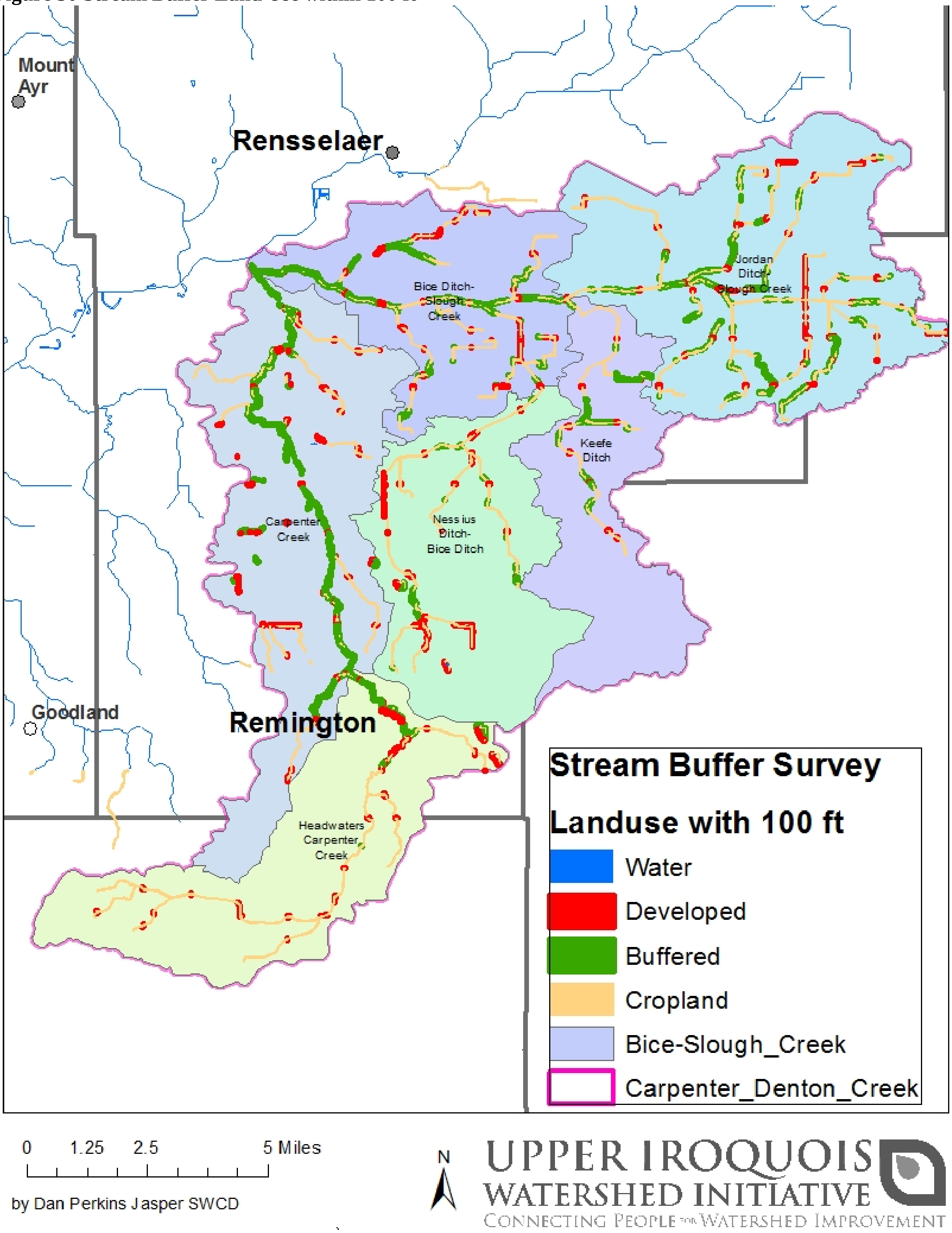
vii. Desktop Survey

Around 20 % of the land within the 100 foot buffer zone of a stream is buffered. With 74% of the land use along streams being cropland that means potential direct contamination of nutrients and E.coli from manure spreading may be occurring and indirect pollution from chemical fertilizers by run-off may be occurring. The map reveals that smaller headwater and tributary streams to Carpenter Creek and Denton Creek seem to have the least buffered area and would be a good area to target for outreach efforts. It appears that large portions of the main stem of the Carpenter and Denton are well buffered and efforts to keep it that way should be encouraged.

Table 36 Carpenter_Denton 100 ft Area around Stream Landuse

HUC 10	Carpenter
100 Ft Zone Acre Total	3,805
Water %	1.4%
Developed %	5%
Buffered %	20%
Cropland %	74%

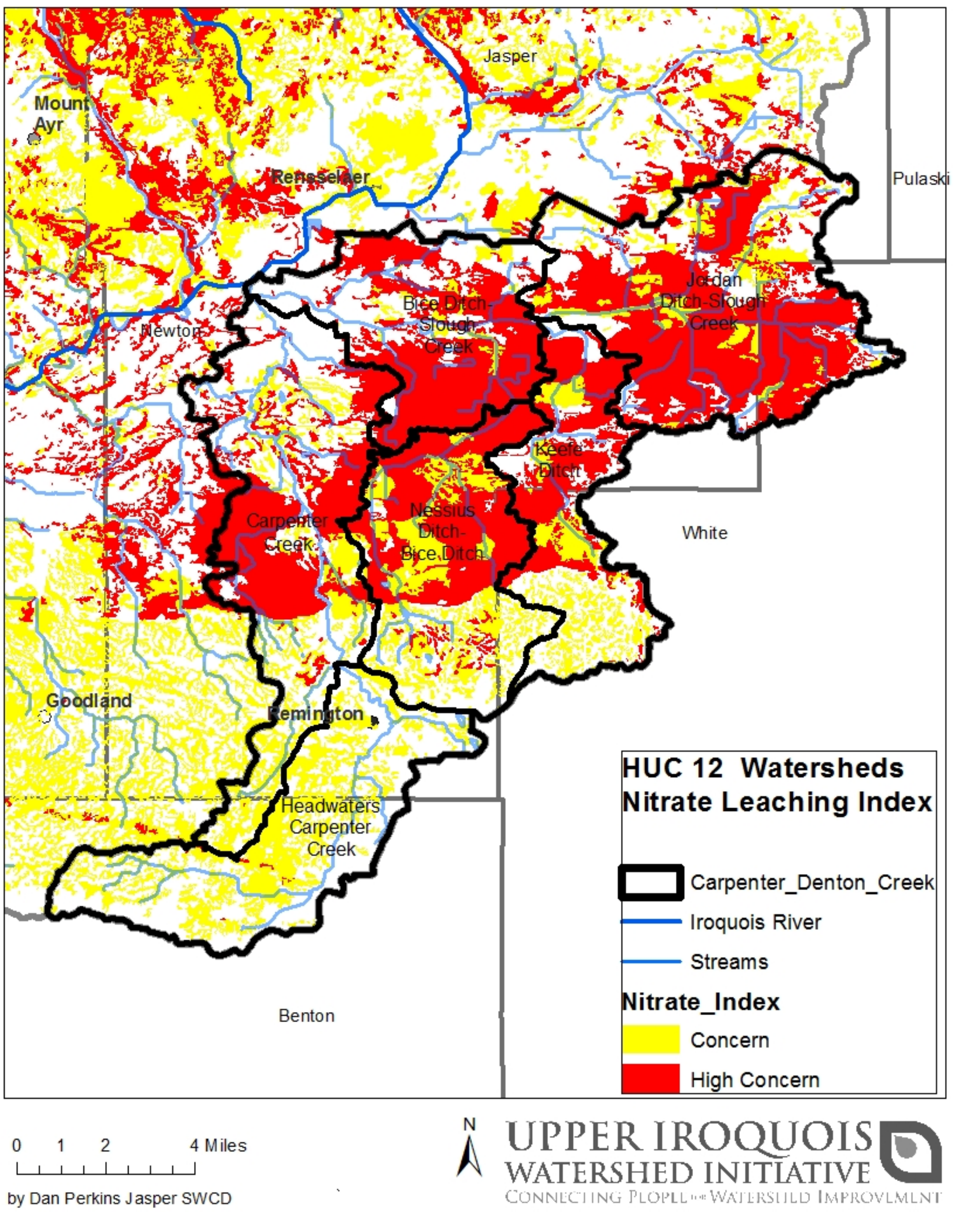
Figure 50 Stream Buffer Land Use within 100 ft



viii.. Nitrate Leaching Index Map

The Carpenter Creek_Denton sub watershed is particularly vulnerable to leaching of pollutants as can be seen with the large amount of "high concern" soil types in the watershed at 31% of total soil acres and 26% of the acres in "concern" index. To address stakeholder concerns these areas should be focused on for specific BMPs that address leaching concerns. It is clear from the map the smaller HUC 12 that should be focused on for leaching concerns – Jordan-Slough, Bice-Slough, Nessius Ditch, and the middle of Carpenter Creek.

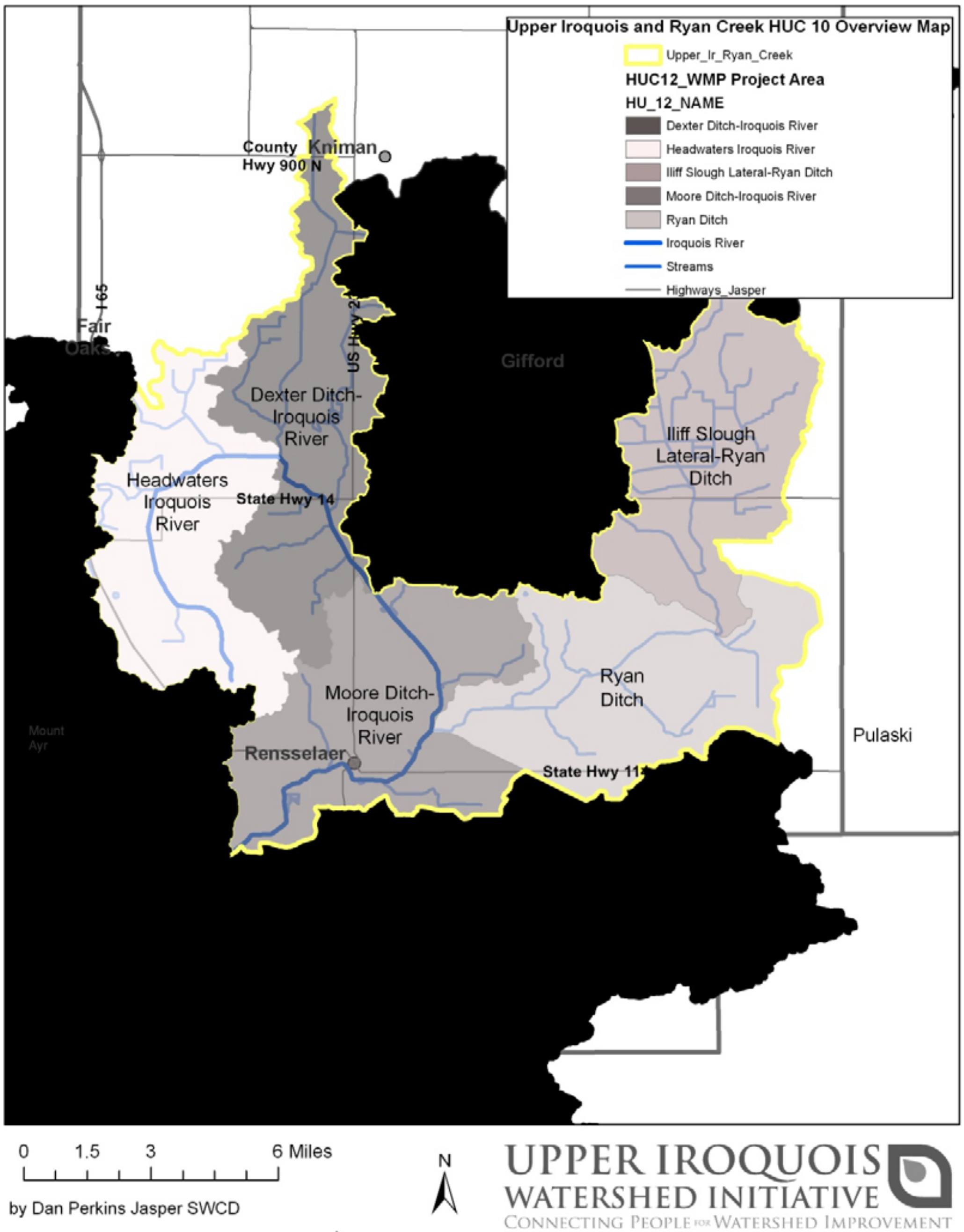
Figure 51 Nitrate Leaching Index for Carpenter_Denton HUC 12s



3.3.3 HUC 10- Upper Iroquois-Ryan Ditch

The Upper Iroquois-Ryan Ditch subwatershed is the middle section and forms the main headwaters of the Iroquois River portion of the watershed. It has an area of approximately 136 square miles, has 136 stream miles, contains 5 HUC 12 subwatersheds- Dexter Ditch, Headwaters of Iroquois River, Moore Ditch, Ryan Ditch, and Iliff Slough Lateral Ditch, and lies entirely within Jasper County.

Figure 52 Upper Iroquois-Ryan Ditch HUC 10 Overview

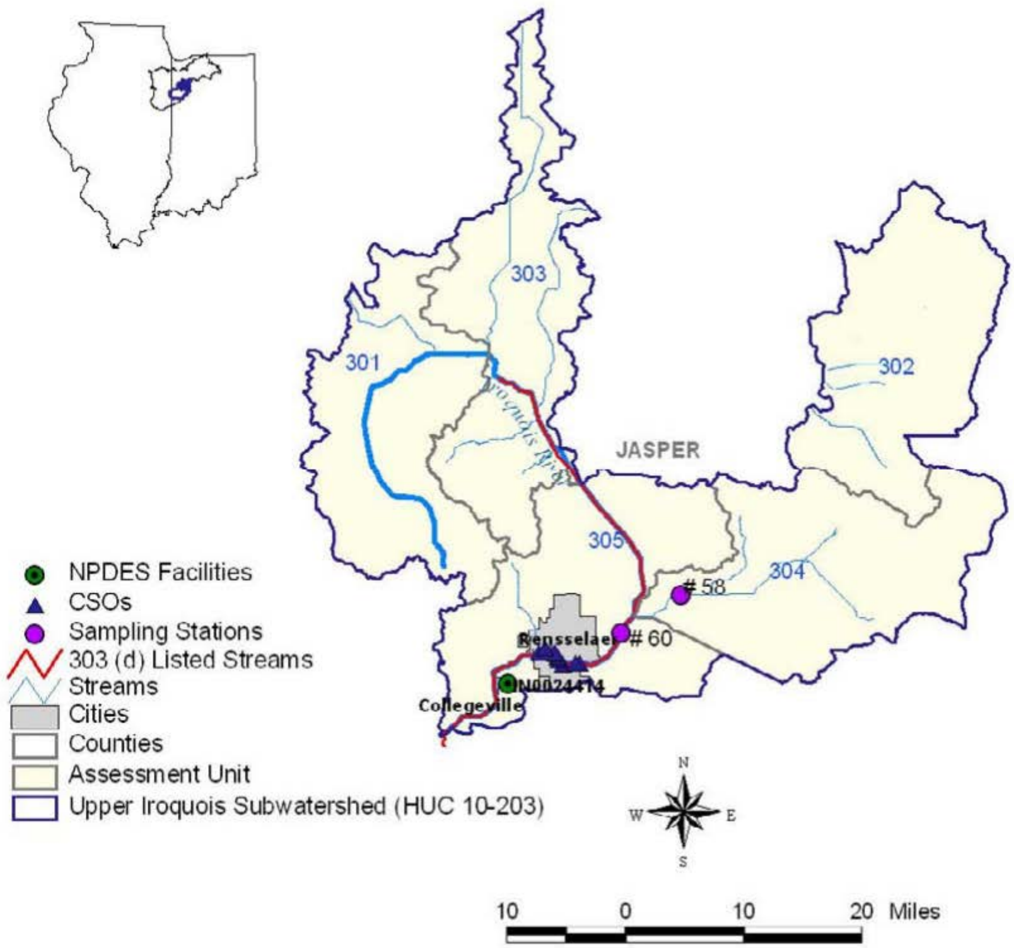


i. Water Quality Information

<u>IDEM 303(d)</u>

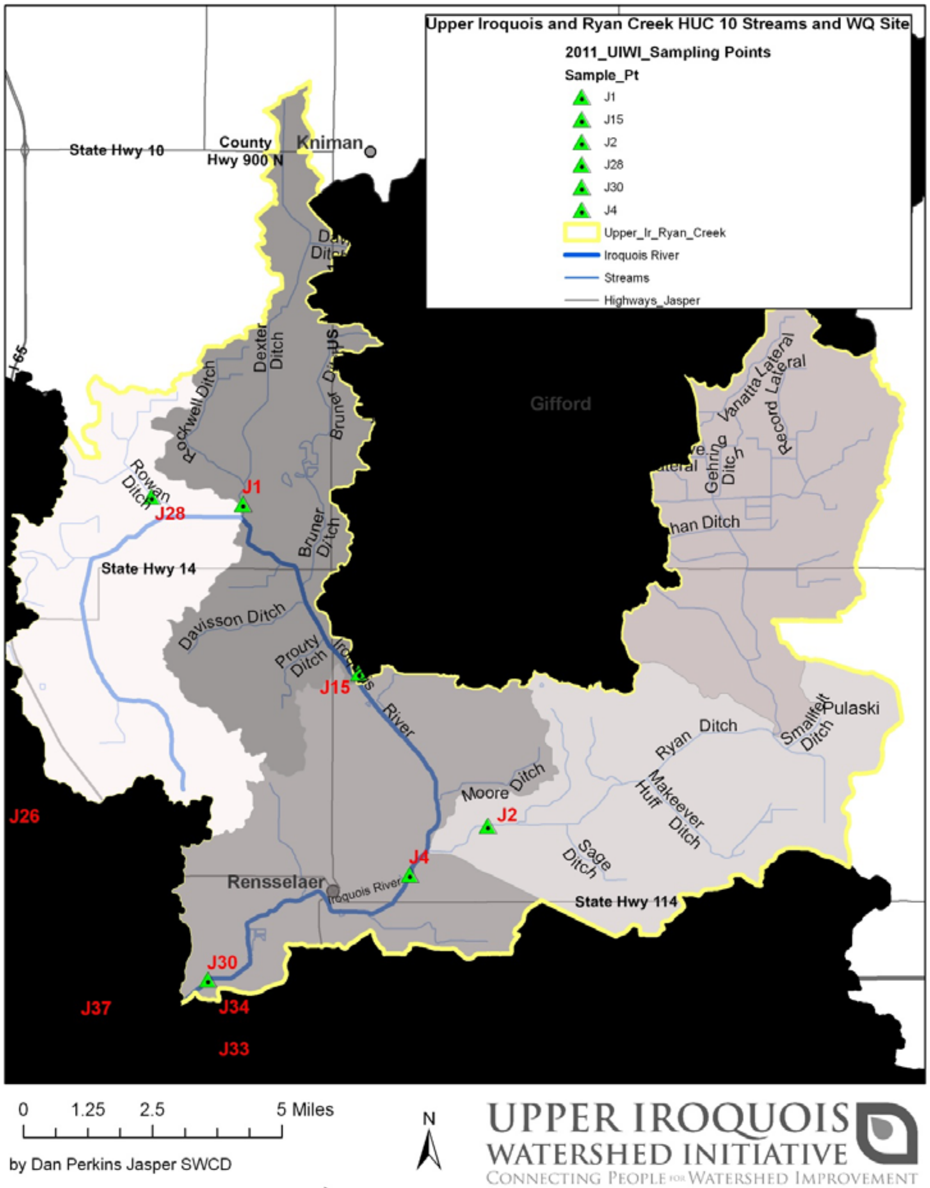
The Upper Iroquois-Ryan ditch subwatershed has a total of 4 impairments- DO, E.coli, and nutrients according to the 2008, 2010, and 2012 303(d) list. There is a 43% increase in miles of impairments from 2008 to 2010, with 28.5 miles impaired in 2008 and 40.8 miles impaired in 2010.

Figure 53 Upper Iroquois-Ryan Ditch IDEM TMDL Sample Pts



UIWI Water Monitoring

Figure 54 Upper Iroquois HUC 10 Stream and WQ Sites



Five sampling sites exist within the Upper Iroquois-Ryan sub watershed. Both water quality and biological monitoring data was collected. See table below for chemical monitoring data of the Upper Iroquois-Ryan ditch sub watershed.

Figure 55 WQ Summary Data for Upper Iroquois May 2011_April 2013

Subwatershed	Site #	Average Temp°C	Average DO%	Average DO mg/L	Average Turbidity
Upper Iroquois Ryan Ditch	J28	14.10	119.20	11.27	56.11
	J1	12.91	97.32	9.29	30.74
	J2	14.98	117.98	11.13	15.92
	J4	14.18	96.15	9.22	24.28
	J30	15.66	108.11	10.10	22.70
	Overall	14.37	107.75	10.20	29.95

Parameter	Upper Iroquois Ryan Ditch Site #	Target Level	Number of Times Exceeding Target Level Range	Number of Times Exceeding Target Level	Number of Samples (n)
Temperature °C	J28	Monthly Standard	0	0	24
	J1		0	0	25
	J2		0	0	19
	J30		0	0	20
DO %	J28	<100	15	15	24
	J1		9	9	25
	J2		12	12	19
	J30		10	10	20
DO mg/L	J28	>4	0	0	24
	J1		0	0	25
	J2		0	0	19
	J30		0	0	20
pH	J28	<9	10	10	24
	J1		5	5	25
	J2		6	6	19
	J30		5	5	20
Turbidity (NTU)	J28	<10.4 (US EPA)	13	13	24
	J1		11	11	25
	J2		9	9	19
	J30		12	12	20
Orthophosphate (mg/L)	J28	<0.005	19	19	19
	J1		17	17	17
	J2		13	13	13
	J30		13	13	13

Parameter	Upper Iroquois Ryan Ditch Site #	Target Level	Number of Times Exceeding Target Level Range	Number of Times Exceeding Target Level	Number of Samples (n)	
Nitrate (mg/L)	J28	<1.5	6	18	J28	18
	J1		5	11		
	J2		1	11		
	J30		2	10	J1	18
	J28	<5.0	6	12		
	J1		3	6		
	J2		5	10	J2	11
	J30		4	8		
	J28	<10	6	6		
	J1		3	3	J30	12
	J2		5	5		
	J30		4	4		
E.coli (cfu/100mL)	J28	<235	1	3	J28	13
	J1		2	3		
	J2		1	1		
	J30		2	5	J1	12
	J28	<410	1	2		
	J1		1	1		
	J2		0	0	J2	10
	J30		2	3		
	J28	<576	1	1		
	J1		0	0	J30	8
	J2		0	0		
	J30		1	1		

Iroquois TMDL

There is only one NPDES facility and two CAFOs within this subwatershed. The WLAs for the NPDES facility were calculated based on their design flows and E.coli permit limits. Rensselaer is the one CSO community with 9 outfalls in this subwatershed. Water quality samples were included from two sites. Based on this data, a reduction range from 64 to 80% was required. See Table 37 TMDLs for Upper Iroquois-Ryan for TMDL data of the Upper Iroquois-Ryan subwatershed.

Station #	Period of Record	Total Number of Samples	Percent of Samples Exceeding *E. coli* WQS (#/100 mL)		Minimum (#/ 100 mL)	Geomean (#/ 100 mL)	Average (#/ 100 mL)	Maximum (#/ 100 mL)	Percent Reduction Based on Geomean
			125	235					(125/ 100mL)
58	6/4/2008 - 7/2/2008	5	100	40	162	343	665	2,419	64%
60	6/4/2008 - 7/2/2008	5	100	100	365	631	672	1,120	80%

Table 37 TMDLs for Upper Iroquois-Ryan.

ii. Habitat/Biological Information

Based on the CMIBI the Upper Iroquois-Ryan Ditch has an average rating of 15, equaling a fair quality score. The CQHEI average score from all sampling sites was a 31.5 in 2011, which is considered unhealthy and a 53 in 2013, which is considered unhealthy.

It should be noted that CQHEI scored did improve by 20 points, but we are unsure of the reason why. From the field sheets it seems dredging may have occurred, similar to the Carpenter_Denton Creek results, but this would need to be confirmed by the county surveyor or private landowners. Regardless, the trend of dredging improving CQHEI scores, but decreasing CMIBI scores holds true.

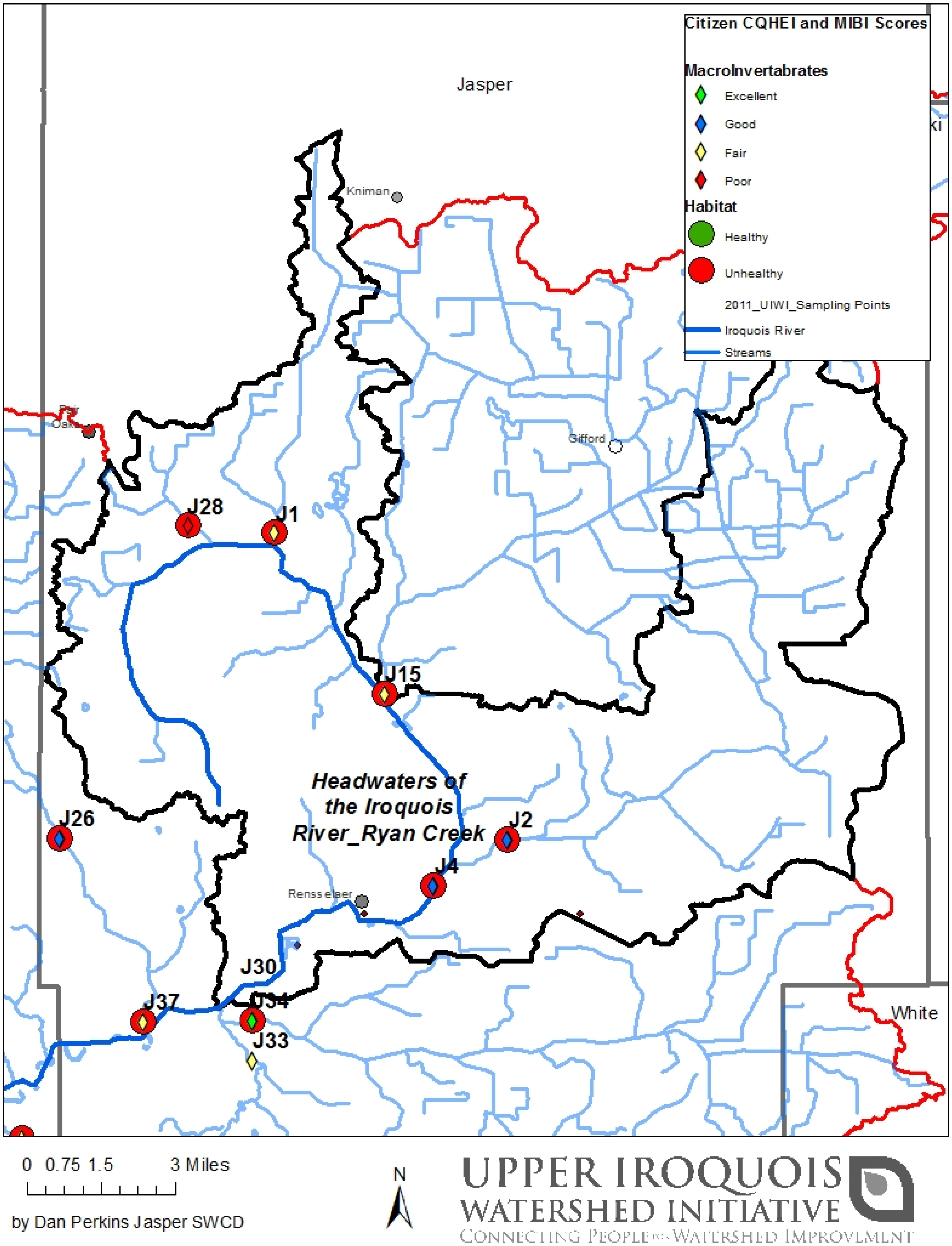
Table 38 Upper Iroquois_Ryan CMIBI Ratings

Citizen MIBI									
Sample Site	Rating 2011	2011 Quality Score	Rating 2013	2013 Quality Score	10 HUC_Subwatershed	2011 Average 10 HUC	2013 Average 10 HUC	2011 Overall Score	2013 Overall Score
J1	15	Fair	12	Fair	Upper Iroquois-Ryan Creek	15.25	14.25	Fair	Fair
J28	10	Poor	15	Fair	Upper Iroquois-Ryan Creek				
J2	19	Good	16	Fair	Upper Iroquois-Ryan Creek				
J4	17	Good	14	Fair	Upper Iroquois-Ryan Creek				
J30	n	n	n	0	Upper Iroquois-Ryan Creek				
HUC 8	14	Fair	13	Fair					
Scale	Quality	Scale	Quality						
10 or less	Poor	11_16	Fair						
17-22	Good	23 >	Excellent						

Table 39 Upper Iroquois and Ryan CQHEI Ratings

Citizen Habitat Evaluation index (CQHEI)									
Site	2011 Rating	2011 Quality Score	2013 Rating	2013 Quality Score	HUC 10 Subwatershed	2011 Average Rating	2013 Average Rating	2011 Overall Quality Score	2013 Overall Quality Score
J1	54	Unhealthy	72	Healthy	Upper Iroquois-Ryan Creek	35.25	51	Unhealthy	Unhealthy
J30	n	n	71	Healthy	Upper Iroquois-Ryan Creek				
J28	12	Unhealthy	24	Unhealthy	Upper Iroquois-Ryan Creek				
J2	21	Unhealthy	30	Unhealthy	Upper Iroquois-Ryan Creek				
J4	54	Unhealthy	60	Healthy	Upper Iroquois-Ryan Creek				
HUC 8	38	Unhealthy	53	Unhealthy					
Citizen Habitat Evaluation Index CQHEI		100>	High Quality Stream						
		> 60	Generally Healthy						
		< 60	Unhealthy						

Figure 56 Upper Iroquois HUC 10 CQHEI and CMIBI Ranks



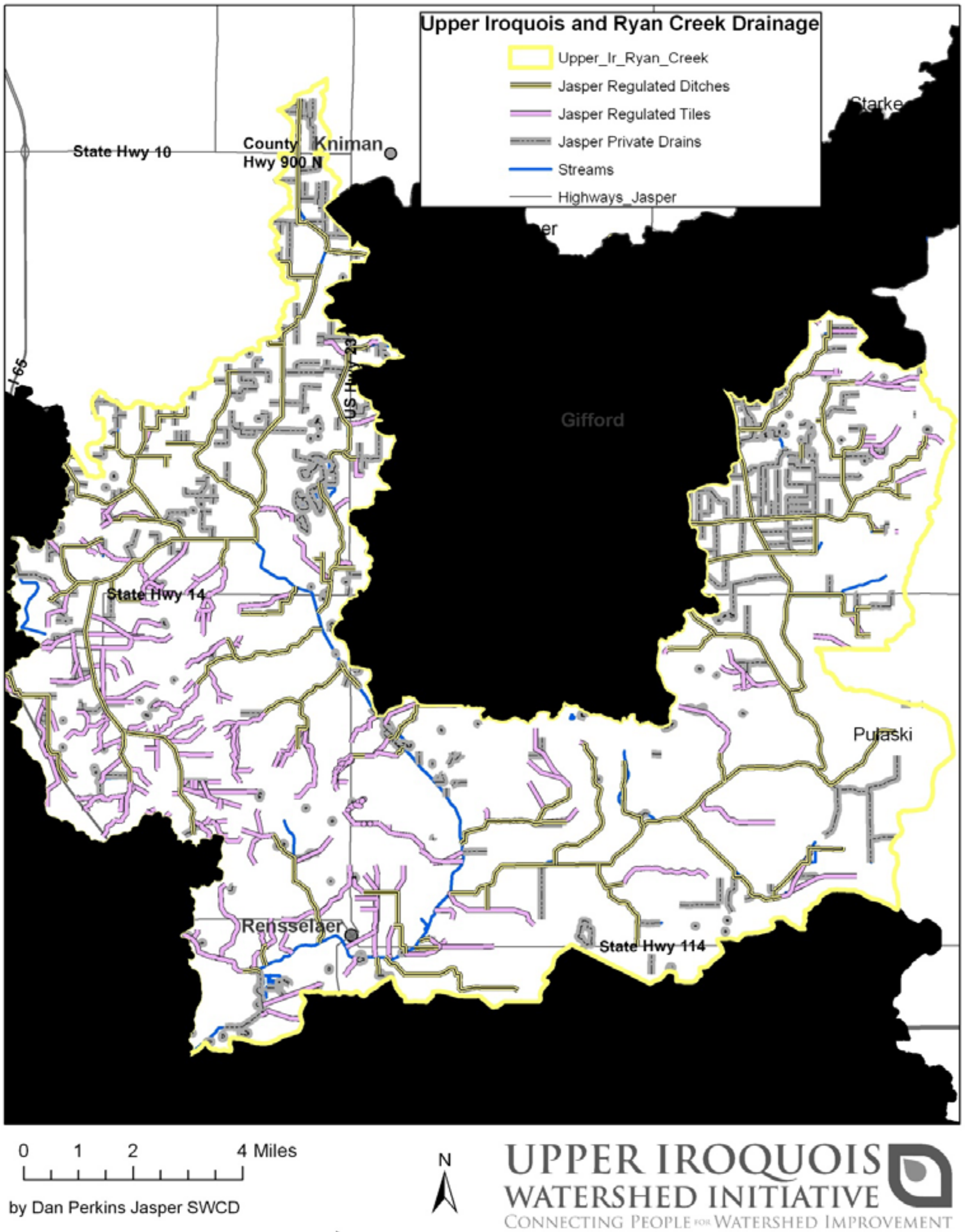
iii. Land Use Information

The Upper Iroquois-Ryan Ditch subwatershed is approximately 86,768 acres or 136 square miles and lies entirely within Jasper County. It has 136 natural stream miles of which 126.85 are regulated open drains. About 123 miles of private drains are known to exist.

The local drainage board has a 75 ft right of way along all regulated drains and schedules maintenance projects. Working with them to ensure minimal in-stream disturbance and habitat loss will be critical to addressing stakeholder concerns. Due to the high percentage of private drains working with landowners and farmers in the same regard will also be critical.

Of particular note is that north of highway 14 where the Iroquois River and a regulated drain meets see Figure 57 Upper Iroquois and Ryan Creek Drainages, there is debate as to where the Iroquois River actually starts. The regulated drain adds about 8 stream miles. Regardless, all the landuse in that area still impacts water quality on the Iroquois River

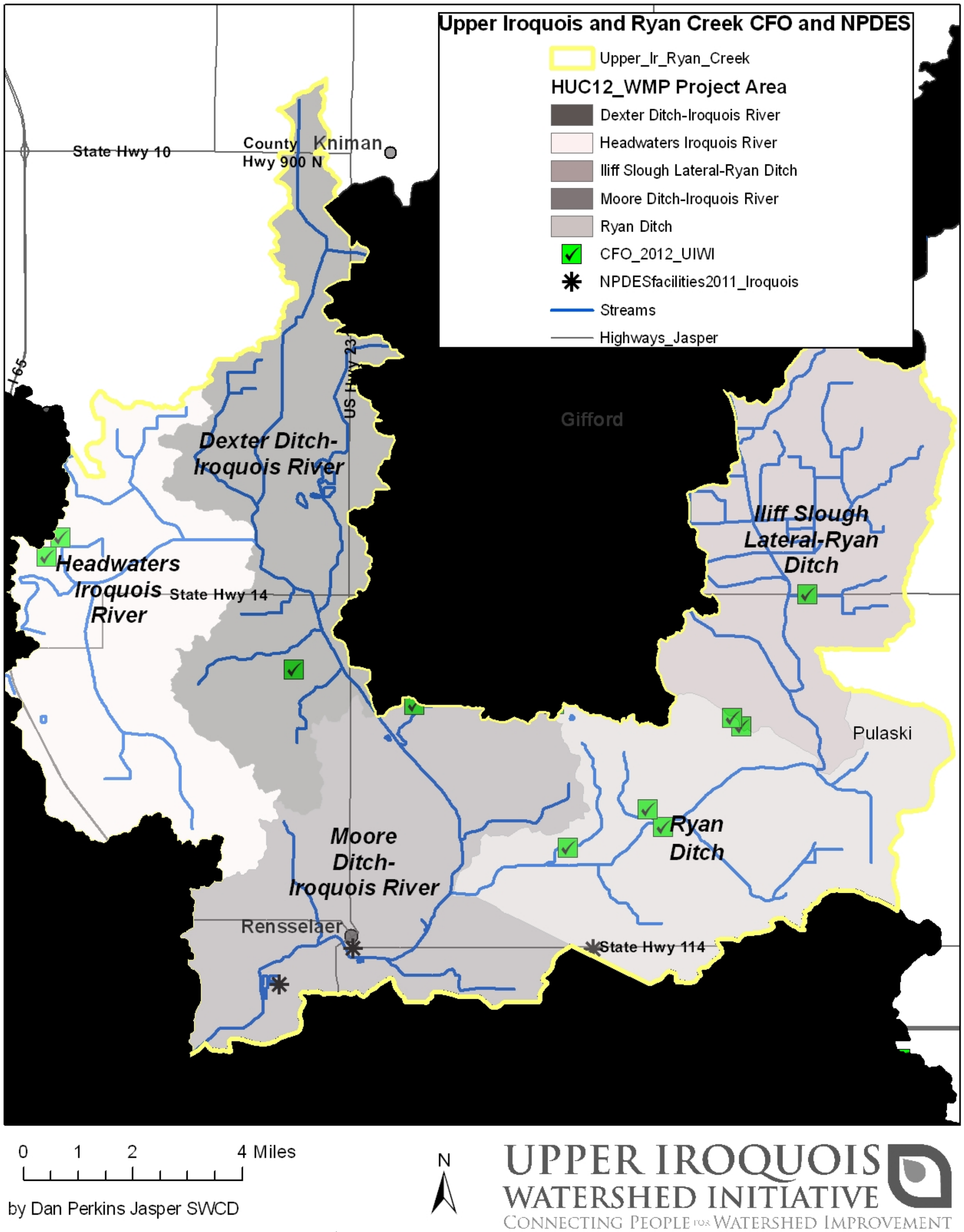
Figure 57 Upper Iroquois and Ryan Creek Drainages



As of 2012, 9 CFO facilities- 5 hog, 2 dairy, and 2 beef facilities are in operation. 3 NPDES sites- Rensselaer WWTP, Iroquois Bio-Energy Company, and Rensselaer Water Treatment Plant.

A 2007-2012 review of IDEM's virtual cabinet and EPA's ECHO database for NPDES and CFO permit holders found 3 out of compliance events, occurring at 2 of the CFOs. Best management practices should continue to be utilized for all manure applications to ensure these facilities are not contributing to stakeholders concerns of excessive nutrients or E.coli in the water.

Figure 58 Upper Iroquois and Ryan CFO and NPDES Sites



One combined sewer overflow (CSO) community does exist within the entire Upper Iroquois River watershed and is possibly a significant source of water quality pollutants. The city of Rensselaer had 9 CSOs that discharged directly into the Iroquois River, but in 2011 one was separated as part of the ongoing stormwater separation. Figure 20 Combined Sewer Outfalls (CSO) and Delineated Drainage Areas shows the location of each outfall and the approximate contributing drainage area for each outfall. The city is working on separating the sanitary sewers from the storm water sewers, but the process will take many years. On average a ½ inch rainfall event results in overloading of the sanitary system causing a discharge at the CSO outlet (per Comm. With Rensselaer Wastewater Treatment Plant). Urban BMPs such as rain gardens, bioswales, pervious pavement, and rain barrels should be promoted to keep a large percentage of storm water run-off from ever entering the sewer system and therefore reducing the amount the CSOs discharge into the river.

Another likely source of E.coli and nutrients is the I-65 interchange at Rt. 114. In 2012, the city extended its city limits to I-65 along Route 114 as part of the Regional Sewer and Water District, which brought sewer and water to businesses and homes along Rt. 114 and the I-65 interchange, which will do much to address the failing septics and need for mound systems in this area.

Figure 59. City of Rensselaer City Limits

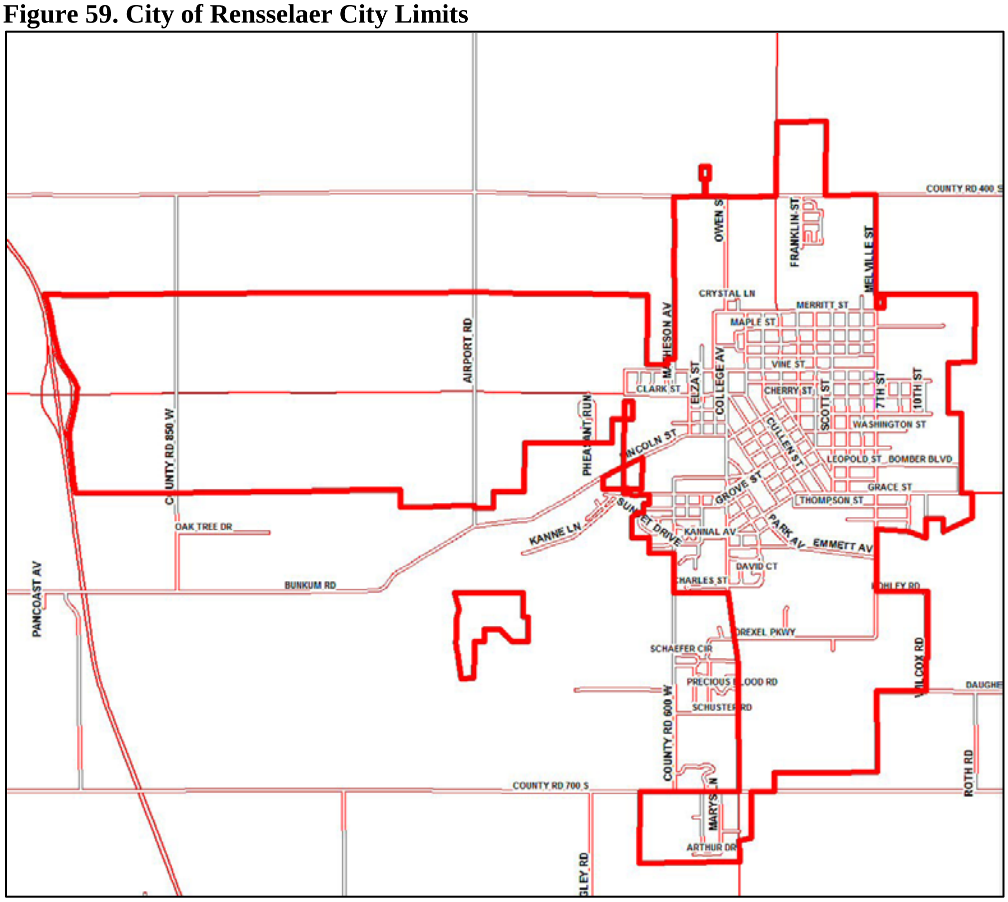


Table 40 Upper Iroquois and Ryan Creek Land Use

Land Use/Land Cover	Subwatershed		
	Area		Percent
	Acres	Square Miles	
Agricultural Land	72,477.52	113.25	83.57
Forested Land	4,947.38	7.73	5.70
Developed Land	5,619.67	8.78	6.48
Pasture/Hay	2,570.65	4.02	2.96
Grassland and Shrubs	693.65	1.08	0.80
Open Water	320.69	0.50	0.37
Wetland	97.41	0.15	0.11
Total	**86,726.97**	**135.51**	**100.00**

Open space is not needed in this area given its agricultural land use and limited urban development. Areas slated for development follow the county ordinances and codes and town boundary restrictions. Of the 37 leaking UST across the entire Iroquois River watershed, 11 of these are in the Upper Iroquois and Ryan Creek watershed. Especially given that 10 of the sites are either within Rensselaer city limits or just outside. The LUSTs need further investigation as to their remediation status. See Table 22 UIWI LUSTs Site Locations.

Application of municipal sludge occurs on 183 acres, which is 7.5% of the total acres that are spread across the entire Upper Iroquois watershed.

iv. Windshield Survey

1. The Upper Iroquois and Ryan Creek watershed windshield survey had a possible 82 points or roads that intersected a stream; of these we surveyed 67 sites. Based on the summary data in

Table 41 Upper Iroquois River_Ryan Creek Windshield Survey Summary 36, 3 maps of concerns were created based on each point showing the following:

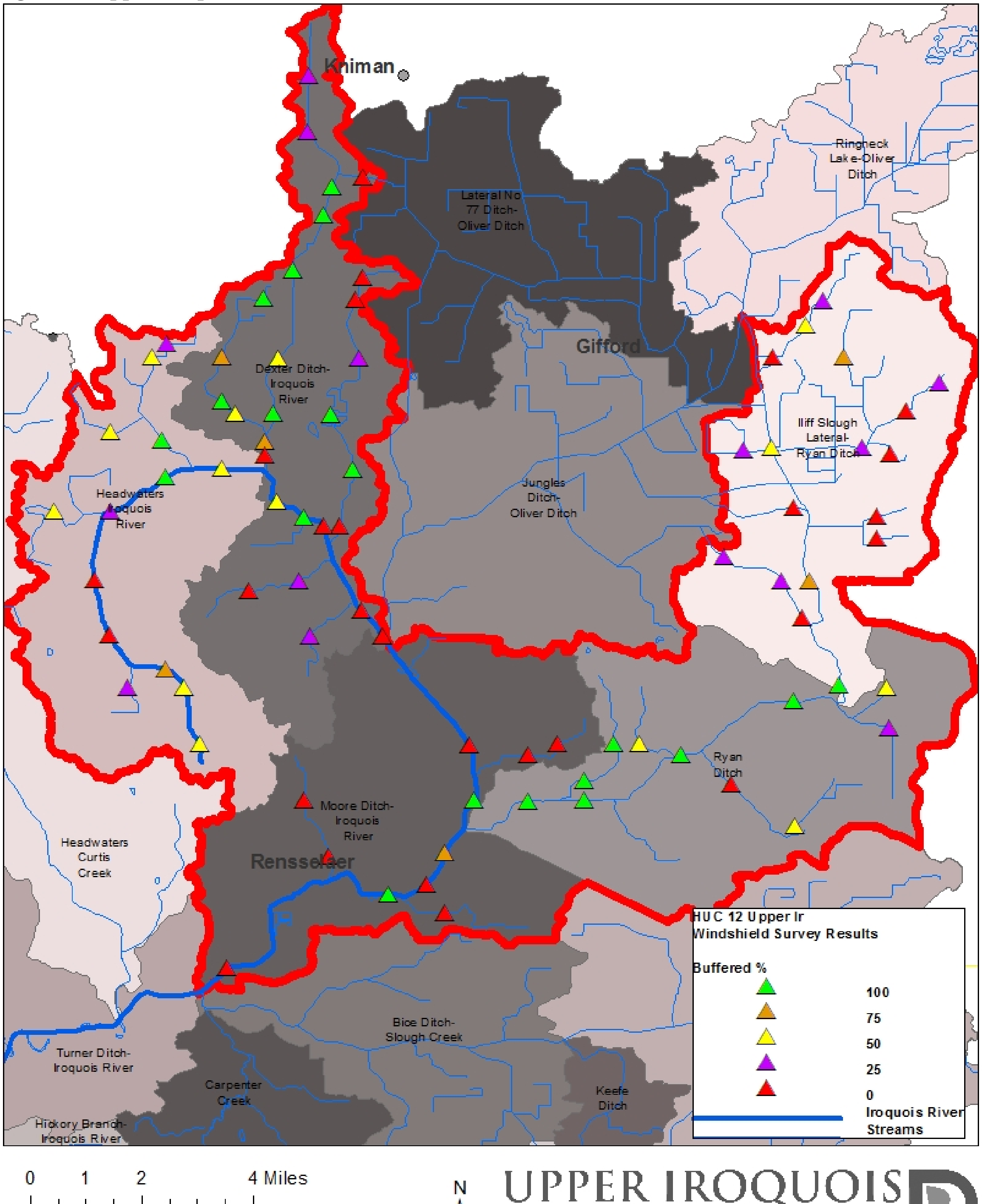
2. Stream Buffer- Present or absent, and if present % of area
3. Areas of active erosion (stream bank)
4. Areas where livestock had direct access to water.
5. Evidence of Channelization

Table 41 Upper Iroquois River_Ryan Creek Windshield Survey Summary

HUC 10 Windshield Survey Summary	Upper Ir_Ryan
Windshield Survey Item	
Number Sites Sampled	67
# Sites with Buffers Present	56
% Sites with 100% Buffer	30%
% Sites with 75% Buffer	9%
% Sites with 50% Buffer	22%
% Sites with 25% Buffer	22%
% Sites with 0% Buffer	16%
# Sites with Active Erosion	19
# Sites with Livestock Access	7
# Sites with Channelization	56

To address the concern of loss of fish habitat and to protect fish habitat, as well as reduce nutrient, bacteria, and sediment loading it will be important to further investigate the sites with: less than 50% buffer which is 38% of the sites, and livestock access particularly the area north of State Road 16, active erosion, and extent of channelization and address these areas with appropriate best management practices.

Figure 60 Upper Iroquois Windshield % Buffer Sites



by Dan Perkins Jasper SWCD

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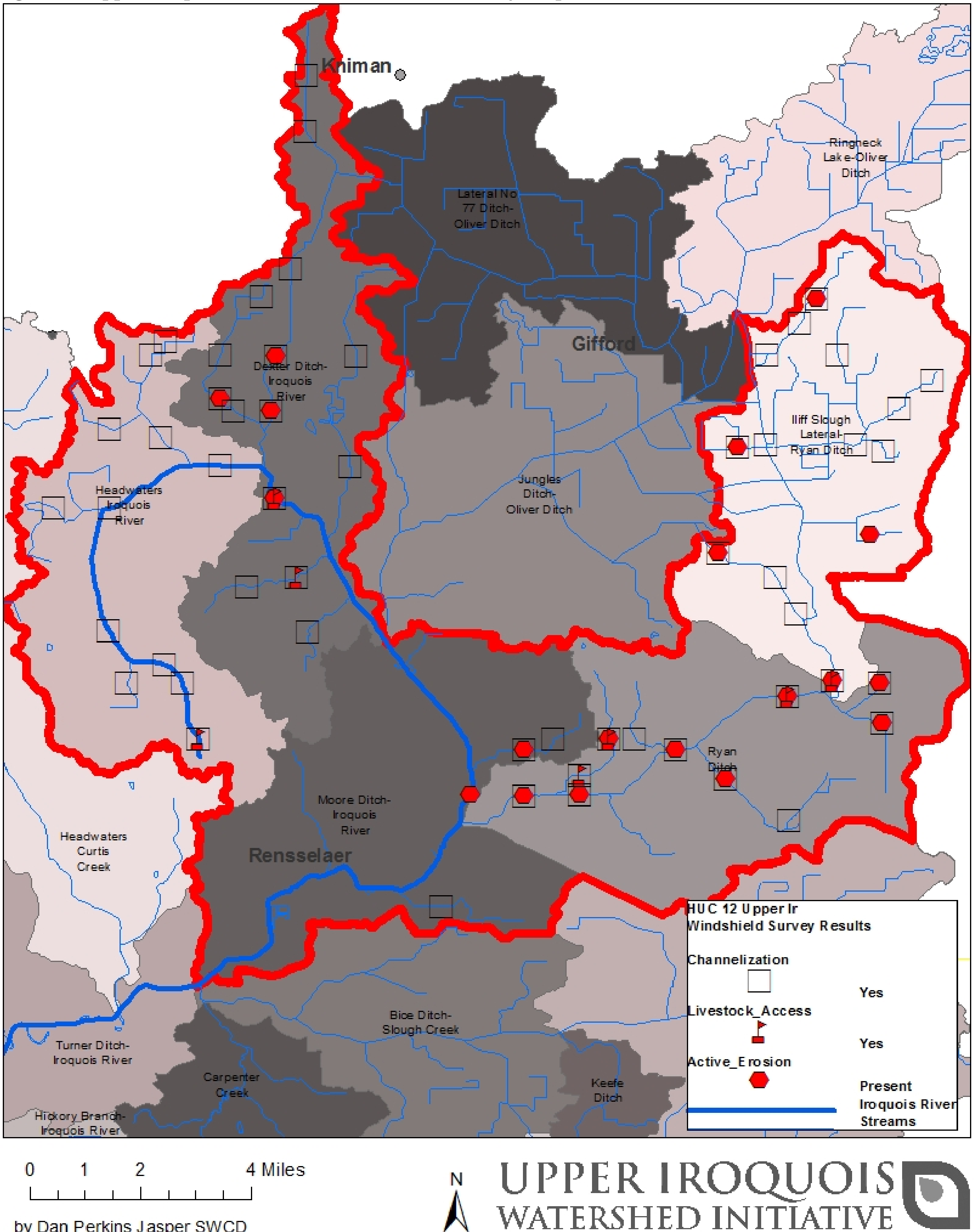
Figure 61 Upper Iroquois Windshield 3 Factors Summary Map



viii. Desktop Survey

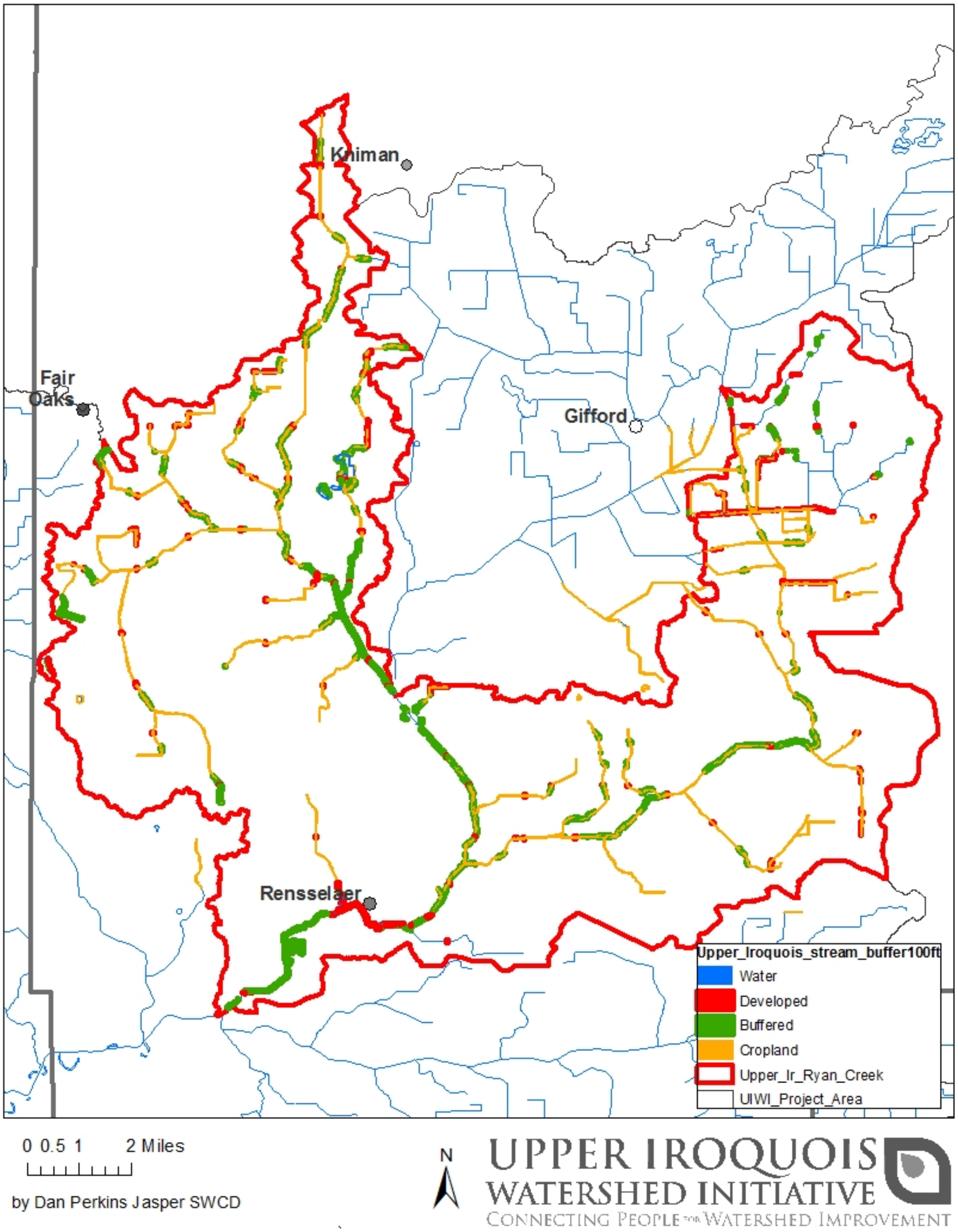
ix.i Land Use within 100 ft of stream

18 percent of land within the 100 foot buffer zone of a stream is buffered. With 74% of the land use along streams being cropland that means potential direct contamination of nutrients and E.coli from manure spreading may be occurring and indirect pollution from chemical fertilizers by run-off may be occurring. The map reveals that smaller headwater and tributary streams seem to have the least buffered area and would be a good area to target for outreach efforts. It appears that large portions of the main stem of the Iroquois and Ryan are well buffered and efforts to keep it that way should be encouraged.

