East Fork Creek Watershed Resource Inventory and Watershed Plan

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Olson Ecological Solutions, LLC

JadEco LAKES AND NATURAL RESOURCES CONSULTATION AND MANAGEMENT

tallgrass RESTORATION, LLC

This report was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

EAST FORK CREEK WATERSHED RESOURCE INVENTORY AND PLAN EXECUTIVE SUMMARY

Written by Rebecca Olson

The East Fork Creek Watershed Resource Inventory and Plan Executive Summary was created to summarize the findings and recommendations of the East Fork Watershed Resource Inventory and Watershed-Based Plan which can be used to inform the community, watershed stakeholders, and local decision makers about the East Fork Creek Watershed Plan. The East Fork Creek Watershed Resource Inventory is detailed in Section 1. Section 2 consists of the East Fork Creek Watershed Plan. The East Fork Creek Watershed Plan provides direction and recommendations to improve the quality of these waters. These efforts were initiated by the Lake Carroll Association and supported by the Illinois Environmental Protection Agency, funded in part through Section 319 of the Clean Water Act.

What is a Watershed?

When a raindrop falls to the ground, it takes the path of least resistance to the nearest stream or lake. It may travel over the land, infiltrate through the soil into the groundwater, or get routed through a drainageway or storm sewer to get there. The entire area that leads to the waterway is a basin called a watershed.

The watershed addressed by this inventory and plan is the East Fork Creek Watershed. Any rain that falls within the East Fork Creek Watershed runs into the East Fork of the Plum River, through Lake Carroll, and then eventually into the Plum River and Mississippi River before it dumps into the Gulf of Mexico.

The black dotted line represents the watershed divide in this illustration. All precipitation that falls within the watershed divide eventually runs to the same stream.

Why are residents concerned about the East Fork Creek Watershed?

Typical of the Midwest, rainfall that hits the East Fork Creek Watershed and runs into East Fork Creek and Lake Carroll picks up pollutants and debris from various land uses, carrying excess nutrients, sediment, and other pollutants from agricultural production, lawn care, and hard surfaces such as roads and rooftops to the streams and lake. Excess nutrients can cause algae blooms and fish kills, sediment can decrease water clarity and reduce lake depths, and pathogens such as E. coli can cause health risks to swimmers and pets. These factors often lead to restricting contact with the water, decreased scenic enjoyment, and diminished quality of wildlife habitat, among other issues.

In order to determine the issues facing the East Fork Creek Watershed and identify opportunities to improve it, the community worked together with consultants and technical advisers. Stakeholders expressed concerns, technical advisers provided local knowledge, and consultants inventoried the resources of the watershed. Stakeholders were brought together on several occasions to identify and prioritize the community's interests, with excess nutrients and sediment in the water as main concerns. During these discussions, they recognized issues directly and indirectly affecting water quality.

- Issues directly affecting water quality included: algae blooms, blue-green algae, excessive milfoil and other non-native aquatic plants, favorable habitat for nuisance geese, excessive pollutants, litter in the lake and along trails, and the storms that seemingly were more frequent and intense, bringing an increased amount of rain and runoff.
- Other concerns indirectly affecting water quality included apathy of community members, lack of funds, and circulation of misinformation.

A watershed resource inventory provided the framework to understand these concerns and their potential causes and sources, identifying the natural resources and opportunities to improve the quality of the streams, ponds, and lake within the East Fork Creek Watershed.

What are the natural resources of the East Fork Creek Watershed?

Steep hills and ravines of the 14,426-acre East Fork Creek Watershed provided a beautiful setting for a 5,000-acre residential community and golf course surrounding the 640-acre Lake Carroll. It was surrounded by cropland with a few pastures and livestock operations at the headwaters. Most of the streams within the watershed were intermittent, carrying only stormwater after rain events and snow melt. At lower elevations close to Lake Carroll, streams became perennial, carrying water year-round and supporting fish and other wildlife.

-Watershed landscape, photo by Joe Rush

To understand the issues of this charming area related to water quality, we looked at landscape features that most directly influenced water runoff: topography, soils, water flow connectivity, geology, floodplains, wetlands, and natural areas. Due to the stark topography of the area, there were few floodplains and wetlands that normally provide natural water detention and filtration services. Even hydric soils, the leftover relicts of areas that were once wetlands, were scarce, suggesting that wetlands were naturally never a significant part of the landscape. Small areas with a 1% chance of flooding, also known as 100-year floodzones, surrounded Lake Carroll and some of its inlets. There were no floodzones with a 0.2% chance of flooding, also known as 500-year floodzones. One large wetland sat at the base of Lake Carroll below the dam surrounded by floodplain, otherwise only a scattering of small wetlands dotted the river corridors upstream of the lake, mostly near lake inlets. Soils of the watershed were mainly silt loams developed shallowly over bedrock. Soils were ranked as roughly 20% prime farmland mostly located at the highest elevations and on ridgetops between ravines, 34% not prime farmland on slopes greater than 5%, and 46% farmland of statewide importance located in between. Streams and ravines in the watershed were about 90% intermittent (65.88 miles), only carrying water during wetter times of the year like spring and after storm events and 10% perennial (6.88 miles), carrying water year-round. There were 19.76 miles of shoreline surrounding the lake, ponds, and basins in the watershed.

How have people shaped the landscape?

To identify opportunities for water quality improvement, we studied past, present, and future predicted land uses; erodibility of soils, streambanks, and shorelines; channelization of streams; conditions within 50 feet of streams, ponds, and the lake; water quality information for Lake Carroll and the larger region surrounding the watershed; and estimated amounts of pollutants coming from the various current land uses of the watershed.

Historically, forest covered two-thirds of the watershed and prairie made up the other one-third. The stream ran where Lake Carroll now sits. Now forest and other natural lands cover about 15% of the watershed, while agricultural production covers 57% and the residential community of Lake Carroll with its golf course and turf open spaces makes up the other 28%. All of the row crop production is currently on a rotation of no-till and conservation tillage practices. About 3% of the watershed is covered with an impervious surface like rooftops, roads, driveways, and parking lots. None of the current land uses are expected to change, as population of the area is predicted to decrease according to the Carroll County Comprehensive Plan. Scheduled road projects were repairs and improvements only, and a future trail system shown by the Greenways and Trails Plan seemed incorporated into existing roads. Although the aforementioned plan acknowledged the need for expansion of rail and water transportation, anticipated changes didn’t seem to have a direct effect on the watershed. Within the Lake Carroll community, there were 971 homes and 2,550 lots surrounding the man-made lake. Therefore, there was a possibility of home construction with a slow predicted pace based on past construction rates.

What is the condition of the watershed’s streams, ponds, and lake?

Water samples within Lake Carroll over multiple years provided us with snapshots of the pollutants within the water, including a few instances when phosphorus and nitrogen were four and ten times in excess of suggested limits, respectively (ILM, 2016). Sediment depth surveys suggested inlets within the lake most in need of sediment removal (LCA, 2018). Downstream of this watershed there were areas of the Plum River that did not properly support aquatic life and had problems with aesthetic quality caused by alterations of stream and lakeside vegetation, sedimentation, suspended solids, and fecal coliform occurring due to channelization and irrigated crop production (Illinois EPA, 2018). Some of the activities causing the problems occurred within our watershed.

From surrounding lands, streams receive sediment, excess nutrients, and pathogens via stormwater runoff. Although this occurs naturally, the rate at which it occurs increases exponentially by intensive human land uses like agricultural production and residential development. We used computer models to predict the rate at which pollutant loading occurs within the East Fork Creek Watershed. We estimated 602 tons of sediment, 4,273 pounds of phosphorus, and 44,275 pounds of nitrogen enter East Fork Creek and Lake Carroll every year from the watershed's agricultural and residential land uses. Generally speaking, agricultural production contributed the most nitrogen per acre while residential land uses contributed the most phosphorus, suspended solids, and pathogens per acre. Because agricultural production is practiced on 2/3rds of the watershed, it is also a major contributor of phosphorus, suspended solids, and pathogens even though the amount per acre is slightly less compared to residential land uses.

-Lake Carroll, photo by Joe Rush

Natural vegetation cover between land uses and waterbodies can filter pollutants from stowmwater before it enters the water. Along the streambanks, ravines, and shorelines, we inventoried a 50-foot width for protective vegetative cover. We found that 37% of the stream and ravine buffer areas had good vegetative cover providing filtration of water runoff prior to it entering the stream. Another 40% had fair vegetative cover, and 23% were in poor condition.

Erosion concern within the watershed came from soil types and bank erosion and channelization of streams and ravines. The well-drained soils of the watershed tended to have moderate runoff potential and were highly to moderately susceptible to detachment with water. They were not particularly susceptible to wind erosion. Alarmingly, about half (51%) of the banks of streams and ravines were severely eroded. The remaining half of banks were split almost evenly between moderately eroded (23%) and slightly eroded (26%). There was no significant difference between streams and ravines. About one-fifth of streams and ravines were highly channelized (22%), while moderate channelization characterized almost half of the streams and ravines (44%) and little to no channelization was found on another third (34%). These conditions were likely exacerbated by the steep topography of the area, combined with invasion of non-native buckthorn shading out forest floors of their stabilizing vegetation. There was little erosion along the shorelines of small ponds and basins throughout the watershed, and the shorelines of Lake Carroll were completely protected by rip rap in various stages of repair, all with only slight erosion.

-Streambanks with varied levels of erosion, photo by Joe Rush

We compiled the information about community concerns, natural resources, and opportunities within the watershed to identify the most probable causes and sources of water quality impairments. Next we developed a course of action to address them in a watershed-based plan.

What is in the East Fork Creek watershed plan?

Watershed plans are valuable because they create a plan of action for the community to make improvements to their watershed. After inventorying the area for natural resources, concerns, and opportunities, stakeholders determined what needed to be accomplished to improve their waters. These desires were encompassed in a community driven, watershed plan as an important first step in improving water quality in East Fork Creek and Lake Carroll. These actions will have positive impacts on the local economy, property values, and recreational opportunities, and they preserve the local heritage for future generations. In addition, they provide benefits downstream for the greater good of the people and wildlife of the Mississippi River and Gulf of Mexico.

During a two-year planning process, stakeholders, consultants, and technical advisers came together to plan vision and direction toward better stewardship of the area's land and water. The resulting watershed plan used the group's feedback combined with the results of the watershed resource inventory to address concerns, put in place goals and objectives with measurable milestones, decide which best management practices would be most applicable to the watershed and acceptable to stakeholders, determine how the chosen projects and practices would positively affect the area's streams and lakes, decide how and when to implement the practices and educate stakeholders, weigh costs and benefits of chosen activities, and put in place monitoring efforts. It also provided guidance toward appropriate local financial and technical resources.

What do we want to see in our community?

The primary motive of stakeholders, as reflected by the East Fork Creek Watershed Plan, was to confront the causes of nonpoint pollution impairing the East Fork Creek and Lake Carroll, namely sediment and excessive nutrients. Goals and specific recommendations were created to make the community's vision a reality. The vision was to:

> "Maintain and improve the agricultural, residential, and recreational community through mutual cooperation by sustaining and improving all uses of the land and water within the watershed so that all obtain the maximum benefit."

~Vision of the East Fork Creek Planning Participants.

Five overarching goals to achieve this vision were:

1. Reduce sediment loading from all sources in the watershed.
2. Reduce nutrient loading from all sources in the watershed.
3. Utilize practices that protect and/or enhance wildlife habitat.
4. Address volume and velocity of water runoff.
5. Educate the watershed community about land and water conservation and this plan.

The community agreed upon meaningful targets in order to reduce the amount of orthophosphate and inorganic nitrogen causing nuisance algae blooms and relieve sedimentation of the streams and lake as follows:

*We propose to decrease total phosphorus by 25%,
which will also result in reduction of orthophosphate.*

*We anticipate reasonable efforts to relieve 25% of the sediment loading
into Lake Carroll and East Fork Creek.*

*We expect to see a reduction of 15% total nitrogen
complimentary to phosphorus load reductions,
which will also result in reduction of inorganic nitrogen.*

In order to meet these goals and targets, stakeholders chose projects and practices appropriate for their area that they were willing and excited to implement.

What conservation practices are already in place?

The community takes pride in their current conservation efforts. Lake homeowners and agricultural producers alike work toward sustainability of their land and water. Of the long list of activities, some highlights include:

Homeowner Efforts

- Lake Carroll's shoreline is entirely stabilized.
- Two sediment basins filter water entering the lake from two main tributaries.
- A dredging program is removing 94,000 cubic yards of sediment from Lake Carroll.
- The Prairie Club of Lake Carroll found a remnant prairie which they steward and monitor.
- Lake Carroll's goose population is being controlled.
- Vendors, including landscapers, must be registered prior to performing work within the Lake Carroll neighborhood.
- Private, improved lots greater than 1 total acre in size may install native plantings. These native planting areas may not exceed 1,000 square feet.
- Septic systems within the Lake Carroll community are monitored and maintained regularly.
- Water quality is monitored at Lake Carroll.

Agricultural Producer Efforts

- All agricultural fields are farmed using no-till and conservation tillage practices on the contour to reduce runoff.
- Producers are utilizing rotational grazing practices and other grazing plans.
- About 20% of the agricultural fields use cover crops.
- Most fields have functioning grassed waterways.
- Agricultural producers practice nutrient management, such as monitoring the timing and amount of fertilizer applied each year.
- Some farms have ponds and basins to slow and detain water during storms.
- Some farms have exemplary manure and leachate management systems.

What more can landowners and homeowners do?

Consultants and technical advisers recommended projects and practices that were adopted and prioritized by stakeholders. Projects to be implemented throughout the watershed receiving the highest priority were:

- Stabilize forested, highly erodible lands by removing invasive buckthorn and allowing the natural ground cover to regenerate (160 acres).
- Stabilize 25% of the watershed's severely eroded streambanks (69,400 feet).
- Stabilize 25% of ravine banks by removing invasive buckthorn to encourage self-healing of banks on highly erodible land (22,421 feet).
- Line stream corridors with 50-foot wide filter strips of native vegetation along 1/3 of the portion of streambanks where they are missing (185 acres).

- Plant filter strips of native vegetation along lake and pond shorelines currently in mowed turf (23 acres).
- Plant 35 swales with native vegetation along water courses that run through greenways (2.4 acres).
- Create rain gardens at 100 of the ¼-acre lots upstream of the ravines (15,000 square ft.).
- Widen existing grassed waterways to handle the larger, flashier, more frequent storms that have been occurring recently (53 acres).
- Fully repair grassed waterways that are currently bare (22 acres).
- Construct detention features, such as ponds, basins, dry detention, and scrapes to ease flashy hydrology to cover 1% of the drainage area (144 acres).

In addition to these watershed-wide recommendations, specific projects were located throughout the Lake Carroll community:

- Encourage self-healing of severely eroded banks along 16 ravines surrounding Lake Carroll by removing invasive buckthorn and other non-native vegetation to allow natural ground cover to regenerate (24,700 feet).
- Stabilize severely eroded banks along two sections of stream (15,000 feet).
- Preserve and plant long-rooted, native vegetation in 17 locations including vegetated swales, filter strips, preservation of a remnant prairie, restoration of wetlands, and other critical plantings (35 acres).
- Place floating island wetlands within 10 areas: coves of the lake with high levels of siltation and ponds (2,250 cubic feet of floating island material).
- Construct an interpretive trail through restored natural filtration areas (3 acres).

For each project and practice, stakeholders will consider the potential to incorporate habitat for wildlife.

How do we accomplish the recommended projects and practices?

To construct the recommended projects and practices throughout the watershed will take time, money, and expertise. The possibilities are greater than what can reasonably be expected by the community. Therefore, stakeholders decided what priority projects they would like to accomplish within a ten-year time frame, resulting in the amounts stated above for each project. There is help out there! The main sources of technical and financial support to implement this watershed plan are:

- Blackhawk Hills Regional Council will assist landowners with grant applications and administration.
- Illinois Environmental Protection Agency’s Section 319 Program will accept grant applications for implementation projects.
- The Natural Resources Conservation Service in partnership with Trout Unlimited has funds set aside in the RCPP program for implementing streambank stabilization projects within the Driftless Area, including this watershed. These funds will be available for the next four years.
- The Natural Resources Conservation Service also has a selection of conservation programs available to agricultural producers.
- Americorps volunteers have worked in the watershed before removing invasive plants.

Several private foundations and public entities also exist with missions aligned with this watershed plan and a focus within the watershed's geographic location.

How do we educate our community?

Educating the community starts with the Lake Carroll Association Board of Directors, staff, community members, and surrounding agricultural producers. The watershed planning members wish to:

- Amend Lake Carroll Association covenants and plats to allow for conservation projects.
- Provide tours and demonstrations of successful, existing projects.
- Provide programs and free consultation to homeowners and landowners.
- Publish articles and "how to" guides in the Lake Carroll Association newsletter and local newspaper regarding conservation projects and this plan.

How do we know if we are successful?

Ongoing monitoring of Lake Carroll's water quality and shorelines will be a good way to measure if added conservation practices are helping, including annual water sample analysis, annual shoreline inspections, and sediment depth measurements every 10 years. It may take a while to see dramatic differences. In the meantime, a dedicated group of stakeholders will annually distribute and collect monitoring worksheets to document conservation activities in the watershed, record watershed improvements, update the plan accordingly, and inform the community of updates and new funding opportunities.

What should we do next?

Now that we have a watershed plan, we strive to implement it over the next ten years. Help us to keep the plan alive. Become involved. For more information, contact the Lake Carroll Association, Lake Carroll Prairie Club, Illinois Environmental Protection Agency's Bureau of Water, JadEco Natural Resources, Olson Ecological Solutions, or a friend or neighbor who was instrumental in the planning process.

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East Fork Creek Watershed Inventory

Section 1

Rebecca Olson, Kristin Adams, and Steve Yost

11/26/2018

This report was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

Executive Summary

The watershed of the East Fork Creek supplies water to Lake Carroll and drains surrounding agricultural and residential landscapes. Having clean water in the streams and lakes of this watershed is integral to the health, safety, and quality of life for residents and visitors in the decades to come.

As a first step of a watershed planning process, an inventory of the East Fork Creek Watershed's existing conditions and features is enclosed within the following pages. This inventory provides a snapshot of the East Fork Creek Watershed as of 2018. The people who live, work, and play in the East Fork Creek Watershed are in the process of developing a watershed plan based upon this inventory. It will include a vision, goals, and recommended best management practices, and it will help to guide land use and land and water stewardship activities toward a vision for the watershed.

The East Fork Creek Watershed (HUC 070600050801), located in northwest Illinois along the borders of Carroll and Stephenson Counties, fed the East Fork of the East Plum River and its tributaries and was dammed toward the base to form the 640-acre Lake Carroll. The 65.88 miles of intermittent stream and 6.88 miles of perennial stream drained the 14,426-acre watershed into the East Plum River and beyond to the Mississippi River, which carried water to the Gulf of Mexico.

Features within the watershed included steep hills and ravines that provided a beautiful setting for the 5,000-acre Lake Carroll residential community and golf course, surrounded by cropland with a few pastures and livestock operations in the headwaters. There was very little floodplain or hydric soils within the stark topography, and a large wetland sat at the base of Lake Carroll below the dam. Throughout the watershed, soils were silt loams with a few areas of silty clay loams. These well drained soils provided mostly farmland of statewide importance and not prime farmland. They tended to have moderately low to moderately high runoff potential and were also highly and moderately susceptible to detachment. These soils were not particularly susceptible to wind erosion. The headwaters of the watershed and some other areas had deep soils with high soil loss tolerance while ravines had soils with low soil loss tolerance. In between were soils with moderate tolerance.

East Fork Creek and Lake Carroll were not listed as impaired waters by the Illinois Environmental Protection Agency. However, the Plum River to which they both drained was impaired, as it did not support aquatic life of primary contact recreation due to alterations of stream and littoral vegetation, sediment and siltation, total suspended solids, and fecal coliform caused by channelization, irrigated crop production, and other unknown sources (2018). Along the streams, riparian conditions varied, with 37% rated as good, 40% fair, and 23% poor quality. About half of all streambanks were severely eroded (51%), while 23% were moderately eroded, and 26% were slightly eroded. Channelization was high in 22% of streams and moderate in 44% of streams, while 34% of streams had low to no channelization. The shorelines of Lake Carroll were completely protected by rip rap in various stages of repair and all with only slight erosion. Ponds and basins also had little to no erosion on their banks.

We estimated pollutant loading by land use to be 44,275 pounds per year of total nitrogen, 4,273 pounds per year of total phosphorous, and 1,203,281 pounds per year of total suspended solids. Generally speaking, the greatest amount of pollutant loading to streams and lakes per acre came from residential land use surrounding Lake Carroll for total phosphorous, total suspended solids, and pathogens. Some of the agricultural lands in the headwaters of the watershed contributed the most total nitrogen per acre. The following inventory provided details for these findings.

Acknowledgements

The watershed inventory and planning process was initiated by efforts of the Lake Carroll Association and JadEco Natural Resource Consultation and Management. These entities had been working to maintain and improve the recreational water quality and fisheries of Lake Carroll for many years. In 2015, they added Olson Ecological Solutions to their team in order to enlarge their efforts to include the entire watershed in which they were a part. As a first step, these three partners jointly asked the Illinois Environmental Protection Agency for funding assistance, which was granted in 2017.

The following individuals were instrumental in compiling this inventory:

Edited by:	Rebecca Olson, Olson Ecological Solutions
Written by:	Rebecca Olson, Olson Ecological Solutions Kristin Adams, Tallgrass Restoration Steve Yost, Olson Ecological Solutions
Maps by:	Kristin Adams, Tallgrass Restoration
Modeling by:	Kristin Adams, Tallgrass Restoration
Stream survey by:	Joe Rush, JadEco Lakes and Natural Resources Consultation and Management
Stream survey data analysis by:	Steve Yost, Olson Ecological Solutions
Pond/basin survey by:	Kristin Adams, Tallgrass Restoration Rebecca Olson, Olson Ecological Solutions
Contributions by:	Doug Block, Landowner and Farmer Mike Schmeider, Lake Carroll Association

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Part 1: East Fork Creek Watershed Boundaries

Location of Watershed

The East Fork Creek Watershed was located in northwest Illinois along the border of Carroll and Stephenson Counties, Illinois. The nearest towns were Lanark to the south, Shannon to the east, and Mt. Carroll to the southeast, all in Carroll County, and Pearl City in Stephenson County to the north (see Figure 1, Figure 2, and Figure 3).

Watershed Size

The East Fork Creek Watershed was about 14,426 acres in size or 22.541 square miles, according to GIS analysis of the HUC12 boundary.

Geographic Boundaries

Watershed boundaries for the East Fork Creek encompassed Lake Carroll and its tributaries, culminating at the confluence of East Plum River (see Figure 4).

Watershed Jurisdictions

Jurisdiction of the watershed was split between Carroll and Stephenson Counties, and further split amongst several townships. Each of the two Counties governed portions of the watershed, separately responsible for zoning, planning, water quality protection, and nonpoint source pollution control.

Carroll County governed 83.6% of the land area in the watershed and Stephenson County represented the other 16.4%. Carroll County was split into Freedom Township to the west and Cherry Grove-Shannon Township to the east. Most of the Lake Carroll Development was within Freedom Township. Stephenson County mostly fell into Loran Township, with about 275 acres of land in Jefferson Township (see Table 1 and Figure 5).

On the State level, several entities helped monitor the natural resources within the East Fork Watershed. The Illinois EPA worked to reduce water pollution from non-point sources through providing grants. The US Army Corps of Engineers Rock Island District oversaw area permitting to maintain the integrity of the area's water features. Illinois Department of Natural Resources protected the environment in regards to the entire state. They had a branch within the Office of Water Resources that covered tasks such as water resource planning, navigation, floodplain management, and managing water supply and drought. Within this branch were two divisions: Capital Programs and Resource Management. The latter managed statewide dams and monitored flood conditions while the former regulated construction within waterways and floodplains. The Illinois Department of Transportation complied with maintaining the Clean Water Act by managing stormwater runoff and avoided wetland impacts caused by road development.

On the local level, the Lake Carroll Association organized a committee to work on their Lake Improvement Project. The goal of this project was to address current and future needs of Lake Carroll to improve the lake's condition. The Soil and Water Conservation District, which was part of the US

Department of Agriculture, had a district conservationist assigned to both counties within the watershed. The Lake Carroll Fishing Club also worked with the Lake Improvement Project to improve the Lake conditions by improving fish habitat.

Table 1 Political Townships

Political Townships			
Township Name	County Name	Acres	% Watershed
Jefferson	Stephenson	275.390	1.91%
Loran	Stephenson	2090.954	14.49%
Freedom	Carroll	3278.473	22.73%
Cherry Grove - Shannon	Carroll	8781.642	60.87%

Figure 1 East Fork Creek Watershed, HUC-08, HUC-10, HUC-12 State Location

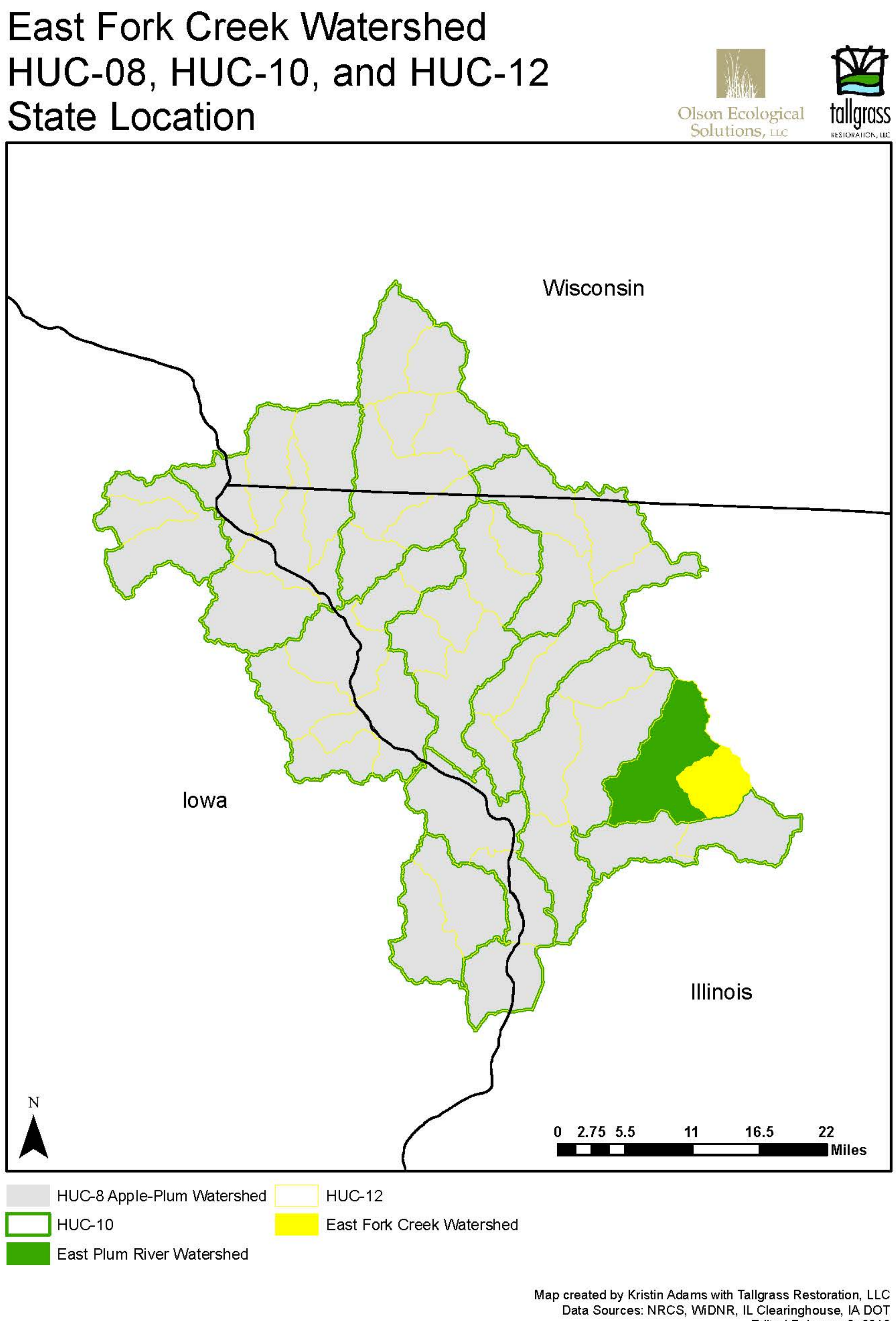


Figure 2 East Fork Creek Watershed, HUC-08, HUC-10, HUC-12 County Location

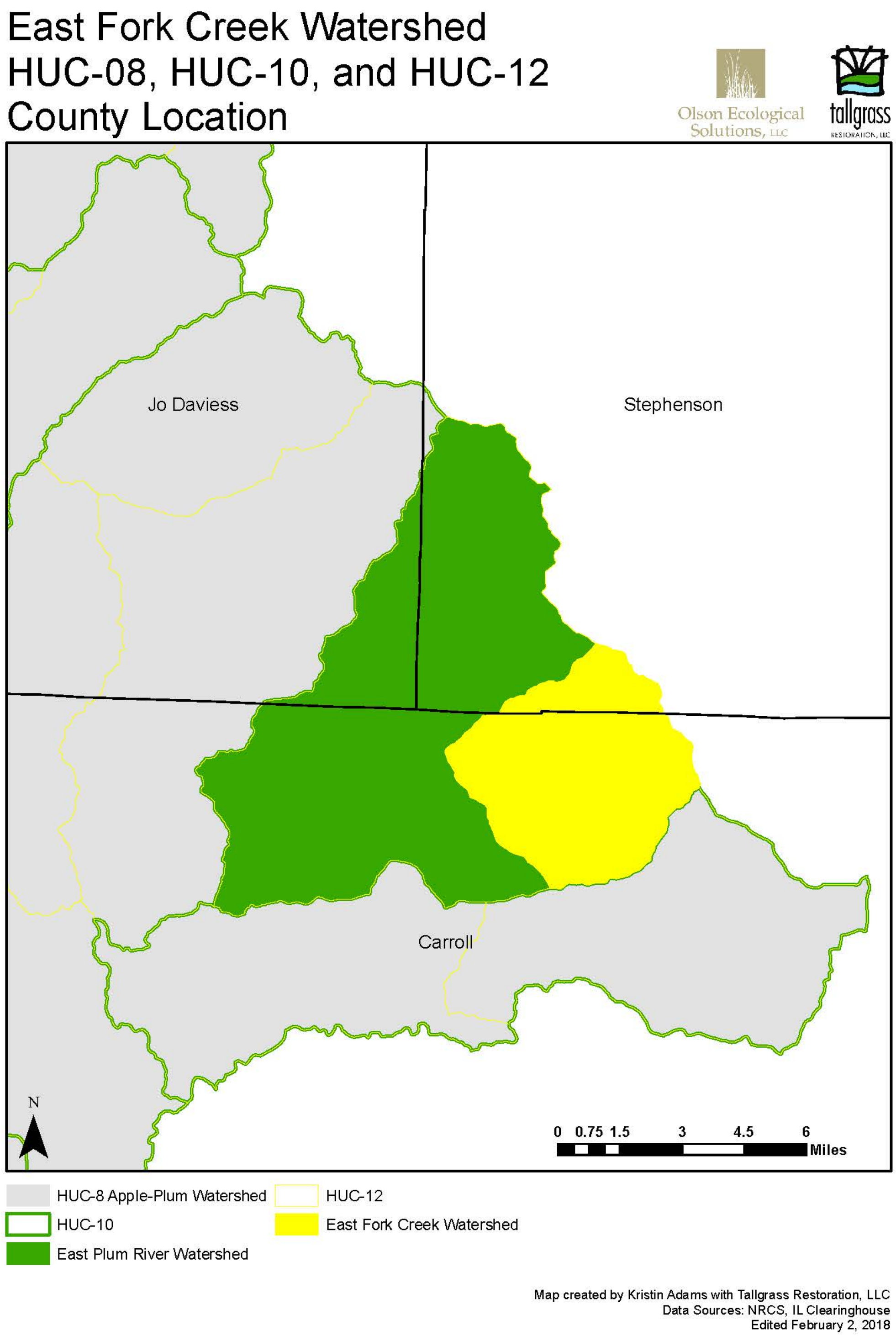


Figure 3 East Fork Creek Watershed, Nearby Municipalities

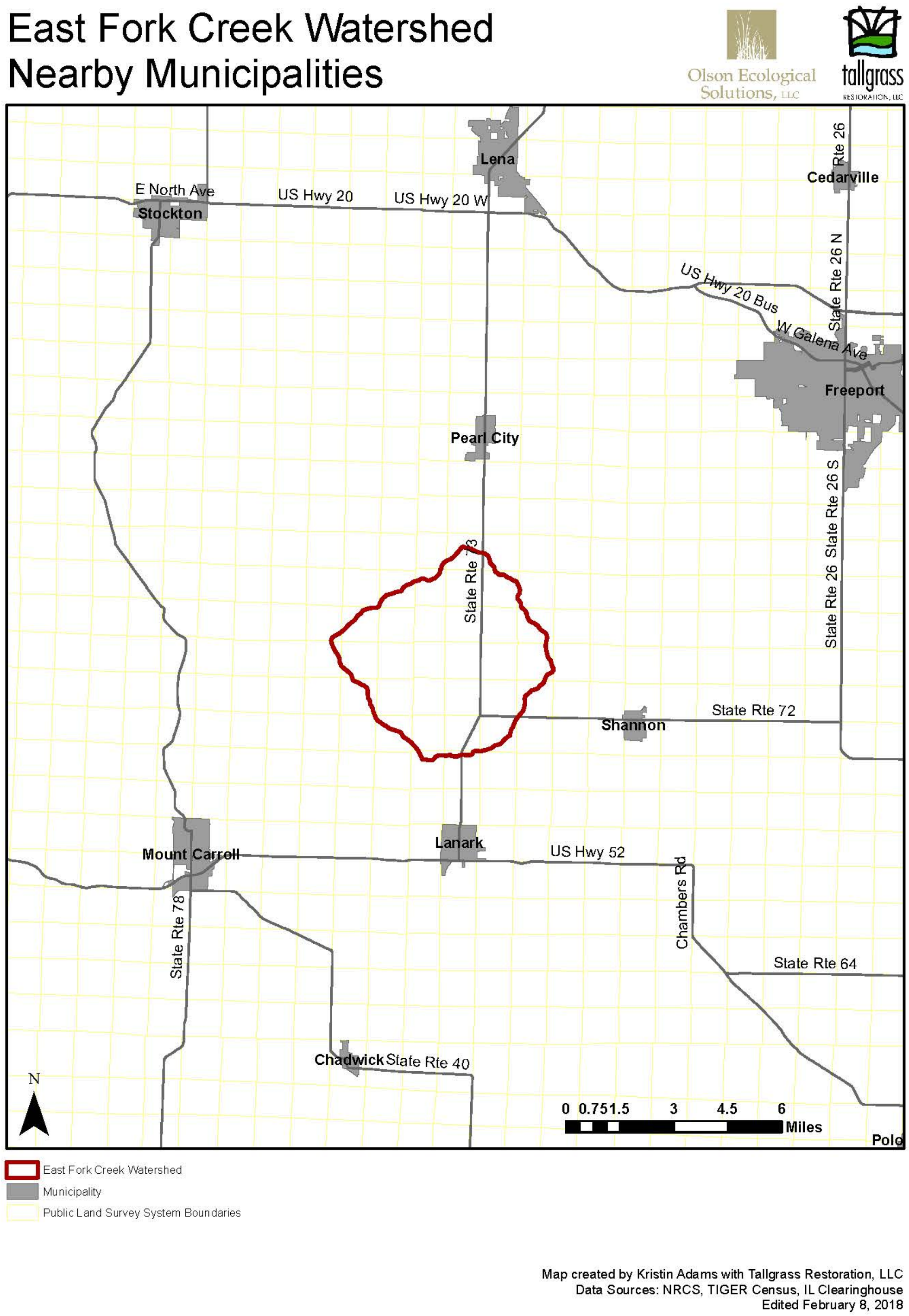
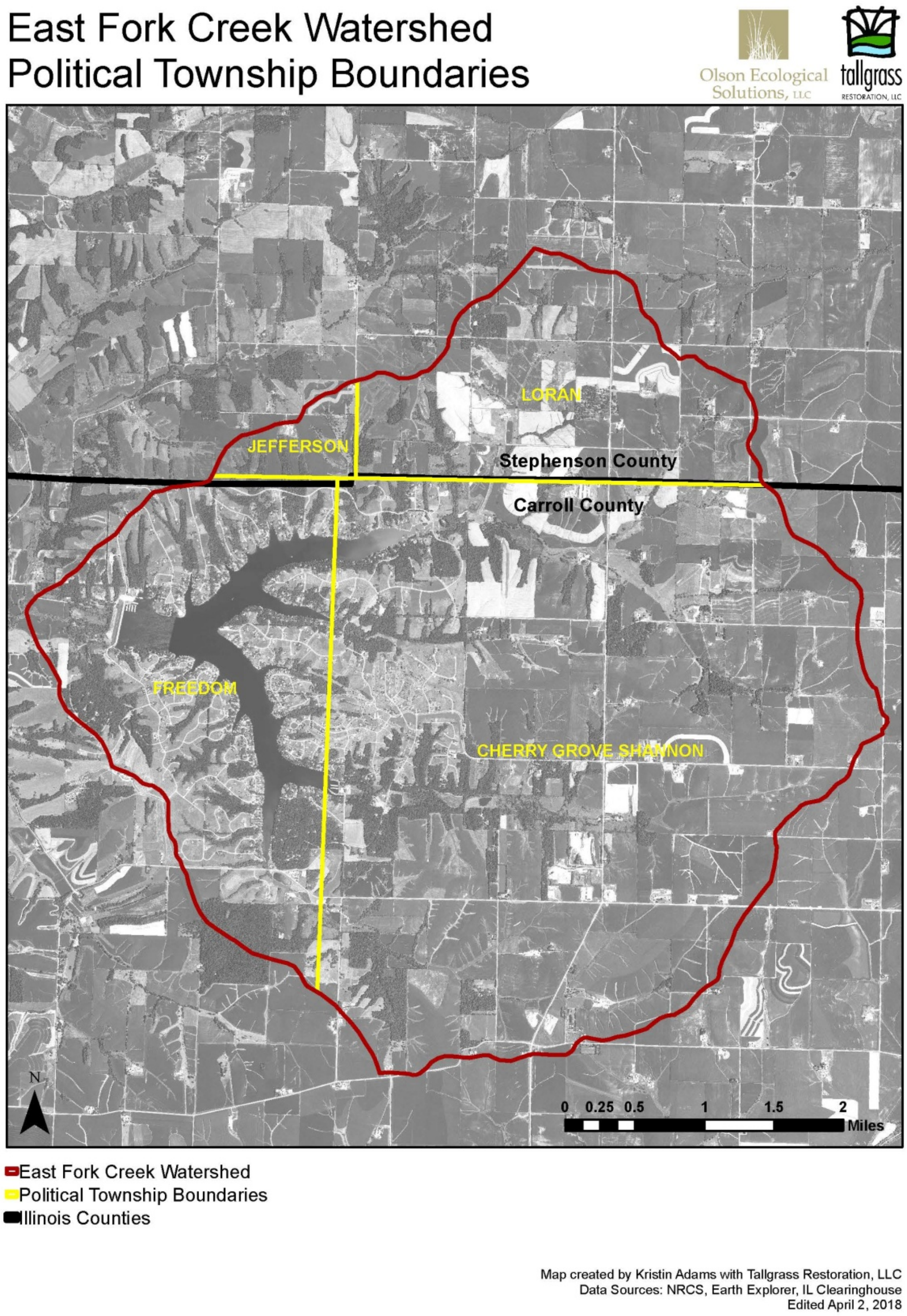


Figure 4 East Fork Creek Watershed, Watershed Boundaries

Figure 5 East Fork Creek Watershed, Political Township Boundaries



Part 2: Watershed Drainage System and Waterbodies

The drainage system of East Fork Creek Watershed was understood by following the connectivity and water flow from one watershed to another, through further dividing the watershed into smaller subwatersheds, and by tracing the path from one stream to the next within the watershed. The relationship of these watersheds and streams with their lakes, ponds, detention basins, flood zones, and wetlands provided a full picture of water flow through the watershed and beyond.

Connectivity and Water Flow of Watersheds

The connectivity and water flow of the East Fork Creek Watershed was defined within the larger context of watersheds in which it lay. The East Fork Creek Watershed was a headwater of the East Plum River, which drained to the receiving Plum River and then joined the Mississippi River near Savanna, Illinois. According to the HUC (Hydrologic Unit Code) system, which organizationally divided larger drainage systems in the United States, the East Fork Creek Watershed was nested within the larger watersheds as follows (see Figure 1):

HUC for East Fork Creek and Associated Watersheds

	"0706"	Upper Mississippi-Maquoketa Plum River
HUC-08	"07060005"	Apple-Plum River
HUC-10	"0706000508"	East Plum River
HUC-12	"070600050801"	East Fork Creek/East Fork East Plum River

Spatial Relationship and Connectivity through Pseudo-HUC System

There was no assigned numbering system beyond the HUC-12 level, of which the East Fork Creek Watershed was the smallest division. In order to illustrate the spatial relationship and connectivity within the East Fork Creek, we applied a pseudo-HUC-14 level, giving seven subwatersheds a letter name of A through H and adding two digits to the HUC-12 code. We used drainage basins defined by elevation as the principal factor in the breakdown into smaller watersheds.

Subwatersheds A, B, C, D, and E represented headwaters to the East Fork Creek watershed. They flowed into F, and G, which housed Lake Carroll. In turn, these flowed into Subwatershed H below the dam of Lake Carroll. All of the subwatersheds terminated at the confluence of the next order stream except for one area; we brought the division to the confluence of the lake between Subwatersheds A, B and G. This kept land uses within the subwatersheds separated between agricultural and residential, in order to aid in interpreting models later in the watershed planning process (see Table 2 and Figure 6).

Connectivity and Water Flow within East Fork Creek Watershed

Water flow through the East Fork Creek Watershed was primarily through a network of intermittent and perennial streams. The connectivity and water flow of these streams was dictated by the steep topography and ravines of the area. Water drained from east to west via numerous intermittent streams, then flowed into a few long, perennial streams that were dammed, creating Lake Carroll in their lower reaches. One main stream led from the dam at Lake Carroll to the East Plum River. Total stream length throughout the watershed, including steep ravines, was 72.76 miles (384,224 feet). Intermittent stream length outnumbered perennial stream length nine to one (90.4% intermittent streams and 9.4% perennial streams). There were about 65.88 miles of intermittent stream (347,936 feet) and 6.88 miles of perennial stream (36,287 feet) throughout the watershed (see Table 3). Steep ravines accounted for 20.29 miles (107,150 feet) of total stream length throughout the watershed, while flatter streams flowed for 52.47 miles (277,075 feet).

In order to communicate about the water flow, we named each of the main branches of the streams. East Fork Creek, the only stream within the watershed to have a published name, was the northernmost of four main tributaries to Lake Carroll. We split it into three tributaries: Upper East Fork Creek, North Lower East Fork Creek, and South Lower East Fork Creek. The three other streams, listed from north to south, we named: North Creek, Central Creek, and South Creek (see Figure 7).

Locations of Waterbodies

The main waterbody within the East Fork Creek Watershed was Lake Carroll, a 640-acre lake formed by the damming of East Fork Creek (Lake Carroll Assoc., 2018). In addition, we found 19 small ponds and seven detention basins visible on aerial imagery. The locations of the ponds were as follows: four ponds in Subwatershed B, three in C, two in D, two in E, one in F, two in G, and five ponds downstream of Lake Carroll in Subwatershed H. Detention ponds were located within the headwater reaches, with two detention ponds in Subwatershed A, four in B, and one in D. The total shoreline from the lakes, ponds, and detention basins was 104,312 feet (19.76 miles), most of which was at Lake Carroll (see Table 3, Figure 6, Figure 7, and Figure 11).

Wetlands

Several wetlands throughout the watershed were recognized by the National Wetlands Inventory (NWI), some of which were also discussed above as waterbodies. The wetlands were all associated with streams and lakes, and none were isolated. Lake Carroll itself was considered a deepwater lake wetland, as were the perennial streams. Upstream of Lake Carroll, a scrub/shrub wetland and two shallow marsh/wet meadow wetlands were clustered at the inlet of the lake in Subwatershed G. Two small open water wetlands were upstream from them in Subwatershed B along the north branch and main stem of Lower East Fork Creek. Along Central Creek in Subwatershed C, there was a small and large open water wetland next to a large bottomland forest. Two other small, open water wetlands occurred upstream of the lake in Subwatershed G and along South Creek in Subwatershed D. The largest wetland was a scrub-shrub wetland along the stream draining Lake Carroll, immediately downstream of the dam in Subwatershed H, with a second smaller shallow marsh/wet meadow wetland downstream near the confluence of the East Plum River. Two open water wetlands lined the tributary in Subwatershed H and one was tucked within the scrub-shrub wetland boundaries (see Figure 8).

This data was collected by remote sensing technology mounted on aircraft capable of detecting soil moisture and saturation. Wetland identification on NWI data was not conclusive identification of a wetland as defined by the US Army Corps of Engineers. Additional potential wetlands, including those isolated from the stream network, likely existed that were not mapped by the NWI.

Floodzones and Flooding Frequency

Floodzones and flooding frequency combined to explain the flooding patterns within the watershed. The floodzones within the watershed included a few areas having a greater than one percent chance of flooding in a year that was recorded as a Special Flood Hazard Area (A & AE) on the Flood Insurance Rate Map. There were no areas of 500-year floodzone. The 100-year floodzones included areas surrounding Lake Carroll and some of its inlets, upstream of inlets on perennial streams, and downstream of the dam. Surrounding the lake, areas in the 100-year floodzone were at lower elevations below the high bedrock escarpment. The inlets with 100-year floodzone included: East Fork Creek in Subwatershed G, Central Creek in Subwatershed C, and South Creek in Subwatershed D. Upstream of the inlets, this floodzone followed the perennial streams of the Upper and Lower East Fork Creek in Subwatersheds A and B for a short distance. Downstream of the dam, 100-year floodzone encompassed the large wetland and perennial stream until its confluence with East Plum River. The remainder of the watershed was considered Minimal Flood Hazard (X) (see Figure 9).

We used “Web Soil Survey” to assess the flooding frequency of the watershed (NRCS, 2017), which sometimes overlapped floodzones but more often offered independent information. Web Soil Survey expressed flood frequency as one of the following classes: none, very rare, occasional, frequent, or very frequent. The watershed had areas of frequent and occasional flooding, with the majority of the watershed having a flooding class of “none.” Portions of frequent and occasional flooding classes existing outside of the 100-year floodzone boundary indicated that there was flood risk along streams outside of the floodzone. Frequent flooding was “flooding is likely to occur often under normal weather conditions” and was more than “50 percent likely in any year but less than 50% in all months of any year.” Areas of frequent flooding overlapped a few of the 100 year flood zone but also were found on much of the intermittent stream segment of North Creek above the lake inlet in Subwatershed E, perennial and intermittent segments of Upper East Fork Creek in Subwatershed A, and certain upper intermittent parts of the watershed: North and South Lower East Fork Creeks in Subwatershed B, Central Creek in Subwatershed C, South Creek in Subwatershed D, and one inlet in Subwatershed G. Occasional flooding, or that which “occurs infrequently under normal weather conditions the chance of flooding is 5 to 50 percent in any year,” was recorded on more of the watershed, including most of the perennial streams, significant parts of the intermittent streams, and an area below the Lake Carroll dam including the probable wetland. Besides those areas in frequent or occasional flood frequency, the rest of the watershed was recorded as no frequency (“none”), where flooding was “not probable” and the “flood frequency is zero percent in any year and flooding occurs less than once in 500 years” (see Figure 10).

Table 2 HUC-14 Subwatershed Boundaries Acreage

HUC 14 Subwatershed Boundaries Acreage			
HUC 14 Code	Name	Acres	% Watershed
07060005080101	A	1413.069	9.79%
07060005080102	B	3117.880	21.61%
07060005080103	C	2796.357	19.38%
07060005080104	D	2875.023	19.93%
07060005080105	E	985.200	6.83%
07060005080106	F	1003.585	6.96%
07060005080107	G	1692.623	11.73%
07060005080108	H	541.213	3.75%

Table 3 Stream and Shoreline Lengths

Stream Length (Feet)		
Subwatershed	Intermittent	Perennial
A *Note: Stream length between A and B is recorded in A	45,116.66	3,248.74
B	98,159.47	3,956.10
C	74,787.27	13,765.51
D	56,282.27	11,184.65
E	23,290.61	0.00
F	9,000.58	0.00
G	33,857.82	0.00
H	7,441.61	4,132.12

Stream Length (Miles)		
Subwatershed	Intermittent	Perennial
A *Note: Stream length between A and B is recorded in A	8.54	0.62
B	18.59	0.75
C	14.16	2.61
D	10.66	2.12
E	4.41	0.00
F	1.70	0.00
G	6.41	0.00
H	1.41	0.78

Shoreline Length		
	Feet	Miles
Lakes, Ponds, & Detention Basins	104,311.70	19.76

Figure 6 East Fork Creek Watershed, HUC-14 Watershed

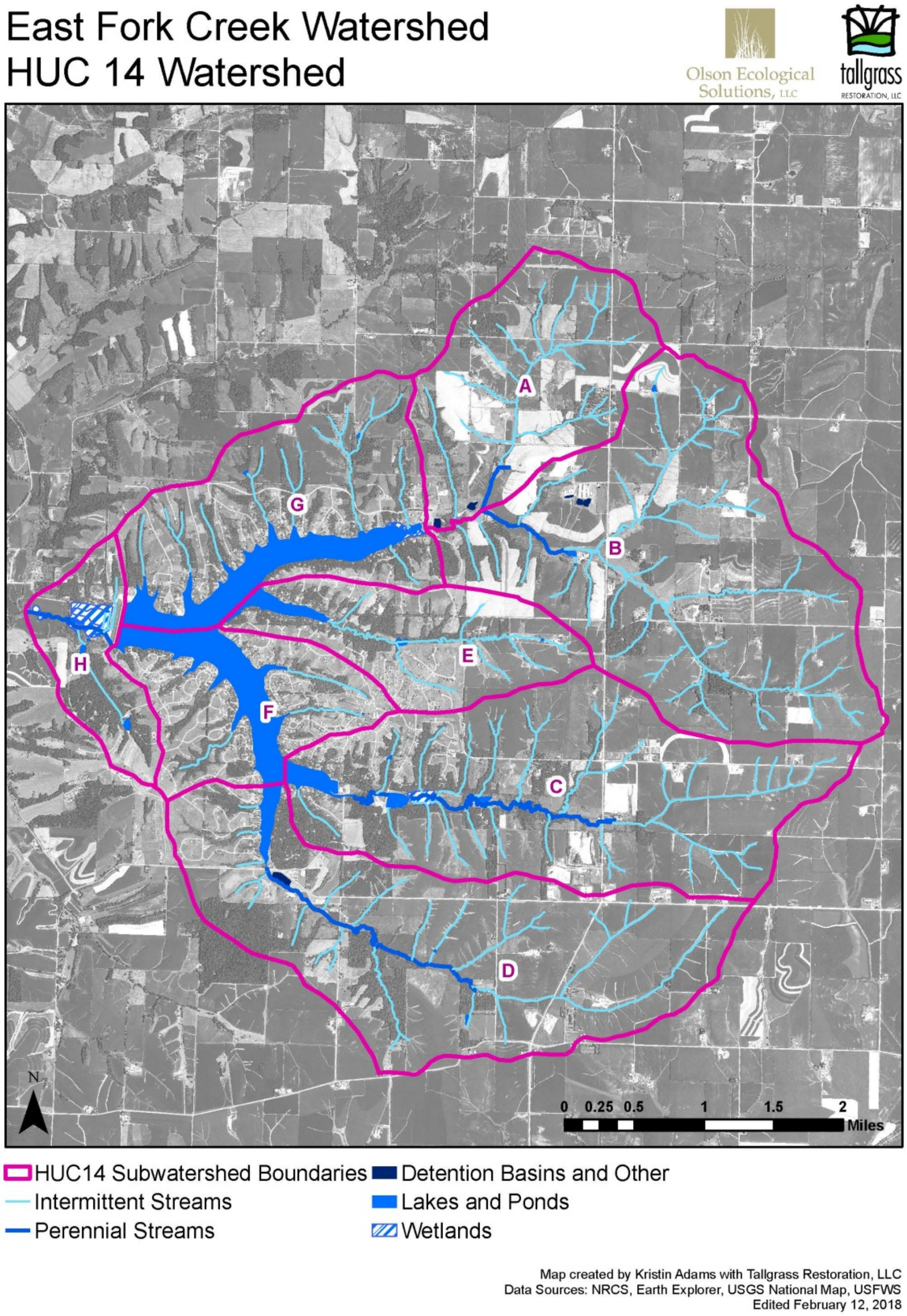


Figure 7 East Fork Creek Watershed, Streams

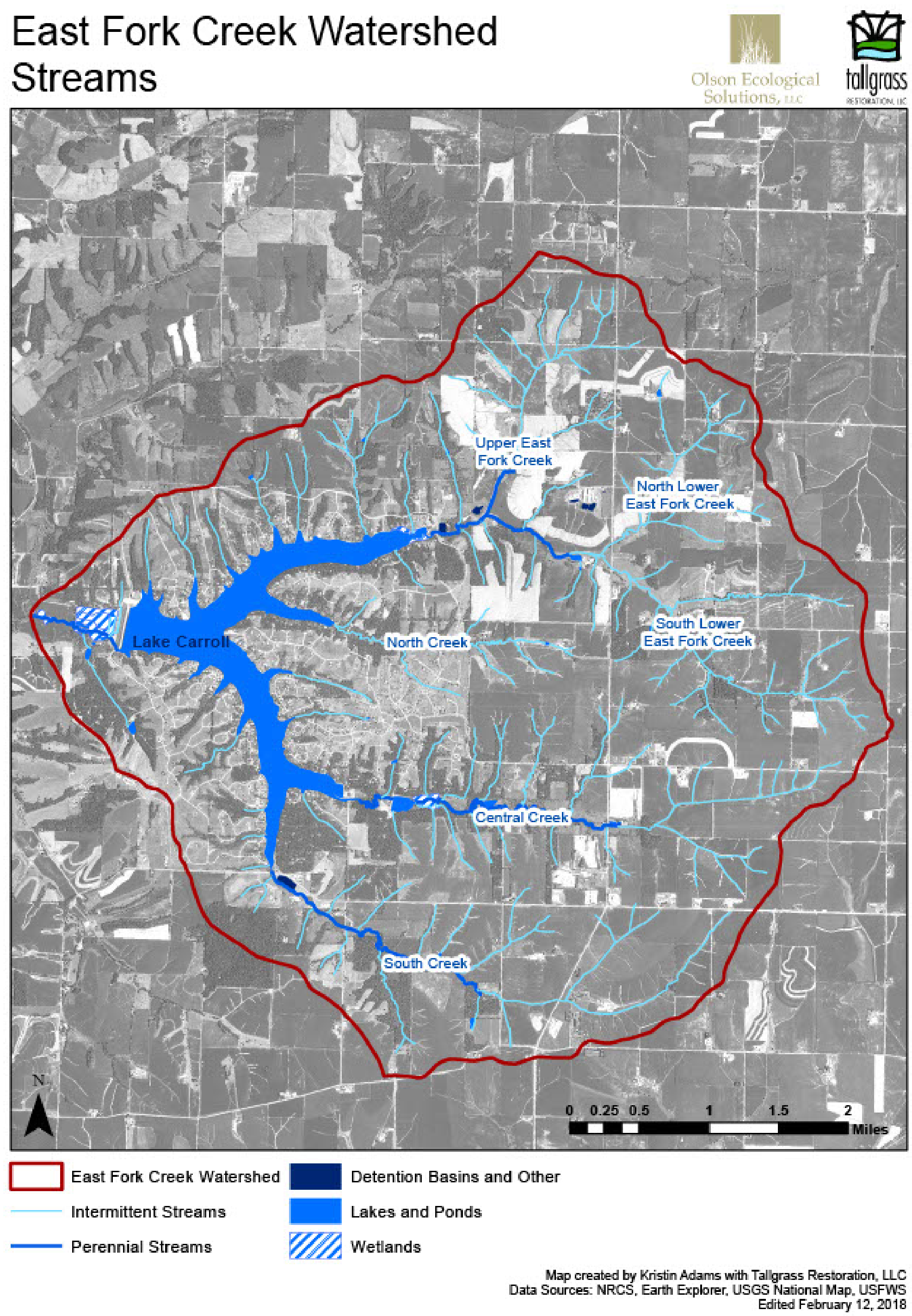


Figure 8 East Fork Creek Watershed, Ravine and Stream Banks

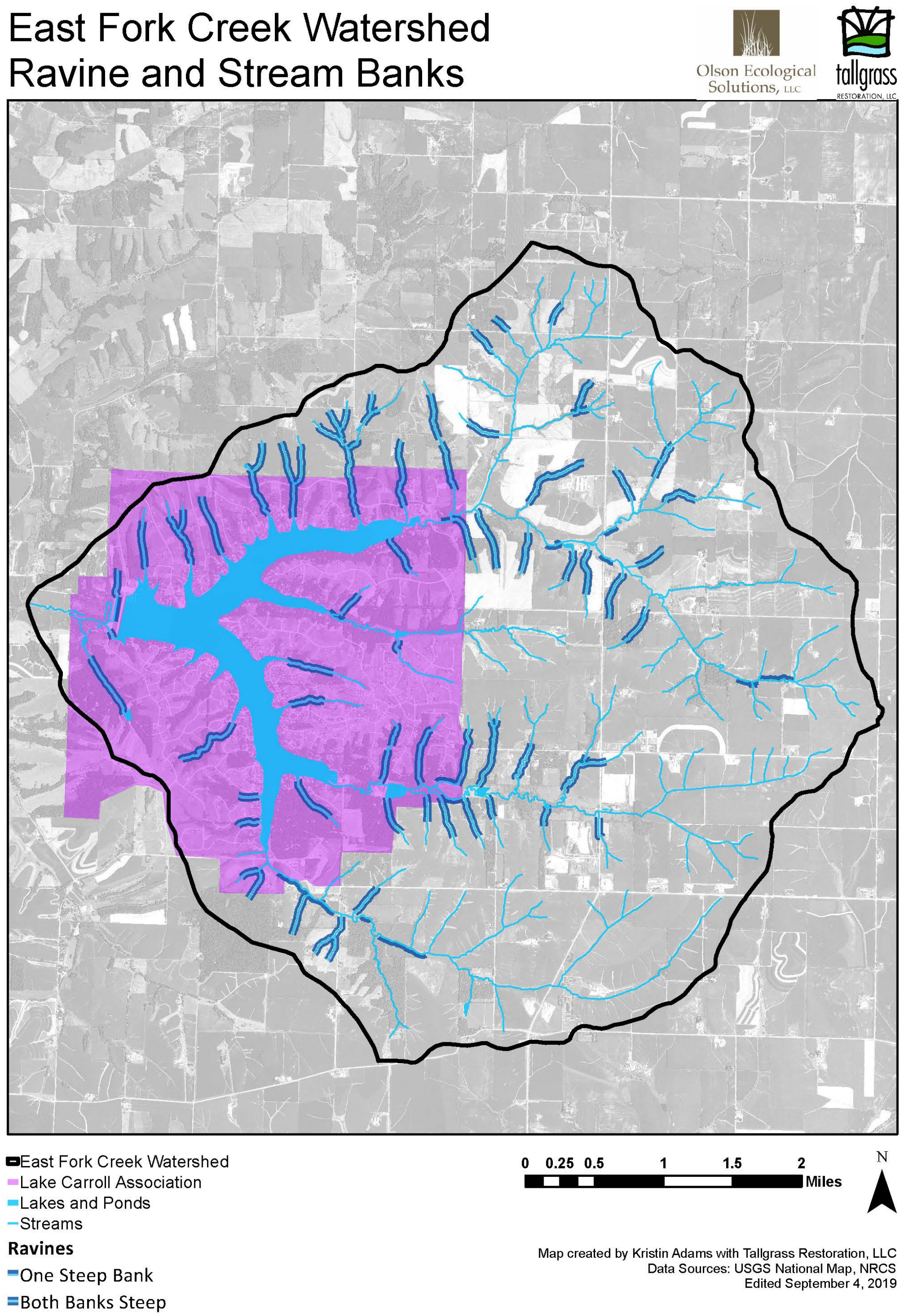


Figure 9 East Fork Creek Watershed, National Wetlands Inventory (NWI)

