# 6.0 Management Measures Action Plan

Earlier sections of this plan summarized the Upper South Branch Kishwaukee River watershed's characteristics and identified causes and sources of watershed impairment. This section includes an "Action Plan" developed to provide stakeholders with recommended "Management Measures" (Best Management Practices) to specifically address plan goals at general and site-specific scales. The Action Plan is divided into two subsections:

- *Programmatic Measures :* general remedial, preventive, and policy watershed-wide Management Measures that can be applied across the watershed by various stakeholders.
- *Site-Specific Measures:* actual locations where Management Measure projects can be implemented to improve surface and groundwater quality, green infrastructure, and flooding.

The recommended programmatic and site-specific Management Measures provide a solid foundation for protecting and improving watershed conditions but should be updated as projects are completed, or other opportunities arise. Lead implementation stakeholders are encouraged to organize partnerships with key stakeholders and develop various funding arrangements to help delegate and implement the recommended actions. The key stakeholders in the watershed are listed in Table 42. Note: all recommendations in this Section are for guidance only and not required by any federal, state, or local agency.

**Table 42.** Key Upper South Branch Kishwaukee River watershed stakeholders/partners.

| Key Watershed Stakeholder/Partner | Acronym/Abbreviation |
|---|---|
| City of DeKalb | DeKalb |
| City of DeKalb Park District | Parks |
| City of Sycamore | Sycamore |
| DeKalb County | DeKalb Co. |
| DeKalb County Community Development Department | DCCDD |
| DeKalb County Community Foundation | DCCF |
| DeKalb County Soil and Water Conservation District | DCSWCD |
| Drainage District # (various) | DD# |
| Forest Preserve District of DeKalb County | FPDDC |
| Golf Courses | GC |
| Illinois Department of Natural Resources | IDNR |
| Illinois Environmental Protection Agency | IEPA |
| Illinois Tollway | IT |
| Kishwaukee Water Reclamation District | KWRD |
| Northern Illinois University | NIU |
| United States Army Corps of Engineers | USACE |
| United States Fish & Wildlife Service | USFWS |
| University of Illinois Extension | Extension |
| Upper South Branch Kishwaukee River Watershed Steering Committee | Steering |
| Village of Malta | Malta |
| Village of Shabbona | Shabbona |

### 6.1 Programmatic Management Measures Action Plan

Numerous types of programmatic Management Measures are recommended to address watershed objectives for each plan goal. The following pages include recommended measures that are applicable throughout the watershed and information needed to facilitate implementation of specific actions. A brief summary of the general programmatic measure types is included below:

*Policy:* Local, state, and federal government can help prevent watershed impairments in various ways through policy but specifically by adopting and/or supporting (via a resolution) the Upper South Branch Kishwaukee River watershed plan, implementing green infrastructure policy, requiring conservation developments for new developments, protecting groundwater, reducing road salt usage and lawn fertilizers, requiring natural detention basins and naturalization of existing basins, and allowing use of native vegetation/landscaping.

*Non-Structural:* This includes a broad group of practices that prevent impairment through maintenance and management of Management Measures or programs that are ongoing in nature and designed to control pollutants at their source. Such programs include the Audubon Cooperative Sanctuary Program (ACSP) for golf courses, many of the agricultural programs available to farmers, and street sweeping.

*Structural:* This includes a broad group of practices that prevent impairment via installation of in-the-ground measures. This plan focuses on implementation of naturalized stormwater measures/ retrofits, permeable paving, vegetated filter strips/buffers, natural area restoration, wetland restoration, and use of rainwater harvesting devices.

*Educational:* Outreach is important to inform the public related to environmental impacts of daily activities and to build support for watershed planning and plan implementation. Topics typically address watersheds, water quality, land management, pet waste management, lawn fertilizer use, good housekeeping, etc

#### 6.1.1 Policy Recommendations

Various recommendations are made throughout this report related to how local governments can improve the condition of Upper South Branch Kishwaukee River watershed through policy. Policy recommendations focus on improving watershed conditions by preserving green infrastructure, protecting groundwater, minimizing road salts, minimizing lawn fertilizer, sustainable management of stormwater, and allowances for native landscaping. To be successful, the Upper South Branch Kishwaukee River Watershed Improvement Plan would need to be adopted and/or supported by local communities. The process of creating and implementing policy changes can be complex and time consuming. And, although there are numerous possible policy recommendations for the watershed, the following policy recommendations are considered the most important and highest priority for implementation.

*Plan Adoption & Implementation Policy Recommendations*

- Watershed Partners adopt and/or support (via a resolution) the Upper South Branch Kishwaukee River Watershed Improvement Plan and incorporate plan goals, objectives, and recommended actions into comprehensive plans and ordinances.

*Green Infrastructure Network Policy Recommendations*

- Each municipality consider incorporating the identified Green Infrastructure Network (GIN) into comprehensive plans and development review maps.
- Utilize tools such as protection overlay zones, setbacks, open space zoning, conservation easements, conservation and/ or low impact development, etc. in municipal comprehensive plans and zoning ordinances to protect environmentally sensitive areas within identified Green Infrastructure Network parcels.
- Utilize tools such as Development Impact Fees, Stormwater Utility Taxes, Special Service Area (SSA) Taxes, etc. to help fund implementation of plan and future management of green infrastructure components where new and redevelopment occurs.
- Require developers to protect sensitive natural areas, restore degraded natural areas and streams, and then encourage donation of all natural areas and naturalized stormwater management systems to a public agency or conservation organization for long term management with dedicated funding such as Development Impact Fees, Stormwater Utility Taxes, Special Service Area (SSA) Taxes, etc. In general, it is not recommended that these features be turned over to HOA's to manage, as they lack the resources and experience to do so effectively.
- Establish incentives for developers who propose sustainable or innovative approaches to implement the watershed-based plan, including priority for preserving green infrastructure and using naturalized stormwater treatment trains.
- Require mitigation for all wetlands lost prior to allowing development within the watershed.

*Groundwater Policy Recommendations*

- Encourage extensive

stormwater management practices that clean and infiltrate water in any development or redevelopment.

- Limit impervious cover within new and redevelopments occurring within Subwatershed Management Units 17, 20, 23-25, 28, 30, 31, and 34 which are ranked as highly vulnerable to future impervious cover.

*Road Salt Policy Recommendations*

- Each municipality/township supplements existing programs with deicing best management practices such as utilizing alternative deicing chemicals, anti-icing or pretreatment, controlling the amount and rate of spreading, controlling the timing of application, utilizing proper application equipment, equipment calibration, and educating/training deicing employees.

- Establish additional new best management practice recommendations based on the results of various ongoing studies and research being produced by Illinois Tollway to reduce, re-use, and offset the impacts of winter roadway operations. These include converting invasives to energy, to harvest cattails for the purpose of removing excess nutrients, potentially quantifying chloride removal, re-using the plant mass for compost or compressed into an Energy product or potentially using the byproducts of the biomass as a replacement for beet juice on roadways (Illinois Tollway, 2019; Paap, 2019; and Wetlands Research, 2019).

*Lawn Fertilizer and Paving Policy Recommendations*

- Local governments extend phosphorus regulation to all non-commercial applicators, require soil testing pre-application, or ban out-right.

- Local governments ban coal tar sealants within their jurisdiction.

- Local governments permit the use of pavement alternatives such as permeable pavers in appropriate areas.

*Stormwater Management Facility Policy Recommendations*

- Require new development and redevelopment to use stormwater management techniques/facilities that serve multiple functions including storage, water quality benefits, infiltration, and wildlife habitat.

- Require reduced runoff volume from new and retrofitted detention basins.

- Local governments allow stormwater trees or create a stormwater tree program.

*Native Landscaping/Natural Area Restoration*

- Allow native landscaping within local ordinances.

- Ensure local "weed control" ordinances do not discourage or prohibit native landscaping.

- Include short- and long-term management with performance standards for restored natural areas and stormwater features within new and redevelopment.

### 6.1.2 Dry & Wet Bottom Detention Basin Design/Retrofits, Establishment, & Maintenance

Detention basins are best described as human made depressions for the temporary storage of stormwater runoff with controlled release following a rain event. There are over 79 detention basins in Upper South Branch Kishwaukee River watershed, and most are associated with residential and urban development. Most existing wet bottom basins are essentially ponds planted with turf grass along the slopes, and the majority of the dry bottom basins are similarly planted with turf grass from end to end. These attributes do not promote water quality improvement, good infiltration, or wildlife habitat capabilities.

Studies conducted by several credible entities over the past two decades reveal the benefits of detention basins that serve multiple functions. According to USEPA, properly designed dry bottom infiltration basins reduce total suspended solids (sediment) by 58%, total phosphorus by 26%, and total nitrogen by 30%. Wet bottom basins designed to have wetland characteristics reduce total suspended solids (sediment) by 78%, total phosphorus by 44% and total nitrogen by 20% (MDEQ, 1999).

*Detention Basin Recommendations*

Future detention basin design within the watershed should consist of naturalized basins that serve multiple functions, including appropriate water storage, water quality improvement, natural aesthetics, and wildlife habitat. There are also a large number of opportunities to retrofit existing dry or wet bottom detention basins by incorporating minor engineering changes and naturalizing with native vegetation. Site-specific retrofit opportunities are identified in the Site-Specific Action Plan. Location, design, establishment, and long-term maintenance recommendations for naturalized detention basins are included below. Note: requirements of the DeKalb County Stormwater

**Figure 58.** Naturalized dry bottom infiltration basin design.

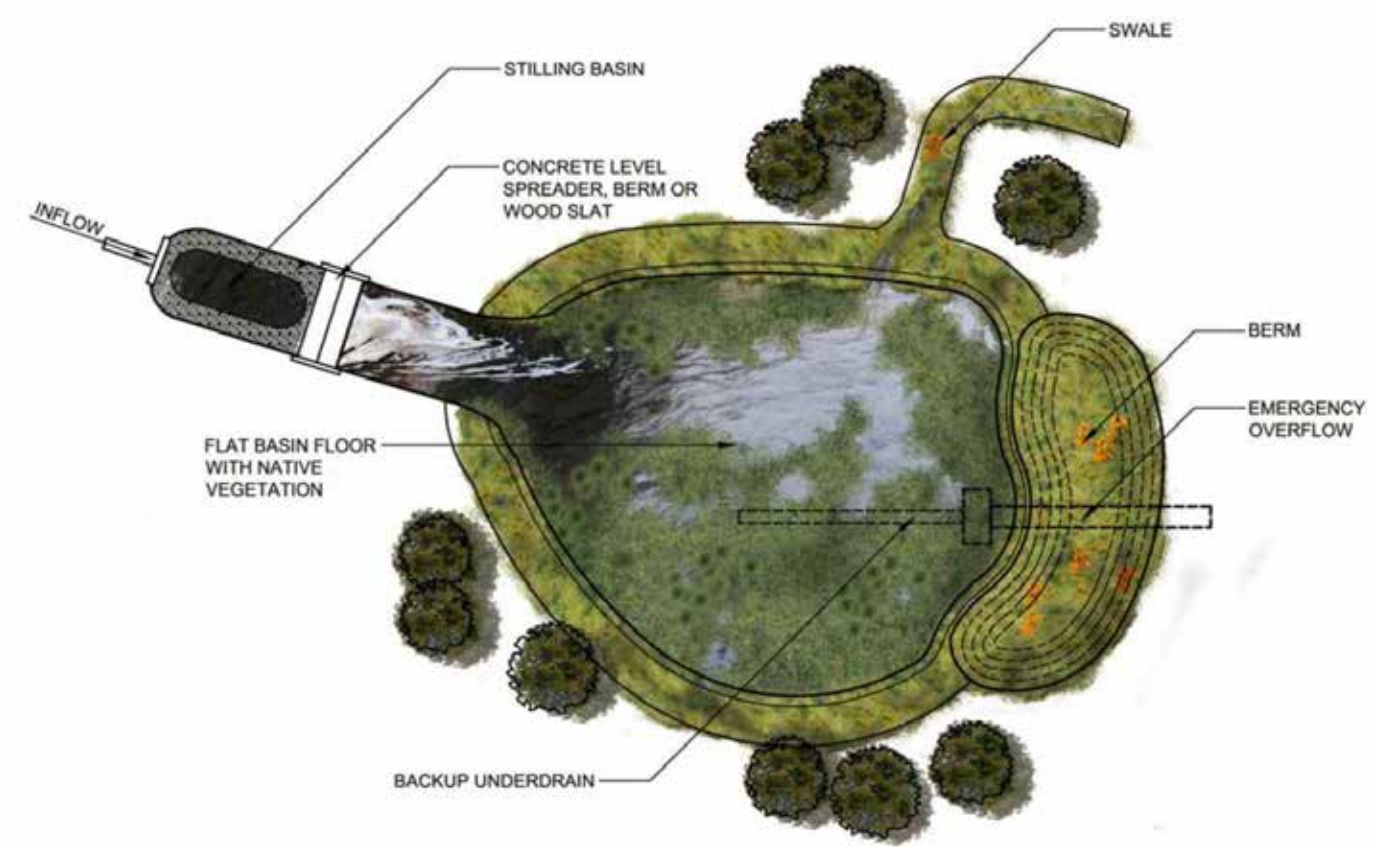
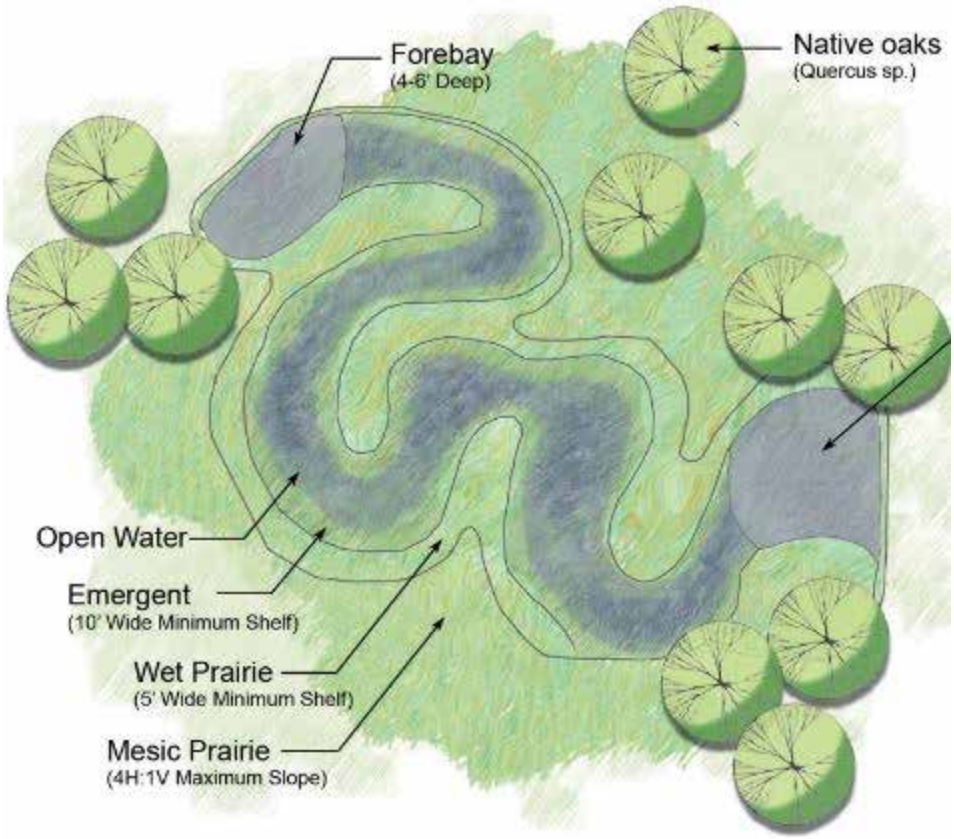



**Figure 59.** Naturalized wet bottom detention basin design.



Ordinance, such as volume and release rates, will apply to the design recommendations included below.

Detention Location Recommendations

- Naturalized detention basins should be restricted to natural depressions or previously drained hydric soil areas and adjacent to other existing green infrastructure in an attempt to aesthetically fit and blend into the landscape. Use of existing isolated wetlands for detention should be evaluated on a case by case basis.

- Basins should not be constructed in any average to high quality ecological community.

- Outlets from detentions should not enter sensitive ecological areas.

Detention Design Recommendations

- One appropriately sized, large detention basin should be constructed across multiple development sites rather than constructing several smaller basins.

- Side slopes should be no steeper than 4H:1V, at least 25 feet wide, planted to native mesic prairie, and stabilized with erosion control blanket. Native oak trees (Quercus sp.) and other fire-tolerant species should be the only tree species planted on the side slopes.

- Dry bottom basins should be planted to mesic or wet-mesic prairie depending on site conditions.

- A minimum 5-foot wide shelf planted to native wet prairie and stabilized with erosion control blanket should be constructed above the normal water level in wet and wetland bottom basins. This area should be designed to inundate after every 0.5-inch rain event or greater.

- A minimum 10-foot wide shelf planted with native emergent plugs should extend from the normal water level to 2 feet below normal water level in wet and wetland bottom basins.

- Permanent pools in wet and wetland bottom basins should be at least 4 feet deep.

- Irregular islands and peninsulas should be constructed in wet and wetland bottom basins to slow the movement of water through the basin. They should be planted to native mesic or wet prairie depending on elevation above normal water level.