Table 42 Upper Iroquois_Ryan within 100 ft of Stream Landuse

HUC 10	Upper Iroq
100 Ft Acre Total	3,220
Stream Miles	136
Water %	2%
Developed %	6%
Buffered %	18%
Cropland %	74%

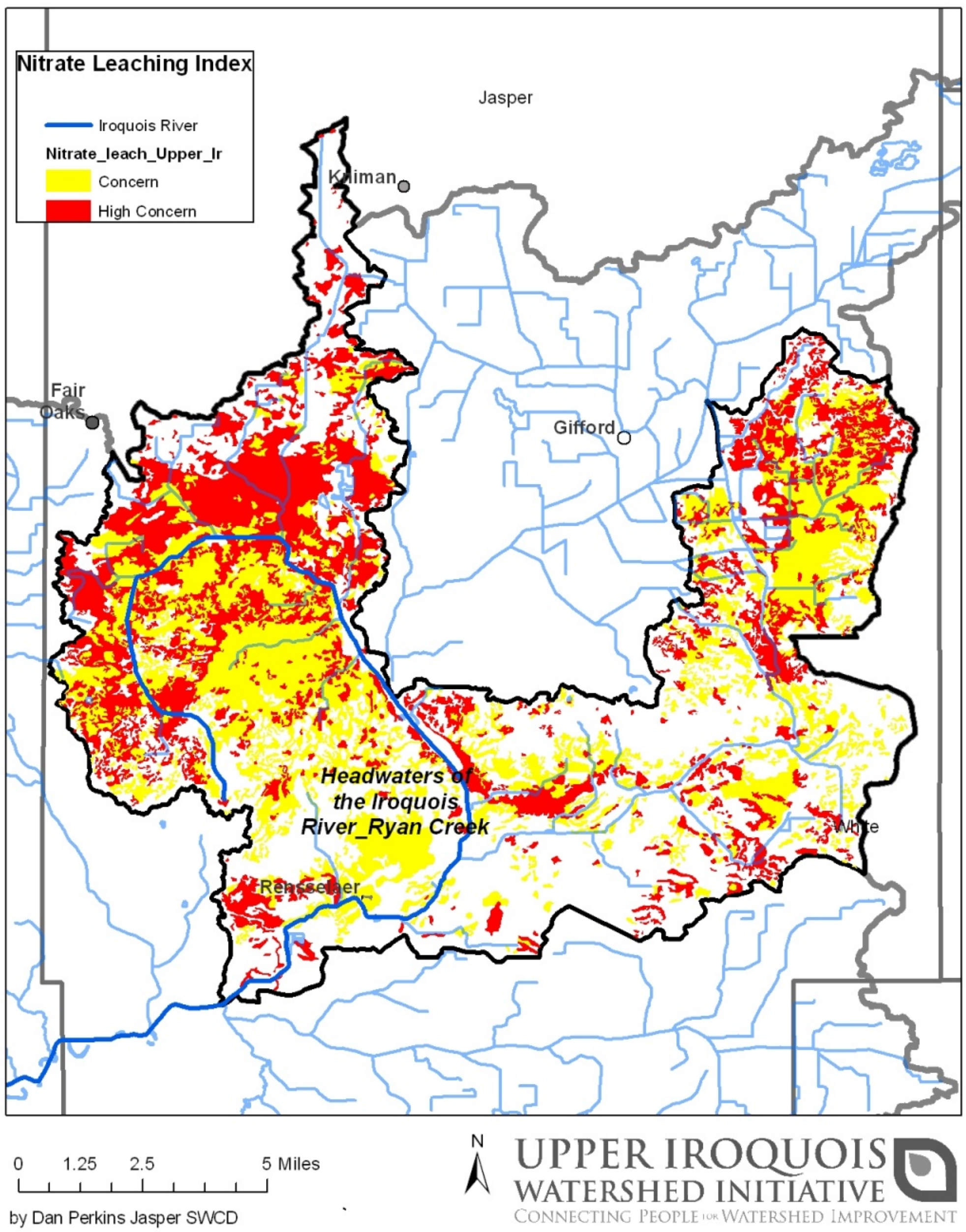
Figure 62 Stream Buffer Land Use within 100 ft



ix. Nitrate Leaching Index Map

The Upper Iroquois_Ryan Creek subwatershed is vulnerable to leaching of pollutants as can be seen with the large amount of “high concern” soil types in the watershed at 23% of total soil acres and 42% of the acres in “concern” index. To address stakeholder concerns these areas should be focused on for specific BMPs that address leaching concerns.

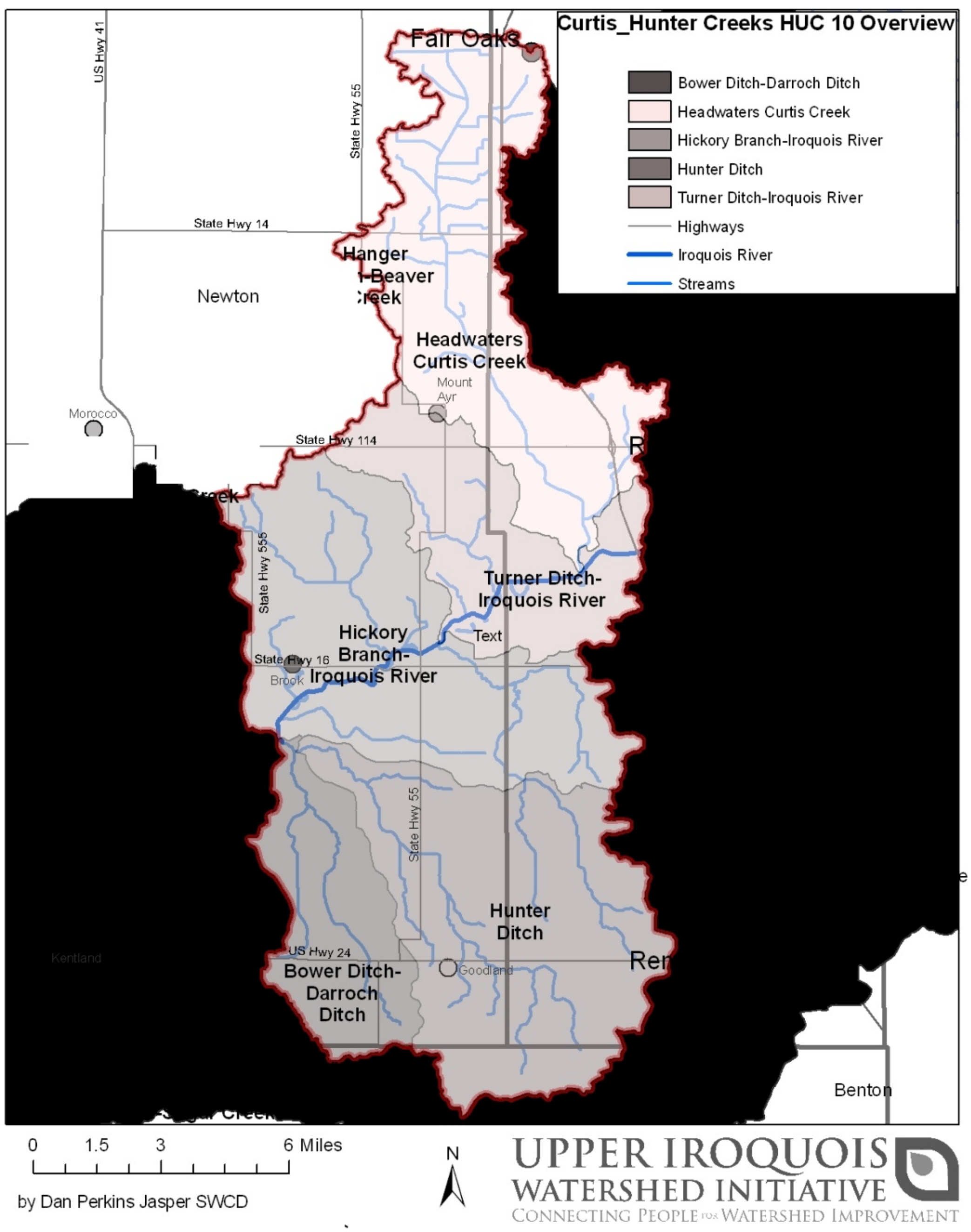
Figure 63 Nitrate Leaching Index Upper Iroquois



3.3.4 HUC 10- Curtis and Hunter Creeks

The Curtis and Hunter Creeks subwatershed is the 2nd largest tributary of the Upper Iroquois River watershed. It has an area of approximately 162 square miles, has 152 stream miles, and lies largely within Jasper and Newton Counties. It contains 5 HUC 12 sub watersheds- Headwaters Curtis Creek, Turner-Ditch, Hickory Branch, Bower Ditch, and Hunter Ditch.

Figure 64 Curtis-Hunter Creek HUC 10 Overview

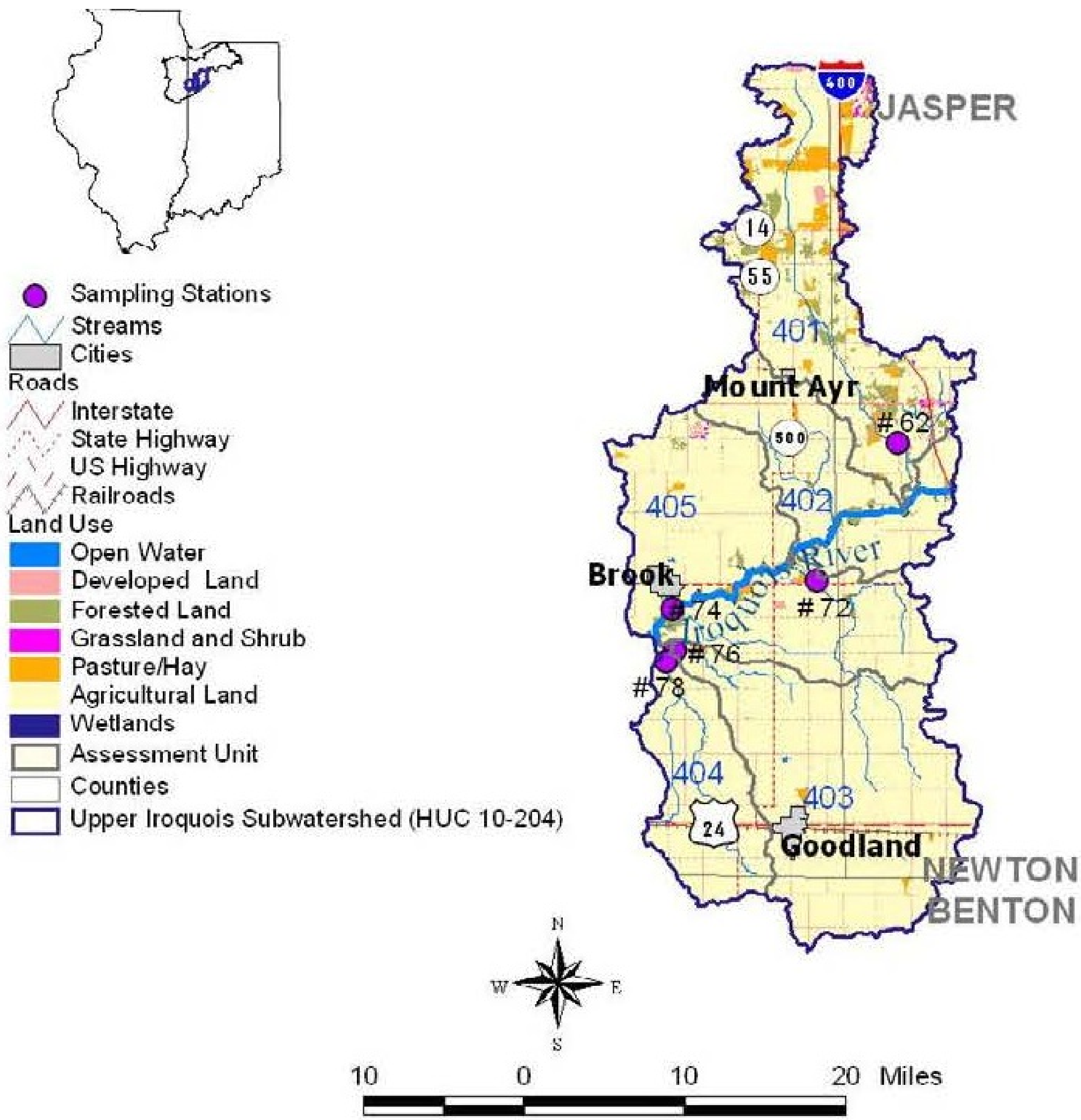


i. Water Quality Information

IDEM 303(d)

The Curtis Hunter Creek subwatershed had a total of 6 impairments- chloride, nutrients, IBC, DO, TDS, and E.coli. In 2008, there were 6 impairments- e.coli, chloride, nutrients, TDS, DO, IBC and in the 2010 303(d) list 4 impairments – chloride, Nutrients, IBC, and DO.. In 2012, there were 5 impairments- nutrients, DO, E.coli, IBC, chloride. There was a 22.2% change in miles of impairments from 2008 to 2010, with 29.5 miles in 2008 and 95 miles impaired in 2010.

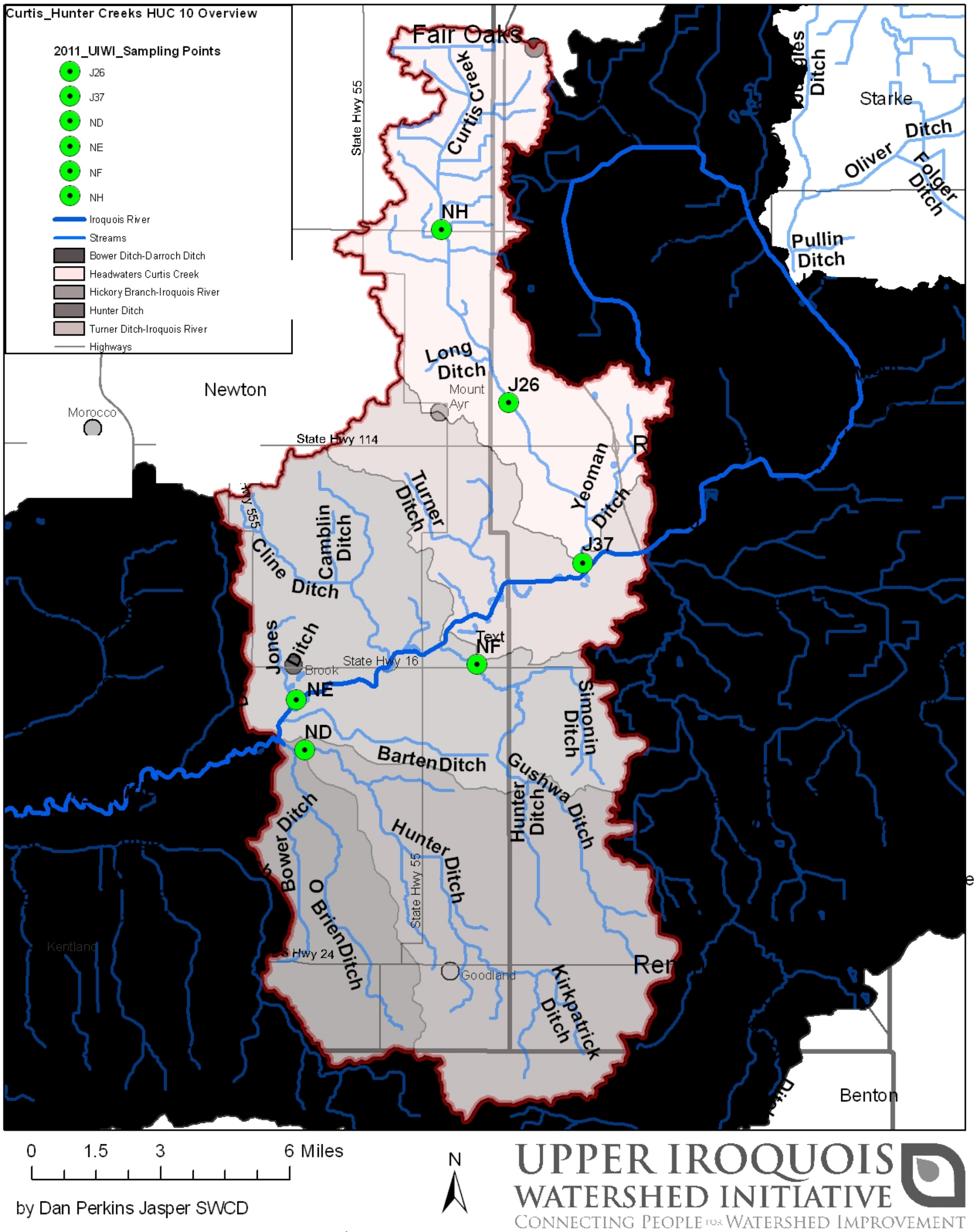
Figure 65 Curtis-Hunter Land Use and IDEM TMDL Sample Pts



UIWI Water Monitoring

Six sampling sites exist within the Curtis-Hunter sub watershed. Both water quality and biological monitoring data was collected.

Figure 66 Curtis and Hunter Creeks Streams and WQ Sample Sites



See below for chemical monitoring data of the Curtis-Hunter Creek subwatershed.

Table 43 Curtis _Hunter HUC 10 WQ Summary Data

Subwatershed	Site #	Average Temp°C	Average DO%	Average DO mg/L	Average Turbidity
Curtis Hunter Creek	NH	14.98	117.96	11.00	13.03
	J26	14.72	117.63	10.98	10.67
	J37	16.46	117.52	10.67	49.77
	NF	13.23	90.43	8.88	40.74
	NE	13.15	102.93	9.92	39.74
	ND	13.99	99.62	9.72	36.57
	Overall	14.42	92.30	8.74	27.22

Parameter	Curtis Hunter Creek Site #	Target Level	Number of Times Exceeding Target Level Range	Number of Times Exceeding Target Level	Number of Samples (n)
Temperature °C	NH	Monthly Standard	0	0	24
	J26		0	0	23
	J37		1	1	19
	NF		0	0	23
	NE		0	0	22
DO %	NH	<100	14	14	24
	J26		13	13	23
	J37		13	13	20
	NF		6	6	23
	NE		9	9	22
DO mg/L	NH	>4	0	0	24
	J26		0	0	23
	J37		0	0	20
	NF		0	0	23
	NE		0	0	22
pH	NH	<9	6	6	24
	J26		47	47	23
	J37		5	5	19
	NF		6	6	23
	NE		6	6	22
Turbidity (NTU)	NH	<10.4 (US EPA)	12	12	24
	J26		47	47	23
	J37		12	12	20
	NF		21	21	23
	NE		17	17	22
Orthophosphate (mg/L)	NH	<0.005	19	19	19
	J26		41	41	15
	J37		12	12	12
	NF		20	20	20
	NE		17	17	17

Parameter	Curtis Hunter Creek Site #	Target Level	Number of Times Exceeding Target Level Range	Number of Times Exceeding Target Level	Number of Samples (n)	
Nitrate (mg/L)	NH	<1.5	5	9	NH	20
	J26		6	8		
	J37		3	5		
	NF		3	9	J26	13
	NE		3	8		
	NH	<5.0	3	4		
	J26		2	2	J37	11
	J37		2	2		
	NF		4	6		
	NE		5	5	NF	18
	NH	<10	1	1		
	J26		0	0		
	J37		0	0	NE	19
	NF		2	2		
	NE		0	0		
E.coli (cfu/100mL)	NH	<235	1	3	NH	12
	J26		0	2		
	J37		1	2		
	NF		1	9	J26	11
	NE		1	7		
	NH	<410	0	2		
	J26		0	2	J37	10
	J37		-1	1		
	NF		1	8		
	NE		2	6	NF	10
	NH	<576	2	2		
	J26		2	2		
	J37		2	2	NE	9
	NF		7	7		
	NE		4	4		

Iroquois TMDL 2008

There are three NPDES facilities and six CAFOs within this subwatershed. The WLAs for the NPDES facility were calculated based on their design flows and E.coli permit limits. Water quality samples for E.coli were included from four sites. Based on this data, a reduction range from 75 to 89% was required. See Table 44 TMDLs for Curtis-Hunter for TMDL data of the Curtis-Hunter subwatershed.

Station #	Period of Record	Total Number of Samples	Percent of Samples Exceeding *E. coli* WQS (#/100 mL)		Minimum (#/ 100 mL)	Geomean (#/ 100 mL)	Average (#/ 100 mL)	Maximum (#/ 100 mL)	Percent Reduction Based on Geomean
			125	235					(125/ 100mL)
62	6/4/2008 - 7/2/2008	5	100	100	326	649	882	2,419	81%
76	6/2/2008 - 6/30/2008	5	100	100	866	1122	1144	1,414	89%
78	6/2/2008 - 6/30/2008	5	100	100	276	755	866	1300	83%
72	6/2/2008 - 6/30/2008	5	100	100	276	544	608	1120	77%
74	6/2/2008 - 6/30/2008	5	100	80	131	495	805	2419	75%

Table 44 TMDLs for Curtis-Hunter

Curtis Creek Watershed Diagnostic Study

As mentioned in Section 3.2 the Curtis Creek study plan was completed to describe the historical and existing conditions of the watershed, identify potential problems and to prioritize recommendations. The relevance of this water quality data and the habitat/biological information below is that it directly relates to four of our stakeholder concerns: healthy fish habitat, too much sediment in water, too much nutrients in water, and high E.coli levels. The study documented high levels of ammonia-nitrogen, nitrate-nitrogen, phosphorus, and E.coli in the watershed streams. Water quality samples taken during storm events exceeded state standards for some chemical parameters and for E.coli at many sample sites.

The physical and chemical data collected from streams in the Curtis Creek Watershed suggest that the streams at least suffer from moderate levels of water quality degradation. With the exception of one sample, bacteria concentrations were high during base and storm run-off conditions. Sediment loading rates varied but ranged from 2.2 to 3,2624 kg/day depending on flow conditions and location. While some reaches acted as sinks for sediment, phosphorus, and bacteria, others exhibited high loading rates for pollutants, particularly during high water stage. Based on this data, Yeoman Ditch, Long ditch, Curtis Creek at CR 100S, and Lower

Curtis Creek are more impaired than other waterbodies or sites in the Curtis Creek Watershed.

ii. Habitat/Biological Information

Based on the CMIBI the Curtis-Hunter subwatershed has an average rating of 15.5, equaling a fair quality score, two sites had a quality score of good and four sites scoring fair in 2011. 2013 results showed overall score dropped by one point, but overall scoring of fair, stayed the same. The 2011 CQHEI score was a 32, which is considered unhealthy and in 2013 was a 48, which is also unhealthy. Among the 5 other HUC 10 this was the 3rd lowest CQHEI score.

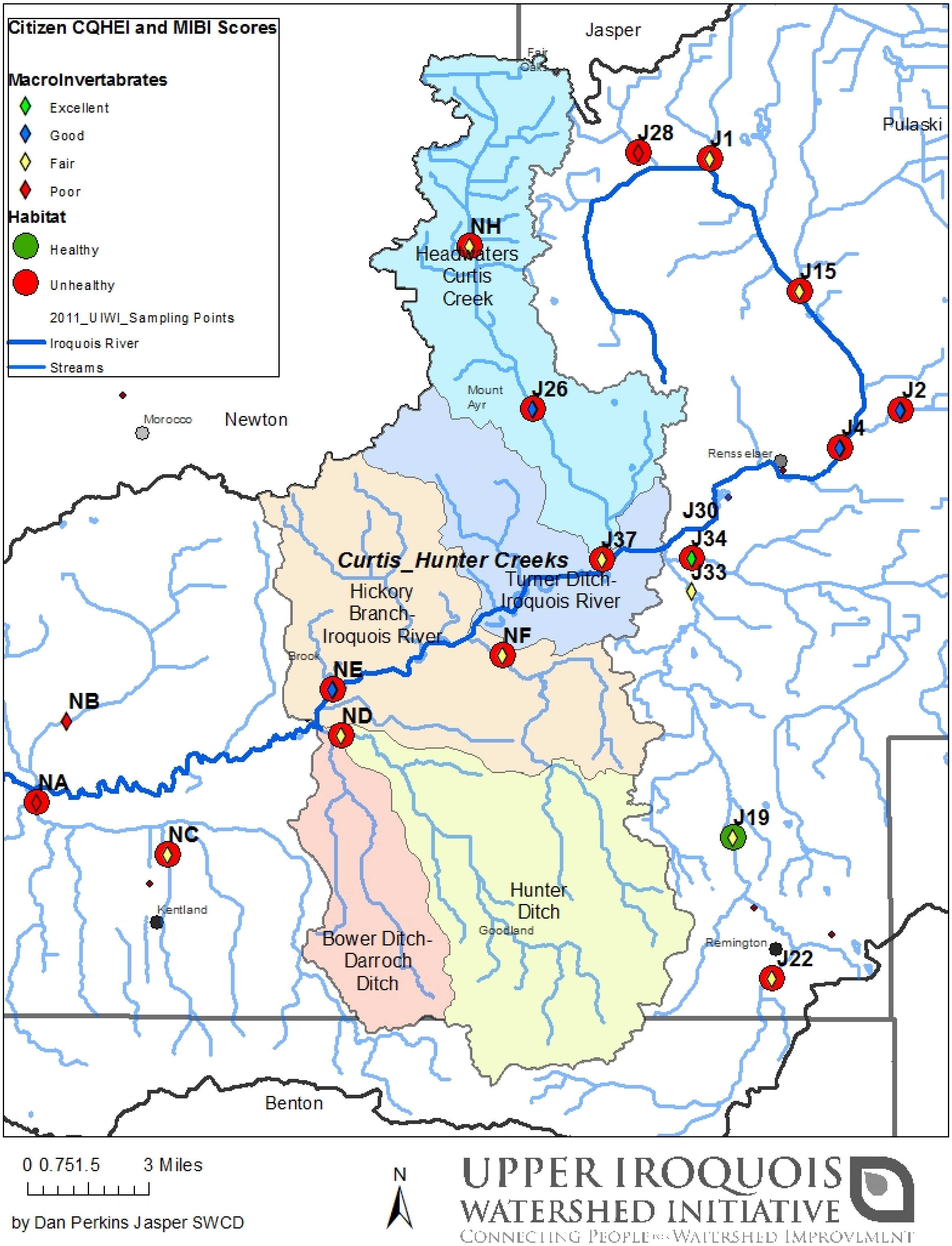
Table 45 Curtis-Hunter CMIBI Ratings

Citizen MIBI									
Sample Site	Rating 2011	2011 Quality Score	Rating 2013	2013 Quality Score	10 HUC_Subwatershed	2011 Average 10 HUC	2013 Average 10 HUC	2011 Overall Score	2013 Overall Score
J37	16	Fair	14	Poor	Curtis-Hunter Creeks	16	15	Fair	Fair
J26	19	Good	21	Good	Curtis-Hunter Creeks				
NH	13	Fair	22	Good	Curtis-Hunter Creeks				
NF	12	Fair	10	Poor	Curtis-Hunter Creeks				
NE	21	Good	11	Fair	Curtis-Hunter Creeks				
ND	14	Fair	9	Poor	Curtis-Hunter Creeks				
HUC 8	14	Fair	13	Fair					
Scale	**Quality**	**Scale**	**Quality**						
10 or less	Poor	11_16	Fair						
17-22	Good	23 >	Excellent						

Table 46 Curtis-Hunter CQHEI Ratings

Citizen Habitat Evaluation index (CQHEI)									
Site	2011 Rating	2011 Quality Score	2013 Rating	2013 Quality Score	HUC 10 Subwatershed	2011 Average Rating	2013 Average Rating	2011 Overall Quality Score	2013 Overall Quality Score
J37	47	Unhealthy	61	Healthy	Curtis-Hunter Creeks	34	48	Unhealthy	Unhealthy
J26	40	Unhealthy	60	Healthy	Curtis-Hunter Creeks				
NH	41	Unhealthy	37	Unhealthy	Curtis-Hunter Creeks				
NF	29	Unhealthy	35	Unhealthy	Curtis-Hunter Creeks				
NE	15	Unhealthy	56	Unhealthy	Curtis-Hunter Creeks				
ND	34	Unhealthy	40	Unhealthy	Curtis-Hunter Creeks				
HUC 8	39	Unhealthy	53	Unhealthy					
Citizen Habitat Evaluation Index CQHEI		100>	High Quality Stream						
		> 60	Generally Healthy						
		< 60	Unhealthy						

Figure 67 Curtis-Hunter_Creeks CQHEI and MIBI Rank



Curtis Creek Watershed Diagnostic Study

Data from macroinvertebrate sampling at each of the 10 sites and a reference site were used to calculate an index of biotic integrity. The macroinvertebrate Index of Biotic Integrity (MIBI) documented a range of moderately impacted to slightly impaired macroinvertebrate communities. Habitat as assessed using the qualitative Habitat Evaluation Index (QHEI) was also less than optimal for aquatic life uses at most sites. The MIBI scores ranged from 2.25 to 5.25. All QHEI scores except Beaver Creek fell below 60, the level conducive to existence of warm water faunas. Many of the study sites lacked at least one of the key elements of natural, healthy stream habitats. The QHEI evaluations from each site described poor substrate quality throughout the streams. Nearly all of the sites had relatively steep banks, indicative of stream modification and channelization. Another aspect of good habitat quality missing from many of the study sites is an effective riparian zone to buffer stream systems from the surrounding land use. Based on observations made, the quality and quantity of riparian zone vegetation is moderately to severely limited throughout the watershed.

This study concurs with current CQHEI and CMIBI data.

iii. Land Use Information

The Curtis and Hunter Creek subwatershed is approximately 103,490 acres or 162 square miles and has 153 natural stream miles of which 111 miles are regulated open drains. About 60 miles of private drains are known to exist.

Working with them to ensure minimal in-stream disturbance and habitat loss will be critical to addressing stakeholder concerns.

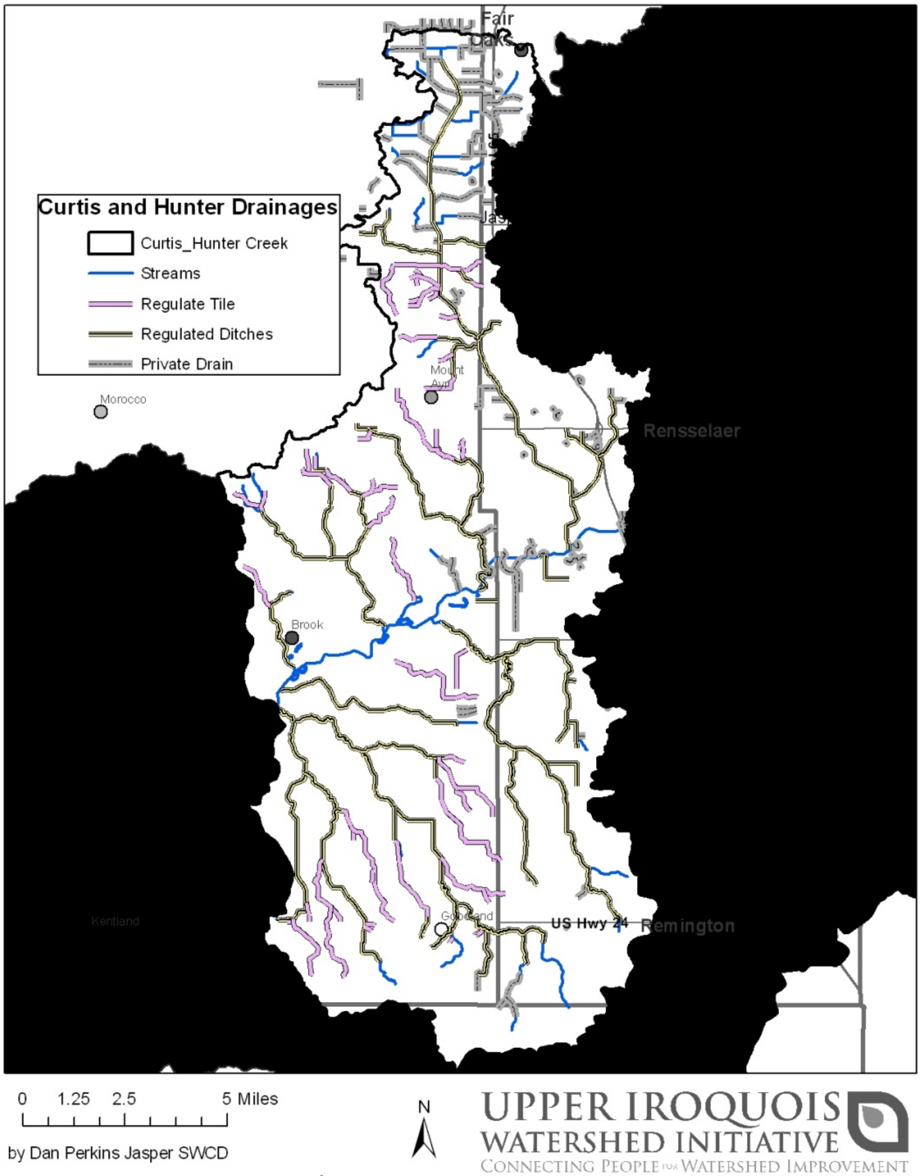
Table 47 Curtis-Hunter Land Use Data

Land Use/Land Cover in the Curtis Creek-Iroquois River Subwatershed

Land Use/Land Cover	Subwatershed		
	Area		Percent
	Acres	Square Miles	
Agricultural Land	89,350.55	139.61	86.34
Forested Land	4,048.90	6.33	3.91
Developed Land	6,291.75	9.83	6.08
Pasture/Hay	3,008.32	4.70	2.91
Grassland and Shrubs	217.06	0.34	0.21
Open Water	178.80	0.28	0.17
Wetland	394.30	0.62	0.38
Total	**103,489.69**	**161.70**	**100.00**

Open space is not needed in this area given its agricultural land use and limited urban development. Areas slated for development follow the county ordinances and codes and town boundary restrictions. Of the 37 leaking UST across the entire Iroquois River watershed, 4 of these are in the Curtis and Hunter Creek watershed. The LUSTs need further investigation as to their remediation status. See Table 22 UIWI LUSTs Site Locations.

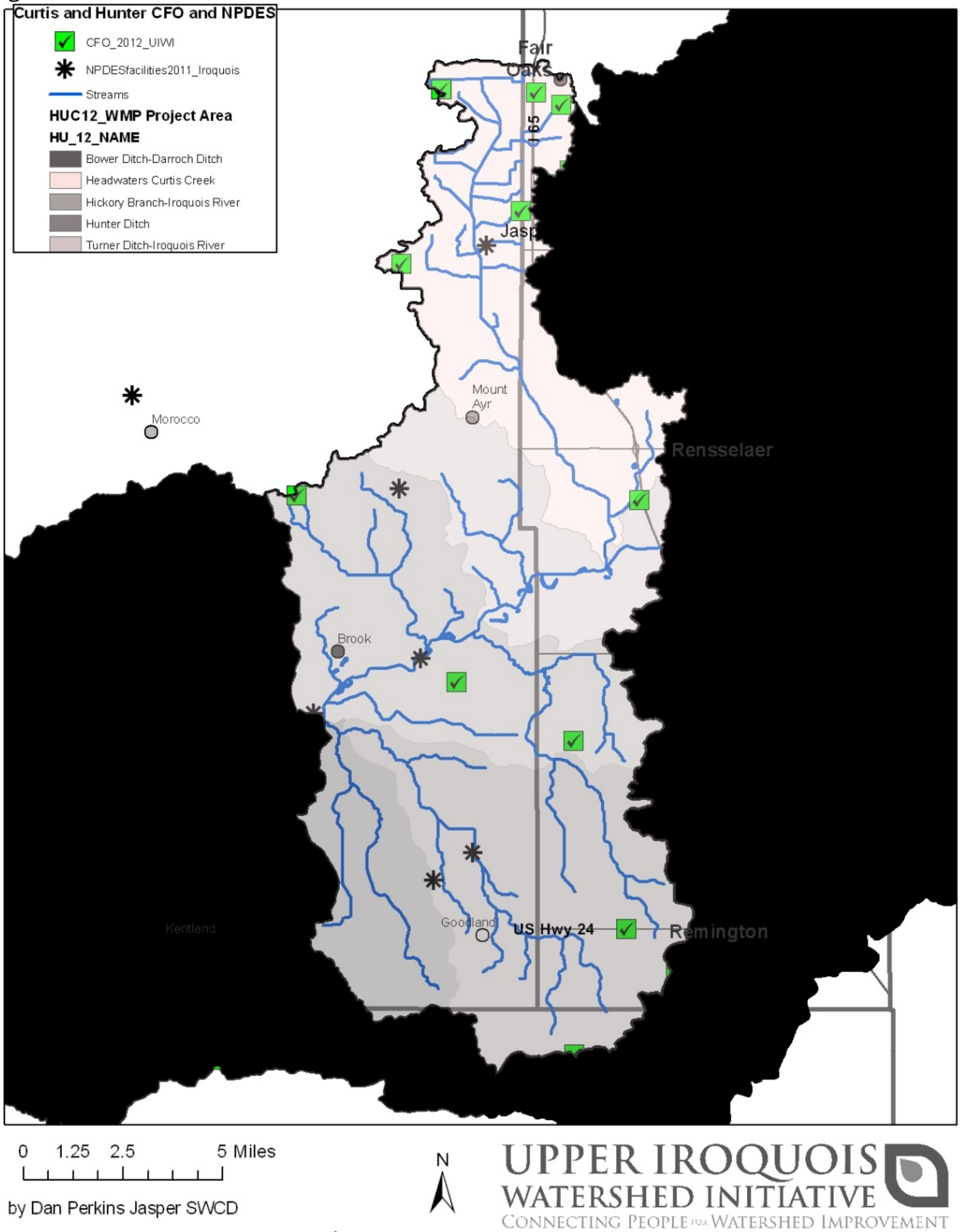
Figure 68 Curtis and Hunter Drainages



As of 2012, 12 CFO facilities – 5 hog, 1 chicken, and 6 dairy facilities are in operation and 5 NPDES sites.

Application of municipal sludge occurs on 91 acres, which is 3% of the total sludge acres that are spread across the entire Upper Iroquois watershed.

Figure 69 Curtis and Hunter NPDES and CFO Sites



A 2007-2012 review of IDEM's virtual cabinet and EPA's ECHO database for NPDES and CFO permit holders found out of compliance events occurring at only 2 of the 12 CFOs and at 2 of the 5 NPDES sites. Best management practices should continue to be utilized for all manure applications to ensure these facilities are not contributing to stakeholders concerns of excessive nutrients or E.coli in the water.

iv. Windshield Survey

The Curtis and Hunter Creek watershed windshield survey had 112 possible points or roads that intersected a stream; of these we surveyed 87 sites.
Based on the summary data 2 maps of concerns were created based on each point showing the following:

1. Stream Buffer- Present or absent, and if present % of area
2. Areas of active erosion (stream bank)
3. Areas where livestock had direct access to water.
4. Evidence of Channelization

Table 48 Curtis-Hunter Windshield Survey Summary

HUC 10 Windshield Survey Summary	Curtis/Hunter
Windshield Survey Item	
Number Sites Sampled	87
# Sites with Buffers Present	64
% Sites with 100% Buffer	48%
% Sites with 75% Buffer	1%
% Sites with 50% Buffer	20%
% Sites with 25% Buffer	5%
% Sites with 0% Buffer	26%
# Sites with Active Erosion	11
# Sites with Livestock Access	19
# Sites with Channelization	62

To address the concern of loss of fish habitat and to protect fish habitat, as well as reduce nutrient, bacteria, and sediment loading it will be important to further investigate the sites with: less than 50% buffer, which 31% of the sites were, livestock access particularly the area north of State Road 16, active erosion, and extent of channelization and address these areas with appropriate best management practices.

Figure 70 Curtis-Hunter Windshield % Buffer Sites

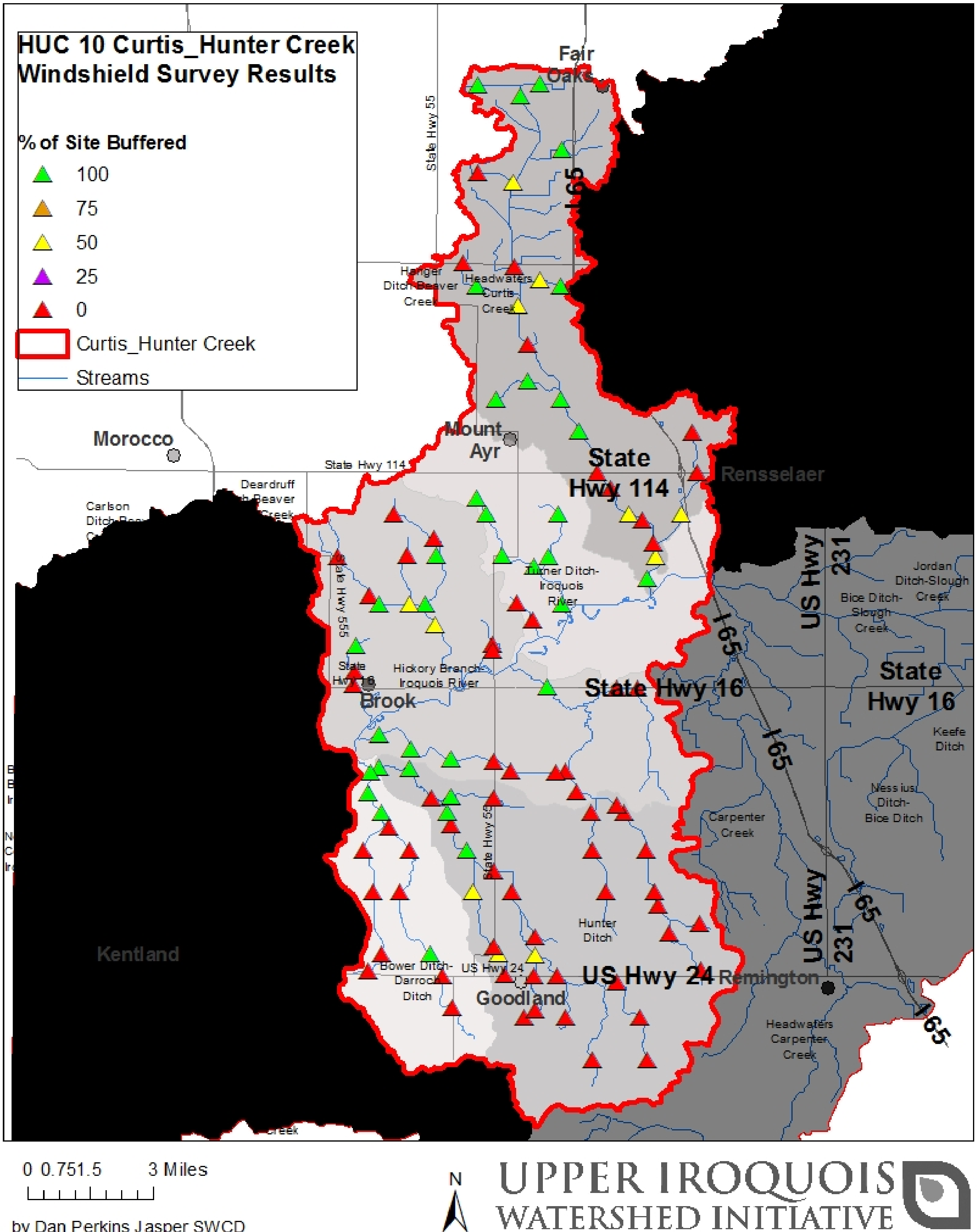
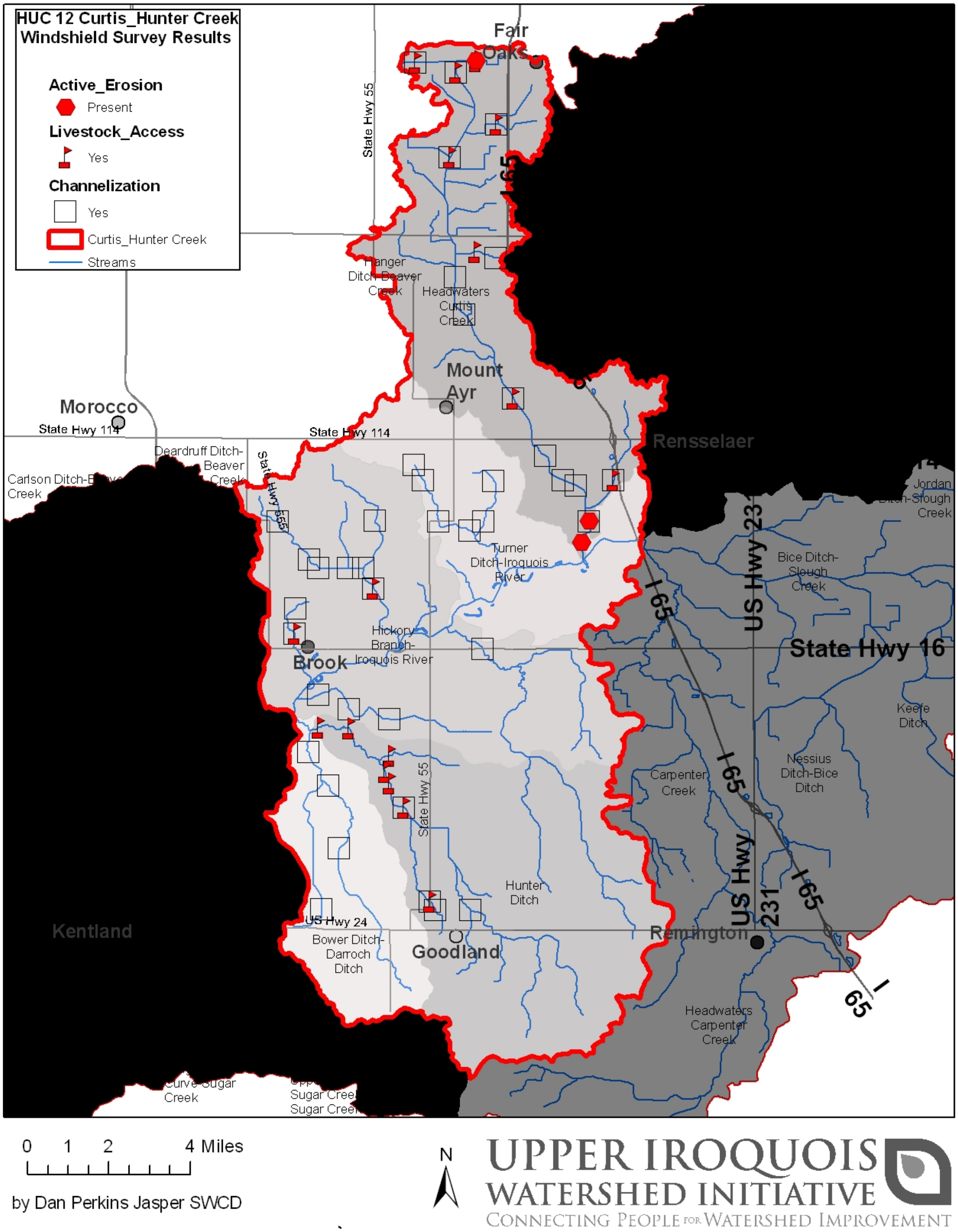


Figure 71 Curtis-Hunter 3 Factors Windshield Map



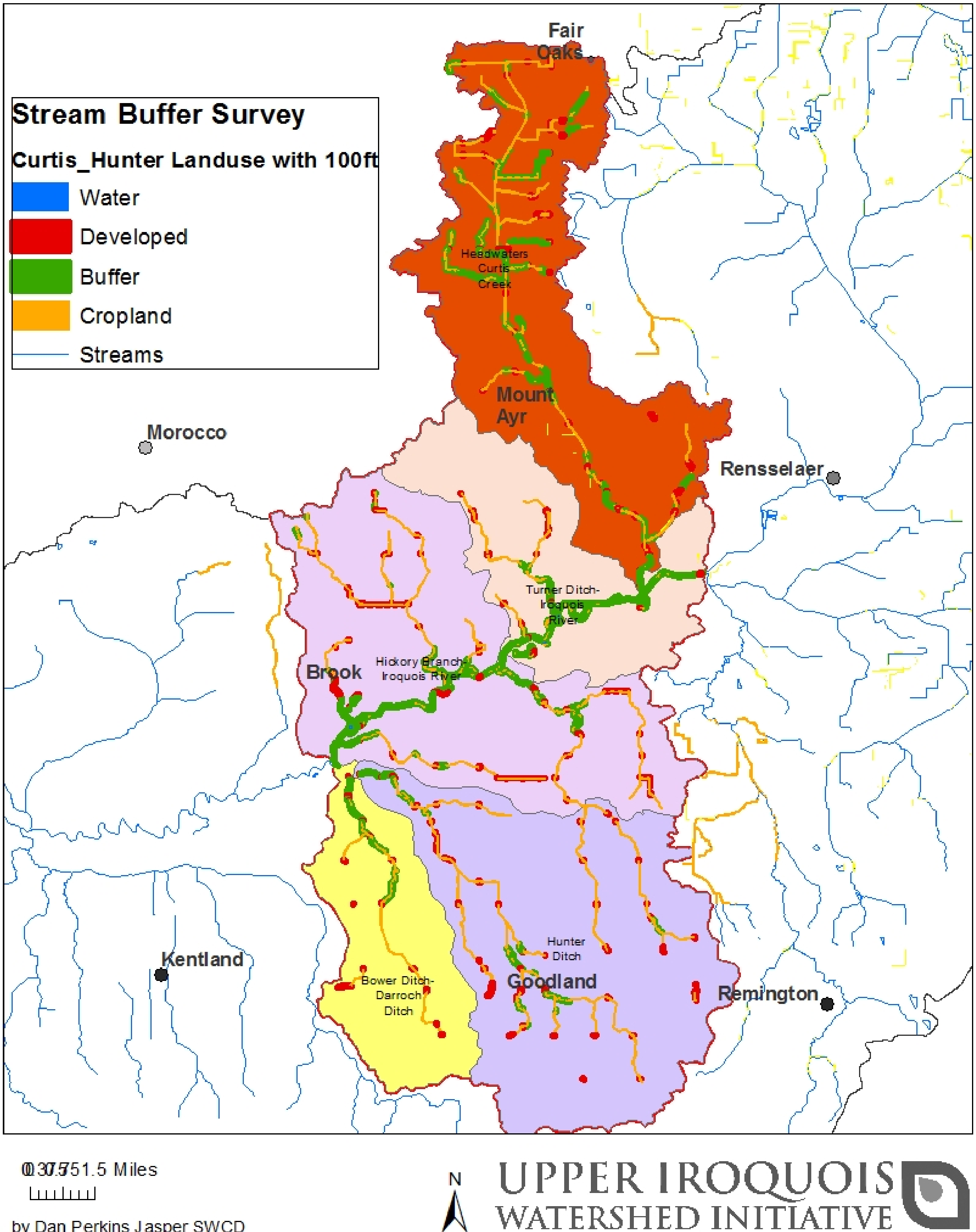
v. Desktop Survey

Around 23% of the land within the 100 foot buffer zone of a stream is buffered. With 71% of the land use along streams being cropland that means potential direct contamination of nutrients and E.coli from manure spreading may be occurring and indirect pollution from chemical fertilizers by run-off may be occurring. The map reveals that smaller headwater and tributary streams seem to have the least buffered area and would be a good area to target for water quality improvement BMPs.

Table 49 Curtis-Hunter Landuse within 100 ft of Stream

HUC 10	Curtis
100 Ft Acre Total	3,888
Stream Miles	162
Water %	1%
Developed %	5%
Buffered %	23%
Cropland %	71%

Figure 72 Curtis-Hunter Stream Land Use with 100ft



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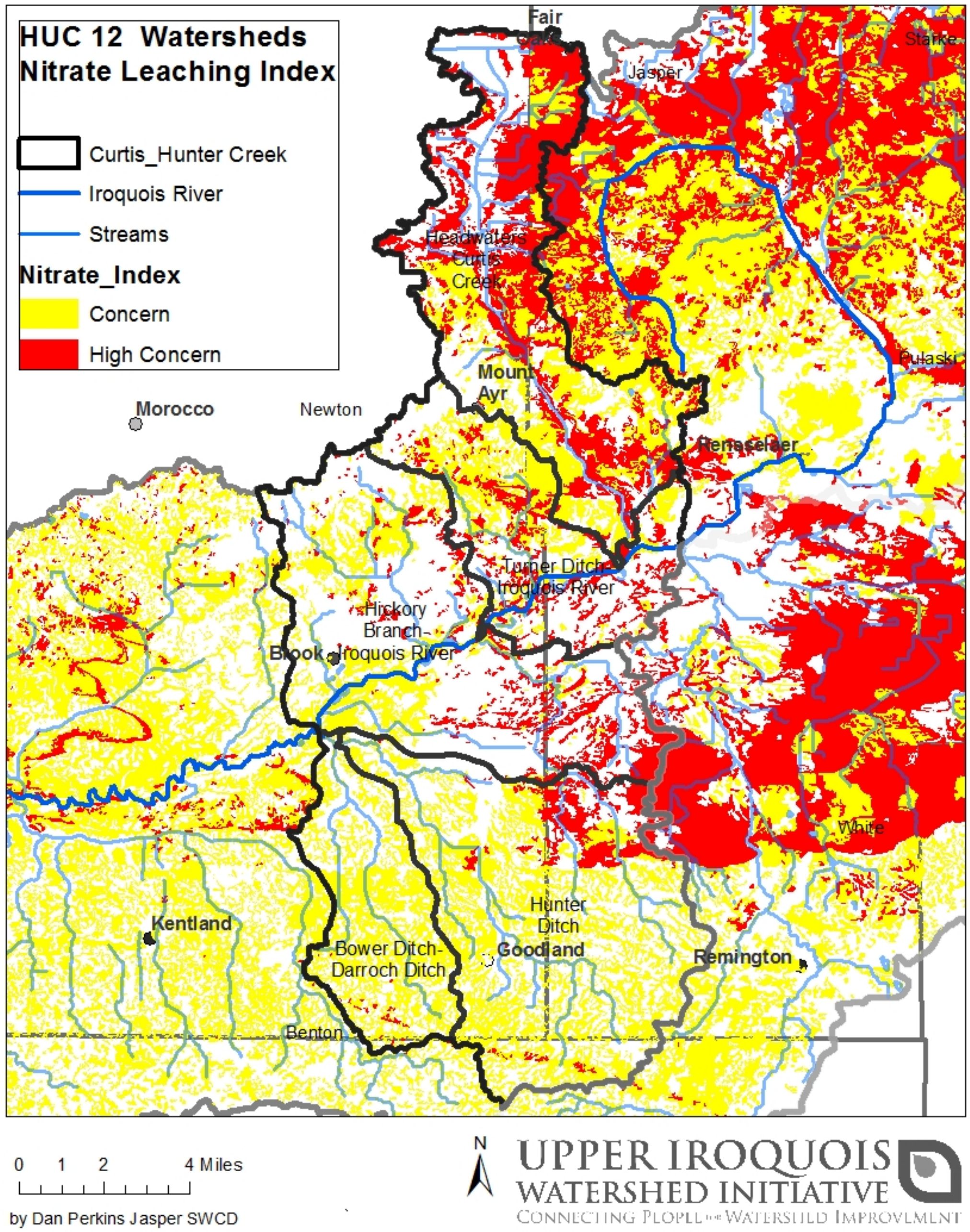
Nitrate Leaching Index Map

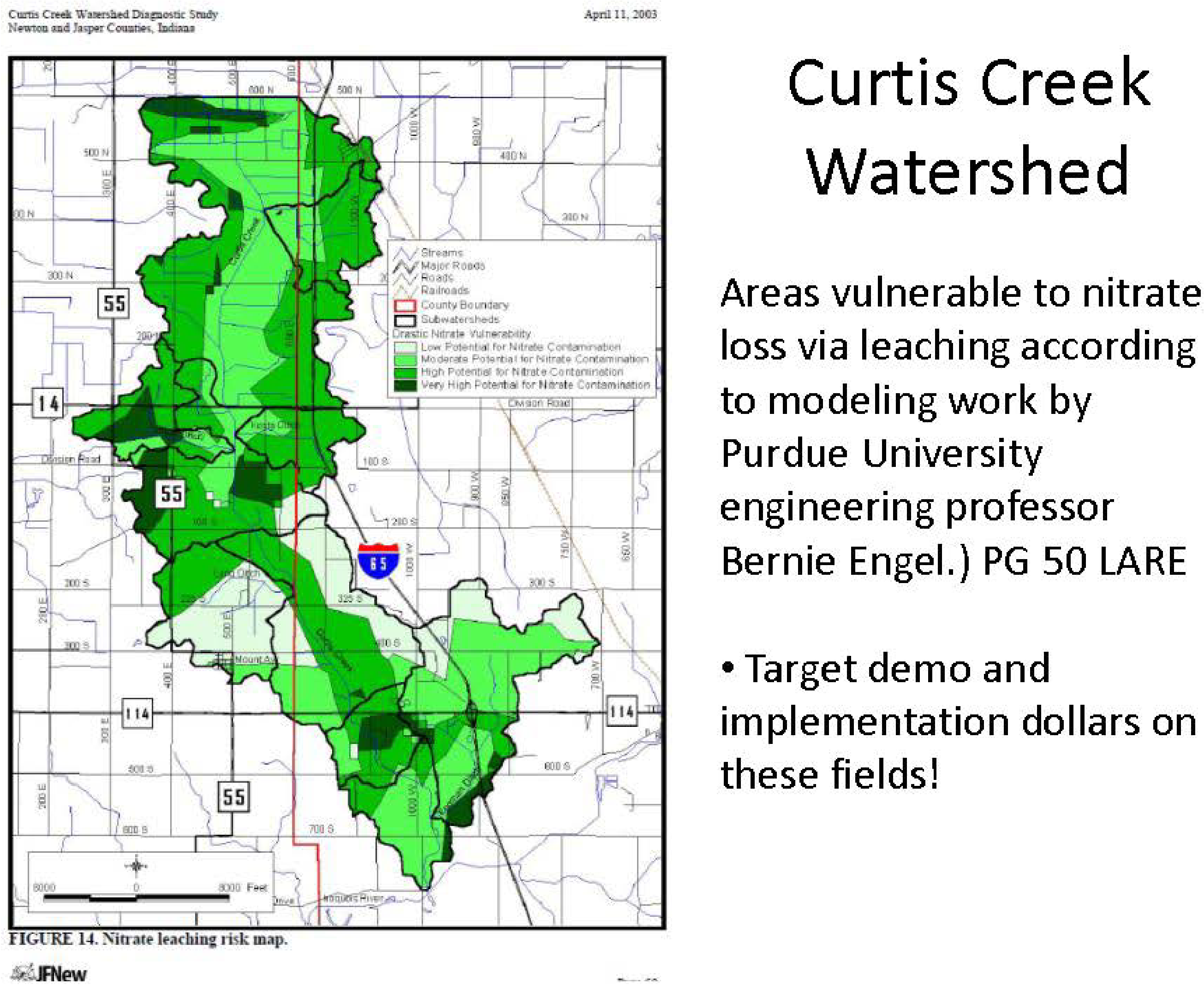
The Curtis-Hunter Creeks subwatershed is less vulnerable to leaching of pollutants as can be seen with the smaller amount of “high concern” soil types in the watershed at 14% of total soil acres and 52% of the acres in “concern” index, according to UIWI desktop survey. To address stakeholder concerns these areas should be focused on for specific BMPs that address leaching concerns.