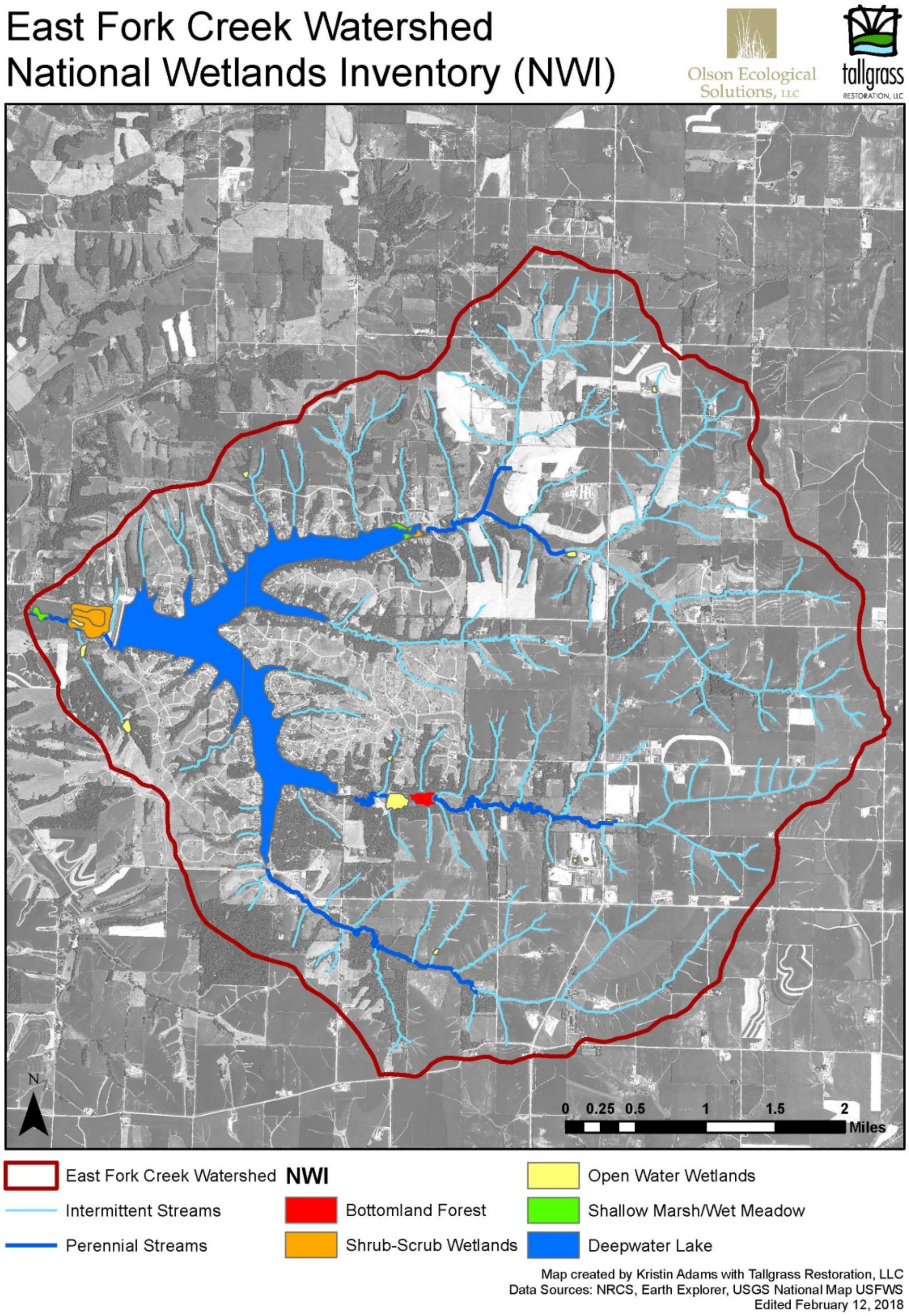


Figure 10 East Fork Creek Watershed, Floodzones

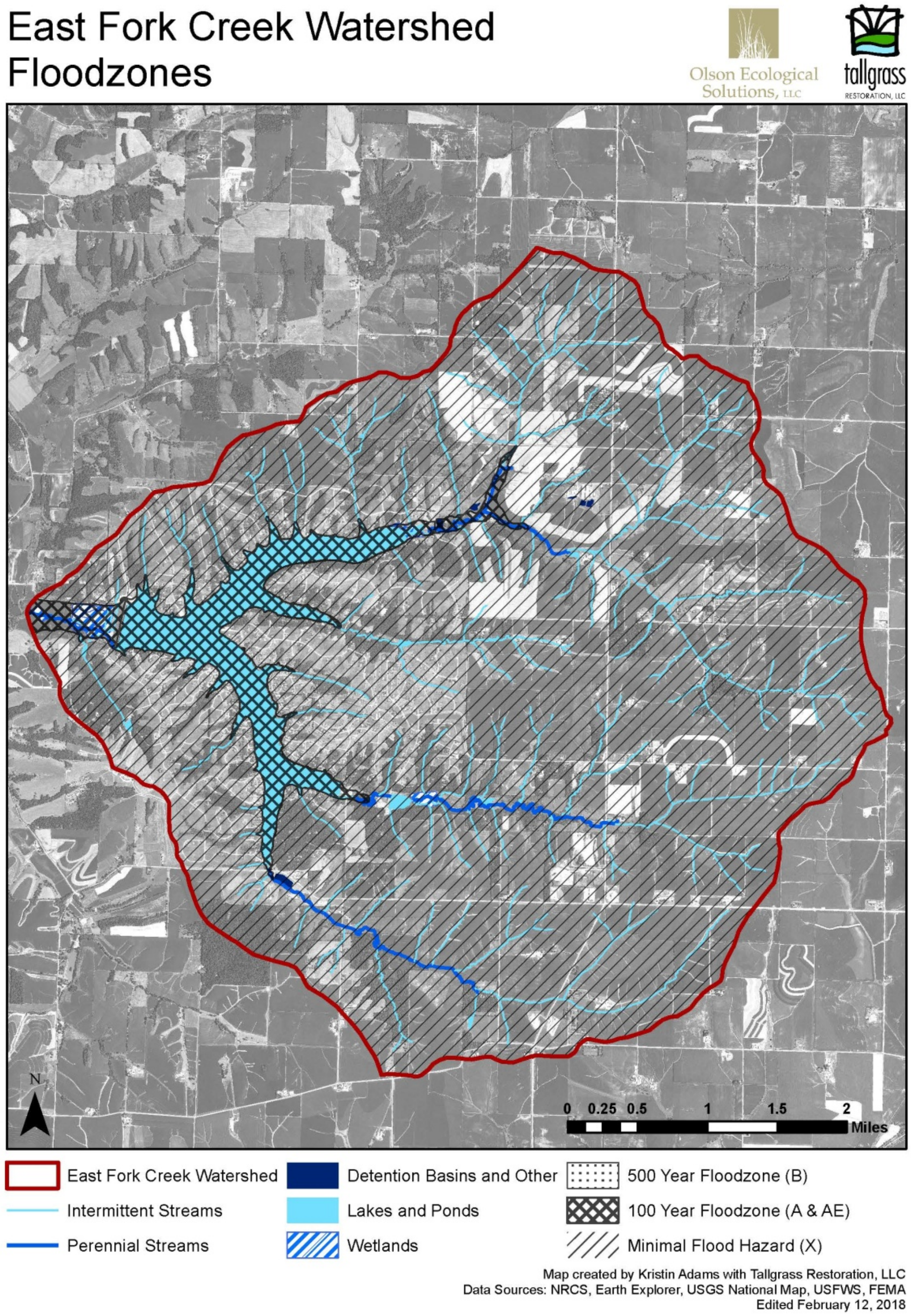


Figure 11 East Fork Creek Watershed, Flooding Frequency Class

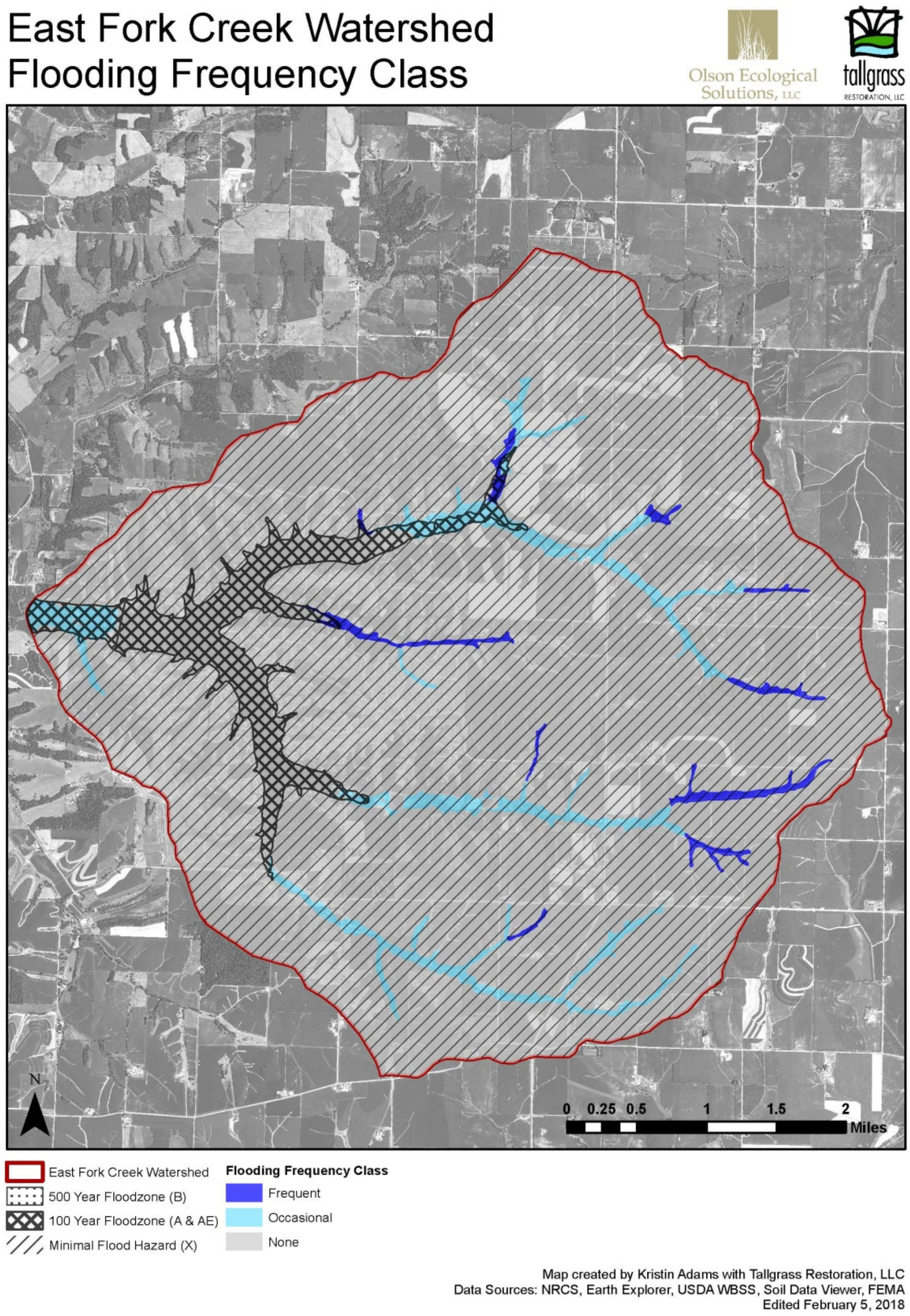
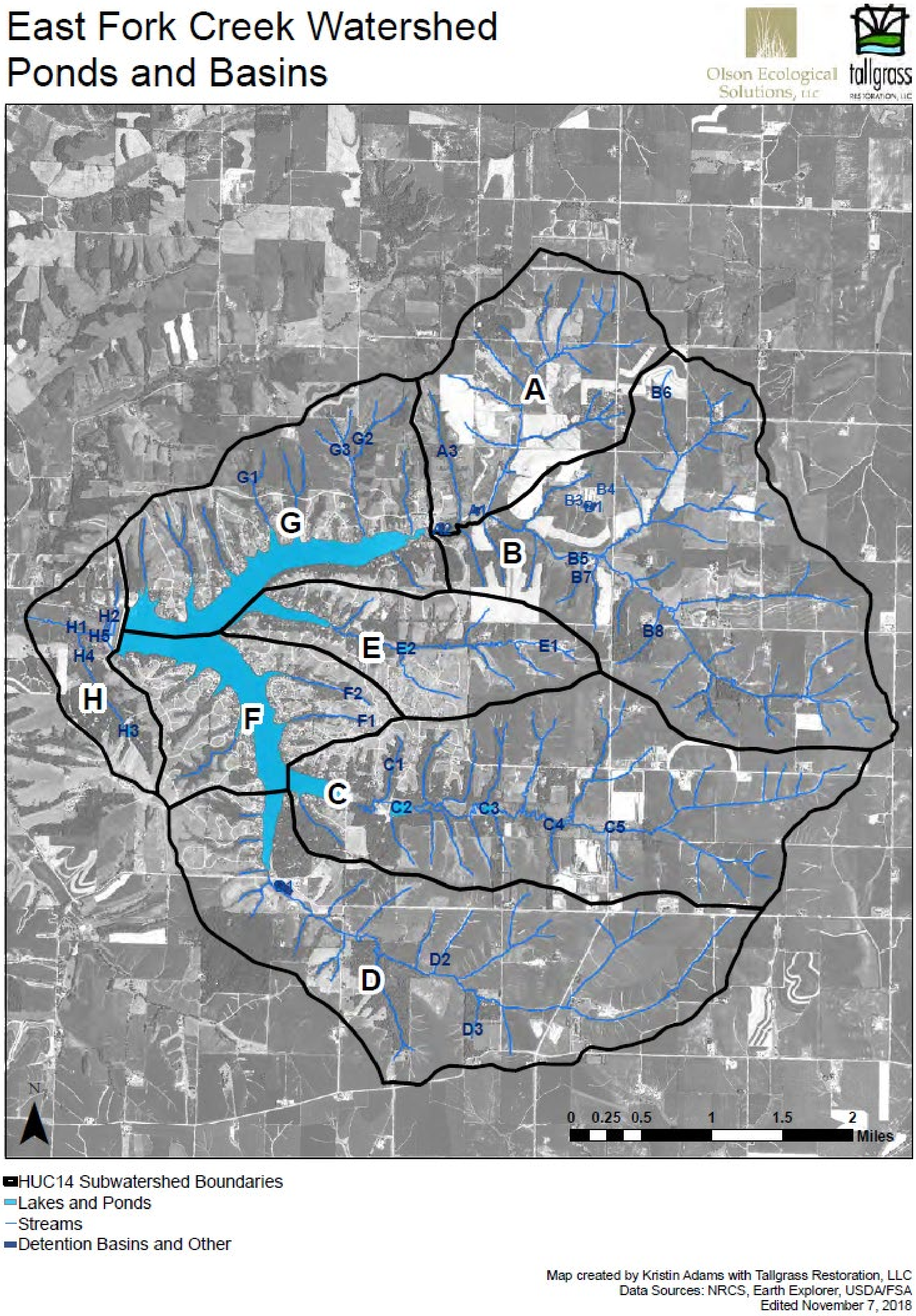


Figure 12 East Fork Creek Ponds and Basins



Part 3: Land Uses and Land Cover

Historic Land Cover

Prairies and forests historically covered the watershed. Prairie made up much of what is now Lake Carroll and the watershed's upper reaches to the east (4,606 acres). Forest covered two-thirds of the watershed (9,512 acres). A few cultural sites, most likely homesteads, dotted the prairies (115 acres). The stream running through the watershed (193 acres) was in its current location, prior to being dammed to form Lake Carroll (see Table 4.1 and Figure 12). The forests and prairies of the past gave way to today's farmland and a residential community with a golf course surrounding Lake Carroll.

Current Land Uses and Land Cover

During this inventory, the major land uses and land cover were agricultural, residential, and forest and open space. Most of the watershed was made up of cropland (56%, 8100 acres), and about 1% was in pasture (182 acres). Within the Lake Carroll Association community, 18% of the watershed (2547 acres) was used for residential, 7% in turf grass and open space (954 acres), and 3% (388 acres) for a golf course. Natural areas covered the remaining 15% as forest, water, and wetlands. Approximately 11% of the watershed was covered with forest (1525 acres). Water, mostly Lake Caroll, accounted for about 4% (590 acres) of the watershed, and a sparse scattering of wetlands added less than 0.5% (78 acres). Another small portion (<0.5%) of the watershed was barren (see Tables 4.2 and 4.3 and Figure 13).

In the upper reaches of the watershed, areas that were once prairie were converted to row crop agriculture. Low density residential homes dotted the agricultural portions of the watershed, and three pastures were located in Subwatersheds A and D. Area covered by water increased due to the construction of Lake Carroll. Roughly half of the remaining land that used to be forested was converted to row crop farming, while the other half housed the community with residences and open spaces (turf grass), a golf course, and Lake Carroll. Remaining forest was found in the steep ravines throughout the watershed, and a few large patches were in Subwatersheds C, D, and H.

Row crop farming, one of the major land uses within the watershed, was conducted by a combination of no-till, conservation till, and conventional till methods. JadEco Natural Resource Consultation and Management conducted a windshield survey of farming methods in order to determine the ratio of each. This provided a snapshot view of farming practices. In 2018, 58% of farmland was farmed using no-till and another 41% used conservation till practices. Less than 1% of all farming in the surveyed year used conventional tillage. Conversations with local farmers confirmed that no-till and conservation till were used when converting fields to beans (including consecutive years of bean production); however, conventional till was sometimes used when converting fields to corn, resulting in substantially higher yields. It was likely that the conventionally tilled field was subject to no till or conservation till in other years.

Predicted Future Land Uses and Land Cover

Impervious surfaces covered about 442.6 acres of the watershed, including homes, roads, paved trails, and paved lots. Anticipated changes to impervious surface were minimal, as gleaned from future land use studies including:

- Northwest Illinois Trails Study (Blackhawk Hills Regional Council, 2018)
- Eight-County Freight Study Summary Report (CPCS Transcom, 2018)
- Lake Carroll Real Estate Guide (Lake Carroll Assoc., December 2018)
- 2014-2019 Comprehensive Economic Development Strategy (Blackhawk Hills Regional Council, 2014)
- Carroll Co., IL 2008 Comprehensive Plan (Carroll Co. Economic Development Corp., 2008)
- Greenways and Trails Plan, Carroll Co., IL (Carroll Co. Economic Development Corp., no date)
- UTV-ATV Trail Proposal Update (Carroll Co., no date)

The population in Carroll County, and specifically in the Census Blocks that encompassed most of the watershed (see Figure 14), had been following a downward trend and was predicted to decrease. Section 8.4 of the Carroll County Comprehensive Plan stated, "Since Carroll County has experienced a decrease in population… it is not necessary to calculate projected residential land use demands." This comprehensive plan set a goal to improve current housing by rehabilitating existing houses (Carroll Co. Economic Development Corp., 2008). With 48 homes and 17 vacant lots for sale within the Lake Carroll Association community (Lake Carroll Real Estate Guide, 2018), we predicted no notable spike in the housing development. Furthermore, most of the watershed's land was in agriculture, which was not anticipated to change in the near future by any of the planning documents.

There were some road and trail projects planned within the watershed. However, road projects planned by the Illinois Department of Transportation included mostly replacements or resurfacing of existing infrastructure, not construction of new roads, and the Greenways and Trails Plan showed a trail system following Zier Road and connecting to Lake Carroll Boulevard. We speculated that this trail will be incorporated into existing roads and will not add to in future construction. Furthermore, the Carroll County Comprehensive Plan stated that expansion of rail and water transportation was needed, but we did not anticipate related changes having any effect on the watershed.

Demographics

There were different demographics within and outside of the Lake Carroll Association complex. We looked at the demographics in terms of numbers of homes, lots, and parcels; well data; and township and county-wide census information, and census block data. Within the Association, there were 933 homes and 2,550 lots as of April 2010 ("About Our Association," 2018), supporting primary and secondary residences (M. Schmeider, personal communication, May 24, 2018). Outside of the Association, there were approximately 175 parcels in different land ownership. These parcels ranged in size from 1/10th of an acre to 1,144 acres, with some landowners owning multiple parcels. About two-thirds (64%) of these parcels were less than 40 acres in size. Of those over 40 acres in size, about 14% were between 40 and 100 acres, 19% were between 100 and 300 acres, and 3% were over 300 acres (Carroll Co. GIS, 2018 and Stephenson Co. GIS, 2018). The majority of the homes on these parcels were single family, mixed with some condominiums.

The number of homes, lots, and parcels did not correlate with the number of wells in the watershed. There were about 800 recorded wells within the watershed, mostly congregated within the Lake Carroll Association. Some wells within the Association may have served more than one residence, while some outside of the Association may have been used for agricultural purposes only, such as irrigation and livestock watering. Therefore, we dismissed well data.

To glean more information about the watershed demographics outside of the Association, we looked at 2016 census data for the four townships and two counties of the watershed. We assessed township data for population distribution and county data for industry. The townships of the watershed were Cherry Grove-Shannon and Freedom Townships in Carroll County and Loran and Jefferson Townships in Stephenson County. We determined how much of each township was comprised of the watershed in order to relate the census information per township to the watershed. Most of East Fork Creek Watershed's acreage was in Cherry Grove-Shannon Township (61%, 8,782 acres) followed by Freedom Township (23%, 3,278 acres), Loran Township (14%, 2,091 acres), and finally Jefferson Township (2%, 275 acres) (see Table 1). Looking at how much of the area of each township was comprised of the watershed, the order was the same: The watershed made up about 26% of Cherry Grove-Shannon Township's area (8,782 of 34,176 acres), 14% of Freedom Township's area (3,278 of 22,912 acres), 9% of Loran Township's area (2,091 of 22,400 acres), and 2% of Jefferson Township's area (275 of 11,712 acres). Therefore, Cherry Grove-Shannon Township census data was most relatable to the watershed. This township had a population of 1,407 in 2016, with about 26.4 people per square mile (per 640 acres), which included the towns of Shannon and Georgetown and rural farmland. This was moderately populated compared to all the townships. By comparison, there were 420 people and 11.7 people per square mile in Freedom Township (including Lake Carroll Association), 1,510 people and 43.1 people per square mile in Loran Township (including Pearl City), and 209 people and 11.4 people per square mile in Jefferson Township, which was entirely rural (U.S. Census Bureau, 2016a, 2016b, 2016c, and 2016d). Industry within Carroll and Stephenson Counties was similar, led by manufacturing; educational services, health care, and social assistance; and retail trade. Agriculture, a strong component of the East Fork Creek Watershed, comprised 8.7% of the industry in Carroll County and 5.1% in Stephenson County (U.S. Census Bureau, 2016e and 2016f). There were no known, predicted population changes or growth forecasts within the watershed or surrounding communities.

Census data also was also grouped by numbered blocks. There were three census block groups that encompassed the East Fork Watershed (See Figure 14). In Illinois Block Group 17177004003, located in the Northwest corner of the watershed and part of Stephenson County, the population was 1,048 in 2018 with an expected -0.6 growth rate, predicting 1,017 people by 2023. There were 36 persons per square mile with a median age of 41, median income of $60,575, 602 people in the workforce, and an unemployment rate of 3%. The Illinois Block Group 17177004001, in the northeast corner of the watershed and also within Stephenson County, had an estimated population of 1,000 people in 2018. By 2023, their population was predicted to dip to 976, a -0.5 growth rate. There were 23 persons per square mile with a median age of 46, median income of $53,136, 559 people in the workforce, and an unemployment rate of4%. The last block group, Illinois Block group 170159601001, covered the southern section of the watershed and was within Carroll County. Their population of 1,449 in 2018 was predicted to dip by -0.2% by 2023, resulting in 1,436 residents. The census data estimated 21 persons per square mile with a median age of 60, median income of $68,328, 666 people in the workforce, and an unemployment rate of 1%.

Table 4.1 Land Cover in the Early 1800's Acreage

Land Cover in the Early 1800's Acreage		
Land Use Type	**Acres**	**% Watershed**
Cultural	114.792	0.80%
Forest	9512.372	65.94%
Prairie	4606.374	31.93%
Water	192.921	1.34%

Figure 13 East Fork Creek Watershed, Landcover in the Early 1800's

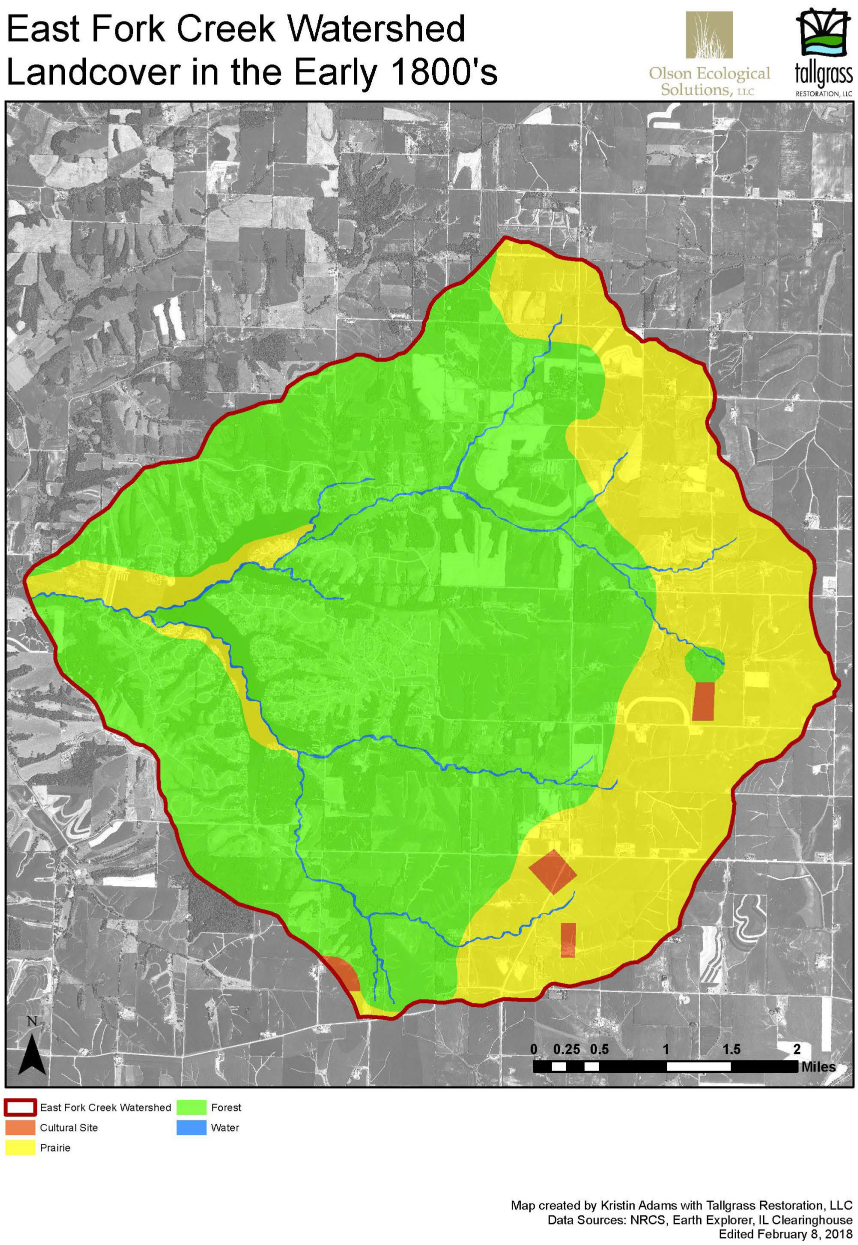


Figure 14 East Fork Creek Watershed, Land Cover

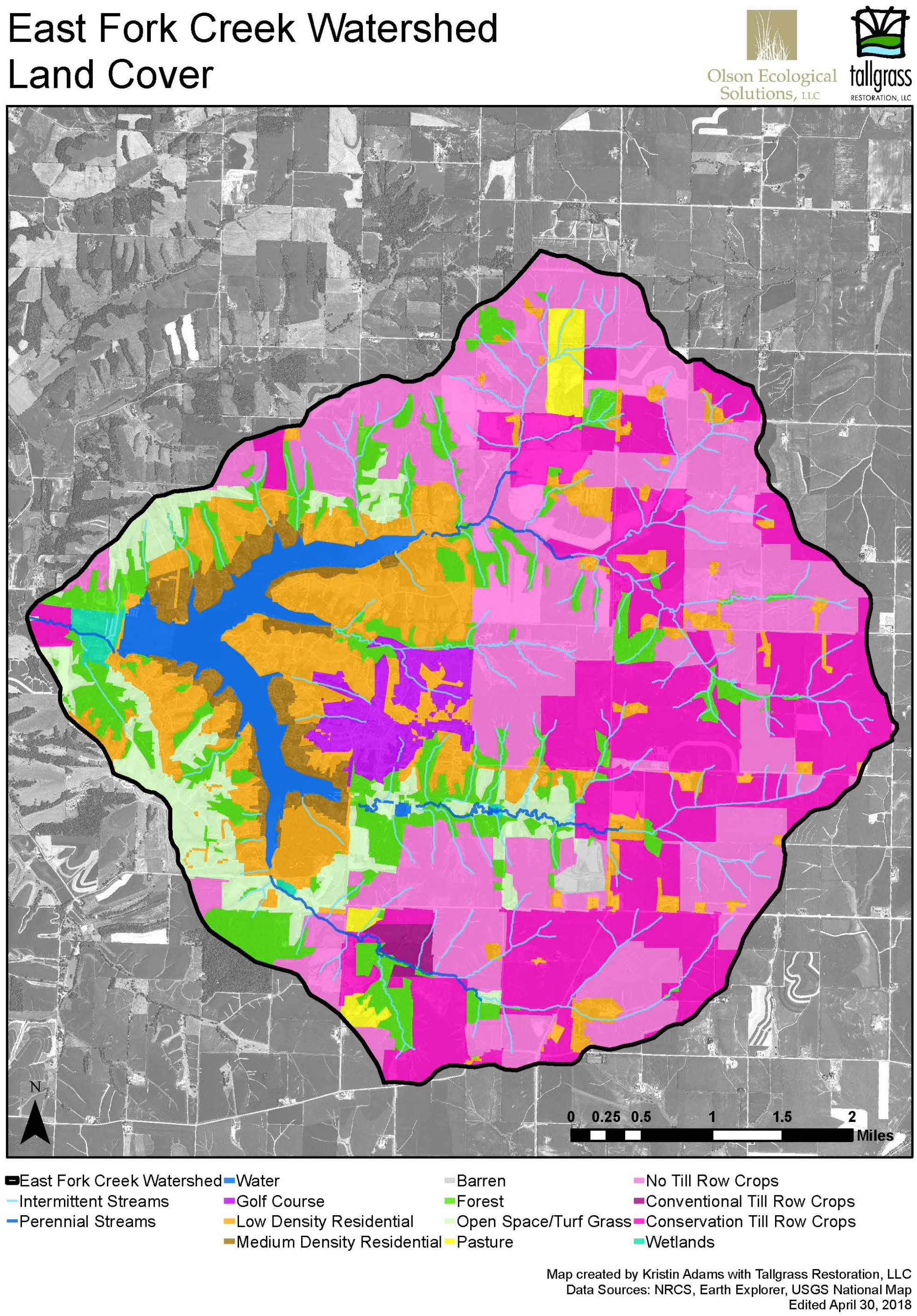


Table 4.2 National Land Cover Database 2011 (NLCD2011) Legend

Class\ Value	Classification Description
Water	
11	**Open Water (Intermittent Streams, Perennial Stream, and Water)**- areas of open water, generally with less than 25% cover of vegetation or soil.
Developed	
21	**Developed, Open Space (Open Space/Turf Grass)**- areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20% of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.
22	**Developed, Low Intensity (Low Density Residential)**- areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% percent of total cover. These areas most commonly include single-family housing units.
23	**Developed, Medium Intensity (Medium Density Residential)** -areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of the total cover. These areas most commonly include single-family housing units.
Barren	
31	**Barren Land-Rock/Sand/Clay (Barren)**- areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.
Forest	
41	**Deciduous Forest (Forest)**- areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species shed foliage simultaneously in response to seasonal change.
Planted/Cultivated	
81	**Pasture/Hay (Pasture)**-areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20% of total vegetation.

82	**Cultivated Crops (No Till, Conservation Till, and Conventional Till Row Crops)** - areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20% of total vegetation. This class also includes all land being actively tilled.
Wetlands	
90	**Woody Wetlands (Wetlands)**- areas where forest or shrubland vegetation accounts for greater than 20% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.
95	**Emergent Herbaceous Wetlands (Wetalands)**- Areas where perennial herbaceous vegetation accounts for greater than 80% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.

(Multi-Resolution Land Characteristics Consortium)

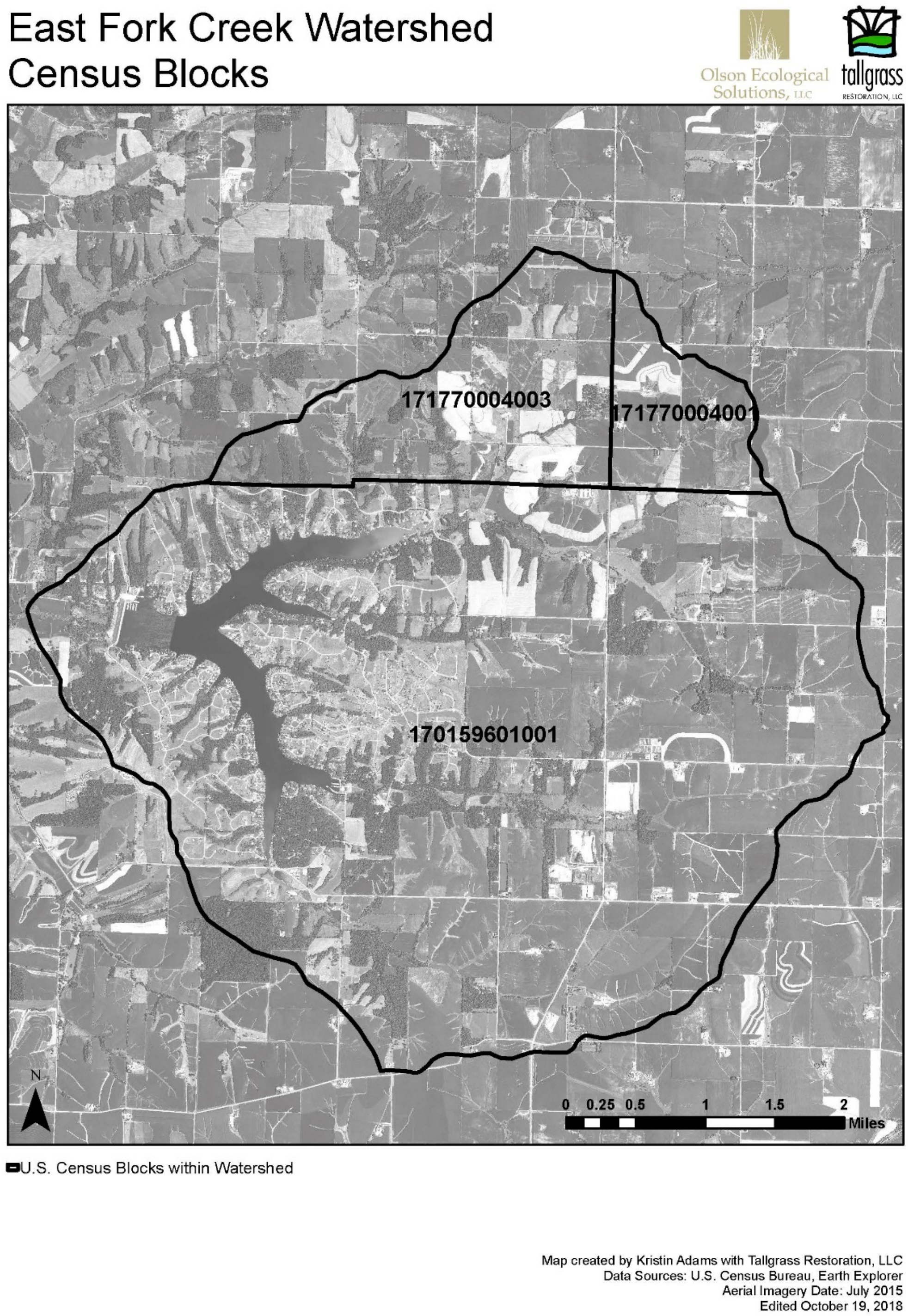
Table 4.3 Land Cover Acreage

Land Cover Acreage	
Land Cover Type	Acreage
Water	590.06
Golf Course	388.38
Low Density Residential	2,124.16
Medium Density Residential	423.24
Barren	60.54
Forest	1,525.13
Open Space/Turf Grass	953.55
Pasture	182.01
No Till Row Crops	4,718.41
Conventional Till Row Crops	77.83
Conservation Till Row Crops	3,304.54
Wetlands	78.37
Total acres:	**14,426**

Table 4.4 Land Cover Acreage by Subwatershed

Land Cover Acreage by Subwatershed								
Land Cover Type	A (Acres)	B (Acres)	C (Acres)	D (Acres)	E (Acres)	F (Acres)	G (Acres)	H (Acres)
Water	0.00	0.00	38.92	29.28	38.47	230.80	251.00	1.58
Golf Course	0.00	0.00	132.18	0.17	143.73	112.24	0.00	0.06
Low Density Residential	79.94	227.58	325.54	252.34	290.28	377.65	416.66	54.17
Medium Density Residential	0.00	0.00	59.42	19.22	23.79	135.56	185.25	0.00
Barren	0.00	0.00	59.63	0.91	0.00	0.00	0.00	0.00
Forest	115.56	227.97	333.90	306.93	64.51	67.81	228.67	179.78
Open Space/Turf Grass	0.00	0.00	216.42	305.85	0.00	79.41	196.46	155.41
Pasture	126.11	0.05	0.01	55.74	0.00	0.00	0.10	0.00
No Till Row Crops	847.88	1,477.69	749.49	929.40	310.99	0.00	371.97	30.70
Conventional Till Row Crops	0.00	0.00	0.00	77.83	0.00	0.00	0.00	0.00
Conservation Till Row Crops	243.70	1,184.60	877.74	891.45	13.46	0.00	42.59	51.00
Wetlands	0.00	0.00	3.11	5.90	0.00	0.00	0.00	69.36
Total	1,413.19	3,117.89	2,796.36	2,875.02	885.23	1,003.47	1,692.70	542.06

Figure 15 East Fork Watershed Census Blocks



Part 4: Geology and Climate

Geology

The geologic features of the East Fork Creek Watershed were governed by steep, rolling topography influenced by lack of glacial activity, bedrock geology, and forces of wind and water combined with silty soils. The footprint of the Wisconsin Driftless System remained unglaciated during the major glacial periods, causing an unusual lack of glacial till and a steep and varied bedrock formation. This was represented by a large escarpment of brownish-gray dolomite bedrock, formed during the Silurian Period from the carbonic mineral dolomite, weathered only by wind and water. Silurian System made up most of the watershed, with Marquoketa Shale Group in its streambed.

Before Lake Carroll was formed in the early 1970s, exposed bluffs extended far above the perennial streams. The bedrock geology of the perennial stream basins included exposed Maquoketa shale and dense clay in areas where dolomite had long been weathered away (NRCS, 2008; Elmer and Higgins, 2006; and McGarry, 1997). Maquoketa shale, predominantly a clay-associate shale within beds of soft limestone and dolostone (non-bedrock), was formed from clay washed into the shallow inland sea that covered the central North American continent during the late Ordovician Tippicanoe Transgression. The dense clay that made up the bulk of the Maquoketa shale, often called "blue clay" in well logs, was nearly impermeable to groundwater. Due to the contrast in permeability between the shale and the overlying dolostone, springs and seeps were common along the contact (Kolata, 2010). In the eastern parts of Carroll County, including the upper reaches of this watershed, silt deposits on dolomitic bedrock with a slope of up to 60% were often only five inches thick, increasing to 10 feet thick on ridge tops. This depth and elevation influenced the development and diversity of soil types (Elmer and Higgins, 2006).

Wind-blown sediments from the Quaternary Period overlaid dolomite from the Silurian System throughout the entire watershed outside of the streambed. Silty sediments known as loess allowed the development of mineral soils at the soil's surface (see comparison of Figure 1512 and Figure 1613). In the eastern part of the watershed, deposits of wind-blown Loess were deeper, and several of the streams and tributaries developed with less of a tree pattern because they were more influenced by thick silty-loam soils, shallower slopes, and remarkably less bedrock near the surface. Moving generally from east to west, the depth of these windblown sediments decreased (Elmer and Higgins 2006). From east to west and in shallower gradients, land cover changed in response the depth of wind-blown sediment. In general, there was a transition from farms in the east to woodlots and residential development on the more exposed rocky escarpment to the west. To the north of East Fork Creek and its watershed, the geologic features allowed for up to five feet of glacial till in the southwest Yellow River Watershed, compared to hundreds of feet in most of the East Fork Creek Watershed and none in the escarpment.

The forces of water cut streams through the changing elevations that varied by each subwatershed and stream valley combined with the ancient, slowly weathering dolomite rock and temperate climate that promoted abundant rainfall. Within the streams, the forces of water over a very long period of time weathered the dolomite rocky escarpment, bringing it to the shale and clay below in some places and allowing sedimentation of silty sediment. This sediment formed in the creek bed over deposits of ancient Maquoketa shale and other rocks older than the dolomite bedrock that loomed over them (McGarry, 1997). Streams naturally meandered through silt loam soils over dolomite bedrock, sometimes reaching the impervious clays below the bedrock. The watershed's consistent, moderately-soft, ancient Silurian dolomite overlaid by relatively shallow, silty soils allowed for an even erosion pattern (see Figure 15). The streams formed with a great distance in between tributaries and in a westerly path. Water cut a system of steeply sloped ravines resembling a tree when viewed on a map, which drained the basins via intermittent streams. In some of the watershed, intermittent streams drained directly into inlets to the lake (See Figure 17). Other intermittent streams became perennial streams, forming the four main tributaries to Lake Carroll and East Fork Creek.

Topography

The upper reaches of the East Fork Creek Watershed had steep and rolling topography with knobby hills, while the lower portion of the watershed was flatter (See Figure 18). Deep-cut ravines lined the streams in areas of distinct topographic relief, especially near Lake Carroll. The slopes and elevations of these areas varied throughout the watershed. According to the National Resource Conservation Service "Web Soil Survey," the majority of the watershed had greater than 5% but less than 30% slopes. Relatively few areas had slopes of greater than 30%, and the areas that were this steep were below the dam on the drainage of Lake Carroll and on some of the bluffs over the lake or streams. The eastern portion was more shallowly sloped and supported somewhat deeper silty-loam sediments. Expectedly, a slope of less than 5% was found across the lake bed, throughout most of the weathered network of perennial streams, and in some of the intermittent streams. The land area sloped greater than 5% was spread over most of the stream network (see Table 5 and Figure 19). The highest elevation was usually 980 feet above mean sea level but reached 990 feet in spots in both the northern and western corners of the watershed, and the lowest elevation was 680 feet above mean sea level at the confluence of the East Fork Creek and East Plum River. The impoundment at Lake Carroll was at 720 feet above mean sea level (see Figure 20).

Climate

Climate, as described in the Carroll County Soil Survey, was a major factor in the formation of soils, influencing plant and animal life. As reported in the survey, climate affected weathering of minerals and transportation of sediments in our watershed. The climate of this region had four distinct seasons and was an especially important factor to the crop producers in the area. Climactic factors included in this analysis were temperature and precipitation.

In Carroll and Stephenson Counties, the climate was temperate and humid. Climate had an overall significant difference with soil formation, but it was not likely to vary within a watershed (Elmer and Higgins, 2006). Average winters saw highs in the 30s and lows in the teens, with an average of 142 days at or below 32°F and 16 days at or below 0°F. Average summers had highs in the 80s and lows in the 60s with 24 days at or above 90°F and one day over 100°F occurring about every other year. Spring and fall had moderate temperatures, with spring highs around 57°F and lows of 36°F and fall highs of 60°F and lows of 40°F. The average length of the frost-free growing season was 165 days. The last occurrence of 32°F each year in the spring was on average April 28, and the first occurrence of this temperature in the fall was on average October 7 (ISWS, 2013).

Average precipitation in the East Fork Creek Watershed and the rest of the Plum River region varied greatly from year to year and between decades. Trends over the past 60 years showed significant increases, while the same data only amounted to slight increases when considering the past 100 years (IDNR, 2001). On average, the watershed and the rest of northern Illinois received from 32 (ISWS, 2005 to 2013) to 40 inches of precipitation annually and was subject to droughts, major prolonged wet periods, and flash floods that dropped four to eight inches of rainfall in a few hours in localized areas.

There were on average 117 days of measurable precipitation, including eight days with one inch or more of rainfall and 12 days with one inch or more of snowfall. Once per year on average, the area experienced a snowfall of six inches or more. The average annual snowfall was 35 inches (ISWS, 2005 to 2013). April, May, and June were typically the wettest months and January and February were the driest. Of the annual average rainfall, 65% usually fell during April through September (ISWS, 2013). Thunderstorms accounted for about 50 - 60% of the precipitation, half of which occurred between June and August. Typically, snow storms that released one inch or greater of snowfall per storm occurred between November 20 and March 26 (ISWS, 2013). Table 6 provided a snapshot of precipitation and temperature monthly averages for the most recent full year, 2017 (Wunderground, 2018).

Table 5 Representative Slope

Representative Slope

Slope (% Rating)	Acreage	% Watershed
0	626.15	4.340
0.5	23.40	0.162
0.9	143.88	0.997
1	678.25	4.701
3	2.87	0.020
3.5	229.92	1.594
4	1801.82	12.490
6	370.88	2.571
7.5	2734.92	18.958
8	3348.20	23.209
9	306.86	2.127
10	19.47	0.135
14	2477.18	17.171
15	11.38	0.079
16	439.73	3.048
23.5	86.59	0.600
26.5	70.29	0.487
27	964.24	6.684
48	90.42	0.627

Table 6 Precipitation and Temperature Monthly Averages for 2017 for East Fork Creek Watershed

Precipitation and temperature monthly averages for 2017 for East Fork Creek Watershed							
Year	**Month**	**Total Precipitation**	**Temperature Average (F)**			**Degree Days**	
		(inches)	**Max.**	**Min.**	**Average**	**Heat Base 65**	**Cool Base 65**
2017	**Jan.**	0.53	30	19	25	40	0
	Feb.	0.24	44	24	34	31	0
	Mar.	0.82	45	27	36	29	0
	Apr.	0.67	61	39	50	15	0
	May	0.94	66	46	56	10	0
	Jun.	2.21	80	58	69	1	5
	Jul.	1.54	78	60	69	1	5
	Aug.	0.81	76	54	65	1	1
	Sep.	0.16	77	50	64	4	3
	Oct.	1.14	63	44	53	12	0
	Nov.	0.22	44	27	36	30	0
	Dec.	0.19	30	15	23	42	0
2017	**Total**	**9.47**	**58**	**39**	**48**	**18**	**1**
2017	**Winter**	0.53	40	23	32	33	0
2017	**Spring**	1.27	69	48	58	9	2
2017	**Summer**	0.84	77	55	66	2	3
2017	**Fall**	0.52	46	29	37	28	0
Station: Freeport, IL. Weather Underground. www.wunderground.com. February 2, 2018.							

Figure 16 East Fork Creek Watershed, Bedrock Geology

Figure 17 East Fork Creek Watershed, Quaternary Deposits

Figure 18 East Fork Creek Watershed, Erosion Hazard

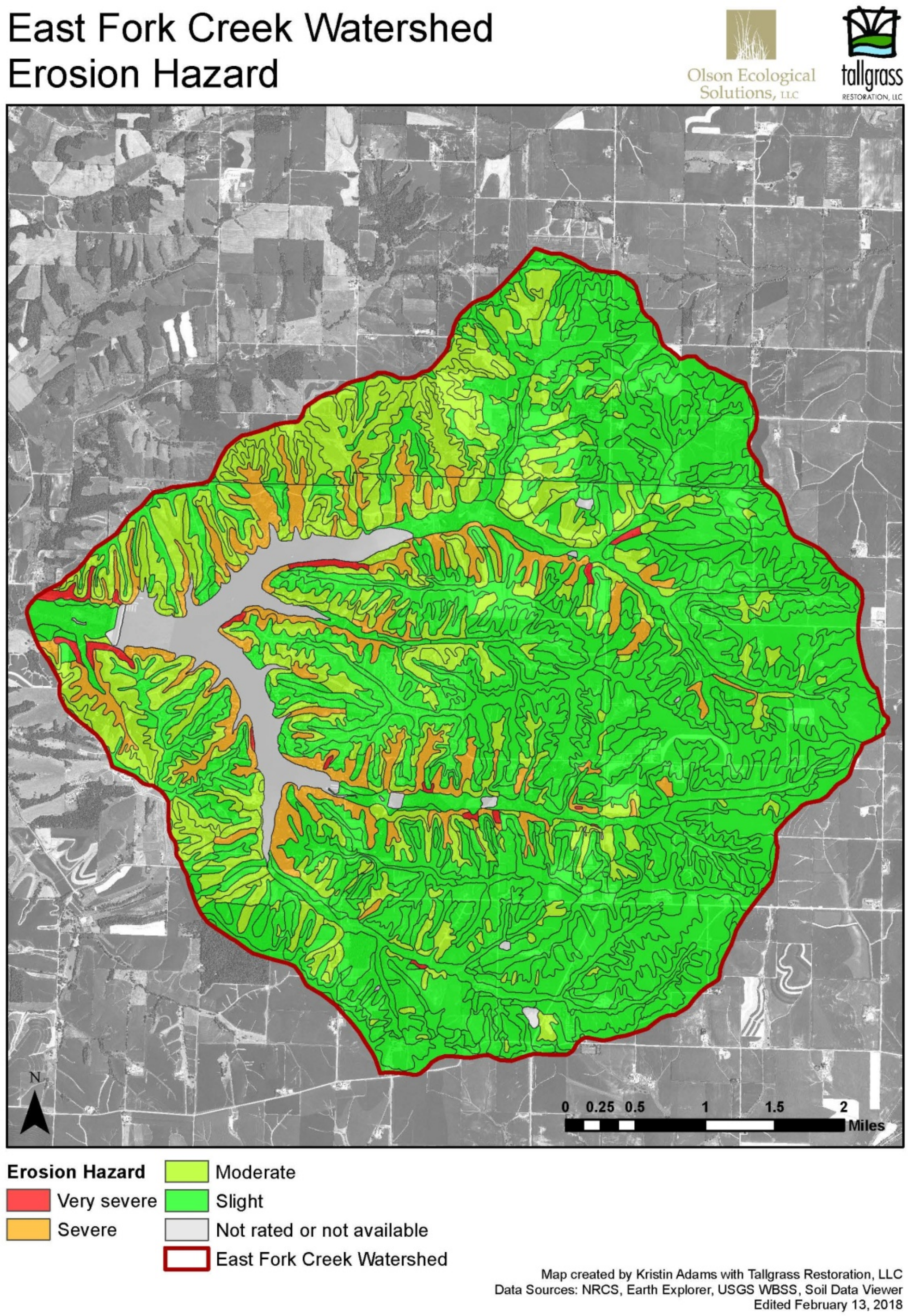
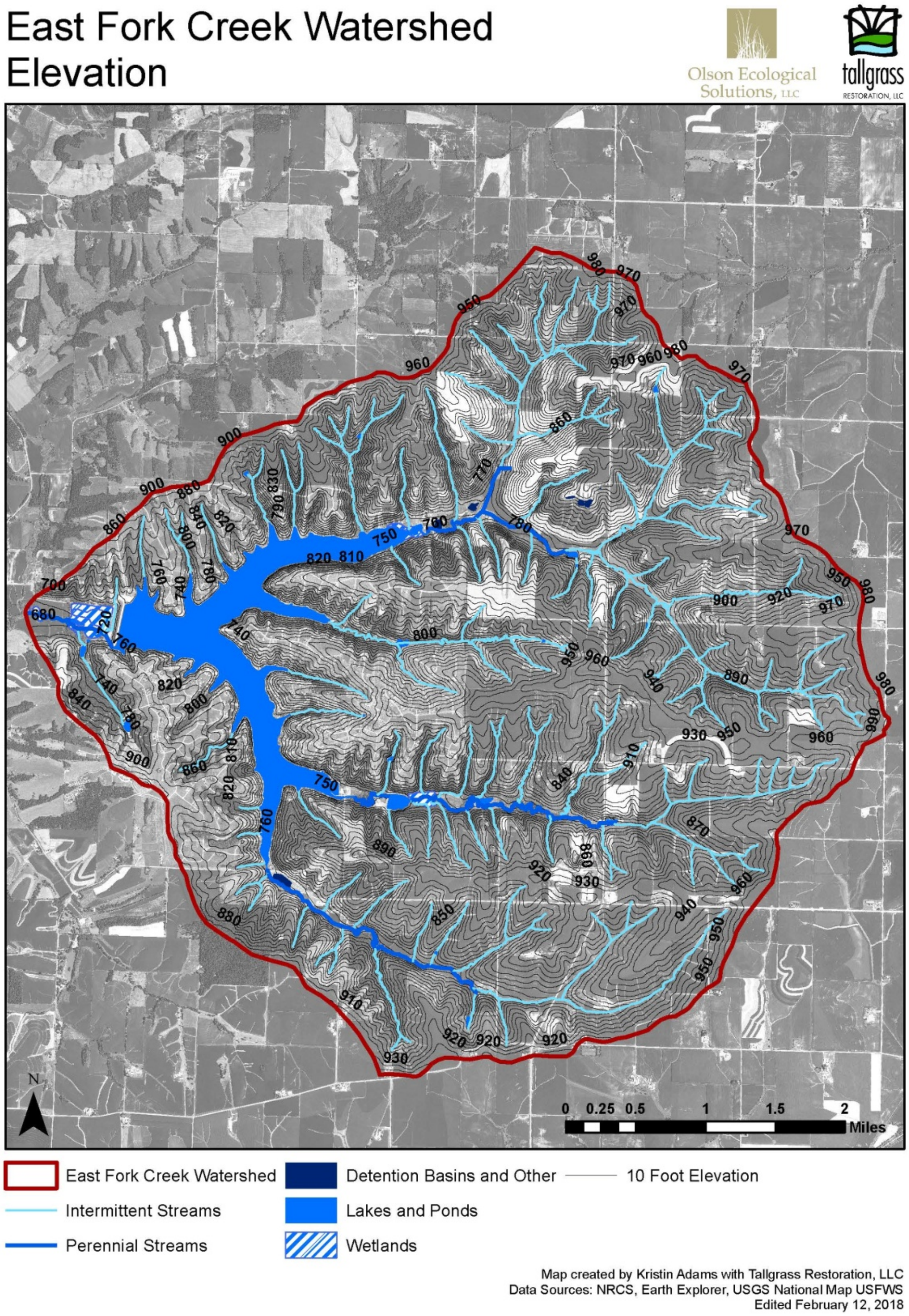


Figure 19 East Fork Creek Watershed, Topographic Relief

Figure 20 East Fork Creek Watershed, Representative Slope (S)

Figure 21 East Fork Creek Watershed, Elevation



Part 5: Soils

Soil development progressed intricately in the East Fork Creek Watershed's shallow bedrock valleys and silty loess plains. As described above, soils were influenced by topography changes and a long, unglaciated history favoring extensive weathering and soil development. This weathering caused the development of an extensive diversity of silt loams across the landscape. To understand soils in the watershed and their role in water quality, we looked at soil texture, types, farmland quality, hydric developments, hydrological groups and water transmission, drainage class, erodibility by water and wind, soil loss tolerance, and highly erodible lands (HELs).

Soil Texture

The soils of the East Fork Creek Watershed developed a silty texture, vastly present as silt loams (88%) with some areas of silty clay loams (7%). The remaining area was classified as water, earthen dam, and quarry (see Table 7 and Figure 21). The silt was provided by the windblown deposits that occurred over geologic time (Elmer and Higgins, 2006). Some exception to silt loam texture occurred along the major streams or washed-out bluffs. In the larger Plum River Watershed of which East Fork Creek Watershed is a part, lacustrine deposits of silty clay to clay developed in the upper few feet of terraces north and east of Savanna. In most stream basins, the wind first deposited silty loess-formed silt loams, which eroded and then sedimentary forces developed either silty clay loams or sandy loams (Ray and Fehrenbacher 1975).

Major Soil Types

Due to the complex topography over the dolomite bedrock and shale and clay beds, combined with the lack of glaciation, there were 87 different soil mapped units in the watershed (NRCS, 2018). None of the soil units represented more than 11% of the watershed area (see Table 9 and Figure 22). Each separate unit was a different soil type with associated percent slope. When we combined soil mapped units of the same soil type with different slopes, we found 49 soil types. The five soil types making up the majority of the watershed were Fayette silt loam (13.48% of the watershed), Palsgrove silt loam (12.27%), Newglarus-Palsgrove silt loams (8.95%), Osco silt loam (8.65%), and Newglarus –Lamoille silt loams (7.31%).

Farmland Quality

Soils are evaluated for their ability to produce food, feed, forage, fiber, and oilseed crops. Illinois soils fall into prime farmland, important farmland (farmland of statewide importance), or other land (not prime farmland). Prime farmland produced the highest yields with the lowest expenditure of energy and economic resources and was the least damaging to the environment. Important farmland was generally less productive than prime farmland and possessed greater restrictions that negatively affected its use for agricultural purposes. Other land may have possessed the potential for use as farmland, but some restriction(s) prevented its use for agriculture (Illinois Dept. of Agriculture, 2001).

There was a minority of prime farmland in the watershed (18.56%, 2,677 acres), with a small amount of prime farmland if protected from flooding (0.85%, 122 acres) or drained and protected from flooding

(0.30%, 44 acres). Most of the land of the watershed was ranked as either farmland of statewide importance (46.17%, 6,661 acres) or not prime farmland (34.12%, 4,923 acres). The prime farmland was mostly located at the highest elevations on the ridgetops between ravines, with a small amount located within flat valleys. This arrangement created long, skinny veins of prime farmland, usually correlating with representative slopes of 5% or less. Surrounding these veins were farmlands of statewide importance and not prime farmland, correlating with slopes greater than 5% (see Table 10 and Figure 23).

Hydric Soils

Few places existed along streams where water flow was slow enough to allow for flooding frequent enough to promote hydric soil development. Hydric soils were poorly drained soils, prone to flooding or wet conditions if not drained, which were sufficiently wet enough to develop anaerobic conditions in the upper part of the soil. They were naturally associated with wet prairies, forest floodplains, and wetlands, as they were either saturated or inundated long enough to support the growth of hydrophytic vegetation (USDA NRCS, n.d.).

Each soil map unit was rated based on its percentage of nonhydric and hydric components. Most of the watershed (89%) supported soils rated non-hydric. Only 0.16% of the watershed had dominantly hydric soils, rated as 90% hydric. Another 11% of the watershed had soils dominated by nonhydric soils but with 1% to 7% of its area with minor hydric components in the lower positions of the landscape (USDA NRCS, n.d.) (see Table 11.1 and Figure 24).

Hydrological Soil Groups and Water Transmission

Hydrological Soil Groups (HSG) explained the runoff response potential of soils based on transmission rate of water; depth to water table or restrictive layer; and soil texture, structure, and degree of swelling when saturated. Soils were assigned into four groups: A, B, C, or D. HSG A included soils with low runoff potential when thoroughly wet, so that water transferred freely through the soil. HSG B included soils with moderately low runoff potential. HSG C included soils with moderately high runoff potential, and HSG D included soils with high runoff potential. Furthermore, if a soil in HSG D was drained, it was assigned a dual class of either A/D, B/D, or C/D, with the first letter indicating the characteristic of the drained soil (NRCS, 2007).

A little more than half of the soils in the watershed (55.93%, 8,068 acres) fell in HSG B with moderately low runoff potential. Soils in this group tended to be sandy loam or loamy sand textures with 50% to 90% sand and 10% to 20% clay, but the silt loams of this watershed were included if they were well aggregated, had low bulk density, or contained more than 35% rock fragments. Another 1/3rd of the watershed (30.5%, 4,399 acres) had soils in HSG C with moderately high runoff potential, as water transmission through the soil was somewhat restricted. Typically, soils in this group were like those found in the watershed, silt loam and silty clay loam, but they could also have been loam, sandy clay loam, and clay loam textures with 20% to 40% clay and less than 50% sand. Soils in HSG D made up another 7% of the watershed (1,016 acres). These soils, typically clay textures with more than 40% clay and less than 50% sand, had high runoff potential and restricted or very restricted water movement through the soil. Usually the depth to a water impermeable layer was less than 20 inches and depth to water table was less than 24 inches (NRCS, 2007). Some soils in the watershed that were naturally in HSG D were drained and therefore assigned a dual classification of B/D or C/D. These soils made up less than 2% of the watershed. HSG A was scarce, covering only 37 acres (0.26%) of the watershed. HSG C and D soils were recorded along around the lower portion of intermittent streams and around inlets to Lake Carroll while soils in HSG B were not as directly related to water paths (see Table 11.2 and Figure 25).

Soil Drainage Class

Soil drainage class referred to the frequency and duration of wet periods for soils in their natural condition, without artificial drainage and under conditions similar to those under which the soil formed. Within the watershed, five of the seven soil drainage classes were represented. The vast majority of soils were well drained, covering 88% of the watershed. In well drained soils, water was removed from the soil readily but not rapidly. Water was available to plants throughout most of the growing season, yet wetness did not inhibit growth of roots for significant periods of time during most growing seasons (Soil Survey Division Staff, 2017). There were also moderately well drained soils covering 4.5% of the watershed in Subwatersheds A and B, and another 3% of land coverage scattered throughout the watershed was made up of poorly drained, somewhat poorly drained, and somewhat excessively drained soils. These soil drainage classes had some correlation to hydrologic soil groups, as soils in classes other than well drained occurred on some of the B/D, C, and D HSGs. The soil drainage classes were not correlated to hydric soils or soil texture, and they had little to no correlation to prime farmland classifications (see Table 12 and Figure 26).

Soil Erodibility

Soil erosion, defined as the breakdown, detachment, transport, and redistribution of soil particles caused by water and wind combined with gravity, was of particular interest for the watershed due to its off-site impacts to water quality. Throughout the nation, soil erosion on cropland had been on a downward trend, decreasing by 43% between 1982 and 2007. Geographically, 54% of soil erosion from water had occurred in two of ten farm production regions in the United States, including Illinois, which emphasized the national importance of reducing erosion in northwest Illinois and this watershed. Expected erosion rates of soil were a factor of long-term climate data, inherent soil and site characteristics, and cropping and management practices (USDA NRCS, 2010). Understanding the first two factors will aid in recommending best management practices involving the third. In order to understand the characteristics of the soil, we looked at soil erodibility according to erosion by water, wind, or tolerance of soil loss on cropland. We determined soil erodibility by water using soil erosivity factor (K factor). We determined Wind Erodibility Group (WEG) to assess soil erodibility via wind, and we used the soil loss tolerance factor (T factor) to determine the tolerance of soil loss on cropland.

Soil Erodibility by Water

Soil eroded by water was assigned a soil erosivity (K) factor based on how easily soil detached and was transported by rainfall and runoff (NRCS, 2015). Soil with a higher K factor, on a scale of 0.02 to 0.64, was more susceptible to sheet and rill erosion by water. These estimates were based primarily on percentage of silt, sand, and organic matter; soil structure; and saturated hydraulic conductivity (Ksat).

Soils having a medium texture, like the silt loams and silty clay loams of the watershed, had moderate K values, generally about 0.25 to 0.4, because they were moderately susceptible to detachment and they produced moderate runoff. Soils with higher silt content most easily detached and tended to produce high rates of runoff, and these soils tended to have a K value higher than 0.4 (Institute of Water Research, 2002).

Soils generally were highly susceptible to detachment and produced high rates of runoff, with 47.84% of the soils throughout the watershed having an erosivity (K) factor of 0.43. Roughly the same amount of soils throughout the watershed were moderately susceptible to detachment and produced moderate rates of runoff, as 37.39% of soils in the watershed had a K factor of 0.37 and another 9.59% had a K factor of 0.32. With 4.42% of the soils not rated or unavailable, there were just 0.38% of the soils falling below 0.32 and 0.37% ranking above 0.43. Higher soil erosivity (K) factors in the watershed were seen in areas with hill and bluff topography elevated above the streams. In this area, wind-deposited soil became relatively thin. The lowest K factors were seen on the less eroded, undulating plains between the headwater streams where bedrock was significantly deeper (McGarry, 1997) (see Table 13 and Figure 27).

Soil Erodibility by Wind

Wind Erodibility Groups (WEG) consisted of soils that had similar properties affecting their susceptibility to wind erosion in cultivated areas: Group 1 soils were the most susceptible and Group 8 were the least susceptible. Most of the soils in the watershed (86.15%) were in WEG 6, with a small representation of Groups 5 (5.19%) and 4L (4.24%). There was 4.42% of the watershed that was not assessed (see Table 10 and Figure). WEG 6 could be silt loam with greater than 20% clay content and 45% nonerodible surface soil aggregates larger than 0.84 mm in diameter. WEG 5 could also be silt loam, but with less than 20% clay content and 40% nonerodible surface soil aggregates. WEG 4L, the soil most susceptible to wind erosion found in the watershed, could be silt loam or silty clay loam with 25% nonerodible surface soil aggregates (Wind Erodibility Groups, 2002). These more susceptible soils were associated with streambeds (see Table 14 and Figure 28).

Soil Loss Tolerance

Soil loss tolerance (T factor) was the estimated maximum rate of annual soil erosion that would allow crop productivity to be sustained economically and indefinitely. The five classes of soil loss tolerance ranged from one ton per acre per year for very shallow soils to five tons per acre per year for very deep soils (USDA NRCS, 2015). Much of the headwaters and higher elevations (41.63% of the watershed) had deeper soils and a T factor of 5, suggesting that these areas could erode 5 tons per acre per year and still sustain crop productivity. Another 19.87% of the watershed had soils with a T factor of 3. These areas correlated strongly with HSG B (and T factor 5 was also correlated with HSG B/D) but did not follow their boundaries exactly. Soils with a T factor of 2 made up another 23.19% of the watershed and seemed greatly associated with ravines and HSG C. The remaining soils had a T factor 1 pertaining to 6.24% of the watershed and associated with HSG C/D, or they had a T factor of 4 in 4.65% of the watershed on HSG C soils. The remaining 4.42% of the watershed was not rated or not applicable (see Table 15 and Figure 29).