- A 4-6-foot-deep forebay, accessible to operations & maintenance crews, should be built at inlet(s) of wet/wetland bottom basins to capture sediment; a 4-6-foot-deep micropool should be constructed at the outlet to prevent clogging.

Short Term (3 Years) Native Vegetation Establishment Recommendations

In most cases, the developer or owner should be responsible for implementing short term management of detention basins and other natural areas to meet a set of performance standards. Generally speaking, a minimum of three years of management is needed to establish native plant communities within detention basins. Measures needed include mowing during the first two growing seasons following seeding to reduce annual and biennial weeds. Spot herbiciding is also needed to eliminate problematic non-native/ invasive species such as thistle, reed canary grass, common reed, purple loosestrife, and emerging cottonwood, willow, buckthorn, and box elder saplings. In addition, the inlet and outlet structures should be checked for erosion and clogging during every site visit. Table 43 includes a three-year schedule appropriate to establish native plantings around naturalized detention basins.

Long Term (3 Years +) Native Vegetation Maintenance Recommendations

Long term management of most detention basins associated with development should be the responsibility of the homeowner or business association or local municipality. Often, these groups lack the knowledge and funding to implement long term management of natural areas resulting in the decline of these areas over time. Future developers should be encouraged to donate naturalized detention basins and other natural areas to a local municipality or conservation organization for long term management who receive funding via a Special Service Area (SSA) tax. Table 44 includes a cyclical long-term schedule appropriate to maintain native vegetation around detention basins; this schedule starts in year 4 and should be repeated every three years.

**Table 43.** Three-year cyclical schedule for long-term maintenance of naturalized detention basins.

| Year 1 Establishment Recommendations |
|---|
| Mow prairie areas to a height of 6-12 inches in May, July, and September. |
| Spot herbicide non-native/invasive species throughout site in late May and again in August/September. Target thistle, reed canary grass, common reed, purple loosestrife, and all emerging woody saplings. |
| Check for clogging and erosion control at inlet and outlet structures during site visit & after >1" rain event. |
| **Year 2 Establishment Recommendations** |
| Mow prairie areas to a height of 12 inches in June and August. |
| Spot herbicide non-native/invasive species throughout site in May and again in August/September. Target thistle, reed canary grass, common reed, purple loosestrife, and all emerging woody saplings. |
| Plant additional emergent plugs if needed and reseed any failed areas in fall. |
| Check for clogging and erosion control at inlet and outlet structures during site visit & after >1" rain event. |
| **Year 3 Establishment Recommendations** |
| Spot herbicide non-native/invasive species throughout site in May and again in August/September. Target thistle, reed canary grass, common reed, purple loosestrife, and all emerging woody saplings. |
| Check for clogging and erosion control at inlet and outlet structures during site visit & after >1" rain event. |

**Table 44.** Three-year cyclical long-term maintenance schedule for naturalized detention basins..

| Year 1 of 3 Year Maintenance Cycle |
|---|
| Conduct controlled burn in early spring. Mow to height of 12 inches in November if burning is restricted. |
| Spot herbicide problematic non-native/invasive species throughout site in mid-August. Specifically target thistle, reed canary grass, common reed, and emerging woody saplings such as willow, cottonwood, buckthorn, and box elder. |
| Check for clogging and erosion control at inlet and outlet structures during site visit & after >1" rain event. |
| **Year 2 of 3 Year Maintenance Cycle** |
| Spot herbicide problematic non-native/invasive species throughout site in August. Specifically target thistle, reed canary grass, common reed, and emerging woody saplings such as willow, cottonwood, buckthorn, and box elder. |
| Mow prairie areas to a height of 6-12 inches in November. |
| Check for clogging and erosion control at inlet and outlet structures during site visit & after >1" rain event. |
| **Year 3 of 3 Year Maintenance Cycle** |
| Spot herbicide problematic non-native/invasive species in August. Specifically target thistle, reed canary grass, common reed, and emerging woody saplings. Cutting & herbiciding stumps of some woody saplings may also be needed. |
| Check for clogging and erosion control at inlet and outlet structures during site visit & after >1" rain event. |
| **Cycle begins again with Year 1 of Maintenance Cycle above** |

### 6.1.3 Rain Gardens

Rain gardens have become a popular new way of creating a perennial garden that cleans and infiltrates stormwater runoff from rooftops and sump pump discharges. A rain garden is a small shallow depression that is typically planted with deep rooted native wetland vegetation. These small gardens can be installed in a variety of locations but work best when located in existing depressional areas or near gutters and sump pump outlets. Not only do rain gardens clean and infiltrate water, they also provide food and shelter for many birds, butterflies, and insects. Rain gardens are typically 100-300 square feet in size, should be installed outside of wetlands and floodplains, and planted with native plants to improve water quality and habitat benefits. They should be placed at least 10 feet away from any building or structure and need to be excavated to a depth of 18-24 inches below the exiting grade. Soil amendments are usually required to ensure support of native plants. After installation, rain gardens require ongoing maintenance to ensure they are performing properly.

The intent of a rain garden program for residents is to encourage and provide an incentive for applicants to install rain gardens on private property to "micro-manage" stormwater runoff as close to the source (like downspouts, driveways, sump pump discharges) as possible. Typically, this incentive comes in the form of a cost-share program designed to reimburse residents for a portion of the costs incurred by installing a rain garden on their property.

*Rain Garden Recommendations*
Information programs in the watershed should focus on teaching residents and businesses the beneficial uses of rain gardens and how to build and maintain them. Local governments and public agencies in the watershed should also install demonstration rain gardens as a way for the general public to better understand their application. Local governments and the DeKalb County Soil and Water Conservation District could hold rain garden training seminars and potentially provide partial funding to residents and businesses that install rain gardens.

### 6.1.4 Vegetated Swales (Bioswales)

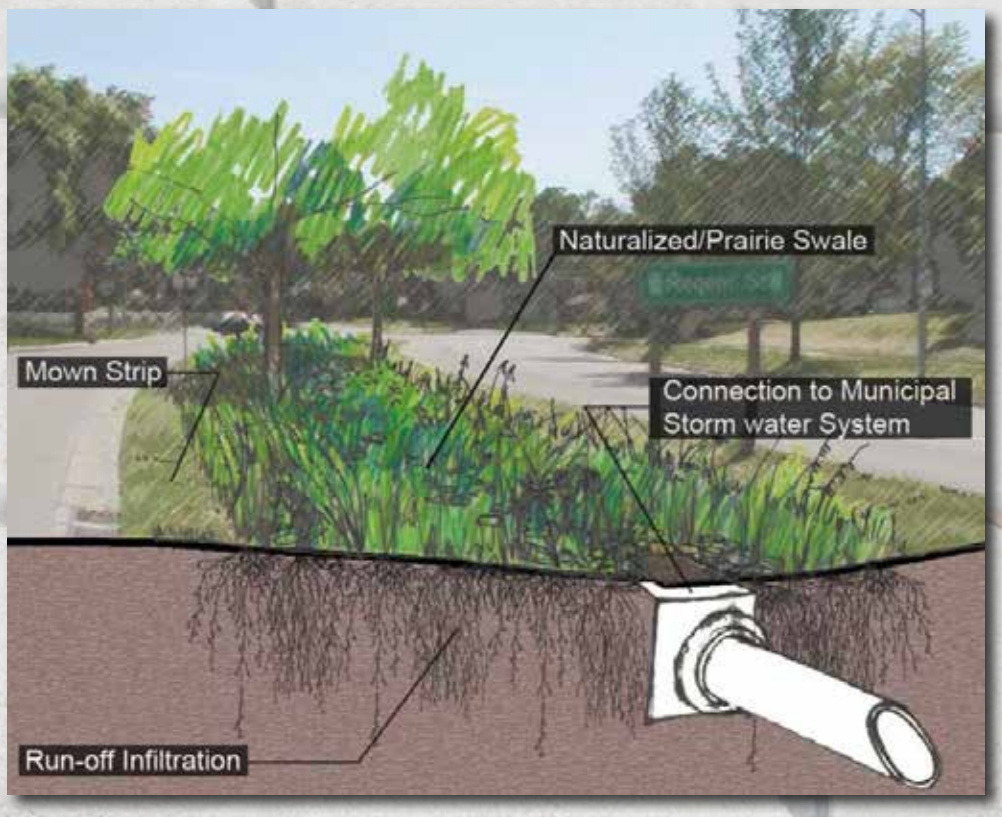
Vegetated swales, also known as bioswales, are designed to convey water and can be modified slightly to capture and treat stormwater for the watershed. Vegetated swales are designed to remove suspended solids and other pollutants from stormwater running through the length of the swale. The type of vegetation can dramatically affect the functionality of the swale. Turf grass is not recommended because it removes less suspended solids than native plants. In addition, vegetated swales can add aesthetic features along a roadway or trail. They can be planted with wetland plants or a mixture of rocks and plant materials can be used to provide interest. Swales can be designed as either wet or dry swales. Dry swales include an underdrain system that allows filtered water to move quickly through the stormwater treatment train. Wet swales retain water in small wetland like basins along the swale. Wet swales act as shallow, narrow wetland treatment systems and are often used in areas with poor soil infiltration or high water tables.

*Rain garden adjacent to single family home*

Water quality is improved by filtration through engineered soils in dry swales and through sediment accumulation and biological systems in wet swales. According to USEPA, vegetated swales reduce total suspended solids (sediment) by 65%, total phosphorus by 25%, and total nitrogen by 10% (MDEQ, 1999).

*Vegetated Swale Recommendations*

Vegetated swales should be used in place of pipes or curbs in new and redevelopment where feasible. Swales can easily be integrated into various urban fabrics with curb cuts for water to access them from roadways, or they can be added between existing lots or in the grassy parkways between roads and sidewalks. Typically, swales are used in lower density settings where infiltration might be maximized. Dry swales should be used for smaller development areas with small drainages. Wet swales should be used along larger roadways, small parking areas, and commercial developments.




*Rendering of dry vegetated swale with engineered soils. Overlay: One type of pervious pavers.*

### 6.1.5 Pavement Alternatives

Pervious concrete, permeable asphalt, and paver systems are potential alternatives to conventional asphalt or concrete parking lots and roadways. These alternatives allow for natural infiltration of the water by allowing water that falls on the surface to flow to a storage gallery through holes in the pavement. Areas that are paved with pervious pavement produce less stormwater runoff than conventionally paved areas.

Traditionally, the quantity and quality of water running off of paved and other impermeable surfaces are the primary reason for the need for stormwater treatment. Pavement alternatives reduce runoff rates and volumes and can be used in almost every capacity in which traditional asphalt, concrete, or pavers are used.

Pavement alternatives capture first flush rainfall events and allow water to percolate into the ground. Pavement alternatives treat stormwater through soil biology and chemistry as the water slowly infiltrates. Groundwater and aquifers are recharged and water that might otherwise go directly to streams will slowly infiltrate, reducing flooding and peak flow rates entering drainage channels. Studies documented by USEPA show that properly designed and maintained pervious pavements reduce total suspended solids (sediment) by 90%, total phosphorus by 65%, and total nitrogen by 85% (MDEQ, 1999).

In recent years, concerns have been raised about the environmental effects of the use of coal-tar sealants. Coal-tar sealant is a surface treatment typically applied to protect asphalt on driveways and parking lots which contains polycyclic aromatic hydrocarbons (PAHs). PAHs are a group of chemicals that have been linked to cancer in humans and have been shown to be toxic to aquatic life and damaging to the environment (Needleman, 2015). According to studies, "PAHs are significantly elevated in stormwater flowing from parking lots and other areas where coal-tar sealcoats were used as compared to stormwater flowing from areas not treated with the sealant (USEPA, 2016)." Pervious concrete, permeable asphalt, and paver systems are all potential alternatives to the need for coal-tar sealants. Additionally, several states and municipalities have banned the use and/or sale of coal-tar sealants to further protect their communities.

*Pervious Pavement Recommendations*

Future development and redevelopment in the Upper South Brank Kishwaukee River watershed should consider the use of pavement alternatives, particularly for parking lots that receive high levels of public use. Pavement alternatives can be used in a variety of settings including parking lots, parking aprons, private roads, fire lanes, alleys. residential driveways, sidewalks, and bike paths. It is important to note that there are limitations to using pavement alternatives based on subsoil composition and they do require annual maintenance to remain effective over time.


*Left: Filter strip along municipal building in Algonquin, Illinois; Right: Native landscaping near residential home. Source: Mike Halverson.*

### 6.1.6 Vegetated Filter Strips

Vegetated filter strips are shallowly sloped vegetated surfaces that remove suspended sediment, and nutrients from sheet flow stormwater that runs across the surface. This Management Measure is often referred to as a buffer strip. The type of vegetation can dramatically affect the functionality of the filter strip. Filter strips can either be planted or can be comprised of existing vegetation. Turf grass should be avoided as it removes less total suspended solids than filter strips planted with native vegetation.

The wider they are the more effective filter strips are because the amount of time water has for interception/ interaction with the plants and soil within the filter strip is increased. When installed and functioning properly, the USEPA has documented that filter strips can reduce total suspended solids (sediment) by 73%, total phosphorus by 45%, and total nitrogen by 40% (MDEQ, 1999).

*Vegetated Filter Strip Recommendations*
Vegetated filter strips work in a variety of locations. Vegetated filter strips in rural and urban areas should be installed along streams, lakes, or ponds. Additionally, they can be used adjacent to buildings and parking lots that sheet drain. The water would then pass through the vegetated filter strip and into a waterway, such as a vegetated swale, stream, lake, pond, or other stormwater feature.

### 6.1.7 Natural Area Restoration & Native Landscaping

Natural area restoration and native landscaping are essentially one in the same but at different scales. Natural area restoration involves transforming a degraded natural area into one that exhibits better ecological health and is typically done on larger sites such as nature/forest preserves. Native landscaping is done at smaller scales around homes or businesses and is often formal in appearance. Both require the use of native plants to create environments that mimic historic landscapes such as prairie, woodland, and wetland. Native plants are defied as indigenous, terrestrial or aquatic plant species that evolved naturally in an ecosystem. The use of native plants in natural area or native landscaping is well documented. They adapt well to environmental conditions, reduce erosion, improve water quality, promote water infiltration, do not need fertilizer, provide wildlife food and habitat, and have minimal maintenance costs.

Several environmental agencies support the use of native plants including Illinois Nature Preserves Commission (INPC), Illinois Department of Natural Resources (IDNR), Forest Preserve District of DeKalb County (FPDDC), DeKalb County Soil and Water Conservation District (SWCD), U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS), National Wildlife Federation (NWF), and the Conservation Foundation (TCF).

*Natural Area Restoration/Native Landscaping Recommendations*
Large residential lots with existing natural components such as oak woodlands and wetlands and golf courses provide many of the best opportunities for natural area restoration and native landscaping at a larger scale. Homeowners interested in restoring natural areas or implementing native landscaping can find guidance through the agencies listed above or by contacting a local ecological consulting company. Backyard habitats can be certified through

the National Wildlife Federation's Certified Wildlife Habitat program or Conservation Foundation's Conservation@Home program.

There are three golf courses in the watershed, and all are situated along Upper South Branch Kishwaukee River or its tributaries within the identified Green Infrastructure Network. These golf courses could improve their function as green infrastructure by implementing natural area restoration into existing designs. The Audubon Cooperative Sanctuary Program (ACSP) is an education and certification program that helps golf courses protect the environment by providing guidance for outreach and education, resource management, water quality and conservation, and wildlife habitat management. A golf course becomes certified under the program when implementing and documenting recommended environmental management practices. Annual program membership fees are $200.