Figure 73 Curtis-Hunter Nitrate Leaching Index Map



This above information should also be combined with a nitrate leaching index for the Headwaters of the Curtis Creek HUC 12 area (JFNew, 2003).

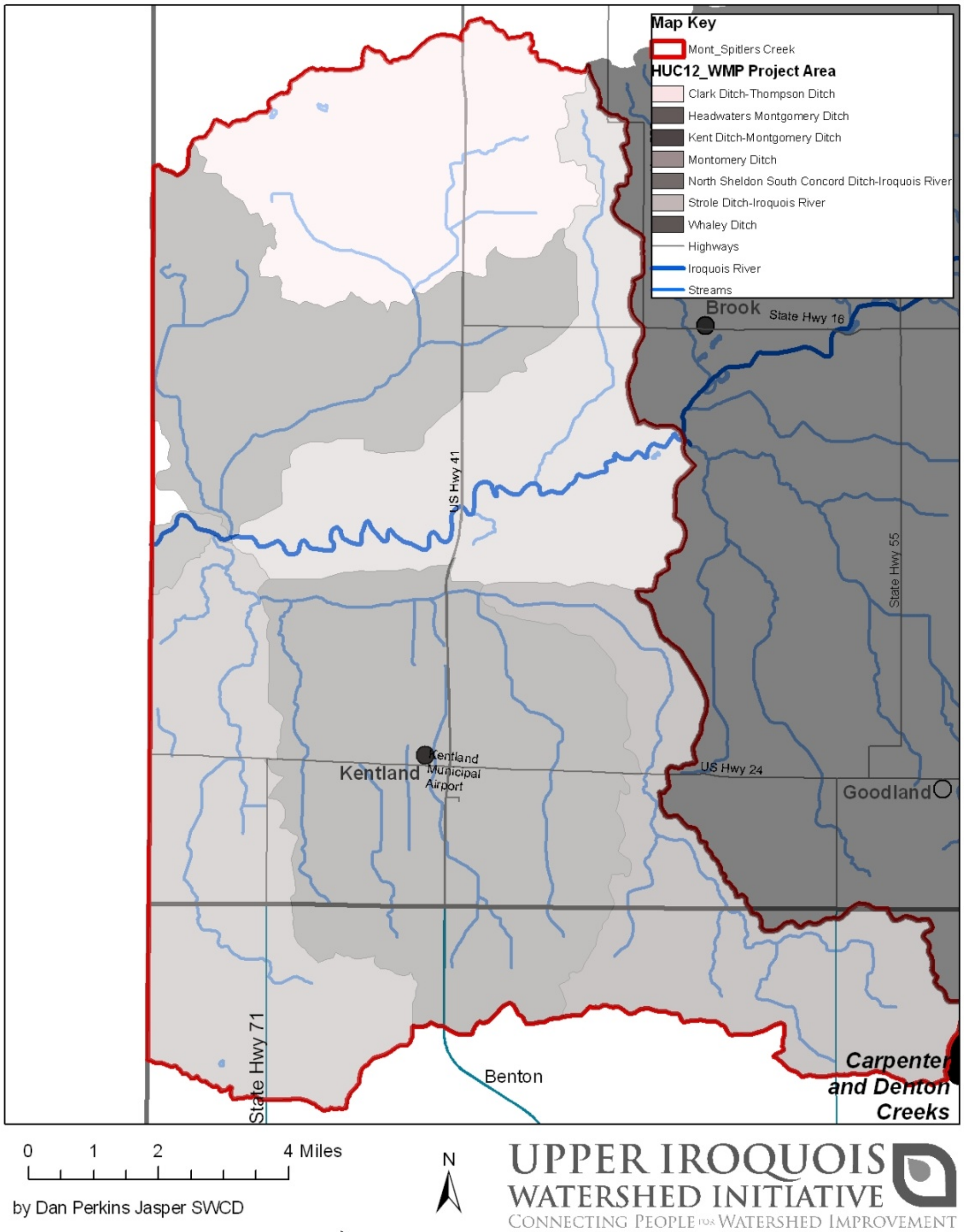
Figure 74 Headwaters of the Curtis Creek HUC 12 Nitrate Leaching Index



3.3.5 HUC 10- Montgomery and Strole Creeks

The Montgomery and Strole Creeks sub watershed lies in the western most portion of the watershed and shares a border with Illinois. It has an area of approximately 81,048 acres or 127 square miles, has 106 stream miles, and lies within Newton and Benton counties. It contains 6 HUC 12 sub watersheds- Clark-Thompson Ditch, Whaley Ditch, Strole-Iroquois River, Montgomery Ditch, Kent-Montgomery Ditch, Headwaters of Montgomery Ditch.

Figure 75 Montgomery-Strole Creek HUC 10 Overview

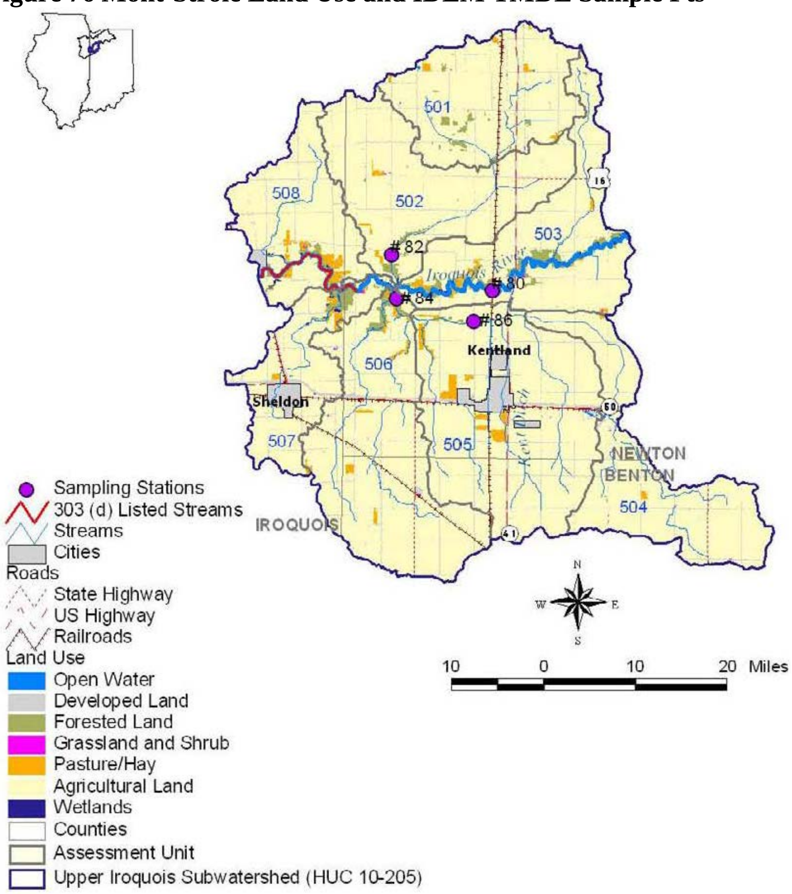


i. Water Quality Information

IDEM 303(d)

The Montgomery-Strole creek subwatershed had a total of 4 impairments- e.coli, nutrients, DO, IBC in 2008 and 3 impairments- Nutrients, IBC, DO in the 2010 303(d) list, and 4 impairments- nutrients, DO, E.coli, IBC in the 2012 303(d) list. There was an 81% change in miles of impairments from 2008-2010, with 53 miles in 2008 and 96 miles impaired in 2010. 90% of the impairments were from impaired biological communities. This area should be further investigated as to why it scored so low in IBC compared to the other HUC 10's across the watershed.

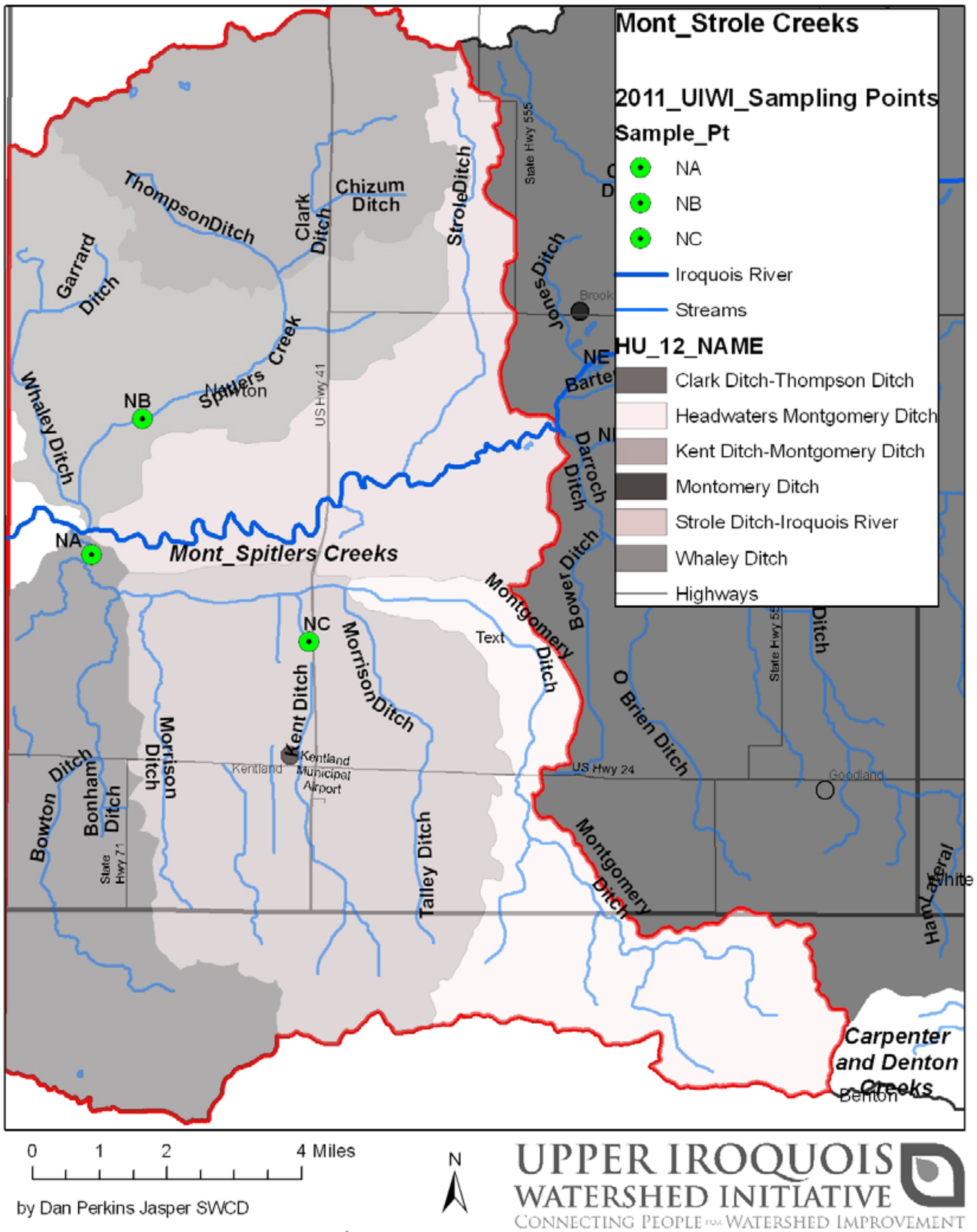
Figure 76 Mont-Strole Land Use and IDEM TMDL Sample Pts



UIWI Water Monitoring

Three sampling sites exist within the Montgomery-Strole subwatershed. Both water quality and biological monitoring data was collected.

Figure 77 Mont-Strole Stream and WQ Sample Sites



See below table for summary of water quality data from May 2011 to April 2013.

Table 50 Mont-Strole HUC 10 WQ Data Summary

Subwatershed	Site #	Average Temp°C	Average DO%	Average DO mg/L	Average Turbidity
Montgomery Spitlers Creeks	NB	13.71	105.72	10.21	22.48
	NA	14.98	101.79	9.57	32.57
	NC	14.26	114.29	10.66	42.77
	Overall	10.74	80.45	7.61	24.46

Parameter	Montgomery Spitlers Creeks Site #	Target Level	Number of Times Exceeding Target Level Range	Number of Times Exceeding Target Level	Number of Samples (n)	
Temperature °C	NB	Monthly Standard	1	1	17	
	NA		1	1	23	
	NC		0	0	22	
DO %	NB	<100	8	8	17	
	NA		11	11	23	
	NC		14	14	22	
DO mg/L	NB	>4	0	0	17	
	NA		0	0	23	
	NC		0	0	22	
pH	NB	<9	7	7	10	
	NA		7	7	18	
	NC		5	5	15	
Turbidity (NTU)	NB	<10.4 (US EPA)	10	10	17	
	NA		21	21	23	
	NC		15	15	22	
Orthophosphate (mg/L)	NB	<0.005	10	10	10	
	NA		18	18	18	
	NC		15	15	15	
Nitrate (mg/L)	NB	<1.5	1	7		
	NA		4	9		8
	NC		5	8	NB	
	NB	<5.0	3	6		
	NA		2	5		15
	NC		1	3	NA	
	NB	<10	3	3		
	NA		3	3	NC	16
	NC		2	2		
E.coli (cfu/100mL)	NB	<235	0	4		
	NA		0	11		6
	NC		0	6	NB	
	NB	<410	0	4		
	NA		2	11		11
	NC		1	6	NA	
	NB	<576	4	4		
	NA		9	9	NC	11
	NC		5	5		

Iroquois TMDL

There are two NPDES facilities and two CAFOs within this subwatershed. The WLAs for the NPDES facility were calculated based on their design flows and E.coli permit limits. Water quality samples for E.coli were included from four sites. Based on this data, a reduction range from 41 to 85% was required. See Table 51 TMDLs for Montgomery-Strole for TMDL data of the Montgomery-Strole subwatershed.

Table 51 TMDLs for Montgomery-Strole

Station #	Period of Record	Total Number of Samples	Percent of Samples Exceeding *E. coli* WQS (#/100 mL)		Minimum (#/ 100 mL)	Geomean (#/ 100 mL)	Average (#/ 100 mL)	Maximum (#/ 100 mL)	Percent Reduction Based on Geomean
			125	235					(125/ 100mL)
82	6/2/2008 - 6/30/2008	5	100	80	214	361	414	866	65%
80	6/2/2008 - 6/30/2008	5	80	40	102	211	252	488	41%
86	6/2/2008 - 6/30/2008	5	100	100	345	581	632	1046	78%
84	6/2/2008 - 6/30/2008	5	100	100	411	813	877	1300	85%

ii. Habitat/Biological Information

Based on the CMIBI the Montgomery-Strole Creeks have an average rating of 8, equaling a poor quality score. The CQHEI average score was a 37.5, which is considered unhealthy. Among the other 5 HUC 10 this was the lowest score for both.

This would coincide with IDEM's 303d listing for impaired water due to impaired biological communities, especially, in areas downstream of the town of Kentland. Further investigation into the cause of this is needed.

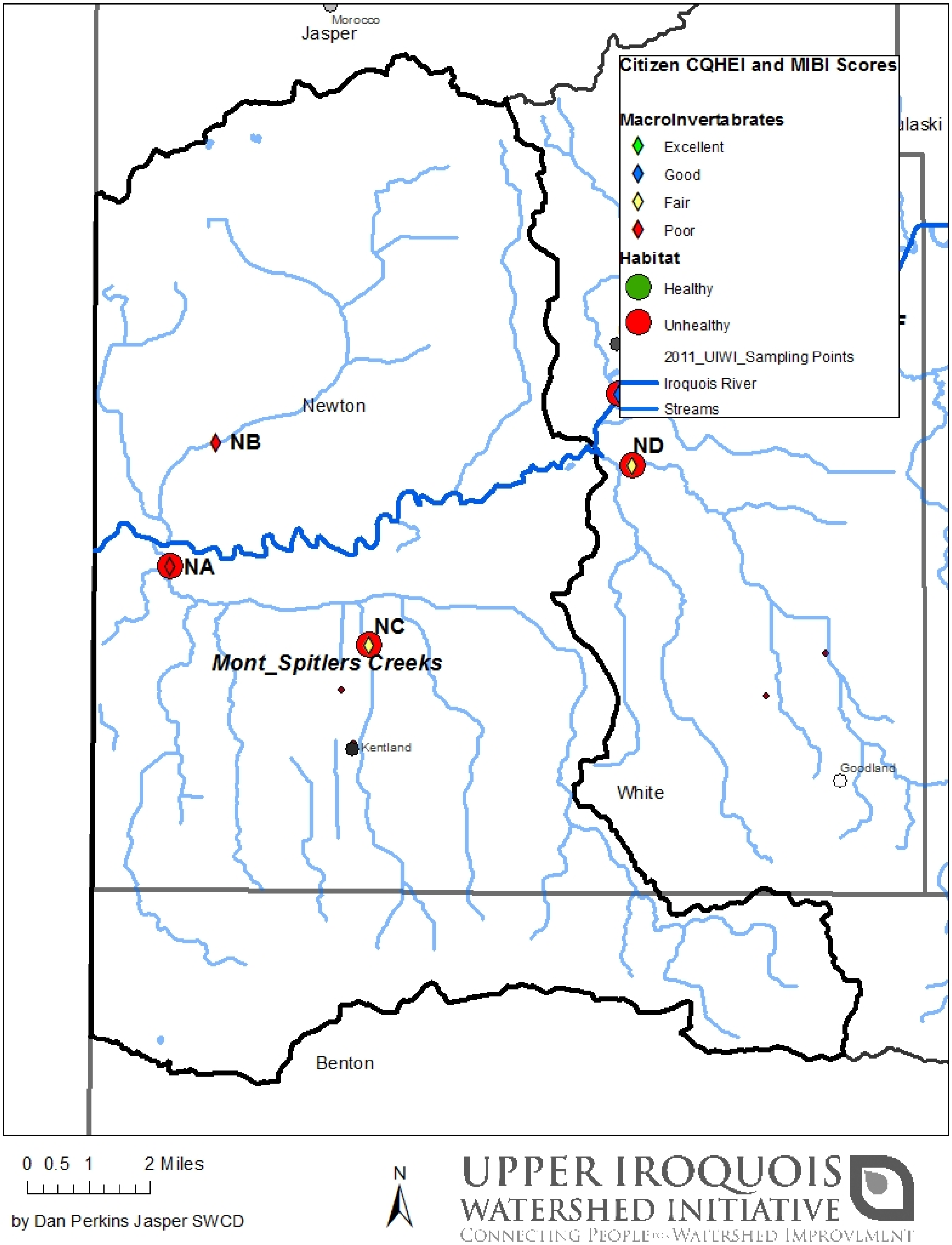
Table 52 Mont-Strole CMIBI Ratings

Citizen MIBI									
Sample Site	Rating 2011	2011 Quality Score	Rating 2013	2013 Quality Score	10 HUC_Subwatershed	2011 Average 10 HUC	2013 Average 10 HUC	2011 Overall Score	2013 Overall Score
NC	11	Fair	2	Poor	Montgomery-Spitlers Creeks				
NA	1	Poor	4	Poor	Montgomery-Spitlers Creeks	5	11	Poor	Fair
NB	4	Poor	26	Excellent	Montgomery-Spitlers Creeks				
HUC 8	14	Fair	13	Fair					
Scale	Quality	Scale	Quality						
10 or less	Poor	11_16	Fair						
17-22	Good	23 >	Excellent						

Table 53 Mont-Strole CQHEI Ratings

Citizen Habitat Evaluation index (CQHEI)									
Site	2011 Rating	2011 Quality Score	2013 Rating	2013 Quality Score	HUC 10 Subwatershed	2011 Average Rating	2013 Average Rating	2011 Overall Quality Score	2013 Overall Quality Score
NC	8	Unhealthy	53	Unhealthy	Montgomery-Spitlers Creeks				
NA	40	Unhealthy	58	Unhealthy	Montgomery-Spitlers Creeks				
NB	0	0	41	Unhealthy	Montgomery-Spitlers Creeks	24	51	Unhealthy	Unhealthy
HUC 8	38.05882	Unhealthy	52.94737	Unhealthy					
Citizen Habitat Evaluation Index CQHEI		100>	High Quality Stream						
		> 60	Generally Healthy						
		< 60	Unhealthy						

Figure 78 CQHEI and CMIBI Scores for Mont-Strole HUC 10



iii. Land Use Information

The Mont-Strole Creeks subwatershed is approximately 81,048 acres or 127 square miles and has 106 natural stream miles of which 79 miles are regulated open drains. About 60 miles of private drains are known to exist.
Working with them to ensure minimal in-stream disturbance and habitat loss will be critical to addressing stakeholder concerns.

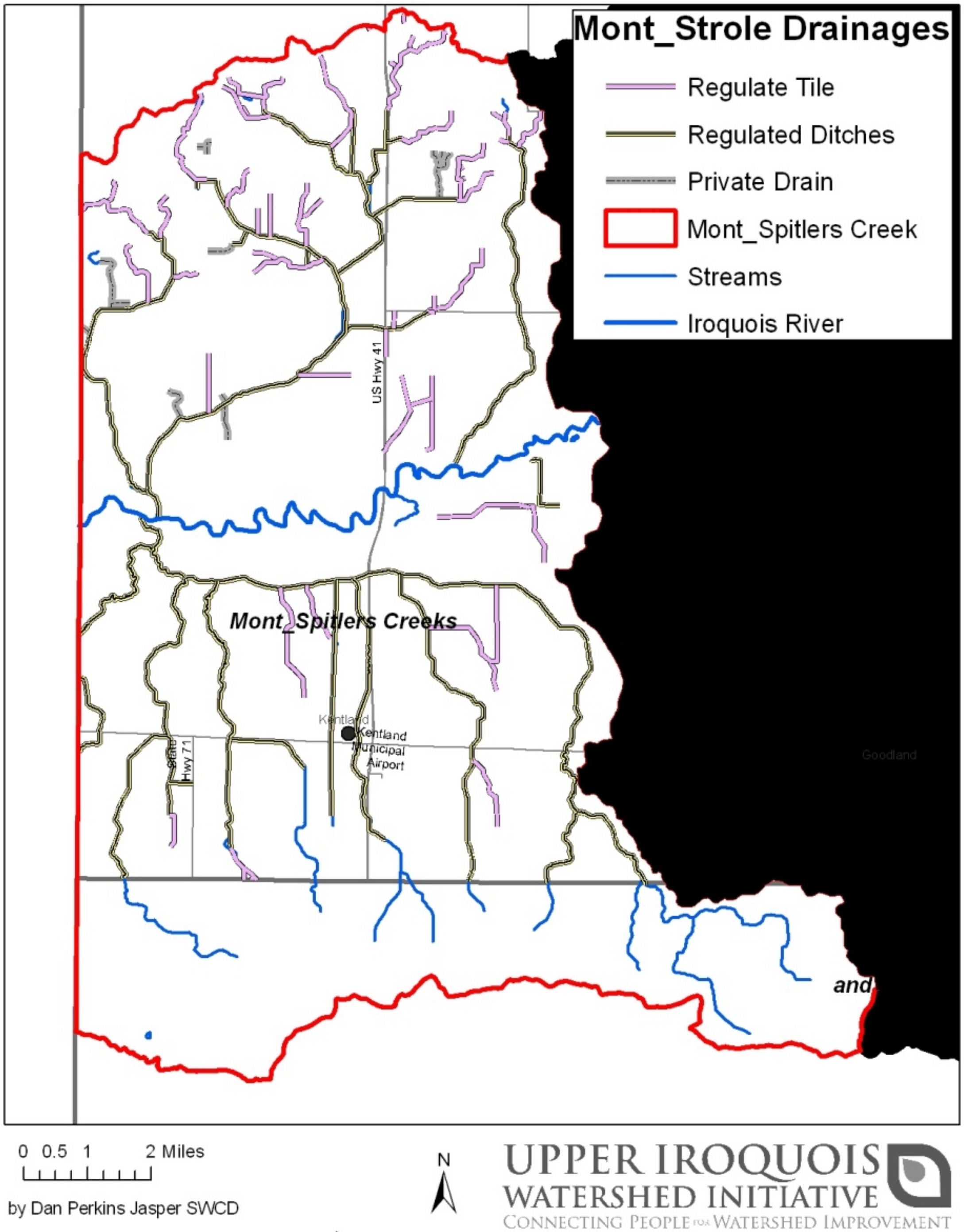
Table 54 Mont-Strole Landuse

Land Use/Land cover in the Montgomery Ditch -Iroquois River Subwatershed

Land Use/Land Cover	Subwatershed		
	Area		Percent
	Acres	Square Miles	
Agricultural Land	91,053.20	142.27	88.70
Developed Land	6,550.84	10.24	6.38
Forested Land	2,462.12	3.85	2.40
Pasture/Hay	2,023.34	3.16	1.97
Open Water	247.97	0.39	0.24
Wetland	236.85	0.37	0.23
Grassland and Shrubs	78.28	0.12	0.08
Total	**102,652.60**	**160.39**	**100.00**

Open space is not needed in this area given its agricultural land use and limited urban development. Areas slated for development follow the county ordinances and codes and town boundary restrictions. Of the 37 leaking UST across the entire Iroquois River watershed, 12 of these are in the Mont_Strole Creek watershed. The LUSTs need further investigation as to their remediation status. See Table 22 UIWI LUSTs Site Locations

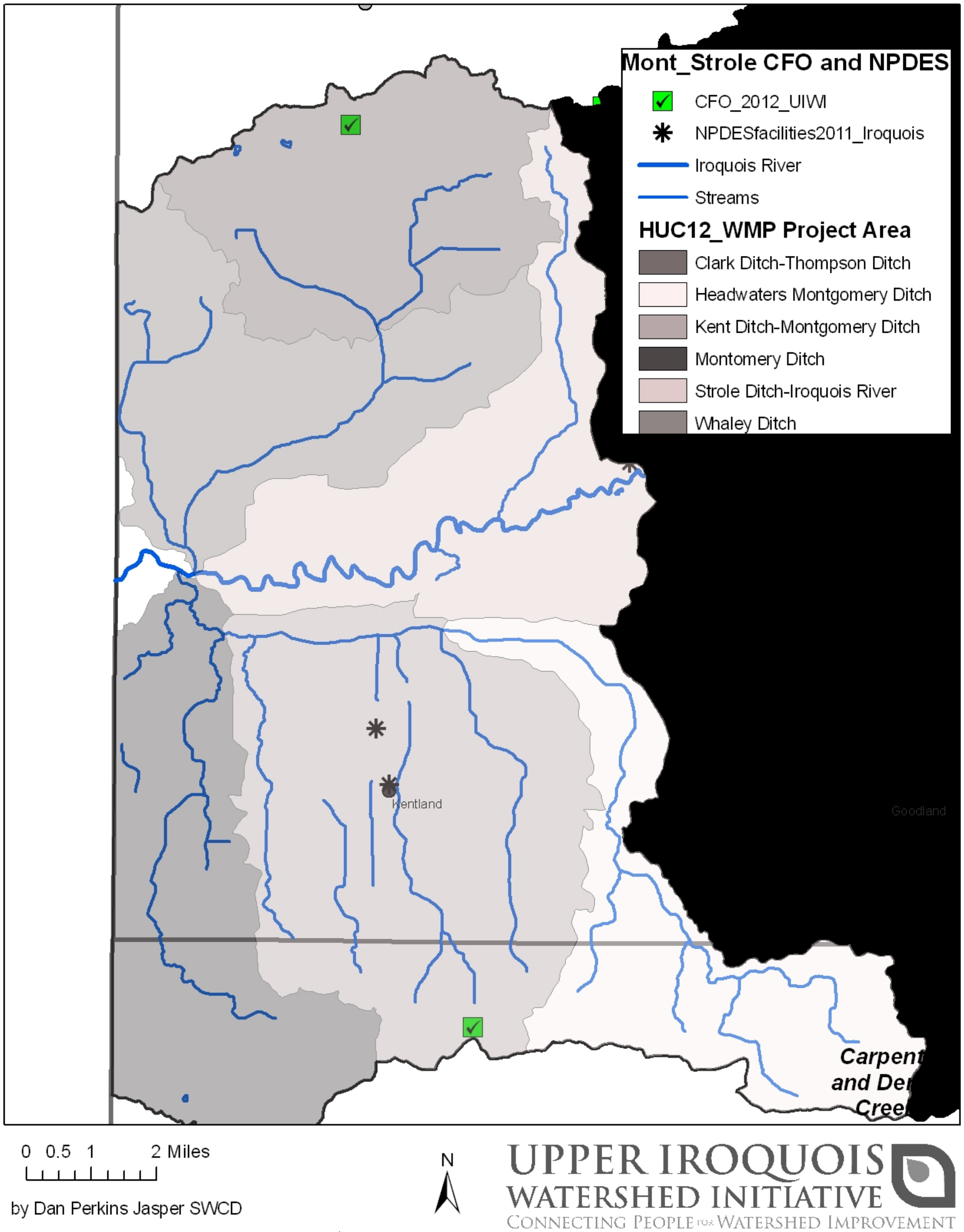
Figure 79 Mont-Strole Drainages



As of 2012, 2 CFO facilities – 2 hog operations are in operation and 2 NPDES sites.

Ensuring that permit holders are within compliance and best management practices are utilized for all manure applications will ensure these facilities are not contributing to stakeholders concerns of excessive nutrients or E.coli in the water.

Figure 80 Mont-Strole NPDES and CFO Sites



Application of municipal sludge occurs on 163 acres, which is 6.7% of the total acres that are spread across the entire Upper Iroquois watershed

ix. Windshield Survey

The Mont and Strole Creek watershed windshield survey had a possible 73 points or roads that intersected a stream of these, we surveyed 58 sites.

Based on the summary data 2 maps of concerns were created based on each point showing the following:

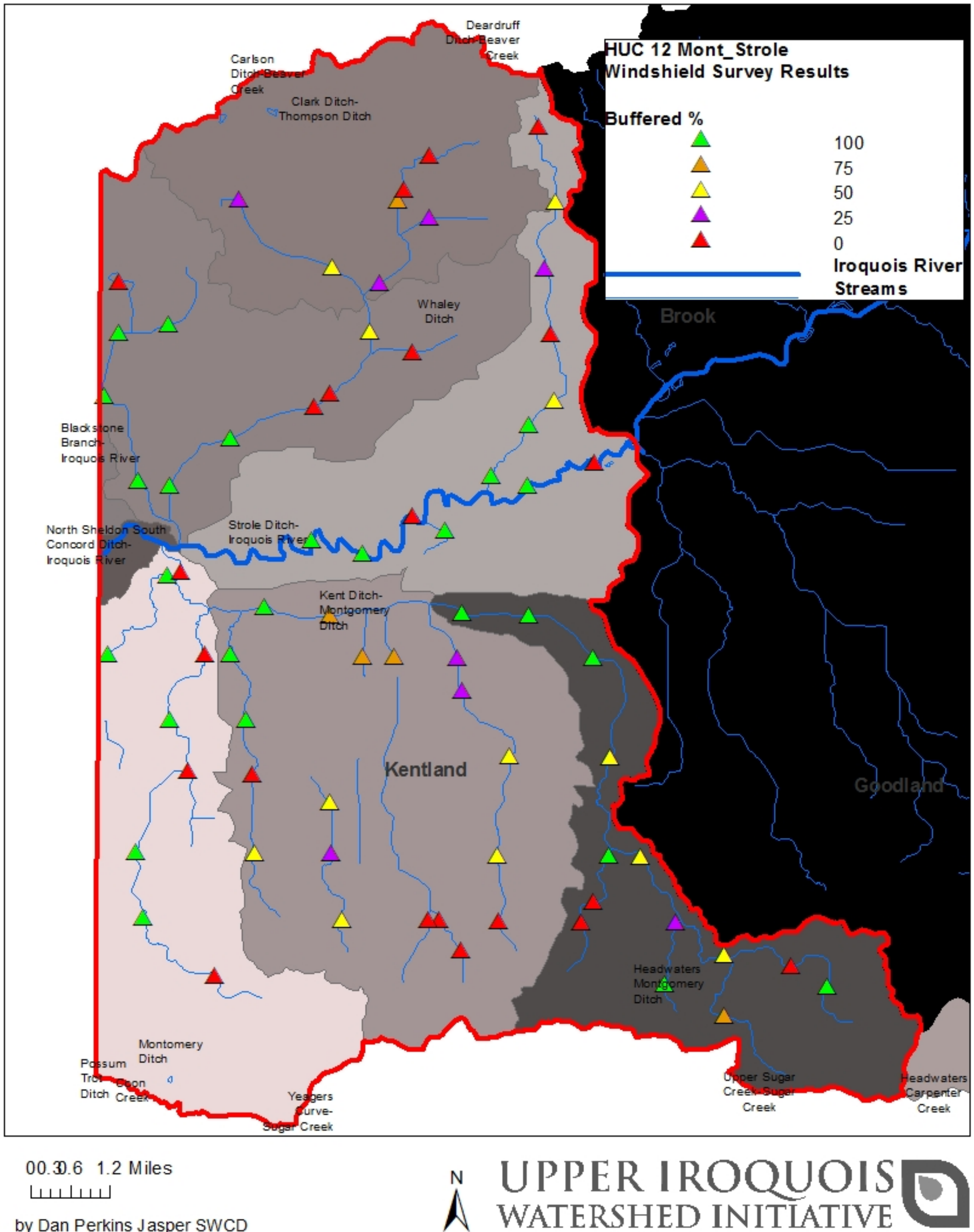
1. Stream Buffer- Present or absent, and if present % of area
2. Areas of active erosion (stream bank)
3. Areas where livestock had direct access to water.
4. Evidence of Channelization.

Table 55 Mont-Strole Windshield Survey Summary

HUC 10 Windshield Survey Summary	Mont/Strole
Windshield Survey Item	
Number Sites Sampled	58
# Sites with Buffers Present	53
% Sites with 100% Buffer	47%
% Sites with 75% Buffer	9%
% Sites with 50% Buffer	21%
% Sites with 25% Buffer	16%
% Sites with 0% Buffer	9%
# Sites with Active Erosion	0
# Sites with Livestock Access	2
# Sites with Channelization	12

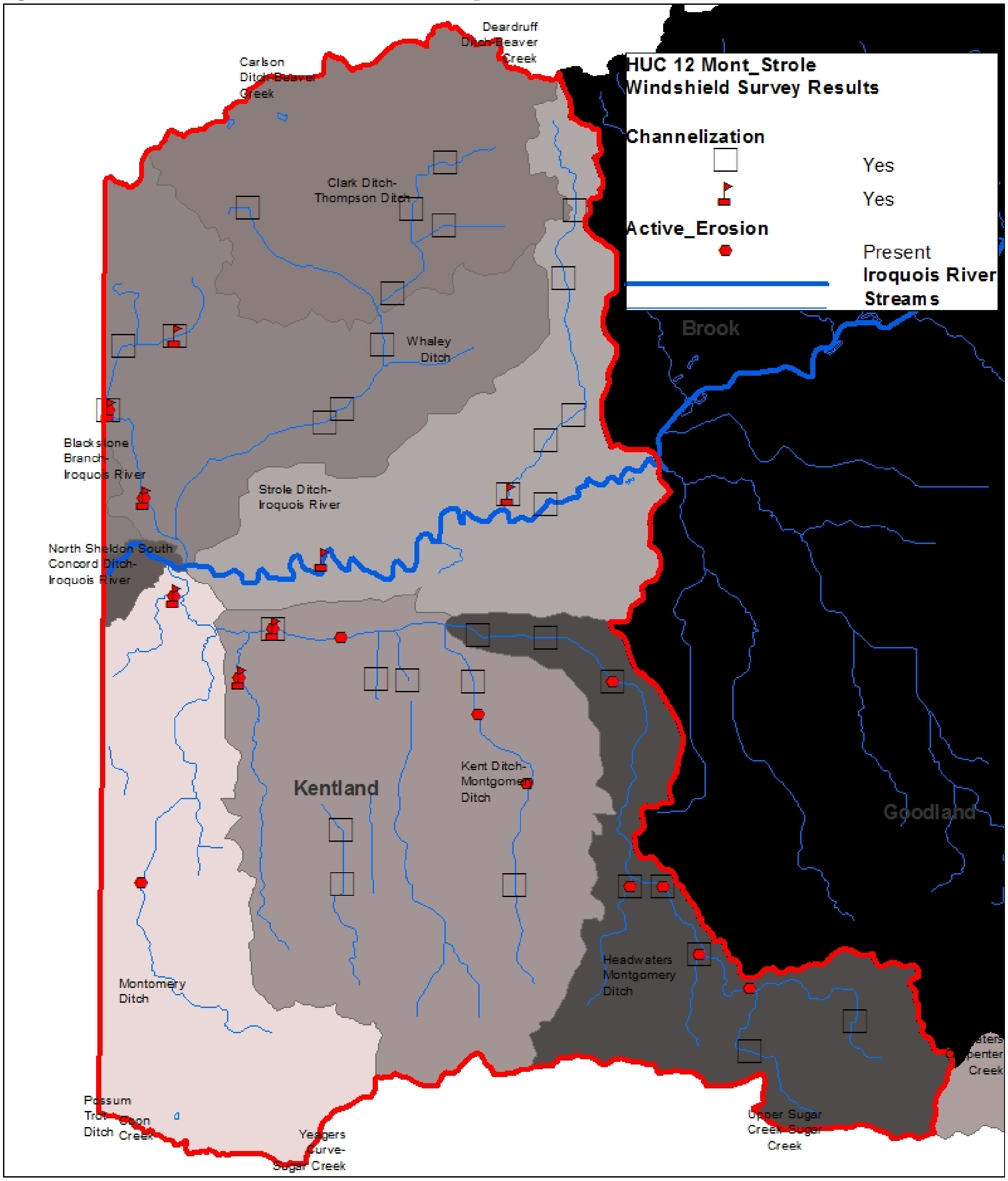
To address the concern of loss of fish habitat and to protect fish habitat, as well as reduce nutrient, bacteria, and sediment loading it will be important to further investigate the sites with: less than 50% buffer- which was 24% of the sites, livestock access and active erosion sites, and if sites of channelization are buffered in order to address these areas with appropriate best management practices.

Figure 81 Mont-Strole Windshield % Buffer at Sites



UPPER IROQUOIS WATERSHED INITIATIVE
CONNECTING PEOPLE FOR WATERSHED IMPROVEMENT

Figure 82 Mont-Strole 3 Factors Windshield Map



0 0.5 1 2 Miles

by Dan Perkins Jasper SWCD

UPPER IROQUOIS WATERSHED INITIATIVE
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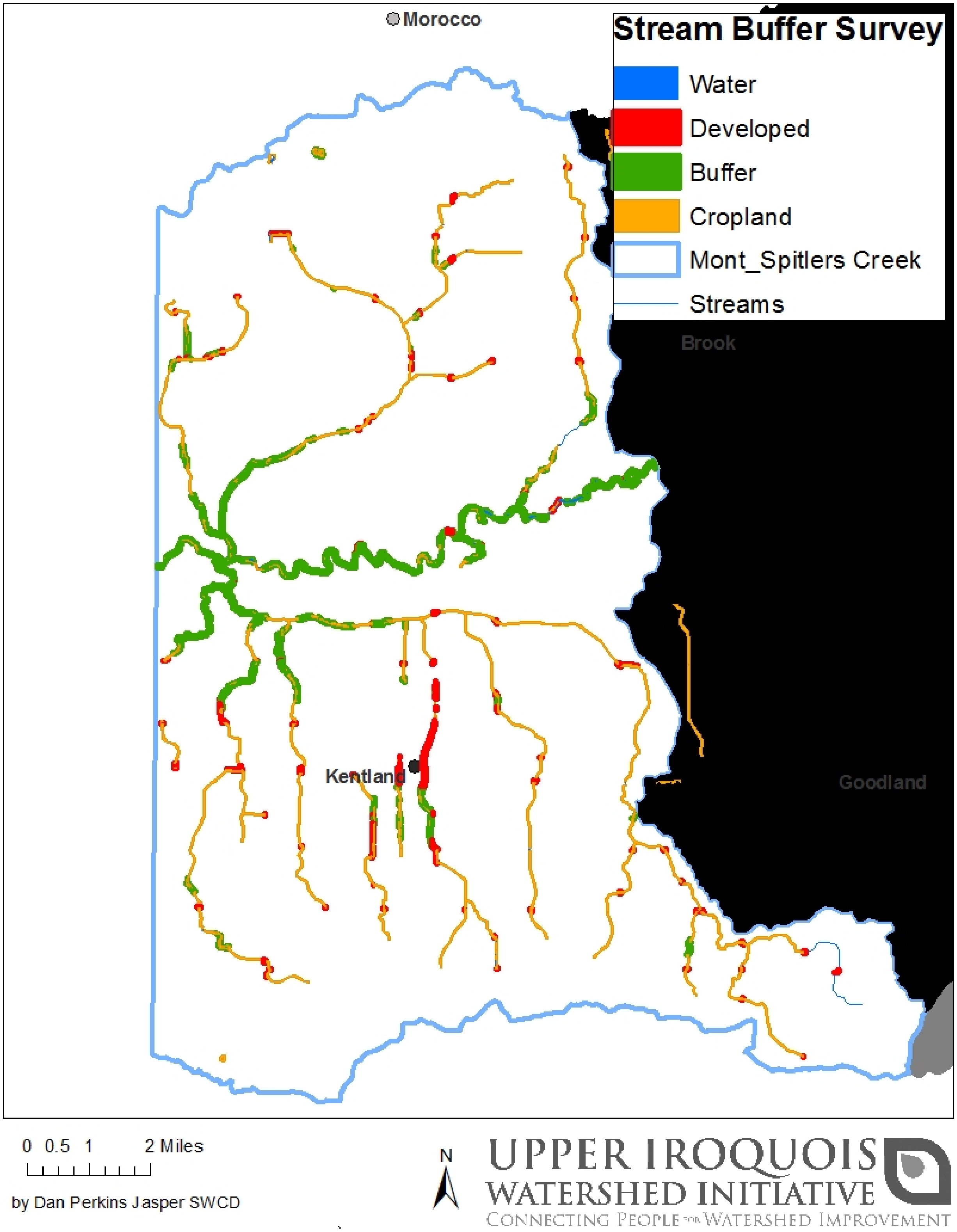
x. Desktop Survey

Around 20% of the land within the 100 foot buffer zone of a stream is buffered. With 70% of the land use along streams being cropland that means potential direct contamination of nutrients and E.coli from manure spreading may be occurring and indirect pollution from chemical fertilizers by run-off may be occurring. The map reveals that smaller headwater and tributary streams seem to have the least buffered area and would be a good area to target for outreach efforts. Priority areas to protect would be the existing buffered areas, especially along the main branch of the Iroquois River.

HUC 10	Mont-Strole
100 Ft Acre Total	2,669
Stream Miles	127
Water %	4%
Developed %	6%
Buffered %	20%
Cropland %	70%

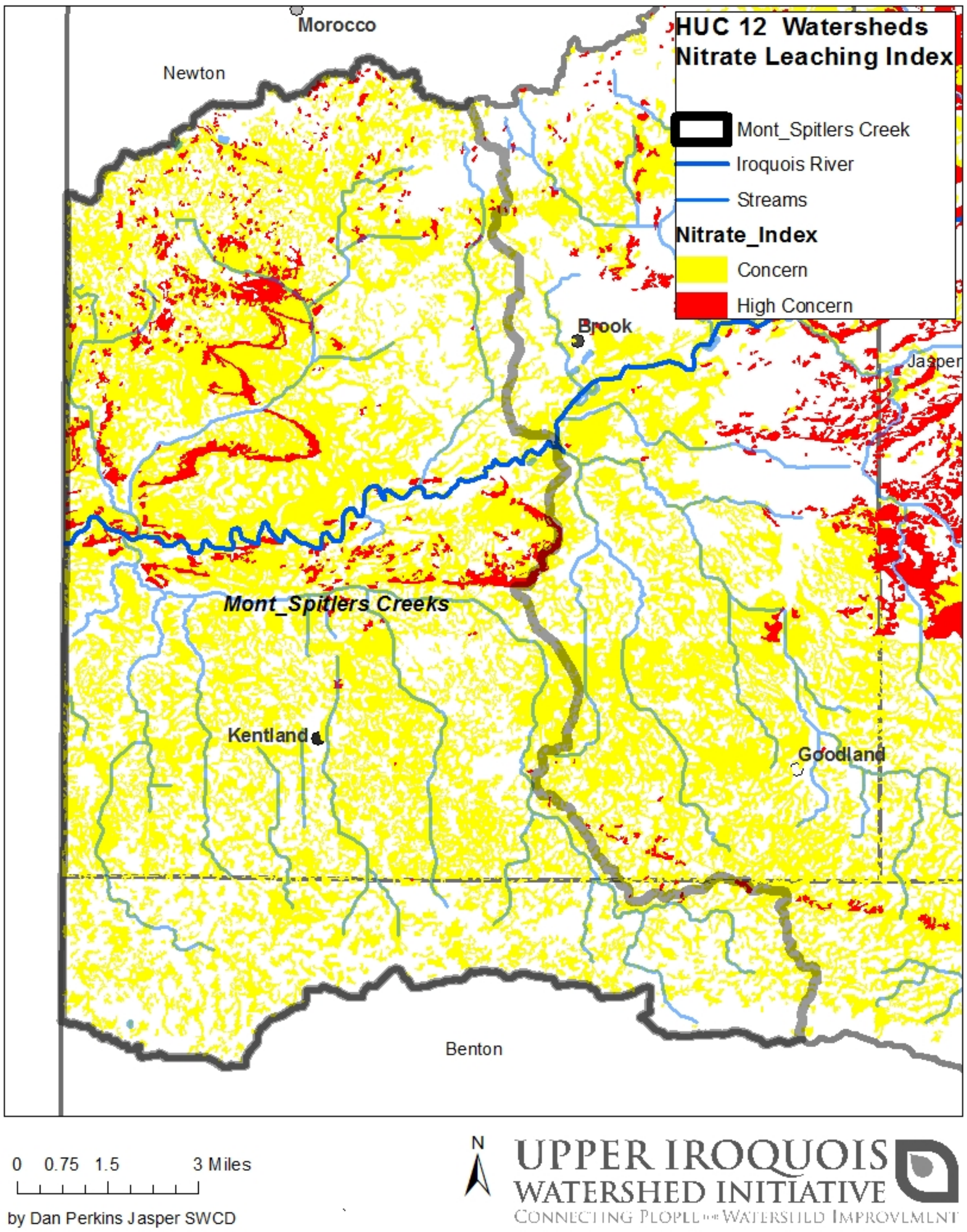
Figure 83 Mont-Strole Stream Land Use within 100 ft



Nitrate Leaching Index Map

The Mont-Strole Creeks subwatershed is less vulnerable to leaching of pollutants as can be seen with the smaller amount of "high concern" soil types in the watershed at 4% of total soil acres and 70% of the acres in "concern" index, according to UIWI desktop survey.

Figure 84 Nitrate Leaching Index Mont_Strole HUC 10



4.0 Watershed Inventory III: Watershed Inventory Summary

The following is a summary of important findings, relationships, and trends that historic and current water quality and habitat/biology data is showing. The findings are organized by major cause/indicator of stakeholder concerns.

Nutrients

Nutrients (ortho-phosphates and nitrates) are identified as a major pollutant of concern in the Upper Iroquois Watershed, and are included on the stakeholders list of concerns. All four HUC 10 subwatersheds listed as impaired on the 2010 IDEMs 303(d) list include nutrients as a source of impairment.
Table 56 Subwatershed Ranking according to IDEM's 303(d) 2010 List shows which subwatershed has the most impairments in 2010 and the greatest increase in miles of stream impairment. Carpenter_Denton Creeks and Curtis-Hunter Creeks are the most impacted watersheds.

Table 56 Subwatershed Ranking according to IDEM's 303(d) 2010 List

Subwatershed Ranking Based on IDEM 303(d) List 2010						
HUC 10 Subwatershed	**Status**	**2010 Parameter**	***Number of Impairments**	**% of Stream Miles Impaired**	****Rank**	**Notes**
Carpenter_Denton	Impaired	Chloride, Nutrients, IBC, DO	4	47%	4	
Upper Ir_Ryan	Impaired	Nutrients, DO	2	29%	2	
Oliver Creek	No impairments	N/A	0	0%	0	
Mont_Spitlers	Impaired	Nutrients, IBC, DO	3	91%	3	IBC 90% of miles
Curtis_Hunter	Impaired	Chloride, Nutrients, IBC, DO	4	62%	4	
*Not counting PCBs,Mercury, e.coli						
**High number = most impacted						
Percent Change in 303d Listing: 2008 to 2010						
UIWI Name	**Acres**	**Total Waterway Miles**	**2010 Miles of Impairment**	**2008 Miles of Impairment**	**% Change 2008 -2010**	**Rank**
Carpenter_Denton	92,875	147	68.5	66	4%	2
Upper Ir_Ryan Ditch	86,768	139	40.8	28.5	43%	3
Oliver Ditch	52,685	117	0	0	0%	1
Mont_Spitlers	81,048	106	96	53	81%	4
Curtis_Hunter	103,490	153	95	29.5	222%	5

UIWI Water Sampling Summary May 2011 to April 2013

UIWI water quality monitoring data also shows excessive orthophosphate and nitrate levels within the watershed; specifically in the Carpenter-Denton and Curtis-Hunter Creek subwatersheds.

Orthophosphate

A target level of a 0.005 mg/L maximum has been set for the Upper Iroquois Watershed in order to protect aquatic life. The Carpenter-Denton sub watershed exceeded the target for orthophosphate 78% of the time. Curtis-Hunter creek sub watershed exceeded the target 100% of the time. A current theory of why this is occurring so often is because of the nature of the soils and groundwater hydrology occurring in the Curtis headwaters area. Further investigation is needed.

Nitrates

The target levels for nitrates were set based on protecting groundwater (10ppm drinking water standard), mid-term goal of <5ppm and warm water fisheries (1.5 ppm). 25% of sites exceeded the 10ppm target (sites J19, J2, NC, ND, NA, J22, and NH). The Carpenter_Denton Creek watershed exceeded the 5ppm target, 13% of the time, and the 1.5ppm target 19% of the time.

The target level of 1.5ppm across the whole watershed was exceeded 36% of the time during 2 years of sampling.

A total of 20 nitrate exceedances for the Carpenter-Denton sub watershed, and 39 exceedances for the Curtis-Hunter creek sub watershed were observed above the 1.5 ppm target range. With these numbers targeting efforts to reduce nitrate loss from agricultural and urban sources will show that greatest impact in these areas.

E.coli

E.coli is another important parameter for water quality in the Upper Iroquois Watershed, and high E.coli levels are included on the stakeholders list of concerns. The 2008 303(d) list includes E.coli as impaired for four sub watersheds. E.coli continues to be a concern within the watershed given that current water quality monitoring indicates 6 occurrences or 20% of samples, where sample sites within the Carpenter-Denton sub watershed exceeded the target level of less than 235 cfu per 100 ml sample for safe bodily contact. Curtis-Hunter creek sub watershed exceeded the target level 5 times or 11% of the time throughout the water quality monitoring time frame of May 2011-April 2013

Dissolved Oxygen

Dissolved Oxygen (DO) is also a parameter of concern for the Upper Iroquois Watershed. All four HUC 10 subwatersheds on the 303(d) list include DO as a parameter to water quality. Water quality monitoring also shows excessive DO levels within the watershed, specifically Carpenter-Denton and Curtis-Hunter creek subwatersheds. Carpenter-Denton exceeded the target level of less than 100% a total of 75% of the time and Curtis-Hunter creek a total of 50% of the time.