Highly Erodible Land (HEL)

Highly erodible lands (HEL) were a big part of this hilly watershed. Cropland, residential, forest and open space, and a golf course all have highly erodible lands to consider with acreages of about 3000, 1200, 1000, and 200 respectively (See Table 8 and Figure 30).

When enrolling farmland into a program considering highly erodible land, it is possible to enroll whole agricultural fields that either had over 33.33% or more than 50 acres of highly erodible soils could be included (Justia US Law, *7 C.F.R. Subpart B – Highly Erodible Land Conservation)*. These highly erodible soils were characterized by soil map units with an erodibility index (EI) of 8 or greater.

HEL status was recorded by Farm Service Agency in 1990 in their Common Land Unit database (CLU). It was called for in the 1985 Food Security Act Farm Bill as a compliance requirement for farmers who used the benefits offered by US Department of Agriculture. The purpose was to minimize soil erosion, preserve land fertility of farmland, and protect water quality along with the nation's wetlands (NRCS, *Background on Highly Erodible Land Compliance*). This database used by the Natural Resources Conservation Service (NRCS) and Farm Services Agency (FSA) for HEL status determination had not been updated since 1990 to include the current erodibility indexes. It was also not available for public use. Despite this, the erodibility index could still be calculated by soil map unit to determine if there was a value over 8 although it wouldn't necessarily be classified as HEL by FSA standards.

Table 7 Soil Texture

Soil Texture

Surface Texture		Acres	% Watershed
Earthen Dam		11.38	0.08
Pits, Quarries		13.04	0.09
Silt loam		12753.93	88.41
Silty clay loam		1034.99	7.17
Water		613.10	4.25

Table 8 Highly Erodible Land (HEL) by Land Use

Landuse of Highly Erodible Lands

Land Use Type	Acreage
Water	1.878221
Golf Course	209.0312
Low Density Residential	982.3342
Medium Density Residential	165.5502
Barren	43.8434
Forest	474.1086
Open Space/Turf Grass	480.5054
Pasture	59.55811
No Till Row Crops	1915.378
Conventional Till Row Crops	51.46825
Conservation Till Row Crops	963.0193
Wetlands	4.096468

Table 9 Soil Map Units Acreage

Soil Map Units Acreage

Map Unit	Name	Acres	% Watershed
429C2	Palsgrove silt loam, 5 to 10 percent slopes, moderately eroded	1583.519	10.98%
905F	Newglarus-Lamoille silt loams, silurian landscape, 18 to 35 percent	964.242	6.68%
86B	Osco silt loam, 2 to 5 percent slopes	898.583	6.23%
928D2	Newglarus-Palsgrove silt loams, silurian landscape, 10 to 18 percent	765.312	5.30%
280B2	Fayette silt loam, 2 to 6 percent slopes, moderately eroded	701.922	4.87%
W	Water	613.105	4.25%
8239A	Dorchester silt loam, 0 to 2 percent slopes, occasionally flooded	611.498	4.24%
280C	Fayette silt loam, glaciated, 5 to 10 percent slopes	605.388	4.20%
29D2	Dubuque silt loam, 10 to 18 percent slopes, moderately eroded	546.198	3.79%
280C2	Fayette silt loam, 5 to 10 percent slopes, eroded	530.897	3.68%
928C2	Newglarus-Palsgrove silt loams, silurian landscape, 5 to 10 percent	525.613	3.64%
419C2	Flagg silt loam, 5 to 10 percent slopes, eroded	507.173	3.52%
410D3	Woodbine silty clay loam, 10 to 18 percent slopes, severely eroded	374.001	2.59%
410D2	Woodbine silt loam, 10 to 18 percent slopes, eroded	294.652	2.04%
505E3	Dunbarton silty clay loam, 12 to 20 percent slopes, severely eroded	280.143	1.94%
412C2	Ogle silt loam, 5 to 10 percent slopes, eroded	275.134	1.91%
411C2	Ashdale silt loam, 5 to 10 percent slopes, eroded	237.197	1.64%
547C2	Eleroy silt loam, 5 to 10 percent slopes, eroded	217.989	1.51%
753C2	Massbach silt loam, 5 to 10 percent slopes, eroded	193.526	1.34%
86C2	Osco silt loam, 5 to 10 percent slopes, eroded	181.607	1.26%
506C2	Hitt silt loam, 5 to 10 percent slopes, eroded	177.171	1.23%
731C2	Nasset silt loam, 5 to 10 percent slopes, eroded	170.733	1.18%
21C2	Pecatonica silt loam, 5 to 10 percent slopes, eroded	170.060	1.18%
86C	Osco silt loam, 5 to 10 percent	168.220	1.17%

Table 9 (continued)

Map Unit	Name	Acres	% Watershed
675B	Greenbush silt loam, 2 to 5 percent slopes	162.498	1.13%
429D2	Palsgrove silt loam, 10 to 18 percent slopes, moderately eroded	161.264	1.12%
414C2	Myrtle silt loam, 5 to 10 percent slopes, eroded	160.540	1.11%
505D2	Dunbarton silt loam, 6 to 12 percent slopes, eroded	159.710	1.11%
505E2	Dunbarton silt loam, 12 to 20 percent slopes, eroded	159.586	1.11%
686C2	Parkway silt loam, 5 to 10 percent slopes, eroded	148.518	1.03%
505D3	Dunbarton silty clay loam, 6 to 12 percent slopes, severely eroded	147.152	1.02%
675C	Greenbush silt loam, 5 to 10 percent slopes	130.008	0.90%
3451A	Lawson silt loam, 0 to 2 percent slopes, frequently flooded	113.953	0.79%
675C2	Greenbush silt loam, 5 to 10 percent slopes, eroded	98.017	0.68%
905G	Newglarus-Lamoille silt loams, silurian landscape, 35 to 60 percent	90.422	0.63%
403E2	Elizabeth silt loam, 12 to 35 percent slopes, eroded	86.585	0.60%
419B	Flagg silt loam, 2 to 5 percent slopes	84.484	0.59%
227C2	Argyle silt loam, 5 to 10 percent slopes, eroded	76.052	0.53%
411B	Ashdale silt loam, 2 to 5 percent slopes	62.950	0.44%
417D2	Derinda silt loam, 10 to 18 percent slopes, eroded	60.706	0.42%
403F2	Elizabeth silt loam, 18 to 35 percent slopes, eroded	60.593	0.42%
546C2	Keltner silt loam, 5 to 10 percent slopes, eroded	59.489	0.41%
280D3	Fayette silty clay loam, glaciated, 10 to 18 percent slopes, severely	58.139	0.40%
418C2	Schapville silt loam, 5 to 10 percent slopes, eroded	53.929	0.37%
572C2	Loran silt loam, 5 to 10 percent slopes, eroded	52.440	0.36%
21D2	Pecatonica silt loam, 10 to 18 percent slopes, eroded	50.582	0.35%
417D3	Derinda silty clay loam, 10 to 18 percent slopes, severely eroded	45.526	0.32%
506C3	Hitt silty clay loam, 5 to 10 percent slopes, severely eroded	32.945	0.23%
21C3	Pecatonica silty clay loam, 5 to 10 percent slopes, severely eroded	32.326	0.22%
280D2	Fayette silt loam, 10 to 18 percent slopes, eroded	29.322	0.20%

Table 9 (continued)

Map Unit	Name	Acres	% Watershed
8451A	Lawson silt loam, cool mesic, 0 to 2 percent slopes, occasionally flooded	28.211	0.20%
21D3	Pecatonica silty clay loam, 10 to 18 percent slopes, severely eroded	28.182	0.20%
547D2	Eleroy silt loam, 10 to 18 percent slopes, eroded	27.205	0.19%
3579A	Beavercreek silt loam, 0 to 2 percent slopes, frequently flooded	27.058	0.19%
429B2	Palsgrove silt loam, 2 to 6 percent slopes, moderately eroded	25.622	0.18%
274B	Seaton silt loam, 2 to 5 percent slopes	25.198	0.17%
3107A+	Sawmill silt loam, 0 to 2 percent slopes, frequently flooded.	23.405	0.16%
233C2	Birkbeck silt loam, 5 to 10 percent slopes, eroded	21.814	0.15%
3333A	Wakeland silt loam, 0 to 2 percent slopes, frequently flooded	20.351	0.14%
40C2	Dodgeville silt loam, 5 to 10 percent slopes, eroded	19.474	0.13%
280C3	Fayette silty clay loam, 5 to 10 percent slopes, severely eroded	18.634	0.13%
547B	Eleroy silt loam, 2 to 5 percent slopes	15.252	0.11%
419D2	Flagg silt loam, 10 to 18 percent slopes, eroded	14.219	0.10%
864	Pits, Quarries	13.042	0.09%
835G	Earthen Dam	11.382	0.08%
686B	Parkway silt loam, 2 to 5 percent slopes	10.304	0.07%
8579A	Beavercreek silt loam, 0 to 2 percent slopes, occasionally flooded	10.152	0.07%
61B	Atterberry silt loam, 2 to 5 percent slopes	9.839	0.07%
21F2	Pecatonica silt loam, 18 to 35 percent slopes, eroded	9.694	0.07%
419D3	Flagg silty clay loam, 10 to 18 percent slopes, severely eroded	9.604	0.07%
414B	Myrtle silt loam, 2 to 5 percent slopes	8.888	0.06%
279B	Rozetta silt loam, 2 to 5 percent slopes	8.666	0.06%
416C3	Durand silty clay loam, 5 to 10 percent slopes, severely eroded	8.343	0.06%
8415A	Orion silt loam, 0 to 3 percent slopes, occasionally flooded	8.038	0.06%
37B	Worthen silt loam, 2 to 5 percent slopes	7.097	0.05%
745C2	Shullsburg silt loam, 5 to 10 percent	6.624	0.05%

Table 9 (continued)

Map Unit	Name	Acres	% Watershed
403D2	Elizabeth silt loam, 10 to 18 percent slopes, eroded	6.345	0.04%
40D2	Dodgeville silt loam, 10 to 18 percent slopes, eroded	5.918	0.04%
51B	Muscatune silt loam, 2 to 5 percent slopes	4.527	0.03%
105C	Batavia silt loam, 5 to 10 percent slopes	4.379	0.03%
81B	Littleton silt loam, 2 to 5 percent slopes	3.297	0.02%
731B	Nasset silt loam, 2 to 5 percent slopes	2.873	0.02%
732C	Appleriver silt loam, 5 to 10 percent slopes	1.982	0.01%
29C2	Dubuque silt loam, 5 to 10 percent slopes, moderately eroded	1.897	0.01%
417C2	Derinda silt loam, 5 to 10 percent slopes, eroded	1.835	0.01%
8074A	Radford silt loam, 0 to 2 percent slopes, occasionally flooded	1.715	0.01%
745B	Shullsburg silt loam, 2 to 5 percent slopes	1.598	0.01%
279A	Rozetta silt loam, 0 to 2 percent slopes	1.157	0.01%
198B	Elbum silt loam, 2 to 5 percent slopes	1.014	0.01%

Table 10 Prime Farmland Acreage

Prime Farmland Acreage		
Farmland Classification	Acres	% Watershed
All areas are prime farmland	2677.195	18.56%
Farmland of statewide importance	6660.741	46.17%
Not prime farmland	4922.776	34.12%
Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season	43.755	0.30%
Prime farmland if protected from flooding or not frequently flooded during the growing season	121.992	0.85%

Table 11.1 Hydric Soil Groups Acreage

Hydric Soil Groups Acreage		
Hydric Rating (1-100)	Acres	% Watershed
0 (Non-Hydric)	12780.328	88.59%
1 (Low)	1.157	0.01%
2 (Low)	525.518	3.64%
3 (Low)	8.038	0.06%
4 (Low)	898.584	6.23%
5 (Low)	47.264	0.33%
6 (Low)	40.824	0.28%
7 (Low)	101.340	0.70%
90 (High)	23.405	0.16%

Table 11.2 Hydrologic Soil Groups Acreage

Hydrologic Soil Groups Acreage		
Hydrologic Soil Group	Acres	% Watershed
A	37.210	0.26%
B	8068.037	55.93%
B/D	266.791	1.85%
C	4398.503	30.49%
C/D	1.982	0.01%
D	1016.403	7.05%
Not Available	637.529	4.42%

Table 12 Soil Drainage Classes Acreage

Soil Drainage Classes Acreage		
Soil Drainage Class	Acres	% Watershed
Not rated or not available	637.529	4.42%
Moderately well drained	645.887	4.48%
Poorly drained	23.405	0.16%
Somewhat excessively drained	153.523	1.06%
Somewhat poorly drained	253.589	1.76%
Well drained	12712.521	88.12%

Table 13 Erosion Factor (Kw) Acreage

Erosion Factor (Kw) Acreage		
K Factor	Acres	% Watershed
Not rated or not available	637.530	4.42%
0.28	54.943	0.38%
0.32	1383.494	9.59%
0.37	5394.686	37.39%
0.43	6902.242	47.84%
0.49	53.564	0.37%

Table 14 Erosion Hazard Acreage

Erosion Hazard Acreage		
Erosion Hazard	Acres	% Watershed
Not rated or not available	637.529	4.42%
Slight	9672.747	67.05%
Moderate	3051.820	21.15%
Severe	973.936	6.75%
Very severe	90.422	0.63%

Table 15 Wind Erodibility Groups Acreage

Wind Erodibility Groups Acreage		
Wind Erodibility Group	Acres	% Watershed
Not rated or not available	637.530	4.42%
4L	611.499	4.24%
5	749.123	5.19%
6	12428.307	86.15%

Table 16 Erosion Factor (T) Acreage

Erosion Factor (T) Acreage		
T Factor	Acres	% Watershed
0	637.529	4.42%
1	900.114	6.24%
2	3346.155	23.19%
3	2866.064	19.87%
4	670.673	4.65%
5	6005.920	41.63%

Figure 22 East Fork Creek Watershed, Soil Texture

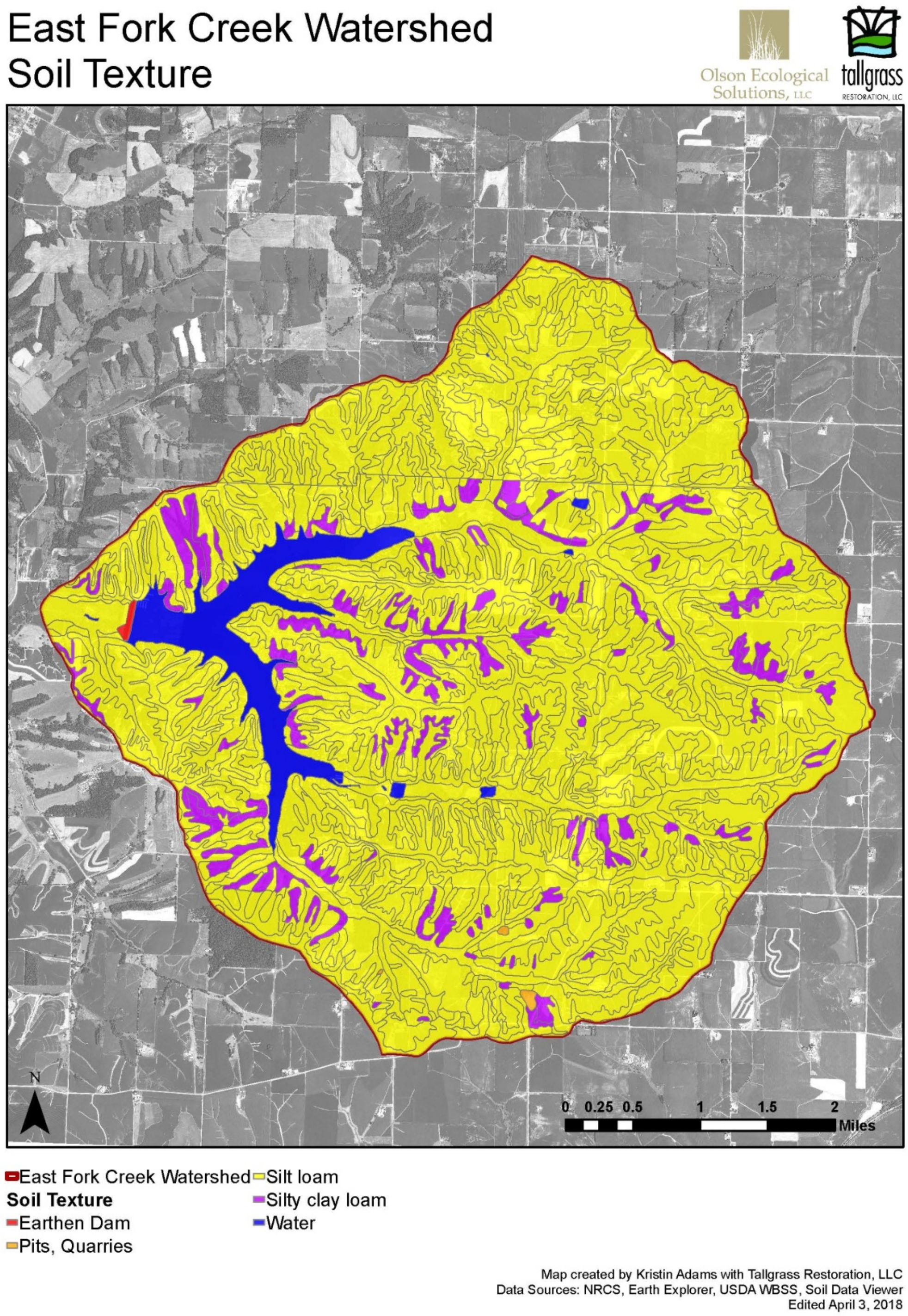


Figure 23 East Fork Creek Watershed, Soil Map Unit

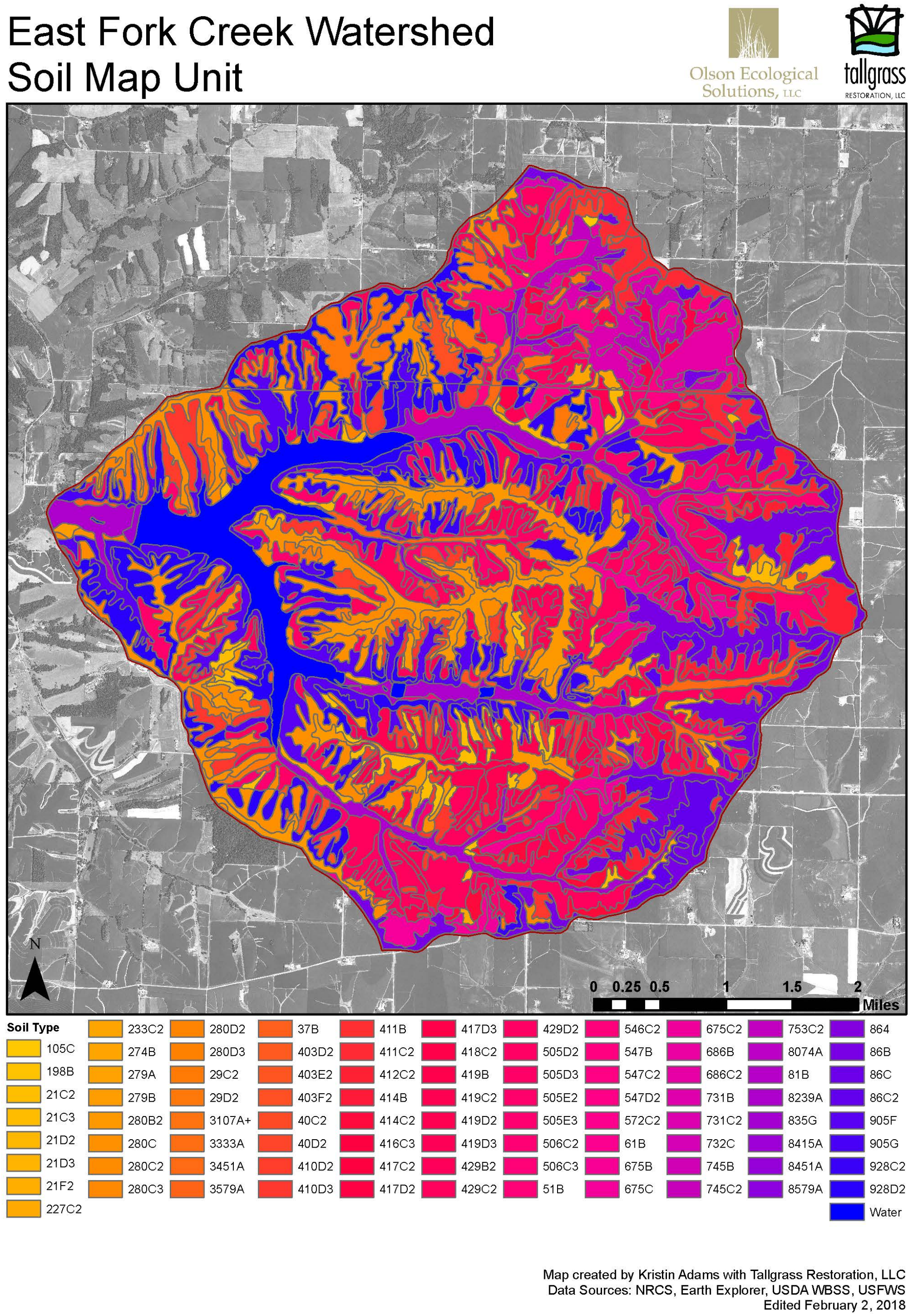


Figure 24 East Fork Creek Watershed, Prime Farmland

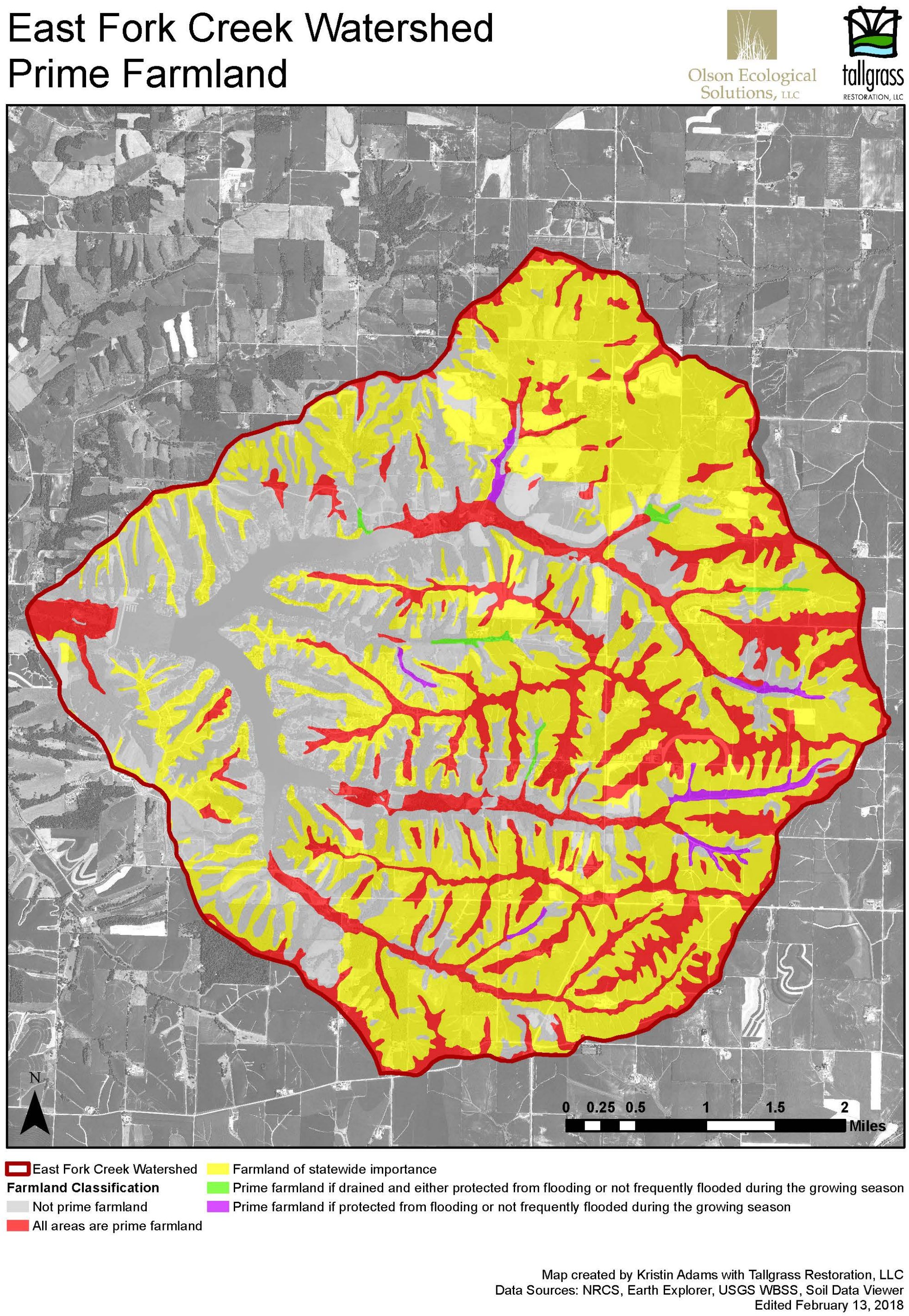


Figure 25 East Fork Creek Watershed, Hydric Soil Map Unit

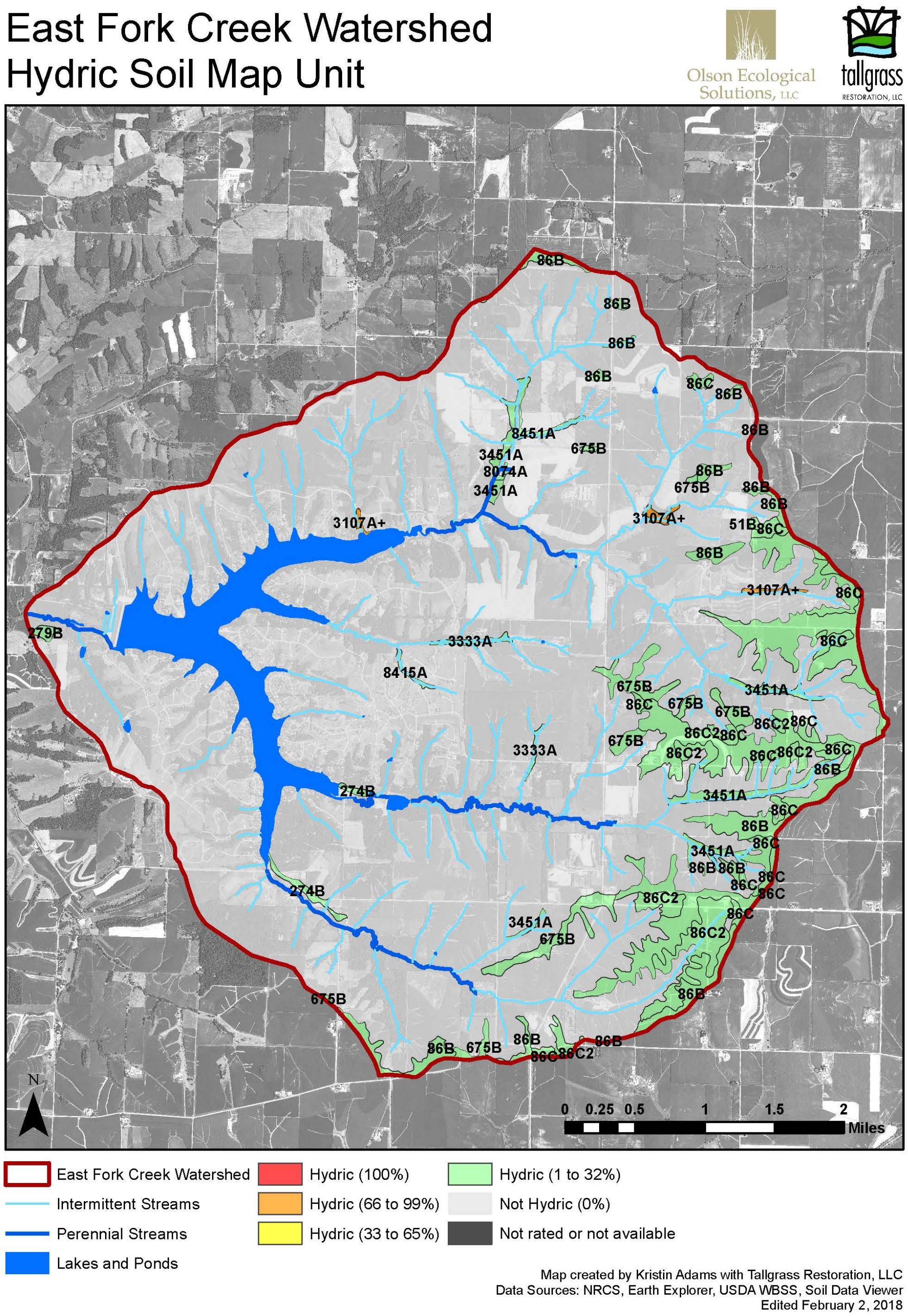


Figure 26 East Fork Creek Watershed, Hydrologic Soil Groups

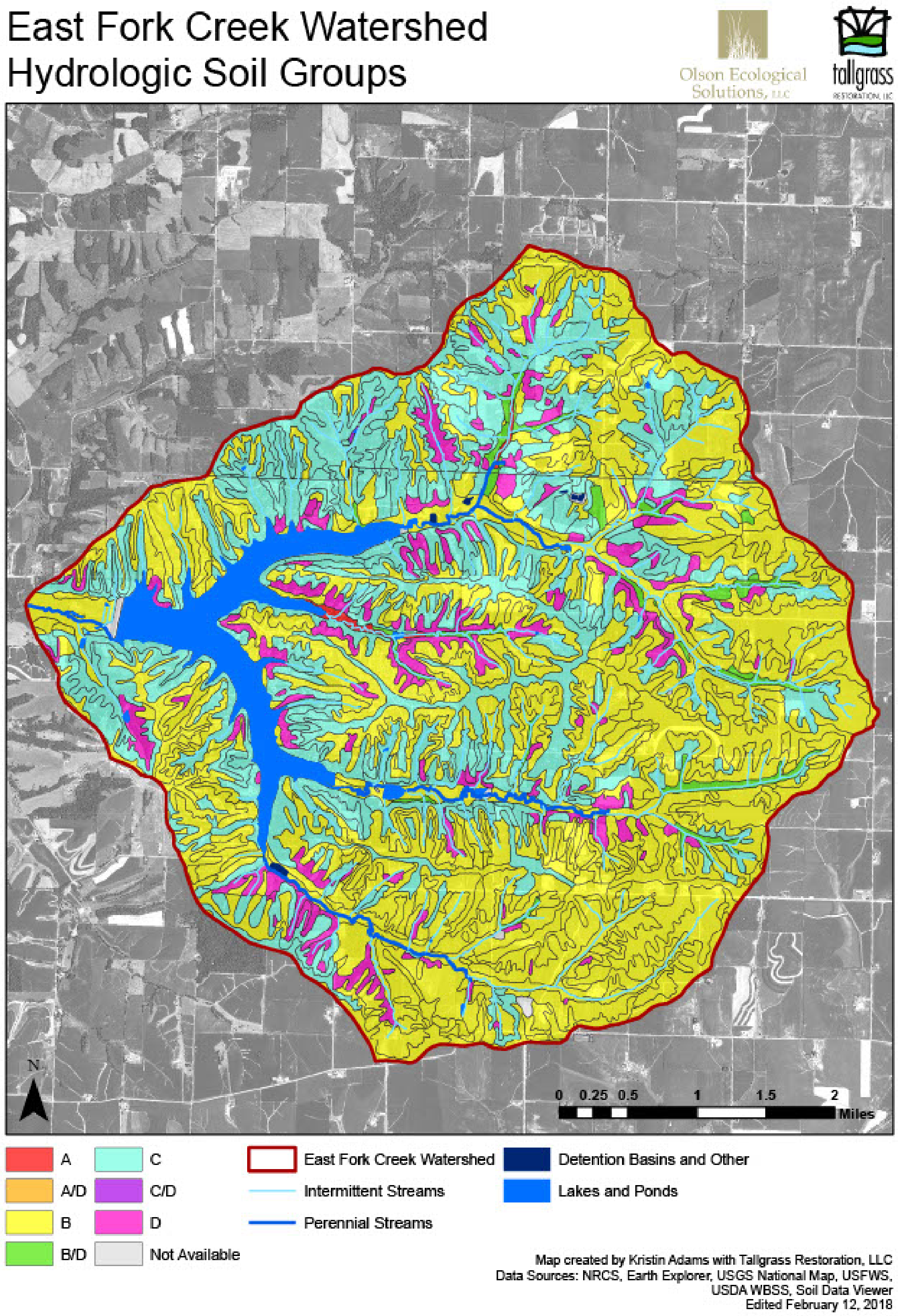


Figure 27 East Fork Creek Watershed, Soil Drainage Class

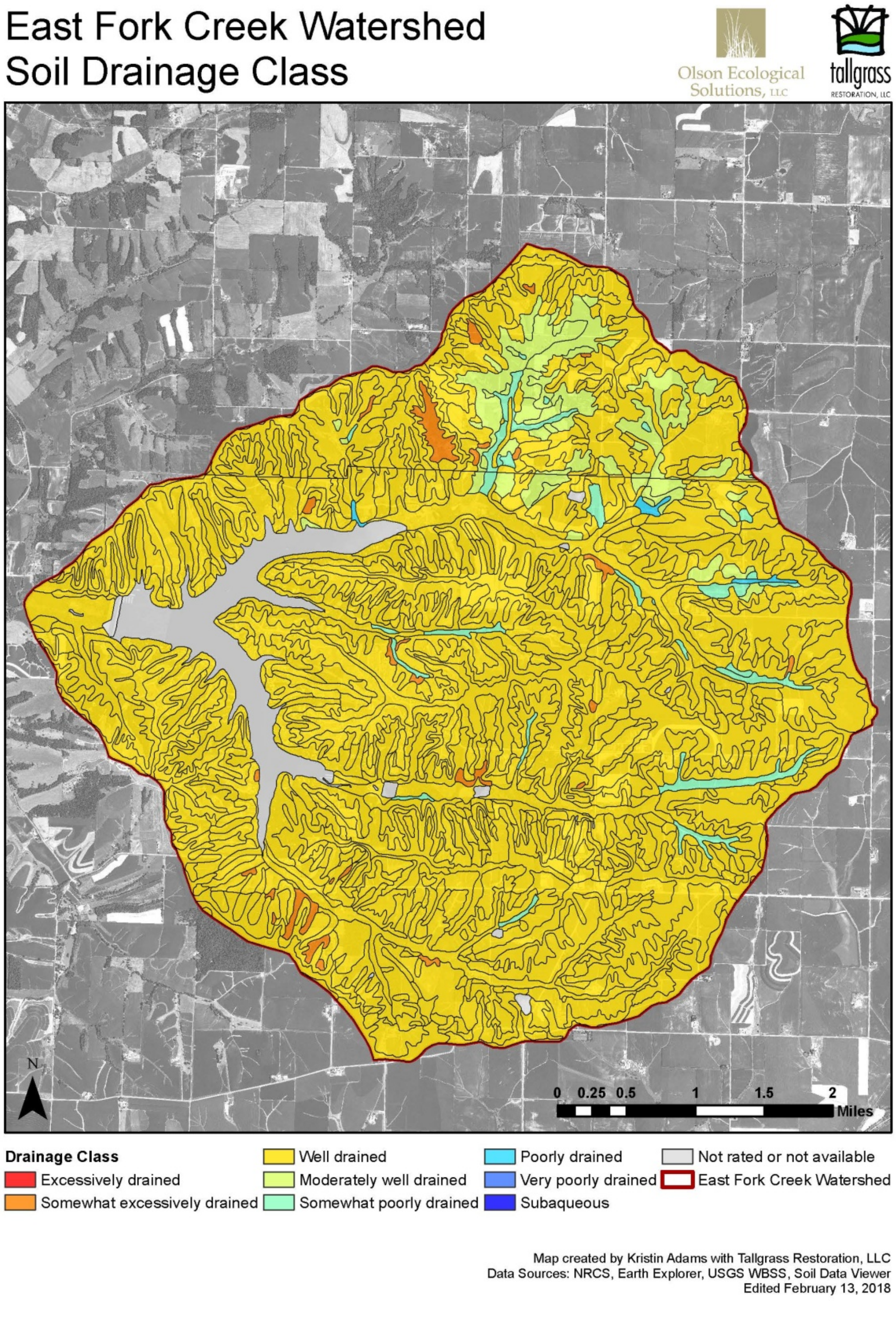


Figure 28 East Fork Creek Watershed, Soil Erodibility Factor (K)

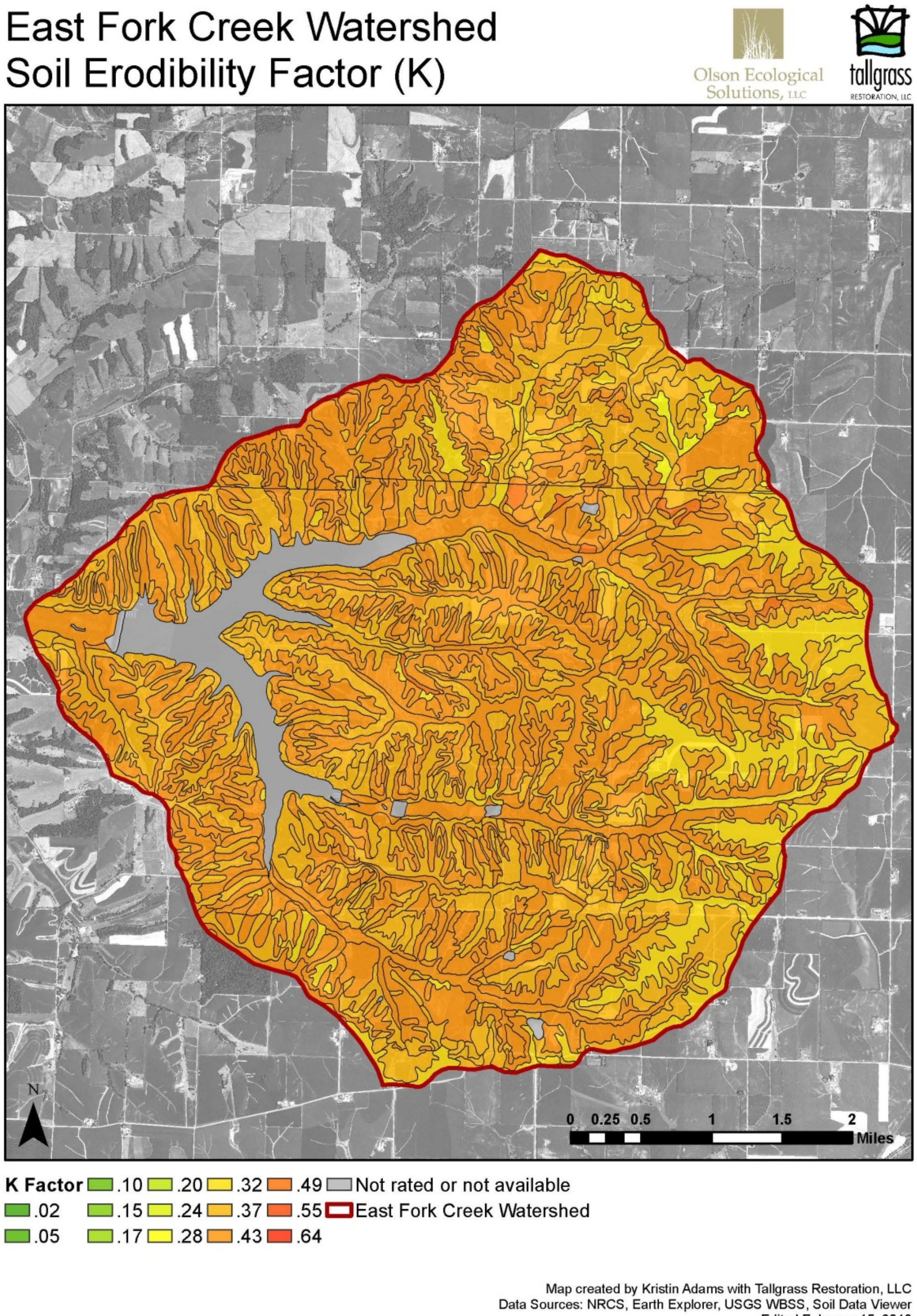


Figure 29 East Fork Creek Watershed, Wind Erodibility Group (WEG)

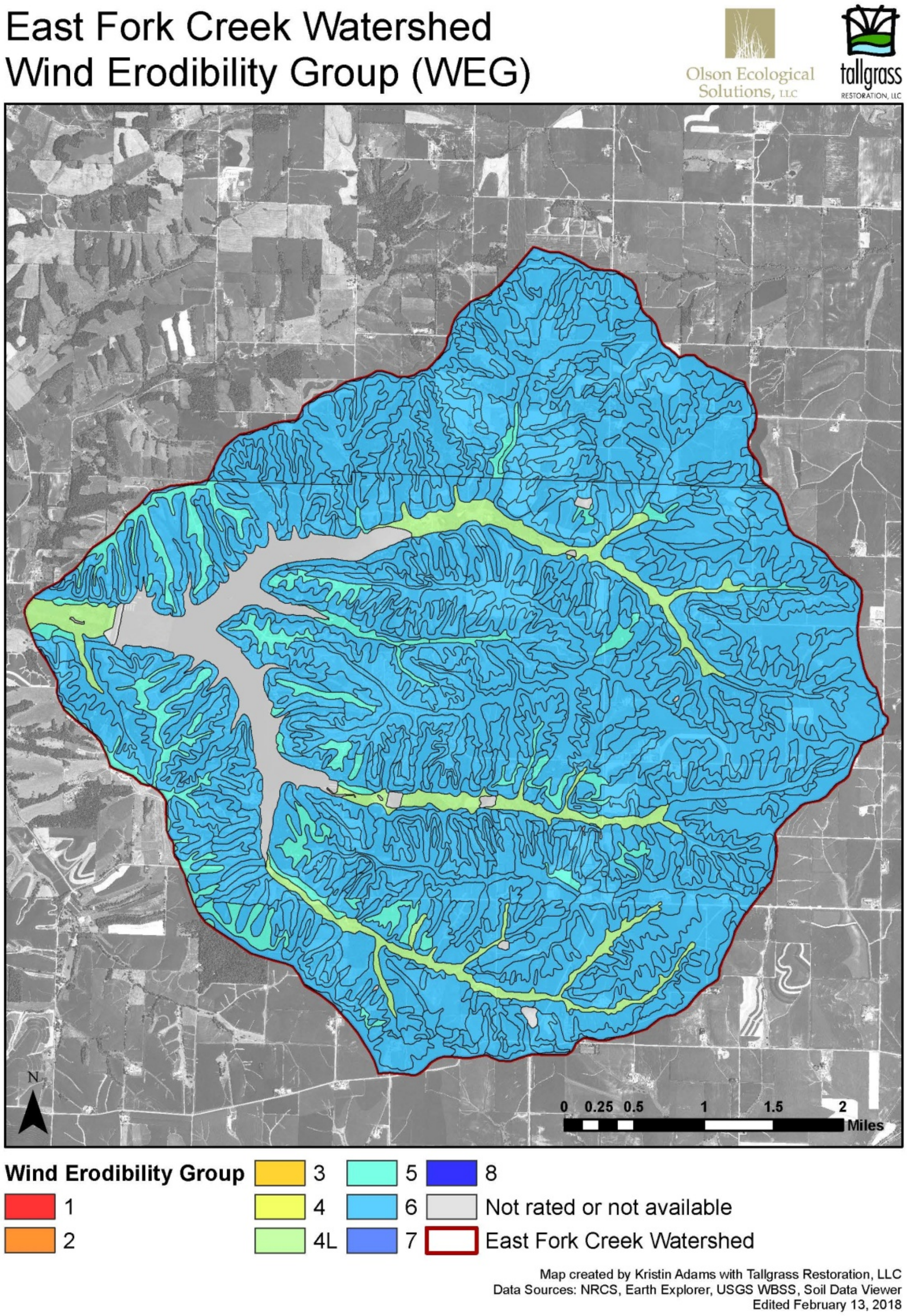


Figure 30 East Fork Creek Watershed, Erosion Factor (T)

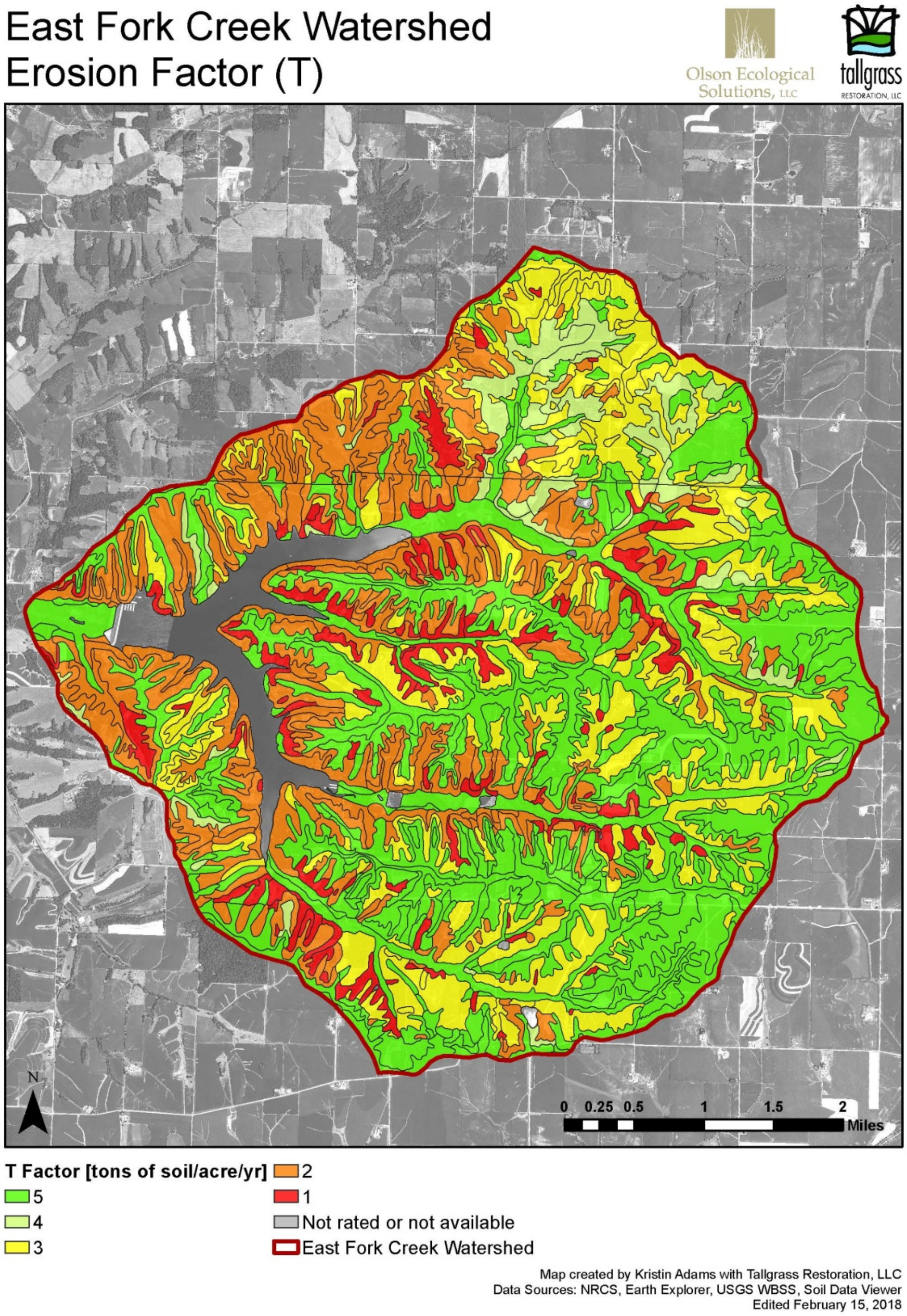
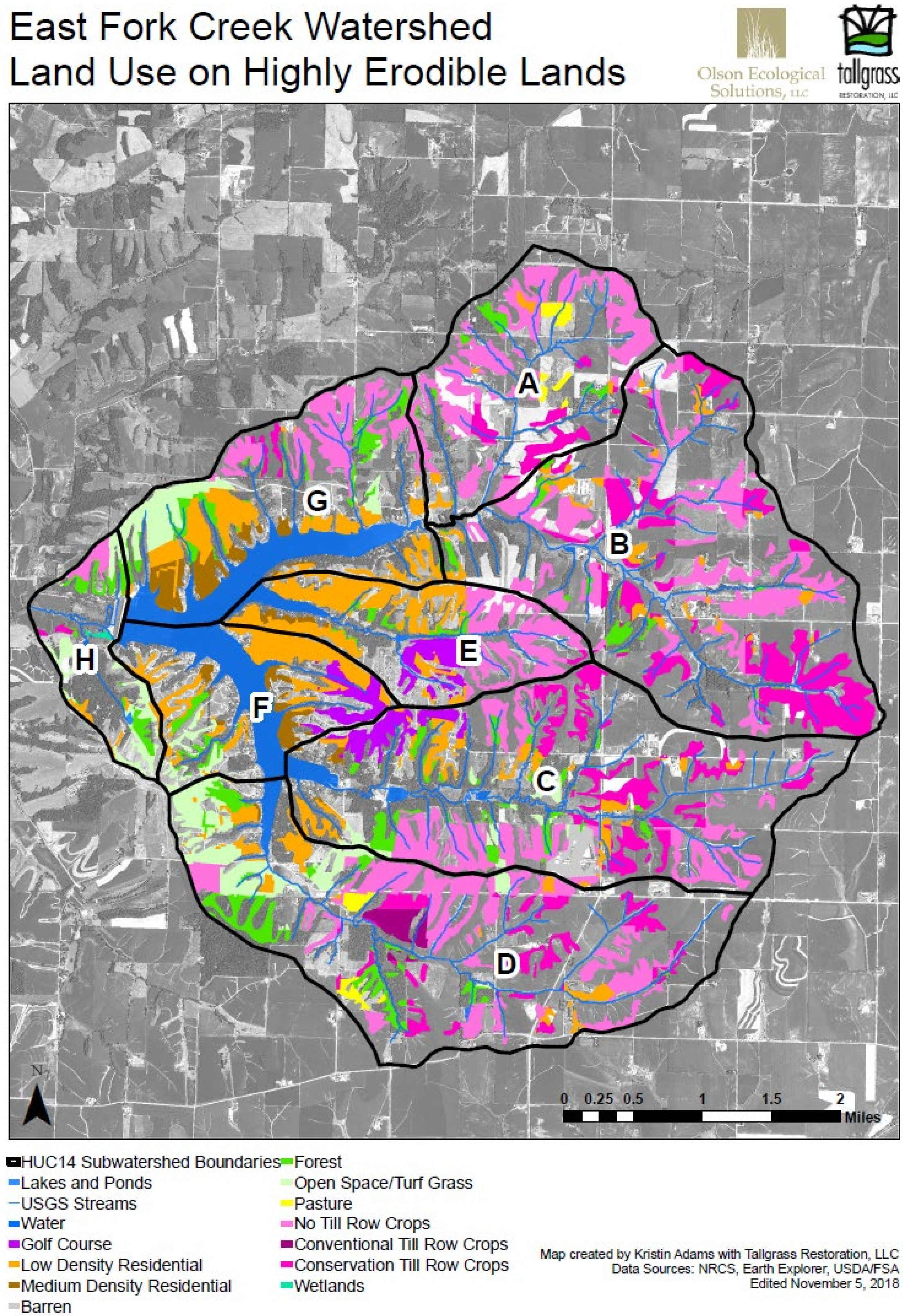


Figure 31 Highly Erodible Lands (HEL) by Land Use Type



Part 6: Water Quality Assessment

We assessed water Quality in the East Fork Creek Watershed from the Illinois Integrated Water Quality and Section 303(e) List; studies of Lake Carroll available from the Lake Carroll Association; a survey of the watershed's streams and streambanks; and a survey of the watershed's lake, pond, and basin shorelines.

Illinois Integrated Water Quality and Section 303(d) List – Volume 1: Surface Water

There was little known about the water quality of the East Fork Creek Watershed, also called the East Fork of the East Plum River. Prior to the publication of this inventory, no management plans or total maximum daily load (TMDL) statements had been issued for any of the watersheds associated with the East Plum River. We gleaned some limited information from the *Illinois Integrated Water Quality Report and Section 303(d) List* (ILEPA, 2018).

The *Illinois Integrated Water Quality Report and Section 303(d) List* identified surface waters that had uses such as aquatic life, fish consumption, primary contact recreation, and aesthetic quality that were impaired by various causes like sedimentation and fecal coliform from various sources. Lake Carroll (IL RMQ) was not listed as an impaired water. It had insufficient information to assess aquatic life and aesthetic quality, while fish consumption and primary contact recreation were not assessed, along with their associated causes and sources. East Fork Creek, also called East Fork East Plum River (IL_MJCB), was not assessed and therefore not listed as an impaired waterway, nor was the East Plum River (IL_MJC) into which it drained. The Plum River, to which both the East Fork Creek and East Plum River drained, had impaired uses of aquatic life and aesthetic quality causes by alterations of stream or littoral vegetation, sedimentation and siltation, total suspended solids, and fecal coliform. Known sources of these impairments included channelization and irrigated crop production. In addition, the Mississippi River was documented as impaired by accumulation mercury and polychlorinated biphenyls (PCBs). The Illinois Environmental Protection Agency provided the following information about the Plum River (ILEPA, 2018):

AUID:	IL_MJ-01 Plum River
Basin:	9, Mississippi North River
Category:	5
Stream Length:	31.39 miles
TMDL:	None
Status of Use Attainment:	Not supporting: aquatic life (N582) and primary contact recreation (N585) Not assessed: fish consumption (X583) and aesthetic quality (X590)
Causes of Impairment:	Alterations of stream or littoral vegetation (84), sedimentation and siltation (371), total suspended solids (403), and fecal coliform (400)
Sources of Impairment:	Channelization (20), irrigated crop production (66), and unknown sources (140)
Priority:	Medium: Ranked 2,192 the list of prioritized 303(d) streams for aquatic life by sedimentation/siltation Ranked 2,193 for aquatic life by fecal coliform Ranked 2,194 for primary contact recreation by fecal coliform

Lake Carroll Water Quality Testing

The water quality of Lake Carroll was monitored annually between 2007 to 2011 and again in 2016 by Integrated Lakes Management. In 2017, volunteers monitored phosphorous and had chlorophyll lab tested by Northern Lake Services. No monitoring data for East Fork Creek was available. Most monitoring events occurred in June of each year. Conditions usually worsen as the warm, summer months continue; therefore, we acknowledge that the results presented below most likely did not reflect the worst lake condition of each year. Lake Carroll Association plans to continue monitoring efforts, likely on an annual basis (Dick Schwalbenberg, pers. comm.).

Water quality monitoring results thus far showed Lake Carroll in good condition relative to most man-made lakes fed by surface water in Illinois. In 2016, the most recent, comprehensively monitored year, the lake was in a mesotrophic state, better than the common nutrient-rich eutrophic and hypereutrophic conditions of most Illinois man-made lakes. Individual water quality parameters monitored varied greatly depending on the sampling date. While water clarity was good and showed trends of improvement, the reason for the improvement was attributed to the invasion of zebra mussels (ILM, 2016), a non-native species that has negatively impacted lake ecology and native mussel populations in areas surrounding the Great Lakes (USGS, 2019). Three important parameters had slight opportunities for improvement, although they were also within a desirable range in most situations: nitrogen, phosphorous, and dissolved oxygen (ILM, 2016).

<u>Nitrogen</u>: Nitrogen in its inorganic form is used as food by plants and algae. Measuring 3.47 mg/l on June 21, 2016, it was present in much higher concentrations than that which can cause algae blooms, 0.3 mg/l (ILM, 2016).

<u>Phosphorous</u>: Phosphorous, the main element regulating plant and algae growth within Lake Carroll, had total phosphorous (TP) levels consistently below the state standard of 0.05 mg/l. However, orthophosphorous, the form of phosphorous most available to plants and algae, had levels that jumped above the recommended guideline of 0.01 mg/l during two of the seven monitored years (2009 and 2011). More than this recommended level is enough to allow nuisance algae blooms to form (ILM, 2016).

<u>Dissolved Oxygen</u>: Dissolved oxygen (DO), or oxygen within the water available to plants and animals, was found in Lake Carroll at quantities able to support life (> 5 mg/l) at all depths except near the lake bottom (ILM, 2016). Oxygen poor, anaerobic conditions near the bottom affect the digestion and sequestration rates of phosphorous and other excess nutrients and organic material in the sediment.

Chlorophyll: All of the factors above relate to algae growth, measured by the concentrations of clorophyll in the water. During most years, chlorophyll was below the 20 ug/l threshold indicating algae blooms, except for 2011, at which time chlorophyll measured about 25 ug/l (ILM, 2016).

Stream Survey

We assessed streams and ravines within the East Fork Creek Watershed for riparian condition, bank erosion, and channelization. In order to do so, JadEco Natural Resource Consulting and Management walked stream and ravine sections selected to represent the watershed by distribution throughout the eight subwatersheds (see Figure 31). We also analyzed channelization using aerial imagery. We appreciated the cooperation of many landowners throughout the watershed who offered permission to access their properties. Joe Rush of JadEco spent eight days surveying the streams and ravines. He recorded riparian condition as good, fair, and poor along both sides of each section; erosion of banks as slight, moderate, and severe; and channelization of streams as low (or none), medium, and high. Riparian condition was defined according to vegetative cover and soil permeability within 50-foot width from the banks. (see Figure 33).

We found that riparian condition varied throughout the watershed, as 37% was good, 40% was fair, and 23% was poor (see Table 16). Erosion was an issue, as 51% of the surveyed streambanks were severely eroded. Erosion was moderate on another 23% and slight on 26% of the banks (see Table 17). There was no significant difference in erosion severity between ravines and streams. Channelization was high on about 1/5th of the surveyed streams (22%). Another 44% of the streams had moderate channelization, and 34% were in a natural state with low to no channelization (see Table 18). Most areas of channelization were found in the headwaters on intermittent streams running through agricultural lands. These reaches were represented in the stream survey where we reported percent channelization (see Figure 32 and Figure 33).

Shoreline Survey

Surveys of shorelines occurred along Lake Carroll and the ponds and basins within the watershed. We assessed bank erosion and riparian condition of shorelines in all locations.

<u>Lake Carroll</u>: The entire shoreline of Lake Carroll was protected with rip rap, with all 11,196 feet qualifying as having slight erosion during an October 2017 survey (see Table 19 and Figure 34). The riparian zone, within the 50'-wide strip buffering the shoreline, was either managed with lawns, docks, and impervious surface or unmanaged, vacant lots. Of the total 81,282 feet of shoreline, 87% (70,690 ft) had managed riparian areas and 13% (10,592 ft) were vacant lots with naturalized riparian zones.

<u>Watershed Ponds and Basins</u>: Bank erosion was determined with a field survey on November 19, 2018. We found slight erosion on 85% (9,971 ft) of the 11,790 feet of shoreline along ponds and basins within the watershed. An additional 15% (1,735 ft) of the banks had moderate erosion, and less than 1% (84 ft) had severe erosion (see Table 20). Riparian condition for a majority of the ponds and basins was in a natural state and considered good (56%, 6,627 ft). Managed riparian areas were poor when mowed to the water's edge in 20% of the area (2,384 ft) and moderate when partially mowed within the 50' riparian zone in 24% of the area (2,779 ft) (see Table 21, Figure 11, and Figure 35).

Estimated Annual Pollutant Load

Pollutant modeling showed a breakdown by subwatersheds of the total pollutant load in a given area. In order to achieve this information, we used the EPA created a software called "Better Assessment Science Integrating Point and Non-point Sources," or BASINS. This software allowed us to analyze watershed and water quality using both user input data and data downloaded from the internet. Within this software was a model called PLOAD, which allowed us to calculate the pollutant load amounts in a watershed. This was useful in figuring out the baseline pollutant loads within the watershed so that we will be able to analyze effects of implementing Best Management Practices (BMP) within the watershed as proposed by future watershed planning.

In order to produce accurate pollutant load estimates, we compiled and created input data for the BASINS program including delineated subwatersheds, land use, precipitation, event mean concentrations. As described earlier in this inventory, we created eight subwatersheds within the HUC 12 East Fork Creek Watershed in ArcMap based on elevation and hydrography. We assigned each subwatershed a specific HUC 14 code and a name: A, B, C, D, E, F, G, and H. The model also required a current land use map, for which we used the National Land Cover Database from 2011 modified within ArcMap to accurately reflect current land uses gathered from knowledge of the area and aerial map imagery. We gathered annual precipitation data from NOAA using the Lanark Station at a value of 39.69 inches. We researched local values for the estimated event mean concentrations (EMC) and used the most current EMC data from February 2018 created for the Des Plaines River Watershed by Northwater Consulting. We also used default EMC values from the EPA's Region 5 Model for land use types that did not have an updated local value. We used the Simple (EMC) Method to generate the pollutant modeling, which determined pollutant loading annually, both in total and per acre for each subwatershed for total nitrogen (TN), total phosphorous (TP), total suspended solids (TSS), and pathogens.

Generally speaking, Subwatersheds E and F showed the greatest amount of annual pollutant loading per acre, with Subwatershed G trailing close behind. These areas were residential lands surrounding Lake Carroll. Of the outlying agricultural areas, Subwatersheds A, D, and H tended to have the least overall impact on pollutant loading, while Subwatersheds B and C led the annual nitrogen loading per acre (see Figure 36, Figure 37, Figure 38, and Figure 39).

To summarize the estimated existing annual pollutant load by land use source at the watershed scale (see Table 22), we used the Export Coefficient Formula below:

$$\text{Export Coefficient (lb/ac/yr)} = ((P \times CF \times Rv) / 12) \times C \times 2.72$$

In this equation, we used the following assumptions (US Congress, 2014):

- P = Annual Precipitation = 39.69 in/yr annual precipitation
- CF = Correction Factor = 0.90 for storms with no runoff
- Rv = Runoff Coefficient = 0.05 + (0.09 x I)
- I = Percent Impervious
- C = Event Mean Concentration (mg/l)

Looking at the total annual loads per subwatershed did not provide results that were as straightforward as the per-acre approach, as Subwatersheds B and C were not only highest overall pollutant contributors but also two of the largest subwatersheds. For the entire East Fork Creek Watershed, pollutant loads from land uses were as follows: 44,275 pounds per year of total nitrogen; 4,273 pounds per year of total phosphorous; and 1,203,281 pounds per ear of total suspended solids (see Table 23 and Figure 40, Figure 41, Figure 42, and Figure 43).