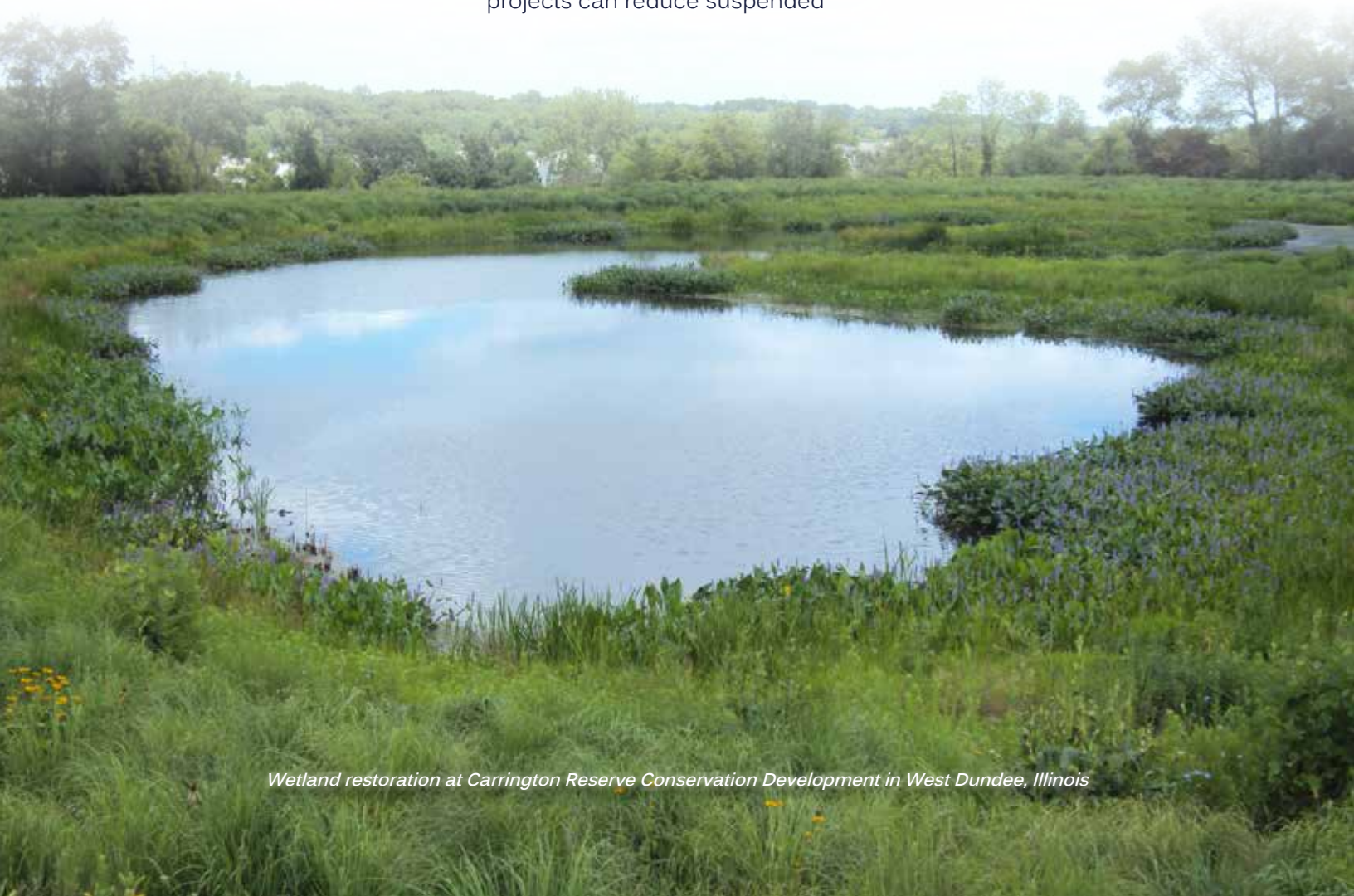
### 6.1.8 Wetland Restoration

Over 24,164 acres or 94% of the historic wetlands in Upper South Branch Kishwaukee River watershed have been lost to farming and other development practices since European settlement in the 1830s. Wetlands are essential for water quality improvement and flood reduction in any watershed and also provide habitat for a wide variety of plant and animal species.

Over 1,300 acres of drained wetland was discovered in areas of the watershed where wetland restoration might be possible but many of these areas are located on land that is currently in agricultural production and in some cases, areas slated for future residential development. The wetland restoration process involves returning hydrology (water) and vegetation to soils that once supported wetlands. The USEPA estimates that wetland restoration projects can reduce suspended solids (sediment) by 77.5%, total phosphorus by 44%, and total nitrogen by 20% (MDEQ, 1999).

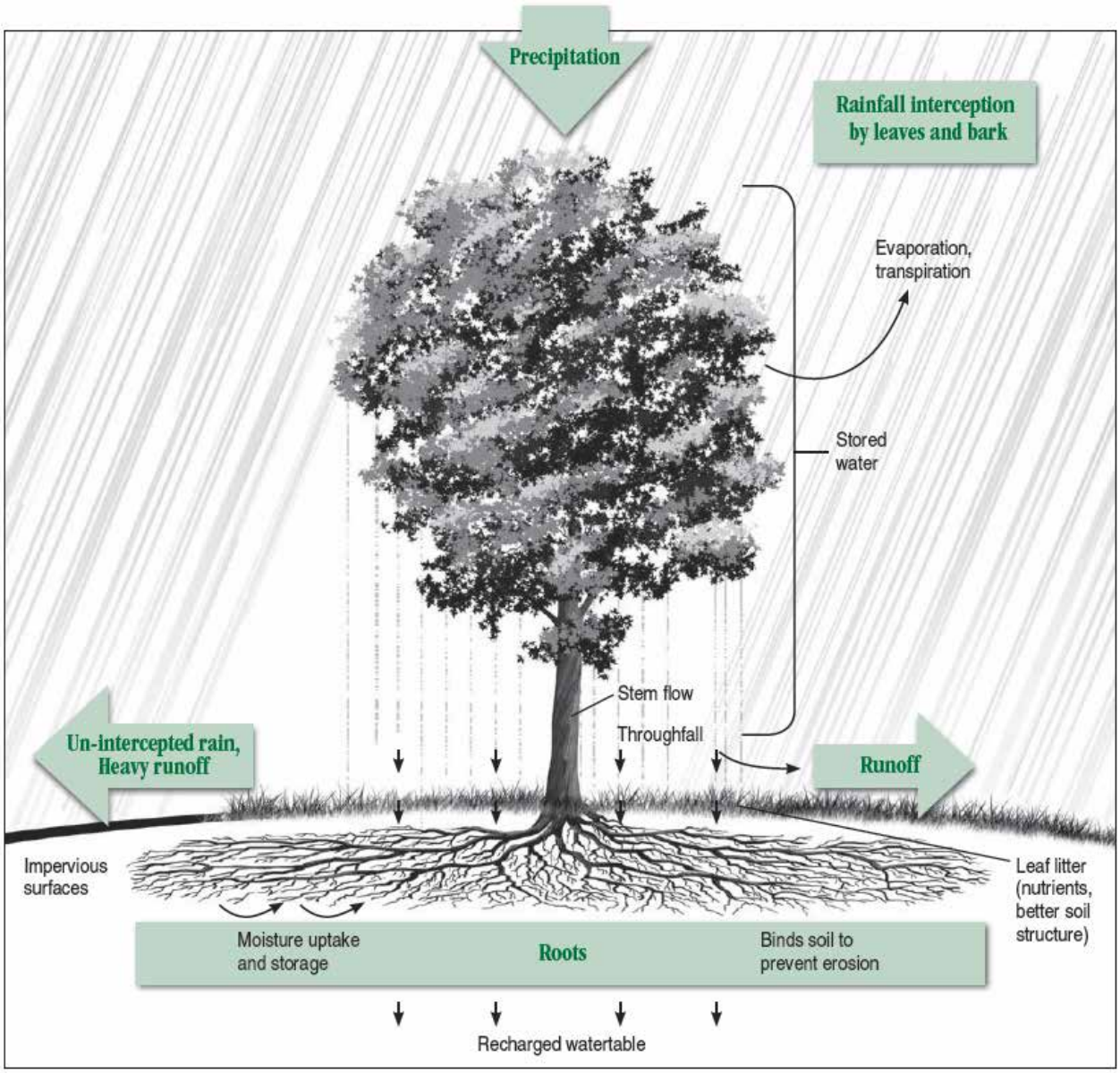
*Wetland Restoration Recommendations*

Local governments should strongly consider requiring "Conservation Design" that incorporates wetland restoration on parcels slated for future development. Another potential option is to restore wetlands as part of a wetland mitigation bank where wetlands are restored on private land and become "fully certified." Then, developers are able to buy wetland mitigation credits from the wetland bank for wetland impacts occurring elsewhere in the watershed. It is also possible that in the future, Illinois EPA may require more strict nutrient policies for wastewater treatment plants. Wetland banks may provide an opportunity for WWTP owners to buy "water quality trading credits." The Site-Specific Action Plan section of this report identified sites where wetland restoration might be feasible.



*Wetland restoration at Carrington Reserve Conservation Development in West Dundee, Illinois*

**Figure 60.** Illustration of how trees help with stormwater management (Source: Fazio, 2010).




### 6.1.9 Stormwater Trees/ Tree Planting Program

Trees provide extensive evapotranspiration and cooling benefits, improve water and air quality, provide habitat, increase property values, and improve aesthetics in urban landscapes (see Figure 60). Trees play a valuable role in trapping absorbing stormwater, reducing pollutants, and holding soils in place during rain events and help to recharge groundwater supplies. A 25-foot canopy diameter tree can process the runoff of a 2,400 square foot adjacent impervious surface (EPA, 2016). Depending on the size and species, one tree can store 100 gallons or more of stormwater (Fazio, 2010).

Implementing a successful stormwater tree program can be complicated. Space and soil quality constraints can often be the limiting factors on whether a site is appropriate for installing stormwater trees. Other constraints include finding an appropriate species of tree, steep slopes, utility lines, impervious surfaces and pre-existing structures. With a little planning and engineering, many of these constraints can be overcome. In 2016, the USEPA produced a Technical Memorandum on Stormwater Trees that provides detailed information on the benefits and challenges to implementing an effective Stormwater Tree program and maintaining the trees over time. This report is available on the USEPA's website at https://www.epa.gov/green-infrastructure/stormwater-trees.

*Tree Program Recommendations*
Municipalities in the watersheds should consider adopting a stormwater tree or tree planting program where these are not already in place.

### 6.1.10 Street Sweeping & Yard Waste Management

Street sweeping is often overlooked as a Management Measure option to reduce pollutant loading in watersheds. With over 3,000 acres dedicated to transportation and roads in the watershed, municipal street sweeping programs could significantly reduce non-point source pollutants from urban areas in Upper South Branch Kishwaukee River watershed. Street sweeping works because pollutants such as sediment, trash, road salt, oils, nutrients, and metals that would otherwise wash into stormsewers and streams following rain events are gathered and disposed of properly. The USEPA and Center for Watershed Protection (CWP) report similar pollutant removal efficiencies for street sweeping; weekly street sweeping can remove between 9% and 16% of sediment and between 3% and 6% of nitrogen and phosphorus (MDEQ, 1999; CWP 2007).

Yard waste, such as grass clipping and leaf litter, can also impact water quality when not managed correctly. "Grasscycling and composting are two techniques homeowners can use to reduce waste disposal and possible water contamination as well as save time, money and energy while returning valuable nutrients back into their lawns and gardens. (Gibbs, 2012)" Composting of yard waste and grasscyclying, or leaving grass clippings on a lawn, can keep nutrients such as nitrogen in place. When grasscycling or composting, it is important to keep clippings on the lawn and off sidewalks, driveways, or other impervious surfaces where they might otherwise get washed into adjacent drainage systems or become a safety hazard (Gibb, 2012).

*Street Sweeping & Yard Waste Management Recommendations*

It is likely that several if not all of the municipalities in the watershed already implement street sweeping to some degree. The frequency of street sweeping is a matter of time and budget and should be determined by each municipality. Weekly street sweeping would provide the best results but bi-weekly sweeping is cited as being sufficient in most cases. Homeowners should also compost yard waste and practice grasscycling at home.

*Routine street sweeping is an effective Management Measure. Source: USGS.*

### 6.1.11 Stream & Riparian Area Restoration & Maintenance

Streambank erosion is fairly limited in Upper South Branch Kishwaukee River watershed, while channelization is common throughout the upper half of the watershed. Stream surveys reveal that about 5% (20,081 lf) of stream length in the watershed is highly eroded and 78% (288,177 lf) is highly channelized. Pollutant modeling indicates that over 13,500 tons/yr of sediment or 40% of sediment loading comes from eroded streambanks. In addition, riparian areas adjacent to streams are suffering as 81% are in poor ecological condition.

Stream and riparian area restoration is one of the best Management Measures that can be implemented to improve degraded stream and riparian area conditions. This work involves improvements to a stream channel using artificial pool-riffle complexes, streambank stabilization using a combination of bioengineering with native vegetation and hard armoring with rock if needed, and adjacent riparian area improvements via removal of non-native vegetation and replacement with native species. These practices are typically done together as a way to improve water quality by reducing sediment transport, increasing oxygen, and improving habitat. The USEPA cites that as much as 90% of sediment, phosphorus, and nitrogen can be reduced following stream restoration. The downside to stream restoration is that it is technical and expensive. Stream restoration projects include detailed construction plans, often complicated permitting, and construction that must be done by a qualified contractor.

With so many individual landowners with parcels intersecting Upper South Branch Kishwaukee River and its tributaries, routine maintenance of stream systems is challenging. In many cases, landowners simply do not have the knowledge or are not physically capable of maintaining streams on their property. Stream maintenance includes an ongoing program to remove blockages caused by accumulated sediment, fallen trees, etc. and is a cost-effective way to prevent flooding and streambank erosion.

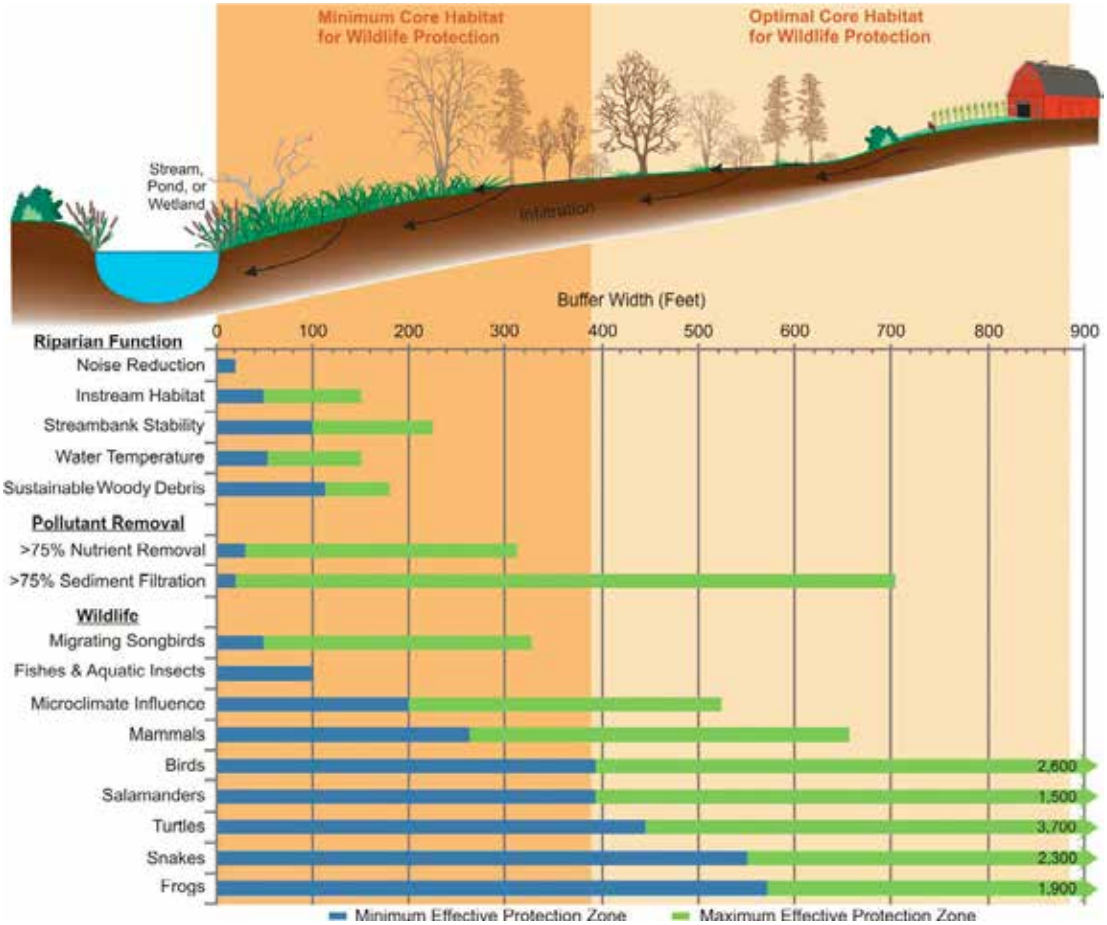
*Stream restoration project in Barrington, IL.*

Riparian buffers are defined as land adjoining any water body including ponds, lakes, streams, and wetlands. In 2010 the Southeastern Wisconsin Regional Planning Commission (SEWRPC) produced a document entitled “Managing the Water’s Edge: Making Natural Connections” (SEWRPC, 2010). The research presented in SEWRPC’s document was conducted to determine if an optimal riparian buffer design or width could be determined that effectively reduces pollutants, provides water quality protection, helps prevent channel erosion, provides adequate fish and wildlife habitat, enhances environmental corridors, augments baseflow, and moderates water temperature.

Interestingly, no consensus of optimal buffer width could be determined but what is apparent is that many riparian corridors no longer fulfill their potential due to encroachment by agricultural and urban development. SEWRPC’s document summarizes how to maximize both water quality protection and conservation of aquatic and terrestrial wildlife populations using buffers as shown in Figure 61.

As described in SERWPC’s document, implementing the green infrastructure network to connect open space and other natural area features should be embraced, whereby 75% minimum of the total stream length should be naturally vegetated to protect the functional integrity of the water resource and

**Figure 61.** Riparian function, pollutant removal, and wildlife benefits for various buffer widths (Source: SEWRPC) 2010).




75 foot wide minimum riparian buffers are recommended from the top edge of each stream bank that are naturally vegetated to protect water quality.

Finally, the majority of stream reaches in the watershed are highly channelized as a result of agricultural ditching practices. However, most of these channelized streams exhibit very little streambank erosion because they are in the final stages of the Stream Evolution Model (see Section 3.14.1 for more information). This observation is extremely important as it relates to improving water quality in the watershed, and stable two stage channels that form on agricultural lands should be protected and maintained during landowner maintenance activities.