Table 57 WQ Targets Exceedances by HUC 10

Parameter	Target Level	Oliver Ditch	Carpenter Denton	Upper Iroquois Ryan Ditch	Curtis Hunter Creek	Montgomery Spitlers Creeks	Total Number of Times Exceeding Target Level
Sites		J15	J22, J34, J33, J19	J28, J1, J2, J4, J30	NH, J26, J37, NF, NE, ND	NB, NA, NC	
Temperature °C	Monthly Standard	1	2	0	1	2	6
DO %	<100	16	52	47	57	28	200
pH	<9	9	27	32	39	19	126
Turbidity (NTU)	<10.4 (US EPA)	14	33	53	75	39	214
Orthophosphate (mg/L)	<0.005	15	39	60	83	34	231
Nitrate (mg/L)	>1.5	3	20	18	39	10	90
	< 5.0	2	16	23	23	11	75
E.coli (cfu/100mL)	<235	1	6	9	5	0	21
	< 410	0	4	2	3	2	11
	<576	1	4	3	15	11	34
Total Number of Exceeds by HUC 10		62	203	247	340	156	1008

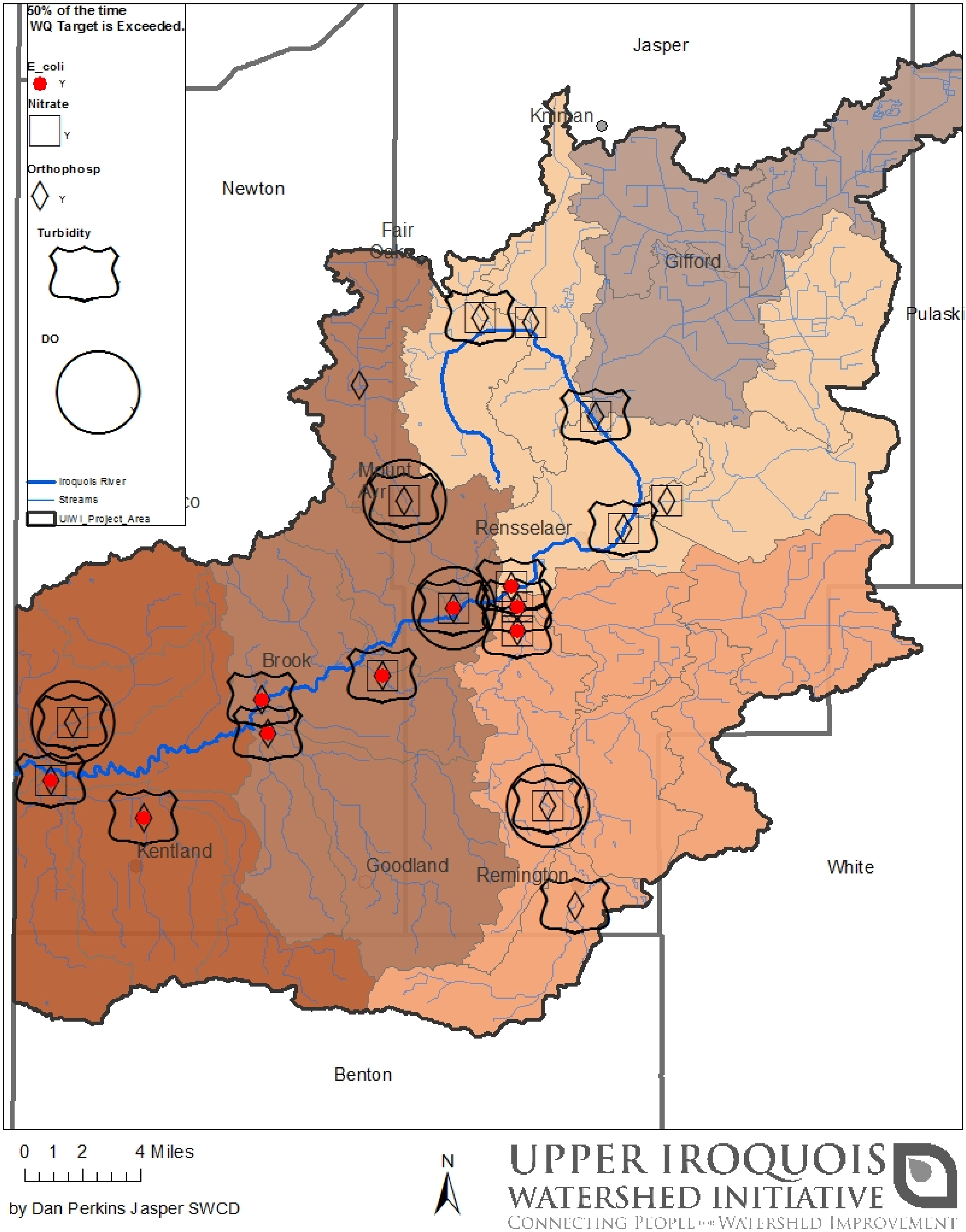
Table 58 % of Samples Exceeding WQ Target by HUC 10

		Exceeding Target Level % of Samples					
Parameter	Target Level	Oliver Ditch	Carpenter Denton	Upper Iroquois Ryan Ditch	Curtis Hunter Creek	Montgomery Spitlers Creeks	Watershed Wide Times Exceeding Target Level
	Sites	J15	J22, J34, J33, J19	J28, J1, J2, J4, J30	NH, J26, J37, NF, NE, ND	NB, NA, NC	
Temperature °C	Monthly Standard	5%	3%	0%	1%	4%	6
DO %	<100	76%	75%	51%	50%	53%	200
pH	<9	43%	39%	34%	34%	36%	126
Turbidity (NTU)	<10.4 (US EPA)	67%	48%	57%	65%	74%	214
Orthophosphate (mg/L)	<0.005	100%	78%	100%	100%	100%	231
Nitrate (mg/L)	>1.5	19%	39%	29%	46%	29%	90
	< 5.0	13%	31%	37%	27%	32%	75
E.coli (cfu/100mL)	<235	13%	20%	23%	11%	0%	21
	< 410	0%	13%	5%	7%	11%	11
	<576	13%	13%	8%	33%	58%	34
Total % samples that Exceed target by HUC 10		50%	50%	46%	51%	52%	50%

Table 59 WQ Targets by Site % of Time Exceed WQ Target

% of Samples Exceeding WQ Target by Site							
Site	Temperature	DO %	pH	Turbidity	Orthopho	Nitrate >1.5ppm	ecoli >235
J1	0%	38%	24%	48%	93%	56%	20%
J15	5%	76%	43%	67%	100%	75%	25%
J19	5%	81%	52%	57%	100%	71%	45%
J2	0%	69%	38%	44%	100%	78%	0%
J22	0%	72%	44%	50%	100%	36%	29%
J26	0%	60%	100%	100%	100%	58%	25%
J28	0%	67%	48%	62%	100%	71%	30%
J30	0%	53%	24%	59%	100%	55%	83%
J33	8%	77%	15%	69%	100%	50%	50%
J34	0%	71%	35%	71%	100%	57%	67%
J37	6%	75%	106%	106%	170%	56%	50%
J4	0%	0%	35%	76%	100%	75%	43%
NA	5%	45%	35%	90%	100%	64%	100%
NB	7%	50%	50%	57%	100%	57%	33%
NC	0%	63%	26%	68%	100%	46%	50%
ND	0%	0%	39%	78%	100%	36%	75%
NE	0%	0%	32%	79%	100%	47%	67%
NF	0%	15%	30%	90%	100%	59%	86%
NH	0%	0%	29%	48%	100%	39%	11%

Figure 85 Water Quality 50% and more of samples exceed target levels.



Habitat and Macro invertebrates Rating

Along with basic chemical monitoring, habitat quality and biological communities have been sampled as part of the UIWI water quality monitoring. It should be noted that “Citizen” level scoring was done to get a rough baseline.

Table 60 Citizen Macro invertebrates Impaired Biological Index (CMIBI) Summary by HUC 10

Citizen MIBI									
Sample Site	Rating 2011	2011 Quality Score	Rating 2013	2013 Quality Score	10 HUC_Subwatershed	2011 Average 10 HUC	2013 Average 10 HUC	2011 Overall Score	2013 Overall Score
J1	15	Fair	12	Fair	Upper Iroquois-Ryan Creek	15.25	14.25	Fair	Fair
J28	10	Poor	15	Fair	Upper Iroquois-Ryan Creek				
J2	19	Good	16	Fair	Upper Iroquois-Ryan Creek				
J4	17	Good	14	Fair	Upper Iroquois-Ryan Creek				
J30	n	n	n		Upper Iroquois-Ryan Creek				
NC	11	Fair	2	Poor	Montgomery-Spitlers Creeks	5.33	10.67	Poor	Fair
NA	1	Poor	4	Poor	Montgomery-Spitlers Creeks				
NB	4	Poor	26	Excellent	Montgomery-Spitlers Creeks				
J37	16	Fair	14	Poor	Curtis-Hunter Creeks	15.67	14.50	Fair	Fair
J26	19	Good	21	Good	Curtis-Hunter Creeks				
NH	13	Fair	22	Good	Curtis-Hunter Creeks				
NF	12	Fair	10	Poor	Curtis-Hunter Creeks				
NE	20	Good	11	Fair	Curtis-Hunter Creeks				
ND	14	Fair	9	Poor	Curtis-Hunter Creeks				
J22	15	Fair	2	Poor	Carpenter-Denton Creeks	16.00	7.25	Fair	Poor
J33	11	Fair	1	Poor	Carpenter-Denton Creeks				
J34	26	Excellent	16	Fair	Carpenter-Denton Creeks				
J19	12	Fair	10	Poor	Carpenter-Denton Creeks				
J15	16	Fair	21	Good	Oliver Ditch	16.00	21.00	Fair	Good
Watershed Average	14	Fair							
Scale	**Quality**	**Scale**	**Quality**						
10 or less	Poor	11_16	Fair						
17-22	Good	23 >	Excellent						

It is recommended that a pre-implementation phase be completed to acquire a full bio monitoring assessment (macroinvertebrates, fish, and habitat) for the following reasons:

1. Animals are exposed continuously to water, so they integrate effects over time (not just a snapshot like most chemical monitoring)
2. Community responses can diagnose particular water quality problems (low oxygen, excessive nutrients, toxins, etc.)

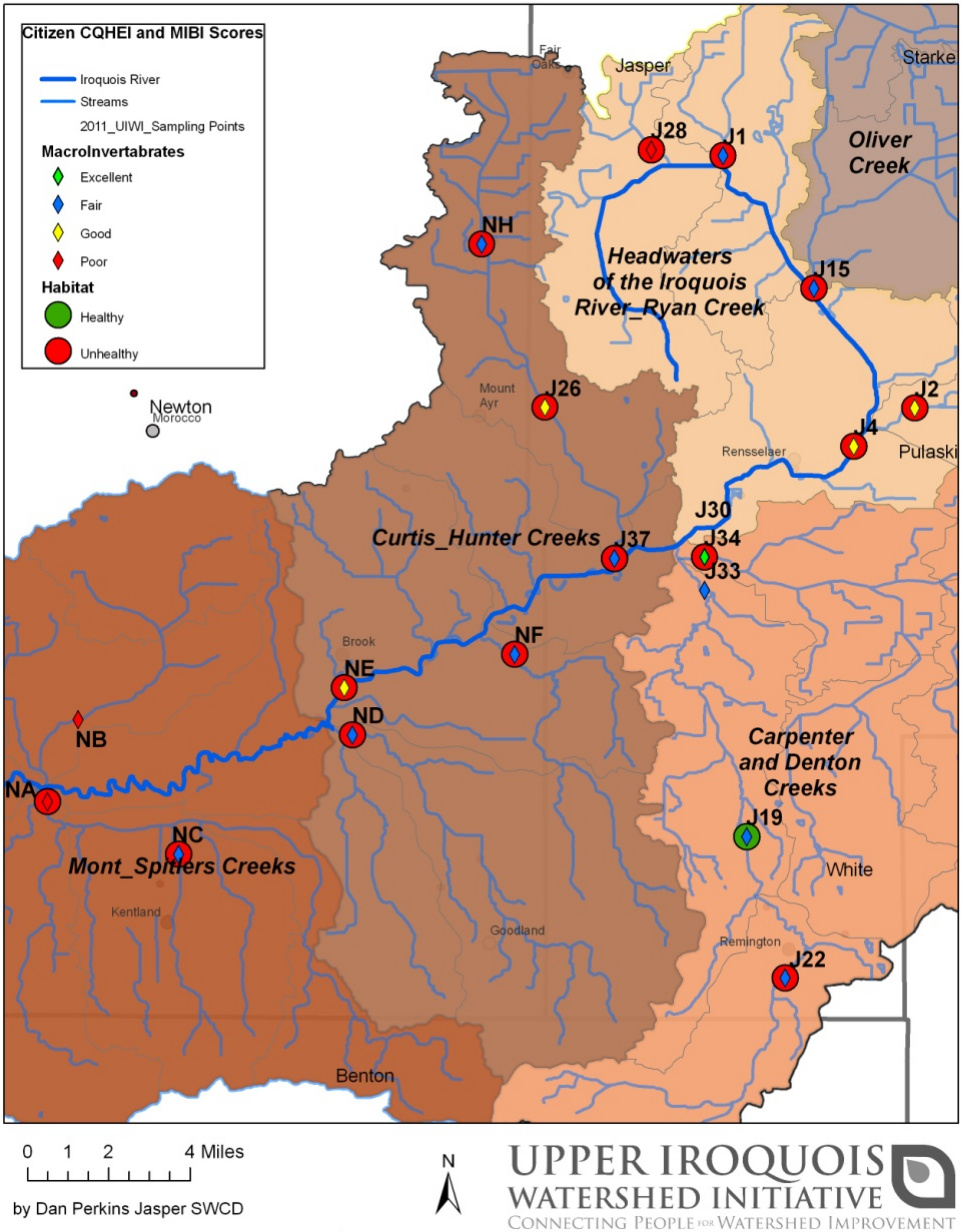
Table 61 Citizen Habitat Evaluation Index Summary by HUC 10

Citizen Habitat Evaluation index (CQHEI)							
Site	2011 Rating	2011 Average Rating	2011 Quality Score	HUC 10 Subwatershed	2013 Rating	2013 Average Rating	2013 Quality Score
J15	44	44	Unhealthy	Oliver Ditch	44	44	Unhealthy
J1	39	31.5	Unhealthy	Upper Iroquois-Ryan Creek	72	51	Unhealthy
J30				Upper Iroquois-Ryan Creek	71		
J28	12		Unhealthy	Upper Iroquois-Ryan Creek	24		
J2	21		Unhealthy	Upper Iroquois-Ryan Creek	30		
J4	54		Unhealthy	Upper Iroquois-Ryan Creek	60		
J33		50.3	Unhealthy	Carpenter-Denton Creeks	46	68	Healthy
J34	48		Unhealthy	Carpenter-Denton Creeks	73		
J19	63		Healthy	Carpenter-Denton Creeks	85		
J22	40		Unhealthy	Carpenter-Denton Creeks			
J37	47	32.33	Unhealthy	Curtis-Hunter Creeks	61	48	Unhealthy
J26	28		Unhealthy	Curtis-Hunter Creeks	60		
NH	41		Unhealthy	Curtis-Hunter Creeks	37		
NF	29		Unhealthy	Curtis-Hunter Creeks	35		
NE	15		Unhealthy	Curtis-Hunter Creeks	56		
ND	34		Unhealthy	Curtis-Hunter Creeks	40		
NC	8	24	Unhealthy	Montgomery-Spitlers Creeks	53	51	Unhealthy
NA	40		Unhealthy	Montgomery-Spitlers Creeks	58		
NB				Montgomery-Spitlers Creeks	41		
HUC 8	Watershed Ave	36.4	Unhealthy				
Citizen Habitat Evaluation Index CQHEI		100>	High Quality Stream				
		> 60	Generally Healthy				
		< 60	Unhealthy				

Sub watersheds which had more than one sampling location within their boundaries took the average score among all sampling site and were scored following either the Citizen MIBI or the Citizen Qualitative Habitat Evaluation index (CQHEI). All sub watersheds scored Fair with the Citizen MIBI except the Montgomery-Strole Creeks sub watershed, which scored Poor, and based on the 2010 303(d) list of impairments that had this area significantly impaired for IBI this shouldn't be a surprise.

Based off of the CQHEI and CMIBI, site J19 within the Carpenter-Denton Creeks sub watershed scored a Healthy rating of 63. However, all other sites within the sub watershed scored unhealthy with ratings in the forties. Habitat and biological measurements directly relate to the stakeholders concern of protecting and creating healthy fish habitat, in that biological monitoring is based on the fact that different species react to pollution in different ways and that benthic macro invertebrates are continuous indicators of environmental quality.

Figure 86 Habitat and Macro invertebrates Scores



4.1 Analysis of Stakeholder Concerns

Following the characterization and inventory of the Upper Iroquois Watershed, stakeholder concerns were analyzed, see Table 62 Analysis of Stakeholders Concerns. As part of this analysis, each concern was evaluated to determine if there was data to support it, if so what evidence is currently available, can the concern be quantified, and is the concern within the scope of this project. These grading variables helped the steering committee decide what to focus on and prioritize the concerns that were gathered during the initial stages of this watershed planning effort. It may appear that the group wants to focus on every concern, but because of the many partnerships in the watershed, the WMP group will play only an advisory or assistance role as needed.

Several of the concerns were chosen not to focus on for several reasons. For example, log jams, since several partnering groups like the IRCD and Friends of the Iroquois have a good handle and mechanisms to deal with this concern. Beaver dams are handled locally by farmers and the county surveyor's office. The fish consumption advisory will not be addressed, largely due to contributing pollutant sources such as methyl mercury and PCB's precipitated from past air pollution from outside the watershed. Perceived poor fishing will also not be targeted as not enough data exists to support this concern.

Table 62 Analysis of Stakeholders Concerns

Concern	Support by data	Evidence	Quantifiable	Outside Scope	Group wants to focus on
Flashiness and flooding of the Iroquois River	Yes	USGS Stream Gage, Local Stories	Yes	No	Yes
Log jams	Yes	IRCD Stream Surveys, Windshield Surveys, Surveyor Reports	Yes	No	No
Beaver dams slowing water	No		No	Yes	No
Too much sediment in water	Yes	Watershed Inventories; WQ monitoring	Yes	No	Yes
Altering of natural hydrology/over ditching	Yes	Desktop Survey, Drainage Miles,	Yes	Yes	No
Lack of drainage in areas	Yes	Local farmers, Surveyor Reports	No	Yes	No
Tile drainage negatively impacts water quality and water flow	Yes	WQ Data-nitrates, USGS Gage	Yes	No	Yes
Decrease in healthy fish habitat within watershed	Yes	WQ Biological Monitoring , CQHEI, CMIBI, Stream Buffer Survey	Yes	No	Yes
Farming right along streams/lack of riparian corridor	Yes	Windshield Survey, Stream Buffer Survey	Yes	No	Yes
Loss of native fish/mussel populations	Yes	Historical fish surveys. Local knowledge	Yes	No	Yes
Fish safe to eat?	Yes	DNR Fish Advisory List	Yes	Yes	No
Fish are unhealthy to eat because of contamination	Yes	Fish Advisory	Yes	Yes	No
Agriculture BMPs should be utilized more	Yes	SI Survey, Tillage Transect, Windshield Survey, WQ Data	Yes	No	Yes
Locals unaware of Ag and Urban BMP options	Yes	SI Survey	Yes	No	Yes
Too many locations where cattle have direct access to watershed streams	Yes	Windshield Survey and WQ Monitoring	Yes	No	Yes

4.2 Identifying Problems and Causes.

Initial stakeholder concerns (Table 6), the 6 preliminary problem statements were grouped and paired down into 5 problem statements, see Table 63 Stakeholder Concerns to Problem Statements. Within these 5 problem statements, potential causes were documented based on historic and current water quality data, see

Table 64 Identification of Causes of Problems. A cause is defined as an event, agent, or series of actions that produces an effect.

Table 63 Stakeholder Concerns to Problem Statements.

Concerns	Problem
Flashiness and flooding of the Iroquois	The Iroquois River has undesirable high and low levels and flows of water that threaten our towns, agricultural land, and health of the river.
Too much sediment	
Tile drainage negatively impacts water quality and water flow	
Decrease in healthy fish habitat within watershed	The desirable native fish populations in the Iroquois River and surrounding waterways are suspected to be in decline.
Loss of native fish/mussel populations	
Channelization/Ditch cleaning that results in loss of fish habitat = altered hydrology	
Fish are unhealthy to eat because of pollution	
Too much sediment in water	Area streams within the watershed are very cloudy and turbid.
Agriculture BMPs should be utilized more	
Locals unaware of BMP options	
Too many locations where cattle have direct access to watershed streams	
Too much Fertilizer entering the water	
Surface and soil erosion contributes to scouring and sloughing of stream banks	
Lack of recreational access to river	Widespread recreational use is prevented.
No trail system in watershed	
High E.coli levels within watershed streams	
Public lacks knowledge about the river and its tributaries' water quality	
Perceived poor fishing	
Septic systems not efficient enough and/or not properly maintained	The Iroquois River and its tributaries are listed on IDEM's 303(d) list for "excessive nutrients, E.coli, and IBI."
Too much nutrients in water	
Surface and soil erosion contributes to scouring and sluffing of stream banks	
CSO's in Rensselaer	

Agriculture BMPs should be utilized more	
Tile drainage negatively impacts water quality and water flow	
Nothing actively growing during non cash crop season to prevent nutrient loss	

Table 64 Identification of Causes of Problems

Problem	Potential Causes
The Iroquois River has undesirable high and low levels and flows of water that threaten our towns, agricultural land, and health of the river.	Increase of tiling and open ditches on agricultural fields has led to increased volume
	Loss of natural riparian habitat and flood zones (reduced flood storage)
	Degraded function and benefit of floodplains (loss of storage capacity and reduced in-stream velocity)
	Increased sedimentation from high velocity flows and channelization causing stream bank erosion
	Log jams
	Lack of education about natural hydrology and effects of channelization
	Lack of unified government strategy about watershed flooding.
The desirable native fish populations in the Iroquois River and surrounding waterways are suspected to be in decline.	Poor habitat/water quality limits the biotic community which is food source for fish
	Dredging and regular ditch cleaning of sediment
	Competing land uses resulting in loss of riparian/diverse fish habitat
Area streams within the watershed are very cloudy and turbid.	Suspended sediments and/or turbidity exceed target values set by this project.
	Livestock access disturb bottom sediments
	soil and wind erosion from agricultural fields and urban construction
	Streambank erosion and slope failures input high levels of sediment
Widespread recreational use is prevented.	Historical view of river just for drainage
	Lack of public access points every 5-10 miles.
	Numerous log jams
	Perceived poor water quality
	Unified source of recreational about region information is not available.
The Iroquois River and its tributaries are listed on IDEM's 303(d) list for "excessive nutrients, e.coli, and IBC."	Nutrient concentrations exceed target values set by this project (nitrate-orthophosphate).
	Lack of nutrient/manure management
	e.coli levels exceed target levels
	Various stream segments are listed as having impaired biological communities
	Lack of Buffer strips along waterways
	Lack of and decline of use of conservation tillage practices
	Nothing actively growing during noncash crop season to prevent nutrient loss
	Continual dredging and cleaning of ditches = unstable watercourses

4.3 Source Identification and Loads: Key Pollutants of Concern

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.

Nonpoint pollution sources are varied, yet common throughout almost any watershed. A summary of potential sources identified in the Upper Iroquois River watershed for each of our problems is listed below:

Nutrients (Nitrogen and Phosphorus):

- Conventional cropping practices
- Waste water treatment discharges
- Industrial discharges
- Excess Agricultural and residential fertilizer
- Poor riparian buffers
- Streambank and bed erosion
- Construction activities
- Improperly managed animal waste
- Confined feeding operations
- Human waste (failing septic systems, package plants, inadequately treated wastewater)
- Altered hydrology (ditching and draining, fish passage limitations, altered stream courses)

E. coli:

- Human waste (failing septic systems, CSO, package plants, inadequately treated wastewater)
- Animal waste (livestock in streams, pet waste, poor manure management, domestic and wildlife run-off)

Sediment:

- Conventional cropping practices
- Stream bank and bed erosion
- Poor riparian buffers
- High velocities as a result of increased agricultural tile drainage and urban run-off (impervious surfaces)
- Construction activities
- Livestock access to streams
- Altered hydrology (ditching and draining, fish passage limitations, altered stream courses)
- Flooding

GIS and water quality data were used to evaluate the potential sources within each subwatershed. Appendix 2: Potential Source Summary Data HUC 10 contains tables detailing the data for each potential source and was used to identify the potential sources listed in Table 65 Potential Causes and Sources for each Pollution Problem.

Table 65 Potential Causes and Sources for each Pollution Problem

Problem	Potential Causes	Potential Sources
The Iroquois River has undesirable high and low levels and flows of water that threaten our towns, agricultural land, and health of the river.	Increase of tiling and open ditches on agricultural fields has led to increased volume	Crop land having artificial drainage as % of total drainage miles; Oliver Ditch 230 miles or 65%, Carpenter-Denton 136 miles or 46%, Upper Iroquois-Ryan with 242 miles or 64% drained, Curtis-Hunter with 111 or 42%, and Mont-Strole with 104 miles or 50%.
	Loss of natural riparian habitat and flood zones (reduced flood storage)	Windshield Survey 5 of sites with less than 50% buffer; Oliver 24 sites, Carpenter-Denton 15, Upper Iroquois-Ryan 26, Curtis_Hunter 27, Mont_Strole 14
		% riparian buffered within 100 ft of waterway; Oliver Ditch 18%, Carpenter-Denton 20%, Upper Iroquois-Ryan 18%, Curtis-Hunter 20%, and Mont-Strole 20%.
	Loss and degraded function and benefit of wetland/floodplains	% of Total land area in Wetland; Oliver Ditch 6.5%, Carpenter-Denton 1%, Upper Iroquois-Ryan 2.5%, Curtis-Hunter 1.4%, Mont-Strole 0.8%
		% riparian buffer within 100 ft of waterway; Oliver Ditch 18%, Carpenter-Denton 20%, Upper Iroquois-Ryan 18%, Curtis-Hunter 20%, and Mont-Strole 20%.
	Increased sedimentation and channelization	# of Active Erosion Sites- Oliver 1, Carpenter_Denton 3, Upper Ir_Ryan 19, Curtis_Hunter 11, Mont_Strole 14
		# of Live Stock Access Sites- Oliver 2, Carpenter_Denton 12, Upper Iroquois_Ryan 7, Curtis_Hunter 19, Mont_Strole 8
	Log jams	County Survey Records and IRCD tracking
	Lack of understanding of flooding, hydrology and effects of channelization	% area in wetland less than 2%, outdated view of drainage options , Crop land having artificial drainage as % of total drainage miles; Oliver Ditch 230 miles or 65%, Carpenter-Denton 136 miles or 46%, Upper Iroquois-Ryan with 242 miles or 64% drained, Curtis-Hunter with 111 or 42%, and Mont-Strole with 104 miles or 50%.
The desirable native fish populations in the Iroquois River and surrounding waterways are suspected to be in decline.	Poor habitat and poor biotic community	# of Poor Rank for Habitat and Biotic communities; Carpenter-Denton 5, Upper Iroquois 5, Curtis-Hunter 5, Mont-Strole 7
	Perceived poor fishing	N/A
	Competing land uses resulting in loss of riparian/diverse fish habitat	# of Poor Rank for Habitat and Biotic communities; Carpenter-Denton 5, Upper Iroquois 5, Curtis-Hunter 5, Mont-Strole 7
		Windshield Survey 5 of sites with less than 50% buffer; Oliver 24 sites, Carpenter-Denton 15, Upper Iroquois-Ryan 26, Curtis_Hunter 27, Mont_Strole 14
		Habitat scores according to CQHEI rank all sites, but one as unhealthy = lack of quality habitat

Problem	Potential Causes	Potential Sources
Area streams within the watershed are very cloudy and turbid.	Suspended sediments and/or turbidity exceed target values set by this project.	% riparian buffer within 100 ft of waterway; Oliver Ditch 18%, Carpenter-Denton 20%, Upper Iroquois-Ryan 18%, Curtis-Hunter 20%, and Mont-Strole 20%. Lack of conservation tillage across watershed - no-til corn less than 10%, soybeans less than 60%.
	Livestock stirring stream bed	# of Live Stock Access Sites- Oliver 2, Carpenter_Denton 12, Upper Iroquois_Ryan 7, Curtis_Hunter 19, Mont_Strole 8
	Streambank erosion and slope failures input high levels of sediment	# of Channelization Sites- Oliver 40, Carpenter_Denton 72, Upper Ir_Ryan 56, Curtis_Hunter 62, Mont_Strole 34
		# of Active Erosion Sites- Oliver 1, Carpenter_Denton 3, Upper Ir_Ryan 19, Curtis_Hunter 11, Mont_Strole 14
Widespread recreational use is prevented.	Historical view of river just for drainage	Lack of unified land use and recreational plans
	Lack of public access points every 5-10 miles.	Lack of funding, traditional view of stream as just for drainage, missed opportunity
	Numerous log jams	stream bank sloughing, flashiness, sedimentation
	Perceived poor water quality	Lack of knowledge and education efforts across watershed
	Unified source of recreational about region information is not available.	No central website or information source.

Problem	Potential Causes	Potential Sources
The Iroquois River and its tributaries are listed on IDEM's 303(d) list for "excessive nutrients, e.coli, and IBC."	Nutrient concentrations exceed target values set by this project.	Crop land having artificial drainage as % of total drainage miles; Oliver Ditch 230 miles or 65%, Carpenter-Denton 136 miles or 46%, Upper Iroquois-Ryan with 242 miles or 64% drained, Curtis-Hunter with 111 or 42%, and Mont-Strole with 104 miles or 50%.
		% riparian buffered within 100 ft of waterway; Oliver Ditch 18%, Carpenter-Denton 20%, Upper Iroquois-Ryan 18%, Curtis-Hunter 20%, and Mont-Strole 20%. Windshield Survey 5 of sites with less than 50% buffer; Oliver
		Nitrate Leaching Index Ranking . . .
		9 cso outlets in Rensselaer that open in 1/2 rain event,
	e.col levels exceed target levels	Failing septic systems in unsewered communites, septics tied directly to subsurface tile lines, manure, wildlife, CSO
	Various stream segments are listed as having impaired biological communities	% riparian buffered within 100 ft of waterway; Oliver Ditch 18%, Carpenter-Denton 20%, Upper Iroquois-Ryan 18%, Curtis-Hunter 20%, and Mont-Strole 20%. Windshield Survey 5 of sites with less than 50% buffer; Oliver
		# of Poor Rank for Habitat and Biotic communities; Carpenter-Denton 5, Upper Iroquois 5, Curtis-Hunter 5, Mont-Strole 7
	Lack of Buffer strips along waterways	% riparian buffer within 100 ft of waterway; Oliver Ditch 18%, Carpenter-Denton 20%, Upper Iroquois-Ryan 18%, Curtis-Hunter 20%, and Mont-Strole 20%.
		Windshield Survey 5 of sites with less than 50% buffer; Oliver
	Lack of and decline of conservation tillage practices	% loss of no-till corn and soybean acres from 2000-2011; Jasper County 8% corn and 3% soybeans. Newton County 13% corn and 12% soybean acres
	Nothing actively growing during non cash crop season to prevent nutrient loss	Lack of cover crop use across watershed: CC Cost Share acres vs total acres in watershed by county,
	Loss of Wetland treatment and function	% of Total land area in Wetland; Oliver Ditch 6.5%, Carpenter-Denton 1%, Upper Iroquois-Ryan 2.5%, Curtis-Hunter 1.4%, Mont-Strole 0.8%

5.0 Current Loads of Pollutants

A good mechanism for determining sources of nonpoint pollution is hydrologic simulation models. Hydrologic models detail the transport of pollutants across the land surface as components of surface water run-off. Rainwater flowing over the land and ground water flowing through the soil can take up pollutants including E.coli, sediments and nutrients. Soil characteristics and land uses influence the way that water moves through the system and each hydrologic model simulates the movement in a different way. They serve as a check on the critical area determinations made using water chemistry sample and GIS-based watershed data. Watershed loading rates can be estimated using a variety of loading models for a variety of parameters. The parameters chosen are those that are potential causes and exceeding current water quality targets. Estimates of current loading were calculated from using water quality data collected from 2011-2012. Each HUC 10 subwatershed had a minimum of 1 to several water sampling sites.

Table 66 Sampling Locations Used for Load Estimations

HUC 10 Subwatershed	Number of Sampling Sites	Sampling Location ID
Oliver Ditch	1	J15
Carpenter-Denton Creeks	4	J22, J34, J33
Upper Iroquois-Ryan Creek	6	J28, J1, J2, J4, J30
Curtis-Hunter Creek	6	NH, J26, J37, NF, NE, ND
Montgomery-Strole Creek	3	NB, NA,NC

Current loading estimates were calculated by Purdue's Online Load Duration Curve Tool in conjunction with IDEM recommendations (Fisher per comm.). Estimates were obtained by multiplying the average pollutant concentration from sampling points in that subwatershed, an estimate of the volume of stream flow passing through that location at a certain point based on actual stream flow or the nearest USGS gage, and a specific conversion factor to transform each concentration measurement into a mass-based or organism-based "load" for that point in time. Our estimates for mass-based pollutants (nutrients and sediment) are expressed in tons per year (T/Yr). Since E. coli does not have a specific mass-based conversion factor, the total number of organisms was calculated to give load in billions of organisms per year (G-org/Yr). Current loads for each subwatershed and required reductions to meet water quality targets are shown in
Table 67 Loads and Load Reductions.

Table 67 Loads and Load Reductions

HUC 10	Oliver Ditch	Carpenter-Denton Creeks	Upper Iroquois-Ryan Creek	Curtis-Hunter Creek	Montgomery-Strole Creek	HUC 8 watershed Overall Totals
Sq.Miles	82	145	136	162	127	651
Annual Nitrate Load (Tons/Yr)	0.16	0.29	0.97	0.312	0.35	2.08
Annual Target Load	0.07	0.09	0.31	0.122	0.09	0.69
Reduction Needed	0.09	0.20	0.66	0.190	0.26	1.40
% Reduction Needed to reach WQ Target (1.5ppm)	55%	68%	68%	61%	74%	67%
Annual orthophosphorus Load (#/Yr)	0.83	48.73	132.99	102.09	92.16	376.79
Annual Target Load	0.07	1.25	4.12	1.08	1.19	7.71
Reduction Needed	0.76	47.48	128.87	101.00	90.96	369.08
% Reduction Needed to reach WQ Target (.005ppm)	91%	97%	97%	99%	99%	98%
Annual Sediment Load (Tons/Yr)	1778	15036.78	11555.37	4974.29	4584.30	37,929.08
Annual Target Load	992	1422.72	4282.52	1697.50	1238.31	9,632.60
Reduction Needed	787	13614.06	7272.85	3276.79	3345.99	28,296.48
% Reduction Needed to reach WQ Target (10.4)	44%	91%	63%	66%	73%	75%
Annual ecoli Load (B-org/Yr)	63	175.25	420.12	175.84	231.54	1,066.12
Annual Target Load	102	133.11	438.73	173.90	126.86	974.19
Reduction Needed	0	42.14	0	1.94	104.68	148.75
% Reduction Needed to reach WQ Target (235 MPN)	0%	24%	0%	1%	45%	14%

Note, current loadings are estimated for a single point in time and may not reflect the variation in actual, real world pollutant loading that occurs within each watershed over the course of the year. We introduce some of these other variables (land use, land cover, etc) in the final critical and priority areas ranks. Downstream watersheds often take on water quality impairments from upstream drainages, so, if we were to focus all our efforts on the drainages where loading is documented, we still might not be addressing the true source of the loading. This is why loading calculations are only one tool in the watershed tool box to help us address nonpoint pollutants.

For example, the 2008 TMDL for E.coli % reduction is 75% watershed wide, and Table 68 compares the UIWI WQ data from 2011-2012 that was used to come up with a watershed wide reduction of only 14% clearly reveals this variation. E.coli monitoring will continue to be conducted to further investigate this variation.

Table 68 E.coli % Reduction UIWI Data vs. TMDL

HUC 10 E.coli % Reduction Needed to reach WQ Target (235 MPN)	Oliver Ditch	Carpenter-Denton Creeks	Upper Iroquois-Ryan Creek	Curtis-Hunter Creek	Montgomery-Strole Creek	HUC 8 watershed Overall Totals
UIWI WQ Data 2011-2012	0%	24%	0%	1%	45%	14%
2008 TMDL %E.coli Reductions Report	69%	74%	72%	81%	67%	73%

6.0 Water Quality and Protection Goal Statements

Based on loading calculations watershed inventory efforts; stakeholder input for concerns, problems, and sources; the following goal statements were created.

In an effort to scale goals to manageable levels, a generational approach occurred. Each goal was scaled to a level of the volume of practices which could realistically be installed within a 5, 10, and 30 year period. These scaled goals represent realistic target reductions based on current technology and funding levels. Each target lists the overall goal, the scaled goal, and indicators that can be measured to determine if the goal is being met. It should be understood that many of these goals work synergistically and overlap in their effect on improving water quality and therefore are not listed multiple times.

Flashiness – Goal Statement

To reduce high and low flow events by 5% across the watershed according the USGS stream gages at Rensselaer and Foremen, the steering committee would like to:

1. 5 year goal:
    a. Ensure flow of water is not hindered via log jams on an annual basis along the main branch of the Iroquois River and tributaries.
    b. Establish two demonstration sites of two-stage ditches.
    c. Establish two demonstration sites of drainage water management
    d. 500 acres of wetland restoration.
    e. Installation of one LID in each urban critical area.
2. 5 -30 year continuing goal: Educate about natural stream design, LIDS(retention basin naturalization, etc), and alternative flood control strategies
3. 10 year goal:
    a. 3- 2 stage ditch sites installed
    b. 3 drainage water management systems in place
    c. 1,000 acres of wetland restoration
    d. Ordinance and zone code have LID requirements
4. 30 year goal: Increase flood storage capacity
    a. X amount of 2 stage installed to increase flood capacity by 5% across watershed
    b. 10 drainage water management systems in place
    c. 2,000 acres of wetland restoration
    d. LID adoption across urban areas widespread and common.

Indicators

- Number of log jams removed.
- Target placement and linear feet of two-stage ditches installed
- Increase use of natural stream channel design
- Increase in no-till corn and soybean acres
- Increase in cover crop acres
- Installation of Low Impact Development technologies across the urban areas
- Increases in SOM = water storage capacity
- Targeted installation of saturated buffers

- Target placement and creation of new wetland areas so each sub watershed has greater 4% of land acres in wetland.
- Preservation of current wetland areas
- Reduction in number of active erosion sites
- Improved MIBI scores, which would indicate more stable flow regime
- Improved CQHEI scores, which would indicate more riparian and flood storage areas.
- # of Education events and materials distributed

Fish and Wildlife Habitat – Goal Statement

To protect and enhance fish and wildlife habitat, the steering committee would like to increase the amount of buffer within 100 ft of all streams from the current status of 20% to a target of 50%, reduce roadside mowing by 25% and replace with native habitat, restore wetland acres from the current status of 1% to a target of 4% of total land acres, improve CMIBI from current poor/fair score to a target of excellent, and CQHEI scores from current status of unhealthy to a target of healthy.

1. Increase amount of 100 ft of land use along streams considered buffered:
   a. 5 year goal: 25% buffered (190 acres or 8 stream miles)
   b. 10 year goal: 35% buffered (570 acres or 24 stream miles)
   c. 30 year goal: 50% buffered (1900 acres or 80 stream miles)

2. Reduce roadside mowing and replace with native vegetation
   a. 5 year goal: Complete assessment and design cost comparison
   b. 10 year goal: Implement 15% no mow areas
   c. 30 year goal: Implement 25% no mow areas

3. Restore sub watersheds to a wetland land percent of total acres to 4%.
   a. 5 year goal: 1% increase
   b. 10 year goal: 2% increase
   c. 30 year goal: 4 % increase

4. CMIBI community scores improve at sites:
   a. 5 year goal: CMIBI scores improve to all good.
   b. 10 year goal: CMIBI scores improve to high good rank
   c. 30 year goal: CMIBI scores at Excellent

5. CQHEI scores improve at sites:
   a. 5 year goal: CQHEI to high 50
   b. 10 year goal: CQHEI to above 60 for 50% of sites.
   c. 30 year goal: CQHEI at all site to healthy score.

6. Educate about native fish, flora, and fauna populations.

7. Determine current native fish populations

Indicators

- No net loss of riparian habitat to other land uses.
- Results of fish surveys done by St. Joseph's College
- Reduced nutrient concentrations and loads in water quality samples
- Improved MIBI scores, which equals more fish food.
- Improved CQHEI scores, which equals better fish habitat.
- Reduced *E. coli* concentrations and loads in storm water quality samples
- Currently impaired segments removed from 303(d) list
- # of Education events and materials distributed

Recreation Use – Goal Statement

To increase recreational use of area streams, the steering committee would like to create more access points from the current 2 to 5, increase public use of streams from less to more often, stream passage by canoe from 60% passable to 100% passable, and associated educational outreach.

1. Create new access points to streams:
    a. 5 year goal: 1 new site along Iroquois
    b. 10 year goal: 2 new sites: one additional to above on Iroquois River and one on Curtis or Carpenter Creeks.
    c. 30 year goal: public access point every 5-10 miles along Iroquois.

2. Increase public use of streams:
    a. 5 year goal: 2 annual float trips conducted by local group
        i. 20 new people floated river
    b. 10 year goal: 4 annual float trips and annual Riverfest Celebration.
        i. 50 new people floated river
        ii. Local livery established to service area
    c. 30 year goal: more of the above.

3. Identify and clear log jams hindering family friendly canoe trips.
    a. Continue to assist and coordinate with Friends of Iroquois, Drainage Boards
    b. 5 year goal of log jam free canoeing from Rensselaer to State Line.

4. Change "perceived" poor water quality fears that hinder recreation use.
    a. 5 year goal: SI survey indicates Iroquois River is valued and not perceived as dirty.
5. Create recreational guide specific to Iroquois River region
    a. 5 year goal: created publication and distribute
    b. 10 year goal: Regionally known as excellence place to recreate. Host 4 events that bring in tourists.
6. Create "Safe to Canoe" Iroquois River website based on USGS gage.
    a. 5 year goal: Site up and utilized by NWIPA and tourism boards.

Indicators

- Public stream access point every 5-10 stream miles on navigable streams
- Number of log jams identified and cleared

- Miles of walking/riding trails along waterways.
- Miles of log jam free canoeing
- Reduced nutrient concentrations and loads in water quality samples
- Improved MIBI scores
- Reduced *E. coli* concentrations and loads in storm water quality samples
- Currently impaired segments removed from 303(d) list
- # of Education events and materials distributed
- # of annual paddle events on river

Nutrients – Goal Statement

To reduce nutrient concentrations (nitrogen and phosphorus) so that monthly water quality samples, do not exceed the 1.5ppm target for nitrate and the 0.005 ppm orthophosphate target more than 20% of the time within 30 years. We need to:

1. reduce orthophosphate loads from the current 377 pounds/year to a target of 100 pounds/year (a 75%% reduction) in 30 years.
    a. 5 year goal: 25% reduction or 25 pounds/year
    b. 10 year goal: 50% reduction or 50 pounds/year
    c. 30 year goal: 75% reduction or 100 pounds/year

And/or reduce the current 95% of the time orthophosphates samples exceed target of 20%

    d. 5 year goal: no more than 80% of samples exceed target annually
    e. 10 year goal: no more than 50% of samples exceed target annually,
    f. 30 year goal: no more than 20% of samples exceed target annually.

2. reduce nitrate levels from the current 2.08 tons/yr to 1.56 tons/yr (a 75% reduction) in 30 years.
    a. 5 year goal: 25% reduction or 0.52 tons/year
    b. 10 year goal: 50% reduction or 1.04 tons/year
    c. 30 year goal: 75% reduction or 1.56 tons/year

And/or reduce the current 36% of the time samples exceed target of 1.5ppm to a target of only 20% of the samples exceeding target.

    a. 5 year goal: no more than 32% of samples exceed annually
    b. 10 year goal: no more than 27 % of samples exceed annually
    d. 30 year goal: no more than 20% of sample exceed annually.

3. Education about local water quality testing via the release of an annual report to area stakeholders and partners.

Indicators for Nutrients:

- Number of sites identified for implementation
- Number of sites with BMPs implemented
- Number of livestock access sites removed from map (watering and fencing installed)
- Number of acres/linear feet of riparian buffers
- Linear feet of two-stage ditches installed
- Increase in no-till corn and soybean acres according to ISDA tillage transect and USDA Farm bill programs
- Increase in cover crop acres
- Number of nutrient management plans developed
- Number of fields enrolled in Indiana On-Farm Network
- Number of farmers using cover crops
- Number of field days and attendees
- Number of education workshops/meetings and attendees
- Number of follow-up emails, appointments, etc. from field days/workshops
- Number of demonstration sites
- Reduced nutrient concentrations and loads in annual water quality samples
- Improved MIBI scores
- # of Education events and materials distributed

Bacteria- E.coli Goal Statements

To reduce E. coli concentrations at all sites to 235 and below cfu/100mL within 30 years. As of April 2013, across the watershed 50% of E.coli samples exceed the WQ target of less than 235 cfu/100mL. To meet TMDL targets a 73% reduction in loading needs to occur across the watershed. The 10 year goal will theoretically achieve this load reduction.

1. 5 year goal: less than 40% of samples exceed target.
2. 10 year goal: less than 30% of samples exceed target
3. 30 year goal: less than 20% of samples exceed target

Given the difference in % reduction needed to achieve WQ goals compared to the 2008 TMDL, the steering committee determined having the stated above goal would achieve the same end goal as the TMDL.

Indicators:

- E.coli will be recorded 6 times a year at each sampling location according to current QAPP procedure. A reduction in levels will be the goal.
- Number of landowners identified amenable to fencing, alternative water supplies,
- Fewer number of visual observations of cattle in the stream
- Number of animals removed from stream by fencing
- Number of alternative water supply systems created
- Number of lagoons, manure systems added/implemented

- Number of homeowner receiving education on septic systems/wastewater disposal
- Number of homeowner receiving education on inflow and infiltration polices
- Retention ponds retrofitted or naturalized to meet Water Quality protection retention rates
- Increased NPDES compliance
- Reduced *E. coli* concentrations and loads in storm water quality samples
- Currently impaired segments removed from 303(d) list
- # of Education events and materials distributed

Sediment: Goal Statement

Total suspended solids (TSS) such as sediment, debris, and organic matter have been identified as a problem throughout the watershed. The steering Committee would like to:

1. reduce TSS loads from 37,929 tons/yr to 9,632 tons/yr (a 75% reduction)
    a. 5 year goal: 25 % reduction in load
    b. 10 year goal: 50% reduction in load
    c. 30 year goal: 75% reduction in load
2. Reduce annual water samples that exceed target to no more than 20% of the time. Currently, 61% of the samples from across the watershed exceed the WQ target.
    a. 5 year goal: 50% or less of samples exceed target annually
    b. 10 year goal: 35% or less of samples exceed target annually
    c. 30 year goal: 20% or less of samples exceed target annually

3. See your toes when standing in the water during mid and low flow conditions.

Indicators:

- Increase in no-till corn and soybean acres
- Reduction of # of active erosion sites on windshield survey maps
- Number of workshops (contractors, fairs)
- Number of urban BMPs (rain barrels, rain gardens) installed in CSO drainage areas in Rensselaer.
- Number of acres of BMPs installed on high concern Wind Erodibility acres
- Number of log jams removed/banks stabilized
- Number of demonstration sites
- Number of farmers using cover crops in critical areas
- Development of detailed maps for streams needing riparian buffers.
- Reduced TSS concentrations and loads in water quality samples
- Improved MIBI scores, which is a sign sediment is not reducing habitat

7.0 Critical Areas

Due to the large size of the Upper Iroquois Watershed and in order to prioritize future implementation and funding efforts, the steering committee worked to develop the top two most “contributing” HUC 10 watersheds and then define Critical Load Areas (CLA’s) and Priority Protection Areas (PPA) within these areas by HUC 12 sub watersheds and “urban area” if applicable.

CLA’s are defined as areas or specific situations which have a high likelihood of contributing pollutant loads or problems to the watershed. Goals were crafted to meet water quality loading reduction goals and to address the 5 stakeholder concerns. Given the dominant agricultural land use across the watershed, “urban areas” or towns where grouped and ranked to form separate CLA’s, rather than grouping them in within the watershed area based CLA’s. Especially given that specific BMP’s and approaches to addressing the 5 stakeholder concerns with in urban areas would be very different from agricultural efforts.

The most “contributing” watersheds for CLAs and highest ranking PPAs was determined by a ranking system, 1 through 5 that would take into account a total possible 46 variables. Given that some sub watersheds had no water quality data available, an inherent minor bias exists because they were not given ranking consideration.

Each potential source was given a score, 1 = least contributing to 5 = most contributing for each variable and then tallied to see which sub watershed ranked the highest “contributing” with all of the selected 34 variables. Summary HUC 10 ranking results are in Table 69 HUC 10 Degradation Score. See Appendix 3 HUC 10 Ranking Scores for 34 variables actually used.

Table 69 HUC 10 Degradation Score

HUC 10 Degradation Score	Total Rank
Curtis-Hunter Creek	108
Carpenter-Denton Creeks	103
Upper Iroquois-Ryan Creek	90
Montgomery- Strole Creek	83
Oliver Ditch	59

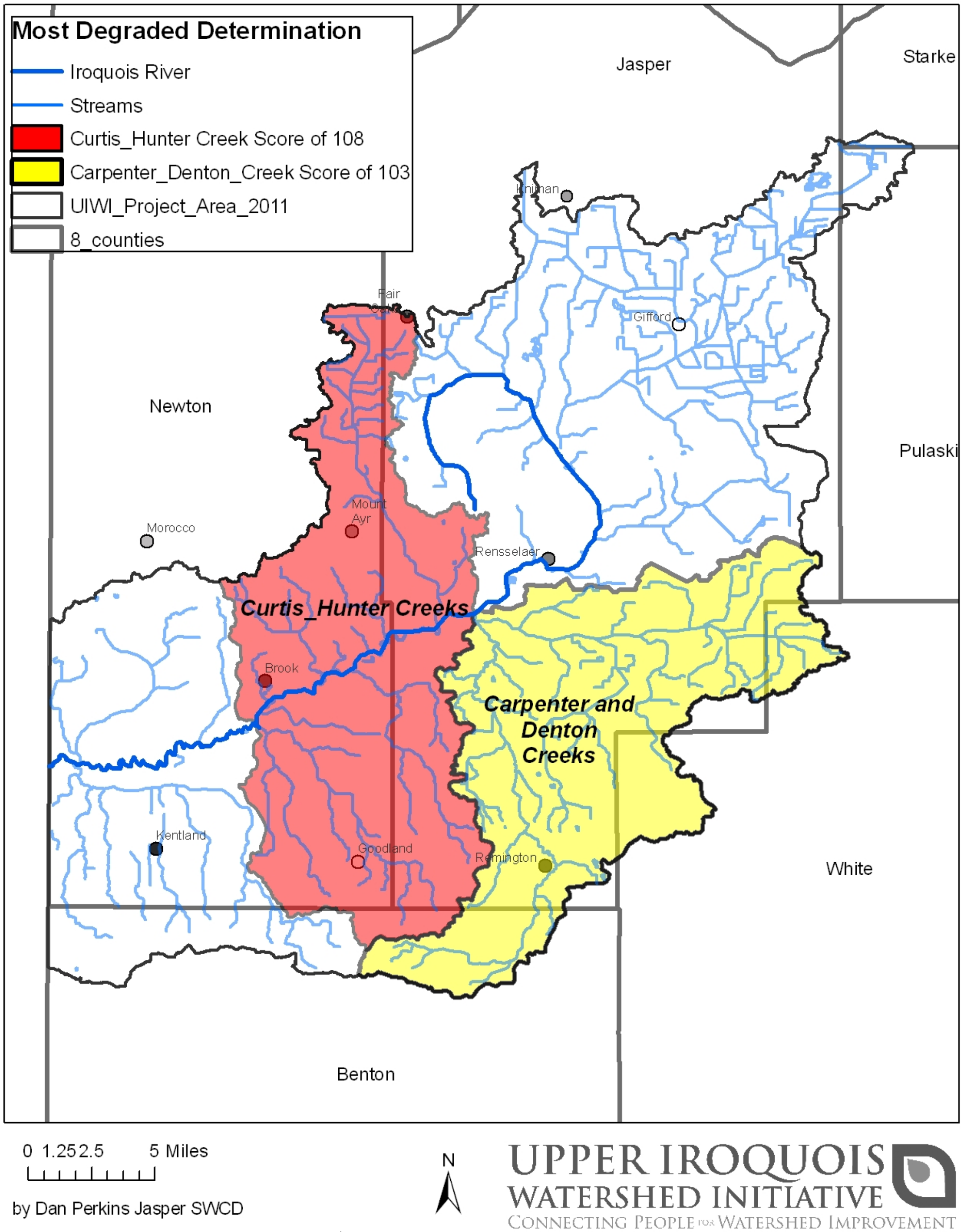
The same list of 46 possible variables was then used to create a set of contributing variables for each problem statement. See Appendix 7 for list and rank of each variable chosen by problem statement.

Table 70 Critical Areas Summary by HUC 10

Problem	The Iroquois River has undesirable high and low levels and flows of water that threaten our towns, agricultural land, and health of the river.	The desirable native fish populations in the Iroquois River and surrounding waterways are suspected to be in decline.	Area streams within the watershed are very cloudy and turbid.	Widespread recreational use is prevented.	The Iroquois River and its tributaries are listed on IDEM's 303(d) list for "excessive nutrients, e.coli, and IBI."				Total Grand Rank (lowest scores = top)
HUC 10	Most Contributing	Most Contributing	Most Contributing	Most Contributing	Nitrate	ecoli	ortho	IBI	
Oliver Ditch	5	5	5	5	5	5	5	5	40
Carpenter-Denton Creeks	2	2	3	3	2	2	2	2	18
Upper Iroquois-Ryan Creek	3	4	2	2	3	3	3	3	23
Curtis-Hunter	1	1	1	1	1	1	1	1	8
Montgomery-Strole Creek	4	3	4	4	4	4	4	4	31

So based on the degradation score the Curtis-Hunter Creek and Carpenter-Denton Creeks watersheds are contributing the most nonpoint pollution, see Figure 87 Top Two Contributing HUC 10 Subwatersheds, followed by the Upper Iroquois-Ryan Creek, Montgomery-Strole Creeks, and the Oliver Ditch.

Figure 87 Top Two Contributing HUC 10 Subwatersheds



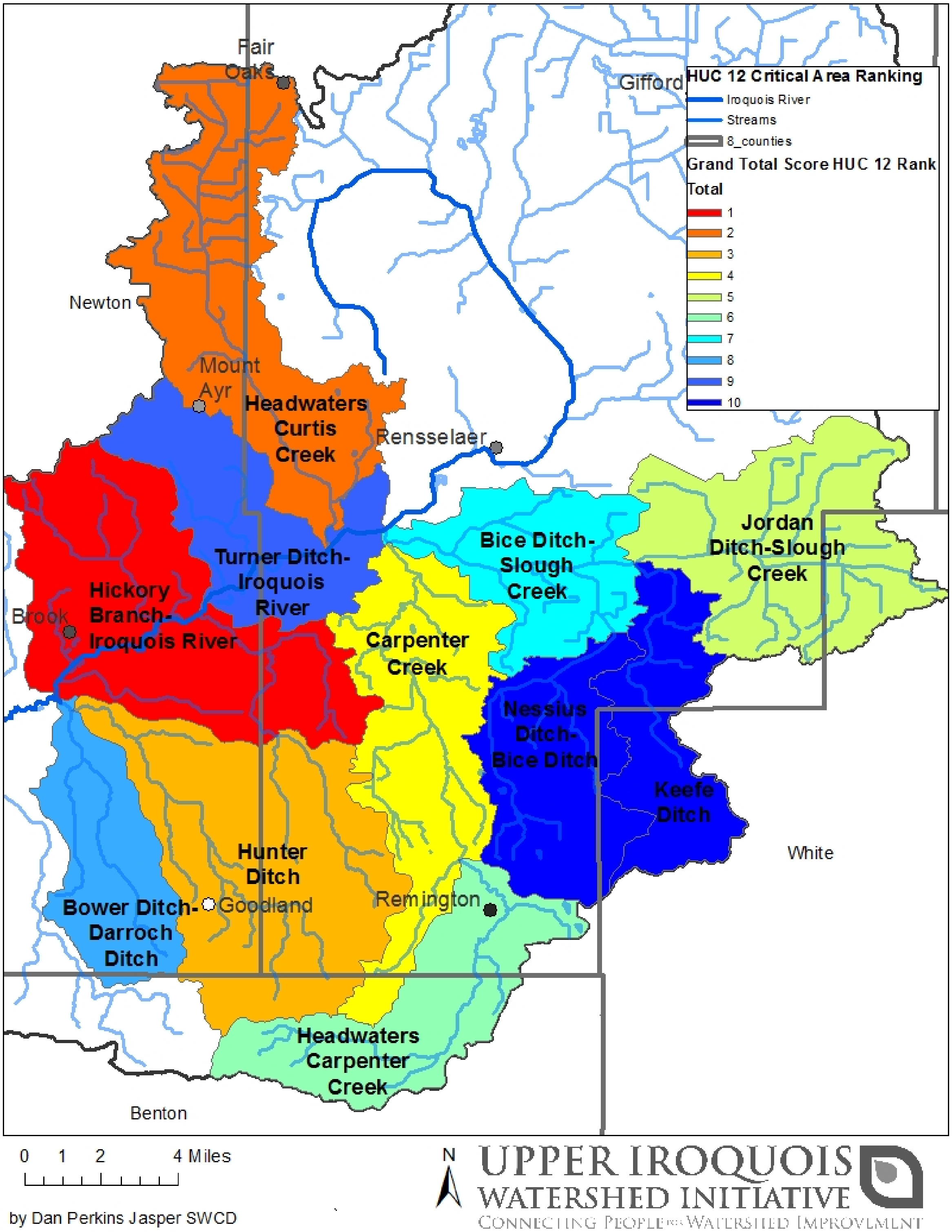
Given the large area of the watershed; the same ranking was then done at the HUC 12 level within the Carpenter and Curtis Creek watersheds. Summary of the HUC 12 ranking results with the Carpenter and Curtis Creek Watershed are in Table 71 HUC 12 Degradation Score. The Hickory Branch-Iroquois River sub watershed is considered the most overall degraded of the 11 sub watersheds. A map showing these areas is in Figure 88 Critical Areas Summary. Red is consider the most degraded/contributing to darkest blue being least contributing on a scale from 1(red) to 10 (dark blue).

Table 71 HUC 12 Degradation Score

HUC 12 (low = most contributing)	Total Rank
Hickory Branch - Iroquois River	13
Heawaters Curtis Creek	16
Hunter Ditch	19
Carpenter Creek	29
Jordan-Slough Creek	42
Headwaters Carpenter Creek	49
Bice-Slough Ditch	52
Bower Ditch - Darroch Ditch	61
Turner Ditch - Iroquois River	71
Keefe Ditch	74
Nessius-Bice Ditch	74

After overall contributing ranking was determined, then from the list of 46 variables, the steering committee assigned source/cause variables under each problem statement and ranked the HUC 12 areas according to each problem statement. The follow section is the map results of this analysis. The data used for this analysis is in Appendix 4 HUC 12 Ranking Scores.