Table 17 Summary of Stream and Tributary Riparian Area Condition

Summary of stream and tributary riparian area condition				Riparian Condition (ft)		
Tributary Name	**Subwatershed**	**Reach Code**	**Total Buffer Length (ft)**	**Good**	**Fair**	**Poor**
Upper East Fork Creek	A	A1	5907	0	4145	1762
South Lower East Fork Creek	B	B1	41914	6759	18025	17129
Central Creek	C	C1	27520	14430	11565	1525
South Creek	D	D1	27486	7969	11236	8282
North Creek	E	E1	6344	4970	690	684
Unnamed Tributary	F	F1	4680	3276	1404	0
Unnamed Tributary	F	F2	6450	4515	1935	0
Unnamed Tributary	F	F3	5690	659	3666	1365
Unnamed Tributary	F	F4	5828	0	4484	1344
Unnamed Tributary	G	G1	6186	969	3859	1358
Unnamed Tributary	G	G2	6028	0	6028	0
Unnamed Tributary	G	G3	2864	2765	83	16
Unnamed Tributary	G	G4	3536	3125	250	161
Unnamed Tributary	G	G5	2908	1314	615	979
Unnamed Tributary	H	H1	8648	3457	750	4442
Unnamed Tributary	H	H2	8182	8182	0	0
Total length (ft)			**170171**	**62390**	**68736**	**39046**
% of Watershed			**100%**	**37%**	**40%**	**23%**

Table 18 Summary of Stream and Tributary Bank Erosion

Summary of stream and tributary bank erosion				Bank Erosion (ft)		
Tributary Name	**Sub-watershed**	**Reach Code**	**Total Stream Length**	**Slight**	**Moderate**	**Severe**
Upper East Fork Creek	A	A1	8863	2341	1846	4676
South Lower East Fork Creek	B	B1	43290	8018	15121	20151
Central Creek	C	C1	27980	3069	4913	19998
South Creek	D	D1	33302	5920	6503	20879
North Creek	E	E1	6704	1410	1254	4040
Unnamed Tributary	F	F1	4680	1945	2420	315
Unnamed Tributary	F	F2	6450	0	778	5672
Unnamed Tributary	F	F3	6764	6632	0	132
Unnamed Tributary	F	F4	5828	3642	848	1338
Unnamed Tributary	G	G1	6350	4112	539	1699
Unnamed Tributary	G	G2	6028	1073	2858	2097
Unnamed Tributary	G	G3	3583	1098	707	1778
Unnamed Tributary	G	G4	4060	994	535	2531
Unnamed Tributary	G	G5	4268	1785	1221	1262
Unnamed Tributary	H	H1	9052	1095	2916	5041
Unnamed Tributary	H	H2	8492	4663	356	3473
Total length (ft)			**185694**	**47797**	**42815**	**95082**
% of Watershed			**100%**	**26%**	**23%**	**51%**

Table 19 Summary of Stream and Tributary Channelization

Summary of stream and tributary channelization				**Channelization (ft)**		
Tributary Name	**Sub-watershed**	**Reach Code**	**Total Stream Length (ft)**	**None/ Low**	**Medium**	**High**
Upper East Fork Creek	A	A1	2817	123	1852	842
South Lower East Fork Creek	B	B1	20992	8058	10707	2228
Central Creek	C	C1	12820	5524	6021	1275
South Creek	D	D1	15558	4681	3277	7601
North Creek	E	E1	3030	1094	1454	483
Unnamed Tributary	F	F1	2340	138	1708	495
Unnamed Tributary	F	F2	3225	1533	1576	117
Unnamed Tributary	F	F3	2747	113	1142	1492
Unnamed Tributary	F	F4	2914	780	1654	480
Unnamed Tributary	G	G1	3093	389	1597	1107
Unnamed Tributary	G	G2	3014	101	1452	1462
Unnamed Tributary	G	G3	1638	481	989	168
Unnamed Tributary	G	G4	1768	1338	430	0
Unnamed Tributary	G	G5	1492	145	1288	59
Unnamed Tributary	H	H1	4404	1234	1908	1263
Unnamed Tributary	H	H2	4038	3613	425	0
Total length (ft)			**85890**	**29343**	**37478**	**19070**
% of Watershed			**100%**	**34%**	**44%**	**22%**

Figure 32 Stream and Tributary Survey Routes

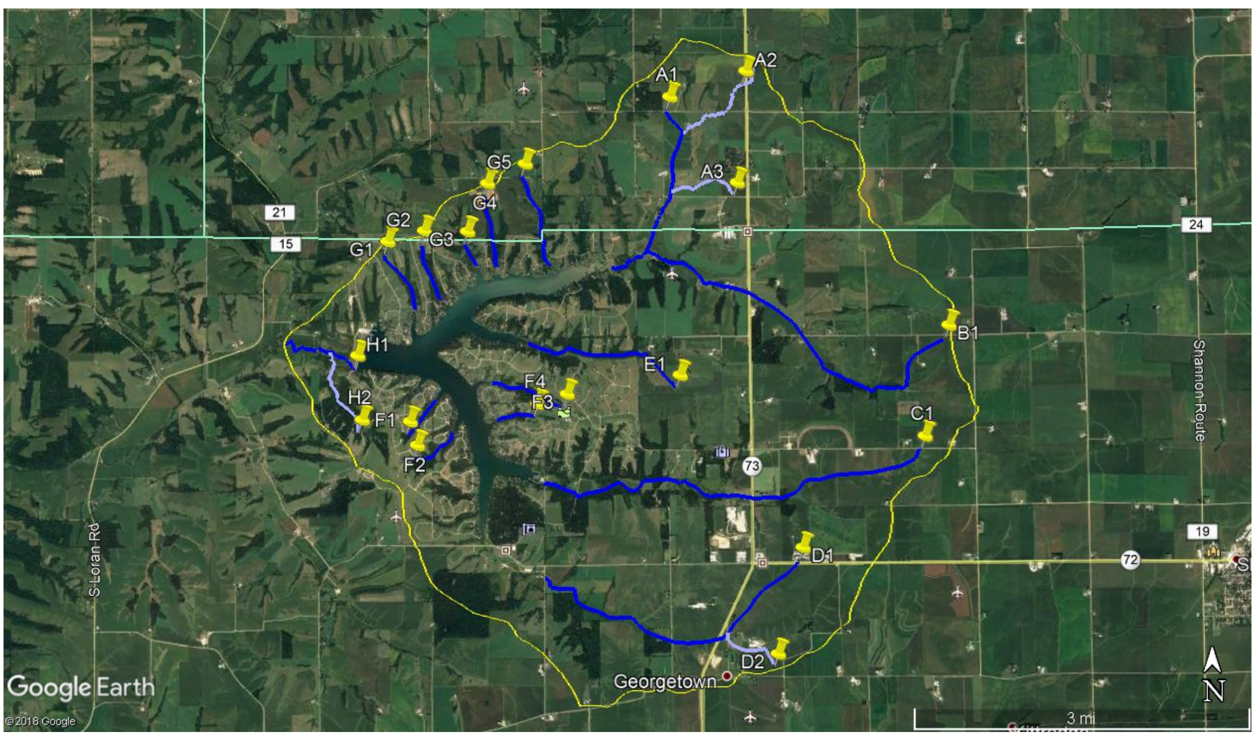


Figure 33 Riparian Buffer Field Indicators

Riparian Buffer Field Indicators

Riparian condition was rated by custom criteria addressing vegetation scarcity, total width of herbaceous or mixed vegetation, and soil permeability. Permeability was determined by presence of sand or sandy loams in buffer soils as measured by observation of surficial soils, bank cut surfaces, or probing with a piece of wood. The definitions below were used to rate each segment.

Good Condition

Width ≥ 50'
And at least 55% vegetated*
And vegetation at least 12" in height

OR
Width ≥ 25'
And at least 70% vegetated* and vegetation at least 12" in height
Or
≥ 55% vegetated* and Sandy L. / Sand and vegetation at least 12" in height

Modifiers.

Grasses about 6 inches in height that had mowed to manage for weeds (noxious or otherwise) were accepted as meeting the 12" condition. We decided on this modifier after speaking with a local farmer who reported a standard practice of mowing grasses to about 6 inches only once per year.

The presence of only non-native shrubs such as honeysuckle without any other vegetation mixed in (such as herbaceous vegetation or native trees/shrubs), was not considered vegetation over 12 inches in height.

Fair Condition

Width
≥15' but ≤ 25'
And ≥55% vegetated *
And vegetation at least 12" in height

Poor Condition

Width
< 15'
Or does not meet the other two categories.

Figure 34 East Fork Creek Watershed, Channelization

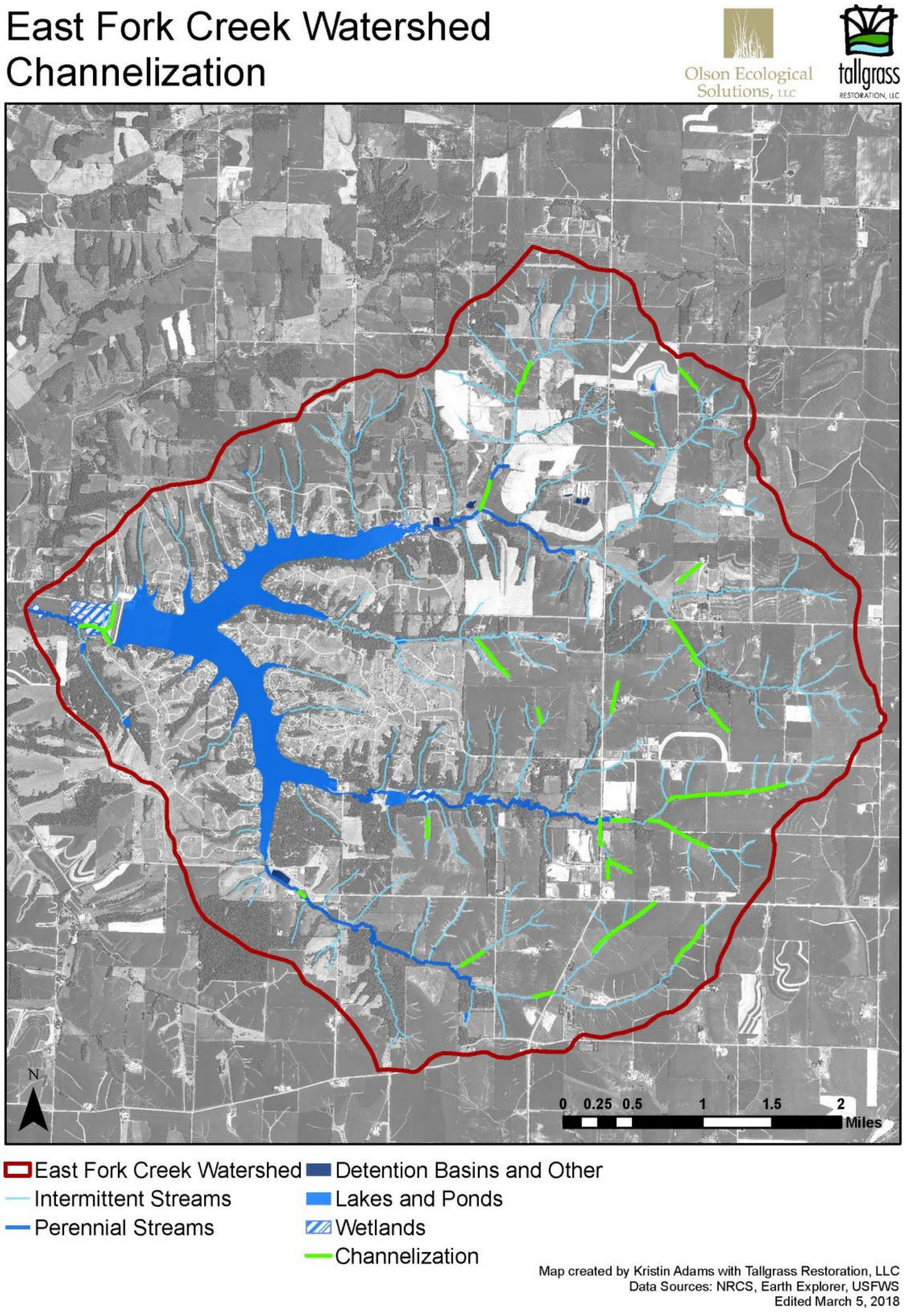


Figure 35 Example Stream Tributaries and Ravines

Table 20 Lake Carroll 2017 October Rip Rap/Shoreline Inspection

2017 OCT RIP RAP/SHORELINE INSPECTION				
	SEC	LOT	NEED TO CORRECT	Shoreline Linear Footage
1	17	181	Exposed Fabric	206
2	17	168	Recommendation - Exposed Fabric	77
3	17	145	Exposed Soil	133
4	17	54	Exposed Soil	138
5	17	45	Rock < 1ft above Pool	177
6	16	230	Exposed Soil	71
7	16	218	Falling Seawall Exposed	90
8	16	101	Exposed Soil	101
9	5	103	Rock < 1ft above Pool	145
10	5	108	Exposed Soil	100
11	5	121	Rock < 1ft above Pool	77
12	5	208	Exposed Fabric	160
13	5	222	Exposed Soil	71
14	12	115	Exposed Fabric	155
15	13	89	Exposed Soil	190
16	13	80R	Washed Out	201
17	22	4	Exposed Soil	208
18	21	19	Exposed Fabric	158
19	21	41	Exposed Fabric	112
20	21	42	Exposed Fabric	203
21	21	45	Exposed Fabric	149
22	21	48	Exposed Fabric	188
23	1	173	Exposed Fabric	191
24	1	145R	Exposed Soil	130
25	1	99	Exposed Fabric	100
26	1	92	Rock < 1ft above Pool	121
27	4	39	Exposed Fabric	130
28	4	40R/41	Exposed Fabric	101
29	4	78	Needs Rip Rap	54
30	4	103	Exposed Soil	76
31	4	105R	Exposed Fabric	62
32	23	31	Exposed Fabric	178
33	23	39	Exposed Fabric	53
34	23	47	Rock < 1ft above Pool	180
35	23	65	Rock < 1ft above Pool	247
36	23	76	Rock < 1ft above Pool & Exposed Soil	131
37	23	218	Exposed Fabric	247
38	23	100	Exposed Fabric	166
39	24	93	Exposed Fabric	214
40	24	92	Exposed Fabric	187
41	24	52	Exposed Soil	146
42	24	51	Exposed Soil	79

2017 OCT RIP RAP/SHORELINE INSPECTION				
	SEC	LOT	NEED TO CORRECT	Shoreline Linear Footage
43	24	30	Rock < 1ft above Pool & Exposed Soil	276
44	24	15	Exposed fabric	210
45	25	87	Exposed Fabric	185
46	25	86	Exposed Fabric	281
47	25	85	Exposed Fabric	114
48	25	75	Exposed Soil	93
49	25	67	Exposed Fabric under Oak Tree	86
50	25	66	Exposed Fabric	306
51	25	65	Exposed Fabric	189
52	25	62	Exposed Fabric	198
53	25	56	Exposed Fabric	149
54	25	54	Exposed Soil & Fabric	215
55	26	6	Exposed Fabric	37
56	26	7	Rock < 1ft above Pool	260
57	26	10	Exposed Fabric	87
58	26	22	Exposed Fabric	255
59	26	26	Exposed Soil	261
60	26	29	Exposed Fabric	62
61	27	12	Exposed Fabric	244
62	27	13	Exposed Soil	71
63	27	45	Rock < 1ft above Pool & Exposed Soil	182
64	27	54	Exposed Fabric & Soil	155
65	28	22	Exposed Fabric	119
66	28	23	Exposed Fabric	116
67	28	25	Exposed Fabric	184
68	28	26	Exposed Soil	182
69	28	37	Rock < 1ft above Pool	211
70	28	38	Rock < 1ft above Pool	215
71	28	43	Exposed Soil	72
72	28	49	Exposed Fabric	278
73				
74				
75				
76				
77			Total Linear Footage	11196
78				

Table 21 Summary of Pond and Basin Erosion

Summary of Pond and Bank Erosion Survey						Bank Erosion		
Reach Code	Subwatershed	Type	Total Shoreline (ft)	Bank Height (ft)	Lateral Recession Rate (ft/yr)	Slight (ft)	Moderate (ft)	Severe (ft)
A2	A	Basin	1888	3	0.01	1794		
				3	0.05		94	
B5	B	Pond	1075	2.5	0.01	860		
				2.5	0.05		215	
B7	B	Basin	349	10	0.01	349		
B8	B	Pond	616	0.5	0.01	308		
				3	0.06		308	
C2	C	Pond	2508	2	0.02	2508		
C4	C	Pond	399	3.5	0.01	339		
				4	0.06		52	
				4	0.03			8
C5	C	Pond	557	2	0.01	279		
				2	0.2		278	
D1	D	Basin	1196	3	0.01	1196		
E2	E	Pond	1466	1.5	0.01	880		
				3	0.06		513	
				8	0.3			73
F1	F	Pond	275	0.5	0.05		275	
F2	F	Basin	255	15	0.01	252		
				10	0.3			3
H3	H	Pond	1206	5	0.01	1206		
Total Length (ft)			**11790**			**9971**	**1735**	**84**
Percent of Watershed (%)			**100%**			**85%**	**15%**	**1%**

Table 22 Summary of Pond and Basin Riparian Area Condition

Summary of Pond and Bank Riparian Area Condition				Riparian Condition		
Reach Code	Subwatershed	Type	Total Shoreline (ft)	Good (ft)	Fair (ft)	Poor (ft)
A2	A	Basin	1888	1888		
B5	B	Pond	1075			1075
B7	B	Basin	349	209		140
B8	B	Pond	616			616
C2	C	Pond	2508	502	2006	
C4	C	Pond	399	359	40	
C5	C	Pond	557	279		278
D1	D	Basin	1196	1196		
E2	E	Pond	1466	733	733	
F1	F	Pond	275			275
F2	F	Basin	255	255		
H3	H	Pond	1206	1206		
Total Length (ft)			**11790**	**6627**	**2779**	**2384**
Percent of Watershed (%)			**100%**	**56%**	**24%**	**20%**

Figure 36 Example Lake Carroll Shoreline

Figure 37 Example Ponds and Basins: Pond B5, Pond E2, and Basin A2

Table 23 Estimated Existing Annual Pollutant Load by Source

Source	Sediment Load (tons/yr)	N Load (lb/yr)	P Load (lb/yr)
Water	0.18	0.09	5.97
Golf Course	66.04	4,956.15	943.40
Low Density Residential	172.63	1,158.14	1,418.90
Med Density Residential	90.97	3,864.76	356.74
Barren	0.37	6.39	3.68
Forest	9.26	6.88	92.61
Open Space/Turf Grass	5.79	6.88	57.90
Pasture	5.53	147.50	44.21
No Till Row Crops	146.14	150.45	955.14
Conventional Till Row Crops	2.41	178.04	18.91
Conservation Till Row Crop	102.35	112.84	367.92
Wetlands	0.16	1.17	6.03

Table 24 Total Pollution Loads by Subwatershed

Total Pollution Loads by Subwatershed

HUC 14 Code	Name	N Load lbs/yr	P Load lbs/yr	TSS Load lbs/yr
07060005080101	A	3,444	290	89,660
07060005080102	B	7,498	599	204,667
07060005080103	C	8,549	877	231,628
07060005080104	D	6,567	544	177,810
07060005080105	E	5,912	699	143,446
07060005080106	F	5,664	651	159,754
07060005080107	G	5,895	543	178,357
07060005080108	H	745	69	17,959
	Totals:	**44,275**	**4,273**	**1,203,281**

Figure 38 East Fork Creek Watershed, Annual Nitrogen Load by Acreage

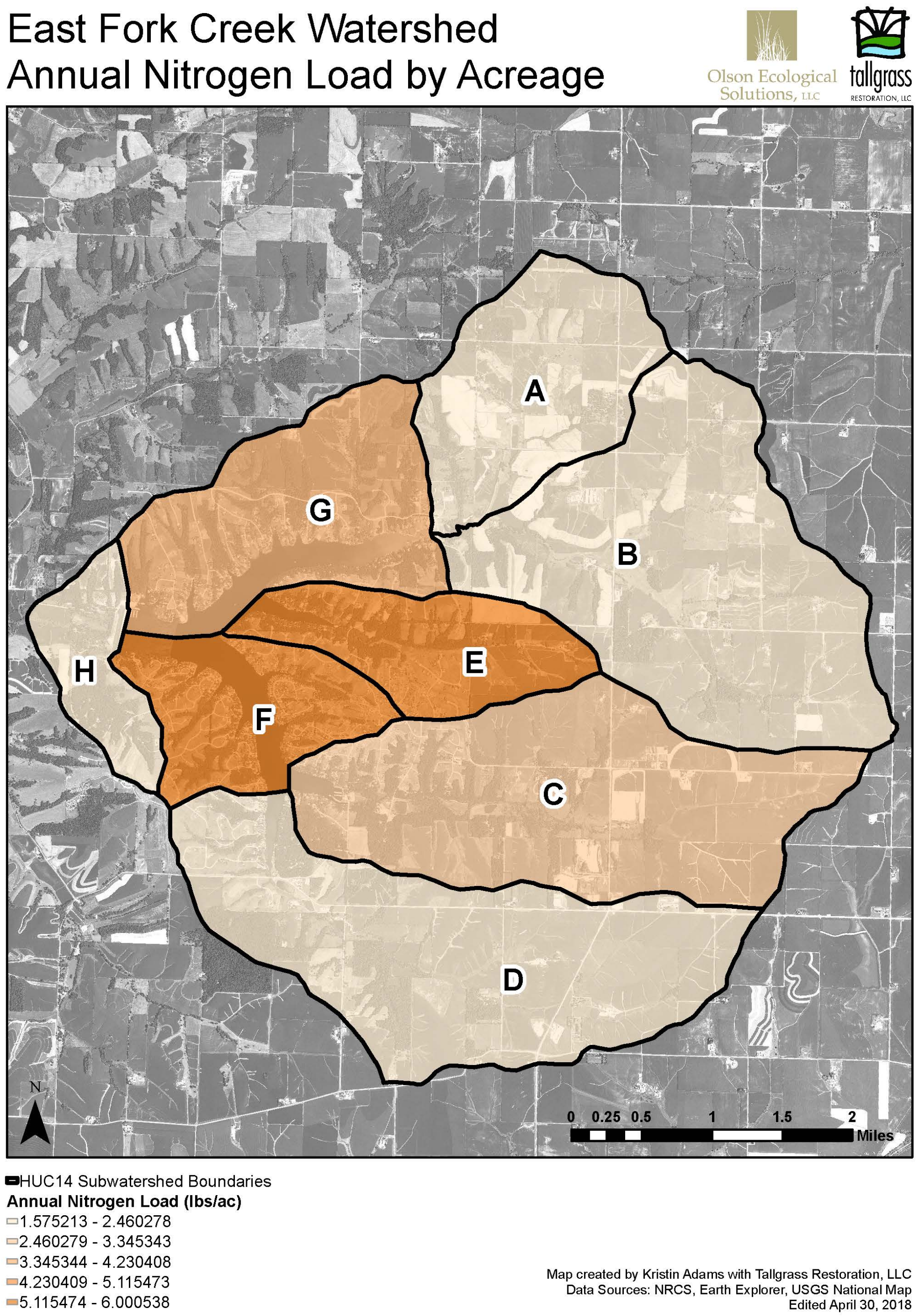


Figure 39 East Fork Creek Watershed, Annual Phosphorous Load by Acreage

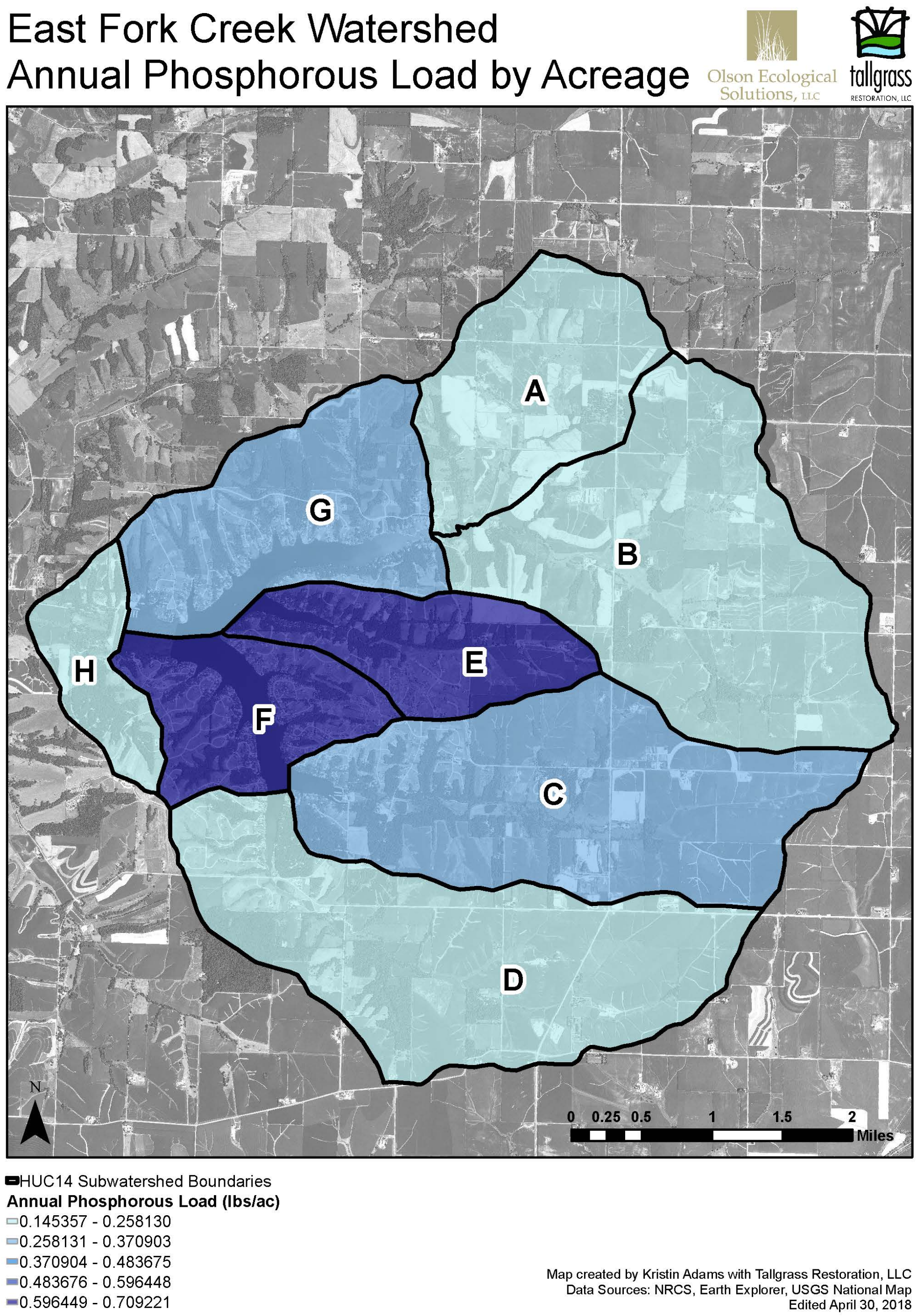


Figure 40 East Fork Creek Watershed, Annual Sediment Load by Acreage

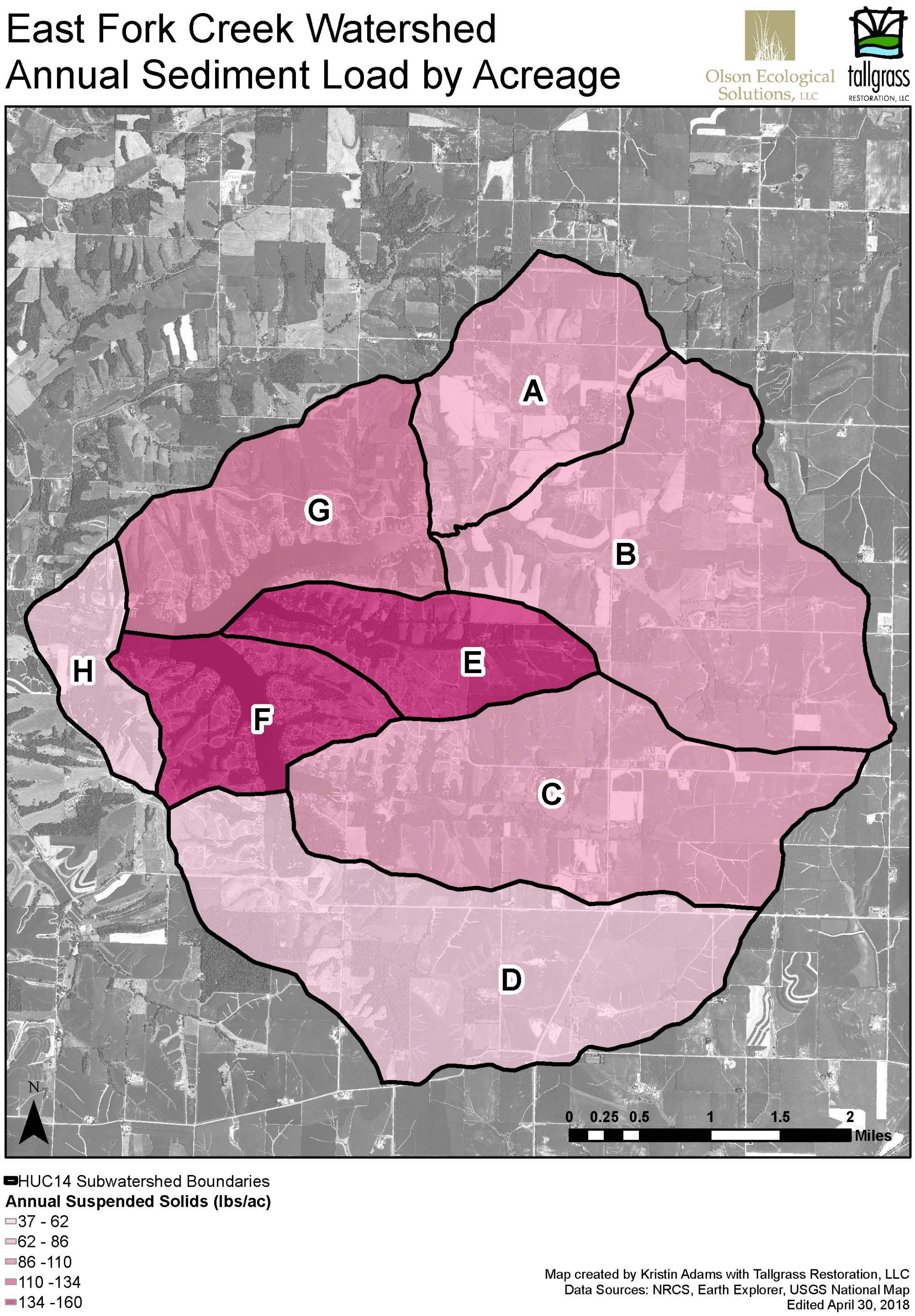


Figure 41 East Fork Creek Watershed, Annual Pathogen Load by Acreage

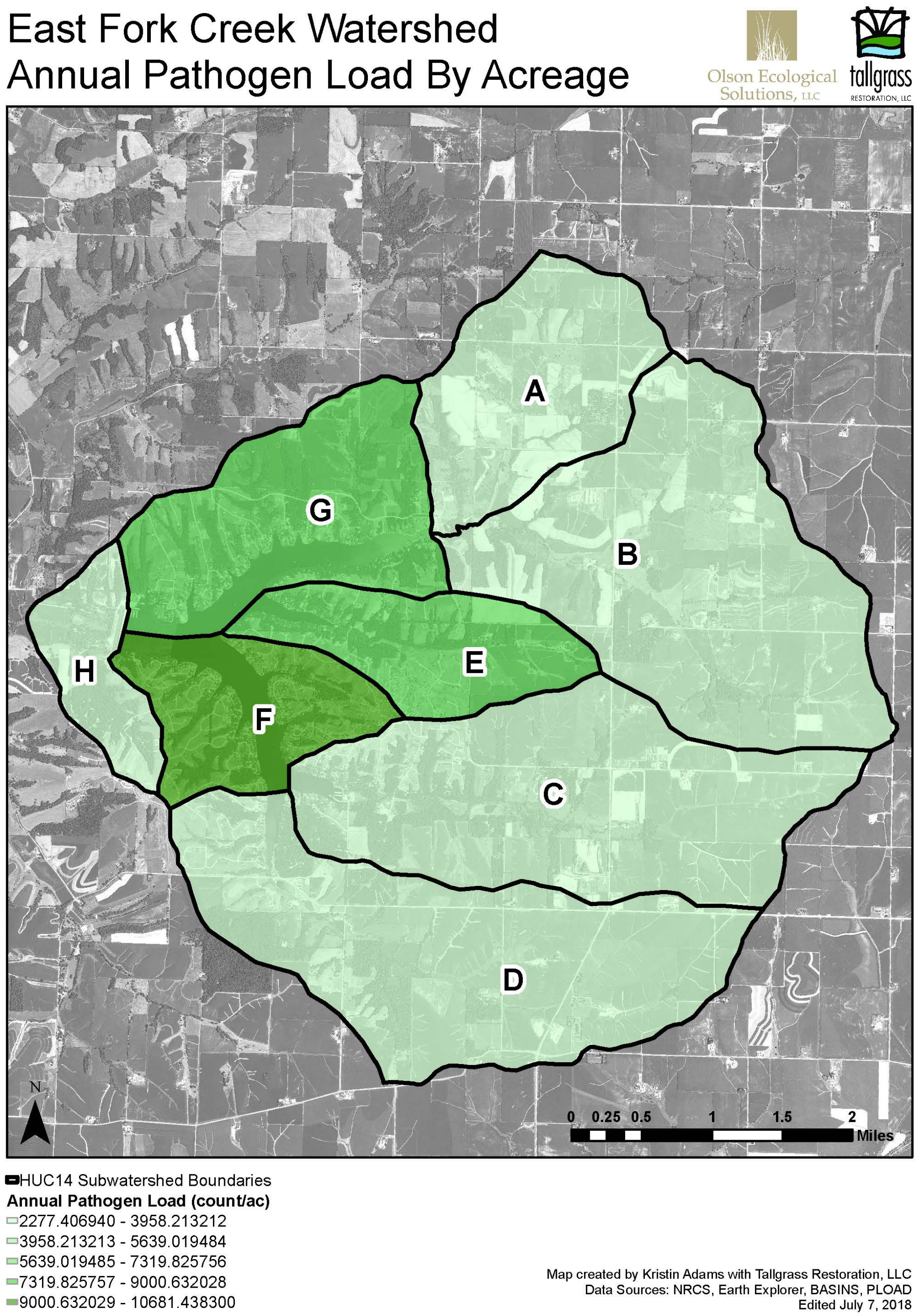


Figure 42 East Fork Creek Watershed, Annual Nitrogen Load Total

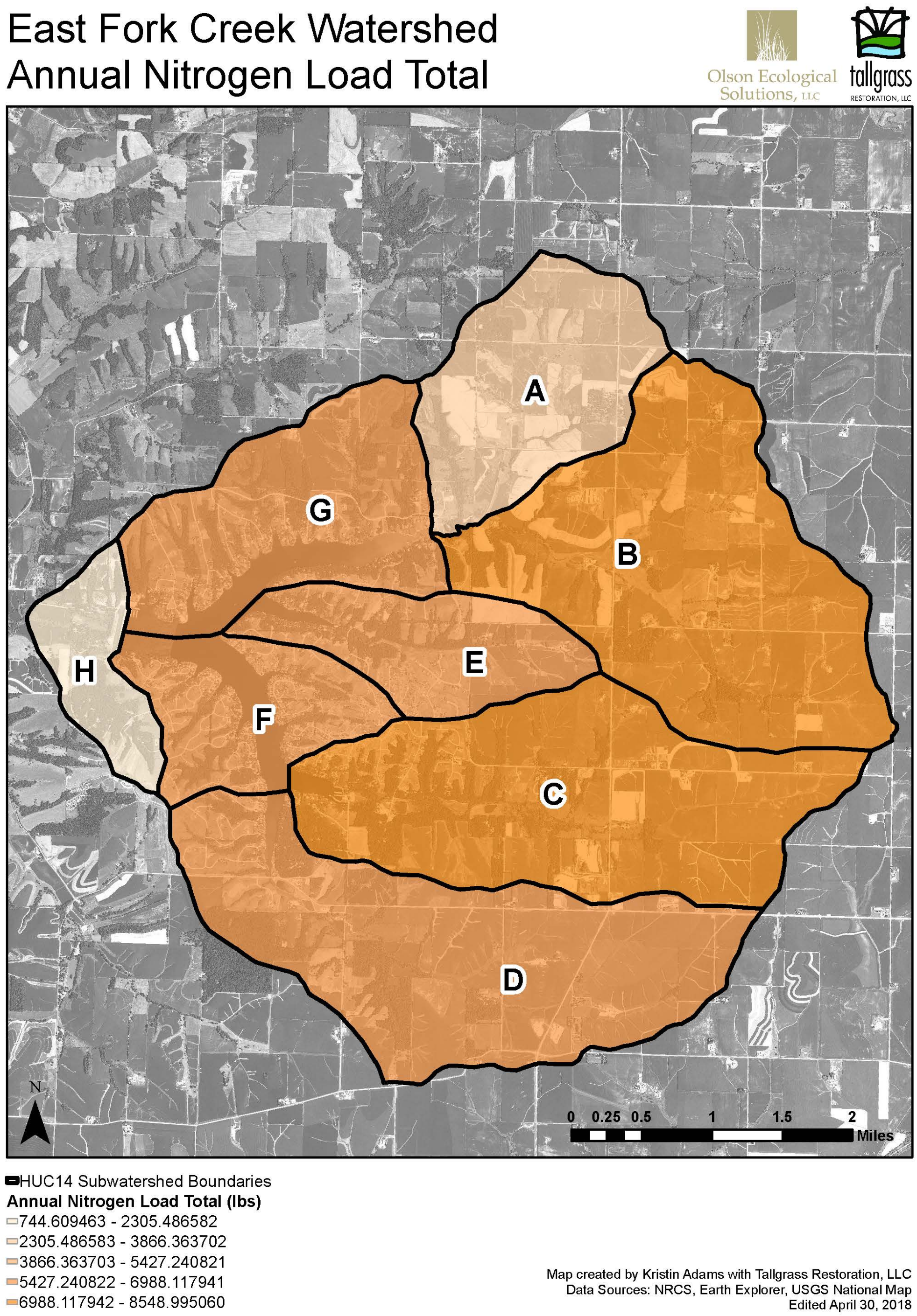


Figure 43 East Fork Creek Watershed, Annual Phosphorous Load Total

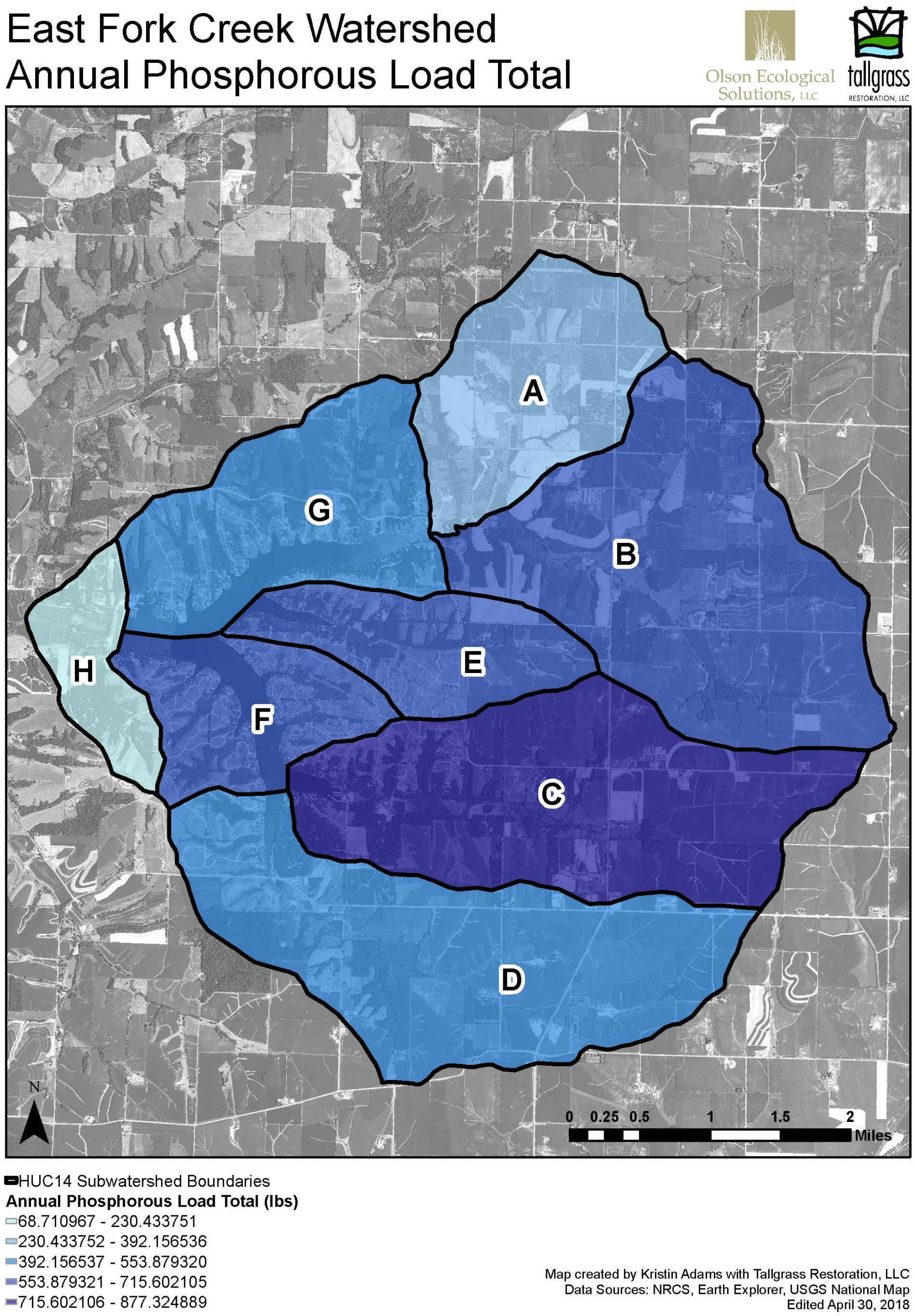


Figure 44 East Fork Creek Watershed, Annual Sediment Load Total

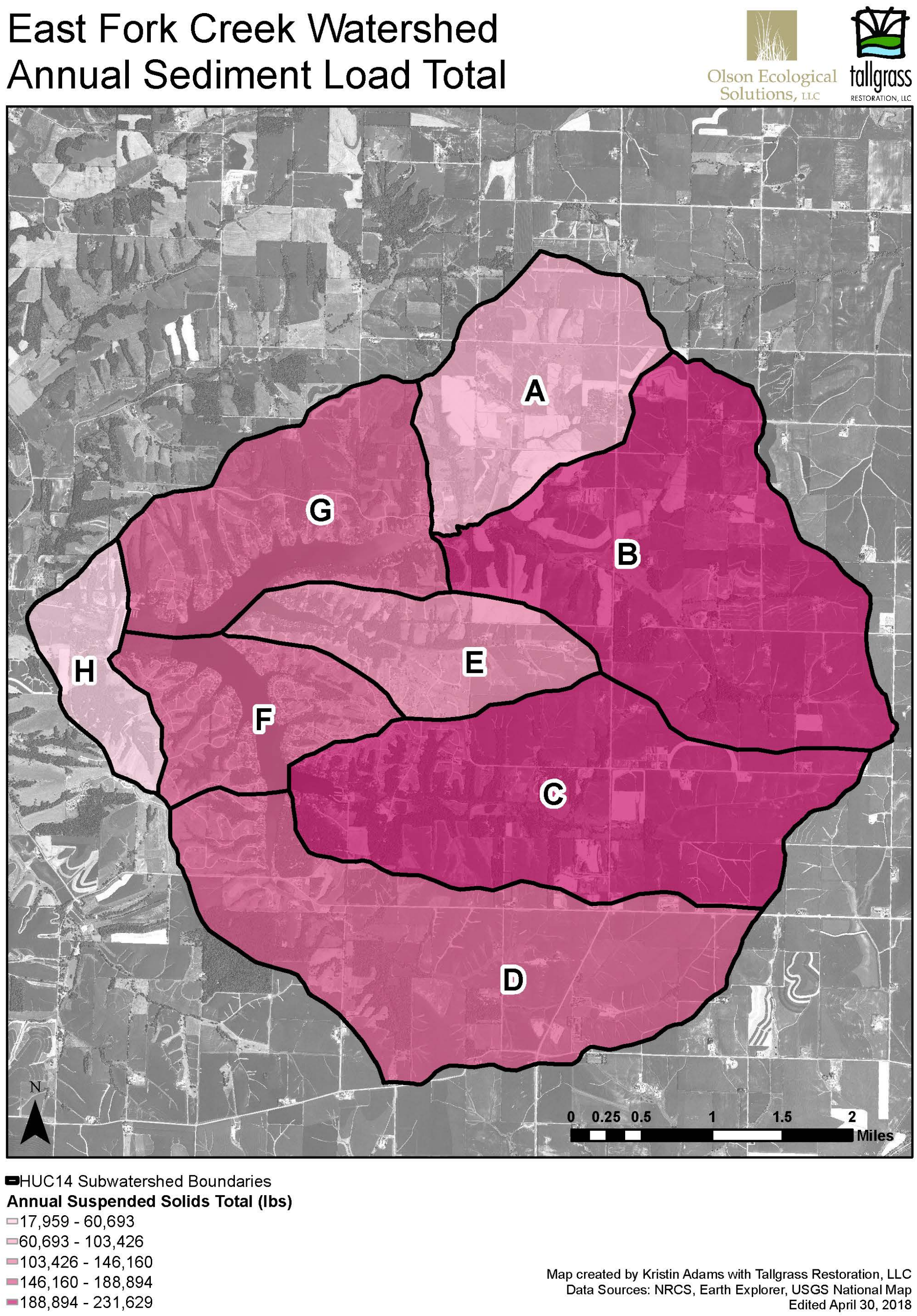
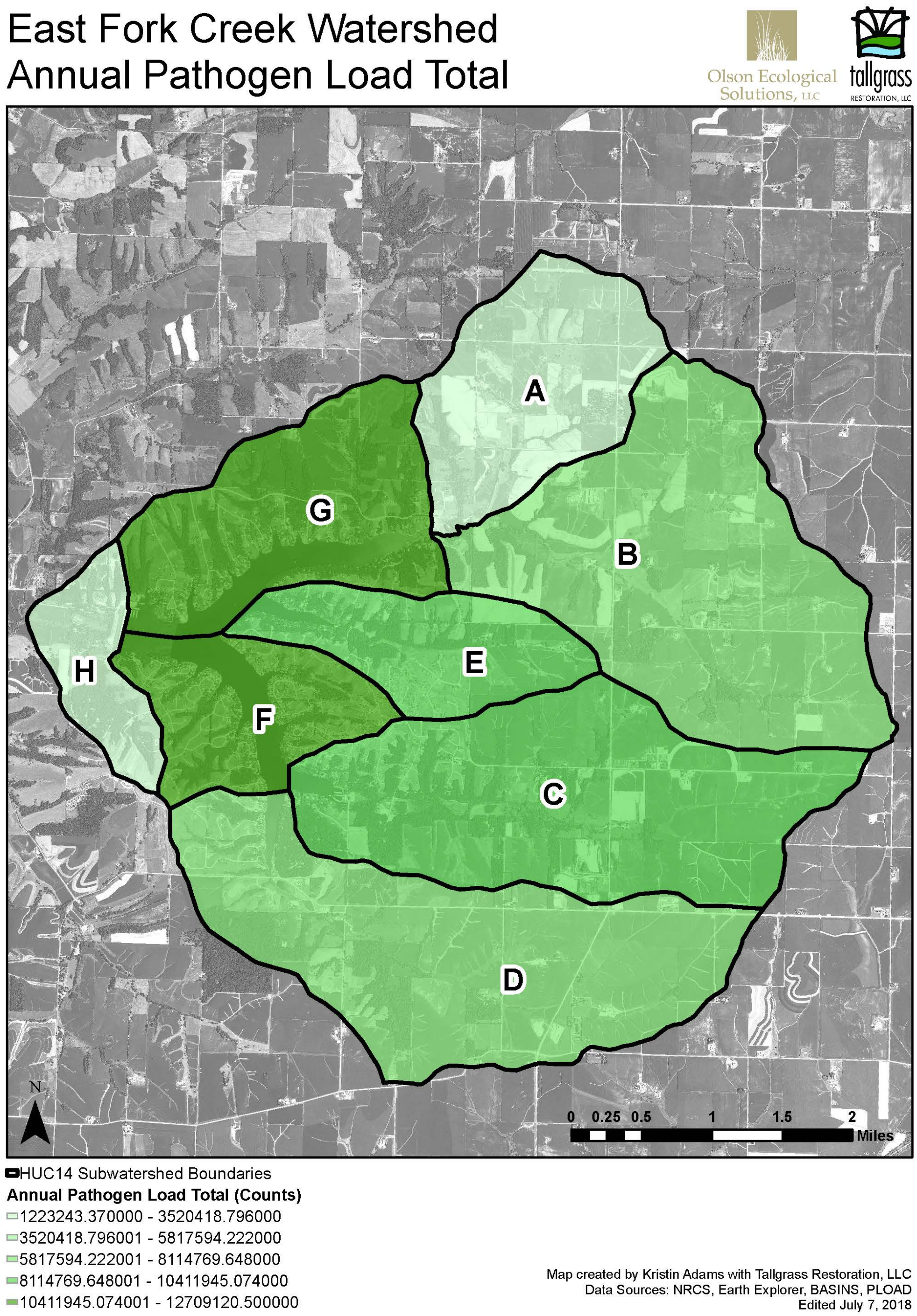


Figure 45 East Fork Creek Watershed, Annual Load Total



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TIGER State and County Demographic Statistics by State, 1 map 0.816 MB - TIGER County Social, Econ, Housing Stats by State, 1 map 3.007 MB - Geographic Names - Populated Places, 2 maps 0.028 MB From USDA Geospatial Data Gateway (see above)

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East Fork Creek Watershed Plan

Section 2

September 2019

Funding for this project provided, in part, by the Illinois Environmental Protection Agency through Section 319 of the Clean Water Act and Lake Carroll Association.

Section 2
Acknowledgements

The East Fork Creek Watershed Plan was initiated by efforts of the Lake Carroll Association and JadEco Natural Resource Consultation and Management. These entities had been working to maintain and improve the recreational water quality and fisheries of Lake Carroll for many years. In 2015, they added Olson Ecological Solutions to their team in order to enlarge their efforts to include the entire watershed in which they were a part. As a first step, these three partners jointly asked the Illinois Environmental Protection Agency for funding assistance, which was granted in 2017.

The People of Carroll County supported the East Fork Creek Watershed Inventory and Plan and its voluntary implementation by resolution of the Carroll County Board on August 15, 2019.

The following individuals were instrumental in compiling this watershed plan:
Edited by: Alyssa Robinson and Rebecca Olson, Olson Ecological Solutions
Written by: Alyssa Robinson and Rebecca Olson, Olson Ecological Solutions
Maps by: Kristin Adams, Tallgrass Restoration
Modeling by: Kristin Adams, Tallgrass Restoration and Rebecca Olson, Olson Ecological Solutions

Contributions by Stakeholders:
Don Aleksi
Donna Aleksi
Barb Anderson
Ken Beach
Jim Benka
Mary Benka
Barb Bostian
Lee Birchen
Doug Block
Tom Block
Tom Bogusevic
Joyce Buisker
Lino D'Amore
Calla D'Amore
Nathan Dinderman
Don Dole
Frances Daley Dole
Chris Flikkema
Jeremy Flikkema
Jaime Freier
Bob Froelich
Dennis Ganz
Gerry Geahos
Clarence Grant
Sam Haldiman
Randy Hasken
Becky Janopoulos
Lou Lamoreux
Ron Lane
Eileen Lane
Janis Madaus
Barb Marchesky
Kim Margosin
Carol Margosin
Steve Marx
Carol Marx
John Mitchell
Gail Mitchell
Cliff Mortenson
Tom Nehrkorn
Steve Nilles
Robin Odeh
Ott Odeh
Allan Rahm
Jim Richards
Pam Richards
Tom Stangl
Rosanne Stangl
Brian Sturtevant
Joe Unser
Moe Unser
Rich Waundukauis
Tom Wienecke
Wayne Wilhelm
Tom Young
Jan Young
Ryan Stoner
Terry Sweitzer
Phil Haugaard

Contributions by Technical Advisers:
Donna Beyer, Lake Carroll Association
Jim Dykema, Natural Resources and Conservation Service
Mike Foutch, Natural Resources and Conservation Service
Jeff Hastings, Trout Unlimited
Julie Jacobs, Blackhawk Hills Regional Council
Dick Schwalbenberg, Lake Carroll Association
Andy Shaw, Blackhawk Hills Regional Council
Scott Tomkins, Illinois Environmental Protection Agency

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Chapter 5

Chapter 6

Section 2
Introduction

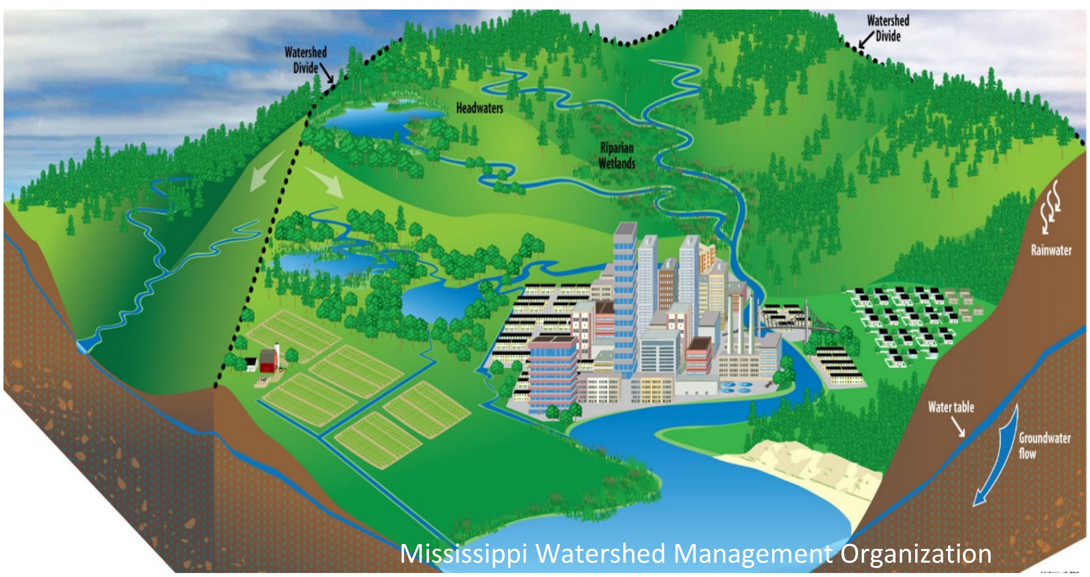
Written by Alyssa Robinson and Rebecca Olson

Section 1 of this document details the Watershed Resource Inventory. This section, Section 2, details the Watershed Plan. Creating a watershed-based plan is an important first step in improving water quality in East Fork Creek and Lake Carroll. Clean water has positive impacts on the local economy, property values, and recreational opportunities. Moreover, it preserves the local heritage for future generations. Watershed-based plans are valuable because they identify the most probable causes and sources of water quality impairments and develop a course of action to address the impairments.

What is a Watershed?

A watershed is a geologic area within the boundary of a drainage divide. In *Figure i.1,* everything within the black dotted line is the watershed. Every form of precipitation, whether rain, sleet, or snow, and all other water sources, i.e. snowmelt, surface runoff, tributaries, and groundwater, that drops on or flows over the land within the watershed boundary eventually drains to the same stream, lake, or river. Any precipitation that falls outside of this watershed boundary drains to a different area. The water quality within a watershed is a reflection of the land use and land management within the watershed.

Figure i.1 Watershed Divide



What is a Watershed-based Plan?

The creation of the East Fork Creek watershed-based plan contains the nine minimum elements that will be consistent with the USEPA watershed-based plan guidance for future implementation of the watershed-based plan recommendations and is required for USEPA Clean Water Act Grants future funding considerations.

EPA's 9 Minimum Elements of a Watershed-Based Plan:

1. Identify causes and sources of pollution.
2. Estimate expected load reductions.
3. Detail management measures and targeted critical areas.
4. Estimate needed technical and financial assistance.
5. Create an information and education component.
6. Develop a project schedule.
7. Describe interim, measurable milestones.
8. Identify indicators to measure progress.
9. Develop a monitoring component (USEPA Introduction to Watershed Planning).

Purpose and Funding

The Lake Carroll Association initiated the planning process with their desire to improve water quality. Together with JadEco Natural Resource Consultants, they requested planning assistance from Olson Ecological Solutions. The Environmental Protection Agency (EPA) provided partial funding through Section 319 of the Clean Water Act. The Lake Carroll Association provided the remainder of the funding and administered the grant. The objective of the EPA Section 319 program is to manage nonpoint source pollutants. Non-point source pollution develops as rainfall or snowmelt flows, picks up natural and man-made pollutants, and carries them to our waterbodies. Nationally, EPA has funded $167.9 million in voluntary projects and programs to reduce nonpoint source pollution from entering our streams and lakes in the year 2017 alone. This number is somewhat typical for the average national annual funding (EPA 2017). The Illinois Environmental Protection Agency (IEPA) estimates that approximately $3.5 million are available for Section 319 program funded projects in Illinois on an average year (IEPA, FAQ). Funds are intended for watershed planning and implementation of projects and programs focused on best management practices. The East Fork Creek Watershed Plan and future implementation of the plan will be strictly voluntary; this is not a regulatory program.

Scope

The East Fork Creek Watershed Plan proposes how to prevent pollution from entering our streams and lake. It was formed with information from an inventory of the watershed, stakeholder involvement through participation in planning, and guidance from technical advisers and consultants. In the following pages, the plan provides a success statement, goals and objectives, proposed projects and programs plus education and outreach efforts needed to reach goals, schedules and priorities for projects and education, cost estimates and guidance for financial and technical support, and a monitoring strategy to evaluate the success of the plan.

This plan does not address retroactive measures to remove pollutants from waterbodies, such as dredging of sediment and mechanical removal of algae. Although these activities are encouraged, they would not likely be candidates for financial and technical assistance by environmental organizations.

Planning

Consultants to the Lake Carroll Association facilitated the watershed planning process, assembled the inventory of the watershed's existing conditions, provided the planning participants with factual information on which to base decisions, and wrote the watershed plan according to decisions and direction of the planning participants and technical advisory panel. The planning effort was facilitated by Rebecca Olson of Olson Ecological Solutions and Joe Rush of JadEco Natural Resources Consulting.

Planning participants were made up of interested stakeholders who live, work, play, and control the land management in the watershed. The community came together 14 times between May 2018 and September 2019. Meeting minutes are posted on the Olson Ecological Solutions website at http://www.olsonecosolutions.com/index.html under the "More" tab entitled "East Fork Creek Watershed". The group of stakeholders determined the vision and direction of the watershed and provided input for all aspects of the watershed plan. Stakeholder participation was encouraged via newspaper announcements, newsletters, emails, and direct mailings.

A technical advisory panel consisted of local experts in natural resources, water management, and agriculture. They provided expert review and recommendations to the planning participants.

Table i.1 lists the past and future planning meetings along with the agenda of the meeting. Completed meetings are shaded in grey, whereas future meetings are shaded in blue.

Table i.1 Schedule of Planning Meetings

Date	**Agenda**
May 21, 2018	Recruit landowner participation in the planning process and provide an overview of the watershed-based plan and process
Aug 21, 2018	Provide feedback for Inventory
Sep 21, 2018	Create success statement and set goals
Oct 27, 2018	Prioritize urban projects and programs
Nov 8, 2018	Prioritize rural projects and programs
Feb 2, 2019	Map site-specific rural projects and detail watershed-wide rural projects
Feb 19, 2019	Map site-specific residential projects and detail watershed-wide residential projects
Feb 28, 2019	Choose rural education/outreach opportunities, set objectives for rural education/outreach, and schedule rural education/outreach efforts: short-term and long-term
Mar 9, 2019	Choose residential education/outreach opportunities, set objectives for residential education/outreach, schedule residential education/outreach efforts: short-term and long term
Mar 19, 2019	Determine rural monitoring/evaluation strategies
Apr 29, 2019	Determine residential monitoring/evaluation strategies
May 29, 2019	Set targets and objectives for selected projects, prioritize selected projects/ programs, and schedule projects/programs: short-term and long-term
July 23, 2019	Review draft executive summary & watershed plan
Sept 23, 2019	Transition the planning committee from planning to implementation and elect leadership for watershed partnership

Watershed planning efforts offered planning participants the opportunity to be proactive in improving water quality on a voluntary basis. The following plan was a result of this community effort to care for East Fork Creek and Lake Carroll.

Section 2, Chapter 1
Concerns, Goals, and Targets

Written by Rebecca Olson and Alyssa Robinson

Introduction

Chapter 1 details the process of stakeholders and technical advisors identifying concerns about the watershed, goals and a vision in addressing these concerns, and tangible targets for reaching stated goals. The following Chapters in Section 2 provide guidance for meeting these goals and objectives.

Enjoyments and Concerns

Watershed planning gave participants the opportunity to come together to share their enjoyments and concerns and consider how they could collaborate toward solutions to common issues. As a past example, Lake Carroll Association helped pay for the cost share programs of upstream agricultural producers in the 1980s and 1990s, which in turn benefitted the lake. Most of the agricultural producers in the watershed interact with Lake Carroll in some capacity, whether by having homes on the lake or family within the Lake Carroll Association. As such, the group of producers and homeowners had a similar list of enjoyments within the watershed, including little car traffic, presence of wildlife, quietness, stargazing, and how the area encouraged quality time with family. In terms of the lake, stakeholders valued water clarity with visibility to about 20 feet in the lake. Other activities many stakeholders enjoyed included boating, fishing, golfing, skiing, tubing, wake surfing, ATV riding, bicycling, and horseback riding.

The group also had concerns for the watershed. For instance, stakeholders foresaw negative repercussions if no action was taken at all to filter and decrease runoff. Even if action was taken, they might still be subjected to more runoff than in the past due to seemingly more frequent, more intense storm events. They discussed obstacles to overcome, which included misinformation, apathy of Association members, and lack of funds. They identified issues of algae blooms, blue-green algae, excessive aquatic plants like milfoil, nuisance geese, pet waste, beach closings, excessive pollutants, and litter in the lake and along the trails. Other potential issues they decided to research were if cattle had stream access and what fertilizer application practices the golf course uses.

Many of these concerns were related to excess nutrients and sediment reaching the lake. Nitrogen and phosphorus naturally occur as nutrients in aquatic systems; however, human activities, both rural and agricultural, have greatly increased the amounts that occur. Too much of these nutrients causes significant jumps in algae growth, which negatively impacts water quality, reduces or eliminates oxygen within the water, harms food resources, degrades aquatic habitats, and can eventually cause algal blooms. Some algal blooms produce toxins and promote bacteria growth, which can harm humans who encounter the water (EPA, Nutrient Pollution: The Issue).

Considering these concerns, the group brainstormed practices that could improve the quality of the lake and streams. They considered cleaning boats prior to launching them, bagging and removing grass clippings and leaves, slowing water runoff rate and installing areas to settle out runoff for filtering pollutants out and reducing flooding, and lining streambanks and shorelines with filter strips and buffer strips. With each practice they considered how it would withstand 100-year and 500-year floods that seemed more common than in the past. They agreed on the importance of education and change in habit and culture.