*Stream & Riparian Area Recommendations*

There are many opportunities to implement stream and riparian area restoration in the watershed. These opportunities are identified in the Site-Specific Action Plan. Where existing riparian area buffers are less than 75 feet, recommendations have been made to extend buffers where possible; that said, extending a riparian buffer to 75 feet where no buffer exists in not always achievable. In these cases, typically recommendations included increasing the buffer to 50 feet along each bank. Finally, where a stable two stage channel (Stage 5) forms in agricultural ditches, it should be protected and maintained during landowner maintenance activities. All stream and riparian area opportunities are identified in the Site-Specific Action Plan.

As far as stream maintenance goes, the Lake County Stormwater Management Commission (LCSMC) is a leader in the Chicago land area when it comes to managing stormwater and has developed an excellent guide for riparian owners called “Riparian Area Management: A Citizen’s Guide.” This short flyer can be found on Lake County’s website and is intended to educate landowners about debris removal and riparian landscaping. It is also important to note that not all debris in streams is harmful. The American Fisheries Society has created a short document called “Stream Obstruction Removal Guidelines” which is meant to clarify the appropriate ways to maintain obstructions in streams to preserve fish habitat.

### 6.1.12 Septic System Maintenance

Septic systems are common in the more rural portions of the Upper South Branch Kishwaukee River watershed; it is estimated that over 1,200 septic systems likely exist in the watershed. Septic systems in DeKalb County are regulated under the Water Wells and Waste and Sewage Disposal section of the DeKalb County Code. When septic systems are not maintained and subsequently fail, they can contribute high levels of nutrients and bacteria to the surrounding environment. The failure rate of septic systems in the watershed is unknown. However, literature sources across the nation indicate a failure rate of approximately 20% (Brown, 1998; Mancl, 1984; Stout, 2003; UKCE, 2012). According to the pollutant loading analysis, septic systems are likely contributing 7,660 lbs/yr (1%) of total nitrogen loading and 3,000 lbs/yr (6%) of total phosphorus loading in the watershed.

*Septic System Recommendations*
Septic owners should contact the DeKalb County Health Department (DCHD) to schedule a septic system inspection to ensure that they are designed and operating properly. The County also has additional guidelines and restrictions for septic system owners including restrictions on the proximity of lawn sprinkler systems, upgrade requirements for hot tubs, garbage grinders, or building additions, and how landscaping might affect septic systems. More information and resources are available online at https://health.dekalbcounty.org/services/well-septic/. USEPA also provides an excellent guide for septic system owners called "A Homeowner's Guide to Septic Systems (USEPA, 2005)." The guide explains how septic systems work, why and how they should be maintained, and what makes a system fail. DCHD should also conduct an inventory of septic systems within the watershed and the condition that they are in as well as hold educational workshops for septic system owners about proper maintenance techniques.


*Conservation Tillage (no till) farming. Source: farmprogress.com.*

### 6.1.13 Agricultural Management Practices

Agriculture is an integral part of the Upper South Branch Kishwaukee River watershed and is by far the most dominant land use, covering a total of 50,405 acres or 80% of the watershed. Pollutant loading estimates using USEPA's STEPL model point to cropland as the largest nonpoint source contributor of nutrient and sediment loading in the watershed, with estimates at 231,584 lbs/yr of nitrogen (28% of total loads), 47,159 lbs/yr of phosphorus (37% of total loads), and 17,813 tons/yr of sediment (53% of total loads). As such, watershed-wide changes to agricultural practices can have a dramatic effect on pollutant loading in the watershed. Fortunately, there are numerous agricultural measures and funding sources that can be utilized by farmers to implement practices on their land to improve water quality and soil health, while reducing soil and nutrient losses. Many recommended programs are offered through the DeKalb County Soil and Water Conservation District (SWCD), U.S. Department of Agriculture (USDA) Natural Resource Conservation Program (NRCS), and Farm Service Agency (FSA). These agencies are discussed in depth in Section 3.5.

*USDA NRCS- Environmental Quality Incentive Program (EQIP)*
The NRCS's Environmental Quality Incentive Program (EQIP) is a voluntary conservation program that provides technical and financial assistance to individuals/entities to address soil, water, air, plant, animal and other related natural resource concerns on their land. EQIP offers financial and technical help to assist participants to install or implement structural and management practices on eligible agricultural land. As the most popular and most utilized conservation program offered by NRCS, EQIP assists thousands of producers annually

in working towards: reducing contamination from agricultural sources such as animal feeding operations, efficiently utilizing nutrients and therefore reducing input costs and nonpoint source pollution, and increasing soil health to improve resiliency to drought and increasingly volatile weather.

This program is available to farmers, ranchers, and forest landowners who own or rent agricultural land. EQIP assistance can be used for agricultural operations such as: conventional and organic agriculture, specialty and commodity crops, forestry and wildlife, livestock operations, and historically underserved farmers. Historically underserved farmers including beginning farmers, farmers with limited resources or those in socially disadvantaged groups, as well as military veterans, are eligible for increased or advance payments following changes in the 2018 Farm Bill.

Other expansions of EQIP under the 2018 Farm Bill include expanding eligibility regarding with whom NRCS can enter into an EQIP contract. Under these expansions, NRCS can enter into contracts with water management entities when they are in support of water conservation or an irrigation efficiency project. Eligible entities include: States, irrigation districts, ground water management districts, or other similar entities.

Beginning in 2020, States may provide increased EQIP payment rates for high-priority practices. Eligible high-priority practices include those that address specific causes of ground or surface water impairment relating to excessive nutrients, address the conservation of water to advance drought mitigation and declining aquifers, meet other environmental priorities and other priority resource concerns identified in habitat or other area restoration plans, or is geographically targeted to address a natural resource concern in a specific watershed. NRCS State Conservationists may designate up to 10 practices to be eligible for increased payments.

No-till is a land management option within the EQIP program and is the leading recommendation for farmers in Upper South Branch Kishwaukee River watershed. With no-till, the land is left undisturbed from harvest through planting, preserving a canopy of crop residue on the surface to protect the soil from erosion. Along with soil conservation benefits, high fuel prices are driving a switch to no-till for many farmers. Eliminating tillage passes reduces both fuel and labor expenses (USDA, 2020).

*Agricultural Conservation Easement Program (ACEP)*
The Agricultural Conservation Easement Program (ACEP) was created in the 2014 Farm Bill through the combination of the previously separate Wetlands

Reserve Program (WRP), Grassland Reserve Program (GRP), and Farm and Ranch Lands Protection Program (FRPP). These programs were originally ratified in 1990, 1996, and 2002 Farm Bills respectively.

The Agricultural Conservation Easement Program assists landowners, land trusts, and other entities protect, restore, and enhance wetlands, grasslands, and working farms and ranches through conservation easements. There are two components to ACEP, the Agricultural Land Easements component and the Wetland Reserve Easement component. The NRCS Agricultural Land Easements component helps American Indian tribes, state and local governments, and nongovernmental organizations protect working agricultural lands and limit non-agricultural uses of the land. NRCS Wetland Reserve Easements component, helps to restore, protect, and enhance enrolled wetlands through the purchase of easements and assistance in restoration (NSAC, 2019).

*ACEP - Wetland Reserve Easements (WRE)*
The Wetlands Reserve Easement program (WRE) is a voluntary program offering farmers the opportunity to protect, restore, enhance, and protect wetlands on their property. The NRCS provides technical and financial support to help landowners with their wetland restoration efforts. The goal of NRCS is to achieve the greatest wetland functions and values, along with optimum wildlife habitat, on every acre enrolled in the program. This program offers landowners an opportunity to establish long-term conservation and wildlife practices and protection.
Land that's eligible for enrollment in ACEP as a Wetland Reserve Easement includes farmed or converted wetland that can be successfully restored as natural wetland habitat in a cost-effective manner. NRCS prioritizes applications for Wetland Reserve Easements based upon their potential for protecting and enhancing habitat for migratory birds and other wildlife.

NRCS enters into purchase agreements with eligible landowners which include the right to develop and implement a wetland reserve restoration easement plan. These plans aim to restore, protect, and enhance the functions and value of the site's wetlands.

Landowners who choose to enroll land in a Wetland Reserve Easement may sell a conservation easement or enter into a cost-share restoration agreement with NRCS to restore and protect wetlands. These easement options include:

- Permanent Easements – These are conservation easements in perpetuity, with NRCS paying 100 percent of the value of the easement to purchase it, and 75 to 100 percent of the cost to restore it.

- 30-Year Easements – Under 30-year easements, NRCS pays 50 to 75 percent of the value of the easement to purchase it, and 50 to 75 percent of the cost to restore it.

- Term Easements – The length of term easements is determined by applicable state laws. NRCS pays 50 to 75 percent the value of the easement to purchase, and 50 to 75 percent of the cost to restore it.

- 30-Year Contracts – 30-year contracts are only available to enroll acreage owned by American Indian Tribes, and program payment rates are similar to that of 30-year easements.

Landowners and NRCS then develop a plan for the restoration and maintenance of the wetland. As a requirement of the program, landowners voluntarily limit future use of the land, yet retain private ownership.

ACEP's wetlands component also includes a wetlands reserve enhancement partnership option (formerly known as the Wetlands Reserve Enhancement Program, WREP) through which NRCS partners with states, non-governmental organizations, or Native American Tribes to protect, restore, and enhance high priority wetlands.

This partnership option is a voluntary program in which NRCS, and eligible partners sign an agreement to leverage resources in restoring high priority wetland protection, restoration, and enhancement to improve habitat for migratory birds and other wildlife. Benefits include wetland restoration and protection of critical areas, ability to cost-share restoration or enhancement beyond NRCS requirements through leveraging resources, and the ability to participate in the management and monitoring of projects with the support of the NRCS's expertise in restoration practices.

Wetland reserve easements enable landowners to reduce impacts from flooding, recharge groundwater, enhance and protect wildlife habitat and provide outdoor recreational and educational opportunities. As with the original WREP, producers can retain grazing rights as part of a wetland easement if the grazing activity is consistent with long-term wetland protection and enhancement goals for which the easement was established. The easement payment would be reduced by an amount equal to the grazing value (USDA, 2020).

*ALE- Agricultural Land Easements (ALE)*

The purpose of the Agricultural Land Easement (ALE) component is to protect farms and ranches from development, specifically to ensure farm viability for future generations, and to conserve grazing land, rangeland, pasture and shrub land. NRCS provides financial assistance to eligible partners for purchasing Agricultural Land Easements that protect the agricultural use and conservation values of eligible land.

In the case of working farms, the program helps farmers and ranchers keep their land in agriculture. The program also protects grazing uses and related conservation values by conserving grassland, including rangeland, pastureland and shrubland. Eligible partners include American Indian tribes, state and local governments and non-governmental organizations that have farmland, rangeland or grassland protection programs.

For Agricultural Land Easements, NRCS can contribute up to 50 percent of the fair market value of the agricultural land easement. Where NRCS determines that grasslands of special environmental significance will be protected, NRCS may contribute up to 75 percent of the fair market value of the agricultural land easement. Eligible entities can now include cash contributions, landowner contributions, or other non-USDA federal funding to satisfy the match requirements.

The 2018 Farm Bill removed the requirement that all agricultural land easement enrollments under ACEP must have a conservation plan, it is now required only for the portions of the agricultural land easement that are highly erodible cropland.

Additionally, the 2018 Farm Bill adds a new priority in evaluating proposals for easements that maintain agricultural viability. This priority includes easements that allow a producer to: productively operative a farm or ranch on the protected land; maintain the long-term affordability of the protected land; maintain an economically sustainable farm business on the land; and maintain the land in a way that enables its agricultural use for future generations.

The 2018 Farm Bill also allows for entities holding an ALE to add deed terms that address mineral

*Farm north of Bethaney Road*

*Above: Grass waterway on highly erodible agricultural land . Source: NRCS.*

development. In instances when mineral development rights are reserved and exercised under ACEP, the activity should be consistent with the conservation and agricultural purposes of the land and all provisions of the program.

Under the agricultural land easement component, ACEP funds are provided to non-profits (such as land trusts), state and local agencies, and Indian tribes to purchase easements. Agricultural land easements are permanent; in states that do not allow permanent easements, the easements will be as long-term as allowed by law.

To qualify for an ALE the easement must have prime, unique, or productive soil (or contain historical or archaeological resources, protect grazing uses by restoring and conserving land, or further a state or local policy consistent with program purposes.) The easement must also be either cropland, rangeland, or grassland; contain forbs or shrub land for which grazing is the predominant use; be located in an area which is historically grassland, forbs, or shrubs and could provide ecologically significant habitat; or be pastureland or non-industrial private forestland which contributes to economic viability of a parcel and serves as a buffer to protect such land from development (USDA, 2020).

*Farm Service Agency (FSA)-Conservation Reserve Program (CRP)*
The USDA Farm Service Agency's (FSA) CRP is a voluntary program that contracts with agricultural producers so that environmentally sensitive agricultural land is devoted to conservation benefits. The Food Security Act of 1985, as amended, authorized CRP. The program is implemented by FSA on behalf of USDA's Commodity Credit Corporation. In exchange for a yearly rental payment, farmers enrolled in the program agree to remove environmentally sensitive land from agricultural production and plant species that will improve environmental health and quality. Contracts for land enrolled in CRP are 10-15 years in length.

CRP participants establish long-term, resource-conserving vegetative species, such as approved grasses or trees (known as "covers"), to control soil erosion, improve the water quality and enhance wildlife habitat. The long-term goal of the program is to re-establish valuable land cover to help improve water quality, prevent soil erosion, and reduce loss of wildlife habitat. CRP protects millions of acres of American topsoil from erosion and is designed to safeguard the nation's natural resources. By reducing water runoff and sedimentation, CRP protects groundwater and helps improve the condition of lakes, rivers, ponds and streams. The vegetative covers also make CRP a major contributor to increased wildlife populations in many parts of the country.

Additionally, there is a CRP Grasslands program which helps landowners and operators protect grassland, rangeland, and pastureland while maintaining the areas as grazing lands. The program emphasizes support for grazing operations, plant and animal biodiversity, and grassland and land containing shrubs and forbs under the greatest threat of conversion.

The following conservation practices are eligible under CRP, and thus land must be suitable for any of these practices: Grass Waterway, Shallow Water Area for Wildlife, Contour Grass Strip, Filter Strip, Riparian Buffer, Denitrifying Bioreactor on Filter Strip and Riparian Buffer, Saturated Filter Strip and Riparian Buffer, Habitat Buffers for Upland Birds, Wetland and Buffer SAFE Practices, Wetland Restoration on Floodplain and Non-Floodplain, Prairie Strips, Windbreaks, Shelterbelts, Living Snow Fences, Marginal Pastureland Wetland Buffer and Wildlife Habitat Buffers, Long Leaf Pine Establishment, Duck Nesting Habitat, Pollinator Habitat, Bottomland Timber Establishment on Wetlands, Farmable Wetlands Program (FWP) Constructed Wetland, FWP Aquaculture Wetland Restoration, FWP Flooded Prairie Wetland, Farmable Wetlands and Farmable Wetland Buffer, and Wellhead Protection Area Practices.

In order to be eligible for the CRP, the landowner must have owned or operated the land for at least 12 months prior to submitting the offer (or there are certain extenuating circumstances). Cropland must be planted to an agricultural commodity, have a

weighted average erosion risk of eight or higher, be enrolled in a CRP contract currently, or be located in a CRP conservation priority area; there are no CRP conservation priority areas in the watershed.

Enrollment in CRP is offered in the form of general enrollment or continuous enrollment. In general enrollment, during annual enrollment periods, producers have the opportunity to offer land for the program which is then ranked according to the factors of the Environmental Benefits Index. This index considers: wildlife habitat benefits resulting from covers on enrolled land, water quality benefits, on-farm benefits from reduced erosion, long-term benefits that will endure beyond the contract period, air quality benefits from reduced wind erosion, and cost. Under continuous enrollment, environmentally sensitive land may be enrolled at any time though is not subject to competitive bidding (FSA, 2019).

### Other Agricultural Recommendations

Additional conservation practices and increases in the extent of reduced tillage practices in the Upper South Branch Kishwaukee River watershed are necessary to reduce cropland pollutant loading. Since 2019 was such an unusual year for the agricultural community, data gathered by the DeKalb County Soil and Water Conservation District (DCSWCD) in 2018 was used to help identify baseline agricultural conditions and practices in the watershed. Agricultural areas in DeKalb County were inventoried for tillage practices during the 2018 Illinois Soil Conservation Transect Survey conducted by DCSWCD. According to that survey, the most common tillage practice found in the watershed was reduced till with 34 of fields (39.1% of fields). Mulch till was practiced on 27 fields (31.0%), while conventional tillage was found on 20 of fields (23.0%). No-till was found at 5 sites, or 5.7% of the surveyed sites. AES recommends encouraging the 39% (19,658 acres) of cropland landowners already participating in reduced or low residue tillage (30-59% residue) to increase residue to 60% or more on their lands. This change alone could reduce watershed wide pollutant loads by 16,912 lbs/year of nitrogen, 7,506 lbs/year of phosphorus, and 3,025 tons/year of sediment and is considered a Critical Area Management Measure.