Figure 88 Critical Areas Summary.



UPPER IROQUOIS WATERSHED INITIATIVE
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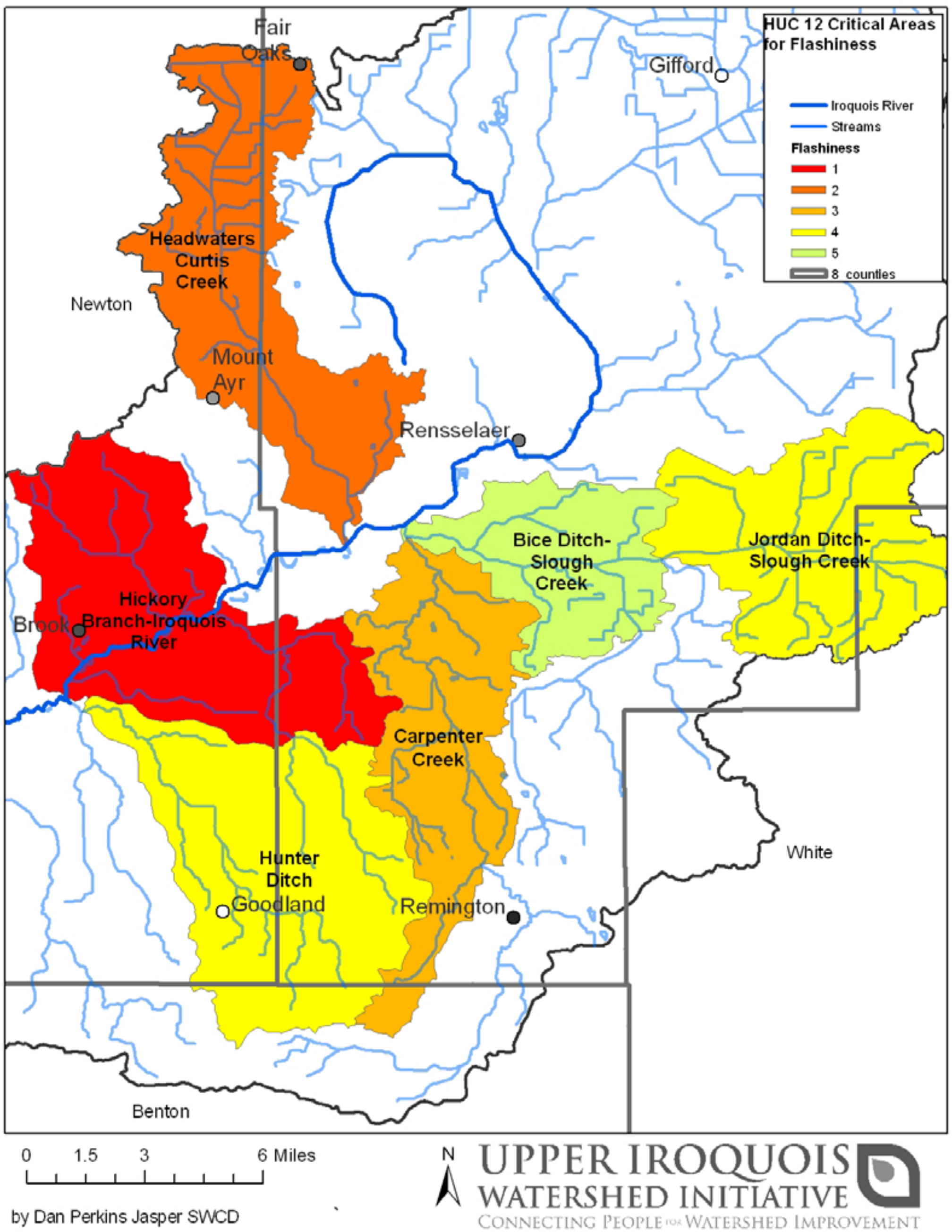
7.1 HUC 12 Critical Areas Flashiness and Flooding.

Based on the 19 variables (see Appendix 8) for Flashiness and flooding the top 5 critical areas in order of contributing watershed are; Hickory-Branch, Headwaters of Curtis Creek, Carpenter Creek, a tie between Hunter Ditch and Jordan Ditch-Slough Creek, and Bice-Slough Creek sub watersheds. The next step will be to apply appropriate BMP's and education to stakeholders in these areas.

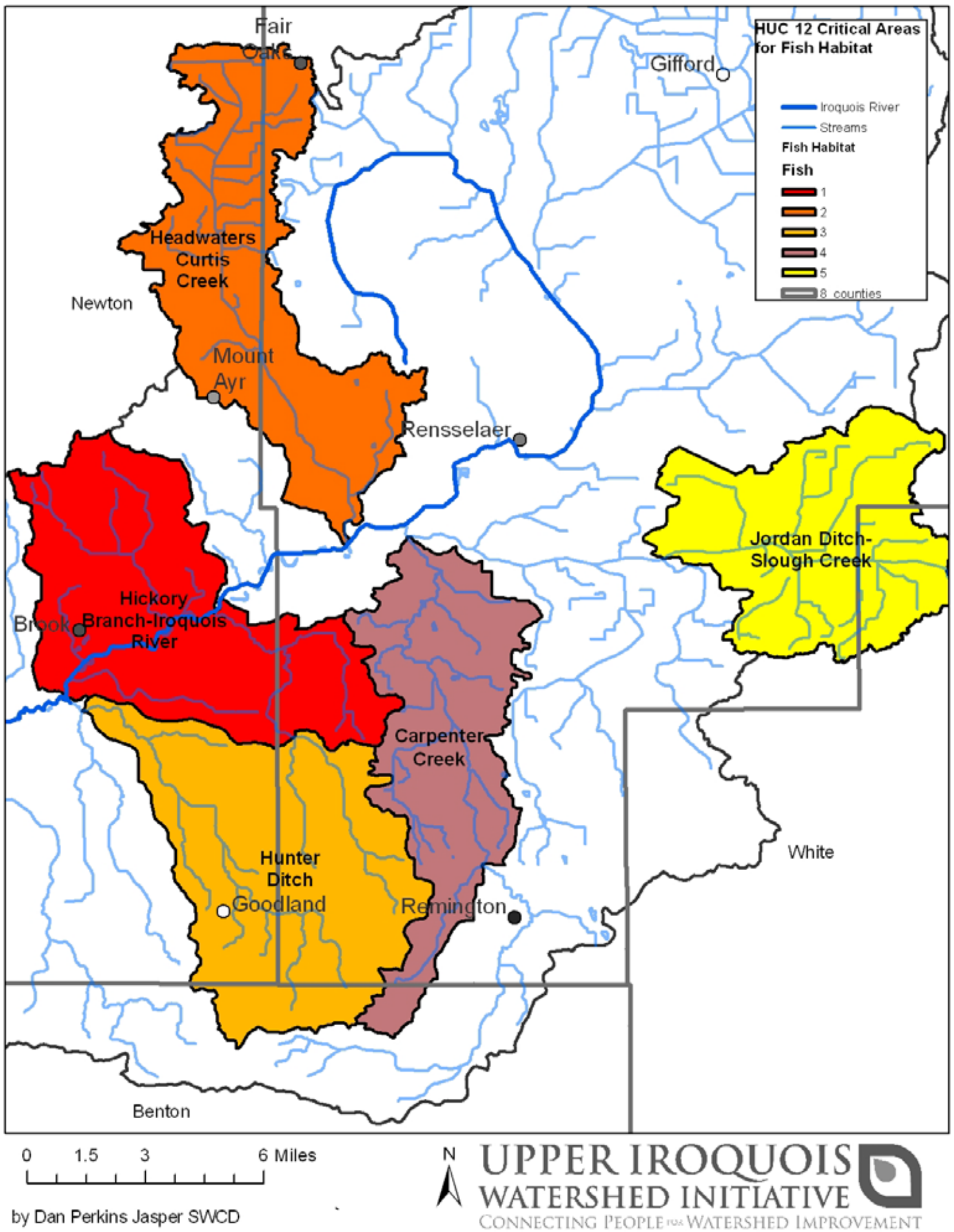
Figure 89 HUC 12 Top 5 Rank for Flashiness and Flooding



7.2 HUC 12 Critical Areas for Native Fish Population in Decline

Based on the 19 variables (see Appendix 8) for native fish populations the top 5 critical areas in order of contributing watershed are; Hickory-Branch, Headwaters of Curtis Creek, Carpenter Creek, a tie between Hunter Ditch and Jordan Ditch-Slough Creek, and Bice-Slough Creek sub watersheds. The next step will be to apply appropriate BMP's and education to stakeholders in these areas.

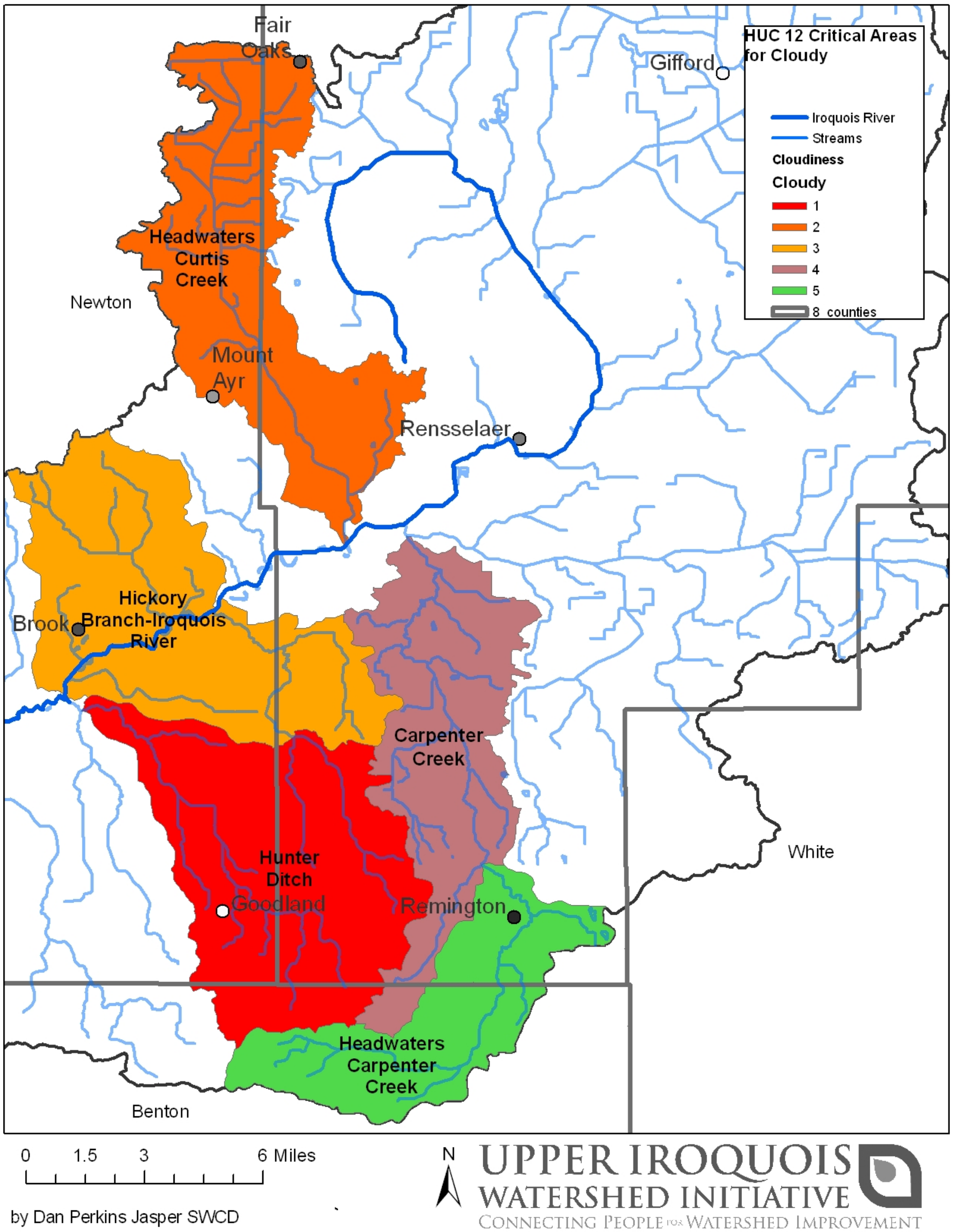
Figure 90 Critical Areas for Fish Populations



7.3 HUC 12 Critical Areas for Cloudy and Turbid Streams

Based on the variables (see Appendix 8) for cloudy and turbid streams the top 5 critical areas in order of contributing watershed are; Hunter Ditch, Headwaters of Curtis Creek, Hickory Branch, Carpenter Creek, and Headwaters Carpenter Creek sub watersheds. The next step will be to apply appropriate BMP's and education to stakeholders in these areas.

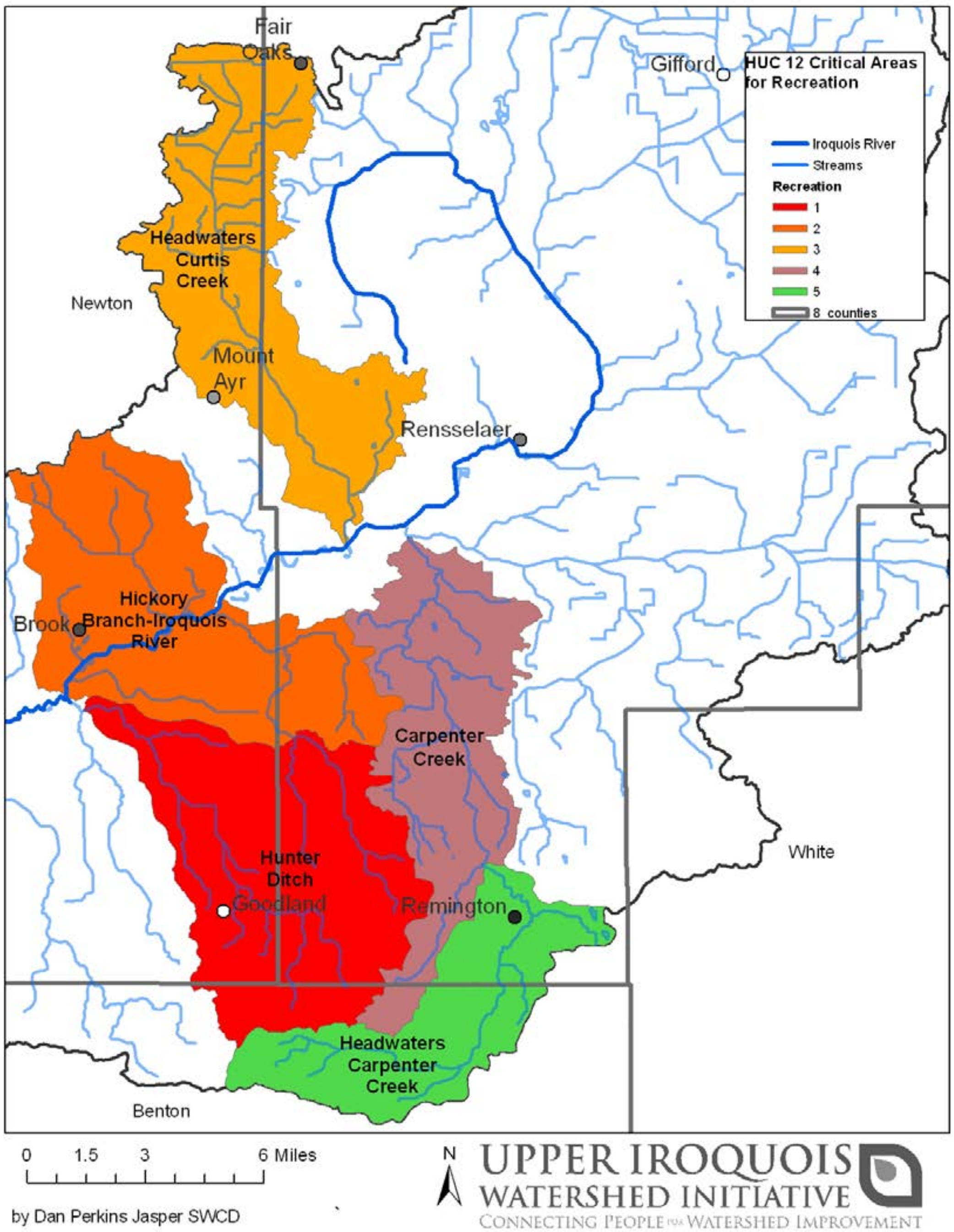
Figure 91 Critical Areas for Cloudy Streams



7.4 HUC 12 Critical Areas for Widespread Recreational Use.

Based on the variables (see Appendix 8) for widespread recreational use the top 5 critical areas in order of contributing watershed are; Hunter Ditch, Hickory Branch, Headwaters of Curtis Creek, Carpenter Creek, and Headwaters Carpenter Creek sub watersheds. The next step will be to apply appropriate BMP's and education to stakeholders in these areas.

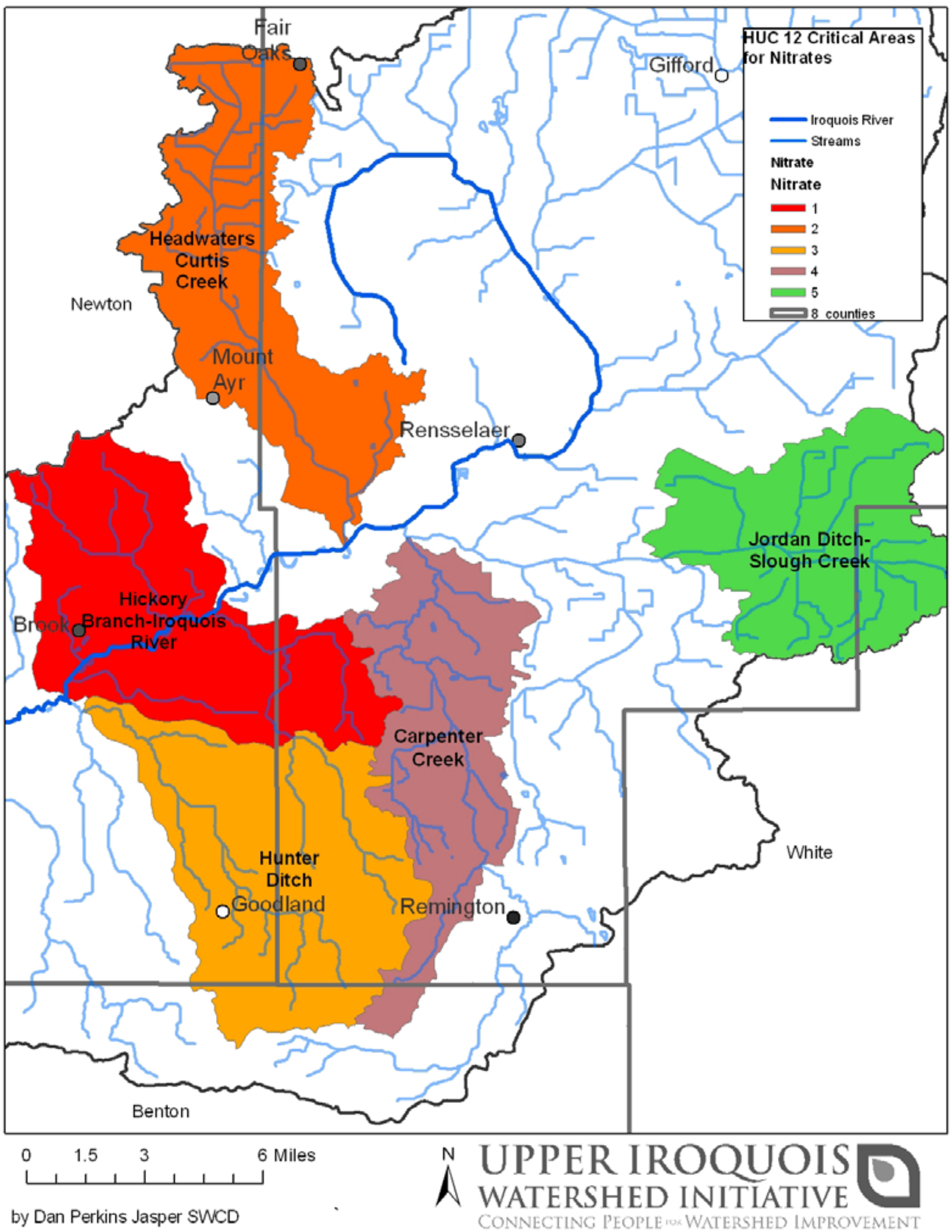
Figure 92 Critical Areas for Widespread Recreation



7.5 HUC 12 Critical Areas for Excessive Nitrates.

Based on the variables (see Appendix 8) for excessive Nitrates the top 5 critical areas in order of contributing watershed are; Hickory Branch, Headwaters Curtis Creek, Hunter Creek, Headwaters Curtis Creek, Carpenter Creek, and Jordan Ditch sub watersheds. The next step will be to apply appropriate BMP's and education to stakeholders in these areas.

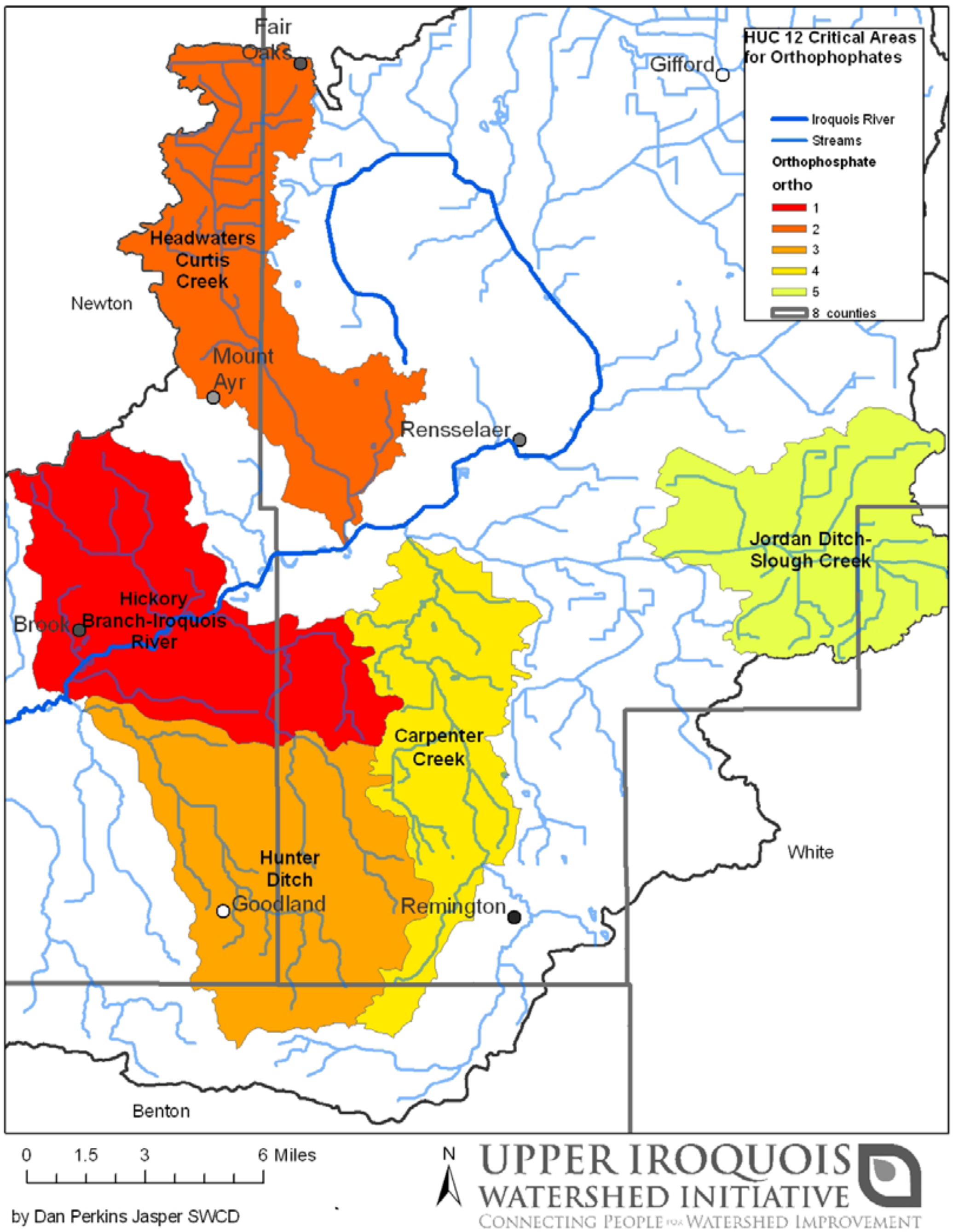
Figure 93 Critical Areas for Nitrates



7.6 HUC 12 Critical Areas for Orthophosphates.

Based on the variables (see Appendix 8) for orthophosphates the top 5 critical areas in order of contributing watershed are; Hickory Branch, Headwaters Curtis Creek, Hunter Creek, Carpenter Creek, and Jordan Ditch sub watersheds. The next step will be to apply appropriate BMP's and education to stakeholders in these areas.

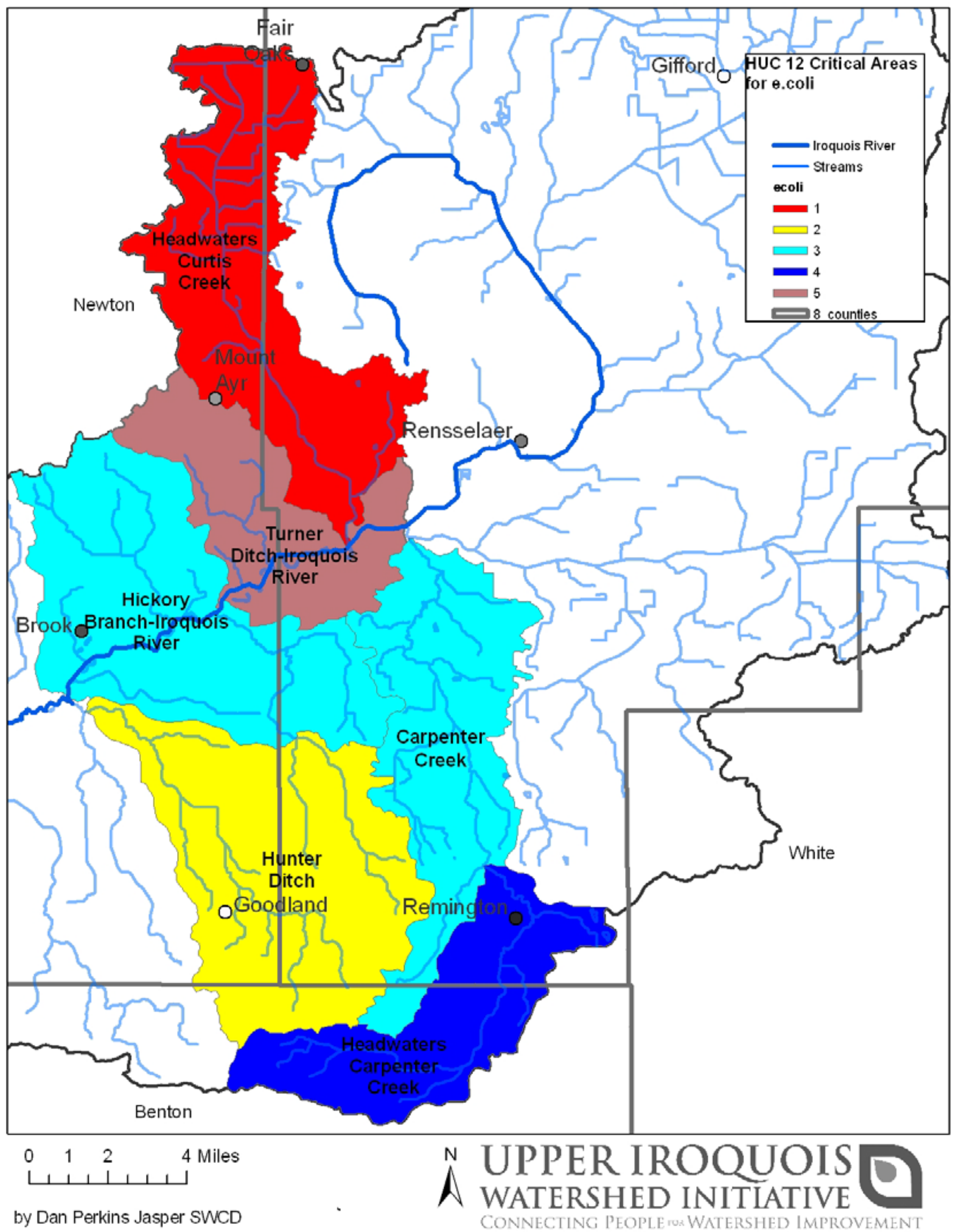
Figure 94 Critical Areas for Orthophosphates



7.7 HUC 12 Critical Areas for E.coli.

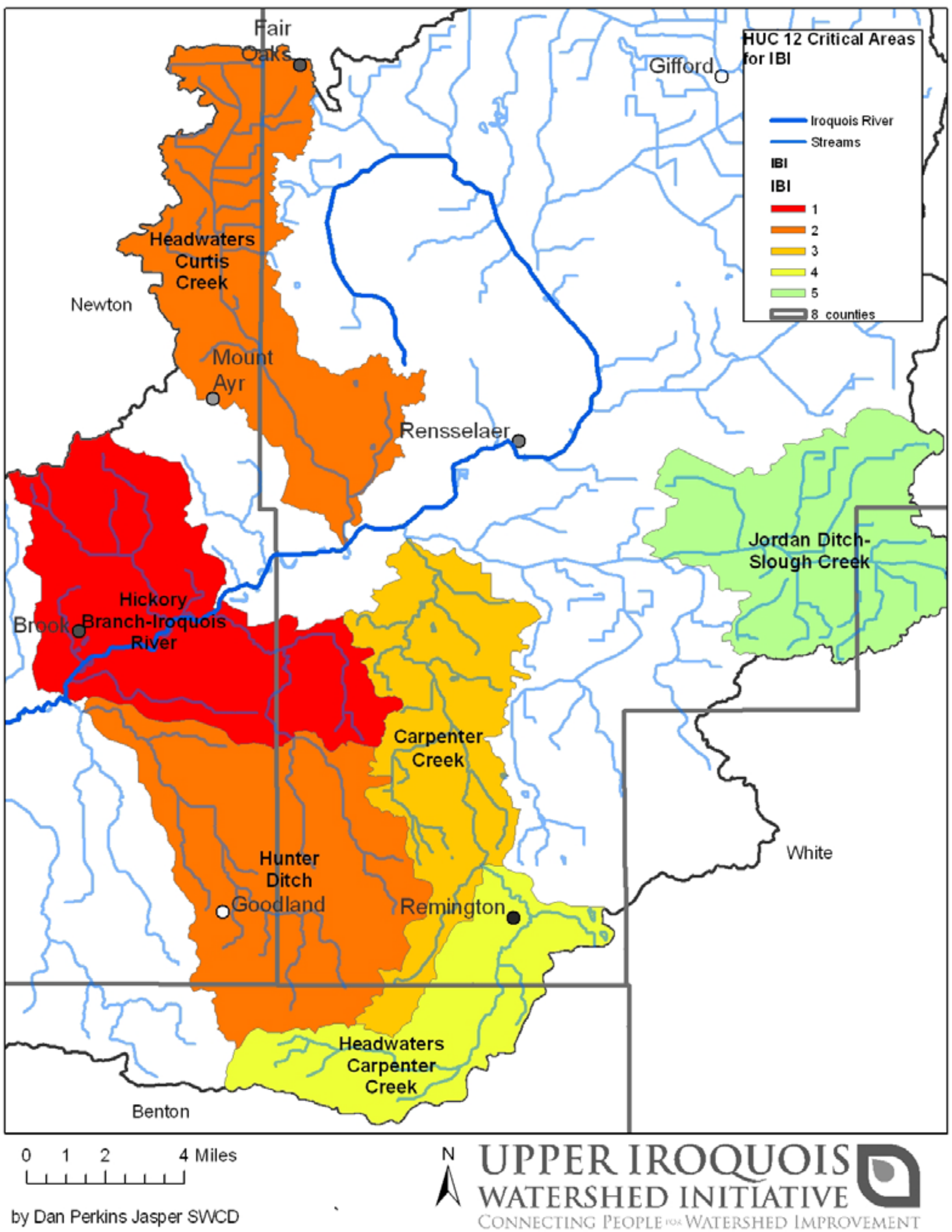
Based on the variables (see Appendix 8) for E.coli the top 5 critical areas in order of contributing watershed are; Headwaters Curtis Creek, Hunter Ditch, a tie with Hickory Branch and Carpenter Creek, and Turner Ditch sub watersheds. The next step will be to apply appropriate BMP's and education to stakeholders in these areas.

Figure 95 Critical Areas for E.coli



7.8 HUC 12 Critical Areas for Impaired Biological Index (IBI)

Based on the variables (see Appendix 8) for IBI the top 5 critical areas in order of contributing watershed are; Hickory Branch, a tie Hunter Ditch and Headwaters Curtis Creek, Headwaters of the Carpenter Creek, and Jordan Ditch subwatersheds. The next step will be to apply appropriate BMP's and education to stakeholders in these areas.



7.9 Critical Areas for Urban Non-Point Pollution

Urban areas or towns where grouped and ranked to form separate CLA's, rather than grouping them in within the watershed area based CLA's. Especially given that specific BMP's and approaches to addressing the 5 stakeholder concerns with in urban areas would be very different from agricultural efforts.
For those reasons, the urban areas of the Upper Iroquois Watershed were ranked according to selected variables chosen by the steering committee. Variables included: # of NPDES dischargers, Permit Compliance at NPDES sites, population, land area, presence of CSO, # of 2012 303d listing within 5 miles downstream of area, and proximity to streams, see Appendix 12 Urban Data used for Ranking. Water quality data from the specific urban areas was limited so only 303d listings within 5 miles downstream of urban areas was factored.

Table 72 Urban Critical Areas Ranking is the results of this ranking. Due to limited resources and time the steering committee chose to focus on the top 4 contributing urban areas – Rensselaer, Kentland, Remington, and Brook in that order of priority, see Figure 96 Urban Critical Areas.

Table 72 Urban Critical Areas Ranking

Urban Areas Scoring (Scale of 1 to 8)									
Towns	# of NPDES	Permit Compliance Issues	population	land area (sq miles)	Number of CSOs	Promixity to Streams (miles)	303d Counts Downstream	Total Score	Overall Contributing Rank
Rensselaer	8	8	8	8	8	8	4	52	1
Kentland	4	7	7	7	0	7	7	39	2
Remington	8	6	6	6	0	4	8	38	3
Brook	4	4	4	4	0	5	5	26	4
Goodland	4	5	5	5	0	1	3	23	5
Fair Oaks	4	3	3	3	0	3	6	22	6
Gifford	1	3	1	1	0	6	1	13	7
Mount Ayr	1	3	2	2	0	2	2	12	8

Rensselaer, was ranked as the highest priority compare to the other 4 urban areas.

The Iroquois River flows through the heart of the city and is a critical area for water quality improvement from urban construction, CSOs, and nutrient, sediment, and bacteria sources. Particularly, pet waste and nutrients from grass clippings that can leach into the sewer system. In particular, the number of active CS0's that open in less than a ½ inch of rainfall need to be addressed. In discussions with the operators of the Rensselaer Water Treatment Plant and referring to it was determined CSO outlet # 19 (circled in red below) flows the most and therefore is the largest contributing CSO watershed of the nine. It should be targeted for urban BMP practices and efforts.

Figure 96 Urban Critical Areas

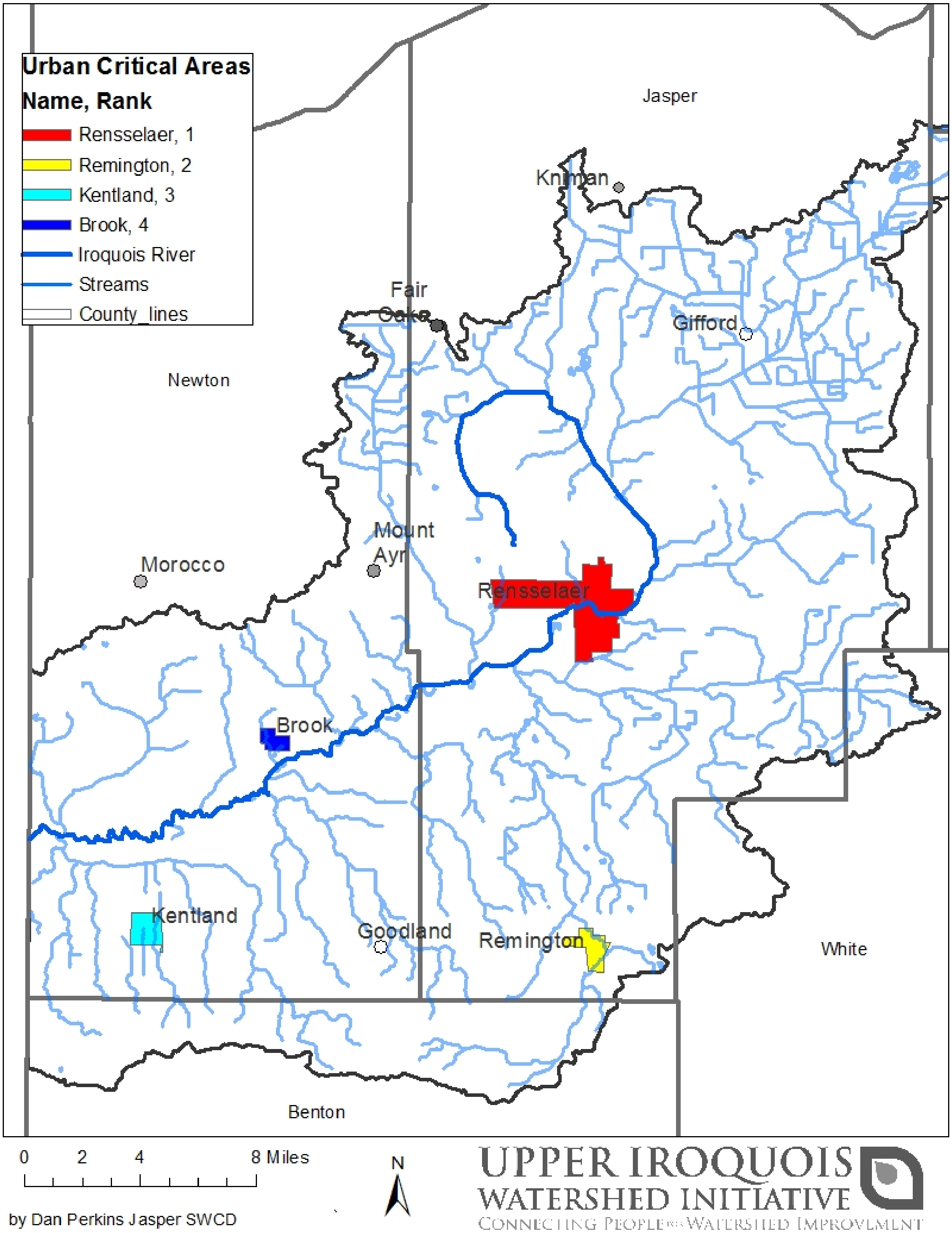
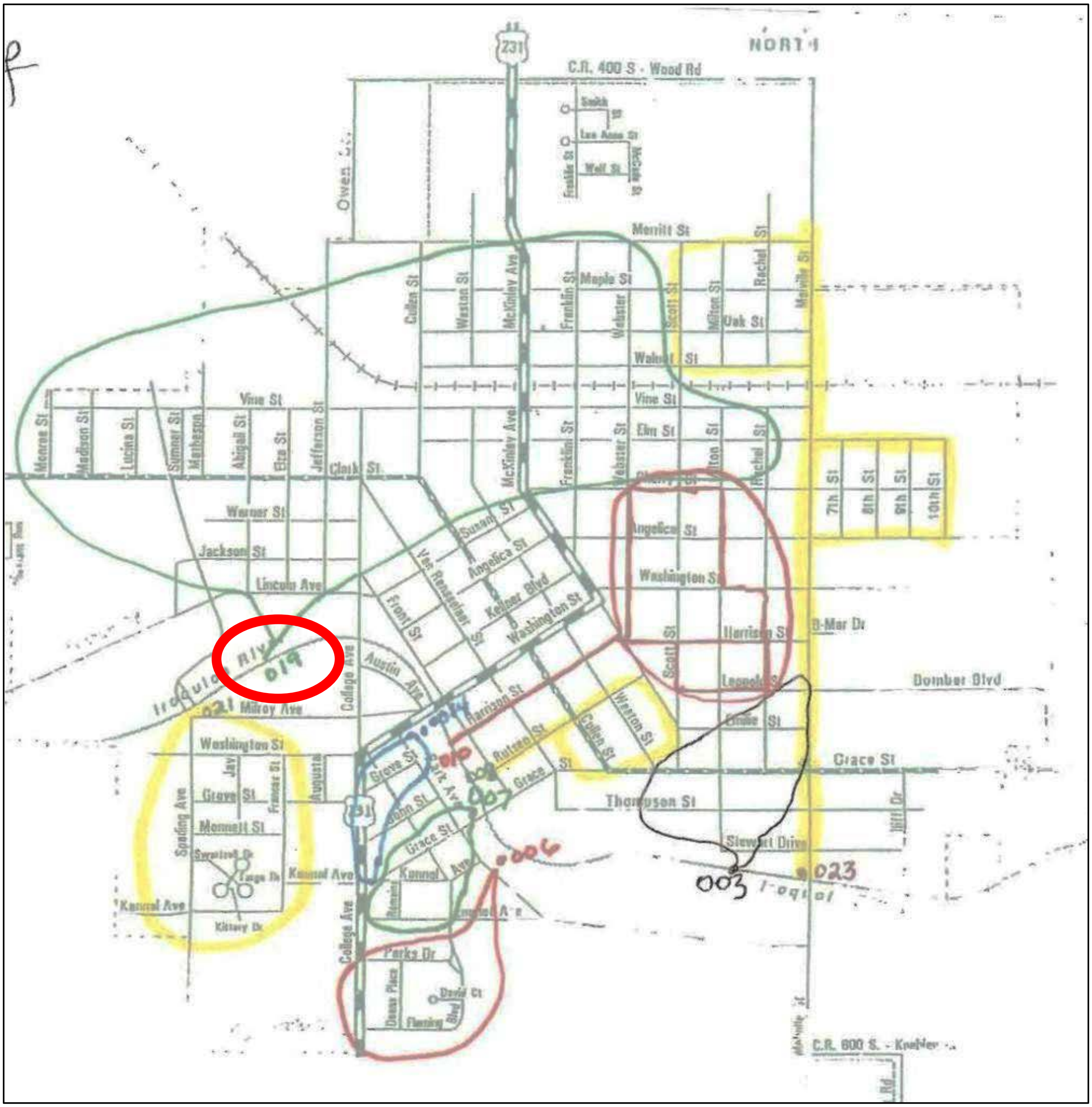


Figure 97 CSO Outlets in Rensselaer



7.10 Priority Protection Areas

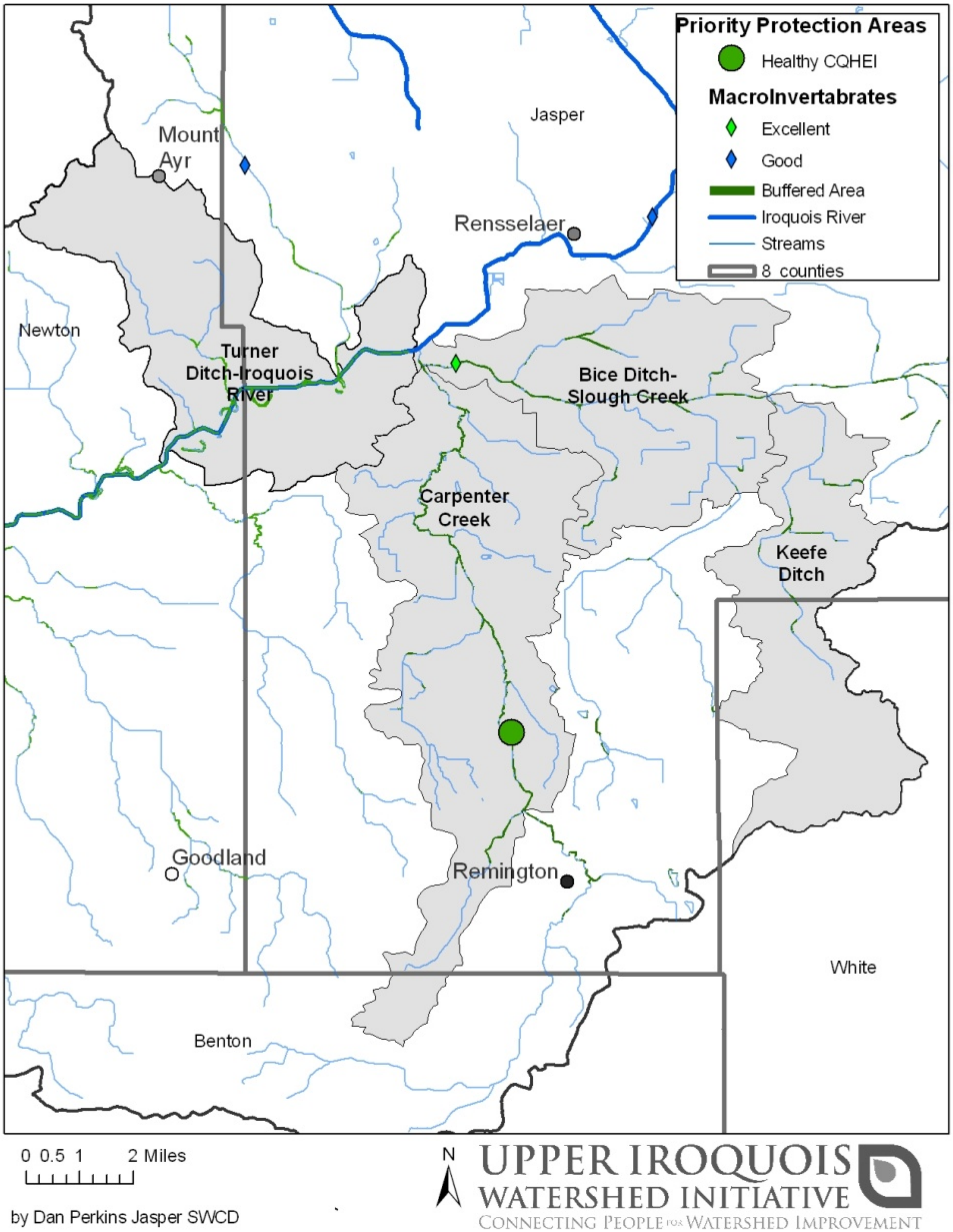
Priority Protection Areas or PPA's are areas that need to be protected to preserve future water quality and watershed functions that are not already protected by parks or other easements. Especially as ditch cleaning occurs or development that may remove wetlands, riparian buffers, and disturb fish and macro-invertebrate habitat. CAs and PPA's may overlap, especially the Carpenter Creek as it is a major contributing creek to the Iroquois River and is well buffered along its main branch (see Figure 50), but a majority of its headwater streams are completely unbuffered. We want to protect the good already there, but also improve the headwater areas that are so critical to improving water quality across the entire watershed.

PPA's were determined within the 2 HUC 10 Critical areas (Carpenter and Curtis Creeks) based on the following criteria:

- HUC 12's with area along streams with more than 50% buffered
- HUC 12's with CMIBI sites rated good to excellent and CQHEI data indicating healthy,
- Areas within 100 ft of streams where the land use is considered "buffered."

Bice-Slough Ditch, Turner Ditch-Iroquois River, Keefe Ditch, and Carpenter Creek are the HUC 12 sub watersheds meeting the above criteria; see Figure 98 Priority Protection Areas.

Figure 98 Priority Protection Areas



8.0 Best Management Practices

A wide variety of practices are available for on-the-ground implementation. Many of these practices will address the stakeholder concerns and result in the reduction of sediment, nutrient, and E.coli loading to the Iroquois River and tributaries. A master list of potential best management practices was reviewed by the project steering committee and project partners. From this list, the following list of practices were deemed most appropriate and most likely to successfully meet loading reduction targets, be feasible to implement, and address stakeholder concerns.

8. 1 Agricultural:

- Alternate Watering Systems
- Bioreactors
- Buffer Strip (Shrub/Tree)
- Conservation Tillage (No till end goal)
- Cover Crop
- Drainage Water Management
- Filter Strip (grass)
- Livestock Restriction or Rotational Grazing
- Manure Management Planning
- Nutrient/Pest Management Planning
- Prairie Restoration
- Two Stage Ditch
- Septic System Upgrades
- Streambank Stabilization
- Wetland Construction or Restoration

8.2 Urban:

Development and the spread of impervious surfaces are occurring throughout the watershed. The highest concentrations of development are located around the towns and outskirts of towns. As impervious surfaces continue to spread throughout the watershed, the volume and velocity of storm water entering the Iroquois River will also increase. The best way to mitigate storm water impacts is to infiltrate, store, and treat storm water onsite before it can run off. Urban best management practices designed to complete these actions are as follows:

- Bioretention Practices
- Concrete Grid Pavement
- Detention Basin Retrofit
- Grass Swale
- Green Roof
- Infrastructure Retrofit
- Pet Waste Control
- Phosphorus-free Fertilizers
- Porous Pavement
- Rain Barrel
- Rain Garden

- Street Sweeping
- Trash Control and Removal

Appendix 10 has each practice defined in more detail. No practice list is exhaustive and additional techniques may be both possible and necessary to reach water quality goals.

8.3 Fish Habitat and Recreational System-Wide Practices

The protection of open space, preservation of habitat corridors, and mitigation of impacts from watershed-wide impacts are important management practices, particularly to protect fish habitat and encourage recreational use. These practices can be used throughout the Upper Iroquois River watershed in locations where specific conditions occur. Potential management practices designed to address these issues are as follows:

- Greenways and Trails
- Habitat Corridor Identification and Improvement
- Low-impact Development
- Point Source Discharge Reduction
- Septic System Care and Maintenance
- Smart Growth/Livable Communities Practices
- Streambank Stabilization
- Threatened and Endangered Species Protection

9.0 Appropriate BMPs for Goals

Table 73 details selected agricultural best management practices by critical area, while Table 74 lists urban best management practices by critical area. Each critical area and the selected best management practices are based on subwatershed characteristics and available water quality data.

Table 73 Agricultural best management practices suggested for each critical area by parameter

Agricultural best management practices for each critical area.

Critical Area/Source	Reason for Being Critical	Suggested BMP
Livestock Access points	e.coli, TSS, nutrients, fish habitat, IBI	Alternative watering system
		Education and outreach
		Livestock exclusion fencing
		Nutrient/manure management
Headwaters Curtis Creek, Hickory Branch-Iroquois River, Hunter Ditch, Carpenter Creek, Headwaters Carpenter Creek	e.coli	Livestock restriction fencing
		Septic system maintenance
		Manure management planning
		Point-source discharge reduction
		Alternative watering system
		Education and outreach
		Cover Crops with manure application
Headwaters Curtis Creek, Hickory Branch-Iroquois River, Hunter Ditch	Nitrate	Cover Crops (100 acres)
		Filter strips, field border
		Nutrient management planning
		Pesticide management
		Manure mangement
		Streambank stabilization
		Conservation Tillage (100 acres)
		Prairie Restoration
		Two-stage Ditch
		Bio reactor installation
		Drainage Water Management
		Education and outreach
		Septic system maintenance
		Floodplain Management
Headwaters Curtis Creek, Hickory Branch-Iroquois River, Hunter Ditch, Carpenter Creek, Headwaters Carpenter Creek, Jordan Ditch-Slough Creek	Phosphorus	Cover Crops
		Filter strips, field border
		Nutrient management planning
		Pesticide management
		Manure mangement
		Streambank stabilization
		Conservation Tillage
		Prairie Restoration
		Two-stage Ditch
		Bio reactor installation
		Drainage Water Management
		Education and outreach
		Septic system maintenance
		Floodplain Management
		Smart Growth Practices
		Low-Impact Development

Agricultural best management practices for each critical area.		
Critical Area/Source	**Reason for Being Critical**	**Suggested BMP**
Headwaters Curtis Creek, Hickory Branch-Iroquois River, Hunter Ditch, Carpenter Creek, Headwaters Carpenter Creek, Jordan Ditch-Slough Creek	Cloudiness (Total Suspended Solids)	Cover Crops
		Filter strips, field border
		Pesticide management
		Streambank stabilization
		Conservation Tillage
		Prairie Restoration
		Two-stage Ditch
		Bio reactor installation
		Education and outreach
		Wetland Restoration
		Floodplain Management
		Smart Growth Practices
		Low-Impact Development
Headwaters Curtis Creek, Hickory Branch-Iroquois River, Hunter Ditch, Carpenter Creek, Jordan Ditch-Slough Creek	Fish Habitat	Filter strips, field border
		Wetland Restoration
		Corridor ID and Restoration
		Education and outreach
		Streambank stabilization
		Restore Stream Hydrology

Table 74 Urban best management practices suggested for each critical area by parameter.

Critical Area/Source	Reason for Being Critical	Suggested BMP
Rensselaer CSO Outlets	e.coli, TSS, nutrients, fish habitat, IBI	Pet Waste Control
		Ordinance/Education of local planners
		Point Source Discharge reduction
		CSO Reduction
		Raingardens/Rain Barrels
		Low Impact Development
Urban Areas- Renselaer, Kentland, Remington, Brook	Nitrate	Grass Swale
		Green roof
		Raingardens/Rain Barrels
		Point Source Discharge reduction
Urban Areas- Renselaer, Kentland, Remington, Brook	Phosphorus	Detention Basin Retrofits
		Pet Waste Control
		Ordinance/Education of local planners
		CSO Reduction
		Green roof
		Grass Swale
		Raingardens/Rain Barrels
		Porous Pavement
		Phosphorus-Free Fertilizer
		Low Impact Development
		Smart Growth Practices
Urban Areas- Renselaer,Kentland, Remington, Brook	diness (total suspended s	Detention Basin Retrofits
		Ordinance/Education of local planners
		Green roof
		Grass Swale
		Raingardens/Rain Barrels
		Porous Pavement
		Low Impact Development
		Smart Growth Practices
Urban Areas- Renselaer, Kentland, Remington, Brook	Fish Habitat	Low Impact Development
		Smart Growth Practices
		Filter Strips/Buffers
		Habitat Corridor Improvement

10.0 Expected Load Reduction from BMPs

Load reduction calculations were estimated for nitrogen, phosphorus and sediment based on the potential best management practices to be implemented. Individual BMPs' estimated values were taken from Region 5, STEPL modeling, PREDict Models, and Watershed Treatment Models and summarized in Table 75 and Table 76 . It is known that implementation of multiple BMPs usually has a synergistic impact, so that the value of the whole is greater than the sums of individual practices.

Table 75 Load reductions achieved by unit installation amount.

