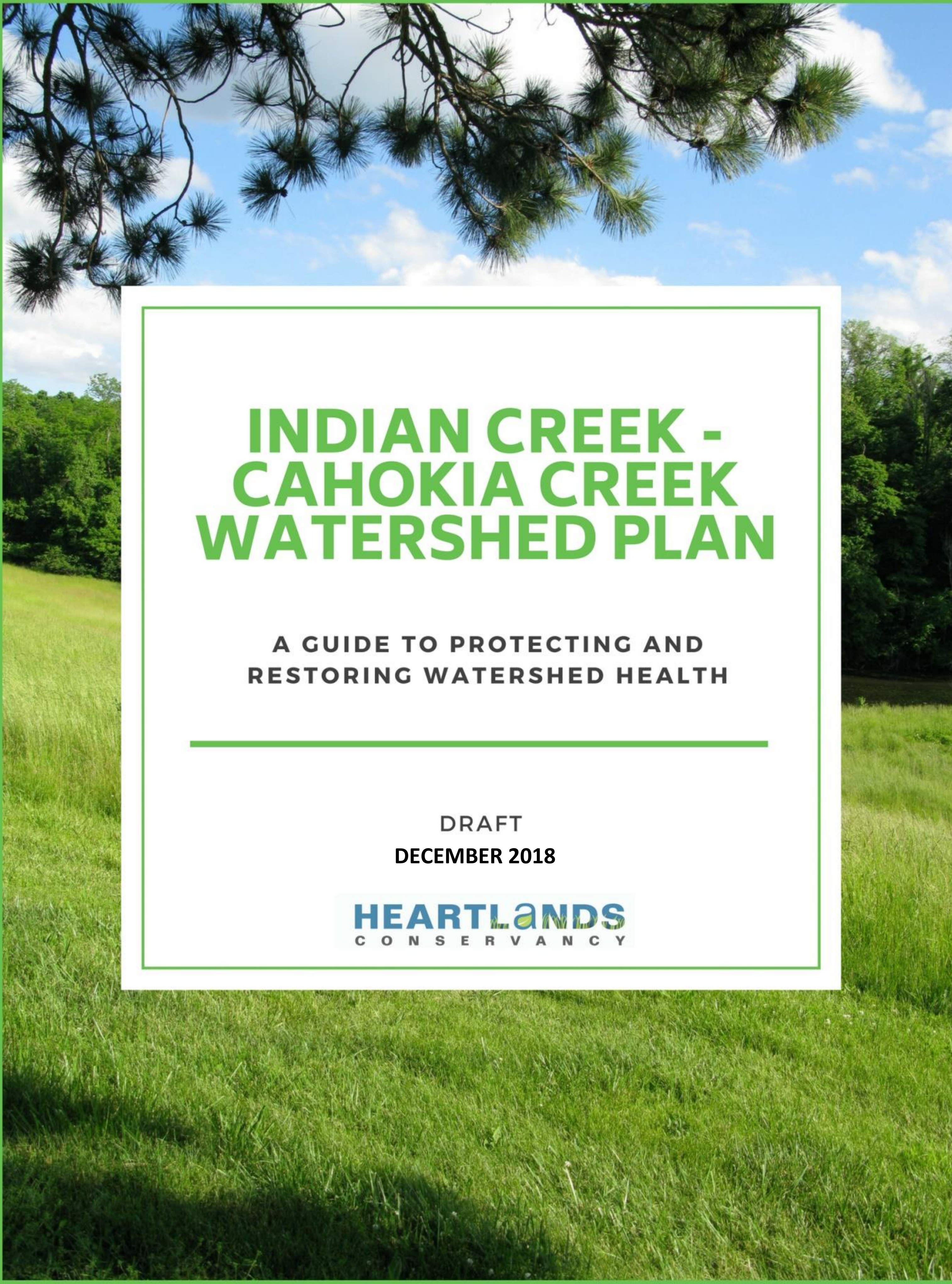

INDIAN CREEK - CAHOKIA CREEK WATERSHED PLAN

A GUIDE TO PROTECTING AND RESTORING WATERSHED HEALTH

DRAFT

DECEMBER 2018

HEARTLANDS CONSERVANCY

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Indian-Cahokia Creek Watershed Plan

A Guide to Protecting and Restoring Watershed Health

October 2018

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EXECUTIVE SUMMARY

Introduction

Executive Summary Contents

Introduction
Goals, Objectives, & Targets
Issues
Critical Areas
Management Measures Action Plan
Information & Education Plan
Implementation
Measuring Success

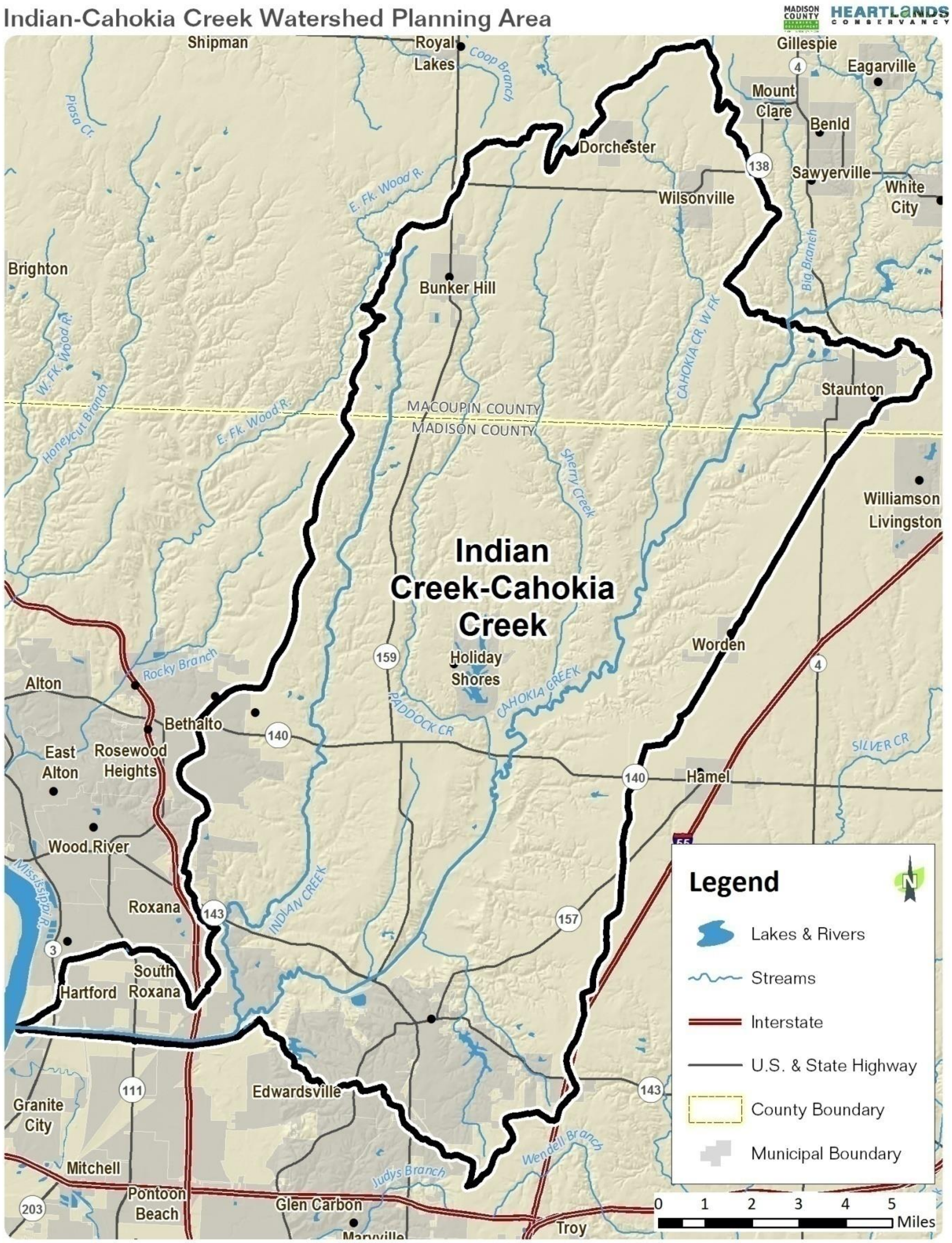
Stormwater management for Madison County is guided by the policy framework established in the Madison County Stormwater Management Plan, a county-wide document that seeks to address the effects of urbanization on stormwater drainage. The plan sets broad policy for Madison County as a whole, and sets policy and provides specific recommendations for each watershed's unique circumstances through individual watershed plans.

In 2013, Madison County and HeartLands Conservancy began to develop the first large-scale watershed plan in the county, for the upper Silver Creek watershed. This plan was completed in 2016 and is pending adoption by the county.

In 2015, the county began to move ahead with watershed plans for two additional adjacent watersheds: the Indian Creek-Cahokia Creek watershed and the Canteen Creek-Cahokia Creek watershed. By working on the two watersheds simultaneously, the planning team could gather input on both watersheds at once from communities straddling the watershed boundary.

This watershed plan offers guidance for managing watershed resources on public property, as well as providing a platform to encourage other watershed stakeholders (landowners, residents, businesses, developers, public agencies, and non-profits) to participate. The plan is not regulatory, meaning it does not become law. The intent is to encourage voluntary improvements to water quality and stormwater management in the watershed, for agricultural, urban, and natural areas and waters.

Figure 1. Watershed Location



The Indian-Cahokia Creek Watershed

The Indian-Cahokia Creek watershed is located approximately 18 miles northeast of downtown St. Louis, Missouri. Over seventy percent (70%) of the watershed lies within Madison County, Illinois, with the remaining 29% in Macoupin County. The watershed's 492 miles of streams drain roughly 126,000 acres of land.

The Indian-Cahokia Creek watershed project area contains numerous subwatersheds, called HUC12s and HUC14s. "HUC" stands for Hydrologic Unit Code, a number that identifies the general location and size of the watershed. Many of the issues identified in the watershed are assessed at these subwatershed levels.

Most of the watershed's 31,500 residents live in unincorporated areas where farming is the primary land use. Agricultural land makes up 58% of the watershed, with most of that land in row crop farming. Twelve municipalities, thirteen townships, and two counties are located within the watershed.

Figure 2. Location of Indian-Cahokia Creek watershed in the State of Illinois.

Goals, Objectives, and Targets

The plan promotes a functioning, healthy watershed and guides the development, enhancement, and implementation of actions to achieve these goals:

GOALS
GOAL 1: Reduce Flooding/Mitigate Flood Damage
GOAL 2: Improve Surface Water Quality
GOAL 3: Promote Environmentally Sensitive Development
GOAL 4: Support Healthy Habitat
GOAL 5: Develop Organizational Frameworks
GOAL 6: Conduct Education and Outreach

Objectives were developed to specify progress towards these goals. Targets in this plan were set at levels that can feasibly be reached by the implementation of a suite of Best Management Practices (BMPs), or Management Measures, over time. The targets include a 25% reduction in phosphorus loading and a 15% reduction in nitrogen loading by 2030 (based on Illinois Nutrient Loss Reduction Strategy), a 20% reduction in sediment loading (based on estimated impacts of proposed BMPs) by 2030, and a 57% reduction in fecal coliform loading (based on 35 Ill. Adm. Code 302) by 2030.

Key Watershed Issues

Analysis of the existing and predicted future conditions in the watershed (Appendix A: Watershed Resource Inventory) included collecting data from several government data sources, delineating HUC14 watershed boundaries, using the U.S. Environmental Protection Agency (USEPA) Spreadsheet Tool for Estimating Pollutant Loads (STEPL), conducting an aerial assessment of stream and riparian conditions, field checks, and stakeholder engagement. From this research, the following issues were identified:

Flooding issues

- **Prevalent flooding, within and outside floodplains**: All municipalities in the watershed have experienced flooding. Respondents to the Flood Survey reported approximately 689 flood events per year outside the 100-year floodplain, while only about 70 were within floodplains. (Note: these are the floodplains currently "in effect," identified in the 1970s to 1980s Federal Emergency Management Agency (FEMA) maps.)
- **Undersized stormwater infrastructure**: In many areas, stormwater infrastructure (e.g., culverts, ditches) is undersized for the amount of water it has to handle, leading to flooding.
- **High water table/groundwater**: When the soil is already saturated, stormwater cannot infiltrate and runs off on the surface.
- **Large areas of impervious cover**: New development and the creation of large areas of impervious surfaces have dramatically changed stormwater drainage in some areas, leading to flooding.
- **Backup issues when the river is high**: If the canals in St. Clair County or the Cahokia Canal at Hartford do not drain to the Mississippi River, the inland waterways back up, causing flooding.
- **Logjams and beavers**: Beavers and logjams contribute to localized flooding issues.
- **Channelization**: When streams are straightened (channelized), such as in Collinsville Township, water moves through them much more quickly and can exacerbate downstream flooding.
- **Sediment deposition**: Dredging in Dunlap Lake and Holiday Lake, as well as countless detention basins, is needed to maintain water storage capacity. Dredging can be very expensive.
- **Dam and spillway maintenance**: The dams and spillways at Holiday Lake and Dunlap Lake require costly ongoing maintenance to prevent failure.
- **Backflow preventer maintenance**: Performing regular maintenance on these devices is important to prevent backflow and flooding from occurring.

Water quality issues

- **Drinking water source protection**: Communities such as Edwardsville, and many individuals in the unincorporated county, use well water as their water supply. Holiday Lake is the water source for Holiday Shores. Contamination of these water sources is a life safety issue and can be costly to remediate.
- **Soil erosion:** Soil erosion contributes large amounts of sediments to streams and waterways.
    - **From streambanks, stream channels, and lake shorelines:** Many residents in the watershed have had yards collapse into a stream because of bank and channel erosion. Logjams can exacerbate the problem, causing scouring and bank collapse.
    - **From farmland:** Valuable topsoil often erodes from the land when the soil is exposed.
    - **From construction sites:** Improperly stored earth at construction sites is highly prone to erosion.

- **Sediment**: Sediment is highly prevalent in streams and runoff throughout the watershed. When soil erodes from the landscape, it ends up as sediment and silt in streams. The soil carries other pollutants such as phosphorus, iron, and manganese with it. When sediment is deposited in streams and detention basins, it forces the water upwards, which can lead to flooding.
  Total Suspended Solids (TSS) is one of the pollutants identified in Holiday Shores (Holiday Lake) on the 2018 Illinois EPA (IEPA) 303(d) List.
- **Pollutants:**
  - **Phosphorus**: Phosphorus is carried into waterways along with soil particles. It often comes from agricultural fertilizer or lawn fertilizer. It can lead to harmful algae blooms. Phosphorus is one of the pollutants identified in Cahokia Diversion Channel, Holiday Shores (Holiday Lake), and Holiday Shores Creek on the 2018 IEPA 303(d) List.
  - **Iron:** Iron is one of the pollutants identified in Cahokia Creek on the 2018 IEPA 303(d) List. It is found in high levels in certain local soils. It can be toxic to aquatic plants and animals.
  - **Chloride**: Application and storage of road salt is a concern where water with high concentrations of chloride flows into groundwater or streams. Chlorides increase treatment costs for water supplies and are harmful to aquatic life in waterways.
  - **Mercury:** High mercury levels have been found in fish in Dunlap Lake by Southern Illinois University Edwardsville (SIUE) researchers. Residents have been advised to only catch and release fish, not eat them.
- **Low Dissolved Oxygen**: Low levels of dissolved oxygen in water cannot support aquatic life. Low dissolved oxygen levels are often a result of algae growth that uses up oxygen in the water, which is caused by high levels of nutrients such as nitrogen and phosphorus. Low DO is listed as an impairment to Cahokia Diversion Channel on the 2018 IEPA 303(d) List.
- **Sewage contamination from private systems**: Poor maintenance of private sewage systems can lead to raw human waste in waterways.
- **Combined sewers**: Hartford has sewer pipes that carry both stormwater and sanitary waste (combined sewers). When large volumes of stormwater enter the system, overflows can carry untreated waste out onto the land and into streams.
- **Infiltration into/out of ageing pipes**: Some pipes in Edwardsville are over 100 years old. Sewage can leak out of sewer pipes, and groundwater leak into water supply pipes.
- **Livestock waste management**: Improperly treated livestock waste can also reach waterways.
- **Litter and dumping:** Littering and unlawful dumping are widespread, particularly at streams.
- **Industrial/oil leaks**: An estimated 25,000 gallons of diesel leaked into Cahokia Canal from Phillips 66 in April 2015. Other, smaller leaks can also pose a significant hazard to water quality.
- **Algae blooms and fish die-outs**: Algae blooms and fish die-outs in streams and lakes, including Dunlap Lake and Holiday Lake, occur as a result of excess amounts of fertilizer in the water. Aquatic Algae is listed as an impairment on the 2018 IEPA 303(d) List for Holiday Shores Creek.
- **Changes to stream velocity and lack of stream-side (riparian) vegetation**: Indian Creek, Cahokia Creek, and the Cahokia Diversion Channel are listed on the 2018 303(d) List for these impairments.

Land cover and development issues

- **Poorly planned development.** Many older developments in the watersheds did not include adequate drainage infrastructure, which has exacerbated water quality and flooding issues. New development often increases the speed of stormwater runoff and does not provide for long-term maintenance of drainage infrastructure, even if it meets local building and stormwater requirements.

Habitat issues

- **Poor riparian condition**: The area either side of a stream is known as the riparian area. This area is considered to be in poor condition when there is not enough vegetation to support the streambanks and provide shade to the stream. These conditions are also important for wildlife, particularly neotropical migratory songbirds that use the Mississippi River flyway.
- **Invasive species present:** Invasive species crowd out native species such as plants that protect streambanks from erosion.
- **Unprotected habitat for endangered species:** Where their native habitat is not preserved, threatened and endangered species such as the chorus frog cannot be expected to thrive over the long term.

Organizational needs/issues

- **Lack of detention basin maintenance**: Detention basins are often not being maintained/dredged to maintain their sediment storage and water storage capacities.
- **Lack of code enforcement**: In some cases, municipal stormwater, development, subdivision, and floodplain codes are not being fully enforced.
- **Lack of funding:** Funding from government entities and other groups is often needed to maintain and expand stormwater infrastructure and improve water quality.
- **Need for strong partnerships:** A network of partner organizations/groups is needed to make large strides towards addressing flooding and other issues in the watersheds.

Information and outreach issues

- **Need for communication and collaboration:** Communication about funding and technical resources is sometimes lacking between potential partners; this information could help bring awareness, technical resources, and funding to address issues.
- **Need for outreach to key stakeholders:** A large group of landowners and other key stakeholders working together is needed to make progress towards addressing flooding and other issues.

Critical Areas

"Critical Areas" were identified at locations in the watershed where existing or potential future causes and sources of pollutants or existing functions are significantly worse than other areas of the watershed, OR there is significant potential for the area to make progress towards one or more of the plan's goals. The Critical Areas were identified using survey and stakeholder information, aerial and field assessments, and U.S. Department of Agriculture (USDA) modeling.

The following Critical Areas were identified:

1. Critical Stream Reaches: Highly or moderately degraded stream reaches with high channelization (5.52 miles)
2. Critical Logjam Areas: Stream reaches with high susceptibility to logjams (37.52 miles)
3. Critical Riparian Areas: Highly degraded riparian areas (21.16 miles)
4. Critical Wetland Areas: Areas suitable for wetland restoration (1,477 acres)

Implementation

The "Action Plan" is designed to provide partners with recommended actions, known as Management Measures, which address the plan's goals, objectives, and targets.

Recommended Management Measures

Programmatic Measures, including general remedial, preventive, and policy watershed-wide measures, and **Site-Specific Measures**, on-the-ground practices that can be implemented to improve surface and groundwater quality and flooding, are recommended. Management Measures identified for Critical Areas are prioritized for short-term implementation (e.g., wetland restoration projects in Critical Wetlands Areas). All recommendations in the plan are for guidance only and are not required by any federal, state, or local agency.

Together, these practices can make changes in the watershed that will meet and exceed the Impairment Reduction Targets. Significant participation from local landowners, farmers, residents, municipalities, and developers will be needed to achieve these targets.

Programmatic Measures

Protection and management of natural areas

- Conservation Development design, which protects natural features like streams, steep slopes, and forest in new development (especially subdivisions).
- Open space and natural area protection from the design stage through to the stage where the landowner owns the property.
- Green infrastructure incentives, which promote the protection of forest, wetlands, and other green infrastructure.
- Long-term management and maintenance of natural areas, through management agreements with responsible entities.
- Monitoring of water quality, flow, and stream health to help measure progress.
- Naming unnamed tributaries, which can increase stream visibility within a community, resulting in improved public engagement water quality.

Restoration of natural areas

- In-lieu fee ecological mitigation, a type of program that funds the restoration of ecologically sensitive wetlands and streams to mitigate for the losses of those features to new development.

- Native landscaping, which encourages the use of native plants on public and private property.
- Stream Cleanup Team, which removes litter and debris from streams and waterbodies.

Wastewater management

- Sewage Treatment Plant upgrades, which reduce the pollutant loading in wastewater discharge from wastewater facilities.
- Private sewage monitoring, a proactive program that samples private sewage systems to check for water quality problems and to encourage regular maintenance.

Natural resource policy

- Flood Damage Prevention Ordinance, which limits inappropriate development in floodplains, adopted by counties and municipalities.
- Riparian Buffer Ordinance, which limits development in riparian areas (areas adjacent to streams and waterbodies), encouraging forest and grassland that helps to filter and slow down runoff.
- Watershed plan integrated into community policies and programs.

Funding

- Federal and state programs such as the Conservation Reserve Enhancement Program (CREP) and the Environmental Quality Incentives Program (EQIP) are available to landowners in the watershed to finance practices that prevent soil erosion, among other benefits.
- Financial support for stormwater infrastructure, such as a Stormwater Utility, that is dedicated to upgrades and maintenance of detention basins, ditches, and other conveyance structures.

Site-Specific Measures

Agricultural

- Animal waste treatment systems, which provide proper treatment and use of waste (primarily manure) from livestock operations.
- Bioreactors, also known as denitrifying bioreactors, which are ditches filled with woodchips that remove nitrogen from water leaving tile-drained fields.
- Comprehensive Nutrient Management Plans (CNMPs), which are farm-specific plans to eliminate unwanted runoff, incorporate manure nutrients into crop nutrient budgets, and efficiently apply manure to cropland, reducing water pollution and increasing soil health.
- Conservation tillage (reduced tillage/no-till), which leads to a reduction in soil erosion and the transport of associated nutrients, such as phosphorus, to the waterways.
- Contour buffer strips, which are narrow strips of perennial vegetation that slow surface runoff and trap sediment, significantly reducing sheet and rill erosion and removing pollutants from runoff.
- Cover crops, which prevent erosion, improve soil health, break pest cycles, and suppress weeds.
- Grassed waterways, which are vegetated channels designed to slow surface water to reduce soil erosion and flooding.
- Nutrient Management Plans (NMPs), which are farm-specific plans for determining nutrient needs for crops and obtaining the maximum return from fertilizers.
- Ponds, which store stormwater, settle out sediments, and allow nutrient uptake by aquatic organisms.
- Riparian buffers, which are vegetated zones immediately adjacent to streams that protect the stream channel.
- Terraces, which consist of ridges and channels constructed across the slope of a field, reducing soil erosion and surface runoff on sloping fields.
- Water and Sediment Control Basins (WASCOBs), which are small earthen ridge-and-channel structures or embankments built across a small watercourse in a field. They hold runoff, reducing the amount of sediment and sediment-borne phosphorus leaving the field and preventing the formation of gullies.
- Wetlands, which function as one of the most effective pollution removal practices.

Forest

- Forest stand improvement, which manages forest species composition (including removal of invasive species), can increase infiltration, reduce erosion, and provide long-term wildlife habitat.

Urban areas

- Bioswales, also known as vegetated swales, which increase infiltration and delay stormwater surges during heavy rainfall.
- Detention basins (new and retrofitted), which store flows during and incrementally release the stored water.
- Pervious pavement, which allows infiltration of stormwater into a below-ground storage area through holes in the pavement.
- Rain gardens, which temporarily store and infiltrate rain water, significantly slowing the flow of water, improving water quality, and providing wildlife food and habitat.
- Rainwater collection and reuse, using rain barrels or cisterns.
- Single property flood reduction strategies, which differ from property to property, based on the sources of flooding and appropriate flood reduction strategies.
- Stormwater system maintenance and expansion, which is crucial for the efficient conveyance of stormwater.
- Tree planting (e.g., street trees), to decrease and filter stormwater, reduce air temperatures, provide pleasing aesthetics.

Streams and lakes

- Lake and stream dredging, which removes sediment from the waterbody and reduces the risk of flooding.
- Logjam removal, which removes debris from the stream channel, reducing scouring in the stream channel and the risk of floods overtopping the channel.
- Shoreline stabilization, which reduces bank erosion along lake shores.
- Streambank and channel restoration, which includes stabilization and grade control structures. These reduce erosion and, in some cases, provide flood storage.

Measuring Success

Water quality monitoring will be conducted by the National Great Rivers Research and Education Center (NGRREC), as funding allows, on a three to five year cycle through the year 2025. A set of Progress Report Cards is included in Appendix H, which includes milestones for short-term (one to 10 years; 2016 to 2026), medium-term (10 to 20 years; 2026 to 2036), and long-term (20+ years; 2036+) timeframes. The report card can be used to identify and track plan implementation and effectiveness. Checking in at appropriate milestones helps watershed partners make corrections and ensure that progress is being made towards achieving the plan's goals.

Information and Education Plan [update based on table 8]

Public outreach and educational activities are vital for supporting a healthier watershed. The Information and Education component of this plan supports the cumulative actions of partners, stakeholders, and the public across the watershed to accomplish its goals and objectives.

Recommended information and outreach activities include:

- Municipal outreach;
- Watershed plan outreach;
- An Agricultural BMP Workshop;
- A BMP or Demonstration Project Tour;
- A public events booth;

- Field days;
- Educational signs;
- School projects; and
- Watershed protection awareness.

SECTION 1: INTRODUCTION

Simply stated, a "watershed" is the area of land that drains into a common waterbody, such as a creek or river. It can be thought of as a large bathtub: when a drop of water hits anywhere in the tub, it eventually finds its way to the drain (the lowest point). The rim of the bathtub is like the watershed boundary—any drop falling outside it will not reach the drain. On land, a watershed boundary is determined by topography, and it includes surface water bodies (e.g., streams, rivers, lakes, reservoirs, and wetlands), groundwater (e.g., aquifers and groundwater basins), and the surrounding landscape.

The Indian-Cahokia Creek watershed is a largely agricultural area in southwestern Illinois that drains to the Mississippi River (Figure 1). Rain falling on the watershed collects sediment containing phosphorus on its way downhill to Cahokia Creek. Excessively high concentrations of these and other pollutants in Cahokia Creek, the Cahokia Diversion Channel, Holiday Shores (Holiday Lake), and Holiday Shores Creek earned these creeks a place on the 2018 IEPA 303(d) list of impaired waters for several successive years. Flooding is also a problem throughout the watershed, both where creeks rise up out of their banks and in urban areas (i.e., "flash flooding").

In 2012, Madison County began work on a county-wide Stormwater Management Plan to manage stormwater runoff. The plan is founded in four principles:

1. Acknowledging that multiple communities are connected by waterways and the actions of one jurisdiction will impact upstream and downstream jurisdictions. Stormwater management efforts should focus on a watershed-scale perspective.

2. Recognizing that a systems approach is needed in managing stormwater.

3. Recognizing that existing streams, creeks, bodies of water, and wetlands are infrastructure that needs to be protected and maintained.

4. Recognizing that future growth and a high quality of life are dependent on managing the effects of stormwater.

Based on these principles, the county will incorporate watershed-level stormwater management plans for all of the major watersheds in the county. The Upper Silver Creek Watershed-Based Plan was completed in 2016. This plan and the Canteen Creek-Cahokia Creek Watershed Plan are on the same schedule. The American Bottom Watershed Plan, for that portion of the Judy's Branch-American Bottom watershed that is in Madison County, is scheduled to be completed by 2020.

A watershed plan is a strategy for managing watershed resources on public property, as well as providing a platform to encourage other watershed stakeholders (e.g., land owners, residents, businesses, developers, and non-profits) to participate. The plan is not regulatory, meaning it does not become law. The intent is to encourage voluntary improvements to stormwater management and water quality in the watershed.

Indian-Cahokia Creek Watershed

The Indian-Cahokia Creek watershed is located approximately 18 miles northeast of downtown St. Louis, Missouri. The majority of the watershed lies within Madison County (71%, Illinois, while 29% lies within Macoupin County. The watershed's 492 miles of streams drain roughly 126,000 acres of land.

The watershed is home to approximately 31,500 people, the majority of which live in unincorporated areas where farming is the primary land use. Agricultural land makes up 58% of the watershed, with most of that land in row crop farming. All or portions of twelve municipalities, thirteen townships, and two counties are located within the watershed (Table 1 and Figure 3).

Table 1. Jurisdictions in the Indian-Cahokia Creek watershed.

Jurisdiction	Area within watershed (acres)
County (inclusive of municipalities)	125,699
Macoupin	36,053
Madison	89,646
Municipalities	13,349
Bethalto	1,609
Bunker Hill	756
Dorchester	457
Edwardsville	5,249
Glen Carbon	195
Hartford	962
Roxana	2,088
South Roxana	599
Staunton	1,434
Wilsonville	619
Wood River	297
Worden	278
Unincorporated Areas	112,350
Macoupin County	9,303
Madison County	34,625
Townships	125,869
Bunker Hill (Macoupin County)	9,260
Chouteau	3,481
Dorchester (Macoupin County)	21,524
Edwardsville	11,396
Fort Russell	22,592
Gillespie	1,832
Hamel	11,774
Moro	14,052
Olive	1,200
Omphghent	20,328
Pin Oak	4,573
Staunton (Macoupin County)	2,923
Wood River	934

The Indian-Cahokia Creek watershed project area contains numerous subwatersheds, called HUC12s and HUC14s. "HUC" stands for Hydrologic Unit Code, a number that identifies the general location and size of the watershed. Many of the issues identified in the watershed are assessed at these subwatershed levels.

Indian Creek, Paddock Creek, Sherry Creek, and Mooney Creek are major tributaries to Cahokia Creek in the watershed. Cahokia Creek drains to the Cahokia Diversion Channel, which empties into the Mississippi River west of Hartford.

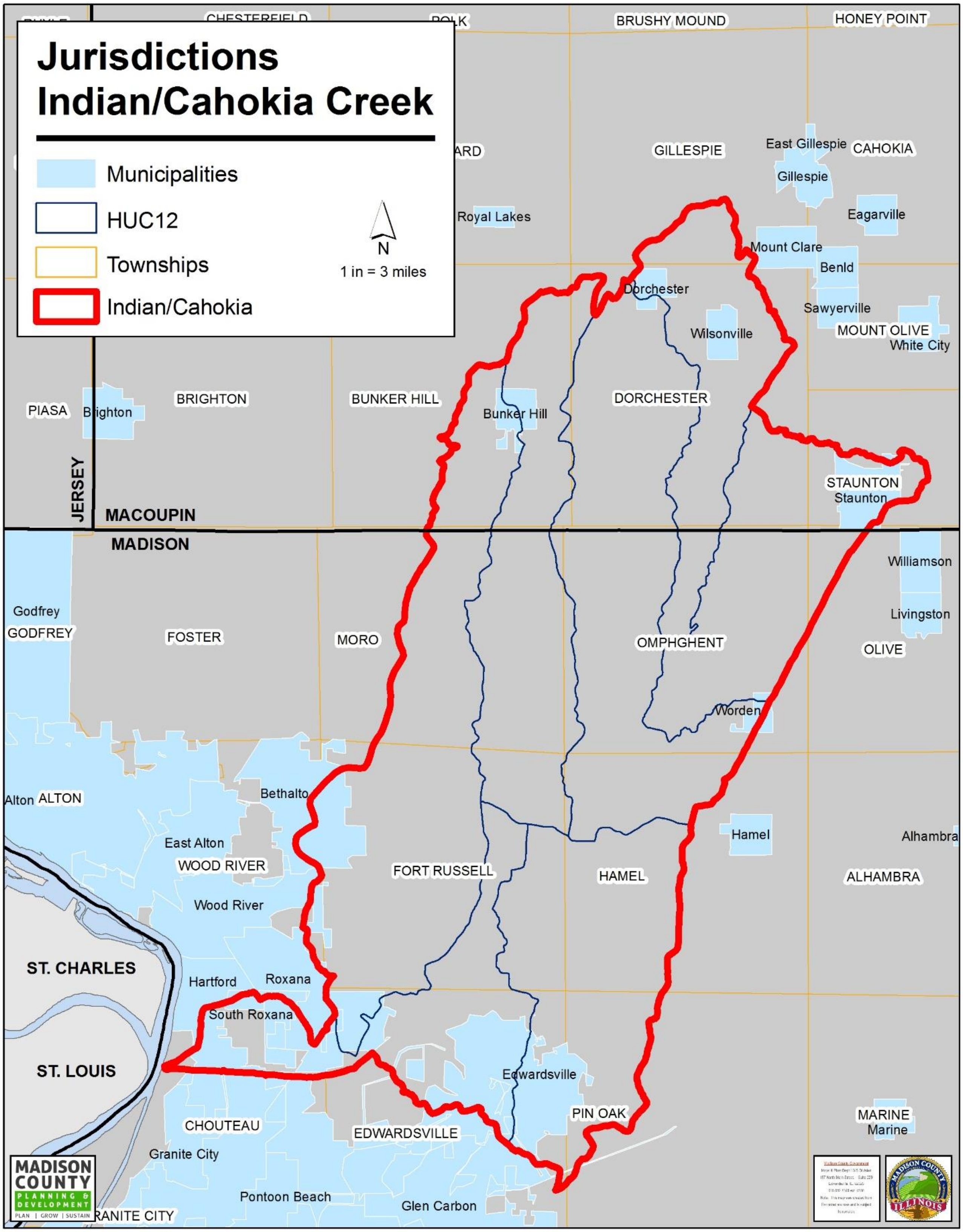


Figure 3. The Indian-Cahokia Creek watershed, containing seven HUC12 subwatersheds and all or portions of 12 municipalities.

Purpose

The purpose of the Indian-Cahokia Creek Watershed Plan is to promote a healthy, functioning watershed that sensitively balances farming, development, and natural ecosystems, including restoring surface water quality to Cahokia Creek and its tributaries and managing stormwater in floodplains and communities. The plan should enhance, manage, and protect the watershed's human, natural, and socio-economic resources by identifying strategies and resources that promote the health and safety of human inhabitants, improve surface and groundwater quality, prevent flood damage, protect wildlife, and increase environmental education.

Madison County Stormwater Plan

The Madison County Stormwater Plan is the overall framework for stormwater management in the county which guides regulations, identifies flood and water quality problems, establishes BMPs, and prioritizes projects. The Indian-Cahokia Creek watershed is one of 10 watersheds for which a watershed plan will be developed as part of the Stormwater Plan. Direction and approval for the Stormwater Plan comes from the Madison County Stormwater Commission, whose members include County Board members and municipal representatives.

The Madison County Stormwater Plan also references stormwater runoff which is transported through Municipal Separate Storm Sewer Systems (MS4s). Madison County acts as the Coordinator for the MS4 Co-Permittee Group which consists of 26 communities (including the county itself). The group works together to help the individual communities and townships meet the six minimum control measures of their ILR40 permits.

The minimum requirements are: 1) public education and outreach, 2) public participation/involvement, 3) illicit discharge detection and elimination, 4) construction site runoff control, 5) post-construction runoff control, and 6) pollution prevention/good housekeeping. Madison County's MS4 activities in 2014 included technical training, outreach at public events, and hazardous waste collection.

Authority

The State of Illinois Counties Code (55 ILCS 5/) gives counties the authority to adopt and enforce floodplain regulations that apply to all buildings, structures, construction, excavation, and fill in the floodplain. The Counties Code also allows "management and mitigation of the effects of urbanization on stormwater drainage" in Madison County, St. Clair County, and seven other counties (55/ILCS 5/5-1062.2).

> *(55/ILCS 5/5-1062.2) Stormwater management. … The purpose of this Section shall be achieved by:*
>
> *(1) Consolidating the existing stormwater management framework into a united, countywide structure.*
>
> *(2) Setting minimum standards for floodplain and stormwater management.*
>
> (3) *Preparing a countywide plan for the management of natural and man-made drainageways. The countywide plan may incorporate watershed plans.*

The Section also allows the establishment of a stormwater management planning committee, whose principal duties "shall be to develop a stormwater management plan for presentation to and approval by the county board, and to direct the plan's implementation and revision." The Madison County Stormwater Commission fulfills this role. The stormwater plan it creates must be reviewed by the Illinois Department of Resources Office of Water Resources (IDNR-OWR), and can include elements such as rules for floodplain and stormwater management, fees or taxes from new development, and incentives for using green infrastructure and other approved drainage structures. Illinois municipalities also have the authority to adopt stormwater plans (65 ILCS/ Art 11 prec Div 110 – Flood Control and Drainage).

Methodology

Madison County and HeartLands Conservancy developed a watershed planning approach based on guidance from the Stormwater Master Plan, the county Stormwater Commission, IEPA's Nonpoint Source Program, and the USEPA's nine elements of watershed planning. The planning process included the following components:

1. Watershed area data collection and analysis
2. Delineation of subwatersheds
3. Technical Committee and Advisory Groups
4. Stakeholder engagement
5. Key issue identification and goal setting
6. Critical Areas identification
7. Management Measure and target development
8. Implementation plan
9. Stormwater Commission and County Board review
10. Integration into the county-wide Stormwater Master Plan

Watershed Data Collection and Analysis

A Watershed Resource Inventory (Appendix A) was developed by the U.S. Army Corps of Engineers (USACE), which reviews the existing conditions within the watershed. The inventory documents existing conditions in Cahokia Creek and its tributaries including channelization, erosion, riparian area condition, soil types, demographics, land use/land cover, and climate. Existing pollutant loads of nitrogen, phosphorus, and sediment are estimated from existing land uses using the STEPL from the USEPA. See planning inputs (right) for a list of data collected or generated for the Watershed Resources Inventory.

Aerial assessment of stream and riparian conditions

Little information existed about the condition of the streams in the watershed. To gather information about the stream reaches, geo-referenced video footage was taken on low-level helicopter flights over the larger streams in the watershed. Midwest Streams viewed the videotapes to assess three parameters for each stream: streambank erosion, degree of channelization, and condition of the riparian area.

Detention basin survey

USACE looked at aerial photographs of the watershed, along with U.S. Geological Survey (USGS) topographic maps, an elevation dataset, and the National Hydrography Dataset, to identify detention and retention basins in both Cahokia Creek watersheds. A point was created for each basin located in or very close to a group of five or more buildings, to avoid classifying natural ponds as detention basins. Forty-nine detention or retention basins were identified in the watershed. Site visits were made to 13 of the 107 accessible basins identified, in order to determine their condition.

Delineation of subwatersheds

The watershed contains seven subwatersheds, or hydrologic units (HUCs), called HUC12s. To provide more detailed analysis and recommendations for the watershed, the HUC12s were further divided into 27 even smaller HUC14 subwatersheds. USACE used USGS methodology for defining watersheds in the Watershed Boundary Dataset (WBD), a component of the National Hydrography Dataset (NHD). Throughout this plan, the term "subwatershed" refers to the HUC14 subwatershed level.

<u>Planning inputs</u>

The following types or sources of data were used to shape the Plan:

Watershed Resources Inventory
Watershed boundaries (incl. HUC14s)
Streams and waterbodies
Direction of flow
Topography
Climate (incl. temperature and precipitation)
Geology
Aquifers
Wells
Hydric and hydrologic soils
Erodible soils
Water table
Jurisdictional roles (federal, state, and local)
Demographics
Land use/land cover
Ecological significance
Fish and wildlife populations
Transportation infrastructure
Cultural/historic resources
Impervious cover
Streambank & streambed erosion
Channelization
Logjams
Detention and retention basins
Floodplains
Infrastructure in floodplains
National Flood Insurance Program (NFIP) communities
IEPA 303(d) impaired waters
Other water quality data
Spreadsheet for Estimating Pollutant Loads (STEPL) analysis

Watershed Plan
Agricultural Conservation Planning Framework (ACPF) GIS tools
Best Management Practice (BMP) pollutant reduction efficiencies

Stakeholder engagement
Advisory Group
Open House Events
Stakeholder meetings
Flood Survey
Landowner/Farmer Survey

Technical Committee

A Technical Committee consisting of experts in stormwater management, water quality, stream and soil health, conservation, and urban planning guided data collection and analysis. The committee was represented by Madison County Planning and Development, HeartLands Conservancy, USACE, Madison County Emergency Management Agency, Madison County Highway Department, and Madison County Soil and Water Conservation District. The Technical Committee provided input to USACE on the Watershed Resources Inventory (Appendix A) and provided technical guidance on recommendations and subsequent drafts of the plan. Specifically, the committee reviewed the methodology of data collection, draft nutrient reduction targets and other targets, Flood Survey results, Best Management Practices (BMPs), and milestones for plan implementation.

Stakeholder Engagement

Early on and throughout the planning process, the planning team engaged more than 600 individuals from more than 90 entities. Interviews were conducted with stakeholders including townships, municipalities, the Madison County Farm Bureau, and County Board members. Small group meetings allowed attendees to provide locations of floods and other issues on large paper maps, and give detailed input on stormwater issues in the watershed. Five Open House events were also used to gather input and get feedback from the general public. Presentations at regularly scheduled meetings of organizations such as the Edwardsville Rotary and the East-West Gateway Council of Government's Water Resources Committee allowed the project planning team to reach larger groups efficiently.

Municipalities were asked about their drinking water source(s), wastewater treatment system(s), and flooding, as well as issues such as erosion, siltation, and water quality issues. Other stakeholders were asked about these issues in their jurisdiction or on their property. A table summarizing the input from municipalities can be found in Appendix A (Watershed Resource Inventory). Stakeholder input was particularly helpful in shaping the Critical Area locations and the Information and Outreach section of the plan, which identifies outreach gaps and opportunities with specific events and groups. Some of the issues identified during outreach include recurrent flooding, high levels of sediment, phosphorus, and nitrogen, and inadequate communication/coordination among potential watershed partners.

Flood Survey

Another component of stakeholder outreach, the Madison County Community Flood Survey for the Indian-Cahokia Creek watershed was sent to 1,600 randomly selected addresses in the watershed, and put online, following the initial stakeholder meetings. More than 280 responses were received. The results revealed trends in flooding locations, frequency, and impacts (Appendix B). The survey found that 21% of respondents experienced flooding in the last decade, and those respondents experience an average of 1.2 floods per year.

Key Issue Identification and Goal Setting

Using the results of the stakeholder outreach process, the project team and technical committee identified the key issues—such as erosion and flash flooding—in the watershed. As the key issues evolved, common themes emerged and the project team was able to develop overarching goals and objectives for the watershed.

Critical Areas Identification

In addition to identification of key issues, the project team used information gathered from municipalities, townships, the county, individual property owners, and a variety of technical and spatial data resources and modeling to determine the locations of Critical Areas in the watershed. A "Critical Area" is a location in the watershed where existing or potential future causes and sources of pollutants are significantly worse than other areas, or there is significant potential to make progress towards watershed plan goals.

Management Measures and Targets

Based on the Watershed Resource Inventory and input from stakeholders and the public, management measures and targets were identified. Management Measures include potential Best Management Practices (BMPs) for prevention, remediation, restoration, and maintenance to achieve water quality, natural resources, and flood control objectives. For each BMP, the plan identifies pollutant load reduction and other benefits, approximate costs, and a schedule for implementation. Sources of financial and technical support are also identified, and measures of success and milestones are established to monitor the ongoing progress of the plan.

Spreadsheet Tool for Estimating Pollutant Loads (STEPL)

USACE used the STEPL, which uses land cover, precipitation, and elevation data to estimate nitrogen, phosphorus, and sediment runoff from specific drainage areas. The tool created estimates for current land use conditions and future land cover scenarios incorporating Management Measures. The Technical Committee used these numbers to set targets for pollutant load reduction in the watershed.

Agricultural Conservation Planning Framework (ACPF)

HeartLands Conservancy used the Agricultural Conservation Planning Framework (ACPF), a set of Geographic Information System (GIS) tools developed by the USDA to identify locations where certain BMPs (e.g., terraces, grassed waterways) would be well-suited. The ACPF uses topographic data (LiDAR) to create maps of drainage pathways across agricultural land. These drainage pathways are used alongside land cover, rainfall, and soils data to create useable maps within the watershed. HeartLands Conservancy worked closely with USDA to use the ACPF tools to get the most accurate and useful results for this watershed.

Implementation Plan

For each Management Measure, an implementation schedule was developed. Partners in the watershed plan can monitor progress and effectiveness using progress report cards (Appendix H).

Water quality monitoring

Water quality monitoring data was collected for the watershed (from ISGS, IEPA, and other sources), and a monitoring plan was created for the coming years (Appendix F).

Stormwater Commission and County Board Review

Drafts of the plan will be reviewed by the Madison County Stormwater Commission. The Stormwater Commission makes a recommendation to the County Board on whether to adopt the plan as a part of the county-wide Stormwater Management Plan.

Integration into Madison County Stormwater Management Plan

Upon adoption by the County Board, the watershed plan will become a part of the county-wide Stormwater Management Plan.

SECTION 2: GOALS, OBJECTIVES, AND TARGETS

Goals and Objectives

A set of long-term goals and objectives were developed to address the challenges and issues associated with maintaining a healthy, functioning watershed (Table 2). These goals address the issues identified in the Watershed Resources Inventory, Community Flood Survey, and input from residents, land owners, businesses, and government officials. Each goal and objective aligns with a challenge/issue to be addressed, a set of recommended Best Management Practices (BMPs), the roles of organizations implementing those BMPs, specific and general projects using those BMPS, and ranking of the priority of the recommended BMPs.

Table 2. Goals and objectives of the Watershed Plan.

Goals	Objectives
Reduce Flooding/Mitigate Flood Damage	• Increase stormwater captured, stored, and infiltrated. • Limit development in the 100-year floodplain. • Ensure thorough inspections and maintenance of dams to minimize flood risk, and decrease water levels in dammed lakes ahead of major storms • Institute development standards that minimize impervious surfaces. • Preserve the natural flow of streams and slow peak stream flow. • Promote ongoing maintenance of stormwater storage and conveyance infrastructure. • Provide information about flood damage prevention and insurance. • Provide information about development in high water table areas.
Improve Surface Water Quality	• Decrease overall pollutant loading to Cahokia Creek and its tributaries, and remove streams from the Illinois EPA 303(d) List. • Protect drinking water sources, through groundwater protection where applicable. • Achieve a 25% reduction in phosphorus to the watershed by 2030. • Achieve a 20% reduction in sediment to the watershed by 2030. • Achieve a 15% reduction in nitrogen to the watershed by 2030. • Maintain Dissolved Oxygen (DO) levels above standard minimums. • Achieve a 57% reduction in fecal coliform to the watershed by 2030. • Create a strategy to improve the assessment and maintenance of private sewage systems. • Monitor water quality and identify trends. • Increase streambank stabilization and riparian area restoration efforts.
Promote Environmentally Sensitive Development	• Conserve sensitive lands. • Increase the acreage of forest, native grassland, and wetlands. • Use wetland mitigation banking or in-lieu fee programs. • Implement low-impact development strategies. • Work with municipalities to amend policies and regulations to include conservation, native landscaping, stormwater management, and low-impact design, and to improve enforcement of existing codes.
Support Healthy Habitat	• Promote healthy ecosystems within streams and riparian areas. • Monitor fish and aquatic macroinverterbrate communities. • Identify and protect key natural features and wildlife corridors. • Prioritize "green" stormwater management approaches. • Create an invasive species removal strategy.
Develop Organizational Frameworks	• Activate a network of partners to implement the plan. • Leverage funding from a variety of sources to implement the plan.
Conduct Education and Outreach	• Identify opportunities to assist stakeholders with watershed management. • Connect watershed stakeholders to decision-makers and experts. • Offer opportunities for public education and participation, such as a lake education campaign. • Develop public recognition programs focused on the watershed plan's goals.

GOAL 1: REDUCE FLOODING AND MITIGATE FLOOD DAMAGE

Manage and mitigate floods to improve water quality, reduce property damage and health risk, and reduce infrastructure maintenance costs.

Within the watershed, there is a need for further outreach and dissemination of resources about flood damage prevention and flood insurance; a decrease in impervious surface area; preservation and slowing of natural stream flow; an increase in flood storage and infiltration features such as detention basins, wetlands, and no-till agriculture; and changes in policy to discourage development in flood-prone areas.

Flood Management Objectives:

1.1 *Increase the amount of stormwater captured, stored, and infiltrated in the watershed, particularly upstream of areas with periodic or regular property damage caused by flooding.*

1.2 *Limit development in the FEMA-identified 100-year floodplain.*

1.3 *Ensure thorough inspections and maintenance of dams to minimize flood risk, and decrease water levels in dammed lakes ahead of major storms.*

1.4 *Institute development standards that seek to minimize the amount of impervious surfaces in new development and redevelopment projects.*

1.5 *Preserve the natural flow regime of streams in the watershed, and identify opportunities to slow peak stream flow and recharge groundwater where increases in flood height are acceptable.*

1.6 *Promote ongoing improvement and maintenance of stormwater storage and conveyance infrastructure (e.g., detention basins and ponds) to maximize storage capacity.*

1.7 *Provide information and outreach about flood damage prevention and flood insurance.*

1.8 *Provide information about development in high water table areas.*

GOAL 2: IMPROVE SURFACE WATER QUALITY

This plan aims to improve surface water quality in the watershed, so that the streams can be safely used by residents, and to remove Cahokia Creek, Cahokia Diversion Channel, Holiday Shores (Holiday Lake), and Holiday Shores Creek from the IEPA 303(d) list of impaired waters.

Four creeks have been listed on the 2018 IEPA 303(d) list of impaired waters for several successive years. The causes of impairment for these creeks include: alteration in stream-side or littoral vegetative covers, iron, changes in stream depth and velocity patterns, loss of instream cover, fecal coliform, fish-passage barrier, dissolved oxygen, total phosphorous, total suspended solids (TSS), and aquatic algae. The Watershed Impairment Reduction Targets table on page 36 (Table 3) provides details on the data sources informing the reduction targets in the following objectives.

__Water Quality Objectives:__

2.1 *Decrease overall pollutant loading to Cahokia Creek and its tributaries. Decrease overall pollutant loading to Cahokia Creek and its tributaries, and remove Cahokia Creek, Cahokia Diversion Channel, Holiday Shores lake, Holiday Shores Creek, and Indian Creek from the Illinois EPA 303(d) List.*

2.2 *Protect drinking water sources from pollutants that threaten human health or increase treatment costs, through groundwater protection where applicable.*

2.3 *Achieve a 25% reduction in phosphorus to the watershed by 2030. (i.e., a 25% reduction in the annual total phosphorus load by 2030, based on the Illinois Nutrient Loss Reduction Strategy), and meet the 2007 phosphorus TMDL Endpoints for Holiday Shores Lake and Tower Lake.*

2.4 *Achieve a 20% reduction in sediment to the watershed by 2030. (i.e., a 20% reduction in the annual sediment load by 2030, based on estimates from a suite of BMPs that also address the needed phosphorus reduction.)*

2.5 *Achieve a 15% reduction in nitrogen to the watershed by 2030. (i.e., a 15% reduction in the annual total nitrogen load by 2030, based on the Illinois Nutrient Loss Reduction Strategy.)*

2.6 *Maintain Dissolved Oxygen (DO) levels above standard minimums (i.e., consistently maintain levels higher than the minimum concentrations set in Illinois standards (35 Ill. Adm. Code 302), set by the Illinois Pollution Control Board in 2011). Also meet the DO TMDL Endpoint for the Cahokia Diversion Canal.*

2.7 *Achieve a 57% reduction in fecal coliform from the watershed by 2030. (i.e., achieve a 57% reduction by 2030 in order to reach the Illinois Pollution Control Board standard of 200 cfu/100ml). This will also meet the 200 cfu/100ml fecal coliform TMDL Endpoint for Cahokia Creek.*

2.8 *Create a strategy to improve the assessment and maintenance of private sewage systems (i.e., septic tanks) for correct functioning.*

2.9 *Monitor water quality in the watershed to identify trends and evaluate the success of management activities (including monitoring of industrial areas for leaks).*

2.10 *Increase streambank stabilization and riparian area restoration efforts.*

2.11 *Increase awareness of the consequences of littering/illegal dumping.*

GOAL 3: PROMOTE ENVIRONMENTALLY SENSITIVE DEVELOPMENT PRACTICES

Promote development practices that protect environmentally sensitive lands (e.g., steep slopes, wetlands, and forests), conserve soil, limit new impervious surfaces, and increase the use of native vegetation.

Development Objectives:

3.1 Conserve sensitive lands by taking them out of crop production and/or protecting them from development. These lands include cropland that frequently floods, steep slopes, and forested lands adjacent to waterways (riparian areas).

3.2 Increase the acreage of forest, native grassland, and wetland in the watershed while reducing the acreage of impervious surface area and turf grass. Reconnect forest tracts for habitat connectivity.

3.3 Use wetland mitigation banking or in-lieu fee programs to offset the environmental impacts of new development.

3.4 Implement low-impact development (LID) strategies so that important watershed processes and water resource functional values are protected. Development should allow high infiltration, use minimal impervious surface area, protect trees and native vegetation, and have adequate stormwater and sediment detention.

3.5 Work with municipalities to amend their comprehensive plans, zoning ordinances, and subdivision regulations to include conservation, native landscaping, stormwater management, and low-impact development standards.

GOAL 4: SUPPORT HEALTHY FISH AND WILDLIFE HABITAT

Improve and protect habitat in streams and water bodies to promote biodiversity.

Habitat Objectives:

4.1 Promote healthy ecosystems within streams and riparian areas to provide habitat for a wide variety of native fish, invertebrate, plant, and animal species.

4.2 Monitor fish and aquatic macroinvertebrate communities alongside water quality data to assess suitability of habitat.

4.3 Identify and protect key natural features and corridors for wildlife, including wetlands, forest, and grassland, to prevent the loss or degradation of fish and wildlife habitat.

4.4 Prioritize "green" stormwater management approaches that use native vegetation to naturally filter pollutants over conventional structural approaches, such as riprap and piped conveyance.

4.5 Create a strategy to remove invasive species within the watershed, and educate landowners about invasive species and how to safely remove them.

GOAL 5: DEVELOP ORGANIZATIONAL FRAMEWORKS TO IMPLEMENT WATERSHED GOALS

Facilitate partnerships with stakeholders and leverage resources to implement the watershed plan.

Organizational Framework Objectives:

5.1 Activate a network of partners dedicated to implementing the watershed plan and other water quality and stormwater management issues throughout the county.

5.2 Leverage funding from a variety of sources to implement the watershed plan.

GOAL 6: CONDUCT EDUCATION AND OUTREACH

Promote public awareness, understanding, and stewardship of the watershed and the watershed plan.

Education and Outreach Objectives:

6.1 Identify opportunities to assist municipalities, counties, state and federal agencies, and other stakeholders with watershed management and conservation efforts.

6.2 Connect watershed residents, farmers, and business owners to decision-makers and experts with knowledge about water quality, flooding issues, and solutions.

6.3 Offer effective opportunities for public education, training, and participation in watershed matters, including information-based resources and demonstration projects.

6.4 Develop public recognition programs focused on the watershed plan's goals.

Watershed Impairment Reduction Targets

Establishing "Impairment Reduction Targets" is an important part of the watershed planning process. It enables calculations to be made about how implementation of a suite of Management Measures can be expected to reduce watershed impairments over time. The Implementation Reduction Targets for this watershed plan are based on the Illinois Nutrient Loss Reduction Strategy, published by IEPA in 2015. The strategy describes a comprehensive suite of BMPs for reducing nutrient loads from wastewater treatment plants and urban and agricultural runoff. Its targets are a 25% reduction in phosphorus and a 15% reduction in nitrogen by 2025, with an eventual target of 45% reduction for both nutrients. This watershed plan adds a target of a 20% reduction in sediment (Table 4).

Additional watershed-wide impairment reduction targets were established for dissolved oxygen, fecal coliform, flood damage, habitat degradation, wetlands, surface water infiltration, infiltration to groundwater, and private sewage.

Table 3. Watershed-wide impairment reduction targets, their basis, and reductions from Critical Areas and other areas recommended.

Impairment: Cause of Impairment	Basis for Impairment	Reduction Target	Reduction from Critical Areas and other areas
Water Quality/Aquatic Life: Phosphorus	149,598 lbs/year of phosphorus loading, based on STEPL model. Also, average observed value of 0.18 mg/L in Holiday Shores Lake and 0.11 mg/L in Tower Lake in 2007 TMDL.	**25%** or 37,400 lbs/year reduction in phosphorus loading by 2030, based on the Illinois Nutrient Loss Reduction Strategy. Holiday Shores Lake and Tower Lake to meet the 2007 TMDL Endpoint of 0.05 mg/L.	3,781 lbs/year reduction from streams and lakes 2,896 lbs/year reduction from riparian areas 1,038 lbs/year reduction from critical wetland areas 30,953 lbs/year reduction from other agricultural areas 2,781 lbs/year reduction from urban and forested areas
TOTAL			**41,450 lbs/year or 28% total phosphorus reduction**
Water Quality/Aquatic Life: Sediment	43,321 tons/year of sediment loading, based on STEPL model	**20%** or 8,646 tons/year reduction in sediment loading by 2030 (the long-term watershed planning horizon), based on estimated impacts of proposed BMPs. Similar target to phosphorus; sediment is its primary transport mechanism.	899 tons/year reduction from streams and lakes 785 tons/year reduction from riparian areas 404 tons/year reduction from critical wetland areas 6,109 tons/year reduction from other agricultural areas 1,096 tons/year reduction from urban and forested areas
TOTAL			**9,293 tons/year or 21% total sediment reduction**
Water Quality/Aquatic Life: Nitrogen	717,606 lbs/year of nitrogen loading, based on STEPL model	**15%** or 107,641 lbs/year reduction in nitrogen loading by 2025, based on the Illinois Nutrient Loss Reduction Strategy	18,065 lbs/year reduction from streams and lakes 12,211 lbs/year reduction from riparian areas 2,255 lbs/year reduction from critical wetland areas 117,824 lbs/year reduction from other agricultural areas 14,830 lbs/year reduction from urban and forested areas
TOTAL			**165,185 lbs/year or 23% total nitrogen reduction**
Water Quality/Aquatic Life: Dissolved Oxygen	Minimum 0.8 mg/L (mean 8.8 mg/L) dissolved oxygen, based on samples collected from Cahokia Creek between 1972 and 1997 by the Illinois Water Science Center and IEPA. Also, average observed value of 3.09 mg/L in the Cahokia Diversion Channel in the 2007 TMDL.	**No samples lower than the minimum** concentration in streams: March – July: 5.0 mg/L at any time, 6.0 mg/L daily mean averaged over 7 days August – February: 3.5 mg/L at any time, 4.0 mg/L daily mean averaged over 7 days, 5.5 mg/L daily mean averaged over 30 days Based on 35 Ill. Adm. Code 302 (Illinois Pollution Control Board (IPCB), 2011). **No samples lower than the TMDL standard** for Cahokia Diversion Channel: 5.0 mg/L instantaneous minimum or 6.0 mg/L minimum during at least 16 hours of any 24-hour period (from 2007 Cahokia Creek/Holiday Shores Lake Watershed TMDL).	96,180 feet streambank and channel restoration, including riffle pools and other structures that increase re-aeration 358 feet of poor condition riparian areas ecologically restored, including 100% of Critical Riparian Areas

Impairment: Cause of Impairment	Basis for Impairment	Reduction Target	Reduction from Critical Areas and other areas
Water Quality/Aquatic Life: Fecal coliform	Median 460 cfu/100ml fecal coliform concentrations, based on samples collected from Cahokia Creek (1974-2014, Illinois Water Science Center and IEPA). Also, average observed value of 388 cfu/mL (geometric mean) on Cahokia Creek in 2007 TMDL.	**57%** or 260 cfu/100 ml reduction by 2030, to reach geometric mean of 200 cfu/100 ml in a minimum of 5 samples taken over ≤30 days; based on 35 Ill. Adm. Code 302 (IPCB, 2011). This is the same standard as the 2007 TMDL Endpoint of 200 cfu/100 mL during October - May for Cahokia Creek.	Reductions following maintenance and replacement as a result of private sewage inspections Reductions following waste (manure) management systems installation
Flood Damage: Flooding inside and outside floodplain	21% of Flood Survey respondents experienced flooding in the last 10 years, reporting a total of >$330,016 in costs over that time	**500 acres dry detention basins** installed **100 acres wet detention basins** installed **Retrofits & maintenance** of existing detention basins **Critical Flooding Areas** prioritized	500 acres dry detention basins installed 100 acres wet detention basins installed Retrofits & maintenance on all 67 identified existing detention basins (average size: 1.4 acres) Single property flood reduction strategies
Habitat Degradation: Invasive/non-native plant species in riparian areas; hydrologic changes due to loss of wetlands; logjams	21.1 miles of riparian areas are currently in poor condition (Critical Riparian Areas), per the aerial assessment results. 37.5 miles of Critical Logjam Areas identified.	**100% Critical Riparian Areas** restored **Majority of riparian areas in poor condition** restored **100% Critical Logjam Areas** assessed **2% Critical Logjam Areas** have logjams removed	358 feet of riparian areas ecologically restored 100% Critical Logjam Areas assessed 3,692 feet or 2% Critical Logjam areas have logjams removed
Wetland Loss: Flood storage and filtration functions	Thousands of acres of wetlands lost since pre-settlement; loss of ecosystem functions	**100% Critical Wetlands Areas** restored	1,477 acres (100%) Critical Wetlands Areas restored
Reduced infiltration to groundwater	Current 27.1% impervious cover; current 9,277 acres developed open space (2011 NLCD) or 5,888 acres open space (EWG)	**Preservation of open space and infiltration measures** used in new and redevelopment **Increase in rain gardens** **Increase in pervious surfaces** in new and redevelopment	Preservation of open space and infiltration measures in all new and redevelopment, e.g., designed for Conservation Development and green infrastructure 20,000 sq. ft of rain gardens installed 100 rain barrels/cisterns installed
Fecal Coliform: Private sewage	Over 3,500 private sewage systems estimated in watershed Estimated 10% private sewage failure rate nationwide	**Reduction** in in-stream measured fecal coliform (see fecal coliform target above) **Proactive inspection programs** for private sewage, not just complaint-based	Reduction in in-stream measured fecal coliform at the USGS gauge site Proactive county/municipal inspection programs for private sewage, beyond complaint-based assessment

* Note: The public water supply standard is 150 µg/L (e.g., for Mount Olive & Staunton surface water public supply).

Table 4. Causes and sources of watershed impairments and the associated goals that address them.

IEPA or other impairment	Cause of impairment	Known or potential source of impairment	Goals
Flood Damage to Structures and Land in Floodplains	Encroachment in 100-year floodplain (known impairment)	Channelized streams; Agricultural drain tiles; Wetland & riparian buffer loss; Logjams and other obstructions in streams; Existing and future urban impervious surfaces;	1, 3, 5
Structural Flood Damage Outside Floodplains	Urban flooding / flash flooding (known impairment)	Existing and future urban impervious surfaces; Inadequate stormwater infrastructure (e.g., too few detention basins); Poor stormwater infrastructure design & function; Lack of funding for stormwater infrastructure; Agricultural drain tiles; Traditional development design	1, 5
Water Quality - Aquatic Life	Nutrients: Phosphorus (known impairment) and Nitrogen (potential impairment)	Streambank & channel erosion; Agricultural row crop runoff; Failing private sewage systems; Wastewater treatment plants; Lawn fertilizer; Level of landowner education; Livestock operations (manure)	2
Water Quality - Aquatic Life	Sediment: Total Suspended Solids / Turbidity (known impairment)	Streambank & channel erosion; Agricultural row crop runoff; Construction sites; Livestock operations (manure)	2
Water Quality - Aquatic Life	Low dissolved oxygen (known impairment)	Heated stormwater runoff from urban areas; Lack of natural riffles in streams (incl. channelized streams)	2
Water Quality - Aquatic Life	Fecal coliform (potential impairment)	Failing private sewage systems; Wastewater treatment plants; Livestock operations (manure)	2
Habitat Degradation	Invasive/non-native plant species & degradation in riparian and other natural areas (known impairment)	Existing and introduced invasive species populations; Logjams, trash/debris, and other obstructions in streams; Level of public education	3, 4, 6
Habitat Degradation	Loss and fragmentation of open space/wetlands/natural habitat (known impairment)	Inadequate protection policy; Lack of land acquisition funds; Traditional development design; Streambank, channel, and riparian area modification; Lack of restoration and maintenance funds; Wetland & riparian buffer loss	3, 4, 5

SECTION 3: ISSUES AND CRITICAL AREAS

Key Issues Identified

The following issues were identified in the watershed planning process. Issues are organized by the primary goal to which they relate, such as flooding. For some issues, Critical Areas where the issue is most prevalent or impactful were identified (see p.50).

Flooding

> **Objectives addressing this issue:**
> ♦ Increase stormwater captured, stored, and infiltrated.
> ♦ Institute development standards that minimize impervious surfaces.

Issue: Prevalent Flooding, within and outside floodplains. Flooding is highly prevalent in the watershed, both inside and outside of floodplains, and in rural and urban areas. Urban flooding was probably the most important to the municipalities interviewed; all of them had experienced at least some flooding in developed areas. Open House attendees and Flood Survey respondents reported flooding on their properties and on the roads around them. The Madison County Community Flood Survey, administered in 2015, revealed significant and widespread flooding problems affecting residents and property owners in the watershed (Appendix B). Frequent flooding damaged homes and businesses, causing health and safety impacts, as well as monetary loss. See Table 4 for causes and sources associated with flooding.

FEMA has identified almost 18% of the watershed in Madison County as 100-year floodplain. This area is almost entirely riverine floodplain around Cahokia Creek and its larger tributaries. Several communities in the watershed are enrolled in the National Flood Insurance Program. A 2010 Oates Associates report for Madison County found 18 road overtopping locations in the watershed based on Flood Insurance Rate Maps (FIRMs), many at creek crossings (Appendix A).

Some areas of flatter, higher ground in the watershed that are not in the floodplain have still been flooded by flash floods/urban flooding from time to time. This flooding is a result of increased impervious surfaces (developed areas), changes in local hydrology (e.g., ditches installed or filled in), and severe storm events with heavy rainfall. Ninety-one percent of the flooding reported in the Madison County Community Flood Survey did not occur in floodplains (Appendix B). Lack of stormwater infrastructure, inadequate infrastructure (e.g., undersized culverts), aging infrastructure, and inadequate maintenance of infrastructure all contribute to the issue of flooding outside of floodplains. The Village of Hartford has been flooded due to ponding of stormwater when the gate to the Mississippi River is closed (when river levels are high), which happened in December 2015/January 2016.

Issue: Undersized stormwater infrastructure: In many areas, stormwater infrastructure is undersized for the amount of water it has to handle, leading to flooding. Ditches and culverts that are too small can create backup of water that can rise up to flood roads. There are also water quality implications. In 2016, IEPA listed urban runoff/storm sewers as a source of impairment of water quality in Cahokia Creek, Cahokia Diversion Channel, and Indian Creek. When water carries pollutants, debris, and sediment into storm drains and ditches, there is no filtration before the runoff reaches streams and lakes.

Objectives addressing this issue:
♦ Promote ongoing improvement and maintenance of stormwater storage and conveyance infrastructure.

Issue: High water table/groundwater: The water table is less than 50 cm deep in 51% of the soils covering the watershed, particularly on the upland farmland and in the low-lying area north of the Cahokia Diversion Channel. Rainfall leads to saturation of soils with a high water table more quickly. When the soil is already saturated, stormwater cannot infiltrate and runs off on the surface, contributing to flooding.

Objectives addressing this issue:
♦ Increase the amount of stormwater captured, stored, and infiltrated in the watershed
♦ Provide information about development in high water table areas.

Issue: **Large areas of impervious cover**: New development and the creation of large areas of impervious surfaces has dramatically changed stormwater drainage in some areas, leading to flooding. The mean imperviousness in the watershed is 27.1% as of 2011, and is set to increase as more development is added to the watershed. Developed land is predicted to increase 118% under a long-term future build-out scenario (see Appendix A). Unless steps are taken to install green infrastructure that allows for infiltration, this development will add large areas of impervious cover and exacerbate flash flooding.

Objectives addressing this issue:
♦ Institute development standards that seek to minimize the amount of impervious surfaces in new development and redevelopment projects.

Issue: Backup issues when the river is high: When the Mississippi River is high, the gates at the levee near the Village of Hartford close and the river rises on its side of the levee. The Cahokia Diversion Channel drains more slowly to the Mississippi River when this happens, or not at all, causing the inland waterways to back up. During the December 2015/January 2016 heavy rain, the water moving towards the river had nowhere to go and caused significant flooding in and around Hartford. The USACE operates a pump station and relief gates along the Cahokia Diversion Channel as well as the gates along the Mississippi River.

Objectives addressing this issue:
♦ Increase the amount of stormwater captured, stored, and infiltrated in the watershed.

Issue: Logjams and beavers: Beavers and logjams contribute to localized flooding issues that can be significant in size. Along streams, a beaver-caused logjam can cause the stream to rise above its banks and flood adjacent lands. Some of these logjams are beneficial to areas downstream, as they slow the peak stream flow and can reduce flooding downstream. The Watershed Nature Center hosts beavers, and notes that although they change the hydrology of the area, their activities help to pond the water, reducing nitrogen levels and increasing

Objectives addressing this issue:
♦ Preserve the natural flow regime of streams in the watershed, and identify opportunities to slow peak stream flow
♦ Limit development in the FEMA identified 100-year floodplain

sediment settling. In other cases, the flooding and streambank scouring caused by logjams does more harm than good.

Issue: Channelization: When streams are straightened (channelized), water moves through them much more quickly and can cause flooding downstream by reaching the next choke point in large volumes. In 2016, IEPA listed channelization as a source of impairment of water quality in Cahokia Creek and Cahokia Diversion Channel.

> **Objectives addressing this issue:**
> ♦ Preserve the natural flow regime of streams in the watershed.

Issue: Sediment deposition: Dredging in Dunlap Lake and Holiday Lake, as well as in countless detention basins, is needed to maintain water storage capacity. Detention basins are often not dredged as often as is necessary to maintain their sediment storage and water storage capacities. This can happen when ownership or maintenance requirements associated with a detention basin are unclear, or simply because dredging can be very expensive.

> **Objectives addressing this issue:**
> ♦ Promote ongoing improvement and maintenance of stormwater storage and conveyance infrastructure (e.g., detention basins and ponds) to maximize storage capacity
> ♦ Reduce sediment by 20% by 2030.

Issue: Dam and spillway maintenance: The dams and spillways at Dunlap Lake and Holiday Lake require costly ongoing maintenance to prevent failure. At Dunlap Lake, the riprap around the dam is occasionally impacted by muskrats, which dig under the riprap build underground dens. Dunlap Lake currently has a reliable notification system when heavy storms are expected, so that the lake level can be drawn down and residents around and below the lake can be notified. This must be maintained.

> **Objectives addressing this issue:**
> ♦ Ensure thorough inspections and maintenance of dams to minimize flood risk, and decrease water levels in dammed lakes ahead of major storms.

At Holiday Lake, it takes a long time to draw the lake down because of the outflow infrastructure, meaning that when heavy storms come, the lake community is unable to decrease lake levels to assist with flood prevention. The Holiday Shores HOA also has a bylaw restricting use of the emergency spillway to once every five years. The emergency outflow pipe is small enough that it would take a week to draw the lake down noticeably. Water has gotten close to homes (e.g., two feet) before, but has not flooded them. The Illinois Department of Natural Resources is looking into tripling the size of the spillway at Holiday Lake in the next 15 years because of increased stormwater in the area.

Issue: Backflow preventer maintenance: At the Watershed Nature Center in Edwardsville, the “flapper valves” were found to be disabled after a big storm caused flooding. The city repaired them, but there has still been flooding recently from large volumes of water coming in from upstream. Regular checks of the valves may be needed before and after every major storm.

> **Objectives addressing this issue:**
> ♦ Promote ongoing improvement and maintenance of stormwater storage and conveyance infrastructure (e.g., detention basins and ponds) to maximize storage capacity.

Surface water quality

Table 4 lists the known water quality impairments in the watershed and their associated causes and sources. The following issues do not refer to point sources of pollution from the seven facilities in the watershed that hold a NPDES permit for discharging wastewater into the watershed.

Issue: Drinking water source protection: Communities such as Edwardsville, Hartford, Roxana, and Bethalto, and many individuals in the unincorporated county, use well water as all or part of their water supply. Holiday Lake is the water source for Holiday Shores, and the Staunton Reservoir is the water source for Staunton. Contamination of these water sources is a life safety issue and can be costly to remediate.

Objectives addressing this issue:
♦ Decrease pollutant loading to Cahokia Creek and its tributaries.
♦ Protect drinking water sources from pollutants that threaten human health or increase treatment costs.
♦ Monitor water quality and identify trends.

Several public water systems in the watershed (including Worden, Bunker Hill, and Wilsonville) purchase surface water for use. Surface water originating in the Mississippi River is often purchased from suppliers such as the Bond-Madison Water Company (which buys water from Illinois American Water).

People also use the lakes in the watershed for boating, swimming, and fishing. Through recreation, people come into direct contact with the water and are exposed to pollutants in it. Both Dunlap Lake and Holiday Shores allow swimming (off boats in Dunlap Lake, and from beaches in Holiday Lake).

Issue: **Soil erosion:** Soil erosion contributes large amounts of sediments to streams and waterways. Soil can erode from farmland when it is exposed to the erosive action of the wind and precipitation. It can also come from streambanks, stream channels, and lake shorelines. Construction sites can also contribute significantly to soil erosion when erosion control practices are not properly planned or followed.

Objectives addressing this issue:
♦ Reduce sediment by 20% by 2030.
♦ Monitor water quality and identify trends.

Because 58% of the watershed is agricultural (and most is row crops), farming practices factor significantly in the amount of soil reaching the waterways. An estimated 54% of sediment in the watershed comes from cropland (see Appendix A, p.251). In 2016, IEPA listed crop production as a source of impairment of water quality in Cahokia Creek and Indian Creek, and agriculture as a source of impairment for Cahokia Creek. In Madison County, 75% of corn and 37% of soybeans are produced using conventional tillage practices, which contribute to high soil erosion. Conservation tillage (i.e., reduced tillage) and no-till practices contribute significantly less sediment and nutrients. Only 1% of corn and 7% of soybeans in Madison County are in no-till crop production.

In addition to soil erosion from farmland, streambank and channel erosion contributes much of the sediment loading in the watershed. Streambank erosion has a very high sediment delivery rate (100%) to the stream. Eight percent of streams assessed in the watershed had high streambank erosion (including Critical Stream Reaches, which had high or moderate streambank erosion and high channelization – see p.50). Forty-seven percent of streams assessed had moderate streambank erosion. Streambanks contribute an estimated 35% of sediment in the watershed to streams (see Appendix A, p.251). Stream erosion is especially problematic in areas that are becoming increasingly urbanized, due to the increased volume of water reaching streams in "flashy" surface flow during storm events. In 2016, IEPA listed streambank modifications/destabilization as a source of impairment of water quality in

Cahokia Diversion Channel.

Streambank erosion is exacerbated by logjams, which are woody vegetation and/or other debris which obstructs a stream channel and backs up stream water. Over 37 miles of Critical Logjam Areas (identified at locations of concentrated logjams) were identified in the watershed (see p.50). Logjams can be both a cause and a result of streambank erosion. They can alter flow, directing water outwards to the streambanks, increasing scouring and bank erosion. Logjams result from streambank erosion when a stream is incising or meandering excessively, causing large woody vegetation on the banks to be undercut and fall into the stream. Several stakeholders identified beavers as a cause of logjams along creeks in the watershed.

Channelization contributes to large amounts of sediment loading through downcutting caused by the increase in stream velocity in a straightened channel. Some measures designed to reduce streambed erosion in channelized areas can cause their own issues. In 1911, when the Cahokia Diversion Channel was completed to divert water to the Mississippi River, a low dam was created near the end of the channel to reduce the downward cutting and meandering actions of the stream whose gradient was increased by the creation of the straight channel. IEPA has listed “dam or impoundment” as a source of impairment of water quality in Cahokia Diversion Channel for many years. Hydromodification activities such as this can diminish the suitability of stream habitat for fish and wildlife. These activities can also alter water temperature, sediment types, and rates of erosion, all of which can impact water quality and contribute to nonpoint source pollution.

Issue: Sediment

Objectives addressing this issue:
♦ Reduce sediment by 20% by 2030.
♦ Monitor water quality and identify trends.

Sediment deposition is the result of soil erosion. Sediment is highly prevalent in streams and runoff throughout the watershed. When soil erodes from the landscape, it ends up as sediment and silt in streams. The soil carries other pollutants such as phosphorus, iron, and manganese with it. When sediment is deposited in streams and detention basins it forces the water upwards, which can lead to flooding. **Total Suspended Solids** is a pollutant identified in Holiday Shores (Holiday Lake) on the 2018 IEPA 303(d) List.

Bunker Hill reports ditches silting in alongside roads, reducing their capacity. Dunlap Lake Property Owners Association reports that approximately 20,000 cubic yards have been added to the lake over the last 10 years. The problem with the sediment entering Dunlap Lake is that it is very fine-textured subsoil with fine clay particles from farmland upstream. Those particles do not settle out in streams; they only start to settle when they reach the lake (and even then not all will settle out). At Holiday Lake, studies by SIUE have shown that only a quarter of the sediment entering the lake is pulled out by dredging. Fortunately, the dredged material is purchased by the farmers upstream of the lake, who use it for the next season's planting.

Issue: Pollutants

Objectives addressing this issue:
♦ Decrease overall pollutant loading to Cahokia Creek and its tributaries.
♦ Monitor water quality and identify trends.

Phosphorus is carried into waterways along with soil particles. It often comes from agricultural fertilizer or lawn fertilizer. An estimated 72% of phosphorus in the watershed comes from cropland (see Appendix A, p.251). Phosphorus can lead to harmful algae blooms. It is one of the pollutants identified in Cahokia Diversion Channel, Holiday Shores (Holiday Lake), and Holiday Shores Creek on the 2018 Illinois EPA 303(d) List.

Fertilizers and erosion on crop land contribute to significant nutrient loading (phosphorus and nitrogen). This issue is detailed in the 2015 Illinois Nutrient Loss Reduction Strategy.

Iron can be carried with soil, and can be toxic to aquatic plants and animals. Iron is one of the pollutants identified in Cahokia Creek on the 2018 IEPA 303(d) List.

Chloride: Application and storage of road salt is a concern where water with high concentrations of chloride flows into groundwater or streams. Chlorides increase treatment costs for water supplies and are harmful to aquatic life in waterways.

Mercury: High mercury levels have been found in fish in Dunlap Lake by SIUE researchers. Residents have been advised to only catch and release fish, not eat them. The mercury is present as a legacy of coal mining.

Other industrial pollutants: Roxana notes that there are many refinery tanks, two to three concrete plants, and one asphalt plant in the watershed. These and other industrial operations may be contributing industrial pollutants to the air and water.

Issue: Low Dissolved Oxygen (DO)

Low levels of DO in water cannot support aquatic life. Low DO levels are often a result of algae growth that uses up oxygen in the water, which is caused by high levels of nutrients such as nitrogen and phosphorus. The Cahokia Diversion Channel has had an impairment for DO for several years, and is on the 2018 IEPA 303(d) list of impaired waters. The Village of Roxana has been involved in remedying this impairment so that its Wastewater Treatment Plant (WWTP) could aerate and release its effluent into the creek with appropriate DO levels.

Objectives addressing this issue:
♦ Maintain DO levels above standard minimums.
♦ Monitor water quality and identify trends.

Issue: Sewage contamination from private systems

Poor maintenance of private sewage systems can lead to raw human waste in waterways. Very large spikes in fecal coliform levels have occurred at monitoring gauges on Cahokia Creek between 1974 and 2014. The watershed has over approximately 3,500 private sewage systems (i.e., septic systems). USEPA uses a figure from the U.S. Census Bureau that at least 10% of septic systems nationwide have stopped working, while local government officials estimate that the failure rate in this watershed is actually much higher (up to 90% in older developments). During the period from 1978 to 1997 when fecal coliforms were monitored in Cahokia Creek, over 90% of the samples had concentrations above the minimum acceptable threshold (200 cfu/100ml). Several municipalities and Open House attendees reported occurrences of and bad odors from failing systems.

Objectives addressing this issue:
♦ Create a private sewage assessment strategy.
♦ Reduce fecal coliform by 57%.
♦ Monitor water quality and identify trends.

Issue: Combined sewers

Hartford has sewer pipes that carry both stormwater and sanitary waste (combined sewers). When large volumes of stormwater enter the system, overflows can carry untreated waste out onto the land and into streams.

Objectives addressing this issue:
♦ Reduce fecal coliform by 57%.
♦ Monitor water quality and identify trends.

Issue: Infiltration into/out of ageing pipes

All of the municipalities in the watershed have some separate storm and sanitary sewer systems, except for one area in the Village of Hartford. However, several municipalities report that aging pipe infrastructure has led to instances of infiltration of stormwater into the sanitary system, resulting in sewer backups, de facto combined sewers, and occurrences of combined sewer overflows (CSOs). This situation results in property damage, raw sewage draining into surface water, and increased costs of cleanup and sewage treatment for municipalities.

Objectives addressing this issue:
♦ Reduce fecal coliform by 57%.

Issue: Livestock waste management

Waste from livestock on farms and in animal feeding operations (AFOs) can contribute nutrients and bacteria including fecal coliform to surface water if it is not properly stored and treated. There are livestock operations in the northern and eastern parts of the watershed.

Objectives addressing this issue:
♦ Reduce fecal coliform by 57%.
♦ Monitor water quality and identify trends.

Issue: Litter and dumping

Trash and debris is an issue throughout the watershed, but particularly in places where roads cross creeks and their tributaries. People throwing trash out of car windows or dumping unwanted or hazardous materials leads to debris deposits that are eyesores, harm to fish and wildlife, and obstructions in the creek. Illegal dumping of large objects into or next to creeks is also an issue, particularly in wooded, secluded areas. Open House attendees mentioned litter, trash, and debris on their property or on the creeks and streams they drive past.

Objectives addressing this issue:
♦ Decrease pollutant loading to Cahokia Creek and its tributaries.
♦ Increase awareness of the consequences of littering/illegal dumping.

Issue: Industrial/oil leaks

An estimated 25,000 gallons of diesel leaked into Cahokia Canal from Phillips 66 during a leak in April 2015. This accident led to the fuel covering water on the canal and its banks, and affected a 35-mile stretch of the Mississippi River. Coast Guard and Phillips 66 personnel moved quickly and contained the spill within two hours of it being identified. Industrial facilities in the watershed handling pollutants, particularly fluids moving through pipelines, are at risk of leaks as infrastructure ages. Companies must have safeguards in place to reduce the risk of leaks and prepare for rapid spill cleanup.

Objectives addressing this issue:
♦ Decrease pollutant loading to Cahokia Creek and its tributaries.

Issue: Algae blooms and fish die-outs

Algae blooms are caused by excess nutrients (such as phosphorus and nitrogen) running off into lakes, ponds, detention basins, and other areas of still, shallow water. The nutrients often come from excess application of fertilizers to farmland and lawns, as well as nutrients carried in eroded soil particles. At Dunlap Lake, there have been reports of algae—including toxic blue-green algae—in the lake in waters that are shallow, still, and warm. The blue-green algae blooms, also known as Harmful Algal Blooms (HABs), caused levels of toxins in the water at levels are well above World Health Organization maximums. If the plants are killed, the toxins will scatter, making the problem worse. The Property

Objectives addressing this issue:
♦ Decrease pollutant loading to Cahokia Creek and its tributaries.
♦ Reduce phosphorus by 25% by 2030.

Owners Association (POA) advised residents to swim only in the deep water. The POA already has setbacks and policies for fertilizer use, but it cannot control inputs from upstream.

Related to algal blooms, fish die-outs can occur when nutrient levels are high. In Holiday Lake, there have been fish die-outs in the spring because of fertilizer in the lake. Holiday Shores has a rule mitigating this – no fertilizer application within 50 feet of the lake – but it is hard to enforce. Aquatic Algae is listed as an impairment on the 2018 IEPA 303(d) List for Holiday Shores Creek.

Issue: Changes to stream velocity and lack of stream-side (riparian) vegetation
Indian Creek, Cahokia Creek, and the Cahokia Diversion Channel have the following causes of impairment from the 2018 303(d) List: Alteration in stream-side or littoral vegetative covers and loss of instream cover. Cahokia Creek and the Cahokia Diversion Channel also have impairments caused by changes in stream depth and velocity patterns.

Objectives addressing this issue:
♦ *Increase* streambank stabilization and riparian area restoration efforts.

Land Cover and Development

Issue: Poorly Planned Development. Flooding and water quality issues are exacerbated by new development that does not include well-designed drainage and green infrastructure. The watershed includes several examples of such poorly planned development, where floods, siltation, streambank erosion, and sewer backups have plagued the structures, roadways, and adjacent property. Current development policy among most watershed communities does not actively promote green infrastructure as a way to manage stormwater and allow infiltration.

Objectives addressing this issue:
♦ Conserve sensitive lands.
♦ Implement low-impact development strategies.
♦ Increase the acreage of forest, native grassland, and wetlands.
♦ Use wetland mitigation banking or in-lieu fee programs.