*Principles of Soil Health*

Improving water quality in runoff from agricultural lands can often be achieved by maintaining soil health and following soil health principles. There are five principles of soil health; they include soil armor, minimizing soil disturbance, plant diversity, continual live plant/root, and livestock integration. Armoring the soil refers to cover for the soil and controls erosion and evaporation rates, maintains soil temperatures, reduces compaction, suppresses weed growth and provides habitats for species. Minimizing soil disturbance reduces erosion, increases infiltration, and helps keep organic matter in the soil. Diversifying crop rotations can improve biodiversity, improves infiltration and nutrient cycling, and reduces pests. Providing some type of live plant root on a year-round basis is important for building soil health, ensuring that there is food for the soil web continuously throughout the year. Finally, integrating animals or livestock in the form of grazing can help balance the carbon to nitrogen ration, manage crop rotation, and help suppress weeds by fulfilling the natural symbiotic relationships between plants, animals, and the soil web (Fuhrer, 2018). Landowners should work with their local USDA-NRCS representative and cropping consultant to implement a system that will work for them.

*Regenerative Agriculture*

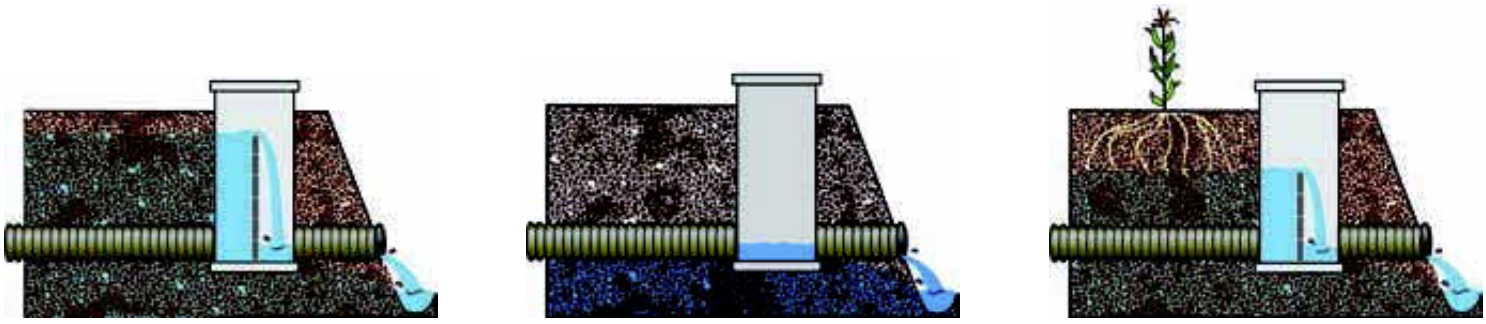
Regenerative agriculture promotes a method of farming that encourages the regeneration of topsoil, improves water quality, increases biodiversity, and supports carbon sequestration in effort to mitigate the effects of climate change (Terra Genesis International, 2016). The practice is guided by a holistic approach of making appropriate, context-specific recommendations for farmers based on agroecology and restoration ecology methodologies with the goal of rebuilding quantity and quality of topsoil while creating equitable and just relationships amongst all stakeholders. By rebuilding soil organic matter and soil health, yields should increase and fewer inputs should be needed over time. Simultaneously, the improved biomass helps to sequester carbon and offset greenhouse gases, while the reduced disturbance of the soil improves water quality (Regeneration International, 2019). Many of the practices involved are recommended by NRCS, the DeKalb County Soil and Water Conservation District, and the principles of soils health. Potential practices include "no-till/minimum tillage techniques, the use of cover crops, crop rotations, compost, and animal manures, the inoculation of soils with composts or compost extracts to restore soil microbial activity, and managed grazing (CSU Chico, 2017)."

The regenerative agriculture approach, research, and methodologies are ever evolving and need to be tailored to the context of individual farms. Many sources of additional information are available including online resources available from Regeneration International, Terra Genesis International, and California State University – Chico, among others.

*Subsurface (Tile) Drainage Best Management Practices- Drainage Water Management*

Subsurface drain tiles are a commonly used practice by farmers to help lower the water table of poorly drained fields and/or wet areas within fields. Unfortunately, nitrogen and phosphorus often find their way into tiles through cracks and macropores in the soil. The tiles then carry these nutrients to local streams.

**Figure 62.** Use of tile control to raise water table after harvest (left), drawdown prior to seeding (middle), and raised again in midsummer (right) (Source: Purdue University).



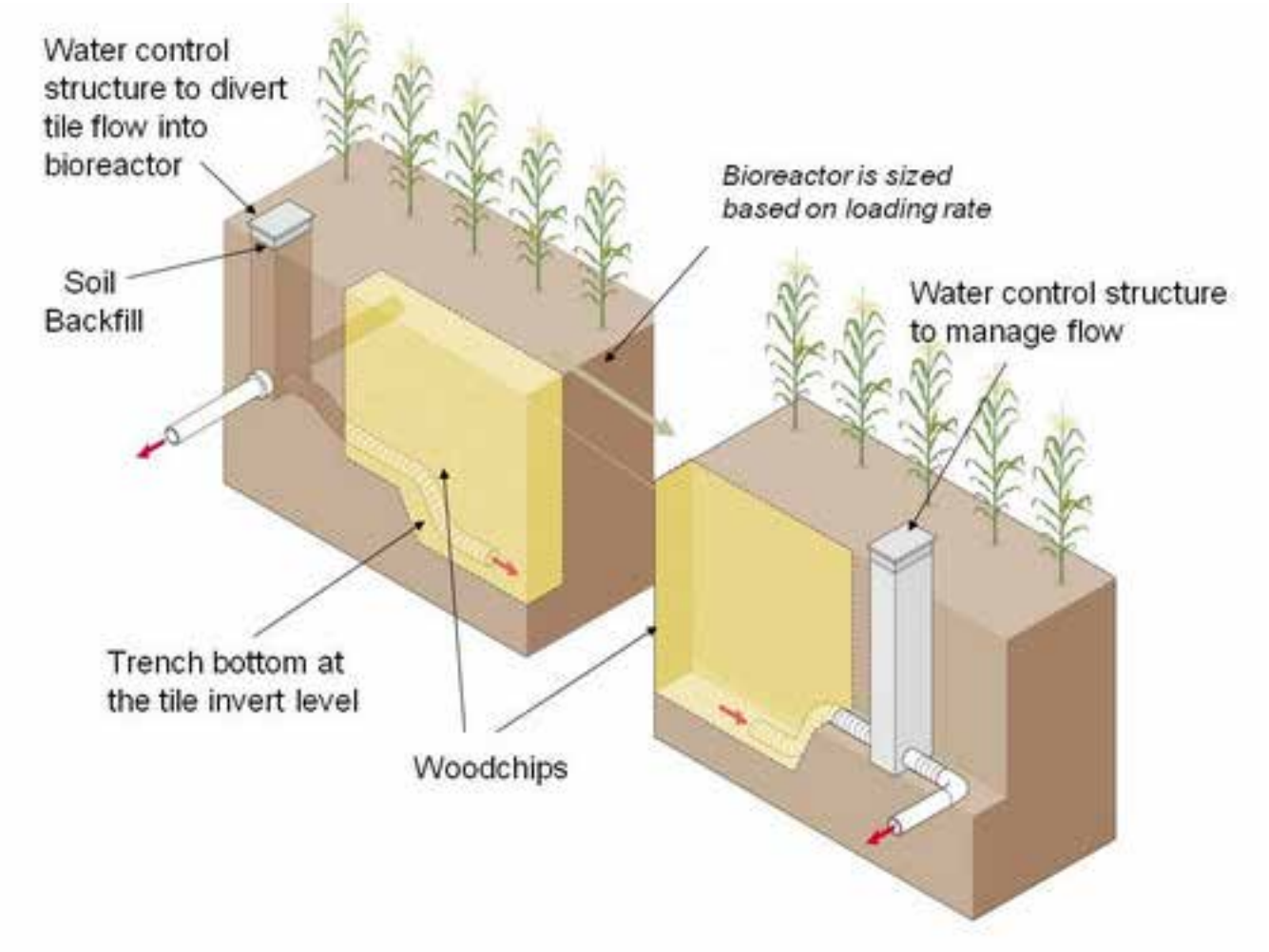
Drainage Water Management, or management of the water table through control structures at drain tile outlets, is an approach to reduce the amount of nutrients that exit the tile lines. DWM is the process of managing the timing and the amount of water discharged from agricultural drainage systems. DWM is based on the premise that the same drainage intensity is not required at all times during the year. This is accomplished by adjusting the control structure so that the water table rises after harvest to limit drainage during the off-season. The water table can then be lowered a few weeks prior to planting in spring. The water table can also be raised in midsummer to store water for crops. With DWM, both water quality improvement and production benefits are possible. Water quality benefits are derived by minimizing unnecessary drainage, reducing the amount of nitrate that leaves farm fields. Producers who use DWM enjoy being able to better control their drainage water instead of the water controlling them (Cooke, 2004).
To ensure successful implementation of a DWM system on agricultural tile drainage, it is essential to have a DWM Plan. A properly prepared DWM plan considers landscape, soils, slope, and current or planned drainage systems as well as the size and location of water control structures and detailed sets of instructions for their operation and maintenance. This includes identification of the zones of influence for each water control structure and the target water elevations for each of the seasonal land uses. The Golden Rule of Drainage (as advocated by NRCS) is: Only release the amount of water necessary to ensure trafficable conditions for field operations and to provide an aerated crop root zone- any drainage in excess of this rule likely carries away nitrate and water that is no longer available for crop uptake (NRCS, 2020).

*Subsurface (Tile) Drainage Best Management Practices- Subsurface Bio-Reactors*
While properly designed and installed subsurface drainage tiles can reduce sediment and phosphorus losses on fields, they can expedite the movement of nitrate-nitrogen to nearby surface waters. BMPs such as subsurface Bioreactors seek to mitigate this issue by providing a subsurface solution to a subsurface problem. Bioreactors consist of a substrate (gravel and a carbon source, typically woodchips, though alternative substrates are being researched) placed underground through which tile water flows. The systems are designed to maintain drainage effectiveness and, once installed, do not require additional land to be taken out of production. The reactors are constructed such that during periods of high flow, the bioreactor is bypassed and water flows through the tile as usual. Bioreactors work by providing a carbon source on which soil organisms colonize. These colonies consume the carbon from the woodchips, and "breathe in" the nitrate from the water which is then "breathed out" as nitrogen gas which enters the atmosphere (similar to how humans breathe in oxygen and breathe out carbon dioxide (Purdue University, 2020).

*Waste (Manure) Management*
Livestock production within the agricultural industry is a producer of waste materials that need management. While there is not currently livestock production in the watershed, there could be in the future. These wastes primarily include manure from livestock; livestock manure is rich in plant nutrients. Manure that is properly applied increases soil fertility and may also improve soil physical properties, improperly applied manure can contaminate surface water and groundwater. In order to protect water quality while maximizing nutrient efficiency, producers must select the relevant best management practice for their crops.

The NRCS has produced the Agricultural Waste Management Field Handbook (AWMFH) to provide specific guidance for planning, designing, and managing systems where agricultural wastes are involved. It can help assist agricultural producers in organizing a comprehensive plan that results in the safe integration

**Figure 63.** Subsurface Bioreactor (Source: Frankenberger.)




of waste management into overall farm operations. Material in this handbook covers a wide range of activities from incorporating available manure nutrients into crop nutrient budgets to proper disposal of waste materials that do not lend themselves to resource recycling (NRCS, 2020).

Generally speaking, one of the most important manure best management practices is the development of a nutrient management plan; this involves accounting for all sources of crop-available nitrogen, performing manure testing to determine nutrient content, determining manure application rates based on crop nitrogen needs, and then applying fertilizer to manured fields only when needed to satisfy crop nutrient needs (UIUC - Extension, 2020).

Best management practices should be applied to the application of manure as well as the stockpiling and storage. When applying manure, generally speaking, attention should be given to not apply manure to sites with excessive slopes or highly erodible soils, or frozen or saturated soils. Manure should only be applied with properly calibrated equipment. Manure should be incorporated into soils as soon as possible after application to reduce losses. Other considerations are the establishment of a buffer zone of at least 100 feet between manure application and water resources, and the planting of permanent vegetation strips between surface waters and croplands to filter runoff. Similarly, manure stockpiles and livestock enclosures should be at least 100 feet away from any water supply, additionally vegetated filter strips should be established around the downhill side of stockpiles and enclosures. Stormwater should be redirected such that flow through stockpiles and enclosures is eliminated or reduced; and enclosures should be frequently cleaned (Colorado State University Extension, 2020).

### 6.1.14 Downspout Disconnection/ Rainwater Harvesting & Re-use

Downspout disconnection and rain barrel programs help reduce the amount of clean water that is used as well as reduce the amount of wastewater discharged to streams. Water harvesting and re-use via rain barrels and cisterns are important options to decrease the amount of stormwater runoff in a watershed. It is a simple, economical solution that can be done by any homeowner or business. On most homes and buildings, the water from roofs flows into downspouts and then onto streets, parking areas, or into storm sewers. Disconnecting downspouts and using either rain barrels or cisterns for re-use later can reduce the flood levels in local streams.

Water re-use differs based on the type of storage and water treatment. A rain barrel is typically attached to a downspout and collects water for later use, such as irrigation purposes. In many areas, irrigation can account for almost 50 percent of residential water consumption. Re-using water collected in a rain barrel is a great way of minimizing outdoor water consumption and reduce water bills.

A cistern also stores water from rooftop runoff to be used later. However, a cistern is often larger, sealed, and the water can be filtered for a wider variety of uses. Cistern water can be used many outdoor uses such as lawn and garden watering, irrigation, car washing, and window cleaning.

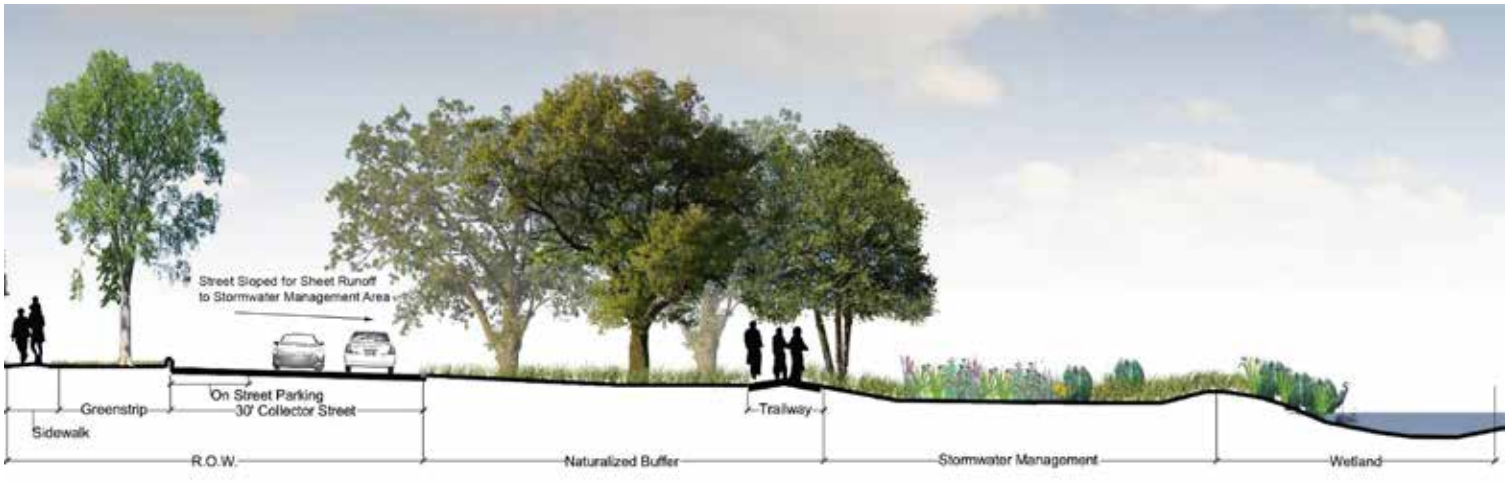
The primary purpose of rain barrels and cisterns is water storage. Rain barrels typically store 55 gallons each. Cisterns can store greater amounts. Rain barrels and cisterns also reduce outdoor water demand in summer months by reducing the potable water used for irrigation or other outdoor household uses.

*Rain barrel connected to a downspout*

*Rainwater Harvesting & Reuse Recommendations*

Education programs in the watershed should focus on teaching residents and businesses the beneficial uses of downspout disconnection, rain barrels and cisterns. Local governments in the watershed should aim to install demonstration projects as a way for the public to better engage in their water use and re-use around residential homes and businesses. Local governments and conservation organizations such as the DeKalb County Soil and Water Conservation District, the Upper South Branch Kishwaukee River Watershed Steering Committee, the DeKalb County Community Foundation, and Northern Illinois University should sponsor programs where residents and businesses can purchase rain barrels.

**Figure 64.** Stormwater Treatment Train within Conservation Development.




### 6.1.15 Conservation & Low Impact Development

Conservation design facilitates development density needs while preserving the most valuable natural features and ecological functions of a site. It does this by reducing lot size, especially lot width, while increasing the available land area to allow for open space and natural resources (Figures 64 - 66). The open space is typically preserved or restored as natural areas that are integrated with newer natural Stormwater Treatment Train features and recreational trails and serve as an amenity to the entire development. The open space allows the residents to feel like they have larger or more private lots because most of the lots adjoin the open space system.