Agricultural best management practices for each critical area.			Estimated Load Reduction by units of BMP		
Critical Area/Source	**Reason for Being Critical**	**Suggested BMP**	Nitrogen lb/yr	Phosphorus lb/yr	Sediment ton/yr
Livestock Access points	e.coli, TSS, nutrients, fish habitat, IBI	Alternative watering system (100 acres)	380	40	2
		Education and outreach	N/A	N/A	N/A
		Livestock exclusion fencing (100 acres)	380	40	2
		Nutrient management (100 acres)	365	29	N/A
Headwaters Curtis Creek, Hickory Branch-Iroquois River, Hunter Ditch, Carpenter Creek, Headwaters Carpenter Creek	e.coli	Livestock restriction fencing	380	40	2
		Septic system maintenance	N/A	N/A	N/A
		Manure management (100 acres)	365	29	N/A
		Alternative watering system	380	40	2
		Education and outreach	N/A	N/A	N/A
		Cover Crops with manure (100 acres)	185	37	77
Headwaters Curtis Creek, Hickory Branch-Iroquois River, Hunter Ditch	Nitrate	Cover Crops (100 acres)	185	37	77
		Filter strips, field border (1 acre)	3.34	0.54	2.72
		Nutrient management (100 acres)	365	29	N/A
		Split application of N (100 acres)	28	N/A	N/A
		Precision Ag: VRT (100 acres)	28	2	N/A
		Irrigation Water Management (100 acres)	240	N/A	N/A
		Precision Ag: Autoswath (100 acres)	15	2	N/A
		Streambank stabilization 1 mile	N/A	N/A	73
		Conservation Tillage (100 acres)	120	60	12
		Prairie Restoration	N/A	N/A	N/A
		Two-stage Ditch 1/2 mile section	N/A	N/A	53
		Bio reactor installation (50)acres	750	N/A	N/A
		Drainage Water Management (50 acres)	750	N/A	N/A
		Education and outreach	N/A	N/A	N/A
		Septic system maintenance	N/A	N/A	N/A
		Floodplain Management	N/A	N/A	N/A
Headwaters Curtis Creek, Hickory Branch-Iroquois River, Hunter Ditch, Carpenter Creek, Headwaters Carpenter Creek, Jordan Ditch-Slough Creek	Phosphorus	Cover Crops (100 acres)	185	370	77
		Filter strips, field border (1 acre)	3.34	0.54	2.72
		Nutrient management (100 acres)	365	29	N/A
		Manure management (100 acres)	365	29	N/A
		Streambank stabilization 1 mile	N/A	N/A	73
		Conservation Tillage (100 acres)	120	60	12
		Prairie Restoration	N/A	N/A	N/A
		Two-stage Ditch 1/2 mile section	N/A	N/A	53
		Bio reactor installation (50)acres	750	N/A	N/A
		Drainage Water Management (50 acres)	750	N/A	N/A
		Education and outreach	N/A	N/A	N/A
		Septic system maintenance	N/A	N/A	N/A
		Floodplain Management	N/A	N/A	N/A
		Smart Growth Practices	N/A	N/A	N/A
		Low-Impact Development (see urban practice	N/A	N/A	N/A

Agricultural best management practices for each critical area.			Estimated Load Reduction by		
Critical Area/Source	**Reason for Being Critical**	**Suggested BMP**	Nitrogen lb/yr	Phosphorus lb/yr	Sediment ton/yr
Headwaters Curtis Creek, Hickory Branch-Iroquois River, Hunter Ditch, Carpenter Creek, Headwaters Carpenter Creek, Jordan Ditch-Slough Creek	Cloudiness (Total Suspended Solids)	Cover Crops (100 acres)	185	370	77
		Livestock exclusion fencing (100 acres)	380	40	2
		Filter strips, field border (1 acre)	334	54	2.72
		Streambank stabilization 1 mile	N/A	75	73
		Conservation Tillage (100 acres)	120	60	12
		Prairie Restoration	N/A	N/A	N/A
		Two-stage Ditch 1/2 mile section	N/A	N/A	53
		Bio reactor installation (50)acres	750	N/A	N/A
		Education and outreach	N/A	N/A	N/A
		Wetland Restoration (100 acres)	475	43	75
		Floodplain Management	N/A	N/A	N/A
		Smart Growth Practices	N/A	N/A	N/A
		Low-Impact Development	N/A	N/A	N/A
Headwaters Curtis Creek, Hickory Branch-Iroquois River, Hunter Ditch, Carpenter Creek, Jordan Ditch-Slough Creek	Fish Habitat	Filter strips, field border (1 acre)	3.34	0.54	2.72
		Wetland Restoration (100 acres)	475	43	N/A
		Corridor ID and Restoration	N/A	N/A	N/A
		Education and outreach	N/A	N/A	N/A
		Streambank stabilization 1 mile	N/A	N/A	73
		Restore Stream Hydrology	N/A	N/A	N/A
Sources of Load Reductions					
STEP-L and PRedICT models					
Watershed Treatment Model, STEP-L and PRedICT models)					
Region 5 model					

Table 76 Urban BMP load reduction estimates

Urban best management practices for each critical area			**Estimated Load Reduction per square mile**		
Critical Area/Source	**Reason for Being Critical**	**Suggested BMP**	Nitrogen	Phosphorus	Sediment
Rensselaer CSO Outlets	e.coli, TSS, nutrients, fish habitat, IBI	Pet Waste Control	N/A	N/A	N/A
		Ordinance/Education of local planners	N/A	N/A	N/A
		Point Source Discharge reduction	N/A	N/A	N/A
		CSO Reduction	95%	95%	95%
		Pourous Pavement	85%	65%	90%
		Concrete Grid Pavement	90%	90%	90%
		Raingardens	20%	20%	80%
		Rainbarrel	0	0	0
		Street Sweeping	UNK	6%	16%
		Detention Basin Retrofits	UNK	52%	82%
		Grass Swale	30%	30%	60%
Urban Areas-Renselaer, Brook, Remington, Mt. Ayr, Goodland	Nitrate	Grass Swale	30%	30%	60%
		Pourous Pavement	85%	65%	90%
		Concrete Grid Pavement	90%	90%	90%
		Green roof	N/A	N/A	N/A
		Raingardens	20%	20%	80%
		Rainbarrel	0	0	0
		Point Source Discharge reduction	N/A	N/A	N/A
Urban Areas-Renselaer, Brook, Remington, Mt. Ayr, Goodland	Phosphorus	Detention Basin Retrofits	UNK	52%	82%
		Pet Waste Control	N/A	N/A	N/A
		Ordinance/Education of local planners	N/A	N/A	N/A
		CSO Reduction	95%	95%	95%
		Green roof	N/A	N/A	N/A
		Grass Swale	30%	30%	60%
		Raingardens	20%	20%	80%
		Rainbarrel	0	0	0
		Pourous Pavement	85%	65%	90%
		Concrete Grid Pavement	90%	90%	90%
		Phosphorus-Free Fertilizer	N/A	N/A	N/A
		Smart Growth Practices	N/A	N/A	N/A
Urban Areas-Renselaer, Brook, Remington, Mt. Ayr, Goodland	diness (total suspended s	Detention Basin Retrofits	UNK	52%	82%
		Ordinance/Education of local planners	N/A	N/A	N/A
		Green roof	N/A	N/A	N/A
		Grass Swale	30%	30%	60%
		Raingardens	20%	20%	80%
		Rainbarrel	0	0	0
		Pourous Pavement	85%	65%	90%
		Concrete Grid Pavement	90%	90%	90%
		Smart Growth Practices	N/A	N/A	N/A
Urban Areas-Renselaer, Brook, Remington, Mt. Ayr, Goodland	Fish Habitat	Pourous Pavement	85%	65%	90%
		Concrete Grid Pavement	90%	90%	90%
		Smart Growth Practices	N/A	N/A	N/A
		Filter Strips/Buffers	70%	75%	65%
		Habitat Corridor Improvement	47%	59%	76%
Sources of Load Reductions					
STEP-L and PRedICT models					
Watershed Treatment Model, STEP-L and PRedICT models)					
Region 5 model					

10.1 STEPL Modeling Predictions

To set realistic goals and the action register timeline to achieve WQ target goals the Spreadsheet Tool for Estimating Pollutant Load (STEPL) tool was utilized STEPL employs simple algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various best management practices (BMPs).

STEPL computes watershed surface runoff; nutrient loads, including nitrogen, phosphorus, and 5-day biological oxygen demand (BOD5); and sediment delivery based on various land uses and management practices. For each watershed, the annual nutrient loading is calculated based on the runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution and management practices. The annual sediment load (sheet and rill erosion only) is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. The sediment and pollutant load reductions that result from the implementation of BMPs are computed using the known BMP efficiencies.

The estimated pollutant load reduction based on STEPL modeling using selected BMP's in Table 73 and Table 74 was calculated under the following 3 scenarios- minimal BMP (within 5yrs), average BMP (10yrs), and excellent BMP implementation (30yrs). Minimal BMP implementation (10% of acres/unit treated), with an expected load reduction of 17% for N, 17% for P, and 17 % for sediment. Average BMP implementation (25% of acres/units treated), with an expected load reduction of 38% for N, 38% for P, and 40% for Sediment. For excellent BMP implementation- (50%of acres/units), with an expected load reduction of 65% for N, 66% for P, and 70% for Sediment. Achieving excellent BMP implementation will almost meet (within 3%) the reduction goals needed to meet WQ targets, as set in Table 67 Loads and Load Reductions.

E.coli loading is not available in the STEPL model. We will calculate pathogen load reductions for BMPs when applicable and as new models are available. The TMDL % reduction needed for E.coli in the Carpenter-Denton Creek HUC 10 is 74% and in the Curtis Hunter Creek HUC 10, an 81% reduction is needed.

11.0 Action Register and Schedule

Throughout the Watershed Management Plan development process the Steering Committee identified measures that could be implemented to reduce non-point pollutant loads and improve water quality. After the completion of the concerns list, problem statements, and specific goals the following actions register and schedule was organized by the 5 major problem statements. The action register for funding purposes took the 5, 10, and 30 year goal statements and compiled them by short term goals (S) as 5 year or less, and long term goals (L) as the 10 and 30 year goals.

Estimated staff time and "structural" costs were calculated for each milestone in the action register and the total cost is in Table 77 below. This was done to help organize and rationalize funding strategies and set realistic timelines about achieving the milestones listed in the Action Register, which will ultimately achieve the water quality goals.

Table 77 Action Register Cost Summary Short and Long Term

Total Cost Projection Short term and Long Term			
Task	**staff**	**structure**	**Totals**
Flashiness	$12,000	$68,000	$80,000
Fish and Wildlife Habitat	$127,000	$160,000	$287,000
Recreation Use	$6,600	$57,500	$64,100
Nutrient Load	$152,100	$529,308	$681,408
Sedmient Load	$1,000	$16,595	$17,595
ecoli load	$1,500	$ 2,500	$4,000
		Grand Total	$1,134,103
staff = interns, consultants, contract work, and additional staff time beyond base			
Estimated structure = all BMPs, materials, land acquisition, brochures, etc.			
Total Cost Projection Just Short Term 0-5 yrs.			
Task	**Staff**	**Structure**	**Totals**
Flashiness	$11,500	$68,000	$79,500
Fish and Wildlife Habitat	$117,000	$10,000	$127,000
Recreation Use	$10,600	500	$11,100
Nutrient Load	$ 150,500	$ 135,300	$285,800
Sedmient Load	$ 1,000	$13,500	$14,500
ecoli load	$1,500	$ 2,500	$4,000
	$292,100	$ 229,800	
		Grand Total	$521,900

11.1 Flashiness

Objective: To reduce high and low flow events by 5% across the watershed according the USGS stream gages at Rensselaer and Foremen.

Action Register for Flashiness							
Goal: To reduce high and low peak flow events across the watershed.							
Strategy	**Target Audience**	**S= < 5 yr L = >5 yr**	**Milestone**	**Cost**	**Item**	**Possible Partners**	**Technical Assistance**
Flow of water is not hindered via log jams	See Recreation Objective 1		See Recreation Objective 1	See Recreation Objective 1		See Recreation Objective 1	See Recreation Objective 1
Increase landowner awareness on the use of drainage water management, install a demonstration area by 2016, and install as possible through 2041.	Agricultural landowners and operators	S	Identify and seek financial incentives for landowners to install drainage water management practices.	$1,000	staff	SWCDs, DNR, TNC, NRCS, USDA, ISDA, NICHES, Purdue Extension, NWF	Purdue Extension, NRCS, and SWCD
		S	Develop an education plan including demonstration day and printed materials targeting drainage water management.		staff		
		S	Implement education plan (2014-2018).		staff		
		S	Host annual workshop or presentation for landowners highlighting the benefits of drainage water management.	$2,000	staff		
		S	Target a drainage water management demonstration area to be installed in 2016.	$3,000	structure		
Increase landowner awareness on the use of two-stage ditches, implement two demonstration sites by 2016, and install as possible through 2041.	Agricultural landowners and operators	S	Complete installation of demonstration two-stage ditch project in Jasper County.		staff	SWCDs, DNR, TNC, NRCS, USDA, ISDA, NICHES, Purdue Extension, NWF	SWCDs, NRCS, TNC
		S	Conduct Assessment of x-feet of 2-stage needed to benefit WQ and storage capacity at specific HUC 12 sites	$3,000	staff		
		S	Develop an education plan including demonstration day and printed materials targeting two stage ditches.				
		S	Implement education plan (2014-2018).				
		S	Host annual workshop or presentation for landowners highlighting the benefits of two stage ditches.	$2,500	staff		
		S	Install two examples one-half mile two-stage ditches by 2016.	$65,000	structure		
		L	Install two stage ditches as possible through 2041.		varies		

Action Register for Flashiness							
Goal: To reduce high and low peak flow events across the watershed.							
Strategy	Target Audience	Range	Milestone	Cost		Possible Partners	Technical Assistance
Increase wetland restoration (slow water down in headwaters) by 500 acres by 2016 and by 2,000 by 2041.	Agricultural landowners and operators, Urban and rural landowners	S	Promote WRP cost-share program in 2014.				
		S	Develop a list of potential wetland restoration sites in headwater areas and conduct one-on-one meetings with individual landowners starting in 2015	$5,000	staff		
		S	Increase awareness about existing programs and offer incentives.	$1,000	staff		
		L	Seek financial incentives for landowner to restore wetlands.	$500	staff		
			Total cost for Flashiness Concern	**$83,000**			

11.2 Fish and Wildlife Habitat

Objective: To protect and enhance fish and wildlife habitat, the steering committee would like to increase the amount of buffer within 100 ft of all streams from the current status of 20% to a target of 50%, reduce roadside mowing by 25% and replace with native habitat, restore wetland acres from the current status of 1% to a target of 4% of total land acres, improve CMIBI from current poor/fair score to a target of excellent, and CQHEI scores from current status of unhealthy to a target of healthy.

Action Register for FIsh and Wildlife Habitat							
Goal: protect and enhance fish and wildlife habitat							
Strategy	Target Audience	S= < 5 yr L = >5 yr	Milestone	Cost	Item	Possible Partners	Technical Assistance
Restore natural stream habitat along the Iroquois River and its tributatires that have less than 50% buffer according to stream buffer GIS analysis.	Ag and Urban landowners along streams	S	By end of 2014 create educational and funding brochure to send to streambank landowners	$1,000	staff	TNC, NICHES, DNR, INDOT, SWCD	TNC, NICHES, DNR, INDOT, SWCD
		S	By 2015 contact all landowners in identified areas	$1,000	staff		
		L	By 2025, less than 10% of streams miles are unbuffered	$10,000	structures		
By 2018, 25% of roadside ditches no longer mowed and possibly replaced turf grass with low-growing native plants.	Landowners with lawns adjacent to roads.	S	By 2015, complete assessment of roadside ditch and those that are mowing using GIS maps and	$10,000	staff	TNC, NICHES, DNR, INDOT, SWCD, Environmental Consultants	TNC, NICHES, DNR, INDOT, SWCD
		S	By 2017, develop an education program to target landowners with mowed roadside				
		S	Implement education plan (2017-2019).				
		L	By 2020, complete assessment of roadside mowing and compare results with 2015 assessment.	$10,000	staff		
Educate about flora and fauna in the Iroquois River	Residents of Watershed	S	By end of 2015 create educational brochure specific to fish, flora, fauna on Iroquois River	$2,000	material	Area schools, Saint Joesphes College, DNR, NICHES, TNC	
		S	Implement education plan (2015-2017).	$2,000	staff		
Increase wetland restoration by 500 acres by 2016 and by 2,000 by 2041.	see Flashiness Objective 1	see Flashiness Objective 1	see Flashiness Objective 1	see Flashiness Objective 1	see Flashiness Objective 1	see Flashiness Objective 1	see Flashiness Objective 1

Action Register for FIsh and Wildlife Habitat							
Goal: improve stream conditions so that CQHEI index is greater than 50 and Citizen IBI is "good" at all sampling sites.							
Strategy	**Target Audience**	**S= < 5 yr L = >5 yr**	**Milestone**	**Cost**	**Item**	**Possible Partners**	**Technical Assistance**
Increase landowner awareness on the use of two-stage ditches, implement two demonstration sites by 2016, and install as possible through 2041.	See Flashiness Objective 1	See Flashiness Objective 1	See Flashiness Objective 1	See Flashiness Objective 1	See Flashiness Objective 1	See Flashiness Objective 1	See Flashiness Objective 1
Create backwater areas in the Iroquois River to improve spawning habitat by 2018.	Agricultural landowners and operators	S	By 2015, complete survey of Iroquois River, Carpenter Creek, and Curtis Creek to identify potential backwater restoration locations.	$10,000	staff	DNR, Army Corps of Engineers, IDEM Section 401 WQ Assistance	DNR, Army Corps of Engineers, Saint Joesph's College, NICHES
		S	By 2016, conduct a feasibility assessment to identify appropriate backwater habitat area.	$30,000	staff		
		S	By 2018, obtain funding for design and construction of backwater habitat area.	$2,000	staff		
		L	Complete backwater habitat area design and construction by 2022.	$150,000	structure		
Increase wetland restoration by 500 acres by 2016 and by 2,000 by 2041.	see Flashiness Objective 1	see Flashiness Objective 1	see Flashiness Objective 1	see Flashiness Objective 1	see Flashiness Objective 1	see Flashiness Objective 1	see Flashiness Objective 1

Action Register for FIsh and Wildlife Habitat							
Goal: improve stream conditions so that CQHEI index is greater than 60 and Citizen IBI is "good" at all sampling sites.							
Strategy	**Target Audience**	**S= < 5 yr L = >5 yr**	**Milestone**	**Cost**	**Item**	**Possible Partners**	**Technical Assistance**
By 2017, complete profitability analysis for farms in the 100-year floodplain.	Agricultural landowners in the 100-year floodplain	S	In 2016, identify a funding source and partner to provide profitability analysis.	$3,000	staff	SWCD, NRCS, Purdue University or Saint Joesph's College	SWCD, NRCS, Purdue University or Saint Joesph's College
		S	By 2017, contact all agricultural landowners with land in the 100-year floodplain to offer analysis. Targeted to areas with less than 50% buffer from desktop survey	$5,000	staff		
		S	By 2018, complete profitability analysis for interested agricultural landowners.	$50,000	staff		
		L	By 2045, restoration plans incorporating easements are complete for agricultural land in the 100-year floodplain.		structure		
Address Active Erosion Sites with appropriate measures	Landowners	S	In 2015, identify a funding source and partner to provide profitability analysis.	$3,000	staff	SWCD, NRCS, Purdue University or Saint Joesph's College	SWCD, NRCS, Purdue University or Saint Joesph's College
		S	resolve 3 active erosions sites as identified by 2012 Windshiled survey annually (2015-2020)	$10,000	structure		
			Total cost fo Fish Habitat Concern	**$263,000**			

11.3 Recreational Use

Objective: To increase recreational use of area streams, the steering committee would like to create more access points from the current 2 to 5, increase public use of streams from less to more often, stream passage by canoe from 60% passable to 100% passable, and associated educational outreach.

Action Register for Recreational Use

Goal: Increase public access to the Iroquois River and its tributaries from 2 to 5.

Strategy	Target Audience	S= < 5 yr L = >5 yr	Milestone	Cost	Item	Possible Partners	Technical Assistanc
Create public access point every 5-10 miles on naviagable steams	Ag landowners and farmers, Urban residents along streams,	S	By 2015 public access point downstream of Rensselaer on Iroquois River	$1,000	staff	IDNR, NICHES, County Surveyor, Boyscouts, Parks Departments	IDNR, County Highway Departme nt, NICHES
		L	By 2020 upsteam and downstream access point of Brook on Iroquois River			IDNR, NICHES, County Surveyor, Parks Departments	IDNR, County Highway Departme nt, NICHES
		L	By 2025 create access point on Carpenter and Curtis Creeks			IDNR, NICHES, County Surveyor, Parks Departments	IDNR, County Highway Departme nt, NICHES
Identify log jams hindering family friendly canoe trips along the main stem of the Iroquois River	Ag landowners and farmers, Urban residents along streams,	S	Annual float entire river to identify significant log jams and map	$500	staff	Surveyor, (IRCD), Friends of the Iroquois	Surveyor, Iroquois River Conserva ncy District (IRCD), Friends of the Iroquois
		S	create google based map so public can identify sites	$100	staff	Saint Joesph's College,Surveyo r, Iroquois River Conservancy District (IRCD), Friends of the Iroquois	Saint Joesph's College,S urveyor, Iroquois River Conserva ncy District (IRCD), Friends of the Iroquois

Action Register for Recreational Use							
Goal: Increase public access to the Iroquois River and its tributaries from 2 to 5.							
Strategy	**Target Audience**	**S= < 5 yr L = >5 yr**	**Milestone**	**Cost**	**Item**	**Possible Partners**	**Technical Assistance**
Remove major log jams that hinder canoeing	Ag landowners and farmers, Urban	S	by 2016 achieve log jam free canoeing from Rensselaer to State line.	$1,000	staff	Friends of the Iroquois, IRCD	DNR, County Surveyor, IRCD
		S	annually cable trees that have fallen into the river to avoid log jams, while preserving fish habitat	$ 500	structure		
Create 10 miles of walking/riding trails along the Iroquois River on both sides of urban areas along the river.	Ag landowners and farmers, Urban residents along streams, Cities	L	by 2025 extend city of Rensselaer urban trails to outside city along course of river	?	?	Parks of Rensselaer, County Surveyor Office, Iroquois River Conservancy District, Friends of the Iroquois	JCEDO, NWIPCS
		L	by 2040 connect river access points via walking/riding trail	?	?	Parks of Rensselaer, County Surveyor Office, Iroquois River Conservancy District, Friends of the Iroquois	JCEDO, NWIPCS

Action Register for Recreational Use							
Goal: Increase public access to the Iroquois River and its tributaries from 2 to 5.							
Strategy	**Target Audience**	**S= < 5 yr L = >5 yr**	**Milestone**	**Cost**	**Item**	**Possible Partners**	**Technical Assistance**
Create and dsitribute recreational guide specific to Iroquois River Region	Area Businesses, Ag landowners and farmers, Urban residents along streams,	S	create recreation map sponsored by area business by 2020	$2,000	staff	NICHES, County Surveyor, Boyscouts, Parks Departments of Rensselaer and Brook, Chamber of Commerce, Area Businesses	Northwest Indiana Paddlers Association
		S	distribute to NW Region	$2,000	staff	NICHES, County Surveyor, Boyscouts, Parks Departments of Rensselaer and Brook, Chamber of Commerce, Area Businesses	Northwest Indiana Paddlers Association
Create "Safe to Paddle Iroquois River" website linked to USGS stream gage	Business, Landowners and farmers, Urban residents along	S	Website development and created by 2018	$4,000	staff	Friends of the Iroquois, IRCD, NWIPA, Chamber of Commerces, Area Businesses	USGS, NWIPA, Saint Joe College

Action Register for Recreational Use							
Goal: Educate to change "percieved" poor water quality threats that hinder recreational use							
Strategy	**Target Audience**	**S= < 5 yr L = >5 yr**	**Milestone**	**Cost**	**Item**	**Possible Partners**	**Technical Assistance**
Release annual report of WQ testing	Stakeholders	S	Annual User Friendly and Informative Report	$1,000	Staff	Saint Joesph's College,Surveyor, Iroquois River Conservancy District (IRCD), Friends of the Iroquois	Saint Joesph's College,Surveyor, NRCS, Purdue University
			Conduct Annual Hoosier River Watch Training	$1,000	Staff	Saint Joesph's College,Surveyor, Iroquois River Conservancy District (IRCD), Friends of the Iroquois	Saint Joesph's College,Surveyor, NRCS, Purdue University
Implement Quarterly WQ outreach effort	Stakeholders	S	Develop annual education outreach plan targeting WQ and the Iroquois River	$1,000	Staff	Saint Joesph's College,Surveyor, Iroquois River Conservancy District (IRCD), Friends of the Iroquois	Saint Joesph's College,Surveyor, NRCS, Purdue University
Distribute fish advisory information to stakeholders	Stakeholders	S	Distribute via annual and quarterly outreach	$500	staff	Chamber of Commerce, Friends of the Iroquois, IRCD	IDNR
			Total cost for Recreation Concern	**$14,600**			

11.4 Nutrients

Objective: To reduce nutrient concentrations (nitrogen and phosphorus) so that monthly water quality samples, do not exceed the 1.5ppm target for nitrate and the 0.005 ppm orthophosphate target more than 20% of the time within 30 years.

Action Register for nutrient loading in the watershed:

Goal: reduce nutrient loading to streams from agricultural lands

Strategy	Target Audience	S= < 5 yr L = >5 yr	Milestone	Cost	Item	Possible Partners	Technical Assistance
Increase cover crop acreage by 8,000 acres by 2016 and by 15,750 acres by 2025.	Agricultural landowners and operators	S	Continue cost-share program in 2014.			ISDA, SWCDs, NRCS, USDA, Purdue Extension	SWCDs, NRCS
		S	Create a contractors list for specific cover crop seeding in 2014.	$ 500	structure		
		S	Develop long term cover crop strip trials tied to yield data and nitrogen use 2015-217.	$ 4,000	structure		
		S	Host cover crop workshop in 2014 and 2016.	$ 1,000	staff		
		S	Annually, identify additional cover crop funding options.	$ 1,000	staff		
		S	Annually (2014-2016) implement 4,000 acres of cover crop.	$ 28,000	structure		
Increase awareness on the use of bioreactors by 2016.	Agricultural landowners and operators, Urban and rural landowners	S	Identify and seek financial incentives for landowners to establish bioreactors.	$ 1,000	staff	ISDA, SWCDs, NRCS, USDA, Purdue Extension	ISDA, SWCDs, NRCS, USDA, Purdue Extension
		S	Develop an education plan including demonstration day and printed materials targeting the use of				
		S	Host annual workshop or presentation for landowners highlighting the benefits of bioreactors.	$ 1,000	staff		
		S	Target a demonstration area to be installed in 2016 and install bioreactors as possible by 2041.	$ 9,000	structure		

Strategy	Target Audience	S= < 5 yr L = >5 yr	Milestone	Cost	Item	Possible Partners	Technical Assistance
Increase awareness on the use of drainage water management	see Flashiness Objective 1	see Flashiness Objective 1	see Flashiness Objective 1	see Flashiness Objective 1	see Flashiness Objective 1	see Flashiness Objective 1	see Flashiness Objective 1
Increase landowner awareness on the use of two-stage ditches	see Flashiness Objective 1	see Flashiness Objective 1	see Flashiness Objective 1	see Flashiness Objective 1	see Flashiness Objective 1	see Flashiness Objective 1	see Flashiness Objective 1

Action Register for nutrient loading in the watershed

Goal: reduce nutrient loading to streams from agricultural lands

Strategy	Target Audience	S= < 5 yr L = >5 yr	Milestone	Cost	Item	Possible Partners	Assistance
Participate in SWCD field days, agricultural customer appreciation days, and other	Ag suppliers, operators, and ag businesses	S	0-2 yrs: Develop catalog of all area SWCD field days and ag customer appreciation days. Review and/or	$ 4,000	Staff	SWCDs, NRCS, CERES, Wilson, Coop Alliance, Ag Equipment Dealers, Vision Ag, CCA	NRCS, ISDA, SWCD
		S	2-15 yrs: Give presentation on programs or have information booth at 20% of events each year. (Rotating to	$ 2,000	Travel		
Work with farmers and commerical applicators to adopt precision agriculture technology to reduce excess applications of	Agricultural landowners, operators, and ag businesses	S	0-2 yrs: Market Precision Ag as tiered cost-share. (Based upon other BMP adoptions). Host P.A. training.	$ 3,500	Lightbar each	CERES, Vision Ag, Wilson Fertilizer, Coop Alliance, etc.	Agronomists, Ag Supplies, NRCS, CCAs
		S	2-15 yrs: Review new P.A. technology on annual basis. Develop adoption / cost share guidelines on new	$ 9,000	Basic precision		
		S	Continue hosting P.A. training on annual basis.	$ 12,000	Autoswath		
Increase farmer participation in NRCS, DNR, and other convservation programs	Agricultural landowners and operators	S	0-3 yrs: Work with agronomists and ag suppliers to strategically market program to producers. Tak applications	$ 120,000	staff for 5 years (Ag Director	CERES, Vision Ag, Wilson Fertilizer, Coop Alliance, etc.	Agronomists, Ag Supplies, NRCS, CCAs
		L	3-15 yrs: Continue marketing and conservation plan development. Enroll at least 2 new producers / year into				
Strategy	**Target Audience**	**S= < 5 yr L = >5 yr**	**Milestone**	**Cost**		**Possible Partners**	**Assistance**
Implement BMPs to improve efficiency of irrigations systems and reduce nutrient losses through surface run-off and leaching	Agricultural landowners, operators, and ag supplies	S	0-5yrs: Strategically market program to producers. Perform uniformity test and flow monitoring on enrolled systems.	$ 500	Irrigation Plan	CERES, Vision Ag, Wilson Fertilizer, Coop Alliance, etc.	Agronomists, Ag Supplies, NRCS, CCAs
		L	6-15 yrs: Continue marketing and conservation plan development. Enroll at least 2 new producers / year into	$ 8	structure (cost per acre)		
		L	By year 15, developed and implemented irrigation water management plans least 50% of	$ 3,000	structure (irrigation upgrade)		

Action Register for nutrient loading in the watershed

Goal: Reduce / prevent nutrients from domestic animals and livestock from entering surface water

Strategy	Target Audience	S= < 5 yr L = >5 yr	Milestone	Cost	Item	Possible Partners	Assistance
Implement structural BMPs (exclusionary fencing / watering facilities) in pastures with livestock access to surface waters. (Where applicable, enroll sites into wetland/stream restoration programs.)	Livestock Owners	S	0-3 yrs: Strategically market program to producers and landowners. Develop site-specific conservation plans. Enroll	$ 5,000	Mitigation Clearing house a year	SWCDs, Regulatory Agencies, Mitigation Partners,	ISDA, NRCS
		S	2-4 yrs: Install exclusionary fencing, stream crossings & watering facilities as required	$ 5,500	Fence/water		
		S	2-5 yrs: Develop engineering plans and secure necessary permits as required	$ 4,000	structure (streamc rossing)		
		L	6-10 yrs: Stream restoration activities	$ 30,000	structure (restoration)		
				$ 5,000	structure (permitting)		
Work with farmers to implement manure management/application BMPs- cover crops, PSNT testing etc.	Livestock Owners	S	0-3 yrs: Strategically market program to producers and landowners. Develop site-specific Conservation Plans and	$ 1,000	structure (nutrient plan)	SWCD, FSA, NRCS, Area Agronomists and Ag businesses	SWCD, FSA, NRCS, Area Agronomists and Ag businesses
		S	1-3 yrs: Focus efforts to have manured acres utilizing a cover crop in year manure is applied		see cover crop cost share under nutrient		
		S	2-5 yrs: Install,filter strips and/or buffers. Install fencing as needed. Implement intensive and/or rotational grazing strategies	$ 150	structure (Filter Strip/acre)		
				$ 1,000	structure (Fence/water)		

Action Register for nutrient loading in the watershed

Goal: Reduce / prevent nutrients from domestic animals and livestock from entering surface water

Strategy	Target Audience	S= < 5 yr L = >5 yr	Milestone	Cost	Item	Possible Partners	Technical Assistance
Work with landowners to insure that	Livestock Owners						

Goal: Reduce / prevent nutrients from residential yards, parks and park-like areas from entering surface water.

Strategy	Target Audience	S= < 5 yr L = >5 yr	Milestone	Cost	Item	Possible Partners	Assistance
Implement buffer strip BMPs on golf courses and parks&cementeries to eliminate/reduce fertilizer runoff.	Park and Golf Boards, Cemetery Boards and Managers	S	0-1 yrs: Work with park boards & managers to define buffer strip needs. Define implementation plan	$ 1,500	structure ($0.50 LF)	DNR, NRCS, TNC, Ducks Unlimited, Pheasants Forever	DNR, NRCS, TNC, Ducks Unlimited,
		S	2-15 yrs: Install buffers	$ 150	structure ($150/acre)	DNR, NRCS, TNC, Ducks Unlimited, Pheasants Forever	DNR, NRCS, TNC, Ducks Unlimited,
		L	Achieve 30% of stream and pond bank buffer by year 10.	$ 150,000	structure (1,000 acres)	DNR, NRCS, TNC, Ducks Unlimited, Pheasants Forever	DNR, NRCS, TNC, Ducks Unlimited,
		L	Achieve 60% of stream and pond banks buffered by yr 15.	$ 150,000	structure (1,000 acres)	DNR, NRCS, TNC, Ducks Unlimited, Pheasants Forever	DNR, NRCS, TNC, Ducks Unlimited,

Action Register for nutrient loading in the watershed							
Goal: Reduce/prevent nutrients from residential yards, parks and park-like areas from entering surface water.							
Strategy	**Target Audience**	**S= < 5 yr L = >5 yr**	**Milestone**	**Cost**	**Item**	**Possible Partners**	**Assistance**
Educate landowners in methods of lawn/landscaping care that can reduce nutrient	Lawn and Garden Care Professionals, Garden Centers, Garden	S	0-1 yr: Develop web page with downloadable fact sheets.	$ 500	staff	TNC, Friends of the Sands, Area Businesses	TNC, Landscaping Companies, Environmental Consultants.
		S	1-2 yrs: Write articles for media. Host workshop in conjunction with rain garden workshop.	$ 500	structure (website)		
Educate private landowners in how buffers can eliminate / reduce nutrient runoff.	Lawn and Garden Care Professionals, Garden Centers, Garden	S	0-1 yr: Develop web page with downloadable fact sheets.	$ 1,000	structure (website)	TNC, Friends of the Sands, Area Businesses	TNC, Landscaping Companies, Environmental Consultants
		S	1-2 yrs: Write articles for media. Host workshop in conjunction with rain garden workshop. Provide technical	$ 1,000	staff		

Action Register for nutrient loading in the watershed

Goal: Reduce/prevent nutrients from residential yards, parks and park-like areas from entering surface water.

Strategy	Target Audience	S= < 5 yr L = >5 yr	Milestone	Cost	Item	Possible Partners	Assistance
Install public and private raingardens equal in volume to approximately 1% of roof and parking area runoff. Especially, targeted at Rensselaer CSO outlet # 19 watershed.	Neighborhood associations, Commercial entities, City of LRensselaer, Goodland, Brook, Church groups	S	0-2 yrs: Awareness campaign, including raingarden webpage and factsheet / flyer	$ 500	staff	City of Rensselaer, Parks Departments, SWCD, Garden Centers, Master Gardners	ISDA, TNC, Environmental Consultants,
		S	Year 2: Host 1st raingarden workshop / install raingarden at public facility.	$ 500	staff		
		L	Year 5: Host 2nd raingarden workshop / install raingarden at public facility	$ 2,500	structure (raingarden)		
		S	2-10 yrs: Promote raingarden installations	$ 3,000	structure (raingarden)		
Install 5 acres of pervious pavement/porous pavers 10 acres of pervious pavement by 2041.	Neighborhood associations, Commercial entities, City of Rensselaer, Brook, Kentland, Goodland, Church groups	S	Identify certified installers and create an information portal to highlight pervious pavement.	$ 1,000	staff	City of Rennselaer, Public Utility, etc.	ISDA, NRCS, Environmental Consultants
		S	Develop education plan to highlight practice, target developers, architects, and engineers, and promote via tours		staff* see note		
		S	Implement education plan (2015-2017).		staff**		
		L	Complete economic cost/benefit analysis.	$ 5,000	staff		
		L	Work with the Rensselaer to develop a credit incentive program.	$ 2,000	staff		
		S	Develop a list of entities to target for pervious pavement installation.	$ 1,000	staff		
		L	Annually (2015-2025) install 1 acre of pervious pavement.	$ 55,000	structure(pavement)		

Action Register for nutrient loading in the watershed

Goal: Reduce / prevent nutrients from failing septic systems from entering surface water

Strategy	Target Audience	S= < 5 yr L = >5 yr	Milestone	Cost	Item	Possible Partners	Technical Assistance
Educate landowners with septic systems on their proper maintenance		S	0-1 yrs: Develop web page with downloadable factsheets	$ 1,000	structure	Local septic professionals, County Boards of Health	Local septic professionals, County Boards of Health
		S	1-2 yrs: Write articles for media.	$ 100	staff		
		S	Year 2: Host workshop. Obtain discounts from local septic care professionals as attendee take-aways	$ 500	staff		
Work with local banks to insure spetic service records and system inspection is a requirement for any home loans	Banks/Loan Offices, County Recorders, Realtors, Appraisers	S	0-1 yrs: Develop web page with downloadable factsheets. Develop form to be file with Board of Health and Buyer.	$ 250	staff	Banks/Loan Offices, County Recorders, Realtors, Appraisers	Banks/Loan Offices, County Recorders, Realtors, Appraisers
		S	1-2 yrs: Launch awareness campaign, especially for real estate professionals.	$ 250	staff		
		L	By year 6, 50% of all real estate transfers done with septic inspection.	$ 250	staff		
		L	By year 10: All real estate transfers done with septic inspection	$ 250	staff		

Goal: Reduce / prevent nutrients from failing septic systems from entering surface water

Strategy	Target Audience	S= < 5 yr L = >5 yr	Milestone	Cost		Possible Partners	Assistance
Work with local health department to review potential list of failing septics and insure effective inspection of system design and installation	County Board of Health, Building Code Officials	S	0-1 yr Create list of possible failing septic systems by date of construction and geographically map.	$ 500	staff	County Board of Health, Building Code Officials	County Board of Health, Building Code Officials
		S	0-2 yrs: Review evaluation and installation inspection requirements based on Indiana Board of Health requirements.	$ 500	staff		

Goal: reduce / prevent nutrients from CSOs from entering surface water.

Strategy	Target Audience	S= < 5 yr L = >5 yr	Milestone	Cost	Item	Possible Partners	Assistance
Work with businesses and landowners to insure that gutters are not connected to stormwater systems.	Urban residents and businesses	S	0-2 yrs: Review of previous disconnect campaigns. Awareness campaign, including stormwater webpage and	$ 500	staff	Town Councils, City and County Sewage Treatment Facilities	Town Councils, City and County Sewage Treatment Facilities
		S	2-5 yrs: On-foot survey of structures	$ 500	staff		
Install public and private raingardens equal in volume to approximately 1% of roof and parking area runoff. Especially, targeted at Rensselaer CSO outlet # 19 watershed.	See Nutrients objective 3	See Nutrients objective 3	See Nutrients objective 3	See Nutrients objective 3	See Nutrients objective 3	See Nutrients objective 3	See Nutrients objective 3
Increase awareness of individuals about the Rensselaer's CSO Long-term Control Plans.	City of Rensselaer and residents	S	Develop an education plan highlighting efforts by the city to reduce Combined Sewer Overflows to the Iroquois River.		staff* see note	City of Rensselaer	City of Rensselaer
		S	Implement education plan (2015-2017).		staff**		
		S	Support CSO implementation plans as possible.	$ 1,000	staff		
Increase the number of trees within the urban core byby 2020	City of Rensselaer and residents	S	Develop education plan highlighting the stormwater and other benefits of trees.		staff* see note	City of Rensselaer, Rensselaer Urban Forestry Council	Purdue Extension, DNR
		S	Implement education plan (2015-2018).		staff**		
		S	Coordinate and support with Rensselaer Urban Forestry Council to plant more trees	$ 50,000	structure (trees, etc.)		
		S	Increase funding for Rensselaer Urban Forestry Council.	$ 1,000	staff		
			Total Cost of Nutrients Program	**$682,908**			

11.5 E.coli

Objective: To reduce E. coli concentrations at all sites to 235 and below cfu/100mL within 30 years. As of April 2013, across the watershed 50% of E.coli samples exceed the WQ target of less than 235 cfu/100mL. To meet TMDL targets a 73% reduction in loading needs to occur across the watershed. The 10 year goal will theoretically achieve this load reduction.

Action Register for e.coli loading from the landscape:							
Goal: reduce e.coli loading to streams from agricultural lands							
Strategy	**Target Audience**	**S= < 5 yr L = >5 yr**	**Milestone**	**Cost**	**Item**	**Possible Partners**	**Technical Assistance**
Increase cover crop acreage	See Nutrients Objective 1		See Nutrients Objective 1	See Nutrients Objective 1	See Nutrients Objective 1	See Nutrients Objective 1	See Nutrients Objective 1
Implement structural BMPs in pastures with livestock access to surface waters.	See Nutrients Objective 2		See Nutrients Objective 2	See Nutrients Objective 2	See Nutrients Objective 2	See Nutrients Objective 2	See Nutrients Objective 2
Work with farmers to implement manure management/application BMPs	See Nutrients Objective 2		See Nutrients Objective 2	See Nutrients Objective 2	See Nutrients Objective 2	See Nutrients Objective 2	See Nutrients Objective 2
Goal: Reduce / prevent e.coli from domestic animals and livestock from entering surface water							
Increase pet owner's awareness on proper disposal of pet waste.	Pet owners, Residential apartment complexes, Pet friendly businesses, Park areas	S	Develop education plan using existing educational materials by 2015.		staff	Veterinarians, Pounds, Parks departments, etc	Veterinarians, Pounds, Parks departments, etc
		S	Implement education plan (2015-2017).		staff		
		S	Target information at pet owners using resident experts, like veterinarians.	$1,000	staff		
		S	Provide pet owner give-aways that encourage proper pet waste disposal.	$2,500	structure		
		S	Review existing successful pet waste programs, to replicate their successes.	$500	staff		
Implement buffer strip BMPs on golf courses and parks&cementeries	See Nutrients objective 3		See Nutrients objective 3	See Nutrients objective 3	See Nutrients objective 3	See Nutrients objective 3	See Nutrients objective 3

Goal 2: Reduce/prevent e.coli from CSOs from entering surface water.							
Strategy	**Target Audience**	**S= < 5 yr L = >5 yr**	**Milestone**	**Cost**		**Possible Partners**	**Technical Assistance**
Work with businesses and landowners to insure that gutters are not connected to stormwater systems.	See Nutrients objective 6		See Nutrients objective 6	See Nutrients objective 6	See Nutrients objective 6	See Nutrients objective 6	See Nutrients objective 6
Install public and private raingardens equal in volume to approximately 1% of roof and parking area runoff.	see Nutrients Objective 6		see Nutrients Objective 6	see Nutrients Objective 6	see Nutrients Objective 6	see Nutrients Objective 6	see Nutrients Objective 6
Increase awareness of individuals about the Rensselaer's CSO Long-term Control Plans.	see Nutrients Objective 6		see Nutrients Objective 6	see Nutrients Objective 6	see Nutrients Objective 6	see Nutrients Objective 6	see Nutrients Objective 6
By 2020, convert 5 acres lawn to prairie or woodland along stream riparian areas.	Homeowners and businesses with large lawns	S	In 2015, identify funding mechanism to complete research on costs of lawn maintenance compared to cost of prairie or woodland restoration.	$1,000	staff	Industrial and Commerical Businesses, Saint Joesph's College	NICHES, JF New, DNR,
		S	In 2016, work with researcher to complete lawn, prairie, and woodland cost and maintenance research.	$15,000	staff		
		S	By 2017, complete white paper on prairie and woodland conversion and present information to watershed residents.	$10,000	staff		
		S	Annually (2016-2019), host field day highlighting lawn or agricultural conversion to prairie or woodland.	$3,000	materials		
		L	Annually (2015-2020), convert 1 acres of lawn to prairie or woodland.	$100,000	structure		

Goal 3: Reduce/prevent e.coli from failing septic systems from entering surface water							
Strategy	**Target Audience**	**S= < 5 yr L = >5 yr**	**Milestone**	**Cost**	**Item**	**Possible Partners**	**Technical Assistance**
Educate landowners with septic systems on their proper maintenance	Landowners and Septic Conctactors	S	0-1 yrs: Develop w eb page w ith dow nloadable factsheets	$500	staff	Local septic professionals, County Boards of Health	Local septic professionals, County Boards of Health
		S	1-2 yrs: Write articles for media.				
		S	Year 2: Host w orkshop. Obtain discounts from local septic care professionals as attendee take-aw ays				
Work with local banks to insure spetic service records and system inspection is a requirement for any home loans	See Nutrients objective 4		See Nutrients objective 4	See Nutrients objective 4	See Nutrients objective 4	See Nutrients objective 4	See Nutrients objective 4
Work with local health department to review potential list of failing	See Nutriencts objective 5		See Nutriencts objective 5	See Nutriencts objective 5	See Nutriencts objective 5	See Nutriencts objective 5	See Nutriencts objective 5
			Total for E.coli Concern	$ 133,500			

11.6 Sediments

Objective: Total suspended solids (TSS) such as sediment, debris, and organic matter have been identified as a problem throughout the watershed. The steering Committee would like to:

1. Reduce TSS loads from 37,929 tons/yr to 9,632 tons/yr (a 75% reduction)
    a. 5 year goal: 25 % reduction in load
    b. 10 year goal: 50% reduction in load
    c. 30 year goal: 75% reduction in load
2. Reduce annual water samples that exceed target to no more than 20% of the time. Currently, 61% of the samples from across the watershed exceed the WQ target.
    a. 5 year goal: 50% or less of samples exceed target annually
    b. 10 year goal: 35% or less of samples exceed target annually
    c. 30 year goal: 20% or less of samples exceed target annually

3. See your toes when standing in the water during mid and low flow conditions.

Action Register for sediment loading in the watershed:

Goal: reduce sediment loading to streams from agricultural lands

Strategy	Target Audience	S= < 5 yr L = >5 yr	Milestone	Cost	Item	Possible Partners	Technical Assistance
Increase cover crop acreage by 8,000 acres by 2016 and by 15,750 acres by 2025.	See Nutrients Objective 1	See Nutrients Objective 1	See Nutrients Objective 1	See Nutrients Objective 1	See Nutrients Objective 1	See Nutrients Objective 1	See Nutrients Objective 1
Increase landowner awareness on the use of two-stage ditches, implement two demonstration sites by 2016, and install as possible through 2041.	See Flashiness Objective 1	See Flashiness Objective 1	See Flashiness Objective 1	See Flashiness Objective 1	See Flashiness Objective 1	See Flashiness Objective 1	See Flashiness Objective 1
Implement agricultural BMPs to increase stormwater infiltration and minimize soil erosion as a result of surface water runoff.	Farmers and Landowners	S	0-3 yrs: Strategically market program to producers.	$1,000	staff	SWCD, NRCS, ISDA, Agronomists and Ag-Suppliers	SWCD, NRCS, ISDA, Agronomists and Ag-Suppliers
		S	Develop site-specific conservation plans.	$1,000	structure (con plan)		
		S	Enroll at least 3 new producers / year into NRCS or BCWP programs.	$3,000	structure (wetland per acre		
		S	3-5 yrs: Continue marketing and conservation plan development.	$4,500	structure (waterway)		
		S	Enroll at least 5 new producers / year into NRCS or BCWP programs.	$5,000	structure (no-till conversion)/acre		
		L	5-15 yrs: Continue marketing and conservation plan development.	$50	structure (crop rotation/acre)		
		L	By year 15, developed conservation plans at least once for at least 50% of agricultural acreage.	$45	structure (cover crop/acre		
		L	By year 15, implement BMPs on at least 50% of agricultural acreage.	$3,000	structure (WASCOB)		

Increase farmer participation in NRCS, DNR, and other convservation programs throught strategic marketing.	See Nutrients Objective 1	See Nutrients Objective 1	See Nutrients Objective 1	See Nutrients Objective 1	See Nutrients Objective 1	See Nutrients Objective 1	See Nutrients Objective 1
Address Active Erosion Sites with appropriate measures	See Fish Habitat Objective 2	See Fish Habitat Objective 2	See Fish Habitat Objective 2	See Fish Habitat Objective 2	See Fish Habitat Objective 2	See Fish Habitat Objective 2	See Fish Habitat Objective 2
			Total for Sediment Concern	$ 17,595.00			

12.0 Tracking Effectiveness

The overall success of a watershed management plan depends upon the implementation of the action register. In order to track effectiveness all of the goals are designed for short term 0-5 yrs and long term 5+ yrs. Regular water quality monitoring, social indicator surveys, and tracking of administrative successes associated with the action register is necessary to help realize actual water quality targets.

12.1 Indicator Tracking

Water quality, social, and administrative indicators need to be tracked over time to evaluate the effectiveness of implementation efforts. The following is for the steering committee and watershed coordinator to complete as they work towards each goal.

12.1.1 Water Quality Indicators

Water quality indicators will be water chemistry, macro invertebrates, fish species, and habitat indexes. As part of our effort to show a measureable change in water quality, water quality indicator monitoring will occur within the Carpenter and Curtis Creek HUC 10 watersheds, according to the current water testing protocol. Depending on funding, more water testing sites may be added to better track changes from implementation across the wider watershed.

In addition to continuing the citizen macro and habitat assessment at water testing sites within the two critical HUC 10s. An outside consultant will be used to conduct a bio-assessment (fish, macro invertebrate, and habitat) across the HUC 10 critical areas. One survey will be done pre-implementation and another at the end of year 4 of implementation. Water quality indicators will be used to identify the following:

- Statistically significant changes in water chemistry at pre-implementation phase and at the end of year 4
- Changes in fish, macro invertebrate and habitat index scores from pre to post implementation survey.

Water quality work group should meet biannually to consider the following questions:

- Have implemented best management practices been effective in improving water quality?
- Should a different suite of best management practices be used?
- Have water quality goals been achieved?
- Have water quality goals changed?

Water quality indicators will be tracked using a water quality database based in excel. This database will contain 3 years of data collected during the planning phase of this project. Data will be updated quarterly and reported to water quality work group. The cost of water chemistry testing in-house will be $8,500 per year, at 4 years = $34,000. The bio assessment will be 15- 16 sites and include fish, marco invertebrates, and habitat assessment in year 1 of implementation and year 5 of implementation to track improvements. Each site costs $1,000, so year one = $16,000 and year 5 = $16,000 for a total of $32,000 for two rounds of testing.

12.1.2 Social Indicators

Social indicators provide information about stakeholder awareness, attitudes, and willingness to change behavior that will directly affect water quality. Social indicators will be used as follows:

- Track change in knowledge about the Iroquois River and its' tributaries.
- Track changes in attitudes towards actions and willingness to implement BMPs or lifestyle changes that would improve water quality in the watershed
- Track participation in education and outreach activities
- Participation in cost-share programs

Social indicator data will be tracked via a post-implementation survey at the end of year 4 of implementation in the Carpenter and Curtis Creek Watersheds. Comparison of this data will be made to the pre-planning survey that was done in the same watersheds. Survey will cost $20,000.
The education and outreach work group will meet biannually to consider the following questions:

- Attendance and data on outreach events?
- Are watershed stakeholders more informed about water quality concerns and watershed issues?
- Have methods for distributing information to stakeholders been effective?
- Have the desired uses of the Iroquois River and its tributaries changed?

12.1.3 Administrative Indicators

Administrative indicators capture the information that water quality and social indicators do not. We will track program participation, action register items completed, and goals attained. Administrative indicators will be used to track the following:

- Attendance at workshops and field days.
- Conservation practice installation including anticipated load reduction, size, and timing.
- Photos of installed practices.
- Media hits (newspaper stories, youtube video subscribers, radio stories, website hits).
- Number of educational materials distributed.
- WMP updates and revisions
- Number of goals met

13.0 Future WMP Activity

The steering committee will continue to meet on a quarterly basis for the purpose of plan implementation. Annually, this committee will review findings of the Education and Outreach, Water Quality, Outdoor Recreation, and Agricultural work groups. The steering committee will review project efforts according to the management plan's goals, objectives, and strategies no less than every 5 years. Revisions and updates to the watershed management plan will occur at the end of year four of implementation and be the responsibility of the steering committee and watershed coordinator. The criteria for revision will be accomplishment of more than 50% of water quality goals.

The Jasper County Soil and Water Conservation District will be responsible for the holding and final revising of the watershed management plan. For questions regarding this watershed management plan please contact the Jasper SWCD at 219-866-8008 ext. 3. www.iroquoiswatershed.org

14. Appendix

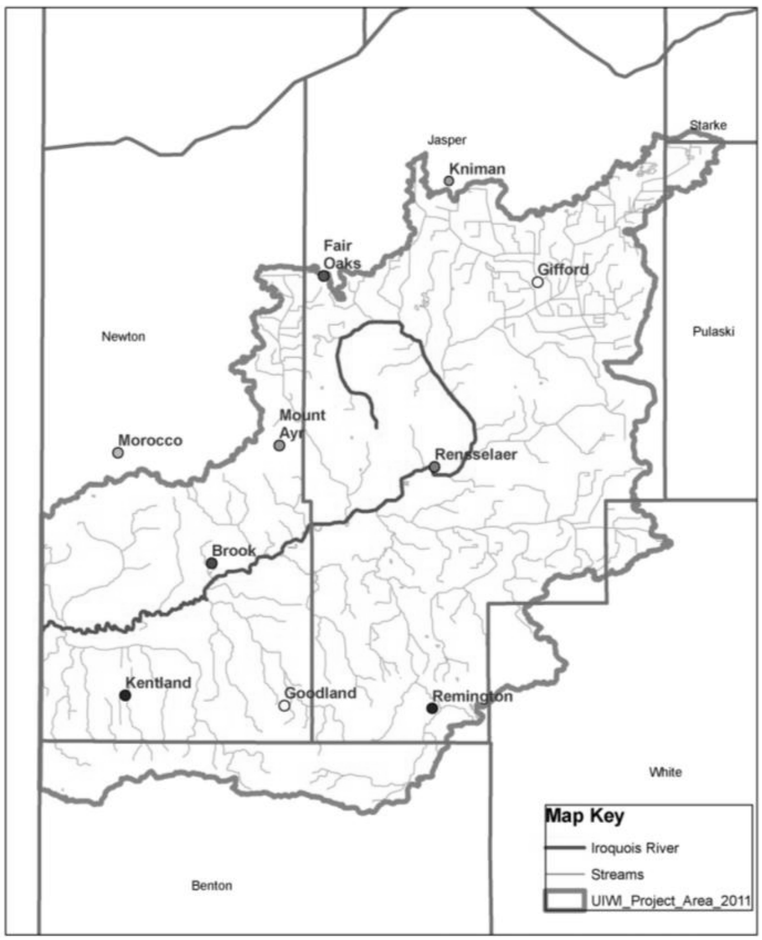
Appendix 1 Corn and Bean Tillage Practices

County	2009 Beans	2011 Beans	Acreage Difference	2009 Corn	2011 Corn	Acreage Difference
No-Till						
Jasper	51,900	38,000	-13,900	12,500	18,700	6,200
Newton	47,800	39,700	-8,100	16,500	8,300	-8,200
Benton	72,400	68,300	-4,100	5,400	16,200	10,800
Pulaski	51,000	49,500	-1,500	28,600	30,700	2,100
White	31,600	31,300	-10,800	6,500	11,200	4,700
Totals	254,700	226,800	-38,400	69,500	85,100	15,600
Mulch-Till						
Jasper	34,000	41,000	7,000	40,600	48,400	7,800
Newton	8,100	18,200	10,100	21,200	57,800	36,600
Benton	17,100	27,100	10,000	17,600	71,600	54,000
Pulaski	22,400	12,400	-10,000	56,200	22,300	-33,900
White	35,400	38,300	2,900	30,000	63,000	33,000
Totals	117,000	137,000	20,000	165,600	263,100	97,500
Reduced-Till						
Jasper	7,000	8,000	1,000	28,100	25,000	-3,100
Newton	7,400	4,000	-3,400	28,300	17,700	-10,600
Benton	8000	3000	-5000	108000	21600	-86400
Pulaski	2,300	11,600	9,300	14,800	33,900	19,100
White	22,000	8,600	-13,400	30,000	31,500	1,500
Totals	46,700	35,200	-11,500	209,200	129,700	-79,500
Conventional-Till						
Jasper	8,000	13,000	5,000	76,400	62,400	-14,000
Newton	4,000	6,100	2,100	51,900	34,200	-17,700
Benton	3,000	2,000	-1,000	4,100	25,700	21,600
Pulaski	800	3,900	3,100	6,400	20,100	13,700
White	6,700	4,800	-1,900	78,000	45,000	-33,000
Totals	22,500	29,800	7,300	216,800	187,400	-29,400

Appendix 2 Agricultural Social Indicators Survey

Your Views on Local Water Resources

The Upper Iroquois Watershed Initiative is a local group of farmers, businesses, and landowners who are conducting this survey in coordination with local partners and Purdue University. The purpose is to identify the concerns you have regarding water quality in the Upper Iroquois Watershed.
We need your help to direct future planning and grant dollar projects. Your opinion will be counted!



You can fill out the survey online by going to www.iroquoiswatershed.org

If you choose to complete the survey online, you will need to enter a "response id", which is the code highlighted above your name on the envelope this survey came in. Please call 219-866-8008 ext 115 if you lost your envelope.

This lets us know that you have completed the survey. The information is confidential and will never be linked to your name, only to this code, which is only for the purpose of knowing who has responded to the survey.

Your voluntary participation in this survey is very important to understanding your needs and concerns. Your answers will be kept confidential and will be released only as summaries. Individual answers cannot be identified.

Please check the circle that corresponds to the answer category that best describes you and your situation or opinion.

The survey should take approximately 25 minutes to complete. Whe
self-addressed envelope. Please read each questior
Thank you!

For more information about the Upper Iroquois Watershed Initiative or this survey, please contact Dan Perkins, Jasper County SWCD Watershed Coordinator at (219-866-8008 ext 115.)

Rating of Water Quality

Overall, how would you rate the quality of the water in your area?