Vision

In making the improvements, stakeholders envisioned a future watershed with reduced algae problems, managed native aquatic plants, a boat cleaning station, and partnerships and cooperation amongst the community. In doing so, they imagined protected wildlife, preserved serenity, reduced damage from dramatic storms, and a maintained recreational and residential community surrounding Lake Carroll.

Stakeholders discussed their future visions and hopes for the watershed. They voiced their desire to keep streams and lakes clean, preserve topsoil, improve the serenity and beauty of the land and water, and build a healthier ecosystem to sustain wildlife, including hunting and fishing game species. They anticipated a better understanding between the agricultural, residential, and recreational communities. The resulting vision statement captured these desires:

"Maintain and improve the agricultural, residential, and recreational community through mutual cooperation by sustaining and improving all uses of the land and water within the watershed so that all obtain the maximum benefit."

Goals

After stakeholders created the vision statement, they discussed specific goals for the watershed that could lead to the fulfillment of the vision. They wanted to take care of the land in order to take care of the water. They recognized that reducing damage from dramatic storms would in turn retain topsoil, keep water clean, and improve wildlife habitat. The resulting five goals captured the most important elements needed to achieve the vision:

"Take care of the land to take care of the water."

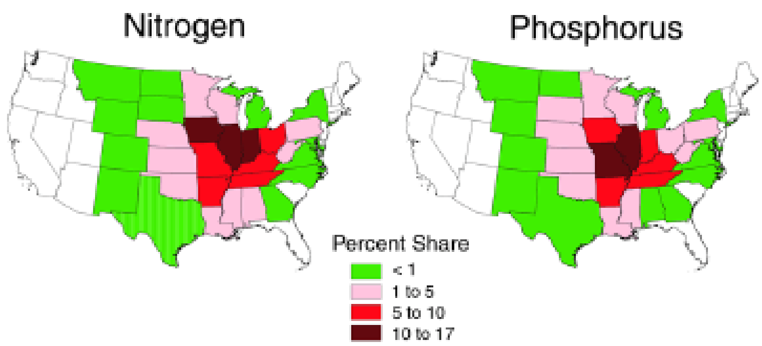
- Goal 1: Reduce sediment loading from all sources in the watershed.
- Goal 2: Reduce nutrient loading from all sources in the watershed.
- Goal 3: Utilize practices that protect and/or enhance wildlife habitat.
- Goal 4: Address volume and velocity of water runoff to enhance water quality.
- Goal 5: Educate the watershed community about land and water conservation and this plan.

These overarching goals encompass the concerns for the watershed, facilitate enhancement of East Fork Creek water quality, and compliment the goals of the Illinois Nutrient Loss Reduction Strategy, which calls on Illinois to address the concerns associated with algal blooms and other negative water quality issues resulting from excess nutrients within the Mississippi River Basin, of which Illinois is a part.

ILLINOIS NUTRIENT LOSS REDUCTION STRATEGY
Improving our water resources with collaboration and innovation

Illinois is one of 12 states in the Mississippi River Basin included in the U.S. EPA's 2008 Gulf Hypoxia Action Plan. This plan calls on the 12 states to develop a strategy to reduce the amount of phosphorus and nitrogen carried to the Gulf of Mexico. Excess nutrients from these states have led to an aquatic life "dead zone" that stretches for thousands of miles. The goals of the Gulf Hypoxia Action Plan are to reduce the amount of total phosphorus and nitrogen by 45%, reduce nutrient loading to the Gulf of Mexico, and reduce the Gulf of Mexico hypoxic zone to 1,930 square miles. Illinois is one of the primary contributors of nitrogen and phosphorous to the Gulf of Mexico by contributing a 10-17 percent share (see *Figure 1.1)*.

Figure 1.1 State Percentage Share of Nitrogen and Phosphorous Contribution to Gulf of Mexico



(USGS, https://water.usgs.gov/nawqa/sparrow/gulf_findings/faq.html)

As a response to the U.S EPA's Gulf Hypoxia Action Plan and an overall concern for Illinois' water quality, Illinois EPA developed the Nutrient Loss Reduction Strategy, or NLRS. The NLRS outlines best management practices to reduce nutrient losses from point sources, urban stormwater, and agricultural nonpoint sources. It uses scientific assessments to target the most critical watersheds and to build upon existing state and industry programs. The goal is to reduce the amount of total phosphorus and nitrate-nitrogen reaching Illinois waters by 45% while also considering land uses and cost-efficiency. A NLRS Report was adopted and publicly released on July 21, 2015, and established 2025 interim milestone goals of reducing phosphorous loads by 25% and nitrogen loads by 15%. The 2015-2017 Biennial Report documents NLRS progress, including the tracking of staff and funding, outreach, land use changes and facility updates, and load reductions (*Nutrient Loss Reduction Strategy-NLRS: past, present, and future)*. In comparing numbers from eight major Illinois rivers from 1980-1996 to data from 2011-2015, Illinois has reduced nitrate-nitrogen by 10% and increased phosphorous by 17% (Drs. Mark David, Greg McIsaac, Corey Mitchell, University of Illinois at Urbana-Champaign in *Nutrient Loss Reduction Strategy-NLRS: past, present, and future*).

> "The Illinois Farm Bureau supports the NLRS because it relies on education, outreach and voluntary incentive-based practices to fulfill agriculture's role in reducing nutrient losses."

~Lauren Lurkins, Director of Natural and Environmental Resources- Illinois Farm Bureau.

In order to reach sediment and nutrient reduction goals, stakeholders would need to meet the targets outlined below.

Targets

We wish to decrease levels of nutrients and sediment within Lake Carroll and East Fork Creek. When applicable, these targets were correlated to the Illinois Nutrient Loss Reduction Strategy, Illinois Environmental Protection Agency General Use Water Quality Standards (IEPA, 2018) and the nearby TMDL study of the Pecatonica River (Tetra Tech and Fluid Clarity, 2014).

We identified reduction targets specific to nutrients and sediment as described below.

Nutrient Load Reduction Targets

Limiting phosphorus and nitrogen will improve the overall health of the lake and streams and reduce nuisance algae blooms. Although phosphorous and nitrogen are essential components of the aquatic food web, through development, agriculture, and lawn care, humans have greatly increased the amount of phosphorous and nitrogen input into water systems. In fresh waters and in the right conditions, even a miniscule jump in phosphorous can cause a negative ripple effect on many other factors, including algae blooms, enhanced plant growth, decreased levels in dissolved oxygen, and the death of certain fish, invertebrates, and other aquatic animals (USEPA, 2012). Specifically, we wish to keep inorganic nitrogen concentration levels at or below 0.3 mg/l and orthophosphate concentration levels consistently at or below 0.01 mg/l but only propose a target related to orthophosphate. See Nitrogen Reduction Targets section below for explanation on why no nitrogen targets are proposed at this time.

Phosphorus Reduction Targets

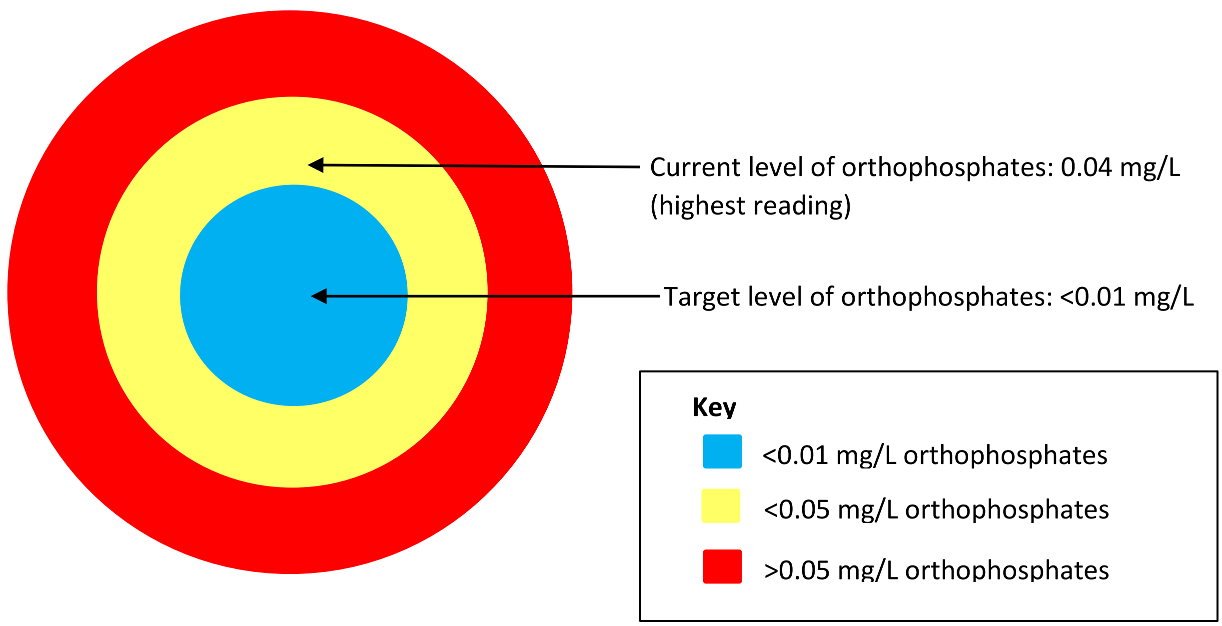
To determine targets for phosphorus reduction, we referenced a TMDL (Total Maximum Daily Load) report, IEPA standards, and the Illinois Nutrient Loss Reduction Strategy to adopt total phosphorus load targets and general guidelines for orthophosphate load reductions for nearby lakes and streams.

For total phosphorus, stakeholders already maintain a target of 0.05 mg/L for lakes according to the General Use Water Quality Standard (IEPA, 2018). The Pecatonica River TMDL for Ecoregion 54 recommended a stream water quality target of 0.0725 mg/L (Tetra Tech and Fluid Clarity, 2014). Over long-term study involving 14 total phosphorus samples between 1995 and 2016, Lake Carroll consistently met the 0.05 mg/L state standard. No baseline monitoring was conducted on East Fork Creek.

Orthophosphate is the inorganic form of phosphorus in a form ready for uptake by plants and algae (USEPA, 2012). Orthophosphate typically represents 60% to 70% of total phosphorus, with the remaining portion mostly being organically bound phosphorus. This organically bound phosphorus can be converted to orthophosphate by biological processes (Commonwealth Engineers, 2017). During a five-year study with five samples, Lake Carroll exhibited orthophosphate levels of 0.04 mg/L twice, once in 2009 and again in 2011, with levels less than 0.01 mg/L during the other three years (ILM, 2016). Issues with algae blooms would decrease if orthophosphate levels in the lake were less than 0.01 mg/L (ILM, 2016) a guideline not consistently met at Lake Carroll. If orthophosphates in the waterways decreased, total phosphorus levels would also decrease.

Stakeholders recognized the need to reduce orthophosphate in order to diminish the frequency and intensity of algae blooms in Lake Carroll. Due to the availability of predictive models for total phosphorus plus the relationship between total phosphorus and orthophosphate, we chose to focus targets for total phosphorus only. Doing so would result in the reduction of both total phosphorus and orthophosphate. *Figure 1.2* depicts current levels and target levels of phosphorous in Lake Carroll.

Figure 1.2 Phosphorous Targets for Lake Carroll



Stakeholders adopted to maintain the total phosphorus general use standards of 0.05 mg/L for lakes and 0.0725 mg/L for streams and to reduce total phosphorus by 25% in order to more consistently meet the guideline of 0.01 mg/L of orthophosphates for lakes. This reduction target is also the interim phosphorus reduction target of the Nutrient Loss Reduction Strategy for Illinois. This percent reduction target represents what can reasonably be expected by this community's effort within the next ten years. *Table 1.1* outlines these water quality targets for phosphorous and orthophosphates.

We propose to decrease total phosphorus by 25%,
which will also result in reduction of orthophosphate.

Table 1.1 Lake Carroll Stream and Lake Water Quality Targets for Phosphorous and Orthophosphate

Load Reduction Parameter	**Stream Water Quality Targets**	**Lake Water Quality Targets**
Total Phosphorus	0.0725 mg/L	0.05 mg/L
Orthophosphate	N/A	0.01 mg/L

Nitrogen Reduction Targets

To determine targets for nitrogen reduction for nearby lakes and streams, we referenced the same resources used for phosphorus (TMDL report, IEPA standards, and the Illinois Nutrient Loss Reduction Strategy). We considered total nitrogen and inorganic nitrogen, which is most readily available to plants and algae. Total nitrogen in Lake Carroll consistently fell under the 15 mg/L General Use Water Quality Standard for total ammonia nitrogen (IEPA, 2018) when measured over a period of five years from 2009 to 2016 (ILM, 2016).

Inorganic nitrogen in the form of nitrate (NO3-N) and nitrite (NO2-N) above 0.30 mg/L can promote algae blooms (ILM, 2016). The inorganic nitrogen concentration at Lake Carroll was highly variable from one sample to the next. Six samples taken between 2007 and 2016 averaged 3.47 mg/L of nitrate-nitrite, which is much higher than the level that could cause an algae bloom. However, during the same sampling period, the algae growth in Lake Carroll was known to be limited by phosphorus, so higher nitrate-nitrite levels would not affect algae growth so long as this remains true. At this time, we recommend focusing on phosphorus load reductions, which will also result in nitrogen load reductions. If at any point the lake switches to a nitrogen-limited system, we recommend revisiting reduction targets for nitrogen. While focusing on reducing phosphorus loads, we can expect to also see a reduction in total nitrogen of 15%, which is the interim standard of the Nutrient Loss Reduction Strategy for Illinois.

We expect to see a reduction of 15% total nitrogen complimentary to phosphorus load reductions, which will also result in reduction of inorganic nitrogen.

Sediment Reduction Targets

Sedimentation, siltation, and total suspended solids were all known causes of impairments to the Plum River, downstream of East Fork Creek (IEPA, 2018). As of 2018, there were 94,000 cubic yards of sediment collected in Lake Carroll (Lake Carroll Association, 2018) hindering the enjoyment of the lake. Contrary to this, water clarity is very good, given the depth of the lake and other factors of lake health putting it in a mesotrophic state. While the Lake Carroll Association works on removing sediment from the lake, the objective of this plan is to prevent sediment from entering the lake. There were no General Use Water Quality Standards for total suspended solids or sediment (IEPA, 2018) and no sediment-related targets in the Nutrient Loss Reduction Strategy. The Pecatonica River TMDL Study recognized a target of a median surface concentration less than 3 mg/L of nonvolatile suspended solids to address aesthetic quality impairments (Tetra Tech and Fluid Clarity, 2014). An objective of this plan is to reduce sediment loading to the extent practicable in order to lessen the need for future dredging and improve

We anticipate reasonable efforts to relieve 25% of the sediment loading into Lake Carroll and East Fork Creek.

aesthetic enjoyment of the lake. We anticipate that reasonable efforts taken within the next ten years will reduce sediment loading into streams, ponds, and the lake by 25%.

Limitations of Reduction Targets

Some issues within the watershed were considered yet not chosen as targets for this plan: reducing fecal coliform, improving dissolved oxygen, and controlling zebra mussels within Lake Carroll. Improving dissolved oxygen levels so that they measure at or above 5 mg/l near the lake bottom would aid in overall lake health and ecological function related to nutrients and organic material, although not addressed by this plan. We acknowledge a zebra mussel infestation, although we did not address zebra mussel control in this plan. The Lake Carroll Association is taking efforts to control zebra mussels by replenishing mussel-eating fish, such as pumpkinseed sunfish reared in their hatchery pond, a project that already has five years longevity. Fecal coliform is a known cause of impairment to the Plum River downstream of East Fork Creek. The Illinois General Use Standard for fecal coliform stated that the mean of five samples taken within 30 days was not to exceed 200 counts per 100 ml (IEPA, 2018). There was no known monitoring of fecal coliform within the East Fork Creek Watershed. Fecal coliform reduction also could not be estimated using predictive models. Since we do not have a method of tracking fecal coliform levels, although we know that fecal coliform will be reduced with recommended best management practices, we have not set a target for fecal coliform reduction.

Agricultural Runoff versus Residential Runoff

It is a common misconception that agricultural production is the main cause of water quality degradation. This is probably due to the visibility of both the vast expanses of agriculture in the Midwest and the significant degradation of streams and lakes. However, it is well documented that impervious cover like roads, rooftops, driveways, and sidewalks have more of a negative impact on water quality than agriculture. All of these impervious surfaces are found in much greater abundance within residential areas. Even watersheds with as little as 6% of impervious cover can start to show measurable degradation of the biological, hydrologic, and geomorphic conditions of its streams, although various studies have found that this minimum can be as high as 20% based on site-specific variables (EPA, 2011).

It is also well known that acre for acre, residential and commercial development have the highest pollutant runoff, with agricultural production as a close second, as indicated by the Event Mean Concentration (EMC) values documented by the EPA and other sources and used in our pollutant load reduction modeling estimates. As watersheds undergo urbanization, developers convert previously vegetated areas to impervious surfaces, i.e. driveways, roadways, parking lots, homes, and corporate/industrial buildings. Impervious surfaces do not allow precipitation to infiltrate into the soil and therefore cause runoff accumulation and flooding. Areas with residential, commercial, and industrial development have more impervious surfaces than agricultural areas, and these impervious surfaces result in more runoff traveling in a concentrated flow. When water quickly runs off impervious surfaces into lower drainages areas or storm drains, it not only causes flooding but also does not allow slow infiltration through the soil. One of nature's ways of filtering out pollutants in precipitation is through soil infiltration. Humans are removing this natural step of filtration by increasingly utilizing impervious surfaces. Moreover, more development results in more pollutant accumulation onto these impervious surfaces. When stormwater flows over these surfaces, it collects pollutants like automobile petroleum by-products, deicing salts, fertilizers, pesticides, pet waste, metals, and sediment and then empties it into the nearest stream, lake, or other waterway. Even areas that are left undeveloped and vegetated may have compacted soils from surrounding development activities. Compacted soils make it difficult for precipitation to infiltrate soil.

Although agricultural areas do have runoff and erosion problems, generally the amount of runoff will be less on agricultural lands than on developed, residential lands. Although agricultural lands may have bare soil or compacted soil at times (especially if conventional till and no cover crop practices are used), they have much less impervious surfaces and concentrated water flows. Although there may be agricultural erosion and runoff concerns, there are more opportunities for precipitation to infiltrate into the soil.

The runoff coefficient, (C), is a value ranging from zero to one that considers the relation between the amount of precipitation and the amount of resulting runoff within a watershed (Water Boards, 2011). Other factors considered and displayed in *Figure 2.1* are soil type, slope, permeability, and land use. A high runoff coefficient means higher runoff and lower infiltration, potentially resulting in flash flooding during storms. Low runoff coefficients have lower runoff rates and higher infiltration. Larger, densely vegetated areas with flat slopes and permeable soil will have the lowest runoff coefficients because they have less impervious pavement. The runoff coefficient increases as impervious surfaces increase, clay content in soil increases, and slope steepens. The different soil groups (Group A, B, C, and D) in the charts below are categorized based on U.S. Soil Conservation Service (SCS) soil identifications and soil infiltration rates. According to *Figure 1.3*, the runoff coefficient for farmland is always less than the runoff coefficient for residential areas, regardless of residential acreage, soil type, or slope.

Figure 1.3 Runoff Coefficient

	Runoff Coefficient, C					
	Soil Group A			Soil Group B		
Slope :	< 2%	2-6%	> 6%	< 2%	2-6%	> 6%
Forest	0.08	0.11	0.14	0.10	0.14	0.18
Meadow	0.14	0.22	0.30	0.20	0.28	0.37
Pasture	0.15	0.25	0.37	0.23	0.34	0.45
Farmland	0.14	0.18	0.22	0.16	0.21	0.28
Res. 1 acre	0.22	0.26	0.29	0.24	0.28	0.34
Res. 1/2 acre	0.25	0.29	0.32	0.28	0.32	0.36
Res. 1/3 acre	0.28	0.32	0.35	0.30	0.35	0.39
Res. 1/4 acre	0.30	0.34	0.37	0.33	0.37	0.42
Res. 1/8 acre	0.33	0.37	0.40	0.35	0.39	0.44
Industrial	0.85	0.85	0.86	0.85	0.86	0.86
Commercial	0.88	0.88	0.89	0.89	0.89	0.89
Streets: ROW	0.76	0.77	0.79	0.80	0.82	0.84
Parking	0.95	0.96	0.97	0.95	0.96	0.97
Disturbed Area	0.65	0.67	0.69	0.66	0.68	0.70

Rational Method Runoff Coefficients - Part I

	Runoff Coefficient, C					
	Soil Group C			Soil Group D		
Slope :	< 2%	2-6%	> 6%	< 2%	2-6%	> 6%
Forest	0.12	0.16	0.20	0.15	0.20	0.25
Meadow	0.26	0.35	0.44	0.30	0.40	0.50
Pasture	0.30	0.42	0.52	0.37	0.50	0.62
Farmland	0.20	0.25	0.34	0.24	0.29	0.41
Res. 1 acre	0.28	0.32	0.40	0.31	0.35	0.46
Res. 1/2 acre	0.31	0.35	0.42	0.34	0.38	0.46
Res. 1/3 acre	0.33	0.38	0.45	0.36	0.40	0.50
Res. 1/4 acre	0.36	0.40	0.47	0.38	0.42	0.52
Res. 1/8 acre	0.38	0.42	0.49	0.41	0.45	0.54
Industrial	0.86	0.86	0.87	0.86	0.86	0.88
Commercial	0.89	0.89	0.90	0.89	0.89	0.90
Streets: ROW	0.84	0.85	0.89	0.89	0.91	0.95
Parking	0.95	0.96	0.97	0.95	0.96	0.97
Disturbed Area	0.68	0.70	0.72	0.69	0.72	0.75

Rational Method Runoff Coefficients - Part II

Source: Knox County Tennessee Stormwater Management Manual

The projects and practices already implemented in and recommended for the East Fork Creek Watershed considered both agricultural and residential settings. With more agricultural land than residential land in the watershed, both are important in reducing sediment and nutrients in order to meet the goals of the plan. Some residential lots at Lake Carroll are greater than one acre.

This plan is conducted at the conceptual level. As such, we used readily available land use data with categories of open space, low density development, and medium density development to define the residential portions of the watershed and estimate their pollutant loading to the streams. However, some of the lots at Lake Carroll Association are five acres in size, and many have not yet been developed. Without calculating the impervious area of each lot, it is possible that the pollutant loads reported from these areas may be overstated compared to actual, current conditions. This data was used in the Watershed Resource Inventory to compare pollutant loading from the subwatersheds and to prioritize areas of opportunity within this plan. It was not used to estimate the benefits that would be realized from implementing the recommended best management practices.

In order to achieve the chosen targets, the stakeholders of the watershed, members of Lake Carroll Association, and consultants considered best management practices that were both effective and likely to be implemented by watershed residents and producers. These best management practices are discussed within the next chapter of this plan.

Section 2, Chapter 2
Recommended Projects and Practices

Written by Rebecca Olson and Alyssa Robinson

Introduction

Chapter 1 detailed the vision, goals, and targets set forth by the stakeholders of the watershed. This chapter details the projects and practices chosen by the stakeholders in order to meet these goals and targets and fulfill the vision. This chapter describes what is already in place in the watershed and what is recommended throughout the entire watershed and at specific locations for chosen projects. Chapters following provide guidance for implementing these projects including costs and benefits.

Stakeholders' Current Conservation Efforts

We address the goals of this watershed plan to improve water quality by suggesting ways to improve land use, implement best management practices, and educate residents and land managers about water quality issues. The watershed planning participants have learned more about the county's current land uses through this watershed planning process. It is impressive the genuine care and respect that both residents and agricultural producers within this watershed provide to their land. While outlining goals and targets for this watershed, we also commend efforts already in place. The stakeholders within the watershed already practice conservation in various ways, both within the Lake Carroll Association and in the rural community.

Homeowner Efforts

Through their Lake Carroll Association, homeowners have stabilized the entire lake shoreline and constructed sediment basins at its inlets, and they have found and protected a large, native prairie remnant that houses rare plant and animal species. They have engaged engineers to explore stabilization of the ravines surrounding the lake, and they are in the process of expanding one of their sediment basins. They have implemented ongoing programs including goose population control, landscaping restrictions, experimental septic systems, and lake water quality monitoring.

- The entire shoreline of Lake Carroll has been stabilized with rip rap, which is monitored and maintained on an annual basis.
- Sediment basins were constructed near the confluence of the two main tributaries to the lake.
- The lake and coves were dredged, removing 94,000 cubic yards of sediment. More dredging is currently taking place, with a focus on the coves that have the most sediment accumulation.
- Ravines contributing the most sediment to the lake have been identified.
- Three existing native prairies are being preserved and maintained: two plantings and one remnant. The remnant prairie of impressive size was discovered in recent years, and Prairie Club of Lake Carroll has adopted ongoing stewardship. Rare species found within the prairie are being monitored as discussed in Chapter 5.
- Goose population control has been an ongoing venture, including egg addling, round-ups, and hunting.
- Vendors, including landscapers, must be registered prior to performing work within the community.

- Private, improved lots greater than 1 total acre in size may install native plantings. These native planting areas may not exceed 1,000 square feet.
- Experimental septic systems within the community include modified sand filters and some chlorinated systems, all of which are monitored every four years for homeowners and pumped annually for Association-owned buildings.
- A Volunteer Lake Management Program (VLMP) had been active for many years and became active again after a break before the program was discontinued by the Illinois Environmental Protection Agency. The Association now hires an environmental consulting firm to monitor the lake's water quality annually, an effort that began in 2007 and overlapped with the VLMP for many years.

Agricultural Producer Efforts

According to the USDA, in the year 2018, Carroll County planted 134,000 acres of corn and produced 28,488,000 bushels of corn. Most farms in the watershed practice a combination of no-till farming and conservation tillage, contoured farming, grassed waterways, and nutrient management. About 20% of them use cover crops. In addition, some have ponds and basins in line with the stream to slow and detain the water during storm events, protecting the streambanks and streambeds below.

- No-till farming doesn't disturb the soil, and conservation tillage leaves good vegetative cover on the ground, preserving soil moisture and organic matter. Stakeholders reported that all crop fields in the watershed rotate no-till and conservation tillage practices, utilizing conventional till only when planting corn for two consecutive years.
- Farming on the contour at a ninety-degree angle from the flow of runoff and grassed waterways safeguards soil and preserves water quality of nearby waterways, which is important on this hilly landscape.
- Grassed waterways protect fields from erosion and deliver stormwater runoff in a controlled manner. As storms have been more frequent and intense in recent years, many area producers have noticed that the grassed waterways need to be widened to handle the larger flows. This concern was echoed by producers in nearby watersheds.
- Nutrient management controls the timing and amount of fertilizer applied to the fields, based on actual field conditions rather than schedules and amounts prescribed by common practice.

In addition to the practices found consistently throughout the watershed, Hunter Haven Farms contains many beautiful examples of how to implement best management practices within livestock operations. Manure management and containment of silage leachate are unique highlights.

- The manure management system turns cow manure into fertilizer, compost, bedding, and even electricity. All portions of the manure management system are disconnected from any waterway leading to the stream, including large manure basins which are pumped into a tank that produces methane gas used to run the motor for the generator that produces electricity. Waste liquid is used to fertilize crops while solids are used for bedding.

- Leachate, an organic liquid that forms when runoff contacts piles of silage, could deplete the oxygen in a receiving stream or pond so quickly that anything living, like fish, could immediately die (Curell and Lee, 2011). The leachate at Hunter Haven Farms is contained in a basin offline from any stream or waterway.

> "The majority of dairy farmers live where they work and they drink the water…. Many of them want that land or business to continue to their children or grandchildren if it's possible. Not only are they in favor of saving the environment… they are not about to harm the environment or the water system because that's where they live."
>
> ~Doug Block, Dairy Farmer – Hunter Haven Farms.

To learn more about their conservation techniques, see Hunter Haven Farms: The People Behind the Product (https://www.youtube.com/watch?v=Zc757kqn5Pw).

What More Can be Accomplished

Local agricultural producers and Lake Carroll Association staff, board members, and homeowners chose which of the best management practices recommended by consultants would most likely be implemented in the watershed. The group was most interested in implementing best management practices within ravines and greenways, on streambanks, and on the land immediately next to streams (riparian area). After reviewing a menu of best management practices appropriate for the watershed, stakeholders prioritized the projects and practices that were most likely to be implemented, as discussed below. They also recognized the need to stay current with best management practice options and adapt the plan accordingly over time, as some opportunities might come into existence after this plan was written.

If East Fork Creek stakeholders choose to implement the recommended best management practices within this plan, then they will help reduce the amount of nutrients that Illinois contributes to waterways which correlates with the goals of the NLRS. Moreover, combing multiple conservation practices together allows for additional compounding benefits.

Stakeholders prioritized selected projects as high, moderate, or low priority, as listed below. Chosen projects are recommended throughout the watershed, with some locations specified. In order to apply some of these practices, the Lake Carroll Association would need to ensure that Association guidelines allowed for shoreline buffer plantings and other native vegetation associated with best management practices on private and association-owned properties. The guidelines would need to describe the allowed function and offer flexibility of the visual affect. Currently, the rules and regulations allow for prairie plantings on private lots up to 1,000 square feet and lots are allowed no more than 40% impervious surface like rooftops, driveways, and sidewalks (Lake Carroll Association, IL Code of Ordinances, 2019). We recognize that many of these applications will require cultural change for the appearance and maintenance of the community's landscape. We hope that once homeowners understand the importance of these best management practices, they will embrace these changes.

All recommended projects and practices, no matter their priority, would ease the sedimentation and nutrification of the lake and streams, and they would ease flashy hydrology during storm events. Further details needed to implement projects and practices are explained in Chapter 4 for watershed-wide recommendations and in Chapter 5 for site-specific projects.

High Priority Projects and Practices

Projects and practices receiving highest priority from stakeholders either applied to the entire watershed or differed between the residential and rural portions of the watershed. Those that applied to the entire watershed included the following:

- Stabilize highly erodible land by removing invasive shrubs or other non-native vegetation, allowing natural ground cover to re-establish.
- Line stream corridors with vegetated filter strips of permanent, native vegetation.
- Stabilize steep ravines, either with grade stabilization structures like check dams, block chutes, and drop boxes or by encouraging self-healing by forest stand improvement.
- Stabilize severely eroded streambanks.

In addition to the projects and practices above that applied to the entire watershed, other applicable residential practices within the Lake Carroll Association given high priority by stakeholders included:

- Plant riparian buffer strips above shoreline rip rap.
- Install vegetated swales planted with native vegetation along water courses that run through greenways.
- Plant rain gardens and bury downspouts and French drains to carry runoff from rooftops to rain gardens.
- Install floating treatment wetlands within coves of the lake with high levels of suspended solids accumulated from runoff.

Within the rural community, projects and practices considered high priority by agricultural producers in addition to those listed above were:

- Repair and widen existing grassed waterways to handle the larger, flashier, more frequent storms that have been occurring recently.
- Construct detention features, such as ponds, basins, dry detention, and scrapes.

Rationale for prioritizing each of these projects and practices as high is discussed below.

Highly Erodible Land Stabilization with Forest Stand Improvement

Many of the highly erodible acres within the watershed were not able to be utilized for production or residential lots. Left to naturalize, invasive shrubs have taken over these areas and shaded out stabilizing ground cover. Stewardship of these lands choked with invasive species would allow ground cover to fill in, therefore reducing erosion and protecting water quality.

There are varying purposes for forest stand improvement. Considerations for implementation and specifications depend on the selected purpose. One purpose of forest stand improvement that correlates to the NLRS is to "alter quantity, quality, and timing of water yield (NRCS eFOTG, 2018)." This calls for diversity in tree age classes and for canopy openings to foster a diverse array of understory vegetation. Trees and understory vegetation should vary in plant species and height. These considerations improve precipitation infiltration, reduce runoff and erosion, and reduce nutrient loading into the watershed.

Most implemented best management practices with the purpose of stabilizing Highly Erodible Land (HEL) will correlate to the goals of the NLRS because erosion and runoff within the East Fork Creek watershed contain nitrogen and phosphorous and stabilizing this land reduces or prevents erosion. The EPA estimates converting land uses to forest to reduce loading by 92% of nitrogen, 28% of phosphorus, and 87% of sediment (Region 5 Model for Estimating Load Reductions, 2018). We assume similar benefits from forest stand improvement in areas of invasive shrub domination on highly erodible land.

There are about 638.5 acres of forested, highly erodible land within the watershed: 370 acres within the Lake Carroll Association and 268 acres in rural areas of the watershed (see Figures 2.1 and 2.2). We plan to focus on 25% of this area (160 acres) located closest to ravines in order to maximize the practice's benefit to water quality. This would best be conducted in conjunction with ravine stabilization.

Ravine Stabilization with Grade Stabilization and Forest Stand Improvement in Riparian Area

Grade stabilization and forest stand improvement would benefit many ravines in the watershed. The steep topography of the area makes these BMPs applicable and desirable for this watershed. Dry dams and drop boxes used to stabilize the ravines were of great interest to the planning group, as was forest stand improvement within riparian areas and on highly erodible lands near ravines. Dry dams and drop boxes are grade stabilizations structures to be installed where a structure is needed to stabilize steep grading and to evenly distribute or drop the water down to elevation. Sloped areas within the watershed where gully erosion occurs could benefit from the installation of these grade stabilization structures. These structures would help to stabilize the sloped soils and reduce erosion and runoff, both of which contains nitrogen and phosphorous. Forest stand improvement within the riparian areas along ravines would control invasive shrub growth that is currently shading out understory vegetation that would otherwise stabilize the area. Sediment and nutrient removal from ravine stabilization vary depending on the severity of the gully erosion, which was calculated by averaging slopes of differing bank heights and lateral recession rates per ravine for site-specific projects and average of all severely eroded ravines for watershed-wide recommendations. Benefits will likely be higher due to the ripple effect of reduced erosion of ravine banks and downcutting of ravines that can be expected when forest stands along riparian areas and banks are improved.

A total of 112,149 feet of ravines were found throughout the watershed, with double this length of banks (224,297 feet). Fifty-one percent (51%) of these banks were severely eroded (114,391 feet).

We used the severely eroded bank length to calculate the opportunity for stabilization. Furthermore, we separated banks of ravines found within the Lake Carroll Association from those found throughout the remainder of the watershed to aid with implementation by the Association and landowners. Severely eroded bank length within the Association included 24,707 feet identified as site-specific projects plus 31,378 throughout the remainder of property owned by the Association and its homeowners. Outside of the Association in the rural portions of the watershed, there were an additional 58,306 feet of severely eroded ravine banks.

Access to install and maintain grade stabilization structures was an issue in some areas near Lake Carroll. Within these areas, forest stand improvement could act alone to allow ravine gullies to self-heal. Ravines with site-specific recommendations could benefit from forest stand improvement on a total of 184 acres of riparian area along 48,446 feet of bank, 24,707 feet of which was highly eroded, as mapped in Chapter 5. Ravines throughout the rural portions of the watershed outside of the Lake Carroll Association are likely accessible. We hope to stabilize the 24,707 feet of site-specific projects plus 25% of the remaining severely eroded banks: 7,845 feet within the Association and 14,576 feet outside of the Association for a total of 22,421 feet of severely eroded ravine banks addressed with watershed-wide projects.

-Ravine headcut, photo by Rebecca Olson

Streambank Stabilization

Streambank Stabilization (i.e. Streambank Protection) is the process of stabilizing and protecting shorelines to reduce the negative effects of sedimentation, both on-site and downstream, resulting from bank erosion. Sediment eroding into streams often contains high levels of nitrogen and phosphorous. Thus, if eroding streambanks within the East Fork watershed are stabilized, then less nitrogen and phosphorous containing sediment enter the streams and lakes. Streambank stabilization reduces sediment and nutrients by varying amounts depending on its severity.

The amount of severely eroding streambanks within the watershed was estimated as 51%, including 277,517 feet of streams that were not ravines. This high amount can be attributed to the steep topography of the watershed and intensive adjacent land uses combined with lack of vegetated filter strips and forest stewardship. Because of the high estimate, this plan focuses on stabilizing severely eroding banks only, not moderately eroding banks, in order to maximize the cost to benefit ratio of the efforts.

The plan aims to stabilize 80,627 feet of severely eroding streambank. This represents 14,998 feet of severely eroded streambank in site-specific locations within the Lake Carroll Association (mapped in Chapter 5) plus 25% of the severely eroded streambank in the rest of the watershed: 8,320 feet within the Association and 57,310 feet outside of the Association.

-Severely eroded streambank, photo by Rebecca Olson

Vegetated Filter Strips

Filter strips are vegetated sections of land that enable stormwater to pass through vegetation, slow runoff, and filter out sediment, organic matter, and other pollutants before emptying into swales or other bodies of water. Filter strips may provide some reduction in stormwater runoff volume, but their primary function is to filter out contaminants in stormwater runoff. Filter strips are usually located between impervious surfaces or agricultural fields and the waters to which they drain. The EPA has estimated load reductions of 40% in nitrogen, 45% in phosphorous, and 73% sediment in water sources when vegetated filter strips are in use (Region 5 Model for Estimating Load Reductions, 2018).

Vegetated filter strips can be located along streambanks and shorelines or at the edge of farm fields or home lots. Runoff sheets off adjacent lands and creeps through the filter strips in a perpendicular direction prior to entering the nearest waterway. Stakeholders indicated that they would be open to working next to the water's edge. Therefore, we focused our recommendations on buffering streams and waterbodies, although at the border of a crop field or residential lot would be just as highly prioritized and effective. We encourage the use of native, deep-rooted vegetation for any new plantings.

Vegetated Filter Strips along Streambanks

Next to streams, 63% of riparian areas throughout the watershed were in poor or fair condition, indicating room for improvement. Within 50 feet of the streambank, this area totaled 556 acres. Within this plan, we aim to stabilize 33% of the area, or 185 acres, with dimensions of 161,374 feet of bank and 50 feet wide.

In addition to the above watershed-wide target, stakeholders identified four sites for installation of riparian buffer strips along streambanks that would filter nutrients and sediment draining from 5,475 acres of residential lots and open spaces. In total, these filter strips would cover 5.3 acres of mapped riparian area.

Vegetated Filter Strips along Shorelines of Lake Carroll, Ponds, and Basins

Vegetated filter strips along shorelines of water bodies, also known as riparian buffer restoration is the process of installing, establishing, and then maintaining plant species that can tolerate intermittent flooding as the dominant vegetation cover in the transitional zone between aquatic and upland habitats. When placed along the shorelines of waterbodies, vegetating these riparian zones provide multiple benefits for wildlife habitat, carbon storage, floodplain storage, and pollinators; moreover, they improve water quality and trap nutrient-ridden sediment and help control nuisance goose populations. At a minimum, riparian buffer strips of lakes, ponds, and basins need to be the larger of 20% of the drainage area length or 15 feet wide to achieve the load reductions stated above. Any width is encouraged, as some homeowners indicated that a strip 15 feet wide would not fit in every situation surrounding Lake Carroll. Stakeholders also felt that many homeowners would not be in favor of the plantings next to the lake. Consultants felt that their inclusion was vital to the success of this plan and used a 15-foot width to calculate acreage of prescribed filter strips.

A surveyed 87% of the riparian areas (67,604 ft of shoreline) adjacent to Lake Carroll were in mowed turf grass with the remainder as naturalized, vacant lots. Next to ponds within the watershed, 20% of riparian areas (3,896 ft of shoreline) were in mowed turf grass or otherwise poor condition within 50 feet of the edge of the water.

Within the Lake Carroll Association, stakeholders identified two locations for installing riparian buffer strips along basins covering a total of 1.6 acres as mapped in Chapter 5. We aim to plant riparian buffer strips within the 1.6 acres of identified locations plus up to 23 additional acres creating a buffer around the entirety of Lake Carroll and outlying ponds.

Vegetated Swales

Swales constructed to carry water away from its source and to the nearest waterbody can be improved by planting deep-rooted, native vegetation within the path of water and in some cases amending the soil to increase infiltration capacity. Vegetated swales reduce sediment by 65%, phosphorus by 25%, and nitrogen by 10% (Region 5 Model for Estimating Load Reductions, 2018).

Greenways conveying water are priority locations for installing best management practices within the Lake Carroll community. Stakeholders identified three locations to install vegetated swales for a total of 9.7 acres. Beyond these site-specific treatments, we recommend finding 35 other swales carrying stormwater that could be filtered by converting turf grass to deep-rooted, native sedges, grasses, and wildflowers. For planning purposes, we estimated each of the additional 35 vegetated swales to be 100 feet long and 30 feet wide, or 3,000 square feet. The 35 swales would cover a total area of 105,000 square feet (2.4 acres).

Wetland Restoration

In addition to the 78 acres of existing wetlands at the time of the inventory, there were only 23 acres of hydric soils with wetland restoration potential. Given the area's steep topography and lack of floodplain, the lack of hydric soils historically developed under wetland conditions was not surprising.

Even though the group recognized the importance of wetland restoration to water filtration, the group realized the lack of opportunity within this watershed and prioritized wetland restoration at four site-specific areas (mapped in Chapter 5) and not throughout the watershed. The four areas would cover a total of 18 acres slated for wetland restoration.

Rain Gardens

Installed next to rooftops, driveways, parking lots, or other impervious surfaces, rain gardens are one of the first conservation features to intercept stormwater runoff from the source. They are small detention features planted with water-tolerant vegetation that are suitable for use in private lawns that can be maintained as attractive gardens. Preferably, the vegetative is deep-rooted native vegetation, which is more capable of infiltrating runoff than cultivars. Detention features are described in more detail below. The EPA estimates that dry detention such as rain gardens can remove 30% nitrogen, 26% phosphorus, and 58% sediment from runoff (Region 5 Model for Estimating Load Reductions, 2018). They also minimize the amount of runoff leaving the property as much of the water will be allowed to infiltrate and evaporate, thus alleviating issues downstream. Keep in mind that these pollutant load reduction estimates can be achieved when rain gardens are properly sized to intercept the stormwater coming from the impervious surface and drainage area.

A successful educational movement could inspire homeowners to plant their own rain gardens. Within the life of this plan, we hope to see 100 rain gardens installed, ideally on 20% of the ¼-acre lots within the Lake Carroll community that are adjacent to and upstream from steep ravines. Although sizes may need to vary, we assumed 150 square feet per rain garden for planning purposes.

Grassed Waterways

Grassed waterways are broad and shallow channels that slow water velocity of runoff through crop fields and release water to a stable outlet. While the focus here is more on preventing erosion and enhancing water conveyance capacity, if the width of the grassed waterway is increased, then the filtering capacity and nutrient removal capabilities also would also be increased. Producers expressed a desire to widen existing grassed waterways to handle the larger, flashier, more frequent storms that have been occurring recently. Furthermore, producers recognized that some grassed waterways needed to be fully repaired each year. When fully functioning, the EPA estimates that grassed waterways remove 10% of nitrogen, 25% of phosphorus, and 65% of sediment from runoff exiting crop fields (Region 5 Model for Estimating Load Reductions, 2018).

In the watershed, grassed waterways in varying conditions would allow for opportunity to widen 67% of the existing grassed waterways and fully repair 14%. The remaining 19% were already wide enough to handle larger storm events. For planning purposes, we used 15 feet as the increased width needed for existing waterways and 30 feet as the desired total width for both widened and fully repaired waterways. We intend to accomplish all opportunities for widening and repairing grassed waterways within the life of this plan. This includes widening 153,318 feet of waterways be an additional 15 feet for a total of 53 acres and fully repairing 32,037 feet of waterways at a width of 30 feet for a total of 22 acres.

Detention Features: Ponds, Basins, Dry Detention, and Scrapes

A combination of detention features, including ponds, basins, dry detention, and scrapes could ease flashy hydrology and were highly prioritized by the planning group. Specific sites were not identified, but detention features could be considered to further enhance any streambank stabilization project. These could either be designed deep for stormwater storage or as shallow marsh features for wildlife habitat. Due to the lack of hydric soils, we did not list wetland detention or wetland scrapes. If the opportunity arises for wetlands to form as part of the detention feature, it would be an improvement over a dry system. In order to estimate pollutant load reduction efficacy, we averaged estimates made by the EPA for wet ponds, wetland detention, and dry detention systems, resulting in estimated removal of 28% nitrogen (N), 38% phosphorus (P), and 68% sediment.

We aim to construct 144 acres of detention features during the life of the plan, equal to 1% of the 14,436-acre drainage area.

Floating Treatment Wetlands

Floating treatment wetlands (FTWs) create an opportunity to filter pollutants in the waterbody. We recommend exhausting all possible preventative measures in addition to using FTWs. One main benefit of the FTWs is their ability to filter free-floating nutrients out of the water that would otherwise feed algae. Wetlands are nature's answer to the ever-increasing need for filtration of pollutants. Creating a floating wetland system introduces this benefit to the water body where only open water previously existed. Once pollutants and excess nutrients runoff into the water system it is difficult to filter them out, unless the ecosystem has a wetland system nearby. Installing these man-made wetlands in areas that have no wetland filtering capacity or have degraded wetlands can greatly increase the filtering capacity of the water body. One 300-square foot island that is 8 inches thick has the capacity to decrease nitrogen and phosphorous in these waters by 331 lb/yr and 106 lb/yr, respectively and 3 tons/yr of sediment (Mark Reinsel, Apex Engineering, personal communication based on measured performance of BioHaven floating islands by Floating Island International in similar conditions).

Stakeholders identified ten coves and ponds on which to install FTWs. Their size, shape, and configuration will be dictated by site constraints, as placement will need to allow for boat passage. Therefore, budget and pollutant load reduction goals remaining after upstream preventative measures have taken effect will dictate project size and desired outcome. During the life of this plan, we aim to install one 300-square foot (225-cubic foot) FTW per location for a total of 3,000 square feet (2,250 cubic feet) of FTWs.

Moderate Priority Projects and Practices

As the group discussed other best management practices that didn't rise to the top but were still recognized as worthy of time and effort, the following projects and practices were recognized for their importance by consultants and stakeholders. These differed between residential and rural settings within the watershed.

Within the Lake Carroll Association, homeowners, staff, and board members wished to accomplish the following:

- Install porous pavement or pavers at the marinas and new driveways, access roads, sidewalks, and other low traffic impervious surfaces.
- Test soils in association with lawn fertilization.
- Establish native plantings throughout the community. For example, change brome to prairie within the Lake Carroll Association on vacant lots and common spaces.

In addition, agricultural producers in the watershed wished to improve their current use of cover crops:

- Install cover crops on the estimated 80% farm fields that currently do not use them.

Rationale for prioritizing each of these projects and practices as moderate is discussed below.

Porous Pavement or Pavers

Porous pavement or pavers turn impervious surfaces into pervious areas that allow stormwater to soak into the ground at first contact with the ground, minimizing runoff from the source. EPA estimates that porous pavements have the potential to reduce nitrogen loading by 85%, phosphorous loading by 65%, and sediment loading by 90% (EPA Region 5 Model for Estimating Load Reductions 2018).

No sites or watershed-wide targets were set for porous pavement or pavers. The parking lot at the Lake Carroll Clubhouse was considered by the Architectural and Environmental Committee, but the lot is on a hillside and maintenance and the ability to plow snow were obstacles. Instead, stakeholders located vegetated filter strips and swales immediately below the parking lot to capture and treat stormwater as it ran off the parking lot. We encourage stakeholders to consider porous pavement or pavers when constructing or repairing driveways, sidewalks, parking lots, trails, and low traffic roads. Future opportunities may be defined as construction or repair plans are formed.

Soil Testing

In an effort to reduce fertilizer application on lawns and crop fields, stakeholders encourage testing soils for their nutrient content prior to applying additional nutrients. Agricultural producers are often aware of resources for such services, but homeowners would benefit from an organized community program and education.

Nutrient reduction potential varies, and no specific actions or targets for soil testing were proposed within the life of this plan, although education and outreach are encouraged.

Native Plantings

Deep-rooted, native vegetation prescribed for best management practices like vegetated filter strips and vegetated swales increases infiltration of runoff, making it a benefit over cultivars no matter where it is planted. Planting natives in the path of water flow is prioritized for water filtration; however, any native planting will improve the overall environmental health of the area and provide important wildlife habitat and is encouraged by stakeholders and this plan. As estimated by the EPA, native plantings can decrease loads of nitrogen by 92%, phosphorus by 67%, and sediment by 87% (EPA, 2018) within the footprint of the planted area when compared to residential land use.

Stakeholders identified one specific location within the Lake Carroll community for a new 0.6-acre native plantings. The Prairie Club already actively manages 21 acres of prairie preservation.

Cover Crops

Cover crops help to stabilize soil in bare crop fields after harvest while also proving to curb nitrogen loss. According to the NLRS 2016 report on effectiveness and cost savings from specific BMPs, utilizing cover crops on corn and soybean fields results in a 20.5% nitrogen loss reduction on tiled-drained acres and a 7.9% nitrogen loss reduction on non-tiled acres (Illinois Nutrient Loss Reduction Strategy 2016).

Cover crops were already planted on about 15% to 20% of the farmed acres within the watershed each year, mostly on wheat ground. Cover crops used included cereal rye and wheat. The producers within the group had an interest in using cover crops on corn and bean fields. They discussed obstacles of timing and application methods. By the time corn is normally harvested, it would be too late in the year to plant cover crops for successful germination. Alternative methods such as aerial application might work but is difficult and expensive. Further discussion is needed to determine the interest of increasing cover crop usage in the watershed.

No specific targets related to cover crop usage were considered by this plan. Stakeholders recognized a strong need for education including successful techniques for implementation.

Low Priority Projects and Practices

Just as important as determining which projects will provide the best water quality benefits to the watershed, the group also decided which projects were not worth pursuing. These included those practices already being implemented and some that did not have high potential or applicability for this watershed.

Projects and practices already in place that did not have great potential for growth included:

- Practice no-till and conservation tillage on active farm fields.
- Implement nutrient management plans on active farm fields and livestock operations.
- Farm with terraces.
- Farm on the contour.
- Implement livestock management plans.

In general, agricultural producers are either already regulated or already practicing these techniques to the best of their ability. As the collective knowledge about such practices improve, we anticipate that the producers of this watershed will improve their techniques accordingly.

Furthermore, restoring stream channels did not have great potential or applicability to this watershed due to the steep topography of the area.

Pollutant load reductions were not calculated for the low priority best management practices, nor were watershed-wide or site-specific targets selected. The rationale for each is discussed below.

No-till farming and Conservation Tillage

No till farming was already occurring throughout the entire watershed on every farm when crops were rotated from beans to corn, corn to beans, or beans to beans. When fields were planted to corn two consecutive years, fields experienced conservation or conventional tillage as necessary to produce profitable yields. The NLRS Science Assessment reported that when 1.8 million acres of conventional tilled land eroding at greater than the soil T value is converted to conservation tillage or no-till, phosphorous is reduced by 50%. This massive phosphorous reduction also results in savings of $17 per acre (Illinois Nutrient Loss Reduction Strategy 2016).

Watershed producers discussed the obstacles to continuous no-till farming, yet they were open to learning new techniques from producers who have successfully used it, as discussed in Chapter 3. Due to the stated challenges, we encourage producer-to-producer sharing of successful methods for continuous no-till practices but did not choose a specific number of acres to convert to continuous no-till.

Nutrient Management Plans

Nutrient management plans were required and followed on large livestock operations within the watershed. Therefore, the opportunity for further implementation would be for smaller farms, of which there were only four. Cost may prohibit formal planning for these smaller farms. In reality, the smaller farms were known by stakeholders to be already following the guidelines of such a plan without going through the formalities. For example, they were already soil testing every three years, sampling within 2.5-acre grids, and timing fertilizer applications. Therefore, we did not recognize room for improvement.

Terraces

Terraces in place were made for different sized equipment than what is currently being used. Producers in the watershed had been removing them and replacing them with grassed waterways.

Contour Farming

Contour farming was already common throughout the watershed, but strip farming was not due to equipment size and style. The group thought that this practice would no longer be needed when the fields were planted via no-till.

Livestock Management Plans

Livestock management was already occurring, such as pasture rotation. Excluding cattle from the stream was not a reasonable expectation on the landscape due to flashy hydrology threatening fencing.

Stream Channel Restoration

Most channelized stream segments were found in headwaters on intermittent streams through agricultural land. This was expected due to the steep topography of the area. Opportunities to re-meander highly channelized stream segments would not be likely; therefore, this option was not considered. Instead, the 22% of stream segments that were highly channelized and 44% of stream segments that exhibited moderate channelization could be studied for their channel stabilization needs and suitability for rock riffles.

Each project and practice listed above, no matter the level of prioritization, should also consider enhancements to benefit wildlife, when applicable.

Enhancements for Wildlife

When implementing any conservation project or practice, we would like stakeholders to consider how it could be enhanced to better serve wildlife. Fish, birds, amphibians, reptiles, and invertebrates could all benefit from adding simple features in and near streams, ponds, and lakes (Hastings, 2009). We encourage special attention paid to habitat enhancements to support threatened and endangered species found in this watershed like rusty patch bumble bee and Indiana bat, other butterfly and bee pollinators, and species in greatest conservation need (SGCN) according to the Illinois Wildlife Action Plan (IDNR, 2019). Trout Unlimited produced the Habitat Guide: Complimentary Opportunities for Stream Restoration Projects, which provided a decision matrix and design specifications for each recommended habitat feature (Hastings, 2009). Suggestions include the following habitat features for each group of wildlife:

Fish

- Lunkers
- Brush bundles
- Deep pools created with cross channel logs and rock weirs
- Rock and log deflectors
- Minnesota skyhook
- Random boulder placement
- Side channels
- Vortex weirs

Birds

- Dead trees and bird perches to provide perches for hawks and other birds of prey
- Various riparian habitat for nesting such as native grasslands, trees, and brush

Amphibians

- Microhabitats including downed woody debris and healthy duff layers

Reptiles

- Open canopy providing varied habitat structure
- Basking logs and rocks
- Turtle and snake hibernaculum

Birds, Amphibians, and Reptiles

- Wetland scrapes near streams and in floodplains
- Vernal pools with shallow standing water that warms up faster than streams and larger ponds
- Mud flats and backwater refuge areas next to streams
- Oxbows
- Riparian prairie plantings

Invertebrates

- Flat and embedded rocks in terrestrial areas
- Various types and sizes of downed woody debris

For more information, consult the Habitat Guide: Complimentary Opportunities for stream Restoration Projects (Hastings, 2009). Note that any surface area within water would grow biofilm, a sticky collection of microorganisms including beneficial bacteria instrumental in digesting excess nutrients and cycling them into the food chain.

Successful implementation of any project or practice will require the support of the entire community. The Lake Carroll Association is poised to organize and manage programs to assist private homeowners, such as educational events and materials, organization of group efforts such as soil testing, and guidance toward technical assistance. Further information needed to education landowners is provided in Chapter 3. Chapters 4 and 5 provide details regarding the costs and benefits of the recommended projects. Financial and technical assistance is also available to all stakeholders of the watershed as referenced in Chapter 6.

Section 2, Chapter 3
Education and Outreach

Written by Rebecca Olson and Alyssa Robinson

Introduction

The recommended projects and conservation practices within this plan are solely up to the stakeholders to implement; therefore, it is essential to prioritize education and local engagement. The goal here is to educate local stakeholders of the value in addressing water quality concerns and empower them to implement and maintain the recommended conservation practices.

Education and outreach efforts focus on engaging landowners, producers, and the supporting community. Topics of education are the creation of this watershed plan and what it entails, existing concerns throughout the watershed, and the potential improvement that recommended projects could have if implemented on stakeholder property. Education and outreach efforts will continue throughout the duration of the plan. This plan requires education, planning, monitoring, meetings, investigations, and follow-up. The purpose of the plan is to address and improve water quality issues, but more importantly, the education, active participation, follow-through, and maintenance of these projects is vital to long-term success.

Existing Opportunities

Various outreach groups and education opportunities already exist within the area to encourage local participation and increase awareness:

- The local library has related presentations and workshops.
- The University of Illinois Extension has helpful links.
- Prairie Club gives presentations about prairies and native plants.
- Driftless Projects Bus Tour by Trout Unlimited and the Driftless Area Restoration Effort

Trout Unlimited and the Driftless Area Restoration Effort hosted the Annual Driftless Projects Bus Tour in October of 2018. They visited nearby projects within the Driftless Area within Illinois, Minnesota, Wisconsin, and Iowa. Although not specific to the East Fork Creek watershed, this free opportunity provided examples of stream and watershed projects appropriate for the region with similar topography, land use, and other natural features. Since this is an annual tour, we hope that more will be available in the future. See website for more details. http://www.darestoration.com/

Opportunities of Interest

The stakeholders expressed ideas and interest involving various education and outreach opportunities that ranged from newsletter articles to bus trips and demonstration projects. *Table 3.1* below categorizes these ideas based on covenant amendments (CA), demonstration projects (DP), education programs (EP), and publications (P).

Table 3.1 Educational Opportunities of Interest

Covenant Amendments:

Estimated Timeframe	Quantity	Ref. #	Amendment Description	Suggested Lead	Cash Needed
Year 1	1 clause by first year	CA - 1	Include a "Right to Farm" clause on the lot agreement so that people know that they will be expected to accept the noises, smells, traffic interruptions, and other aspects of living within a rural, agricultural community. The lot agreement is between the homeowner and the Lake Carroll Association.	Lake Carroll Assoc.	$0

Demonstration Projects:

Estimated Timeframe	Quantity	Ref #	Project Description	Suggested Lead	Cash Needed
Year 1-3	2-3 islands by third year	DP - 1	Launch 2-3 floating islands at hatchery pond.	Fishing Club	$15,000
Year 1-10	1 event/year	DP - 2	Conduct educational tours to demonstrate BMP implementation within the watershed and larger region.	Lake Carroll Assoc., Prairie Club, NRCS, JoDaviess Conservation Foundation, Natural Land Institute, Blackhawk Hills Regional Council	$0-3,000/year

Educational Programs*:

Estimated Timeframe	Quantity	Ref #	Program Description	Suggested Lead	Cash Needed
Year 1-10	1 event/year	EP - 1	Offer seed packets to stakeholders, picked by volunteers from local remnant prairies.	Prairie Club	$0
Year 1-10	1 event/year	EP - 2	Offer professional consultation free to homeowners.	Lake Carroll Assoc. HOA	$2,500/year
Year 1-10	1 event/year	EP - 3	Offer rural peer-led workshops to share experience in applying agricultural BMPs.	Agricultural Producers, NRCS, and SWCD Board	$0-$1,500/year
Year 1	1 event	EP - 4	Host a Farm-to-Table Dinner with educational presentation by a Michael Fields Agricultural Institute speaker	Lake Carroll Assoc.	$3,000**

Year 1-10	1 event/year per club	EP - 5	Invite educational speakers to present at local clubs (women's club, fishing club, golf club).	Lake Carroll Assoc.	$0-$500/year
Year 1-10	1 meeting/year	EP - 6	Conduct a contractor's meeting to educate landscaping companies and other registered vendors of watershed concerns and regulations.	Lake Carroll Assoc. Prairie Club	$0-$500/year

*During each Educational Program, advertise the publications referenced below.
**Cost can be offset by selling tickets for event.

Publications:

Estimated Timeframe	**Quantity**	**Ref #**	**Publication Description**	**Suggested Lead**	**Cash Needed**
Year 1-10	1 distribution/ year	P - 1	Distribute to stakeholders the educational fliers found in this chapter and other publications that provide specific, detailed direction with examples for implementing best management practices (via mailings, social media, newsletter).	Lake Carroll Assoc.	$0-$1,500/year
Year 1-10	monthly	P - 2	Publish a series of articles in the LCA newsletter and other local newspapers about each recommended BMP.	Prairie Club	$0
Year 1-10	1 event/ year	P - 3	Offer "how to" guides on managing forest lands.	Prairie Club	$0
Year 1-10	as needed	P – 4	Distribute a Welcome Packet to new homeowners that includes a copy of this plan's Executive Summary.	Lake Carroll Assoc.	$0-$200/year
Year 1	as needed or at each event	P - 5	Provide a website link to this Plan, Executive Summary, and Educational Fliers from this Chapter.		$0

Table 3.2 estimates the minimum and maximum cost for education and outreach for each year depending on availability of knowledgeable volunteers or need to hire professional consultants to provide tours and presentations.

Table 3.2 Cost Summary for Education & Outreach

Year	Minimum Estimated Cost	Maximum Estimated Cost
Year 1	$ 5,500.00	$ 12,700.00
Year 2	$ 2,500.00	$ 9,700.00
Year 3	$ 17,500.00	$ 24,700.00
Year 4	$ 2,500.00	$ 9,700.00
Year 5	$ 2,500.00	$ 9,700.00
Year 6	$ 2,500.00	$ 9,700.00
Year 7	$ 2,500.00	$ 9,700.00
Year 8	$ 2,500.00	$ 9,700.00
Year 9	$ 2,500.00	$ 9,700.00
Year 10	$ 2,500.00	$ 9,700.00
Total	**$ 43,000.00**	**$ 115,000.00**

The group talked about targeting education efforts towards the Lake Carroll board, community, and maintenance staff; landowners; and surrounding watershed residents, including FFA (Future Farmers of America) groups and outside vendors of pesticide application for the Lake Carroll community. Educating the people and operators who experience the problems and who can make decisions and implement the plans proved to be a priority. The group acknowledged that education should be a continuous process to ensure the public is acquainted with project updates and progress. Educational and project updates should be communicated through the Lake Carrol Association website, email blasts, social media (i.e. Lake Carroll Association Facebook page), and newsletters.

Stakeholders expressed an interest in staying current on best management practices, which could be accomplished through a series of articles within the LCA newspaper and local newspapers (Ref #: P-2). It was suggested that these articles be sent out for 12 months and shared through multiple media avenues. Newsletter articles may feature how to install a prairie garden, rain garden, vegetated buffer strip, vegetated swale, and buried downspouts, for example. They could highlight the importance of various covenants and bylaws. Successful articles will answer the question, "what's in it for me?" and address the need to focus on critical areas to thwart the misconception that a person would need to rip up their entire yard and forego enjoyment and use. Another newspaper topic could be appropriate use and application of fertilizers. One resource that could be sent to the stakeholders is the Natural Land Institute's *Guide to Natural Areas in Northern Illinois* (Ref #: P-4), which can be found online at https://www.naturalland.org/wp-content/uploads/2017/03/Natural_Areas-Guide3_finalfullbook-2.pdf.

The group also discussed having specific educational programs geared towards registered Association vendors and the rural community. Any contractor or vendor interested in working within the Lake Carroll Association community must first become registered through the Lake Carroll Association office. In order to ensure lawn care and pesticide applicator vendors are educated on the issues and concerns of the watershed, the group suggested that the Association requires all interested vendors to attend an educational meeting about watershed concerns and changes in regulations (Ref #: EP-6). Additionally, the rural community discussed an interest in participating in peer-led education workshops with other local producers that have had success with various best management practices (Ref #: EP-3). We admit that some of the most practiced and knowledgeable people in agricultural production and associated conservation were represented by our stakeholders. Even so, individuals within the region may be able to shed light on some of the obstacles found by local producers. Providing an organized format for discussions could lead to communication between producers who may not otherwise have the opportunity. Example topics of discussion would likely include continual no-till planting, preservation of soil integrity, and successful methods for improving overall farming operations and yields when using conservation practices.