Such flexibility is intended to retain or increase the development rights of the property owner and the number of occupancy units permitted by the underlying zoning designation, while encouraging environmentally responsible development. Conservation design is most appropriate in areas having natural and open space resources to be protected and preserved such as floodplains, groundwater recharge areas, wetlands, woodlands, streams, wildlife habitat, etc. It can also be used to preserve and integrate agricultural uses into the land pattern. The approach first

**Figure 65.** Traditional vs. Conservation Development Design (Elkhorn, WI).

**Figure 66.** Conservation/Low Impact development design.

considers the natural landscape and ecology of a development site rather than determining design features on the basis of pre-established density criteria. The general steps included below are generally followed when designing the layout of a development site:

*Step 1:* Identify natural resources, conservation areas, open space areas, physical features, and scenic areas and preserve and protect these areas from any negative impacts generated as a result of the development.

*Step 2:* Locate building sites to take advantage of open space and scenic views by requiring smaller lot sizes or cluster housing as well as to protect the development rights of the property owner and the number of occupancy units permitted by the underlying zoning of the property.

*Step 3:* Design the transportation system to provide access to building sites and to allow movement throughout the site and onto adjoining lands; roads should not traverse sensitive natural areas.

*Step 4:* Prepare engineering plans which indicate how each building site can be served by essential public utilities.

**Figure 67.** Greener Streetscape using LID practices. Source: "*Greening the Code*" Washington County, OR.


*Prairie Crossing Conservation Development in Grayslake, Illinois*

### *Low Impact Development (LID)*

Low impact development (LID) focuses on the hydrologic impact of development and tries to maintain pre-development hydrologic systems, treating water as close to the source as possible (see Figure 67). LID principles can be incorporated into development or stormwater ordinances and used in new development or retrofitting existing developments. Green infrastructure systems are created to mimic natural processes that promote water infiltration, native plant evapotranspiration, and stormwater reuse.

Low impact development seeks to keep stormwater out of pipes and instead keep the entire infrastructure more natural and above ground. Solutions start at the lot scale such as rain gardens and overflows to swales adjacent to roads. Larger impervious areas, such as a commercial development may utilize constructed wetlands for stormwater storage while adding value to the area by enhancing aesthetics, site interest and the ecology. Entities such as Milwaukee Metropolitan Sewerage District have been influential in determining pollutant reductions for various LID methodologies.

### *Economics of Conservation Developments and Low Impact Development*

Both conservation developments and low impact development (LID) are not only environmentally sound choices, but economical ones for both developers and municipalities. Conservation design can produce some of its biggest cost savings in infrastructure costs such as site preparation, stormwater management, site paving, and sidewalks (Conservation Research Institute, 2005). According to a study conducted by Applied Ecological Services, Inc., the average savings created by choosing conservation development over more traditional footprints is 24% (Table 45) (AES, 2007). Not only do lots in conservation developments typically cost less to install, but they also "carry a price premium ... and sell more quickly than lots in conventional subdivisions (Mohamed, 2006)." Another study conducted in Concord, Massachusetts found that over an eight-year period, a cluster development with protected open space had a 2.6% higher annual appreciation rate over "residential properties with significantly larger private yards, but without the associated open-space (Lacy, 1990)."

While low impact development covers a range of stormwater practices, it has some of the same cost benefits as conservation design. Typically LID practices "can cost less to install, have lower operations and maintenance costs, and provide more cost-effective stormwater management and water-quality services than conventional stormwater controls (ECONorthwest, 2007)." Similar to conservation design, cost savings from utilizing LID practices can be found as a reduction in the amount of drainage infrastructure and land disturbance required; additionally, property values can be increased by 12 - 16% (UNH Stormwater Center, 2011).

There is also evidence that combining both conservation and low impact development practices through holistic site design can create deeper cost savings for developers as well as increased ecosystem benefits – particularly by combining clustered site designing and naturalized stormwater management systems (Conservation Research Institute, 2005). Not only do conservation and low impact development practices provide a more economical possibility for developers and municipalities, but they can improve water quality, habitat, and property values in the watershed.

**Table 45.** Savings of Conservation Development over Traditional Subdivision Design for ten Midwestern conservation development projects.

**Savings of Conservation Development over Traditional Subdivision Design (P=Project)**

Positive numbers are savings of Conservation Development over Traditional.
Negative numbers are costs of Conservation Development over Traditional.

| Project: | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 | P10 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |
| **ITEM** | | | | | | | | | | | |
| Grading | -$214,740 | $257,832 | $1,813,726 | $2,215,025 | $1,856,206 | $1,862,988 | $796,705 | $291,957 | $302,497 | $2,852,312 | 51.00% |
| Roadway | $84,702 | $18,754 | -$16,477 | -$130,230 | $1,464,599 | $1,187,386 | $205,168 | $9,231 | -$9,963 | $801,484 | 18.00% |
| Storm Sewer | $181,611 | $31,220 | $6,648 | $89,676 | $974,689 | $547,184 | $210,289 | $65,501 | $110,021 | $678,302 | 40.00% |
| Sanitary Sewer | $41,614 | -$4,365 | $0 | -$203,064 | $850,962 | $224,776 | $72,436 | -$15,502 | $5,960 | $423,458 | 6.00% |
| Water | $44,483 | -$4,671 | -$63,680 | -$215,881 | $905,157 | $240,064 | $76,815 | -$16,257 | $5,973 | $451,084 | 5.00% |
| Ecological | -$56,500 | -$74,857 | -$277,472 | -$400,321 | -$407,131 | -$625,084 | -$160,341 | -$93,954 | -$264,513 | -$380,992 | -154.00% |
| Amenities | $17,572 | -$16,202 | -$94,399 | -$226,216 | $552,667 | $221,666 | $7,825 | -$15,749 | -$39,274 | $266,982 | 6.00% |
| Contingencies | $132,055 | $51,928 | $342,087 | $282,247 | $1,549,287 | $914,745 | $302,225 | $56,307 | $27,675 | $1,273,157 | 24.00% |
| | | | | | | | | | | | |
| Total Savings | $660,277 | $259,639 | $1,710,433 | $1,411,235 | $7,746,436 | $4,573,725 | $1,511,124 | $281,534 | $138,377 | $6,365,787 | |
| **Total Percent Savings** | **19.00%** | **20.00%** | **33.00%** | **15.00%** | **43.00%** | **32.00%** | **25.00%** | **15.00%** | **4.00%** | **37.00%** | **24.30%*** |
| **Cost Savings Per Lot** | **$8,725.00** | **$6,978.00** | **$147,012.00** | **$29,012.00** | **$7,904.00** | **$20,077.00** | **$7,346.00** | **$4,078.00** | **$4,959.00** | **$67,676.00** | **$30,376.70** |

* Total Savings Percentage is *not* the percentage savings of all individual Items added together, because dollar-values of Items are different.
Visit www.appliedeco.com for more detailed info.

### 6.1.16 Green Infrastructure Network Planning

A green infrastructure network provides communities with a tool to identify and prioritize open space land use or conservation opportunities and plan development that benefits both people and nature by providing a framework for future growth. It identifies areas not suitable for development, areas suitable for development but that should incorporate conservation or low impact design standards, and areas that do not affect green infrastructure.

Park Districts, Forest Preserve Districts, IDNR, and watershed stakeholders can use green infrastructure plans for trail routing, open space linkages, and natural area restoration decisions. Residents can use green infrastructure recommendations to reduce runoff from their properties and to see how their properties fit into the larger network. A Green Infrastructure Network for the watershed was developed in Section 3.12.

Green Infrastructure Network *implementation* has several actions:

- Protect specific unprotected green infrastructure parcels through acquisition, regulation, and/or incentives.
- Incorporate conservation or low impact design standards on green infrastructure parcels where development is planned.
- Limit future subdivision of green infrastructure parcels.
- Implement long-term management of green infrastructure.

*Green Infrastructure Recommendations*

A Green Infrastructure Network can only be realized by coordinated planning efforts of local municipalities, park districts, developers, and private landowners. Stakeholders should follow the recommended process below to initiate and implement the Green Infrastructure Network for the Upper South Branch Kishwaukee River watershed.

1. Include all green infrastructure parcels in updated community comprehensive plans and development review maps.
2. Create zoning overlay and update development ordinances to require conservation development/low impact design on all green infrastructure parcels.
3. Require Development Impact Fees and/or Special Service Area taxes for all new development to help fund future management of green infrastructure.
4. Identify important unprotected green infrastructure parcels not suited for development then protect and implement long term management.
5. Work with private land owners along stream/tributary corridors to manage their land for green infrastructure benefits.
6. Use the Green Infrastructure Network to identify new trails and trail connections.

### 6.1.17 Water Quality Trading & Adaptive Management

While Illinois has not yet set up policies or a system to implement water quality trading or adaptive management, nearby Wisconsin has developed policies and a number of resources for both and their guidance could be used as a model or example to follow in Illinois. The following information is cited directly from a Wisconsin Department of Natural Resources (WDNR) document entitled “A Water Quality Trading How to Manual” (WDNR 2013).

Water Quality Trading presents a way for municipal and industrial NPDES permit holders to demonstrate compliance with water quality-based effluent limitations. Generally, trading involves a point source facing relatively high pollutant reduction costs compensating another party to achieve less costly pollutant reduction with the same or greater water quality benefit. In other words, trading provides point sources with the flexibility to acquire pollutant reductions from other sources in the watershed to offset their point source load so that they will comply with their own permit requirements, while simultaneously helping to fund water quality improvements nearby. Trading is not a mandatory program or regulatory requirement, but rather a market-based option that may enable some industrial and municipal facilities within the watershed to meet regulatory requirements more cost-effectively. With ever-tightening water quality standards and restrictions going

into effect, trading may become economically preferable to other compliance options.

There are many benefits to trading:

1. Permit compliance through trading may be economically preferable to other compliance options.

2. New and expanding point source discharges can utilize trading to develop new economic opportunities in a region, while still meeting water quality goals.

3. Permittees, and the point and nonpoint sources that work cooperatively with them, can demonstrate their commitment to the community and to the environment by working together to protect and restore local water resources.

Adaptive management is sometimes confused with trading, since both options allow permittees to work with nonpoint or other point sources of phosphorus in a watershed to reduce the overall phosphorus load to a given waterbody. In Wisconsin, which has developed a numeric phosphorus criterion, adaptive management is solely focused on phosphorus compliance and improving water quality so that the applicable phosphorus criterion is met. Trading is not limited to phosphorus and may be used to meet limits for any pollutant for which a criterion has been established. Trading focuses on compliance with a discharge limit while adaptive management focuses on compliance with phosphorus criteria.

Water quality trading has seven components: pollutant, trading participants, pollution reduction credit, credit threshold, trade ratio, location, and timing (Figure 68). Each of these components must be adequately addressed in a trading strategy. The "pollutant" is simply the contaminant being traded. The "trading participants" are entities involved in the trade. "Credit" is the amount of a given pollutant that is available for trading. "Credit Threshold" is the amount of pollutant reduction that needs to be achieved before credits are generated. "Trade ratios" are put in place due to uncertainty margins. "Location" refers to the fact that the credit user and generator must discharge to the same waterbody. "Timing" is important because credits must be generated before they can be used to offsite the pollution.

For more information and guidance on water quality trading and adaptive management, see Wisconsin Department of Natural Resources (WDNR) document entitled "A Water Quality Trading How to Manual" (WDNR, 2013).

**Figure 68.** Water quality trading components (source: WDNR).

### 6.2 Site-Specific Management Measures Action Plan

Site Specific Management Measure (Best Management Practice [BMP]) recommendations made in this section of the report are backed by findings from the watershed field inventory, overall watershed resource inventory, and input from stakeholders. In general, the recommendations address sites where watershed problems and opportunities can best be addressed to achieve watershed goals and objectives. The Site-Specific Management Measures Action Plan is organized by the jurisdiction in which recommendations are located making it easy for users to identify the location of project sites and corresponding project details. It is important to note that project implementation is voluntary and there is no penalty or reduction in future grant opportunities for not following recommendations. Site Specific Management Measures were identified within the following jurisdictional boundaries and are included in the Action Plan:

- *City of DeKalb*
- *DeKalb County*
- *Shabbona*
- *Sycamore*

Management Measure categories in the Site-Specific Management Measures Action Plan include:

- *Detention Basin Retrofits & Maintenance*
- *Wetland Restoration*
- *Streambank & Riparian Area Restoration*
- *Agricultural Management Practices*
- *Other Management Measures*

Descriptions and location maps for each Management Measure category follow. Table 48 includes useful project details such as site ID#, Location, Units (size/length), Existing Condition, Management Measure Recommendation, Pollutant Load Reduction Efficiency, Priority, Owner/Responsible Entity, Sources of Technical Assistance, Cost Estimate, and Implementation Schedule.

Project importance, technical and financial needs, cost, feasibility, and ownership type were taken into consideration when prioritizing and scheduling Management Measures for implementation. High, Medium, or Low Priority was assigned to each recommendation. "Critical Areas" as discussed in Section 5.2 are all High Priority and highlighted in red on project category maps and the Action Plan table. For this watershed plan a "Critical Area" is best described as a location in the watershed where existing or potential future causes and sources of an impairment or existing function are significantly worse than other areas of the watershed. Cost estimates were typically developed based on a per acre or per linear foot cost (see Appendix D for details). Implementation schedule varies greatly with each project but is generally based on the short term (within 1-10 years) for High Priority/ Critical Area projects, within years 5-15 for medium priority projects, and 10-20+ years for low priority projects. Maintenance projects are ongoing.

The Site-Specific Management Measures Action Plan is designed to be used in one of two ways.

*Method 1:* The user should find the respective jurisdictional boundary (listed alphabetically in Table 48) then identify the Management Measure category of interest within that boundary. A Site ID# can be found in the first column under each recommendation that corresponds to the Site ID# on a map (Figures 69-73) associated with each category.

*Method 2:* The user should go to the page(s) summarizing the Management Measure category of interest then locate the corresponding map and Site ID# of the site-specific recommendations for that category. Next, the user should go to Table 48 and locate the jurisdiction where the project is located, then go to the project category and Site ID# for details about the project.

### *Pollutant Load Reduction Estimates*

Where applicable, pollutant load reductions and/or estimates for total suspended solids (TSS), nitrogen (TN), and phosphorus (TP) were evaluated for each recommended Management Measure based on efficiency calculations developed for the USEPA's Region 5 Model. This model uses "Pollutants Controlled Calculation and Documentation for Section 319 Watersheds Training Manual" (MDEQ, 1999) to provide estimates of total suspended solids and nutrient load reductions from the implementation of agricultural Measures. Estimate of total suspended solids and nutrient load reduction from implementation of urban Measures is based on efficiency calculations developed by Illinois EPA. This watershed-based plan is focused on nutrients and total suspended solids because of the models used for estimating pollutant loading and reductions and references total suspended solids in tons per year (not pounds) in all cases.

Estimates of pollutant load reduction using the Region 5 Model are measured in weight/year (tons/yr for total suspended solids and lbs/yr for nitrogen and phosphorus). The model was generally used to calculate weight of pollutant reductions for all recommended Management Measures where calculation of such data is applicable. In summary, pollutant reductions were calculated for 79 detention basin retrofit, creation, & maintenance projects, 68 wetland restoration projects, 50 stream & riparian area restoration projects, 15 agricultural management projects, and 18 other management measure recommendations. Spreadsheets used to determine pollutant load reductions can be found in Appendix D.

For context and as a general guide, estimated percent removal of total suspended solids, nitrogen, and phosphorus based on the Region 5 Model are depicted for various Management Measures in Table 46.

**Table 46.** Region 5 Model percent pollutant removal efficiencies for various Management Measures.

| Management Measures | TSS | TN | TP |
|---|---|---|---|
| Vegetated Filter Strips | 73% | 40% | 45% |
| Wet Pond/Detention | 60% | 35% | 45% |
| Wetland Detention | 77.5% | 20% | 44% |
| Dry Detention | 57.5% | 30% | 26% |
| Infiltration Basin | 75% | 60% | 65% |
| Streambank/Lake Shoreline Stabilization | 90% | 90% | 90% |
| Weekly Street Sweeping | 16% | 6% | 6% |
| Porous Pavement | 90% | 85% | 65% |
| Manure Waste Management | na | 80% | 90% |

***Watershed-Wide Summary of Action Recommendations***

All Site-Specific Management Measures, Education Plan (Section 7.0), and Monitoring Plan (Section 9.1) recommendation information is condensed by Category in Table 47. This information provides a watershed-wide summary of the "Total Units" (size/length), "Total Cost," and "Total Estimate of Pollutant Load Reduction" if all the recommendations in the Site-Specific Management Measures Action Plan, Education Plan, and Monitoring Plan are implemented. Key points include:

- 22,922 acres of ecological restoration with a total cost of $24,502,330.
- 325,351 linear feet of stream and riparian area restoration costing $15,365,050.
- 12,651 tons/year of total suspended solids (TSS) would potentially be reduced each year, which would far exceed the Reduction Target identified in Section 5.3.
- 19,188 pounds/year of phosphorus (TP) would potentially be reduced each year, representing 35.3% of the 54,351 pounds/year Reduction Target identified in Section 5.3.
- 57,623 pounds/year of nitrogen (TN) would potentially be reduced each year, representing only 31.5% of the 185,469 pounds/year Reduction Target identified in Section 5.3
- Education programs will cost at least $13,115 to implement (see Section 7.0).
- A monitoring plan will cost at least $16,000 annually to implement (see Section 9.1).