Development in the Metro East is occurring at a rapid pace. Madison and St. Clair counties combined lose 0.33 acre of agricultural land to development every minute, according to the USDA's National Agricultural Statistics Service (NASS) for 2007 to 2012. The population in the watershed is also projected to increase over the next few decades. New development will likely occur within and around municipalities and in unincorporated areas in the watershed, consuming as much as 40,000 acres of farmland and 7,000 acres of forest/grassland. New impervious surfaces will compound the problems of flooding, lack of infiltration, and poor water quality. Without changes in policy, local flash flooding will pose significant risks to both new and existing development. Furthermore, maintenance agreements are not always put in place for new development to ensure stormwater features continue to function. (See the issue, "Need for Updated Operations.") Municipalities in the watershed need stronger policies to maintain stormwater infrastructure, protect steep slopes, and preserve native vegetation as development occurs.

Habitat

Issue: Poor Riparian Conditions. The area either side of a stream is known as the riparian area. The forested riparian area along Cahokia Creek and the other major creeks in non-urbanized areas provides habitat for neo-tropical migratory songbirds which fly through and/or nest there after migrating from Central and South America. The songbirds require dense forest interior conditions without holes or gaps, which encourage nest predators such as raccoons, opossums, skunks, and cowbirds. Vegetation, particularly forest, in the riparian area supports the streambanks and provides shade to the stream. Approximately 21% of the riparian area along streams is in "poor" ecological condition (Appendix A, Table A.46). Examples of areas where trees have been cut down directly adjacent to streams to increase crop acreage can be found throughout the watershed, including Fort Russell Township. Over 21 miles of streams were identified as Critical Riparian Areas (see p.50).

Objectives addressing this issue:
♦ Conserve sensitive lands.
♦ Work with municipalities to amend policies and regulations to include conservation, native landscaping, stormwater management, and low-impact design.
♦ Prioritize "green" stormwater management approaches.
♦ Identify and protect key natural features and wildlife corridors.

Issue: Invasive Species
Invasive species, such as bush honeysuckle, tree-of-heaven, garlic mustard, and climbing euonymous (wintercreeper), are threats to many natural areas because they crowd out native trees and shrubs that protect streambanks from erosion. Invasives also crowd out food sources of animals and insects, further degrading the ecosystem. See Table 4 for causes and sources associated with habitat degradation. Additionally, Asian carp are present in the Cahokia Diversion Channel, altering the ecology of the stream.

Objectives addressing this issue:
♦ Create an invasive species removal strategy.
♦ Work with municipalities to amend policies and regulations to include conservation, native landscaping, stormwater management, and low-impact design.
♦ Increase the acreage of forest, native grassland, and wetlands.
♦ Monitor fish and aquatic macroinvertebrate communities.

Issue: Unprotected Habitat for Endangered Species
Federally endangered species such as the Indiana bat and leafy prairie clover may be present in the watershed. One state-endangered species, the Illinois Chorus Frog, is confirmed to be present. Where their native habitat is not preserved, threatened and endangered species such as the chorus frog cannot be expected to thrive over the long term. Removing invasive species and protecting native habitat around streams will provide locations for endangered species to thrive.

Objectives addressing this issue:
♦ Promote healthy ecosystems within streams and riparian areas.
♦ Conserve sensitive lands.
♦ Use wetland mitigation banking or in-lieu fee mitigation.
♦ Identify and protect key natural features and wildlife corridors.
♦ Monitor fish and aquatic macroinvertebrate communities.

Organizational needs/issues

Issue: Lack of detention basin maintenance

Detention basins are often not being maintained/dredged to maintain their sediment storage and water storage capacities. Two out of five sites visited by the U.S. Army Corps of Engineers for the detention basin inventory for this watershed plan were in poor condition. This can happen when ownership or maintenance requirements associated with a detention basin are unclear, or simply because dredging can be very expensive. Older detention basins may no longer function properly and would benefit from adding extended detention outlet structures and vegetation, which would remove sediment and alter flow-through patterns.

Objectives addressing this issue:
♦ Promote ongoing improvement and maintenance of stormwater storage and conveyance infrastructure.
♦ Activate a network of partners dedicated to implementing the watershed plan.

Issue: Lack of code enforcement

In some cases, existing municipal stormwater, development, subdivision, and floodplain codes are not being fully enforced. Codes related to development in floodplains and sediment and erosion control during construction are particularly important when it comes to protecting water quality and preventing flood damage.

Objectives addressing this issue:
♦ Activate a network of partners dedicated to implementing the watershed plan.

Issue: Lack of funding

Funding from government entities and other groups is often needed to maintain and expand stormwater infrastructure and improve water quality. There are a variety of funding sources and programs available to implement goals and objectives of the watershed plan. Existing resources include IEPA Section 319, Conservation Reserve Program (CRP), Conservation Reserve Enhancement Program (CREP), Environmental Quality Incentives Program (EQIP), Conservation Stewardship Program (CSP), foundation grants, and various other programs.

Objectives addressing this issue:
♦ Leverage funding from a variety of sources to implement the plan.
♦ Develop public recognition programs focused on the watershed plan's goals.

Issue: Need for strong partnerships

A network of partner organizations/groups is needed to make large strides towards addressing flooding and other issues in the watersheds. There are many potential partners in the region dedicated to different aspects of water quality and stormwater management, including federal agencies, state agencies, non-profits, land trusts, land owners, institutions, and local governments. To effectively implement the watershed plan and the county's stormwater program, a network of these partners should be established to help tackle certain issues and objectives.

Objectives addressing this issue:
♦ Formalize a network of partners to implement the plan.

Information and Outreach

Issue: Need for communication and collaboration

The public engagement process for the plan revealed a need for education on water quality and flooding for the general public. For example, the Flood Survey revealed a need for further education about flooding and flood insurance. Eight percent of Flood Survey respondents did not know that all or part of their property was in the floodplain. The majority of flooding reported in the survey (91%) was outside of FEMA-designated floodplains, and 9% of property owners had flood insurance policies on structures outside of the floodplain. Over half of respondents who experienced flooding did not report it to anyone. Given that 21% of respondents experienced flooding over the last 10 years, there is a clear mandate to further educate residents on flood damage prevention and mitigation. Communication about funding and technical resources is also sometimes lacking between potential partners; this information could help bring awareness, technical resources, and funding to address issues.

Objectives addressing this issue:
♦ Connect watershed stakeholders to decision-makers and experts.
♦ Offer opportunities for public education and participation in watershed matters.

Issue: Need for Outreach to Key Stakeholders

Because a large proportion of the watershed is private property, and water-based recreation is uncommon, individual interactions with streams and waterbodies in the watershed are limited. Education and outreach efforts to engage landowners and other key stakeholders are needed to increase environmental awareness and achieve the goals of this plan. A single regulatory agency or group cannot be as effective as a combined effort with other groups all working towards the same goal. Many people will work hard to help make the watershed better if they understand what to do and how it will help.

Objectives addressing this issue:
♦ Develop public recognition programs focused on the watershed plan's goals.

Critical Areas

For this plan, a "Critical Area" is best described as a location in the watershed where existing or potential future causes and sources of pollutants or issues are significantly worse than other areas of the watershed, OR there is significant potential for the area to make progress towards one or more of the watershed plan goals. The following Critical Areas were identified:

1. Highly or moderately degraded stream reaches with high channelization (Critical Stream Reaches);
2. Stream reaches with high susceptibility to logjams (Critical Logjam Areas);
3. Highly degraded riparian areas (Critical Riparian Areas);
4. Areas of prevalent flooding (Critical Flooding Areas); and
5. Areas suitable for wetland restoration (Critical Wetland Areas).

The Management Measures recommended are focused on these Critical Areas, but are also recommended for application elsewhere in the watershed where conditions are suitable.

The location and extent of each Critical Area was informed by data collected in the Watershed Resource Inventory, including an aerial assessment of streambank condition, riparian area condition, and channelization. Information was also collected during stakeholder engagement. The Agricultural Conservation Planning Framework (ACPF), a GIS model developed by USDA, provided locations for Critical Areas on agricultural land. The following explains how the Critical Areas were delineated.

Critical Stream Reaches

Critical stream reaches exhibit highly eroded banks or stream beds, or degraded channel conditions, that are a major source of total suspended solids (sediment), phosphorus and nitrogen carried with it. **5.52 miles** of stream reaches have been identified as high priority "Critical Stream Reaches," using aerial assessment and field verification data on streambank erosion, streambed erosion, and channelization. The critical reaches have high or moderate streambank erosion AND high channelization. Streambank stabilization and channel restoration BMPs, including bioengineering, will greatly reduce sediment and nutrients transported downstream, increase dissolved oxygen levels, and improve habitat.

Critical Logjam Areas

Critical areas for logjams were delineated from known locations of logjams identified in the aerial stream assessment for this Watershed Plan. The Critical Areas are stream reaches that are within 0.25 mile of another reported logjam. These areas represent current or likely locations of logjams, but not where they would cause the greatest flood impacts or damage. **37.52 miles** of stream reaches have been identified as Critical Logjam Areas. Localized assessment is recommended for these reaches to determine whether logjam removal is appropriate and cost-effective at specific locations. The American Fisheries Society's 1983 "Stream Obstruction Removal Guidelines" are a reliable source for determining what types of logjams should be removed.

Critical Riparian Areas

Critical riparian areas are areas adjacent to stream reaches that:

1) Have limited or no vegetated buffer beside the stream (i.e., "poor" riparian condition as determined by aerial assessment), and/or
2) Receive significant surface runoff and groundwater and have high ecological significance (i.e., riparian areas that are determined as "Critical Zones" by the ACPF modeling—see Appendix D).

Along the stream corridors, **111,725 feet (21.16 miles)** were identified as Critical Riparian Areas. Removal of invasive species and revegetation of these areas with appropriate native vegetation will increase surface water infiltration and reduce sediment and nutrient flows to the streams.

Critical Wetland Areas

Wetlands are highly effective at filtering pollutants from surface water, in addition to providing flood storage and wildlife habitat benefits. Critical wetland areas, which are highly suitable for restoration/construction of wetlands, were found as:

1) Areas on agricultural land that are highly suitable for nutrient removal wetlands and have high, very high, or critical runoff risk, as determined by the ACPF.

Because the ACPF tool is directed at agricultural land, the nutrient removal wetlands output by the model are all in agricultural fields. They tend to be large areas, ranging between one and 33 acres.

The Critical Wetland Areas identified can catch sediment which has eroded from agricultural land and stream channels close to the sources of such sediment. There are **1,477 acres** of Critical Wetland Areas in the watershed.

All of the Critical Areas identified in the watershed are shown in Figure 4. Appendix D shows the Critical Areas in more detail in each HUC14 subwatershed.

There are twelve locations in the watershed where different types of Critical Areas overlap. The locations of overlap were on several of the major streams, including Indian Creek, Cahokia Creek, Sherry's Branch, Mooney Creek, and Paddock Creek. In total, 62 miles of streams had two or more Critical Areas overlapping (13% of the streams in the watershed).

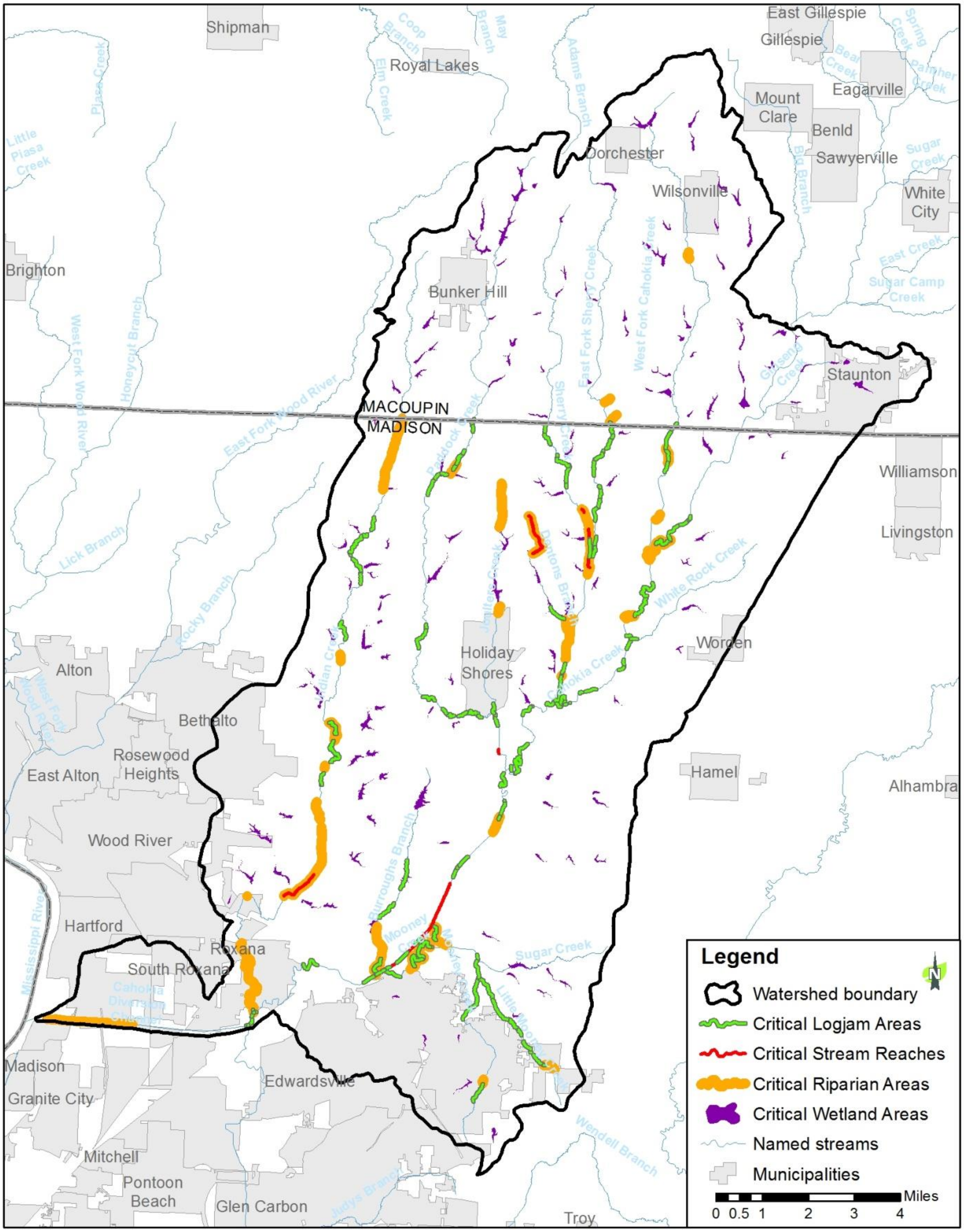


Figure 4. Critical Areas for stream reaches, logjams, riparian areas, and wetlands. See Appendix D for maps of each HUC 14.

SECTION 4: OVERVIEW OF MANAGEMENT MEASURES

The term "Management Measures" or "Best Management Practices" generally describes acceptable practices that could be put into place to protect water quality and control stormwater. BMPs are typically designed to reduce stormwater volume, peak flows, and/or nonpoint source pollution. Two types of Management Measures are recommended to address the goals of this plan:

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

Programmatic Measures include policy changes, environmental monitoring, design processes, and other measures that can be applied by various partner and stakeholder organizations across the watershed. Information and education measures can be considered programmatic measures, and these are outlined separately in the Information and Education Plan section (Section 6).

Site-Specific Measures, which are often structural, can be implemented on the ground to improve surface and groundwater quality, green infrastructure, and flooding. The Site-Specific Management Measures are divided into four categories: **agricultural**, **urban, forest**, and **streams and lakes**.

This section provides an overview of many Management Measures that are recommended within the watershed.

Programmatic Management Measures

Conservation Development

Primary goal addressed: 3. Promote Environmentally Sensitive Development

Conservation Development, also known as Cluster Design or Open Space Design, is a set of tools for designing development in a way that protects open space, aquatic habitat, and other natural resources. Conservation Development subdivisions are characterized by compact, clustered lots surrounding a common open space, which often includes a waterway, waterbody, or detention area. This facilitates development density needs while preserving the most valuable natural features and ecological functions of a site.

Open space designs have many benefits in comparison to conventional subdivisions: they can reduce impervious cover, stormwater pollutants, construction costs, grading, and the loss of natural areas. Despite these benefits, many communities' zoning ordinances do not permit Conservation Development designs because of code requirements for minimum lot sizes, setbacks, frontage distances, and more. These ordinances should be amended to allow for the implementation of Conservation Development design. Ordinance effectiveness and implementation should be periodically reviewed.

Developers should be encouraged to set up management procedures that protect sensitive natural areas/open space. Natural areas and systems can be donated to a public agency or conservation organization for long-term management to ensure that they have regular maintenance over time and remain aesthetically pleasing and functional spaces. Alternatively, Homeowners Associations (HOAs) can explicitly take on the management of the natural areas, writing rules about maintenance and fees into their bylaws.

As the area's population grows, the demand for recreational space also increases. Recreational features, such as multi-use trails, can be implemented alongside new or existing management measures to improve quality of life and provide educational opportunities for watershed residents. For example, hiking or biking trails can be established along levees, or portions of natural areas can be designated for picnicking or wildlife appreciation. Potential recreational opportunities should be explored when implementing the watershed plan BMPs.

Dam safety analysis

The 2010 Oates Associates report for Madison County recommended a dam safety analysis and spillway structure design improvements at Dunlap Lake in Edwardsville. According to the report, while no specific issues were identified by the city, there is a significant risk of property damage—or even loss of life—should any significant failure of the dam occur. Once studies are performed to assess the condition of the facility, it is likely that some costly repair and maintenance work will be necessary.

Federal and State Programs

Federal and state agricultural easement and working lands programs such as CRP, CSP, EQIP, and the Agricultural Conservation Easement Program (ACEP) are designed to reimburse farmers and landowners for implementing practices that protect soil and water health.

Primary goal addressed: 1. Improve Surface Water Quality

Financial support for stormwater infrastructure

Primary goal addressed: 2. Reduce Flooding/Mitigate Flood Damage

Maintenance of wastewater treatment systems imposes costs on communities that are usually recaptured through municipal property taxes and/or sewer fees. Stormwater infrastructure, however, does not often have such dedicated funding. Permitted municipal separate storm sewer systems (MS4s) are required to meet minimum control measures, but there are needs and issues beyond these measures, such as flood mitigation, that do not have dedicated funding. Green infrastructure is also not often funded through typical stormwater programs.

Several policy approaches can assign dedicated funding for stormwater infrastructure that prevents flooding and allows infiltration. As outlined in the 2015 Urban Flooding Awareness Act Report prepared by IDNR, USEPA recommendations for financing stormwater management include:

- Stormwater utility (or service fees),
- Property taxes/general funds,
- Sales tax,
- Special assessment districts,
- System development charges,
- Municipal bonds and state grants, and
- Low-interest loans.

These funding options are explored in more detail in Appendix E.

Flood Damage Prevention Ordinance

Primary goal addressed: 2. Reduce Flooding/Mitigate Flood Damage

All counties and most communities in the watershed are members of the National Flood Insurance Program (NFIP), and as such, have a Floodplain Ordinance in effect. These ordinances require specific development standards for structures and activities in the 100-year floodplain (as designated by FEMA). Due to increasing flood risk and flood insurance rates from climatic changes and inadequate policies, strengthening these ordinances would help protect individuals and communities from flood loss and damage. One way of strengthening floodplain ordinances to reduce flood risk is to use text from the State of Illinois's Model Floodplain Ordinance, or the model ordinance published by the Association of State Floodplain Managers (ASFPM). In a 2014 report, HeartLands Conservancy reviewed flood prevention BMPs and recommended that Madison County adopt an updated, stand-alone Flood Damage Prevention Ordinance. Subsequently, HeartLands Conservancy created a draft ordinance based on state and regional best practices. The practices recommended include more stringent standards for development in floodplains so that flood damage becomes less likely and less severe. Ordinance effectiveness and implementation should be periodically reviewed.

Green infrastructure incentives

Primary goal addressed: 3. Promote Environmentally Sensitive Development

Green infrastructure can be defined as our region's natural resources, including open space, woodlands, wetlands, gardens, trees, and agricultural land. It can also be defined as the nodes and corridors of vegetation over the region, or the site-scale structures and landscaping that recreate natural processes (e.g., rainscaping). Green infrastructure results in a higher diversity of plants and animals, removal of nonpoint source pollution, infiltration of stormwater, and healthier ecosystems. Communities can offer incentives for developers that design for or implement green infrastructure, including flexible implementation of regulations, fee waivers, tax abatement, and streamlining the development review process. These incentives can be granted on a case-by-case basis.

In-lieu fee ecological mitigation

Primary goal addressed: 1. Improve Surface Water Quality

In-lieu fee mitigation is an opportunity to assist developers in meeting their mitigation needs while directing mitigation to high quality sites in the watershed. Under an in-lieu fee program, a developer can pay a fee in lieu of having to restore or protect wetlands on the development site, or to mitigate losses of those sites by protecting or restoring wetlands off-site. The fee goes to a third-party organization which can direct the funds to high quality ecological sites for which restoration efforts will have the most environmental impact.

Long-term management of natural areas

Primary goal addressed: 5. Develop Organizational Frameworks

Developers should be encouraged to protect sensitive natural areas/open space and create naturalized stormwater management systems (including green infrastructure). These practices are key components of Conservation Development design. Developers should be encouraged to donate natural areas and systems to a public agency or conservation organization for long-term management. This ensures that the natural areas have regular maintenance over time and remain aesthetically pleasing and functional spaces. Alternatively, HOAs can explicitly take on the management of the natural areas, writing rules about maintenance and fees into their bylaws.

Monitoring

Monitoring of water quality, flow, and stream health in the watershed will provide data that can be used to support future resource management decisions and assess the effectiveness of Management Measures that are implemented. NGRREC, a partner on this plan, is well-situated to conduct this monitoring.

Primary goal addressed: 1. Improve Surface Water Quality

Continuous monitoring at the USGS gage 05587900 located on Cahokia Creek in Edwardsville will provide a broad assessment of the effect of land management practices in the watershed on surface water quality throughout the year. It will also allow trends to be identified by comparing new monitoring data to historical water quality data collected by USGS and the Illinois Water Sciences Center (IWSC) from this location.

In addition to continuous monitoring at the USGS gauge, secondary monitoring stations will be added upstream from the USGS gauge in order to identify the relative contributions of HUC14 subwatersheds to overall water quality in the larger watershed. Sampling locations will be identified near the outflow of each subwatershed, and samples will be collected quarterly to determine seasonal variations in water quality. Additional sampling will be done during major storm events. See Appendix F for more detail on the recommended monitoring components. See Section 7 (Implementation) for the monitoring timeline.

The following parameters will be monitored:

- Flow
- Sediment (TSS)
- Total Phosphorus
- Total Nitrogen
- Non-Purgeable Organic Carbon (NPOC)
- Soluble reactive phosphate (SRP)
- Nitrite+nitrate-nitrogen (NO_2+NO_3-N)
- Ammonium-nitrogen (NH_4-N)

Naming Unnamed Tributaries

Naming unnamed tributaries throughout the watershed is one way to raise awareness for stream health. Names are typically given to geographic features of importance. Assigning a name to a stream can increase its visibility within a community, and as a result improve public engagement (e.g., cleanups, monitoring) and water quality.

Primary goal addressed: 1. Improve Surface Water Quality

Native landscaping

The use of native plants in landscaping on public and private property should be encouraged as a way to enhance stormwater management structures, slow down surface runoff, extend green infrastructure networks, and support wildlife. For example, the Rock Hill Trails subdivision, east of Wood River in unincorporated Madison County, displays several species of native plants in landscaping put in place through an IEPA 319 grant. Changes to weed control ordinances (or other ordinances that specify plant species to be used in landscaping) may be needed to allow appropriate growth of native plants.

Primary goal addressed: 4. Support Healthy Habitat

Ordinance effectiveness and implementation should be periodically reviewed. Likewise, the removal of invasive species is important in promoting biodiversity.

Open space and natural area protection

Primary goal addressed: 3. Promote Environmentally Sensitive Development

Several actions can be taken to encourage the protection of natural areas and open space in new development. These include establishing a dedicated source of funding for open space acquisition and management, creating agriculture zoning districts with very large minimum lot sizes, adopting an open space and parks plan, and implementing regulations to protect steep slopes, wetlands, and other sensitive natural areas. Comprehensive plans should be regularly updated to help protect valuable natural areas and open space from development and guide new development in ways that minimize negative water quality and flooding impacts.

Private sewage monitoring

Primary goal addressed: 1. Improve Surface Water Quality

Private sewage inspections are required by Madison County during real estate transactions and are performed following complaints; however, the inspections can occur many years apart for a single property. More regular inspections (e.g., every three to five years) should be considered by watershed jurisdictions. An intensive inspection of private septic systems in areas with recurring problems should also be considered. Data on private sewage violations and water quality parameter exceedances should be collected and mapped. Connections to public sewer systems should be encouraged in new development. Counties and municipalities can create a Special Service Area (SSA) to fund improvements to localized private sewage problems.

Riparian Buffer Ordinance

Primary goal addressed: 3. Promote Environmentally Sensitive Development

A riparian buffer is an undisturbed naturally vegetated strip of land adjacent to a body of water. Among their many benefits, riparian buffers improve water quality, reduce erosion, store floodwater, and provide habitat for wildlife. In this region, oak-hickory forest or prairie grassland are appropriate vegetation types. A riparian buffer ordinance protects a riparian area of a certain width from new development and other disturbances, and promotes revegetation/reforestation.

Sewage Treatment Plant upgrades

Primary goal addressed: 1. Improve Surface Water Quality

Upgrades to wastewater treatment plants in the watershed should be installed to meet permit requirements, and to protect these critical facilities from flooding. Other improvements may include incorporating nutrient removal technologies. USEPA's draft "Case Studies on Implementing Low-Cost Modifications to Improve Nutrient Reduction at Wastewater Treatment Plants" document, published in August 2015, is a good source of information about optimizing nutrient removal in different types of treatment systems. As a further measure, a Nutrient Credit Trading system can be set up. In this system, municipalities can create agreements a land conservation organization and IEPA to provide payments on a conservation easement that reduces nutrient discharge from agricultural land in order to offset a Sewage Treatment Plant's discharge.

Stream Cleanup Team

Primary goal addressed: 4. Support Healthy Habitat

A Stream Cleanup Team with funding and resources dedicated to stream cleanup in the watershed would help to improve water quality, reduce flood risk (by removing litter and debris), and monitor stream health. Many Madison County residents were vocal in their support of the grant-funded

Stream Cleanup Team that operated in 2008 to 2009. The program could be expanded from its previous scope to include an education component, roles for volunteers, and a stream inventory. The team could inform local sheriffs' departments about sites with the most litter/debris so that they can more effectively enforce laws on littering and dumping. In previous years (2013 to 2016), Streambank Cleanup and Lakeshore Enhancement (SCALE) grants from USEPA were made available to support cleanup efforts under Section 319 of the Clean Water Act. The funds were paid to groups that "have already established a recurring streambank or lakeshore cleanup," and used for dumpster rental, landfill fees, and safety attire. Local recipients such as Alton Marketplace/Main Street and the Village of Swansea received $500 (or more if more participants were involved). This program may be funded again in future.

Watershed Plan supported and integrated into community plans

Primary goal addressed: 5. Develop Organizational Frameworks

Watershed partners, including communities, should adopt or support the watershed plan and incorporate its goals and recommended actions into their policies (such as ordinances and comprehensive plans).

Site-Specific Management Measures

The following BMPs are recommended for agricultural, forest, and urban areas, and streams and lakes. See Appendix E for more detailed descriptions of these BMPs, including the amount, cost, and pollutant load reduction.

Agricultural Measures

Animal waste storage/treatment system

Livestock produce waste, primarily manure, which needs to be well-managed to maintain water quality. Proper treatment and use of animal waste can be determined in a Comprehensive Nutrient Management Plan (CNMP) that helps farmers to integrate waste management into overall farm operations (see below). A waste storage and treatment system may be recommended for individual farms.

Primary goal addressed: 1. Improve Surface Water Quality
Pollution reduction: 75% sediment, 70% P, 65% N
Cost: $260,000/waste storage structure

Bioreactors (denitrifying)

Bioreactors, also known as denitrifying bioreactors, are ditches filled with wood chips that contain denitrifying bacteria. The bioreactor is placed at the outlet of a tile drainage system, and the bacteria remove nitrogen from water leaving the system. Research has shown an estimated bioreactor lifespan of 15 to 20 years, after which the woodchips would be replaced if treatment was to be continued.

Primary goal addressed: 1. Improve Surface Water Quality
ACPF areas identified: Yes
Pollution reduction: 0% sediment, 0% P, 40% N
Cost: $158/acre drained

Comprehensive Nutrient Management Plans (CNMPs)

A CNMP is a strategy for farmers to integrate livestock waste management into overall farm operations. Such a plan can recommend waste storage structures and strategies that increase waste storage time, eliminate unwanted runoff, incorporate manure nutrients into crop nutrient budgets, and efficiently apply manure to cropland without runoff (e.g., manure injection). When these structures and strategies are in place, manure is a useful asset to cropland that provides benefits to soil health.

Primary goal addressed: 1. Improve Surface Water Quality
Cost: $55/acre planned for

Conservation tillage (reduced tillage/no-till)

Reducing the extent of tillage is known as conservation tillage; when no tillage is used, it is called no-till. Reducing tillage leads to a reduction in soil erosion and the transport of associated nutrients, such as phosphorus, to the waterways. No-till allows natural soil structure to develop, which results in increased infiltration of rain water, reduced surface runoff, and reduced overtopping of roads adjacent to farm fields.

Primary goal addressed: 1. Improve Surface Water Quality
Pollution reduction: 59% sediment, 52% P, 20% N
Cost: $59/acre

Contour buffer strips

Contour buffer strips are strips of perennial vegetation that alternate with wider cultivated strips down a slope; the crop rows are farmed along the contour. The narrow strips of perennial vegetation are not part of the normal crop rotation. They slow surface runoff and trap sediment, significantly reducing sheet and rill erosion and removing pollutants from runoff.

Primary goal addressed: 1. Improve Surface Water Quality
ACPF areas identified: Yes
Pollution reduction: 53% sediment, 61% P, 53% N
Cost: $175/acre

Cover crops

Cover crops can provide multiple benefits: preventing erosion, improving soil's physical and biological properties, supplying nutrients, improving the availability of soil water, breaking pest cycles, and suppressing weeds. Planted in the fall and/or spring, they take up unused fertilizer, build soil structure, and release nutrients for the following crop to use. The species of cover crop selected along with its timing and management determine the specific benefits.

Primary goal addressed: 1. Improve Surface Water Quality
Pollution reduction: 15% sediment, 30% P, 30% N
Cost: $31/acre

Grassed waterways

A grassed waterway is a vegetated channel designed to move stormwater at a non-erosive velocity to reduce soil erosion and flooding. Grassed waterways prevent gully erosion and protect water quality. They are most appropriate for areas where there is soil erosion from concentrated runoff.

Primary goal addressed: 1. Improve Surface Water Quality
ACPF areas identified: Yes
Pollution reduction: 80% sediment, 45% P, 55% N
Cost: $8,653/acre

Nutrient Management Plans (NMPs)

A NMP is a strategy for obtaining the maximum return from on- and off-farm fertilizer resources in a manner that protects the quality of nearby water resources. Creating an NMP involves reviewing soil maps, field boundaries, and nutrient uptake of crops to determine nutrient needs for each field and the types and amounts of fertilizers to meet those needs.

Primary goal addressed: 1. Improve Surface Water Quality
ACPF areas identified: Yes
Cost: $14/acre

Ponds

Ponds are popular features that also have significant pollutant removal benefits when well sited and designed. Also known as wet ponds, stormwater ponds, or wet retention ponds, they are constructed basins that have a permanent pool of water throughout the year (or at least throughout the wet season). As stormwater runoff enters the pond, the sediment settles out and some nutrient uptake takes place. Nitrogen removal via denitrifying bacteria can also occur in ponds.

Primary goal addressed: 1. Improve Surface Water Quality
Pollution reduction: 58% sediment, 48% P, 31% N
Cost: $15,270/acre

Riparian buffers

Riparian buffers are vegetated zones immediately adjacent to a stream. They protect the stream channel and provide room for streams to move naturally, support habitat, reduce erosion, offer recreational space, and protect water quality. Buffers function as a vegetated filter strip and as overbank erosion protection during peak flows. The vegetation can be native forest, grasses, or shrubs.

Primary goal addressed: 1. Improve Surface Water Quality
Addresses Critical Riparian Areas
Pollution reduction: 53% sediment, 43% P, 38% N
Cost: $53/acre

Terraces

Terraces consist of ridges and channels constructed perpendicular to the slope of a field to intercept runoff water. Terracing is a soil conservation practice that reduces soil erosion and surface runoff on sloping fields. Terraces may be parallel on fairly uniform terrain or vary from parallel when the terrain is undulating. Over 140,000 feet of terraces have been put in place on farmland in St. Clair County between 2010 and 2015 thanks to the efforts of the Natural Resources Conservation Service (NRCS) and other partners.

Primary goal addressed: 1. Improve Surface Water Quality
ACPF areas identified: Yes
Pollution reduction: 40% sediment, 31% P, 25% N
Cost: $3.36/linear foot

Water and Sediment Control Basins (WASCOBs)

WASCOBs are small earthen ridge-and-channel structures or embankments that are built across a small watercourse or area of concentrated flow within a field. They are designed to hold agricultural water so that sediment and sediment-borne phosphorus settle out, reducing the amount of sediment leaving the field and preventing the formation of gullies.

Primary goal addressed: 1. Improve Surface Water Quality
ACPF areas identified: Yes
Pollution reduction: 58% sediment, 35% P, 28% N
Cost: $366/acre

Wetlands

Primary goal addressed: 1. Improve Surface Water Quality
Addresses Critical Wetland Areas
ACPF areas identified: Yes
Pollution reduction: 78% sediment, 44% P, 20% N
Cost: $13,163/acre

Wetlands, also known as Nutrient Removal Wetlands, consist of a depression created in the landscape where hydric soils allow aquatic vegetation to become established. They are among the most effective stormwater practices in terms of pollutant removal. Wetlands can easily be designed for flood control by providing flood storage above the level of the permanent pool. The wetlands and surrounding buffers also offer environmental benefits such as increases in wildlife habitat and carbon sequestration. Wetlands can be natural or “constructed,” meaning that they mimic naturally occurring wetlands. Wetland restoration is an important tool for bringing back the ecosystem services of nutrient removal and flood storage to a drainage area. Wetlands that have filled with sediment over time can be dredged to improve flood storage while retaining wildlife habitat.

Forest Management Measure

Forest stand improvement

Forest stand improvement is an approach to forest management that prioritizes forest health and wildlife habitat. Trees within the stand that are a desirable species, age class, and form are retained while those competing with these trees are “culled” (i.e., cut or girdled). This decreases competition for the desirable trees, increases growth rates, and allows managers to shape the future forest. Forest management can favor trees that produce more hard and soft mast (nuts, seeds and fruit) to support wildlife populations. Additionally, forest stand improvement can help improve water quality by removing undesirable species, including invasive species such as honeysuckle, that increase soil erosion on the forest floor by suppressing ground cover vegetation.

Primary goal addressed: 4. Support Healthy Habitat
Pollution reduction: est.5% sediment, 5% P, 5% N
Cost: $356/acre

Selected Agricultural Management Measures (Best Management Practices, or BMPs).

Above: Terraces. Photo: NRCS.

Above: Contour buffer strips. Photo: NRCS.

Above: Grassed waterways in Upper Silver Creek watershed. Photo: HeartLands Conservancy.

Above: Cover crops demonstration plot. Photo: HeartLands Conservancy, 2016.

Left: Water and Sediment Control Basin (WASCOB). Photo: Friends of Northern Lake Champaign.

Urban Management Measures

Bioswales

Bioswales are swaled (sloped) drainage courses designed to remove debris and reduce pollution from surface water. The sides of the swale are less than 6% slope and the swale may be filled with vegetation, compost, and/or riprap. The design of the swale should maximize the time water spends there, which aids in infiltration (for groundwater recharge) and pollutant removal. Bioswales are often effective when sited adjacent to parking lots. They can capture and treat stormwater during the "first flush" of rain on the parking lot, which carries substantial automotive pollution.

Primary goal addressed: 2. Reduce Flooding/Mitigate Flood Damage
Pollution reduction: 77% sediment, 17% P, 47% N
Cost: $18/sq ft

Detention basins

A detention basin is a constructed basin that receives, temporarily stores, and then gradually releases stormwater. They are designed to store flows during the most critical part of the flood and release the stored water as the flood subsides. While detention does not reduce the total volume of runoff from a flood event, it does reduce the peak flow rate. Many are also designed to treat stormwater by removing sediments, nutrients, and other pollutants.

Primary goal addressed: 2. Reduce Flooding/Mitigate Flood Damage
Pollution reduction: 58% (dry) or 60% (wet) sediment, 26% (dry) or 45% (wet) P, 30% (dry) or 35% (wet) N
Cost: $43,805/acre (dry), $48,122/acre (wet)

Older detention basins may no longer function properly and would benefit from adding extended detention outlet structures and vegetation, which would remove sediment and alter flow-through patterns. Retrofitting existing detention basins can be cheaper than constructing new basins. New detention basins (dry and wet), retrofits to existing basins (e.g., addition of native vegetation, volume increases), and maintenance of existing basins (e.g., dredging to remove sediment) are recommended in this plan. Detention basins are recommended for municipalities in the 2014 Madison County EMA All-Hazard Mitigation Plan (Appendix E—Management Measures). Large, regional detention basins serving several municipalities/entities may also be an effective option for reducing flood impacts to communities downstream.

Pervious pavement

Pervious pavement, also referred to as porous or permeable pavement, allows infiltration of stormwater into a below-ground storage area through holes in the pavement. It reduces the amount and rate of stormwater runoff over the ground surface and is a useful practice for areas requiring a smooth, paved surface that would normally be covered with impervious concrete or asphalt. Pervious pavement is suitable for parking lots, private roads, fire lanes, residential driveways, sidewalks, and bike paths, where the subsoil is of a suitable composition. Pervious pavement does require periodic cleaning with a vacuum to remain effective over time.

Primary goal addressed: 2. Reduce Flooding/Mitigate Flood Damage
Pollution reduction: 90% sediment, 65% P, 85% N
Cost: $100,558/acre

Rain gardens

Rain gardens are vegetated basins that temporarily store and infiltrate rain water. Situated near the lowest point of a small drainage area (such as a single residential lot), they

Primary goal addressed: 1. Improve Surface Water Quality
Pollution reduction: 67% sediment, 27% P, 35% N
Cost: $9.27/sq ft

significantly slow the flow of water, improve water quality, and provide food and shelter for birds, butterflies, and insects. Rain gardens can be used in combination with roof downspout disconnection and redirection, so that rainwater from a roof is channeled to the rain garden to infiltrate into the soil, reducing stormwater runoff.

Rainwater collection

Rainwater collection systems gather rainwater in structures such as rain barrels or cisterns, so that it can be used or released at a later time. They are often connected to roofs and gutters. Collecting rainwater in these systems decreases localized stormwater runoff during times of peak flow and reduces household water use and water bills.

Primary goal addressed: 2. Reduce Flooding/Mitigate Flood Damage
Pollution reduction: n/a
Cost: $237 per barrel/small cistern

Single property flood reduction strategies

Property owners can use a number of practices to reduce flood damage, including many low-cost options. The key to successfully mitigating future damages is to identify the source(s) of flooding at the site scale. It is important to educate property owners about these sources of flooding and appropriate flood reduction strategies. The 2014 Madison County EMA All-Hazard Mitigation Plan recommends several actions to mitigate flood damage: 1) full or partial buyouts to relieve homeowners in frequently flooded areas, 2) elevating structures in frequently flooded areas, 3) making informational materials about the NFIP available, 4) participating in the Community Rating System, and 5) sanitary sewer line repairs to prevent stormwater infiltration and sewer backups in Worden and Marine (Appendix E – Management Measures).

Primary goal addressed: 2. Reduce Flooding/Mitigate Flood Damage
Addresses Critical Flood Areas
Pollution reduction: n/a
Cost: $2,000 per property

The Illinois Urban Flooding Awareness Act Final Report, published in June 2015, identified typical causes of basement flooding including overland flow, infiltration, and sewer backup. The report identified solutions available to address these causes, such as structural inspections, site grading, overhead sewer installation, drain tile, downspout disconnection, rain gardens, and pervious pavement. Information from this Report is located in Appendix E. Additional mitigation activities include elevating structures in frequently flooded areas and sanitary sewer line repairs to prevent stormwater infiltration and sewer backups (Appendix E – Management Measures).

To aid homeowners in making decisions about flood risk to their homes, materials about the NFIP should be made available by communities. Additionally, communities should consider coordinating with FEMA and IDNR on a home buyout program to relieve homeowners in frequently flooded areas who do not wish to remain.

Stormwater and sanitary sewer system maintenance and expansion

Storm drain systems require regular maintenance to function as planned. Cleaning out culverts, ditches, clogged drains, and storm drain inlets reduces the amount of pollutants, trash, and debris entering receiving waters. In some cases, stormwater infrastructure is not appropriately sized to accommodate the flow it receives due to changes in the upstream drainage area or inappropriate sizing. In some areas, a stormwater pipe designed to convey the 10-year storm based on rainfall data through 1960 would only carry the 6.6-year rainfall estimated from a dataset extending to the 1980s.

Primary goal addressed: 2. Reduce Flooding/Mitigate Flood Damage
Pollution reduction: n/a
Cost: $81/linear foot (storm drain cleaning)

The 2014 Madison County EMA All-Hazard Mitigation Plan recommended several storm drain system improvement projects in municipalities in the watershed including Bethalto, Edwardsville, Roxana, Wood River, and Worden (Appendix E – Management Measures). Culverts, ditches, and detention basins that often overflow should be assessed for potential enlargement. Upgrades should be made in response to storm drain system inspections, citizen complaints, and/or updated modeling of the system.

In addition, sanitary sewer systems should be maintained in order to prevent infiltration and combined sewer overflows. Expansion of sanitary sewers to new development and existing buildings (already a common practice among municipalities) should continue wherever feasible.

Tree planting (e.g., street trees)

Street trees are trees that are planted in the public right-of-way. They are an important component of municipal green infrastructure and provide benefits including reducing stormwater runoff, filtering pollutants in air and water, mitigating high “urban heat island” air temperatures, and providing pleasing aesthetics that increase property values.

Primary goal addressed: 4. Promote Environmentally Sensitive Development

Selected Urban Management Measures (BMPs).

Downspout disconnection, a single property flood reduction strategy. Photo: National Downspout Services.

Storm drain cleaning. Photo: Ann Arundel County, Maryland.

Stream and Lake Measures

Lake and stream dredging

Several lakes and streams in the watershed have filled in with sediment, decreasing the volume of their storage capacity. In particular, the 2010 Oates Associates report for Madison County recommended routine sediment and debris removal from the following waterbodies:

Primary goal addressed: 2. Reduce Flooding/Mitigate Flood Damage
Addresses Critical Flood Areas
Pollution reduction: n/a
Cost: $27/cubic yard

- Dunlap Lake,
- Cahokia Diversion Canal (15,000 linear feet of stream channel),
- Delaplaine Branch Stream Channel (15,000 linear feet of stream channel) (near Georgia St, Edwardsville), and
- Old Alton/Edwardsville Road Ditch, Roxana (15,000 linear feet of stream channel).

Logjams—assessment and removal

Primary goal addressed: 1. Improve Surface Water Quality
Pollution reduction: n/a
Cost: $31/linear foot

A logjam is any woody vegetation, with or without other debris, which obstructs a stream channel and backs up stream water. Beaver populations can increase the number of logjams in an area. Reports of beavers in streams and lakes in the watershed, particularly Dunlap Lake, were made by residents in the watershed. Logjams occur naturally, providing beneficial stream structure and cover for fish and wildlife and allowing nutrient-rich sediments to be deposited on adjacent floodplain. Adding and maintaining logjams is sometimes a management improvement for fish habitat.

However, the benefits of logjams can sometimes be outweighed by the drawbacks. Logjams can impact water quality and impede the ability of streams in the watershed to drain and convey water from the land in a timely manner. They increase the impacts of flood events and contribute sediment when water scours the streambanks beside the logjam, taking soil and debris from the bank into the stream channel. Logjams can be beneficial or harmful depending on their size, location, the extent to which they stabilize streambanks, and the condition and land use of the riparian area. The decision to remove a logjam should be made following a thorough site inspection.

Localized assessment is recommended to determine whether logjam removal is appropriate and cost-effective at specific locations. The American Fisheries Society's 1983 "Stream Obstruction Removal Guidelines" are a reliable source for determining what types of logjams should be removed.

Shoreline stabilization

Primary goal addressed: 1. Improve Surface Water Quality
Pollution reduction: 58% sediment, 22% P, 15% N
Cost: $83/linear foot

The shoreline provides habitat for fish and wildlife, supports recreation for humans, and cleans stormwater runoff before it enters the water. Shoreline erosion is a natural process that occurs on lakes and rivers and along the coast. It is the gradual, although sometimes rapid, removal of sediments from the shoreline. It is caused by a number of factors including storms, wave action, rain, ice, winds, runoff, and loss of trees and other vegetation. Stabilizing the shoreline of lakes in the watershed can reduce sediment erosion and support vegetation and wildlife habitat.

Streambank and channel restoration

Primary goal addressed: 1. Improve Surface Water Quality
Addresses Critical Stream Reaches
Pollution reduction: 98% sediment, 90% P, 90% N
Cost: $78/linear foot

Streambank and channel restoration includes several practices. Streambed erosion (incision) is the first consideration for treatment. Treatment methods include installation of pool-riffle complexes, which consist of areas of rapid water movement over coarse substrate (riffles) and areas with slower stream movement and a smooth surface (pools). Riffle-pool complexes help support healthy fish and wildlife habitat by increasing water depth and increasing DO.

Streambank stabilization methods use a combination of bioengineering with native vegetation and hard armoring. These practices are typically implemented together, often alongside riparian buffer improvements. They improve water quality by reducing sediment transport and increasing oxygen. Some practices, such as two-stage channels, help to store floodwater during periods of high flow.

Selected Stream Management Measures (BMPs).

Stone toe protection, which prevents streambank erosion and shoreline erosion. Photo: Montgomery County, Maryland.

Logjam removal. Photo: Downriver Citizens for a Safe Environment, Michigan.

SECTION 5: MANAGEMENT MEASURES ACTION PLAN

Management Measure Selection

BMPs for stormwater management and water quality were identified from several sources, including the Association of Illinois Soil and Water Conservation Districts (Illinois Urban Manual) and USEPA (e.g., the Water Quality Scorecard). Full descriptions of Management Measures selected are located in Appendix E.

The Management Measures were selected based on the following factors:

- Performance—Research-based pollutant reduction estimates for each BMP;
- Cost—The costs associated with installation and maintenance of each BMP;
- Public acceptance; and
- Ease of construction and maintenance.

Pollutant load reduction values associated with the Management Measures were identified from several sources, including the USEPA's Region 5 Load Estimation Model Users Manual and the International Stormwater BMPs Database (see Appendix E).

Cost estimates were assembled from several sources, including the Illinois Nutrient Loss Reduction Strategy (2015), experienced local contractors, and other watershed-based plans (see Appendix E).

Levels of public acceptance for various Management Measures were gauged during stakeholder engagement activities. Data on ease of construction and maintenance were collected from sources including NRCS's 2014 National Conservation Practice Standards.

Table 5 shows all Management Measures selected, with the primary goal addressed by each measure. Secondary and/or tertiary goals addressed are also identified. Estimates of the pollutant load reduction efficiencies of each measure are listed for sediment, TSS, phosphorus, and nitrogen. If implemented, these Management Measures will achieve the goals, objectives, and targets of this plan.

Some BMPs are more effective at pollutant reduction when implemented in a treatment train (e.g., a terrace leading to a wetland). The STEPL can assess the efficiency of several BMP combinations.

Note: All recommendations in this section are voluntary and are not required by any federal, state, or local agency.

All Management Measures recommended

Table 5. All Management Measures recommended, goals addressed (see goal numbers in Section 2), and pollutant load reduction efficiencies.

	Goals addressed			Pollutant load reduction efficiency			
	Primary goal addressed	Secondary goal addressed	Tertiary goal addressed	% sediment removal*	% TSS removal*	% P removal	% N removal
Programmatic Measures							
Conservation Development	3						
Federal and state programs (CRP, CREP, etc.)	1	3	4				
Financial support for stormwater infrastructure	2	5					
Flood Damage Prevention Ordinance	2						
Green infrastructure incentives	3						
In-lieu fee mitigation	1	2	3				
Monitoring (water quality, flow, and stream health)	1	4	6				
Naming unnamed tributaries	1	3	4				
Native landscaping	4	3	2				
Open space and natural area protection	3	5					
Private sewage monitoring	1						
Riparian Buffer Ordinance	3	1	5				
Sewage Treatment Plant upgrades	1						
Stream Cleanup Team	4	2					
Watershed Plan integrated in community efforts	5						
Site-Specific Management Measures							
Agricultural Management Measures							
Animal waste treatment system	1			75%	75%	70%	65%
Bioreactor	1	4		0%	0%	0%	40%
Comprehensive Nutrient Management Plan (CNMP)	1	2		n/a	n/a	n/a	n/a
Conservation tillage	1			59%	59%	52%	20%
Contour buffer strips	1			53%	53%	61%	53%
Cover crops	1			15%	15%	30%	30%
Grassed waterways	1			80%	80%	45%	55%
Nutrient Management Plan (NMP)	1	2		n/a	n/a	n/a	n/a
Ponds	1	2		58%	67%	48%	31%
Riparian buffers	1	4		53%	53%	43%	38%
Terraces	1			40%	40%	31%	25%
Water and sediment control basins (WASCOBs)	1	2		58%	58%	35%	28%
Wetlands	1	2	4	78%	78%	44%	20%
Forest Management Measures							
Forest stand improvement	4	1		5%	5%	5%	5%
Urban Management Measures							
Bioswales	2	4		77%	77%	17%	47%
Dry detention basins, new	2	1		58%	58%	26%	30%
Wet detention basins, new	2	1		60%	60%	45%	35%
Detention basin retrofits (vegetated buffers, etc.)	2	1	4	53%	73%	45%	40%
Detention basin maintenance (dredging, invasives, etc.)	2	1		n/a	n/a	n/a	n/a
Pervious pavement	2	1		90%	90%	65%	85%
Rain gardens	1	4	2	67%	67%	27%	35%
Rainwater collection	2	1		n/a	n/a	n/a	n/a
Single property flood reduction strategies	2			n/a	n/a	n/a	n/a
Stormwater & sanitary sewer maintenance & expansion	2	1		n/a	n/a	n/a	n/a
Tree planting (e.g., street trees)	1	2		31%	31%	31%	27%
Stream and Lake Management Measures							
Lake and stream dredging	2			n/a	n/a	n/a	n/a
Logjam assessment and removal	1	2	4	n/a	n/a	n/a	n/a
Shoreline stabilization	1			58%	58%	22%	15%
Streambank & channel restoration	1	4		98%	90%	90%	90%

*Independently calculated sediment and total suspended solids (TSS) values were used where available. Where only one sediment or TSS value was available, the known sediment and TSS reduction efficiency was used (purple cells).

Summary of Site-Specific Management Measures recommended

Table 6 shows the Site-Specific Management Measures recommended, along with associated costs and estimated pollutant reductions for sediment, TSS, phosphorus, and nitrogen. All recommendations are for implementation by 2050, or the long-term watershed planning horizon.

Agricultural Management Measures include 100 acres of *animal waste storage/treatment systems* for livestock waste management. This represents 1.8% of the approximately 5,604 acres of farms in the watershed with livestock.

Bioreactors are recommended at 129 locations, draining approximately 70 acres per bioreactor, for a total of 9,030 acres drained. The locations of 129 potential sites for bioreactors were determined by the ACPF model, which uses topography and soil type to estimate which fields in the watershed are likely to be tile drained.

Comprehensive Nutrient Management Plans (CNMPs) are recommended for 500 acres of farmland.

Conservation tillage is recommended for 23,437 acres of land, representing 33% of agricultural land in the watershed.

Contour buffer strips are recommended to cover 32 acres with Critical, Very High, or High runoff risk. This represents 15% of the 214 acres of sites well suited for contour buffer strips identified by the ACPF model, which uses buffer strips 15 feet wide with a 90 foot minimum distance between them.

Cover crops are recommended for 23,437 acres of land. Cover crops are highly compatible with conservation tillage; a farmer planting cover crops will often find it more beneficial to till less or not at all.

Grassed waterways are recommended for 77 acres on agricultural land with Critical, Very High, or High runoff risk, as identified in the ACPF. This figure represents 33% of the grassed waterway locations identified in the ACPF, which are suited for drainage areas greater than six acres. Grassed waterways are a well-known practice among landowners and farmers in the watershed.

Nutrient Management Plans (NMPs) are recommended for 2,000 acres of agricultural land.

Ponds are recommended to cover 100 acres on agricultural land. Ponds are already a popular project for landowners in the watershed, who often use them for recreation and stock them with fish. Ponds are not eligible for funding by the major federal agricultural conservation programs such as CRP, but there appears to be high demand, and they function well as retention basins.

Riparian buffers are recommended for 358 acres along streams (assuming a 100-foot buffer width), representing 50% of the 21.1 miles of streams identified as having poor or moderate riparian condition. The recommended area includes 100% of the Critical Riparian Areas in the watershed (21.16 miles) which are composed of “poor condition” riparian areas identified in the aerial assessment and areas identified in the ACPF as Critical Zones (see Appendix B).

Terraces are recommended for a total length of 80,000 feet (15.2 miles). Specific locations where terraces would be well-suited were not identified (and were not included in the ACPF tool), but it is likely that areas suitable for contour buffer strips would also be suitable for terraces.

WASCOBs are recommended for 50 acres on agricultural land with Critical, Very High, or High runoff risk. This area represents 100% of the WASCOB locations identified by the ACPF. Runoff risk classifications represent the risk of direct runoff contribution to stream channels from agricultural land. Runoff risk categories were assessed by distance to the nearest stream and slope steepness; the closer the stream and the steeper the slope, the greater the runoff risk. See Appendix B for more information on this assessment process.

Wetlands are recommended to be installed or restored on 1,477 acres in the watershed. This represents 100% of the Critical Wetland Areas identified using the ACPF.

Table 6. Summary of Site-Specific Management Measures recommended, including amount, cost (implementation cost), and pollutant load reduction.

					Cumulative pollutant load reduction			
BMP Name	**Amount**	**Unit**	**Cost per unit**	**Total Cost**	**Sediment (tons/yr)**	**Total Suspended Solids (lbs/yr)**	**Phosphorus (lbs/yr)**	**Nitrogen (lbs/yr)**
Agricultural management practices								
Animal waste storage/treatment system	100	systems	$260,000	$26,000,000	333	666,431	1,417	6,289
Bioreactors	9,030	acres drained	$157.81	$1,425,031	0	0	0	27,573
Comp. Nutrient Mgmt Plans (CNMPs)	500	acres	$54.97	$27,486	0	0	0	0
Conservation tillage	23,437	acres	$58.65	$1,374,505	4,819	9,637,380	19,528	35,782
Contour buffer strips	32	acres	$175.11	$5,623	6	11,819	31	130
Cover crops	23,437	acres	$30.54	$715,694	1,232	2,464,803	11,234	53,673
Grassed waterways	77	acres	$8,653	$662,068	21	42,916	55	321
Nutrient Management Plans (NMPs)	2,000	acres	$13.83	$27,669	0	0	0	0
Ponds	100	acres	$15,270	$1,527,000	20	46,975	77	237
Riparian buffers	358	acres	$52.65	$18,858	785	1,570,105	2,896	12,211
Terraces	80,000	feet	$3.36	$268,752	0	515	1	4
Water and sediment control basin	50	acres	$366.48	$18,429	10	20,273	28	106
Wetlands	1,477	acres	$13,162.50	$19,439,828	404	807,679	1,038	2,255
Forest related practices								
Forest stand improvement	50	acres	$356.30	$17,815	2	3,921	9	43
Urban/Other Measures								
Bioswales	100,000	sq. ft	$18	$1,800,000	4	8,631	4	57
Dry detention basins, new	500	acres	$43,804.80	$21,902,400	702	1,403,783	1,446	7,974
Wet detention basins, new	100	acres	$48,122.10	$4,812,210	146	292,963	501	1,861
Detention basin retrofits (native vegetation buffers, etc.)	20	acres	$15,236.94	$304,739	26	71,288	100	425
Detention basin maintenance (dredging, mowing, burning, invasives, etc.)	20	acres	$992.09	$19,842	n/a	n/a	n/a	n/a
Pervious pavement	100	acres	$100,557.50	$10,055,750	220	439,445	723	4,519
Rain gardens	20,000	sq. ft	$9.27	$185,440	1	1,502	1	9
Rainwater collection	100	rain barrels/ cisterns	$236.93	$23,693	n/a	n/a	n/a	n/a
Single property flood reduction strategies	1,837	properties	$1,053	$1,934,361	n/a	n/a	n/a	n/a
Storm drain system maintenance and expansion	10,000	feet	$80.55	$805,545	n/a	n/a	n/a	n/a
Tree planting (e.g., street trees)	2,280,000	sq. ft. canopy	$2.78	$6,347,000	40	79,227	181	751
Waterways								
Lake and stream dredging	179,021	cubic yards	$27	$4,834,016	n/a	n/a	n/a	n/a
Logjam removal	3,692	feet	$31.20	$115,190	n/a	n/a	n/a	n/a
Shoreline stabilization	2,295	feet	$83.48	$191,550	716	1,431,578	1,248	4,066
Streambank & channel restoration	96,180	feet	$78	$7,502,077	899	1,659,233	3,781	18,065
TOTAL				**$83,535,549**	**10,386**	**20,660,464**	**44,301**	**176,348**
% Reduction From Current Total:					**24.0%**	**23.9%**	**29.6%**	**24.6%**

Forest Management Measures consist of 50 acres of *forest stand improvement.* This represents 0.002% of the forested area in the watershed (31,749 acres).

Urban Management Measures including 100,000 square feet of *bioswales.* If each bioswale treats an area of 10 acres or less, as is recommended, this represents minimum of 10,000 swales implemented.

New dry detention basins (500 acres) and *wet detention (or retention) basins* (100 acres) are recommended. New detention and retention basins are anticipated to be constructed alongside new residential, suburban, commercial, and industrial development in the watershed. Assuming an average basin size of one acre, 500 acres of basins represents 500 new basins in total.

Detention basin retrofits are recommended for 20 acres of existing detention/retention basins, which represents 40% of the 49 detention basins identified from aerial photographs in the watershed, assuming an average basin size of one acre. It is anticipated that all existing basins will benefit from upgrades by 2050. Several have already filled with sediment and fallen into disrepair, especially in older subdivisions. *Detention basin maintenance* for those 20 acres of detention/retention basins is also recommended to ensure that appropriate maintenance techniques and schedules are designed and adhered to in future.

Pervious pavement is recommended for 100 acres in the watershed, or 1.0% of the total current impervious area in the watershed (high, medium, and low development land cover). Pervious pavement is an increasingly popular paving choice, and has been used at pilot sites at Scott Air Force Base.

Storm drain system maintenance and expansion is recommended for 10,000 feet of stormwater ditches and storm sewers in the watershed. This includes cleaning out culverts, ditches, drains, and storm inlets, and expanding stormwater infrastructure to new development and increasing culverts and other features that are not appropriately sized to accommodate the flow received. If divided equally among the 12 municipalities in the watershed, the 100,000 feet of maintenance and expansion comes to 8,333 ft per municipality.

Rain gardens are recommended to be installed on 20,000 square feet of urban land in the watershed. Rain gardens are gaining in popularity among homeowners because of their infiltration capacity and wildlife benefits, and they can be attractive community features as well.

Rainwater collection is recommended through the installation of 100 rain barrels or cisterns.

Single-property flood reduction projects are recommended for 1,837 properties. This number is a best estimate of properties with moderate to serious flooding/groundwater issues requiring upgrades by 2050, based on the proportion of property damage to primary homes/businesses reported in the Flood Survey (Appendix B). Building owners may wish to update or elevate their properties to reduce flood damage, or alter drainage on their properties by improving basement drainage, altering driveway grade, or other actions.

Tree planting of approximately 20,000 trees is recommended, especially along streets. With an estimated canopy area of 114 sq ft for a 10-year-old mature street tree, this amounts to 2,280,000 sq. ft. of recommended canopy cover – 4% of the "high" and "very high" priority planting areas identified by Davey Resource Group in a 2018 analysis.

Stream and Lake Management Measures recommended including 179,021 cubic yards of lake and stream dredging.

Recommendations include 3,629 feet of *logjam removal*s. Some stream reaches with many trees and unstable streambanks may need to have multiple logjams removed.

Shoreline stabilization is recommended for 2,295 feet of lake shoreline. This represents 5% of the total perimeter of the shorelines of named, major lakes in the watershed.

*Streambank and channel restoration*s recommended for 96,180 feet of streams. This number represents 33% of all streams with high streambank erosion, and includes 100% of Critical Stream Reaches (which have high streambank erosion *and* high channelization. Streambank erosion is a major source of sediment and nutrient loading in the watershed.

Locations of Site-Specific Management Measures

Where data was available, Site-Specific Management Measures were recommended for implementation in certain locations. For example, Management Measures associated with Critical Areas are recommended for those areas.

Critical Areas and areas recommended for Management Measures through the USDA's Agricultural Conservation Planning Framework (ACPF) are provided in a spreadsheet with longitude and latitude data in Appendix I. Table 7 summarizes the Site-Specific Management Measures provided in Appendix I by HUC14 subwatershed.

Table 7. Area and length of six Site-Specific Management Measures at known locations, divided by HUC14 subwatershed (summary of Appendix I, but using up-to-date HUC14 codes), alongside four Critical Areas with known locations (summary of Critical Areas information in Section 3). Riparian buffers and wetlands are recommended for the exact locations for which Critical Areas were identified. Greatest values in each category are shown in **bold red font**.

HUC14 (up-to-date)	Bioreactors (sq m)	Contour buffer strips (sq m)	Drainage management (acres)	Grassed waterways (feet)	WASCOBs (acres)	Riparian buffers (acres)	*Critical Riparian Areas (feet)*	Wetlands (acres)	*Critical Wetland Areas (acres)*	*Critical Stream Reaches (miles)*	*Critical Logjam Areas (miles)*
7140101020101	5,954	2,968	**1,902**	20,331	3	298	978.70	60	60.73	0.00	0
7140101020102	5,498	0	1,140	4,800	0	47	0.00	56	54.78	0.00	0
7140101020103	0	4,667	312	16,971	1	519	3,013.55	54	55.77	0.00	1.2
7140101020201	1,887	665	550	5,125	1	281	0.00	**113**	111.99	0.00	0
7140101020202	5,155	4,620	1,263	3,582	5	321	0.00	46	45.99	0.00	0
7140101020203	4,975	27,242	1,529	8,959	12	638	8,066.75	28	26.88	0.00	3.2
7140101020301	8,485	3,719	1,351	27,097	3	241	0.00	0	**141.63**	0.00	0
7140101020302	2,481	41,847	488	9,875	30	150	6,145.46	0	42.60	0.00	0.3
7140101020303	9,146	76,997	674	19,649	49	803	1,388.94	0	68.23	0.10	4.2
7140101020401	7,428	14,358	851	**35,592**	11	**904**	2,085.84	0	78.04	0.00	2.8
7140101020402	4,265	19,954	1,552	24,136	35	644	8,020.68	0	79.44	0.97	2
7140101020403	1,838	37,184	323	5,913	24	240	12,467.16	0	77.28	1.11	1.4
7140101020404	3,994	58,974	952	12,580	41	516	0.00	25	24.13	0.00	**5.8**
7140101020501	4,049	32,780	682	10,686	24	309	1,998.74	28	26.87	0.00	1
7140101020502	10,819	58,069	1,125	12,258	22	363	0.00	25	23.98	0.00	0.6
7140101020503	411	11,197	205	2,473	20	190	1,536.55	5	4.52	0.00	2.7
7140101020504	477	10,533	365	4,355	10	53	0.00	42	41.69	0.00	0
7140101020505	1,279	8,482	217	1,601	10	405	4,093.65	23	22.10	0.00	2.6
7140101020506	0	7,335	218	3,545	6	100	0.00	7	6.94	1.00	0
7140101020601	5,257	22,033	508	33,576	9	372	7,437.32	51	51.12	0.00	0
7140101020602	2,169	111,081	208	31,472	45	362	2,266.62	101	101.46	0.00	2.4
7140101020603	2,880	49,170	274	6,765	57	362	3,825.12	87	86.37	0.00	1.3
7140101020604	**11,569**	**139,258**	470	23,131	**73**	345	8,112.61	63	63.44	0.00	0.3
7140101020605	2,331	101,600	335	28,845	42	384	**16,594.22**	81	81.69	0.90	0.1
7140101020701	6,593	23,535	398	9,390	16	156	13,796.38	90	89.05	**1.44**	4.3
7140101020702	0	13,982	0	4,058	7	455	0.00	10	10.20	0.00	0.9
7140101020703	3,100	0	1,165	0	2	520	9,887.87	0	0.00	0.00	0.4
Grand Total	**112,040**	**882,250**	**19,057**	**366,765**	**558**	**9,978**	**111,716.14**	**995**	**1,476.91**	**5.52**	**37.5**

Specific project locations

Nine specific project locations were identified by the watershed planning team. These projects address life safety issues and multiple goals of this plan by implementing a variety of Management Measures. A shortlist of these projects will help Madison County in its efforts to help communities and landowners in the watershed address the needs they identified in the stakeholder engagement process, and provide a near-term jumping off point for plan implementation by and for local government.

The locations were identified using the following information:

- Locations of issues identified by stakeholders on both public and private land;
- Critical Areas on public land, identified by cross-referencing the two map files;
- Parcels in which multiple types of Critical Areas are present, on both public and private land;
- Locations of agricultural BMPs identified by the ACPF;
- Road flooding locations identified by stakeholders, especially where floods threaten road access; and
- Madison County Community Flood Survey responses (which were returned with the promise of anonymity, so specific parcels from which a response was sent were not identified as project locations. However, flood issues reported nearby were included in the assessment criteria below).

Once these locations were identified, the following criteria were used to select a shortlist of projects:

- Threats to critical facilities such as water treatment plants, wastewater treatment plants, fire stations, etc. (i.e., threats from flooding);
- Loss of road access to properties as a result of floods overtopping roads (which can harm health and wellbeing when access to hospitals, schools, and other services is curtailed);
- Frequency of flooding (if known);
- Proximity to flood issues identified in the Madison County Community Flood Survey;
- Representation of publicly and privately owned land;
- Estimated potential water quality benefits of the project (if known), based on area/length of project multiplied by the amount of pollution reduced);
- Number and type of Critical Areas the project would address, so that several types of issues are addressed; and
- Geographic distribution, with projects that are located throughout the watershed benefitting multiple municipalities, landowners, and other stakeholders.

For each project location, the problem/issue is explored, along with a description of the problem. Then, potential solutions that might be used to address the issue(s) are discussed. A map of each project location is provided for reference.

It is important to note that these specific project locations are only the sites of potential projects. The types of projects suggested are voluntary, not mandatory, and each one warrants further stakeholder engagement and site assessment to determine feasibility. Individual landowners with a stake in the projects may not have been consulted. These sites are identified here for outreach purposes only, so that the organizations and individuals implementing the Plan have places to begin planning for implementation.

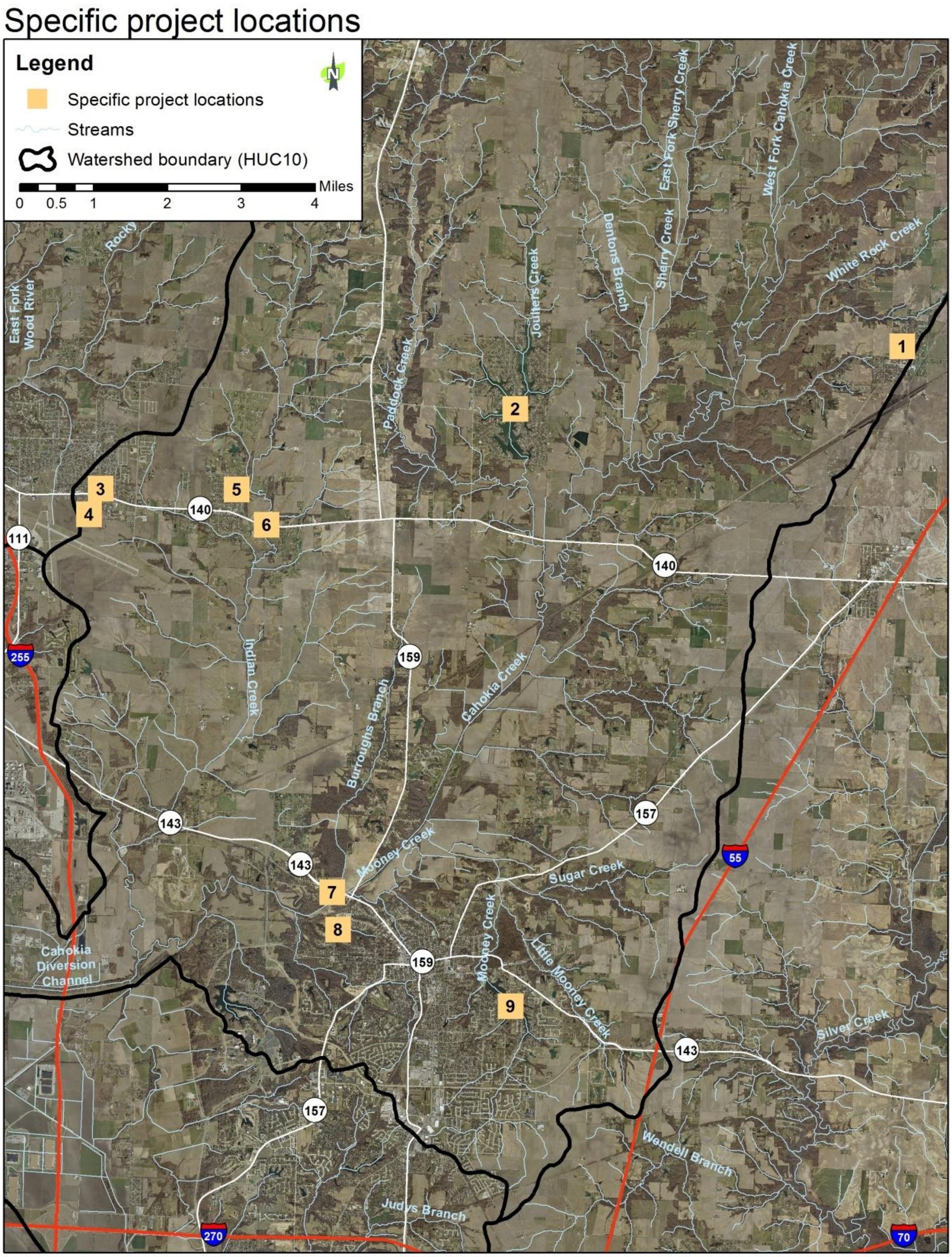


Figure 5. Map of specific project locations. Numbered squares relate to project numbers in the following pages.

List of Specific Project Locations

The following specific project locations are listed and numbered from north to south (not in order of priority).

1. Worden flooding
2. Holiday Lake flooding
3. Sewer discharges into ditches by Route 140 in Bethalto
4. Runoff from St. Louis Regional Airport (Bethalto)
5. Meadowbrook flooding
6. Flooding on Route 140 at Indian Creek (Bethalto)
7. Flooding at Route 143, Route 159, and Old Alton Edwardsville Road
8. Flooding at the Watershed Nature Center
9. Dunlap Lake siltation, flooding, and water quality

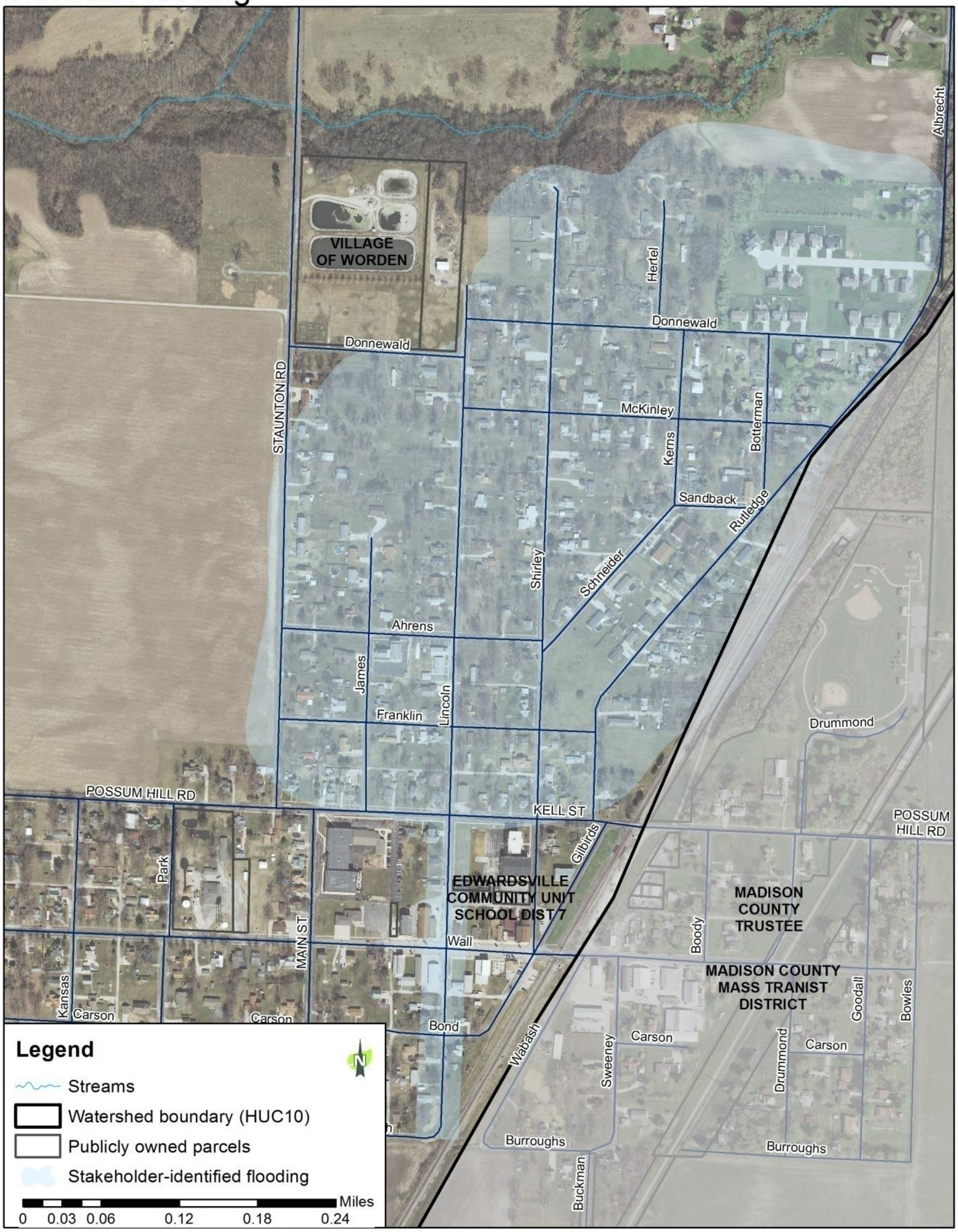
Project #1: Worden flooding

Description of problem: Heavy rain leads to ponding on several streets and in backyards on the north side of the Village of Worden (causing no property damage). Flooding occurs on Possum Hill Road one to two times per year. Recently, it has been worse than it was historically. Backyards have been flooded for almost the entire spring in some cases. A project underneath Lincoln Street to improve drainage has helped remove water from ditches between rain events.

Flood Survey: One survey was returned from Worden, reporting flooding in the last 10 years.

Possible solution: Improvement of stormwater infrastructure such as larger culverts, implementing detention/retention ponds, and green infrastructure to increase infiltration.

Worden Flooding



Project #2: Holiday Lake flooding

Description of problem: Holiday Lake is a 430-acre lake in northern Madison County around which the unincorporated community of Holiday Shores is arranged. The lake is managed by an active HOA and offers fishing, swimming, and boating. The lake has a dam and emergency spillway but does not have a control structure to release water quickly and lower lake levels ahead of predicted storms (there is no weather warning/notification system in place). In 2008, flooding caused by Hurricane Ike caused $2 million in damage to the lake community. There was significant property damage, and cars that were parked past barriers were swept into the lake. The flooding of late December 2015/early January 2016 was much less impactful, only raising the lake level to three feet above crest, because the lake level had been drawn down for sea wall repair.

The lake is silting in at a rapid pace, as documented by the silt samples taken by the HOA in each arm of the lake every year. The HOA contracts with upstream farmers to dredge silt from the lake and return it to the farmers' land. Fertilizer pollution has led to fish die-outs in the lake in the spring. The HOA has a rule prohibiting fertilizer application within 50 feet of the lake, but it is difficult to enforce and fertilizer use upstream is not restricted.

Floodplain: The lake, and a large area around it, is in the 100-year floodplain.

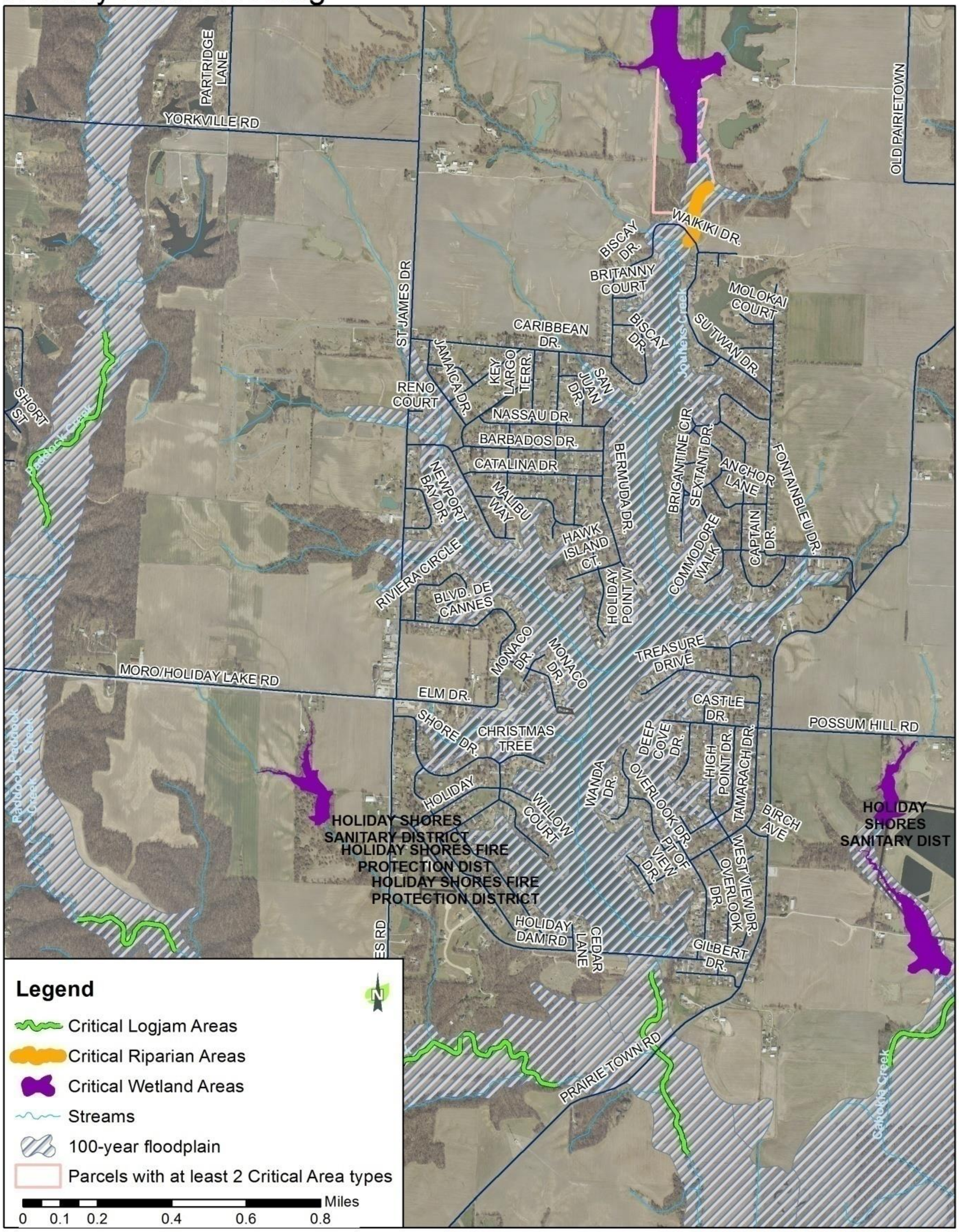
Flood Survey: Twenty-two people in the Holiday Shores community responded to the Flood Survey. Eleven of these said they had been flooded in the last 10 years. The most commonly flooded property flooded 10 to 49 times in the last 10 years. Three of the respondents reported basement flooding, and one reported flooding reaching the first floor. Several respondents reported their flooding to the Holiday Shores HOA. Three respondents had monetary loss.

Critical Areas: A large area on the northernmost tributary to the lake was identified as a Critical Wetland Area. Just south of this location is a Critical Riparian Area.

Other: Five stormwater complaints have been received by the Madison County Stormwater Coordinator from Holiday Shores between 2012 and 2015.

Possible solution: The dam and spillway system is upgraded with a control structure to allow faster drawdown of lake levels, and an HOA rule change allowing drawdown when heavy storms are expected. These measures will dramatically decrease flood risk to Holiday Shores residents. In addition, measures decreasing the inflow of sediment to the lake should be taken, such as sediment basins in the surrounding landscape, and the restoration of streambanks, stream channel, and the riparian area on tributaries.

Holiday Lake Flooding



Project #3: Sewer discharges into ditches by Route 140 in Bethalto

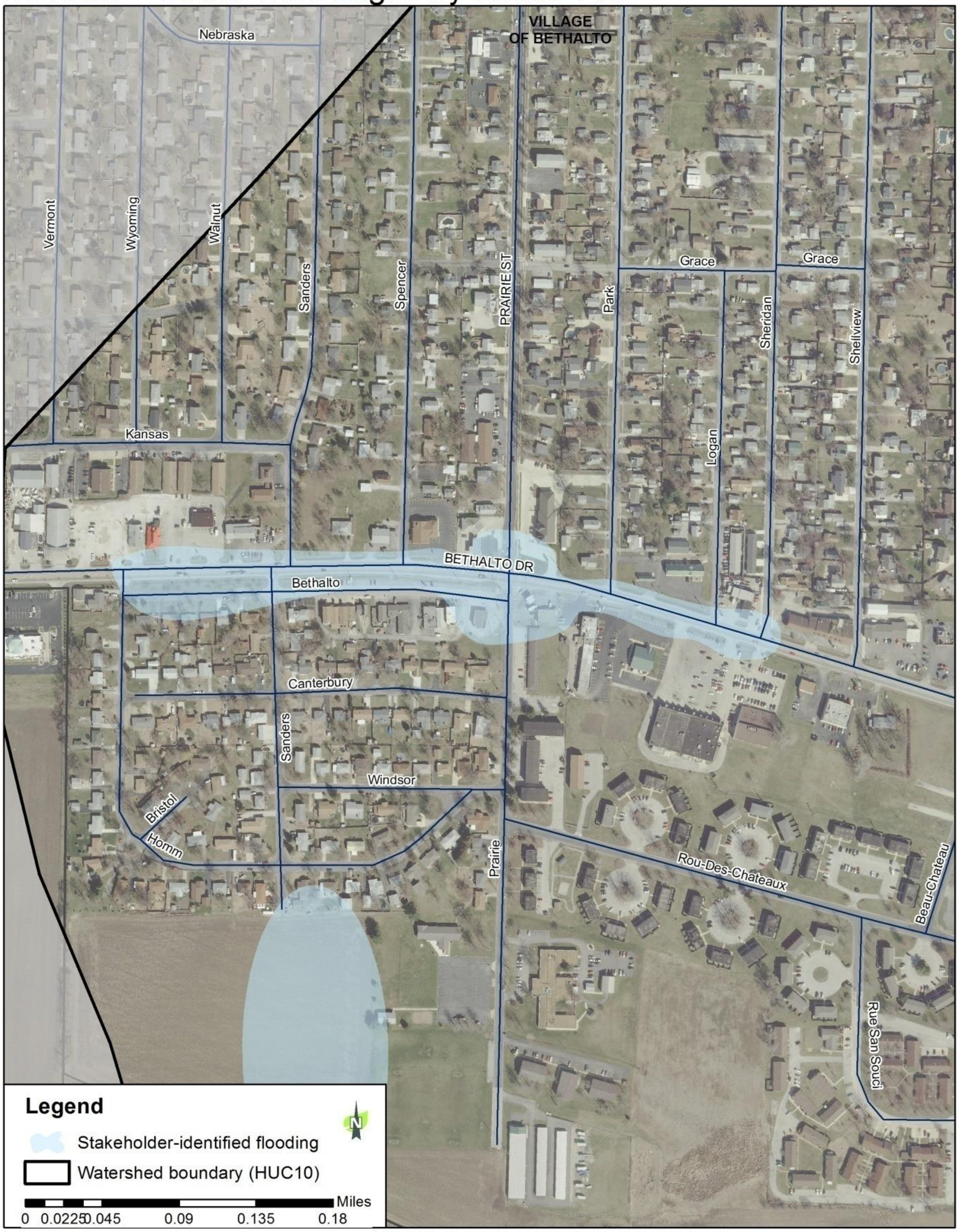
Description of problem: Untreated sewer discharges have entered ditches along Route 140 in the Village of Bethalto during and following heavy storms. The sewage lift station flooded in July 2016 and water overtopped Route 140, causing raw sewage to enter the ditch and the roadway. The intersection was shut down and the village had to fill out illegal discharge paperwork with IEPA.