	Poor	Okay	Good	Don't Know
1. For canoeing / kayaking / other boating	( )	( )	( )	( )
2. For eating locally caught fish	( )	( )	( )	( )
3. For swimming	( )	( )	( )	( )
4. For picnicking and family activities	( )	( )	( )	( )
5. For fish habitat	( )	( )	( )	( )
6. For scenic beauty	( )	( )	( )	( )

Your Water Resources

1. Of these activities, which is the most important to you?

( ) For canoeing / kayaking / other boating
( ) For eating locally caught fish
( ) For swimming
( ) For picnicking and family activities
( ) For fish habitat
( ) For scenic beauty

2. Do you know where the rain water goes when it runs off of your property?

( ) No
( ) Yes

3. If you answered 'Yes' above, where does your rain water drain to?

Your Opinions

Please indicate your level of agreement or disagreement with the statements below.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1. Using recommended management practices on farms improves water quality.	( )	( )	( )	( )	( )
2. It is my personal responsibility to help protect water quality.	( )	( )	( )	( )	( )
3. It is important to protect water quality even if it slows economic development.	( )	( )	( )	( )	( )
4. My actions have an impact on water quality.	( )	( )	( )	( )	( )
5. I would be willing to pay more to improve water quality (for example: through local taxes or fees)	( )	( )	( )	( )	( )
6. I would be willing to change management practices to improve water quality.	( )	( )	( )	( )	( )
7. The quality of life in my community depends on good water quality in local streams, rivers and lakes.	( )	( )	( )	( )	( )

Water Impairments

Below is a list of water pollutants and conditions that are generally present in water bodies to some extent. The pollutants and conditions become a problem when present in excessive amounts. In your opinion, how much of a problem are the following water impairments in your area?

	Not a Problem	Slight Problem	Moderate Problem	Severe Problem	Don't Know
1. Sedimentation (dirt and soil) in the water	( )	( )	( )	( )	( )
2. Nitrogen	( )	( )	( )	( )	( )
3. Bacteria and viruses in the water (such as E.coli / coliform)	( )	( )	( )	( )	( )
4. Trash or debris in the water	( )	( )	( )	( )	( )
5. Atrazine	( )	( )	( )	( )	( )
6. Heavy metals	( )	( )	( )	( )	( )
7. Not enough oxygen in the water	( )	( )	( )	( )	( )
8. Habitat alteration harming local fish	( )	( )	( )	( )	( )

9. Pesticides	( )	( )	( )	( )	( )
10. Straightening of stream {channelization}	( )	( )	( )	( )	( )

Sources of Water Pollution

The items listed below are sources of water quality pollution across the country. In your opinion, how much of a problem are the following sources in your area?

	Not a Problem	Slight Problem	Moderate Problem	Severe Problem	Don't Know
1. Discharges from sewage treatment plants	( )	( )	( )	( )	( )
2. Soil erosion from farm fields	( )	( )	( )	( )	( )
3. Improper disposal of used motor oil and/or antifreeze	( )	( )	( )	( )	( )
4. Improperly maintained septic systems	( )	( )	( )	( )	( )
5. Manure from farm animals	( )	( )	( )	( )	( )
6. Stormwater run-off from streets and/or highways	( )	( )	( )	( )	( )
7. Excessive use of fertilizers for crop production	( )	( )	( )	( )	( )
8. Crop production (irrigated)	( )	( )	( )	( )	( )
9. Animal feeding operations	( )	( )	( )	( )	( )
10. Land development or redevelopment	( )	( )	( )	( )	( )
11. Soil loss from stream channels	( )	( )	( )	( )	( )
12. Dredging of streams	( )	( )	( )	( )	( )
13. Drainage/filling of wetlands	( )	( )	( )	( )	( )
14. Combined Sewer Overflow {CSO}	( )	( )	( )	( )	( )
15. Livestock in streams or ditches	( )	( )	( )	( )	( )
16. Failing septic systems	( )	( )	( )	( )	( )
17. Straightening of streams {channelization}	( )	( )	( )	( )	( )
18. Removal of vegetation along a stream-ditch	( )	( )	( )	( )	( )

Consequences of Poor Water Quality

Poor water quality can lead to a variety of consequences for communities. In your opinion, how much of a problem are the following issues in your area?

	Not a Problem	Slight Problem	Moderate Problem	Severe Problem	Don't Know
1. Contaminated drinking water	( )	( )	( )	( )	( )
2. Contaminated fish	( )	( )	( )	( )	( )
3. Loss of desirable fish species	( )	( )	( )	( )	( )

4. Reduced opportunities for water recreation	( )	( )	( )	( )	( )
5. Fish kills	( )	( )	( )	( )	( )
6. Lower property values	( )	( )	( )	( )	( )

Practices to Improve Water Quality

Please indicate which statement most accurately describes your level of experience with each practice listed below.

	Not relevant for my property	Never heard of it	Somewhat familiar with it	Know how to use it; not using it	Currently use it
1. Conduct regular soil tests for pH, phosphorus, nitrogen and potassium	( )	( )	( )	( )	( )
2. Use manure in accordance with its nutrient content	( )	( )	( )	( )	( )
3. Consider the nitrogen contribution from legumes in rotation when establishing nitrogen fertilizer application	( )	( )	( )	( )	( )
4. Adjust crops or fertilization in high risk areas of the field (e.g. sink holes, shallow soils over fractured bedrock)	( )	( )	( )	( )	( )
5. Avoid fall application of manure or nitrogen fertilizer to reduce environmental losses	( )	( )	( )	( )	( )
6. Use variable rate application technology for more precise crop production	( )	( )	( )	( )	( )
7. Maintain the calibration of fertilizer application equipment	( )	( )	( )	( )	( )
8. Use field records of crops, pests and pesticide use to help develop pest control strategies	( )	( )	( )	( )	( )
9. Consider location and soil characteristics to minimize leaching or run-off	( )	( )	( )	( )	( )
10. Apply manure so that nutrients are being applied within university recommendations	( )	( )	( )	( )	( )
11. Restore/enhance wetland	( )	( )	( )	( )	( )
12. Improve stream habitat	( )	( )	( )	( )	( )

Specific Constraints of Practices

Regular Septic System Servicing: Having septic system thoroughly cleaned every 3-5 years to remove all the sludge, effluent and scum from the tank.

1. How familiar are you with this practice?

( ) Not relevant

( ) Never heard of it

( ) Somewhat familiar with it

( ) Know how to use it; not using it

( ) Currently use it

Regular Septic System Servicing continued:

2. If the practice is not relevant, please explain why.

3. Are you willing to try this practice?

( ) Yes or already do

( ) Maybe

( ) No

How much do the following factors limit your ability to implement regular septic servicing?

	Not at all	A little	Some	A lot	Don't Know
4. Don't know how to do it	( )	( )	( )	( )	( )
5. Time required	( )	( )	( )	( )	( )
6. Cost	( )	( )	( )	( )	( )
7. The features of my property make it difficult	( )	( )	( )	( )	( )
8. Not certain of water quality benefit	( )	( )	( )	( )	( )
9. I have not needed to do this in the past	( )	( )	( )	( )	( )
10. Physical or health limitations	( )	( )	( )	( )	( )
11. Hard to use with my farming system	( )	( )	( )	( )	( )
12. Lack of equipment	( )	( )	( )	( )	( )

Cover Crops: Planting cover crops for erosion protection and soil improvement

13. How familiar are you with this practice?

( ) Not relevant

( ) Never heard of it

14. If the practice is not relevant, please explain why.

( ) Somewhat familiar with it
( ) Know how to use it; not using it
( ) Currently use it

15. Are you willing to try this practice?
( ) Yes or already do
( ) Maybe
( ) No

Cover crops continued: How much do the following factors limit your ability to implement cover cropping?

	Not at all	A little	Some	A lot	Don't Know
16. Don't know how to do it	( )	( )	( )	( )	( )
17. Time required	( )	( )	( )	( )	( )
18. Cost	( )	( )	( )	( )	( )
19. The features of my property make it difficult	( )	( )	( )	( )	( )
20. Not certain of soil and water quality benefit	( )	( )	( )	( )	( )
21. Desire to keep things the way they are	( )	( )	( )	( )	( )
22. Hard to use with my farming system	( )	( )	( )	( )	( )
23. Lack of equipment	( )	( )	( )	( )	( )

Riparian (area along a stream or ditch) Fencing: Fencing that excludes animals from stream or ditch water.

24. How familiar are you with this practice?
( ) Not relevant
( ) Never heard of it
( ) Somewhat familiar with it
( ) Know how to use it; not using it
( ) Currently use it

25. If the practice is not relevant, please explain why.

26. Are you willing to try this practice?
( ) Yes or already do

( ) Maybe
( ) No

How much do the following factors limit your ability to implement this practice?

	Not at all	A little	Some	A lot	Don't Know
27. Don't know how to do it	( )	( )	( )	( )	( )
28. Time required	( )	( )	( )	( )	( )
29. Cost	( )	( )	( )	( )	( )
30. The features of my property make it difficult	( )	( )	( )	( )	( )
31. Not certain of water quality benefit	( )	( )	( )	( )	( )
32. Desire to keep things the way they are	( )	( )	( )	( )	( )
33. Hard to use with my farming system	( )	( )	( )	( )	( )
34. Lack of equipment	( )	( )	( )	( )	( )

Conservation Tillage: Establishing crops in the previous crop residues which are purposely left on the soil surface.

35. How familiar are you with this practice?
( ) Not relevant
( ) Never heard of it
( ) Somewhat familiar with it
( ) Know how to use it; not using it
( ) Currently use it

36. If the practice is not relevant, please explain why.

37. Are you willing to try this practice?
( ) Yes or already do
( ) Maybe
( ) No

How much do the following factors limit your ability to implement this practice?

	Not at all	A little	Some	A lot	Don't Know
38. Don't know how to do it	( )	( )	( )	( )	( )
39. Time required	( )	( )	( )	( )	( )
40. Cost	( )	( )	( )	( )	( )
41. The features of my property make it difficult	( )	( )	( )	( )	( )

42. Not sure of soil or water quality benefits	( )	( )	( )	( )	( )
43. Desire to keep things the way they are	( )	( )	( )	( )	( )
44. Hard to use with my farming system	( )	( )	( )	( )	( )
45. Lack of equipment	( )	( )	( )	( )	( )

Other comments regarding conservation tillage and your farm:

Making Decisions for my Property

In general, how much does each issue limit your ability to change your agricultural management practices?

	Not at all	A little	Some	A lot	Don't Know
1. Personal out-of-pocket expense	( )	( )	( )	( )	( )
2. Lack of government funds for cost share	( )	( )	( )	( )	( )
3. Not having access to the equipment that I need	( )	( )	( )	( )	( )
4. Lack of available information about a practice	( )	( )	( )	( )	( )
5. No one else I know is implementing the practice	( )	( )	( )	( )	( )
6. Concerns about reduced yields	( )	( )	( )	( )	( )
7. Approval of my neighbors	( )	( )	( )	( )	( )
8. Don't want to participate in government programs	( )	( )	( )	( )	( )
9. Requirements or restrictions of government programs	( )	( )	( )	( )	( )
10. Possible interference with my flexibility to change land use practices as conditions warrant	( )	( )	( )	( )	( )
11. Environmental damage caused by practice	( )	( )	( )	( )	( )

12. I do not own the property	( )	( )	( )	( )	( )
13. Not being able to see a demonstration of the practice before I decide	( )	( )	( )	( )	( )

About Your Farm Operation

1. Please select the option that best describes who generally makes management decisions for your operation.

( ) Me alone or with my spouse

( ) Me with my family partners (siblings, parents, children)

( ) Me with the landowner

( ) Me with my tenant

( ) Me and my business partners

( ) Someone else makes the decision for the operation

( ) Other

2. Please estimate the total tillable acreage (owned and/or rented) of your farming operation this year.

3. This year, how many acres of corn do you manage? If none, please enter a zero.

4. This year, how many acres of soybeans do you manage? If none, please enter a zero.

5. This year, how many acres of small grains do you manage? If none, please enter a zero.

6. This year, how many acres of pasture do you manage? If none, please enter a zero.

7. How many years have you been farming? (Please enter years)

8. Did any family member own and operate this farm before you did?

( ) No

( ) Yes

9. If you answered 'yes' to the previous question, how many years has the farm been in the family?

10. How likely is it that any family member will continue farm operations when you retire or quit farming?
( ) Definitely will not happen
( ) Probably will not happen
( ) Probably will happen
( ) Definitely will happen

11. Does the property you manage touch a stream, river, lake, or wetland?
( ) Yes
( ) No

12. Five years from now, which statement will best describe your farm operation?
( ) It will be about the same as it is today
( ) It will be larger
( ) It will be smaller
( ) I don't know

13. Do you have a nutrient management plan for your farm operation?
( ) No
( ) Yes

14. Who developed your current nutrient management plan?
( ) My land Conservation District / Department, University Extension, or NRCS office
( ) A private-sector agronomist or crop consultant
( ) I created my own plan
( ) I don't know
( ) Other

15. What is included in your nutrient management plans?
[ ] Commercial nutrients
[ ] Livestock manure
[ ] Septic waste
[ ] Municipal sludge

[ ] Industrial sludge
[ ] Other

About You

1. What is your gender?
( ) Male
( ) Female

2. What is your age?

3. What is the highest grade in school you have completed?
( ) Some formal schooling
( ) High school diploma/GED
( ) Some college
( ) 2 year college degree
( ) 4 year college degree
( ) Post-graduate degree

4. How long have you lived at your current residence (years)?

5. Which of the following best describes where you live?
( ) In a town, village, or city
( ) In an isolated, rural, non-farm residence
( ) Rural subdivision or development
( ) On a farm

6. In addition to your residence, which of the following do you own or manage? (check all that apply)
[ ] An agricultural operation
[ ] Forested land
[ ] Rural recreational property
[ ] None of these

7. How many days, if any, did you work at least 4 hours per day off your farm operation for pay in the past year? (Include work on someone else's farm for pay.)
( ) None
( ) 1 - 49 days
( ) 50 - 99 days
( ) 100 - 199 days
( ) 200 days or more

8. Do you consider yourself retired from your farm operation?
( ) Retired
( ) Partially retired
( ) Not retired

9. Where are you likely to seek information about soil and water conservation issues? (Check all that apply)
[ ] Newsletters/brochure/factsheet
[ ] Internet
[ ] Radio
[ ] Workshops/demonstrations/meetings
[ ] Conversations with others
[ ] Trade publications/magazines
[ ] None of the above

10. Do you regularly read a local newspaper?
( ) Yes
( ) No

Information Sources

People get information about water quality from a number of different sources. To what extent do you trust those listed below as a source of information about soil and water?

	Not at all	Slightly	Moderately	Very much	Am not familiar
1. Soil and Water Conservation District	( )	( )	( )	( )	( )
2. Natural Resources Conservation Service	( )	( )	( )	( )	( )
3. University Extension	( )	( )	( )	( )	( )

4. Farm Bureau	( )	( )	( )	( )	( )
5. Fertilizer representatives	( )	( )	( )	( )	( )
6. Crop consultants	( )	( )	( )	( )	( )
7. Other landowners / friends	( )	( )	( )	( )	( )
8. Farm Service Agency	( )	( )	( )	( )	( )

Septic Systems

1. Do you have a septic system?

( ) No

( ) Don't Know

( ) Yes

2. If you answered 'yes' to the previous question, in what year was it installed?

3. Within the last five years, have you had any of the following problems? (Check all that apply)-

[ ] Slow drains

[ ] Sewage backup in house

[ ] Bad smells near tank or drain field

[ ] Sewage on the surface

[ ] Sewage flowing to ditch

[ ] Frozen septic

[ ] Other

[ ] None

[ ] Don't know

4. In the future, would you like a reminder from your local health department regarding inspection/maintenance of your septic system?

( ) Yes

( ) No

( ) Don't know

5. Does your septic system have an absorption field (finger system)?

( ) Yes
( ) No
( ) Don't know

6. How would you know if your septic system was NOT working properly? (Check all that apply)
[ ] Slow drains
[ ] Sewage backup in house
[ ] Bad smells
[ ] Toilet backs up
[ ] Wet spots in lawn
[ ] Pumping tank monthly or more
[ ] Straight pipe to ditch
[ ] Frozen septic
[ ] Don't know
[ ] Other

7. Is your septic system designed to treat sewage or get rid of waste?
( ) Treat sewage
( ) Get rid of waste
( ) Both
( ) Neither
( ) Don't know

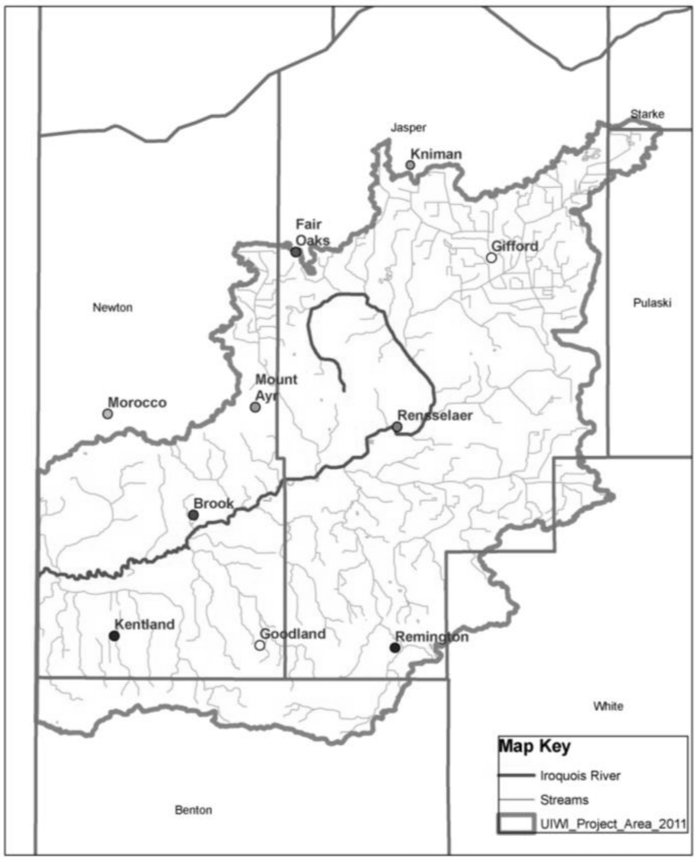
Thank You

1. Please use the space below for any additional comments about this survey or water resources in your community.

Appendix 3 Urban Social Indicators Survey

Your Views on Local Water Resources

The Upper Iroquois Watershed Initiative is a local group of farmers, businesses, and landowners who are conducting this survey in coordination with local partners and Purdue University. The purpose is to identify the concerns you have regarding water quality in the Upper Iroquois Watershed.
We need your help to direct future planning and grant dollar projects. Your opinion will be counted!



You can fill out the survey online by going to www.iroquoiswatershed.org

If you choose to complete the survey online, you will need to enter a "response id", which is the code highlighted above your name on the envelope this survey came in. Please call 219-866-8008 ext 115 if you lost your envelope.

This lets us know that you have completed the survey. The information is confidential and will never be linked to your name, only to this code, which is only for the purpose of knowing who has responded to the survey.

Your voluntary participation in this survey is very important to understanding your needs and concerns. Your answers will be kept confidential and will be released only as summaries. Individual answers cannot be identified.

Please check the circle that corresponds to the answer category that best describes you and your situation or opinion for the residence located within the area shown on the map.

The survey should take approximately 25 minutes to complete. Ple
carefully.
Thank you!

For more information about the Upper Iroquois Watershed Initiativ
contact Dan Perkins, Jasper County SWCD Watershed Coordinator a

Rating of Water Quality

Overall, how would you rate the quality of the water in your area?

	Poor	Okay	Good	Don't Know
1. For canoeing / kayaking / other boating	( )	( )	( )	( )
2. For eating locally caught fish	( )	( )	( )	( )
3. For swimming	( )	( )	( )	( )
4. For picnicking and family activities	( )	( )	( )	( )
5. For fish habitat	( )	( )	( )	( )
6. For scenic beauty	( )	( )	( )	( )

Your Water Resources

1. Of these activities, which is the most important to you?

( ) For canoeing / kayaking / other boating
( ) For eating locally caught fish
( ) For swimming
( ) For picnicking and family activities
( ) For fish habitat
( ) For scenic beauty

2. Do you know where the rain water goes when it runs off of your property?

( ) No
( ) Yes

3. If you answered 'Yes' above, where does your rain water drain to?

Your Opinions

Please indicate your level of agreement or disagreement with the statements below.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1. The way that I care for my lawn and yard can influence water quality in local streams and lakes.	( )	( )	( )	( )	( )
2. It is my personal responsibility to help protect water quality.	( )	( )	( )	( )	( )
3. It is important to protect water quality even if it slows economic development.	( )	( )	( )	( )	( )
4. My actions have an impact on water quality.	( )	( )	( )	( )	( )
5. I would be willing to pay more to improve water quality (for example: through local taxes or fees)	( )	( )	( )	( )	( )
6. I would be willing to change the way I care for my lawn and yard to improve water quality.	( )	( )	( )	( )	( )
7. The quality of life in my community depends on good water quality in local streams, rivers and lakes.	( )	( )	( )	( )	( )

Water Impairments

Below is a list of water pollutants and conditions that are generally present in water bodies to some extent. The pollutants and conditions become a problem when present in excessive amounts. In your opinion, how much of a problem are the following water impairments in your area?

	Not a Problem	Slight Problem	Moderate Problem	Severe Problem	Don't Know
1. Sedimentation (dirt and soil) in the water	( )	( )	( )	( )	( )
2. Nitrogen	( )	( )	( )	( )	( )
3. Phosphorus	( )	( )	( )	( )	( )
4. Bacteria and viruses in the water (such as E.coli / coliform)	( )	( )	( )	( )	( )
5. Toxic materials in the water	( )	( )	( )	( )	( )
6. Arsenic	( )	( )	( )	( )	( )
7. Algae in the water	( )	( )	( )	( )	( )
8. Habitat alteration harming local fish	( )	( )	( )	( )	( )

9. Pesticides	( )	( )	( )	( )	( )
10. Straightening of stream {channelization}	( )	( )	( )	( )	( )

Sources of Water Pollution

The items listed below are sources of water quality pollution across the country. In your opinion, how much of a problem are the following sources in your area?

	Not a Problem	Slight Problem	Moderate Problem	Severe Problem	Don't Know
1. Discharges from sewage treatment plants	( )	( )	( )	( )	( )
2. Soil erosion from farm fields	( )	( )	( )	( )	( )
3. Excessive use of lawn fertilizers and/or pesticides	( )	( )	( )	( )	( )
4. Improperly maintained septic systems	( )	( )	( )	( )	( )
5. Manure from farm animals	( )	( )	( )	( )	( )
6. Stormwater run-off from rooftops and/or parking lots	( )	( )	( )	( )	( )
7. Stormwater run-off from streets and/or highways	( )	( )	( )	( )	( )
8. Waste material from pets	( )	( )	( )	( )	( )
9. Littering/illegal dumping of trash	( )	( )	( )	( )	( )
10. Excessive use of fertilizers for crop production	( )	( )	( )	( )	( )
11. Landfill(s)	( )	( )	( )	( )	( )
12. Inappropriate waste disposal	( )	( )	( )	( )	( )
13. Dredging of streams	( )	( )	( )	( )	( )
14. Failing septic systems	( )	( )	( )	( )	( )
15. Removal of vegetation along a stream-ditch	( )	( )	( )	( )	( )
16. Straightening of streams {channelization}	( )	( )	( )	( )	( )
17. Combined sewer overflows {CSO}	( )	( )	( )	( )	( )

Consequences of Poor Water Quality

Poor water quality can lead to a variety of consequences for communities. In your opinion, how much of a problem are the following issues in your area?

	Not a Problem	Slight Problem	Moderate Problem	Severe Problem	Don't Know
1. Contaminated drinking water	( )	( )	( )	( )	( )

2. Polluted swimming areas	( )	( )	( )	( )	( )
3. Contaminated fish	( )	( )	( )	( )	( )
4. High drinking water treatment costs	( )	( )	( )	( )	( )
5. Loss of desirable fish species	( )	( )	( )	( )	( )
6. Reduced beauty of lakes or streams	( )	( )	( )	( )	( )
7. Reduced opportunities for water recreation	( )	( )	( )	( )	( )
8. Reduced quality of water recreation activities	( )	( )	( )	( )	( )
9. Excessive aquatic plants or algae	( )	( )	( )	( )	( )
10. Fish kills	( )	( )	( )	( )	( )
11. Odor	( )	( )	( )	( )	( )
12. Lower property values	( )	( )	( )	( )	( )

Practices to Improve Water Quality

Please indicate which statement most accurately describes your level of experience with each practice listed below.

	Not relevant for my property	Never heard of it	Somewhat familiar with it	Know how to use it; not using it	Currently use it
1. Following the manufacturer's instructions when fertilizing lawn or garden	( )	( )	( )	( )	( )
2. Create a rain garden	( )	( )	( )	( )	( )
3. Use a mulching lawn mower	( )	( )	( )	( )	( )
4. Follow pesticide application instructions for lawn and garden	( )	( )	( )	( )	( )
5. Use phosphate free fertilizer	( )	( )	( )	( )	( )
6. Recycle automotive oil	( )	( )	( )	( )	( )
7. Properly dispose of pet waste	( )	( )	( )	( )	( )
8. Use rain barrels	( )	( )	( )	( )	( )
9. Add tank additives to a septic system	( )	( )	( )	( )	( )
10. Inspect septic system for size and condition	( )	( )	( )	( )	( )
11. Not planting trees and shrubs over septic system	( )	( )	( )	( )	( )
12. Restore native plant communities	( )	( )	( )	( )	( )

Specific Constraints of Practices

Grass Clipping Management: Keep grass clippings and leaves out of the roads, ditches, and gutters

1. How familiar are you with this practice?

( ) Not relevant

( ) Never heard of it

( ) Somewhat familiar with it

( ) Know how to use it; not using it

( ) Currently use it

2. If the practice is not relevant, please explain why.

3. Are you willing to try this practice?

( ) Yes or already do

( ) Maybe

( ) No

<u>Grass Clipping Management continued:</u>

How much do the following factors limit your ability to implement this practice?

	Not at all	A little	Some	A lot	Don't Know
4. Don't know how to do it	( )	( )	( )	( )	( )
5. Time required	( )	( )	( )	( )	( )
6. Cost	( )	( )	( )	( )	( )
7. The features of my property make it difficult	( )	( )	( )	( )	( )
8. Not certain of water quality benefits	( )	( )	( )	( )	( )
9. Desire to keep things the way they are	( )	( )	( )	( )	( )
10. Physical or health limitations	( )	( )	( )	( )	( )
11. Hard to use with my farming system	( )	( )	( )	( )	( )
12. Lack of equipment	( )	( )	( )	( )	( )

Regular Septic System Servicing: Having septic system thoroughly cleaned every 3-5 years to remove all the sludge, effluent and scum from the tank.

13. How familiar are you with this practice?

( ) Not relevant

( ) Never heard of it

14. If the practice is not relevant, please explain why.

( ) Somewhat familiar with it
( ) Know how to use it; not using it
( ) Currently use it

15. Are you willing to try this practice?
( ) Yes or already do
( ) Maybe
( ) No

Regular septic servicing continued:
How much do the following factors limit your ability to implement this practice?

	Not at all	A little	Some	A lot	Don't Know
16. Don't know how to do it	( )	( )	( )	( )	( )
17. Time required	( )	( )	( )	( )	( )
18. Cost	( )	( )	( )	( )	( )
19. The features of my property make it difficult	( )	( )	( )	( )	( )
20. Not certain of water quality benefit	( )	( )	( )	( )	( )
21. Desire to keep things the way they are	( )	( )	( )	( )	( )
22. Physical or health limitations	( )	( )	( )	( )	( )
23. Hard to use with my farming system	( )	( )	( )	( )	( )
24. Lack of equipment	( )	( )	( )	( )	( )

Porous Pavement: Pervious pavement (porous asphalt, grass pavers) allows rain to enter the soil, recharging the groundwater and filtering environmental contaminants.

25. How familiar are you with this practice?

26. If the practice is not relevant, please explain why.

( ) Not relevant
( ) Never heard of it
( ) Somewhat familiar with it
( ) Know how to use it; not using it
( ) Currently use it

27. Are you willing to try this practice?
( ) Yes or already do
( ) Maybe
( ) No

How much do the following factors limit your ability to implement this practice?

	Not at all	**A little**	**Some**	**A lot**	**Don't Know**
28. Don't know how to do it	( )	( )	( )	( )	( )
29. Time required	( )	( )	( )	( )	( )
30. Cost	( )	( )	( )	( )	( )
31. The features of my property make it difficult	( )	( )	( )	( )	( )
32. Not certain of water quality benefit	( )	( )	( )	( )	( )
33. Desire to keep things the way they are	( )	( )	( )	( )	( )
34. Physical or health limitations	( )	( )	( )	( )	( )

Roof Run-off Management: Collecting run-off from roofs in a rain barrel or directing it a rain garden so it can infiltrate and not leave your property.

35. How familiar are you with this practice?
( ) Not relevant
( ) Never heard of it
( ) Somewhat familiar with it
( ) Know how to use it; not using it
( ) Currently use it

36. If the practice is not relevant, please explain why.

37. Are you willing to try this practice?
( ) Yes or already do
( ) Maybe
( ) No

How much do the following factors limit your ability to implement this practice?

	Not at all	A little	Some	A lot	Don't Know
38. Don't know how to do it	( )	( )	( )	( )	( )
39. Time required	( )	( )	( )	( )	( )
40. Cost	( )	( )	( )	( )	( )
41. The features of my property make it difficult	( )	( )	( )	( )	( )
42. Not certain of water quality benefit	( )	( )	( )	( )	( )
43. Desire to keep things the way they are	( )	( )	( )	( )	( )
44. Physical or health limitations	( )	( )	( )	( )	( )
45. Hard to use with my farming system	( )	( )	( )	( )	( )
46. Lack of equipment	( )	( )	( )	( )	( )

Making Decisions for my Property

In general, how much does each issue limit your ability to change your agricultural management practices?

	Not at all	A little	Some	A lot	Don't Know
1. Personal out-of-pocket expense	( )	( )	( )	( )	( )
2. My own physical abilities	( )	( )	( )	( )	( )
3. Not having access to the equipment that I need	( )	( )	( )	( )	( )

4. Lack of available information about a practice	( )	( )	( )	( )	( )
5. No one else I know is implementing the practice	( )	( )	( )	( )	( )
6. Approval of my neighbors	( )	( )	( )	( )	( )
7. Don't know where to get information and/or assistance about those practices	( )	( )	( )	( )	( )
8. Environmental damage caused by practice	( )	( )	( )	( )	( )
9. Legal restrictions on my property	( )	( )	( )	( )	( )
10. Concerns about resale value	( )	( )	( )	( )	( )
11. Not being able to see a demonstration of the practice before I decide	( )	( )	( )	( )	( )
12. The need to learn new skills or techniques	( )	( )	( )	( )	( )

About You

1. Do you make the home and lawn care decisions in your household?

( ) Yes

( ) No

2. What is your gender?

( ) Male

( ) Female

3. What is your age?

4. What is the highest grade in school you have completed?

( ) Some formal schooling

( ) High school diploma/GED

( ) Some college

( ) 2 year college degree

( ) 4 year college degree

( ) Post-graduate degree

About you continued:

5. What is your occupation?

6. What is the approximate size of your residential lot?
( ) 1/4 acre or less
( ) More than 1/4 acre but less than 1 acre
( ) 1 acre to less than 5 acres
( ) 5 acres or more

7. Do you own or rent your home?
( ) Own
( ) Rent

8. How long have you lived at your current residence (years)?

9. Which of the following best describes where you live?
( ) In a town, village, or city
( ) In an isolated, rural, non-farm residence
( ) Rural subdivision or development
( ) On a farm

10. In addition to your residence, which of the following do you own or manage? (check all that apply)
[ ] An agricultural operation
[ ] Forested land
[ ] Rural recreational property
[ ] None of these

11. Do you use a professional lawn care service?
( ) Yes, just for mowing
( ) Yes, for mowing and fertilizing
( ) Yes, just for fertilizing and pest control
( ) Yes, for mowing, fertilizing, and pest control
( ) No

About you continued:

12. Where are you likely to seek information about water quality issues?
[ ] Newsletters/brochure/fact sheet
[ ] Internet
[ ] Radio
[ ] Newspapers/magazines
[ ] Workshops/demonstrations/meetings
[ ] Conversations with others
[ ] None of the above

Information Sources

People get information about water quality from a number of different sources. To what extent do you trust those listed below as a source of information about soil and water?

	Not at all	Slightly	Moderately	Very much	Am not familiar
1. Local watershed project	( )	( )	( )	( )	( )
2. Local government	( )	( )	( )	( )	( )
3. U.S. Environmental Protection Agency	( )	( )	( )	( )	( )
4. University Extension	( )	( )	( )	( )	( )
5. Environmental groups	( )	( )	( )	( )	( )
6. Local garden center	( )	( )	( )	( )	( )
7. Lawn care company	( )	( )	( )	( )	( )
8. Local community leader	( )	( )	( )	( )	( )
9. Neighbors / friends	( )	( )	( )	( )	( )
10. State natural resources agency	( )	( )	( )	( )	( )
11. County Health department	( )	( )	( )	( )	( )
12. Land trust	( )	( )	( )	( )	( )

Septic Systems

1. Do you have a septic system? (If no, please proceed to “Thank You” section of survey).
( ) No
( ) Don't Know
( ) Yes

2. If you answered 'yes' to the previous question, in what year was it installed?

Septic Systems continued:

3. Within the last five years, have you had any of the following problems? (Check all that apply)-

[ ] Slow drains

[ ] Sewage backup in house

[ ] Bad smells near tank or drain field

[ ] Sewage on the surface

[ ] Sewage flowing to ditch

[ ] Frozen septic

[ ] Other

[ ] None

[ ] Don't know

4. In the future, would you like a reminder from your local health department regarding inspection/maintenance of your septic system?

( ) Yes

( ) No

( ) Don't know

5. Do you have a garbage disposal?

( ) Yes, I use it daily

( ) Yes, I use it occasionally

( ) Yes, but I don't use it

( ) No

6. Does your septic system have an absorption field (finger system)?

( ) Yes

( ) No

( ) Don't know

7. How would you know if your septic system was NOT working properly? (Check all that apply)

[ ] Slow drains

[ ] Sewage backup in house

[ ] Bad smells

[ ] Toilet backs up

[ ] Wet spots in lawn

[ ] Pumping tank monthly or more
[ ] Straight pipe to ditch
[ ] Frozen septic
[ ] Don't know
[ ] Other

Septic Systems continued:

8. Is your septic system designed to treat sewage or get rid of waste?
( ) Treat sewage
( ) Get rid of waste
( ) Both
( ) Neither
( ) Don't know

9. Do you think a local government agency should handle inspection and maintenance of septic systems?
( ) Yes
( ) No
( ) Don't Know

Thank You

1. Please use the space below for any additional comments about this survey or water resources in your community.

Appendix 4. Windshield Survey Form

Windshield Survey Field Sheet

Watershed ______________ Site ID (Taken from Map) ______________

Date ______________ Field Investigator(s) ______________

Time ______________

Water Odors	Water Color/Appearance	Algae
check all that apply	*check all that apply*	*check all that apply*
☐ Normal	☐ Clear	☐ Floating
☐ Sewage	☐ Green	☐ Attached to Substrate
☐ Petroleum	☐ Brown	☐ Thick mats
☐ Chemical	☐ Murky	☐ Limited growth
☐ Other ______	☐ Oily Sheen	☐ Moderate growth
	☐ Other ______	☐ Excessive growth

Stream Buffer

	North Side	Y	N	
☐ Present	South side	Y	N	
☐ Absent	East Side	Y	N	
	West Side	Y	N	

Stream Buffer Notes:

☐ Natural
☐ Installed
☐ Unknown

Buffer Type
check all that apply Notes:

☐ Trees
☐ Shrubs
☐ Grasses
☐ Other ______________

Estimated Width of Buffer
______________ feet

Landuse adjacent to Buffer ______________

Active Erosion
☐ Present
☐ Absent

Pictures Taken
☐ Yes
☐ No

Signs of Livestock Access
☐ Yes
☐ No

Evidence of Channelization/Cleaning
☐ Yes
☐ No

Brief Description

Land Use - *Check land uses that best apply*

☐ Residential
- ☐ Single Family
- ☐ Multi-family
- ☐ Stormdrain marking present
- ☐ Stormwater management practices
  - ☐ curb and gutter
  - ☐ retention basins
  - ☐ naturalized drainage systems

☐ Industrial
☐ Commercial (Strip malls, restaurants, etc)
☐ Forestry
☐ Mining

☐ Agricultural
- ☐ Row Crop
- ☐ Pasture
  - ☐ Stream access
  - ☐ Fenced from stream
- ☐ Feedlot
  - ☐ Cattle (dairy)
  - ☐ Cattle (other)
  - ☐ Hogs
  - ☐ Other ______________
  - Estimated size of operation ________
- ☐ Tillage type
  - ☐ no-till
  - ☐ reduced till
  - ☐ conventional

Explain any opportunities you see at this site for a BMP:

Is there anything else about this site worth recording?

Appendix 5: Potential Source Summary Data HUC 10

Item Code	Watershed (Count/%) miles/sq miles	Oliver Ditch	Carpenter-Denton Creeks	Upper Iroquois-Ryan Creek	Curtis-Hunter Creek	Montgomery- Strole Creek
0	Size (Sq Miles)	82	145	136	162	127
1	Size (Acres)	52,685	92,875	86,768	103,490	81,048
2	Artificial Drainage Length (mi.)	230	136	242	111	104
3	Natural Stream (mi.)	124	160	136	153	106
4	Total Natural + Artificial Drain (mi.)	354	296	378	264	210
5	Artificial Drain as % of Total Drain(mi.)	65%	46%	64%	42%	50%
6	Livestock Access Sites	2	12	7	19	2
7	# of Active CSO	0	?	9+	?	?
8	Number of CFO facilities	4	10	10	10	2
9	Number of NPDES Facilities	0	2	3	6	2
10	100 ft Stream Buffer % class as Buffered	18	20	18	23	20
11	% of Land Area in Wetland	6.5	1	2.5	1.4	0.8
12	Active Erosion Sites	1	2	19	11	0
13	Channelization Sites	40	72	56	62	12
14	% of Windshield Sites 100% Buffer	22	61	30	48	38
15	% of Windshield Sites 75% Buffer	14	5	9	1	0
16	% of Windshield Sites 50% Buffer	18	15	22	20	19
17	% of Windshield Sites 25% Buffer	23	3	22	5	19
18	% of Windshield Sites 0% Buffer	23	16	16	26	25
19	Sediment Exceedance target (10.4 NTU)	10	34	8	53	3
20	E.coli Samples					
21	E.coli exceedance 5 yr target (576u/100ml)	1	4	3	15	12
22	E.coli exceedance 10 yr target (235u/100ml)	1	19	14	23	13
23	Nitrate-Nitrogen Samples	16				
24	Nitrate-Nitrogen exceedance 5 yr target (10 mg/L)	1	4	1	2	2
25	Nitrate-Nitrogen exceedance 20 yr target (1.5 mg/L)	6	28	4	33	7
26	Orthophosphate Samples					
27	Orthophosphate Exceedance target (0.005 mg/L)	12	47	4	63	16
28	Sites with MIBI Score < 10 Poor			1		2
29	Sites CQHEI<60 Unhealthy	1	2	4	5	5

30	Site MIBI Score < 16 Fair	1	3	2	6	1
31	Sites CQHEI<99 Healthy		1			
32	Sites MIBI Score <22 Good			1		
33	Sites CQHE >100 High Quality					
34	Sites MIBI Score >23 Excellent		1			
35	Tillage Transect % Corn Acres No-till Decline 2000-20011	8	8	8	13	13
36	Tillage Transect % Soybean Acres No-till Decline 2000-2011	3	3	3	12	12
37	Nitrate Load Reduction Needed	55	68	68	61	74
38	TSS Load Reduction Needed	44	91	63	66	73
39	Orthophosphate Reduction Needed	?	?	?	?	?
40	E.coli Reduction Needed	-60	24	-4	1	45
41	% land in Wetland Acres (NWI)	6.5	1	2.5	1.4	0.8
42	303(d) 2010 Impairment Rank (higher # worse)	0	4	2	4	3
43	303(d) 2008 Impairment Rank (higher # worse)	0	5	2	6	4
44	Impervious Surface (%)	?	?	?	?	?
45	Nitrate Leaching High Concerns Acres (%)	44%	23%	14%	31%	4%
46	Nitrate Leaching Concerns Acres (%)	24%	42%	52%	26%	67%

Appendix 6 HUC 10 Ranking Scores

Item Code	Watershed Rank (1 is lowest, 5 is most)	Oliver Ditch	Carpenter-Denton Creeks	Upper Iroquois-Ryan Creek	Curtis-Hunter Creek	Montgomery- Strole Creek
0	Size (Sq Miles)	1	4	3	5	2
1	Size (Acres)	1	4	3	5	2
2	Artificial Drainage Length (mi.)	4	3	5	2	1
3	Natural Stream (mi.)	2	5	3	4	1
4	Total Natural + Artificial Drain (mi.)	4	3	5	2	1
5	Artificial Drain as % of Total Drain(mi.)	5	2	4	1	3
6	Livestock Access Sites	1	4	3	5	2
7	# of Active CSO	1	4	5	3	2
8	Number of CFO facilities	2	5	5	5	1
9	Number of NPDES Facilities	1	3	4	5	2
10	100 ft Stream Buffer % class as Buffered	5	2	4	1	3
11	% of Land Area in Wetland	1	5	2	3	5
12	Active Erosion Sites	2	3	5	4	1
13	Channelization Sites	2	5	3	4	1
14	% of Windshield Sites 100% Buffer	5	1	4	2	3
15	% of Windshield Sites 75% Buffer					
16	% of Windshield Sites 50% Buffer					
17	% of Windshield Sites 25% Buffer					
18	% of Windshield Sites 0% Buffer	3	2	1	5	4
19	Sediment Exceedance target (10.4 NTU)	3	4	2	5	1
20	E.coli Samples					
21	E.coli exceedance 5 yr target (576u/100ml)	1	3	2	5	4
22	E.coli exceedance 10 yr target (235u/100ml)	3	4	2	5	1
23	Nitrate-Nitrogen Samples					
24	Nitrate-Nitrogen exceedance 5 yr target (10 mg/L)	1	5	2	4	3
25	Nitrate-Nitrogen exceedance 20 yr target (1.5 mg/L)	2	4	1	5	3
26	Orthophosphate Samples					
27	Orthophosphate Exceedance target (0.005 mg/L)	2	4	1	5	3

28	Sites with MIBI Score < 10 Poor			5		4
29	Sites CQHEI<60 Unhealthy	1	2	3	5	4
30	Site MIBI Score < 16 Fair	3	2	5	1	4
31	Sites CQHEI<99 Healthy					
32	Sites MIBI Score <22 Good					
33	Sites CQHE >100 High Quality					
34	Sites MIBI Score >23 Excellent					
35	Tillage Transect % Corn Acres No-till Decline 2000-20011	1	3	2	5	4
36	Tillage Transect % Soybean Acres No-till Decline 2000-2011	1	3	2	5	4
37	Nitrate Load Reduction Needed	1	4	3	2	5
38	TSS Load Reduction Needed	1	5	2	3	4
39	Orthophosphate Reduction Needed					
40	E.coli Reduction Needed	1	4	2	3	5
41	% land in Wetland Acres (NWI)	1	4	2	3	5
42	303(d) 2010 Impairment Rank (higher # worse)	0	5	1	5	2
43	303(d) 2008 Impairment Rank (higher # worse)	0	4	1	5	2
44	Impervious Surface (%)					
45	Nitrate Leaching High Concerns Acres (%)	1	3	4	2	5
46	Nitrate Leaching Concerns Acres (%)	5	3	2	4	1

Appendix 7 HUC 12 Ranking Scores

		HUC 10	Carpenter Denton Creeks						Curtis-Hunter Creeks				
Item Code	Watershed (Count/%) miles/sq miles	HUC 12	Keefe Ditch	Jordan-Slough Creek	Nessius-Bice Ditch	Headwaters Carpenter Cree	Carpenter Creek	Bice-Slough Ditch	Heawaters Curtis Creek	Turner Ditch - Iroquois Rive	Hunter Ditch	Bower Ditch - Darroch Ditch	Hickory Branch - Iroquois R
0	Size (Sq Miles)		1	8	4	6	7	3	9	5	11	2	10
1	Size (Acres)		1	8	4	6	7	3	9	5	11	2	10
2	Artifical Drainage Length (mi.)		2	11	5	1	9	10	6	4	3	7	8
3	Natural Stream (mi.)		1	11	4	5	8	6	9	3	7	2	10
4	Total Natural+Artifical Drain (mi.)		1	11	5	2	10	7	8	3	6	4	9
5	Regulated stream miles as % of Total Drain(mi.)		10	8	6	1	5	9	3	7	2	11	4
6	Livestock Access Sites		2	6	1	3	7	4	10	1	9	1	5
7	# of Active CSO												
8	Number of CFO facilities			3	1	1	2	1	3	1	1		2
9	Number of NPDES Facilities					2			1		2		3
10	100 ft Stream Buffer % class as Buffered		3	5	11	8	6	1	7	2	10	7	4
11	% of Land Area in Wetland		3	7	5	4	6	8	9	11	1	2	10
12	Active Erosion Sites		1	0	1	2	0	0	3	0	0	0	0
13	Channelization Sites		3	9	4	6	6	5	7	2	1	1	8
14	% of Windshield Sites 100% Buffer		10	6	1	2	4	5	7	3	11	8	9
15	% of Windshield Sites 75% Buffer		0	0	0	0	0	0	0	0	0	0	0
16	% of Windshield Sites 50% Buffer		1	2	0	0	6	4	3	0	7	0	7
17	% of Windshield Sites 25% Buffer		1	0	0	0	0	0	0	0	0	0	0
18	% of Windshield Sites 0% Buffer		7	5	0	1	2	6	8	4	11	10	9
	# of WQ Sample Sites (UIWI Data)		0	0	0	1	2	1	3	0	1	0	2
19	Sediment Exceedance target (10.4 NTU)					1	4	2	5		3		7
20	e.coli Samples												
21	e.coli exceedance 5 yr target (576u/100ml)					1	2	0	4		3		5
22	e.coli exceedance 10 yr target (235u/100ml)					1	5	2	4		3		6
23	Nitrate-Nitrogen Samples												
24	Nitrate-Nitrogen exceedance 5 yr target (10 mg/L)					2	2	1	1		1		2
25	Nitrate-Nitrogen exceedance 20 yr target (1.5 mg/L)					1	4	2	6		3		5
26	Orthophosphate Samples												
27	Orthophosphate Exceedance target (0.005 mg/L)					2	5	1	6		3		4
28	# Sites with MIBI Score < 10 Poor					0	0	0	0		0		0
29	# Sites CQHEI<60 Unhealthy					9	9		11		9		10
30	Site MIBI Score < 16 Fair					1	1	1	1		1		1
31	Sites CQHEI<99 Healthy					1	1		0		1		0
32	Sites MIBI Score <22 Good					1	1	1	0		1		0
33	Sites CQHE >100 High Quality					0	0		0		0		0
34	Sites MIBI Score >23 Excellent					1	0	1	1		1		1
35	Tillage Transect % Corn No-till Decline 2000-20011												
36	Tillage Transect % SoybeanNo-till Decline 2000-2011												
37	% Nitrate Load Reduction Needed					6	2	5	1		4		3
38	TSS Load Reduction Needed					5	6	2	1		4		3
39	% Orthophosphate Reduction Needed					2	3	1	4		5		5
40	E.coli Reduction Needed					0	1	0	0		2		0
41	% land in Wetland Acres (NWI)		9	5	7	8	6	4	3	1	11	10	2
42	303d 2010 Impairment Rank # of		0	0	0	10	11	0	10	10	9	0	8
43	303d 2008 Impairment Rank # of		0	0	0	10	11	8	9	8	9	0	9
44	Impervious Survace (%)												
45	Nitrate Leaching High Concern Acres (%)		7	11	9	1	6	10	8	5	3	2	4
46	Nitrate Leaching Concern Acres (%)		3	1	6	9	5	2	4	8	10	7	11
47	Wind Erodibility Group Acres (%)												

Appendix 8 Problem Statement Critical Areas HUC 10

Table 78 Problem Statement Variables and Ranking.

	The Iroquois River has undesirable high and low levels and flows of water that threaten our towns, agricultural land, and health of the river.	Subwatershed				
		Oliver Ditch	Carpenter-Denton Creeks	Upper Iroquois-Ryan Creek	Curtis-Hunter Creek	Montgomery- Strole Creek
Code	**Ranking Variable**	Ranking (1-5, 5 most contributing)				
1	Size (Acres)	1	4	3	5	2
2	Artificial Drainage Length (mi.)	4	3	5	2	1
3	Natural Stream (mi.)	2	5	3	4	1
4	Total Natural + Artificial Drain (mi.)	4	3	5	2	1
5	Artificial Drain as % of Total Drain(mi.)	5	2	4	1	3
10	100 ft Stream Buffer % class as Buffered	5	2	4	1	3
11	% of Land Area in Wetland	1	4	2	3	5
12	Active Erosion Sites	2	3	5	4	1
13	Channelization Sites	2	5	3	4	1
18	% of Windshield Sites 0% Buffer	3	2	1	5	4
21	Sediment Exceedance target (10.4 NTU)	3	4	2	5	1
31	Sites CQHEI<60 Unhealthy	1	2	3	5	4
37	Tillage Transect % Corn No-till Decline 2000-20011	1	3	2	5	4
38	Tillage Transect % Soybean No-till Decline 2000-2011	1	3	2	5	4
43	% land in Wetland Acres (NWI)	1	4	2	3	5
46	Impervious Survace (%)					
	Total Score	36	49	46	54	40
	Overall Rank	5	2	3	1	4

1 is most contributing

The desirable native fish populations in the Iroquois River and surrounding waterways are suspected to be in decline.		Subwatershed				
		Oliver Ditch	Carpenter-Denton Creeks	Upper Iroquois-Ry Creek	Curtis-Hunter Cree	Montgomery- Stro Creek
Code	**Ranking Variable**	Ranking (1-5, 5 most contributing)				
1	Size (Acres)	1	4	3	5	2
3	Natural Stream (mi.)	2	5	3	4	1
5	Artifical Drain as % of Total Drain(mi.)	5	2	4	1	3
6	Livestock Access Sites	1	4	3	5	2
7	# of Active CSO	1	4	5	3	2
8	Number of CFO facilities	2	5	5	5	1
9	Number of NPDES Facilities	1	3	4	5	2
10	100 ft Stream Buffer % class as Buffered	5	2	4	1	3
11	% of Land Area in Wetland	1	5	2	3	5
12	Active Erosion Sites	2	3	5	4	1
14	% of Windshield Sites 100% Buffer	5	1	4	2	3
15	% of Windshield Sites 75% Buffer					
16	% of Windshield Sites 50% Buffer					
17	% of Windshield Sites 25% Buffer					
18	% of Windshield Sites 0% Buffer	3	2	1	5	4
21	Sediment Exceedance target (10.4 NTU)	3	4	2	5	1
26	Nitrate-Nitrogen exceedance 5 yr target (10 mg/L)	1	5	2	4	3
27	Nitrate-Nitrogen exceedance 20 yr target (1.5 mg/L)	2	4	1	5	3
29	Orthophosphate Exceedance target (0.005 mg/L)	2	4	1	5	3
30	Sites with MIBI Score < 10 Poor			5		4
31	Sites CQHEI<60 Unhealthy	1	2	3	5	4
32	Site MIBI Score < 16 Fair	3	2	5	1	4
33	Sites CQHEI<99 Healthy					
34	Sites MIBI Score <22 Good					
35	Sites CQHE >100 High Quality					
36	Sites MIBI Score >23 Excellent					
39	Nitrate Load Reduction Needed	1	4	3	2	5
40	TSS Load Reduction Needed	1	5	2	3	4
41	Orthophosphate Reduction Needed					
42	E.coli Reduction Needed	1	4	2	3	5
43	% land in Wetland Acres (NWI)	1	4	2	3	5
44	303d 2010 Impairment Rank (higher # worse)	0	5	1	5	2
45	303d 2008 Impairment Rank (higher # worse)	0	4	1	5	2
	Total Score	45	87	73	89	74
	Overall Rank	5	2	4	1	3
		1 is most contributing				

Area streams within the watershed are very cloudy and turbid.

Code	Ranking Variable	Oliver Ditch	Carpenter-Denton Creeks	Upper Iroquois-Ryan Creek	Curtis Hunter Creek	Montgomery-Strole Creek
		Subwatershed				
		Ranking (1-5, 5 most contributing)				
1	Size (Acres)	1	4	3	5	2
6	Livestock Access Sites	1	4	3	5	2
7	# of Active CSO	1	4	5	3	2
8	Number of CFO facilities	2	5	5	5	1
9	Number of NPDES Facilities	1	3	4	5	2
10	100 ft Stream Buffer % class as Buffered	5	2	4	1	3
12	Active Erosion Sites	2	3	5	4	1
14	% of Windshield Sites 100% Buffer	5	1	4	2	3
15	% of Windshield Sites 75% Buffer	5	4	3	2	1
16	% of Windshield Sites 50% Buffer	4	1	5	3	2
17	% of Windshield Sites 25% Buffer	5	1	4	2	3
18	% of Windshield Sites 0% Buffer	3	2	1	5	4
21	E.coli exceedance 5 yr target (576u/100ml)	1	3	2	5	4
29	Sites CQHEI<60 Unhealthy	1	2	3	5	4
31	Sites CQHEI<99 Healthy					
33	Sites CQHE >100 High Quality					
35	Tillage Transect % Corn Acres No-till Decline 2000-20011	1	3	2	5	4
38	TSS Load Reduction Needed	1	5	2	3	4
39	Orthophosphate Reduction Needed					
41	% land in Wetland Acres (NWI)	1	4	2	3	5
44	Impervious Surface (%)					
	Total Score	40	51	57	63	47
	Overall Rank	5	3	2	1	4

1 is most contributing

		Subwatershed				
	Widespread recreational use is prevented.	Oliver Ditch	Carpenter-Denton Creeks	Upper Iroquois-Ryan Creek	Curtis-Hunter Creek	Montgomery-Strole Creek
Code	**Ranking Variable**	Ranking (1-5, 5 most contributing)				
1	Size (Acres)	1	4	3	5	2
6	Livestock Access Sites	1	4	3	5	2
7	# of Active CSO	1	4	5	3	2
8	Number of CFO facilities	2	5	5	5	1
9	Number of NPDES Facilities	1	3	4	5	2
10	100 ft Stream Buffer % class as Buffered	5	2	4	1	3
12	Active Erosion Sites	2	3	5	4	1
14	% of Windshield Sites 100% Buffer	5	1	4	2	3
15	% of Windshield Sites 75% Buffer					
16	% of Windshield Sites 50% Buffer					
17	% of Windshield Sites 25% Buffer					
18	% of Windshield Sites 0% Buffer	3	2	1	5	4
21	E.coli exceedance 5 yr target (576u/100ml)	1	3	2	5	4
29	Sites CQHEI<60 Unhealthy	1	2	3	5	4
37	Nitrate Load Reduction Needed	1	4	3	2	5
38	TSS Load Reduction Needed	1	5	2	3	4
39	Orthophosphate Reduction Needed					
	Total Score	25	42	44	50	37
	Overall Rank	5	3	2	1	4

1 is most contributing

The Iroquois River and its tributaries are listed on IDEM's 303(d) list for "excessive nitrate."

		Subwatershed				
		Oliver Ditch	Carpenter-Denton Creeks	Upper Iroquois-Ryan Creek	Curtis-Hunter Creek	Montgomery- Strole Creek
Code	**Ranking Variable**	Ranking (1-5, 5 most contributing)				
1	Size (Acres)	1	4	3	5	2
2	Artificial Drainage Length (mi.)	4	3	5	2	1
4	Total Natural + Artificial Drain (mi.)	4	3	5	2	1
5	Artificial Drain as % of Total Drain(mi.)	5	2	4	1	3
6	Livestock Access Sites	1	4	3	5	2
7	# of Active CSO	1	4	5	3	2
8	Number of CFO facilities	2	5	5	5	1
9	Number of NPDES Facilities	1	3	4	5	2
10	100 ft Stream Buffer % class as Buffered	5	2	4	1	3
11	% of Land Area in Wetland	1	5	2	3	5
12	Active Erosion Sites	2	3	5	4	1
14	% of Windshield Sites 100% Buffer	5	1	4	2	3
15	% of Windshield Sites 75% Buffer					
16	% of Windshield Sites 50% Buffer					
17	% of Windshield Sites 25% Buffer					
18	% of Windshield Sites 0% Buffer	3	2	1	5	4
19	Sediment Exceedance target (10.4 NTU)	3	4	2	5	1
24	Nitrate-Nitrogen exceedance 5 yr target (10 mg/L)	1	5	2	4	3
25	Nitrate-Nitrogen exceedance 20 yr target (1.5 mg/L)	2	4	1	5	3
35	Tillage Transect % Corn No-till Decline 2000-20011	1	3	2	5	4
36	Tillage Transect % Soybean No-till Decline 2000-2011	1	3	2	5	4
37	Nitrate Load Reduction Needed	1	4	3	2	5
41	% land in Wetland Acres (NWI)	1	4	2	3	5
42	303(d) 2010 Impairment Rank (higher # worse)	0	5	1	5	2
43	303(d) 2008 Impairment Rank (higher # worse)	0	4	1	5	2
45	Nitrate Leaching High Concerns Acres (%)	1	3	4	2	5
46	Nitrate Leaching Concerns Acres (%)	5	3	2	4	1
	Total Score	51	83	72	88	65
	Overall Rank	5	2	3	1	4

1 is most contributing

The Iroquois River and its tributaries are listed on IDEM's 303(d) list for "E.coli."