**Table 47.** Watershed-wide summary of Management Measures recommended for implementation.

| Management Measure Category | Total Units (size/length) | Total Cost | Estimated Load Reduction | | |
|---|---|---|---|---|---|
| | | | TSS (t/yr) | TP (lbs/yr) | TN (lbs/yr) |
| **Detention Basin Retrofits & Maintenance** | 288.5 acres | $6,294,750 | 1,213 | 1,835 | 7,251 |
| **Wetland Restoration** | 1,345.8 acres | $15,281,380 | 524 | 750 | 4,132 |
| **Streambank, Channel, & Riparian Restoration** | | | | | |
| *Streams* | 325,351.1 lf | $15,365,050 | 4,709 | 4,002 | 8,006 |
| *Riparian Areas* | 746.9 acres | | 930 | 1,933 | 14,812 |
| **Agricultural Management Practices** | | | | | |
| *Grass waterways or swales installed* | 174.6 acres | na | 2,156 | 2,925 | 5,488 |
| *Increased residue to >60% for those practicing reduced tillage* | 19,658 acres | na | 3,025 | 7,506 | 16,912 |
| **Other Management Measures** | | | | | |
| *8 Natural area restorations* | 271.4 acres | $1,815,100 | 37 | 48 | 241 |
| *3 Golf course naturalizations* | 366.8 acres | $910,000 | 8 | 64 | 147 |
| *3 Parking lot best management practice recommendations* | 9.2 acres | na | 10 | 17 | 252 |
| *1 swale retrofit* | 0.7 acres | $16,600 | 1 | 1 | 5 |
| *1 turf/park retrofit* | 5.4 acres | $94,500 | 3 | 4 | 25 |
| *1 wetland management area* | 17.4 acres | $34,800 | 2 | 4 | 17 |
| *1 project to maintain a series of naturalized detention basins* | 36.8 acres | $55,200 | 33 | 99 | 335 |
| **Information & Education Plan** | Entire Plan | >$13,115 | na | na | na |
| **Water Quality Monitoring Plan** | Entire Plan | $16K/year | na | na | na |
| TOTALS | **22,921.5 acres** | **$24,502,330** | **12,651 tons/yr** | **19,188 lbs/yr** | **57,623 lbs/yr** |
| | **325,351.1 lf** | **$15,365,050** | | | |
| | **Education** | **>$13,115** | | | |
| | **Monitoring** | **>$16K/year** | | | |

### 6.2.1 Detention Basin Retrofits & Maintenance Recommendations

During the inventory, 79 detention basin retrofit opportunities were identified in Upper South Branch Kishwaukee River watershed, predominantly in the northeaster portion of the watershed since that is the most urbanized area. Most detention basins provide little by way of water quality improvement, infiltration capability, and wildlife habitat. In the future it is recommended that new standards for detention basins be implemented in local and county development ordinances (see Section 6.1.2). Applied Ecological Services, Inc. (AES) conducted an inventory of detention basins in late spring of 2019. The results of the detention basin inventory are summarized in Section 3.14. Detailed field investigation datasheets and maps can be found in Appendix C.

The type and ecological condition of the detention basins in the watershed varies. The inventory resulted in 34 wet /wetland bottom with turf slopes, 25 dry-bottom with turf slopes, 18 naturalized wet/ wetland bottom, and 2 naturalized dry bottom basins. Additionally, of the 79 basins, only 8 (10%) likely provide "Good" ecological and water quality benefits while 24 basins (30%) likely provide "Average" benefits. The remaining 47 basins (60%) likely provide "Poor" ecological and water quality benefits because most were designed simply to meet stormwater storage volume requirements.

The majority of detention basins are located within the municipalities of DeKalb and Sycamore. Many of the wet and dry detention basins are planted with mown turf grass side slopes. In addition, some of the dry bottom basins are constructed with either concrete low flow channels that run directly from the inlet to the outlet or have outlet drains flush with the bottom of the basin. Many of the dry, wet, and wetland bottom basins in the watershed present excellent retrofit opportunities. Most would be relatively easy to naturalize with native plantings and concrete structures and drains in dry basins can be manipulated to store and infiltrate water as desired.

All recommended detention basin retrofits and/or maintenance recommendations are shown in Figure 69 by priority and Site ID# which correspond with the ID# used in the field investigation. Details about each recommendation can be found in the Action Plan Table (Table 48) within the appropriate jurisdictional boundary. All of the High priority recommendations are considered "Critical Areas." Most of these are basins were prioritized based on their location and/or ability to treat polluted stormwater runoff, have significant problems, or present a good opportunity for retrofitting. Low or Medium priority is generally assigned to smaller private basins and those with fewer problems or maintenance needs.

*Example of a detention basin retrofit in West Dundee, IL*

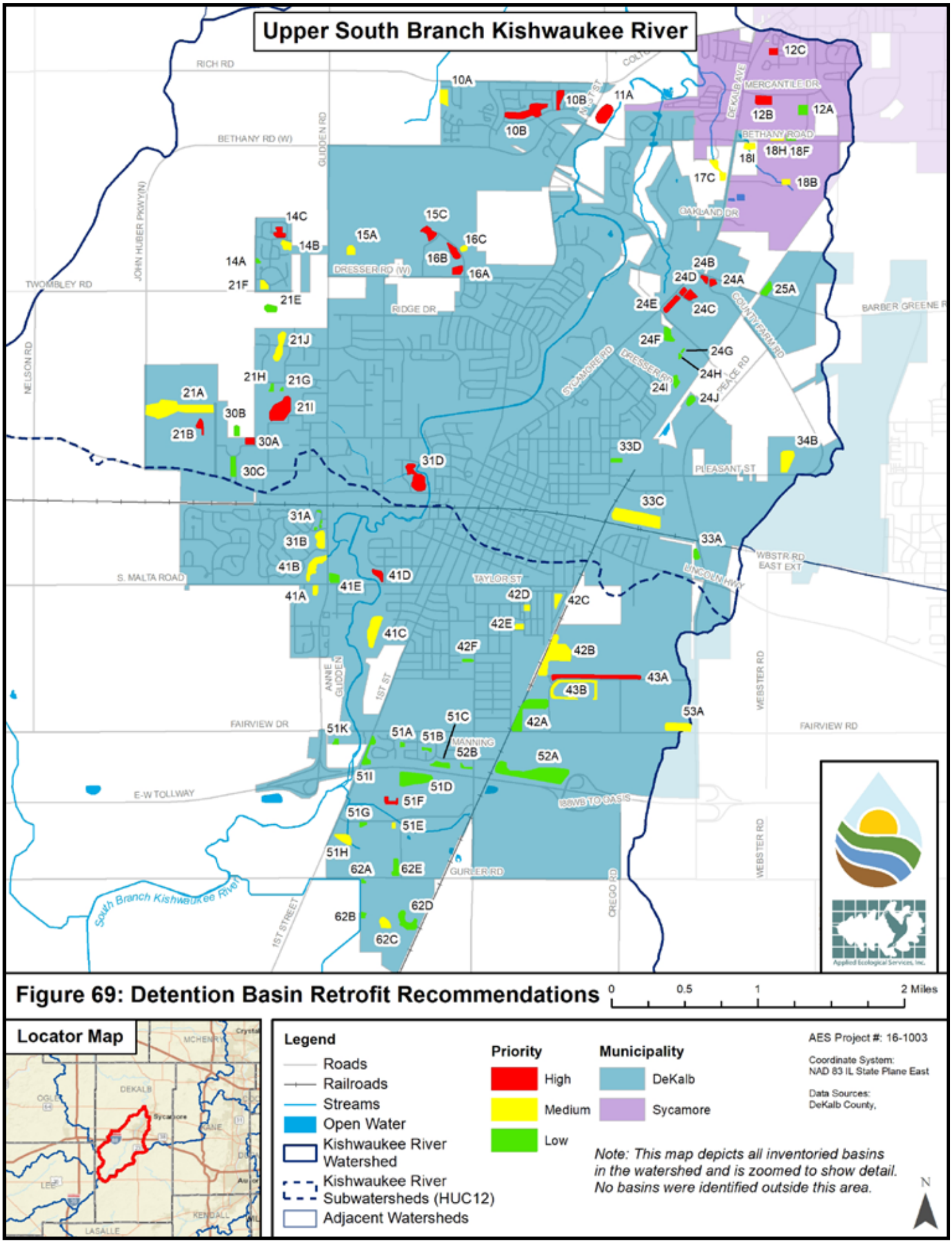



**Figure 69: Detention Basin Retrofit Recommendations**

### 6.2.2 Wetland Restoration Recommendations

Wetland restoration is the process of bringing back historic wetlands in areas where they have been drained. This section does not include enhancement and maintenance for existing wetlands. Restoration can be important for mitigation purposes or done simply to benefit basic environmental functions that historic wetlands once served. Improvement in water quality is the greatest benefit provided by wetland restoration. Other benefits include reducing flood volumes/rates and improved habitat to increase plant and wildlife biodiversity. The wetland restoration process is generally the same for all sites. First a study must be completed to determine if restoration at the site is actually feasible. If it is, a design plan is developed, permits obtained, then the project is implemented by breaking existing drain tiles and/or regrading soils to attain proper hydrology to support wetland vegetation. Planting with native wetland species is the next step followed by short- and long-term maintenance and monitoring to ensure establishment.

Wetland restoration sites were identified in Section 3.14.3 using a GIS exercise and then confirmed in the field to meet specific criteria determined to be essential for restoration of a functional and beneficial wetland. The analysis resulted in 68 sites meeting the criteria and considered as potentially feasible wetland restoration sites.

Figure 70 includes the location of all the potential wetland restoration sites by site priority and site ID#. The site ID#s match those used in Section 3.14.3. Ten sites were determined to be high priority/critical area restorations, while the remaining 58 were considered medium priority; there were no low priority wetland restoration sites. Details about each recommendation can be found in the Action Plan Table (Table 48) within the appropriate jurisdictional boundary. In general, large sites on agricultural land, sites on public land, and sites within the identified Green Infrastructure Network are higher priority than smaller sites and those on private land.

*Example wetland restoration at AES wetland mitigation site*

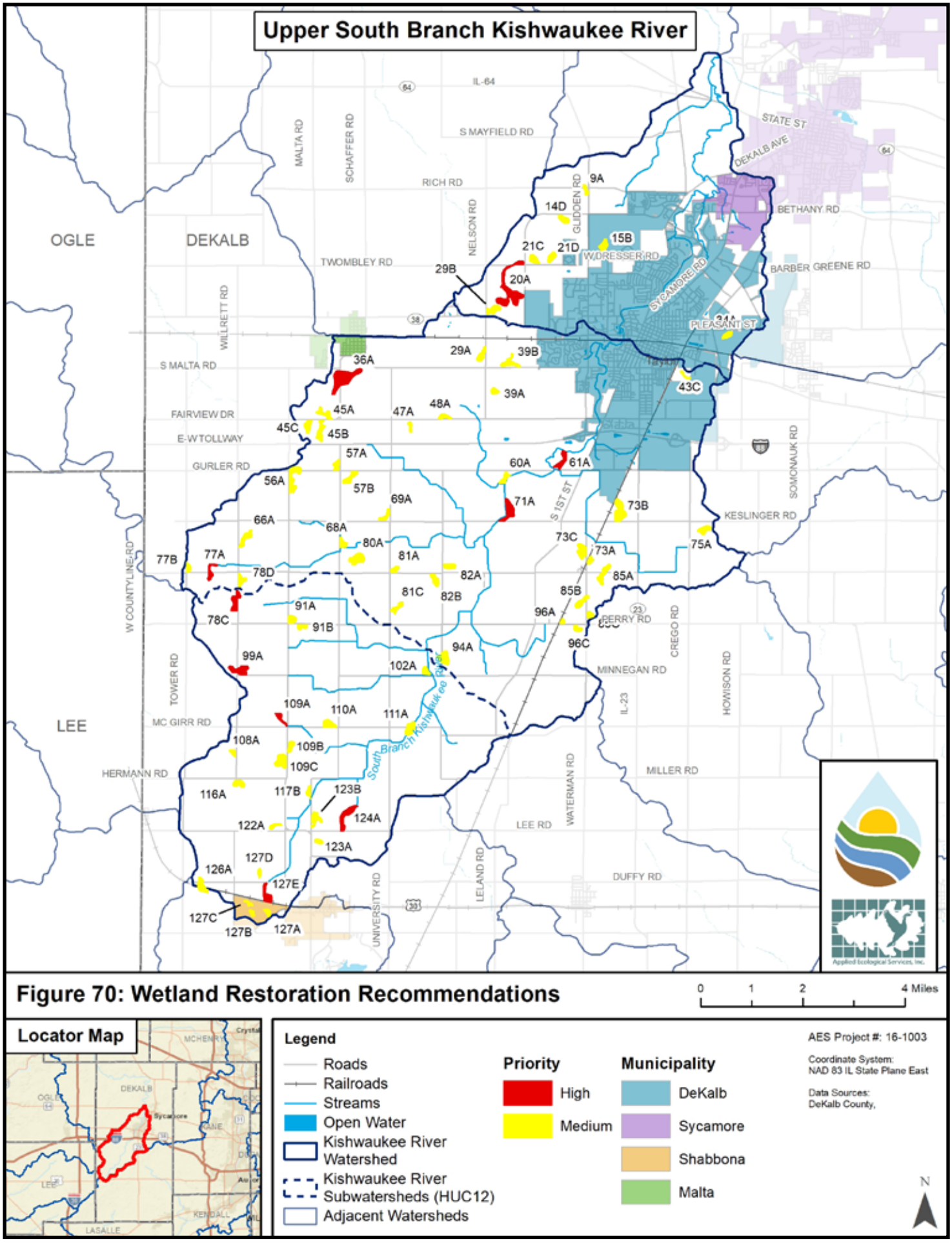



**Figure 70: Wetland Restoration Recommendations**

### 6.2.3 Streambank & Riparian Area Restoration Recommendations

Applied Ecological Services, Inc. (AES) completed a general inventory of Upper South Branch Kishwaukee River and its tributaries in spring of 2019. All streams and tributaries were assessed based on divisions into "Stream Reaches". Fifty-seven (57) stream reaches were assessed accounting for 370,289 linear feet or 69.7 linear miles. Detailed notes were recorded for each stream reach related to potential Management Measure recommendations such as improving streambank and channel conditions, restoring riparian areas, and maintaining these reaches long term. The results of the stream inventory are summarized in Section 3.14; detailed field investigation datasheets can be found in Appendix C.

The condition of stream reaches in the watershed varies. According to the stream inventory, 13% (49,108 lf) of stream and tributary length is naturally meandering; approximately 9% (33,004 lf) is moderately channelized; 78% (288,177 lf) is highly channelized. Approximately 77% (284,692 lf) of the total stream and tributary length exhibits no or low bank erosion while moderate erosion is occurring along 18% (65,516 lf) of streambanks. Highly eroded streambanks account for only 5% (20,081 lf) of the total stream length and are typically found in the downstream portions of the watershed. On the other hand, approximately 81% (along 299,515 linear feet of streams) of the riparian areas are "Poor" quality. Of the remaining reaches, 40,712 linear feet or 11% of riparian areas are in "Moderate" condition and 8% (30,062 linear feet) are in good condition. Almost all of the tributaries that exist today were not defined stream channels priori to European settlement.

Stream and riparian area recommendations for this watershed plan generally focus on restoring and improving the riparian corridor, with some spot stabilization of banks recommended where appropriate since there is little channel erosion in the watershed. Where existing buffers are less than 75 feet,

*Example of an AES stream restoration in Barrington, Illinois*

recommendations have been made to extend buffers where possible; that said, extending a riparian buffer to 75 feet where no buffer exists is not always achievable. In these cases, typically recommendations included increasing the buffer to 50 feet along each bank. Most of the highly channelized agricultural reaches in the watershed are in the more advanced stages of recovering a stable two-stage channel, which should be encouraged and protected during other restoration and maintenance activities. In general, the addition of riffles or improvement of in-stream habitat is not recommended since attempts to address these issues could result in worsening channel conditions.

Most stream restoration projects include at least one of the following three water quality and habitat improvement components; 1) removal of existing invasive vegetation including trees and shrubs from the banks and extending buffers where none currently exists followed by; 2) spot stabilization of banks using bioengineering, regrading of banks, and installation of native vegetation where necessary; and 3) restored riffles/grade controls in the stream channel to simulate conditions found in naturally meandering streams and to improve in-stream habitat. Short- and long-term maintenance then follows and is critically important in the development process and to maintain restored conditions. Figure 71 shows the location of all potential streambank and riparian area restoration projects by reach ID# and priority while Table 48 lists project details about each recommendation within the appropriate jurisdictional boundary. Potential streambank and riparian area restoration projects on public land and reaches exhibiting severe problems on private land are generally assigned as higher priority for implementation. Medium and Low priority was generally assigned to stream reaches exhibiting less urgent problems. Recommendations are not made for stream reaches where restoration is not needed. In total, 215,995 linear feet of stream are considered High Priority/ Critical Area projects.