Floodplain: The area affected by this flooding is not in the 100-year floodplain.

Flood Survey: None returned from immediate area.

Possible solution: Elevation of the sewage lift station and maintenance/repair of sanitary sewer infrastructure.

Bethalto—Sewer Discharges by Route 140



Project #4: Runoff from St. Louis Regional Airport (Bethalto)

Description of problem: The St. Louis Regional Airport largely drains towards the Village of Bethalto. Runoff from the airport property has contributed to significant flooding in surrounding neighborhoods. The Village of Bethalto has identified the Kutter-Aljets subdivision as the greatest flooding problem, with structure flooding, road flooding, and loss of access to homes. Water from the airport flows south to north towards this subdivision and the subdivision containing Homm and Windsor Streets, which have also had houses flooded.

The village has had meetings about the situation with the airport, Lewis and Clark Community College, and Terra Group. The village claims that the airport has substandard detention and that the village does not have enough space to accommodate all of the needed detention, so some of it must be on airport land. Some are also concerned that the airport is building more runways and buying more land, which may exacerbate the problem. The airport contends that it was already built when the subdivisions were developed, and that the development did not contain adequate drainage facilities (which the village does not dispute). Federal Aviation Administration (FAA) guidelines place limits on features such as detention basins and ponds that may attract wildlife close to runways, as wildlife can be a significant hazard to aircraft.

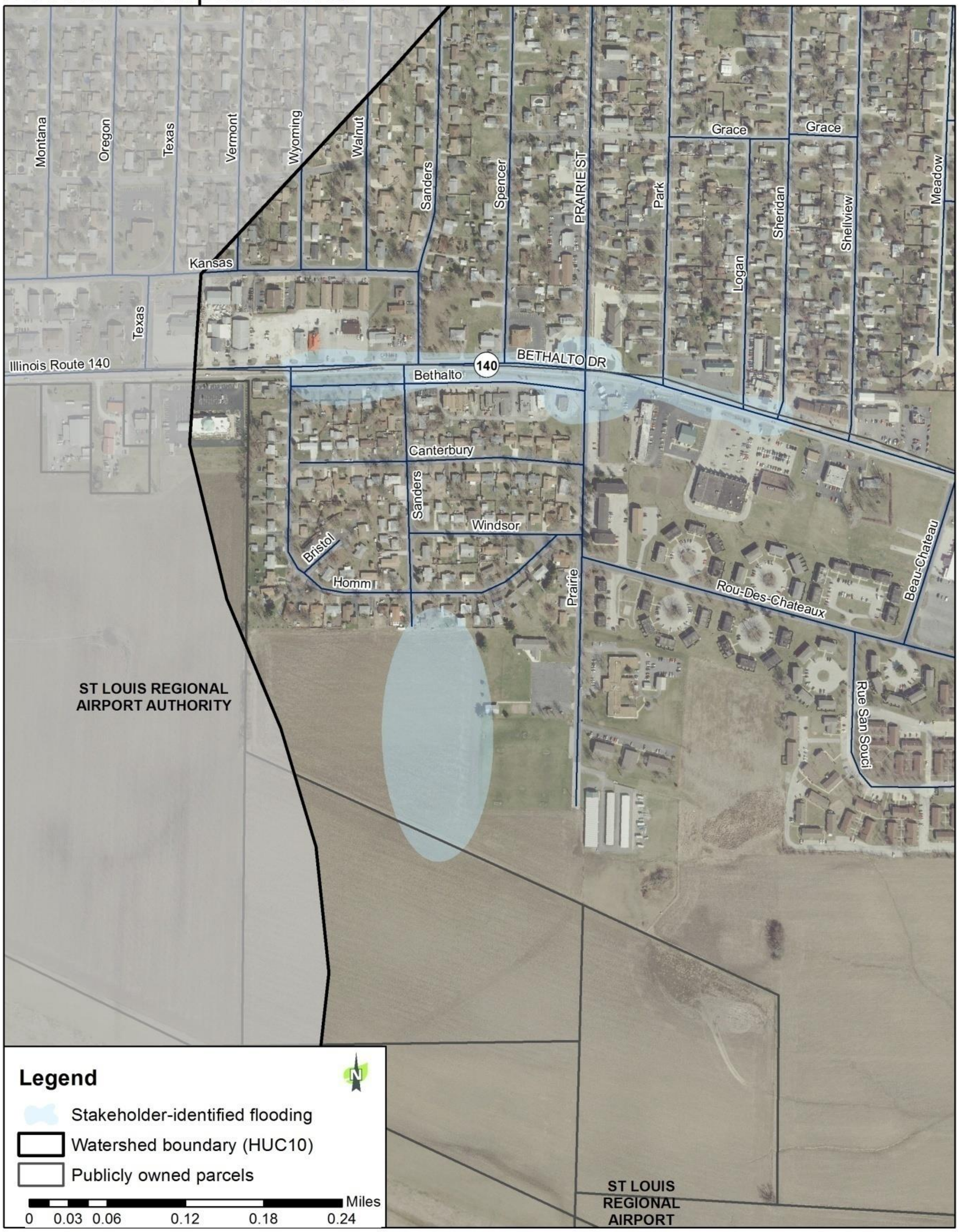
The village is moving forward with drainage improvements with 20 feet of land ceded from Rose Lawn Memory Gardens and 20 feet ceded from the Kutter-Aljets subdivision, yielding three lots to be used for detention.

Floodplain: The area affected by this flooding is not in the 100-year floodplain.

Flood Survey: One parcel on Sanders Road adjacent to the airport returned a Flood Survey and reported that their primary home or business at this address was flooded one to three times over the last 10 years, causing stress and less than $5,000 of damage. One or two neighboring properties had also been flooded in the last 10 years with similar severity.

Possible solution: The airport and the village collaborate on regional detention/retention solutions that meet their needs. This could include dry detention or underground detention (e.g., cisterns).

Bethalto—Airport Runoff



Project #5: Meadowbrook flooding

Description of problem: Meadowbrook is an unincorporated community east of Bethalto. Flooding was reported at two locations in Meadowbrook yards and streets. The Meadowbrook Sewer District has had issues with sewer overflow. Stakeholders identified flooding locations along Roosevelt Road, and between Fairway Drive and Truman Street.

Flood Survey: Four addresses from Meadowbrook returned a Flood Survey, but none of these reported flooding.

Stormwater complaints: Madison County received two stormwater complaints from Meadowbrook addresses (Neunaber Drive and Vine Street).

Public land: Meadowbrook Public Water District owns three parcels along Route 141, and Meadowbrook Fire Protection District owns two parcels adjacent to these on Sunset Drive. The Fort Russell Township Highway Department is located on Clover Street.

Critical Areas: A Critical Wetland Area is located northeast of Meadowbrook on a small tributary to Indian Creek. It would not likely affect the flooding in Meadowbrook itself.

Possible solution: Maintenance, repairs, and upgrades to sewer infrastructure and stormwater infrastructure.

Meadowbrook Flooding

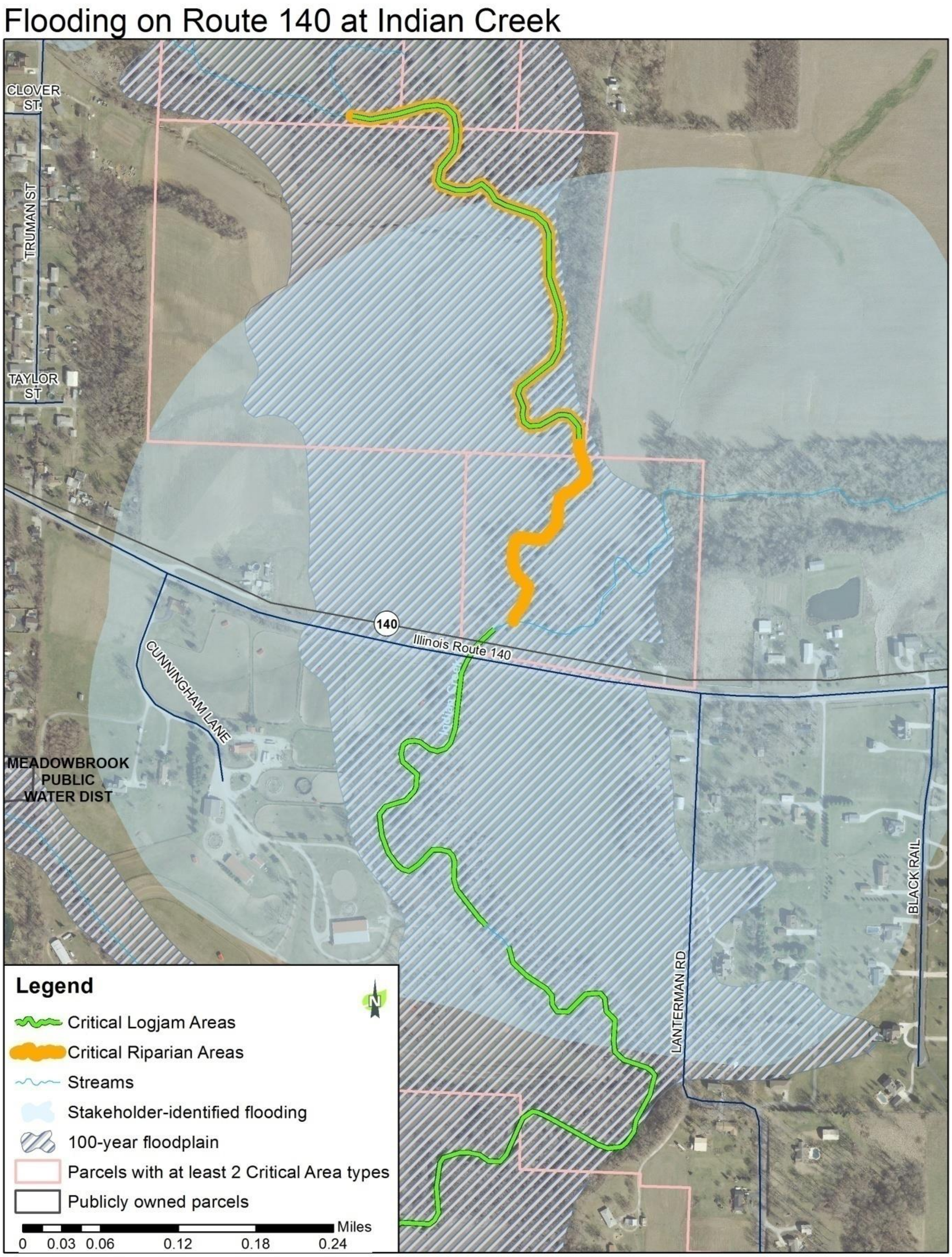
Project #6: Flooding on Route 140 at Indian Creek

Description of problem: Route 140 is a busy road connecting northern Madison County from west to east, connecting communities including Alton, Bethalto, Meadowbrook, Hamel, and Alhambra. Flooding occurs on Route 140 about once a year at Indian Creek. As of 2018, the state of Illinois has plans to fix the road at this location and presumably make improvements to drainage so the road no longer floods.

Floodplain: A wide swath of land surrounding the creek upstream and downstream of the road is in the 100-year floodplain.

Critical Areas: A long section of Indian Creek upstream of Route 140 is a Critical Riparian Area.

Possible solution: The bridge could be raised or the culvert enlarged at Route 140.


Flooding on Route 140 at Indian Creek
CLOVER ST
TRUMAN ST
TAYLOR ST
140
Illinois Route 140
CUNNINGHAM LANE
MEADOWBROOK PUBLIC WATER DIST
LANTERMAN RD
BLACK RAIL
Legend
Critical Logjam Areas
Critical Riparian Areas
Streams
Stakeholder-identified flooding
100-year floodplain
Parcels with at least 2 Critical Area types
Publicly owned parcels
Miles
0 0.03 0.06 0.12 0.18 0.24

Project #7: Flooding at Route 143, Route 159, and Old Alton Edwardsville Road

Description of problem: Flooding at and around Burroughs Branch bridge at 143 and Old Alton Edwardsville Road, and on Route 159 at Cahokia Creek affecting Drda Lane, is a recurrent problem. This flooding is all hydrologically connected. A group of concerned citizens (Cahokia Creek Forever) brought information to an Open House concerning floodway encroachment in this area, where a business has allowed its trucks to dump loads of material on land that is in the floodway. The county, FEMA, IDNR, and others have been aware of this issue for over a decade, and the Cahokia Creek Forever group has documented the steps taken so far.

Floodplain: A wide area on either side of the stream is in the 100-year floodplain. The dumping issue is located in the floodway.

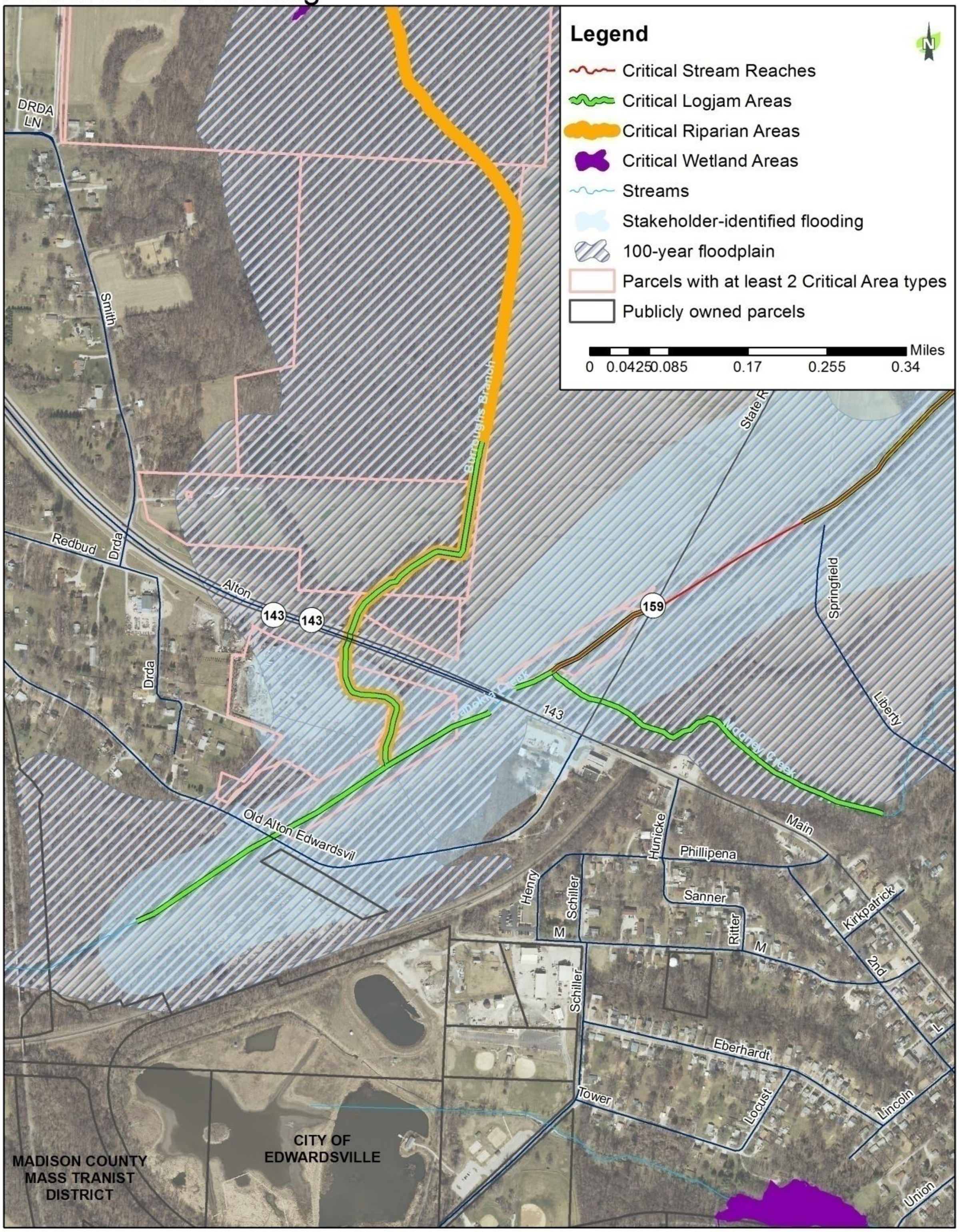
Flood Survey: Five responses were received from the area nearby to the problem location. Of these, two had been flooded in the last 10 years (four to six times each), with the water reaching their basements. Property owners lost money and had to take time off work to clean up. The cost of the damage was between $5,000 and $20,000 for both of them. They stated that six or more neighboring properties had also experienced flooding. None of the properties are located in the 100-year floodplain or have flood insurance.

Critical Areas: A long stretch of Burroughs Branch above its confluence with Cahokia Creek is a Critical Riparian Area. A long stretch of Cahokia Creek north of the culvert below Route 143 is a Critical Stream Reach.

Other: A Flood Survey respondent mentioned that illegal dumping, covering nine acres, caused flooding in their neighborhood.

Possible solution: Dumping activities in the floodplain cease. The riparian area around Burroughs Branch is improved with vegetation and potential off-stream detention to decrease stormflow pressure in Cahokia Creek. Cahokia Creek itself is improved with streambank and stream channel stabilization and potential off-stream detention.

Edwardsville Flooding



Project #8: Flooding at the Watershed Nature Center

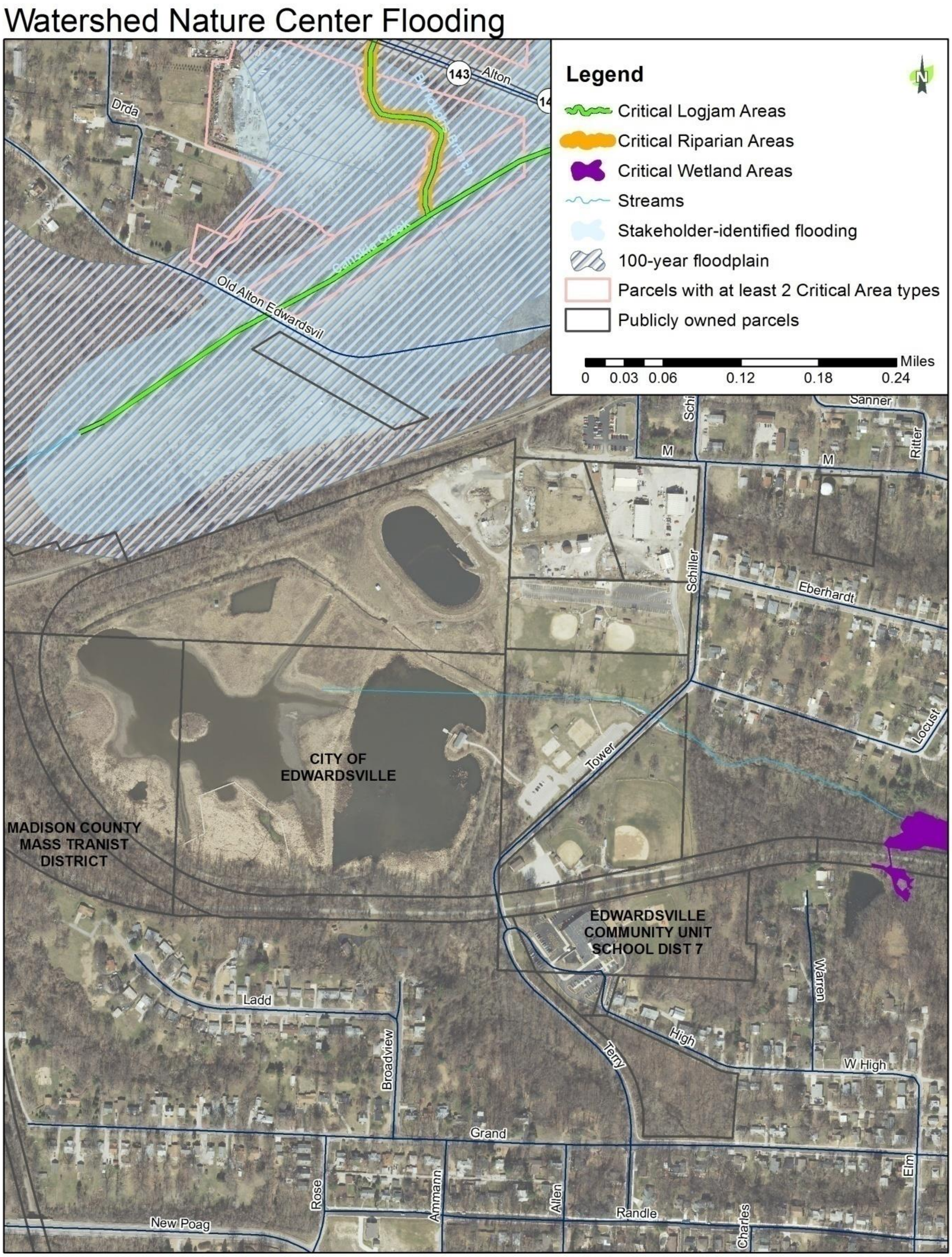
Description of problem: The Watershed Nature Center, located in northwest Edwardsville near the downtown, has flooded several times. In 2014, the flooding was especially severe, rising to at least two feet above the floor of the building and causing significant damage. The habitat in and around the lakes was also damaged, and invasive Asian carp species were able to enter the lakes. The flooding was exacerbated by the backflow preventers (known as “flapper gates”) that were not functioning at the time (e.g., one was propped open by driftwood). Since then the city has repaired the gates and Watershed Nature Center staff have been checking the gates before and after heavy storm events. Even with these changes, there has still been flooding caused by high volumes of water coming in from upstream.

The Watershed Nature Center is working with SIUE to obtain a grant to support water quality monitoring on the inflow to the ponds and outflow from the ponds, to see if and how well the ponds remove nutrients. The ponds have experienced fish kills due to a lack of oxygen caused by high nutrient levels. The center is also monitoring beaver activity, as beaver lodges have interfered with drainage at the site. IDNR has identified state-threatened aquatic species at the site and center staff are monitoring and encouraging visitors to monitor other animals and birds present.

Floodplain: The area downstream of the Watershed Nature Center is in the 100-year floodplain.

Flood Survey: Fourteen responses were received from the Watershed Nature Center subwatershed. Of these, three had been flooded in the last 10 years. Two of these respondents knew of neighbors who had also flooded in the last 10 years. The survey from Henry Street, almost adjacent to the Watershed Nature Center, said flooding had happened seven to nine times over the last 10 years.

Possible solution: The buildings at the center could be elevated to prevent future property damage. In winter, the center would like to keep the water level low at the marsh walk so that ice does not damage the structure and so they can allow for more flooding. Upstream, additional detention could be added to decrease the volume of high storm flows. One possible location for this detention area is the Critical Wetland Area identified on a tributary east of the Center adjacent to Madison County Transit-owned property. Further research opportunities in partnership with SIUE may help identify further flood control measures.


Watershed Nature Center Flooding
Legend
Critical Logjam Areas
Critical Riparian Areas
Critical Wetland Areas
Streams
Stakeholder-identified flooding
100-year floodplain
Parcels with at least 2 Critical Area types
Publicly owned parcels
Miles
0 0.03 0.06 0.12 0.18 0.24
143
Alton
Drda
Cahokia Creek
Old Alton Edwardsvil
Sanner
M
Ritter
Schiller
Eberhardt
Locust
Tower
CITY OF EDWARDSVILLE
MADISON COUNTY MASS TRANIST DISTRICT
EDWARDSVILLE COMMUNITY UNIT SCHOOL DIST 7
Warren
Ladd
Broadview
High
W High
Terry
Grand
Rose
Ammann
Allen
Randle
Charles
Elm
New Poag

Project #9: Dunlap Lake siltation and water quality

Description of problem: Dunlap Lake is a 138-acre private lake surrounded by a residential area on the east side of Edwardsville. The lake is managed by an active Property Owners Association (POA). The lake was created in 1939 by damming Mooney Creek with a 700-foot long, 30-foot high earthen dam. People use the lake for swimming and boating, and the lake is stocked every year for fishing.

The two major issues at Dunlap Lake are that it is silting in (i.e., reducing storage capacity and increasing flood risk), and that it has water quality problems, such as algal blooms and high fecal coliform levels. The lake has slowly been filling with sediment and silt over time, as sediment carried into the lake by tributaries is deposited. The lake level is lowered before heavy storms, but the lake's capacity is shrinking; it needs to be dredged. Neighborhoods upstream of the lake experience road flooding and basement flooding at times. When Willow Creek Road is flooded, it removes access to ~89 homes. Some of this flooding was reported to the POA and the Madison County Stormwater Coordinator.

There is severe erosion south of the lake where streambanks are 25 to 30 feet high in places, which contributes large amounts of sediment to the lake. Besides sediment, other water quality concerns are the nutrients (e.g., phosphorus, nitrogen) that cause algae blooms—including at least one instance of a harmful algal bloom (HAB) in the lake—human and animal waste that has led to high fecal coliform measurements, and trash.

The Dunlap Lake POA is concerned about the safety of the earthen dam, noting that the amount and velocity at which water enters the lake has increased. Riprap has been added to the dam to support it. There is an emergency plan for if the dam is ever breached.

Floodplain: The 100-year floodplain covers the lake and extends up its banks.

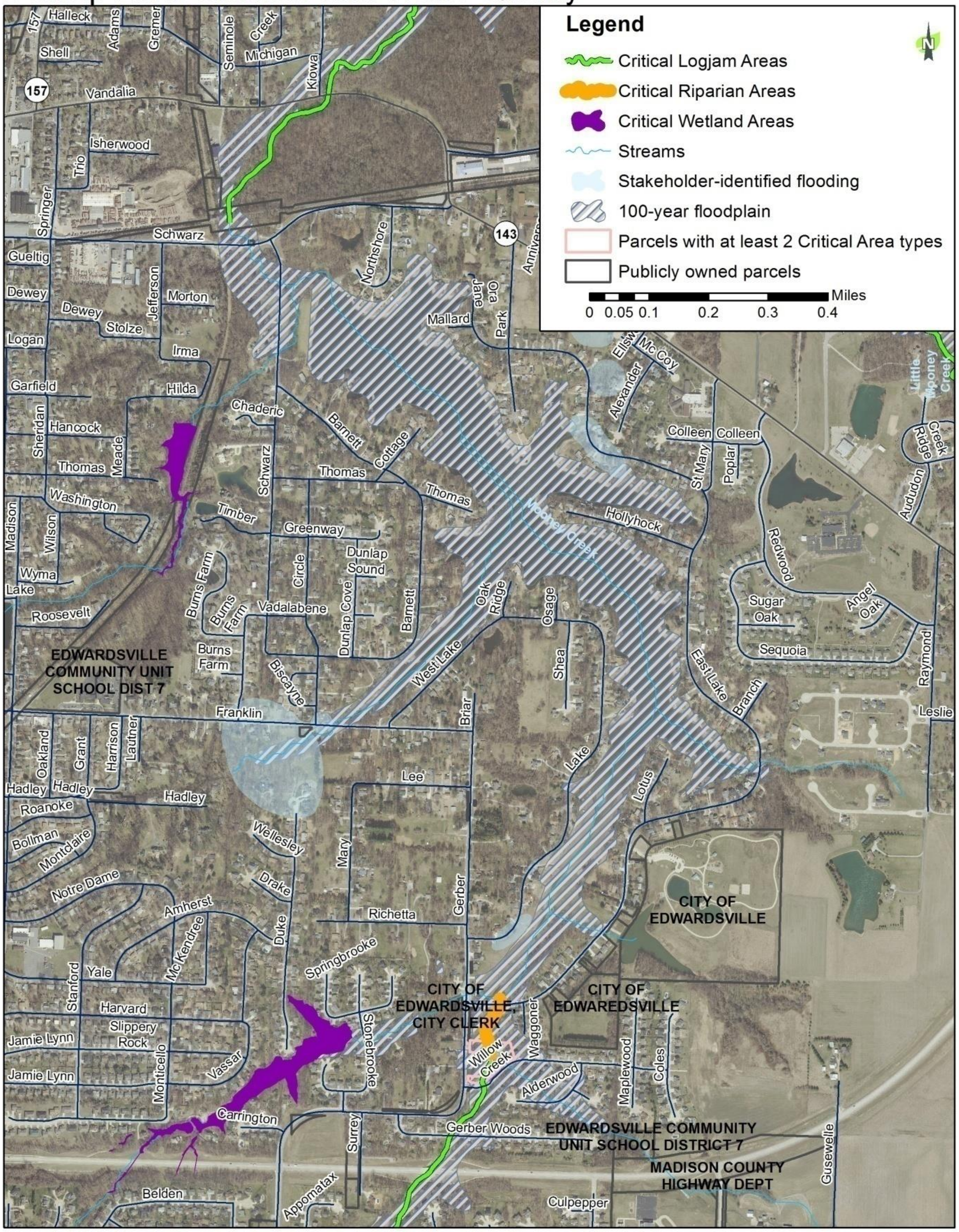
Flood Survey: Three parcels in the immediate watershed of the lake returned the Flood Survey (Stonebrooke Drive, Springbrooke Drive, and Roanoke Drive). The flooding caused stress, resulted in partial loss of access to the properties, and required time off work to clean up. The Stonebrooke Drive respondent reported being flooded 10 to 49 times over the last 10 years, or more than once a year on average, saying, "Every time it rains, my property floods." The respondent said their sump pump works continuously during heavy rainstorms but sometimes fails. They had between $1 and $5,000 in damage.

Critical Areas: A Critical Riparian Area (with poor riparian condition) was identified where a tributary to the lake crosses East Lake Road. There is sparse or absent vegetation and eroded streambanks at this locations. There is also a Critical Wetland Area (an area where wetland would be well suited) west of Stonebrooke Drive.

Other: The City of Edwardsville has excellent maps of its sewer infrastructure covering this area.

Possible solution: The POA is on board with solutions such as increasing detention upstream, reducing streambank erosion upstream, reducing chemical fertilizer use upstream, and dredging the lake.

Dunlap Lake Siltation and Water Quality



Management Measures on Public Land

To increase the ease with which this plan can be implemented when funds become available for the counties and municipalities in the watershed, it is recommended that a shortlist of five to 10 projects are identified for implementation on public land. These projects should improve life safety, address multiple goals of this plan, involve multiple partners, and implement a range of Management Measure types when possible. A shortlist of these projects will help Madison County in its efforts to help communities in the watershed address the needs they identified in the stakeholder engagement process, and provide a near-term jumping off point for plan implementation by and for local government.

SECTION 6: INFORMATION & EDUCATION PLAN

This section is designed to provide an Information and Education component to spark interest in and enhance public understanding of the watershed plan, and to encourage early and continued participation in selecting, designing, and implementing its recommendations. It explores Goal 6 of this plan, "Promote public awareness, understanding, and stewardship of the watershed and the watershed plan."

The watershed faces challenges and threats from high nutrient and sediment loads, streambank erosion and channelization, widespread flooding, increasing development and land use changes, deteriorating stormwater and sewer infrastructure, invasive species, and more. Key audiences lack the knowledge and resources to make informed decisions and adopt constructive behaviors to mitigate these challenges and threats.

Since a significant amount of the watershed is held as private property, education and outreach efforts to engage landowners and other key stakeholders are needed to improve water quality and achieve other goals of this plan. A single regulatory agency or group working alone cannot be as effective in reducing stormwater pollution as a combined effort with other groups in the watershed all working towards the same goal. Many people will commit to protecting and improving the watershed if they understand what to do and how it will help.

This Information and Education Plan will serve as an outline for outreach that supports achievement of the long-term goals and objectives of the watershed plan. The cumulative actions of individuals and communities across the watershed can accomplish these goals and objectives. County, municipal and township staff, elected officials, and other key stakeholders have tools at their disposal to establish best practices in their activities and procedures. Developers can follow guidelines that consider watershed health, and residents in the watershed can be actively involved in monitoring, protecting, and restoring Cahokia Creek and its tributaries. As these stakeholders become aware of the creek's location and needs and adopt specific behaviors to improve its health, the threats and challenges in the watershed will decrease. Public information and stakeholder education efforts will ultimately inspire watershed residents and community members to adopt recommended behaviors that improve the water quality and overall health of the watershed.

Information and Education Process

To develop the strategies for the Information and Education Plan, the following questions were asked:

- Who can affect this issue?
- What actions can people take to address it?
- What do people need to know before they can take action?

The list of activities has been divided into three broad timeline categories: short-term, medium-term, and long-term. The full list of objectives and activities can be found in Table 8. A rough estimate of the cost of the outreach activities outlined in this plan is $20,000, which includes many unforeseeable component costs including staff time and costs for rental and materials.

Target Audiences

2015 Cahokia Creek Watershed Open House.
Photo: HeartLands Conservancy

Key stakeholder audiences that can effect significant changes in watershed health, and who should be reached by outreach and education, include:

- Madison County government departments and elected officials
- Municipal staff, township staff, and elected officials (including Municipal Separate Storm Sewer System (MS4) Co-Permittee Group Members)
- HOAs
- Developers
- Residents with property adjacent to Cahokia Creek and its tributaries
- Residents throughout the watershed
- Farmers and farm groups
- Local engineering clubs and societies

Decision-makers are an important audience that can impact all the other audiences by controlling long-term regulatory actions and policy initiatives. Madison County staff, members of the Technical Committee, and watershed residents can be messengers to reach the decision-maker audience.

Watershed residents at a 2015 open house event.
Photo: HeartLands Conservancy.

Jurisdictions with Phase II MS4s are required to educate their communities on the pollution potential of common activities such as littering, disposing of trash and recyclables, disposing of pet waste, applying lawn chemicals, washing cars, changing motor oil on impervious driveways, and household behaviors like disposing leftover paint and household chemicals.

Some of the HOAs for subdivisions in the area have a shared detention or retention basin. However, these basins are often not covered by a maintenance agreement and after some time will fill up with sediment and deteriorate in function. For new subdivisions, it is important for HOAs to designate funding and a maintenance schedule for management of detention and retention infrastructure. If possible, existing HOAs should adopt maintenance by-laws.

Residents of the watershed often feel a deep connection to their neighborhood and to the land on which they live. Several families in the watershed can trace their ancestry back for generations to European settlers who put down roots in the area in the 1800s. Outreach with messages that emphasize sustaining the rich soil and the landscape for the next generation is likely to resonate with this audience.

Residents with property adjacent to Cahokia Creek and its tributaries will be more willing to make changes to the creek on their property if they understand how it can enhance their property and its value. They should also be made aware of landscaping BMPs along the creek, in terms of beneficial or harmful structures, vegetation, and management practices.

Activities and Tools

Before the plan is complete

Making this watershed plan available to stakeholders, and informing them of its location and contents, is a major component of the Information and Education Plan. To this end, the plan document is available for download on the watershed plan website hosted by HeartLands Conservancy, www.heartlandsconservancy.org/cahokiacreek.php. Printed copies of the Executive Summary and the full plan will also be shared with key watershed stakeholders. Emails to stakeholders engaged in the planning process provided updates on the plan's progress and point to the website for all plan materials.

Landowner/farmer survey

Another key component of the Information and Education Plan is a survey to that was sent out to over 600 landowners in the watershed who own parcels of at least five acres in size. HeartLands Conservancy and Madison County collaborated to send out this survey in 2018 and responses continue to be received. The goal of the survey was to create awareness among landowners about the types of grants that are available to them to implement the BMPs recommended in this watershed plan. This will help in creating a seamless transition between the planning and implementation processes, and will keep momentum going after the plan is complete. See Appendix C for the Landowner/Farmer Survey and its preliminary results.

After the plan is complete

Table 8 outlines each objective followed by recommended strategies that can be implemented to achieve the goals/objectives. For each activity, a target audience, suggested strategies, schedule, lead and supporting agencies, the desired outcomes and issues addressed, and estimated costs to implement is provided. Periodic review of the watershed plan is recommended, with meetings of the plan partners held twice a year at six month intervals. Larger annual meetings may be held to include stakeholders and the public. Plan revision should be considered at five-year intervals.

Table 8. Information and Education Plan recommended programs and strategies. Acronyms used: HLC: HeartLands Conservancy; NGRREC: National Great Rivers Research and Education Center; SWCD: Soil and Water Conservation District; CREP: Conservation Reserve Enhancement Program.

Program	Target Audience(s)	Strategies	Schedule	Lead & Supporting Orgs	Desired Outcomes/Issues Addressed	Est. Cost
Objective 6.1: Identify opportunities to assist local, state, and federal agencies and stakeholders with watershed management and conservation efforts.						
Municipal Outreach	Municipalities	• Connect officials and staff to resources about water quality, best practices for stormwater management, floodproofing, and flood damage repair • Provide sample permitting language, ordinances, and lists of preferred practices • Discuss projects for shortlist of Management Measures on public land • Invite FEMA to present about floodplain management and flood insurance. • Share case studies of conservation development • Present at municipal council and committee meetings • Share sample funding structures for infrastructure changes • Share GIS data and maps from the watershed plan to aid municipal decision-making	Long-Term	Madison County, Macoupin County	• Municipalities adopt green infrastructure practices as part of development plans, permits and ordinances. • Developers follow recommended practices in new and retrofitted developments. • More stormwater is infiltrated, water quality is improved, problematic flooding is reduced, and wildlife habitat is preserved.	Staff time
Watershed Plan Outreach	Watershed residents, developers, municipalities	• Mail or e-mail Executive Summary of the Watershed Plan to municipalities and key stakeholders • Final plan and recommendations on web page. Post progress updates. • Press release announcing completed plan. • Meetings of the watershed plan partners held twice a year, at six month intervals. Possible larger annual meeting to include stakeholders and the public. Plan revision considered at five-year intervals.	Short-Term	Madison County, HLC, other partners	• Majority of watershed residents have knowledge of watershed conditions, possible behavior improvements, and key contacts to get involved and implement projects. • The public begins to alter activities leading to watershed improvement.	Printing: $200

Program	Target Audience(s)	Strategies	Schedule	Lead & Supporting Orgs	Desired Outcomes/Issues Addressed	Est. Cost
Objective 6.2: Connect watershed stakeholders to decision-makers and experts with knowledge about water quality, flooding issues, and solutions.						
Agricultural BMP Workshop	Rural Landowners, Farmers	• Host workshop to inform about and demonstrate recommended BMPs. • Provide information about available funding for BMPs.	Medium-Term	SWCD or HLC	• Farmers and landowners learn about and implement BMPs, as well as funding/ program support.	$500 Materials + Staff time
BMP or Demonstration Project Tour	Watershed residents, developers, municipalities, farmers	• Take participants on a tour of BMPs in this area, such as NGRREC or a farm enrolled in the CRP. • Host a demonstration project event, such as a demonstration on cover crops.	Short-term	Madison County, NGRREC, Farm Bureau, SWCD	• Landowners/stakeholders learn about BMPs and can visualize them on their property. • Increase in landowners implementing BMPs. • Soil erosion is reduced and stormwater is infiltrated.	$1,000 per tour
Public Events Booth	Watershed residents	• Host a booth with materials about the plan, water quality, stormwater management, flooding, and BMPs at public events, such as county fairs, environmental fests, etc.	Ongoing	Madison County, HLC, NGRREC	• Residents understand importance of healthy watershed. • Property owners in flood-prone areas understand and monitor development upstream to prevent flood problems from increasing. • Residents understand the location of floodplains and why they should obtain flood insurance.	$150 per event

Program	Target Audience(s)	Strategies	Schedule	Lead & Supporting Orgs	Desired Outcomes/Issues Addressed	Est. Cost
Objective 6.3: Offer opportunities for education, training, and participation in watershed matters.						
Field Days	Residents, Students, Non Profits, Volunteer Groups	• Organize stream cleanup volunteer opportunities. • Promote volunteer field days through media, social media, and community groups. • "Adopt a Stream" program (similar to Adopt a Road) • HOA Basin/Pond Maintenance Field Days • Coordinate with local governments to host a Stream Awareness Day, to include activities like stream cleanup, water quality testing, or restoration activities.	Medium-Term	HLC, Madison County, Macoupin County, Sierra Club, volunteer groups	• Amount of debris is reduced in streams. • People develop an interest in watershed protection and conservation. • Invasive species are removed and participants learn how to manage invasives on their own. • Leverages in-kind donations for future grants. • Riparian area and habitat conditions improve. • Stormwater storage features are maintained/capacity is increased.	$500 per event
Educational Signs	Residents, Visitors	• Mark watershed boundaries with signs • Post warning signs about littering and illegal dumping • Encourage neighborhoods to create stream names for local streams	Medium-Term	Madison County, Macoupin County	• People better understand the term "watershed." • Littering and illegal dumping is reduced. • Increased awareness of watershed boundaries and streams.	$2,500 (25 signs)
School Projects	Students, Parents, Teachers, Administrators	• Develop age-appropriate project opportunities for schools and colleges such as rain gauge maintenance, rainscaping, wildlife habitat restoration, and geocaching.	Long-term	Schools & colleges, Madison County, Macoupin County	• Students and parents develop interest in watershed protection and conservation. • Teachers and administrators implement related coursework into curriculum.	Equip-ment costs and staff time
Professional Development	Engineers	• Coordinate with engineering organizations to host professional development opportunities.	Long-term	Engineering clubs or societies	• Engineers receive continuing education on green infrastructure and BMPs.	Staff time
Objective 6.4: Develop public recognition programs focused on the watershed plan's goals.						

Program	Target Audience(s)	Strategies	Schedule	Lead & Supporting Orgs	Desired Outcomes/Issues Addressed	Est. Cost
Watershed Protection Awareness	All stakeholders	• Develop messaging based on goals in the watershed plan and disseminate the message using media, social media, collateral (e.g., pencils, bumper stickers, temporary tattoos), and other materials.	Medium-term	Madison County, Macoupin County, HLC	• Increased interest and understanding of watershed protection and the watershed plan's goals. • Water quality and habitat conditions are improved.	Cost of materials and ads

Additional resources

The following resources have been compiled either as other successful campaign examples, or as inspiration for ways to implement the activities identified in Table 9.

Table 9. Resources and tools for activities/campaigns.

Activity / Campaign Examples	**Activity / Campaign Tools and Resources**
"How's My Waterway?"	Quick information about waterways, presented in plain language, from USEPA. http://watersgeo.epa.gov/mywaterway/
Surf Your Watershed	Links and information on streamflow, water quality, and groups working on environmental protection in your watershed, from USEPA. http://cfpub.epa.gov/surf/locate/index.cfm
Storm drain stencilling	Free storm drain stencil kits with directions. http://prairierivers.org/articles/2008/09/stenciling/
Student and citizen monitoring	Illinois RiverWatch and the National Great Rivers Research and Education Center (NGRREC) (http://www.ngrrec.org/riverwatch/). Stream monitoring manual, kit supply lists, monitoring guidelines, identification keys, biotic index calculator, and volunteer training.
Native plants	List of Illinois native plant species: www.wildflower.org/collections
Flooding	How to prepare for and prevent flooding: www.ready.gov/floods
Green Infrastructure	Chicago Wilderness Green Infrastructure Vision and data: www.cmap.illinois.gov/green-infrastructure
River/stream cleanup	American Rivers: www.americanrivers.org/take-action/cleanup. Living Lands and Waters: http://livinglandsandwaters.org/
Sustainable backyards	Sustainable backyard tours in St. Louis: http://www.sustainablebackyardtour.com/grassrootsgreenstl.com/Home.html Urban farm and chicken coop tour in Alton: http://www.sierraclubppg.org/index.cfm?page=2970&eventID=12083&view=event Conservation@Home program The National Wildlife Federation's Certified Wildlife Habitat program

SECTION 7: IMPLEMENTATION

Implementing the recommendations in this watershed plan will take time and commitment from partners and stakeholders. No single stakeholder has all of the financial or technical resources to implement the plan. Successful implementation will require stakeholders working together, using their individual strengths.

Implementation Schedule

The Implementation Schedule provides a timeline for when the recommended Management Measures should be implemented in relationship to each other, allowing reasonable amounts of time for preparing for and transitioning between projects.

The Management Measures are recommended for the short term (one to 10 years), medium term (10 to 20 years), long-term (20+ years), ongoing (for maintenance activities), or as-needed. The "Information and Education Plan" also uses these schedule options. The schedule is arranged to accommodate practices based on practice type, available funds, technical assistance needs, and timeframe for each recommendation. Higher scheduling priority was given to Management Measures that address an issue in a Critical Area, are recommended in greater amounts, have greater eligibility for state and federal programs, and are more widely known among stakeholders (Table 10).

Table 10. Implementation schedule for Management Measures, watershed-wide. Acronyms used: NRCS: Natural Resources Conservation Service; SWCD: Soil and Water Conservation District; NGRREC: the National Great Rivers Research and Education Center; IEPA: Illinois Environmental Protection Agency; IDNR: Illinois Department of Natural Resources; USFWS: U.S. Fish and Wildlife Service; FEMA: Federal Emergency Management Agency; HOA: Homeowners Association; HLC: HeartLands Conservancy.

BMP/Management Measure Recommended	Responsible entity/ entities	Priority	Sources of Technical Assistance	Implementation Schedule
PROGRAMMATIC MANAGEMENT MEASURES				
Conservation Development	Counties, municipalities, developers	Medium	Urban planners, planning resources, HLC	Medium term
Federal and state programs (e.g., CRP)	Landowners/farmers, NRCS, SWCD	Medium	NRCS, SWCD, NGRREC	Medium term
Financial support for stormwater infrastructure	Counties, municipalities	Medium	Regional/statewide community examples	Long term
Flood Damage Prevention Ordinance	Counties, municipalities	Medium	IDNR, FEMA, HLC	Medium term
Green infrastructure incentives	Counties, municipalities, developers	Low	IEPA, HLC, regional/statewide community examples	Long term
In-lieu fee mitigation	Developers, Counties, NGOs	Medium	USACE, IDNR	Ongoing (as development occurs)
Native landscaping ordinance	Counties, municipalities, developers, residents	Low	IDNR, regional/statewide community examples	Long term
Open space and natural area protection	Counties, municipalities, developers	Medium	IDNR, regional/statewide community examples	Medium term
Private sewage monitoring	Counties, residents, some HOAs	Medium	Counties, IEPA	Ongoing
Riparian Buffer Ordinance	Counties, municipalities	Medium	IDNR, HLC	Medium term
Sewage Treatment Plant upgrades	Municipalities, STP operators	Low	IEPA, contractors	Long term
Stream Cleanup Team	Counties, NGOs, residents	Medium	Madison County, NGOs	Long term
Watershed plan supported and integrated into community plans	Counties, municipalities	Low	Watershed plan partners	Short term
Information and Education Plan	Several entities	High	Counties, IEPA, HLC	Ongoing
Monitoring (water quality, flow, etc.)	USGS, IEPA, NGRREC	High	USGS, IEPA, NGRREC, SIUE, SIU-Carbondale	Ongoing

Table 10, continued.

BMP/Management Measure Recommended	Responsible entity / entities	Priority	Sources of Technical Assistance	Implementation Schedule
SITE-SPECIFIC MANAGEMENT MEASURES				
Agricultural Management Measures				
Riparian buffers	Landowners/ farmers	High: Critical Areas	NRCS, Ecological consultant/ contractor	Short term
Wetlands	Landowners/ farmers	High: Critical Areas	USACE, NRCS, Ecological consultant/ contractor	Short term
Animal waste storage/treatment systems	Landowners/farmers	Medium	NRCS, SWCD, consultant/ contractor	Medium term
Bioreactors	Landowners/farmers	Medium	NRCS, SWCD, contractor	Medium term
CNMPs	Landowners/farmers	Medium	NRCS, SWCD, contractor	Medium term
Conservation tillage	Landowners/ farmers	Medium	NRCS, SWCD, contractor	Ongoing
Contour buffer strips	Landowners/ farmers	Medium	NRCS, SWCD, contractor	Medium term
Cover crops	Landowners/ farmers	Medium	NRCS, SWCD, contractor	Ongoing
Grassed waterways	Landowners/ farmers	Medium	NRCS, SWCD, contractor	Medium term
NMPs	Landowners/ farmers	Medium	NRCS, SWCD, contractor	Medium term
Ponds	Landowners/ farmers	Medium	NRCS, SWCD, contractor	Medium term
Terraces	Landowners/ farmers	Medium	NRCS, SWCD, contractor	Long term
Water and sediment control basin	Landowners/ farmers	Medium	NRCS, SWCD, contractor	Medium term
Forest Management Measures				
Forest stand improvement	Landowners, St. Clair County, SAFB, MidAmerica Airport	Low	NRCS, SWCD, IDNR, USFWS, contractor	Long term
Urban Management Measures				
Single property flood reduction strategies	Residents, industry/ commercial	High	FEMA, municipalities, contractors	Short term
Bioswales	Developers, municipalities, HOAs	Medium	SWCD, contractor	Medium term
Dry detention basins, new	Developers, residents, municipalities, HOAs, landowners/farmers	Low	SWCD, contractor	Long term
Wet detention basins, new	Developers, residents, municipalities, HOAs, landowners/farmers	Low	SWCD, contractor	Long term
Detention basin retrofits (native vegetation buffers, etc.)	Municipalities, residents, HOAs, landowners/farmers	Medium	SWCD, contractor	Medium term

Table 10, continued.

BMP/Management Measure Recommended	Responsible entity / entities	Priority	Sources of Technical Assistance	Implementation Schedule
Urban Management Measures (continued)				
Detention basin maintenance (dredging, mowing, burning, invasives, etc.)	Municipalities, residents, HOAs, landowners/farmers	Medium	SWCD, contractor	Ongoing/As needed
Pervious pavement	Developers, municipalities, residents	Low	NGRREC, IEPA	Long term
Rain gardens	Residents, industry/ commercial	Medium	NGRREC, IEPA	Medium term
Rainwater collection	Residents, industry/ commercial	Low	NGRREC, IEPA	Long term
Stormwater and sanitary sewer system maintenance and expansion	Municipalities, HOAs	Medium	Municipalities, IEPA, contractors	Ongoing/As needed
Tree planting (e.g., street trees)	Municipalities, townships, HOAs	Medium	Municipalities, Tree City USA, arborist/contractor	Short term
Stream and Lake Management Measures				
Logjam removal	Landowners/ farmers, residents, municipalities	High	Ecological consultant/ contractor	Short term
Streambank and channel stabilization and restoration	Landowners/ farmers, residents, municipalities	High: Critical Areas	Ecological consultant/ contractor	Short term
Shoreline stabilization	Municipalities, landowners, developers	Medium	Ecological consultant/ contractor	Medium term

Funding Sources

Many opportunities are available to secure funding for the varied and diverse Management Measures recommended in this plan. Entities such as government agencies, non-profit organizations, and companies that provide funding for watershed improvement projects often require that partnerships are in place and funds are leveraged. Table 11 shows some of the potential funding sources for agricultural and stream and lake BMPs recommended in this plan. Table 12 provides a longer list of funding opportunities for management measures in this plan. More detail about these opportunities is included in Appendix G.

Funds may come from existing grant programs run by public agencies, from partner organizations, or through other avenues. Partners may wish to become involved if the project helps to achieve their objectives, is a priority, or provides networking opportunities. Partnerships are also critical for leveraging assets including political support; partners can leverage valuable goodwill and relationships that have the potential to lead to other assistance.

Identifying suitable partners to support a specific project involves assessing the organizations' jurisdictional, programmatic, and fiscal priorities and limitations. Different partners will be attracted to different projects. It is beneficial to all partners to maintain relationships and communication, with each organization denoting a specific staff member responsible for maintaining these connections. One or two enthusiastic individuals or "champions" who believe that engagement in this process is in the interests of all the partners can make a huge difference in the success of a partnership.

Table 11. Funding sources for agricultural and in-stream BMPs from state and federal programs. CRP: Conservation Reserve Program, from USDA. CPP: Conservation Practice Program, from USDA. EQIP: Environmental Quality Incentives Program, from USDA. CSP: Conservation Stewardship Program, from USDA. WRE: Wetland Reserve Easement program, from USDA. SSRP: Streambank Stabilization and Restoration Program, from the State of Illinois. 319: Illinois EPA funding under Section 319 of the Clean Water Act for addressing nonpoint source pollution.

BMP/Management Measure Recommended	Program(s) for which Practices are Eligible
Agricultural Management Measures	
Animal waste storage/treatment systems	EQIP, CPP, CSP, 319
Bioreactors	EQIP, CPP, CSP, 319
Comprehensive Nutrient Management Plans (NMPs)	EQIP, CPP, CSP, 319
Conservation tillage	EQIP (no-till only), CSP, 319
Contour buffer strips	CRP, CPP, EQIP, 319
Cover crops	EQIP, CPP, CSP, 319
Grassed waterways	CRP, EQIP, CPP, 319
Nutrient Management Plans (NMPs)	EQIP, CPP, CSP, 319
Ponds	EQIP (if sole livestock drinking water source), 319
Riparian buffers	CRP, CREP, EQIP, 319
Terraces	EQIP, CPP, 319
Waste storage structure	EQIP, 319
Water and sediment control basin	EQIP, CPP, CRP (as part of selected other structures), 319
Wetlands	CRP, CREP, WRE, 319
Forest Management Measures	
Forest stand improvement	EQIP, CRP, CPP, CSP, 319
Stream and Lake Management Measures	
Shoreline restoration	EQIP, 319
Streambank & channel restoration	SSRP, 319

Table 12. Funding sources for management measures recommended. See Appendix G for more information.

Funding Sources	**Grant Programs**	**Currently Funded** (As of June 2018)
State/Federal Government		
Illinois Environmental Protection Agency	Section 319(h) Nonpoint Source Pollution Control Financial Assistance Program	Yes
	State Revolving Fund Loan Program, including: • Public Water Supply Loan Program • Water Pollution Control Loan Program	Yes
	Streambank Cleanup and Lakeshore Enhancement Grants	No. Funding may be reinstated in the future.
Illinois Department of Agriculture	Streambank Stabilization and Restoration Program	No. Funding may be reinstated in the future.
	Conservation Practice Program	No. Funding may be reinstated in the future.
	Sustainable Agriculture Grant Program	Yes
Illinois Department of Natural Resources	Urban Flood Control Program	Yes
Illinois Emergency Management Agency	Flood Mitigation Assistance Program	Yes
	Pre-Disaster Mitigation Program	Yes
	Hazard Mitigation Grant Program	Yes
	Severe Repetitive Loss Program	Yes
Illinois Department of Commerce and Economic Opportunity	Illinois Development Assistance Program	Yes
U.S. Army Corps of Engineers	Continuing Authorities Program *(not a grant)*	Yes
	Flood Plain Management Services (FPMS) Program *(not a grant)*	Yes
	Planning Assistance to States (PAS) Program *(not a grant)*	Yes
U.S. Department of Housing and Urban Development	National Disaster Resilience Competition	No. Funding may be reinstated in the future.
U.S. Environmental Protection Agency	USEPA Source Reduction Assistance Grant Program	Yes
	Environmental Education Grants Program	Yes
	Environmental Justice Small Grants Program	Yes
	Urban Waters Small Grants Program	No. Funding may be reinstated in the future.
	Technical assistance from EPA Regions for: • Green stormwater management • Protection of healthy watersheds	Yes
U.S. Department of Agriculture	Conservation Reserve Program	Yes
	CRP—Grasslands	Yes
	Conservation Reserve Enhancement Program (CREP)	Yes
	Agricultural Conservation Easement Program, including: Agricultural Land Easements and Wetland Reserve Easements	Yes
	Environmental Quality Incentive Program	Yes
	Conservation Stewardship Program	Yes
	Healthy Forests Reserve Program	Yes
	Regional Conservation Partnership Program	Yes
	Conservation Innovation Grants	Yes
	Water and Waste Water Disposal Loan and Grant Program	Yes
	Forest Legacy Program	Yes
U.S. Fish and Wildlife Service	Partners for Fish and Wildlife Program	Yes

Table 12, continued. Funding sources for management measures recommended.

Funding Sources	**Grant Programs**	**Currently Funded** (As of June 2018)
Non-Governmental Organizations (non-profit organizations, private foundations/companies, other) that support watershed management efforts.		
Ducks Unlimited	Living Lake Initiative	N/A
Pheasants Forever	N/A	N/A
Trees Forever	Working Watersheds: Buffers and Beyond	Yes
The Nature Conservancy	N/A	N/A
The National Fish and Wildlife Foundation	N/A	N/A
The National Wildlife Federation	N/A	N/A
Water Environment Federation	N/A	N/A
Coca-Cola Foundation	Community Support Program	Yes
Illinois American Water	2018 Environmental Grant Program	Yes
In-Lieu Fee Mitigation Program	N/A	N/A
McKnight Foundation	N/A	Yes
Walton Family Foundation	N/A	Yes

Monitoring Timeline

As funding allows, the collection and analysis of monitoring data should be expanded in the watershed. For example, sampling at Cahokia Creek and its tributaries—for example, at the outflow of HUC14 subwatersheds—would provide baseline data for a better understanding of watershed-wide pollutant contributions. This data would also help calibrate and ground-truth the pollutant modeling, such as the STEPL, used in this plan.

Opportunities for continuing or expanding the monitoring program should be evaluated in order to further assess water quality conditions throughout the watershed, the causes and sources of pollution, the impact of nonpoint source pollution, and changes in water quality related to implementation of the watershed plan as well as social indicator data related to the plan's goals and objectives. A monitoring plan was developed with the NGRREC, a project partner with the expertise and capabilities to carry out this monitoring (Appendix F). Monitoring can be conducted on a three- to five-year cycle through the year 2030 (Table 13). Quality Assurance Project Plans (QAPP) should be developed for those monitoring opportunities that are selected for implementation in support of the watershed plan.

Table 13. Water quality monitoring timeline. Monitoring activities likely to be conducted primarily by NGRREC and Illinois RiverWatch. Acronyms: TSS: Total Suspended Solids. TP: Total Phosphorus. TN: Total Nitrogen. SRP: soluble reactive phosphate.

	2019				2020				2021				2022-2030
Monitoring Activity	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	
Develop Standard Operating Procedures for collection and laboratory analysis of samples	■												
Sampling near USGS gage site 05594800													
Install continuous monitoring equipment		■											
Monitor TSS, TP, TN		■	■	■	■	■	■						
Evaluate and adjust continuous monitoring plan								■					
Monitor TSS, TP, and TN based on revised plan								■	■	■	■	■	■
Discrete sampling at the HUC14 level													
Identification of HUC14 discrete sampling sites	■												
Monitor TSS, TP, TN, SRP, NO3-N		■	■	■	■	■	■						
Evaluate and adjust discrete monitoring plan								■					
Continue discrete monitoring based on revised plan								■	■	■	■	■	■

MEASURING SUCCESS

The success of the watershed plan can be measured by tracking several indicators at several milestone points in time. Success can be documented in terms of:

- Plan effectiveness: the absolute improvements seen in water quality, flooding, habitat, and other plan goals; and
- Plan implementation: the number and extent of Management Measures implemented, understood as a proxy for absolute improvements.

For both of these dimensions, measurement indicators were identified that would establish the progress made towards each goal of the plan. Interim milestones were established for each indicator so that improvements in effectiveness and extent of implementation could be tracked. Rather than waiting several years to measure the effectiveness of the plan, measuring ongoing improvement allows for more dynamic, directed, and effective implementation.

Measurement indicators

Measurement indicators were established to determine whether and how much progress is being made towards achieving each of the goals of the plan (Table 14).

Interim milestones

Milestones represent time periods or deadlines for meeting watershed plan objectives. Tracking milestones allows for adaptive management; if milestones are not being met, the most current information can be used to implement a course correction or a plan update.

Meetings of the watershed plan partners should be held twice a year, at six month intervals, in order to assess the progress of the plan and address deficiencies in its implementation. The partners may also hold a larger annual meeting to which stakeholders and the public will be invited. The need for a plan revision will be assessed at five-year intervals. When deficiencies in plan implementation are identified, the plan's timeline and focus should be revised to address the issues. The watershed planning process of issue identification, goal-setting, and management measure recommendation should be reiterated, paying special attention to current data and new data sources.

A set of Progress Report Cards was developed for the watershed with milestones for the short-term (one to 10 years; 2018-2028), medium-term (10 to 20 years; 2028 to 2038), and long-term (20+ years; 2038+) timeframes. The milestones and scorecard can be used to identify and track plan implementation and effectiveness. Checking in on the measurement indicators at the appropriate milestones helps watershed partners to make corrections as necessary and ensure that progress is being made towards achieving the plan's goals.

The Progress Report Cards provide for each goal:

1. Summaries of current conditions
2. Measures of progress (Measurement Indicators)
3. Milestones for short-, medium-, and long-term timeframes
4. Sources of data required to evaluate milestones
5. Notes section

Grades for each milestone term should be calculated using the following scale: [adapt/simplify based on short, medium, long term milestones?]

Grade	Percentage milestones met
A	80-100%
B	60-79%
C	40-59%
Fail	<40%

Lack of progress can be demonstrated where water quality monitoring results show no improvement, new environmental problems, lack of technical assistance, or lack of funds. These factors should be explained in the Notes section of the scorecard.

The Progress Report Cards should be used at every biannual meeting of the watershed plan partners, and should be fully filled out and evaluated every five years to determine if sufficient progress is being made and whether remedial actions are needed. The Progress Report Cards can be found in Appendix H.

Table 14. Measures of success and measurement indicators for each watershed plan goal. Specific interim milestones incorporating these measurement indicators can be found in the Progress Report Cards in Appendix H.

Goal(s) Addressed	Measure of Success	Measurement Indicators
All goals	Projects and Practices Implemented: BMPs to manage stormwater runoff, including those that encourage infiltration, clean water of pollutants, and replenish groundwater.	Number and extent of Management Measures (BMPs) implemented on public and private land, wherever such data is available.
	Financial and Technical Assistance Secured: Sources of funding and technical assistance committed towards plan implementation.	Number of funding sources secured for plan implementation. Number of partnerships developed that provide technical and/or financial assistance.
Surface Water Quality	Use Impairments: The reduction of use impairments as defined by IEPA.	Removal of Cahokia Creek, Cahokia Diversion Holiday Shores (Holiday Lake), and Holiday Shores Creek from the IEPA 303(d) list.
	Pollutant Loads: A decrease in pollutants observed through water quality monitoring.	Concentrations and loads of in-stream pollutants including phosphorus and sediment (assessed by monitoring), to measure against plan target reductions.
	Point-source Pollution Facility Upgrades: Upgrades to facilities such as sewage treatment plants and others that require a NPDES permit.	Nutrient removal technologies incorporated into upgrades of wastewater treatment plants in the watershed. Measured pollutant loads in effluent.
	Connecting to Public Sewers: Connection of new and existing properties to public sewers so that individual septic systems are no longer needed.	Percentage of new development projects with private sewer. Number of existing on-site treatment systems connected to public sewers.
	Inspection and Maintenance of On-Site Waste Systems: Local government codes and programs for on-site treatment systems.	Number and extent of local ordinances requiring regular inspection and maintenance of on-site sewage systems. Number of county/municipal programs inspecting more frequently than is complaint-driven.
Surface Water Quality / Flooding and Flood Damage	Wetlands: Restoring and creating wetlands, which are very effective at storing and filtering stormwater.	Number and acreage of wetland construction/restoration, enhancement, and protection.
Flooding and Flood Damage	Stream Discharge: Moderate peak flows and adequate minimum stream flows.	Stream flow data from the USGS gauge on Cahokia Creek, plus flow data collected from monitoring at other HUC14 locations. Data correlated with rainfall.
	Flood Protection Ordinances: Enaction of local ordinances to restrict construction in floodplains and floodprone areas.	Number and extent of flood damage prevention ordinances, riparian buffer ordinances, and other actions by local governments to restrict construction in floodplains and riparian areas.
Environmentally Sensitive Development Practices	Infiltration: Practices allowing stormwater to infiltrate to groundwater.	Area of impervious surfaces in new development (see NLCD Percent Developed Impervious Surface dataset) and number of detention basins or other stormwater infrastructure constructed and retrofitted to allow more infiltration.

Table 14, continued.

Goal(s) Addressed	Measure of Success	Measurement Indicators
Environmentally Sensitive Development Practices	Land Conservation: Preservation of sensitive lands.	Acreage of land enrolled in conservation easements including CRP, and number of new development proposals using Conservation Development design to protect natural features.
	Green Infrastructure Implementation: Encouragement of green infrastructure and native landscaping, including incentives for developers that design for or implement it.	Number of counties/municipalities implementing green infrastructure incentives, e.g., flexible regulation implementation, fee waivers, tax abatement, and streamlined development review process. Number of ordinance changes allowing/encouraging native landscaping.
	In-Lieu Fee Mitigation: Program that allows and incentivizes wetland and streambank restoration in impactful locations	Number of acres wetland restored and number of feet streambank restored under in-lieu fee mitigation program.
Flooding and Flood Damage/ Fish and Wildlife Habitat	Riparian Buffers: Vegetated, undeveloped buffers adjacent to waterways.	Area and length of restored riparian corridors. Number and area of conservation easements for riparian areas. Number and extent of riparian buffer ordinances adopted by local government.
Fish and Wildlife Habitat	Improvements to Fish and Wildlife Habitat: Protection and restoration of stream areas for fish and wildlife.	Macroinvertebrate sampling results (diversity and stream health indicators) from Illinois RiverWatch volunteers and fish sample data collected by the Illinois Natural History Survey.
	Stream Cleanup Efforts: Programs with funding and resources for stream cleanup.	Number of programs and participants for stream cleanup activities in the watershed.
Flooding and Flood Damage/ Organizational Frameworks	Financial Support for Stormwater Infrastructure: Funding sources directed to infrastructure maintenance and upgrades.	Number of counties/municipalities with dedicated funding for stormwater infrastructure, e.g., a Stormwater Utility. Dollar amount of revenue.
Organizational Frameworks/ Environmentally Sensitive Development Practices	Protection through Policy: Several aspects of local policy can protect watershed resources, including ordinances and agreements.	Number of watershed partners adopt and/or support (via a resolution) this plan as a "guidance document." Number and extent of municipal ordinances that support: stormwater, flood management, green infrastructure, wetlands protection (e.g., in-lieu fee), and native landscaping.
	Open Space and Natural Area Protection and Management: protection of sensitive natural areas/open space, creation of naturalized stormwater management systems, and long-term management of those features.	Number of new and redevelopment projects protecting sensitive natural areas/open space and creating naturalized stormwater systems. Area of land donated to a public agency/conservation organization for long-term management. Number of HOAs with rules about management of the natural areas in their bylaws.
Education & Outreach	Public Involvement: Public awareness, understanding and action, which affect decisions in watersheds where individuals own most of the land.	Number of people reached by and involved in outreach efforts related to this Watershed Plan. Percent of county residents who know which watershed they live in (survey).
	Education: Effective materials to encourage behavior changes for a healthier watershed.	Percent of attendees at watershed-related presentations and other events, and percent who commit to action or follow-up with the county. Percent of schools that incorporate a watershed-based project or curriculum.

Glossary of Terms

Terms found in the Watershed Plan and Appendices:

100-year floodplain: Land adjoining the channel of a river, stream, watercourse, lake, or wetland that has been or may be inundated by floodwater during periods of high water that exceed normal bank-full elevations. The 100-year floodplain has a probability of 1% chance per year of being flooded.

303(d) list of impaired waters: The federal Clean Water Act requires states to submit a list of impaired waters to the U.S. Environmental Protection Agency for review and approval every two years using water quality assessment data from the Section 305(b) Water Quality Report. These impaired waters are referred to as "303(d) impaired waters." States are then required to establish priorities for the development of Total Maximum Daily Load analyses for these waters and a long-term plan to meet them.

305(b): The Illinois 305(b) Water Quality Report is a water quality assessment of the state's surface and groundwater resources compiled by the Illinois Environmental Protection Agency and submitted as a report to the U.S. Environmental Protection Agency as required under Section 305(b) of the Clean Water Act.

Agricultural Conservation Easement Program (ACEP): Provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits.

Animal Feeding Operations (AFO): Agricultural operations where animals are kept and raised in confined situations. Feed is brought to the animals rather than the animals grazing or otherwise seeking feed in pastures.

Agricultural Conservation Planning Framework (ACPF): A GIS model developed by USDA.

Aquifer: A layer of permeable rock, sand, or gravel through which groundwater flows, containing enough water to supply springs and wells.

Base flow: The flow to which a perennially flowing stream reduces during the dry season. It is commonly supported by groundwater seepage into the channel.

Bedrock: The solid rock that lays beneath loose material, such as soil, sand, clay, or gravel.

Best Management Practices (BMPs): See Management Measures.

Biodiversity: The variety of organisms (plants, animals and other life forms) that includes the totality of genes, species and ecosystems in a region.

Center for Watershed Protection (CWP): Non-profit 501(c)3 corporation founded in 1992 that provides government entities, watershed organizations, and others around the country with the tools to protect streams, lakes, rivers, and watersheds.

Channelization: The artificial straightening, deepening, or widening of a stream or river to accommodate increased stormwater flows, typically to increase the amount of adjacent developable land for urban development, agriculture, or navigation.

Comprehensive Nutrient Management Plans (CNMPs): A strategy for farmers to integrate livestock waste management into overall farm operations.

Conservation Development: A development designed to protect open space and natural resources for people and wildlife while at the same time allowing building to continue. See Appendix E for more detail.

Conservation easement: The transfer of land use rights without the transfer of land ownership. Conservation easements can be attractive to property owners who do not want to sell their land now, but would support perpetual protection from further development. Conservation easements can be donated or purchased.

Conservation Practice Program (CPP): Illinois Department of Agriculture program implemented by the Soil and Water Conservation Districts (SWCDs) in Illinois. Cost-share funds are available through the SWCDs for various conservation practices including Filter Strips, Grassed Waterways, No-Till, and Terraces. See Appendix E for more detail.

Conservation Reserve Enhancement Program (CREP): The country's largest private land conservation program, administered by the Farm Service Agency (FSA). An offshoot of the Conservation Reserve Program (CRP), CREP compensates farmers and landowners for removing environmentally sensitive land from production and implementing conservation practices. See Appendix E for more detail.

Conservation Reserve Program (CRP): A land conservation program administered by the FSA, which provides a yearly rental payment for farmers who remove environmentally sensitive land from agricultural production and plant species that will improve environmental health and quality. See Appendix E for more detail.

Conservation Stewardship Program (CSP): U.S. Department of Agriculture program that helps producers maintain and improve existing conservation systems and implement additional activities to address priority resources concerns. See Appendix E for more detail.

Conservation tillage: Any method of soil cultivation that leaves the previous year's crop residue (such as corn stalks or wheat stubble) on fields before and after planting the next crop, to reduce soil erosion and runoff.

Contour Buffer Strip: Strips of perennial vegetation that alternate with strips of row crops on sloped fields. The strips of perennial vegetation, consisting of adapted species of grasses or a mixture of grasses and legumes, slow runoff and remove from it sediment, nutrients, pesticides, and other contaminants. See Appendix E for more detail.

Conveyance: The act or means of carrying or transporting water from place to place.

Cover crops: Crops that protect soil from erosion by covering the ground in the fall and sometimes in the spring. See Appendix E for more detail.

Designated use: Appropriate use of a waterbody as designated by states and tribes. Designated uses are identified by considering the use, suitability, and value of the water body for public water supply; protection of fish and wildlife; and recreational, agricultural, industrial, and navigational purposes. Determinations are based on its physical, chemical, and biological characteristics; geographical setting and scenic qualities; and economic considerations.

Detention basin: A man-made structure for the storage of stormwater runoff with controlled release during or immediately following a storm. Wet detention basins are also known as retention ponds. See Appendix E for more detail.

Digital Elevation Model (DEM): Grid of elevation points used to produce elevation maps.

Discharge (streamflow): The volume of water passing through a channel over a given time period, usually measured in cubic feet per second.

Dissolved oxygen (DO): The amount of oxygen in water, usually measured in milligrams/liter.

East-West Gateway Council of Governments (EWG): The metropolitan planning organization (MPO) for the 4,500 square miles encompassed by the City of St. Louis; Franklin, Jefferson, St. Charles, and St. Louis counties in Missouri; Madison, Monroe, and St. Clair counties in Illinois. EWG is a forum for local governments of the bi-state St. Louis area to work together to solve problems that cross jurisdictional boundaries.

Environmental Quality Incentives Program (EQIP): A program that provides financial and technical assistance to agricultural producers, helping them to plan and implement conservation practices that address natural resource concerns and improve natural resources on agricultural land and non-industrial private forestland. See Appendix E for more detail.

Erosion: The displacement of soil particles on land surfaces due to water or wind action.

Federal Emergency Management Agency (FEMA): Government agency within the Department of Homeland Security that responds to, plans for, coordinates recovery from, and mitigates against natural and man-made disasters and emergencies, including significant floods.

Flash flood: A rapid rise of water along a stream or low-lying area, usually produced when heavy localized precipitation falls over an area in a short amount of time. Flash floods are considered the most dangerous type of flood event because they offer little or no warning time and their capacity for damage, including the capability to induce mudslides.

Flood Damage Prevention Ordinance: Ordinance that imposes certain rules and limitations on development in floodplains in order to reduce the risk of flood damage. See Appendix E for more detail.

Geographic Information System (GIS): A computer-based approach to interpreting maps and images and applying them to problem-solving.

Geology: The scientific study of the structure of the Earth, focused primarily on the composition and origins of rocks, soil, and minerals.

Grassed waterways: Vegetated channels designed to prevent gully erosion by slowing the flow of surface water with vegetation. See Appendix E for more detail.

Green infrastructure: Green infrastructure can be defined as our region's natural resources, including open space, woodlands, wetlands, gardens, trees, and agricultural land. It can also be defined as the nodes and corridors of vegetation over the region, or the site-scale structures and landscaping that recreate natural processes. See Appendix E for more detail.

Groundwater recharge: Primary mechanism for aquifer replenishment which ensures future sources of groundwater for commercial and residential use.

Headwaters: Upper reaches of streams and tributaries in a watershed.

HUC or HUC Code: A Hydrologic Unit Code (HUC) that refers to the division and subdivision of U.S. watersheds. The hydrologic units are arranged or nested within each other, from the largest geographic area (regions) to the smallest geographic area (cataloging units). Where two digits follow "HUC," they refer to the length of the HUC code. For example, "HUC14" refers to the lowest-nested subwatershed level with a 14-digit long code, such as HUC 07140204050101.

Hydric soil: Soil units that are wet frequently enough to periodically produce anaerobic conditions, thereby influencing the species composition and/or growth of plants on those soils.

Hydrologic Soil Groups (HSG): Soil classifications from the Natural Resource Conservation Service based on the soil's runoff potential. The four Hydrologic Soils Groups are A, B, C and D. A's generally have the smallest runoff potential and D's the greatest.

Hydrology: The scientific study of the properties, distribution, and effects of water in relation to the earth's surface, in the soil and underlying rocks, and in the atmosphere.

Hydrophytic vegetation: Plant life growing in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content; one of the indicators of a wetland.

Illinois Department of Natural Resources (IDNR): State government agency established to manage, protect, and sustain Illinois' natural and cultural resources, provide resource-compatible recreational opportunities, and promote natural resource-related issues for the public's safety and education.

Illinois Environmental Protection Agency (IEPA): State government agency established to safeguard environmental quality so as to protect health, welfare, property, and quality of life in Illinois.

Illinois Nature Preserves Commission (INPC): Commission responsible for protecting Illinois Nature Preserves, state-protected areas that are provided the highest level of legal protection, and have management plans in place.

Illinois Pollution Control Board (IPCB): An independent agency created in 1970 by the Environmental Protection Act. The Board is responsible for adopting Illinois' environmental regulations and deciding contested environmental cases.

Impervious Cover Model: Simple urban stream classification model based on impervious cover and stream quality. The classification system contains three stream categories (sensitive, impacted, and non-supporting) based on the percentage of impervious cover.

Impervious cover/surface: An area covered with solid material or that is compacted to the point where water cannot infiltrate underlying soils (e.g., parking lots, roads, houses).

In-lieu fee: A payment made to a natural resource management entity for implementation of projects for wetland or other aquatic resource development, in lieu of (in place of) on-site restoration or site mitigation. See Appendix E for more detail.

Infiltration: Rainfall or surface runoff that moves downward from the surface into the subsurface soil.

Loess: An unstratified loamy deposit, usually buff to yellowish brown, chiefly deposited by the wind and thought to have formed by the grinding of glaciers.

Logjam: Any woody vegetation, with or without other debris, which obstructs a stream channel and backs up stream water like a natural dam.

Low Impact Development: Comprehensive land planning and engineering design approach with a goal of maintaining and enhancing the pre-development hydrologic regime of urban and developing watersheds.

Macroinvertebrates (aquatic): Invertebrates that can be seen by the unaided eye (macro). Most benthic invertebrates in flowing water are aquatic insects or the aquatic stage of insects, such as mayfly nymphs and midge larvae. They also include organisms such as leeches, clams, and worms. The presence of benthic (bottom-dwelling) macroinvertebrates that are intolerant of pollutants is a good indicator of good water quality.

Management Measures: Also known as Best Management Practices (BMPs). Methods or techniques that are the most effective or practical means to achieving objectives including improving water quality, reducing flooding, and improving fish and wildlife habitat. These practices include non-structural practices such as site planning and design aimed to reduce stormwater runoff and avoid adverse development impacts, or structural practices that are designed to store or treat stormwater runoff to mitigate flood damage and reduce pollution.

Marsh: An area of soft, wet, low-lying land, characterized by grassy vegetation and often forming a transition zone between water and land.

Missouri Resource Assessment Partnership (MoRAP): Program at the University of Missouri which develops, analyzes, and delivers geospatial data for natural and cultural resource management. MoRAP partnered with the East-West Gateway Council of Governments to deliver mapped data on wetland importance and wetland restoration value.

Mitigation: Measures taken to eliminate or minimize damage from development activities such as construction in wetlands.

Municipal Separate Storm Sewer System (MS4): A system that transports or holds stormwater, such as catch basins, curbs, gutters, and ditches, before discharging into local waterbodies.

National Hydrography Dataset (NHD): Digital database of surface water features, such as lakes, ponds, streams, and rivers. The NHD is used to make hydrology and watershed boundary maps.

National Pollutant Discharge Elimination System (NPDES) Phase II: Permit program authorized by the Clean Water Act requiring smaller communities and public entities that own and operate a Municipal Separate Storm Sewer System (MS4) to apply and obtain a NPDES permit for stormwater discharges to surface water. Permittees must develop, implement, and enforce a stormwater program designed to reduce the discharge of pollutants from the MS4 to the maximum extent practicable. Individual homes that use a septic system, are connected to a municipal system, or do not have a surface discharge do not need an NPDES permit. The NPDES permit program is administered by authorized states. In Illinois, the Illinois EPA administers the program.

National Land Cover Database (NLCD): Database with mapped land cover categories produced by the Multi-Resolution Land Characteristics (MRLC) Consortium with land cover classifications based on Landsat satellite data and ancillary data sources such as topography, census and agricultural statistics, soil characteristics, wetlands, and other land cover maps.

Native landscaping: A landscape that contains native plants or plant communities that are indigenous to a particular region.

Natural Resources Conservation Service (NRCS): Government agency under the U.S. Department of Agriculture (USDA) that provides technical assistance to landowners and land managers.

Nitrogen: A colorless, odorless, unreactive gas that constitutes about 78% of the earth's atmosphere. The availability of nitrogen in soil is important for plant growth and ecosystem processes, and nitrogen is used in many fertilizers.

No-till: No-till farming (also called zero tillage) is a way of growing crops or pasture from year to year without disturbing the soil through tillage. It uses herbicides to control weeds and results in reduced soil erosion and the preservation of soil nutrients. See Appendix E for more detail.

Nonpoint source pollution (NPS pollution): Any source of water pollution that is not from a discrete outflow point. Instead, NPS pollution comes from diffuse sources and is carried into waterways with runoff from the land. Pollutants can include oil, grease, sediment, and nutrients in excess fertilizer.

Nutrients: Substances needed for the growth of plants and animals, such as phosphorous and nitrogen. The addition of too many nutrients to a waterway causes problems to the aquatic ecosystem by promoting nuisance vegetation including excess algae growth.

Nutrient Management Plans (NMPs): A strategy for obtaining the maximum return from on- and off-farm fertilizer resources in a manner that protects the quality of nearby water resources.

Overland flood: Flooding that occurs when rainfall collects on saturated or frozen ground. When surface runoff cannot find a channel, it may flow out over a large area at a somewhat uniform depth in sheet flow or collect in depressions as ponding.

Partners: Key watershed stakeholders who take an active role in the watershed management planning process and implementing the watershed plan.

Pervious pavement: Pavement type (also referred to as porous or permeable pavement) that allows water to infiltrate to the soil or a storage area below. See Appendix E for more detail.

Phosphorus: A nonmetallic element that occurs widely in many combined forms especially as inorganic phosphates in minerals, soils, natural waters, bones, and teeth and as organic phosphates in all living cells.

Point source pollution: Pollution that discharges in water from a single, discrete source, such as an outfall pipe from an industrial plant or wastewater treatment facility.

Pollutant load: The amount of any pollutant deposited into waterbodies from point source discharges, combined sewer overflows, and/or stormwater runoff.

Private sewage: Sewage systems that are the responsibility of the owners or occupiers of the properties connected to them. These systems can include septic tanks, lagoons, and leach fields.

Rain garden: Vegetated depression that cleans and infiltrates stormwater from rooftops and sump pump discharges, typically planted with deep-rooted native wetland vegetation. See Appendix E for more detail.

Rainwater Harvesting: The accumulation and storing of rainwater for reuse before it reaches an aquifer. See Appendix E for more detail.

Retention basin: A man-made structure with a permanent pool of water for the storage of stormwater runoff. Also known as a wet pond, or wet detention basin.

Retrofit: Modifications to improve problems with existing stormwater control structures such as detention basins and conveyance systems such as ditches and storm sewers. See Appendix E for more detail on detention basin retrofits.

Riparian: The riverside or riverine environment adjacent to the stream channel. For example, riparian, or streamside, vegetation grows next to (and over) a stream.

Riparian Buffer: An undisturbed naturally vegetated strip of land adjacent to a body of water, such as a stream or lake. Riparian buffers have water quality, flooding, and habitat benefits.

Riverine flood: The gradual rise of water in a river, stream, lake, reservoir, or other waterway that results in the waterway overflowing its banks. This type of flooding generally occurs when storm systems remain in the area for extended periods of time, when winter or spring rains combine with melting snow to create higher flows, or when obstructions, such as logjams, block normal water flow.

Runoff: The portion of precipitation that does not infiltrate into the ground and is discharged into streams by flowing over the ground.

Sediment: Soil particles that have been transported from their natural location by wind or water action.

Special Flood Hazard Area: The area inundated during the base flood is called the Special Flood Hazard Area or 100-year floodplain.

Special Service Area (SSA): Special taxing districts in counties and municipalities that are established by ordinance. Taxes from SSAs are used to pass on the costs of items such as streets, landscaping, water lines, and sewer systems in new development to homeowners who reside within it. See Appendix E for more detail.

Stakeholders: Individuals, organizations, or enterprises that have an interest or a share in a project.

Stream reach: A stream segment having fairly homogenous hydraulic, geomorphic, riparian cover, and land use characteristics.

Streambank stabilization: Techniques used for stabilizing eroding streambanks.

Streambank Stabilization and Restoration Program (SSRP): Illinois Department of Agriculture (IDOA) program designed to demonstrate effective streambank stabilization at demonstration sites using inexpensive vegetative and bio-engineering techniques. See Appendix E for more detail.

Subwatershed: Any drainage basin within a larger drainage basin or watershed.

Terrace: Ridges and channels constructed across the slope of a field to intercept runoff water, reducing soil erosion. See Appendix E for more detail.

Threatened and endangered species: A "threatened" species is one that is likely to become endangered in the foreseeable future. An "endangered" species is one that is in danger of extinction throughout all or a significant portion of its range.

Topography: The relative elevations of a landscape describing the configuration of its surface.

Total Maximum Daily Load (TMDL): The highest amount of discharge of a particular pollutant that a waterbody can handle safely per day.

Total Suspended Solids (TSS): The organic and inorganic material suspended in the water column greater than 0.45 micron in size.

U.S. Army Corps of Engineers (USACE): Federal group of civilian and military engineers and scientists that provide services for planning, designing, building, and operating water resources and other Civil Works projects. These include flood control and environmental protection projects.

U.S. Department of Agriculture (USDA): Federal government agency that provides leadership on food, agriculture, natural resources, rural development, nutrition, and related issues. The USDA administers several programs to encourage land conservation and agricultural best practices.

U.S. Environmental Protection Agency (USEPA): Federal agency whose mission is to protect human health and the environment. USEPA enforces the Clean Water Act, among other laws.

U.S. Fish and Wildlife Service (USFWS): Federal government agency within the U.S. Department of the Interior dedicated to the management of fish and wildlife and their habitats.

U.S. Geological Survey (USGS): Federal government agency established with the responsibility to provide reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect quality of life.

Urban runoff: Runoff that runs over urban developed surfaces such as streets, lawns, and parking lots, entering directly into storm sewers rather than infiltrating the land upon which it falls.

Wastewater Treatment: Process that treats wastewater to alter its characteristics such as its biological oxygen demand, chemical oxygen demand, pH, etc. in order to meet effluent or water discharge standards.

Water and Sediment Control Basin (WASCOB): Small earthen ridge-and-channel or embankment built across a small watercourse or area of concentrated flow in a field. See Appendix E for more detail.

Watershed: The area of land that contributes runoff to a single point on a waterbody (in this case, the outlet of Silver Creek from Madison County to St. Clair County).

Watershed-Based Plan: A strategy and work plan for achieving water resource goals that provides assessment and management information for a geographically defined watershed, including the analysis, actions, participants, and resources related to development and implementation of the plan.