Other outreach and education ideas arose at community meetings. The group expressed a need for "how to" guidance for managing forest lands (Ref #: P-3). Stakeholders also acknowledged potential locations for educational opportunities. The Lake Carroll Clubhouse could host a Farm-to-Table dinner event and present an educational slide show (Ref #: EP-4). Michael Fields Agricultural Institute could provide a speaker for this Farm-to-Table event in summer of 2019. See website for more details on the Institute: http://michaelfields.org/the-institutes-big-brown-barn/. Local outdoor clubs, such as the Women's Club, Fishing Club, and Golf Club, could also host educational speakers to present on selected watershed issues (Ref #: EP-5). Within the region, other locations discussed had potential for demonstrating BMP implementation via tours: the fish hatchery to Lake Carroll's East Marina could demonstrate streambank stabilization with rip rap; the Lost Lake River Conservancy District could showcase turf reinforcement and bank stabilization at Babbling Brook and on a private farm upstream of the lake; the Nature Conservancy at the Nachusa Grasslands in Franklin Grove, IL, could demonstrate various conservation techniques; Candlewick Lake Association in Poplar Grove, IL, could demonstrate vegetated swales and rain gardens; Levings Lake in Rockford, IL, could demonstrate floating islands, filter strips, and constructed wetlands; and dairy and hog operations around Lake Carroll could highlight BMP success/implementation (Ref #: DP-2). One particular farm, Hunter Haven Farms in Pearl City, IL, has installed contour farming, no-till planting, grassed waterways, dry basins, ponds, manure management, and leachate management. Ideally, self-guided tour booklets would be offered at these locations to further assist in education. Moreover, by installing BMPs like filter strips, vegetated swales, riparian buffers, floating islands, and permeable pavers, residents and stakeholders can easily view BMP application nearby and become more aware of their benefits (Ref #: DP-1).

Education Planning

The watershed planning participants met two times to specifically discuss educational opportunities and brainstorm ideas for outreach. They plan to set up more meetings in June 2019 to review education and outreach efforts as well as the costs associated with them. At these meetings they decided on various communication channels for raising awareness of the watershed issues and watershed plan at-large: word-of-mouth, website updates, email blasts, blog, and social media. Another avenue for communication could be the drafting of a Welcome Packet to be given to all Lake Carroll Association members. The Welcome Packet could include a copy of the watershed plan's executive summary as well as education and benefits of the recommended practices. On February 28, 2019, a group of stakeholders met to discuss education needs and opportunities for the rural community of the East Fork Creek watershed. On March 9, 2019, the group held another meeting to discuss education needs and opportunities for the residential community of the East Fork Creek watershed. On March 22, 2019, the Lake Carroll Association Board of Directors approved funding for planning, implementing, and educating the public on the watershed plan. June 1, 2019, marked the beginning of the Lake Carroll Association member education process.

Table 3.3 Schedule of Education Meetings and Agenda

Date	Agenda	Completion Status
February 28, 2019	Choose rural education/outreach opportunities: Setting objectives and short-term/long-term efforts	Completed
March 9, 2019	Choose residential education/outreach opportunities: Setting objectives and short-term/long-term efforts	Completed
July 23, 2019	Review education efforts and costs	Completed

Educational Fliers

The following pages contain educational fliers that describe each best management practice prioritized for residential and rural areas within the watershed. These flyers can be used to support education and outreach efforts discussed above.

Best Management Practices

East Fork Creek Watershed

Olson Ecological Solutions, LLC

This report was prepared using United States Environmental Protection Agency funds under Section 319 of the Clean Water Act distributed through the Illinois Environmental Protection Agency. The findings and recommendations contained herein are not necessarily those of the funding agencies.

East Fork Creek Watershed: Rural Best Management Practices

Grassed Waterways

Grassed waterways, either natural or constructed, are shaped or graded channels that are planted with suitable vegetation for runoff conveyance without causing channel erosion. (EPA BMP Descriptions for STEPL and Region 5 Model 2018).

Benefits:

- ✓ Conveys runoff from terraces, diversions, and other water concentrations without flooding or erosion
- ✓ Prevents gully formation
- ✓ Protects and improves water quality
- ✓ Provide wildlife habitat, corridor connections, and vegetative diversity

Clean Water Iowa

NRCS Wisconsin

With a life span of ten years, some waterways are maintained and improved each year. Existing grassed waterways within the watershed can be improved in order to handle larger storm events. The watershed-based plan will recognize the efforts being taken to maintain these grassed waterways, and implementation projects may include match funding for repairs.

Olson Ecological Solutions, LLC

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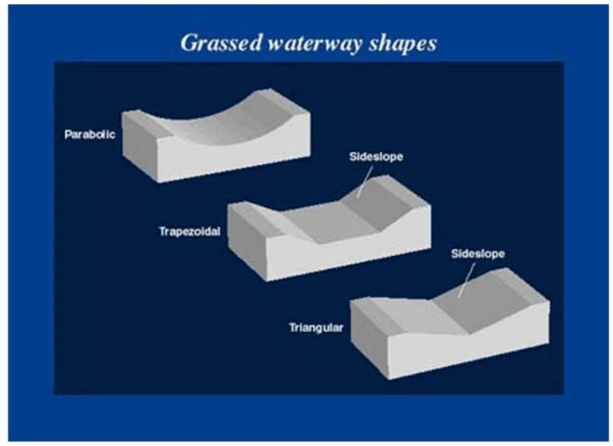
East Fork Creek Watershed:

Rural Best Management Practices

Grassed Waterways



University of Illinois Extension, This Land

When designing grassed waterways, one must consider slope, vegetative cover, soil conditions and erodibility, channel shape and maintenance (US EPA Agricultural Management Practices for Water Quality Protection). Generally farmers use one of three grassed waterway shapes: parabolic, trapezoidal, or triangular. Many favor the parabolic shape as it is the shape naturally taken in watercourses, an easier shape to visualize and build, and easiest shape to cross with farm equipment. However, small water flows are less likely to meander in parabolic waterways (University of Illinois Extension, *This Land*).

Important Resources for planning and designing:

NRCS National Handbook of Conservation Practices
NRCS Engineering Field Handbook

US EPA

When initially installing grassed waterways, it is important to allow for grassed vegetation to establish in order for it to withstand the water velocities it is designed to accommodate. To aid in this process, side diversions can be installed along the sides of the waterway to keep flow out of the channel. Once grass has established, these diversions should be removed. Alternatively, one may utilize rock/fabric checks or mulching.

Conservation Practice Standard: Grassed Waterway, **Code 412**

Olson Ecological Solutions, LLC

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East Fork Creek Watershed: Rural Best Management Practices

Ponds & Basins

Ponds and basins are constructed bodies of water created by either excavating an area for water storage or installing a dam across an existing water course (i.e. an existing gully or low-lying area). When installing these ponds and basins, one should ensure compliance with state laws and permits during planning, design, and layout phases.

NRCS USDA Ohio

When possible, a pond should be installed with 2 or more specified uses. These intended uses should impact the installation and storage requirement specifications. The stated uses below are not All compatible with each other. It is also recommended that the plan include vegetation to allow for pollution to be filtered out of the Water (NRCS Engineering Field Handbook).

Benefits and Uses:

- ✓ Captures runoff water
- ✓ Provides water for livestock or household use
- ✓ Offers irrigation storage
- ✓ Provides water source for pesticide spraying and/or fire protection
- ✓ Allows for recreational uses (fishing, boating, swimming, ice skating, etc.)
- ✓ Enhances wildlife habitat and/or aesthetic appearance

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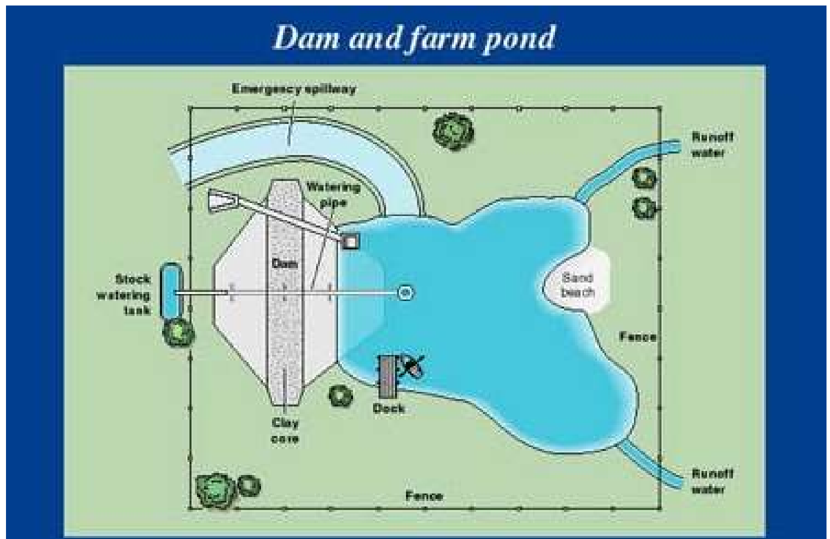
East Fork Creek Watershed:
Rural Best Management Practices
Ponds & Basins

Topography, hydrology, and water storage capacity play key roles in site selection for farm ponds and basins. One should locate a pond where the largest amount of storage capacity exists with the least amount of earthfill. Ideal topography utilizes existing low-lying areas. For instance, an area with a wide and gently sloping basin along with steep banks that come together at the dam site provides ideal water storage and a location for dam construction (thisland.Illinois.edu). Soils surrounding the pond must contain enough clay to ensure a watertight dam as well as to reduce the amount of water seepage through the bottom of the pond. Alternatively, a clay core in the dam center can assist in sealing the dam if there is not enough watertight soil. Installing a pre-fabricated pond liner could also help with minimizing seepage.



University of Illinois Extension, This Land

For more information on installing farms ponds and basins, please see the USDA NRCS Engineering Field Handbook.
Conservation Practice Standard: Pond, **Code 378**

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East Fork Creek Watershed: Rural Best Management Practices

Forest Stewardship

Problem: Current forested lands are choked out by invasive plant species. Invasive plants grow, reproduce, and spread very quickly and eventually choke out native vegetation as they outcompete native plants and fill in the seed bank. Invasive plants are plants from other countries that have been brought over and established in natural areas. Invasives are able to kill off native habitats by spreading aggressively because of the lack of established predators and diseases that normally regulate them in their origin countries. If these invasive species are left unmanaged they have the high potential of taking over natural areas by drowning out native plants, forming a monoculture, decreasing biodiversity, reducing habitat, and negatively affecting the natural ecosystem and its inhabitants. Invasive and weedy trees and shrubs create an overstory that blocks the sun and reduces the potential for native seed germination.

Northwest Illinois Forestry Association

Olson Ecological Solutions, LLC

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East Fork Creek Watershed:
Rural Best Management Practices
Forest Stewardship

Solution: By clearing invasive/weedy trees and shrubs, the canopy is opened for sunlight to reach the forest floor, which can then foster a healthy environment for establishment of native vegetation. More ground layer vegetation reduces and filters stormwater runoff and stabilizes the soil. Cutting woody stems (via chainsaw, brush cutters, or loppers) and herbicide treatment of stumps is an easy way to clear woody invasive plants and can be conducted at any time of the year. Larger tree clearing projects usually occur in the winter months as frozen grounds help to reduce soil disturbance.


Tall Bellflower, native woodland plant

Lake County Forest Preserves

For herbaceous plants, invasive plant management includes manual removal (i.e. hand weeding), mowing (annuals or biennials soon before going to seed), or foliar herbicide application during the growing season. Foliar application is used for aggressive, perennial invasive plants like purple loose-strife, reed canary grass, common and cut-leaved teasel. For more information visit: www.invasive.org/illinois/SpeciesofConcern.html

Conservation Practice Standard: Forest Stand Improvement, **Code 666**

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East Fork Creek Watershed:

Rural Best Management Practices

Dry Dams & Drop Boxes

As a BMP, grade stabilization structures are designed to decrease channel grade (i.e. steepness) or control gully erosion in constructed or natural waterways. Two types of grade stabilization structures in use or of interest to Lake Carroll are:

1. Dry dams
2. Drop boxes

Benefits of Grade Stabilization Structures:

- Stabilize grade
- Reduce erosion
- Improve water quality

Recommended Resource: NRCS electronic Field Office Technical Guide (eFOTG)>Illinois> Section IV>Conservation Practices

https://efotg.sc.egov.usda.gov/#/details

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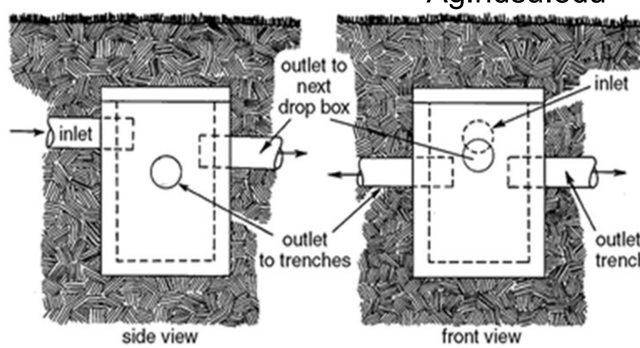
East Fork Creek Watershed:
Rural Best Management Practices
Dry Dams & Drop Boxes

A **drop box**, also known as a culvert inlet, is a rectangular box inlet drop spillway placed at the upstream end of a culvert. These box structures, usually made of reinforced concrete, can be placed where a road intersects an open field/slope and a waterway is causing erosion around the road or sloped area. The box structure collects water into a culvert that carries water under the road to the other side and releases it at grade. This structure allows the water to step down to the elevation of the culvert, which reduces erosion and decreases any potential cutting from the field. A drop box can be built as a part of a new culvert or added into existing culverts. However, if no headwall is present, one must be added. A drop box is advantageous in solving erosion issues in roadside ditches because of its weir length can fit in a narrow waterway. Drop boxes do require structurally sound culverts.

Ag.ndsu.edu



Dry dams are dam structures placed in areas that become inundated during rain events, particularly in ravine or other waterways that a steeply sloped. These dam structures go up and back down, thus allowing water to back up behind it. A culvert pipe should be installed to slowly let water pass through the dam. If the dam completely overflows then water will eventually flow over it. This structure is permanent, but only holds water when it rains. This structure can help to reduce water velocity and water force, thus decreasing erosion.

Conservation Practice Standard: Grade Stabilization Structure, **Code 410**

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East Fork Creek Watershed:
Rural Best Management Practices

Stabilize Highly Erodible Land

According to the Food Security Act of 1985, USDA program participants who farm fields that are designed as Highly Erodible Land (HEL) are required to control sheet and rill erosion and wind erosion, control all ephemeral gullies, and maintain wetlands. If farmers do not control this erosion, they can risk losing USDA farm program benefits and crop insurance eligibility. The Natural Resources Conservation Service (NRCS) randomly selects HEL fields to perform compliance reviews to verify that erosion is sufficiently controlled (USDA, Iowa NRCS. "Conservation Choices: Controlling Ephemeral Gullies." Oct 2018).Ephemeral gullies are eroded channels cutting into the soil that form in natural concentrated flow areas due to the erosive nature of flowing water. There are many different types of conservation practices (BMPs)that can aid in Reducing this type of erosion on HEL: Grassed Waterways, Terraces, Water and Sediment Control Basins (WASCOBs), Critical Area Planting, Cover Crops, and No-Till.

USDA, NRCS. Ephemeral gullies and rill erosion.

NRCS Ohio

This flier was developed by Olson Ecological Solutions, LLC. Funding for this project provided, in part, by the Illinois Environmental Protection Agency through Section 319 of the Clean Water Act.

East Fork Creek Watershed: Rural Best Management Practices

Stabilize Highly Erodible Land

When deciding on which conservation practice to enlist for stabilizing HEL and preventing ephemeral gullies, a primary factor to consider is the size and slope of the watershed. The steeper the slopes and the larger the watershed results in the need for a more efficient conservation practice.

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East Fork Creek Watershed: Rural Best Management Practices

Streambank Stabilization

Streambank stabilization, or streambank and shoreline protection, is the process of employing methods that protect and stabilize banks of streams, shorelines of lakes, reservoirs, or estuaries, and constructed water channels. These methods are employed on banks that are particularly susceptible to erosion and siltation.

A channel is considered stable if the bottom of the channel remains at a relatively consistent elevation over long periods of time. Methods of protecting and stabilizing banks include altering channel capacity, installing riprap lining (use of stones and rocks to amour banks against water's force), vegetating the banks and channel, and creating channel crossing for livestock.

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East Fork Creek Watershed: Rural Best Management Practices

Streambank Stabilization

In order to implement these streambank stabilization methods, it is important to identify the causes of streambank erosion and instability through shoreline site assessments. Potential causes of shoreline instability include watershed alterations (which can modify discharge and sediment amounts), in-channel modifications such as gravel mining, livestock access, water level fluctuations, and boat-generated waves.

Benefits:

- ✓ Reduces the negative effects of sedimentation, both on-site and downstream, resulting from bank erosion
- ✓ Prevents the loss of land or destruction of land uses or facilities near the waterway
- ✓ Helps to maintain the flow capacity of the waterway
- ✓ Improves stream corridor for fish and wildlife habitat and recreational uses
- ✓ Enhances aesthetics

Conservation Practice Standard: Streambank and Shoreline Protection, **Code 580**

NRCS USDA

NRCS Georgia

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East Fork Creek Watershed: Rural Best Management Practices

Filter Strips

A filter strip is an area or strip of permanent, herbaceous vegetation for removing organic matter, sediment, and other pollutants from wastewater and runoff before it enters water sources or water bodies. Filter strips are installed in environmentally sensitive areas that need protection from contaminated runoff.

Conservation Practice Standard: Filter Strips, **Code 393**

Benefits:

- ✓ Reduces suspended solids and other pollutants in runoff
- ✓ Reduces excessive sediment in waterways
- ✓ Decreases dissolved contaminant loadings in runoff


NRCS Georgia


NRCS USDA

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East Fork Creek Watershed: Rural Best Management Practices

Filter Strips

Design Considerations: Filter strips should be planted cross-slope or on the contour downhill from the source of contamination. They should be wide enough to accomplish intended purposes. According to the NRCS Conservation Practice Standard, filter strip width should be based on a 15 minute flow through time determined not to exceed a 30 minute flow through time.

Species Considerations: Plant species should be adapted to climate and soil of the planting site and have a moderate to aggressive establishment rate in order to inhabit the site quickly. Chosen plants should also be able to tolerate polluted runoff, sediment deposition, and herbicide runoff. Ideally, selected plant species could have stiff stems and a high stem density close to ground surface.

Operation/Maintenance Considerations: In order to maintain the filter strip's filtering capacity, filter strip vegetation should be harvested and removed at appropriate times. Harvesting and removing dead vegetation will improve vigor and density of vegetation, remove pollutants absorbed in plant tissue, and aid in maintaining upright growth habit. Periodically it may be necessary to regrade or reestablish filter strip vegetation when sedimentation jeopardize the filter strip's function.

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East Fork Creek Watershed: Rural Best Management Practices

Reduced Tillage

Tilling the soil with conventional plow-based systems leaves the soil vulnerable to erosion and intensifies agricultural runoff. Many farmers have been turning to more conservative tillage practices to reduce negative impacts. Reduced tillage as a BMP is the process of utilizing any tillage practices that are less intensive or aggressive than conventional tillage. For example, if a tillage process that requires less energy per unit area replaces a conventional tillage process, then the farmer has achieved reduced tillage. The term reduced tillage sometimes implies conservation tillage, but conservation tillage systems require farmers to cover 30 percent of the soil surface With residue after planting (EPA BMP Descriptions for STEPL and Region 5 Model 2018).

Photo credit: Jason Johnson, NRCS-Iowa. A no-till planter plants soybeans into a terminated cover crop

No till is already occurring throughout the entire East Fork Creek watershed on all farms when crops are rotated from beans to corn, corn to beans, or beans to beans. When rotating corn to corn, no till processes are difficult due to yield loss, rut formation, and periodic implementation of conventional tilling. It is recommended to perform continuous no till, since periodic tilling practices negates the benefits of no till.

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East Fork Creek Watershed:
Rural Best Management Practices
Reduced Till

Currently plans are being made to bring in some farmers who have seen success with no till practices. For instance, Cade Bushnell, a farmer in Ogle County, has preserved soil integrity and developed successful methods for consistent no till that have improved his overall farming operations and yields.

Conservation Practice Standard: Residue and Tillage Management, **Code 345**

Positives:

- ✓ Reduces soil erosion (in some cases by 70-100%)
- ✓ Reduces polluted runoff flow into water bodies
- ✓ Improves soil health and structure & reduces soil compaction
- ✓ Conserves water
- ✓ Decreases fuel by 50-80% and labor costs by 30-50%
- ✓ Sequesters carbon

Negatives:

- ✓ Transition from conventional to no till is difficult
- ✓ Requires pricey equipment (i.e. specialized no-till seeding equipment)
- ✓ Increases reliance on herbicide (alternatively farmers can use cover crop and crop rotation to aid in weed management)
- ✓ Causes unexpected shifts in weeds, disease, or pest prevalence
- ✓ Potentially slows germination and reduces yields

(Huggins, David & Reganold, John. “No-Till: The Quiet Revolution.” *Scientific American Inc*. 2008, pp. 70-77.)

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East Fork Creek Watershed
Lake Carroll Best Management Practices:

Permeable Pavement Parking Lot

Permeable pavement is pavement designs with various percolating layers that filter stormwater. They are especially important in filtering out the first flush pollutants, like car oil, gasoline, heavy metals, litter, suspended solids, and road salt, at the beginning of a storm event.

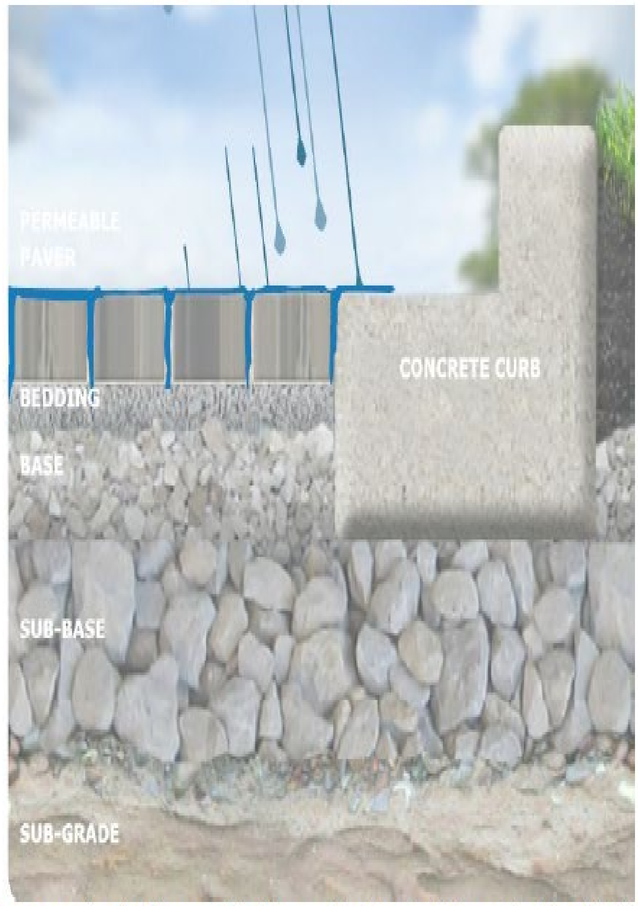

Figure 5.13. Example of a Permeable Paver Parking Lot Cross-Section (APT, 2011)
(MWRD, 2015)

Benefits:

- ✓ decreased surface runoff
- ✓ reduced runoff velocity
- ✓ improved water quality
- ✓ groundwater recharge through more direct infiltration

Applicable locations for implementation: The installation of permeable pavement is recommended for the marina parking lots and new driveways, access roads, sidewalks, and other low traffic impervious surfaces.

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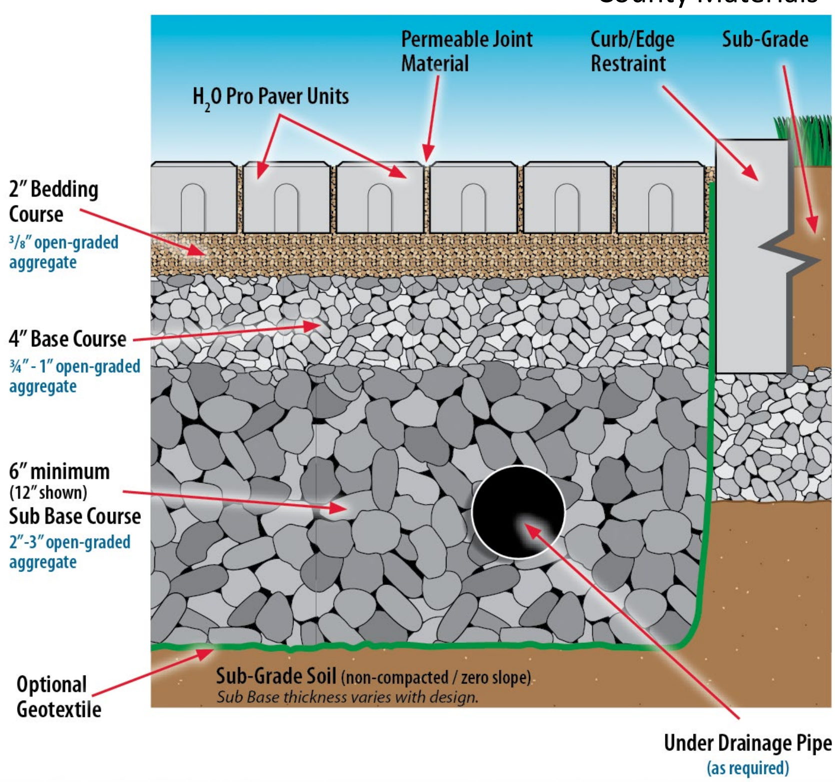
East Fork Creek Watershed
Lake Carroll Best Management Practices

Permeable Pavement Parking Lot

Morton Arboretum, Lisle. Permeable pavers

A recent National Water Quality Inventory reported that runoff from urban areas is the primary source of water quality impairments to tested estuaries and the third-largest source of impairments to surveyed lakes (EPA, *Protecting Water Quality from Urban Runoff*).

County Materials



Permeable pavements infiltrate, filter, and/or store precipit ation where it falls. These pavements are usually installed using permeable interlocking pavers. This best management practice could be cost effective where property values are high and flooding or icing is an issue (EPA, What is Green Infrastructure?).

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East Fork Creek Watershed
Lake Carroll Best Management Practices:

Vegetated Swales

Vegetated swales are shallow channels or swales vegetated with deep rooted plants, which filter out pollutants and slow stormwater. Similar to filter strips, vegetated swales intercept stormwater runoff from nearby impervious areas. Their primary function is to filter pollutants and sediment from stormwater runoff.

Benefits:

- ✓ Collect stormwater sediment
- ✓ Filter pollutants
- ✓ Slow stormwater runoff

Permeable paving drains into a vegetated swale at Elmhurst College (Jaffe, M., et al 2010)

Agrecol Native Nursery Swale Mix

Vegetated swales can be applied in most development situations with few restrictions. They are well-suited to treat highway or residential road stormwater runoff due to their linear nature.

Applicable locations: at the end of drains or buildings, adjacent to impervious surfaces such as parking lots and roads

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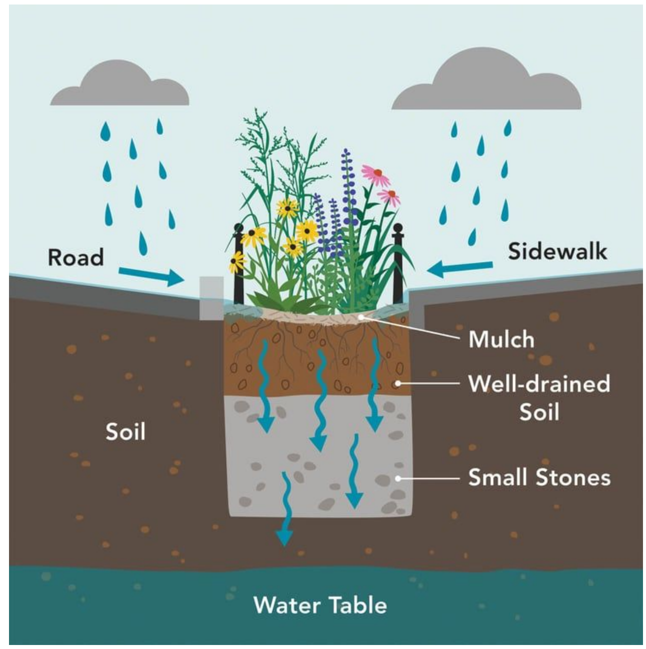
East Fork Creek Watershed
Lake Carroll Best Management Practices:

Vegetated Swales

Vegetated swales must be sized to allow sufficient contact time with the swales, such as shallow water depths and low velocities, in order for adequate pollutant removal to occur. In designing these swales, they also must consider drainage area, soils, and the volume control storage. Swales utilize drainage pipes, well-drained soils, and gravel underneath vegetation to aid in water infiltration.



Connecticut Fund for the Environment

City of Columbus, columbus.gov

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East Fork Creek Watershed

Lake Carroll Best Management Practices:

Vegetated Filter Strips

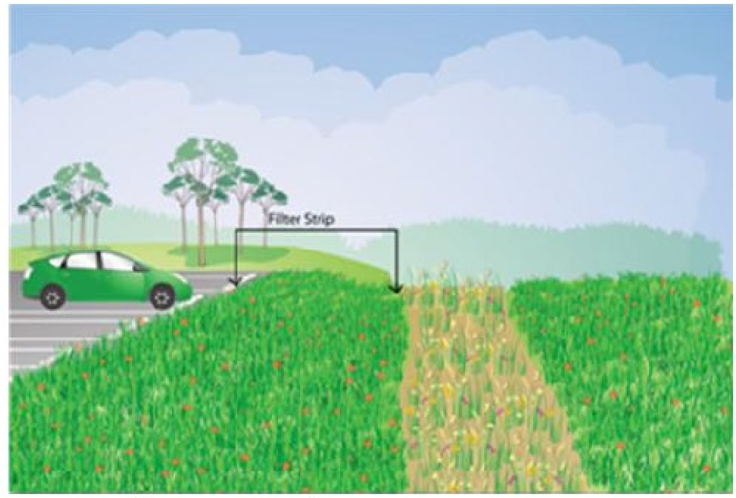

Figure 5.19. Illustration of a Filter Strip (MWRD, 2015)

Filter strips are vegetated sections of land located between impervious surfaces or agricultural fields and the waters to which they drain. When installed next to impervious surfaces, vegetated filter strips slow runoff, enable stormwater to pass through deep-rooted vegetation, and filter out pollutants before emptying into swales or other bodies of water. Filter strips may provide some reduction in stormwater runoff volume, but their primary function is to filter out contaminants in stormwater runoff.

The EPA has estimated the following load reductions in nitrogen (N), phosphorous (P), biochemical oxygen demand (BOD), and sediment in water sources when vegetated filter strips are in use.

BMP & Efficiency	N	P	BOD	Sediment
Vegetated Filter Strips	**40%**	**45%**	**51%**	**73%**

(EPA Region 5 Model for Estimating Load Reductions, 2018)

Nitrogen and phosphorous naturally occur as nutrients in aquatic systems; however, human activities have greatly increased the amounts that occur. Too much of these nutrients cause significant jumps in algae growth, which negatively impacts water quality, reduces or eliminates oxygen within the water, harms food resources, degrades aquatic habitats, and can eventually cause algal blooms. Some algal blooms produce toxins and promote bacteria growth, which can harm humans who come in contact with the water (EPA, “Nutrient Pollution: The Problem”).

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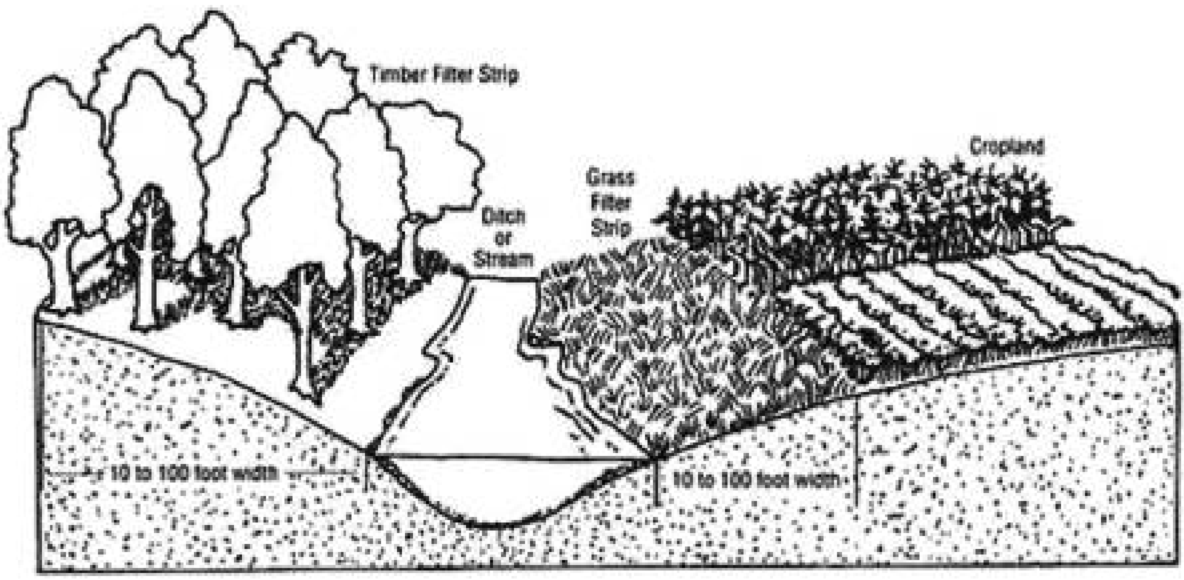
East Fork Creek Watershed
Lake Carroll Best Management
Practices:

Vegetated Filter Strips

Vegetated filter strips include various types of vegetation, including timber filter strips, grassway filter strips, or native plant filter strips.



(NRCS USDA)

It is suggested that the Lake Carroll Association continue to plant native vegetation around lake shores and inlets in order to filter incoming pollutants. The more land near water that is covered with native plant vegetation, the more likely it is for pollutants (i.e. organic matter, sediments, heavy metals, bacteria, trash, gasoline, chemicals, etc.) to be filtered out of water runoff before it hits fresh surface water. It is recommended for each strip of native vegetation to be as wide as the space will allow, with a 15-foot minimum (OES, 2014).

Applicable Locations: downslope of any area that produces large amounts of stormwater runoff

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East Fork Creek Watershed
Lake Carroll Best Management Practices:

Riparian Buffer Restoration

Riparian Buffer Restoration is the process of creating a small plant habitat situated above the banks of lakes, streams, or ponds by installing hydrophilic plants, which grow in or near water and can tolerate various levels of saturation.

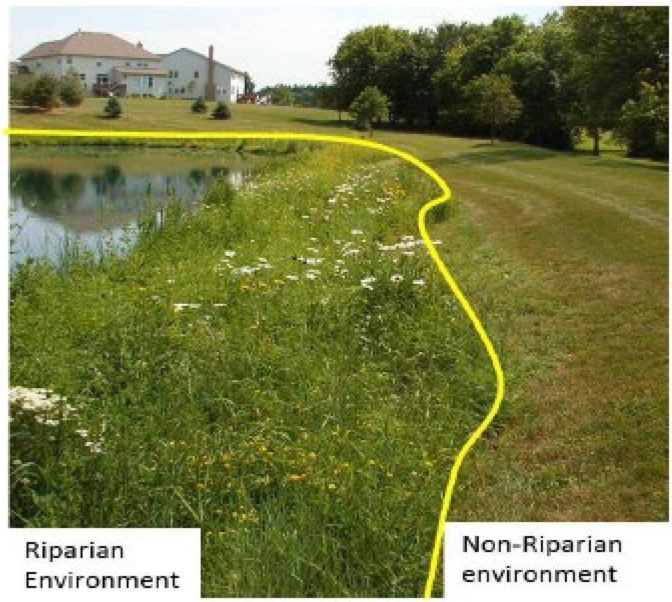

Figure 6.13. Examples of Riparian and Non-riparian Environments

Benefits:

- ✓ Reduces flood flow rates, velocities, and volumes
- ✓ Minimizes erosion and promotes bank stability of streams, lakes, ponds, or wetland shorelines
- ✓ Helps to control sediment from upland areas by filtering and assimilating nutrients discharged from surrounding uplands
- ✓ Enhances wildlife habitat
- ✓ Overhanging vegetation within buffer helps to cool stream flow
- ✓ Provides nutrient uptake that may reduce algal blooms and subsequent depressed levels of dissolved oxygen in-stream.
- ✓ Enhances natural aesthetics of water bodies

(MWRD, 2015)

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East Fork Creek Watershed
Lake Carroll Best Management Practices:

Riparian Buffer Restoration

Native plant buffers (riparian buffers) should be at least 10 feet of dense native plants grown along the water's edge to allow pollutants to filter out and the banks to stabilize (Lake County Stormwater Management Commission, 2018).

Riparian buffer restoration above rip rap shoreline protection would detract geese and filter pollutants from stormwater running from lawns, parking lots, and other land uses next to the shoreline. Steep terrain leading to the lake heightens the need for riparian buffers because these buffers help to stabilize the land just next to the lake and provide erosion control.

Applicable locations: There are opportunities to install riparian buffers above the rip rap that envelops the shorelines at Lake Carroll.

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East Fork Creek Watershed

Lake Carroll Best Management Practices:

Native Plantings

Plants native to the region provide benefits to water quality, streambank stabilization, erosion control, animal and insect habitat, and aesthetic appeal. Many native plants have much deeper roots than cultivated or invasive plants.

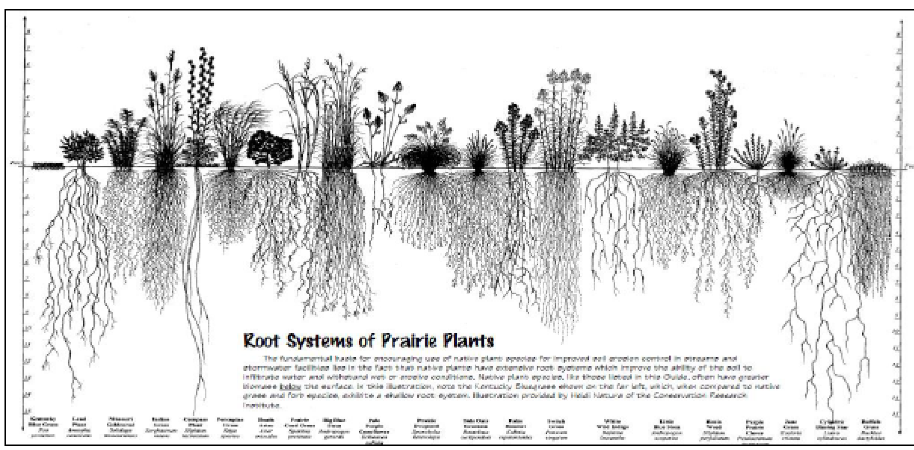

Figure 5.16. Root Systems of Grass and Prairie Plants (Source: Heidi Natura, CRI, 1995).
(MWRD, 2015)

Deep-rooted plants can trap suspended sediment and incorporate excessive nutrients into their biomass as polluted water flows through the vegetation. Deep roots also stabilize water shorelines, decrease erosion, and prevent sediment from entering water bodies. Sediment is considered a pollutant to water quality because it alters the volume capacity that a lake or steam can hold, thus eliminating potential habitat, and fluctuates water temperatures, which negatively impacts aquatic life and water quality. By increasing natural areas planted with native plants, Lake Carroll also increases habitat for birds, mammals, butterflies, and amphibians.

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East Fork Creek Watershed
Lake Carroll Best Management Practices:

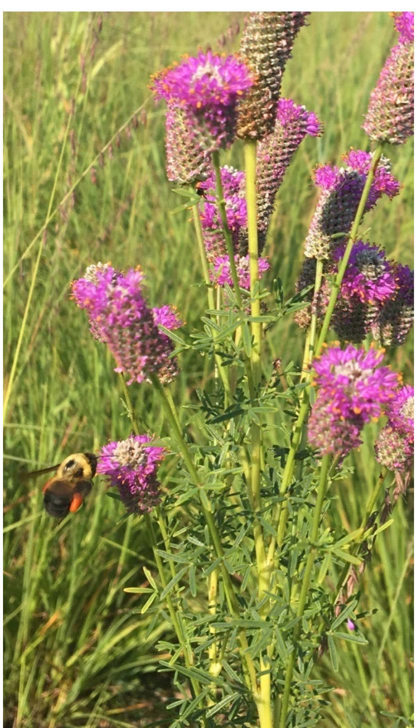
Native Plantings

In 2015 the Metropolitan Water Reclamation District compared the runoff coefficient between impervious surfaces (ie. asphalt parking lots, concrete sidewalks, etc.) to other permeable surfaces like native plantings and porous pavement. The runoff coefficient (C) relates the amount of runoff to the amount of precipitation. A larger value in C means lower infiltration rates and higher runoff. They found that while impervious surfaces have a runoff coefficient of .90, areas planted with native plants has a much lower C of .15.

Table 5-2. Runoff Coefficients (C Values) for the Rational Method

Surface Type	Runoff Coefficient, C
Impervious area (Roads, roofs, sidewalks, etc.)	0.90
Pervious Area	0.45
Gravel (loose, unbound)	0.75
Water Surface (open water)	1.00
Native Plantings	0.15
Wetlands	0.79
Synthetic Turf Fields	0.75
Green Infrastructure:	
Pervious Surfaces (Porous Asphalt, Pervious Concrete, Permeable Pavers)	0.75
Bioswale	0.10
Rain Garden	0.10
Green Roof	(Refer to Table 5-9)

(MWRD, 2015)



Native plants can be utilized in many of the recommended best management practices for Lake Carroll, including vegetated swales, vegetated filter strips, riparian buffer restoration, and floating islands. Native plantings help the East Fork Creek watershed plan goals no matter where they are planted, but they are most beneficial when planted within the path of stormwater.

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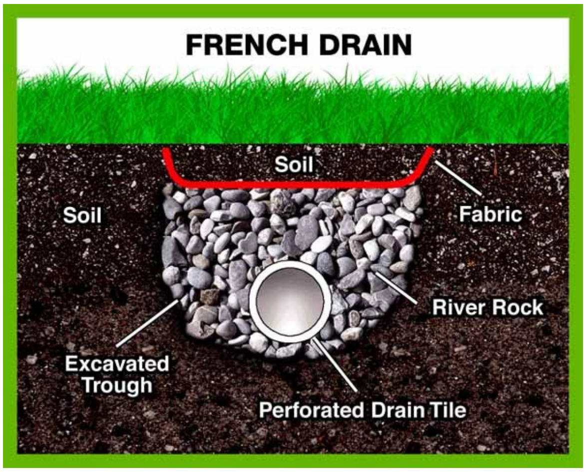
East Fork Creek Watershed
Lake Carroll Best Management Practices:

Bury Downspouts & Install French Drains

Professional Gutter & Drain



A French drain is a perforated drainage pipe buried within a gravel-filled trench that collects and redirects Stormwater away from a structure or area. French drains disperse stormwater and prevent flooding. The perforated pipes allow for stormwater to leech into the groundwater as is flows through the pipe to allow for gradual infiltration and reduce potential for flooding and erosion. Homeowners could either bury downspouts and run stormwater into French drains themselves or hire a landscape contractor to do so.

Benefits:

- ✓ Eliminates standing water in low-lying areas of yards
- ✓Absorbs excessive amounts of water into soil
- ✓Reduces erosion
- ✓Reduces flooding near foundation of homes

Photo Credit: Carroll's Building Materials

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East Fork Creek Watershed
Lake Carroll Best Management Practices:

Bury Downspouts & Install French Drains

There are limitations to the French drain and various factors to take into consideration that could effect the efficiency of the French drain. It is important to examine certain yard characteristics, including soil type, slope, proximity to your home, and tree root interference to the drains. Existing conditions of the yard's landscape and grading can effect the French drain's performance. If the downspout system is being connected to the French drain system, it is important that the connection is made at least 10-15 feet away from the foundation of the home to ensure that basement and crawlspace flooding does not occur (Professional Gutter & Drain Ltd.)

Fairfax Contracter

KG Landscape

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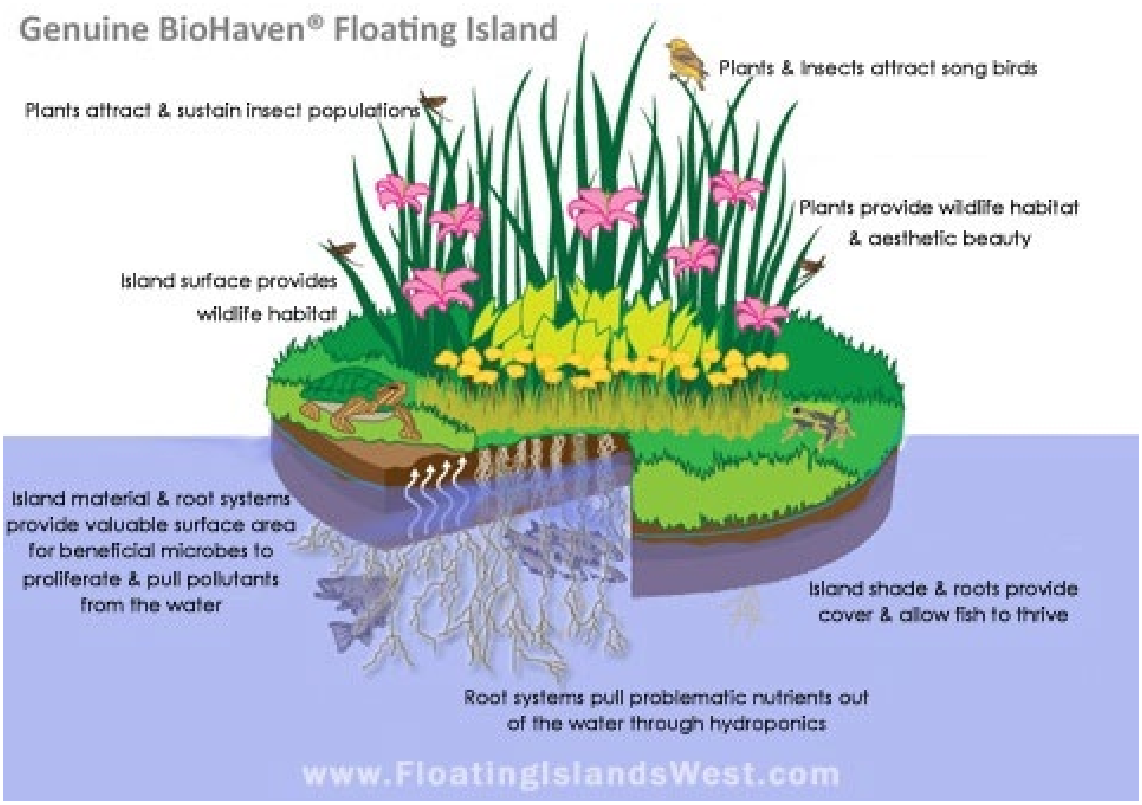
East Fork Creek Watershed
Lake Carroll Best Management Practices:

Floating Islands

Many best management practices for water quality focus on preventing pollutants from entering local fresh water sources, i.e. preventative measures. There is a best management practice that focuses on filtering out pollutants that still entered the targeted bodies of water. Floating wetlands, or islands, can further reduce pollutants in the lake as a long-term solution: 82% reduction in total phosphorous, 70% reduction in total nitrogen, and 45% reduction in BOD (biological oxygen demand).



Floating Treatment wetlands are manmade floating wetlands that when installed mimic naturally occurring wetlands in a concentrated capacity. 250 square feet of island translates to the equivalent filtering capacity of 1 acre of wetland. Natural wetlands are nature's water filters. Wetlands remove nitrates, filter excessive nutrients and sediment, recharge groundwater, and aid in erosion and flood control (Floating Islands West).

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East Fork Creek Watershed
Lake Carroll Best Management Practices:

Floating Islands

Floating islands have seen successful implementation in various waterways with a diverse wealth of benefits: habitat enhancement, wetland and lake restoration, water quality improvement, stormwater treatment, and recreational use. BioHaven floating islands use marine-grade, non-toxic materials. These islands have also been shown to remove heavy metals, nutrients and other pollutants at removal rates of 63%-98%.

Floating islands in Levings Lake, Rockford, IL

Floating islands allow filtering plants and good bacteria to float on the water in a constructed island, introducing a filtration capability where there wasn't an opportunity before. Floating islands are recommended in addition to preventative measures in areas where pollutant reduction goals cannot be met using preventative measures alone, or where other benefits such as fish habitat are desired.

Applicable locations for installation: The Association could put floating Islands in strategic coves and areas of the lake.

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Example Planting List #1

Suggested Area: wet-medium wet rain gardens, bioswales, or parking lot plantings

Scientific Name	Common Name	Max Height	Bloom Time	Bloom Color	Sun/Shade	Wet Tolerance	Salt Tolerance
Aclepias incarnata	Swamp Milkweed	4 ft	Jun-Aug	Pink	Full, Partial	Wet, Medium-Wet	Mod
Acorus calamus	Sweet Flag	2 ft	May-Jul	Green	Full	Wet, Medium-Wet	Low-Mod
Boltonia asteroides	False Aster	4 ft	Aug-Oct	White	Full, Partial	Wet, Medium-Wet, Medium	Mod
Calamagrostis canadensis	Blue Joint Grass	4 ft	Jun-Aug	Pink-Green	Full, Partial	Wet, Medium-Wet, Medium	
Carex hystericina	Porcupine Sedge	3 ft	Jun	Green	Full	Wet, Medium-Wet	Mod
Carex lacustris	Common Lake Sedge	3 ft	May-Jul	Green	Full, Partial, Shade	Wet, Medium-Wet	Mod
Carex stipata	Common Fox Sedge	3 ft	Jun	Green Orange	Full, Partial, Sahde	Wet, Medium-Wet	Low-Mod
Carex vulpinoidea	Brown Fox Sedge	3 ft	Jun-Jul	Green, Orange	Full, Partial	Wet, Med-Wet, Med, Med-Dry	Low-Mod
Helenium autumnale	Sneezeweed	4 ft	Aug-Oct	Yellow	Full, Partial	Wet, Medium-Wet	
Mimulus ringens	Monkey Flower	2 ft	Jun-Sept	Purple	Full, Partial	Wet, Medium-Wet	
Penthorum sedoides	Ditch Stonecrop	2 ft	Jun-Sept	Green, Red	Full, Partial	Wet, Medium-Wet	
Pycnanthemum virginianum	Mountain Mint	4 ft	Jul-Sept	White	Full, Partial	Wet, Medium	
Sagittaria latifolia	Common Arrowhead	3 ft	Jul-Sept	White	Full, Partial	Wet	

Example Planting List #2

Suggested Area: wet rain gardens, bioswales, or parking lot plantings

Scientific Name	Common Name	Max Height	Bloom Time	Bloom Color	Sun	Wet Tolerance
Acorus calamus	Sweet Flag	2 ft	May-Jul	Green	Full	Wet, Medium-Wet
Carex lacustris	Common Lake Sedge	3 ft	May-Jul	Green	Full, Partial, Shade	Wet, Medium-Wet
Iris virginica var. shrevei	Blue Flag Iris	3 ft	May-Jul	Purple	Full, Partial	Wet, Medium-Wet, Medium
Lobelia cardinalis	Cardinal Flower	4 ft	Jul-Sept	Red	Full, Partial	Wet, Medium-Wet
Lobelia siphilitica	Great Blue Lobelia	3 ft	Jul-Oct	Blue	Full, Partial	Wet, Medium-Wet, Medium
Mimulus ringens	Monkey Flower	2 ft	Jun-Sept	Purple	Full, Partial	Wet, Medium-Wet
Penthorum sedoides	Ditch Stonecrop	2 ft	Jun-Sept	Green, Red	Full, Partial	Wet, Medium-Wet
Pontederia cordata	Pickerel Weed	4 ft	Jun-Oct	Purple	Full	Wet
Sagittaria latifolia	Common Arrowhead	3 ft	Jul-Sept	White	Full, Partial	Wet

Example Planting #3

Suggested Area: any rain garden, bioswales, or parking lot plantings that require salt tolerance

Approved Substitutions List

Latin Name	Common Name	Growing Condition 1	Growing Condition 2	Growing Condition 3	Grass/Forb
Alisma subcordatum	Mud Plantain			3	Forb
Amorpha canescens	Lead Plant	1			Forb
Andropogon scoparius	Little Bluestem	1			Grass
Aquilegia canadensis	Wild Columbine	1			Forb
Asclepias incarnata	Swamp Milkweed		2	3	Forb
Asclepias tuberosa	Butterfly Weed	1			Forb
Aster ericoides	Heath Aster	1			Forb
Aster laevis	Smooth Blue Aster	1	2		Forb
Aster simplex	Panicled Aster				Forb
Bouteloua curtipendula	Side-oats Grama	1			Grass
Carex stipata	Common Fox Sedge		2	3	Grass
Carex vulpinoidea	Brown Fox Sedge	1	2	3	Grass
Coreopsis lanceolata	Sand Coreopsis	1			Forb
Echinacea purpurea	Purple Coneflower	1	2		Forb
Eleocharis palustris	Great Spike Rush			3	Grass
Eupatorium perfoliatum	Boneset		2	3	Forb
Helenium autumnale	Sneezeweed		2	3	Forb
Juncus canadensis	Canada Rush	1	2		Grass
Juncus torreyi	Torrey's Rush		2		Grass
Lobelia siphilitica	Great Blue Lobelia			3	Forb
Panicum virgatum	Switch Grass	1	2		Grass
Petalostemum purpureum	Purple Prairie Clover	1			Forb
Physostegia virginiana	Obedient Plant	1	2		Forb
Polygonum pensylvanicum**	Pinkweed		2	3	Forb
Rudbeckia hirta*	Black-eyed Susan	1			Forb
Sagittaria latifolia	Common Arrowhead			3	Forb
Scirpus cyperinus	Wool Grass		2	3	Grass
Scirpus pungens	Chairmaker's Rush			3	Grass
Solidago rigida	Stiff Goldenrod	1	2		Forb
Teucrium canadense	Germander	1	2		Forb
Verbena hastata	Blue Vervain		2		Forb
Zizia aurea	Golden Alexanders	1	2		Forb

Notes:

*Biennial species

**Annual species

Species with most confidence of salt tolerance.

Species with moderate confidence of salt tolerance.

Species with low to moderate confidence of salt tolerance.

Species with less confidence of salt tolerance.

Growing Conditions:

1: Species that tend to grow in drier environments, mainly for the slopes and upper reaches of the swales.

2: Species that prefer wetter conditions, and will mostly be planted in trench of the swale that will tend to be wetter.

3: Species for areas that have standing water most or all of the time.

Section 2, Chapter 4
Implementation of Watershed-Wide Practices

Written by Rebecca Olson and Alyssa Robinson

Introduction

Chapter 3 provided the foundation for education and outreach to stakeholders of the watershed that have the power to make positive landscape and cultural changes to the watershed. This chapter details the steps needed to implement the watershed-wide projects and practices recommended in Chapter 2. The next chapter will detail site-specific projects. Support resources for financial and technical needs to implementing these projects and practices is found in Chapter 6.

In order to implement watershed-wide projects and practices in a planned manner, we need to understand the benefits in terms of pollution load reduction estimates and the costs from various perspectives such as total cost and cost effectiveness. With this information, we have planned a general schedule over the next ten years and have predicted improvement to be experienced along the way.

The following pages prioritize watershed-wide best management practices geographically; estimate how much sediment, phosphorus, and nitrogen would be removed from the water utilizing each of the proposed watershed-wide best management practices; and then estimate the cost of implementing each practice. The costs are analyzed per pound of nutrient or ton of sediment to determine how cost effective each practice would be to implement. Determining both the most effective and most cost-effective methods of keeping pollutants out of the water can give us needed direction. Due to the large amount of information regarding watershed-wide and site-specific projects, the two are presented separately, in this chapter and the next.

Priority Areas for Watershed-Wide Projects and Practices

In order to prioritize areas to implement watershed-wide practices recommended in Chapter 2, we considered the origin of nonpoint source pollution, estimated pollutant loading from each subwatershed, and environmentally sensitive lands. For maximum effect, priority locations for best management practices should be placed as close to the origin of nonpoint source pollution as possible, such as management practices within crop fields and lawns and projects adjacent to impervious surfaces, lawns, and crop fields. Once those areas have been explored, we recognize the best opportunity for improvement to move down the watershed, working within and next to greenways, steep ravines, streams, and wetlands. Keeping this pattern in mind, a given project may be more effective if it is placed in a prioritized subwatershed, in an environmentally sensitive area, or both.

The East Fork Creek Watershed can be broken down into subwatersheds. Figures 38-45 in Section 1 (East Fork Creek Watershed Inventory) depict these subwatershed boundaries as well as nitrogen, phosphorous, sediment, and pathogen loading within each subwatershed. These figures depict annual pollutant load per acre within each watershed and total annual pollutant load within each subwatershed. Because all the subwatersheds vary in size, priority was given to the areas with higher pollutant loads by acreage as opposed to looking at the total pollutant load. Recommended best management practices and projects that can be implemented within the subwatersheds that have higher pollutant loads per acre are the areas of highest priority. Subwatersheds A, B, C, and D consist primarily of agricultural land. Subwatersheds E, F, and G house mostly residential property. Since different types of best management practices are recommended for agricultural and residential land use, our prioritization of practices based on geographical location differs between the two land uses.

Subwatershed H is comprised mostly of forests, open spaces, and wetlands with a small amount of both residential and agricultural land uses. Compared to the other subwatersheds, it consistently has pollutant loads by acreage on the lower end of the spectrum.

This plan has identified sediment as the first priority pollutant, phosphorous as a second, and nitrogen as a third. Looking at the residential subwatersheds, E and F are predicted to contribute more sediment, phosphorus, and nitrogen per acre than subwatershed G. Therefore, the greatest opportunity for implementation of projects in residential areas are within subwatersheds E and F. Considering agricultural subwatersheds, sediment runoff per acre is equally led by subwatersheds A, B, and C followed by D while nutrient runoff of phosphorus and nitrogen is most concentrated in subwatershed C, followed equally by A, B, and D. Within the agricultural portions of the watershed, areas of greatest potential vary if focusing on sediment or nutrients. For practices aimed at reducing sediment loads to the stream, subwatersheds A, B, and C equally offer the greatest opportunity. For practices focused on phosphorus and nitrogen reduction, a practice within subwatershed C may be more effective than a similar project elsewhere. *Table 4.1* portrays a visual of which watershed has the great reduction potential per pollutant load.

Table 4.1 Prioritized Subwatersheds

Subwatershed	Primary Land Use	#1 Priority -Sediment Reduction Potential	#2 Priority -Phosphorous Reduction Potential	#3 Priority Nitrogen Reduction Potential
A	Agricultural	★		
B	Agricultural	★		
C	Agricultural	★	★	★
D	Agricultural			
E	Residential	★	★	★
F	Residential	★	★	★
G	Residential			
H	Natural Areas			

Agricultural ★ Greatest Reduction Potential

Residential Natural Areas

Beyond the prioritized subwatersheds, other areas with the greatest opportunity for pollutant reduction are those that are most sensitive to water quality impairments. These sensitive areas include land near open water and wetlands, areas in flood zones, areas with high runoff potential, areas with hydric soils, areas with frequent flooding, and areas with highly erodible land. *Figure 4.1* depicts these various parameters that are more likely to be sensitive to water quality impairments. The NWI, or National Wetland Inventory, layer depicts the abundance of wetlands. The Hydrologic Groups D, B/D, and C/D depict soils with the highest runoff potential. Hydrologic soil groups are the classifications that the National Resource Conservation Service (NRCS) have given soils based on the soil's runoff potential. There are four hydrologic soils groups: A, B, C, and D. Hydrologic Soil Group A has the smallest runoff potential, while Hydrologic Soil Group D has the greatest soil runoff potential. Dual Hydrologic soil groups are designated for soils that were originally classified in group D but have been adequately drained to the point where they are classified into a different hydrologic soil group. Hydrologic soil groups B/D and C/D represent areas that after adequate drainage have moved from a hydrologic soil group D condition into either a hydrologic soil group C or B condition. Soils are drained mostly likely for agricultural and developmental purposes. We consider these areas to be sensitive because these particular hydrologic soil groups depict areas with potential for minimizing flashy hydrology by treating the increased flow via drain tiles. The next parameter included in *Figure 4.1* is hydric soils. Hydric soils are soils that developed under historic wetland conditions, even in areas that are not currently functioning as wetland (e.g. drained wetlands). Similarly, areas with frequent flooding and the FEMA (Federal Emergency Management Agency) flood hazard zones are also included on the Priority Areas Map. Because areas of frequent flooding, flood hazard zones, and areas with hydric soils are more likely to have ponding or flooding and are usually in close proximity to wetlands and open water, they can be more sensitive to water pollution. One final parameter included in the Priority Area Map is HEL, which stands for highly erodible land. For land to be categorized as highly erodible land, factors like wind erosion and water erosion are considered to determine the land's erodibility potential. HEL is more sensitive to erosion and runoff. These priority areas that are more sensitive to erosion and water quality impairments pose the great opportunity for implementation of best management practices and projects. Stakeholders can make the greatest impact in reducing water quality impairments by implementing recommended best management practices and projects at locations where these sensitive priority areas and prioritized subwatersheds overlap.

Areas for Watershed-Wide Stabilization Projects

In order to stabilize highly erodible land, ravines, and streambanks, we located the areas appropriate for projects throughout the watershed. *Figure 4.2* maps forested, highly erodible land (HEL) with land covers categorized as forested and residential within the Lake Carroll Association. *Figure 4.3* illustrates HEL categorized as forested land cover throughout the watershed. *Figure 4.4* provides a breakdown of stream and ravine classification based on topographic maps and aerial photography.