		Subwatershed				
		Oliver Ditch	Carpenter-Benton Creeks	Upper Iroquois-Ryan Creek	Curtis-Hunter Creek	Montgomery- Strole Creek
Code	**Ranking Variable**	Ranking (1-5, 5 most contributing)				
1	Size (Acres)	1	4	3	5	2
6	Livestock Access Sites	1	4	3	5	2
7	# of Active CSO	1	4	5	3	2
8	Number of CFO facilities	2	5	5	5	1
9	Number of NPDES Facilities	1	3	4	5	2
10	100 ft Stream Buffer % class as Buffered	5	2	4	1	3
11	% of Land Area in Wetland	1	5	2	3	5
12	Active Erosion Sites	2	3	5	4	1
21	E.coli exceedance 5 yr target (576u/100ml)	1	3	2	5	4
22	E.coli exceedance 10 yr target (235u/100ml)	3	4	2	5	1
35	Tillage Transect % Corn No-till Decline 2000-20011	1	3	2	5	4
36	Tillage Transect % Soybean No-till Decline 2000-2011	1	3	2	5	4
40	E.coli Reduction Needed	1	4	2	3	5
41	% land in Wetland Acres (NWI)	1	4	2	3	5
42	303(d) 2010 Impairment Rank (higher # worse)	0	5	1	5	2
43	303(d) 2008 Impairment Rank (higher # worse)	0	4	1	5	2
	Total Score	22	60	45	67	45
	Overall Rank	5	2	3	1	4

1 is most contributing

The Iroquois River and its tributaries are listed on IDEM's 303(d) list for "orthophosphate."

		Subwatershed				
		Oliver Ditch	Carpenter-Denton Creeks	Upper Iroquois-Ryan Creek	Curtis-Hunter Creek	Montgomery- Strole Creek
Code	**Ranking Variable**	Ranking (1-5, 5 most contributing)				
1	Size (Acres)	1	4	3	5	2
2	Artificial Drainage Length (mi.)	4	3	5	2	1
3	Natural Stream (mi.)	2	5	3	4	1
4	Total Natural + Artificial Drain (mi.)	4	3	5	2	1
5	Artificial Drain as % of Total Drain(mi.)	5	2	4	1	3
7	# of Active CSO	1	4	5	3	2
8	Number of CFO facilities	2	5	5	5	1
9	Number of NPDES Facilities	1	3	4	5	2
10	100 ft Stream Buffer % class as Buffered	5	2	4	1	3
11	% of Land Area in Wetland	1	5	2	3	5
12	Active Erosion Sites	2	3	5	4	1
14	% of Windshield Sites 100% Buffer	5	1	4	2	3
18	% of Windshield Sites 0% Buffer	3	2	1	5	4
19	Sediment Exceedance target (10.4 NTU)	3	4	2	5	1
27	Orthophosphate Exceedance target (0.005 mg/L)	2	4	1	5	3
35	Tillage Transect % Corn No-till Decline 2000-20011	1	3	2	5	4
36	Tillage Transect % Soybean No-till Decline 2000-2011	1	3	2	5	4
38	TSS Load Reduction Needed	1	5	2	3	4
39	Orthophosphate Reduction Needed					
41	% land in Wetland Acres (NWI)	1	4	2	3	5
42	303(d) 2010 Impairment Rank (higher # worse)	0	5	1	5	2
43	303(d) 2008 Impairment Rank (higher # worse)	0	4	1	5	2
44	Impervious Surface (%)					
	Total Score	45	74	63	78	54
	Overall Rank	5	2	3	1	4

1 is most contributing

The Iroquois River and its tributaries are listed on IDEM's 303(d) list for "impaired biological communities (IBI)."

		Subwatershed				
		Oliver Ditch	Carpenter-Denton Creeks	Upper Iroquois-Ryan Creek	Curtis-Hunter Creek	Montgomery- Strole Creek
Code	**Ranking Variable**	Ranking (1-5, 5 most contributing)				
1	Size (Acres)	1	4	3	5	2
3	Natural Stream (mi.)	2	5	3	4	1
5	Artificial Drain as % of Total Drain(mi.)	5	2	4	1	3
6	Livestock Access Sites	1	4	3	5	2
7	# of Active CSO	1	4	5	3	2
8	Number of CFO facilities	2	5	5	5	1
9	Number of NPDES Facilities	1	3	4	5	2
10	100 ft Stream Buffer % class as Buffered	5	2	4	1	3
11	% of Land Area in Wetland	1	5	2	3	5
12	Active Erosion Sites	2	3	5	4	1
13	Channelization Sites	2	5	3	4	1
14	% of Windshield Sites 100% Buffer	5	1	4	2	3
18	% of Windshield Sites 0% Buffer	3	2	1	5	4
19	Sediment Exceedance target (10.4 NTU)	3	4	2	5	1
24	Nitrate-Nitrogen exceedance 5 yr target (10 mg/L)	1	5	2	4	3
25	Nitrate-Nitrogen exceedance 20 yr target (1.5 mg/L)	2	4	1	5	3
27	Orthophosphate Exceedance target (0.005 mg/L)	2	4	1	5	3
28	Sites with MIBI Score < 10 Poor			5		4
29	Sites CQHEI<60 Unhealthy	1	2	3	5	4
30	Site MIBI Score < 16 Fair	3	2	5	1	4
31	Sites CQHEI<99 Healthy					
32	Sites MIBI Score <22 Good					
33	Sites CQHE >100 High Quality					
34	Sites MIBI Score >23 Excellent					
37	Nitrate Load Reduction Needed	1	4	3	2	5
38	TSS Load Reduction Needed	1	5	2	3	4
39	Orthophosphate Reduction Needed					
40	E.coli Reduction Needed	1	4	2	3	5
41	% land in Wetland Acres (NWI)	1	4	2	3	5
	Total Score	47	83	74	83	71
	Overall Rank	5	2	3	1	4

1 is most contributing

Appendix 9 Problem Statement Critical Areas by HUC 12

Table 79 Flashiness and Flooding HUC 12 Variables and Rank

The Iroquois River has undesirable high and low levels and flows of water that threaten our towns, agricultural land, and health of the river.		Subwatershed										
		Keefe Ditch	Jordan-Slough Creek	Nessius-Bice Ditch	Headwaters Carpenter Creek	Carpenter Creek	Bice-Slough Ditch	Heawaters Curtis Creek	Turner Ditch - Iroquois River	Hunte Ditch	Bower Ditch - Darroch Ditch	Hickory Branch - Iroquois River
Code	**Ranking Variable**	Ranking (1-11),11 most contributing)										
1	Size (Acres)	1	8	4	6	7	3	9	5	11	2	10
2	Artifical Drainage Length (mi.)	2	11	5	1	9	10	6	4	3	7	8
3	Natural Stream (mi.)	1	11	4	5	8	6	9	3	7	2	10
4	Total Natural+Artifical Drain (mi.)	1	11	5	2	10	7	8	3	6	4	9
5	Regulated stream miles as % of Total Drain(mi.)	10	8	6	1	5	9	3	7	2	11	4
10	100 ft Stream Buffer % class as Buffered	3	5	11	8	6	1	7	2	10	7	4
11	% of Land Area in Wetland	3	7	5	4	6	8	9	11	1	2	10
12	Active Erosion Sites	1	0	1	2	0	0	3	0	0	0	0
13	Channelization Sites	3	9	4	6	6	5	7	2	1	1	8
18	% of Windshield Sites 0% Buffer	7	5	0	1	2	6	8	4	11	10	9
19	Sediment Exceedance target (10.4 NTU)				1	4	2	5		3		7
29	# Sites CQHEI<60 Unhealthy				9	9		11		9		10
35	Tillage Transect % Corn Acres No-till Decline 2000-20011											
36	Tillage Transect % Soybean Acres No-till Decline 2000-2011											
38	TSS Load Reduction Needed				5	6	2	1		4		3
41	% land in Wetland Acres (NWI)	9	5	7	8	6	4	3	1	11	10	2
44	Impervious Survace (%)											
45	Nitrate Leaching High Concern Acres (%)	7	11	9	1	6	10	8	5	3	2	4
46	Nitrate Leaching Concern Acres (%)	3	1	6	9	5	2	4	8	10	7	11
	Total Score	51	92	67	69	95	75	101	55	92	65	109
	Overall Rank	10	4	9	6	3	5	2	8	4	7	1
		1 is most contributing										

Table 80 Fish and Wildlife Habitat Variables and Ranking by HUC 12

The desirable native fish populations in the Iroquois River and surrounding waterways are suspected to be in decline.

		Subwatershed										
		Keefe Ditch	Jordan-Slough Creek	Nessius-Bice Ditch	Headwaters Carpenter Creek	Carpenter Creek	Bice-Slough Ditch	Heawaters Curtis Creek	Turner Ditch - Iroquois River	Hunte Ditch	Bower Ditch - Darroch Ditch	Hickory Branch - Iroquois River
Code	**Ranking Variable**	Ranking (1-11),11 most contributing)										
1	Size (Acres)	1	8	4	6	7	3	9	5	11	2	10
3	Natural Stream (mi.)	1	11	4	5	8	6	9	3	7	2	10
4	Total Natural+Artifical Drain (mi.)	1	11	5	2	10	7	8	3	6	4	9
6	Livestock Access Sites	2	6	1	3	7	4	10	1	9	1	5
7	# of Active CSO											
8	Number of CFO facilities		3	1	1	2	1	3	1	1		2
9	Number of NPDES Facilities				2			1		2		3
10	100 ft Stream Buffer % class as Buffered	3	5	11	8	6	1	7	2	10	7	4
11	% of Land Area in Wetland	3	7	5	4	6	8	9	11	1	2	10
12	Active Erosion Sites	1	0	1	2	0	0	3	0	0	0	0
14	% of Windshield Sites 100% Buffer	10	6	1	2	4	5	7	3	11	8	9
15	% of Windshield Sites 75% Buffer	0	0	0	0	0	0	0	0	0	0	0
16	% of Windshield Sites 50% Buffer	1	2	0	0	6	4	3	0	7	0	7
17	% of Windshield Sites 25% Buffer	1	0	0	0	0	0	0	0	0	0	0
18	% of Windshield Sites 0% Buffer	7	5	0	1	2	6	8	4	11	10	9
19	Sediment Exceedance target (10.4 NTU)				1	4	2	5		3		7
24	Nitrate-Nitrogen exceedance 5 yr target (10 mg/L)				2	2	1	1		1		2
25	Nitrate-Nitrogen exceedance 20 yr target (1.5 mg/L)				1	4	2	6		3		5
27	Orthophosphate Exceedance target (0.005 mg/L)				2	5	1	6		3		4
28	# Sites with MIBI Score < 10 Poor				0	0	0	0		0		0
29	# Sites CQHEI<60 Unhealthy				9	9		11		9		10
30	Site MIBI Score < 16 Fair				1	1	1	1		1		1
31	Sites CQHEI<99 Healthy				1	1		0		1		0
32	Sites MIBI Score <22 Good				1	1	1	0		1		0
33	Sites CQHE >100 High Quality				0	0		0		0		0
34	Sites MIBI Score >23 Excellent				1	0	1	1		1		1
37	% Nitrate Load Reduction Needed				6	2	5	1		4		3
38	TSS Load Reduction Needed				5	6	2	1		4		3
39	% Orthophosphate Reduction Needed				2	3	1	4		5		5
41	% land in Wetland Acres (NWI)	9	5	7	8	6	4	3	1	11	10	2
42	303d 2010 Impairment Rank # of	0	0	0	10	11	0	10	10	9	0	8
43	303d 2008 Impairment Rank # of	0	0	0	10	11	8	9	8	9	0	9
	Total Score	31	64	33	42	73	51	95	33	86	36	96
	Overall Rank	10	5	9	7	4	6	2	9	3	8	1
		1 is most contributing										

Table 81 Cloudy and Turbid Variables and Ranking by HUC 12

		Subwatershed										
	Area streams within the watershed are very cloudy and turbid.	Keefe Ditch	Jordan-Slough Creek	Nessius-Bice Ditch	Headwaters Carpenter Creek	Carpenter Creek	Bice-Slough Ditch	Heawaters Curtis Creek	Turner Ditch - Iroquois River	Hunte Ditch	Bower Ditch - Darroch Ditch	Hickory Branch - Iroquois River
Code	**Ranking Variable**	Ranking (1-11),11 most contributing)										
1	Size (Acres)	1	8	4	6	7	3	9	5	11	2	10
6	Livestock Access Sites	2	6	1	3	7	4	10	1	9	1	5
7	# of Active CSO											
8	Number of CFO facilities		3	1	1	2	1	3	1	1		2
9	Number of NPDES Facilities				2			1		2		3
10	100 ft Stream Buffer % class as Buffered	3	5	11	8	6	1	7	2	10	7	4
12	Active Erosion Sites	1	0	1	2	0	0	3	0	0	0	0
14	% of Windshield Sites 100% Buffer	10	6	1	2	4	5	7	3	11	8	9
15	% of Windshield Sites 75% Buffer	0	0	0	0	0	0	0	0	0	0	0
16	% of Windshield Sites 50% Buffer	1	2	0	0	6	4	3	0	7	0	7
17	% of Windshield Sites 25% Buffer	1	0	0	0	0	0	0	0	0	0	0
18	% of Windshield Sites 0% Buffer	7	5	0	1	2	6	8	4	11	10	9
19	Sediment Exceedance target (10.4 NTU)				1	4	2	5		3		7
27	Orthophosphate Exceedance target (0.005 mg/L)				2	5	1	6		3		4
29	# Sites CQHEI<60 Unhealthy				9	9		11		9		10
31	Sites CQHEI<99 Healthy				1	1		0		1		0
33	Sites CQHE >100 High Quality				0	0		0		0		0
35	Tillage Transect % Corn Acres No-till Decline 2000-20011											
36	Tillage Transect % Soybean Acres No-till Decline 2000-2011											
38	TSS Load Reduction Needed				5	6	2	1		4		3
39	% Orthophosphate Reduction Needed				2	3	1	4		5		5
41	% land in Wetland Acres (NWI)	9	5	7	8	6	4	3	1	11	10	2
44	Impervious Survace (%)											
47	Wind Erodibility Group Acres (%)											
	Total Score	35	40	26	53	68	34	81	17	98	38	80
	Overall Rank	8	6	10	5	4	9	2	11	1	7	3
		1 is most contributing										

Table 82 Widespread Recreational Use Variables and Ranking by HUC 12

	Widespread recreational use is prevented.	Subwatershed										
		Keefe Ditch	Jordan-Slough Creek	Nessius-Bice Ditch	Headwaters Carpenter Creek	Carpenter Creek	Bice-Slough Ditch	Heawaters Curtis Creek	Turner Ditch - Iroquois River	Hunte Ditch	Bower Ditch - Darroch Ditch	Hickory Branch - Iroquois River
Code	**Ranking Variable**	Ranking (1-11),11 most contributing)										
1	Size (Acres)	1	8	4	6	7	3	9	5	11	2	10
6	Livestock Access Sites	2	6	1	3	7	4	10	1	9	1	5
7	# of Active CSO											
8	Number of CFO facilities		3	1	1	2	1	3	1	1		2
9	Number of NPDES Facilities				2			1		2		3
10	100 ft Stream Buffer % class as Buffered	3	5	11	8	6	1	7	2	10	7	4
12	Active Erosion Sites	1	0	1	2	0	0	3	0	0	0	0
14	% of Windshield Sites 100% Buffer	10	6	1	2	4	5	7	3	11	8	9
15	% of Windshield Sites 75% Buffer	0	0	0	0	0	0	0	0	0	0	0
16	% of Windshield Sites 50% Buffer	1	2	0	0	6	4	3	0	7	0	7
17	% of Windshield Sites 25% Buffer	1	0	0	0	0	0	0	0	0	0	0
18	% of Windshield Sites 0% Buffer	7	5	0	1	2	6	8	4	11	10	9
21	e.coli exceedance 5 yr target (576u/100ml)				1	2	0	4		3		5
22	e.coli exceedance 10 yr target (235u/100ml)				1	5	2	4		3		6
29	# Sites CQHEI<60 Unhealthy				9	9		11		9		10
37	% Nitrate Load Reduction Needed				6	2	5	1		4		3
38	TSS Load Reduction Needed				5	6	2	1		4		3
39	% Orthophosphate Reduction Needed				2	3	1	4		5		5
40	E.coli Reduction Needed				0	1	0	0		2		0
	Total Score	26	35	19	49	62	34	76	16	92	28	81
	Overall Rank	9	6	10	5	4	7	3	11	1	8	2
		1 is most contributing										

Table 83 Nitrates are Excessive Variables and Ranking by HUC 12

	The Iroquois River and its tributaries are listed on IDEM's 303(d) list for "excessive nitrate."	Subwatershed										
		Keefe Ditch	Jordan-Slough Creek	Nessius-Bice Ditch	Headwaters Carpenter Creek	Carpenter Creek	Bice-Slough Ditch	Heawaters Curtis Creek	Turner Ditch - Iroquois River	Hunte Ditch	Bower Ditch - Darroch Ditch	Hickory Branch - Iroquois River
Code	**Ranking Variable**	Ranking (1-11),11 most contributing)										
1	Size (Acres)	1	8	4	6	7	3	9	5	11	2	10
2	Artifical Drainage Length (mi.)	2	11	5	1	9	10	6	4	3	7	8
4	Total Natural+Artifical Drain (mi.)	1	11	5	2	10	7	8	3	6	4	9
5	Regulated stream miles as % of Total Drain(mi.)	10	8	6	1	5	9	3	7	2	11	4
6	Livestock Access Sites	2	6	1	3	7	4	10	1	9	1	5
7	# of Active CSO											
8	Number of CFO facilities		3	1	1	2	1	3	1	1		2
9	Number of NPDES Facilities				2			1		2		3
10	100 ft Stream Buffer % class as Buffered	3	5	11	8	6	1	7	2	10	7	4
11	% of Land Area in Wetland	3	7	5	4	6	8	9	11	1	2	10
12	Active Erosion Sites	1	0	1	2	0	0	3	0	0	0	0
14	% of Windshield Sites 100% Buffer	10	6	1	2	4	5	7	3	11	8	9
15	% of Windshield Sites 75% Buffer	0	0	0	0	0	0	0	0	0	0	0
16	% of Windshield Sites 50% Buffer	1	2	0	0	6	4	3	0	7	0	7
17	% of Windshield Sites 25% Buffer	1	0	0	0	0	0	0	0	0	0	0
18	% of Windshield Sites 0% Buffer	7	5	0	1	2	6	8	4	11	10	9
19	Sediment Exceedance target (10.4 NTU)				1	4	2	5		3		7
24	Nitrate-Nitrogen exceedance 5 yr target (10 mg/L)				2	2	1	1		1		2
25	Nitrate-Nitrogen exceedance 20 yr target (1.5 mg/L)				1	4	2	6		3		5
35	Tillage Transect % Corn Acres No-till Decline 2000-20011											
36	Tillage Transect % Soybean Acres No-till Decline 2000-2011											
37	% Nitrate Load Reduction Needed				6	2	5	1		4		3
41	% land in Wetland Acres (NWI)	9	5	7	8	6	4	3	1	11	10	2
42	303d 2010 Impairment Rank # of	0	0	0	10	11	0	10	10	9	0	8
43	303d 2008 Impairment Rank # of	0	0	0	10	11	8	9	8	9	0	9
45	Nitrate Leaching High Concern Acres (%)	7	11	9	1	6	10	8	5	3	2	4
46	Nitrate Leaching Concern Acres (%)	3	1	6	9	5	2	4	8	10	7	11
47	Wind Erodibility Group Acres (%)											
	Total Score	42	72	40	37	74	63	89	41	81	52	94
	Overall Rank	8	5	10	11	4	6	2	9	3	7	1
		1 is most contributing										

Table 84 E.coli is Excessive Variables and Ranking by HUC 12

The Iroquois River and its tributaries are listed on IDEM's 303(d) list for "e.coli."
☐

		Subwatershed										
		Keefe Ditch	Jordan-Slough Creek	Nessius-Bice Ditch	Headwaters Carpenter Creek	Carpenter Creek	Bice-Slough Ditch	Heawaters Curtis Creek	Turner Ditch - Iroquois River	Hunte Ditch	Bower Ditch - Darroch Ditch	Hickory Branch - Iroquois River
Code	**Ranking Variable**	Ranking (1-11),11 most contributing)										
1	Size (Acres)	1	8	4	6	7	3	9	5	11	2	10
6	Livestock Access Sites	2	6	1	3	7	4	10	1	9	1	5
7	# of Active CSO											
8	Number of CFO facilities		3	1	1	2	1	3	1	1		2
9	Number of NPDES Facilities				2			1		2		3
10	100 ft Stream Buffer % class as Buffered	3	5	11	8	6	1	7	2	10	7	4
11	% of Land Area in Wetland	3	7	5	4	6	8	9	11	1	2	10
12	Active Erosion Sites	1	0	1	2	0	0	3	0	0	0	0
21	e.coli exceedance 5 yr target (576u/100ml)				1	2	0	4		3		5
22	e.coli exceedance 10 yr target (235u/100ml)				1	5	2	4		3		6
35	Tillage Transect % Corn Acres No-till Decline 2000-20011											
36	Tillage Transect % Soybean Acres No-till Decline 2000-2011											
40	E.coli Reduction Needed				0	1	0	0		2		0
41	% land in Wetland Acres (NWI)	9	5	7	8	6	4	3	1	11	10	2
42	303d 2010 Impairment Rank # of	0	0	0	10	11	0	10	10	9	0	8
43	303d 2008 Impairment Rank # of	0	0	0	10	11	8	9	8	9	0	9
44	Impervious Survace (%)											
47	Wind Erodibility Group Acres (%)											
	Total Score	19	34	30	56	64	31	72	39	71	22	64
	Overall Rank	10	6	8	4	3	7	1	5	2	9	3

Table 85 Orthophosphates are Excessive Variables and Ranking by HUC 12

The Iroquois River and its tributaries are listed on IDEM's 303(d) list for "orthophosphate."

Code	Ranking Variable	Subwatershed: Keefe Ditch	Jordan-Slough Creek	Nessius-Bice Ditch	Headwaters Carpenter Creek	Carpenter Creek	Bice-Slough Ditch	Heawaters Curtis Creek	Turner Ditch - Iroquois River	Hunte Ditch	Bower Ditch - Darroch Ditch	Hickory Branch - Iroquois River
		Ranking (1-11),11 most contributing)										
1	Size (Acres)	1	8	4	6	7	3	9	5	11	2	10
2	Artifical Drainage Length (mi.)	2	11	5	1	9	10	6	4	3	7	8
3	Natural Stream (mi.)	1	11	4	5	8	6	9	3	7	2	10
4	Total Natural+Artifical Drain (mi.)	1	11	5	2	10	7	8	3	6	4	9
5	Regulated stream miles as % of Total Drain(mi.)	10	8	6	1	5	9	3	7	2	11	4
7	# of Active CSO											
8	Number of CFO facilities		3	1	1	2	1	3	1	1		2
9	Number of NPDES Facilities				2			1		2		3
10	100 ft Stream Buffer % class as Buffered	3	5	11	8	6	1	7	2	10	7	4
11	% of Land Area in Wetland	3	7	5	4	6	8	9	11	1	2	10
12	Active Erosion Sites	1	0	1	2	0	0	3	0	0	0	0
14	% of Windshield Sites 100% Buffer	10	6	1	2	4	5	7	3	11	8	9
18	% of Windshield Sites 0% Buffer	7	5	0	1	2	6	8	4	11	10	9
19	Sediment Exceedance target (10.4 NTU)				1	4	2	5		3		7
27	Orthophosphate Exceedance target (0.005 mg/L)				2	5	1	6		3		4
35	Tillage Transect % Corn Acres No-till Decline 2000-20011											
36	Tillage Transect % Soybean Acres No-till Decline 2000-2011											
38	TSS Load Reduction Needed				5	6	2	1		4		3
39	% Orthophosphate Reduction Needed				2	3	1	4		5		5
41	% land in Wetland Acres (NWI)	9	5	7	8	6	4	3	1	11	10	2
42	303d 2010 Impairment Rank # of	0	0	0	10	11	0	10	10	9	0	8
43	303d 2008 Impairment Rank # of	0	0	0	10	11	8	9	8	9	0	9
44	Impervious Survace (%)											
47	Wind Erodibility Group Acres (%)											
	Total Score	48	80	50	73	105	74	111	62	109	63	116
	Overall Rank	11	5	10	7	4	6	2	9	3	8	1
		1 is most contributing										

Table 86 Impaired Biological Communities Variables and Ranking by HUC 12

The Iroquois River and its tributaries are listed on IDEM's 303(d) list for "impaired biological communities (IBI)." ☐

Code	Ranking Variable	Keefe Ditch	Jordan-Slough Creek	Nessius-Bice Ditch	Headwaters Carpenter Creek	Carpenter Creek	Bice-Slough Ditch	Heawaters Curtis Creek	Turner Ditch - Iroquois River	Hunte Ditch	Bower Ditch - Darroch Ditch	Hickory Branch - Iroquois River
		Subwatershed										
		Ranking (1-11),11 most contributing)										
1	Size (Acres)	1	8	4	6	7	3	9	5	11	2	10
3	Natural Stream (mi.)	1	11	4	5	8	6	9	3	7	2	10
5	Regulated stream miles as % of Total Drain(mi.)	10	8	6	1	5	9	3	7	2	11	4
6	Livestock Access Sites	2	6	1	3	7	4	10	1	9	1	5
7	# of Active CSO											
8	Number of CFO facilities		3	1	1	2	1	3	1	1		2
9	Number of NPDES Facilities				2			1		2		3
10	100 ft Stream Buffer % class as Buffered	3	5	11	8	6	1	7	2	10	7	4
11	% of Land Area in Wetland	3	7	5	4	6	8	9	11	1	2	10
12	Active Erosion Sites	1	0	1	2	0	0	3	0	0	0	0
13	Channelization Sites	3	9	4	6	6	5	7	2	1	1	8
14	% of Windshield Sites 100% Buffer	10	6	1	2	4	5	7	3	11	8	9
18	% of Windshield Sites 0% Buffer	7	5	0	1	2	6	8	4	11	10	9
19	Sediment Exceedance target (10.4 NTU)				1	4	2	5		3		7
24	Nitrate-Nitrogen exceedance 5 yr target (10 mg/L)				2	2	1	1		1		2
25	Nitrate-Nitrogen exceedance 20 yr target (1.5 mg/L)				1	4	2	6		3		5
27	Orthophosphate Exceedance target (0.005 mg/L)				2	5	1	6		3		4
28	# Sites with MIBI Score < 10 Poor				0	0	0	0		0		0
29	# Sites CQHEI<60 Unhealthy				9	9		11		9		10
30	Site MIBI Score < 16 Fair				1	1	1	1		1		1
31	Sites CQHEI<99 Healthy				1	1		0		1		0
32	Sites MIBI Score <22 Good				1	1	1	0		1		0
33	Sites CQHE >100 High Quality				0	0		0		0		0
34	Sites MIBI Score >23 Excellent				1	0	1	1		1		1
37	% Nitrate Load Reduction Needed				6	2	5	1		4		3
38	TSS Load Reduction Needed				5	6	2	1		4		3
39	% Orthophosphate Reduction Needed				2	3	1	4		5		5
40	E.coli Reduction Needed				0	1	0	0		2		0
41	% land in Wetland Acres (NWI)	9	5	7	8	6	4	3	1	11	10	2
45	Nitrate Leaching High Concern Acres (%)	7	11	9	1	6	10	8	5	3	2	4
46	Nitrate Leaching Concern Acres (%)	3	1	6	9	5	2	4	8	10	7	11
47	Wind Erodibility Group Acres (%)											
	Total Score	60	85	60	91	109	81	128	53	128	63	132
	Overall Rank	8	5	8	4	3	6	2	9	2	7	1
		1 is most contributing										

Appendix 10 BMP Definitions (WREC, 2010)

Appendix 10.1 Agricultural BMPs

Agricultural best management practices are implemented on agricultural lands,

- Alternate Watering Systems
- Bioreactors
- Buffer Strip (Shrub/Tree)
- Conservation Tillage (No till end goal)
- Cover Crop
- Drainage Water Management
- Filter Strip (grass)
- Livestock Restriction or Rotational Grazing
- Manure Management Planning
- Nutrient/Pest Management Planning
- Prairie Restoration
- Reforestation
- Two Stage Ditch
- Septic System Upgrades
- Streambank Stabilization
- Wetland Construction or Restoration

Alternate Watering Systems

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. Two main types of alternative watering systems are used including pump systems and gravity systems.

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.

Buffer Strip / Filter Strip

Installing natural buffers or filters along major and minor drainage ways in the watershed helps reduce the nutrient and sediment loads reaching surface waterbodies. These practices are used throughout the Upper Iroquois River watershed with nearly 47% of agricultural survey respondents indicating that they currently use filter or buffer strips on their agricultural operation. 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 run-off, and the character of the buffer area. The most effective buffer width can vary along the length of a channel. Adjacent land uses, topography, run-off 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 run-off 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 run-off may be effectively removed. Computer modeling also indicates that over the long run (30 years), filter strips significantly reduce amounts of pollutants entering waterways.

Both filter strips and buffer strips should be designed as permanent plantings to treat run-off 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.

Conservation Tillage

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, zero till, slot plant, row till, direct seeding, or 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 run-off 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 run-off, 93% less erosion, and 69% less water run-off volume when compared to conventional tillage

(Conservation Technology Information Center, 2000). Reductions in pesticide loading have also been reported (Olem and Flock, 1990). Conservation tillage is widely used throughout the watershed with 70% of agricultural survey respondents indicating that they currently use conservation tillage. Only 3% of respondents indicate that they are unfamiliar with conservation tillage.

Cover Crop

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 run-off. Both wind and water erosion move soil particles that have phosphorus attached. Sediment that reaches water bodies may release phosphorus into the water. The cover crop vegetation recovers plant-available phosphorus in the soil and recycles it through the plant biomass for succeeding crops. Run-off water can wash soluble phosphorus from the surface soil and crop residue and carry it off the field. Cover crops are a familiar conservation practice throughout the watershed; however, only 40% of agricultural survey respondents indicate that they are currently using cover crops. Nearly equal percentages of agricultural land owners indicate limited and full knowledge of cover crops.

Drainage Water Management

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 cover crops and conservation tillage.

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. This BMP can reduce pollutants in runoff and deposition of sediment in nearby waterbodies. 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.

Livestock Restriction or Rotational Grazing

Livestock that have unrestricted access to a stream or wetland have the potential to degrade the waterbody's water quality and biotic integrity. Only 30% of agricultural landowners responding to the social indicator survey indicate that they have livestock. Of those agricultural landowners that own livestock, nearly 30% use grazing management plans. 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 run-off. Removal of vegetation in a wetland or riparian zone also limits the area's ability to filter pollutants in run-off. The degradation of a waterbody's water quality and habitat typically results in the impairment of the biota living in the waterbody.

Restoring areas impacting 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. Education and outreach programs focusing on rotational grazing and exclusionary fencing are important in the success of this BMP.

Nutrient/Pest Management Planning

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. This practice is used on roughly half of agricultural lands within the watershed. Of those agricultural producers not currently using nutrient or pest management planning, nearly 80% indicate a general unfamiliarity with the practice. 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.

Manure Management Planning

Large volumes of manure are generated by both small, unregulated animal operations and by confined feeding operations located throughout the Upper Iroquois 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.

Prairie Restoration

Restoration of prairies within the northern portion of the watershed is a viable way to restore historic habitat. Prairies provide deep soils which have historically been used to aid in crop production, reduce sediment and nutrient transport, and restore nutrient and organic carbon to soils. Prairie restoration typically includes planting of grasses and forbs with deep roots. Restoration of permanent vegetation is used on 44% of retired agricultural land of the Iroquois River watershed. Not all of this vegetation is prairie plants and this is indicated by the fact that 15% of agricultural producers indicate that they are restoring native plant communities.

Reforestation

Reforestation is the restocking of existing forests and woodlands which have been depleted. Reforestation can be used to improve the quality of human life by reducing pollution and dust from the air and rebuild natural habitats and ecosystems.

Two-Stage Ditch

When water is confined to a stream or ditch channel it has the potential to cause bank erosion and channel down-cutting. 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. 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 marine 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 courser material forming the bed.

Wetland Construction or Restoration

Visual observation and historical records indicate at least a portion of the Upper Iroquois River watersheds 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. With nearly 60% of agricultural land owners indicating a lack of knowledge about wetland restoration, this practice offers a high potential to improve water quality within the watershed. 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 water bodies.

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, storm water mitigation, and recreational opportunities.

Appendix 10.2 Urban Best Management Practices

Urban best management practices are as follows:

- Bio retention Practices
- Concrete Grid Pavement
- Detention Basin Retrofit
- Grass Swale
- Green Roof
- Infrastructure Retrofit
- Pet Waste Control
- Phosphorus-free Fertilizers
- Porous Pavement
- Rain Barrel
- Rain Garden
- Street Sweeping
- Trash Control and Removal
- Urban Wildlife Population Control

Bio retention Practices

Bio retention practices use bio filtration or bio infiltration to filter run-off by storing it in shallow depressions. Bio retention 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. Bio infiltration can also be used to treat run-off from parking lots, roads, driveways and other areas in the urban environment. Bio retention should not be used in highly urbanized areas rather; it should be used in areas where on-site storage space is available.

Detention Basin Retrofit

Traditionally, detention basins are large, open, un-vegetated basins designed to hold water for short periods of time following a rain event (dry detention basin) or continuously (wet detention basin). Retrofits of detention basins consist of a basin redesign allowing for longer periods of storm water runoff retention. Longer retention time results in increased time for pollutants to precipitate out of storm water runoff and in the case of dry detention basins increased storm water infiltration rates. Where space permits, basin/pond buffers can also be used to increase storm water infiltration rates and pollutant removal.

Grass Swale

Grass swales are used in urban areas and are often considered landscape features. Swales are graded to be linear with a shallow, open channel of a trapezoidal or parabolic shape. Vegetation which is water tolerant is planted within the channel which promotes the slowing of water flow through the system. Swales reduce sediment and nutrients as water moves through the swale and water infiltrates into the groundwater. Based on social indicator data, nearly 60% of urban residents are unfamiliar with grass swales, while 8% are currently using this practice to reduce storm water run-off impacts.

Green Roof

A green roof is a building who's roof is partially or completely covered with vegetation and a growing medium planted on top of a waterproof membrane. Irrigation and drainage systems move water through the plant mater and growing medium and discharge it into the building's drainage system. Green roofs absorb rainwater, provide installation, reduce air temperatures, and provide habitat for wildlife. Green roofs can retain up to 75% of rainwater gradually releasing it via condensation and transpiration while retaining sediment and nutrients. Green roofs can be installed on any type of roof – slanting to flat – with an ideal slope of 25%. Nearly 45% of urban residents indicate unfamiliarity with the use of a green roof; <1% of urban residents responding to the social indicator survey indicate that they are currently using a green roof.

Infrastructure Retrofit

Typical storm water infrastructure includes pipe and storm drains, or hard infrastructure, to convey water away from hard surfaces and into the storm water 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 storm water. Many of the treatments listed in this section can be utilized to retrofit infrastructure including pervious pavement, green roofs, constructed wetlands, rain gardens, and more. In order for the installation to meet a "retrofit" requirement, existing infrastructure must already be in place, subsequently removed, and replaced with green infrastructure.

Porous Pavement Systems

Porous pavement systems come in many forms including porous pavement and porous paver/modular block pavement. Both types of pervious pavement can be installed on most any travel surface with a slope of 5% or less. Urban residents of the Upper Iroquois River watershed indicate a general lack of knowledge with regards to pervious pavement. Only 13% indicated that they know how to use pervious pavement with 1.2% of respondents indicating current use of pervious pavement.

Pervious pavement systems are specially designed pavement systems that allow rain and snowmelt to infiltrate through the pavement material and discharge into an underlying stone reservoir where the water is either allowed to infiltrate into the underlying soil material, discharge into an auxiliary drainage system, or discharge in a secondary storm water treatment device. Porous pavement systems have the approximate strength and characteristics of traditional pavement. The primary difference is that they lack the "fine" aggregate materials found in traditional pavements. This allows for larger interconnected voids which allow for the storm water infiltration.

A typically pervious concrete system consists of a geotextile fabric overlying the soil subgrade, a stone/gravel substrate reservoir, and the overlying pervious pavement. The paving material consists of a mixture of Portland cement, coarse aggregate, and water.

Porous asphalt is a type of pervious pavement consisting of bituminous asphalt in which the "fines" have been screened and reduced, creating 16 to 18 percent void space thus making it permeable to water. The void space in conventional asphalt is typically 2 to 3 percent. This system consists of the underlying soil, a stone reservoir surrounded by a gravel filter layer, and the overlying porous asphalt.

Porous paver/modular pavement systems consist of modular concrete paving blocks, modular plastic lattice that can be stretched or expanded, or cast in place concrete grids. These systems typically overly a sand or gravel substrate and are structurally engineered to provide a load-bearing surface that is adequate to support personal vehicles, while allowing infiltration of surface water into the underlying soil. This type of system is usually used in low-volume traffic areas such as overflow parking lots and lightly used access roads. Many of these systems are constructed with voids that can be filled with soil material and vegetated.

Pet Waste Control

Pet waste cannot be considered the predominant waste product within a watershed nor the one that produces the greatest impact. Nonetheless, the cumulative impact of pet waste within a watershed can produce a major impact on water quality. Pet waste contains bacteria and parasites, organic matter, phosphorus, nitrogen, and *E. coli* and can carry diseases including *Campylobacteriosis*, *Slamonellosis*, and *Toxocarisis*. Studies indicate that the average dog produces 13 pounds of nitrogen, 2 pounds of phosphorus, and 1,200 pounds of sediment annually (Miles, 2007).

Many options for managing pet waste are available with most efforts focusing on educational options to turn pet waste from an ‘out of sight, out of mind’ issue to one that every pet owner considers for their pet. Pet waste can be flushed, resulting in waste traveling to the wastewater treatment plant or through the septic system for treatment, buried, where it gradually breaks down over time with nutrients entering the soil and microorganisms converting diseases and bacteria into less benign forms, or trashed, resulting in potential landfill issues. Ordinances, signage, and public education are needed to inform the community about options for treating pet waste issues.

Phosphorus-free Fertilizers

Phosphorus-free fertilizers are those fertilizers that supply nitrogen and minor nutrients without the addition of phosphorus. Phosphorus increases algae and plant growth which can cause negative impacts on water quality within aquatic systems. The Clear Choices, Clean Water (2010) program estimates that a one acre lawn fertilized with traditional fertilizer supplies 7.8 pounds of phosphorus to local water bodies annually. Given that 75% of urban residents within the Upper Iroquois River watershed indicate either limited knowledge or that they don't use phosphorus free fertilizers, there is great potential for reducing urban sources of phosphorus by targeting this practice. Established lawns take their nutrients from the soil in which they grow and need little additional nutrients to continue plant growth. Fertilizers are manufactured in a variety of forms including that without phosphorus. Phosphorus-free fertilizer should be considered for use in areas where grass is already established.

Protecting Open Space and Natural Areas

Several techniques can be used for protecting natural areas and open space in both public and private ownership. Several entities throughout the watershed assist with the transfer of lands into protective status. Other open space can be protected using conservation design development techniques, and is more likely to be managed by homeowner associations.

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 storm water run-off to streams and storm sewer systems. Although rain barrels don't specific reduce nutrient or sediment loading to water bodies, 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 3% of survey respondents indicate that they have installed a rain barrel. Furthermore, 75% of respondents indicate a willingness to consider installing a rain barrel.

Rain Garden

Rain gardens are small-scale bio retention systems that be can be used as landscape features and small-scale storm water management systems for single-family homes, townhouse units, some small commercial development, and to treat parking lot or building run-off. Rain gardens provide a landscape feature for the site and reduce the need for irrigation, and can be used to provide storm water depression storage and treatment near the point of generation. These systems can be integrated into the storm water management system since the components can be optimized to maximize depression storage, pretreatment of the storm water run-off, 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 run-off generated by a storm event. Additionally, rain gardens can be designed to provide a significant improvement in the quality of the storm water run-off. Within the Iroquois River watershed, there is a general lack of knowledge about rain gardens and their cost, installation efforts needed, and water quality benefit. Nearly 60% of urban residents that responded to the social indicator survey stated that they had never heard of rain gardens. Less than 10% indicated familiarity with rain gardens or that they had rain garden installed on their property.

Street Sweeping

Street sweeping removes accumulated pollutants including debris, sediment, salt, trash, trace metals, and more while improving aesthetics, controlling dust, and decreasing the volume of materials accumulating in storm drains. Street sweeping is currently practices in Rensselaer, but it is unclear if other towns do. Additional arterial streets within the cities or sweeping of streets within smaller municipalities throughout the watershed could benefit water quality in the Iroquois River.

Trash Control and Removal

Trash and debris located throughout urban areas indicate that these materials can have a significant negative impact on water quality within the Iroquois River. A majority of trash observed occurs adjacent to streets, road right of ways, and sidewalks throughout the urban portions of the watershed. Surveys in larger urban areas indicate that plastic bottles, Styrofoam cups, and paper are the most common trash items found in or adjacent to storm drains. It is necessary to quantify the impacts of trash on the Iroquois River and the cities' wastewater treatment facilities to determine if it is necessary to address trash in ways currently not occurring within the watershed.

Urban Wildlife Population Control

Wildlife populations located within urban areas can negatively impact water quality. Deer, Canada geese, raccoons, squirrels, and other animals can reach nuisance levels within urban areas. To control the population, a survey of the types of animals present, the volume of each species, the health and wellness of the populations, and habitat availability must be surveyed. Control of the goose population by habitat modification and relocation are the most likely scenarios for control.

Fish Passage Improvement

Fish passage issues are typically considered of utmost importance for salmonid and trout species. Although the Iroquois River does not support a cold-water fishery, restriction of fish passage is still of concern. Existing highway culverts are the primary source of fish passage restriction. Many of these structures were installed prior to the consideration of impacts of barriers to fish passage or the needs of fish species. Specific locations where fish passage barriers exist were mapped as part of the Watershed Inventory. As these bridges are slated for improvement or repair, discussion of fish passage mitigation will be included.

Greenways and Trails

Greenways can provide a large number of functions and benefits to nature and the public. For plants and animals, greenways provide habitat, a buffer from development, and a corridor for migration. Greenways located along streams include riparian buffers that protect water quality by filtering sediments and nutrients from surface run-off and stabilizing stream banks. By buffering the stream from adjacent developed land use, riparian greenways offset some of the impacts associated with increased impervious surface in a watershed. Maintaining a good riparian buffer can mitigate the negative impacts of approximately 5% additional impervious surface in the watershed.

Habitat Corridor Identification and Improvement

Protection of habitat corridors requires a multi-phase program including identification of appropriate habitat corridors, development of a corridor management plan, and creation of an improvement plan. Most long-term corridor protection will require land transfer into protected status. There are several options for land transfer ranging from donation to fee simple land purchase. Donations can be solicited and encouraged through incentive programs. Outright purchase of property offers a secondary option and is frequently the least complicated and most permanent protection technique, but is also the most costly. A conservation easement is a less expensive technique than outright purchase and does not require the transfer of land ownership but rather a transfer of use rights. Conservation easements might be attractive to property owners who do not want to sell their land at the present time, but would support perpetual protection from further development. Conservation easements can be donated or purchased.

Several techniques can be used for protecting natural areas and open space in both public and private ownership. The first step in the process is to identify and prioritize properties for protection. The highest priority natural areas should be permanently protected by the ownership or under the management of public agencies or private organizations dedicated to land conservation. Other open space can be protected using conservation design development techniques, and is more likely to be managed by homeowner associations.

Low Impact Development

Low Impact Development (LID) is a land development or re-development process that works in concert with nature to manage stormwater at the source, or as close as possible to the source. Preservation of open space, recreation of natural landscape features, reduction of impervious surface coverage, and utilization of on-site drainage to treat stormwater are the key features of low impact development. This technique uses a suite of practices highlighted above including bioretention, rain gardens, green or vegetated roofs, rain barrels, pervious pavement, and more. LID can be used anywhere as part of a new development, redevelopment, or retrofit of existing development or infrastructure. If used correctly, LID can restore a watershed's hydrologic and ecological function.

Point Source Discharge Reduction

Several point source permitted discharges are located in the Iroquois River watershed. These include large wastewater treatment plants, like those that service Rensselaer; small wastewater treatment and package plants. A majority of the facilities permitted throughout the watershed operate within their permitted requirements with regards to water discharges. 9 combined sewer overflows are located within the watershed and are controlled by the City of Rensselaer. The city are in the process of implementing long-term control plans focused on reducing combined sewer overflow impacts to the Iroquois River and although we cannot assist them with infrastructure changes, we can lead the charge to reduce the volume of water entering the stormwater system, promote successes to improve water quality leaving any NPDES-permitted facility, and highlight efforts to reduce impacts to the Iroquois River.

Septic System Care and Maintenance

Septic, or on-site waste disposal systems, are the primary means of sanitary flow treatment outside of incorporated areas. 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.

Smart Growth/Livable Communities Practices

Like low impact development, smart growth or livable communities preserves natural lands and natural features and protects water quality. However, smart growth goes farther focusing on improving resident's everyday lives through their home, health, local schools, tax structure, daily commute, economic growth potential, and natural environment. Smart growth communities are new developments or revitalized communities focused on neighborhoods with shops, offices, schools, businesses, churches, parks, and infrastructure within walking or biking distance or providing public transportation to facilitate community use. Smart growth practices can be used in existing communities by highlighting walkability, preserving or recreating open space, encouraging community stakeholder involvement, providing an opportunity of housing options, and making use of compact building structures.

Stream bank Stabilization

Stream bank stabilization or stream restoration techniques are used to improve stream conditions so they more closely mimic natural conditions. The most feasible restoration options return the stream to natural stream conditions without restoring the stream to its original condition. 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.

Threatened and Endangered Species Protection

Threatened and endangered species are those plant and animal species whose survival is in peril. Federally and state listed species identified within the Upper Iroquois 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.

Appendix 11. CFO Compliance / Enforcement Tally

FarmID	OperationN	Permit Compliance/ Enforcement issues since existence	HUC 10	County	PermitProg	PermType	ConstrucAp	NurseryPig	Finishers	Sows	BeefCattle	BeefCalves	DairyCattl	DairyCalve	Layers	Pullets
6207	SEVEN HILLS DAIRY LLC	3	Carpenter_Denton	BENTON	CAFO	GENERAL PERMIT	4/8/2010	-	-	-	-	-	3,250	16	-	-
4390	RONALD HATHAWAY	0	Carpenter_Denton	JASPER	CFO	CFO APPROVAL	5/29/1998	-	2,120	-	-	-	-	-	-	-
745	FREY FARM	0	Carpenter_Denton	JASPER	CFO	CFO APPROVAL	4/8/1997	1,250	-	-	-	-	-	-	-	-
2689	TIP TOP PIGS INCORPORATED 1	0	Carpenter_Denton	JASPER	CAFO	GENERAL PERMIT	8/12/1991	3,060	3,060	530	-	-	-	-	-	-
3423	WHITE COUNTY PULLETS	0	Carpenter_Denton	WHITE	CFO	NPDES EXEMPTION	2/13/1985	-	-	-	-	-	-	-	-	480,000
3506	ROSE ACRE FARMS JASPER COUNTY PULLETS	0	Carpenter_Denton	JASPER	CFO	NPDES EXEMPTION	3/17/1988	-	-	-	-	-	-	-	-	520,000
3422	WHITE COUNTY EGG FARM	10	Carpenter_Denton	WHITE	CAFO	GENERAL PERMIT	8/24/2004	-	-	-	-	-	-	-	2,120,000	-
2891	MARK & REBECCA STREITMATTER	0	Carpenter_Denton	WHITE	CFO	CFO APPROVAL	3/1/2002	-	2,440	20	-	-	-	-	-	-
516	JACK RODIBAUGH & SONS INCORPORATED	0	Carpenter_Denton	JASPER	CFO	CFO APPROVAL	1/17/1995	200	1,056	296	-	-	-	-	-	-
4260	KEITH STREITMATTER	0	Carpenter_Denton	JASPER	CFO	CFO APPROVAL	12/29/1994	-	1,100	-	-	-	-	-	-	-
3279	OINKER ACRES	0	Curtis_Hunter	JASPER	CFO	CFO APPROVAL	5/17/1994	600	1,200	200	-	-	-	-	-	-
3182	FOXHILL HOG FARM	0	Curtis_Hunter	JASPER	CFO	CFO APPROVAL	6/2/1980	600	600	-	-	-	-	-	-	-
3372	NEWTON COUNTY EGG FARM	7	Curtis_Hunter	NEWTON	CAFO	GENERAL PERMIT	10/27/2010	-	-	-	-	-	-	-	1,830,000	-
651	KORNIAK FARM	0	Curtis_Hunter	JASPER	CFO	CFO APPROVAL	12/22/1998	-	720	-	-	-	-	-	-	-
2399	NURSERY FINISHING SITE	0	Curtis_Hunter	NEWTON	CFO	NPDES EXEMPTION	11/27/2001	4,000	9,600	-	-	-	-	-	-	-
3535	CAMBALOT SWINE BREEDERS	0	Curtis_Hunter	NEWTON	CAFO	GENERAL PERMIT	2/22/2008	1,500	-	5,894	-	-	-	-	-	-
6036	FAIR OAKS DAIRY FARM SOUTH SITE 2	7	Curtis_Hunter	NEWTON	CAFO	GENERAL PERMIT	6/17/2010	-	-	-	-	-	3,000	-	-	-
3732	CALF LAND LLC	0	Curtis_Hunter	JASPER	CAFO	GENERAL PERMIT	10/21/2002	-	-	-	-	-	-	5,000	-	-
6064	FAIR OAKS DAIRY FARM CENTRAL 3	0	Curtis_Hunter	NEWTON	CAFO	GENERAL PERMIT	10/8/1999	-	-	-	-	-	3,000	-	-	-
6341	FAIR OAKS DAIRY FARM LLC NORTH CENTRAL 5	-	Curtis_Hunter	NEWTON	CAFO	GENERAL PERMIT	10/29/2008	-	-	-	-	-	10,560	-	-	-
6065	FAIR OAKS DAIRY FARM WEST 4	0	Curtis_Hunter	NEWTON	CAFO	GENERAL PERMIT	2/18/2003	-	-	-	-	-	3,000	-	-	-
1680	HAROLD & DON GRETENCORD	0	Mont_Strole	BENTON	CFO	CFO APPROVAL	3/30/1995	1,800	-	-	-	-	-	-	-	-
669	GARY A CLARK	0	Mont_Strole	NEWTON	CFO	CFO APPROVAL	7/20/1993	-	2,000	-	-	-	-	-	-	-
6380	HIDDEN VIEW DAIRY	1	Oliver	JASPER	CAFO	GENERAL PERMIT	2/23/2007	-	-	-	-	-	4,000	-	-	-
6083	NEWBERRY FARMS LLC	0	Oliver	JASPER	CAFO	GENERAL PERMIT	9/14/2006	-	-	-	-	-	3,000	-	-	-
6383	PEMBROKE OAKS FARM LLC	0	Oliver	JASPER	CFO	CFO APPROVAL	10/20/2005	-	-	2,496	-	-	-	-	-	-
4656	GOP FARMS	0	Upper_Ir_Ryan	JASPER	CFO	CFO APPROVAL	10/9/2001	-	1,485	-	65	-	-	-	-	-
4337	MOORE FARMS	0	Upper_Ir_Ryan	JASPER	CFO	CFO APPROVAL	12/29/1994	-	-	-	600	-	-	-	-	-
4235	PARKINSON & RODIBAUGH	0	Upper_Ir_Ryan	JASPER	CFO	CFO APPROVAL	1/17/1995	160	435	80	-	-	-	-	-	-
4056	HURLEY SWINE ENTERPRISES 1	0	Upper_Ir_Ryan	JASPER	CAFO	GENERAL PERMIT	12/2/2010	-	7,600	-	-	-	-	-	-	-
4991	NORTHWIND PORK LLC	0	Upper_Ir_Ryan	JASPER	CFO	CFO APPROVAL	10/19/1998	8,000	-	3,208	-	-	-	-	-	-
652	PULLIN FARMS INCORPORATED	0	Upper_Ir_Ryan	JASPER	CFO	CFO APPROVAL	9/18/1972	780	1,546	315	-	-	-	-	-	-
2542	MAX L FARMS LLC	0	Upper_Ir_Ryan	JASPER	CFO	NPDES EXEMPTION	8/16/2002	-	3,600	-	-	-	-	-	-	-
876	GROW FARM & FEEDLOTS INC	2	Upper_Ir_Ryan	JASPER	CAFO	GENERAL PERMIT	6/25/2007	-	-	-	2,000	-	-	-	-	-
6604	DE JONG FAMILY FARMS LLC	0	Upper_Ir_Ryan	JASPER	CAFO	GENERAL PERMIT	6/17/2010	-	-	-	-	-	3,800	-	-	-
6045	WINDY RIDGE DAIRY LLC	1	Upper_Ir_Ryan	JASPER	CAFO	GENERAL PERMIT	12/3/2009	-	-	-	-	-	6,500	-	-	-
3700	IROQUOIS VALLEY SWINE	0	Upper_Ir_Ryan	JASPER	CFO	NPDES EXEMPTION	9/13/1991	2,160	7,200	1,010	-	-	-	-	-	-

Appendix 12. NPDES Permit Compliance Tally

Site Map #	NPDES Facility Name	Permit Compliance Violations in last 5 years	Location	County	Receiving Waters	Primary Discharge
5	REMINGTON WWTP	5	REMINGTON	Jasper	CARPENTER CREEK	Sewerage Systems
9	KENTLAND WWTP	8	KENTLAND	Newton	MONTGOMERY Ditch	Sewerage Systems
4	FAIR OAKS BOTTLING CO	0	FAIR OAKS	Newton	CURTIS CREEK	Dairy Products, Except Dried Or Canned
1	RENSSELAER WWTP	16	RENSSELAER	Jasper	IROQUOIS RIVER	Water Supply and Sewerage System
7	GOODLAND WWTP	2	GOODLAND	Newton	HUNTER DITCH TRIB	Sewerage Systems
6	IROQUOIS BIO-ENERGY	16	RENSSELAER	Jasper	PINKAMINK DITCH	Industrial Organic Chemicals
3	GEORGE ADE HEALTH CARE	2	BROOK	Newton	IROQUOIS RIVER	Skilled Nursing Care Facilities
0	BROOK WWTP	1	BROOK	Newton	IROQUOIS RIVER	Sewerage Systems
10	NEWTON WATER/SEWER DISTRICT	0	BROOK	Newton	BATTLEDAY DITCH	Sewerage Systems
2	REMINGTON I69 PLAZA	0	REMINGTON	Jasper	BICE DITCH	Gasoline Service Stations

Appendix 12: Urban Areas Data Used For Ranking

Urban Areas Ranking Data

Towns	# of NPDES	Permit Compliance Issues	population	land area (sq miles)	Number of CSOs	Promixity to Streams (miles)	2012 303d listing downstream of town	303d Counts Downstream
Gifford	0	0	42	0.1	0	0.15	E.coli	2
Mount Ayr	0	0	122	0.15	0	1.50	E.coli,Chloride	2
Goodland	1	2	1043	0.78	0	2.00	E.coli, IBC	2
Rensselaer	2	16	5,928	3.8	9	0.00	Nutrients, E.coli, Choloride	3
Brook	1	1	997	0.66	0	0.24	Nutrients, E.coli, IBC	3
Fair Oaks	1	0	842	0.65	0	0.50	DO, Nutrients, E.coli	3
Kentland	1	8	1,822	1.53	0	0.13	DO, Nutrients, E.coli, IBC	4
Remington	2	5	1,185	1.03	0	0.36	DO, Nutrients, E.coli, IBC, Chloride	5

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