Wetland: Lands that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, under normal conditions, a prevalence of vegetation adapted for life in saturated soil conditions (known as hydrophytic vegetation). A wetland is identified based upon the three attributes: 1) hydrology, 2) hydric soils, and 3) hydrophytic vegetation. A wetland is considered a subset of the definition of the Waters of the United States.

Wetland Reserve Easement (WRE) program: Component of the Agricultural Conservation Easement Program (ACEP) that provides technical and financial assistance to restore, protect, and enhance wetlands. See Appendix E for more detail.

Cahokia Creek Watershed Planning

HEARTLANDS CONSERVANCY

Investing In The Nature Of Southwestern Illinois

MADISON COUNTY PLANNING & DEVELOPMENT

MADISON COUNTY ILLINOIS SEPTEMBER 14, 1812

MADISON COUNTY STORMWATER MANAGEMENT

Appendix A : Watershed Resources Inventory for Indian Creek-Cahokia Creek

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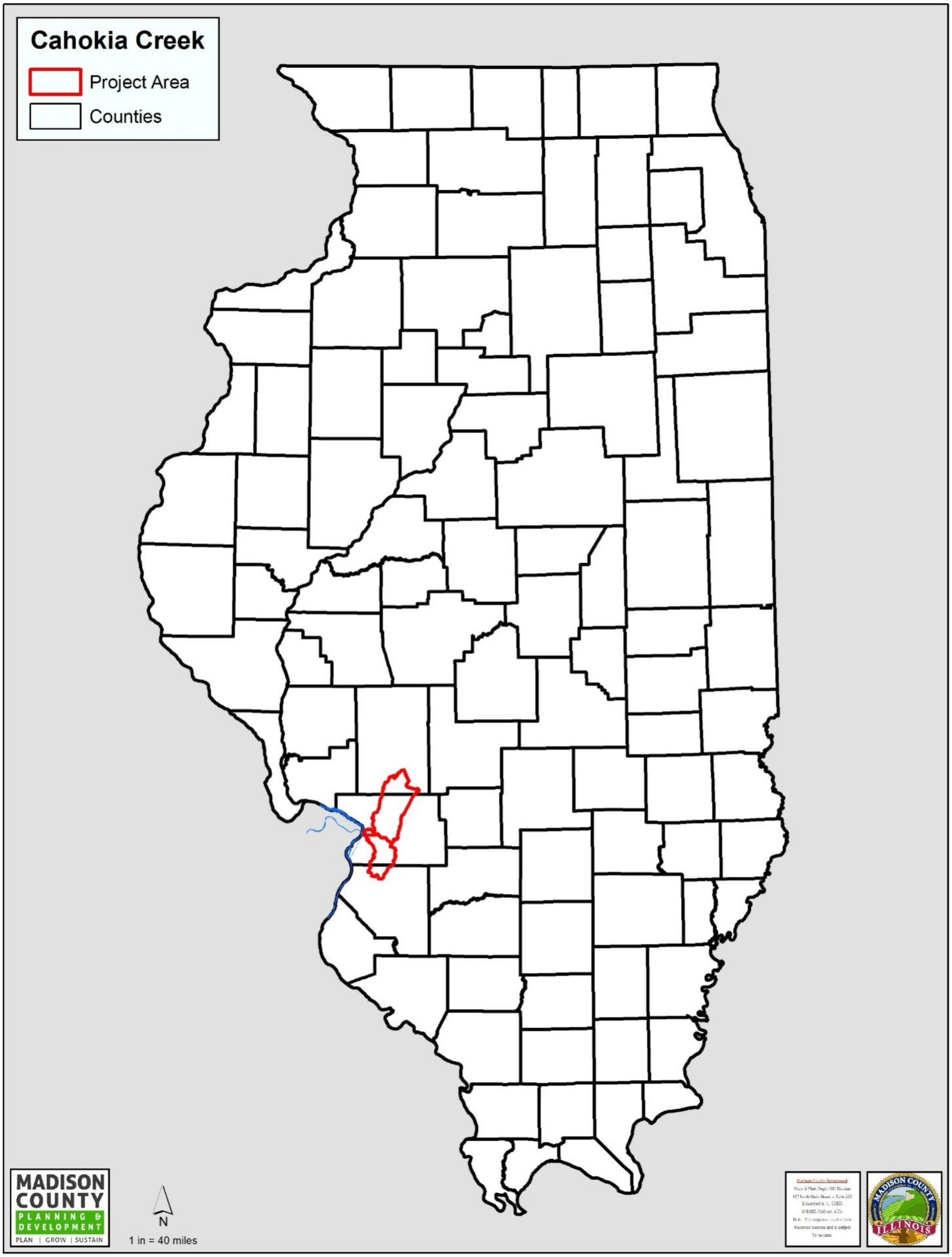
Figure A.1: Location of the Indian-Canteen-Cahokia Creek watershed in the State of Illinois.



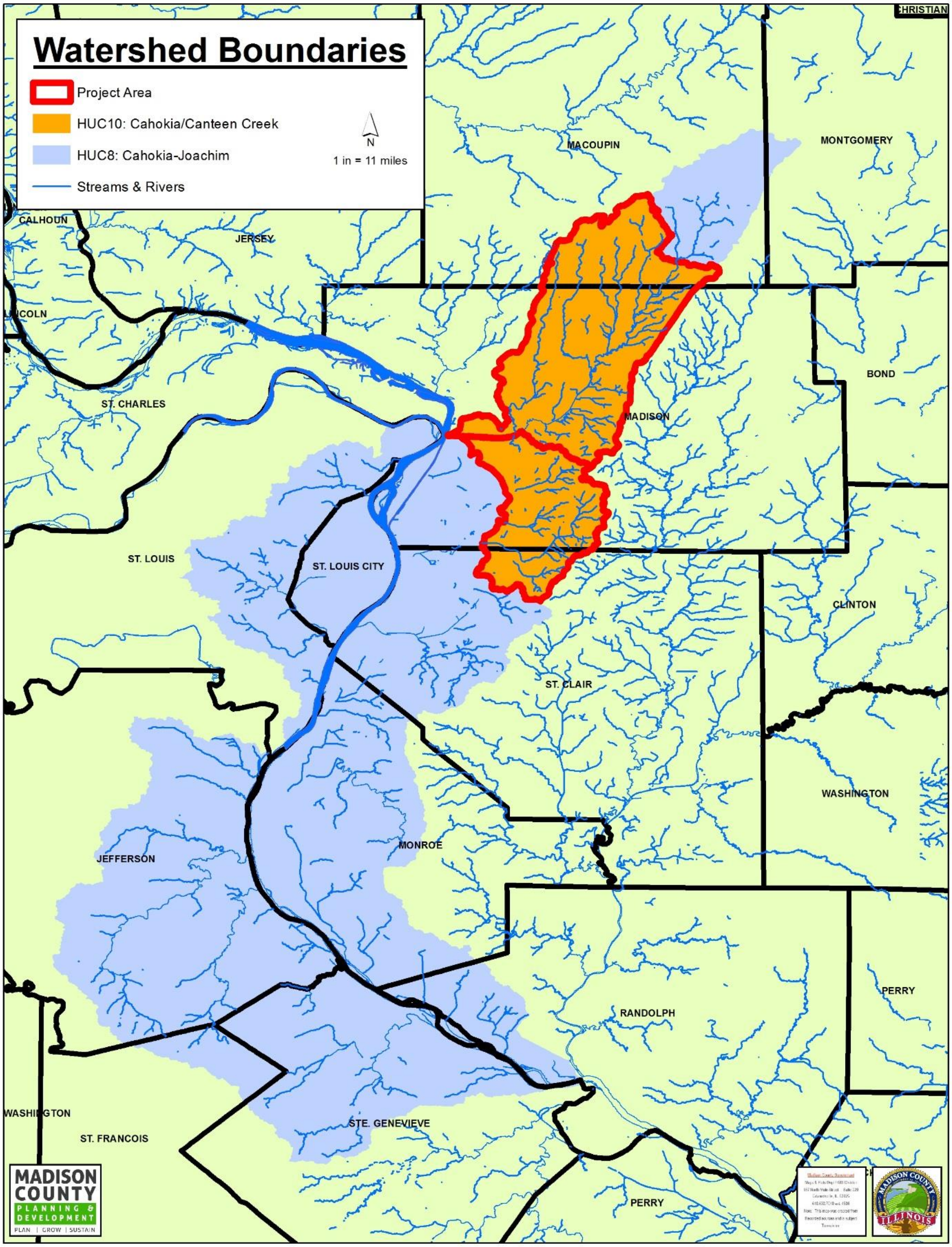
Watershed Boundaries

The U.S. Geological Survey (USGS) has established the hydrologic units system to delineate, locate, and define watersheds in the United States. Starting with Hydrologic Unit Code (HUC) 2 watersheds, which are the largest, down to HUC14 watersheds currently being developed around the country as the smallest. The Indian-Cahokia Creek Watershed is in the Upper Mississippi River Region (HUC2), Cahokia-Joachim Catalog Unit (HUC8). Two HUC 10 watersheds were planned for at the same time: the Indian-Cahokia Creek watershed and Canteen-Cahokia Creek watershed. The Indian-Cahokia Creek watershed includes southern Macoupin County and drains into Madison County, while the Canteen-Cahokia Creek watershed drains northern St. Clair County and southern Madison County. Table A.1 below shows the contributing area for the HUC 8 and HUC 10 watersheds as well as the project area.

Table A.1: Area of the hydrologic units nested in the Indian-Canteen-Cahokia Creek Watershed Plan project area.

Watershed	Area (acres)
Cahokia-Joachim HUC 07140101 (HUC 8)	1,053,318
Indian-Cahokia Creek HUC 0714010102 (HUC 10)	125,699
Canteen-Cahokia Creek HUC 0714010103 (HUC 10)	57,277
Both watersheds combined	182,976

Figure A.2: The Indian-Canteen-Cahokia Creek Watershed plan project area in context of the Cahokia-Joachim Creek HUC8 watershed.



Subwatersheds

The project area contains numerous smaller subwatersheds, or hydrologic units, including 10 HUC 12s and 37 HUC14s. The HUC14s were delineated for this inventory by The U.S. Army Corps of Engineers, St. Louis District using GeoHMS for ArcGIS and methods employed by the USGS to define watersheds in the Watershed Boundary Database (WBD), a component of the National Hydrography Dataset (NHD). Each HUC12 watershed contains two to six HUC 14s ranging between about 2,000-8,500 acres in size. The following figures and tables show the 10 HUC12s and their component HUC14s.

Table A.2: HUC12 name and numbers with HUC14 names, numbers, area and municipalities for the Indian Creek-Cahokia Creek watershed.

HUC12		HUC14		HUC14 Area (acres)	Municipalities Present
Name	**Number**	**Name**	**Number**		
West Fork Cahokia Creek	071401010201	Upper West Fork Cahokia Creek	07140101020101	4,881	Dorchester, Wilsonville
		Village of Wilsonville	07140101020102	2,528	Wilsonville
		Lower West Fork Cahokia Creek	07140101020103	4,214	
White Rock Creek-Cahokia Creek	071401010202	Ginseng Creek-Cahokia Creek	07140101020201	4,557	Staunton
		Vesper Lake-Cahokia Creek	07140101020202	5,100	Staunton
		White Rock Creek-Cahokia Creek	07140101020203	5,820	Worden
Paddock Creek	071401010203	Upper Paddock Creek	07140101020301	5,148	Bunker Hill
		Joulters Creek	07140101020302	3,940	Holiday Shores
		Lower Paddock Creek	07140101020303	7,066	Holiday Shores
Sherry Creek-Cahokia Creek	071401010204	East Fork Sherry Creek	07140101020401	8,208	Dorchester
		Headwaters Sherry Creek	07140101020402	6,522	
		Dentons Branch-Sherry Creek	07140101020403	3,216	
		Village of Worden-Cahokia Creek	07140101020404	6,084	Worden
Mooney Creek	071401010205	Lake Meadow-Cahokia Creek	07140101020501	3,388	
		Quercus Grove-Cahokia Creek	07140101020502	5,785	
		Little Mooney Creek	07140101020503	2,141	Edwardsville
		Sugar Creek	07140101020504	2,063	
		Mooney Creek	07140101020505	3,964	Edwardsville, Glen Carbon
		Graney-Cahokia Creek	07140101020506	1,355	
Indian Creek	071401010206	Headwaters Indian Creek	07140101020601	5,138	Bunker Hill
		Upper Indian Creek	07140101020602	5,541	
		Middle Indian Creek	07140101020603	4,574	Bethalto
		Lower Indian Creek	07140101020604	5,658	Bethalto
		Outlet Indian Creek	07140101020605	5,122	Bethalto, Wood River, Roxana
Burroughs Branch-Cahokia Creek	071401010207	Burroughs Branch-Cahokia Creek	07140101020701	4,510	Edwardsville
		Tower Lake-Cahokia Creek	07140101020702	5,325	Edwardsville, Glen Carbon, Roxana
		Cahokia Diversion Channel	07140101020703	3,866	Edwardsville, Hartford, Roxana, South Roxana

Figure A.3: HUC14s in the West Fork Cahokia Creek HUC12 watershed.

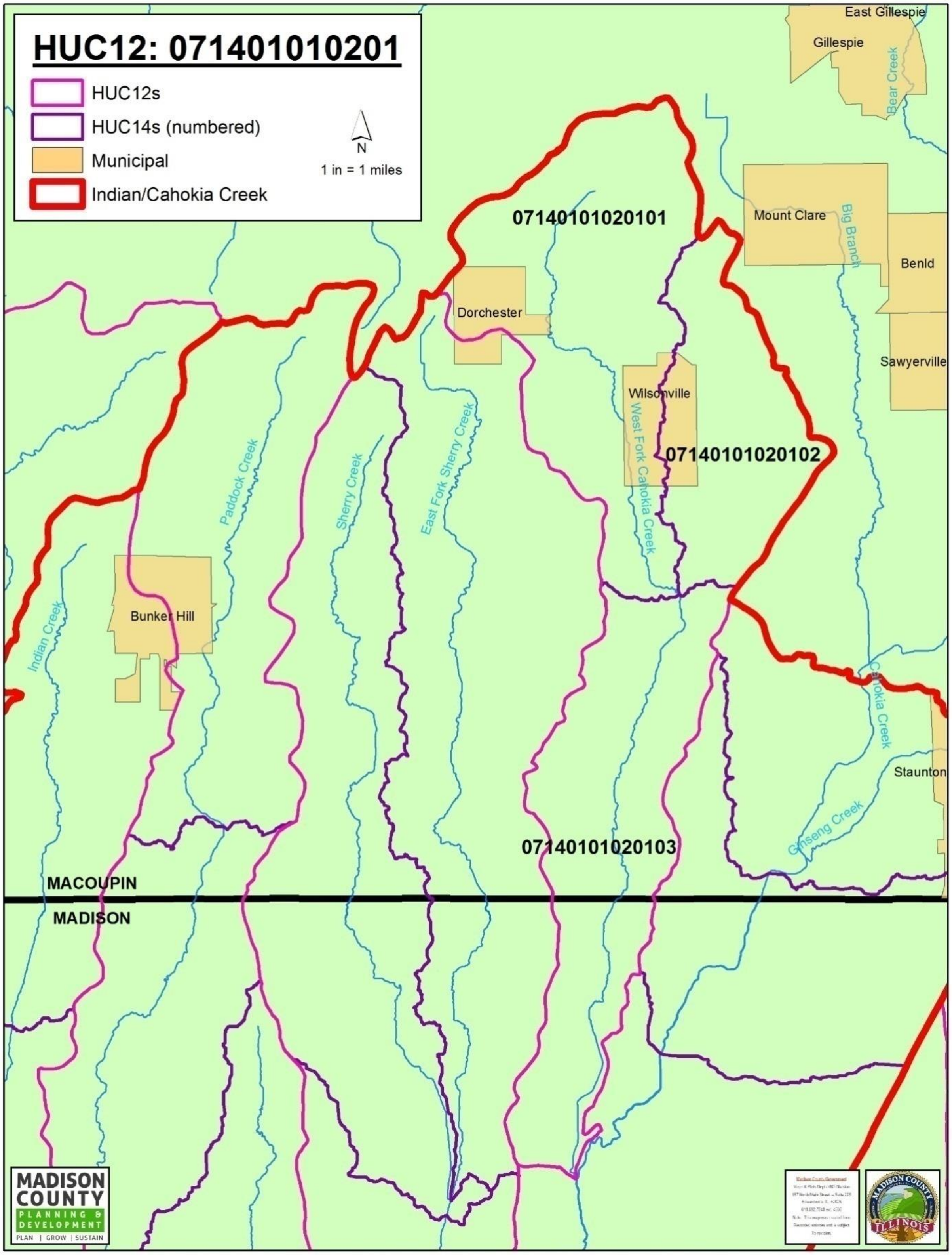


Figure A.4: HUC14s in the White Rock Creek-Cahokia Creek HUC12 watershed.

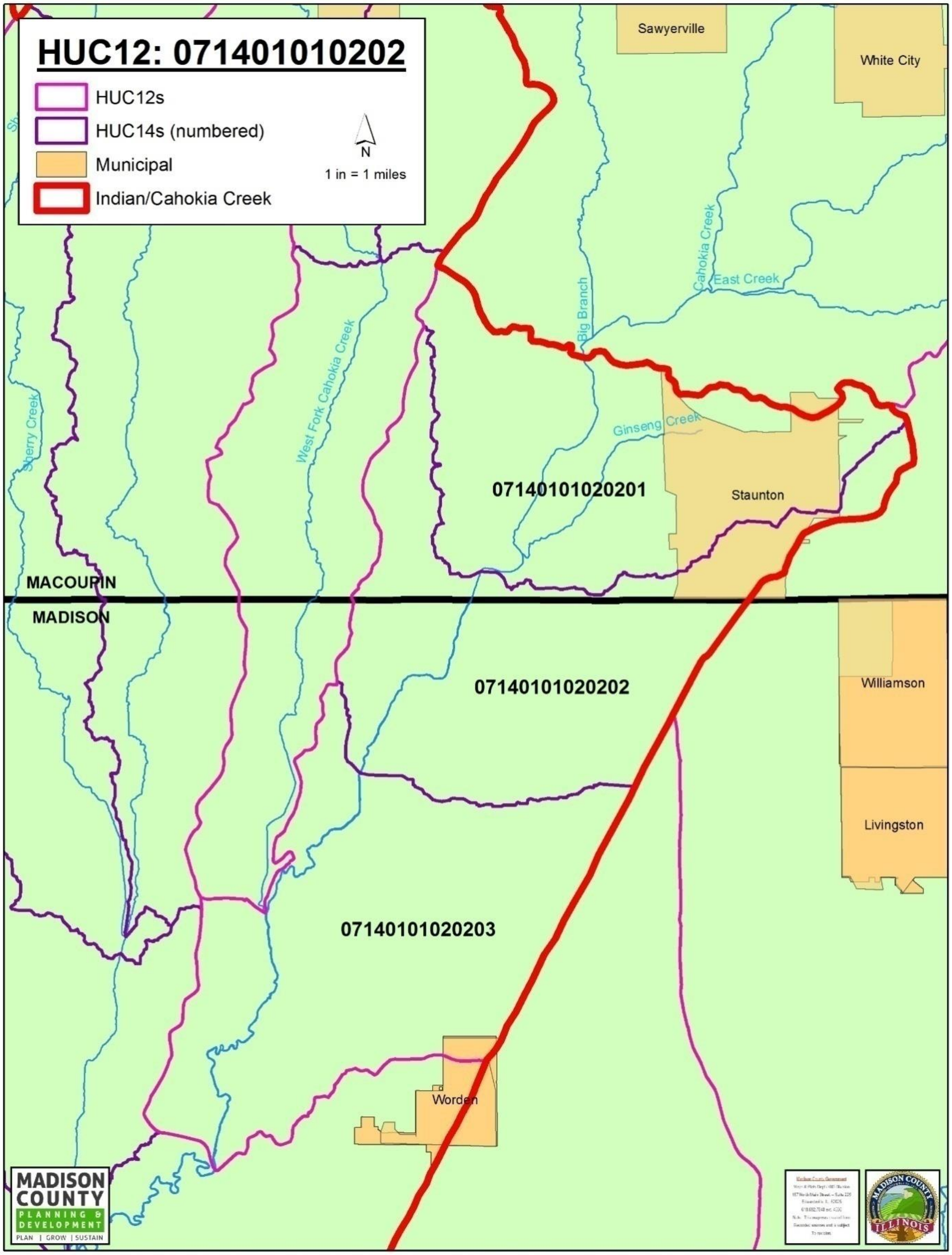


Figure A.5: HUC14s in the Paddock Creek HUC12 watershed.

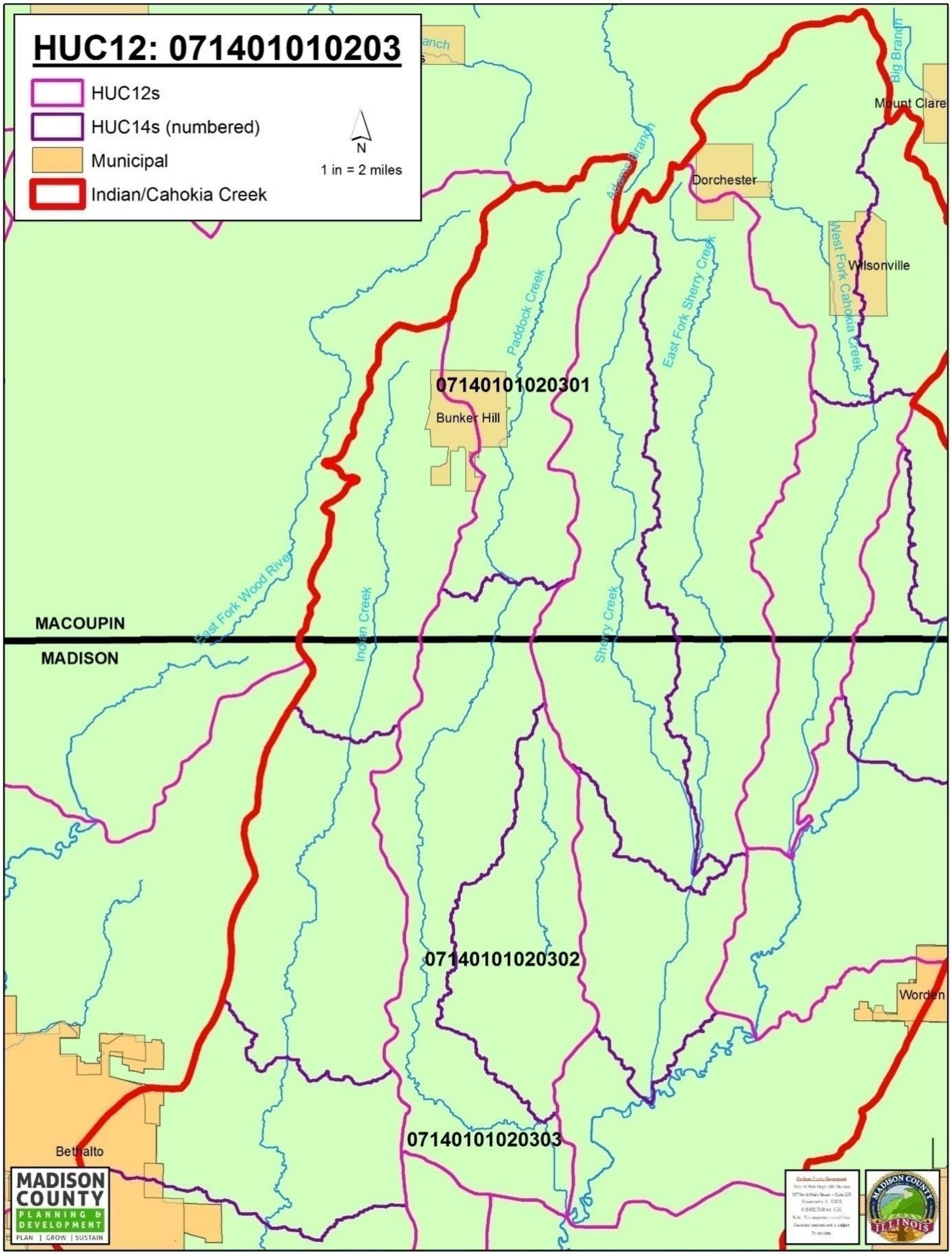


Figure A.6: HUC14s in the Sherry Creek HUC12 watershed.

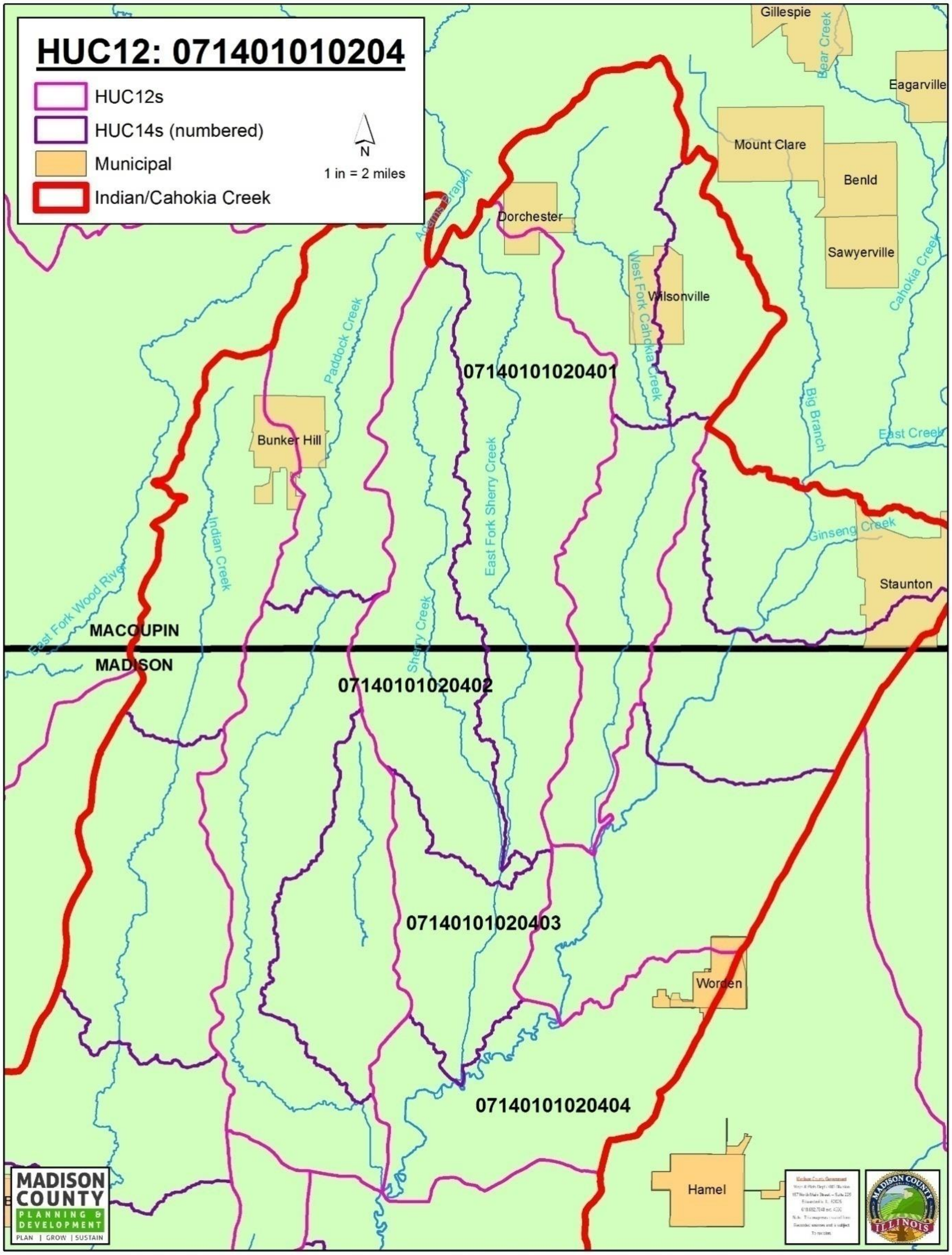


Figure A.7: HUC14s in the Mooney Creek HUC12 watershed.

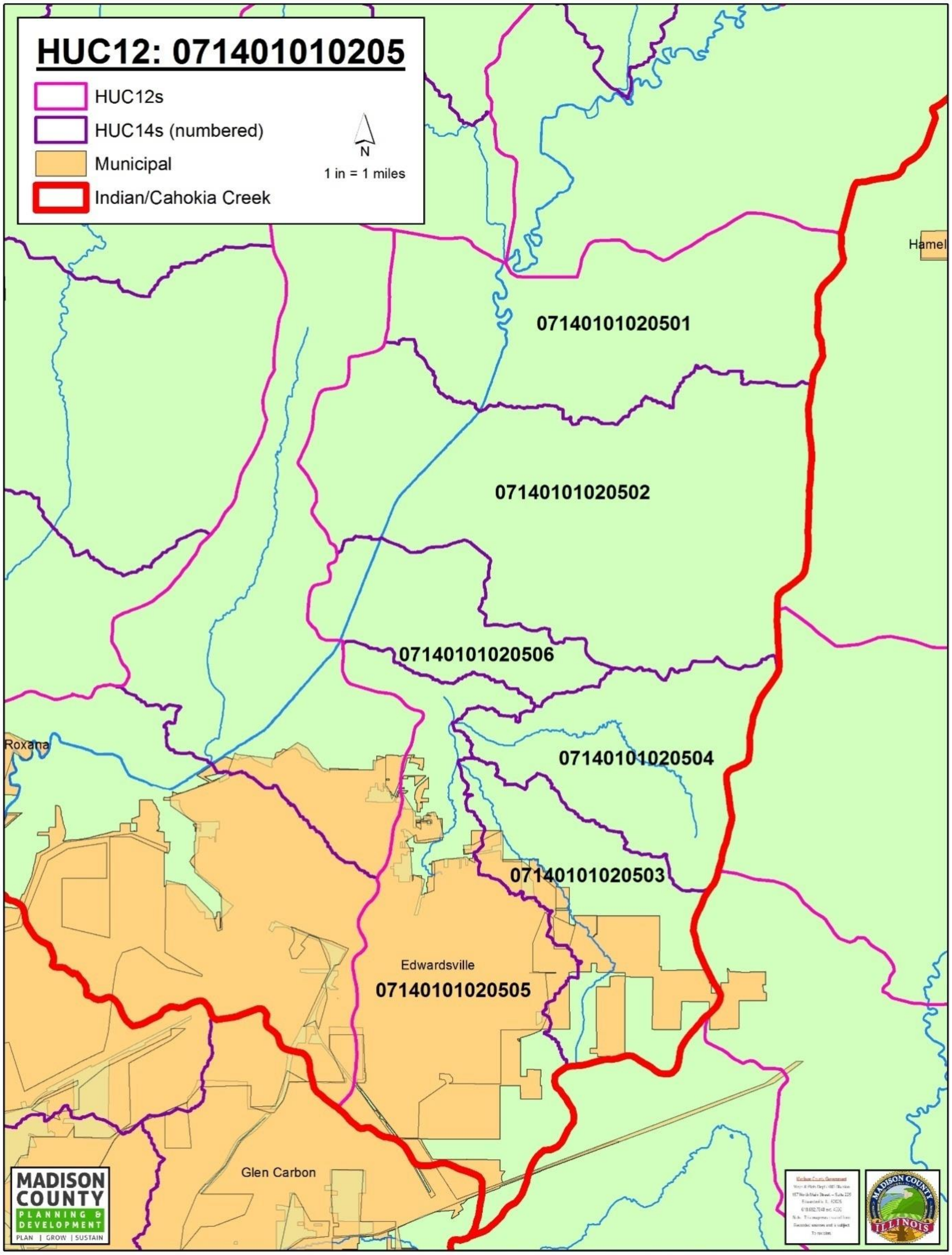


Figure A.8: HUC14s in the Indian Creek HUC12 watershed.

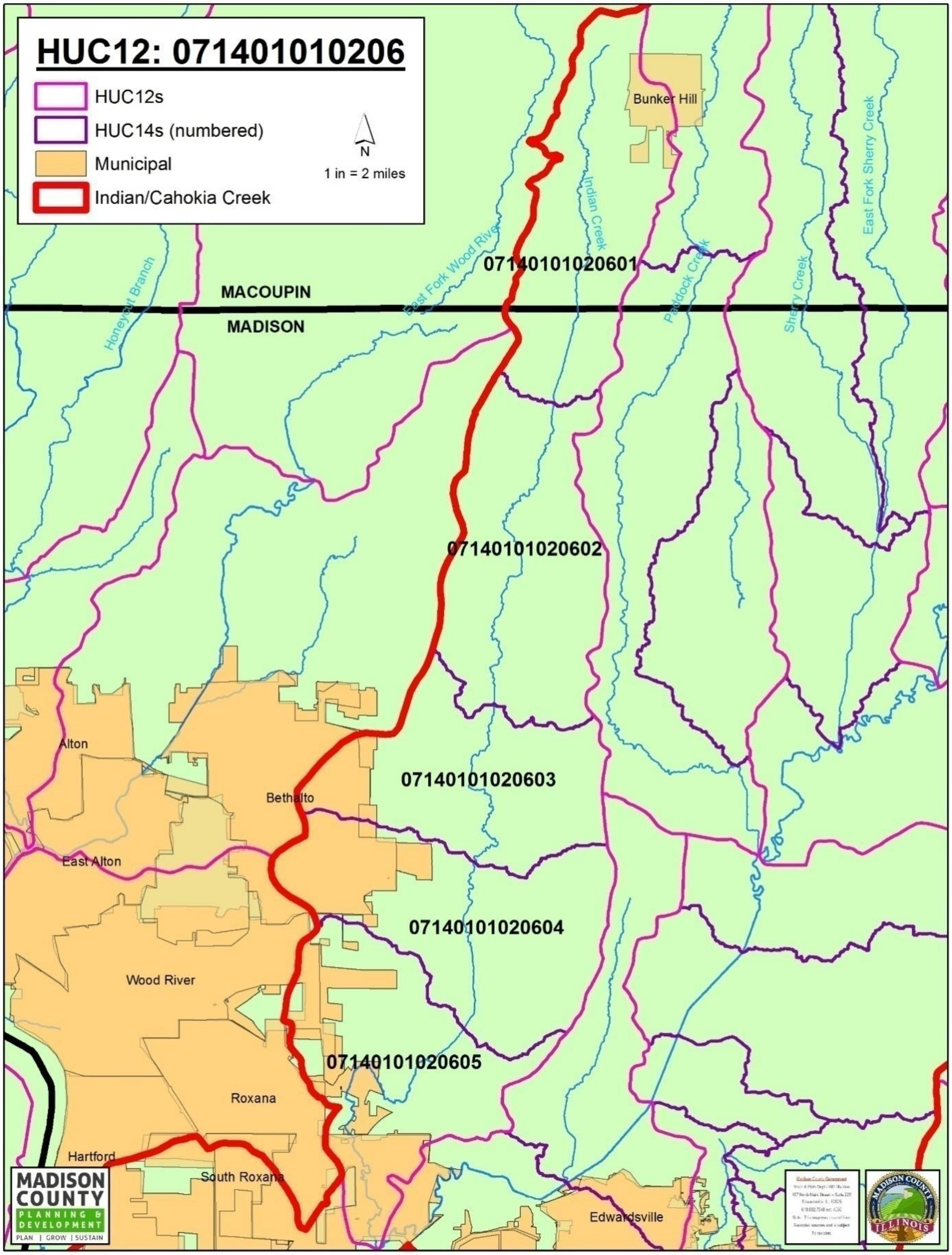
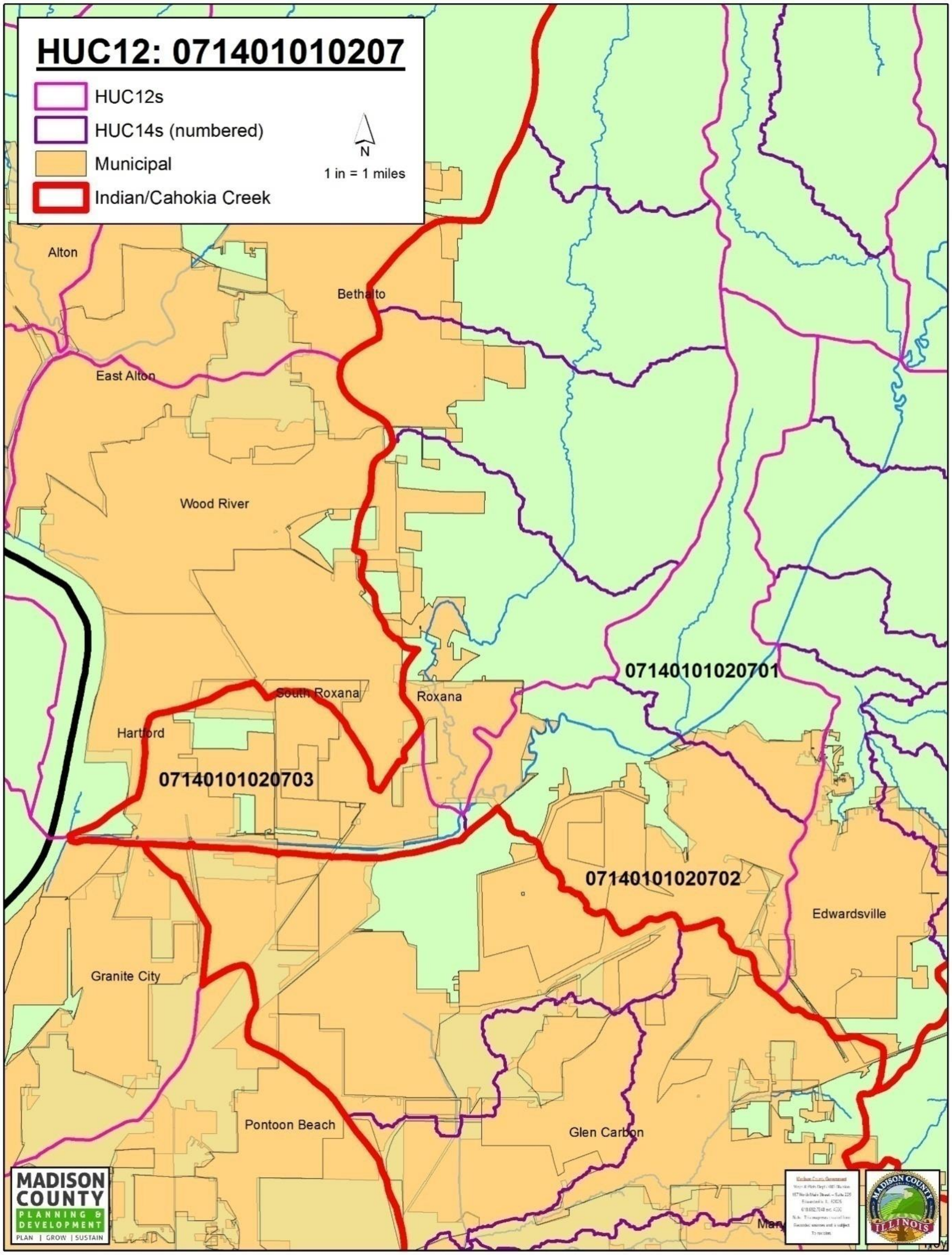


Figure A.9: HUC14s in the Burrough's Branch-Cahokia Creek HUC12 watershed.



Stream miles and reach categorizations

There are 754 stream miles in the Indian-Cahokia and Canteen-Cahokia Creek watersheds combined. According to the National Hydrography Dataset (NHD) maintained by the United States Geologic Survey (USGS), 492 of those stream miles are located in the Indian-Cahokia Creek watershed, and the remaining 262 miles are in the Canteen-Cahokia Creek watershed. Each stream reach is labeled as one of seven categories in the NHD: artificial path, canal/ditch, coastline, connector, pipeline, stream/river or underground conduit. Of these seven categories, only artificial path, canal/ditch, connector, and stream/river are present in either the Indian-Cahokia Creek or Canteen-Cahokia Creek watersheds.

Direction of flow and major tributaries

In the Indian-Cahokia Creek watershed, water generally flows north to south and east to west. The uppermost reach of the watershed is in the West Fork-Cahokia Creek watershed, which starts in Macoupin County. The watershed drains the area north of Dorchester and Wilsonville down through Roxana, South Roxana, and Hartford. Cahokia Creek drains to the Cahokia Diversion Channel, which empties into the Mississippi River west of Hartford.

Waterbodies

There are 297 waterbodies in the Indian-Cahokia Creek watershed, according to the NHD. These waterbodies include lakes, ponds, swamps, and marshes and have an average area of 3.06 acres. The largest three waterbodies in the watershed are all lakes. Holiday Lake is the largest at 254 acres in Holiday shores, followed by Dunlap Lake (106 acres, Edwardsville) and Tower Lake (71 acres, Edwardsville).

Topography

Topography in the watershed is fairly flat, with gradual slopes throughout most of the watershed, except where the bluff line drops away steeply to the American Bottom. The watershed has slopes ranging between 0% to 108.5%, with an average slope of 4.7% over the majority of the watershed. The standard deviation of the slopes within the watershed is 6.3, meaning that 68.2% of the slopes in the watershed fall between 0% and 11%.

The highest point in the watershed has an elevation of 678 feet, in the Paddock Creek HUC12 watershed in Macoupin County. The highest streams in the watershed come into Madison County from Macoupin County. The watershed flows to the Mississippi River through the Cahokia Diversion Channel, the lowest point in the watershed, with an elevation of 402 feet at the extreme west end of the channel within the watershed boundary.

Figure A.10: Topography/elevation in the Indian-Cahokia Creek watershed project area, from the Digital Elevation Model (DEM) in the USGS National Elevation Dataset.

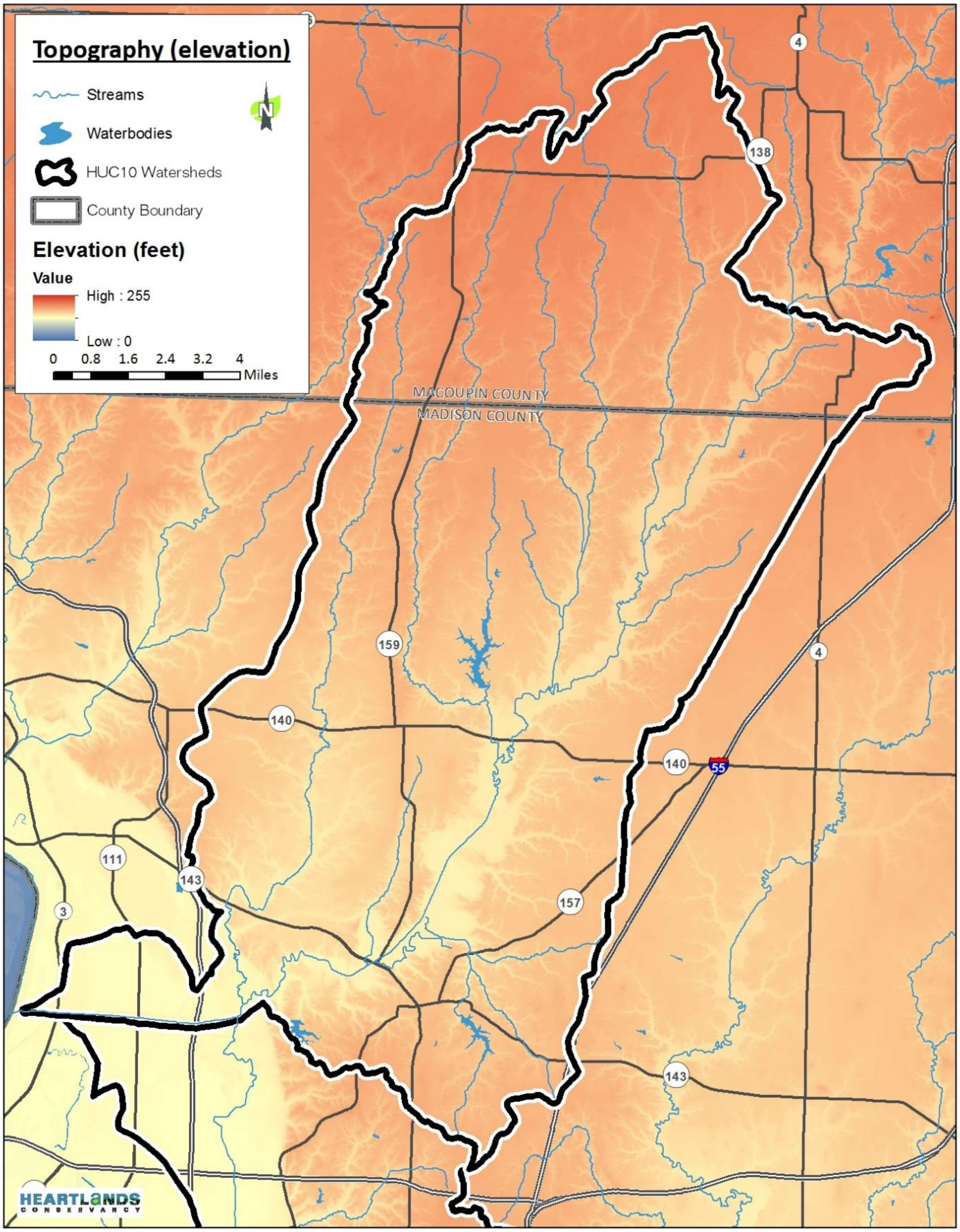
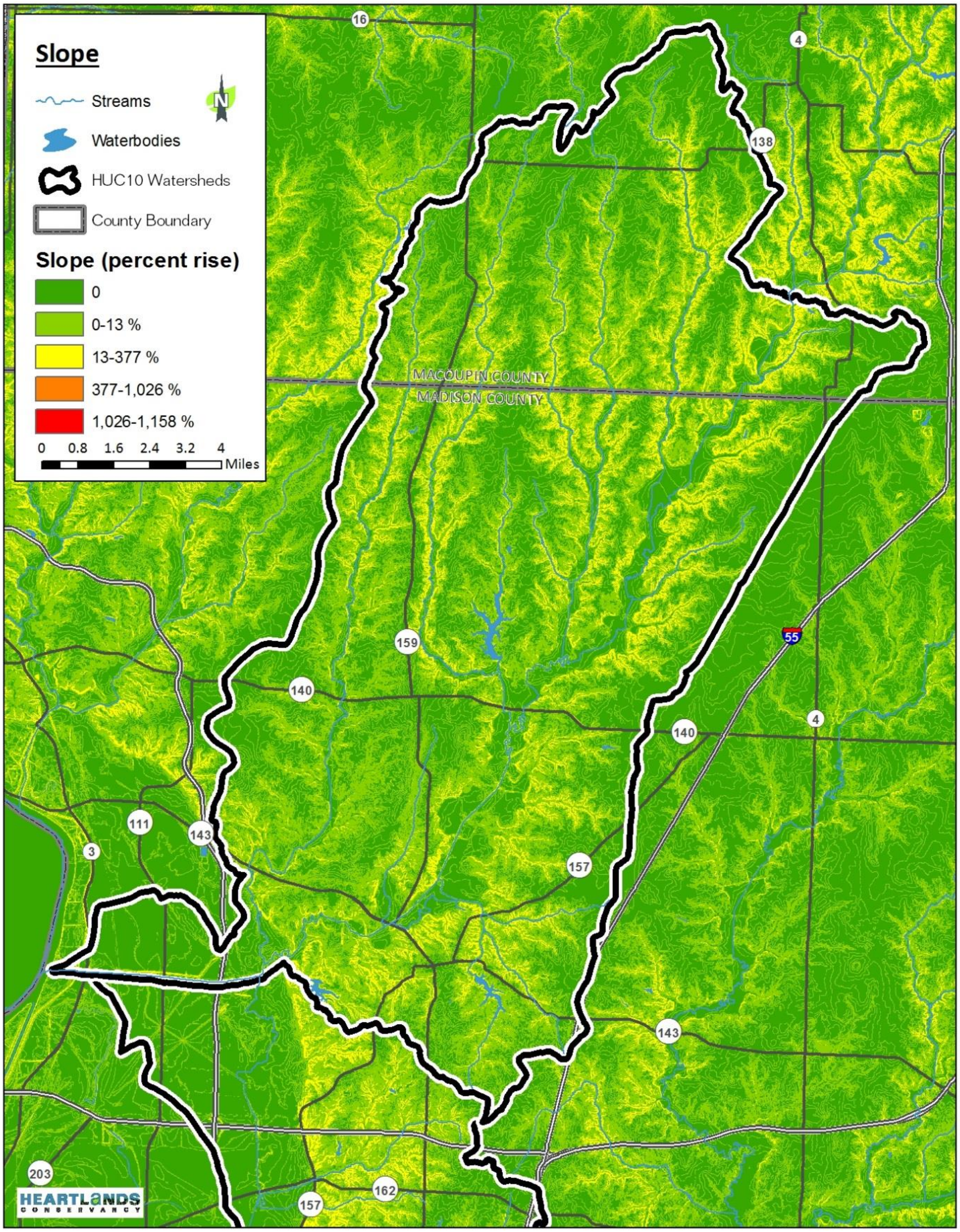


Figure A.11: Slope in the Indian-Cahokia Creek watershed project area, in percent



Climate

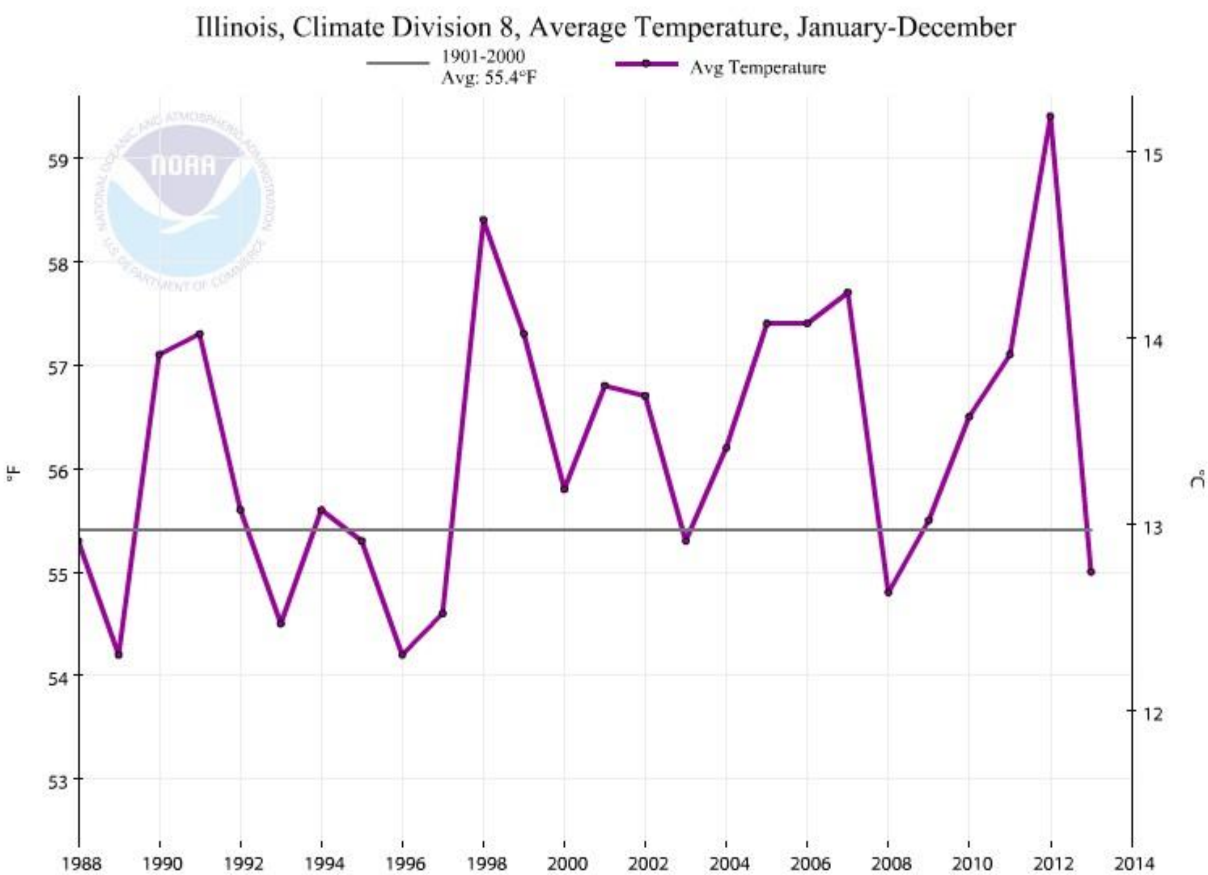
The watershed experiences typical weather for southwestern Illinois, including great variation in temperature, precipitation, and snowfall from one year to the next.

Temperature

Southern Illinois experiences an average of just over 40 days at or above 90°F and an average two days at 100°F or higher every year. The average length of the frost-free growing season in southern Illinois is more than 190 days. The average annual temperature for the region is 55.4°F (measured between 1901 and 2000). Over the past 25 years, the average annual temperature in southwestern Illinois has increased, reaching a 25-year high of approximately 59.5°F in 2012 (Figure A.12).

Between 1988 and 2013, southern Illinois has experienced 853.2 days of maximum temperature equal to or greater than 90°F. This equates to an average of 32.8 days per year of temperatures over 90°F (data from monthly averages from gauging stations in all three counties). The maximum recorded temperature in the three counties between 1988 and 2014 was 106°F in July 2012, recorded in Alton in Madison County. The minimum recorded temperature in the three counties between 1988 and 2014 was -20°F in December 1989 at two gauge stations in Macoupin County. (1)

Figure A.12: Average annual temperatures in southwestern Illinois between 1988 and 2014, from NOAA's Climate At-A-Glance Time Series. The leftmost y axis shows average annual temperature in degrees Fahrenheit. (2)



Precipitation

Average precipitation exceeds 48 inches a year in southern Illinois, which allows farms to rely on precipitation rather than irrigation for much of the year. (3) Precipitation gauge stations in Mount Olive and Edwardsville measured an average annual precipitation of 40.21 inches and 38.73 inches, respectively, between 1971 and 2000, and 40.10 and 44.77 inches between 1981 and 2010. The average annual number of days with 0.1 inch or more of precipitation was 62 days (averaged between recorded data from the two stations between 1971 and 2000), with May as the wettest month and January as the driest. The average annual total snowfall recorded was 18.5 inches (between 1971 and 2000). (4)

Flooding is the single most damaging weather hazard in Illinois. Rainstorms in Illinois produce 40 or more flash floods on average per year across the state, each with four to eight inches of rainfall in a few hours in localized areas. (3) The greatest recorded 24-hour precipitation event was recorded in Edwardsville is 7.05 inches of rain in August 1995 (Table A.3). Flash floods can occur at any time of year in Illinois, but they are most common in the spring and summer months. (5) See Flooding section for more information on occurrences of flash flooding and general flooding.

Table A.3: Highest daily precipitation over 24 hours between 1893 and 2014 at gauge stations located in Edwardsville and Mount Olive. (4)

Rank	Daily Precipitation (inches)	Date	Gauge Station
1	7.05	8/20/1995	Edwardsville
2	6.43	5/26/2009	Edwardsville
3	6.00	7/14/1912	Edwardsville
4	5.97	5/17/1943	Edwardsville
5	5.86	8/16/1946	Edwardsville
6	5.13	4/22/1944	Edwardsville
7	5.10	9/17/1969	Mt Olive*
8	4.87	4/22/1944	Mt Olive*
9	4.63	8/24/1977	Edwardsville
10	4.57	8/10/1961	Edwardsville

*Data from Mount Olive gauge only available from 1940-2014.

Drought

There has been considerable variability in precipitation in the state over time, including major multi-year droughts in the 1930s and 1950s and major multi-year wet periods in the 1970s and 1980s. (3) The National Climatic Data Center (NCDC) database reported 26 drought/heat wave events in Macoupin County from 1995 to 2010, with the most recent event in June 2009. (6) Madison County experienced four drought events between 1983 and 2012, three of which occurred in 2005 or later. (5) Extreme heat often accompanied rainfall and surface water shortages during these events.

Tornadoes

Illinois experiences about 29 tornadoes annually, 63% of which occur in peak months April, May, and June. (3) A significant recent tornado struck the city of Mount Olive in May 2013, damaging more than 40 homes and businesses in the downtown area, including City Hall. (7) It was not declared a presidential disaster. (8) In Madison County, 39 tornadoes were reported between 1950 and 2006. In Macoupin County, 31 tornadoes/funnel clouds were reported between December 1950 and 2010. The greatest recorded magnitude among these events was an F4 on the Fujita Scale (one event in Madison County). Typically, the area impacted by tornadoes in the three counties was less than four square miles. (5) (6) (9)

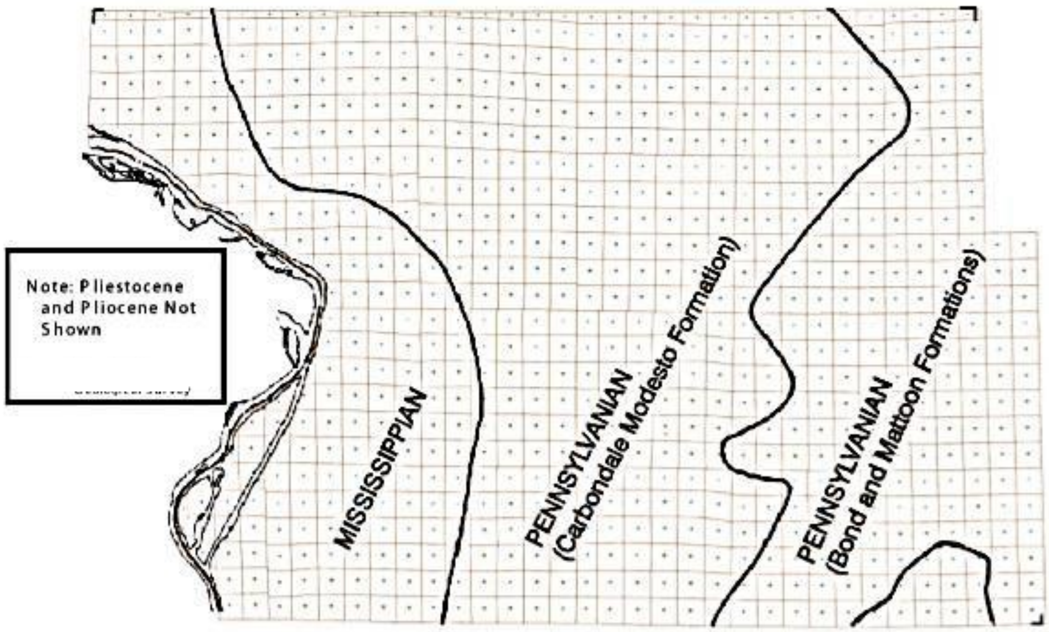
Geology

The bedrock underlying southwestern Illinois is composed of Cambrian, Ordivician, Silurian, Devonian, Mississippian, and Pennsylvanian sedimentary rocks (i.e., sandstone, shale, dolomite, and limestone) resting on crystalline basement rocks consisting mainly of granite. Tilting and folding of the bedrock surface below Madison County resulted in the present bedrock surface topography. Figure A.13 shows the generalized bedrock geology beneath Madison County.

Directly below the glacial drift in the central and eastern portions of the county, including below the Cahokia Creek watershed, are Pennsylvanian rocks. These rocks have relatively low permeability and consist mainly of shales, sandstone, thin limestone, and coal. The water-yielding character of these Pennsylvanian formations is variable but generally very low; the sandstones are the only formations that yield any appreciable amounts of water. The sandstones differ laterally in permeability and are not water-yielding at all sites. In some locations, small, local supplies of suitable groundwater may be obtained from shallow sandstone and creviced limestone, but the probability of obtaining a well in the Pennsylvanian aquifers yielding more than 20 gallons per minute (gpm) is low. Furthermore, as the depth of large aquifers increases, the water's mineral content also increases, limiting the uses of the groundwater.

Blanketing the bedrock are unconsolidated deposits from glacial drift, ranging in thickness from two to 200 feet across southwestern Illinois. The glacial materials in the watershed and Madison County were deposited during the Pleistocene Epoch by the Illinoian glacial advance. The Illinoian Till Plain comprises much of the area east of the Mississippi River bluffs. A second glacial movement (Wisconsinan) did not advance on the area, but its deposits were widely transported here by wind and water. After the glaciers had receded and the deposits had dried, the wind picked up many of the fine-grained sand, silt, and clay (mostly silt) sediments and deposited them on the uplands in uniform layers known as loess. Since winds were generally from the northwest, the loess deposits are thicker on the uplands adjacent to the Mississippi River flood plain. The thickness of the glacial drift is highly variable.

Figure A.13: Generalized Bedrock Geology in Madison County, Illinois. Data from Illinois State Geological Survey.



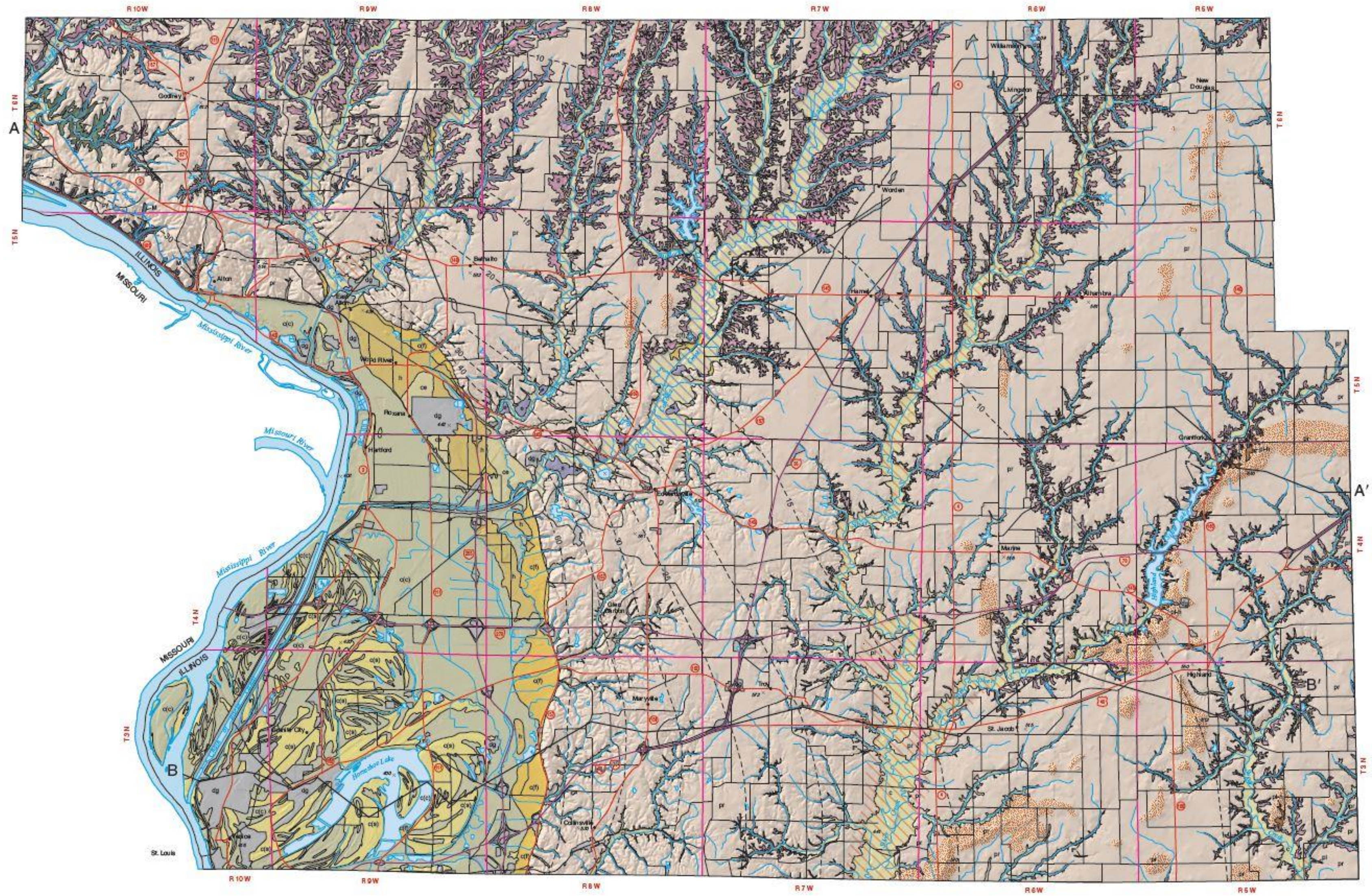
A map of Madison County's surficial geology reveals that the county is largely covered by loess deposits (Figure A.14). Near and in the Cahokia Creek watershed, the deposits are mainly silt, silty clay, and fine sand.

The cross-sections of the landscape at line A in Figure A.14 shows that the rock layers underlying the Cahokia Creek channel are, from bedrock to surface: Pennsylvanian bedrock; Pearl Formation deposits (sand with some gravel); Equality Formation deposits (silt loam to silty clay loam with some fine sand); Cahokia Formation deposits (mainly silt, silty clay, and fine sand); and on the stream banks, silt loam or loess (Wisconsin; loess). The thickness of the loess (windblown silt) is shown on the map as contours. The loess layer becomes thinner as you move eastward from the Mississippi River. The loess thickness is 40 feet thick in the lower part of the Cahokia Creek watershed near Maryville, but is only five to 10 feet thick at the northern end of the watershed. (10)

The valley fill material along Cahokia Creek is an important source of groundwater for industries and municipalities on the floodplain. Wells reaching to sand and gravel aquifers in underlying till plain deposits produce moderate amounts of water for small communities and rural households. Drinking water for most rural households using wells comes from low-yielding wells 35 to 150 feet deep. The numerous ponds throughout the watershed supply ample water for livestock and wildlife. (11)

The cross-sections of the landscape at line B in Figure A.15 shows that the rock layers underlying the Canteen Creek channel are, from bedrock to surface: Peoria and Roxana silts, Glasford formation (<5 feet of loess cover), Petersburg silt, Banner Formation (undivided). This strata configuration is relatively consistent throughout the highlands of the watershed, with significantly different geology in the American Bottom, west of Illinois State Route 157.

Figure A.14: Surficial geology of the Cahokia Creek watershed area in Madison County.



The legend for this figure is found on the following page. Cross-sections at lines A′ and B′ are shown in Figure A.15. Maps of surficial geology for the portions of the watershed in Macoupin and Montgomery Counties were not available.

Figure A.14 Legend: Surficial geology of the Cahokia Creek watershed area in Madison County.

QUATERNARY DEPOSITS

Description	Unit	Interpretation
HUDSON EPISODE (~12,000 years before present (B.P.) to today)		
Fill or removed earth; various sediment types	Disturbed ground (dg)	Man-made fill or excavations
Mainly silt, silty clay and fine sand; weakly to well stratified; includes some coarser beds	Cahokia Formation (undivided) (c)	River deposits (alluvium); mapped in valleys tributary to the Mississippi Valley
Silt loam with thin fine sand beds; weakly stratified	Cahokia Formation (fan facies) (c(f))	Alluvial fan deposits; mainly reworked loess from bluffs east of American Bottoms
Silty clay loam, silty clay, and silty loam; massive to stratified; some fine sand lenses	Cahokia Formation (clayey facies) (c(c))	Overbank alluvium, abandoned channel and swale fills; mapped only in Mississippi Valley
Very fine, fine and medium sand; stratified; moderately to well sorted	Cahokia Formation (sandy facies) (c(s))	Alluvium; point bar and channel deposits; mapped only in Mississippi Valley
Silt loam, pebbly silt loam or pebbly silty clay diamicton	Peyton Formation (py)	Sediments moved downslope by gravity (colluvium); creep layers, slumps, or landslides
Silty clay to silt with some fine sand; massive to stratified	Cahokia or Equality Formation (undifferentiated) (ce)	Overbank alluvium or lake deposits; occurs on or near the Wood River Terrace
WISCONSIN EPISODE (~75,000–12,000 years B.P.)		
Silt loam to silty clay loam with some fine sand; massive to stratified	Equality Formation (e) (hachures on map where buried)	Lake deposits; of slackwater origin during peak Mississippi River aggradation
Fine, medium and coarse sand; stratified; generally coarsens at depth; some gravelly zones	Henry Formation (h)	Outwash (glacial meltwater deposits); on Wood River Terrace in northern American Bottoms
Silt loam; massive; upper 3/5 of unit is more tan or gray (Peoria); lower portion has pinkish hue (Roxana)	Peoria and Roxana Silts (pr)	Loess (windblown silt); blankets all uplands; thickness contours shown on map; thins eastward from Mississippi Valley bluffs
ILLINOIS EPISODE (~200,000–130,000 years B.P.)		
Mixture of loam, sand and gravel, and diamicton; weakly stratified; poorly to well sorted sands; may be fractured or faulted (from glacial processes)	Hagarstown Member, Pearl Formation (pl-h) (stipples on map where buried)	Ice-contact sediments; deposited mainly in ice-marginal, subglacial, or supraglacial channels; locally includes glaciotectonic faulting and deformation
Sand with some gravel; stratified; may include silty or clayey zones, especially near surface	Pearl Formation (outwash facies) (pl) (hachures on map where buried)	Outwash; common in loess-covered terraces along Silver Creek
Pebbly loam diamicton (mixture of clay, silt, sand, and gravel); generally massive; includes some sand and gravel lenses (especially in upper portion)	Glasford Formation (< 5 feet of loess cover) (g)	Till and ice marginal deposits; includes subglacial and supraglacial deposits
Silt loam to silty clay loam; massive to weakly stratified; locally fossiliferous.	Petersburg Silt (cross sections only) (pb)	Lake sediment; deposited under slackwater conditions or ice marginal settings.
PRE-ILLINOIS EPISODE (~700,000–400,000 years B.P.)		
Pebbly silty clay loam diamicton; generally massive; include sand and gravel lenses, zones of stratified silt near base	Banner Formation, (undivided) (cross sections only) (b)	Till and ice marginal deposits; includes subglacial fill and supraglacial debris flows; may include lake sediment
Silty clay loam, silty clay, and silt loam; weakly stratified; contains some fine sand beds	Banner Formation, Canteen member (cross sections only) (b-c)	Preglacial alluvium and lake deposits; may include some residuum or colluvium at base; occurs mainly in preglacial bedrock valleys

PRE-QUATERNARY DEPOSITS

Description	Unit	Interpretation
Shale, siltstone, limestone, and sandstone; less commonly beds of coal and underclay	Pennsylvanian or Mississippian bedrock (P | M)	Bedrock outcrops or bedrock within 5 feet of land surface; most common in bluff area west of Alton; includes Pennsylvanian and Mississippian rocks

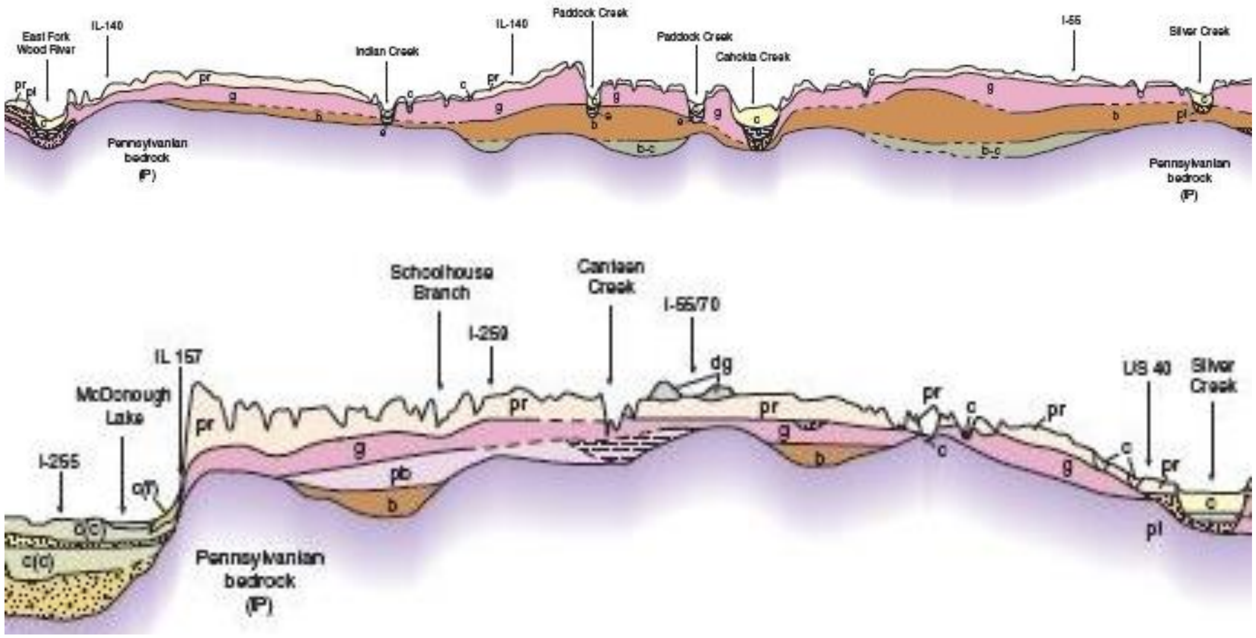
Illinois Episode till border (areas to southwest of line are driftless)

– – 15 – – Loess thickness contour (in feet)

A — A′ Line of cross section

Note: Loess contours show the combined thickness of Peoria and Roxana Silts on uneroded upland areas. The actual thickness at a given spot may be much less, especially along valley slopes where post-depositional erosion of loess has been significant (see cross sections).

Figure A.15: Cross-sections of surficial geology at lines A and B in Figure A.14 (12)



Cross-section A extends from East Fork Wood River to Silver Creek, including Indian, Paddock and Cahokia Creeks
Cross-section B extends from McDonough Lake to Silver Creek, including Schoolhouse Branch and Canteen Creek.
See Figure A.14 for the legend.

Aquifers

There are four types of aquifers in the Cahokia Creek watersheds as defined by the Illinois State Geological Survey: potential shallow aquifers, major sand a gravel aquifers, and two types of deep major bedrock aquifers, those containing 2,500-10,000 mg/L of Total Suspended Solids (TSS) and those containing more than 10,000 mg/L TSS.

Potential aquifers are defined as sand and gravel units at least five feet thick, sandstone at least ten feet thick, and fractured limestone or dolomite at least 15 feet thick with a lateral extent of at least one square mile. The locations of these potential aquifers were determined by the presence of coarse-grained materials and permeable bedrock including bedrock, sand and gravel, and alluvial units with characteristics that suggest a potential to store or conduct groundwater and yield potable water to wells and springs. Minor aquifers of this type typically yield from five to seventy gallons of potable water per minute.

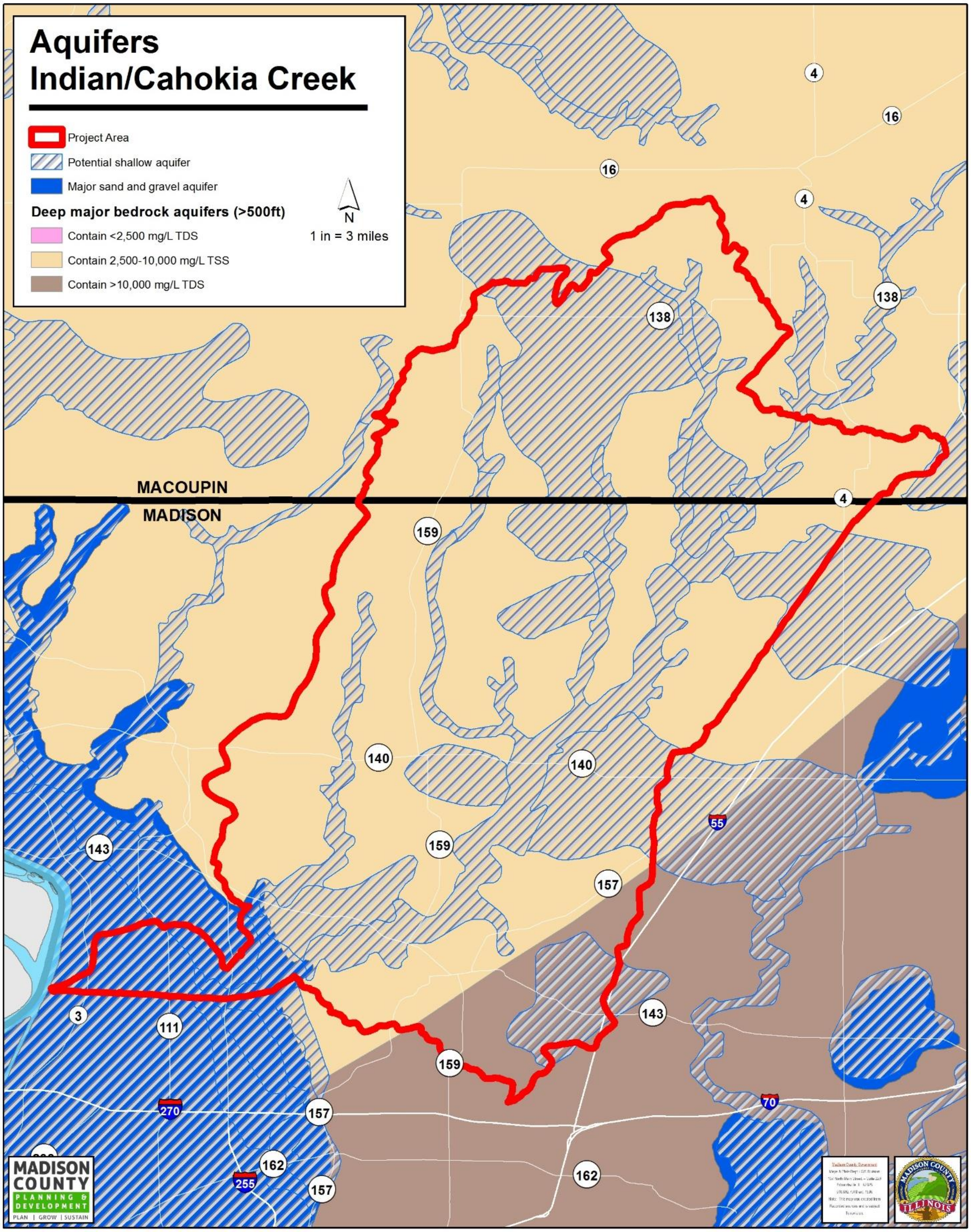
Major sand and gravel aquifers generally lie within 300 feet of the surface, and the bases occur within 500 feet. Major aquifers are defined as geologic units capable of yielding 70 gallons of potable water per minute. Potable water is defined as containing less than 2,500 milligram per liter total dissolved solids. Major sand and gravel aquifers are commonly separated from shallower aquifers by layers of less permeable till or fine-grained lacustrine deposits.

Deep major bedrock aquifers are distributed beneath the entire watershed at depths greater than 500 feet below the ground surface. They are capable of yielding 70 gallons of water per minute. The deep aquifers beneath these watersheds do not yield potable water (containing less than 2,500 milligrams per liter of TSS). Instead, they yield water containing more than 2,500 milligrams per liter of TSS. Deep major bedrock aquifers yielding water containing greater than 10,000 milligrams per liter of TSS are given their own category and are shown in darker brown (Figures A.16).

There is one major sand and gravel aquifer in the southern Indian-Cahokia Creek watershed, shown in dark blue in Figure A.16. It is situated below the confluence of Indian Creek and Cahokia Creek, and also the Cahokia Diversion Channel. It underlies 4,951 acres (4%) of the Indian-Cahokia Creek watershed, and its volume is unknown.

There may be several potential aquifers 50 ft or less below the ground surface in the watershed, underlying 22,257 acres (18%) of the watershed area, as shown with blue/grey diagonal lines in Figure A.16. The deep major bedrock aquifers beneath the watershed yield water containing more than 2,500 milligrams per liter of TSS.

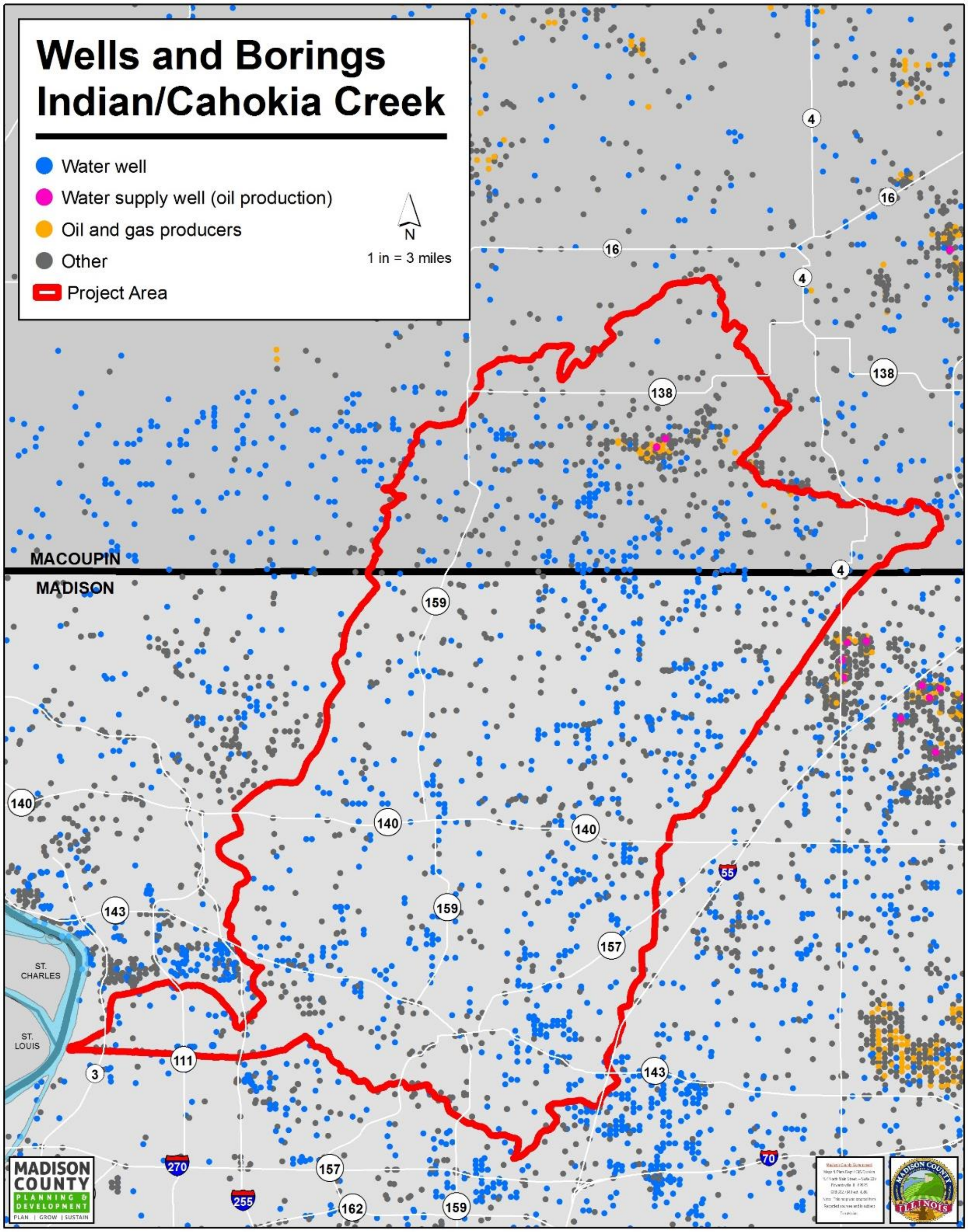
Figure A.16: Known and potential aquifers underlying the Indian-Cahokia Creek Watershed at various depths. These can be viewed online in Illinois SGS's Water Well Interactive Map.



Wells

The Illinois State Geological Survey (ISGS) has documented 1,828 wells and borings in the Indian-Cahokia Creek watershed, of which 868 are water wells (Figure A.17). Permits for drilling have been issued for one additional well.

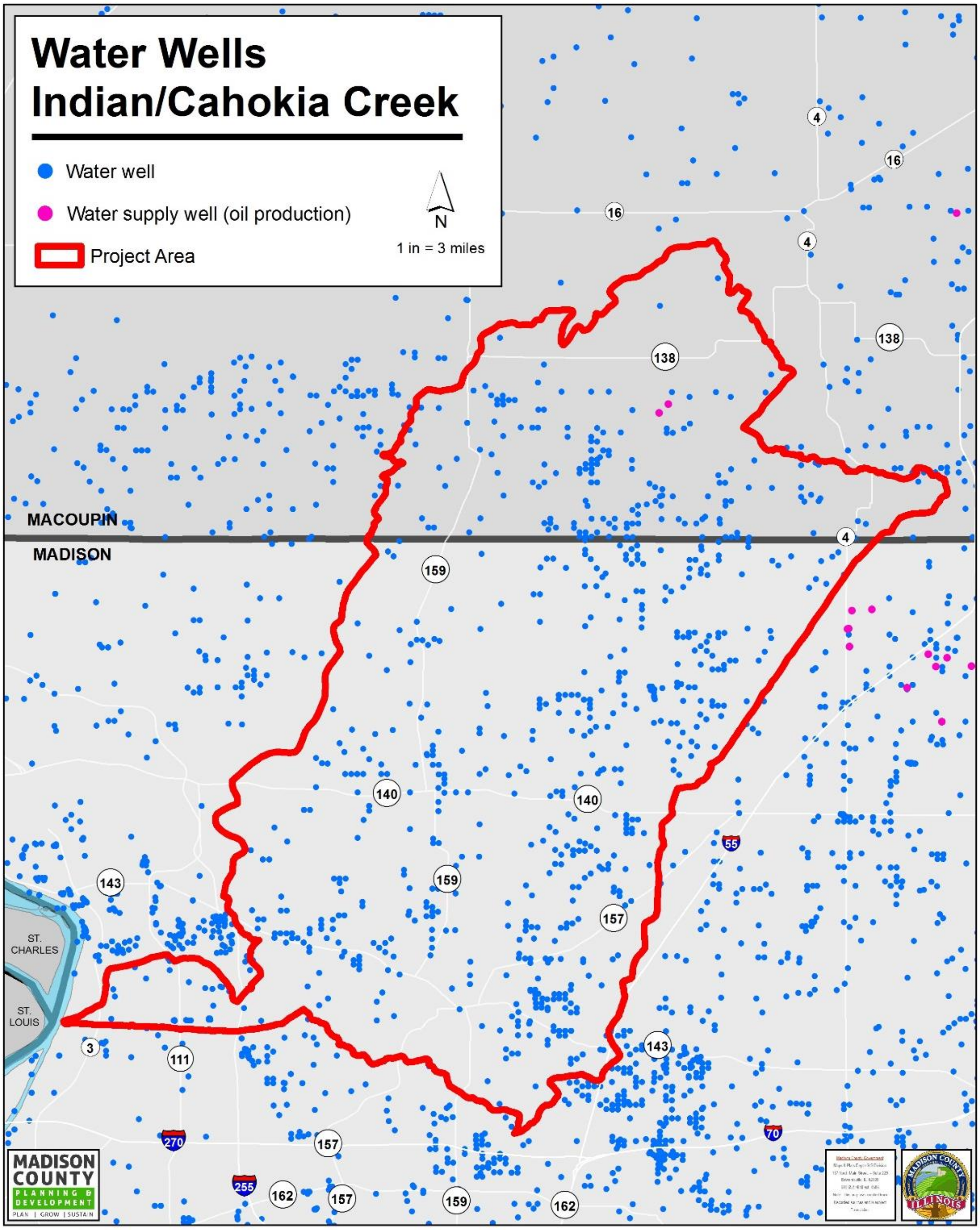
Figure A.17: Wells and borings in the Indian-Cahokia Creek watershed from ISGS's Wells and Borings Database.