Figure 4.1

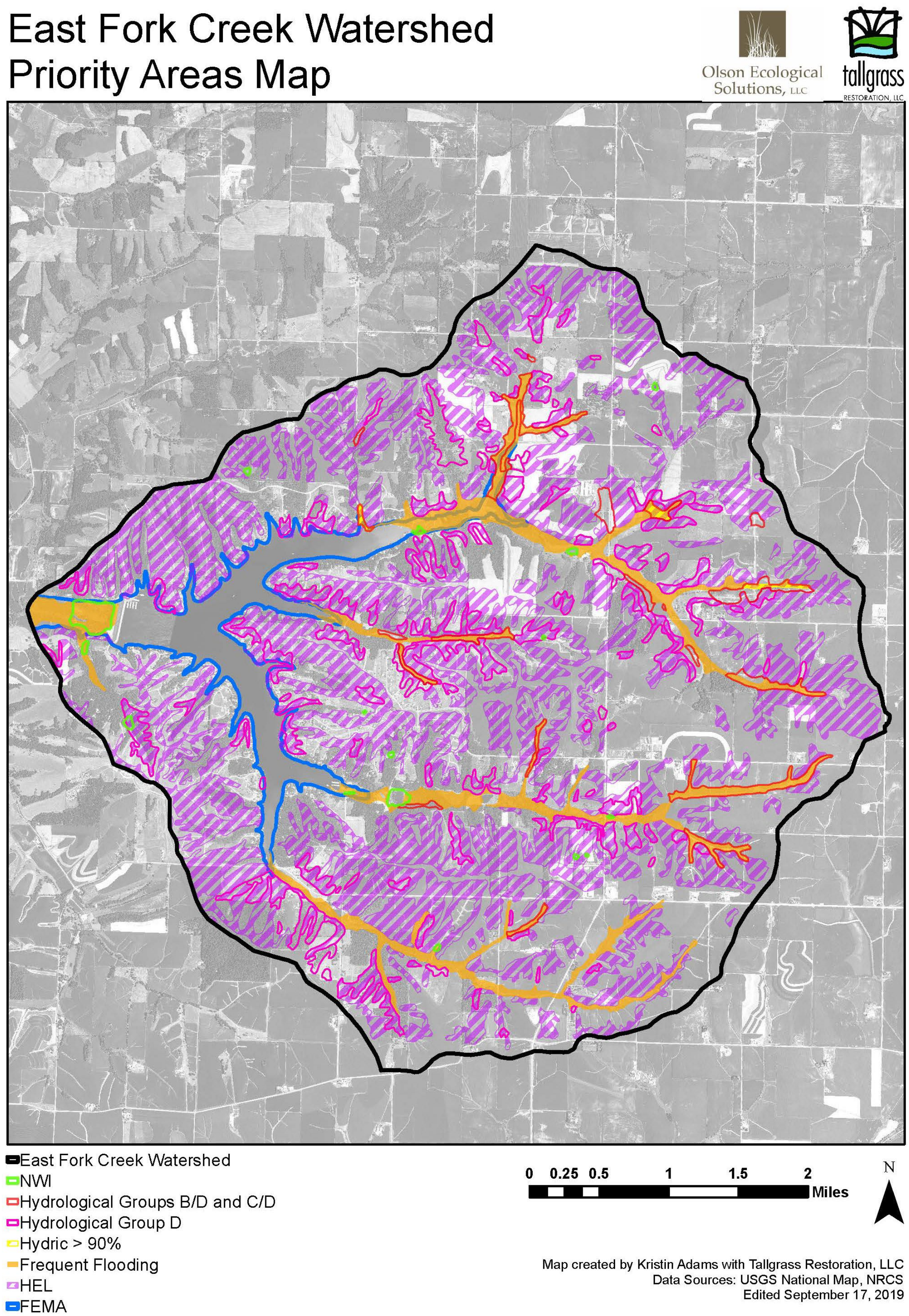

East Fork Creek Watershed
Priority Areas Map
Olson Ecological Solutions, LLC
tallgrass RESTORATION, LLC
East Fork Creek Watershed
NWI
Hydrological Groups B/D and C/D
Hydrological Group D
Hydric > 90%
Frequent Flooding
HEL
FEMA
0 0.25 0.5 1 1.5 2
Miles
N
Map created by Kristin Adams with Tallgrass Restoration, LLC
Data Sources: USGS National Map, NRCS
Edited September 17, 2019

Figure 4.2

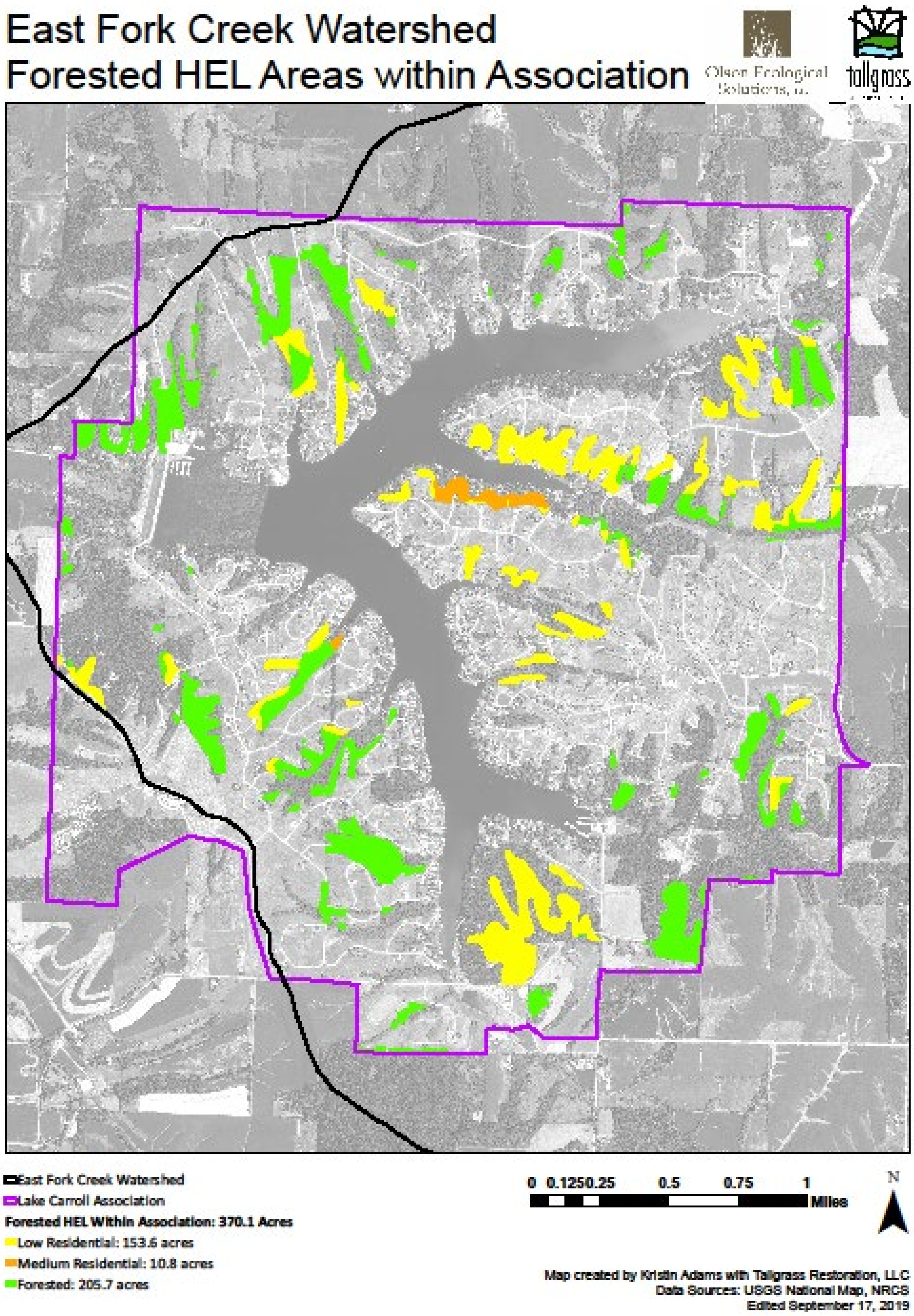

East Fork Creek Watershed
Forested HEL Areas within Association
Olsen Ecological Solutions, LLC
tallgrass
East Fork Creek Watershed
Lake Carroll Association
Forested HEL Within Association: 370.1 Acres
Low Residential: 153.6 acres
Medium Residential: 10.8 acres
Forested: 205.7 acres
0 0.125 0.25 0.5 0.75 1
Miles
N
Map created by Kristin Adams with Tallgrass Restoration, LLC
Data Sources: USGS National Map, NRCS
Edited September 17, 2019

Figure 4.3

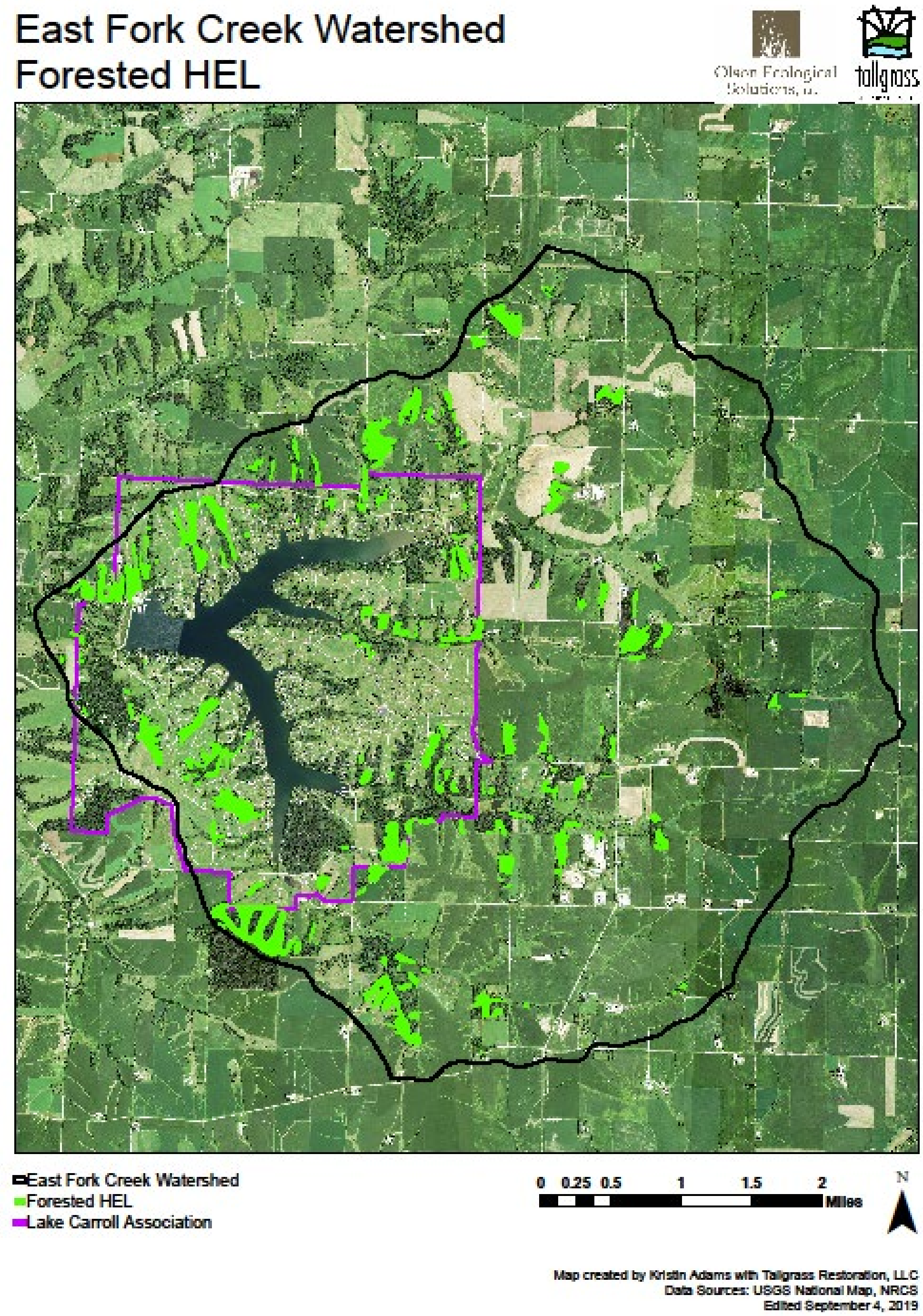
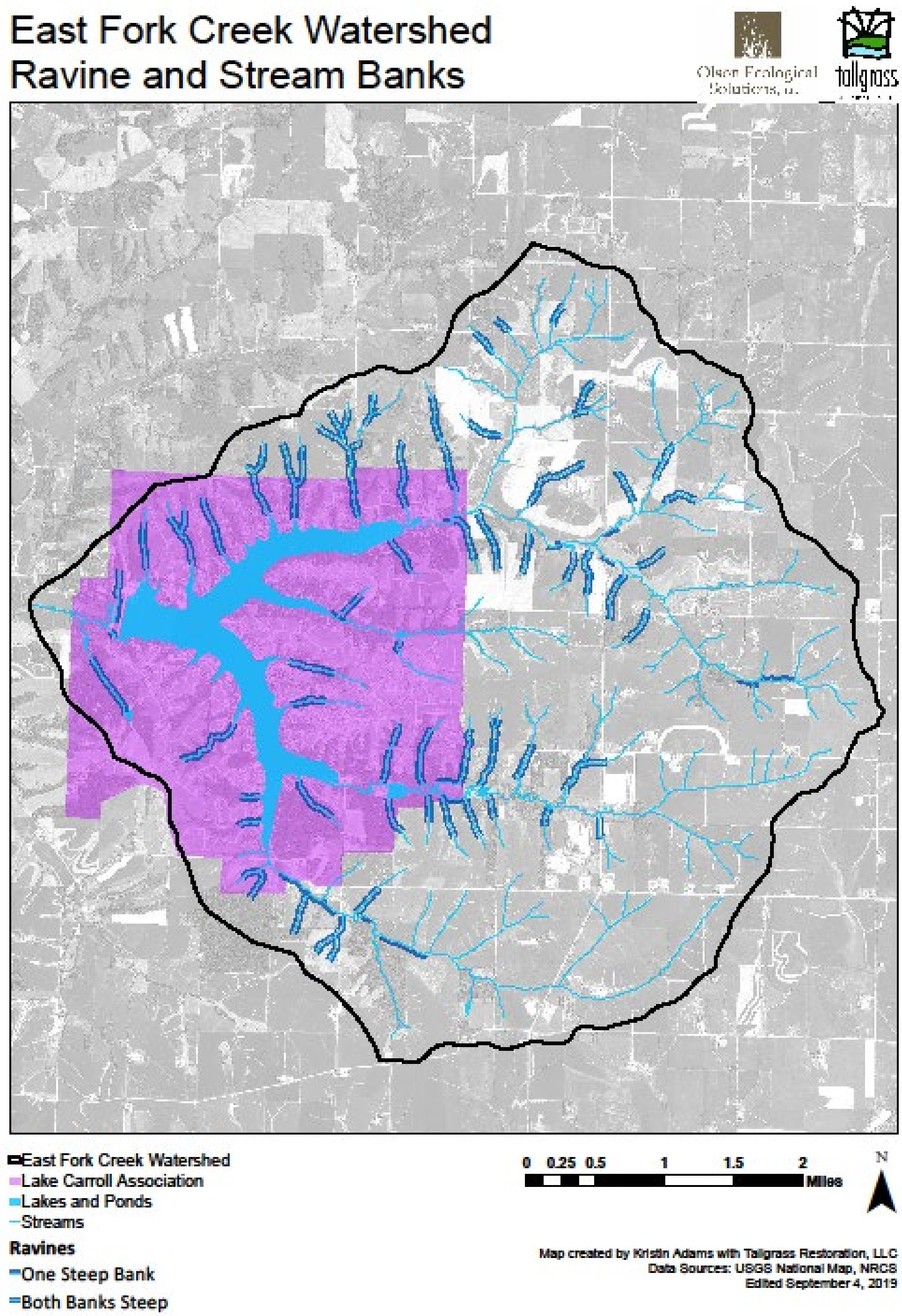

East Fork Creek Watershed
Forested HEL
Olson Ecological Solutions, LLC
tallgrass
East Fork Creek Watershed
Forested HEL
Lake Carroll Association
0 0.25 0.5 1 1.5 2
Miles
N
Map created by Kristin Adams with Tallgrass Restoration, LLC
Data Sources: USGS National Map, NRCS
Edited September 4, 2019

Figure 4.4


East Fork Creek Watershed
Ravine and Stream Banks
Olson Ecological Solutions, LLC
tallgrass
East Fork Creek Watershed
Lake Carroll Association
Lakes and Ponds
Streams
Ravines
One Steep Bank
Both Banks Steep
0 0.25 0.5 1 1.5 2
Miles
N
Map created by Kristin Adams with Tallgrass Restoration, LLC
Data Sources: USGS National Map, NRCS
Edited September 4, 2019

Pollution Load Reduction Estimates for Watershed-Wide Practices

All of the projects and practices highly prioritized by stakeholders would add significant value to the efforts of reducing sediment and nutrients in the waters of East Fork Creek and Lake Carroll. The main concern for stakeholders is sedimentation to Lake Carroll, followed by excess phosphorus loading responsible for nuisance algae blooms, and thirdly, excess nitrogen. Pollution load reduction estimates for each watershed-wide project and practice are listed below in *Tables 4.2 and 4.3*, first by percent efficacy then as predicted for the total watershed-wide practices prescribed in this plan.

From these summary charts, we can see that the best opportunities for removing sediment, phosphorus, and nitrogen in the watershed are to stabilize ravines and severely eroded streambank, followed by widening and repairing grassed waterways and constructing detention features. Removing nitrogen could also be well served by focusing on vegetating highly erodible land and installing vegetated filter strips and swales. These decisions are made evident when considering the opportunities in the watershed rather than the percent of sediment and nutrient removal per practice.

Table 4.2 Pollution Load Reduction Efficacy per Watershed-Wide Practices

#	Recommended BMPs - Watershed Wide	Sediment Reduction Efficiency (%)	Phosphorus Reduction Efficiency (%)	Nitrogen Reduction Efficiency (%)	Source of Reduction Efficiency Information
1	HEL Stabilization with Forest Stand Improvement	87%	28%	92%	Region 5 - Conservation Easements Worksheet
2	Ravine Stabilization	N/A	N/A	N/A	N/A - Not a land use-based BMP, no Region 5 percent reduction est.
3	Streambank Stabilization - Severe	N/A	N/A	N/A	N/A - Not a land use-based BMP, no Region 5 percent reduction est.
4	Vegetated Filter Strips - Stream	73%	45%	40%	Region 5 - Urban Runoff Loading Rate Worksheet
5	Vegetative Filter Strips - Shoreline	73%	45%	40%	Region 5 - Urban Runoff Loading Rate Worksheet
6	Vegetated Swales	65%	25%	10%	Region 5 - Urban Runoff Loading Rate Worksheet
7	Rain Gardens (DIY)	58%	26%	30%	Region 5 - Urban EMC Worksheet for Dry Detention
8	Grassed Waterways - widen existing waterways (1/3 efficiency added)	21%	8%	3%	Region 5 - Urban Runoff EMC Worksheet x 1/3
9	Grassed Waterways (full repair, full efficiency)	65%	25%	10%	Region 5 - Urban Runoff EMC Worksheet
10	Detention Features	65%	38%	28%	Region 5 - Urban Runoff Loading Rate Worksheet, Avg of wet pond, wetland detention, and dry detention

*Source of cost estimates: Illinois CPPE. 2015. Provided by Stephenson Co. NRCS. Cost of site preparation and installation with 10% added for inflation/buffering.

**Cost estimate breakdown for install of a DIY rain garden is $2.00/sf for volunteer labor and $6.00/sf for materials and equipment rental. Install of a rain garden by a contractor is estimated for $12-$15/sf.

Table 4.3 Pollution Load Reduction Estimates for Recommended Watershed-Wide Practices

#	Recommended BMPs - Watershed Wide	Description (Chosen area only)	Amount	Unit	Total Phosphorus Reduction (lb/yr)	Total Nitrogen Reduction (lb/yr)	Sediment Reduction (ton/yr)
1	HEL Stabilization w/Forest Stand Improvement	Stabilize the forested, highly erodible lands throughout the watershed by removing invasive buckthorn and allowing the ground cover to regenerate.	160	ac.	8	352	11
2	Ravine Stabilization	Stabilize 1/4 of the ravines throughout the watershed (not including site-specific ravines within the Lake Carroll Association).	22,421	ft.	1,643	3,285	1,932
3	Streambank Stabilization - Severe	Stabilize 1/4 of the severely eroded streambank throughout the watershed.	65,630	ft.	4,808	9,616	5,656
4	Vegetated Filter Strips - Stream	Install 50'-wide vegetated filter strips along 1/3 of the 63% of streambanks in poor or fair condition (161,374').	185	ac.	277	2,382	131
5	Vegetated Filter Strips - Lake and Ponds	Install vegetated filter strips along lake shore and ponds currently in mowed turf.	23	ac.	34	296	16
6	Vegetated Swales	Install 35 vegetated swales throughout the Lake Carroll community (100'x30' ea).	105,000	sf	294	910	147
7	Rain Gardens	Create rain gardens at 100 residences w/priority for 20% of the 1/4-ac lots in Lake Carroll Assoc. upstream of ravines and other BMPs (150 sf ea.)	15,000	sf	3	23	1
8	Grassed Waterways - widen	Widen grassed waterways from 15' to 30' wide to handle larger storms for 67% of grassed waterways throughout the watershed for an estimated improvement of 1/3 pollutant load reductions (53 ac. or 153,318' x 15' wide).	53	ac.	1,238	2,476	1,238
9	Grassed Waterways - fully repair	Install grassed waterways in waterways that are currently bare for 14% of waterways throughout the watershed (22 ac. or 32,037' x 30' wide).	22	ac.	776	1,552	776
10	Detention Features	Construct vegetated, shallow water detention/scrapes and dry detention to ease flashy hydrology (1% of drainage area).	144	ac.	1,179	8,286	572
		TOTAL			**10,260**	**29,177**	**10,480**

Cost Estimates for Watershed-Wide Practices

Valuation for each best management practice was estimated using cost estimates provided mostly by Stephenson County Natural Resource Conservation Service, as provided in *Table 4.4*. Exceptions to this resource were the cost estimates for vegetated swales, ravine stabilization, and rain gardens which were provided by Olson Ecological Solutions. These estimates were applied to the opportunities for implementing each practice throughout the watershed to come up with a total cost per practice as shown in *Table 4.5*. Cost estimates were considered for the total amount of each best management practice proposed for implementation during the life of the plan. In *Table 4.5*, riparian buffer strips are recommended to be installed along lake shore and ponds (BMP #4) totaling 23 acres of shoreline. Please note that 15-foot wide buffers were used to come up with the 23-acre estimate. Although a 15-foot width is recommended in order to increase effectiveness of this particular BMP, any width is encouraged.

Table 4.4 Cost Estimates for Watershed-Wide Practices per Unit

#	Recommended BMPs - Watershed Wide	Cost Est. per Unit	Unit	Source of Cost Estimate Information
1	HEL Stabilization with Forest Stand Improvement	$ 1,074	ac.	Stephenson Co. NRCS*
2	Ravine Stabilization	$ 58	ft.	Olson Ecological Solutions
3	Streambank Stabilization - Severe	$ 58	ft.	Stephenson Co. NRCS*
4	Vegetated Filter Strips - Stream	$ 919	ac.	Stephenson Co. NRCS*
5	Vegetative Filter Strips - Shoreline	$ 919	ac.	Stephenson Co. NRCS*
6	Vegetated Swales	$ 2.11	sf	Olson Ecological Solutions
7	Rain Gardens (DIY)	$ 8.00	sf	Olson Ecological Solutions**
8	Grassed Waterways - widen existing waterways (1/3 efficiency added)	$ 2,580	ac.	Stepenson Co. NRCS (cost through EQIP program)
9	Grassed Waterways (full repair, full efficiency)	$ 3,650	ac.	Stepenson Co. NRCS (cost through EQIP program)
10	Detention Features	$ 765	ac.	Stephenson Co. NRCS*

*Source of cost estimates: Illinois CPPE. 2015. Provided by Stephenson Co. NRCS. Cost of site preparation and installation with 10% added for inflation/buffering.
**Cost estimate breakdown for install of a DIY rain garden is $2.00/sf for volunteer labor and $6.00/sf for materials and equipment rental. Install of a rain garden by a contractor is estimated for $12-$15/sf.

Table 4.5 Cost Estimates for Watershed-Wide Practices

#	Recommended BMPs - Watershed Wide	Description (Chosen area only)	Amount	Unit	Cost Est. ($)
1	HEL Stabilization w/Forest Stand Improvement	Stabilize the forested, highly erodible lands throughout the watershed by removing invasive buckthorn and allowing the ground cover to regenerate.	160	ac.	$ 172,000
2	Ravine Stabilization	Stabilize 1/4 of the ravines throughout the watershed (not including site-specific ravines within the Lake Carroll Association).	22,421	ft.	$ 1,307,000
3	Streambank Stabilization - Severe	Stabilize 1/4 of the severely eroded streambank throughout the watershed.	65,630	ft.	$ 3,826,000
4	Vegetated Filter Strips - Stream	Install 50'-wide vegetated filter strips along 1/3 of the 63% of streambanks in poor or fair condition (161,374').	185	ac.	$ 170,500
5	Vegetated Filter Strips - Lake and Ponds	Install vegetated filter strips along lake shore and ponds currently in mowed turf.	23	ac.	$ 21,000
6	Vegetated Swales	Install 35 vegetated swales throughout the Lake Carroll community (100'x30' ea).	105,000	sf	$ 222,000
7	Rain Gardens	Create rain gardens at 100 residences w/priority for 20% of the 1/4-ac lots in Lake Carroll Assoc. upstream of ravines and other BMPs (150 sf ea.)	15,000	sf	$ 120,000
8	Grassed Waterways - widen	Widen grassed waterways from 15' to 30' wide to handle larger storms for 67% of grassed waterways throughout the watershed for an estimated improvement of 1/3 pollutant load reductions (53 ac. or 153,318' x 15' wide).	53	ac.	$ 80,500
9	Grassed Waterways - fully repair	Install grassed waterways in waterways that are currently bare for 14% of waterways throughout the watershed (22 ac. or 32,037' x 30' wide).	22	ac.	$ 137,000
10	Detention Features	Construct vegetated, shallow water detention/scrapes and dry detention to ease flashy hydrology (1% of drainage area).	144	ac.	$ 110,000
TOTAL					**6,166,000**

Costs per Unit of Reduced Pollutants

Some of the projects have significant cost when compared to others. This may be that they are more expensive, but more likely there is better opportunity and more of this type of practice is slated for implementation. Another way to look at costs is dollars per pound of pollutant removed. The chart below in *Table 4.6* presents cost per pound of each pollutant removed. In most cases, the dollars per ton of sediment removed will be most important to stakeholders.

Table 4.6 Cost per Unit of Reduced Pollutants

#	Recommended BMPs - Watershed Wide	Description (Chosen area only)	Amount	Unit	Cost to Remove 1 lb TP ($/lb)	Cost to Remove 1 lb TN ($/lb)	Cost to Remove 1 ton Sediment ($/ton)
1	HEL Stabilization w/Forest Stand Improvement	Stabilize the forested, highly erodible lands throughout the watershed by removing invasive buckthorn and allowing the ground cover to regenerate.	160	ac.	$ 21,500	$ 489	$ 16,165
2	Ravine Stabilization	Stabilize 1/4 of the ravines throughout the watershed (not including site-specific ravines within the Lake Carroll Association).	22,421	ft.	$ 795	$ 398	$ 677
3	Streambank Stabilization - Severe	Stabilize 1/4 of the severely eroded streambank throughout the watershed.	65,630	ft.	$ 796	$ 398	$ 676
4	Vegetated Filter Strips - Stream	Install 50'-wide vegetated filter strips along 1/3 of the 63% of streambanks in poor or fair condition (161,374').	185	ac.	$ 616	$ 72	$ 1,301
5	Vegetated Filter Strips - Lake and Ponds	Install vegetated filter strips along lake shore and ponds currently in mowed turf.	23	ac.	$ 611	$ 71	$ 1,292
6	Vegetated Swales	Install 35 vegetated swales throughout the Lake Carroll community (100'x30' ea).	105,000	sf	$ 755	$ 244	$ 1,511
7	Rain Gardens	Create rain gardens at 100 residences w/priority for 20% of the 1/4-ac lots in Lake Carroll Assoc. upstream of ravines and other BMPs (150 sf ea.)	15,000	sf	$ 40,000	$ 5,217	$ 120,000
8	Grassed Waterways - widen	Widen grassed waterways from 15' to 30' wide to handle larger storms for 67% of grassed waterways throughout the watershed for an estimated improvement of 1/3 pollutant load reductions (53 ac. or 153,318' x 15' wide).	53	ac.	$ 65	$ 33	$ 65
9	Grassed Waterways - fully repair	Install grassed waterways in waterways that are currently bare for 14% of waterways throughout the watershed (22 ac. or 32,037' x 30' wide).	22	ac.	$ 177	$ 88	$ 177
10	Detention Features	Construct vegetated, shallow water detention/scrapes and dry detention to ease flashy hydrology (1% of drainage area).	144	ac.	$ 93	$ 13	$ 192

Looking at projects and practices in terms of the cost to remove one pound of nutrient or one ton of sediment provides us with a different perspective regarding the cost of pollutant removal. Focusing on sediment, widening and repairing grassed waterways and constructing detention features were the most cost-effective solutions, ranging from $65 to $192 per ton of sediment. Ravine and streambank stabilization had a moderate cost of $677 per ton of sediment, and it would cost from $1,292 to $1,511 per ton of sediment to install vegetated filter strips along streams and around lakes and ponds and vegetated swales. Rain gardens and forest stand improvement on highly erodible land were not cost effective in terms of sediment removal.

The cost to remove one pound of phosphorus, a secondary interest to stakeholders, closely mirrored the cost effectiveness of sediment removal. The only difference was that vegetated filter strips along streambanks and shorelines were less expensive per pound of phosphorus than ravine and streambank stabilization, which was not the case for sediment removal. Widening and repairing grassed waterways and constructing detention features were most cost effective at $65 to $93 per pound of phosphorus removed. Moderately cost-effective projects included planting vegetated filter strips along streams and shorelines, constructing vegetated swales, and stabilizing severely eroding streambanks and ravines, ranging from $611 to $795 per pound. Forest stand improvement on highly erodible lands and rain gardens were not cost-effective ways to control phosphorus.

The pattern of cost effectiveness held true for nitrogen, except that installing vegetated filter strips along streambanks and shorelines also a cost-effective way to control nitrogen. Widening and repairing grassed waterways, constructing detention features, and vegetated filter strips along streambanks and shorelines were most cost effective, ranging from $13 to $88 per pound of nitrogen removed. Vegetated swales, stabilization of ravines and streambanks, and forest stand improvement on highly erodible land all had a moderate cost of $244 to $489 per pound. Rain gardens were not a cost-effective way to remove nitrogen.

Schedule of Implementation of Watershed-Wide Practices

To implement the proposed projects and practices over a ten-year time frame, we plan to spread the budget evenly at about $616,600 per year. Grants and financial assistance organizations usually will require match, although amounts vary. One grant may require 40% match, which would require local sources to spend $246,640 while obtaining $369,960 from grant sources. Another may require 20% or 50%, creating a range of match needed per year. The schedule of implementation for watershed-wide practices is presented in *Table 4.7*. More detail about abbreviated funding and technical support is offered in Chapter 6.

The schedule of implementation is simple, implementing an equal area or size of each best management practice and keeping the same budget every year for ten years. It may take longer to set up such a schedule in the first place, but it then becomes routine each year. Doing so would allow landowners a consistent variety of options for participation each year. This may be optimum, as factors may affect a landowner’s ability and interest to participate in the implementation of a particular program each year. We recognize that the actual schedule will depend on many factors including leadership, community interest, and financial and technical support opportunities. This schedule should be reviewed and revised annually.

Table 4.7 Schedule of Implementation of Watershed-Wide Practices

Year(s)	Interim, Measurable Milestone	Potential Funding/ Tech. Support	Annual Cost Estimate ($/yr)
1-10	Improve forest stand by removing invasive buckthorn on 16 ac. of highly erodible land per year.	Trees Forever, NRCS, IEPA, USFWS, IDOA, NWTF, PF, JDCF	$17,200
1-10	Stabilize 2,242 ft of ravine banks each year (not including site-specific ravines within the Lake Carroll Association).	NRCS, TU, IEPA	$130,700
1-10	Stabilize 6,563 ft of severely eroded streambank each year.	NRCS, TU, IEPA	$382,600
1-10	Install 18.5 acres of vegetated filter strips along streambanks in poor or fair condition each year.	USDA, NRCS, IEPA, IDOA, Trees Forever, PF	$17,050
1-10	Install 2.3 acres of riparian buffer strips along lake and pond shorelines each year.	IEPA, Trees Forever, PF	$2,100
1-10	Install 10,500 sf of vegetated swales per year.	IEPA, Patagonia, Wyss	$22,200
1-10	Create 10 rain gardens per year, preferably on private residences near ravines.	Prairie Club	$12,000
1-10	Widen 15,332 ft of grassed waterways annually (5.3 ac).	NRCS, IEPA	$8,050
1-10	Repair 3,200 ft of grassed waterways annually (2.2 ac).	NRCS, IEPA	$13,700
1-10	Construct 14.4 ac of vegetated, shallow water detention/scrapes and dry detention per year.	USDA, NRCS, IEPA, IDNR, USFWS, IDOA, PF, TU, DU	$11,000
	Total per Year		**$616,600**

Responsible Parties

We ask all stakeholders to do what they can to help implement the plan. In addition to private homeowners and landowners, this watershed uniquely has structure and organization offered by the Blackhawk Hills Regional Planning Council and Lake Carroll Association and its various committees. Both entities have expressed a willingness to help implement the plan.

Section 2, Chapter 5
Implementation of Site-Specific Practices

Written by Rebecca Olson

Introduction

Chapter 4 detailed the steps needed to implement the watershed-wide practices. This chapter similarly provides necessary details about site-specific projects recommended in Chapter 2. Support resources for financial and technical needs to implementing these projects and practices are found in the next chapter.

In order to implement both site-specific projects and practices in a planned manner, we need to better understand the locations and sizes of projects, benefits in terms of pollution load reduction estimates, and costs such as total cost and cost effectiveness. With this information, we can plan a schedule over the next ten years and be able to predict improvement to be experienced along the way.

The following pages illustrate the locations and sizes of projects; estimate how much sediment, phosphorus, and nitrogen would be removed from the water utilizing each of the proposed site-specific best management practices; and then estimate the cost of implementing each practice. The costs are analyzed per pound of nutrient or ton of sediment to determine how cost effective each practice would be to implement. Determining both the most effective and most cost-effective methods of keeping pollutants out of the water can give us needed direction.

Site-Specific Practice Locations and Sizes

Stakeholders chose locations of site-specific projects within the Lake Carroll Association, including an interpretive trail, ravine and stream bank stabilization, native plantings, vegetated swales, prairie preservation and plantings, and floating islands as described below.

- A 3-acre interpretive trail highlights some of the site-specific projects as accessed from the Lake Carroll Clubhouse.
- The 16 mapped ravine stabilization sites recognize opportunity to help heal a little more than 24,700 feet of severely eroded bank.
- Two mapped streambank stabilization projects have opportunity to stabilize an estimated 15,000 feet of severely eroding bank.
- Six riparian buffer strips covering a combined seven acres would treat pollutants draining from 5,517 acres of surrounding residences and open space, usually filling in vegetation near forested riparian corridors.
- Three vegetated swales covering 10 acres treat drainage from about 130 acres of surrounding lands before it enters the stream.
- Four native wetland plantings create a series of filtration wetlands along a stream leading a main inlet to the lake known as Three Tubes.
- The preservation of three existing prairies and one landscape prairie feature combine for 56 acres of native vegetation plantings.
- Ten coves fitted with floating treatment wetlands are spread throughout 10 prime locations, each of which house 300 square feet (225 cubic feet each) of floating treatment wetlands for a total of 3,000 square feet (2,250 cubic feet).

Figure 5.1 illustrates the overall arrangement of best management practices throughout the Association. In *Figures 5.2* through *5.7*, portions of the watershed are magnified and projects are labeled. Maps are followed by benefit and cost estimates and a schedule of implementation.

Figure 5.1

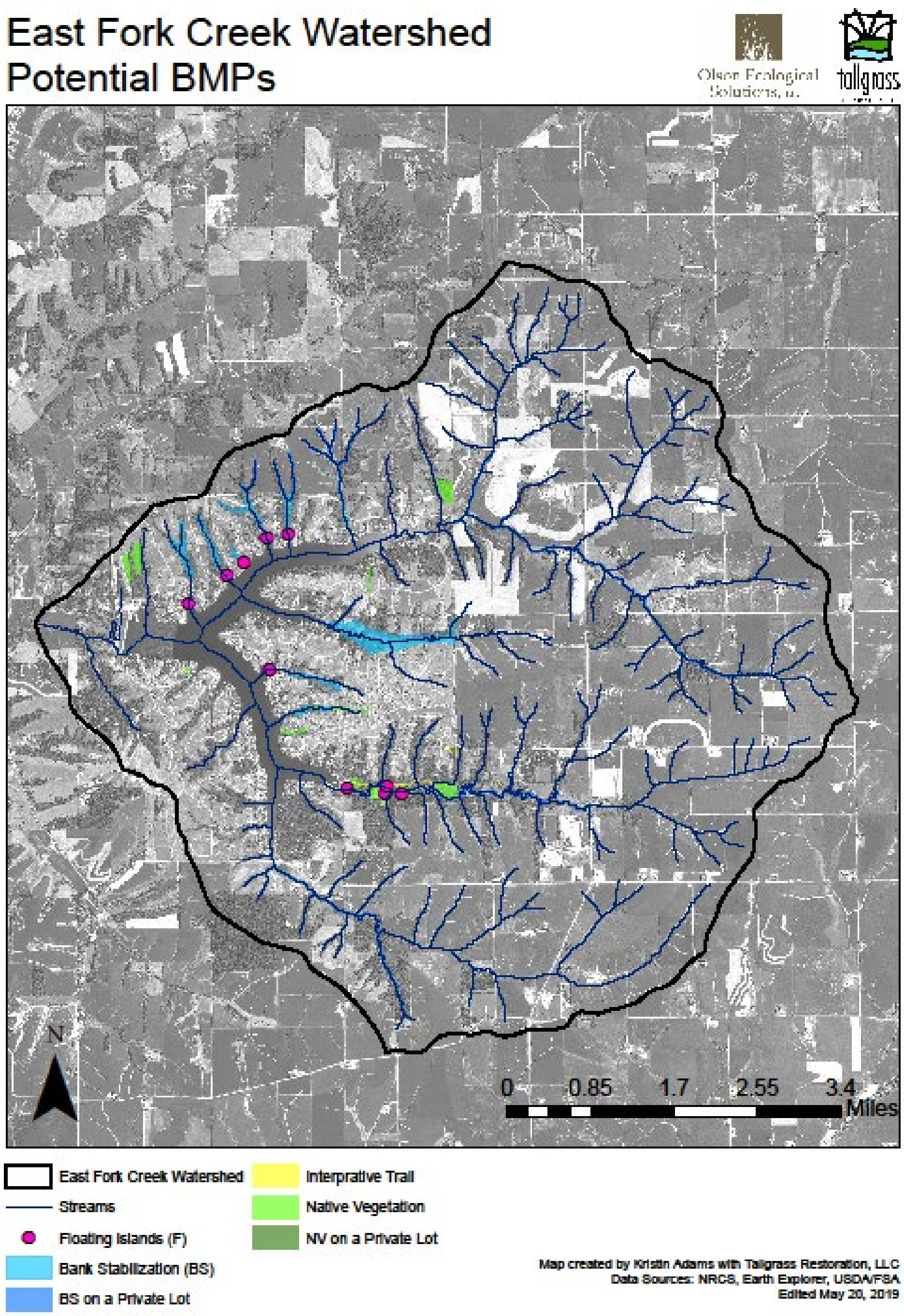


Figure 5.2

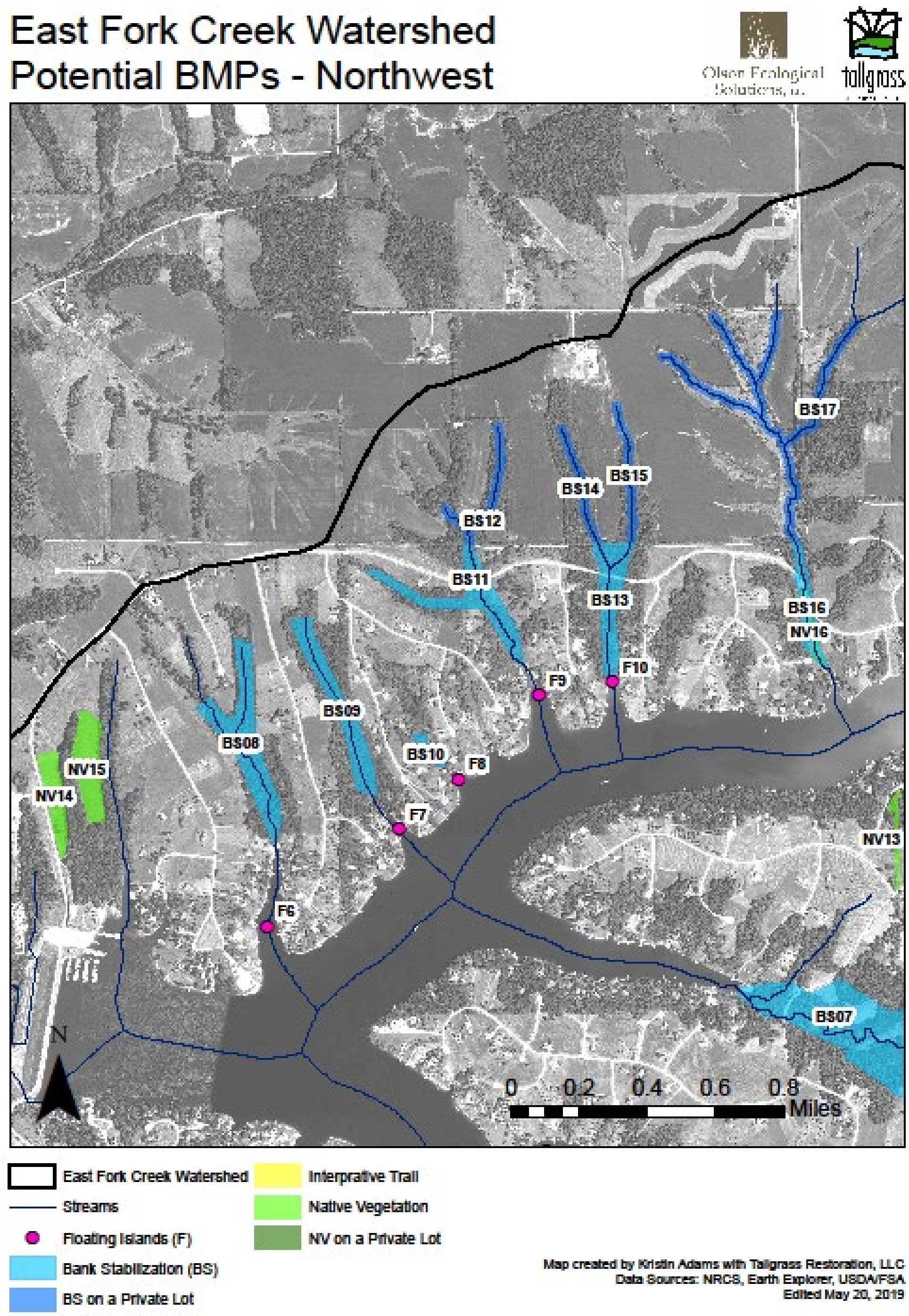

East Fork Creek Watershed
Potential BMPs - Northwest
Olsen Ecological Solutions, LLC
tallgrass
BS17
BS15
BS14
BS12
BS11
BS13
BS16
NV16
F10
F9
BS09
BS08
BS10
F8
NV15
NV14
F7
NV13
F6
BS07
N
0 0.2 0.4 0.6 0.8
Miles
East Fork Creek Watershed
Streams
Floating Islands (F)
Bank Stabilization (BS)
BS on a Private Lot
Interprative Trail
Native Vegetation
NV on a Private Lot
Map created by Kristin Adams with Tallgrass Restoration, LLC
Data Sources: NRCS, Earth Explorer, USDA/FSA
Edited May 20, 2019

Figure 5.3

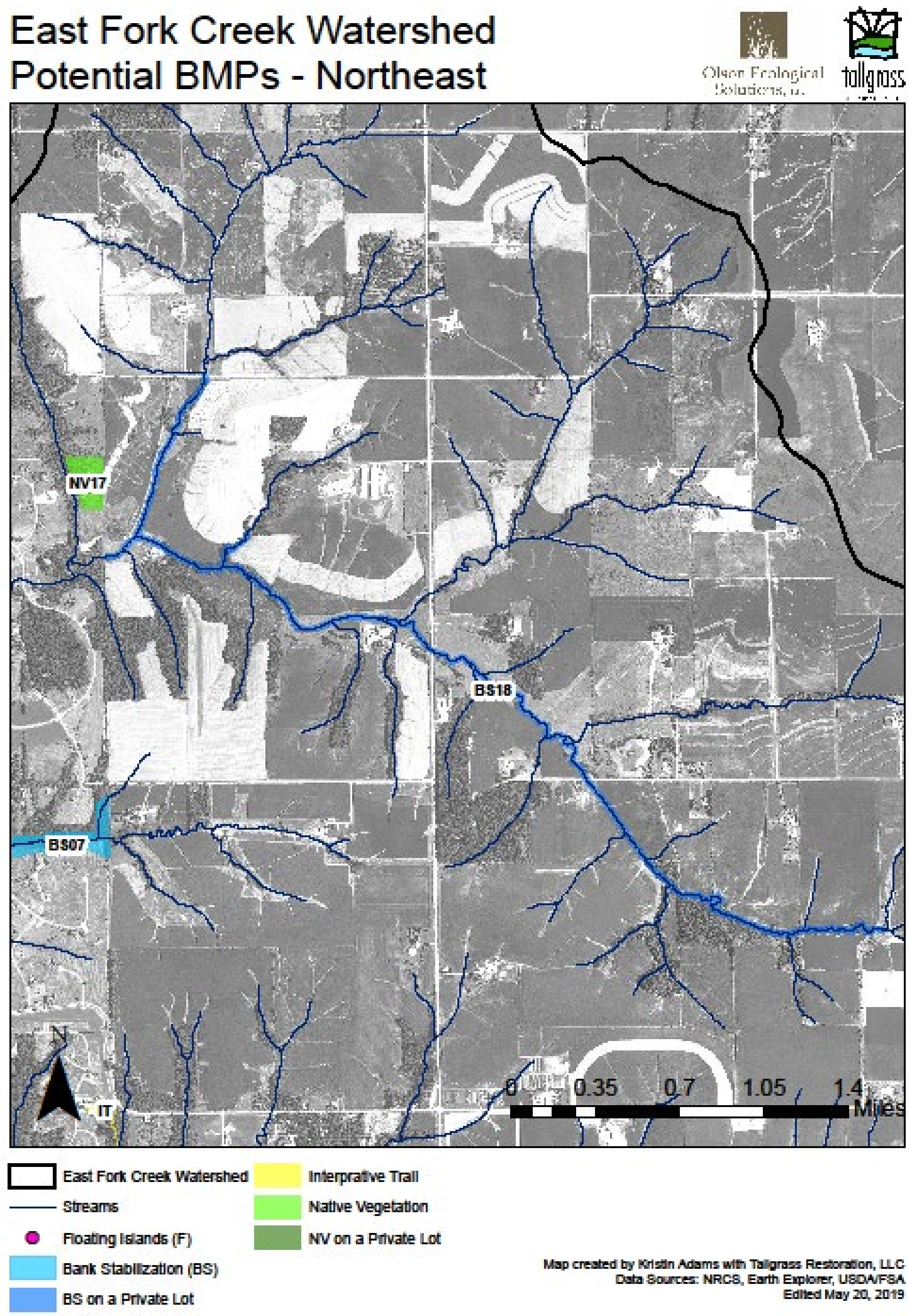

East Fork Creek Watershed
Potential BMPs - Northeast
Olsen Ecological Solutions, LLC
tallgrass
NV17
BS18
BS07
IT
N
0
0.35
0.7
1.05
1.4
Miles
East Fork Creek Watershed
Streams
Floating Islands (F)
Bank Stabilization (BS)
BS on a Private Lot
Interprative Trail
Native Vegetation
NV on a Private Lot
Map created by Kristin Adams with Tallgrass Restoration, LLC
Data Sources: NRCS, Earth Explorer, USDA/FSA
Edited May 20, 2019

Figure 5.4

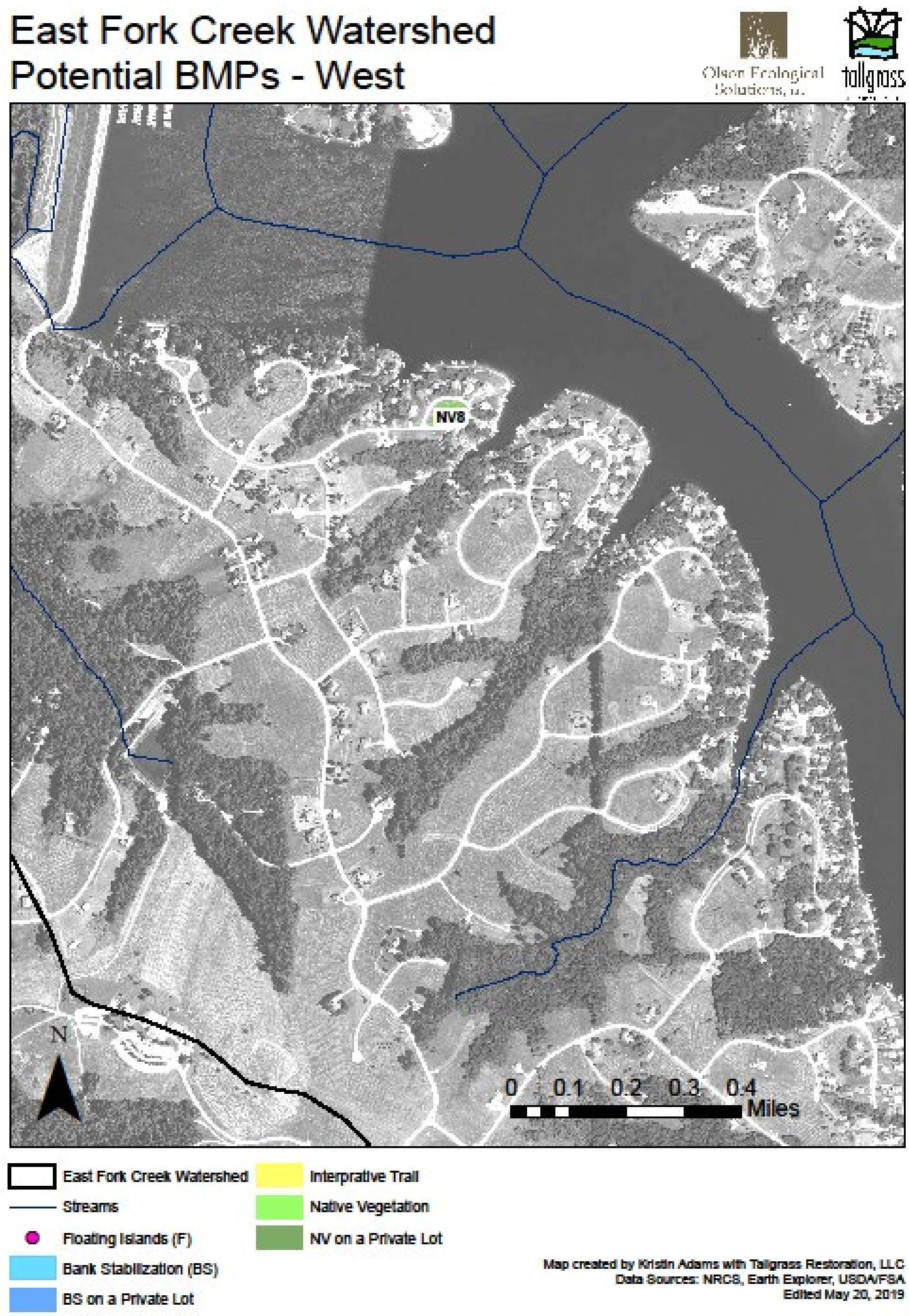

East Fork Creek Watershed
Potential BMPs - West
Olsen Ecological Solutions, LLC
tallgrass
NV8
N
0 0.1 0.2 0.3 0.4
Miles
East Fork Creek Watershed
Streams
Floating Islands (F)
Bank Stabilization (BS)
BS on a Private Lot
Interprative Trail
Native Vegetation
NV on a Private Lot
Map created by Kristin Adams with Tallgrass Restoration, LLC
Data Sources: NRCS, Earth Explorer, USDA/FSA
Edited May 20, 2019

Figure 5.5

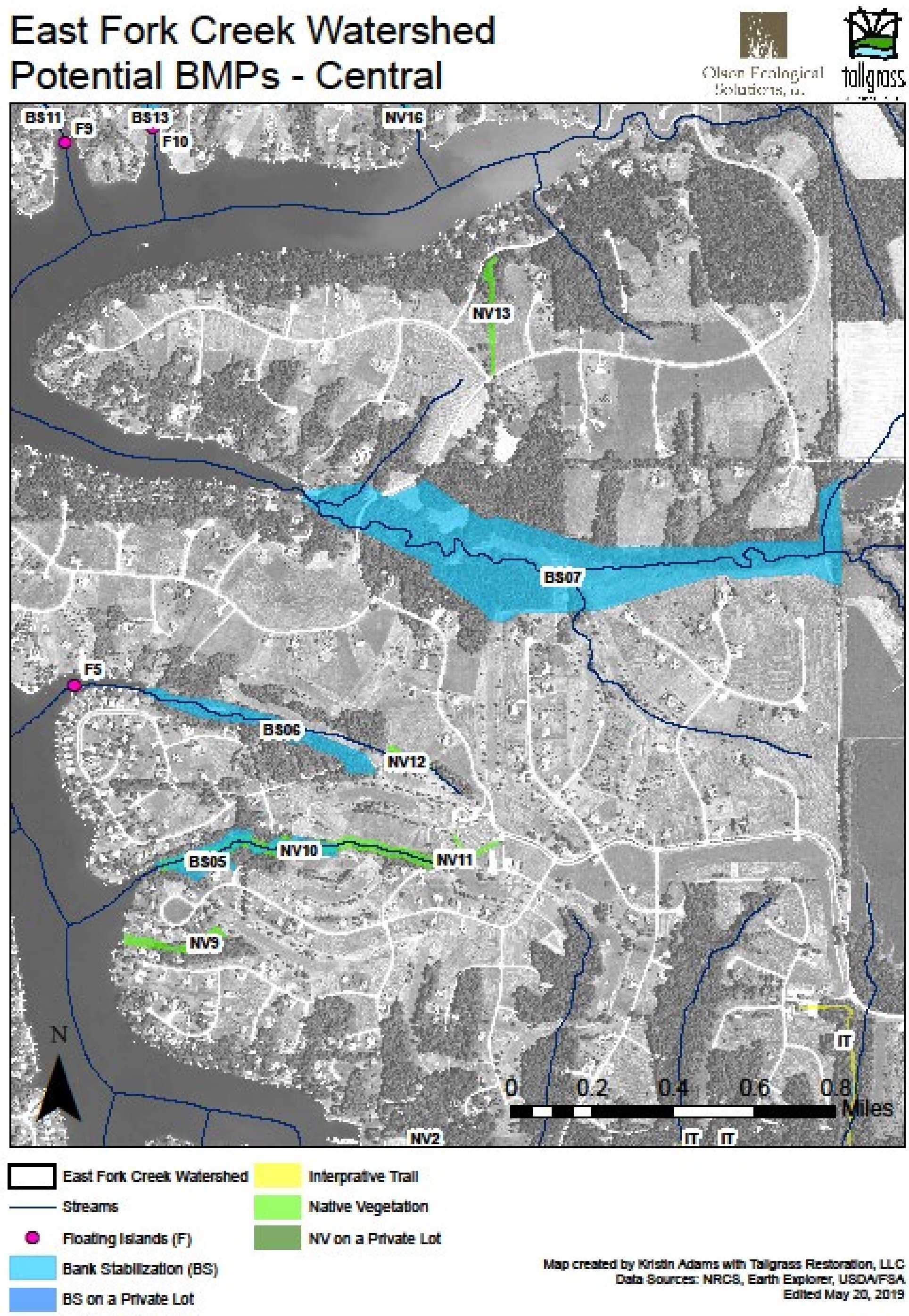

East Fork Creek Watershed
Potential BMPs - Central
Olsen Ecological Solutions, LLC
tallgrass
BS11
F9
BS13
F10
NV16
NV13
BS07
F5
BS06
NV12
BS05
NV10
NV11
NV9
IT
IT
IT
NV2
N
0 0.2 0.4 0.6 0.8
Miles
East Fork Creek Watershed
Streams
Floating Islands (F)
Bank Stabilization (BS)
BS on a Private Lot
Interpretive Trail
Native Vegetation
NV on a Private Lot
Map created by Kristin Adams with Tallgrass Restoration, LLC
Data Sources: NRCS, Earth Explorer, USDA/FSA
Edited May 20, 2019

Figure 5.6

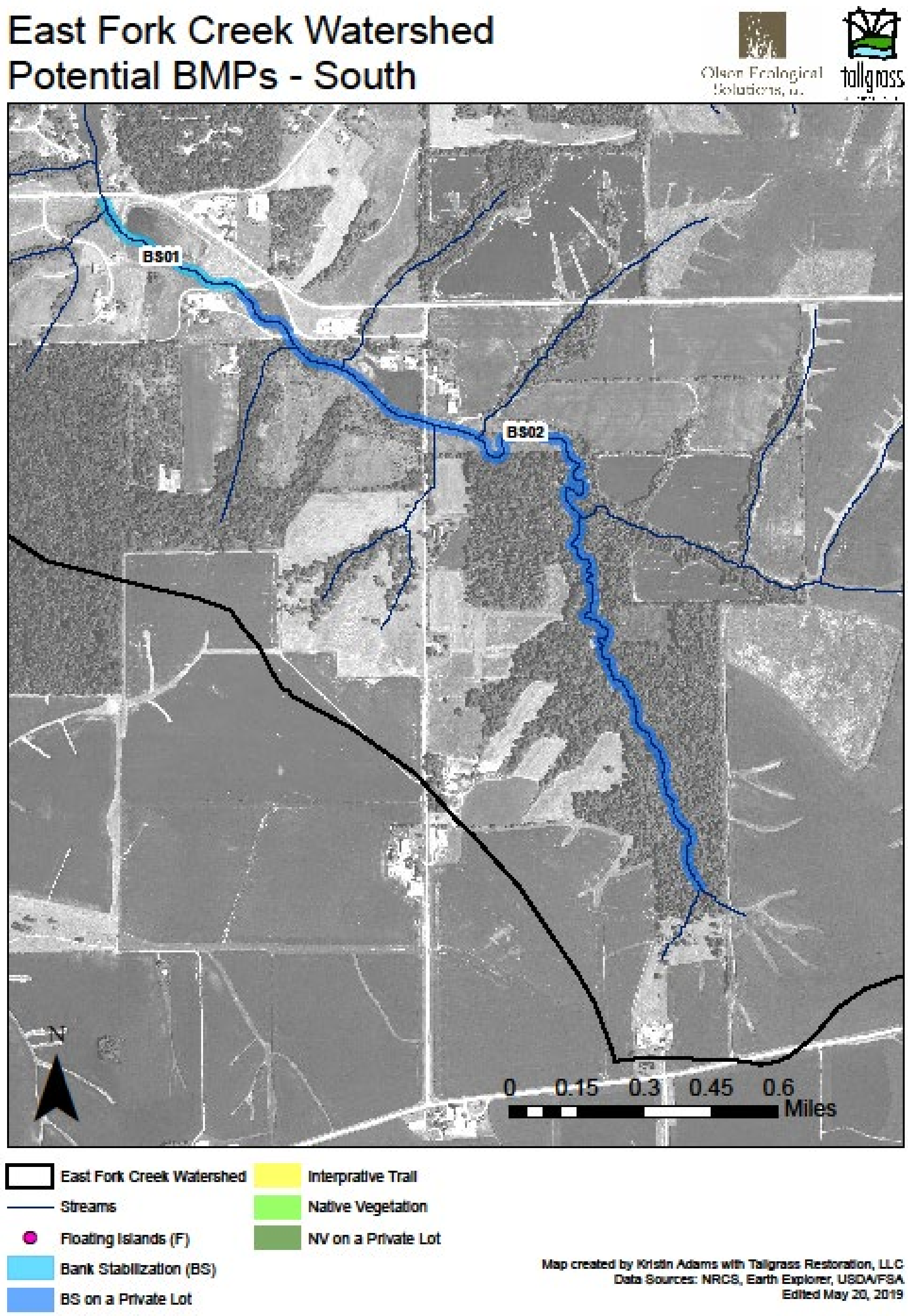
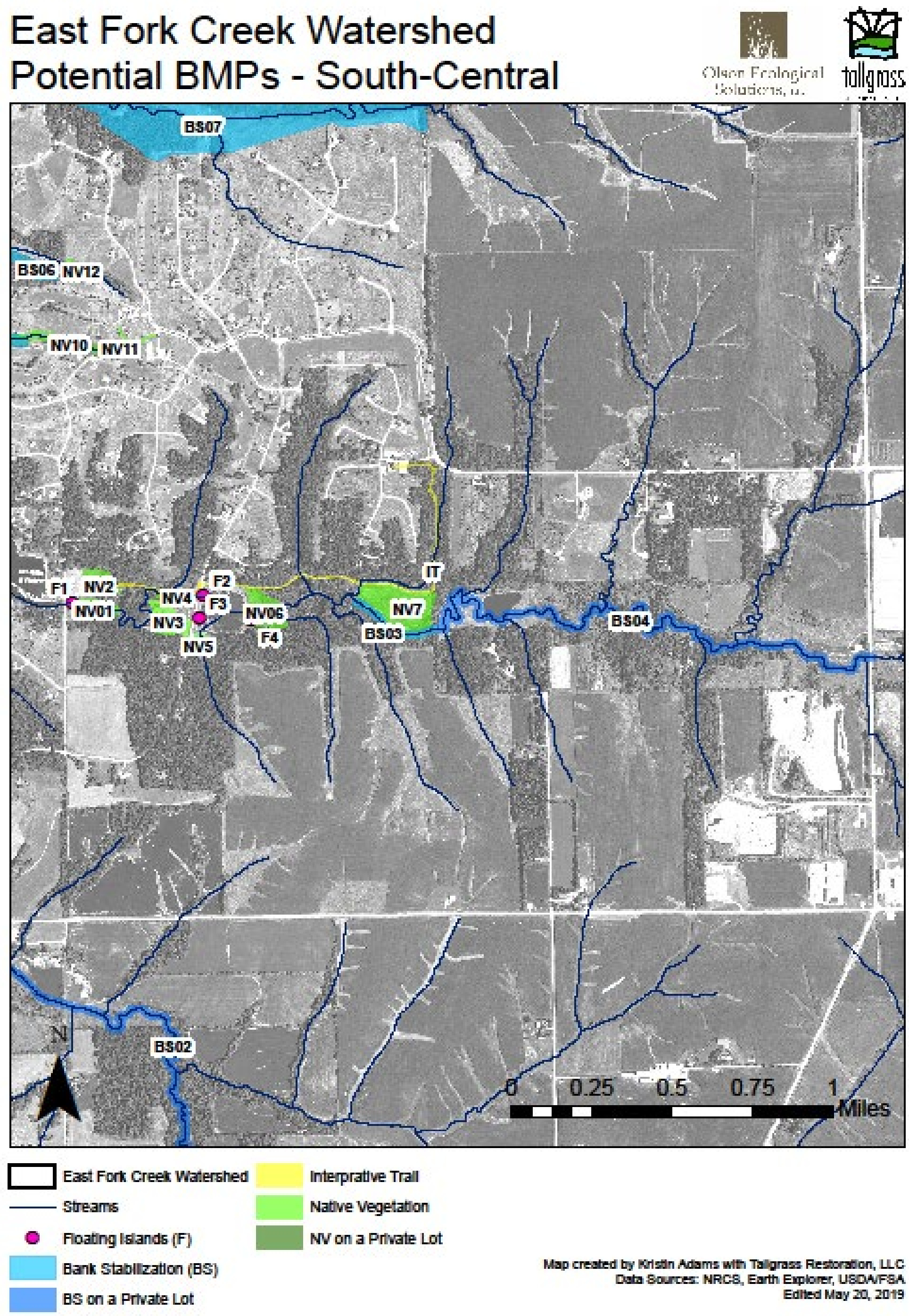

East Fork Creek Watershed
Potential BMPs - South
BS01
BS02
N
0 0.15 0.3 0.45 0.6
Miles
East Fork Creek Watershed
Streams
Floating Islands (F)
Bank Stabilization (BS)
BS on a Private Lot
Interprative Trail
Native Vegetation
NV on a Private Lot
Map created by Kristin Adams with Tallgrass Restoration, LLC
Data Sources: NRCS, Earth Explorer, USDA/FSA
Edited May 20, 2019

Figure 5.7


East Fork Creek Watershed
Potential BMPs - South-Central
Olsen Ecological Solutions, LLC
tallgrass
BS07
BS06
NV12
NV10
NV11
F1
NV2
NV01
NV4
F2
F3
NV3
NV5
NV06
F4
IT
NV7
BS03
BS04
BS02
N
0
0.25
0.5
0.75
1
Miles
East Fork Creek Watershed
Streams
Floating Islands (F)
Bank Stabilization (BS)
BS on a Private Lot
Interprative Trail
Native Vegetation
NV on a Private Lot
Map created by Kristin Adams with Tallgrass Restoration, LLC
Data Sources: NRCS, Earth Explorer, USDA/FSA
Edited May 20, 2019

Pollution Load Reduction Estimates for Site-Specific Practices

All of the site-specific projects and practices are highly prioritized by stakeholders, and they would add significant value to the efforts of reducing sediment and nutrients in Lake Carroll. The main concern for stakeholders is sedimentation to Lake Carroll, followed by excess phosphorus loading responsible for nuisance algae blooms. Excess nitrogen, although high at times, does not contribute to any of the concerns of stakeholders. Therefore, its reduction is noted but not a focus of this plan. Pollution load reduction estimates for each site-specific project are listed below in *Table 5.1* through *Table 5.9*.