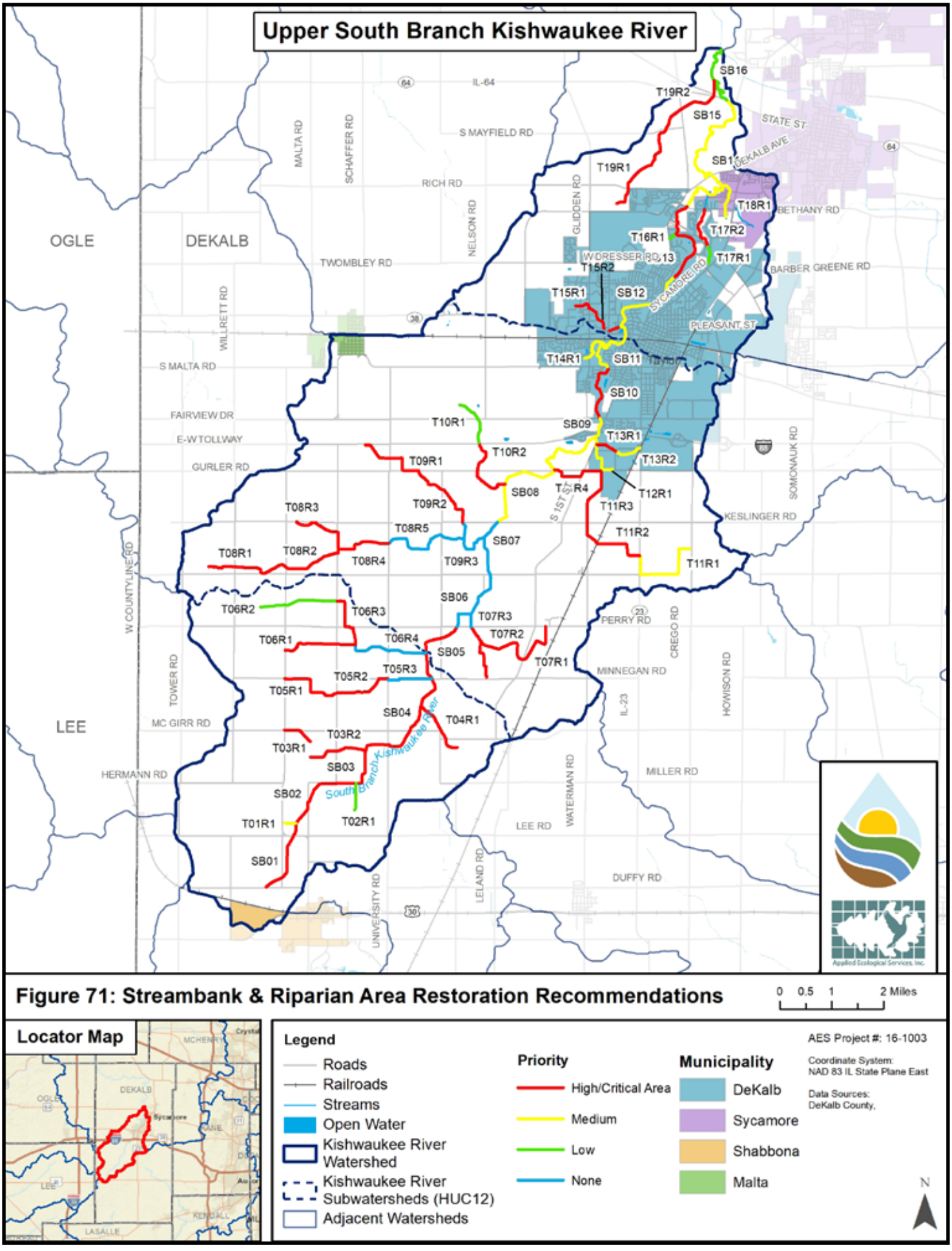



**Figure 71: Streambank & Riparian Area Restoration Recommendations**

0 0.5 1 2 Miles

**Locator Map**




**Legend**

- Roads
- Railroads
- Streams
- Open Water
- Kishwaukee River Watershed
- Kishwaukee River Subwatersheds (HUC12)
- Adjacent Watersheds

**Priority**

- High/Critical Area
- Medium
- Low
- None

**Municipality**

- DeKalb
- Sycamore
- Shabbona
- Malta

AES Project #: 16-1003

Coordinate System: NAD 83 IL State Plane East

Data Sources: DeKalb County,

N

### 6.2.4 Agricultural Management Practices Recommendations

Agricultural land uses represent roughly 80% of the Upper South Branch Kishwaukee River watershed, and nearly all of it is row crop farmland. According to the nonpoint source pollutant loading analysis, cropland contributes the highest loads of nitrogen (231,584 lbs/yr: 28%), phosphorus (47,159 lbs/yr: 37%), and total suspended soilds (17,813 t/yr: 53%), in large part due to the extent of agricultural land in the watershed.

Unfortunately, 2019 was an unusually wet season, so much so that almost no crops went in on time, some fields were left fallow for the season, and many others followed exceptional planting practices in trying to accommodate the weather. Therefore, AES could not complete the agricultural field inventory to the extent it normally would, but AES was able to identify a number of areas where additional grass waterways or vegetated swales were needed. A 2018 Illinois Soil Conservation Transect Survey conducted by DCSWCD was used to identify baseline agricultural conditions and practices in the watershed. The most common tillage practice found in the watershed was reduced till with 34 fields (39.1% of fields). Mulch till was practiced on 27 fields (31.0%), while conventional tillage was found on 20 fields (23.0%). No-till was found at 5 fields, or 5.7% of the surveyed fields.

Agricultural land can be a significant contributor of nutrients and sediment to local streams when practices such as grass swales, filter strips, and reduced tillage farming are not in place. Observations made during Applied Ecological Service's, field inventory in late spring 2019 indicate that practices such as additional grass waterways or vegetated swales may be necessary in some fields. Fifteen (15) agricultural areas were identified as being in need of additional grass waterways or vegetated swales. Implementing these practices where obviously eroded swales have been identified could significantly reduce pollutant loading. Figure 72 shows the location of all 15 sites by ID# while Table 48 includes action recommendations for each. Note: cost estimates for implementing conservation tillage are not included because the costs are largely dependent on a farmer's available equipment.

Additional conservation practices and increases in the extent of reduced tillage practices in the Upper South Branch Kishwaukee River watershed are necessary to reduce cropland pollutant loading. Unfortunately, these additional recommendations could not be accounted for via the Site-Specific Action Plan due to the inability to conduct a reliable inventory of these practices in 2019. Within the Programmatic Action Plan, AES recommends encouraging the 39% (19,658 acres) of cropland landowners already participating in low residue tillage (30-59% residue) to increase residue to 60% or more on their lands. This change alone could reduce watershed wide pollutant loads by 16,912 lbs/year of nitrogen, 7,506 lbs/year of phosphorus, and 3,025 tons/year of sediment. These recommendations are not mapped to specific fields, but rather are recommended across the entire watershed as a programmatic recommendation. For more information, please refer Section 6.1.3 of the Programmatic Action Plan.

*Example of no-till farming and in-field filter strips*

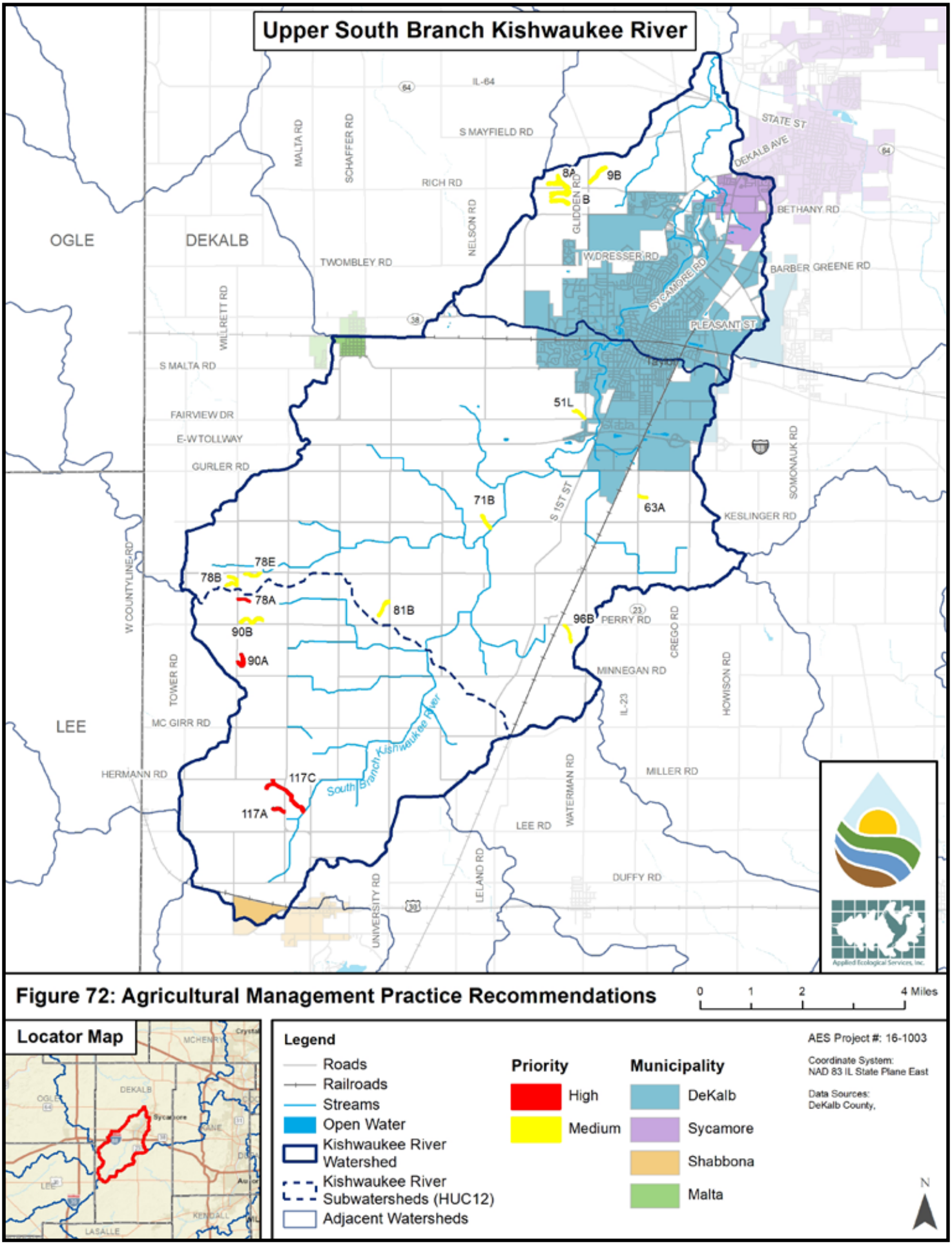



**Figure 72: Agricultural Management Practice Recommendations**

### 6.2.5 Flood Mitigation Recommendations

All Flood Problem Areas (FPAs) identified for the Upper South Branch Kishwaukee River watershed are documented in Section 3.14.4. For this report, a Flood Problem Area (FPA) is defined as a location where documented overbanking is occurring. Information about the location and condition of documented FPAs was obtained directly from stakeholder feedback during the February 5th, 2020, Goals Workshop meeting

Eight documented FPAs were identified in Upper South Branch Kishwaukee River watershed and mapped in Figure 46 (Section 3.14.4) and information about each FPA is included in Table 23 (Section 3.14.4). All eight FPAs documented in the watershed are locations where overbanking is occurring and potential mitigation measures for all eight are to reconnect the stream to the floodplain where possible to accommodate floodwaters. These sites need detailed site investigations to determine the source of flooding and feasible mitigation options. All potential mitigations at FPA locations are considered high priority/critical area projects. Site visits and feasibility studies must be conducted prior to the implementation of any mitigation effort but are outside the scope of this watershed planning effort.

### 6.2.6 Other Management Recommendations

While completing the general inventory of Upper South Branch Kishwaukee River watershed, Applied Ecological Services, Inc. (AES) noted potential Management Measure projects that fit under miscellaneous other categories. In total there were 18 projects that fell into the other management measures. Detailed field investigation datasheets for these projects can be found in Appendix C. Figure 73 shows the location of all "Other Management Measure" recommendations by ID# while Table 48 lists details about each recommendation within the appropriate jurisdictional boundary.

Potential projects include:

- 8 Natural area restorations
- 3 Golf course naturalizations
- 3 Parking lot best management practice recommendations
- 1 swale retrofit
- 1 turf/park retrofit
- 1 wetland management area
- 1 project to maintain a series of naturalized detention basins

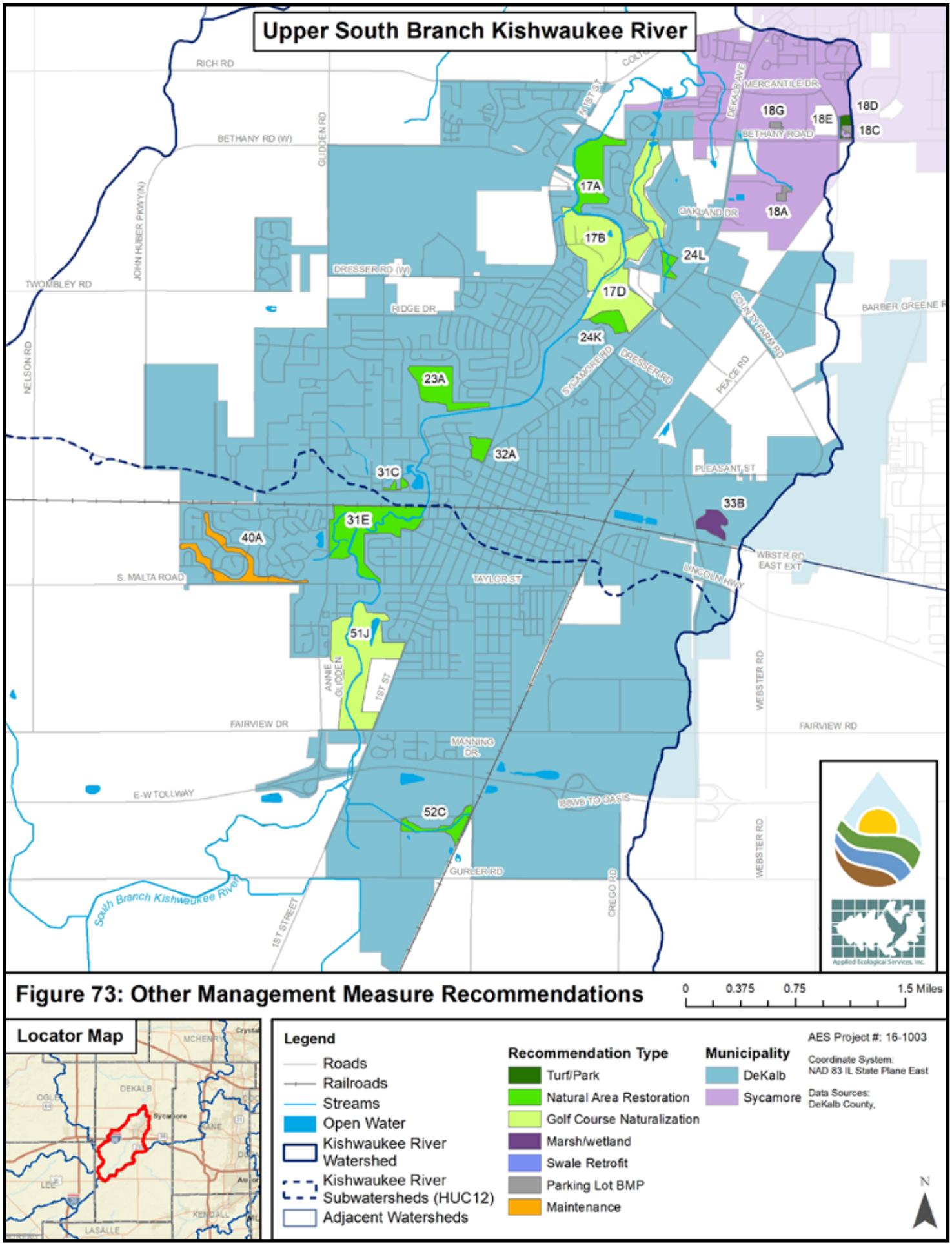



**Figure 73: Other Management Measure Recommendations**

0 0.375 0.75 1.5 Miles

**Locator Map**




**Legend**

- Roads
- Railroads
- Streams
- Open Water
- Kishwaukee River Watershed
- Kishwaukee River Subwatersheds (HUC12)
- Adjacent Watersheds

**Recommendation Type**

- Turf/Park
- Natural Area Restoration
- Golf Course Naturalization
- Marsh/wetland
- Swale Retrofit
- Parking Lot BMP
- Maintenance

**Municipality**

- DeKalb
- Sycamore

AES Project #: 16-1003

Coordinate System: NAD 83 IL State Plane East

Data Sources: DeKalb County,

N