Water Wells

Water wells are fairly evenly distributed across the watershed (Figure A.18). (13) The water wells category includes municipal water supply, irrigation, industrial, commercial, and several types of test wells. More detailed information on well types and specifications is available to order from ISGS for a fee. (14)

Figure A.18: Water wells and water supply wells for gas production from the ISGS Wells and Borings Database.



Drinking water

There are 11 drinking water systems in the Cahokia Creek watersheds that supply community water to nearly 95,000 people. This water comes from both ground water and surface water and supplies the counties of Macoupin, Madison, and St. Clair.

Nine out of 19 municipalities obtain their water supply from groundwater from their own wells, most of which are inside the watershed. Only one municipality (Staunton) and one Homeowners Association (Holiday Shores) draw surface water from adjacent reservoirs. The remaining municipalities purchase groundwater or surface water from each other (e.g., Glen Carbon purchases water from Edwardsville) or from water companies such as Illinois American Water, which obtains its supply from the Mississippi River. Private wells supply many individual residences and businesses with water throughout both watersheds, particularly in unincorporated areas.

There are six drinking water supply systems in the Indian-Cahokia Creek watershed, four of which serve Madison County. The other two serve Macoupin County (Table A.4). The population served includes over 27,000 people in the two counties. The Bethalto, South Roxana, and SIUE water systems rely on groundwater, while the Bunker Hill, Dorchester, and Worden systems purchase surface water for use.

Table A.4: Water supply systems with records in USEPA's Safe Drinking Water Information System.

System	Water System ID	Water System Name	County(s) Served	Population Served	Primary Water Source Type*
Community Water	IL1190150	Bethalto	Madison	17,500	Ground water
Community Water	IL1190970	South Roxana	Madison	2,008	Ground water Purchased
Community Water	IL1195550	Southern Illinois University - Edwardsville (SIUE)	Madison	3,500	Ground water Purchased
Community Water	IL1170100	Bunker Hill	Macoupin	2,587	Surface water Purchased
Community Water	IL1170250	Dorchester	Macoupin	550	Surface water Purchased
Community Water	IL1191200	Worden	Madison	936	Surface water Purchased

*Water intake locations were not specified in the EPA records; some systems may withdraw water from outside the watershed (especially purchased water).

Soils

A combination of physical, chemical, and biological variables such as topography, climate, drainage patterns, and vegetation have interacted over centuries to form the complex variety of soils found in the Cahokia Creek watershed. Data provided by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) was used to identify the soil types in the watershed. There are 127 soil types present in the watershed, each of which has a designated hydrologic soil group, hydric soil category, and erodible soil category. See full table of soil types and their attributes in the Data Tables section.

Hydrologic soil groups

Soils are classified by the Natural Resource Conservation Service into Hydrologic Soil Groups (HSGs) based on their infiltration and transmission (permeability) attributes. The ease with which certain soils drain water affects groundwater recharge and the type and location of suitable infiltration management measures (such as detention basins) at a given site.

HSGs are classified into four primary categories (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The soil texture, drainage description, runoff potential, infiltration rate, and transmission rate of the four primary categories are identified in Table A.5. Sandy type A soils drain much better and allow more infiltration than clay type D soils.

Soil type data was acquired from the USDA Soil Survey Geographic database (SSURGO) file. The SSURGO data for the project area included 127 soil types. The NRCS county level Soil Surveys contain definitions of the soil types and note the HSG of each soil type. This corresponding data was joined to the SSURGO map layer to create maps of the HSG categories of soils in the watershed.

Table A.5: The four primary Hydrologic Soil Groups (HSGs) and their texture, drainage description, runoff potential, infiltration rate, and transmission rate.

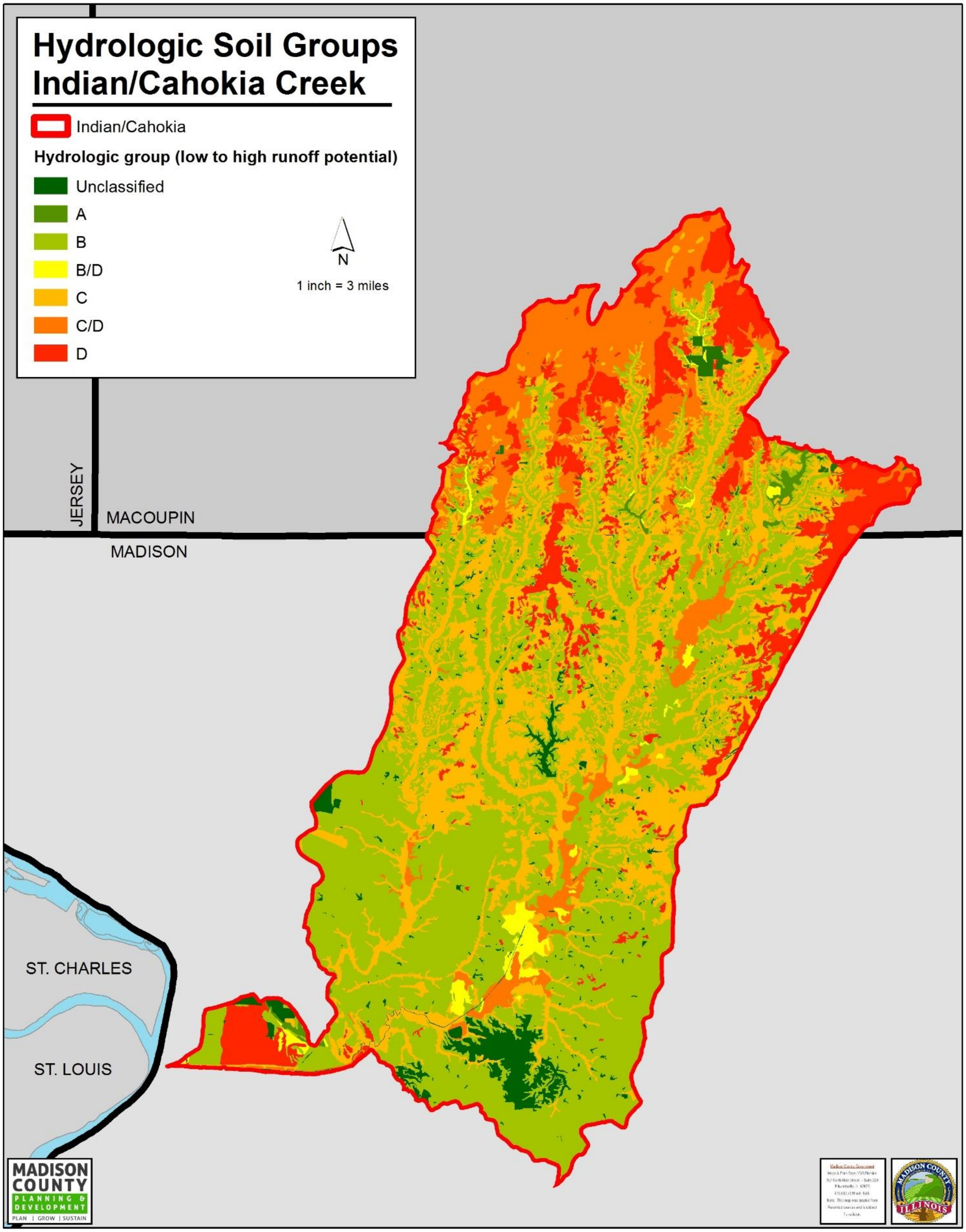
HSG	Soil Texture	Drainage Description	Runoff Potential	Infiltration Rate	Transmission Rate
A	Sand, Loamy Sand, or Sandy Loam	Well to excessively drained	Low	High	High
B	Silt Loam or Loam	Moderately well to well drained	Moderate	Moderate	Moderate
C	Sandy Clay Loam	Somewhat poorly drained	High	Low	Low
D	Clay Loam, Silty Clay Loam, Sandy Clay Loam, Silty Clay or Clay	Poorly drained	High	Very Low	Very low

Hydrologic soil groups (HSG) B and C are the most prevalent HSGs in the watershed, each covering 32% of its area (Table A.6). See Data Tables section for a breakdown of hydrologic soil groups by HUC14 sub watershed. Group D soils are most prevalent in the northern and eastern edges of the watershed, along with a sizable portion of the canal/watershed exit area (Figure A.19). Group B soils cover large swaths of land in the middle of the watershed. Group C soils, which drain somewhat poorly and have low infiltration, are distinctly located along the waterways of Indian Creek and its tributaries. Unclassified soil group areas include water, miscellaneous water, urban land, or dumps.

Table A.6: Hydrologic soil groups including acreage and percent of watershed. Unclassified soil group areas are listed as water, miscellaneous water, urban land, or dumps.[37, 38, 39, 40]

Hydrologic Soil Group	Area (acres)	Percent of watershed
Unclassified	2,353	1.9%
A	610	0.5%
B	40,899	32.5%
B/D	9,905	7.9%
C	40,757	32.4%
C/D	20,751	16.5%
D	10,424	8.3%
Grand Total	**125,699**	**100%**

Figure A.19: Hydrologic soil groups in the Indian-Cahokia Creek watershed.



Hydric soil types

Hydric soils are soils that are wet frequently enough to periodically produce anaerobic conditions. They generally form over poorly drained clay material associated with marshes and other wetlands. The locations and attributes of existing wetlands are discussed in the Land Use/Land Cover section. The species composition and growth of vegetation growing on hydric soils is distinct from non-hydric soils. Hydric soils not only indicate the presence of existing wetlands but also of drained wetlands where restoration may be possible.

Hydric soils were identified through the three NRCS county level Soil Surveys, which identify hydric soils by soil type. A hydric soil designation was then joined to the SSURGO map layer to identify the acreage and location of hydric soils in the watershed (Figure A.20). Twenty-two soil types in the watershed were identified as hydric soils, covering a total area of 21,228 acres (Table A.7). Full data on soil types in the watershed and their hydric status is included in the Data Tables section.

Hydric soils constitute 17% of the soils in the watershed (Table A.8). Soils in areas of water, urban land, and dumps were considered to be non-hydric. See Data Tables section for a breakdown of hydric soils by HUC14 sub watershed.

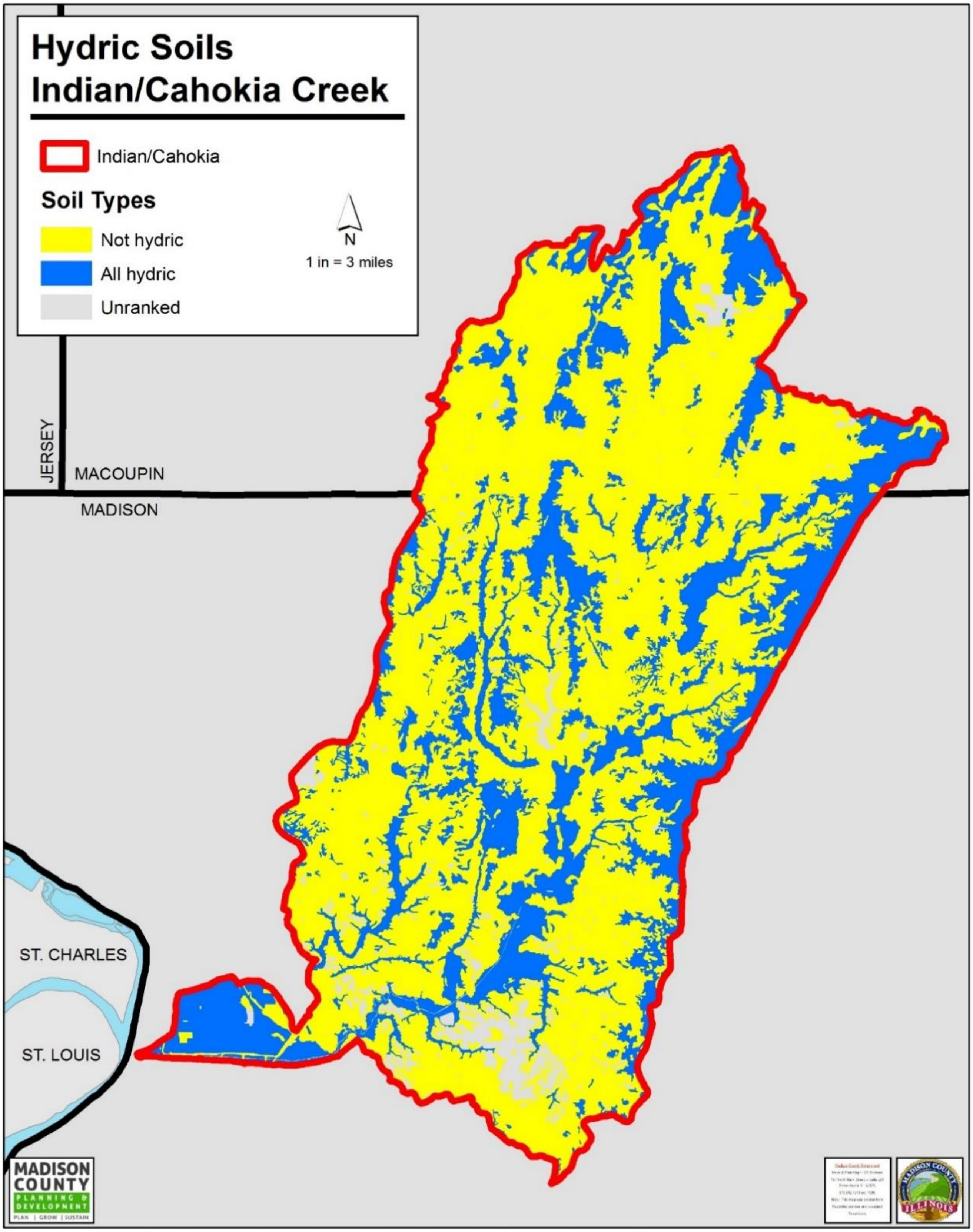
Table A.7: Soil types and their hydric status and acreage in the Indian-Cahokia Creek watershed.

Map Symbol Code	Soil Type (SSURGO map unit name)	Hydric Soil?	Hydric Soils area (acres)
1070L	Beaucoup silty clay loam undrained 0-2% slope occasionally flooded long duration	Yes	**155**
112A	Cowden silt loam 0-2% slope	Yes	**220**
165A	Weir silt loam 0-2% slope	Yes	**119**
16A	Rushville silt loam 0-2% slopes	Yes	**709**
3070A	Beaucoup silty clay loam 0-2% slope frequently flooded	Yes	**1,146**
3071L	Darwin silty clay, 0 to 2 percent slopes, frequently flooded, long duration	Yes	**9**
3076A	Otter silt loam, 0 to 2 percent slopes, frequently flooded	Yes	**31**
3107A	Sawmill silty clay loam, 0 to 2 percent slopes, frequently flooded	Yes	**19**
31A	Pierron silt loam 0-2% slope	Yes	**99**
3334A	Birds silt loam 0-2% slope frequently flooded	Yes	**3,351**
385A	Mascoutah silty clay loam 0-2% slope	Yes	**1,315**
474A	Piasa silt loam 0-2% slope	Yes	**124**
50A	Virden silt loam 0-2% slope	Yes	**763**
657A	Burksville silt loam 0-2% slope	Yes	**139**
703A	Pierron-Burksville silt loams 0-2% slope	Yes	**459**
8070A	Beaucoup silty clay loam, 0 to 2 percent slopes, occasionally flooded	Yes	**263**
8071L	Darwin silty clay, 0 to 2 percent slopes, occasionally flooded, long duration	Yes	**1,221**
8302A	Ambraw silty clay loam, 0 to 2 percent slopes, occasionally flooded	Yes	**163**
8591A	Fults silty clay, 0 to 2 percent slopes, occasionally flooded	Yes	**13**
8831A	Fluvaquents, clayey, 0 to 2 percent slopes, occasionally flooded	Yes	**114**
885A	Virden-Fosterburg silt loams 0-2% slope	Yes	**3,116**
993A	Cowden-Piasa silt loam 0-2% slope	Yes	**7,680**
Total			**21,228**

Table A.8: Hydric soils by acreage and percentage

Hydric Soil	Area (acres)	Percent of Watershed (%)
Hydric Soils	21,228	16.9%
Non-Hydric Soils	102,379	81.4%
Unknown	2,092	1.7%
Total	**125,699**	**100%**

Figure A.20: Hydric and non-hydric soils in the Indian-Cahokia Creek watershed.



Highly erodible soils

Over time, soils exhibit some degree of risk of erosion from water and wind. Certain soils are highly erodible due to a combination of natural and human-influenced factors. Some of the natural properties of soils that make them susceptible to erosion include low permeability (<0.6 in/hour), high silt content (soil particles that measure between 0.002 to 0.53 mm diameter), significant slope (>5%), and low water holding capacity. Human activities that affect soil erosion include agriculture—especially tillage operations, livestock grazing, urbanization, and construction. No single soil property determines whether or not a soil will erode. Rather, it is a combination of all properties interacting simultaneously. The NRCS uses the Universal Soil Loss Equation (USLE) to calculate a potential average annual rate of sheet and rill erosion. That value is divided by a predetermined soil loss tolerance level (T) to determine if a soil is highly erodible. Variables that are inputted into the USLE include rainfall, the degree to which a soil resists water erosion, slope length, and slope steepness to determine the potential average annual rate of sheet and rill erosion. The T-level represents the maximum annual rate of soil erosion that could occur without causing a decline in long-term productivity.

The Madison County Soil Survey was used as the primary reference for identifying highly erodible soils in the Cahokia Creek watershed. The soil survey is the most authoritative source of soils data for the watershed because it is was developed with a considerable amount of field observations combined with GIS modeling. Calculations based solely on GIS modeling can overestimate or underestimate the extent of actively eroding soils. The Madison County Soil Survey identifies which soils are currently classified as eroded or severely eroded. These soils all shared the similar properties of steep slopes (five to 18%) and high silt content (55 to 72%). Several soil types that exhibited these same properties but were not currently classified as eroded or highly eroded were also added to the list of highly erodible soils.

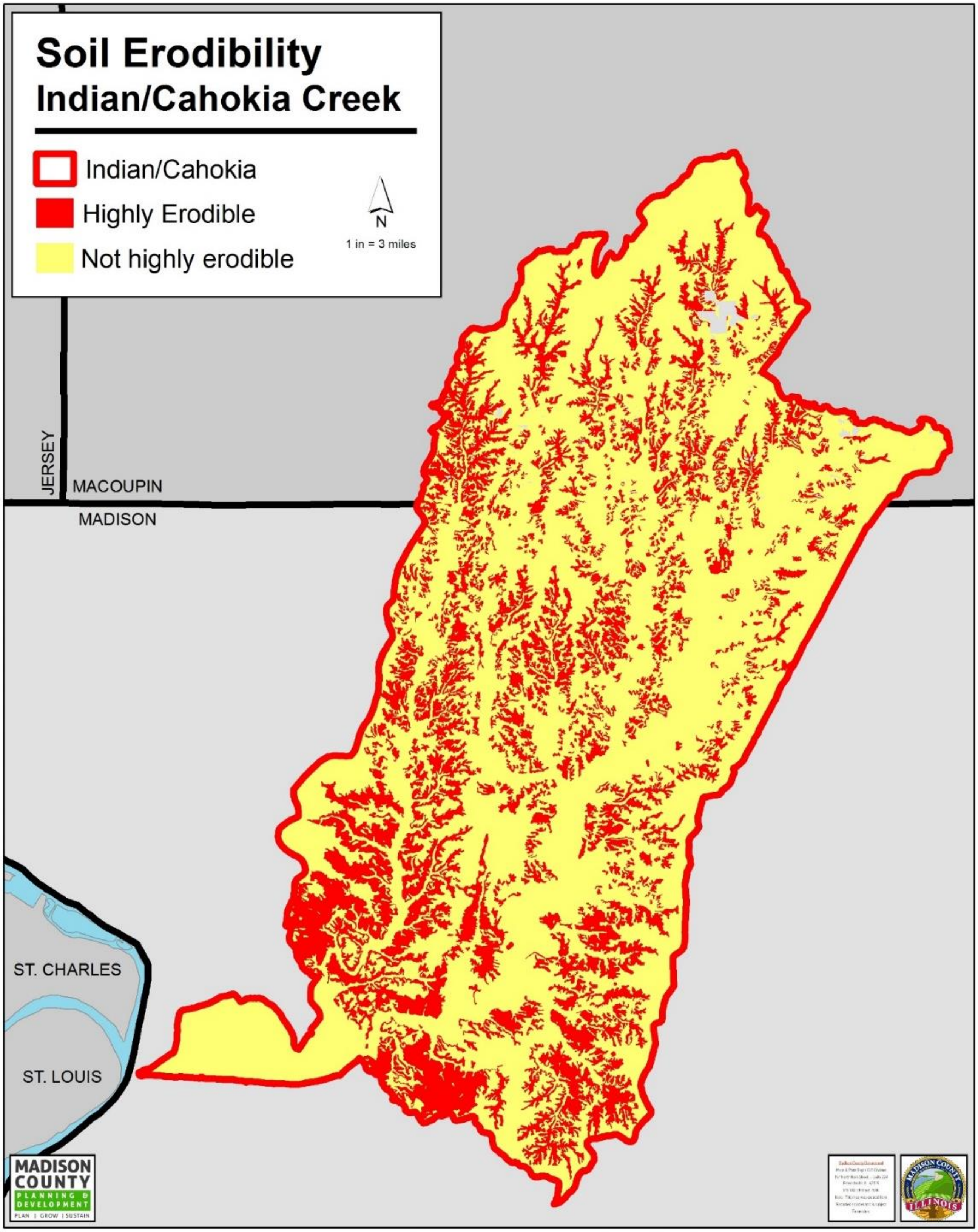
Highly erodible soils are present throughout the watersheds, particularly on steep slopes (Figure A.21). A strong correlation between slope and high erodibility can be seen in the maps for these factors.

A large area of soils that do not readily erode are present in the southwest portion of the watershed immediately north of the Cahokia Diversion Canal (Table A.9). These soils are also present throughout the watershed, noticeably on the outlying areas of the watershed and a section on the east side of the watershed that runs at an angle from the northwest corner of the watershed to the south central portion of the watershed, along the Cahokia Creek stream corridor.

Table A.9: Soil erodibility by area and percentage in the watershed.

Erodibility	Acres	Percentage of Watershed
Not erodible	97,199	77%
Erodible	26,344	21%
Unknown	2,128	2%
Total	**125,671**	**100%**

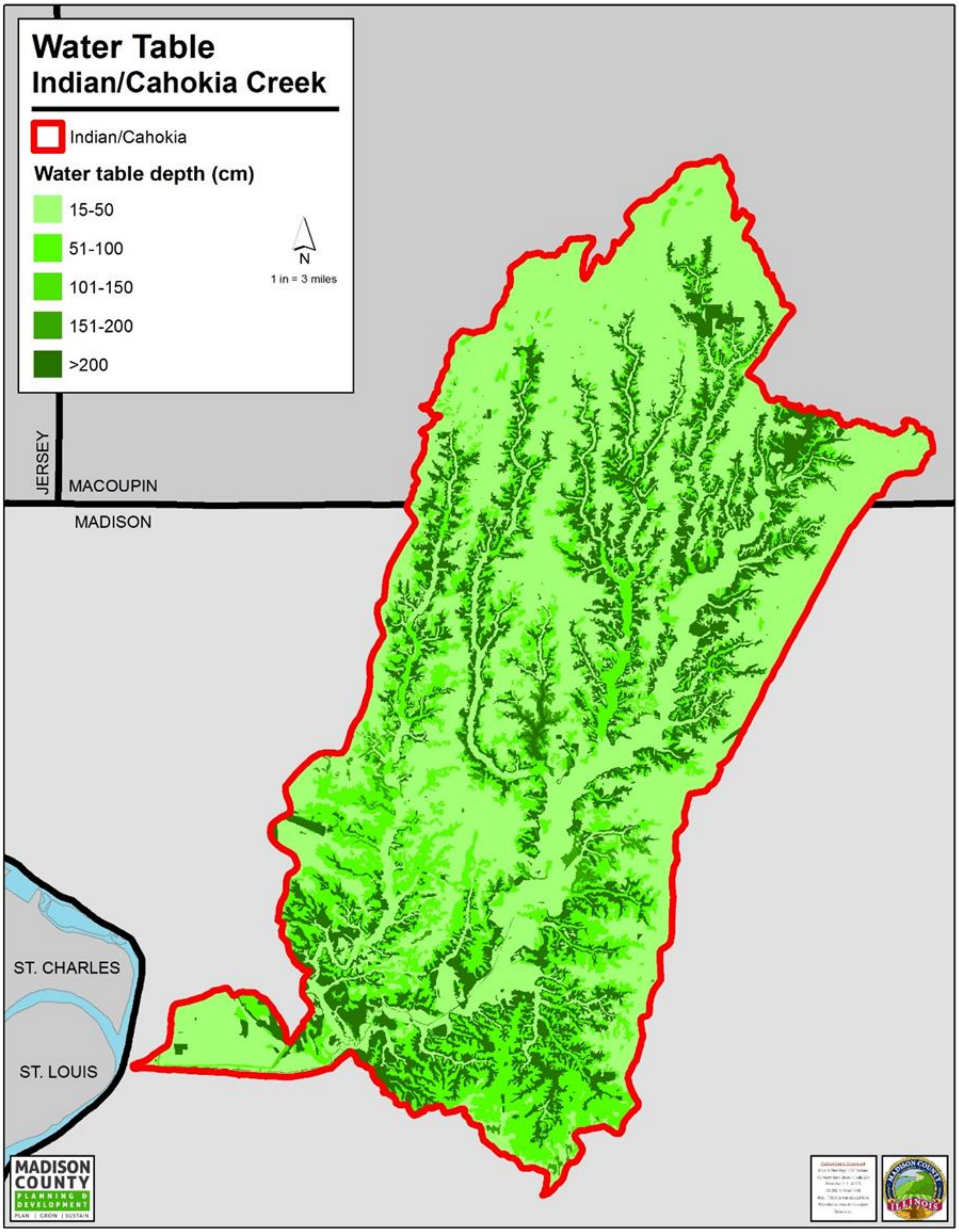
Figure A.21: Highly erodible soils, identified using erodibility classifications from the Madison County Soil Survey for the Indian-Cahokia Creek watershed.



Water Table

The depth of the water table is <50 centimeters (cm) in the soils covering 51% of the watershed (Figure A.22). The soils in 34% of the watershed have a water table 200 cm or more below the surface.

Figure A.22: Water table depths by soil type according to Madison County soil surveys for the Indian-Cahokia Creek watershed.



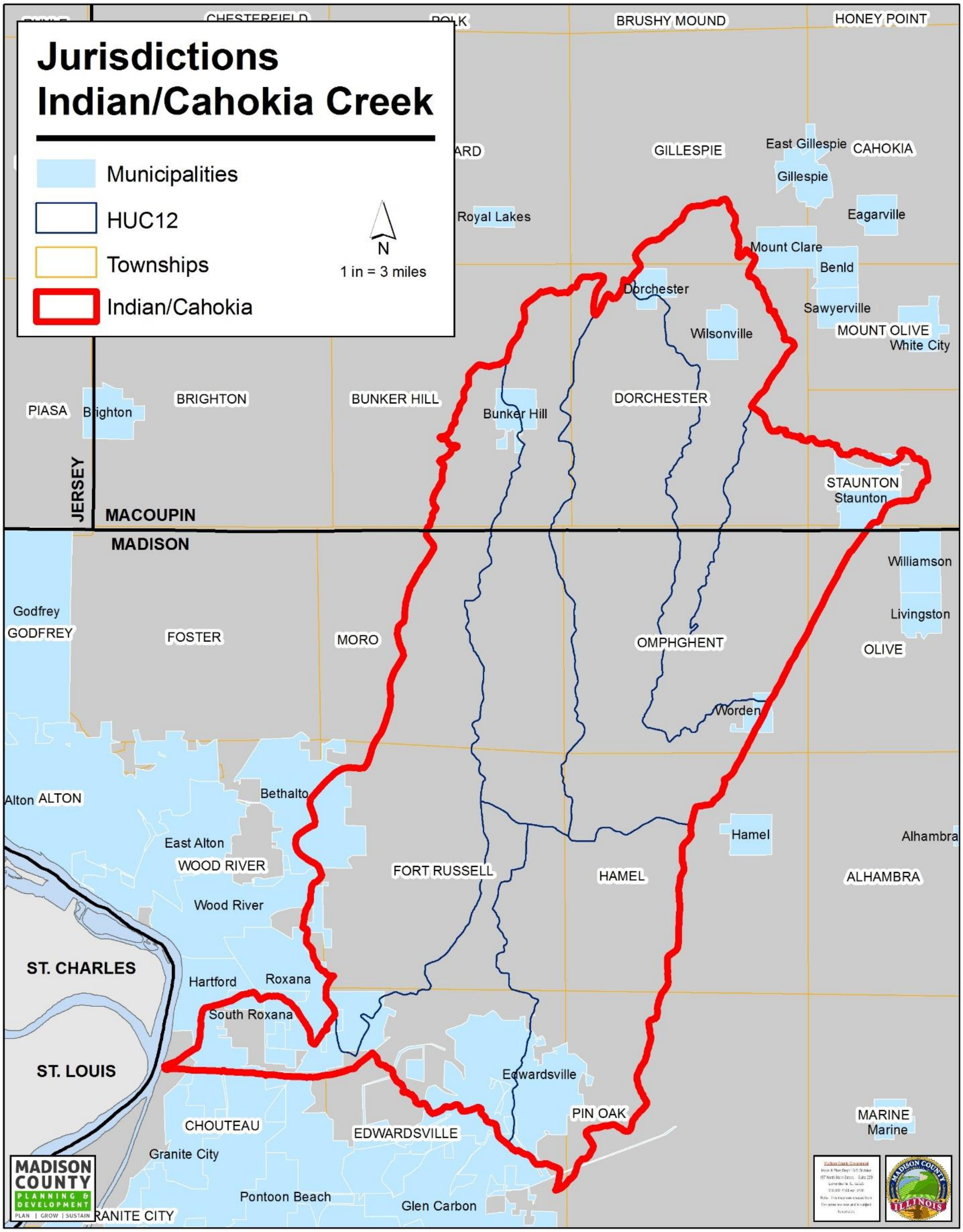
Watershed Jurisdictions

The Indian-Cahokia Creek watershed is located in two counties, 13 townships, and 12 municipalities (Table A.10 and Figure A.23).

Table A.10: County, township, unincorporated, and municipal jurisdictions within the Indian-Cahokia Creek watershed.

Jurisdiction	Area (acres)	Area within watershed (acres)	% of Watershed
County (inclusive of municipalities)	1,029,628	125,699	100%
Macoupin	555,563	36,053	29%
Madison	474,065	89,646	71%
Municipalities	28,779	13,349	11%
Bethalto	4,216	1,609	1%
Bunker Hill	756	756	1%
Dorchester	458	457	0%
Edwardsville	9,004	5,249	4%
Glen Carbon	4,805	195	0%
Hartford	2,527	962	1%
Roxana	4,439	2,088	2%
South Roxana	1,053	599	0%
Staunton	1,521	1,434	1%
Wilsonville	619	619	0%
Wood River	3,839	297	0%
Worden	406	278	0%
Unincorporated Areas	131,0454	112,350	89%
Macoupin County	537,098	9,303	7%
Madison County	337,819	34,625	28%
Townships	279,115	125,869	100%
Bunker Hill (Macoupin County)	24,752	9,260	7%
Chouteau	20,715	3,481	3%
Dorchester (Macoupin County)	24,410	21,524	17%
Edwardsville	22,962	11,396	9%
Fort Russell	23,222	22,592	18%
Gillespie	21,876	1,832	1%
Hamel	22,942	11,774	9%
Moro	21,222	14,052	11%
Olive	20,102	1,200	1%
Omphghent	21,887	20,328	16%
Pin Oak	23,451	4,573	4%
Staunton (Macoupin County)	13,831	2,923	2%
Wood River	17,743	934	1%

Figure A.23: County, township, unincorporated and municipal jurisdictions within the Indian-Cahokia Creek watershed.



Jurisdictional roles

Several government entities at federal, state, and local levels have jurisdiction over watershed protection.

Federal and State Entities

The U.S. Army Corps of Engineers (USACE) regulates wetlands through Section 404 of the Clean Water Act. Buffers or wetland mitigation are commonly required for developments that impact wetlands. USACE also regulates land development affecting water resources (rivers, streams, lakes, wetlands, and floodplains) when "Waters of the U.S." are involved, a category that includes any wetland or stream/river that is hydrologically connected to navigable waters. Counties also regulate wetlands and other aspects of stormwater management through county Stormwater Ordinances. (15)

The U.S. Fish and Wildlife Service (USFWS), Illinois Department of Natural Resources (IDNR), Illinois Nature Preserves Commission (INPC), and Forest Preserve Districts play a critical role in protecting high quality habitat and threatened and endangered species, often on land that contains wetlands, lakes, ponds, and streams.

The Illinois Environmental Protection Agency (IEPA) Bureau of Water regulates wastewater and stormwater discharges to streams, rivers, and lakes through the National Pollutant Discharge Elimination System (NPDES). The NPDES Phase I Stormwater Program applies to large and medium-sized Municipal Separate Storm Sewer Systems (MS4's), several industrial categories, and construction sites hydrologically disturbing five acres of land or more. The NPDES Phase II program covers additional MS4 categories, additional industrial coverage, and construction sites hydrologically disturbing more than one acre of land. Under the NPDES Phase II program, all municipalities with small, medium, and large MS4's are required to complete a series of Best Management Practices (BMPs) and measure goals for six minimum control measures, including public education and participation, illicit discharge detention, construction site runoff control, and pollution prevention. (16)

For construction sites over one acre in size, which are covered by the NPDES Phase II Program, the developer or owner must comply with all requirements including developing a Stormwater Pollution Prevention Plan (SWPPP) that shows how the site will be protected to control erosion and sedimentation and completing final stabilization of the site. Several municipalities and companies in the Cahokia Creek watersheds have been issued NPDES permits by Illinois for stormwater discharges to MS4s.

The county Soil and Water Conservation Districts (SWCDs), under NRCS, influence watershed protection through soil and sediment control and pre and post- development site inspections. They also provide technical assistance to regulatory agencies and the public.

Local Government

Watershed protection in Madison and Macoupin counties is primarily the responsibility of county and municipal level government. County Boards oversee decisions made by county governments and have the power to adopt, override, and alter policies and regulations. County departments, especially those with functions of planning, zoning, and development, help shape the policies enacted in the unincorporated areas. Local municipalities also have ordinances that address other natural resource issues, which can include conservation development, Special Service Area (SSA) or watershed protection fees, and native landscaping.

Land development in unincorporated Madison County is regulated by the Madison County Planning and Development Department. Madison County enforces floodplain development regulations in its Zoning Ordinance, construction and fill activities in its Fill Ordinance, future development in its Land Use Plan, regulations on new housing subdivisions in its Subdivision Ordinance, and stormwater management regulations in its Stormwater Ordinance. Madison County is also a member of the National Flood Insurance Program (NFIP). Madison County's Stormwater Ordinance (amended in 2007) regulates development activities which alter stormwater flows and enable the County to comply with National Pollutant Discharge Elimination System (NPDES) regulations. The ordinance requires several types of development activity proposed in the unincorporated area of the county to obtain a permit, including any land disturbing activities if the activity is within 25 feet of a river, lake, pond, stream, sinkhole, or wetland. Madison County is also currently in the process of adopting a Stormwater Plan, which will guide future stormwater management activities.

Several municipalities in Madison County have passed similar ordinances. Alhambra, Edwardsville, Glen Carbon, Hamel, Marine, and Worden have passed Subdivision Ordinances and Zoning Ordinances. Alhambra, Edwardsville, and Hamel have also passed Drainage Ordinances. Other municipalities in Madison County may have passed these ordinances as well; these were the participating jurisdictions in the draft Madison County Multi- Jurisdictional All Hazards Mitigation Plan. (5) Many municipalities in the watershed are also members of the NFIP and have passed floodplain ordinances (see Flooding section for more information). The Madison County All-Hazard Mitigation Plan also includes a summary of planning documents in effect for the county and municipalities (Table A.11).

Macoupin County passed a Subdivision Control Ordinance in 2005, which governs review and construction procedures for new subdivisions. The county SWCD is one of the parties with review of new subdivisions. Macoupin County and its municipalities have no standalone stormwater management ordinance, flood damage prevention ordinance, zoning ordinance, land use plan, or erosion management program/policy as of 2010. The county is a member of the NFIP. Two cities in the county, one of which is the City of Staunton, have passed a Zoning Ordinance (in 2009) which regulates aspects of zoning including land use, building regulations, and procedures for approval of new construction. Staunton also passed a Subdivision Control Ordinance in 2005. (6)

Table A.11: Existing planning documents by jurisdiction, of the municipalities in the Indian-Cahokia Creek watershed that participated in the Madison County All-Hazards Mitigation Plan, excerpt from Table 7 in that plan. (5)

Existing Planning Documents	Madison County	Edwardsville	Glen Carbon	Hartford	South Roxana
Plans					
Comprehensive Plan	X	X	X		
Emergency Management Plan	X	X			
Land Use Plan	X	X	X		
Codes and Ordinances					
Building Codes	X	X	X		
Drainage Ordinances	X	X			
Historic Preservation Ordinance	X	X			
Subdivision Ordinance(s)	X	X	X		
Zoning Ordinances	X	X	X		
Maps					
Existing Land Use Map	X	X	X		
Infrastructure Map	X	X	X		
Zoning Map	X	X	X		
Flood-Related					
Flood Ordinance(s)	X	X	X		
Flood Insurance Rate Maps (FIRMs)	X	X			
Repetitive Flood Lost List	X	X			
Elevation Certificates for Buildings	X	X			

Potential projects throughout the watershed

A 2010 Oates Associates report generated for Madison County was used to develop a flooding assessment to advise the Stormwater Commission and contribute to the county Stormwater Plan. The flooding assessment used GIS data review and analysis, community data requests, meetings with individual communities, and FEMA's Flood Insurance Study for the county and flood maps to identify stormwater-related problems. The assessment identified several projects that municipalities had identified to improve their drainage, in categories such as maintenance, dam safety, localized flooding, stream channel flooding, combined sewers, and roadway overtopping.

Table A.12. Oates Associates Project Summary project locations in Indian-Cahokia Creek watershed.

ID	Project Name	Municipality/Township	Project Type	Project Description	Recommended Solution
ED-1	Dunlap Lake Sedimentation	Edwardsville	Maintenance	Sediment and debris accumulation resulting in higher lake levels and reduced accessibility.	Dredging of impoundment area to remove accumulated sediment.
ED-2	Dunlap Lake Dam Safety Analysis	Edwardsville	Dam Safety	Dam safety analysis and design of improvements to spillway structures.	Engineering study.
ED-4	Troy Road Flooding	Edwardsville	Localized Flooding	Roadway flooding in busy commercial area.	Provide additional detention and enlarge existing collection system and drainage channels.
ED-5	Gerber Woods / Willow Creek Drive Overtopping	Edwardsville	Stream Channel Flooding	Undersized culverts result in roadway overtopping which cuts off only access to subdivisions. Roadway stability also compromised.	Pipe culvert enlargement / replacement
ED-6	Delaplaine Branch Stream Channel	Edwardsville	Maintenance	Sediment and debris accumulation resulting in reduced flow capacity and localized flooding.	Routine debris and sediment removal - 15,000 LF of stream channel.
HF-1	East Rand Avenue	Hartford	Localized Flooding	Roadway flooding and subgrade failure	Provide expanded collection system and/or raise roadway profile.
HF-2	7th Street Park	Hartford	Localized Flooding	Flooding of park, walking paths, and roadway	Provide additional detention and enlarge existing collection system and drainage channels.
R-1	Old Alton / Edwardsville Road Ditch	Roxana	Maintenance	Sediment and debris accumulation resulting in reduced flow capacity and localized flooding.	Routine debris and sediment removal - 15,000 LF of stream channel.
R-2	Cahokia Diversion Canal	Roxana	Maintenance	Sediment and debris accumulation resulting in reduced flow capacity and localized flooding.	Routine debris and sediment removal - 15,000 LF of stream channel.
WR-1	Wood River Combined Sewer Flooding	Wood River	Combined sewers	Surcharged sanitary sewers due to stormwater inflow and infiltration.	Inflow and infiltration reduction. Separation of storm inlets and area drains from sanitary system.

Stakeholder Outreach to Municipalities

The planning team met with more than 80 individuals from 33 governmental and non-governmental organizations in fall 2015. Municipalities were asked about their drinking water source(s), wastewater treatment system(s), and flooding, as well as other issues such as erosion, siltation, and water quality. Other stakeholders were asked about these issues in their jurisdiction or on their property.

Wastewater treatment

Municipal wastewater treatment in the Indian-Canteen-Cahokia Creek watershed is largely conducted at facilities within municipal boundaries. At least seven of the 19 municipalities have their own wastewater treatment facility. At least four municipalities send their wastewater to a facility in another jurisdiction for treatment (Maryville, Glen Carbon, Fairview Heights, and Hartford).

Hartford and Wood River have combined sewers (sanitary and stormwater system combined). Several other municipalities acknowledged that leaks in the sanitary sewer infrastructure may inadvertently be creating combined sewers by letting stormwater seep in. Edwardsville indicated that the city treats much more wastewater than it provides as water supply (i.e., 1.85 times the amount of water supplied, based on 2014 data). This shows that a lot of rainwater/groundwater is entering its sanitary sewer system, and it illustrates the huge impact of inflow and infiltration on the sewer infrastructure.

Private sewage systems, such as septic systems, are commonplace within municipal boundaries, and several municipalities indicated plans to extend public sewer lines to these properties in future. Outside of municipal boundaries, nearly all properties have individual private sewage treatment systems. Municipalities and Open House attendees reported occasional bad smells from private sewage systems, which may indicate malfunctioning systems.

Flooding

Urban flooding was probably the most important issue to the municipalities interviewed, and all had experienced at least some flooding in developed areas. Several municipalities and other stakeholders reported flooding in their jurisdictions, on their properties, and on the roads around them. Parts of several municipalities are in the 1% annual chance exceedance floodplain (more so in areas that lie west of the bluff line in the American Bottom area). Several individuals reported more frequent, intense storms, beavers, and logjams as contributing factors to flooding. Hartford has flooding problems when the Mississippi River rises and the gravity drains through the levee are closed. Since the gravity drains are the only feature allowing drainage from Hartford to the river, once the gravity drains close, interior water is unable to discharge to the river, contributing to flooding in Hartford. Residents around Dunlap Lake were spared extreme flood damage from the December 2015/January 2016 floods because they had drawn the lake level down ahead of the storms. This action was taken following the Property Owners Association’s recent assessment of risk and dam failure, which put in place a weather warning system to activate a lake level drawdown. Holiday Lake also avoided flooding during the December/January storms, but only because the lake level had been drawn down weeks ago for dock maintenance (the spillway is too small to reduce water levels quickly on demand).

Dunlap Lake Property Owners Association noted flooding from rivers and creeks as a problem for their operations, and almost all stakeholders were able to point to instances of road overtopping as a result of riverine flooding.

Glen Carbon commissioned and received a Stormwater Management Preliminary Drainage Analysis report in 2014 from Gonzalez Companies, LLC. (17) The report provides preliminary investigation and analysis of sites that have experienced stormwater-related issues. The village solicited information on resident concerns through the use of surveys and a public meeting, and kept lists of complaints from problem areas. The report outlines a prioritized plan for the village to address these issues. Gonzalez also reviewed existing Village of Glen Carbon ordinances and policies related to stormwater and proposed ordinance updates in appendices. Preliminary analysis was conducted at 28 sites, and a total construction cost of $2.45 million was estimated for these sites.

Erosion

Several municipalities highlighted soil erosion issues within their municipal boundaries along creeks and ditches. Bethalto reported severe streambank erosion in residents' backyards. Dunlap Lake Property Owners Association highlighted severe streambank erosion south of the lake, where banks were 25 to 30 feet deep, significantly deeper than expected. Glen Carbon reports erosion on Judy Creek. Through various regulatory site visits, USACE has identified headcutting and incision in tributaries to Dunlap Lake.

At one new development in Edwardsville, the developer/builder failed to implement adequate erosion prevention measures for excavated soils, resulting in significant erosion. Glen Carbon reports severe erosion in a ravine on a city lot, and minor erosion around lakes maintained by HOAs.

Logjams

Two counties and several municipalities and landowners mentioned logjams as an issue in the watersheds. Bethalto reported logjams in a creek that result in water backing up into a neighborhood.

Siltation and Sedimentation

Siltation was an issue for several communities who noticed reduction in the capacity of retention basins and lakes as a result of increasing silt and sediment deposition. Bunker Hill reports ditches silting in alongside roads, reducing their capacity.

Dunlap Lake Property Owners Association (POA) reports that approximately 20,000 cubic yards have been added to the lake over the last 10 years. The problem with the sediment entering Dunlap Lake is that it is very fine-textured subsoil with fine clay particles from farmland upstream. Those particles do not settle out in streams; they only start to settle when they reach the lake (and even then not all will settle out). Farmers have indicated they are not interested in joining the Conservation Reserve Program (CRP), which protects erosive land and offers several BMPs for soil erosion reduction, because they would need to sign 10-year agreements. The Dunlap Lake POA's Silt Committee worked with Horner & Shifrin Engineering to find the best option for dredging and improving the south end silt retention basin to keep the lake from refilling, and came up with a report that maps the coves in the lake with the most significant silt accumulation. The report proposed a silt dewatering basin and a silt retention basin and the POA is working to further explore scope and pricing.

Holiday Lake test studies by SIUE have shown that only a quarter of the sediment entering the lake is pulled out by dredging. The dredged material is purchased by the farmers upstream of the lake, in a closed loop that shows how much topsoil is lost to erosion. Roxana reports siltation at its borrow pits, including a 20-acre borrow pit detention basin.

Surface water quality issues

Water quality issues were noted in seven communities. Several property owners who attended open house events noted litter or trash as an issue within the watershed. (18)

Recreation

Water-based recreation takes place on and around several of the larger lakes and ponds in the watersheds. Dunlap Lake, Holiday Lake, and other lakes and ponds in subdivisions often offer boating and fishing opportunities to neighborhood residents. Holiday Lake allows swimming as well. The Watershed Nature Center, situated on over 40 acres with prairie, forest, and wetland, offers recreational trails, bird- and wildlife watching, and environmental education events. SIUE has miles of bike trails connecting to Madison County Transit (MCT) trails spanning the county.

The I-55 Plan speaks to future recreation in its planning area of approximately 4,800 acres in the I-55 corridor north of its intersection with I-270. Edwardsville has purchased 70 acres for parks in the planning area.

The input from municipalities can be found in Table A.13. (19)

Table A.13: Summary of municipal input from stakeholder engagement. Information on water supply and wastewater treatment for communities not met with is from Safe Drinking Water Information System (SDWIS) and the Integrated Compliance Information System (ICIS) from USEPA.

	Drinking water supply				**Wastewater treatment systems**			**Flooding**		**Other issues**			
Municipality	Municipal Groundwater (wells)	Municipal surface water	Purchased groundwater	Purchased Surface water	Municipal WWTP	Private Sewage	Combined Sewers	Urban flooding	Riverine flooding	Erosion	Siltation	Surface water quality issues	Water-based recreation
Bethalto	X							X		X			
Bunker Hill				X	X	X		X			X	X	
Dorchester													
Edwardsville	X*				X	X	maybe	X		X		X	X
Fairmont City													
Glen Carbon			X			X		X		X			X
Hartford	X						X	X					
Roxana	X				X			X			X	X	
South Roxana			X										
Staunton		X		X									
Wilsonville				X	X			X					
Wood River	X												
Worden				X	X			X					X
Dunlap Lake POA			X*				n/a	X	X	X	X	X	X
Holiday Shores HOA	X					X		X				X	X
SIUE			X										

*Wells are located outside the watershed

**Surface water source is outside the watershed

Demographics

Population

Madison County is the most populous of the two project area counties, with 269,282 people as of 2010. Macoupin County has approximately 47,765 people as of 2010.

The 2010 U.S. Census found a population of approximately 31,561 in the Indian-Cahokia Creek watershed.

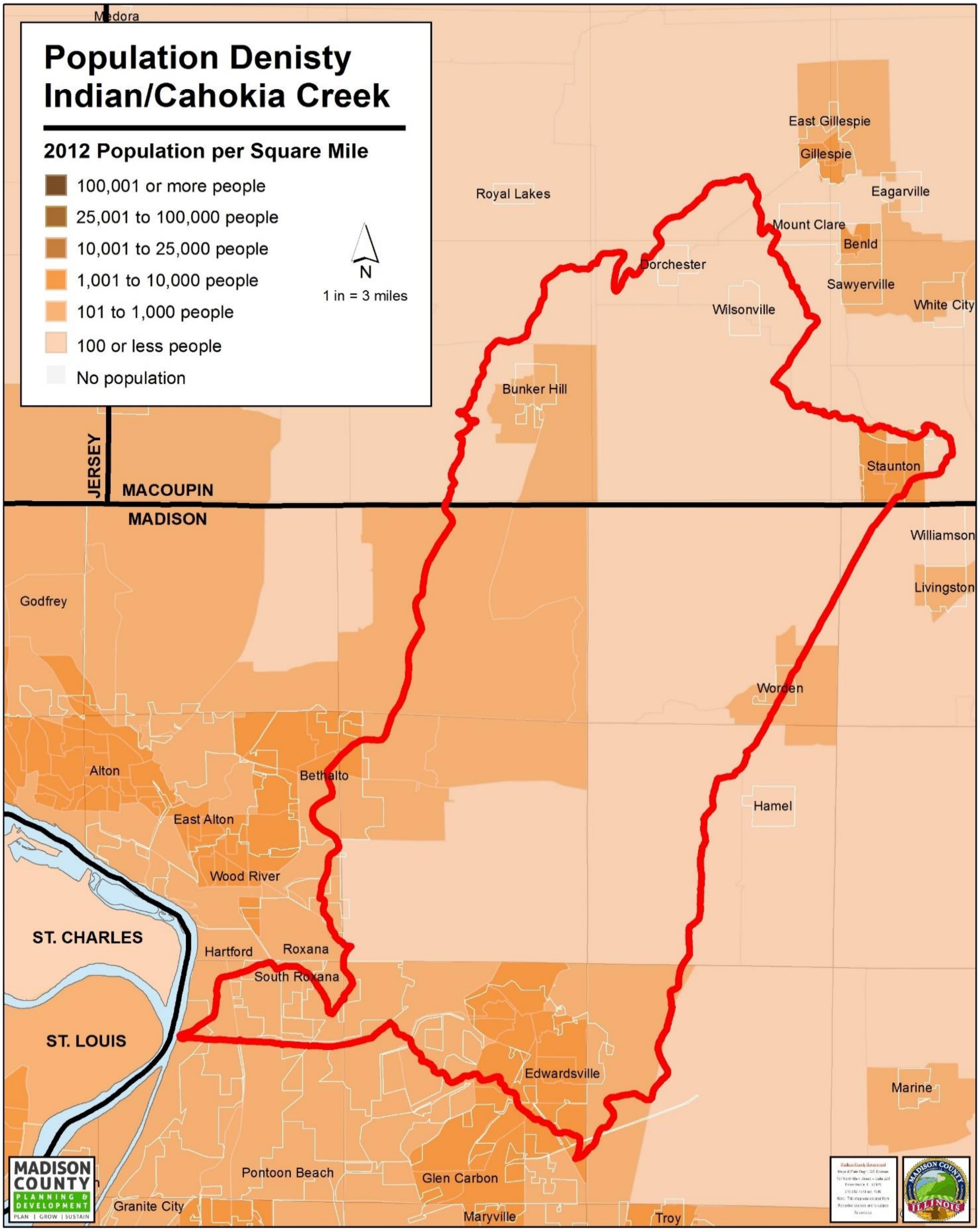
Of the municipalities represented within the project area, Edwardsville has the largest population, with 24,293 people as of the 2010 Census. Glen Carbon, Wood River and Bethalto are the next most populous municipalities, respectively. The least populous municipalities in the project area include Dorchester, Wilsonville, and Worden. Edwardsville has the largest population and the largest proportion of its population in the watershed (Table A.14).

Population density varies throughout the watershed. The average population density within the project area is 100 or fewer people per square mile. The lowest population density is 100 or fewer people per square mile in several of the municipalities, and the highest population density is 1,001 to 10,000 people in Edwardsville and Staunton (Figure A.24).

Table A.14: Population of the municipalities represented in the project area from the 2010 Census, official 2015 population estimate, and approximate population in each municipality living in the watershed.[55]

Municipality	Population (2010 Census)	Population (2015 Estimate)	Approx. Population in the watershed (2010 Census)
Bethalto	9,521	9,349	3,000
Bunker Hill	1,774	1,716	1,774
Dorchester	151	146	151
Edwardsville	24,293	24,992	16,000
Glen Carbon	12,934	12,966	500
Hartford	1,429	1,382	500
Roxana	1,542	1,483	750
South Roxana	2,053	1,997	1,700
Staunton	5,139	5,018	4,850
Wilsonville	586	566	586
Wood River	10,657	10,294	1,000
Worden	1,044	1,028	750

Figure A.24: Population density by census block in the Indian-Cahokia Creek watershed, according to 2012 estimates.



Population Change

Between 2000 and 2010, the population of Macoupoin County declined by 2.8%. However, some of the greatest recent population growth occurred in the Macoupin portion of the watershed.

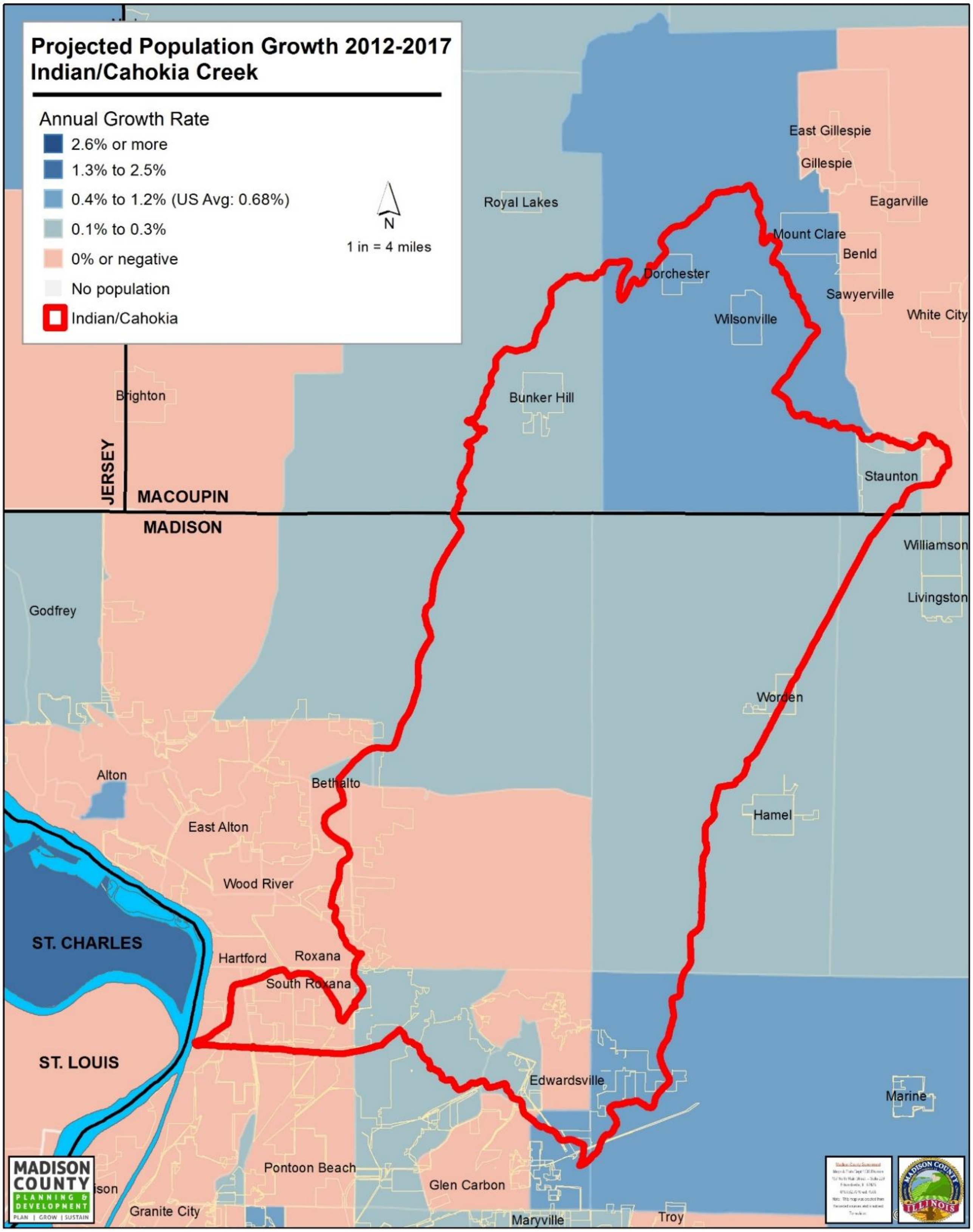
According to U.S. Census projections, two-thirds of the counties in the project area are expected to increase in population by the year 2025. Madison County is projected to experience the largest actual growth (more than 6,778 people) and is projected to experience the greatest percentage increase in population (Table A.15). A different estimate of Madison County's population growth under a slow-growth scenario by the East-West Gateway Council of Governments puts Madison County's population at 290,143 in 2030, a smaller 8.6% increase from 2013.

Ten-year population growth estimates show -2.0% to 2.5% population growth between 2015 and 2025 over much of the project area (Figure A.25). This growth estimate follows the national average annual growth rate for this time period (0.68%). Some parts of the watershed will experience higher growth of 1.0% to 2.5%, while other areas are expected not to grow or to lose population.

Table A.15: Population of the counties represented in the project area from the 2000 and 2010 Censuses, with official 2015 population estimates and 2025 population forecasts, and percent change between 2015 and 2025. (14) (20)

Total Population	2000 Census	2010 Census	2015 Estimate	2025 Forecast	Change from 2015-2025 (# of people)	Percent Change from 2015-2025
Madison County	259,391	269,282	266,209	272,987	6,778	**2.5%**
Macoupin County	49,103	47,765	46,045	45,162	-883	**-2.0%**

Figure A.25: Projected population growth between 2012 and 2017 in the Indian-Cahokia Creek watershed from the U.S. Census 5-year population estimates.



Median Income

Median income can be an indicator of financial ability to make improvements to property, such as improved septic systems. The median family income in Madison County is $52,756. In Macoupin county, the median family income is $48,788 (Table A.16).

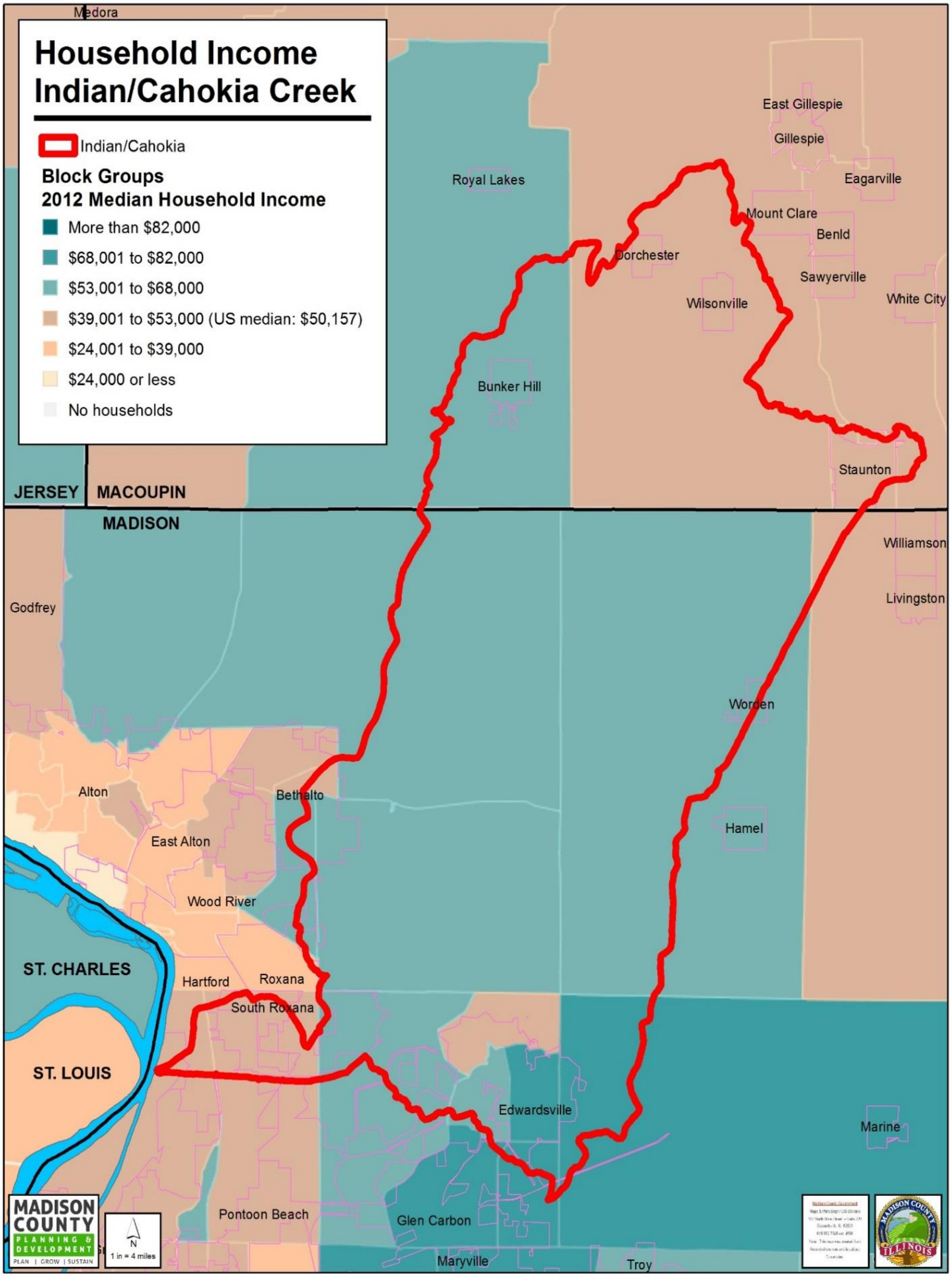
The municipalities with the highest median family income (upwards of $70,000) are Edwardsville and Glen Carbon. The municipalities with the lowest proportion of people with income below the poverty level are Bethalto and Glen Carbon, each with around 10%.

The municipalities with the lowest median family income (less than $46,000) are Bunker Hill, Hartford, Roxana, South Roxana, Staunton, Wilsonville, and Wood River. Roxana, South Roxana, Wilsonville, Worden had the highest percentages of people with income below the poverty level.

Table A.16: Median family income and poverty in the municipalities and counties in the project area. (20)

Community	Median Family Income (2014 inflation-adjusted dollars)	Percentage of people whose income in the past 12 months is below the poverty level (2014)
Bethalto	$60,236	10.8%
Bunker Hill	$45,615	11.4%
Dorchester	$48,750	14.3%
Edwardsville	$70,791	12.1%
Glen Carbon	$69,419	9.8%
Hartford	$42,169	12.2%
Roxana	$43,333	19.1%
South Roxana	$40,107	25.9%
Staunton	$42,835	14.6%
Wilsonville	$28,935	21.3%
Wood River	$43,075	16.6%
Worden	$53,867	19.7%
AVERAGE	**$49,094.33**	**15.65%**
Macoupin County	$48,788	12.5%
Madison County	$52,756	13.9%
AVERAGE	**$50,772.00**	**13.20%**

Figure A.26: Median household income by census block in the Indian-Cahokia Creek watershed.



Employment

Employment can be an indicator of future growth and development in an area. Madison County experienced a 3.0% increase in the number of jobs between 2010 and 2014 (Table A.17). In 2014, the three industry sectors with the largest number of jobs were government (17,053 jobs), retail trade, (15,011 jobs), and health care/social assistance (14,944 jobs). From 2010 to 2014, jobs in service industries grew 4.8%. The sectors that added the most new jobs were transportation and warehousing (1,546 new jobs), administrative and waste services (1,078 new jobs), and manufacturing (1,063 new jobs). The number of government jobs was relatively static, decreasing -1.8%. Jobs in non-service industries shrank -0.3%, from 21,557 to 21,485 jobs.

Macoupin County experienced a -4.1% decrease in the number of jobs between 2010 and 2014. Government jobs decreased the most, from 2,695 to 2,444 (a -9.3% decrease), followed by non-service industry jobs (a -6% decrease) and service industry jobs (a -4.1% decrease). The sectors that added the most jobs between 2010 and 2014 were whole sale trade (70 new jobs) and other services, except public administration (27 new jobs).

Table A.17: Percentage of the workforce working in non-services, services, and government sectors in 2010 and 2014, & percentage change in that time. (21)

	Madison County			Macoupin County		
	2010	2014	% Change 2010-2014	2010	2014	% Change 2010-2014
Percent of Total			*3.0%*			*-4.1%*
Non-Services Related	17.2%	16.6%	-0.3%	˜18.8%	˜18.5%	-˜6.0%
Farm	1.1%	0.9%	-16.4%	7.2%	7.0%	-6.5%
Forestry, Fishing & Related Activities	0.1%	0.1%	-3.4%	N/A	N/A	N/A
Mining (including fossil fuels)	0.3%	0.4%	31.0%	N/A	N/A	N/A
Construction	6.4%	5.4%	-12.8%	6.8%	6.4%	-9.0%
Manufacturing	9.2%	9.8%	9.2%	4.9%	5.0%	-1.2%
Services Related	68.9%	70.2%	4.8%	˜49.6%	˜49.6%	-˜4.1%
Utilities	0.3%	0.4%	25.6%	0.5%	0.5%	-5.1%
Wholesale Trade	2.7%	2.8%	5.2%	5.7%	6.4%	7.3%
Retail Trade	11.8%	11.6%	1.9%	11.4%	11.8%	-0.7%
Transportation & Warehousing	4.8%	5.9%	25.6%	3.6%	3.7%	-0.7%
Information	0.8%	0.7%	-10.3%	0.8%	0.7%	-16.2%
Finance & Insurance	5.3%	5.0%	-2.7%	5.7%	5.6%	-5.6%
Real Estate, Rental & Leasing	3.5%	3.2%	-5.5%	2.8%	2.9%	-0.6%
Professional & Technical Services	4.8%	4.8%	1.9%	3.2%	2.6%	-21.8%
Management of Companies & Enterprises	0.8%	0.6%	-21.8%	˜0.1%	˜0.0%	-˜40.0%
Administrative & Waste Services	4.0%	4.7%	21.5%	˜1.5%	˜1.9%	˜16.3%
Educational Services	1.2%	1.1%	-1.3%	N/A	N/A	N/A
Health Care and Social Assistance	11.8%	11.6%	0.7%	N/A	N/A	N/A
Arts, Entertainment & Recreation	2.4%	2.3%	-3.0%	1.6%	1.3%	-21.7%
Accommodation & Food Service	8.1%	8.6%	9.0%	5.8%	4.9%	-20.2%
Other Services (except public admin.)	6.6%	7.0%	8.4%	6.9%	7.3%	2.3%
Government	13.9%	13.2%	-1.8%	16.1%	15.2%	-9.3%

All employment data are reported by place of work. Estimates for data that were not disclosed are indicated with tildes (~).55

Home Values

Investment and development in the Cahokia Creek watershed has brought more people to buy homes here to be near their place of work, local schools, and other amenities. Home values are an indication of a location's desirability, the income of community residents, and the tax base local governments have to support themselves and their activities, among other things. Changes in home values over time can show movement from a buyer's to a seller's market, or vice versa.

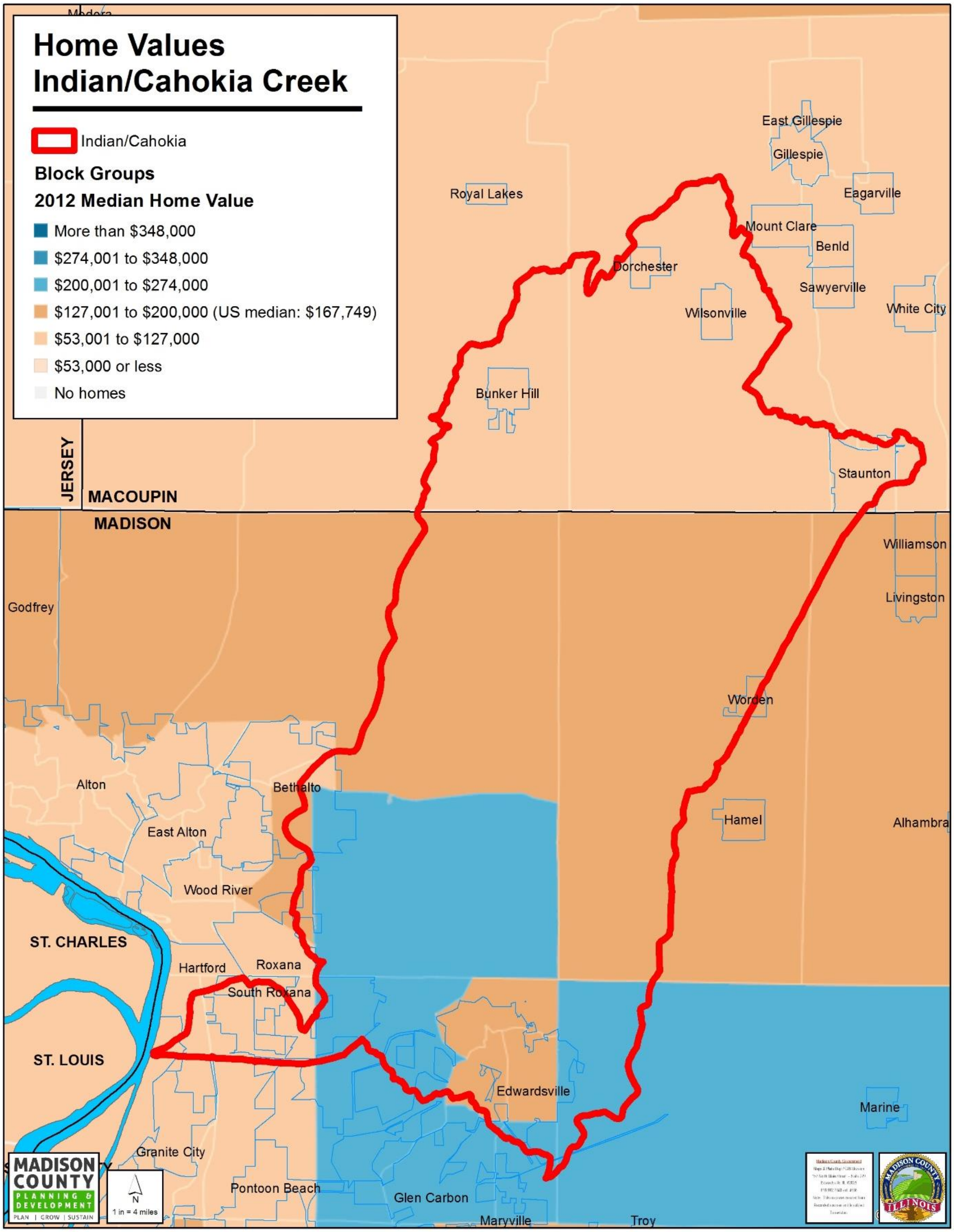
Estimates mapped by ESRI in 2012 show that median home values in the watershed are generally higher in the southern part of the watershed than in the north (Figure A.27). (22) According to data from housing website Zillow.com, the average median home price in the municipalities in the project area is $107,512.50 (Table A.18). Some of the municipalities experienced a decrease in home values over the past year, and the prediction for next year is a 0.18% increase.

Few homes in the watershed have negative equity, meaning the market value of the property has fallen below the outstanding amount of the mortgage secured on it. The percentage is similar to the U.S. average of 0.1% (as of June 2016). Approximately 0.0% of homes are delinquent on their mortgages in the three counties, which is the same as the 0.0% U.S. average (as of June 2016).

Table A.18: Home values, recent and predicted change in home values, and percentages of homes with negative equity and that are delinquent on their mortgages. (23)

Community	Median home value	Change in home values	Predicted change in home values	Homes with negative equity	Delinquent on mortgage
Bethalto	$113,400	5.20%	2.90%	0.20%	0.00%
Bunker Hill	No data	No data	No data	0.30%	0.00%
Dorchester	No data	No data	No data	No data	No data
Edwardsville	$172,900	2.00%	2.40%	0.10%	0.00%
Glen Carbon	$181,500	4.90%	3.10%	0.10%	0.00%
Hartford	$47,200	-7.30%	1.00%	0.30%	0.30%
Roxana	$64,100	-0.50%	1.40%	0.30%	0.10%
South Roxana	$55,400	0.40%	2.30%	0.30%	0.10%
Staunton	No data	No data	No data	0.30%	0.00%
Wilsonville	No data	No data	No data	0.30%	0.00%
Wood River	$68,500	-3.10%	0.90%	0.30%	0.10%
Worden	$157,100	-0.20%	1.90%	0.10%	0.00%
AVERAGE	**$107,512.50**	**0.18%**	**1.99%**	**0.22%**	**0.05%**
Macoupin	No data	No data	No data	0.30%	0.00%
Madison	$105,200	3.50%	2.30%	0.20%	0.00%
St Clair	$89,200	4.70%	2.30%	0.30%	0.00%
AVERAGE	**$97,200.00**	**4.10%**	**2.30%**	**0.27%**	**0.00%**

Figure A.27: Median home values from 2012 by census block for the Indian-Cahokia Creek watershed. (22)

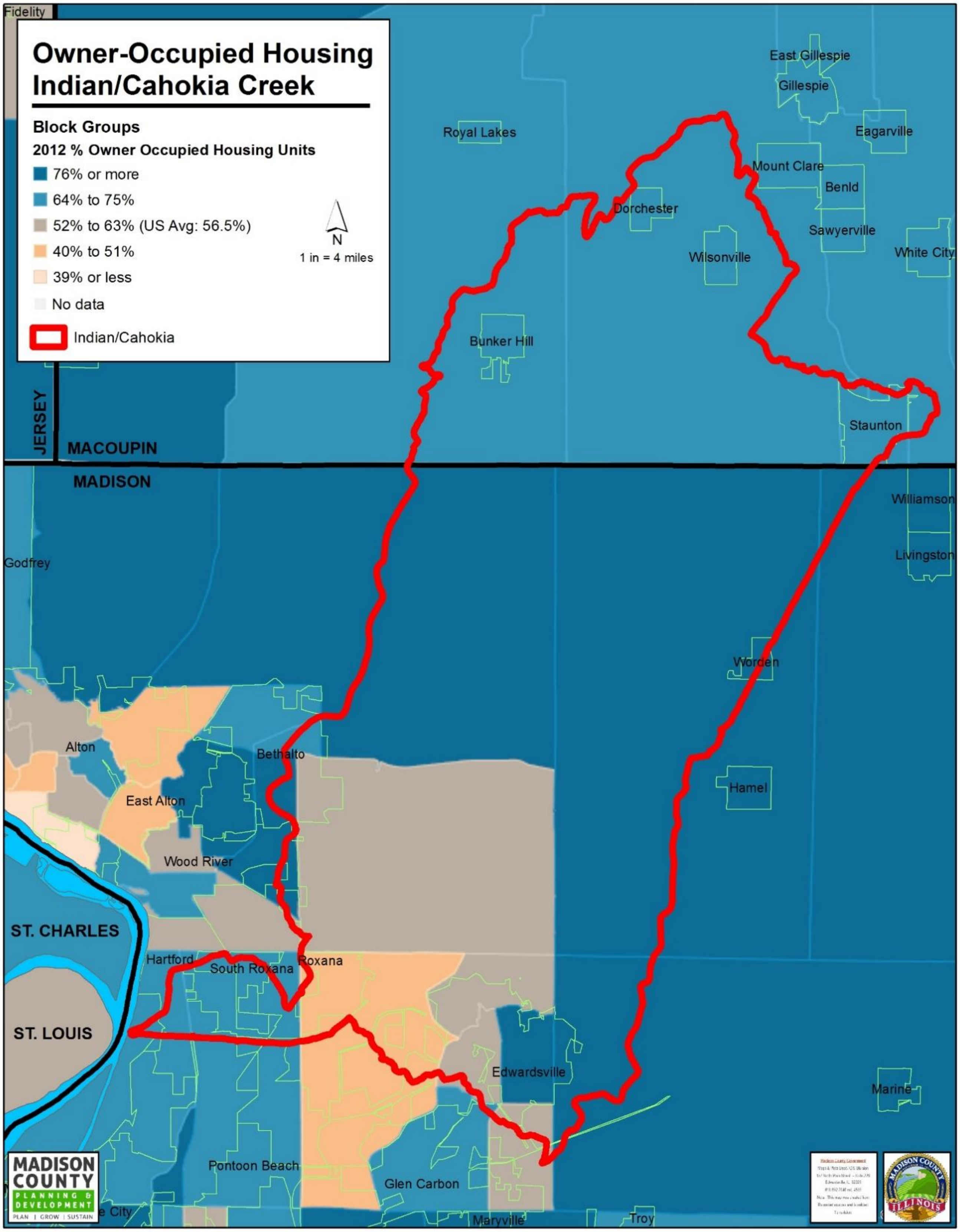


Owner-Occupied Housing

Homeownership rates can indicate transience or financial stability in a population. The U.S. Census Bureau defines the homeownership rate as the percentage of homes that are occupied by the owner, and presents homeownership data for states and major metropolitan areas. In Illinois, homeownership rates have declined over the past 10 years. This change followed national trends associated with the economic recession and housing market collapse of the mid-2000s and the tendency for the millennial generation to rent homes instead of purchasing.

Owner occupied housing rates are at 64% or more across most of the watersheds as of 2012, which is higher than the national average of 57%. The St. Louis Metropolitan Area average is 71.2%. Rates are lower in municipalities, such as Edwardsville and Roxana, presumably as a result of the increased availability and demand for rental housing available in more urbanized areas (Figures A.28).

Figure A.28: Percent of owner occupied housing in 2012 by census block in the Indian-Cahokia Creek watershed.



Land Use/Land Cover

Land use/land cover data for the Indian-Cahokia Creek watershed was collected from the 2011 National Land Cover Database (NLCD). Cultivated crops are the most common land use in the watershed at 52,594 acres or 43% (Table A.19). Other common land uses include deciduous forest (31,286 acres, 25%), pasture/hay (18,427 acres, 15%), developed, open space (9,277 acres, 7%), and developed, low intensity (7,650 acres, 6%). Urbanized areas are distributed throughout the watershed, but the largest urbanized area is located in the south portion of the watershed (Figure A.29) around Edwardsville and Glen Carbon. Other land use areas that are a small percentage of the total watershed include high intensity development, open water, barren land, evergreen forest, grassland/herbaceous, woody wetlands, and emergent herbaceous wetlands.

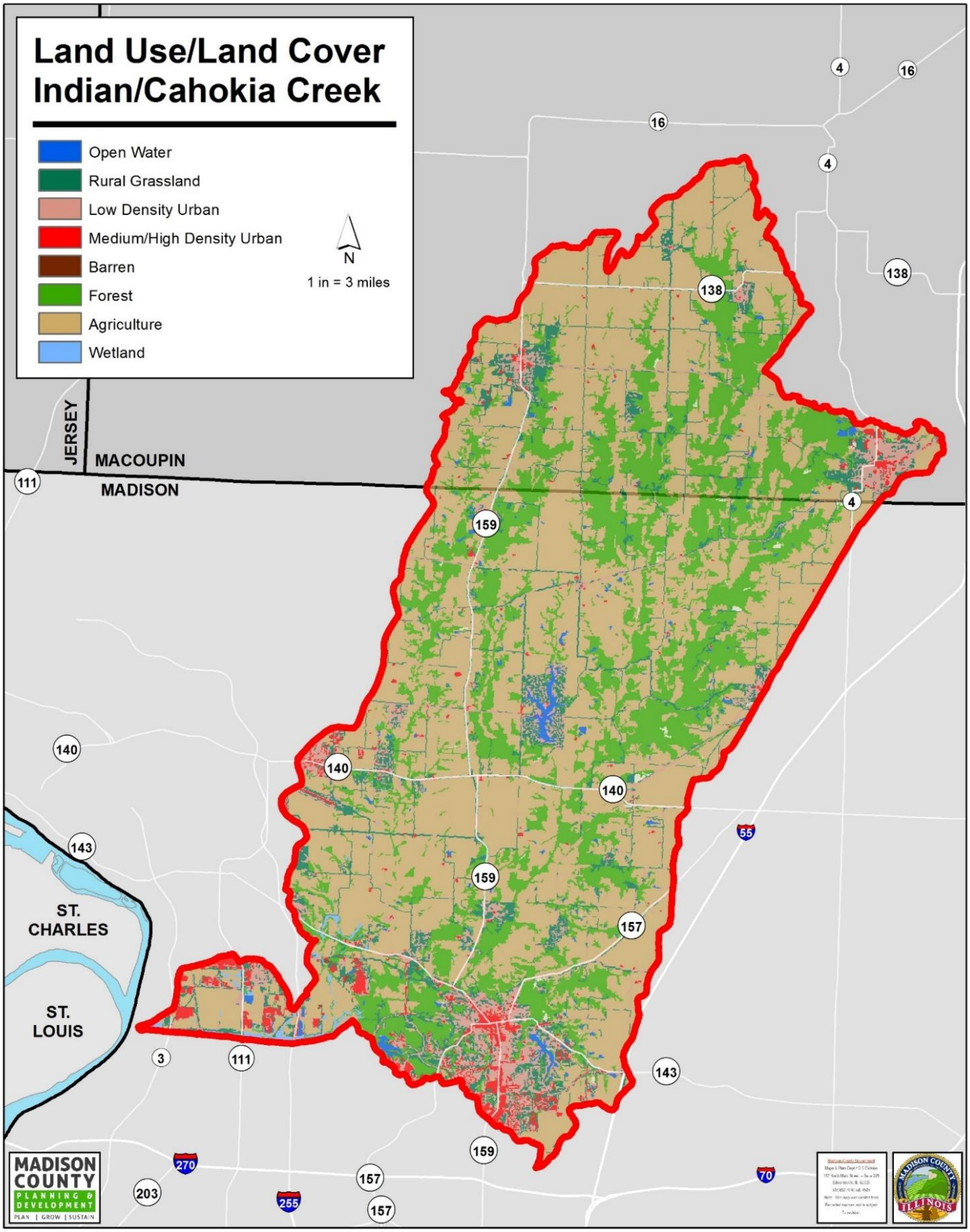
See Data Tables section for a detailed breakdown of land use by HUC14.

Table A.19: 2011 land use/land cover classifications and acreage in the Indian-Cahokia Creek Watershed.

Land Use	Description	Area (acres)	Percent of watershed (%)
Cultivated Crop	Areas used for the production of annual crops, such as corn and soybeans. Crop vegetation accounts for greater than 20% of total vegetation. Includes all land being actively tilled.	52,594	43%
Deciduous Forest	Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of tree species shed foliage with seasonal change.	31,286	25%
Hay/Pasture	Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed of hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for >20% of total vegetation.	18,427	15%
Developed, Open Space	Areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces cover <20% area. These areas most commonly include large-lot single family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.	9,277	7%
Developed, Low Intensity	Areas with a mixture of constructed materials and vegetation. E.g. single family houses. Impervious surfaces cover 20-40% area.	7,650	6%
Developed, Medium Intensity	Areas with a mixture of constructed materials and vegetation. E.g. single family houses. Impervious surfaces cover 50-79% area.	1,888	2%
Developed, High Intensity	Highly developed areas where people reside or work in high numbers. E.g. apartment complexes, row houses, commercial/industrial. Impervious surfaces cover 80-100% area.	660	1%
Open Water	Areas of open water, generally with<25% of vegetation or soil.	1,168	1%
Barren Land	Areas of bedrock, desert pavement, scarps, and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.	26	0%
Emergent Herbaceous Wetlands	Areas where perennial herbaceous vegetation accounts for >80% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.	28	0%
Evergreen Forest	Areas dominated by trees generally greater than 5 meters tall, and >20% of total vegetation cover. More than 75% of the tree species maintain leaves all year. Canopy is never without green foliage.	8	0%

Land Use	Description	Area (acres)	Percent of watershed (%)
Herbaceous	Areas dominated by gramanoid or herbaceous vegetation, generally >80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.	255	0%
Mixed Forest	Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75% of total tree cover.	0	0%
Shrub/Scrub	Areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation.	0	0%
Woody Wetlands	Areas where forest or shrub land vegetation accounts for >20% of vegetative cover and the soil or substrate is periodically saturated or covered with water.	463	0%
Grand Total		**123,730**	**100.00%**

Figure A.29: Land use/land cover categories in the Indian-Cahokia Creek watershed.