From the summaries provided in *Tables 5.1* and *5.2*, some best management practices seem to remove more sediment, phosphorus, and nitrogen better than others. For example, of the land use-based options below in *Table 5.1*, wetland restoration and native plantings have the greatest potential to remove sediment, followed by vegetated filter strips and then vegetated swales. However, the area proposed for each practice varies widely. Ravine and streambank stabilization are not land-use based and therefore do not have the same percent efficiency comparison.

As evident in *Table 5.*2, stabilization of ravines and streambanks give the greatest sediment reduction, followed by vegetated filter strips along streambanks and wetland restoration. Minimal sediment reduction is offered by vegetated filter strips along shorelines, vegetated swales, native plantings, and floating treatment wetlands. The larger opportunity area covered by ravine and streambank stabilization explains the difference. The breakdown of areas and pollutant load reduction estimates for each practice are presented in *Table 5.3* through *Table 5.10.* All pollutant load reduction estimates were calculated using Illinois EPA Region 5 STEPL Modeling Worksheets (US EPA, 2018).

Phosphorus and nitrogen reduction estimated per best management practice are also led by ravine and streambank stabilization, followed by floating treatment wetlands. It is notable that FTWs take up very little area and are easy to install compared to bank stabilization projects. However, FTWs are meant to be combined with preventative measures, as they are located within the lake itself. Vegetated filter strips along streambanks and wetland restoration also provide significant nutrient removal. Vegetated filter strips along shorelines, vegetated swales, and native plantings do not provide significant nutrient reduction when considering each project type fully implemented. Again, it is important to consider the variation in the amount of each project type recommended when comparing the summative pollutant load reduction estimates.

Table 5.1 Pollution Load Reduction Efficacy per Site-Specific Practice

Recommended BMPs -Site-Specific	Sediment Reduction Efficiency (%)	Phosphorus Reduction Efficiency (%)	Nitrogen Reduction Efficiency (%)	Source of Reduction Efficiency Information
Ravine Stabilization	N/A	N/A	N/A	N/A - Not a land use-based BMP, no Region 5 percent reduction est.
Streambank Stabilization - Severe	N/A	N/A	N/A	N/A - Not a land use-based BMP, no Region 5 percent reduction est.
Vegetated Filter Strips - Stream	73%	45%	40%	Region 5 - Urban Runoff Loading Rate Worksheet
Vegetative Filter Strips - Shoreline	73%	45%	40%	Region 5 - Urban Runoff Loading Rate Worksheet
Vegetated Swales	65%	25%	10%	Region 5 - Urban Runoff Loading Rate Worksheet
Wetland Restoration	86%	69%	55%	Region 5 - Urban Runoff EMC Workshet (Ext. Wet Detention)
Native Plantings	87%	67%	92%	Region 5 - Conservation Easements Worksheet (Residential, Unsewered)
Floating Islands	TSS: 26 lb/yr/ft3	0.47 lb/yr/ft3	1.47 lb/yr/ft3	Apex Engineering

Table 5.2 Pollution Load Reduction Estimates Summary of Site-Specific Best Management Practices

#	See Table #	Site-Specific BMP Type	Total Phosphorus Reductions (lb/yr)	Total Nitrogen Reduction (lb/yr)	Sediment Reduction (ton/yr)
BS	5.2	Streambank Stabilization	2289	4576	2692
BS	5.3	Ravine Stabilization	3600	7201	3777
NV	5.4	Vegetated Filter Strips - Streambank	474	4378	247
NV	5.5	Vegetated Filter Strips - Shoreline	6	41	2
NV	5.6	Vegetated Swales	4	6	1
NV	5.7	Wetland Restoration	318	2722	131
NV	5.8	Native Plantings	0	2	0
F	5.9	Floating Treatment Wetlands	1060	3310	30
TOTAL			**7751**	**22236**	**6880**

The following *Table 5.3* through *Table 5.10* provide the size needed and the pollutant load reduction estimate calculated for each individual project. First, streambank stabilization is tabulated (*Table 5.3*), then ravine stabilization (*Table 5.4*), vegetated filter strips along streambanks (*Table 5.5*), vegetated filter strips along shorelines (*Table 5.6*), vegetated swales (*Table 5.7*), wetland restoration (*Table 5.8*), native plantings (*Table 5.9*), and floating treatment wetlands (*Table 5.10*). All projects are mapped in *Figure 5.1* through *Figure 5.7.* Reference numbers from the tables can be found on the figures.

Of the 29,407 feet of streambank to be stabilized, 51% (14,998 feet) are likely severely eroded based on average from streambank survey reported in Section 1 (Watershed Resource Inventory).

Table 5.3 Pollution Load Reduction Estimates for Site-Specific Streambank Stabilization (BS)

#	Riparian Area (ac)	Length of Bank (ft)	Total Phosphorus Reductions (lb/yr)	Total Nitrogen Reduction (lb/yr)	Sediment Reduction (ton/yr)
BS04	19.1	8,530	720	1,439	847
BS18	47.3	20,877	1,569	3,137	1,845
TOTAL	**66.4**	**29,407**	**2,289**	**4,576**	**2,692**

Of the 48,446 feet of ravine to be treated, approximately 51% (24,707 feet) are severely eroded. Forest stand improvement on 184 acres of riparian area would provide the pollutant load reductions in areas of limited access for installation of grade stabilization structures.

Table 5.4 Pollution Load Reduction Estimates for Site-Specific Ravine Stabilization (BS)

#	Riparian Area (ac)	Length of Bank (ft)	Total Phosphorus Reductions (lb/yr)	Total Nitrogen Reduction (lb/yr)	Sediment Reduction (ton/yr)
BS01	3.6	1,563	102	204	120
BS02	20	8,865	578	1,156	680
BS03	2.7	1,173	99	198	116
BS05	6.8	1,856	141	282	141
BS06	7.7	2,346	401	802	401
BS07	66.5	8,104	690	1,380	690
BS08	14.1	3,057	262	524	262
BS09	9.9	2,217	152	304	152
BS10	1.5	517	41	81	41
BS11	10.3	3,024	183	367	183
BS12	4.4	1,975	120	240	120
BS13	8.6	2,001	89	179	105
BS14	3.3	1,428	64	128	75
BS15	3.8	1,653	74	148	87
BS16	5	1,504	105	210	105
BS17	15.9	7,163	499	998	499
TOTAL	**184.1**	**48,446**	**3,600**	**7,201**	**3,777**

Table 5.5 Pollution Load Reduction Estimates for Site-Specific Streambank Vegetated Filter Strips (NV)

#	BMP Area (ac)	Treated Drainage Area (ac)	Total Phosphorus Reductions (lb/yr)	Total Nitrogen Reduction (lb/yr)	Sediment Reduction (ton/yr)
NV01	1.6	2,574	226	2,069	116
NV04	0.9	2,487	217	2,027	114
NV05	0.8	69	5	34	2
NV16	2	345	26	248	15
TOTAL	**5.3**	**5,475**	**474**	**4,378**	**247**

Table 5.6 Pollution Load Reduction Estimates for Site-Specific Shoreline Vegetated Filter Strips (NV)

#	Riparian Area (ac)	Treated Drainage Area (ac)	Total Phosphorus Reductions (lb/yr)	Total Nitrogen Reduction (lb/yr)	Sediment Reduction (ton/yr)
NV11	0.8	9	0	0	0
NV12	0.8	33	6	41	2
TOTAL	**1.6**	**42**	**6**	**41**	**2**

Table 5.7 Pollutant Load Reduction Estimates for Site-Specific Vegetated Swales (NV)

#	Area (ac)	Treated Drainage Area (ac)	Total Phosphorus Reductions (lb/yr)	Total Nitrogen Reduction (lb/yr)	Sediment Reduction (ton/yr)
NV09	1.9	22	0	1	0
NV10	6.6	95	2	5	1
NV13	1.2	12	2	0	0
TOTAL	**9.7**	**129**	**4**	**6**	**1**

Table 5.8 Pollutant Load Reduction Estimates for Site-Specific Wetland Restoration (NV)

#	Area (ac)	Treated Drainage Area (ac)	Total Phosphorus Reductions (lb/yr)	Total Nitrogen Reduction (lb/yr)	Sediment Reduction (ton/yr)
NV02	2.8	31	6	34	1
NV03	3.3	73	7	45	2
NV06	3.7	2313	301	2620	127
NV07	8.1	45	4	23	1
TOTAL	**17.9**	**2462**	**318**	**2722**	**131**

Table 5.9 Pollution Load Reduction Estimates for Site-Specific Native Plantings (NV)

#	Area (ac)	Treated Drainage Area (ac)	Total Phosphorus Reductions (lb/yr)	Total Nitrogen Reduction (lb/yr)	Sediment Reduction (ton/yr)
NV08	0.6	N/A	0	2	0
TOTAL	**0.6**		**0**	**2**	**0**

The floating treatment wetlands in *Table 5.10* are of uniform size: 300 square feet per location (225 cubic feet per location). The square footage at each location can be made up of one or several floating wetlands. It is most effective to incorporate smaller floating wetlands with more edge in an archipelago arrangement, and the cost estimate remains the same as it is based on square footage or cubic footage. For example, three 100-sf islands, six 50 sf islands, or some combination of varying sizes could be arranged within a cove instead of one 300-sf island.

Table 5.10 Pollution Load Reduction Estimates for Site-Specific Floating Treatment Wetlands (F)

#	BMP Size (ft^2)	BMP Size (ft^3)	Total Phosphorus Reductions (lb/yr)	Total Nitrogen Reduction (lb/yr)	Sediment Reduction (ton/yr)
F01	300	225	106	331	3
F02	300	225	106	331	3
F03	300	225	106	331	3
F04	300	225	106	331	3
F05	300	225	106	331	3
F06	300	225	106	331	3
F07	300	225	106	331	3
F08	300	225	106	331	3
F09	300	225	106	331	3
F10	300	225	106	331	3
TOTAL	**3000**	**2250**	**1060**	**3310**	**30**

Cost Estimates for Site-Specific Projects

Cost estimates applied to the opportunities for implementing each type of site-specific project provided total costs as shown in *Table 5.11*. Cost estimates were considered for the total amount of each best management practice proposed for implementation during the life of the plan. Valuation for each project was estimated using per unit cost estimates as provided in *Table 5.12*.

Some of the projects have significant cost when compared to others. This may be that they are more expensive, but more likely there is better opportunity and more of this type of practice is slated for implementation. Another way to look at costs is dollars per pound of pollutant removed. The chart below in *Table 5.13* presents cost per pound of each pollutant removed, utilizing the information provided in the tables above. In most cases, the dollars per ton of sediment removed will be most important to stakeholders.

Table 5.11 Cost Estimates for Site-Specific Practices

Site-Specific BMP	Amount	Unit	Cost Estimate ($)
Streambank Stabilization	14,998	ft.	$ 870,000
Ravine Stabilization	24,707	ft.	$ 1,433,000
Vegetated Filter Strips - Stream	5.3	ac.	$ 5,000
Vegetated Filter Strips - Shorelines	1.6		$ 1,500
Vegetated Swales	10	ac.	$ 920,000
Wetland Restoration	18	ac.	$ 45,000
Native Planting	0.6	ac.	$ 1,500
Floating Islands	2,250	ft^3	$ 150,750
TOTAL			**$3,426,750**

Table 5.12 Cost Estimates for Site-Specific Practices per Unit

Recommended BMPs -Site-Specific	Cost Est. per Unit	Unit	Source of Cost Estimate Information
Ravine Stabilization	$ 58	ft.	Olson Ecological Solutions
Streambank Stabilization - Severe	$ 58	ft.	Stephenson Co. NRCS*
Vegetated Filter Strips - Stream	$ 919	ac.	Stephenson Co. NRCS*
Vegetative Filter Strips - Shoreline	$ 919	ac.	Stephenson Co. NRCS*
Vegetated Swales	$ 2.11	sf	Olson Ecological Solutions
Wetland Restoration	$ 2,500	ac.	Olson Ecological Solutions
Native Plantings	$ 2,500	ac.	Olson Ecological Solutions
Floating Islands	$ 67	ft^3	Midwest Floating Island

*Source of cost estimates: Illinois CPPE. 2015. Provided by Stephenson Co. NRCS. Cost of site preparation and installation with 10% added for inflation/buffering.

Table 5.13 Cost per Unit of Reduced Pollutants

Site-Specific BMP	Cost to Remove 1 lb TP ($/lb)	Cost to Remove 1 lb TN ($/lb)	Cost to Remove 1 ton Sediment ($/ton)
Ravine Stabilization	$ 380	$ 190	$ 323
Streambank Stabilization	$ 398	$ 199	$ 379
Vegetated Filter Strips – Streambank	$ 11	$ 1.50	$ 20
Vegetated Filter Strips - Shoreline	$ 250	$ 36.50	$ 750
Vegetated Swales	$ 230,000	$ 153,333	$ 920,000
Wetland Restoration	$ 141	$ 16.50	$ 344
Native Planting	N/D	$ 750	N/D
Floating Treatment Wetlands	$ 142	$ 46	$5,025

Looking at projects and practices in terms of the cost to remove one pound of nutrient or one ton of sediment provides us with a different perspective regarding the cost of pollutant removal. Focusing on sediment, vegetated filter strips along streambanks, ravine and streambank stabilization, and wetland restoration were the most cost-effective solutions, ranging from $20 to $344 per ton of sediment. Vegetated filter strips along shorelines were moderately priced at $750 per ton. Vegetated swales and floating islands were not cost effective to remove sediment.

Cost estimates can range based on the type of plant material and implementation technique. It is likely that ravine stabilization using drop boxes and other grade stabilization structures could reduce the cost of the overall project using plan details not available at the time this plan was written. It is also possible that vegetated swales could be installed for much less; however, their pollutant load reduction estimates were also very low.

The removal of nutrients, also important to stakeholders, was most cost effective using vegetated filter strips, wetland restoration, and floating treatment wetlands with costs ranging from $11 to $250 per pound of phosphorus and $1.50 to $121 per pound of nitrogen. Streambank and ravine stabilization were moderately cost effective for phosphorus removal at $380 to $398 per pound and nitrogen removal at $190 to $199 per pound. Vegetated swales were not cost effective, and the native planting was too small to reliably detect nutrient reductions in order to calculate costs per pound.

Overall, planting vegetated filter strips along the streambanks clearly was the most cost-effective way to treat sediment and both nutrients. All best management practices had strengths and are worthy of consideration. Vegetated swales have such comparatively high costs that we question the modeling tool used to predict pollutant load reductions. Therefore, we do not want to dismiss them as applicable projects.

Schedule of Implementation of Site-Specific Practices

To implement the proposed projects and practices over a ten-year time frame, we plan to spread the budget evenly at about $342,675 per year. Grants and financial assistance organization usually will require some type of matching funds, although amounts vary. One grant may require 40% match, which would require local sources to spend $137,070 while obtaining $205,605 from grant sources. Another may require 20% or 50%, creating a range of match needed per year. The schedule of implementation for site-specific practices is presented in *Table 5.14*. More detail about abbreviated funding and technical support is offered in Chapter 6.

Within the ten-year life of the plan, a simple schedule depicts one-tenth of each best management practice being implemented. This allows stakeholders to set up a program that will work year after year, and it offers flexibility for homeowner cooperation given a variety of participation choices. During the first year, we plan to plant the 0.6-acre native planting in addition to the following annual schedule. Therefore, costs in Year 1 would be $344,025, $1,500 higher than the $342,525 suggested annual budget for the remaining nine years.

Table 5.14 Schedule of Implementation of Site-Specific Projects

Year(s)	Interim, Measurable Milestone	Potential Funding/ Tech. Support	Annual Cost Estimate ($/yr)
1-10	Stabilize 1,500 ft of severely eroded streambank per year.	IEPA	$ 87,000
1-10	Stabilize 2,470 ft of severely eroded ravines per year.	IEPA	$ 143,300
1-10	Install vegetated filter strips along streambanks in 0.53 ac. per year.	IEPA, Trees Forever	$ 500
1-10	Install vegetated filter strips along shorelines in 0.16 ac. per year.	IEPA	$ 150
1-10	Install vegetated swales in 1 ac. per year	IEPA, Patagonia, Wyss	$92,000
1-10	Restore wetlands and other native vegetation in 1.8 ac. each year.	IEPA, IDNR, USFWS, PF, TU, DU	$ 4,500
1-10	Create native plantings on 0.06 ac. or more per year.	JDCF, NLI	$150
1-10	Install 300 sf (225 ft3) of floating islands at one location per year.	IEPA, Patagonia, DU	$15,075
	Total per Year		**$ 342,675**

Responsible Parties

Since all of the site-specific projects are within the boundaries of the Lake Carroll Association, we hope that they will take on the responsibility of implementing these projects within their existing structure. We ask that all homeowners within the association to do what they can to help implement the plan.

Section 2, Chapter 6
Financial and Technical Resources

Written by Alyssa Robinson, Rebecca Olson, and Taylor McClerin

Introduction

Potential funding and technical assistance is available through various grant agencies and local environmental organizations suggested in this chapter. Costs can be deferred by organizing volunteer efforts, as grant agencies recognize the value of volunteer time and allow that value to provide matching funds for their grant dollars. For example, if a grant is secured to support 60% of the cost of implementing a $100,000 project, then the financial assistance would be $60,000 from the grant agency and the local community would need to budget $40,000 in cash and value of volunteer time to match the other 40%.

Local sources of matching funds are recommended and usually required to qualify for grant funding. Local match can come from several sources, including local environmental organizations and associations, businesses, developers, municipalities, and private citizens. Funds can be in the form of cash or the value of volunteer time. The national average for the estimated value of volunteer time in 2013 was $22.55 per hour according to the Independent Sector. It is important to recognize this value, as many projects that benefit water quality rely on dedication and many hours spent by volunteers.

There are many potential funding and technical assistance resources for the planning and implementation of conservation practices. *Table 6.1* lists potential agencies that provide funding and/or technical support for implementing these types of conservation projects and practices. The pages that follow provide more detail into each organization.

Table 6.1 Funding and Technical Support Agencies
*denotes a local agency

Abbr.	Agency	Funding/ Technical Support	Mission or Program Goal	Website
IDNR	Illinois Department of Natural Resources	Funding	Recreation facilities and trails, wildlife habitat, water quality, open space protection, etc.	http://www.dnr.illinois.gov/Pages/default.aspx
IEPA	Illinois Environmental Protection Agency, Bureau of Water	Funding	"Ensure that Illinois' rivers, streams, and lakes will support all uses for which they are designated including protection of aquatic life, recreation, and drinking water supplies."	https://www2.illinois.gov/epa/topics/water-quality/Pages/default.aspx
NRCS	Carroll County Natural Resources Conservation District	Technical, Funding	Reducing runoff of pollution from agricultural areas into streams and lakes.	No direct website. Go to: http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/water/
USFWS	U.S. Fish and Wildlife Service	Funding	Protects waterfowl and migratory birds and their habitat.	http://www.fws.gov/grants/

Abbr.	Agency	Funding/ Technical Support	Mission or Program Goal	Website
USDA	U.S. Department of Agriculture, Farm Service Agency	Funding	Provides yearly rental payment to farmers who convert environmentally sensitive land from agricultural production to native plantings.	https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/crp-continuous-enrollment/index
	Illinois Department of Agriculture, Partners for Conservation	Funding	Provides funding, cost-share assistance and technical assistance for natural resource management projects.	https://www2.illinois.gov/sites/agr/Resources/Conservation/Pages/default.aspx http://www.iira.org/rdrg/partners-for-conservation-streambank-stabilization-and-restoration-program-ssrp/
UofIL-Extension	University of Illinois Extension Soil Testing	Technical	Offers soil testing assistance and educational materials.	https://extension.illinois.edu/soiltest/
McKnight	McKnight Foundation	Funding	"We use our resources to restore the water quality and resilience of the Mississippi River."	http://www.mcknight.org/
Patagonia	Patagonia Corporate Grants Program	Funding	Donates funds to non-profit, community-based groups working towards a positive change for the planet.	https://www.patagonia.com/grant-guidelines.html
Grand Victoria	Grand Victoria Foundation, Vital Funds	Funding	Provides land acquisition funds to assist projects that pursue permanent protection and long-term stewardship of Illinois' vital lands.	https://grandvictoriafdn.org/what-we-fund/environment/
Trees Forever	Trees Forever: Illinois Buffer Partnership	Funding	Funds voluntary efforts of farmers and rural landowners in planting, maintaining, and enhancing conservation practices and buffers.	http://www.treesforever.org/Illinois_Buffer_Partnership
Illinois Clean Energy	Illinois Clean Energy Community Foundation, Natural Areas Program	Funding	Offers funding for conservation group organization capacity, community stewardship engagement, land acquisition, and planning for land acquisition.	https://www.illinoiscleanenergy.org/natural-areas-program
NLI	Natural Land Institute*	Technical	Assists landowners and groups with native planting, invasive species removal, and advice on improved mowing practices.	naturalland.org

Abbr.	Agency	Funding/ Technical Support	Mission or Program Goal	Website
bhrc	Blackhawk Hills Regional Council*	Technical	Supports land management and water conservation by promoting restoration of native vegetation along streams and upland soil conservation.	blackhawkhills.com
LCA	Lake Carroll Association*	Technical	Maintains and enhances the assets of the Lake Carroll 5,000+ acre complex.	golakecarroll.com
	Lake Carroll Prairie Club	Technical	Seed collection efforts. Potential for these efforts could qualify as a funding match.	
JDCF	Jo Daviess Conservation Association*	Technical	Promotes land stewardship (including registries, easements, and land donations) and resource conservation.	jdcf.org
	Pheasants Forever*	Technical	Conserves pheasants, quail and other wildlife through habitat improvements, public awareness, and land management policies and programs.	pheasantsforever.org
NWTF	National Wildlife Turkey Federation*	Technical	Conserves wild turkey and preserves our hunting heritage.	nwtf.org
TU	Trout Unlimited*	Technical	Conserves, protects, and restores North America's coldwater fisheries and their watersheds.	tu.org
Ducks	Ducks Unlimited*	Technical	Conserves, restores, and manages wetlands and associated habitats for North America's waterfowl.	ducks.org
	AmeriCorps	Technical	Restore natural areas by treating a removing invasive plant species.	https://www.nationalservice.gov/programs/americorps

Financial and Technical Assistance Resources

Programs funded through NRCS:

The Natural Resources Conservation Service (NRCS) provides financial and technical assistance as well as easement programs to assist agricultural producers and landowners implement and maintain conservations practices that help protect agricultural land and natural resources. Applying for grant funding, organizing and planning for the workload, and implementing the specific conservation practices is completely left to the willingness of the farmer. Information about guidelines and specifications for conservation practices can be found in the State of Illinois Old Section IV of the NRCS electronic Field Office Technical Guide (FOTG).

Below are more details on programs that offer assistance:

- Financial Assistance:
    - Environmental Quality Incentives Program (EQIP)
    - Conservation Stewardship Program (CSP)
    - Regional Conservation Partnership Program (RCPP)
- Easement Programs:
    - Agricultural Conservation Easement Programs (ACEO)

https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/farmbill/

Environmental Quality Incentives Program (EQIP)

Through EQIP, NRCS and grant recipients finance solutions that conserve natural resources while also improving agricultural operation. NRCS assists agricultural producers with financial resources, the development of a unique conservation plan, and implementation of conservation practices. With NRCS acting as a co-funder for conservation practice implementation, the participating agricultural producer voluntarily implements these practices. The best way to learn if EQIP is a good fit for you is by contacting your local NRCS office.
https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/
Carroll County NRCS conservationist: James Ritterbusch, District Conservationist, (815) 618-3156, james.ritterbusch@il.usda.gov

One of EQIP's Water-Based Landscape Initiatives is the Mississippi River Basin Healthy Watershed Initiative, which utilizes Farm Bill programs including the Environmental Quality Incentives Program and the Agricultural Conservation Easement Program to aid landowners in conserving natural resources by voluntarily implementing conservation practices. The overall goals of MRBI are to improve water quality, restore wetlands and enhance wildlife habitat while ensuring economic viability of agricultural lands.
https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/programs/initiatives/?cid=stelprdb1048200

Conservation Stewardship Program (CSP)

The Conservation Stewardship Program partners qualifying farmers with NRCS to maintain and improve existing conservation plans and fund conservation practices, including brush management, residue and till management, conservation cover, cover crop, critical area planting, filter strip, grade stabilization structures, grassed waterways, streambank and shoreline protection, and more. This program helps to build on your existing conservation efforts while strengthening your operation. Funding is based off the conservation performance, i.e. the higher the conservation performance results in increased funding. Applications are accepted throughout the year. CSP contracts last 5 years, with the option to renew if

participant has reached contract goals and agrees to implement additional conservation objectives. CSP contracts have a $1,500 minimum annual payment. To be eligible, one must have current farm records with USDA Farm Service Agency and must be in compliance with highly erodible land and wetland conservation requirements.
https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/programs/financial/csp/?cid=nrcseprd1288620

Regional Conservation Partnership Program (RCPP)
Through RCPP, NRCS provides funding to landowners and agricultural producers via RCPP contracts and RCPP easements. Funding projects are allocated for effective, innovative solutions to natural resource challenges. **Funds have been set aside for specific use in northwest Illinois, including the East Fork Creek Watershed.**
https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/rcpp/

Agricultural Conservation Easement Programs (ACEQ)
ACEQ protects wetlands and agricultural lands from being developed and converted to alternative uses via agricultural land easements and wetland reserve easements. Agricultural Land Easements protect the nation's long-term food supply by protecting productive agricultural land from conversion to non-agricultural uses. NRCS may fund up to 50% of the fair market value of the agricultural land easement. If NCRS determines that grasslands with environmental significance are protected, then additional funding may be provided. Through Wetland Reserve Easements, NRCS offers technical and financial assistance to private landowners who protect, restore, and improve wetlands with the procurement of a wetland reserve easement.
https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/acep/

Programs funded through Illinois Environmental Protection Agency (IEPA)

- Section 319
- State Revolving Fund (SRF): Water Pollution Control Loan Program (WPCLP)

Section 319 Program
Through the Clean Water Act, the United States EPA provides Section 319 grants to state environmental protection agencies in order to attain and preserve the beneficial use of water. Section 319 provides watershed project funding for planning grants and implementation grants. States are required to use at least 50% of the annual appropriation of Section 319 funds to implement watershed projects that focus on restoring impaired waters and are guided by watershed-based plans. The federal contribution may not exceed 60% of the entire implementation cost. Administrative costs may not exceed 10% of the funding. Cost-sharing is available, but only for costs related to implementing demonstration projects. Demonstration projects are used to show the effectiveness of an approach as it applies to solving a water-quality issue in a specific area and its unique hydrogeological and sociological features. States can allow these grant funds to be made available via subgrants to both public and private entities. Subgrants to individuals are limited to demonstration projects.
https://www.epa.gov/nps/319-grant-current-guidance
https://www.epa.gov/nps/funding-resources-watershed-protection-and-restoration

State Revolving Fund (SRF) Loan Programs: Water Pollution Control Loan Programs
Through the State Revolving Fund, a combination of federal and state funds provide loans to eligible recipients for wastewater, stormwater, and drinking water projects, including controlling nonpoint sources of pollution; implementing green infrastructure projects; developing and implementing watershed projects that are within the CWA section 122 criteria; and managing, treating, and recapturing stormwater or subsurface drainage water. In order to be considered for annual funding, applicants must submit a funding nomination form (FNF) on or before January 31st preceding the fiscal year in which the funding is requested and receive approval by January 31st. Once the FNF is in and the project is reviewed and qualifies, then projects with approved planning will be ranked and considered for placement on the Intended Funding List (IFL). This is a low interest loan program, not a grant funding program. For Wastewater/Stormwater Loan Program Forms, please visit: https://www2.illinois.gov/epa/topics/grants-loans/state-revolving-fund/Pages/state-revolving-fund-forms.aspx To view some of the PDF links on the EPA website, it is recommended to use Internet Explorer as your browser.

Other useful EPA resources include:
https://www.epa.gov/cwsrf/learn-about-clean-water-state-revolving-fund-cwsrf
https://www2.illinois.gov/epa/topics/grants-loans/state-revolving-fund/Pages/default.aspx

Programs funded through United States Department of Agriculture (USDA) Farm Service Agency

Conservation Reserve Program (CRP)
Through the USDA Farm Service Agency, the Conservation Reserve Program provides a yearly rental payment to farmers who remove environmentally sensitive land from agricultural production and convert it to native plantings in order to improve water quality, reduce soil erosion, and increase wildlife habitat. Generally, USDA Farm Service Agency opens up the signup period from June to August. All applicants must have owned their land for at least 12 months before submitting applications. Through this program, the farmer is offered annual rental payments based on acreage and cost-share assistance up to 50% of the cost of implementing the conservation practice.
https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/crp-continuous-enrollment/index

Programs funded through the Illinois Department of Agriculture (USDA) Partners for Conservation Program

https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/index

Sustainable Agriculture Grants Program provides funding to organizations, educational institutions, nonprofits, governmental agencies, and individuals who demonstrate comprehension of sustainable agriculture systems and implement conservation practice projects. Illinois' soil and water conservation districts prioritize and select projects that will receive cost-share funding. To be eligible, the land for which the conservation practice is to be applied must have erosion rates greater than one and one-half times the tolerable soil loss level.

Streambank Stabilization and Restoration Program (SSRP) provides cost-share assistance or demonstration project funding to landowners who implement streambank stabilization projects that demonstrate effective and inexpensive solutions to soil and stream bank erosion. Funding partners for this program are the Illinois Department of Agriculture, Illinois' soil and water conservation districts (SWCSs), and Natural Resources Conservation Service (NRCS) of the USDA. Recipients must maintain the selected bank stabilization practices for at least 10 years.

Soil and Water Conservation District Grants Program, through the Illinois Agricultural Department, offers operating cost assistance and technical assistance to landowners in natural resource management. All Illinois districts are eligible and encouraged to contact the Illinois Department of Agriculture for information about receiving grants.
https://www2.illinois.gov/sites/agr/Resources/Conservation/Pages/default.aspx
http://www.iira.org/rdrg/partners-for-conservation-streambank-stabilization-and-restoration-program-ssrp/

Programs funded through Illinois Department of Natural Resources (IDNR):

Open Space Lands Acquisition & Development (OSLAD)
Land & Water Conservation Programs (LWCF)

Both of these programs allow local units of government to apply for funding when acquiring or developing land for open space or public parks. Applications must be submitted between May 1 and July 1. Types of projects funded through this program include the creation of water quality basins with native plantings and the preservation or improvement of permanent wetlands. This grant program awards up to $750,000 for acquisition projects or up to $400,000 for development/renovation projects (i.e. OSLAD program only). Under both OSLAD and LWCF, funding is available for up to 50% of total approved projects costs.
https://www.dnr.illinois.gov/AEG/Pages/OpenSpaceLandsAquisitionDevelopment-Grant.aspx

Programs funded through US Fish and Wildlife Service (FWS)
https://www.fws.gov/grants/programs.html

Partners for Fish and Wildlife
Partners for Fish and Wildlife provides technical and financial assistance to private landowners who voluntarily implement habitat restoration and improvement programs. Typically, Partners will provide assistance for protects that conserve and restore native vegetation, hydrology, and soils.
https://www.fws.gov/partners/aboutus.html

Wildlife and Sport Fish Restoration Program (WSFR)
This program cooperates with states and other partnerships to conserve and manage fish and wildlife and their habitats. It funds activities that promote wildlife restoration and wildlife-based recreation. Through this program, states may receive up to 75% federal funding, while 25% of funding is required from non-federal resources.
https://wsfrprograms.fws.gov/home.html

Other Funding Programs outside of governmental agencies

ComEd Green Region Program

Openlands partners with ComEd to administer the ComEd Green Region Program. Through this program ComEd supports municipalities, townships, counties, park districts, conservation districts and forest preserve districts in northern Illinois and within ComEd's service territory with efforts to protect or improve public spaces for the benefit of all. Non-profit organizations and all other units of government not listed above (such as schools, school districts, and housing authorities) are not eligible to apply but are strongly encouraged to partner on joint projects with an Eligible Applicant. Lake Carrol is located within the ComEd's service territory; however, the ComEd service territory line only covers the eastern third of Carroll County. The application deadline for 2019 has passed on March 15. In order to apply, one must create an account and start an application through https://openlands.submittable.com/submit. Funding of up $10,000 finance open space projects that emphasis the planning, acquisition, and improvement of natural areas, recreation resources, and local parks. Green Region grant recipients may pool funds from other grant/funding sources that are associated with their open space projects. https://www.openlands.org/livability/greenregion/

Patagonia Corporate Grants Program

Patagonia donates funds to non-profit, community-based groups working towards a positive change for the planet in their own backyards and have a demonstrated strong support base. Eligible community-based groups/projects must fit the following criteria: be a non-profit organization; focus on the root cause of the problem; have distinct action competent with measurable goals and objectives; and NOT be solely for environmental education, involve land acquisitions, land trusts, or conservation easements, be primarily research based, for an endowment fund, for a political candidate campaign, for a green building project, nor for a conference. If the project is not located near on of Patagonia's U.S. retail stores, then the proposal will be reviewed by an employee grants council at company headquarters. They provide grants ranging between $5000- $20,000 for projects like taking down dams, restoring forest and rivers, protecting critical land and marine habitat, and supporting local, organic, and sustainable agriculture. One proposal is accepted per group per fiscal year (May 1-April 30). There are two annual deadlines: April 30 (receive response by August 30) or August 31 (receive response by end of January). To find out if your group is eligible go to https://www.patagonia.com/corporate-funding-guidelines.html. For grant guidelines, visit https://www.patagonia.com/grant-guidelines.html

Grand Victoria Foundation- Vital Lands

Vital Lands land acquisition funds are intended to assist projects that pursue permanent protection and long-term stewardship of Illinois' vital lands. While criteria for proposed projects is flexible, the minimum standards are set high. Eligible applicants must be well-managed, fiscally healthy 501(c)(3) public charities or certified public institutions registered in Illinois and in good standing. 501(c)(3) organizations seeking land acquisition funding must have conservation programs in Illinois and have adopted the Land Trust Alliance's Standards and Practices. Grand Victoria Foundation will only provide up to 30% of total dedicated funds calculated for long-term stewardship. In the application process, organizations will be asked to describe and document how they responsibly invest, manage, and use financial assets and build and maintain dedicated funds for stewardship and defense. Applications may be submitted at any time, as grants are awarded on a rolling basis. Apply online by creating an account at https://www.grantrequest.com/SID_5410?SA=SNA&FID=35006

McKnight Foundation

The McKnight Foundation uses their resources to "restore the water quality and resilience of the Mississippi River." It provides funding support for projects and management practices that restore and protect floodplains and wetlands and reduce agricultural pollution within the Mississippi River Basin including Illinois. They have four deadlines for initial inquiries throughout the year: February 1, May 1, August 1, and November 1. https://www.mcknight.org/programs/mississippi-river/how-to-apply/

Trees Forever: Illinois Buffer Partnership

The Illinois Buffer Partnership is a water quality program funded by Trees Forever, Syngenta, Operation Pollinator, and Growmark. These funding partners desire to highlight the voluntary efforts of farmers and rural landowners in planting, maintaining, and enhancing conservation practices and buffers. The mission of this Partnership is to showcase the actions taking place to restore Illinois flood plains and to raise awareness of potential for streamside buffers to enhance water quality and pollinator habitat. Cost-share funding is available for various water quality projects including, but not limited to, streamside buffers, wildlife/pollinator habitat, wetland or pond project, rain garden/bioswale, field windbreak, livestock confinement buffer planting, organic crop buffer, nut or fruit production, and agroforestry projects. After all federal, state, and local funding has been applied, recipients will be reimbursed for 50% of their remaining expenses, up to $2,000. Applications are available in August and must be submitted by December 31st. Recipients agree to allow their projects to serve as demonstration sites for education. Projects are expected to be completed within the same year that the funding is awarded. If extensions are needed, then they must be requested in writing and will be approved on a case-by-case basis. http://www.treesforever.org/Illinois_Buffer_Partnership

Illinois Clean Energy Community Foundation: Natural Areas Program

The Illinois Clean Energy Community Foundation has six categories within their Natural Areas Program for funding. Categories that could potentially be applicable to watershed planning and the broader mission of conservation include Capacity Building, Community Stewardship Challenge Grant, Land Acquisition, and Planning for Land Acquisition:

Capacity Building: Funding for this category is for projects that focus on increasing the organizational capacity of conservation groups active in protecting natural areas and wildlife habitat. This program is primarily for 501(c)(3) nonprofit organizations. Funding rarely covers the entire costs of the project. Applicants may apply for up to $40,000 for a two-year grant project. Deadlines for application submissions are February 21, 2019 and August 27, 2019.
Community Stewardship Challenge Grant: This program is geared toward increasing community participation in the protection and care of natural areas that are managed by nonprofit organizations. This program can provide funding via 1) a cash donation match ($3 provided: $1 raised, not exceeding donation of $21,000), 2) volunteer labor ($4,000 awarded for stewardship activities upon verification of 400 stewardship volunteer hours logged), or 3) equipment purchase (reimburse up to 80% or $5,000 for capital cost of stewardship equipment). This program is for 501(c)(3) nonprofit organizations that have active volunteer participation in the stewardship of publicly-accessible natural areas that are owned by a non-profit, local government, or government agency. Grants awarded up to $32,000 for natural area sites owned by a nonprofit and $27,000 for sites owned by the government.

Land Acquisition: This program desires to aid non-profits that purchase land outright with the purpose of protecting and enhancing wildlife habitat. Eligible applicants include nonprofit organizations and local government agencies that serve Illinois residents. Priority is given to projects that purchase natural habitat, as opposed to open space or parks, utilize all the funds for the direct purchase of the natural habitat, and meet specified transactional requirements for payment. The program funds up to 80% of the direct cost in purchasing the land and up to $10,000 for restoration completed within the first year of purchase. Deadlines for application submissions are February 21, 2019 and August 27, 2019.

Planning for Land Acquisition: The Foundation provides some financial assistance to nonprofit conservation groups who are planning the management and protection of natural areas. Grants under this program are awarded to individual organizations, but project action can include the participation of multiple organizations, including public and private. Majority of applicants are nonprofit organizations; however, if a local government agency, college, or university desires to seek grant funding through this program, they may contact the Foundation before application submission. Deadlines for application submissions are February 21, 2019 and August 27, 2019.
https://www.illinoiscleanenergy.org/natural-areas-program

NATURAL LAND INSTITUTE
Conserving Land in Northern Illinois

The Natural Land Institute
The Natural Land Institute (NLI), a 501(c)(3) nonprofit organization, works in the Mississippi River Bluffs and the Rock River Watershed. NLI advocates for land preservation, land use planning, and direct action to preserve areas by acquisition, either on its own or in conjunction with other organizations and agencies. Specific support to landowners include support with native planting, invasive species removal, and advice on improved mowing practices. naturalland.org

Blackhawk Hills RC&D (Resource Conservation and Development)

bhrc
Blackhawk Hills Regional Council

The Blackhawk Hills RC&D (Resource Conservation and Development), a 501(c)(3) nonprofit organization servicing all of Carroll County, helps communities protect and maintain their natural resources to improve the local economy, environment, and living standards. They support land management and water conservation by promoting restoration of native vegetation along streams to shade streams, stabilize banks, and filter sediment and chemicals from runoff before they reach the streams. Additionally, they promote upland soil conservation measures by managing grazing, weeds, and brush on buffer areas and by repairing and reseeding rills in eroded areas. blackhawkhills.com

Lake Carroll Association

The Lake Carroll Association (LCA), a not-for profit organization, maintains and enhances the assets of the Lake Carroll 5,000+ acre complex while striving to ensure that each lot owner has the opportunity to partake of the various amenities, according to his or her schedule, while protecting the ecosystem. They support Lake Carroll residents and business with services for dredging, installing bio-buffers (vegetated swales and filter strips) and other techniques to mitigate soil runoff, installing rip raps and culverts, and grading. They also coordinate and support non-native species removal, via harvesting (association weed harvester machine), hand pulling or raking (individual homeowners on their lots), and chemical control of non-natives (association). golakecarroll.com

Jo Daviess Conservation Association

The Jo Daviess Conservation Association, a not for profit corporation serving Galena and its surrounding areas, promotes land stewardship (including registries, easements, and land donations) and resource conservation. http://jdcf.org/

University of Illinois Extension Soil Testing

The University of Illinois Extension Soil Testing, servicing all of Carroll County, endeavors to enable people to improve their lives and communities through learning partnerships that put knowledge to work. https://extension.illinois.edu/soiltest/

Pheasants Forever

Pheasants Forever is a 501(c)(3) nonprofit organization that services all of Carroll County. The organization is dedicated to the conservation of pheasants, quail and other wildlife through habitat improvements, public awareness, education, and land management policies and programs. pheasantsforever.org

National Wildlife Turkey Federation

The NWTF, a nonprofit organization servicing all of Carroll County, is dedicated to the conservation of the wild turkey and the preservation of our hunting heritage. nwtf.org

Trout Unlimited

Trout Unlimited, a 501(c)(3) nonprofit organization servicing all of Carroll County, endeavors to conserve, protect and restore North America's coldwater fisheries and their watersheds. tu.org

Ducks Unlimited

Ducks Unlimited, a 501(c)(3) nonprofit organization servicing Carroll County, conserves, restores, and manages wetlands and associated habitats for North America's waterfowl. ducks.org

AmeriCorps

AmeriCorps is a voluntary civil society program that aims to help others and address critical needs of the community. In the past AmeriCorps groups have helped remove invasive plants in 9 acres next to hatchery and helped in a savanna restoration project. https://www.nationalservice.gov/programs/americorps

Section 2, Chapter 7
Monitoring and Evaluation Strategy

Written by Alyssa Robinson

Introduction

In order to track watershed improvements and effectiveness of the plan, the community developed a realistic system for monitoring and evaluation. This chapter presents the selected strategies that will monitor and evaluate the effects of adopting and implementing the plan. These strategies prioritize the promotion of watershed goals and progress of plan implementation.

The community met on March 19, 2019, to determine rural monitoring and evaluation strategies. On April 29, 2019, the community met again to ascertain residential monitoring and evaluation strategies. Stakeholders plan to establish the East Fork Creek Watershed Evaluation Committee, who will be responsible for carrying out the monitoring and evaluation efforts.

Criteria to Measure Success

The Evaluation Committee will meet annually or biannually to track evaluation milestones.

Annual measurable milestones for the Evaluation Committee:

1. Communication to stakeholders.
    a. Send standardized Monitoring Worksheets to stakeholders and allow them time to send in updates.
    b. Send plan updates and progress to stakeholders annually, including examples and photos
2. Submit grant applications to funding agencies.
3. Report updates of new funding opportunities or programs available to stakeholders
4. Gather and compile data on nutrient loading, sediment loading, wildlife presence, runoff volume and velocity, and education.
5. Perform evaluation of nutrient and sediment loading reductions, wildlife enhancement, runoff volume and velocity reductions, and education/outreach progress based on completed projects.
6. Revisit and evaluate Watershed Plan and make updates or changes necessary.

Monitoring Focus

Monitoring will focus on sediment levels in the lake, suspended solids in water flow, water quality of the lake, and condition of the remnant prairie. The Evaluation Committee will track the amount of sediment removed during dredging. After rainfall events, the Committee should perform visual observations of the presence of sediment plumes and water clarity. It is vital for the committee to establish consistent mechanisms for their on-site monitoring. In order to establish some consistency, the Committee should select a specific hour after the termination of the storm to perform visual observations. These monitoring actions will aid to address Goal 1 to reduce sediment loading from all sources in the watershed. Additionally, the Committee could sample total suspended solids (TSS) and measure water flow velocity at the spillway after these storm events. Joe Rush of JadEco Consulting has already organized the collection of annual samplings of Lake Carroll water quality levels from 3 locations: the Dam, East Marina, and Three Tubes. Continuing to test various water quality conditions in the waterways can aid in establishing whether or not implemented projects and practices are efficient and/or if more conservation efforts need to be undertaken.

These samples test for multiple water quality conditions:

- dissolved oxygen (DO)
- temperature
- clarity
- orthophosphorous (OP) and total phosphorous (TP)
- nitrate, nitrite, and Kjeldahl nitrogen (NNK)
- total suspended solids (TSS) and total volatile solids (TVS)
- chlorophyll a

Testing for these water quality condition levels aids in discovering if the watershed efforts are addressing Goals 1 and 2, which are to reduce sediment loading and nutrient loading from all sources in the watershed.

In terms of tracking implementation of conservation practices, the Committee can conduct observational surveys where they track new acres that have been enrolled in conservation practices, ie. low/no-till or cover crop usage. Another focus for monitoring is wildlife habitat enhancement and reestablishment. The Watershed Plan prioritizes the protection and/or enhancement of wildlife habitat through Goal 3. The Prairie Club identified a natural area as a remnant prairie within the watershed and has written up management plans for both this remnant prairie and the prairie on Lake Carroll Boulevard. Management plans for each prairie can be found at the end of this chapter. Within this remnant prairie, there are a couple flora and fauna species of interest for monitoring and tracking that the Prairie club is already monitoring:

1. Rusty Patched Bumble Bee (*Bombus affinis*)-The U.S. Fish & Wildlife Service has placed this bumble bee on the Endangered Species list. It is the first bee in the continental U.S. to be listed. Citizens can submit bubble bee sightings to Bubble Bee Watch at https://www.bumblebeewatch.org/. The Bubble Bee Watch website also provides information on how to identify and conserve bumble bees and other pollinators. Another resource for Rusty patched bumble bee guidance is the U.S. Fish & Wildlife Service at https://www.fws.gov/midwest/endangered/insects/rpbb/surveys.html

2. Red-breasted Merganser (*Mergus serrator*) is a slim, crested, diving duck generally seen around piers. The Audubon Society has deemed this species climate endangered. https://www.audubon.org/field-guide/bird/red-breasted-merganser

3. Tall Green milkweed (*Asclepias hirtella*) and Short Green Milkweed (*Asclepias viridiflora*)- A remnant prairie was newly found on Lake Carroll Association property. The Prairie club has been stewarding the site and has identified some populations of green milkweed there.

Asclepias viridiflora.
Source: Lady Bird Johnson Wildflower Center

Asclepias hirtella.
Source: missouriplants.com

The Committee also has specific ideas for the monitoring and evaluation of residential-specific issues and projects. The Committee will track streambank stabilization projects and progress through photo documentation and physical observations. Photo documentation should occur at least every 5 years. Documentation should also occur after storm events to track effectiveness of stabilization and determine where more streambank stabilization is needed. If there are rural streambank stabilization projects implemented, then this monitoring strategy can apply for those rural projects as well. Joe Rush is also looking into getting hydrographic or acoustical surveys for 22 acres of the area surrounding Lake Carroll Association. The estimate for this cost is $22,000.

The Committee has established some specific reporting points to be conducted:

- Perform annual shoreline inspections, with mailing follow-up to homeowners that need to repair rip rap when necessary
- Ensure landscaping contactors are informed of correct lawn care application
- Conduct periodic testing for sediment depth in lake every 10 years
- Conduct in-house aquatic plant and fish surveys to monitor success of native plants and track any invasive plant or fish species infestations.
    - These surveys should be conducted every couple years either by Association staff or volunteers
    - Through the assistance of the Illinois River Watch Network, the group could conduct aquatic macroinvertebrate surveys, which can indicate level of water quality.

The Illinois River Watch Network is a state program offered through the National Great Rivers Research and Education Center. This program assists and trains Illinois citizens in water quality data collection within their local streams and educates those citizens to be better stewards of their own watersheds. The Illinois River Watch Network could assist in monitoring 4 main tributaries of East Fork Creek. Joe Rush is working on getting this relationship established with the River Watch Network. http://www.ngrrec.org/riverwatch/

Monitoring Worksheets

The East Fork Creek Watershed Evaluation Committee will utilize standardized monitoring worksheets to track BMP implementation and effectiveness throughout the Watershed. The Evaluation Committee will be responsible for distribution, retrieval, and compilation of worksheet data. The East Fork Creek Watershed Monitoring Worksheet can be found on pages 5-6 of this Chapter.

These monitoring worksheets will:

- Quantify BMPs over time
- Track maintenance
- Ensure follow-up
- Reiterate the goals of the East Fork Creek Watershed though annual distribution
- Consolidate information in a cohesive manner

By utilizing these worksheets to consolidate data and show active enthusiasm and participation in BMP implementation, potential for funding opportunities increases. These monitoring worksheets also provide feedback to the Evaluation Committee for them to evaluate effectives of BMPs and for progress towards the five selected Goals of this watershed plan.

East Fork Creek Watershed Monitoring Worksheet

The Monitoring Committee asks that landowners and stakeholders use this worksheet to track their implementation of best management practices and conservation efforts throughout the watershed. The Committee will utilize the information provided to monitor BMP implementation progress and efficiency towards the goals of the watershed plan. With positive landowner participation in BMP implementation and tracking, funding opportunity potential increases. By showing that landowners and stakeholders are taking initiative and ownership of successful implementation of the watershed plan, grant dollars are more likely to be awarded.

Please return this worksheet to: Lake Carroll Association
3-200 Association Dr.
Lanark, IL 61046

1. Name and detailed description of project or best management practice, including area (in feet or acres) affected and location:

2. Start date:

3. Completion date:

4. Approximate cost:

5. Unexpected costs or frustrations:

6. Scope of project:

7. Why did you decided to implement this practice?

8. Is the project or practice implemented working?

9. What are your anticipated benefits from implementation of this practice?

10. If applicable, have you observed any changes in erosion, runoff, sedimentation in waterways, flooding, or wildlife using the area after project implementation?

11. Identify which goals you believe your project applies to. Circle all that apply:

    a. Goal 1: Reduce sediment loading from all sources in the watershed.

    b. Goal 2: Reduce nutrient loading from all sources in the watershed.

    c. Goal 3: Utilize practices that protect and/or enhance wildlife habitat.

    d. Goal 4: Address volume and velocity of water runoff to enhance water quality.

    e. Goal 5: Educate the watershed community about land and water conservation and this plan.

12. Please provide a map of your project location and before and after photographic documentation:

13. Did you receive technical assistance in implementing this project or practice? If yes, from whom?

14. Will you be pursuing future best management practices? If so, would you be interested in learning about financial or technical assistance for any of these projects?

15. Are there best management practices you would like to learn more about? If so, please list them here.

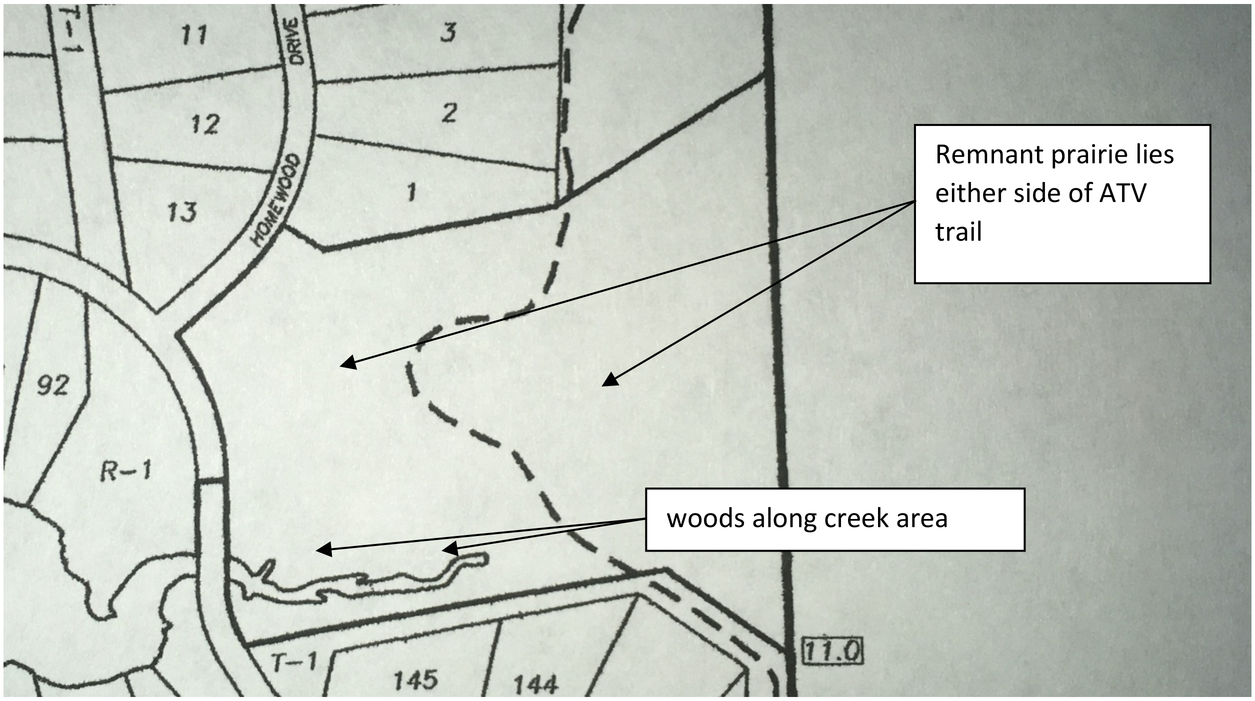
16. Are you interested in becoming more involved in the East Fork Creek Watershed conservation efforts?

17. If you answered yes to questions #14, #15, or #16, please provide your name, phone number, mailing address and email address:

Lake Carroll Remnant Prairie Management Plan

Created and Written by Jim Richards of the Prairie Club

The Lake Carroll remnant prairie on the northeast side of Lake Carroll on either side of the ATV trail in section 25.



Remnant Prairie Map in Section 25

The site is anchored by a giant white oak, that is estimated at 200 - 250 years old.

We removed most of the understory vegetation from around the oak in late fall 2018. We piled in on either flank of where it sits, onto cedars and tried burning the piles in February 2019.

The site was confirmed a remnant of the great prairie when we found short green milkweed (*asclepias viridiflora*), a rare plant with an 8 on the conservancy index. That particular species is almost exclusively found in undisturbed areas. It prefers dry, rocky soils, which is consistent with the location we found the species.

The photo at the left is the *Asclepias Viridiflora* found at the site. We were fortunate enough to collect a seed pod from this plant. The seeds are being propagated by Northwest Illinois Prairie Enthusiasts (NIPE). We will plant the seedlings near where we collected the pod and across the ATV trail where more plants were subsequently found. Each will be covered with a milk jug and monitored for survival for a period of four weeks.

Plans for 2019

Early spring: Plant the short green milkweed plants by early May. Cover with prepared milk jugs and monitor for four weeks. Plant two groups: one near parent plant and the other on the other side of ATV trail near plants discovered there.

Early spring to summer: Inventory the site by listing plant species and locations. Note primary locations of plant species and significant geologic differences, as well as possible fire breaks for the site at the tree line and north edge. This is to be done by late Fall.

Early spring - late fall: Continue removal of woody species. The goal is to clear the area surrounding the oak and toward the tree line at the east side for the northern half of the remnant. For the southern half, clear woody species up to the tree line to the east. Cut cedars, but do not herbicide the stumps, as they will not resprout. Removal of the black cherry next to the oak is to be done by early May. Burn the debris on the two piles already begun, as this will sterilize the soil. If it isn't possible or practical to do so, choose sites which have a minimal chance of containing native plants. Over seed the piles with seeds collected solely from remnant when completed.

Spring: Begin determining fire breaks at the site. Priority burn break area is the north side of the ATV trail, as we will target a prescribed burn for spring 2020. Once a site for the fire breaks has been determined, have the break line mowed or at minimum staked out for later mowing.

Spring/summer: Begin removal of wild parsnip and sweet clover. If wild parsnip and sweet clover have not flowered, then discard in the area. If they have flowered, then bag and remove debris. Place debris in yard waste dump below dam. This removal process will continue through the year into late fall 2019.

Begin monitoring the insect and bird population, noting type and species if possible. Take note of any animal activity at the site.

Spring - early winter: Continue removing woody invasive plants, paying close attention to the areas along the tree line. Begin developing fire breaks along this area, in preparation for prescribed burn in the fall. Burn breaks shall be mowed prior to the burn.

Early fall: Begin scouting the area for plants that have seeds ready to pick. Collect seeds as they become ready.

Plans for 2020

All year: Continue to remove woody invasive plants and remove debris by burning.

Early spring: Begin determining fire breaks for southern half of prairie for 2021 prescribed burn.

Early spring: Conduct a prescribed burn of the north side of the remnant prairie. Be sure to protect the oak and its progeny by raking debris from around trunks.

Early spring: Continue to remove wild parsnip and sweet clover by mechanical control. Treat debris as before.

Early spring into summer: Continue to update site inventory.

Early to late fall: Begin scouting for plants that are ready to pick seeds from. Collect as they become available.

Plans for 2021

Early spring: Conduct prescribed burn of southern end of remnant.

Early spring to late fall: Continue to sweep the site for wild parsnip, sweet clover, and resprouts of woody invasive species. Dispose of debris properly if necessary.

Early spring to late fall: Continue monitoring and inventorying insect, bird, and animal activity. Note type and species if possible.

Year round: Continue removing woody invasive plants. Burn debris, as necessary as before, choosing sites where the possibility of finding native plants is minimal. Over seed the burn piles when completed using seeds collected from remnant only.

Plans for 2022

Early spring to late fall: Continue to monitor the site for invasive plants. Cut and treat stumps of invasive woody plants if needed. Remove all debris either through burning or physically removing to yard waste dump. Push management of invasive plants to the west on both southern and northern halves.

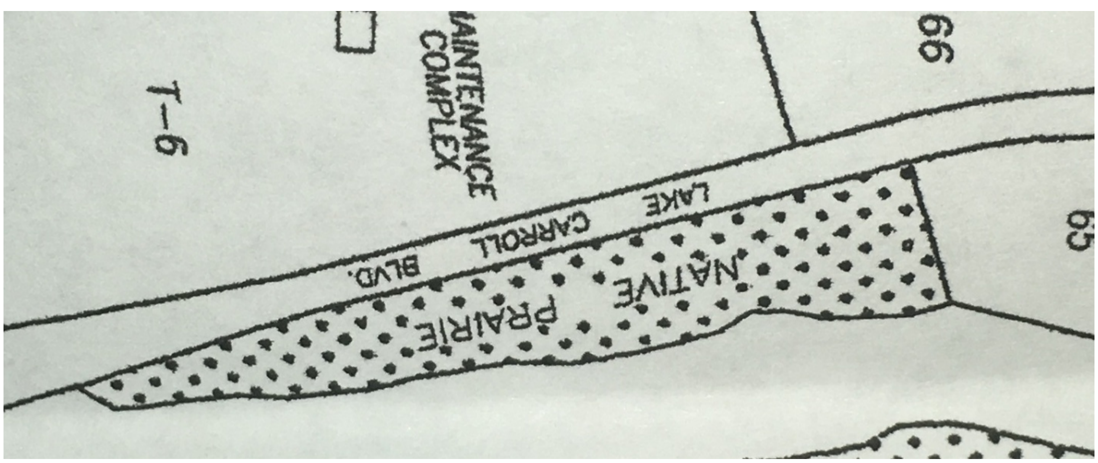
Early spring to late fall: Continue monitoring and inventorying insect, bird, and animal activity. Note type and species if possible. Check for changes in activity with restoration efforts.

Lake Carroll Boulevard Prairie Management Plan

Created and Written by Jim Richards of the Prairie Club

The Lake Carroll Boulevard prairie is located just north of the dam on the east side of Lake Carroll Boulevard, across from the maintenance shed.

It is estimated at 7 - 10 acres in size. We have documented well over thirty species of native plants at the site. It was planted in 1989 through a joint cooperative between Lake Carroll, Pheasants Forever Stephenson Co., and the DNR.



Plans for 2019

Early spring: Meet with Don Aleksy to determine walking paths to be mowed and location of picnic table. Target date for meeting is early April.

Early spring to summer: Inventory the site, listing plants and locations. Note primary locations of plant species and significant geologic differences, as well as possible fire breaks for the site at the tree line and north edge. This is to be done by late fall.

Spring: Scout the site for woody resprouts where we took the black locusts and honeysuckle down. Burn the debris from last year. Once burning of woody debris is complete, overseed the burn scar with seeds collected the following year.

Spring/summer: Begin removal of wild parsnip and other invasive plants. If removed plants have not flowered, then discard in the area. If invasive plants have flowered, then bag and remove. Place removed debris in yard waste dump below dam. This removal process of wild parsnip and other invasive, weedy plant species will continue through the year into late fall 2019.

Begin monitoring the insect and bird population, noting type and species if possible. Take note of any animal activity at the site.

Spring - early winter: Continue removing woody invasive plants, paying close attention to the areas along the tree line. Begin developing fire breaks along this area, in preparation for prescribed burn in the fall. Mow or develop burn breaks prior to the burn.

Early fall: Begin scouting the area for plants that have seeds ready to pick. Collect as they become ready.

Late Fall: Burn the Lake Carroll Boulevard (LCB) prairie. Over seed sparse or barren areas and burn piles.

Plans for 2020

All year: Continue to remove woody invasive plant and remove debris by burning.

Early spring: Continue to remove wild parsnip by predation. Treat debris as before.

Early spring into summer: Continue to update site inventory.

Early to late fall: Begin scouting for plants that are ready to pick seeds from. Collect as they become available.

Plans for 2021

Early spring to late fall: Continue to sweep the site for wild parsnip. Dispose of debris properly if necessary.

Early spring to late fall: Continue monitoring and inventorying insect, bird, and animal activity. Note type and species if possible.

Year round: Continue removing woody invasive species. Burn debris as necessary as before, choosing sites where the possibility of finding native plants is minimal. Over seed the burn scars when completed using seeds collected from the site.

Plans for 2022

Early spring to late fall: Continue to monitor the site for invasive plants. Remove if needed and treat cut stumps with herbicide if necessary. Remove all debris either through burning or physically removing to yard waste dump.

Early spring to late fall: Continue monitoring and inventorying insect, bird, and animal activity. Note type and species if possible. Check for changes in activity with restoration efforts.

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