Forest

Mixed, deciduous forest in the watershed contains a wide variety of tree species. On the uplands, dominant species include oaks and hickories. In the floodplains, water-tolerant species such as silver maple, cottonwood, sycamore, pecan, box elder and ash tend to dominate. Forest currently covers approximately 25% of the Indian-Cahokia Creek watershed. (11)

Davey Resource Group conducted an analysis of tree cover in Madison County in 2018 as part of a U.S. Urban Forestry grant with HeartLands Conservancy. This analysis included an assessment of "priority planting locations", created in GIS by taking all grass/open space and bare ground areas and combining them into one dataset. Non-feasible planting areas such as agricultural fields, recreational fields, major utility corridors, airports, etc. were removed from consideration. The remaining planting space was ranked into five (5) classes ranging from Very Low to Very High planting priority. The ranking criteria used included proximity to hardscape, canopy fragmentation, slope soil permeability, and soil erosion factor (K-factor). In the Indian-Cahokia Creek watershed (Madison County only), there were 540,151,740 sq ft of "high" and "very high" priority planting areas, with 49,572,066 sq ft of these within municipal boundaries. (24)

Wetlands

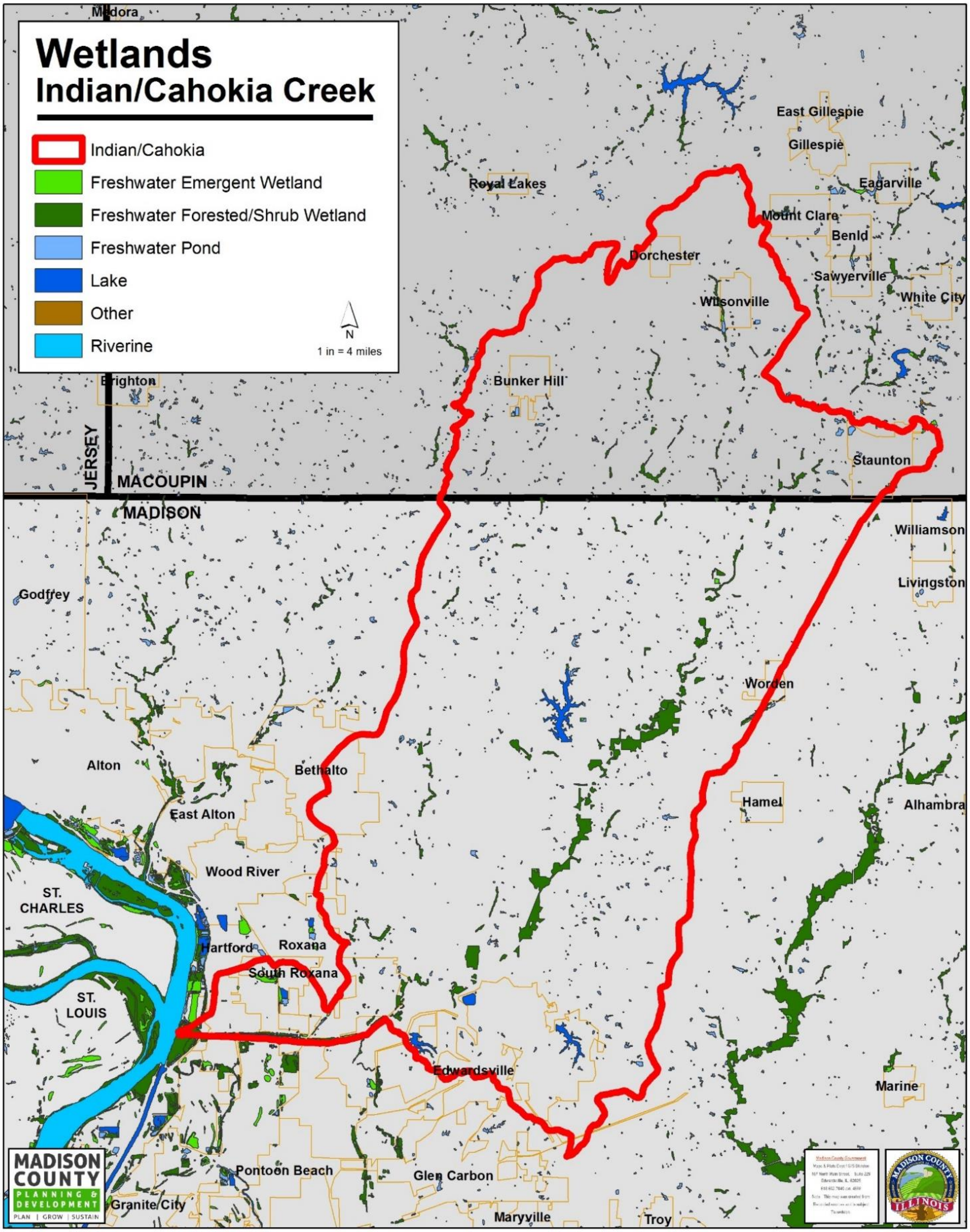
Historically, Illinois lost 90% of its wetlands between the 1780s and 1980s, primarily as a result of farmland being drained for agriculture. The National Wetlands Inventory (NWI) represents the current extent, approximate location and type of wetlands in the United States, as determined using aerial imagery. Figure A.30 shows the wetlands in the Indian-Cahokia watershed, as reported in the NWI.

In the future, this area may be covered by NWIPlus, an enhanced National Wetlands Inventory database that includes attributes related to ecological functions. These functions include surface water detention, streamflow maintenance, sediment and particulate retention, carbon sequestration, shoreline stabilization, and provision of fish and shellfish habitat.

Wetlands mitigation importance values and wetland restoration importance values were created for the watershed by the Missouri Resource Assessment Partnership (MoRAP). Several layers of data, especially topography, soil type, and land cover, were used to create maps of existing wetlands which it is highly important to protect, and areas which were formerly wetlands which it would be highly beneficial to restore. This work has been done previously for other areas in this region, as seen in the 2013 report by MoRAP, “Ecological Approach to Infrastructure Development: Wetlands Mapping and Analysis for the Mississippi and Mississippi River Floodplains.”

According to the NWI, freshwater forested/shrub wetland is the most prevalent wetland type in the project area (Figure A.30), with a few lakes in the area as well. Field checks are needed to more accurately assess the extent of wetlands in the watershed and support the general inventory provided by the NWI. Approximately 4,108 acres of the Indian-Cahokia Creek watershed currently contains wetlands.

Figure A.30: Wetlands in the Indian-Cahokia Creek watershed as determined by the National Wetlands Inventory.

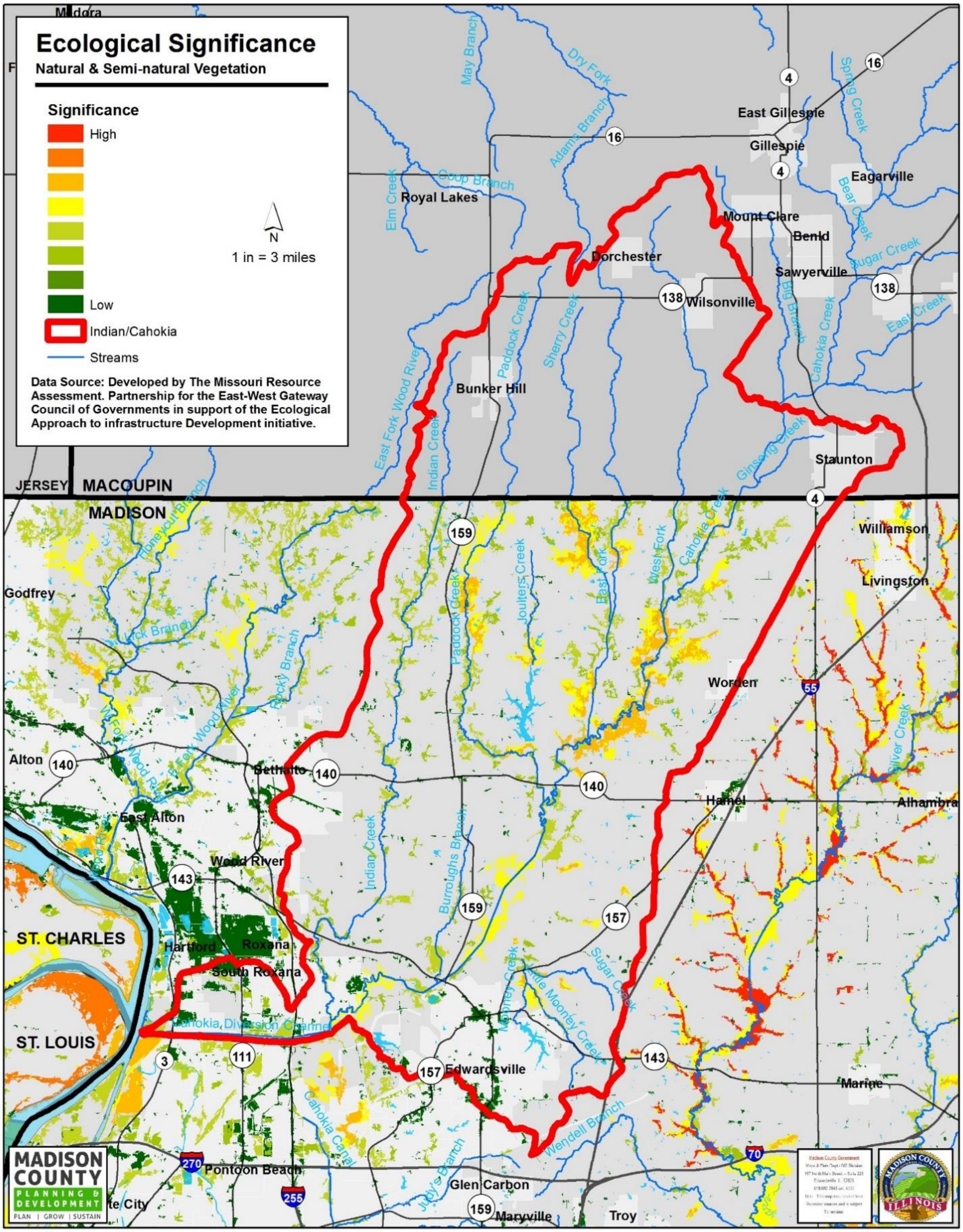


Ecological Significance

The Missouri Resource Assessment Partnership (MoRAP) and the East-West Gateway Council of Governments (EWG) created an ecological significance GIS data layer for EWG's eight-county planning region in 2010. The attribute variables important to ecological significance included the results of existing aquatic conservation assessments, vegetation type, vegetation patch size, natural diversity, occurrence of rare species, and land ownership (public/private). Eight tiers of importance were identified from high to low ecological significance.

In the Indian-Cahokia Creek watershed, most of the areas in the northeastern portion of the watershed are considered to have somewhat high ecological significance, while the northwestern and southern portions of the watershed have lower significance. Areas with the highest significance in the Indian-Cahokia Creek watershed include the Cahokia Creek corridor and some of its major tributaries, as shown in Figure A.31.

Figure A.31: Ecological significance attributes (out of eight tiers of importance) calculated by the MoRAP and EWG for the Indian-Cahokia Creek watershed.



Threatened and Endangered Species

Ten animal and plant species are listed as threatened, endangered, or proposed as threatened in the counties included in the study area. The most likely present species include the Northern long-eared bat, the decurrent false aster, and the eastern prairie fringed orchid. A full list of species is shown below in Table A.20.

Table A.20: Threatened and endangered species listed by the U.S. Fish and Wildlife Service as being present in one or more of the counties in the Indian-Canteen-Cahokia watershed. (25)

Species	Status	Range	Habitat
Mammals			
Indiana Bat (Myotis sodalist)	Endangered	Potential habitat statewide; Known occurrences in 28 counties in Illinois, including Madison.	Caves, mines (hibernacula); small stream corridors with well developed riparian woods; upland forests (foraging)
Northern long-eared bat (Myotis septentrionalis)	Threatened	Statewide	Hibernate in caves and mines – swarming in surrounding wooded areas in autumn; Roosts and forages in upland forests and woods
Birds			
Least Tern (Sterna antillarum)	Endangered	10 counties in Illinois	Bare alluvial and dredged spoil islands
Reptile			
Eastern Massasauga (Sistrurus catenatus)	Proposed as Threatened	7 counties in Illinois, including Madison	Graminoid dominated plant communities (fens, sedge meadows, peatlands, wet prairies, open woodlands, and shrublands)
Fish			
Pallid Sturgeon (Scaphirhynchus albus)	Endangered	7 counties in Illinois, including Madison	Large rivers
Mussels			
Spectaclecase mussel (Cumberlandia monodonta)	Endangered	6 counties in Illinois, including Madison	Large rivers in areas sheltered from the main force of the current
Crustaceans			
Illinois cave amphipod (Gammarus acherondytes)	Endangered	2 counties in Illinois	Cave streams in Illinois sinkhole plain
Plants			

Species	Status	Range	Habitat
Decurrent false aster (Boltonia decurrens)	Threatened	20 counties in Illinois, including Madison	Disturbed alluvial soils
Eastern prairie fringed orchid (Platanthera leucophaea)	Threatened	82 counties in Illinois, including Macoupin and Madison	Mesic to wet prairies
Leafy prairie clover (Dalea foliosa)	Endangered	9 counties in Illinois, including Madison	Prairie remnants on thin soil over limestone

Table A.21 – Wildlife Survey Compilation Matrix for McDonough Lake, 2000s.

	McDonough Lake
BIRDS: Species	
Blue Wing Teal	X
Widgeon	X
Canada Goose	X
Red Winged Black Bird	X
MAMMALS: Species	
White Tailed Deer	X
REPTILES & AMPHIBIANS: Species	
Bull Frog	X
Chorus Frog	X
Leopard Frog	X
MACROINVERTEBRATES: Species	
Midge Fly Larvae	X
Scuds	X
Dragon Fly	X
Right Handed Snail	X
Leeches	X
Mosquito Larvae	X
Caddisfly	X

Fish

The Illinois Natural History Survey (INHS) keeps records of fish sampling in Illinois. Samples were taken in the Indian-Cahokia Creek watershed at three locations each on the Cahokia Canal and Indian Creek, two locations on Cahokia Creek, and one location each on the Cahokia Diversion Canal and Canteen Creek. Sampling occurred in 1966, 1973, 1978, 1998, 2005 and 2007. (26) Twenty-one species of fish were found, and 124 individuals collected. Six of the 16 species are tolerant of various environmental perturbations, three are moderately tolerant, and two are moderately intolerant (the other five were not rated by U.S. EPA). (27)

The 2005 Mississippi South Central Basin Fish Community Survey collected data on fishes, macroinvertebrates, habitat, and water quality at 18 sites on 15 streams in Macoupin, Madison, St. Clair, Monroe, and Randolph counties in southwestern Illinois. (28) Cahokia Creek, Cahokia Canal, Cahokia Diversion Channel, Indian Creek, and Canteen Creek were sampled. Table A.22 shows the fish sample data for these sites in 2005, and Index of Biotic Integrity (IBI) scores for 2005 and 1998.

Sample locations:

- Cahokia Canal – JN-02 (Sand Prairie Rd Br., 3 mi. W Collinsville)
- Canteen Creek – JNA-01 (Sand Prairie Rd Br., 3 mi. W Collinsville)
- Canteen Creek – JNA-02 (Rte 157 Br., Caseyville)
- Cahokia Creek – JQ-03 (Renken Rd. Br., 4 mi. NE Prairietown)
- Cahokia Creek – JQ-05 (Old Alton-Edwardsville Rd. Br., NW edge Edwardsville)
- Cahokia Diversion Channel – JQ-07 (Oldenburg Rd. N of New Poag Rd, 2 mi. S Hartford)
- Indian Creek – JQA-01 (Rt. 143 br., 2.5 mi. E Roxana)

Table A.22. Fishes collected by all methods in the Mississippi South Central Basin in 2005, with IBI scores from 2005 and 1998.

	STATION CODE						
COMMON NAME	JN-02	JNA-01	JNA-02	JQ-03	JQ-05	JQ-07	JQA-01
Gizzard shad					2	143	
Carp		2		1	7	11	7
Golden shiner				1			
Creek chub	5	69	94	64			1
Central stoneroller				376	87		
Suckermouth minnow				24	19		
Spotfin shiner					7		
Red shiner	2	54	30	62	232		7
Red shiner x Spotfin shiner hybrid					29		4
Red shiner x Notropis sp. hybrid			1				
Fathead minnow	1	3					
Bluntnose minnow				60	10		6
Emerald shiner			2				
Bigmouth shiner		211	4	644			
Sand shiner		1575	121	290	96		11
White sucker	113	272	27	20	1		25
Shorthead redhorse					19	7	
Golden redhorse				2	7	4	
Yellow bullhead		3	8	4	2		2
Flathead catfish					6	2	
Blackstripe topminnow				12	12	1	1
Mosquitofish		1	2		2		
White crappie					5		
Largemouth bass	6	1		3	27	17	3
Green sunfish	5	1	19	5	14	9	12
Bluegill x Green sunfish hybrid	1				1	2	
Green sunfish x Orangespotted sunfish hybrid						2	
Bluegill	8	5		1	13	10	4
Pumpkinseed				3			
Orangespotted sunfish					2	24	
Walleye	1						
Slenderhead darter					16	1	
Logperch				2	24		1
Orangethroat darter							
Freshwater drum						4	1
Total	142	2197	308	1574	640	237	85
IBI score (2005)	17	29	35	46	54	41	27
IBI score (1998)	18	NA	23	26	32	NA	24

Note: IDNR data from 2015 shows the presence of Asian carp species (grass carp, bighead carp, and silver carp) in streams in the watershed – an increase from 0 in 1998 and 2005.

Crustaceans

The INHS Crustacean Collection database keeps records of crustaceans sampled in Illinois. Crustaceans were sampled at seven locations in the Cahokia Creek watershed. Sampling occurred in 1973, 1974, 1975 and 1977. Four species of crustaceans were found, and 10 individuals collected. (29) Due to the age of this data, additional research is needed to confirm or refute the presence of crustaceans in the watershed.

Mussels

The INHS Mussel Collection database keeps records of mussels sampled in Illinois. Mussels were sampled at five locations in the Cahokia Creek watershed. Sampling occurred in 1999, 2005, and 2010. Eight species were found, and more than 12 individuals collected. (30) Illinois RiverWatch volunteers found no Zebra mussels at the sites they monitored in the watershed between 1996 and 2014; however, they did find Native mussels and Finger Nail Clams. (31)

Livestock and Domestic Animals

Animal (livestock) data is available from the USDA 2012 Agricultural Census database at the county level (Table A.23). (32) The watersheds have no Concentrated Animal Feeding Operations (CAFOs) according to the IEPA data layer in the Resource Management Mapping Service (RMMS). (33)

Table A.23: Livestock in Macoupin and Madison Counties as of 2012.

Livestock	Macoupin County		Madison County	
	Farms	Head	Farms	Head
Cattle and calves	303	23,071	285	11,044
Hogs and pigs	26	34,373	14	8,885
Sheep and lambs	23	702	33	413
Goats	33	433	30	542
Equine	76	323	170	1,065
Poultry	53		87	

Agricultural Land Use/Land Cover

Illinois, and the Cahokia Creek watersheds, lie at the heart of the "Corn Belt." The area's gentle topography, moderate, wet climate, and location adjacent to the Mississippi River support agricultural success. Furthermore, the thick layer of loess on uplands in the watershed provides abundant farmland. Besides mineral content, much of the soils' richness comes from layers of organic matter from the area's historic vegetation, forest, and tallgrass prairie. As a result of intensive row crop agriculture on upland fields, most of the original top soil has been lost to erosion. It is common in many crop fields to find that 50 to 90% of the original top soil layer is gone, and farmers are increasingly farming the heavier clay subsoils. (14) The delivery of sediment to downstream water bodies is an ongoing water quality problem. Some farmers in the watershed have enrolled in land conservation programs such as the Conservation Reserve Program (CRP) to protect highly erodible soils.

The pressures of urbanization have led to encroachment on/conversion of farmland in Illinois over time. There are fewer farms and fewer acres in agricultural production in the state than at any time since the 1982 USDA's Agricultural Census. Between 1997 and 2003, 50,000 acres was converted to urban use in the Metro Area of St. Louis, which includes Madison County; however, the portion of farmland converted to urban use in Madison County is unknown. The population, while relatively stagnant in overall size, shifted eastward onto larger lots and "farmettes," but often did not take up farming. (11) The Cahokia Creek watersheds appear to have a lower proportion of owner-farmers than southwestern Illinois as a whole, as much of the land is rented out to be farmed (based on anecdotal information).

The Howard G. Buffett Foundation and Conservation Technology Information Center conducted a Cropping Decisions Survey in September 2010, sending a questionnaire about crop cultivation activities to farmers in many states. (34) Of all the states, the heaviest concentration of responses from this survey came from Illinois (111 responses). The following are data from the Illinois participants that likely hold true for the farm activities in the Cahokia Creek watersheds.

- 76% of participants had never used cover crops; only 7% currently use cover crops.
- One third of participants are not interested in trying cover crops.
- Many participants doing continuous no-till thought they are doing enough.
- Soil erosion control is major reason to consider cover crops and characteristic most desired in a cover crop.
- Time required for increased management and cost of cover crop seed are predominant challenges to managing cover crops.
- Narrow window to get planted is a major barrier to using cover crops; many are concerned about the soil not drying out in the spring.

- Top trusted sources for information about cover crops are: a successful farmer using cover crops, extension and agribusiness.

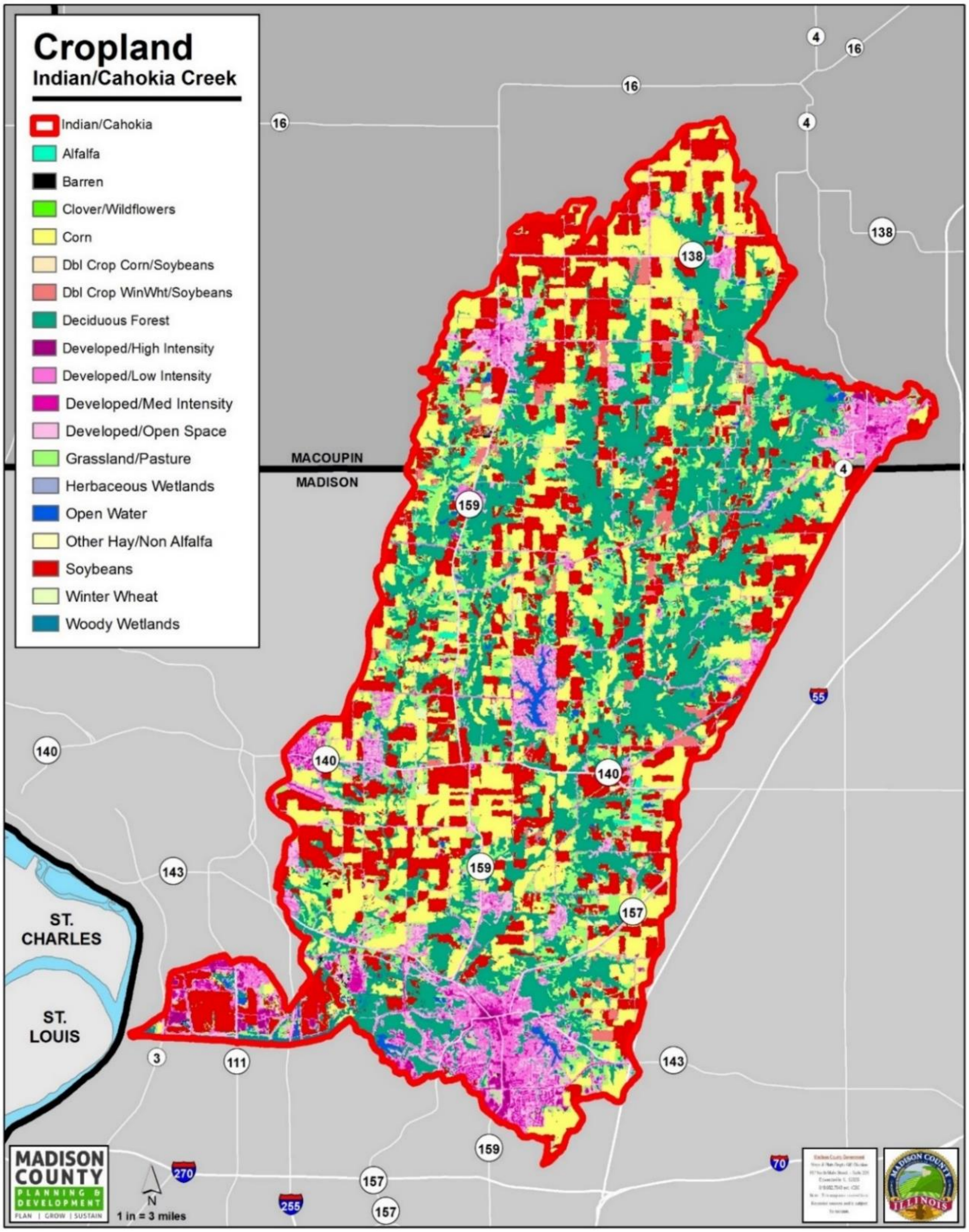
The Indian Creek-Cahokia watershed acreage of land in agricultural use is 71,021 acres (58%), of which 43% is used for cultivated crops and 15% is used for hay/pasture (Table A.24). Corn, soybeans, and wheat are grown extensively in the watershed. Sorghum, horseradish, sweet corn, tomatoes, onions, potatoes, berries, and fruits are also grown. The average farm size in the two counties (Macoupin and Madison) is 330 acres, while the median size is 92 acres, indicating that there are a few very large farms. Madison County farms are typically smaller than farms in the other two counties.

Table A.24: Data about agriculture in Macoupin and Madison counties.

Land Use	Macoupin	Madison
Farms	1,190	1,110
Land in farms (acres)	438,592	307,135
Average size of farms (acres)	369	277
Median size of farms (acres)	115	66
Total cropland (acres)	371,038	276,513
Irrigated land (acres)	30	2,364
Avg market value of ag products sold per farm (dollars)	$186,369	$127,692
Average net farm cash income (dollars)	$44,417	$31,474
Farms harvesting corn for grain	601	491
Acres farmed for corn for grain	220,412	116,881
Farms with hired farm labor	312	286
Number of hired farm labor workers	886	1,328
Farms enrolled in Conservation Reserve, Wetlands Reserve, Farmable Wetlands, or Conservation Reserve Enhancement Programs	495	179
Land enrolled in Conservation Reserve, Wetlands Reserve, Farmable Wetlands, or Conservation Reserve Enhancement Programs (acres)	16,995	3,785

In 2011 (the most recent year for which detailed data is available), corn and soybeans were the major crops grown in the watershed, followed by double cropped winter wheat and soybeans and grassland/pasture (Figure A.32). The USDA-NASS Cropland Data Layer from 2011 also shows large areas of developed land and deciduous forest in the watershed. (32)

Figure A.32: Cropland types and land use from the 2011 USDA-NASS Cropland Data Layer for the Indian-Cahokia Creek watershed. (35)



Open space

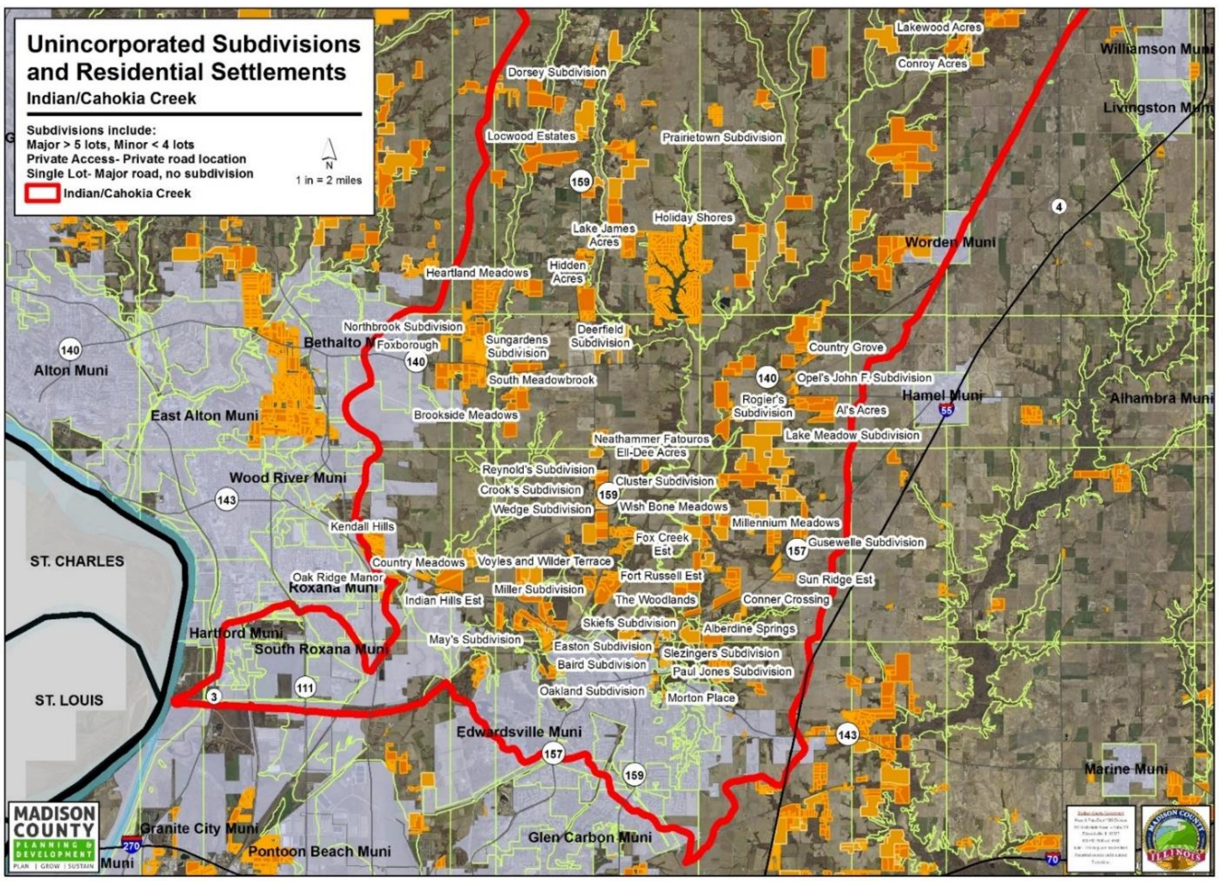
There are no federally owned areas of open space in the watershed. However, there are 135 areas of open space covering 5,888 acres (2.6% of the watershed). These open spaces include municipal parks, bike trails, campgrounds, and athletic fields. There are also four golf courses in the watershed as well as the Cahokia Mounds State Historic Site, which is located within the Canteen-Cahokia Creek watershed immediately east of Fairmont City. (36)

Subdivisions

Madison County is currently working on assembling data on all subdivisions in the unincorporated area, with a particular focus on those subdivided in the last 10 years. The term "developed" area includes major and minor subdivisions, private access subdivisions, single lot subdivisions, and single lot additions. Plat years are recorded for some, but not all, major and minor subdivisions.

The total "developed" area in the watershed in Madison County is 20,490 acres (16.3%). There are many more subdivisions in the south than in the north, particularly around Edwardsville (Figure A.33).

Figure A.33: Subdivisions in the Indian-Cahokia Creek watershed in Madison County.



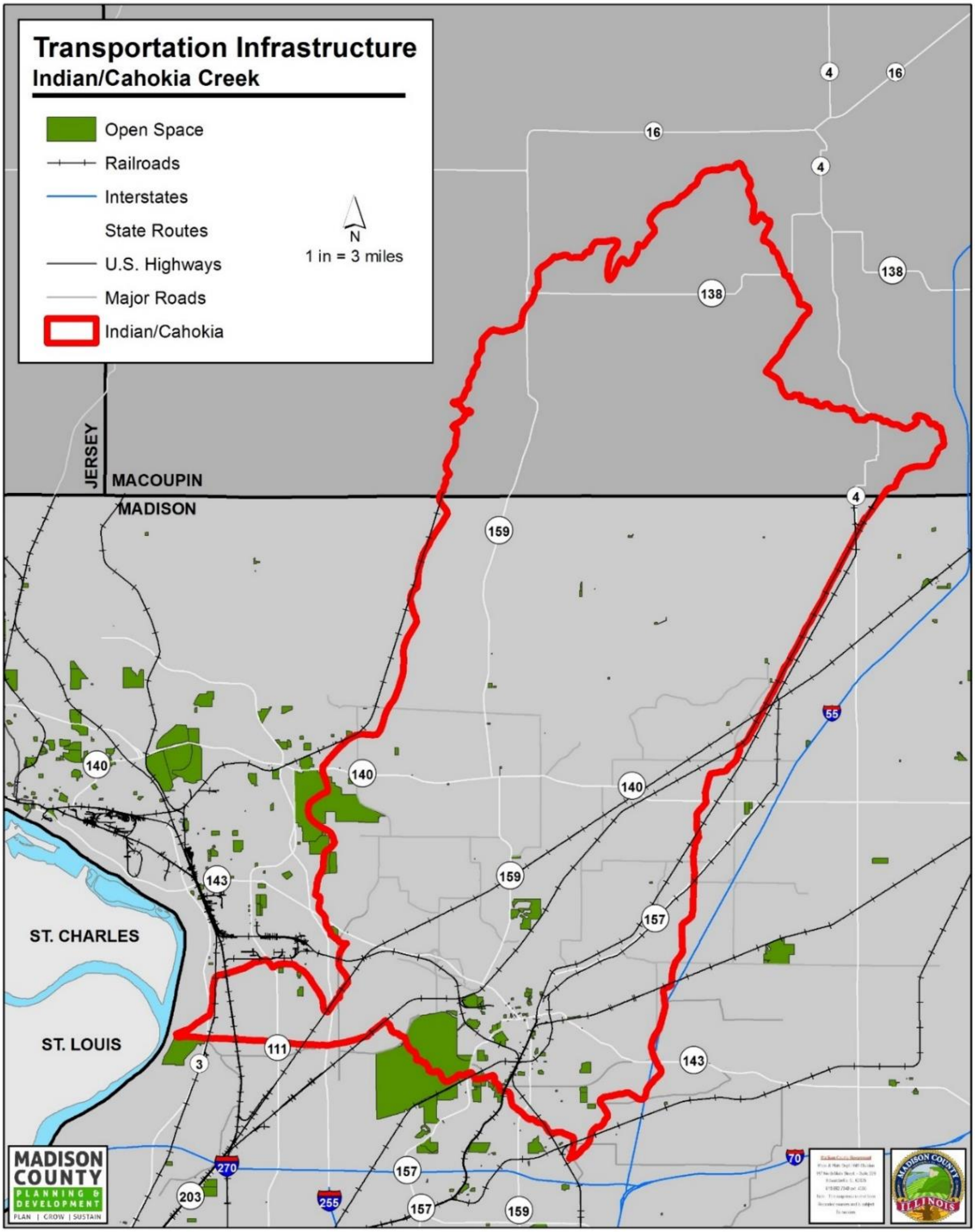
Transportation Infrastructure

The watershed contains several important components of southern Illinois' transportation network, including railroads, state routes, and a small portion of Interstate 55 (Figure A.34). State Route 159 runs north-south through the entire watershed. Multiple railroad lines generally run diagonally through the watershed. Railroads and open spaces identified by the East-West Gateway Council of Governments are only available for Madison County. Some railroads are not currently in use.

Landfills

There are 14 landfills in the Indian-Cahokia Creek watershed, according to the data layer hosted by the Illinois Resource Management Mapping Service (2018). (37)

Figure A.34: Transportation infrastructure and open space in the Indian-Cahokia Creek watershed.



Cultural/Historic Resources

Cahokia, a pre-Columbian Native American city, covered about six square miles at its population peak (1200s CE) and was the largest and most influential urban settlement in Mississippian culture. Many earthen mounds were built by those peoples in and around Cahokia, including some in the Cahokia Creek watersheds. They were identified by HeartLands Conservancy in "The Mounds – America's First Cities: A Feasibility Study" in 2014, which mapped over 550 mound sites in the St. Louis region. Many mound sites were identified by this study in these two watersheds. (37)

The primary mound center in the watershed is located in Mitchell, Illinois, and is currently designated as a National Registered Historic Site. It is owned privately and by the State of Illinois (Illinois Department of Transportation). In ancient times, the town of Mitchell was a large, residential and religious node that encompassed the core of surrounding communities. It was a place where people lived, interacted, worshiped, and died.

Table A.25: Information about the Priority Mound Site in Mitchell.

National Park Service (NPS) criteria as related to Priority Mound Sites	Priority Mound Site: Mitchell, IL
Current designation	National Registered Historic Site
Potential NPS designation	Part of National Trail with Cahokia
Ownership	Private/State (IDOT)
Opportunities	Route 66, existing mound interpretation
Primary challenge	Programming, land acquisition

Route 66, also known as the Mother Road, was one of the original highways in the U.S. highway system. First established in 1926, the highway became one of the most famous roads in America and was a major route for those migrating west during the Dust Bowl of the 1930s. Today, much of the road has been designated as a National Scenic Byway and given the name "Historic Route 66." The route changed considerably over the years, including and excluding these places at different times. Many municipalities still make the most of this history, welcoming motorists through the year and in mid-June for the Illinois Route 66 Mother Road Tour. Historic Route 66 also passes through Edwardsville. Edwardsville marked this heritage with "The Edwardsville Route 66 Conference" in October 2015. (38)

Mound sites within the Indian-Cahokia creek watershed are located in the southwest portion of the watershed near South Roxana and Edwardsville. There are nine distinct sites, either wholly or partially located in the watershed, generally surrounding the Cahokia Diversion Channel.

Future land use/land cover predictions

Changes to land use/land cover in the watershed were projected from municipal Comprehensive Plans, where available. Using these plans, percentages of the different land uses under a future build-out scenario were estimated for the 1.5-mile zone outside each municipality. A 1.5-mile buffer around the municipalities was created in ArcGIS, a Geographic Information System (GIS) software program, and the new land use/land cover percentages were applied to the buffer. Land use/land cover percentage changes were assumed to be consistent throughout the county. The remaining land outside the 1.5-mile zone was considered to retain its current land use/land cover designations. The resulting land use/land cover predictions represent a full build-out scenario for the municipalities in the watershed, while retaining a conservative estimate of zero land use/land cover change in the unincorporated area.

The largest predicted change in land use/land cover pertains to agricultural land, with 12,987 acres or 96% decrease in cultivated crops and a 2457 acres or 93% decrease in hay/pasture across the watershed. (Table A.26). Deciduous forest is expected to shrink by 97%. In total, approximately 30448 acres of existing agricultural lands, wooded/herbaceous wetland, and forest is expected to be lost to development. Much of the new development will likely occur in the 1.5-mile zones around municipalities in the watershed. See Data Tables section for a detailed breakdown of future land use/land cover by HUC14.

Table A.26: Existing and predicted future land use/land cover in the Indian-Cahokia Creek watershed.

Land Use/Land Cover Description	Land Use Code	Current Area (acres)	Current Area (%)	Predicted Area (acres)*	Predicted Area (%)	Change (acres)	Percent Change
Barren Land	31	10	0%	0	0%	-10	-100%
Cultivated crop	82	13471	24%	484	1%	-12987	-96%
Deciduous forest	41	12292	21%	326	1%	-11966	-97%
Developed, High Intensity	24	1381	2%	3007	5%	1626	118%
Developed, Low Intensity	22	9876	17%	21504	38%	11628	118%
Developed, Medium Intensity	23	3998	7%	8705	15%	4707	118%
Developed, Open Space	21	10606	19%	23093	40%	12487	118%
Emergent herbaceous wetlands	95	219	0%	0	0%	-219	-100%
Evergreen forest	42	0	0%	0	0%	0	0%
Hay/Pasture	81	2649	5%	192	0%	-2457	-93%
Herbaceous	71	94	0%	0	0%	-94	-100%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	683	1%	2	0%	-681	-100%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	2037	4%	3	0%	-2034	-100%

*predicted land use/land cover is based on zoning identified in the Comprehensive Plans of municipalities in the watershed for the 1.5 mile zone outside their current boundaries

Impervious cover

Impervious cover is the surfaces of an urban landscape that prevent infiltration of precipitation and runoff into the ground. Imperviousness is a useful indicator of the impacts of urban land use/land cover on water quality, hydrology, and flooding. Runoff over impervious surfaces warms the water and collects pollutants causing receiving stream to experience a shift in plant, macroinvertebrate, and fish communities. Sensitive species can no longer thrive, and pollution-tolerant species begin to dominate. Higher impervious cover also translates to greater runoff volumes, resulting in changes to stream hydrology.

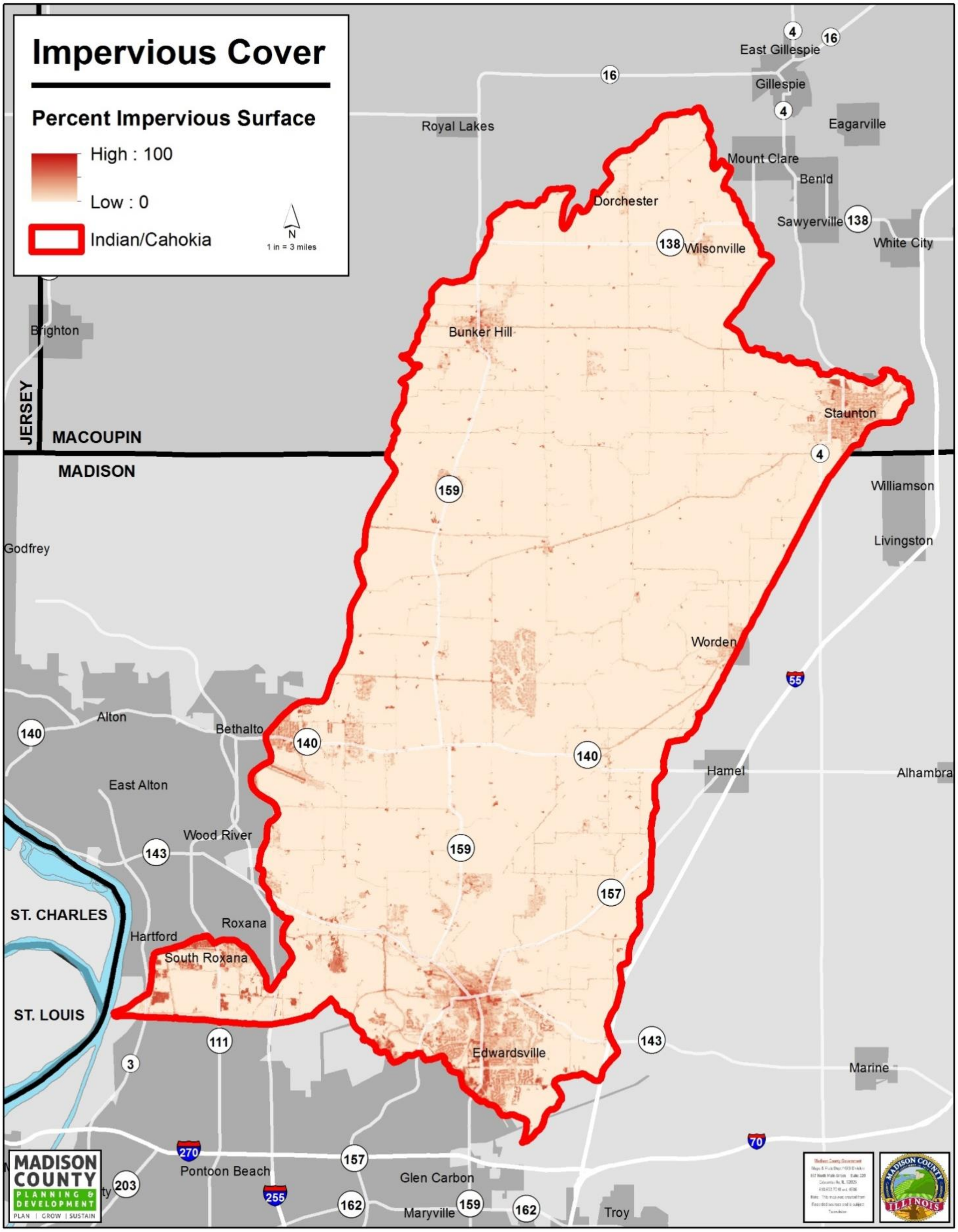
The National Land Cover Database (NLCD) Percent Developed Impervious Surface file provides nationally consistent estimates of the amount of man-made impervious surfaces present over a given area. The values are derived from Landsat satellite imagery, using classification and regression tree analysis. Values range from zero to 100 percent, indicating the degree to which the area is covered by impervious features.

In the Indian Creek watershed, the mean imperviousness is 27.1% with a standard deviation of 21.2% (Table A.27). Most of the watershed is not highly impervious. However, selected areas have a lot of impervious cover, up to 100% (Figure A.35). These areas correlate with developed land use/land cover as seen in Figure A.32.

Table A.27: Existing impervious cover by HUC 14 in the Indian-Cahokia Creek watershed, as assessed from the NLCD Percent Developed Impervious Surface dataset.

HUC14	Existing Impervious %
07140101020101	16.1%
07140101020102	19.9%
07140101020103	16.1%
07140101020201	29.7%
07140101020202	23.3%
07140101020203	16.5%
07140101020301	21.5%
07140101020302	20.0%
07140101020303	21.2%
07140101020401	15.4%
07140101020402	17.0%
07140101020403	20.7%
07140101020404	19.3%
07140101020501	21.8%
07140101020502	20.4%
07140101020503	19.4%
07140101020504	32.8%
07140101020601	23.7%
07140101020602	19.0%
07140101020603	29.3%
07140101020604	22.2%
07140101020605	23.3%
07140101020701	30.2%
07140101020702	34.9%
07140101020703	38.4%
Average	**22.88%**

Figure A.35: Impervious cover in the Indian-Cahokia Creek watershed.



Watershed Drainage

Stream Delineation

The stream reaches used in assessing stream conditions are from the National Hydrography Dataset (NHD). A reach is a continuous piece of surface water with similar hydrologic characteristics. The NHD catalogs stream reaches, giving each reach a unique 14-digit Reach Code. The first eight digits are the same as the HUC8 code for the Cahokia-Joachim watershed (07140101). The next six digits are sequential numbers that are unique within the HUC8 watershed.

The segments are listed as perennial or intermittent streams/rivers, with the exception of certain “artificial path” or “connector” segments, which represent non-specific connections between non-adjacent segments. A full table of NHD stream reaches in the watersheds can be found in the Data Tables section. In this assessment/project, the NHD stream reaches were utilized for the study’s stream units. The reaches were not subdivided further, as there was no way to assess homogenous stream conditions on a smaller scale than the NHD within the bounds of the project.

There is little existing information about the condition of the streams in the project area. To gather information about the stream reaches, geo-referenced video footage was taken on low level helicopter flights over the larger streams in the watershed. Fostaire Helicopter was selected to gather the flight data, using Red Hen software to collect and store the video in a GIS database. The video was collected during the winter (February 2016) when leaf cover was absent and vegetation was dormant in order to increase the visibility of the streams flown. A total of 134.2 miles or 17.8% of the total stream miles in the watershed were flown and videotaped. Streams named in the NHD were flown under the assumption that they were larger and represented a large portion of the drainage area of each watershed. Since these streams were larger, it was also assumed that instances of erosion, channelization, riparian area, and logjams would be easier to see on aerial imagery.

Limitations on visibility affected the collection of streambank erosion, channelization, and riparian condition data from the flight video. The video imaging works best on larger streams and streams with poor woody riparian areas. Those streams where the tree canopy completely covered the stream offered limited visibility of the stream condition, even with no leaf cover. In some instances no data was collected from the video imaging due to the inability to see the streambanks, and in others, data collection was incomplete or questionable due to poor visibility. Due to the long stream length assessed for erosion, channelization and riparian condition, field assessment was not a viable option for the watershed.

The video images were then viewed to assess five different parameters for each stream. These parameters were streambed erosion, streambank erosion, degree of channelization, condition of the riparian area and logjams.

There are 719 NHD stream reaches in the Indian- Cahokia Creek watershed, comprising 489.7 miles of streams. The average length of an Indian- Cahokia Creek NHD stream reach is 0.6 miles, while the range of stream lengths is 0.0082 miles to 8.1 miles.

Streambank Erosion

As the video from the aerial survey was reviewed, areas of eroding streambank were identified and catalogued in a feature table in a GIS database. The feature table includes the degree of erosion based on IEPA guidelines (Table A.28), the estimated length, and the location of each stream sections determined to be eroding at a moderate or severe rate. Lengths with slight bank erosion were then determined by subtracting the length of severe and moderate erosion sections from the entire stream segment length.

The slight, moderate, and severe erosion categories were based on IEPA's guidelines for lateral recession from the IEPA Load Reduction Worksheet. (39) The very severe erosion category was not used in this assessment.

Table A.28: Lateral recession category guidelines used in classifying streambank erosion in the assessment of the video footage of aerial assessment. (40)

Lateral Recession Rate* (ft/year)	Category	Description
0.01-0.05	Slight	Some bare bank but active erosion not readily apparent. Some rills but no vegetative overhang.
0.06-0.2	Moderate	Bank is predominantly bare with some rills and vegetative overhang
0.3-0.5	Severe	Bank is bare with rills and severe vegetative overhang. Many exposed tree roots and some fallen trees and slumps or slips. Some changes in cultural features such as fence corners missing and realignment of roads or trails. Channel cross-section becomes more U-shaped as opposed to V-shaped
0.5+	Very Severe	Bank is bare with gullies and severe vegetative overhang. Many fallen trees, drains and culverts eroding out and change in cultural features as above. Massive slips or washouts common. Channel cross-section is U-shaped and stream course or gully may be meandering.

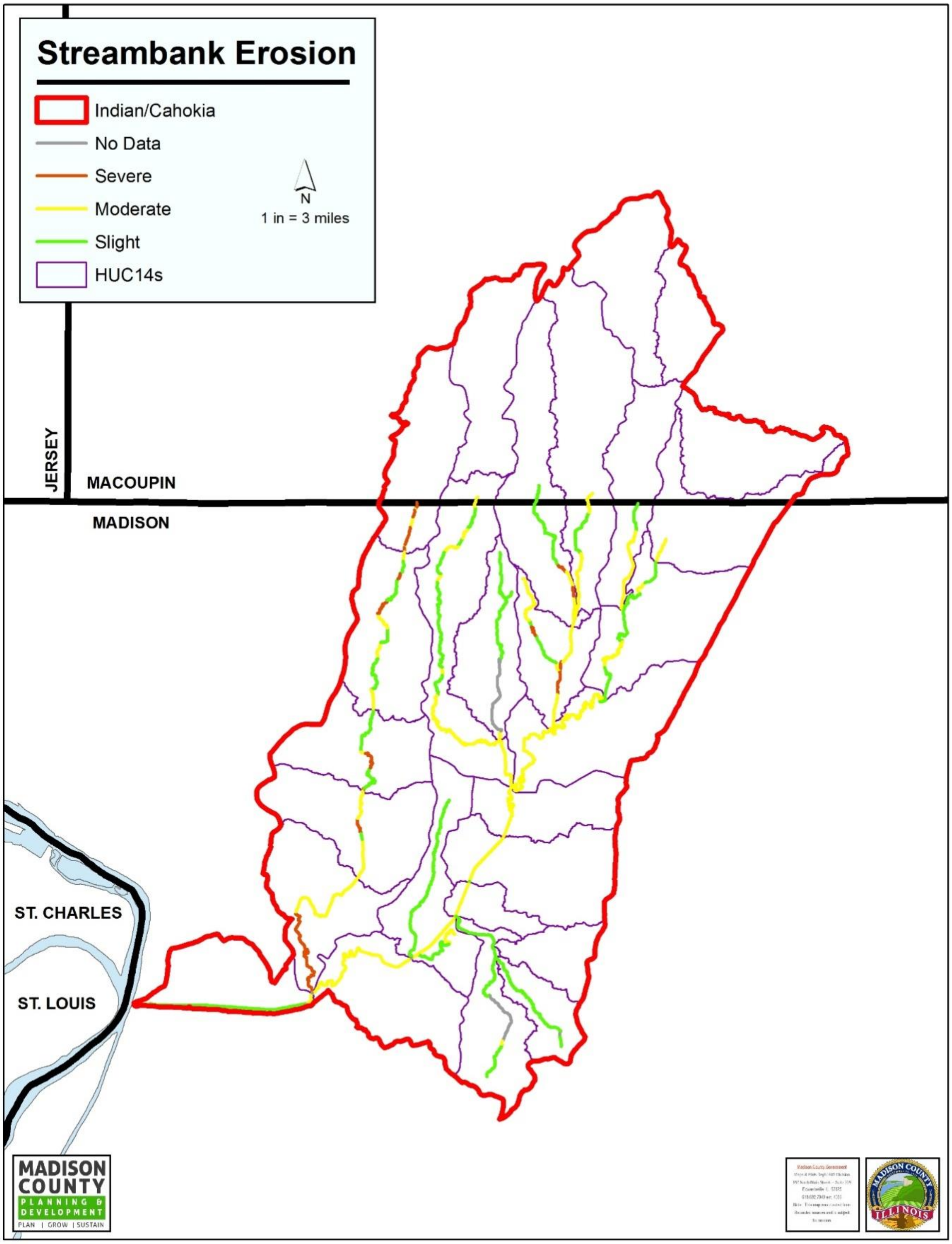
In total, 105 miles of streams were successfully assessed for streambank erosion using geo-referenced video footage. Of the assessed length, 45% had none or low/slight erosion, 47% had moderate erosion, and 8% had high/severe erosion (Table A.29).

Lengths of moderate and severe streambank erosion were identified throughout the watershed in tributaries and on the main branches (Figure A.36). Many headwater streams were determined to have "none or low" erosion, but this may be because they were left unmarked in several instances where visibility was poor and no erosion category could be assigned. Headwater streams often have a steeper gradient and may in fact have a higher degree of bank erosion due to higher velocities, even though flow is low.

Table A.29: Streambank erosion along assessed stream reaches in the Indian-Cahokia Creek watershed.

	Stream Length Assessed (ft)	None or Low Erosion		Moderate Erosion		High Erosion	
		ft	%	ft	%	ft	%
Total	532,224	240,768		249,744		41,712	
Average			45		47		8

Figure A.36: Streambank erosion conditions assessed from video footage of an aerial survey of the Indian-Cahokia Creek watershed.



Degree of Channelization

Changes in stream channelization were identified from the video and geo-referenced in a feature table. The degree of channelization between geo-referenced points was then marked the same for the sections between marked locations. Lengths of high, moderate and low channelization were then determined by measurement between marked boundaries, using criteria based on stream straightness and evidence of man-made modifications (Table A.30).

Table A.30: Criteria used to assess degree of channelization.

Condition	Description
Low	Natural meandering stream with no obvious evidence of modification
Moderate	Not "straight" but evidence of modification to planform by human activity
High	Straight or nearly straight channelized stream segment

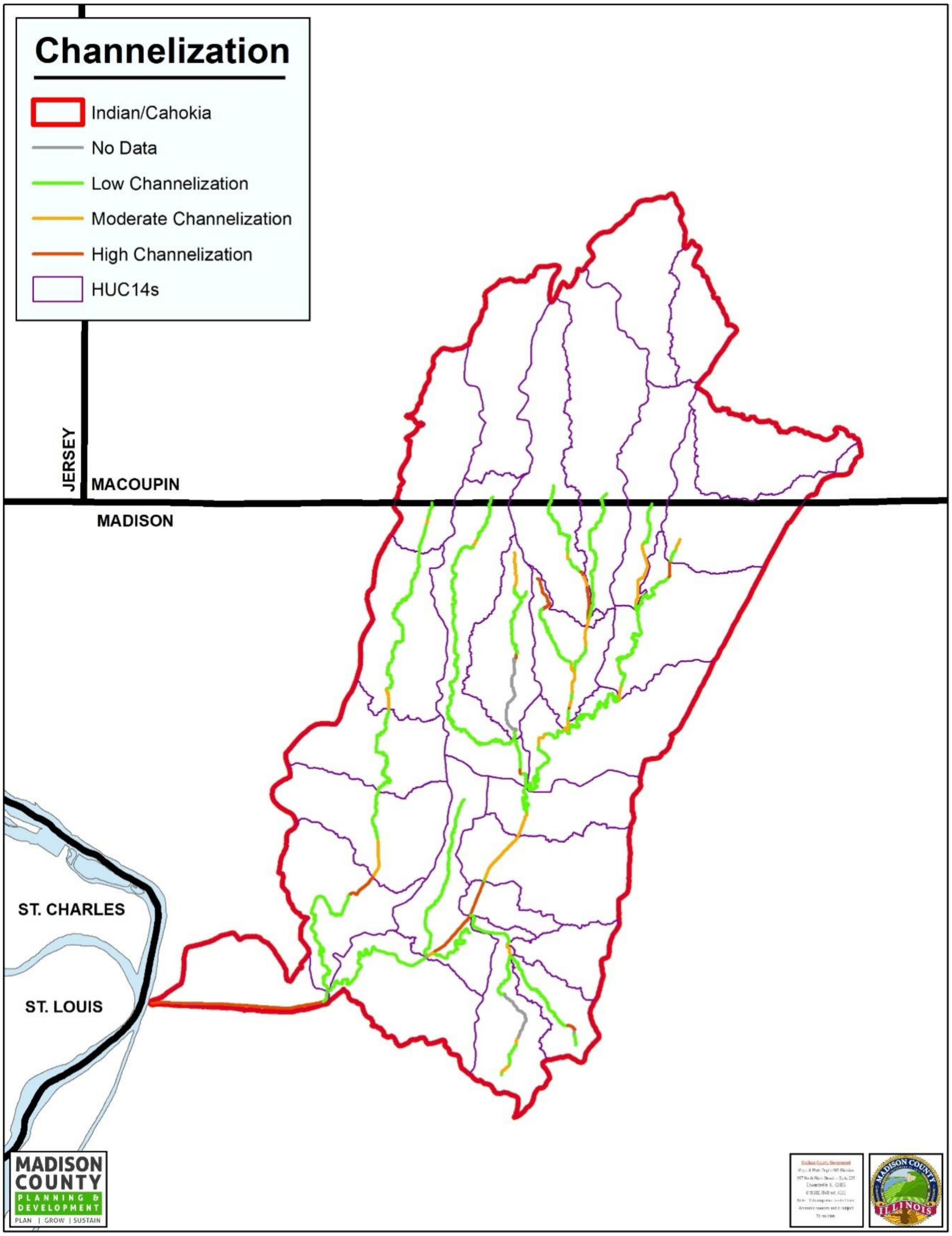
In total, 100.8 miles of streams were successfully assessed for degree of channelization using geo-referenced video footage. Of the assessed length, 77% had none or low channelization, 12% had moderate channelization, and 11% had high channelization (Table A.31).

Lengths of moderate and high channelization were identified throughout the watershed (Figure A.37). The headwaters often showed high channelization, likely because of their beginnings in farm fields as drainage ditches, where stream size is much smaller and channelization less expensive. Moderately and highly channelized streams appear to be interspersed elsewhere with lengths of low channelization.

Table A.31: Degree of channelization along assessed stream reaches in the Indian-Cahokia Creek watershed.

	Stream Length Assessed (ft)	None or Low Channelization		Moderate Channelization		High Channelization	
		ft	%	ft	%	ft	%
Total	100.8	77.7		12.1		11.0	
Average			77		12		11

Figure A. 37: Channelization condition assessed from video footage of an aerial survey of the Indian-Cahokia Creek watershed.



Riparian Condition

Riparian condition was assessed from the video review by geo-referencing in a feature table each location where type and extent of woody cover changed. The riparian area between geo-referenced points was then considered the same for the area between marked locations. Lengths of good, fair, and poor riparian area were then determined by measurement between marked boundaries. The criteria used to assess riparian condition are based on width of vegetative cover on both sides of the waterway, extent of vegetative cover, and type of vegetation (Table A.32).

Table A.32: Criteria used to assess riparian condition.

Condition	Description
Good	Wide (minimum of two stream widths) vegetative cover with woody plants on both banks
Fair	Narrow (less than two stream widths) vegetative cover of woody plants or grass cover on both banks
Poor	No woody vegetation with narrow (< 10 feet) of grass or herbaceous cover on one or both banks

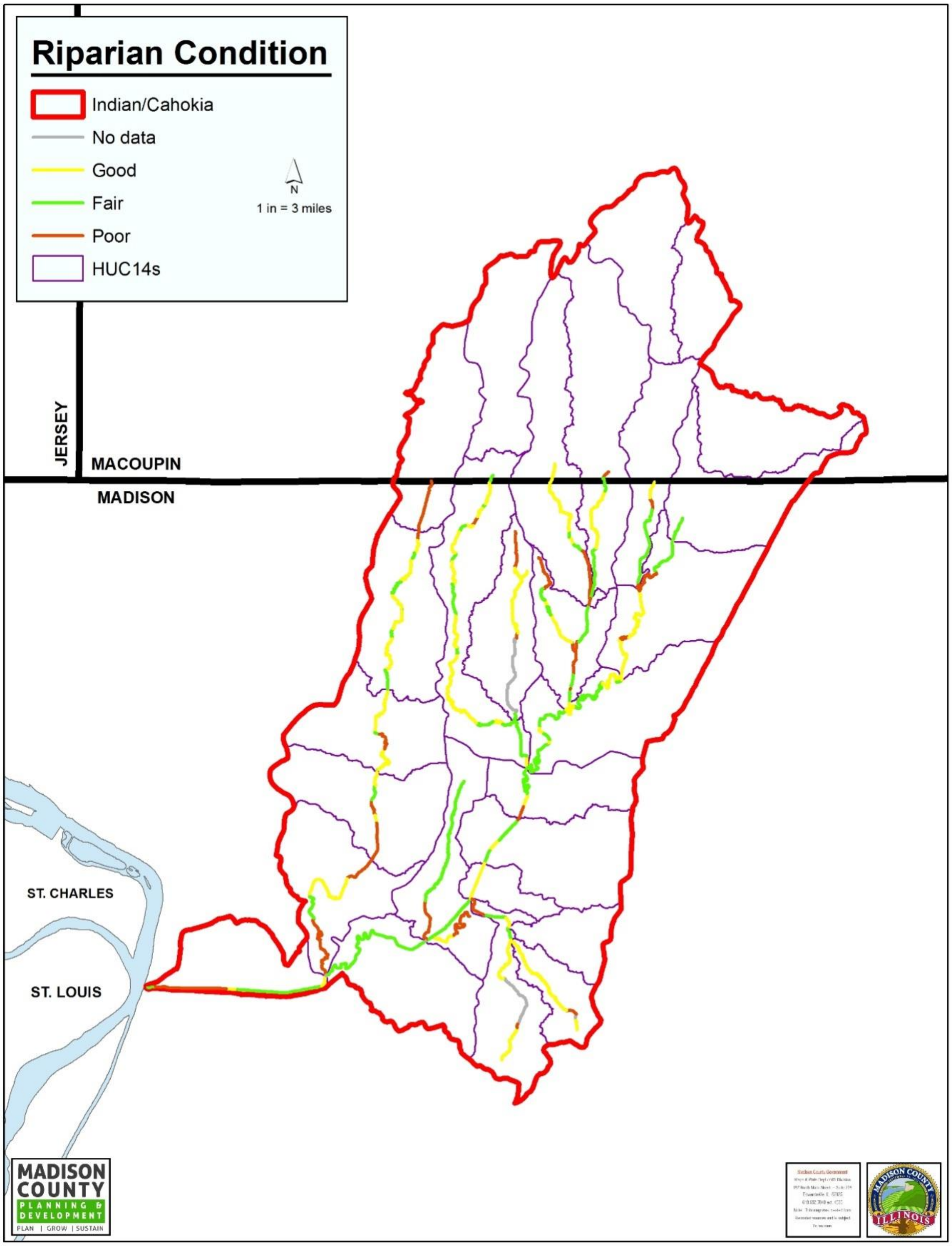
In total, 100.8 miles of streams were successfully assessed for riparian condition using geo- referenced video footage. Of the assessed length, 41% had good riparian condition, 38% had fair riparian condition, and 21% had poor riparian condition (Table A.33).

The stream lengths with good and fair riparian conditions are spread throughout the watershed (Figure A.38). Vegetative and tree cover is poor wherever farm fields or urban development extend out to or close to the streambank.

Table A.33: Riparian condition along assessed stream reaches in the Indian-Cahokia Creek watershed.

	Stream Length Assessed (miles)	Good Condition		Fair Condition		Poor Condition	
		miles	%	miles	%	miles	%
Total	100.8	41.1		38.6		21.1	
Average			41		38		21

Figure A.38: Riparian condition assessed from video footage of an aerial survey of the Indian-Cahokia Creek watershed.



Streambed Erosion

Streambed erosion was assessed from the video review by geo-referencing in a feature table each location where type and extent of erosion changed. Lengths of low, moderate and high streambed erosion were then determined by aerial video assessment per the conditions described in Table A.34.

Table A.34: Criteria used to assess degree of streambed erosion.

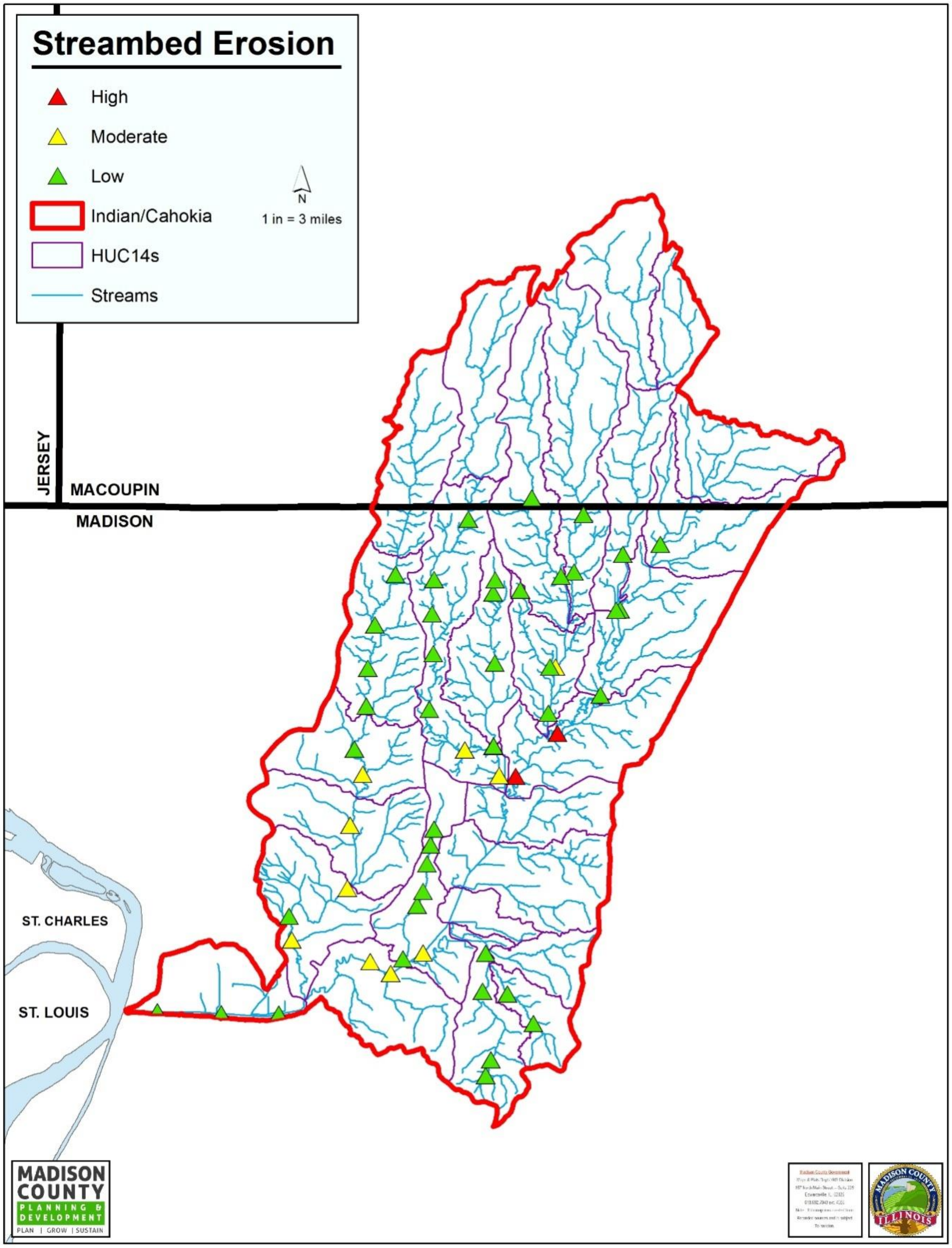
Degree of streambed erosion	Description
Low	Bedload material found deposited in stream cross-over points with evidence of frequent out-of bank flow in the adjacent floodplain. Absence of residual bed material exposed anywhere except in bottom of pools.
Moderate	Bedload material not found consistently in stream cross over locations with some evidence of residual material exposed or very near the surface in cross over locations. Evidence of out of bank flow very hard to identify (few or no trash lines over top of bank).
High	Little or no bedload found in stream cross over locations. Large areas of residual material exposed in the streambed. Trash lines primarily confined to upper portion of the bank with no evidence of out of bank flow except on rare occasions of very large storm events.

Streams in the watershed were assessed for the degree of streambed erosion during aerial assessment. Of the 55 locations assessed in the Indian-Cahokia Creek watershed, 78% had low streambed erosion, 18% had moderate streambed erosion and 4% had high streambed erosion.

Table A.35: Degree of streambed erosion along assessed stream reaches in the watershed.

	Indian-Cahokia Creek
Low Streambed Erosion	
Locations (#)	43
%	78
Moderate Streambed Erosion	
Locations (#)	10
%	18
High Streambed Erosion	
Locations (#)	2
%	4

Figure A.39: Streambed erosion conditions noted in the Indian-Cahokia Creek watershed



Debris Blockages (Logjams)

Logjams alter stream hydrology, increasing the scouring effect of flow on the streambank and streambed as water is channeled around the blockage. If the logjam spans the channel, the stream is more likely to overtop and flood nearby land during times of high flow. Logjams were identified in video footage from the aerial survey.

Table A.36 and Figure A.40 identify the number and location of logjams in the Indian-Cahokia Creek watershed, organized by HUC14.

Table A.36: Logjams identified in the Indian-Cahokia Creek in video footage from the aerial survey (February 2016).

HUC14	Logjams identified in aerial survey (number)
07140101020101	3
07140101020102	5
07140101020103	18
07140101020201	5
07140101020202	5
07140101020203	10
07140101020301	19
07140101020302	1
07140101020303	16
07140101020401	14
07140101020402	16
07140101020403	7
07140101020404	14
07140101020501	15
07140101020502	3
07140101020503	8
07140101020504	2
07140101020601	6
07140101020602	7
07140101020603	5
07140101020604	7
07140101020605	7
07140101020701	3
07140101020702	9
07140101020703	8
Total	**213**

Figure A.40: Logjams in the Indian-Cahokia Creek watershed as identified from video footage from the aerial survey (February 2016).

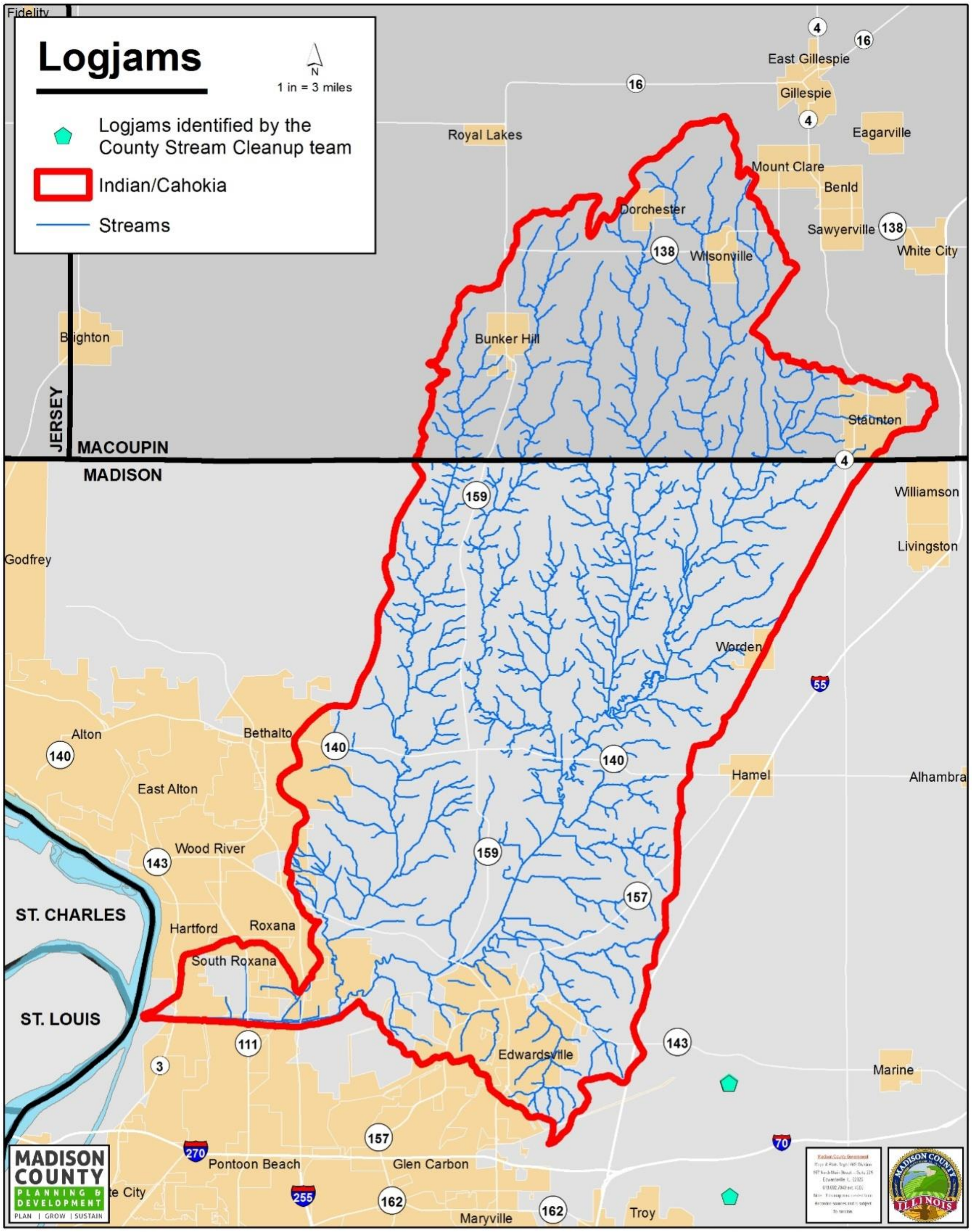


Figure A.43a. Logjams in the Cahokia Creek watershed identified by the Madison County Stream Cleanup team (2008-2009).

Ephemeral/Gully Erosion

The Illinois Department of Agriculture's periodic Soil Conservation Transect Survey gathers information about conservation tillage practices in the state. Its measure of ephemeral erosion indicates the extent of gully erosion by county, as surveyors identify fields in which ephemeral or gully erosion has occurred or is likely to occur in areas of concentrated surface water flow. According to the 2015 transect survey, Macoupin County has low ephemeral erosion (4%), while Madison County has a higher than state average (12.6%) rate of 45% as shown in Table A.37. (41)

Table A.37: Percent and number of fields with indicated ephemeral/gully erosion by county as of 2015.

County	Yes		No		Total
	%	Number	%	Number	
Macoupin	4	21	96	478	499
Madison	45	162	55	202	364
Total		**183**		**680**	**863**

Shoreline Erosion

There are 909 acres of waterbodies in the NHD in the watershed. Ten lakes in the watershed are named, covering 474 acres, and with a total perimeter of 45,894 ft. The named lakes in the watershed include Holiday Lake (by far the largest lake in the watershed), Dunlap Lake in Edwardsville, and Tower Lake at Southern Illinois University-Edwardsville. No shoreline erosion data was available for these lakes.

Levees

There are 11.58 miles of levees in the Indian-Cahokia Creek watershed, 4.43 miles of which are sponsored and maintained by the U.S. Army Corps of Engineers (42). There are three levee systems in the watershed, all of which are in Madison County (Figure A.41 below).

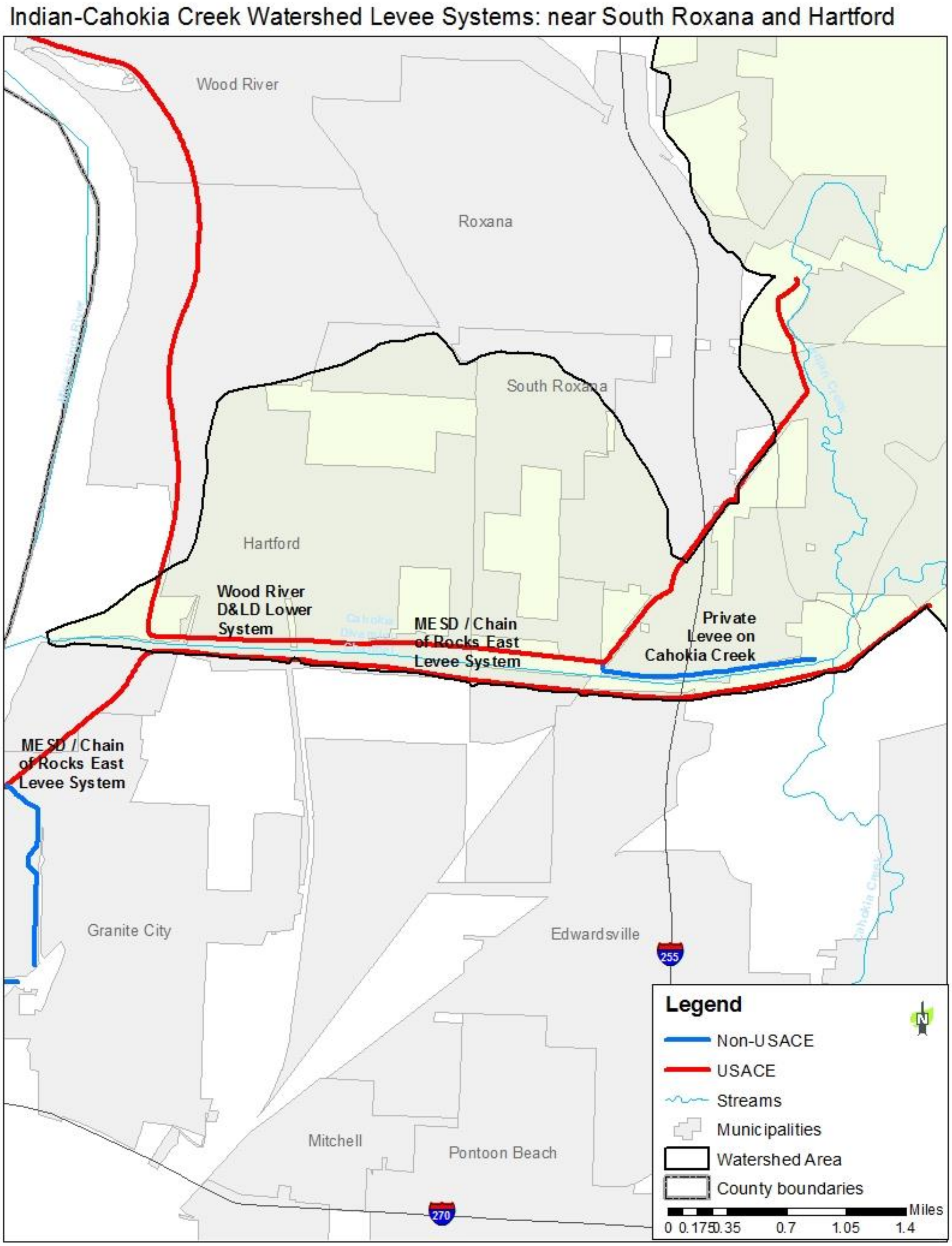


Figure A.41: Levee systems in the Indian-Cahokia Creek watershed.

Detention and Retention Basins

USACE looked at National Agriculture Imagery Program (NAIP) aerial photographs of the watershed, along with USGS topographic maps and the National Hydrography Dataset, to identify detention and retention basins. A detention basin is a low lying area that is designed to temporarily hold water while slowly draining to another location. A retention pond is designed to hold a specific amount of water indefinitely, usually leading to another location when the water level exceeds the design capacity. (43) A point was created for each basin located in or very close to a group of five or more buildings. This was in order to avoid classifying natural ponds as detention basins. With significant developed area near the basin, there was a higher likelihood that the basin had been engineered or altered by man in some way. It should be noted that detention and retention basins on agricultural land are very common, but they were not included in this inventory, partly because the Agricultural Conservation Planning Framework (ACPF) used to identify BMPs also identifies likely detention locations.

The data gathered includes whether the detention basin is in a subdivision, along with the year the subdivision was first developed and the year of latest development (from plat information from Madison County). Also noted was the presence of standing water, the number of visible inlets/outlets, whether the basin was “on-line” (on a stream or at the start of a stream) or “off-line” (outside the waterway), the type of side slope vegetation, whether the basin was already in the National Hydrography Dataset, and the accessibility of the basin from nearby roads or public land.

Site visits were made on August 15, 2016 to 13 of the 107 accessible sites identified in the two watersheds in order to determine the basins’ conditions. The sites were selected by geographic location, distributed somewhat evenly throughout the watershed, and by prioritizing basins about which the Madison County Stormwater Coordinator received complaints. On the site visits, location, type and condition of the basins were confirmed. The condition of the basins was rated and is shown in Table A.38. These ratings are somewhat subjective and based on the factors listed in Table A.39. The factors listed in Table A.39 are intended to be somewhat comprehensive and as a result, some issues such as trash, submerged inlet pipe and others show no sites with these issues within either watershed. This does not mean that there aren’t trash issues in the watersheds; however, none were observed in the few basins visited. Basins visited ranged in size between 54 acres and 2.10 acres, with an average area of 1.65 acres. All 13 retention basins were wet and no dry detention basins were visited.

Figure A.42: Images from four detention basins from site visits on August 15, 2016. Note that Madison experienced precipitation for the past 24 hours and a flash flood warning was issued.

Forty nine (49) detention or retention basins were identified in the Indian Creek-Cahokia Creek watershed, with the majority occurring in either the northern or southern portions of the watershed, with an obvious diagonal strip in the middle of the watershed with no basins present (Table A.38, Figure A.43). Most of the basins have water in them (96%); however, it was much easier to identify basins containing water than dry basins, so wet basins may be overrepresented. Nearly seventy percent (69.4%) of the basins were already in the National Hydrography Dataset as "Lake/Pond, perennial." Turf is the most common vegetation on the side slopes of the basins, present in 51% of the basins identified. Rocks are present on 26.5% of the basins' side slopes, and trees are present on 22.4% of the side slopes.

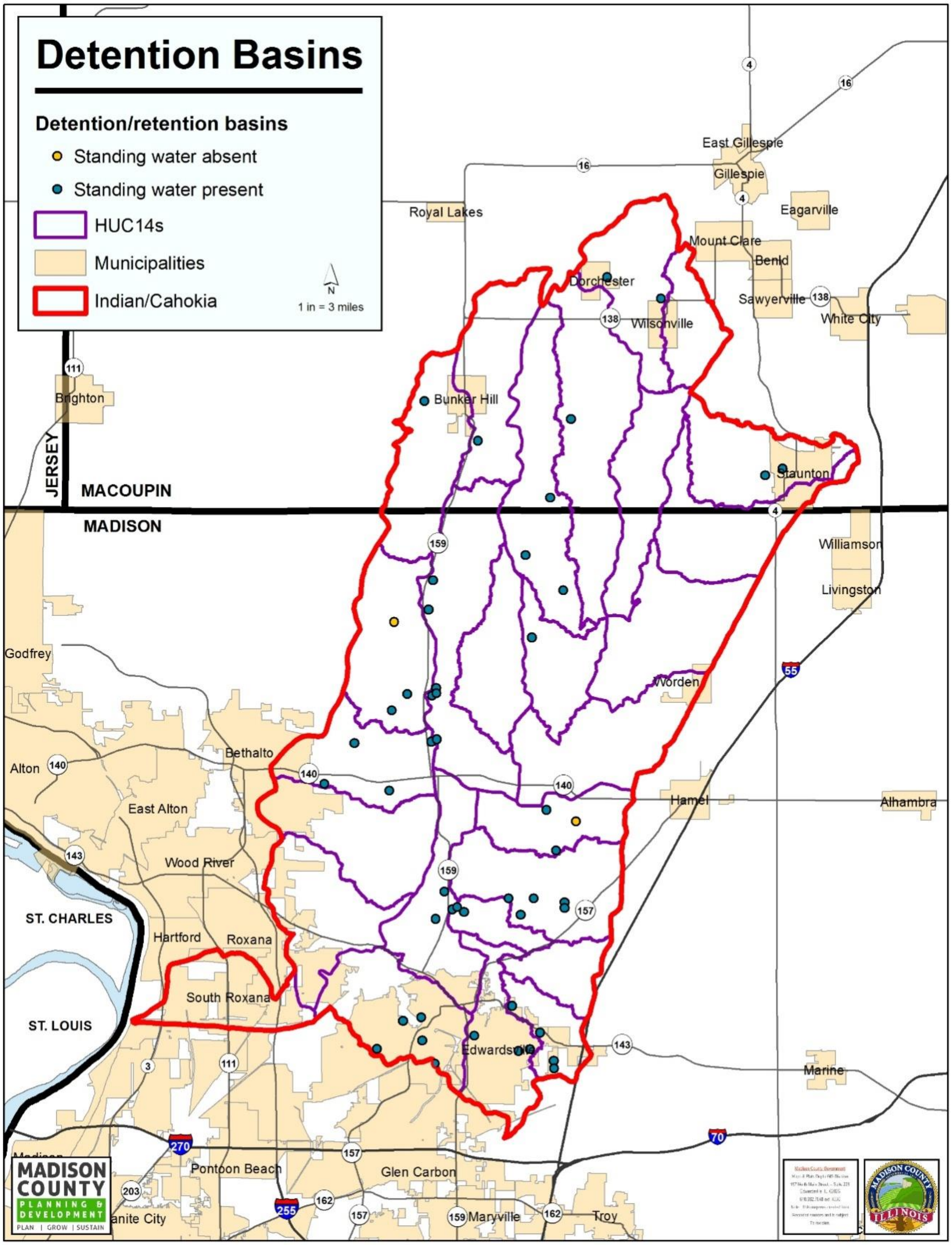
Table A.38: Number of detention and retention basins identified in each HUC14 in the Indian-Cahokia Creek watershed.

HUC14	Number of basins identified	Number of basins visited	Condition of basins visited
07140101020101	2		
07140101020201	2		
07140101020301	1		
07140101020302	6	1	GOOD
07140101020303	1		
07140101020401	1		
07140101020402	3	1	GOOD
07140101020501	3		
07140101020503	7	1	POOR
07140101020504	3	1	POOR
07140101020505	4		
07140101020601	1		
07140101020602	3		
07140101020603	4	1	GOOD
07140101020701	3		
07140101020702	5		
Total	**49**	**5**	**3 Good** **2 Poor**

Table A.39: Summary of location, type, and condition of detention and retention basins inspected on site visits.

Issue	Number of Sites
Algae (submerged or on surface)	0
Sediment (reduced basin capacity)	0
Bank erosion	1
Trash	0
Blocked culvert under road leading to basin, road floods	0
Murky, milky water appearance	0
Outlet pipe leads towards power station – potentially unsafe	0
Scouring of outlet channel	0
Submerged inlet pipe	0

Figure A.43: Location of detention and retention basins in the Indian-Cahokia Creek Watershed, identified by aerial imagery assessment.



Flooding

Flooding Types and Contributing Factors

A flood is defined by FEMA as a general or temporary condition where two or more acres of normally dry land or two or more properties are inundated by:

- overflow of inland or tidal waters;
- unusual and rapid accumulation or runoff of surface waters from any source;
- mudflows; or
- a sudden collapse or subsidence of shoreline land.

The severity of floods are determined by a number of factors, including topography, ground cover, precipitation and weather patterns, recent soil moisture, the presence of streams and other waterbodies, as well as a location's relationship to the watershed. Floods can cause utility damage and outages, infrastructure damage, structural damage, crop loss, decreased land values, loss of life, and impediments to travel, including emergency access.

Two main types of flooding affect the Indian-Cahokia and Canteen-Cahokia watersheds: flash flooding and general flooding. A flash flood is a rapid rise of water along a stream or low-lying area, usually produced when heavy localized precipitation falls over an area in a short amount of time. Flash floods are considered the most dangerous type of flood event because there is often little or no warning time, and because of their capacity for damage, including the capability to induce mudslides. Vulnerability to flash flooding changes most often with a change in land use. As impervious surface area increases, the risk of flash flooding increases, as rain and snowmelt can no longer infiltrate the ground slowly and flows quickly downstream.

General flooding can be broken down into two categories: riverine flooding and shallow or overland flooding. A riverine flood is the gradual rise of water in a river, stream, lake, or other waterway that results in the waterway overflowing its banks. This type of flooding generally occurs when storm systems remain in the area for extended periods of time, when winter or spring rains combine with melting snow to create higher flows, or when obstructions such as logjams block normal water flow. One famous example of a riverine flood is The Great Flood of '93 where intense rainfall events, coupled with already saturated ground surfaces and spring snow melt in northern states, resulting in the Mississippi River flooding out of its banks for months on end.

A shallow or overland flood is the pooling of water outside of a defined river or stream (e.g., in sheet flow or ponding). An overland flood generally occurs when rainfall collects on saturated or frozen ground. When surface runoff cannot find a channel, it may flow out over a large area at a somewhat uniform depth in sheet flow, or collect in depressions and low-lying areas, creating a ponding effect.

Vulnerability to riverine flooding in the NFIP member communities is low as long as existing floodplain ordinances are enforced. Floodplain ordinances are the major mechanism for ensuring that new structures either are not built in flood-prone areas or are elevated or protected from floodwaters to severely limit their potential flood damage.

The general definition of a floodplain is any land area susceptible to being inundated or flooded by water from any source (such as a river or stream). A regulatory or base floodplain is defined as the land area that is covered by the floodwaters of the base flood. This land area is subject to a 1% chance of flooding in any given year. (5) For the following sections, the regulatory definition of a floodplain will be used.

Extent of the Floodplain

In the Indian-Cahokia Creek watershed within Madison County, 17.46% of the land (15,662 acres) is designated as regulatory flood plain.

There is no mapped floodplain in Macoupin County within the watershed.

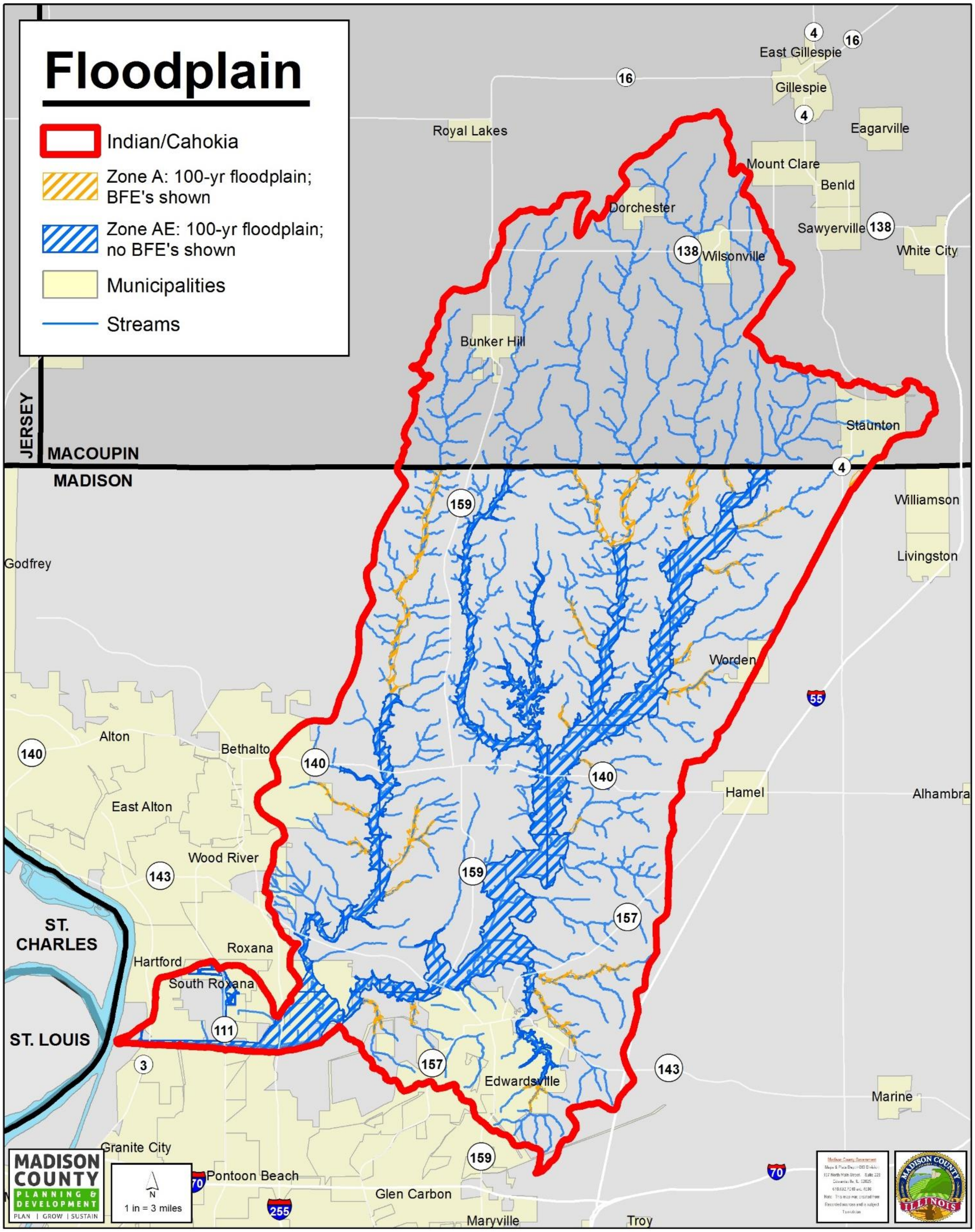
Development in the Floodplain

In the Indian-Cahokia Creek watershed, 391 structures in municipalities are at least partially located in the 1% chance FEMA floodplain. In the watershed area covering Bethalto, Pontoon Beach, Wood River and Worden, there are no structures in the floodplain. Holiday Shores and Edwardsville have the most structures in the floodplain, 284 in total (Table A.40). All of the communities are fully covered by Flood Insurance Rate Maps (FIRM), so the number of structures at risk from a 1% chance flood is comprehensive of the municipality.

Table A.40: Number of Structures Partially or Wholly within the Floodplain in the Indian-Cahokia Creeks Watershed.

Municipality	Number of Structures
Bethalto	0
Edwardsville	130
Hartford	2
Holiday Shores	154
Pontoon Beach	0
Roxana	17
South Roxana	88
Wood River	0
Worden	0
Total	**391**

Figure A.44: FEMA designated floodplain in the Indian-Cahokia Creek watershed.



Repetitive Loss Structures in the Watershed

FEMA defines a repetitive loss structure as one covered by flood insurance under the NFIP which has suffered flood damage on two occasions during a 10-year period that ends on the date of the second loss, in which the cost to repair the flood damage is at least 25% of the market value of the structure at the time of each flood loss.

Of the 14 municipalities in Madison County and the Indian-Cahokia and Canteen-Cahokia watersheds, four contain repetitive loss structures. Of the unincorporated areas of Madison County within these watersheds there are 11 repetitive loss properties, which have made 30 claim payments. The exact locations of these properties are kept on file with FEMA and are not eligible for publication. A breakdown of buildings and number of losses by municipality are shown below in Table A.41.

Table A.41: Repetitive loss information for portions of Madison County.

City	Buildings	Losses	Claims	Total Claim Amount
Bethalto	1	2	6	$61,382.16
Collinsville	2	6	12	$100,721.25
Pontoon Beach	2	5	28	$152,833.16
Wood River	3	6	24	$165,644.00
Unincorporated Madison County	11	30	184	$1,951,001.77
Total	**19**	**49**	**254**	**$2,431,582.34**

For the unincorporated parts of Madison County, the data provided by FEMA includes all areas within the county, not just those in the watershed boundary.

There are not repetitive loss structures in the Macoupin County portion of the watershed, as they are currently participating in the emergency phase of the NFIP, resulting in limited coverage and no flood hazard information.

Critical Facilities

Some structures are particularly vulnerable to floods and require special protection to protect vulnerable populations and public health. FEMA recognizes these critical facilities under two categories:

1. At-risk essential facilities: Facilities that are vital to flood response activities or critical to the health and safety of the public before, during, and after a flood, such as a hospital, emergency operations center, electric substation, police station, fire station, nursing home, school, vehicle and equipment storage facility, or shelter.
2. At-risk critical facilities: Facilities that, if flooded, would make the flood's impacts much worse, such as a hazardous materials facility, power generation facility, water utility, or wastewater treatment plant.

According to the Illinois Natural Hazard Mitigation Plan, Madison County has the most critical facilities in the 1% chance floodplain of any county in Illinois. Facilities at risk include schools, police stations, wastewater treatment plants and communication facilities. In Macoupin County, there are 79 "essential facilities," a subset of critical facilities, including schools, medical care facilities, fire stations and Emergency Operations Centers. It is not known how many of these facilities are located in the floodplain. (44)

According to FEMA's "Hazus" multi-hazard risk assessment tool, the Indian-Cahokia Creek watershed has 251 critical facilities. A further breakdown of the quantity of each type of facility in the watershed is given in Table A.42.

Table A.42: Critical facilities in the Indian-Cahokia watershed.

Facility Type	Indian-Cahokia Creek
Beef cattle feedlots	5
Biological products (except diagnostics)	2
Chemical Plant	
Industrial products	8
Nitrogen fertilizers	0
Pharmaceutical preparations	0
Communication cellular tower	1
Education	
Private school	7
Public school	18
Emergency	
EMS	4
Fire Station	10
Local Emergency Operations Center	1
Shelter	14
Energy	
Electrical power generator	1
Propane	9
Energy substation	3
Cities/Townships/Villages	8
Law Enforcement	
Police Department	5
Jail	1
Mail – US Postal Service	9
Manufacturing	
Wood product manufacturing	5
Natural Historic Site	2
Public Venue	
Library	10
Park	7
Place of worship	6
Transportation	
Airport	3
Railroad bridge	111
Water Supply	
Wastewater treatment plant	1

Infrastructure in the Floodplain

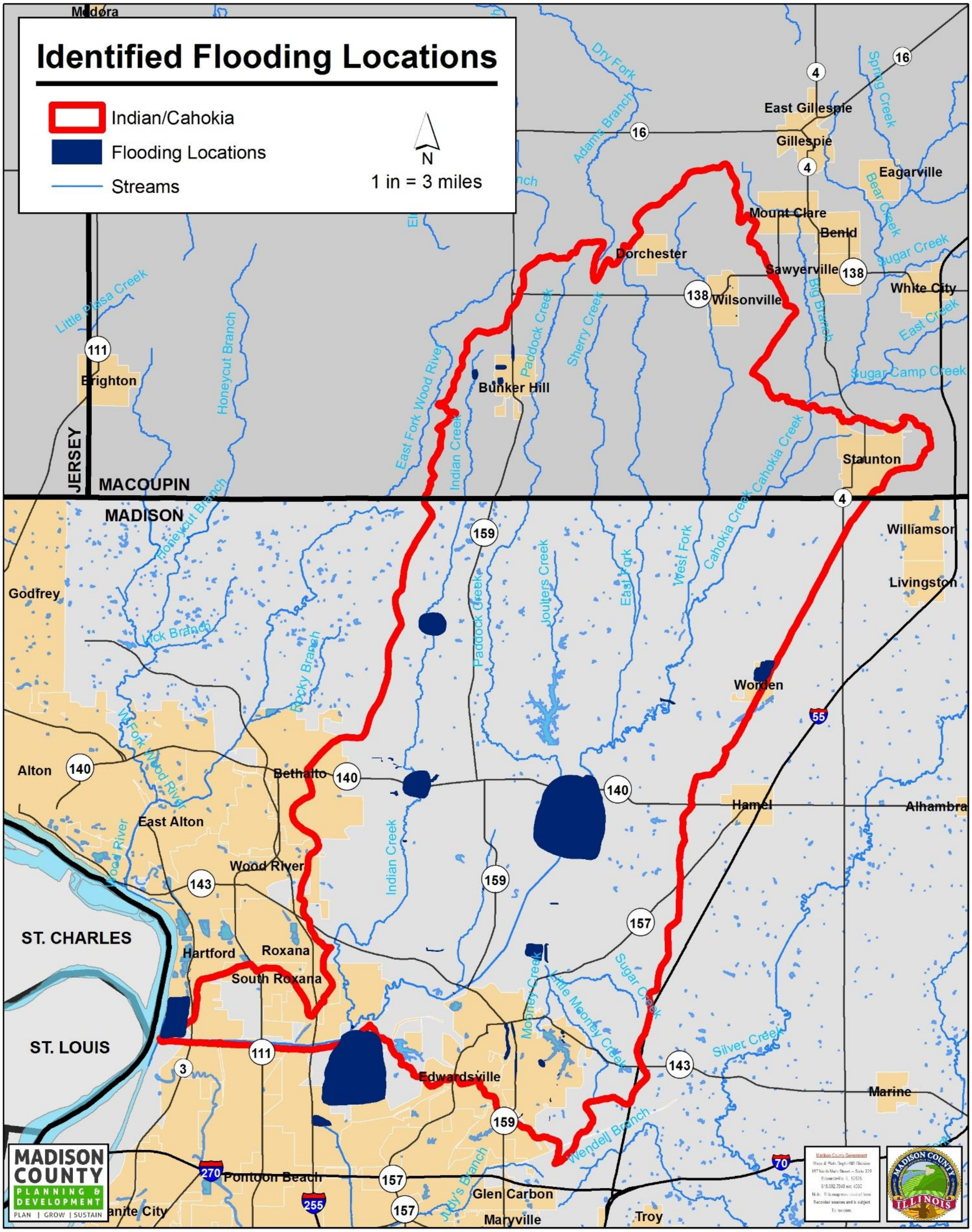
Roads, bridges, and buried power and communication lines are located within or adjacent to floodplains throughout the watershed. Nearly the entire watershed is vulnerable to both flash flooding and interior flooding from either overloaded storm sewer systems or improper drainage. A majority of the buildings, infrastructure, and critical facilities that may be impacted by flooding are located outside of the base floodplain (for a count of facilities within each watershed, see "Critical Facilities" section). Stakeholder outreach conducted for this plan helped to highlight several other instances of flooding outside of floodplains.

Locations Affected by Floods

Flooding Locations Identified at Stakeholder Meetings

While introducing the Cahokia Creeks Watershed Plan to residents, two stakeholder meetings were held in the fall of 2015 to get input from attendees, mostly local residents. Meeting attendees were invited to identify flooding locations within the watershed (Figure A.45). They looked at maps which included roads, municipalities, structures, and FEMA floodplains to identify locations that typically flood, either by a point or area designation. This input was then digitized to show flooding "hot spots" within the watershed.

Figure A.45: Flooding locations identified at stakeholder meetings for the Indian-Cahokia Creek watershed.



Flooding Locations Identified in the Community Flood Survey

The Madison County Community Flood Survey was created by HeartLands Conservancy and the Madison County Planning and Development office and distributed to residents and businesses in the fall of 2015. Surveys were sent out for both the Indian-Cahokia Creek watershed and Canteen-Cahokia watershed at the same time. The intent of the survey was to gather information regarding the location, extent, impacts and causes of flooding in each watershed. The results of each community flood survey are shown in the Flood Survey Report in Appendix B. It should be noted that these survey responses were received prior to the winter flood that occurred around Christmas 2015 and the 2016 New Year. Many areas within the watershed flooded during this winter event that had not flooded recently.

A total of 282 surveys were completed from residents and business owners in the Indian-Cahokia Creek watershed, out of 1,600 mailed out, giving a response rate of 18%. This total also includes surveys filled out online. Well over half (68%) of respondents were from the Edwardsville zip code.

Survey responses showed that 21% of respondents experienced flooding in the last 10 years, with 9.6% of respondents noting flooding at least once per year in the past 10 years. On average, those who were flooded experienced 1.2 floods per year. The respondents with the highest proportions of flooding were in the Dorsey, Bethalto, Moro, and Warden zip codes. Dorsey had the greatest proportion of respondents to report flooding (50%).

An assessment was made of flooding "hotspot" locations in the watershed based on four attributes: 1) percentage of respondents who said they had been flooded, 2) flood frequency, 3) percentage who said that neighbors had been flooded, and 4) monetary loss as a result of flooding.

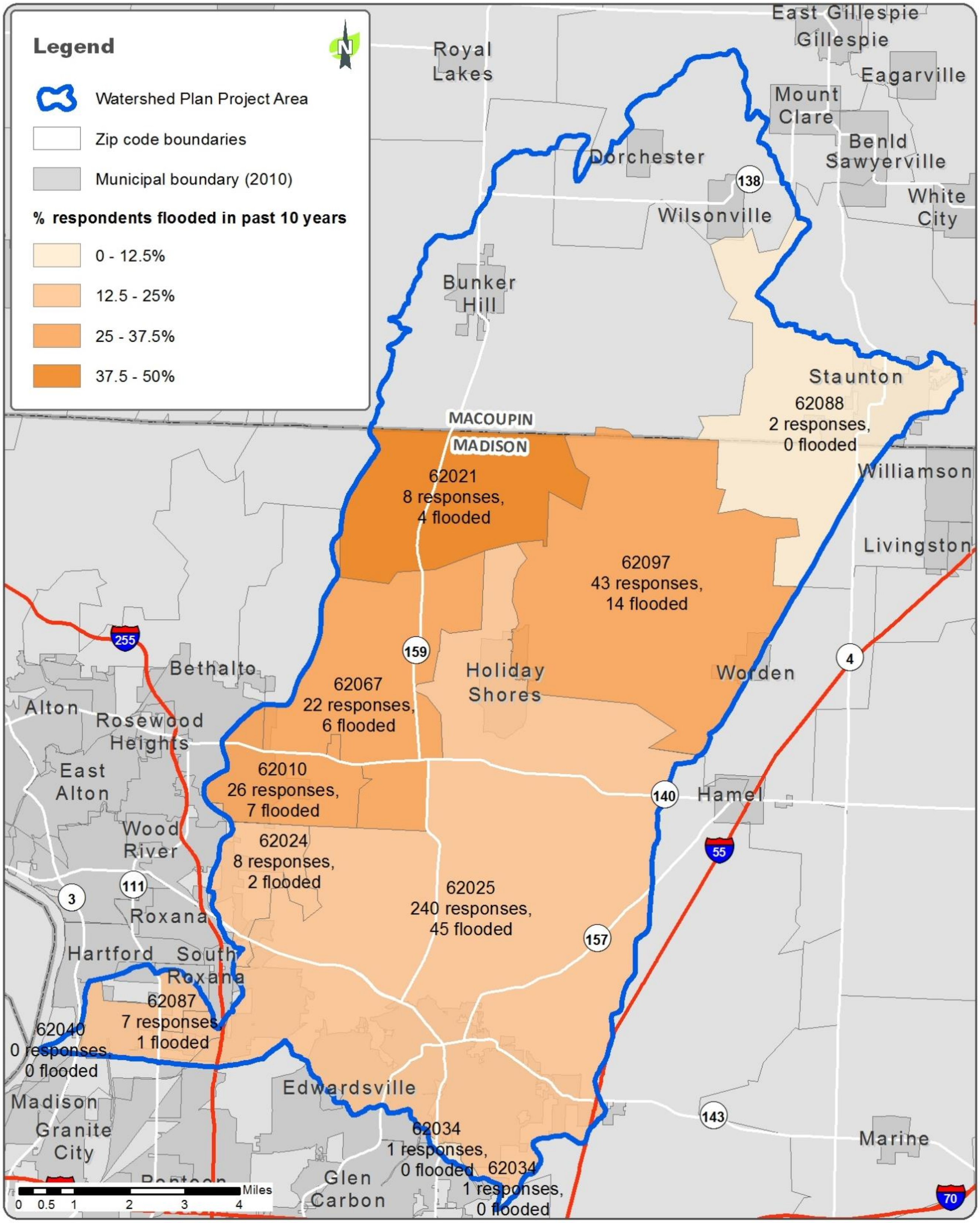
The top three flooding hotspots, based on flooded area, from the survey results are listed below:

1. Just south of Holiday Shores, at the confluence of Paddock Creek and Sherry Creek; old Carpenter Road, southwest of Brakane Road
2. Confluence of White Rock Creek and West Fork Cahokia Creek, southwest of Staunton; Southeast of Renken Road and Dustman Road
3. Area just southwest of Worden at Possum Hill Road, Schien Road and Behmer Road

Table A.43: Responses to the flood survey question, "Have you experienced flooding in the last 10-years?" (45)

Response	Percent of Responses
Yes	21%
No	76%
No Answer	4%

Figure A.46: Percent of respondents flooded in the Indian-Cahokia Creek watershed.



Flooding Outside the Floodplains

Madison County has experienced flash floods and riverine floods, which are discussed in their countywide hazard mitigation plans. Madison County has had 11 federally declared disasters since 1965, nine of which have been due, at least in part, to flooding. (5)

FEMA designated floodplains cover 13% of the total acreage of the Indian-Cahokia Creek watershed in Madison County. Of the flood surveys received from this watershed, 11% came from parcels wholly or partly located within these floodplains. Of all survey respondents, 7.4% unknowingly live on or own a property that is at least partially in the floodplain.

Survey respondents reported approximately 689 events per year taking place outside of FEMA designated floodplains. Within floodplains, approximately 70 parcels per year were flooded. (45)

Table A.44: Frequency and location of flooding in and outside of floodplains, according to the mapped locations of responses.

		Parcels in floodplain		Parcels outside floodplain	
Flood Frequency over 10 year period	**Average times per year**	**Number**	**Number of times flooded per year**	**Number**	**Number of times flooded per year**
1-3 times	0.2	5	1	18	3.6
4-6 times	0.5	1	0.5	7	3.5
7-9 times	0.8	2	1.6	7	5.6
10-49 times	1.95	2	3.9	16	31.2
50 or more times	5	0	0	5	25
Total	**1.69 (average)**	**10**	**7**	**53**	**68.9**

Flooding on Roads

Besides several road overtopping locations identified at stakeholder meetings, a 2010 Oates Associates report generated for Madison County was used to assess road overtopping as well. This report was used to develop a flooding assessment to advise the Stormwater Commission and contribute to the county Stormwater Plan. The flooding assessment used GIS data review and analysis, community data requests, meetings with individual communities, and FEMA's Flood Insurance Study for the county and flood maps to identify stormwater-related problems. The assessment identified several projects that municipalities had identified to improve their drainage, in categories such as maintenance, dam safety, localized flooding, stream channel flooding, combined sewers, and roadway overtopping.

Eighteen road overtopping locations were identified from FEMA's 2008 Draft Flood Insurance Rate Maps (D-FIRMs) and the associated 2003 Flood Insurance Study (FIS) for Madison County (locations are shown below in Table A.45). Of these, seven were considered to have "major" flood severity, meaning that the stream profile indicated water was overtopping the roadway at a structure crossing in either the 100-year or 500-year storm event. Eleven road overtopping locations were considered to have "minor" flood severity.

Table A.45: Road overtopping locations identified in the Indian-Cahokia Creek watershed in the 2010 Oates Associates Flooding Assessment report.

ID	Waterway Name	FEMA Stream Profile Number	Watershed	Crossing	Approximate Flowline Elevation (NAVD)	Flood Severity
1	Cahokia Creek	02P	Burroughs Branch-Cahokia Creek	Wanda Road	436.0	Minor
2	Cahokia Creek	08P	White Rock Creek-Cahokia Creek	Renken Road	498.0	Major
12	Indian Creek	22P	Indian Creek	Railroad/Old Alton Edwardsville Road	443.5	Minor
13	Indian Creek	24P	Indian Creek	Roosevelt Drive	485.0	Minor
14	Joulters Creek	27P	Paddock Creek	Renken Road	556.5	Major
40	Mooney Creek	58P	Mooney Creek	Railroad/State Route 157	561.5	Major
41	Mooney Creek	60P	Mooney Creek	Marine Road	476.5	Minor
42	Mooney Creek	60P	Mooney Creek	Indian Creek Road	474.0	Minor
43	Mooney Creek	60P	Mooney Creek	Culvert downstream of Schwarz Road	480.0	Major
44	Mooney Creek	60P	Mooney Creek	Schwarz Road	483.0	Minor
45	Mooney Creek	61P	Mooney Creek	East Lake Drive	515.0	Major
46	Mooney Creek	61P	Mooney Creek	Willow Creek Drive	516.0	Minor
49	Paddock Creek	64P	Paddock Creek	State Route 140	476.5	Minor
50	Paddock Creek	64P	Paddock Creek	St. James Drive	483.5	Minor
51	Paddock Creek	65P	Paddock Creek	Moro Road	501.5	Minor
52	Paddock Creek	65P	Paddock Creek	Renken Road	531.0	Major
53	Sherry Creek	67P	Sherry Creek	Possum Hill Road	482.0	Minor
54	Sherry Creek	67P	Sherry Creek	Renken Road	504.5	Major

Flooding and Drainage Complaints

The Madison County Stormwater Coordinator keeps a record of complaints received about drainage issues. Between 2012 and 2016, a total of 72 stormwater complaints were recorded in the Cahokia Creek's watershed. A breakdown of complaints over time is given below.

There were 30 complaints logged with Madison County in the Indian-Cahokia Creek watershed from 2012-2016. The majority of these complaints (87%) were logged at addresses within the City of Edwardsville, since Edwardsville is the largest municipality in the watershed, these results are not surprising. The most complaints were logged in 2015, followed by 2014 and 2013 totaling 24 complaints over the three-year period.

Table A.46: Number of complaints received by year and municipality from 2012 to 2016 in the Indian-Cahokia Creek watershed.

Municipality	2012	2013	2014	2015	2016	Total
Dorsey			1			1
Edwardsville	3	5	6	9	3	26
Moro		1	1	1		3
Total	**3**	**6**	**8**	**10**	**3**	**30**

History of Flooding in the Watershed

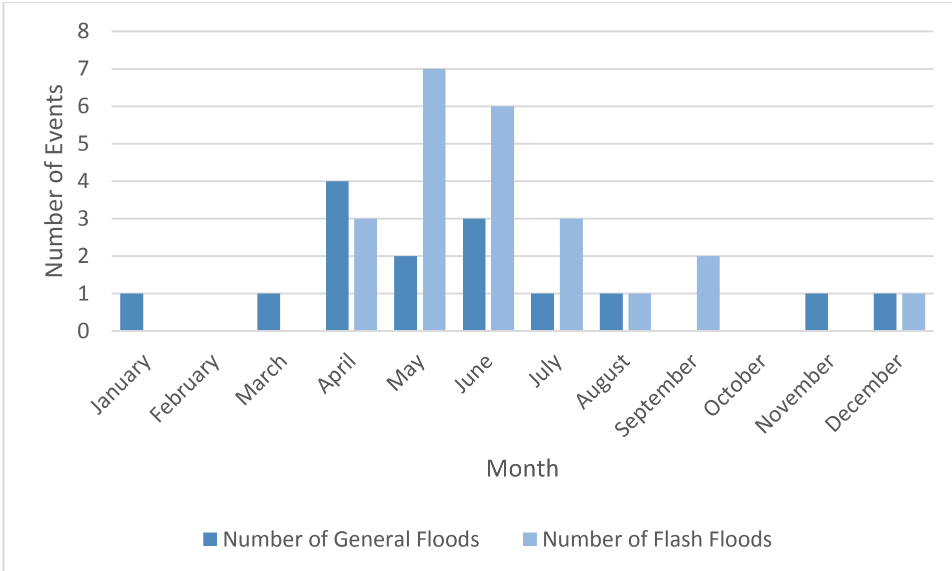
Both counties in the project area have identified flooding as a major hazard in their County Hazard Mitigation Plans. Macoupin County has experienced 17 floods in the 19 years from 1994 to 2013. Madison County's Hazard Mitigation Plan, finalized in June 2006, lists five events where major flooding occurred in the St. Louis Metropolitan region, including Madison County: July 1947, July 1951, April 1973, August 1993, and May 1995. Since the publication of the countywide plan, the St. Louis region has also experienced flooding in 2008, 2011, 2013, 2014, and most recently during the winter of 2015 to 2016. All of the general flood events in Madison County, with one exception, were considered countywide events. No specific jurisdictions in Madison County experienced flash floods only in one municipality.

The greatest risk for flooding in the Cahokia Creek watershed is in the spring and summer. The most likely month for flash floods in Madison County is May (historically 60.5% of events), and the most likely month for general floods is April (historically 39.5% of flood events) as shown in Figure A.47.

Table A.47: Occurrences of floods and most likely months for flooding to occur in the two counties in the project area.

	Macoupin County (1994-2013)	Madison County (1993-2012)
Number of General Floods Reported	1	16 (1973-2012)
Number of Flash Floods Reported	16	23
Total Number of Floods Reported	17	≥ 23

Figure A.47: Reported flood events in Madison County by month. Multi-month events are shown only in the month they began.



Impacts of Floods

Injury and Death

In Illinois, flooding causes an average of four deaths per year. Historically, the number of injuries and deaths in Madison County from flooding has been very low. No injuries or deaths were reported as a result of any of the 16 recorded general floods from 1973-2012. However, as there is often little-to-no warning for flash flood events, the risk to public health and safety is elevated.

The major cause of death during floods is drowning with nearly half of all flash flood deaths occurring as vehicles are swept downstream. According to FEMA, six inches of water will reach the bottom of most passenger cars, causing loss of control and potential stalling, a foot of water will float many vehicles, and two feet of rushing water will carry away most vehicles, including SUVs and pickup trucks. The United States Geologic Survey (USGS) reports that one foot of water typically exerts 500 pounds of lateral force on a vehicle. Floodwaters also damage roadways, bridges, and other transportation structures, affecting mobility including evacuation routes.

Floodwaters not only pose harm through the volume of water transported but also in the potential contaminants in the water. Biological and chemical contaminants in floodwater also pose a risk to public health and safety. Wastewater treatment plants are often located either in or near floodplains, and high water events can allow for untreated sewage to mix with stormwater and be transported onto streets, yards, parks, and into buildings. If left untreated, these locations can serve as breeding grounds for bacteria and other disease causing agents. If underground utilities are disrupted by flood events, gasoline, oil, and other contaminants can also contaminate floodwaters. Depending on the time of year that flooding occurs, agricultural chemicals can also be seen in high concentrations in flood water. Once floodwaters recede, mold and mildew can pose health risks to young children, the elderly and those with asthma or allergies. (5) (6) (9)

Financial Impacts

Flooding has caused an estimated $257 million per year in damages across Illinois since 1983, making it the single most financially damaging natural hazard in the state. Structural damage to property accounts for a large portion of these financial damages and can include foundation, flooring, drywall, and framing damage as well as damages to buildings contents. Losses in agricultural, commercial, and industrial productivity as well as tourism are also impacted by floods.

Between 1978 and 2013, NFIP paid out more than $3 million to Madison County policy holders alone, an average of nearly $86,000 annually. Six of the 16 general flood events in Madison County between 1973 and 2012 caused $12.5 million in crop damages and nearly $37 million in property damage. (46) Four of these six events were federally declared disasters. Madison County has experienced 23 flash flood events between 1993 and 2012, six of which caused $95,000 in crop damage and nearly $7.3 million in property damage. Damage information was unavailable for the remaining 17 reported flash floods. (5)

The Madison County Community Flood Survey questioned residents on flood frequency and costs of flood damage in the watershed. Table A.48 below shows a statistical breakdown of financial impacts as reported by residents in the flood survey.

Table A.48: Key financial impact results from the community flood survey

	Indian-Cahokia Creek Watershed
Respondents whose home, business or property has flooded in the last 10-years	9.6
Number of floods experienced annually	1.2
Of respondents who experienced flooding in the last 10 years:	
No monetary loss	37%
< $5,000	35%
$5,001-$20,000	20%
$20,001-$50,000	6%
$50,001-$100,000	2%
Total costs due to flooding in the last 10 years (low estimate)	$160,031

Other Impacts

Stress was the most commonly reported impact from flooding besides financial losses. Other effects include lack of access to property and major routes to/from homes, lost business income, crop damage, and repair and replacement costs of goods and structures. (45) (47)

The National Flood Insurance Program (NFIP)

The NFIP was created by Congress in 1968 through the National Flood Insurance Act. Communities participating in the NFIP agree to adopt a floodplain management ordinance to reduce flood risks to new construction in Special Flood Hazard Areas (SFHAs), which are subject to inundation by the "base flood," also known as the "1 percent chance flood," the "100-year flood," or "regulatory flood," as designated on Flood Insurance Rate Maps (FIRMs). In return, the NFIP makes flood insurance available within the community as a financial protection against flood losses. Four percent of U.S. households in 22,000 communities participated in the NFIP as of 2010. The NFIP is managed within the Federal Emergency Management Agency (FEMA)'s Mitigation Division. Illinois is in Region V. (48)

Communities Enrolled in the NFIP and Their Policies

In the watershed area within Madison County, ten municipalities participate in the NFIP. Madison

County also participates in the program, so unincorporated portions of the county that are within a FEMA designated SFHA are also eligible for flood insurance. Holiday Shores is included in the unincorporated Madison County area.

The county has 1,184 policies in effect covering over $246 million in assets. The communities of Wood River and Pontoon Beach have the most policies in effect of all municipalities within the watersheds. Table A.49 gives a breakdown of the policies in the watershed, including the entirety of municipalities wholly or partially within the watershed.

Table A.49: NFIP policies in effect in the Indian-Canteen-Cahokia Creek watershed as of the end of 2013.

Municipality	Policies in Force	Premium	Insurance in Force	Closed Losses	Cost of Closed Paid Losses	Adjustment Expense
Bethalto	4	$2,081	$836,800	5	$14,264	$1,170
Collinsville	36	$36,490	$9,077,000	10	$77,735	$4,450
Edwardsville	15	$11,010	$3,239,400	2	$38,359	$2,050
Fairmont City	17	$9,030	$2,458,800	0	$0.00	$0.00
Glen Carbon	12	$4,551	$3,150,000	0	$0.00	$0.00
Hartford	52	$27,375	$14,762,000	14	$22,873	$3,070
Pontoon Beach	143	$111,943	$17,983,500	17	$75,017	$8,670
Roxana	7	$2,720	$1,505,000	0	$0.00	$0.00
South Roxana	13	$9,217	$2,758,800	0	$0.00	$0.00
Unincorporated Madison County*	722	$552,866	$163,270,400	168	$1,609,990	$70,224
Wood River	163	$123,233	$27,808,200	22	$138,146	$7,902
Total	**1184**	**$890,516**	**$246,849,900**	**238**	**$1,976,384**	**$97,536**

*this area includes large portions outside of the watershed boundary

Terms included in Table A.49 are defined below:

- **Policies In Force**: Policies in force on the "as of" date of the report
- **Insurance In Force**: The coverage amount for policies in force
- **Closed losses**: Losses that have been paid

Madison County is currently undergoing review of new floodplain maps for the county. (49)

Nine percent (26 responses) of respondents in the Indian-Cahokia Creek watershed reported having flood insurance in the community flood survey. (45)

Table A.50: Communities in the Indian-Cahokia Creek watershed enrolled in the NFIP.

Community	Initial FIRM	Effective FIRM Date
Bethalto	07/02/1980	07/02/1980
Edwardsville	01/18/1984	01/18/1984
Glen Carbon	N/A	N/A
Hartford	05/01/1979	05/01/1979
Roxana	05/01/1979	05/01/1979
South Roxana	11/26/1982	11/26/1982
Unincorporated Madison County	04/15/1982	04/15/1982
Wood River	05/01/1979	05/01/1979

Communities Not Enrolled in the NFIP

Macoupin County is currently enrolled in the emergency phase of the NFIP and flood insurance coverage in more limited within the county than in areas fully participating in the program. In the emergency phase, there is no flood hazard information for floodplain management purposes. The Village of Worden does not have any SFHA within the city limits.

When the NFIP began, separate areas of government jurisdiction were shown on separate FIRMs. This is the case for several communities with FIRMs created in the 1980s. Some communities were not mapped, and as a result, do not face any sanctions for being flood prone while not enrolled. The term "sanctions" includes penalties for no flood insurance, no federal mortgage insurance, and no federal grants or loans for development. These communities may join the NFIP at any time.

Since the 1990s, FEMA has mapped all areas of a county on the same map to eliminate gaps and outdated information as municipalities grow and communities incorporate. (50) When the next FIRMs are created, current "holes in the map" will be eliminated and the entire county will be covered.

Impacts of Recent Federal Flood Insurance Reform

The Biggert-Waters Flood Insurance Reform Act (Biggert-Waters, H.R.1309), passed in June 2012, is a landmark bill that aims to improve the NFIP's financial solvency, ensure flood insurance reflects real flood risks, and encourage floodproofing and mitigation activities. Biggert-Waters extended the NFIP for five years (until 2017) and made a number of changes related to flood insurance, flood risk mapping, and flood mitigation programs. For a fuller description of Biggert-Waters' reforms, see the H.R. 4348 Conference Report Summary. (51)

The Homeowner Flood Insurance Affordability Act of 2014 (HFIAA, H.R. 3370) was signed by President Obama on March 21, 2014. (52) The HFIAA made changes to several provisions of Biggert-Waters and also created new policies for the NFIP.

The greatest changes to the NFIP under these pieces of legislation affect subsidized flood insurance policies. In Madison County, most subsidized policies cover structures built before the communities' first Flood Insurance Rate Maps (FIRMs) were released (usually between 1978 and 1984). (49) (53) Subsidies for non-primary residences (including businesses and second homes) began to be phased out from October 2013 as the policies came up for renewal. The remaining subsidized structures, all primary residences, were allowed to keep their lower rates until a "trigger event" occurs, such as substantial damage or the sale of the property.

Since the HFIAA rates are not publicly available, it is impossible to determine its final effects on property owners in the Cahokia Creek watershed. However, it may be possible to make some generalized conclusions based on the trends in the two Acts and the number of NFIP policies affected in the county. For example, the rate increases under Biggert-Waters that were not repealed by the HFIAA may stunt the growth of local housing markets and economies over the medium term. New structures may cost more to build as developers must elevate them in order to make manageable flood insurance rates available, and certain older properties will prove more difficult to maintain or sell as premiums rise. However, these effects will likely not be highly pronounced in the Cahokia Creek watershed, as not many subsidized policies are located there (they are more commonly clustered along the Mississippi River and in the American Bottoms). Furthermore, as premiums increase to actuarially-based levels, development and habitation will be redirected away from floodprone areas while flood mitigation activities are incentivized there, reducing flood risk to life and property.

See the recent HeartLands Conservancy report “Impacts of Federal Flood Insurance Reform Legislation on Madison County, Illinois” for more information on potential impacts to Madison County. (54)

Future Development and Flood Ordinances

The 2008 Hazard Mitigation Plan for Madison County predicted little flood risk in current development trends in Madison County, as most residential growth was occurring in regions not prone to bottomland flooding, and development planned on the fringe of major drainage features would be discouraged by floodplain regulations. (5) Similarly, in Macoupin County, no construction was planned within the 100-year floodplain as of 2010 and the Macoupin County Planning Commission reviews all new subdivision development for compliance with its Subdivision Control Ordinance, which contains certain flood management provisions. (6) Both counties remain vulnerable to flash flooding depending on the amount of precipitation received, topography, land use, and other factors.

Prioritizing Floods among Other Natural Hazards

Some jurisdictions have tried to rank the various natural hazards with which they are faced, in order to more effectively direct their hazard mitigation efforts. In Macoupin County’s Multi-Hazard Mitigation Plan, Hazard Rankings are calculated for nine hazards: flooding, tornado, transportation hazardous material release, thunderstorms/high winds/hail/lightning, winter storms, subsidence, earthquake, fire/explosion, and dam/levee failure. For each community and each hazard, a probability value and a magnitude/severity value was assigned, resulting in a Risk Priority Index (RPI) value. These values were ranked for each community, and are listed below for the communities in the Indian-Cahokia Creek watershed (6):

- Bunker Hill: 4
- Dorchester: 7
- Staunton: 5
- Wilsonville: N/A

No such hazard ranking assessment has been done in Madison County’s most recent Draft Multi-Jurisdictional All Hazards Mitigation Plan. (5)

Water Quality

Impaired Waters

Under Section 305(b) of the Clean Water Act, IEPA must submit to the USEPA a biennial report of the quality of the state's surface and groundwater resources. The report, called the Illinois Integrated Water Quality Report and Section 303(d) List, must describe how Illinois waters meet or fail to meet water quality standards appropriate for certain "Designated Uses" assigned to them. There are six Designated Uses in Illinois, of which five have been assigned to streams and lakes in the Indian Creek-Cahokia Creek watersheds in 2018:

- **Aquatic Life**: the waterway's ability to support fish and aquatic macroinvertebrates.
- **Fish Consumption**: the waterway's ability to support fish that are suitable for consumption (i.e., are free of contamination from mercury and polychlorinated biphenyls).
- **Primary Contact**: the waterway's ability to support activities such as swimming and water skiing.
- **Public and Food Processing Water Supply**: water that can be used for human consumption or food processing (i.e., waterways free of nitrate, simazine, and manganese).
- **Aesthetic Quality**: a watershed free from impairments such as sludge, bottom deposits, floating debris, visible oil, odor, etc.

When a designated use cannot be met, a waterbody is determined to be impaired, and IEPA must list the potential causes and sources for impairment in the 303(d) impaired waters list. The Indian-Cahokia Creek watershed at the HUC10 level (HUC 0714010102) has four impairments as of the 2018 Illinois Integrated Water Quality Report (Table A.51). The impairments occur at the following stretches of waters in the Indian-Cahokia Creek watershed: Cahokia Creek, Cahokia Diversion Channel, Holiday Shores (Holiday Lake), and Holiday Shores Creek (Figure A.48).

Causes of impairments in the Indian–Cahokia Creek watershed have changed over time (Table A.52). In 2006, there were five causes: sedimentation/siltation, total fecal coliform, alteration in stream-side or littoral vegetative covers, and copper. In 2018, the number of causes had increased to ten. Sedimentation/siltation and copper were no longer present on the list, while iron, total suspended solids, and aquatic algae have been added. Dissolved oxygen, total fecal coliform, and alternation in stream-side or littoral vegetative covers have been consistent impairments over the last 12 years.

Table A.51: 2018 Illinois EPA Designated Uses and Impairments for streams and waterbodies in the Indian-Cahokia Creek watershed.

Name	Assessment Unit ID	Size (mi)	Designated Use	Use Attainment	Impaired?	Cause of Impairment	Source of Impairment
Burroughs Branch	IL_JQB	5.36	Aquatic Life	Not Assessed	No	No source identified	No source identified
			Fish Consumption				
			Primary Contact				
			Aesthetic Quality				
Cahokia Creek	IL_JQ-03	20.09	Aquatic Life	Fully Supporting	No	No source identified	No source identified
			Fish Consumption	Not Assessed			
			Primary Contact	Not Assessed			
			Aesthetic Quality	Fully Supporting			
	IL_JQ-05	10.69	Aquatic Life	Not Supporting	Yes	Alteration in stream-side or littoral vegetative covers, iron, changes in stream depth and velocity patterns, loss of instream cover, fecal coliform	Loss of riparian habitat, urban runoff/storm sewers, highway/road/bridge runoff, crop production, agriculture
			Fish Consumption	Not Assessed			
			Primary Contact	Not Supporting			
			Aesthetic Quality	Fully Supporting			
Cahokia Diversion Channel	IL_JQ-07	5.29	Aquatic Life	Not Supporting	Yes	Alteration in stream-side or littoral vegetative covers, fish-passage barrier, dissolved oxygen, phosphorus (total), changes in stream depth and velocity patterns, loss of instream cover	Channelization, streambank modifications/destabilization, dam or impoundment, agriculture, urban runoff/storm sewers
			Fish Consumption	Not Assessed			
			Primary Contact				
			Aesthetic Quality				
Dentons Branch		3.39	Any	Not Assessed	No	No Source Identified	No Source Identified
East Fork Sherry Creek		11.81	Any	Not Assessed	No	No Source Identified	No Source Identified
Ginseng Creek	IL_GQ	2.39	Aquatic Life	Not Assessed	No	No Source Identified	No Source Identified
			Fish Consumption				

Name	Assessment Unit ID	Size (mi)	Designated Use	Use Attainment	Impaired?	Cause of Impairment	Source of Impairment
			Primary Contact				
			Aesthetic Quality				
Holiday Shores (Holiday Lake)	RJN	430 acres	Aquatic Life	Fully Supporting	Yes	Total Suspended Solids (TSS), phosphorus (total)	Crop production, urban runoff/storm sewers
			Fish Consumption	Not Assessed			
			Public and Food Processing Water Supplies	Fully Supporting			
			Primary Contact	Not Assessed			
			Aesthetic Quality	Not Supporting			
Holiday Shores Creek (part of Joulters Creek)	IL-JQO-HS-C1	0.25	Aquatic Life	Not Supporting	Yes	Phosphorus (total), aquatic algae	Municipal point source pollution, agriculture
			Fish Consumption	Not Assessed			
			Primary Contact				
			Aesthetic Quality				
Indian Creek	IL_JQA-01	23.34	Aquatic Life	Not Supporting	No	Alteration in stream-side or littoral vegetative covers, loss of instream cover	Channelization, loss of riparian habitat, crop production, agriculture
			Fish Consumption	Not Assessed			
			Primary Contact	Not Assessed			
			Aesthetic Quality	Fully Supporting			
Little Mooney Creek	IL_JQCB	3.98	Aquatic Life	Not Assessed	No	No Source Identified	No Source Identified
			Fish Consumption				
			Primary Contact				
			Aesthetic Quality				
Mooney Creek	IL_JQC	5.13	Aquatic Life	Not Assessed	No	No Source Identified	No Source Identified
			Fish Consumption				
			Primary Contact				
			Aesthetic Quality				
Paddock Creek	IL_JQD	19	Aquatic Life	Not Assessed	No	No Source Identified	No Source Identified
			Fish Consumption				
			Primary Contact				

Name	Assessment Unit ID	Size (mi)	Designated Use	Use Attainment	Impaired?	Cause of Impairment	Source of Impairment
			Aesthetic Quality				
Sherry Creek	IL_JQE	13.39	Aquatic Life	Not Supporting	No	Alteration in stream-side or littoral vegetative covers, changes in stream depth and velocity patterns, loss of instream cover	Crop production, agriculture, loss of riparian habitat, streambank modifications/destabilization
			Fish Consumption	Not Assessed			
			Primary Contact	Not Assessed			
			Aesthetic Quality	Fully Supporting			
West Fork Cahokia Creek	IL_JQF	12.69	Aquatic Life	Not Assessed	No	No Source Identified	No Source Identified
			Fish Consumption				
			Primary Contact				
			Aesthetic Quality				
White Rock Creek		4.22	Any	Not Assessed	No	No Source Identified	No Source Identified

Impaired Waters in the Canteen-Cahokia Creek Watershed (2018)

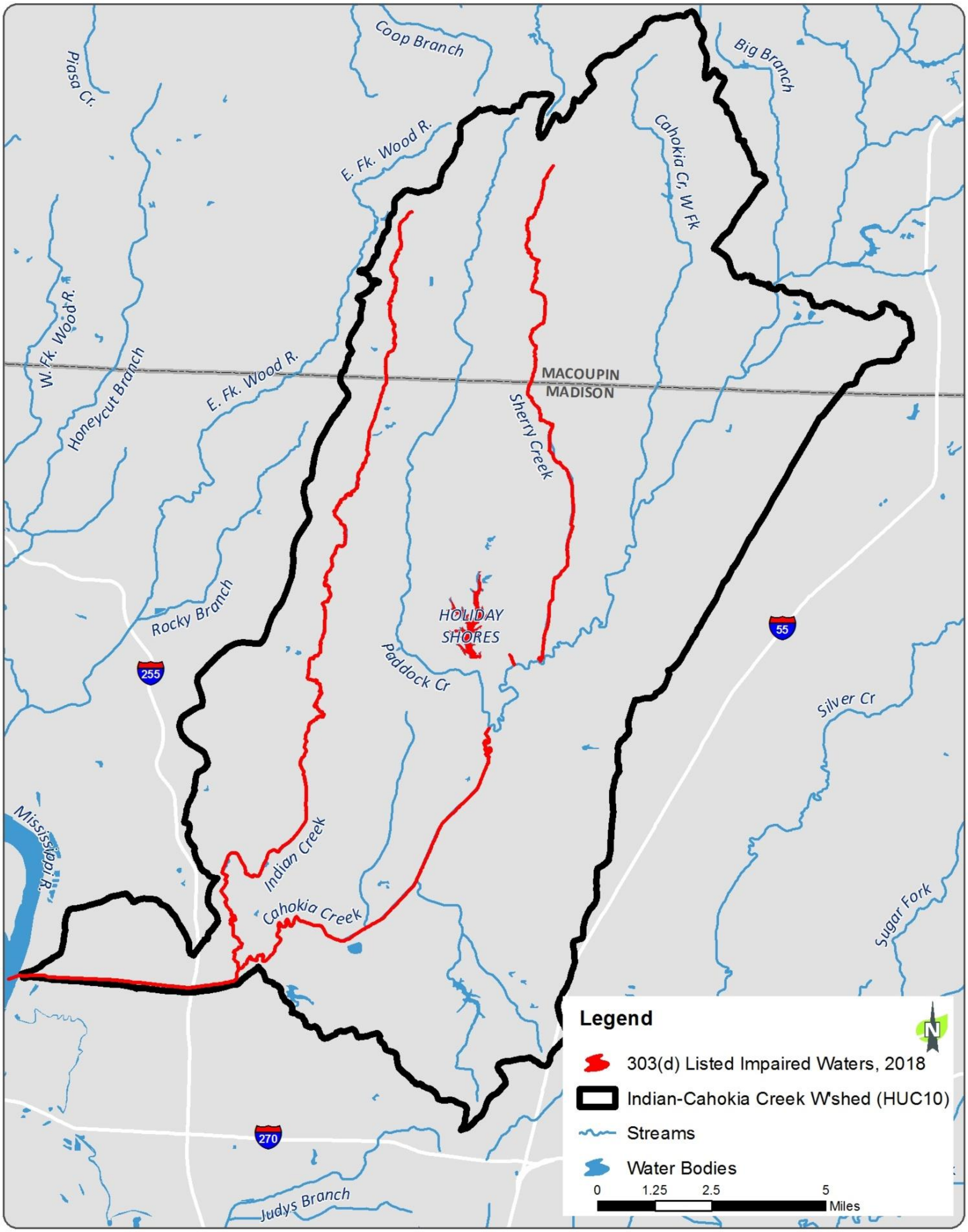


Figure A.48: Impaired waters in the Indian-Cahokia Creek watershed (2018).

Table A.52: Impairments for the Indian-Cahokia Creek watershed (HUC 0714010102) between 2006 and 2018.

	Impairment												
Year	**DO**	**Total P**	**Sedimen-tation/ Siltation**	**Mn**	**Total Fecal Coliform**	**Alteration in stream-side or littoral vegetative covers**	**Fish Passage Barrier**	**Changes in Stream Depth and Velocity Patterns**	**Loss of Instream Cover**	**Copper**	**Iron**	**Total Suspended Solids**	**Aquatic Algae**
2018	X	X			X	X	X	X	X		X	X	X
2016	X	X		X	X	X	X	X	X				
2014	X	X		X	X	X	X	X	X				
2012	X	X		X	X	X	X	X	X				
2010	X	X			X	X	X	X	X				
2008	X	X			X	X	X	X	X				
2006	X		X		X	X				X			

"DO" is dissolved oxygen
"Total P" is total phosphorous
"Mn" is magnesium

Once IEPA determines that a waterbody is impaired, it must establish priorities for the development of Total Maximum Daily Loads (TMDLs)—the highest amount of discharge of a particular pollutant that a waterbody can handle safely per day—and a long-term plan to meet them. The TMDL endpoints for the impaired segments of the Indian-Cahokia Creek watershed are listed in Table A.53 below (55). These endpoints were established based on the protection of aquatic life in the watershed.

Table A.53. TMDL endpoints and average observed concentrations for impaired constituents in the Indian-Cahokia Creek watershed.

Impaired Segment	**Constituent**	**TMDL Endpoint**	**Average Observed Value on Impaired Segment**
Cahokia Creek, JQ05	Fecal Coliform	200 cfu/100 mL during October to May	388 cfu/mL (geometric mean)
Cahokia Diversion Canal, JQ07	DO	6.0 mg/L (16 hours of any 24-hour period), 5.0 mg/L instantaneous minimum	3.09 mg/L
Holiday Shores Lake, RJN	Total Phosphorus	0.05 mg/L	0.18 mg/L

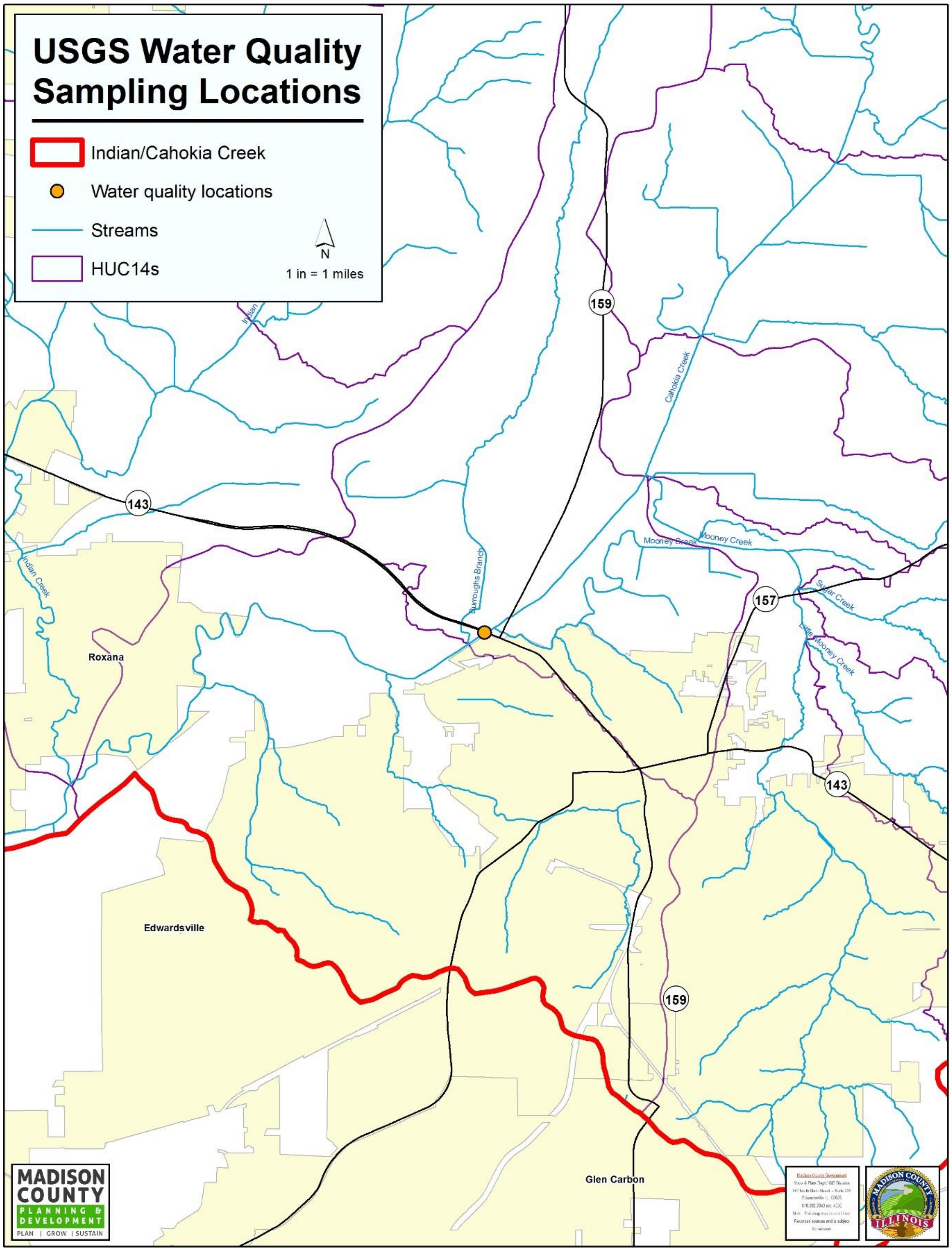
Water Quality Indicators and Research

Water quality in the Indian-Cahokia Creek Watershed is impacted primarily by agriculture. Agriculture, including cultivated crops and pasture/hay, accounts for 56.5% of the land cover in the Indian-Cahokia Creek watershed, 41.7% of which is cultivated crops. Developed land in the watershed, including open space, low, medium and high intensity areas account for only 16.9% of the watershed's area. As expected, the developed land in the watershed is concentrated around major municipalities including Staunton, Holiday Shores, Worden, Bethalto, Edwardsville, Hartford, Roxana, and South Roxana. There is also a concentration of developed area in Macoupin County within the Indian Creek and Paddock Creek watersheds that is developed but unincorporated. Urbanization is expected to increase by 11% in Madison County during the next 15 years due to its location in the Metro East area of the Saint Louis metropolitan region.

Sources of Data

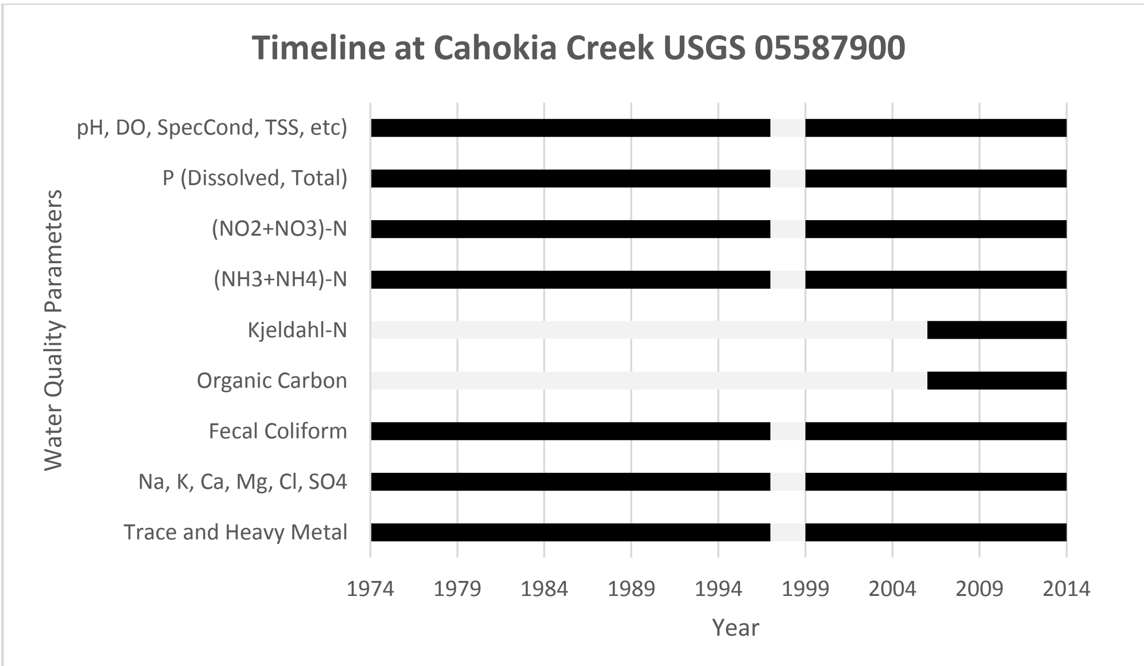
Water quality monitoring in the Indian-Cahokia Creek watershed was carried out at various times from 1930 to 2014 by the U.S. Geological Survey-Illinois Water Science Center (USGS-IWSC) and IEPA. Gage locations for these sampling sites are shown in Figure A.49. Generally, there are three gages in the Indian-Cahokia Creek watershed: one in the northern-most portion of the White Rock Creek-Cahokia Creek watershed, one in the southern end of the Sherry Creek-Cahokia Creek watershed, and one in the Burroughs Branch-Cahokia Creek watersheds. An additional gage exists near Wanda, Illinois at Indian Creek.

Figure A.49: USGS Water Quality sampling locations.



In general, USGS-IWSC monitoring was conducted from the late 1970s until 1997. After a gap of several years in monitoring, IEPA began monitoring at the same site from 1999 to 2014. Most of the same parameters were monitored by both agencies. Figure A.50 shows a timeline for when the various water quality parameters were measured at this location. In addition to the timeline shown in Figure A.50, daily mean discharge data for the USGS Gage 05587900 was obtained for the time period from 1968 to 2016.

Figure A.50: Timeline showing when various water quality parameters were measured at the Cahokia Creek USGS gage.

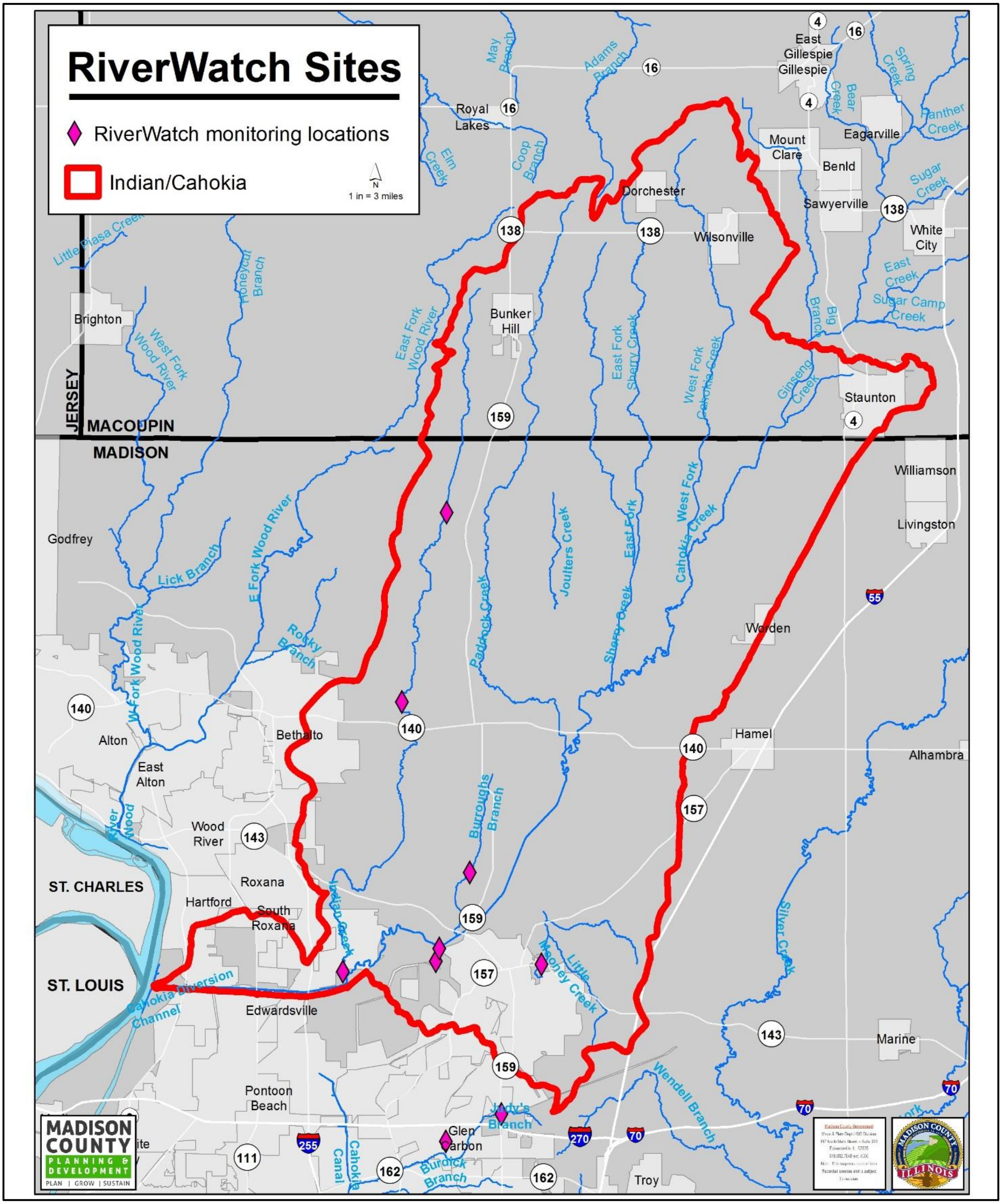


A third data source is the data gathered by Illinois RiverWatch volunteers at two sites in the watershed between 1998 and 2015 (Table A.54, Figure A.51). RiverWatch volunteers are trained and tested in gathering data on various metrics of water quality through the RiverWatch program. The local chapter of this program is hosted at the National Great Rivers Research and Education Center (NGRREC) in East Alton. Data collected by RiverWatch volunteers in the watershed includes stream width, average stream velocity and discharge, water appearance, air and water temperature, turbidity, percent algal coverage, channelization, and the presence of macroinvertebrates. (56) (57)

Table A.54: Location, date and number of volunteers at RiverWatch sampling sites in the Indian-Cahokia Creek watershed

Stream Sampled	# Times Sampled	Years sampled	Number of Volunteers
Burroughs Branch	3	1997, 2000 and 2001	**1-3**
Cahokia Creek (1)	6	1997-2001 and 2013	**1-3**
Cahokia Creek (2)	2	1997 and 2013	**1-3**
Cahokia Creek (3)	4	1997 and 1999-2001	**1-3**
Cahokia Creek (4)	3	2001, 2002, and 2004	**1-3**
Cahokia Creek Trib at Old Poag RD	8	2008-2015	**1-3**
Cahokia Cr Trib	7	1996-2002	**1-3**

Figure A.51: Locations sampled by Illinois RiverWatch volunteers in the Indian-Cahokia Creek watershed (1998-2015).



Stream Flow

RiverWatch volunteers measured an average stream discharge and peak discharge of all sites in the Indian-Cahokia Creek watershed. Table A.55 below summarized stream discharge at each creek and branch. The highest peak discharge and velocity occurred at Cahokia Creek Tributary, northwest of Glen Carbon. Figures A.52, A. 53, A.54 show the annual peak streamflow, annual mean discharge and mean daily discharge (respectively) for the USGS gage on Cahokia Creek near Edwardsville. The drainage area for the USGS gage is 212 square miles, which more than covers the project area, as this gage also sees water from the East Creek-Cahokia Creek and Bear Creek-Cahokia Creek watersheds, which were not included in this study's project area.

Table A.55: Summary of stream discharge and velocity in the Indian-Cahokia Creek Watershed (1998-2015).

Waterbody	Avg. Discharge	Peak Discharge	Avg. Velocity	Peak Velocity	Latitude	Longitude
Cahokia Creek	19.04	100.7	0.66	1.37	39.0311	-89.8183
Indian Creek	5.02	13.7	0.77	1.37	38.9728	-89.9617
Mooney Creek	4.82	10.49	0.45	1.20	38.8136	-89.9394
Cahokia Creek Trib	21.51	109.50	0.87	2.36	38.8108	-90.0283
Cahokia Cr Trib at Old Poag Road	1.95	3.91	0.34	0.70	38.8114	-89.9531
Burroughs Branch	4.81	16.48	0.36	0.67	38.8431	-89.9694
Miner Park Creek	3.08	6.52	0.32	0.81	38.7511	-89.9817

Figure A.52: Annual peak streamflow measured at USGS gage 05587900 in the Indian-Cahokia Creek watershed (1969-2015).

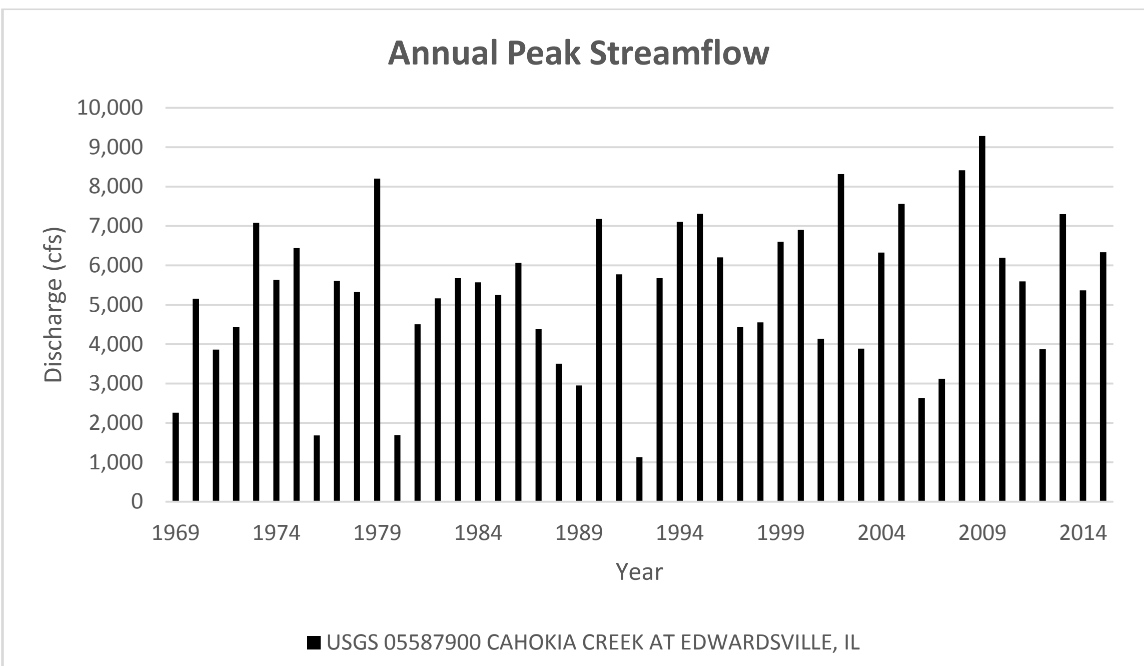


Figure A.53: Annual mean discharge for the Cahokia Creek gage in Edwardsville (1970-2015).

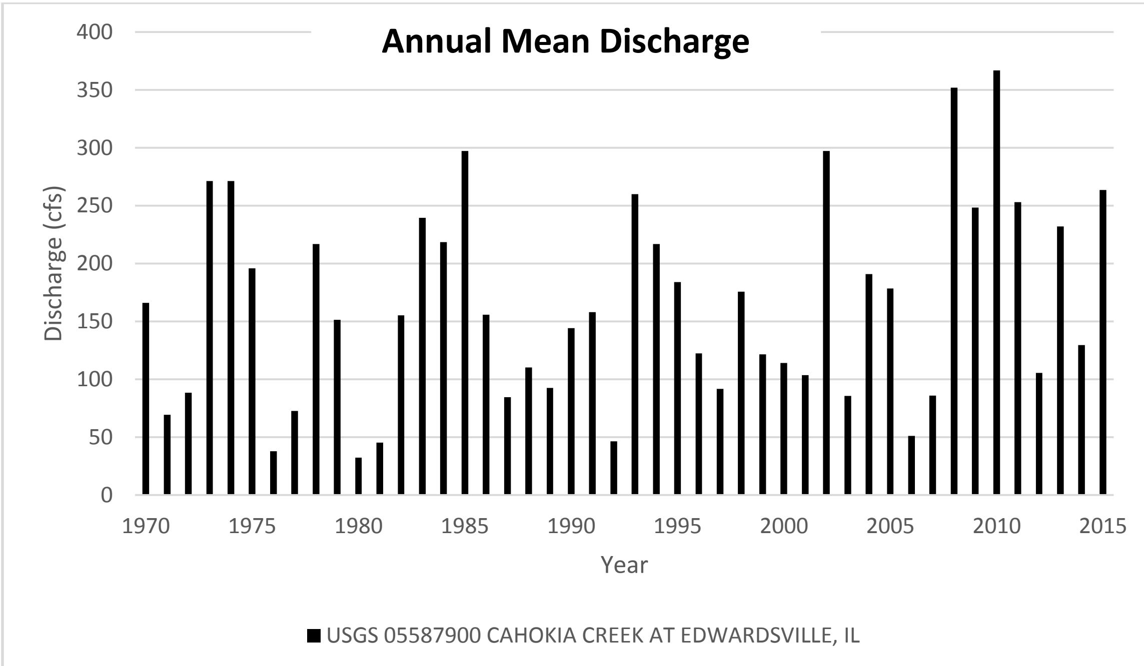


Figure A.54: Mean daily discharge measured at USGS gage 05587900 in the Indian-Cahokia Creek watershed (1968-2016).

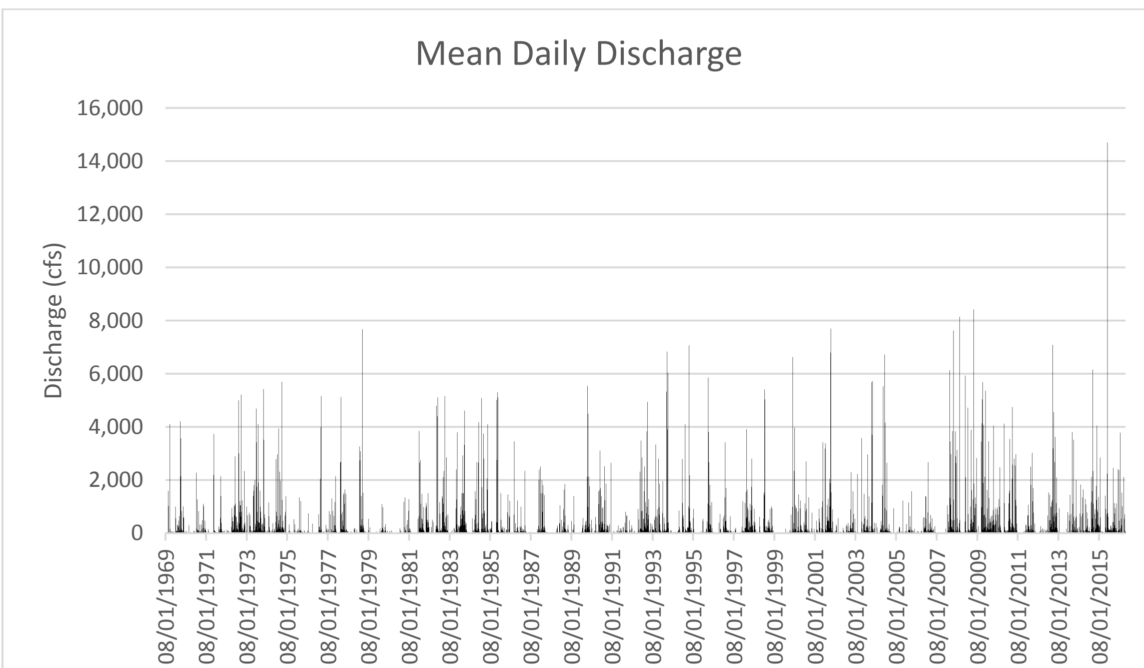
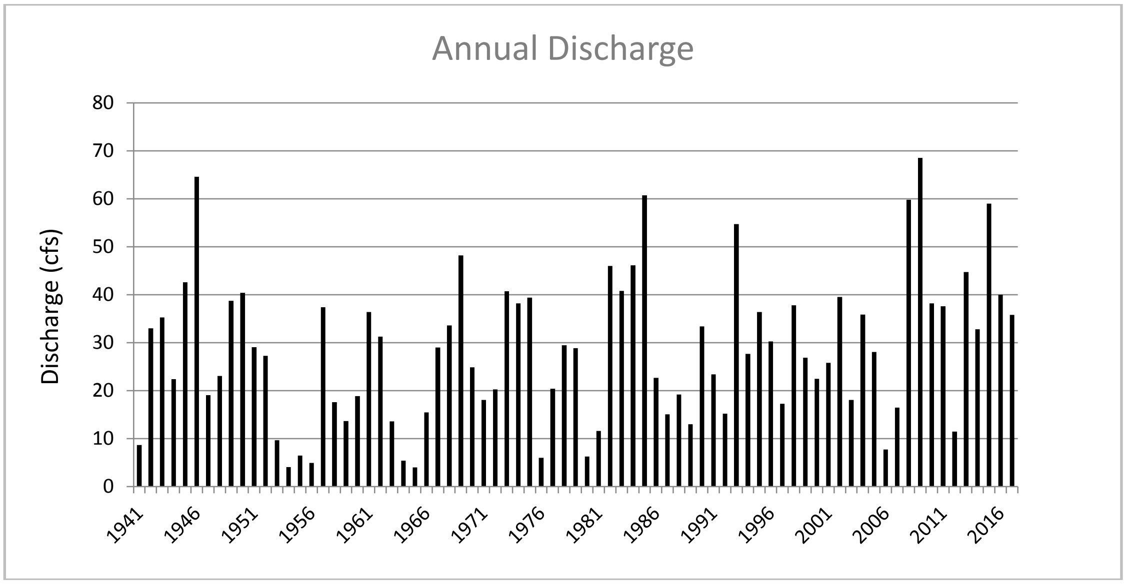


Figure A.55. Annual Discharge measured at USGS gage 05588000 Indian Creek at Wanda, Illinois (1940 to 2018).



Sediment Loads

There are no continuous sediment records for streams in the watersheds. A total of six samples were collected at three USGS gages from 1979 to 1981 by the USGS-IWSC. These gages are located at USGS 05587815 near Carpenter, IL, USGS 05587900 at Edwardsville, IL, and USGS 05587740 near Staunton, IL. Table A.56 shows the data collected. The IEPA did not collect sediment loads data. Suspended sediment concentrations ranged from 21 mg/L to 158 mg/L. Due to limited data collected at Cahokia Creek, no trends were established between sediment loads, sediment concentration, and discharge.

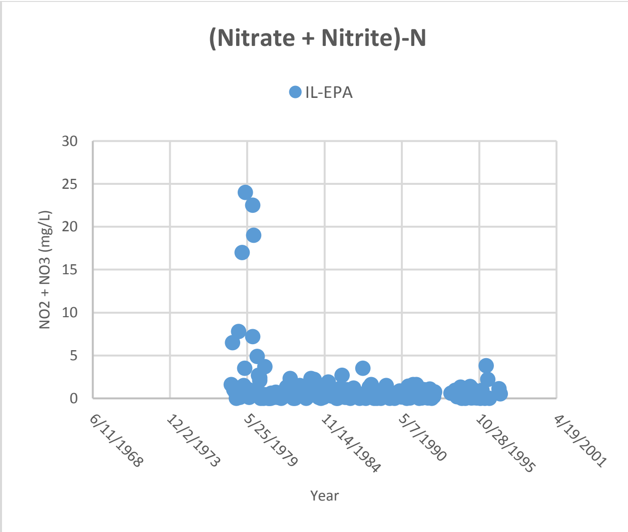
Table A.56: Suspended sediment concentration and discharge at three locations in the Indian-Cahokia Creek watershed.

Sample Date	USGS Gage	City	Suspended Sediment Concentration (mg/L)	Suspended Sediment Discharge (ton/day)
May 15, 1981	05587740	Staunton, IL	33	2.10
May 13, 1981	05587900	Edwardsville, IL	73	13.0
June 19, 1979	05587815	Carpenter, IL	47	0.32
July 30, 1979	05587815	Carpenter, IL	158	16.0
October 19, 1979	05587815	Carpenter, IL	21	0.00
April 2, 1980	05587815	Carpenter, IL	110	30.0

Nitrogen

More than 89% of the nitrate-nitrogen concentrations measured at the USGS gage site from 1978 to 1997 were below 2 mg/L. During peak discharge periods, values reached concentrations as high as 24.00 mg/L (Figure A.56 and Table A.57). The average nitrate concentration for the Indian-Cahokia Creek from 1974 to 2004 was 1.50 mg/L, which is less than the statewide average of 3.89 mg/L from 1980 to 1996 reported in a 1999 IEPA study. (58) The average base flow concentrations of NO_3-N were typically below 1 mg/L in the Indian-Cahokia Creek watershed. High levels of nitrate can indicate significant installation of tile drainage; these moderate levels may indicate that the watershed is not overly tiled. The presence of tile drains is difficult to measure.

Figure A.56: Nitrate + Nitrite nitrogen concentrations in Cahokia Creek at USGS gage site 05587900 near Edwardsville (1978-1997



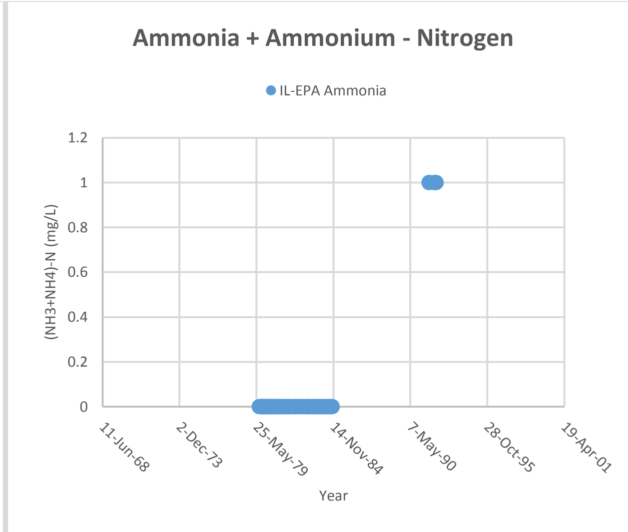


Table A.57: Statistical summary of nutrients and nutrient-related parameters measured in samples collected from Cahokia Creek at the USGS gage 05587900 between 1974 and 2014 by the Illinois Water Science Center and IEPA.

Nutrient	Unit	n	min	10th pctl	25th pctl	Median	75th pctl	90th pctl	Max	Mean
(NH3+NH4)-N	mg/l	169	0.00	0.06	0.13	0.13	0.32	0.58	6.57	0.33
(NO2+NO3)-N	mg/l	152	0.00	0.05	0.24	0.74	1.21	2.30	24.00	1.50
Organic N	mg/l	4	0.40	0.58	0.85	1.10	1.60	2.32	2.80	1.35
Kjeldahl N	mg/l	72	0.14	0.32	0.43	0.65	0.96	1.44	3.14	0.79
Total N	mg/l	39	0.01	0.01	0.01	0.09	0.32	0.86	3.80	0.33
P, Dissolved	mg/l	225	0.65	2.80	3.60	4.40	5.20	6.60	11.00	4.52
P, Total	mg/l	277	1.80	3.20	3.80	4.60	5.60	6.74	14.00	4.91
Organic Carbon	mg/l	57	3.33	3.86	4.21	4.84	6.01	7.92	15.20	5.46
Fecal Coliforms	Col/100ml	126	10	49	126	460	2000	6400	590K	7086

Table A.58: Statistical summary of standard water quality parameters measured in samples collected from Cahokia Creek at the USGS gage 05587900 between 1972 and 1997 by the Illinois Water Science Center and IEPA.

Standard Parameter	Unit	n	min	10th pctl	25th pctl	Median	75th pctl	90th pctl	Max	Mean
Temperature (Water)	C	407	0.00	1.00	3.00	7.50	19.50	24.62	34.00	10.98
pH		293	6.70	7.10	7.30	7.60	7.90	8.10	10.40	7.62
Specific Conductance	uS/cm	159	11.0	334	532	631	699	785	1060	602
Chemical Oxygen Demand (COD)	mg/l	144	0.00	11.3	16.0	21.0	30.0	46.1	300	27.6
Dissolved Oxygen (DO)	mg/l	272	0.80	5.40	6.49	8.40	11.13	13.00	15.00	8.80
Alkalinity	mg/l	95	70.20	125.00	157.50	204.00	244.00	260.00	282.00	197.20
Acidity	mg/l as CaCO3		0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.05
Total Dissolved Solids	Ton/day	14	1.07	1.19	3.04	12.10	38.20	71.00	261.00	36.98
Total Suspended Solids	mg/l	258	4.00	11.00	28.8	56.5	189	283	3170	138
Total Volatile Solids	mg/l	85	2.00	4.00	5.00	8.00	12.00	18.60	67.00	10.62
Suspended Sediment Concentration	mg/l	1	73.0	73.0	73.0	73.0	73.0	73.0	73.0	73.0
Suspended Sediment Concentration	Tons/day	1	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
Total Hardness (as CaCO3)	mg/l	139	56.0	180	237	290	330	370	420	278
Turbidity	NTU	221	1.40	4.10	8.00	18.00	47.00	130.00	1600	58.38

Ammonium

Ammonium-nitrogen ((NH_3+NH_4)-N), which includes both ammonia (NH_3) and ammonium (NH_4) forms, but is mostly the latter, was measured at the USGS gage 05587900. Between 1974 and 1997, ammonium-nitrogen ranged from 0.03 to 0.84 mg/L with a median value of 0.014 mg/L and an average of 0.22 mg/L. The average was slightly lower than the statewide average of 0.32 mg/L for Illinois from 1980 to 1996. There was no available ammonium data for the period after 1997 for the USGS gage 05587900 site.

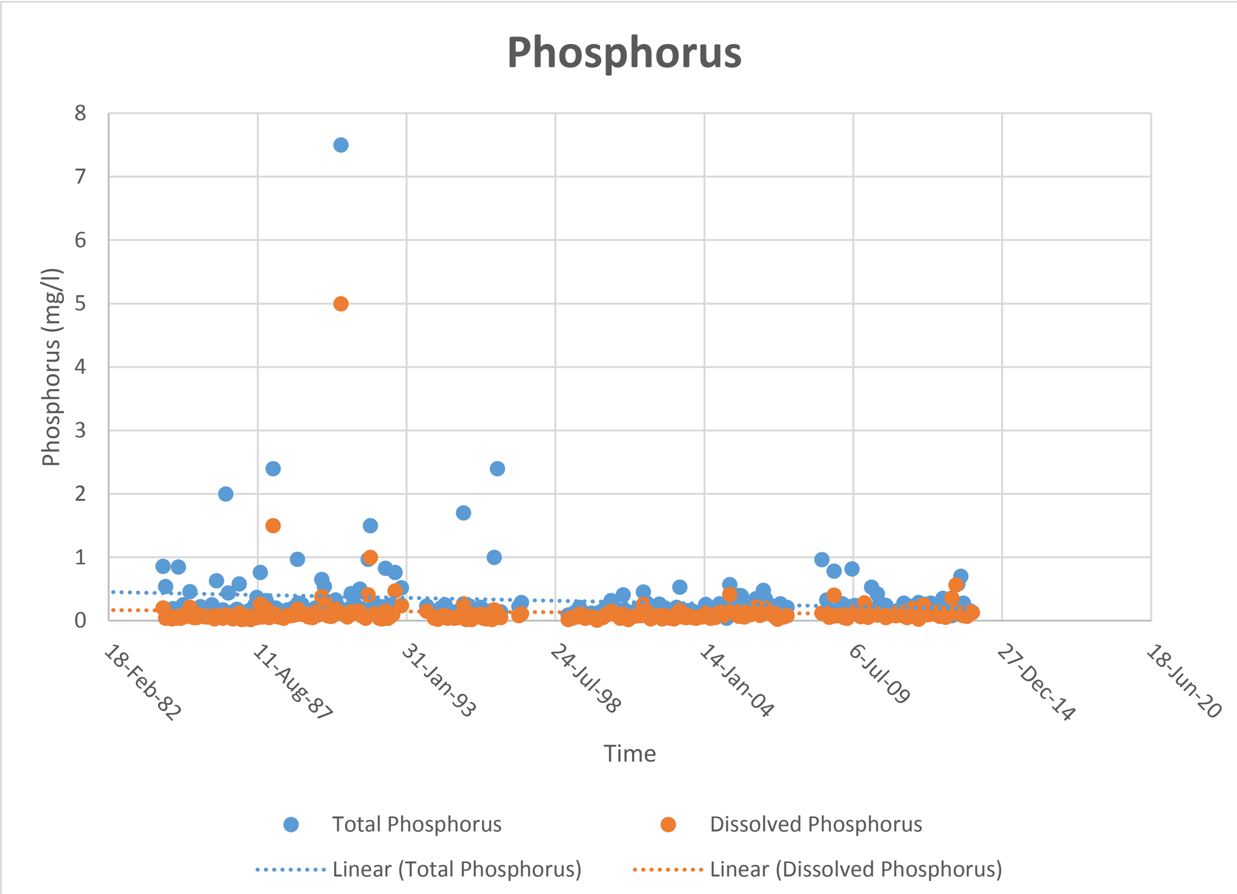
Total/Kjeldahl/Organic N

On a few occasions during the period from 1999 to 2015, other forms of nitrogen were measured at the USGS gage, including organic N, Kjeldahl N, and Total N. Nitrogen in these forms consistently followed the trend of Organic-N > Kjeldahl-N > Total-N. Kjeldahl N was measured in 72 samples by the IEPA, although the latter agency analyzed most of those samples. The amounts of nitrogen in these forms were smaller than the concentrations reported for nitrate and ammonium. Without additional data for these forms of nitrogen, it is impossible to discern trends over time. However, when all the forms of nitrogen are considered together, nitrogen is not a significant problem in the watershed. Total N was listed as an impairment on the 2004 and 2006 303(d) list, but since then has not been considered an impairment.

Phosphorus

Both total and dissolved phosphorus were measured at USGS gage 05587900 from 1974 to 2015. Dissolved P is primarily orthophosphate (soluble reactive phosphorus) and is the form that is biologically active. Dissolved P tended to be high in the main stem of Cahokia Creek (Figure A.57) as well as in subcatchment waters during both base flow and storm flow. The average total and dissolved phosphorus levels for Cahokia Creek are 0.31 and 0.13 mg/l respectively, which are below the Illinois statewide average for soluble phosphorus of 1.25 mg/L.

Figure A.57: Dissolved and total phosphorous concentrations in water samples collected from Cahokia Creek at the USGS gage 05587900 by the IWSC and IEPA.

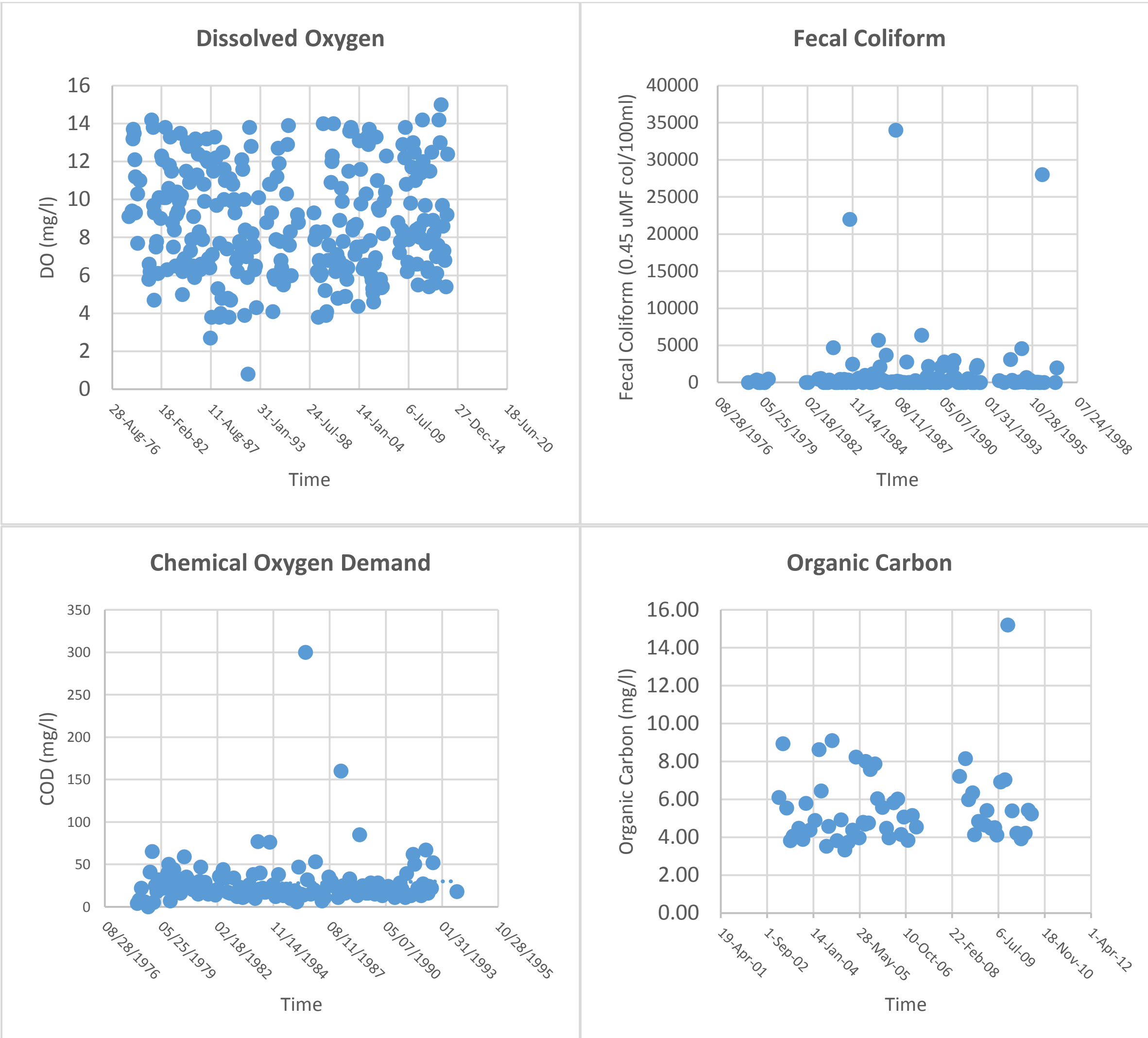


Biological Indicators of Water Quality

Chemical Oxygen Demand (COD) was measured from 1978 to 1993 and there was no significant trend over time (Figure A.58). Most values were below 50 mg/L, but some values ranged from 50 to 160 mg/L. A single extremely high value of 300 mg/L was observed on a single day in 1986 that corresponded to a major hydrological event. The average COD is 28 mg/l. COD is typically below 20 mg/L in unpolluted waters, so the values measured in Cahokia Creek indicate there is a significant organic carbon load in the stream for much of the time.

Dissolved oxygen (DO) was measured from 7/11/1978 to 11/20/2013 during three distinct periods. DO values less than 2 mg/L indicate hypoxic conditions, but there was one of 272 samples in the Cahokia Creek watershed had DO values below 2 mg/L (the minimum values was 0.80 mg/L). There was no significant trend over time, except for seasonal trends with DO values generally higher in the cooler winter months and lower during the hot summer months (Figure A.58). This is because warmer water can hold less DO. When shade trees are cut down next to streams, this has the same effect—the water becomes warmer and DO levels decrease. The median DO in the stream between 1978 and 2013 is 8.40 mg/L. It is unclear why DO was included on the list of impairments for the Cahokia Creek watershed, especially since the later IEPA measurement were never below 4 mg/L.

Figure A.58: Some water quality parameters relating to biological activity in water samples collected by the IWSC and IEPA at the Cahokia Creek USGS Gage 05587900 (1977 to 2011).



Fecal coliforms were measured from 3/29/1978 to 4/22/1997 as the number of colony forming units per 100mL (cfu/100mL). Reported values ranged from 10 to 590,000* cfu/100mL. The highest value confirmed by the USGS was 34,000 cfu/100mL. Before switching to other indicators of fecal contamination, the EPA used a threshold of 200 cfu/100mL to indicate unacceptable water quality for fishing and swimming. During the period from 1978 to 1997 when fecal coliforms were monitored, over 90% of the samples had concentrations above the minimum acceptable threshold (Figure A.58). Bacterial contamination has not been reported since 1997. Fecal coliforms were listed as an impairment on the 2004 303(d) list, but has not been re-listed since then.

**NOTE— This number was collected but not verified by a technician to confirm the value.*

Organic carbon is both an important indicator of biological activity as well as a substrate for microbial activity. Measurements by the IEPA from 2002 to 2014 were less than 1 0 mg/L (Figure A.58). No measurements of organic carbon prior to 2002. In general, the organic carbon values are typical of rivers in the Midwest.

Aquatic macroinvertebrate communities are also indicators of water quality. Macroinvertebrates are organisms without a backbone that are visible to the naked eye. Those that live in streams include the immature and adult stages of many flies, beetles, stoneflies, caddisflies, mayflies, dragonflies, aquatic worms, snails, and leeches. Illinois RiverWatch volunteers conducted surveys of macroinvertebrates 71 times at 20 sites in the watershed between 1997 and 2015. The volunteer groups counted the number of individuals of different types of macroinvertebrate in the riffles of the stream sites and calculated several metrics to describe the communities found.

These are:

- **Taxa richness** – Taxa richness measures the abundance of a variety of different organisms as determined by the total number of taxa represented in a sample. Generally, taxa richness increases as water quality, habitat diversity, and habitat suitability increase. Low taxa richness generally indicates low water quality.
- **EPT taxa richness** – Ephemeroptera, Plecoptera, and Trichoptera (EPT) are the three most pollution-sensitive insect orders. The abundance of these orders in a population is an indicator of water quality. The lower the EPT taxa richness, the lower the number of EPT insects sampled, and the worse the water quality.
- **MBI** – Macroinvertebrate Biotic Index, a measure of water quality based on taxa richness, EPT taxa richness, and number of organisms sampled, as calculated through Illinois RiverWatch criteria. (59)

The metrics from the RiverWatch data indicate that the macroinvertebrate species richness, habitat, and associated water quality at the 20 sites sampled is typically poor to fair (Table A.58). Taxa richness at the sites was typically poor/very poor, while EPT taxa richness ranged between poor and very poor over time. Macroinvertebrate diversity in Cahokia Creek is good among three most abundant taxa spread proportionally between many creeks and branches.

The average MBI scores indicated fair water quality, but those scores increased to high, “very poor” water quality ratings from time to time over the monitoring period.

Table A.58: Metrics based on macroinvertebrate populations sampled in the Indian-Cahokia Creek watershed.

STREAM NAME	FIELD DATE	# ORGANISMS SAMPLED	TAXA RICHNESS	EPT TAXA RICHNESS	MBI
Burroughs Branch	05/22/2001	149	7	2	5.30
Burroughs Branch	07/08/2000	5	5	2	4.80
Burroughs Branch	05/22/1997	44	9	1	5.91
Average		66	7	1.7	5.3
Description of average			Poor	Poor	Fair
Range			5 - 9	1 - 2	4.80 - 5.91
Description of range					
Cahokia Creek R0718001	07/16/2013	27	4	2	5.48
Cahokia Creek R0718001	06/30/2001	57	13	3	5.54
Cahokia Creek R0718001	05/12/2000	200	16	2	6.80
Cahokia Creek R0718001	06/07/1999	73	10	4	5.53
Cahokia Creek R0718001	05/30/1998	16	6	1	4.97
Cahokia Creek R0718001	05/16/1997	81	10	5	4.77
Average		75.7	9.8	2.8	5.5
Description of average			Fair	Fair	Fair
Range			4 - 16	1 - 5	4.77 – 6.80
Description of range			Very Poor - Excellent	Very Poor - Excellent	Very Poor - Good
Cahokia Creek R0718002	07/16/2013	9	6	2	5.44
Cahokia Creek R0718002	06/21/1997	95	9	3	5.33
Average		52	7.5	2.5	5.4
Description of average			Poor	Poor	Fair
Range			6 - 9	2 - 3	5.33 – 5.44
Description of range			Very Poor - Fair	Poor - Fair	Fair
Cahokia Creek R0718003	05/18/2001	104	10	4	5.62
Cahokia Creek	07/07/2000	5	5	3	4.90

STREAM NAME	FIELD DATE	# ORGANISMS SAMPLED	TAXA RICHNESS	EPT TAXA RICHNESS	MBI
R0718003					
Cahokia Creek R0718003	05/26/1999	89	10	3	5.19
Cahokia Creek R0718003	06/24/1997	89	6	3	5.66
Average		71.8	7.8	3.3	5.3
Description of average			Poor	Fair	Fair
Range			5 - 10	3 - 4	4.90 – 5.66
Description of range			Very Poor - Fair	Fair - Good	Fair - Good
Cahokia Creek R0718004	6/11/2002	58	12	2	5.37
Cahokia Creek R0718004	6/11/2001	49	6	2	5.69
Average		53.5	9	2	5.50
Description of average			Fair	Poor	Fair
Range			6 - 12	2 - 2	5.37 – 5.69
Description of range			Very Poor - Good	Poor - Poor	Fair - Fair
Cahokia Creek Trib R0720802	6/4/2015	106	7	3	4.80
Cahokia Creek Trib R0720802	6/17/2014	55	8	3	5.46
Cahokia Creek Trib R0720802	5/15/2013	64	4	1	4.67
Cahokia Creek Trib R0720802	6/8/2012	15	6	4	5.20
Cahokia Creek Trib R0720802	6/17/2011	102	8	4	4.64
Cahokia Creek Trib R0720802	6/22/2010	76	8	2	5.86
Cahokia Creek Trib R0720802	6/25/2009	154	6	1	4.11
Cahokia Creek Trib R0720802	7/12/2008	14	3	0	4.71

STREAM NAME	FIELD DATE	# ORGANISMS SAMPLED	TAXA RICHNESS	EPT TAXA RICHNESS	MBI
Average		73.3	6.3	2.3	4.9
Description of average			Poor	Poor	Good
Range			3 - 8	0 – 4	4.11 – 5.86
Description of range			Very Poor – Poor	Very Poor - Good	Fair - Excellent
Cahokia Creek Trib R0720801	5/28/2002	317	8	1	5.93
Cahokia Creek Trib R0720801	6/16/2001	19	7	2	5.50
Cahokia Creek Trib R0720801	7/1/2000	125	6	2	4.17
Cahokia Creek Trib R0720801	6/6/1999	60	5	2	5.65
Cahokia Creek Trib R0720801	6/13/1998	94	6	1	4.48
Cahokia Creek Trib R0720801	6/14/1997	113	10	0	6.99
Cahokia Creek Trib R0720801	6/30/1996	113	8	2	5.30
Average		120.1	7.1	1.4	5.4
Description of average			Poor	Poor	Fair
Range			5 – 10	0 – 2	4.17 – 6.99
Description of range			Very Poor – Fair	Very Poor - Poor	Very Poor - Excellent
Indian Creek R0718101	6/8/2003	199	9	1	6.09
Indian Creek R0718101	6/30/2001	49	5	1	6.67
Indian Creek R0718101	5/30/1998	72	9	2	6.40
Indian Creek R0718101	6/25/1997	118	9	2	6.28
Indian Creek R0718101	6/22/1996	143	3	0	6.13
Average		116.2	7.0	1.2	6.3
Description of			Poor	Poor	Very Poor

STREAM NAME	FIELD DATE	# ORGANISMS SAMPLED	TAXA RICHNESS	EPT TAXA RICHNESS	MBI
average					
Range			3 – 9	0 - 2	6.13 – 6.67
Description of range			Very Poor – Fair	Very Poor – Poor	Very Poor - Poor
Indian Creek R0718102	6/28/1998	110	9	2	6.48
Average		110	9	2	6.5
Description of average			Fair	Poor	Very Poor
Range			9	2	6.48
Description of range			Fair – Fair	Poor – Poor	Very Poor – Very Poor

Earth and Trace Metals

Water quality monitoring by the USGS-IWSC and IEPA at the USGS gage 05587900 included a large number of common earth metals (Table A.59) as well as trace and heavy metals (Table A.60). In most cases, both dissolved and total forms were reported. Earth metals are typically found in high concentrations throughout the environment because they are common ingredients in soils and plants. Trace and heavy metals are also relatively ubiquitous in the natural environment, but they tend not to be found in high concentrations. High concentrations of trace and heavy metals usually indicate some type of industrial contamination. This large Cahokia Creek dataset showed that these naturally occurring elements were all within normal ranges found in natural environments.

Manganese, which is listed as one of the impairments for Cahokia Creek, is a mineral that naturally occurs in rocks and soil. In trace amounts, it is essential to the health of plants and animals. It has similar properties to iron and is used in compounds for uses including metal alloys, antiseptic creams, preservatives, batteries, fireworks, fertilizers, and animal feed. Manganese was listed as an impairment in 2010, 2012, and 2014. Measurements taken prior to 1997 are higher than those taken more recently, perhaps as a result of more accurate measurement procedures. The method detection level prior to 1997 was >1 µg/L.

Sources of manganese include atmospheric deposition (i.e., particles in the air from industry and coal-burning power plants), groundwater as it flows through rocks and soils with high natural manganese, discharges from industrial operations (including the production of metal alloys, antiseptic creams, preservatives, batteries, fireworks, fertilizers, and animal feed), and runoff from fertilizer on cropland. When water contains too much manganese, it leaves stains on everything with which it comes in contact, including pipelines, faucets, and fabrics. At concentrations exceeding 0.15 ppm, manganese imparts an undesirable taste to beverages and stains plumbing fixtures. The value recommended by the FAO is 0.1 ppm. The USEPA Secondary Maximum Contaminant Level (MCL), a recommended concentration set of drinking water for aesthetic reasons (i.e., to avoid staining to pipes), is 0.05mg/L (0.05 ppm). (60) The median manganese concentration in Cahokia Creek between 1978 and 2014 is 0.185 ppm (185 ug/L) dissolved manganese, while the maximum observed manganese was 1.270 ppm (1270 ug/L) dissolved manganese— just below the USEPA and FAO recommended levels for drinking water (Figure A.59). However, surface water samples typically range from 1 to 200 µg/L. (61)

Figure A.59: Manganese concentrations measured at the Edwardsville USGS gage (1978-2014).

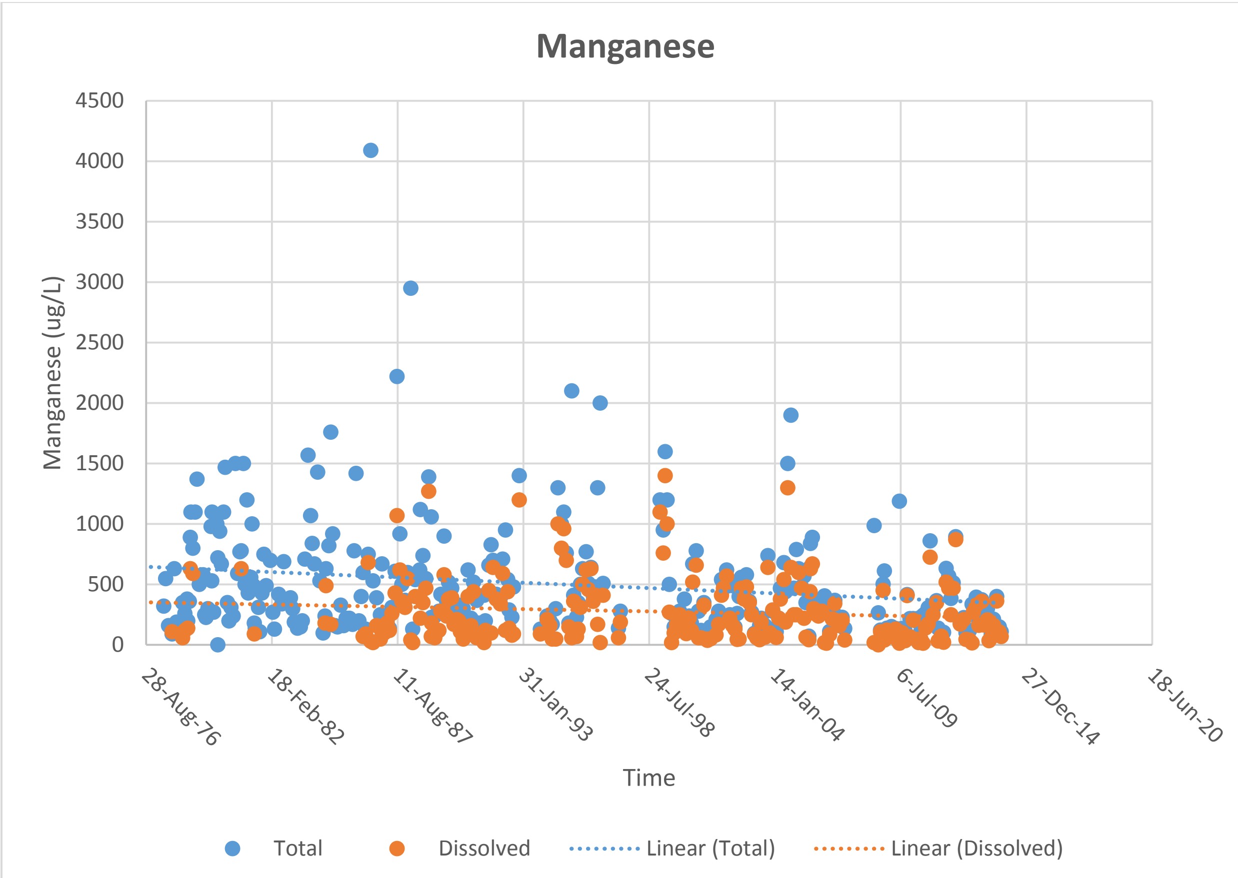


Table A.59: Statistical summary of earth metal concentrations monitored in Cahokia Creek at USGS Gage 05587900 (1978-1997) by the Illinois Water Science Center and IEPA.

Earth Metals	Units	n	Min	10th Pctl	25th Pctl	Median	75th Pctl	90th Pctl	Max	Mean
Aluminum, Dissolved	µg/L	183	2.89	31.60	50.00	89.00	100.00	150.00	1410.00	100.62
Aluminum, Total	µg/L	242	42.30	189.40	345.25	895.00	1907.50	4080.00	66,600.00	2605.45
Iron, Dissolved	µg/L	196	4.46	17.75	50.00	50.00	63.25	125.50	1440.00	77.94
Iron, Total	µg/L	304	264.00	530.00	800.00	1300.00	2807.50	5849.00	79500.00	3481.05
Mn, Dissolved	µg/L	221	13.70	42.20	73.40	180.00	400.00	630.00	1400.00	277.06
Mn, Total	µg/L	307	0.00	136.60	205.00	360.00	636.50	1064.00	4090.00	505.11
K, Dissolved	mg/L	225	0.64	2.80	3.60	4.40	5.20	6.60	11.00	4.52
K, Total	mg/L	277	1.80	3.20	3.80	4.60	5.60	6.74	14.00	4.91
Na, Dissolved	mg/L	225	4.00	12.64	19.00	24.70	28.00	32.00	57.00	23.92
Na, Total	mg/L	278	5.80	13.00	20.00	25.30	29.00	34.00	69.00	25.11
Calcium, Dissolved	mg/L	225	14.00	37.28	52.00	63.50	72.00	79.96	94.00	60.74
Calcium, Total	mg/L	278	18.00	45.70	57.00	68.00	78.00	85.00	106.00	66.65
Chloride, Total	mg/L	112	3.57	16.00	22.23	26.40	33.28	40.57	62.70	28.09
Fluoride, Total	mg/L	3	0.20	0.22	0.25	0.30	0.30	0.30	0.30	0.27
Fluoride, Dissolved	mg/L	1	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Oil+grea, Total	mg/L	2	0	0	0	0	0	0	0	0
Phenols, Total	µg/L	4	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Sulfate, Dissolved	mg/L	169	17.00	55.00	73.00	113.00	150.00	180.20	244.00	115.13
Sulfate, Total	mg/L	91	13.10	26.40	40.10	58.70	75.20	89.90	112.00	58.70

Table A.60: Statistical summary of trace and heavy metal concentrations monitored in Cahokia Creek at USGS Gage 05587900 (1978-2015) by the Illinois Water Science Center and IEPA.

Trace and Heavy Metals	Units	n	Min	10th Pctl	25th Pctl	Median	75th Pctl	90th Pctl	Max	Mean
Arsenic, Total	µg/L	37	1.13	1.43	1.90	2.56	3.26	4.47	62.20	4.43
Barium, Dissolved	µg/L	225	1.00	50.24	61.00	72.00	80.60	88.00	124.00	70.52
Barium, Total	µg/L	205	49.60	74.70	86.00	99.00	100.00	148.00	1000.00	116.96
Beryllium, Dissolved	µg/L	147	0.13	0.36	0.50	1.00	1.00	1.00	5.00	0.76
Beryllium, Total	µg/L	197	0.00	0.29	0.50	1.00	1.00	1.00	5.00	0.83
Boron, Dissolved	µg/L	213	10.00	48.64	60.00	80.00	101.00	130.00	200.00	84.39
Boron, Total	µg/L	275	10.00	50.00	70.00	86.00	110.50	146.00	330.00	95.55
Cadmium, Dissolved	µg/L	142	0.20	1.06	3.00	3.00	3.00	3.00	5.00	2.88
Cadmium, Total	µg/L	200	0.00	0.29	3.00	3.00	3.00	3.07	20.00	2.94
Chromium, Dissolved	µg/L	160	0.25	0.89	5.00	5.00	5.00	5.00	12.00	4.26
Chromium, Total	µg/L	241	0.00	1.28	5.00	5.00	5.00	10.00	132.00	6.90
Cobalt, Dissolved	µg/L	164	0.35	1.00	4.59	5.00	10.00	10.00	10.00	5.92
Cobalt, Total	µg/L	220	0.23	1.31	5.00	5.00	10.00	10.00	60.00	6.85
Copper, Dissolved	µg/L	170	0.38	1.90	5.00	5.00	5.00	10.00	10.00	5.99
Copper, Total	µg/L	238	0.00	1.90	5.00	5.00	10.00	20.00	90.00	8.44
Lead, Dissolved	µg/L	152	0.13	2.13	5.00	5.00	5.00	50.00	60.00	12.02
Lead, Total	µg/L	241	0.00	0.00	4.93	5.00	50.00	50.00	300.00	20.85
Manganese, Dissolved	ugL	221	13.70	42.20	73.40	180.00	400.00	630.00	1400.00	277.06
Manganese, Total	ugL	307	0.00	136.60	205.00	360.00	636.50	1064.00	4090.00	505.11
Nickel, Dissolved	µg/L	171	0.44	1.41	2.38	5.00	25.00	25.00	55.00	11.49
Nickel, Total	µg/L	195	0.00	1.35	3.10	5.00	21.50	25.00	100.00	10.99
Strontium, Dissolved	µg/L	224	40.00	98.25	130.00	160.00	180.00	190.00	330.00	153.75
Strontium, Total	µg/L	279	58.10	111.60	146.00	171.00	190.00	200.00	380.00	166.83
Vanadium, Dissolved	µg/L	144	0.30	3.66	5.00	5.00	5.00	5.00	10.20	4.76
Vanadium, Total	µg/L	188	0.21	4.66	5.00	5.00	8.25	20.00	150.00	10.48
Zinc, Dissolved	µg/L	170	0.40	5.79	22.50	50.00	100.00	100.00	320.00	59.76
Zinc, Total	µg/L	272	0.00	4.90	16.75	50.00	100.00	100.00	510.00	65.31

Metals in fish in Dunlap Lake

Dr. Christopher Theodorakis of SIUE led the testing of fish tissue samples from Dunlap Lake gathered on July 3rd, 2015. A total of 34 samples were analyzed using ICP-MS (inductively coupled plasma mass spectrometry). The following elements were tested for:

- Selenium (Se)
- Lead (Pb)
- Mercury (Hg)
- Arsenic (As)
- Cadmium (Cd)

Table A.61: Concentrations of metals found in fish in Dunlap Lake.

	Se		Pb		Hg		As		Cd	
	AVG	STD	AVG	STD	AVG	STD	AVG	STD	AVG	STD
3 lb fellite speciment (tail cut)	0.902	0.012	0.051	0.023	2.769	0.097	0.487	0.070	0.008	0.004
3 lb fellite speciment (center cut)	0.873	0.007	0.022	0.006	2.622	0.147	0.475	0.038	0.003	0.000
5 lb fellite speciment (tail cut)	1.009	0.042	0.032	0.021	2.511	0.140	0.347	0.008	0.002	0.001
5 lb fellite speciment (center cut)	0.969	0.027	0.026	0.011	2.247	0.071	0.346	0.015	0.002	0.001
Whole fish fellite speciment (tail cut)	1.207	0.020	0.038	0.023	0.701	0.029	0.457	0.020	0.002	0.000
Whole fish fellite speciment (center cut)	1.142	0.063	0.024	0.008	0.658	0.020	0.454	0.044	0.001	0.000

Water Appearance

Water appearance documented by the Illinois RiverWatch volunteers at the twenty sites in the watershed between 1997 and 2015 was described as clear, green, milky, or foamy (Table A.62). The Indian Creek site (38.9728, -89.9617) had the greatest proportion of assessments with non-clear water appearance—two out of six, or 33.3% of visits showed non-clear water such as green. At the Cahokia Creek site near the USGS gage ("Cahokia Creek Tributary and Cahokia Creek Tributary at Old Poag Road"), the water appeared clear seven out of seven, and eight out of eight times respectively (100% of visits). The volunteers also collected qualitative data on the worst weather in the last 24 and 48 hours.

When the worst weather in the last 48 hours included rain, 18% of the water appearance descriptions were not "clear." However, clear or overcast weather did not guarantee clear water; five out of 50 (10%) of the monitoring events with no rain in the last 48 hours had a milky, foamy, and green appearance. The data show no clear trend of improvement or deterioration of water appearance over time.

Table A. 62: Water appearance at the three RiverWatch monitoring sites, compared with worst weather in the last 48 hours at those sites, based on 84 monitoring events.

	Frequency					
	Worst weather in last 48 hours					
Water appearance	**Clear/Sunny**	**Overcast**	**Rain**	**Shower**	**Storm**	Total
Clear	28	14	8	12	7	69
Foamy	1					1
Milky	1	1		3		5
Green	2			1		3

	Frequency					
	Worst weather in last 48 hours					
Water appearance	**Clear/Sunny**	**Overcast**	**Rain**	**Shower**	**Storm**	Total
Other	1	2	1	1	1	6
Total	**33**	**17**	**9**	**17**	**8**	**84**

Turbidity

Of the 78 monitoring occasions where turbidity was reported by RiverWatch volunteers, 33 marked "clear," 28 marked "slight," 16 marked "medium," and 1 marked "heavy." Half the medium and heavy turbidity determinations occurred within 48 hours of a rain event. The data show no clear trend of improvement or deterioration in turbidity over time. (31)

Agriculture and Water Quality

Grain agriculture requires the use of nitrogen and phosphorus fertilizers. This results in the annual addition of soluble nutrients to the watershed. A 2010 study published in the Journal of Environmental Quality reported that 75% of the nitrogen inputs into Madison County were a result of fertilizer applications, with another 9.3% from manure, 6.7% from the atmosphere, and 8.6% from human activities (sewage). (62) Similarly, a 2011 study in the Journal of Environmental Quality reported that 73% of phosphorus inputs into Madison County came from fertilizer, 21.2% from manure, and 5.6% from sewage. (63) The tillage practices associated with grain production result in annual disturbance of the soil surface making it more susceptible to sheet and rill erosion during precipitation events. The 2012 Illinois Department of Agriculture Soil Conservation Transect Survey reported that 75% of corn and 37% of soybeans in Madison County are produced using conventional tillage practices that result in significant soil disturbance. (41) These values are much higher than the state averages of 49.1% for corn and 21.5% for soybean. Inversely, the amount of no till crop production is 1% for corn and 7% for soybean, which is much lower than the state averages of 10.8% for corn and 38.6% for soybean. It is apparent that row crop agriculture in Madison County has the greatest impact on surface water quality.

Urbanization and Water Quality

The greatest detriment to water quality from urbanization is an increase in the amount of impervious surfaces such as asphalt. Impervious surfaces prevent the natural process of rain infiltration into the soil. Instead, rainfall is rapidly directed into stormwater sewer systems that deliver the water directly to streams, unless a special effort is made to capture sediment prior to discharge. The rapid increase in runoff volume induces severe streambank and streambed erosion in the ephemeral streams that initially receive the water. Another impact of urbanization on water quality is the use of fertilizers by homeowners. Urban landowners are more likely to apply excessive amounts of nitrogen and phosphorus fertilizers on a unit of land. Although each homeowner controls a small amount of land, the cumulative effect of residential landscape fertilization can be significant in densely populated areas. Surface runoff from urban landscapes reaches streams more quickly than from agricultural or natural landscapes due to the prevalence of impervious surfaces.

Dunlap Lake (Indian-Cahokia Creek watershed)

In addition to the sources previously mentioned for water quality data in the watershed, the Dunlap Lake Home Owners Association (HOA) has also collected water quality data from the lake multiple times in the last six years. Table A.63 shows all of the data provided by the HOA, blank cells indicate one of two things: the sample did not include testing for that contaminate, or the test did not give results above the minimum quantitative limit.

Table A.63: Dunlap Lake water quality data from 2010-2016.

Contaminant	July 2017			July 2016			August 2015			September 2014			August 2010		
	1	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**North**	**South**	**Central**	**1**	**2**	**3**
Aluminum (mg/L)													0.92	0.43	0.34
Arsenic (mg/L)	<0.0250	<0.0250	<0.0250	<0.0250	<0.0250	<0.0250	<0.0250	<0.0250	<0.0250	0.008*	0.007*	0.007*			
Barium (mg/L)													0.07		
Boron (mg/L)													0.17	0.22	0.36
Calcium (mg/L)													21.98	23.13	24.00
Chromium (mg/L)													0.14		
Copper (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0024	<0.0050	<0.0050	<0.0050			
E. Coli (P/A)	Absent		Absent	Absent	Absent	Absent									
Fecal coliform (CFU/100 mL)	30	<10	10	<20	40	20	500	<100	400	4	<1	5	833	93	129
Iron (mg/L)													0.88	0.87	0.27
Lead (mg/L)	<0.0150	<0.0150	<0.0150	<0.0150	<0.0150	<0.0150	<0.0150	<0.0150	<0.0150	0.011	0.008	0.011			
Magnesium (mg/L)													11.72	13.88	14.43
Manganese (mg/L)													0.13	0.11	0.11
Mercury (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.001	<0.001	<0.001			
Nickel (mg/L)														0.06	
Nitrate (mg/L)	<0.050	<0.050	<0.050	0.126	<0.050	<0.050	0.011	<0.050	0.462	<0.1	<0.1	<0.1	0.2	0.2	0.1
Nitrite (mg/L)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.01	<0.05	0.01	<0.1	<0.1	<0.1	0.02	<0.05	<0.05
Nitrogen, Total (mg/L)	2.33	1.53	1.62	1.23	0.92	0.93	1.22	0.85	1.17						
Phosphate (ppm)										0.2	0.2	0.2			
Phosphorus, Total (mg/L)	0.261	0.155	0.139	0.088	0.139	0.119	0.377	0.195	0.214				0.14	0.28	0.35
Potassium (mg/L)													5.31	3.88	3.80
Silicon (mg/L)													4.23	2.13	1.89
Sodium (mg/L)													14.84	17.99	19.20
Strontium (mg/L)													0.12	0.11	0.12
Sulfur (mg/L)													17.46	17.34	17.88
Total Kjeldahl Nitrogen (mg/L)	2.3	1.5	1.6	1.1	0.90	0.91	1.2	0.85	0.70						
Zinc (mg/L)													0.07	0.05	0.05

*these values are reported in parts per million (ppm)

NPDES Permitted Discharges

There are seven facilities with National Pollution Discharge Elimination System (NPDES) permits to discharge into the Indian-Cahokia Creek watershed (Table A.64). Five of them are water, wastewater, or sewage treatment plants. Several other facilities in the watershed have been issued NPDES permits in the past, which have now expired. None of the facilities have exceeded the capacity for which they were designed. The permit limits can be downloaded from the Discharge Monitoring Report (DMR) Pollutant Loading Tool.

Several pollutants are required to be monitored at these facilities, including residual chlorine, biological oxygen demand, fecal coliform, ammonia nitrogen, suspended solids, pH, dissolved oxygen, and total flow. Suspended solids monitored at the facilities are shown in Table A.65. Five of the seven permitted facilities monitored total suspended solids, and the average total of the total suspended solids from these seven facilities was 20.432 lb/d. Translated into a yearly value, that is 3.73 t/year.

The Edwardsville Sewage Treatment Plant (STP) is the only facility in the watershed to track manganese, nitrogen, or phosphorus discharge from 2009-2016 (Table A.66). These pollutants are not subject to limits in the permit.

Table A.64: NPDES Permitted Discharges into the Indian-Cahokia Creek watershed

HUC 12	Site Name	Permit Number	Permit Exp. Date	Design Flow (MGD)	Average Daily Flow (MGD)
071401010201	Wilsonville STP	ILG580172	June 30, 2018	0.345	0.0698
071401010202	Staunton WTP	ILG640124	April 30, 2017		0.035
071401010202	Staunton WWTP	IL0031232	August 31, 2018	10.7	1.751
071401010204	Worden STP, Village	ILG580015	June 30, 2018	0.33	0.135
071401010206	Bunker Hill STP	ILG580154	June 30, 2018	0.557	0.237
071401010207	Southern Illinois University-E Swim	IL0075841	July 31, 2017		0.150
071401010207	Southern Illinois University-Edwardsville	IL0046761	July 31, 2018		0.217

Table A.65: Total suspended solids as averages from measurements from the PCS/ICIS for the Indian-Cahokia Creek watershed.

HUC12	Name of facility	Permit #	Average Total Suspended Solids Discharge (lb/d)	Dates of data used
071401010201	Wilsonville STP	ILG580172	10.26	31-MAY-2014 - 31-JUL-2016
071401010202	Staunton WTP	ILG640124		31-JUL-2012 - 31-JUL-2016
071401010202	Staunton WWTP	IL0031232	65.36	30-SEP-2013 - 31-JUL-2016
071401010204	Worden STP, Village	ILG580015	3.96	31-MAY-2014 - 31-MAY-2016
071401010206	Bunker Hill STP	ILG580154	18.23	31-MAY-2014 - 30-JUN-2016
071401010207	Southern Illinois University-E Swim	IL0075841		31-AUG-2012 - 31-MAY-2016
071401010207	Southern Illinois University-Edwardsville	IL0046761	4.35	30-SEP-2013- 31-MAY-2016

Table A.66: Pollutant loads of Manganese, manganese compounds, nitrogen and phosphorous from Edwardsville STP.

Chemical Name	Total Discharged (lbs/year)								Average (lbs/year)
	2009	2010	2011	2012	2013	2014	2015	2016	
Manganese & manganese compounds	677	1,694	2850	1058			903	451	1,272
Nitrogen							6,401	13745	10,073
Phosphorus							58,74	54,516	56,629

Outfalls

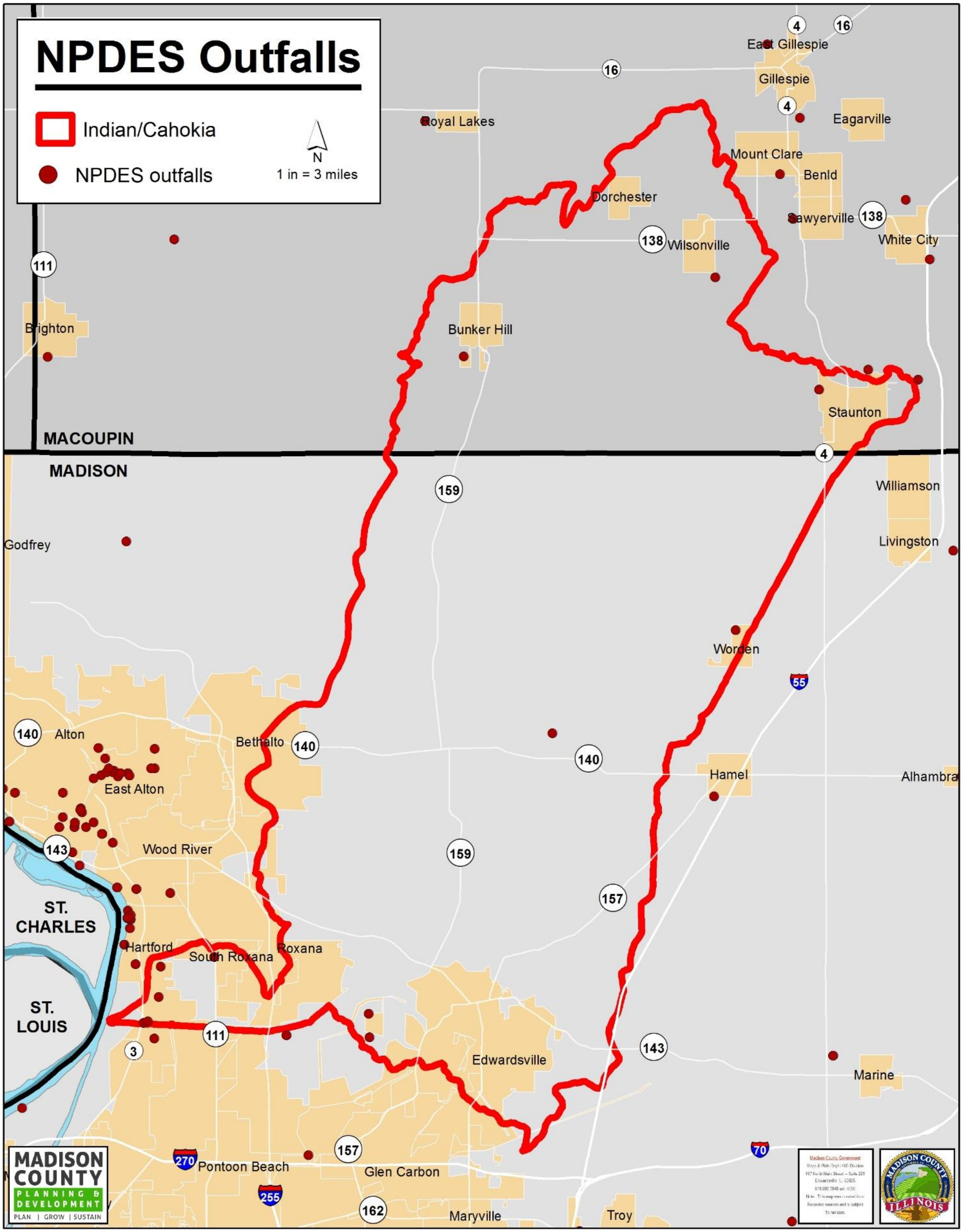
According to the federal definition, “outfall” means a point source at the point where a municipal separate storm sewer discharges to waters of the United States, as defined by 40 CFR 122.2. Outfalls do not include open conveyances connecting two municipal storm sewers, or pipes, tunnels, or other conveyances which connect segments of the same stream or other waters of the United States and are used to convey waters of the United States.[213] NPDES outfall locations are available to download from Illinois’ Resource Management Mapping Service (RMMS). Madison County also created a georeferenced outfalls file covering the county some years ago, but it is not clear that the makers of this file used the federal definition of outfalls, and the file is not accompanied by metadata that could explain its attributes.

There are 12 outfalls within the watershed. Eight of the outfalls are within municipal boundaries, as indicated by an asterisk by the facility name in Table A.67 (Figure A.60).

Table A.67: NPDES Outfalls in the Indian-Cahokia Creek watershed.

HUC14	Facility Name	NPID	Description
07140101020102	Wilsonville STP	ILG580172	STP Outfall
07140101020201	Staunton WWTP	IL0031232	STP Outfall
07140101020203	Worden STP*	ILG580015	STP Outfall
07140101020404	Holiday Shores STP	ILG580193	STP Outfall
07140101020601	Bunker Hill STP	ILG580154	STP Outfall
07140101020702	Southern Illinois University-Edwardsville*	IL0046761	STP Outfall
07140101020702	Southern Illinois University-Edwardsville Pool*	IL0075841	Swimming Pool Water
07140101020703	Conoco Phillips-Wood River*	IL0000205	SW Discharge
07140101020703	Estate of Chemetco-Hartford*	IL0025747	SW Lagoon
07140101020703	Explorer Pipeline-Wood River*	IL0061522	Tnk Bttm, Wtr Drw, Hydstc Tst Wt
07140101020703	Conoco Inc Wood River Term Tank*	IL0071803	Hydrostatic Test Effluent
07140101020703	Roxana STP*	IL0077356	STP Outfall

Figure A.60: NPDES Outfall locations in the Indian-Cahokia Creek watershed.



Pollutant Loading Analysis

Estimating Pollutant Loads by Source

Nutrient (total nitrogen and total phosphorus) and sediment loads (sheet and rill erosion) for the Cahokia Creek watershed were calculated using the Spreadsheet Tool for Estimating Pollutant Load (STEPL), a tool developed by the USEPA. (64) STEPL employs simple algorithms to calculate nitrogen, phosphorus, and sediment loads from different land uses.

Inputs required by the model include land uses, animal operations, precipitation, soil types, and Universal Soil Loss Equation (USLE) parameters, septic systems, and direct discharges. Land use data was identified from the most recent National Land Cover Database (NLCD 2011). Animal (livestock) data was obtained from the USDA 2012 Agricultural Census database at the county level. (32) Runoff volumes were based on long-term precipitation records from the Southern Illinois University weather station at Belleville. The annual sediment load (sheet and rill erosion only) is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. USLE parameters were from the Madison County Soil Survey. Data related to septic systems was obtained from the U.S. Census Bureau and the USEPS. The remaining user input parameters were obtained from the online STEPL Input Data Server. (64)

Sediment loads due to streambank erosion were calculated with the STEPL tool. It was assumed that the average impaired streambank location included moderate lateral recession and an average erosional height of five feet on both sides of the river within the impaired stream length.

Table A.68: Estimated current and annual pollutant load by source at the watershed scale.

Sources	N Load		P Load		Sediment Load	
	(lb/yr)	(%)	(lb/yr)	(%)	(t/yr)	(%)
Cropland	425,137	59.2	103,216	71.9	23,406	54.1
Pastureland	117,010	16.3	10,255	7.1	1,491	3.4
Forest	7,926	1.1	3,892	2.7	194	0.4
Urban	128,464	17.9	19,838	9.6	2,950	6.8
Feedlots	14,310	2.0	2,862	2.0		
Septic	455	0.1	178	0.2		
Streambank	24,304	3.4	9,357	6.5	15,190	35
Total	**717,606**	**100**	**149,598**	**100**	**43,231**	**100**

The STEPL model for Indian-Cahokia Creek watershed calculated nutrient loads for each of the primary land uses as used in the NLCD (Table A.68). Cropland was by far the greatest source of nutrients and sediments in the watershed. Cultivated cropland accounts for 42.5% of the total land surface in the watershed, but contributes 59.2% of the nitrogen load, 71.9% of the phosphorus load, and 54.1% of the sediment load. Hay and pastureland cover 15.1% of the land surface in the watershed but contribute much smaller amounts of nutrients and sediments due to protection of the soil surface by a permanent vegetative cover.

Forest also covers 25.6% of the watershed but contributes less than 2% of the nutrient and sediment loads. Developed urban areas cover 16.9% of the watershed and contribute 17.9% of the nitrogen load, 9.6% of the phosphorus load, and 6.8% of the sediment load. Although these amounts are relatively small compared to the agricultural sources, a trend towards increasing urbanization indicates that urban sources of pollutants will account for a greater portion of pollutant loads in the future. Streambank erosion is also large contributor of sediments (35.1%) in the watershed based on the observations and calculations conducted for this report.

Estimated Pollutant Loads by Subwatershed

Additional insight into the impact of land use on pollutant loads can be discerned by examining pollutant loads and land use/land cover by HUC12 subwatershed (Table A.69). It should be noted that while other sections of this report evaluate information from the Cahokia Creek watershed at the HUC14 level, the information available for the STEPL tool was only available at the HUC 12 level.

Table A.69: Annual pollutant loads by subwatershed, and area of cropland in acres.

HUC12	Total Area	Cropland	N Load	P Load	N Load	P Load	Sediment Load
	(acres)		(lb/year)		(lb/acre/year)		(ton/year)
071401010201	11,587	5,780	71,395	16,998	6.2	1.5	7,640
071401010202	15,295	5,014	73,830	14,758	4.8	1.0	2,920
071401010203	15,812	6,495	109,827	21,254	6.9	1.3	3,695
071401010204	23,838	10,397	134,148	28,519	5.6	1.2	8,887
071402010205	18,426	7,496	82,144	16,724	4.5	0.9	4,085
071402010206	25,705	13,528	175,505	37,524	6.8	1.5	3,271
071402010207	13,132	3,869	70,757	13,821	5.4	1.1	2,732
TOTAL	**123,795**	**52,579**	**717,606**	**149,598**	**40.2**	**8.5**	**33,230**

The relationship between nutrient loads and crop acreage is very strong, as is the relationship between sediment load and cropland. The correlation between total nutrient and sediment loads and all other land uses was weak or nonexistent, and are not shown in Table A.69. This does not indicate that other nutrient and sediment sources are unimportant, but rather that the amounts contributed by non-crop land sources are relatively small compared to cropland.

The HUC12 with the greatest nitrogen loading is 071402010206, with 175,505 lb/year. The same HUC12 also has the most phosphorus loading (37,524 lb/year) and the most sediment loading (13,271 tons/year). It is important to note that 07140204050101 is also the largest subwatershed in the project area. Even when adjusted for area, it produces the most nitrogen per acre, with 6.8 lb/acre/year.

The pattern is the same for phosphorus loading (Figure A.62), with HUC12 071402010206 producing the most phosphorus in total and per acre (1.5 lb/acre/year). The amount of phosphorus loading is much smaller than the nitrogen loading in terms of pounds.

Areas of high sediment loading are distributed somewhat evenly throughout the watershed with the highest loading in HUC 071402010206 and the lowest loading in 071402010207.

Figure A.61: Nitrogen loads by HUC 14 in the Indian-Canteen-Cahokia Creeks watershed, as modeled using STEPL.

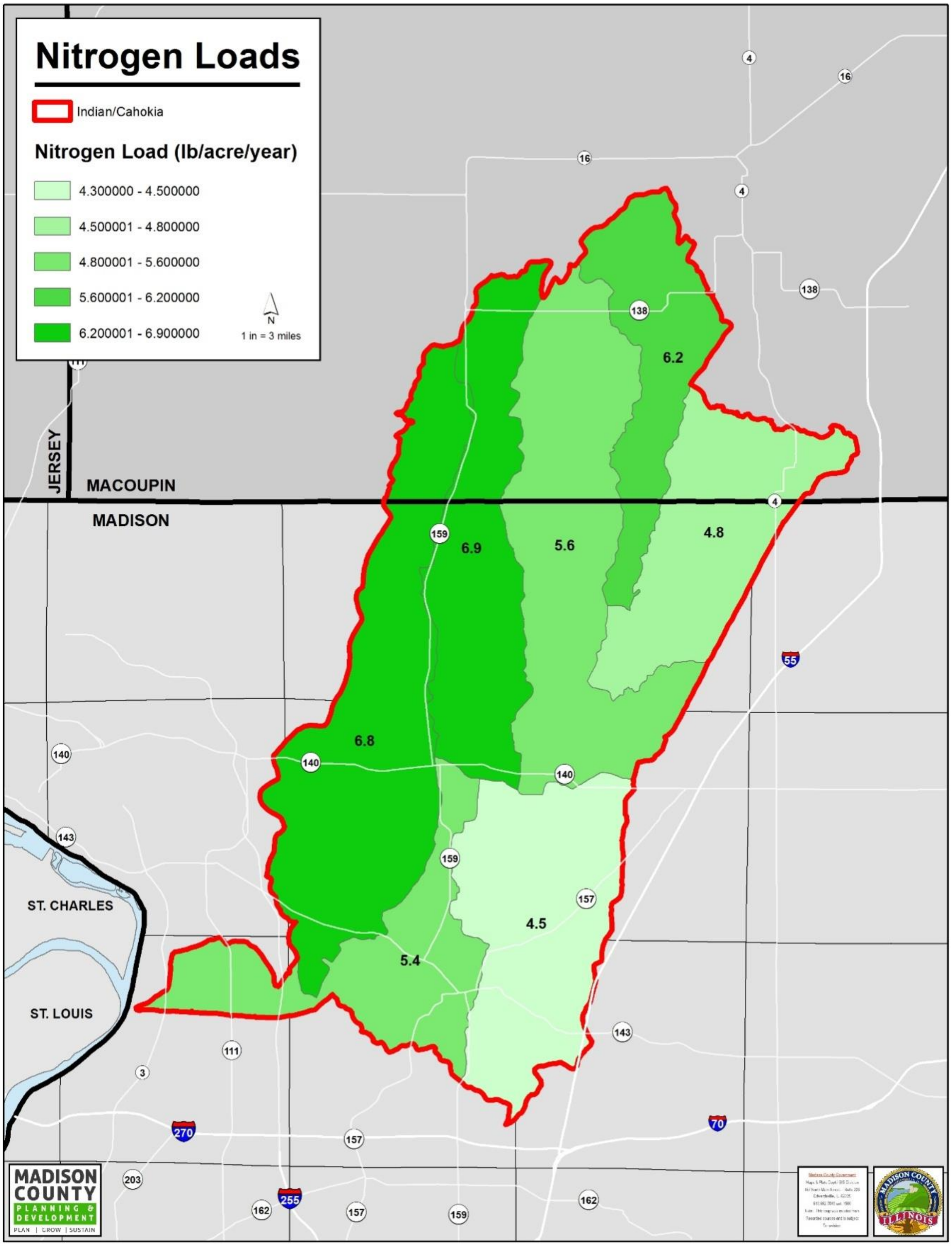


Figure A.62: Phosphorus loads by HUC 14 in the Indian-Canteen-Cahokia Creeks watershed, as modeled using STEPL.

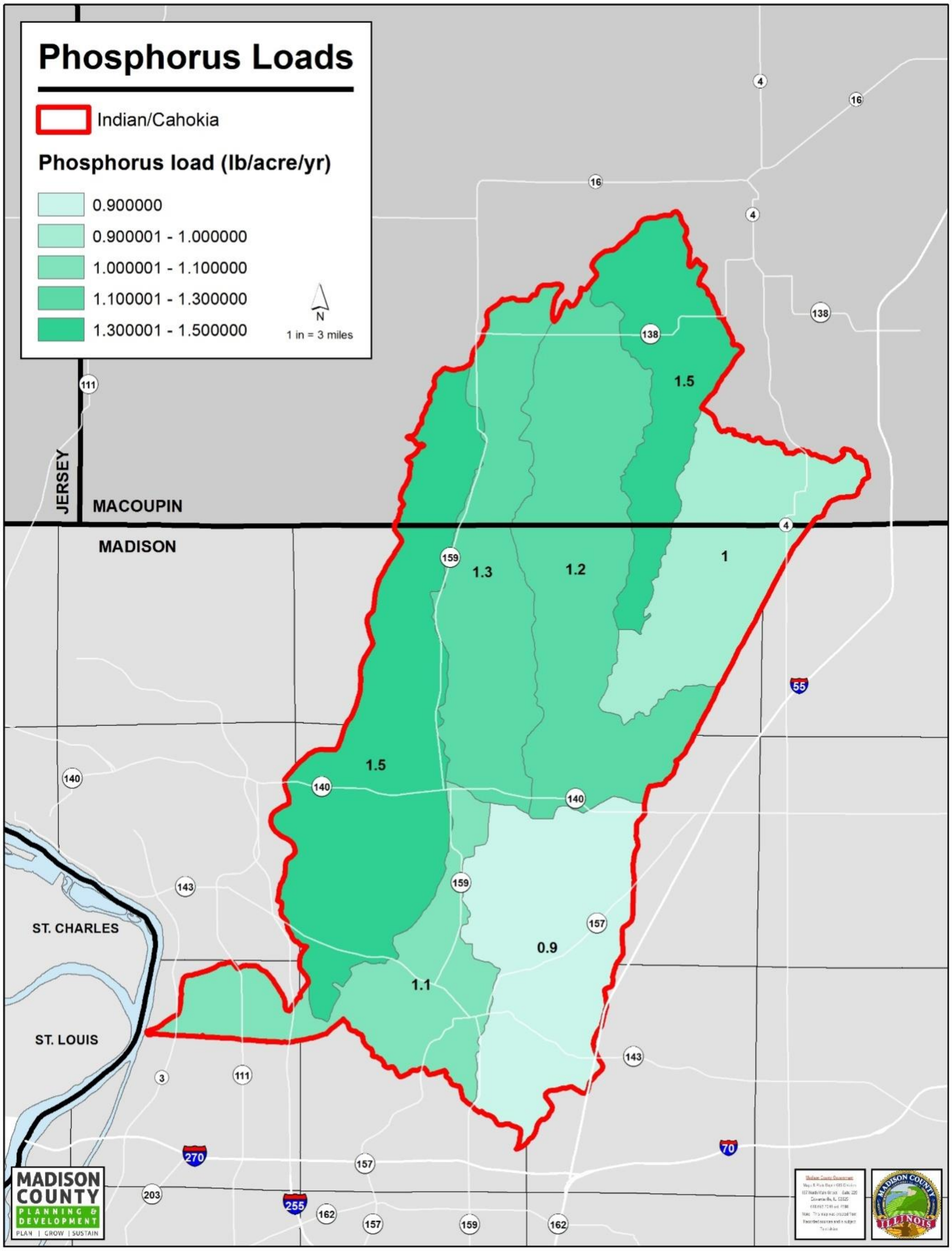
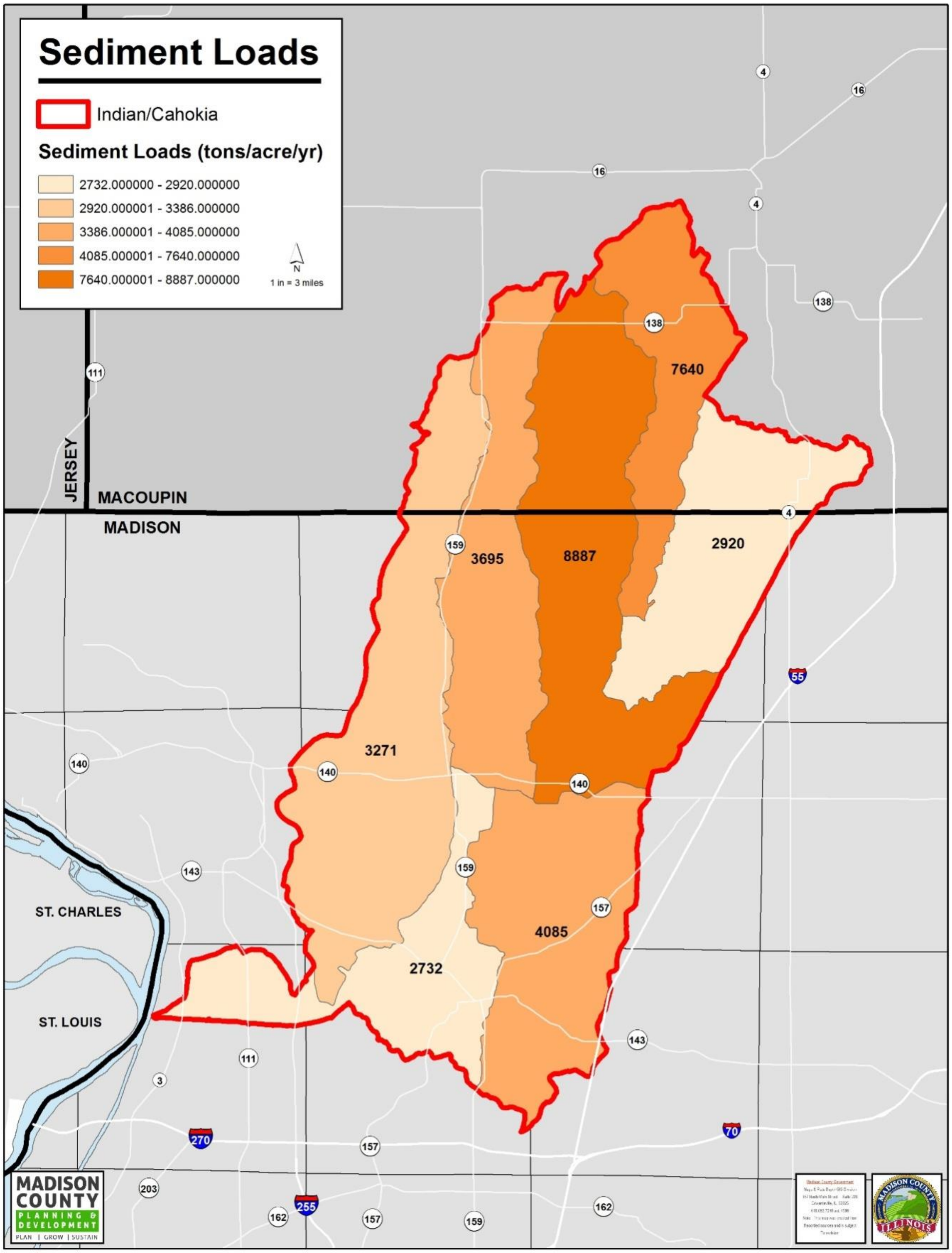


Figure A.63: Sediment loads by HUC 14 in the Indian-Canteen-Cahokia Creeks watershed, as modeled using STEPL.



Glossary of Terms

100-year floodplain: Land adjoining the channel of a river, stream, watercourse, lake, or wetland that has been or may be inundated by floodwater during periods of high water that exceed normal bank-full elevations. The 100-year floodplain has a probability of 1% chance per year of being flooded.

303(d) Impaired Waters: The federal Clean Water Act requires states to submit a list of impaired waters to the U.S. Environmental Protection Agency for review and approval every two years using water quality assessment data from the Section 305(b) Water Quality Report. These impaired waters are referred to as "303(d) impaired waters." States are then required to establish priorities for the development of Total Maximum Daily Load analyses (TMDLs) for these waters and a long-term plan to meet them.

305(b): The Illinois 305(b) Water Quality Report is a water quality assessment of the state's surface and groundwater resources compiled by the Illinois Environmental Protection Agency and submitted as a report to the U.S. Environmental Protection Agency as required under Section 305(b) of the Clean Water Act.

Aquifer: A layer of permeable rock, sand, or gravel through which groundwater flows, containing enough water to supply springs and wells.

Base flow: The flow to which a perennially flowing stream reduces during the dry season. It is commonly supported by groundwater seepage into the channel.

Bedrock: The solid rock that lies beneath loose material, such as soil, sand, clay, or gravel.

Center for Watershed Protection (CWP): Non-profit 501(c)3 corporation founded in 1992 that provides government entities, watershed organizations, and others around the country with the tools to protect streams, lakes, rivers, and watersheds.

Channelization: The artificial straightening, deepening, or widening of a stream or river to accommodate increased stormwater flows, typically to increase the amount of adjacent developable land for urban development, agriculture, or navigation.

Designated use: Appropriate use of a waterbody as designated by states and tribes. Designated uses are identified by considering the use, suitability, and value of the water body for public water supply; protection of fish and wildlife; and recreational, agricultural, industrial, and navigational purposes. Determinations are based on its physical, chemical, and biological characteristics; geographical setting and scenic qualities; and economic considerations.

Digital Elevation Model (DEM): Grid of elevation points used to produce elevation maps.

Discharge (streamflow): The volume of water passing through a channel over a given time period, usually measured in cubic feet per second.

Dissolved oxygen (DO): The amount of oxygen in water, usually measured in milligrams/liter.

Erosion: The displacement of soil particles on land surfaces due to water or wind action.

Federal Emergency Management Agency (FEMA): Government agency within the Department of Homeland Security that responds to, plans for, coordinates recovery from, and mitigates against natural and man-made disasters and emergencies, including significant floods.

Flash flood: A rapid rise of water along a stream or low-lying area, usually produced when heavy localized precipitation falls over an area in a short amount of time. Flash floods are considered the most dangerous type of flood event because they offer little or no warning time and their capacity for damage, including the capability to induce mudslides.

Geographic Information System (GIS): A computer-based approach to interpreting maps and images and applying them to problem-solving.

Geology: The scientific study of the structure of the Earth, focused primarily on the composition and origins of rocks, soil, and minerals.

Headwaters: Upper reaches of streams and tributaries in a watershed.

HUC or HUC Code: A Hydrologic Unit Code (HUC) that refers to the division and subdivision of U.S. watersheds. The hydrologic units are arranged or nested within each other, from the largest geographic area (regions) to the smallest geographic area (cataloging units). Where two digits follow “HUC,” they refer to the length of the HUC code. For example, “HUC14” refers to the lowest-nested subwatershed level with a 14-digit long code, such as HUC 07140204050101.

Hydric soil: Soil units that are wet frequently enough to periodically produce anaerobic conditions, thereby influencing the species composition and/or growth of plants on those soils.

Hydrology: The scientific study of the properties, distribution, and effects of water in relation to the earth’s surface, in the soil and underlying rocks, and in the atmosphere.

Hydrologic Soil Groups (HSG): Soils are classified by the Natural Resource Conservation Service into four Hydrologic Soil Groups, A, B, C and D, based on the soil’s runoff potential. A’s generally have the smallest runoff potential and D’s the greatest.

Hydrophytic vegetation: Plant life growing in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content; one of the indicators of a wetland.

Illinois Department of Natural Resources (IDNR): State government agency established to manage, protect, and sustain Illinois’ natural and cultural resources, provide resource-compatible recreational opportunities, and promote natural resource-related issues for the public’s safety and education.

Illinois Environmental Protection Agency (IEPA): State government agency established to safeguard environmental quality so as to protect health, welfare, property, and quality of life in Illinois.

Illinois Nature Preserves Commission (INPC): Commission responsible for protecting Illinois Nature Preserves, state-protected areas that are provided the highest level of legal protection, and have management plans in place.

Impervious Cover Model: Simple urban stream classification model based on impervious cover and stream quality. The classification system contains three stream categories (sensitive, impacted, and non-supporting) based on the percentage of impervious cover.

Impervious cover/surface: An area covered with solid material or that is compacted to the point where water cannot infiltrate underlying soils (e.g. parking lots, roads, houses, etc.).

Infiltration: Rainfall or surface runoff that moves downward from the surface into the subsurface soil.

Loess: An unstratified loamy deposit, usually buff to yellowish brown, chiefly deposited by the wind and thought to have formed by the grinding of glaciers.

Marsh: An area of soft, wet, low-lying land, characterized by grassy vegetation and often forming a transition zone between water and land.

Municipal Separate Storm Sewer System (MS4): A system that transports or holds stormwater, such as catch basins, curbs, gutters, and ditches, before discharging into local waterbodies.

National Flood Insurance Program (NFIP): Federal program created by Congress in 1968 to help provide a means for property owners to financially protect themselves from flood risk.

National Hydrography Dataset (NHD): Digital database of surface water features, such as lakes, ponds, streams, and rivers. The NHD is used to make hydrology and watershed boundary maps.

National Pollutant Discharge Elimination System (NPDES) Phase II: Permit program authorized by the Clean Water Act requiring smaller communities and public entities that own and operate a Municipal Separate Storm Sewer System (MS4) to apply and obtain a NPDES permit for stormwater discharges to surface water. Permittees must develop, implement, and enforce a stormwater program designed to reduce the discharge of pollutants from the MS4 to the maximum extent practicable. Individual homes that use a septic system, are connected to a municipal system, or do not have a surface discharge do not need an NPDES permit. The NPDES permit program is administered by authorized states. In Illinois, the Illinois EPA administers the program.

National Wetland Inventory (NWI): U.S. Fish and Wildlife Service program that provides information on the characteristics, extent, and status of U.S. wetlands and deepwater habitats.

Native vegetation/plants: Plant species that have historically been found in a given area.

Natural Resources Conservation Service (NRCS): Government agency under the U.S. Department of Agriculture (USDA) that provides technical assistance to landowners and land managers.

Nitrogen: A colorless, odorless, unreactive gas that constitutes about 78% of the earth's atmosphere. The availability of nitrogen in soil is important for plant growth and ecosystem processes, and nitrogen is used in many fertilizers.

Nonpoint source pollution (NPS pollution): Any source of water pollution that is not from a discrete outflow point. Instead, NPS pollution comes from diffuse sources and is carried into waterways with runoff from the land. Pollutants can include oil, grease, sediment, and nutrients in excess fertilizer.

Nutrients: Substances needed for the growth of plants and animals, such as phosphorous and nitrogen. The addition of too many nutrients to a waterway causes problems to the aquatic ecosystem by promoting nuisance vegetation including excess algae growth.

Open space parcel: Any parcel of land that is not developed and is set aside for recreation or conservation purposes.

Overland flood: Flooding that occurs when rainfall collects on saturated or frozen ground. When surface runoff cannot find a channel, it may flow out over a large area at a somewhat uniform depth in sheet flow or collect in depressions as ponding.

Point source pollution: Pollution that discharges in water from a single, discrete source, such as an outfall pipe from an industrial plant or wastewater treatment facility.

Pollutant load: The amount of any pollutant deposited into waterbodies from point source discharges, combined sewer overflows, and/or stormwater runoff.

Riparian: The riverside or riverine environment adjacent to the stream channel. For example, riparian, or streamside, vegetation grows next to (and over) a stream.

Riverine flood: The gradual rise of water in a river, stream, lake, reservoir, or other waterway that results in the waterway overflowing its banks. This type of flooding generally occurs when storm systems remain in the area for extended periods of time, when winter or spring rains combine with melting snow to create higher flows, or when obstructions, such as logjams, block normal water flow.

Runoff: The portion of precipitation that does not infiltrate into the ground and is discharged into streams by flowing over the ground.

Sediment: Soil particles that have been transported from their natural location by wind or water action.

Sedimentation: The process that deposits soils, debris, and other materials either on other ground surfaces or in bodies of water.

Special Flood Hazard Area: The area inundated during the base flood is called the Special Flood Hazard Area or 100-year floodplain.

Stakeholders: Individuals, organizations, or enterprises that have an interest or a share in a project.

Stream reach: A stream segment having fairly homogenous hydraulic, geomorphic, riparian cover, and land use characteristics.

Subwatershed: Any drainage basin within a larger drainage basin or watershed.

Threatened and endangered species: A "threatened" species is one that is likely to become endangered in the foreseeable future. An "endangered" species is one that is in danger of extinction throughout all or a significant portion of its range.

Topography: The relative elevations of a landscape describing the configuration of its surface. Also, the study and depiction of the distribution, relative positions, and elevations of natural and man-made features of a particular landscape (e.g. on a map).

Total Maximum Daily Load (TMDL): The highest amount of discharge of a particular pollutant that a waterbody can handle safely per day.

Total Suspended Solids (TSS): The organic and inorganic material suspended in the water column greater than 0.45 micron in size.

United States Army Corps of Engineers (USACE): Federal group of civilian and military engineers and scientists that provide services for planning, designing, building, and operating water resources and other Civil Works projects. These include flood control and environmental protection projects.

U.S. Fish and Wildlife Service (USFWS): Federal government agency within the U.S. Department of the Interior dedicated to the management of fish and wildlife and their habitats.

United States Geological Survey (USGS): Federal government agency established with the responsibility to provide reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect quality of life.

Urban runoff: Runoff that runs over urban developed surfaces such as streets, lawns, and parking lots, entering directly into storm sewers rather than infiltrating the land upon which it falls.

Watershed: The area of land that contributes runoff to a single point on a waterbody.

Watershed-Based Plan: A strategy and work plan for achieving water resource goals that provides assessment and management information for a geographically defined watershed, including the analysis, actions, participants, and resources related to development and implementation of the plan.

Wetland: Lands that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, under normal conditions, a prevalence of vegetation adapted for life in saturated soil conditions (known as hydrophytic vegetation). A wetland is identified based upon the three attributes: 1) hydrology, 2) hydric soils, and 3) hydrophytic vegetation. A wetland is considered a subset of the definition of the Waters of the United States.

Data Tables

Hydrologic soil groups by HUC14

Table A.70: Area of hydrologic soil group by HUC14 in the Indian-Cahokia Creek watershed

HUC14	Area of Hydrologic Soil Group (acres)							Total area (acres)
	Unclassified	A	B	B/D	C	C/D	D	
07140101020101	419	0	2,971	560	468	228	242	**4,888**
07140101020102	66	0	4,801	25	440	82	114	**5,528**
07140101020103	30	0	2,164	0	1,326	504	189	**4,213**
07140101020201	530	0	1,536	0	894	236	1,395	**4,591**
07140101020202	57	0	1,785	0	1,223	205	1,591	**4,861**
07140101020203	36	0	2,587	90	1,304	665	645	**5,327**
07140101020301	22	0	2,570	413	1,102	428	612	**5,147**
07140101020302	90	0	3,540	0	3,943	106	394	**8,073**
07140101020303	318	0	1,339	0	1,890	0	393	**3,940**
07140101020401	56	0	3,558	316	2,030	807	1,014	**7,781**
07140101020402	44	0	2,498	17	1,448	271	1,467	**5,745**
07140101020403	52	0	1,327	83	1,021	106	381	**2,970**
07140101020404	57	0	5,725	0	3,213	319	335	**9,649**
07140101020501	48	0	1,431	26	1,138	329	73	**3,045**
07140101020502	33	0	2,019	317	873	364	44	**3,650**
07140101020503	46	0	2,456	398	233	235	59	**3,427**
07140101020504	861	0	6,289	15	575	84	8	**7,832**
07140101020601	86	0	1,913	0	1,519	728	881	**5,127**
07140101020602	42	0	2,458	0	2,658	12	198	**5,368**
07140101020603	24	0	2,489	0	1,611	23	51	**4,198**
07140101020604	27	0	4,742	0	769	126	6	**5,670**
07140101020605	34	0	4,031	0	822	6	32	**4,925**
07140101020701	400	0	2,890	218	591	388	11	**4,498**
07140101020702	940	0	3,301	0	824	64	60	**5,189**
07140101020703	225	157	1,148	163	319	190	1,365	**3,567**
Total	**4,543**	**157**	**71,568**	**2,641**	**32,234**	**6,506**	**11,560**	**129,209**

Soil types with hydric category and hydrologic group

Table A.71: Soil types in the Indian-Cahokia Creek watershed with their hydric category and hydrologic group

Hydrologic Soil Group	Map Symbol Code	Soil Type (SSURGO map unit name)	Hydric Soil?	Non-Hydric Soils area (acres)	Hydric Soils area (acres)	Total area (acres)
	533	Urban land		142		**142**
	536	Dumps, mine		310		**310**
	867	Oil waste land		4		**4**
C/D	1070L	Beaucoup silty clay loam, undrained, 0 to 2 percent	Yes		155	**155**
C/D	112A	Cowden silt loam, 0 to 2 percent slopes	Yes		220	**220**
C/D	113A	Oconee silt loam, 0 to 2 percent slopes	No	810		**810**
C/D	113B	Oconee silt loam, 2 to 5 percent slopes	No	1,555		**1,555**
C	119B2	Elco silt loam, 2 to 5 percent slopes, eroded	No	6		**6**
C	119C2	Elco silt loam, 5 to 10 percent slopes, eroded	No	41		**41**
C	119C3	Elco silty clay loam, 5 to 10 percent slopes, severely	No	1,263		**1,263**
C	119D2	Elco silt loam, 10 to 18 percent slopes, eroded	No	569		**569**
C	119D3	Elco silty clay loam, 10 to 18 percent slopes,	No	1,642		**1,642**
C	127B	Harrison silt loam, 2 to 5 percent slopes	No	247		**247**
D	165A	Weir silt loam, 0 to 2 percent slopes	Yes		119	**119**
D	16A	Rushville silt loam, 0 to 2 percent slopes	Yes		709	**709**
B	2079D	Menfro-Orthents-Urban land complex, 8 to 15	No	220		**220**
C/D	2122B	Colp-Orthents-Urban land complex, 2 to 5 percent	No	170		**170**
C	2477B	Winfield-Orthents-Urban land complex, 2 to 8	No	1463		**1,463**
D	267A	Caseyville silt loam, 0 to 2 percent slopes	Yes		1593	**1,593**
B/D	267B	Caseyville silt loam, 2 to 5 percent slopes	No	1,293		**1,293**
C	283B	Downsouth silt loam, 2 to 5 percent slopes	No	1,135		**1,135**

Hydrologic Soil Group	Map Symbol Code	Soil Type (SSURGO map unit name)	Hydric Soil?	Non-Hydric Soils area (acres)	Hydric Soils area (acres)	Total area (acres)
C	283C2	Downsouth silt loam, 5 to 10 percent slopes, eroded	No	197		**197**
B/D	3070A	Beaucoup silty clay loam, 0 to 2 percent slopes,	Yes		1146	**1,146**
B/D	3076A	Otter silt loam, 0 to 2 percent slopes, frequently	Yes		31	**31**
B/D	3107A	Sawmill silty clay loam, 0 to 2 percent slopes,	Yes		19	**19**
D	31A	Pierron silt loam, 0 to 2 percent slopes	Yes		99	**99**
A	3304A	Landes fine sandy loam, 0 to 2 percent slopes,	No	429		**429**
B/D	3333A	Wakeland silt loam, 0 to 2 percent slopes, frequently	No	4,451		**4,451**
C/D	3334A	Birds silt loam, 0 to 2 percent slopes, frequently	Yes		3351	**3,351**
B/D	3336A	Wilbur silt loam, 0 to 2 percent slopes, frequently	No	49		**49**
C	3415A	Orion silt loam, 0 to 2 percent slopes, frequently	No	2,588		**2,588**
B/D	3428A	Coffeen silt loam, 0 to 2 percent slopes, frequently	No	1,779		**1,779**
B/D	3451A	Lawson silt loam, 0 to 2 percent slopes, frequently	No	3,192		**3,192**
B	35F	Bold silt loam, 18 to 35 percent slopes	No	65		**65**
B/D	384A	Edwardsville silt loam, 0 to 2 percent slopes	No	2,837		**2,837**
B/D	385A	Mascoutah silty clay loam, 0 to 2 percent slopes	Yes		1154	**1,154**
C	438B	Aviston silt loam, 2 to 5 percent slopes	No	26		**26**
B	441B	Wakenda silt loam, 2 to 5 percent slopes	No	172		**172**
B	441C2	Wakenda silt loam, 5 to 10 percent slopes, eroded	No	27		**27**
C/D	46A	Herrick silt loam, 0 to 2 percent slopes	No	1,126		**1,126**
C/D	470B	Piasa silt loam, 0 to 2 percent slopes	No	166		**166**
D	474A	Winfield silt loam, 2 to 5 percent slopes	Yes		32	**32**
C	477B	Winfield silt loam, 2 to 5 percent slopes	No	4,645		**4,645**
C	477B3	Winfield silty clay loam, 2 to 5 percent slopes,	No	65		**65**

Hydrologic Soil Group	Map Symbol Code	Soil Type (SSURGO map unit name)	Hydric Soil?	Non-Hydric Soils area (acres)	Hydric Soils area (acres)	Total area (acres)
C	477C2	Winfield silt loam, 5 to 10 percent slopes, eroded	No	608		**608**
C	477C3	Winfield silty clay loam, 5 to 10 percent slopes,	No	1,912		**1,912**
C	477D3	Winfield silty clay loam, 10 to 18 percent slopes,	No	1,509		**1,509**
B	491B	Ruma silt loam, 2 to 5 percent slopes	No	104		**104**
B	491C2	Ruma silt loam, 5 to 10 percent slopes, eroded	No	112		**112**
B	491D2	Ruma silt loam, 10 to 18 percent slopes, eroded	No	70		**70**
B	491D3	Ruma silty clay loam, 10 to 18 percent slopes,	No	10		**10**
C/D	50A	Virden silt loam, 0 to 2 percent slopes	Yes		738	**738**
C/D	515B3	Bunkum silty clay loam, 2 to 5 percent slopes,	No	1,049		**1,049**
C/D	515C3	Bunkum silty clay loam, 5 to 10 percent slopes,	No	1,826		**1,826**
C/D	515D3	Bunkum silty clay loam, 10 to 18 percent slopes,	No	658		**658**
C/D	517A	Marine silt loam, 0 to 2 percent slopes	No	7,232		**7,232**
C/D	517B	Marine silt loam, 2 to 5 percent slopes	No	5,284		**5,284**
B	570D2	Martinsville sandy loam, 10 to 18 percent slopes,	No	3		**3**
D	581B2	Tamalco silt loam, 2 to 5 percent slopes, eroded	No	6		**6**
C	582B	Homen silt loam, 2 to 5 percent slopes	No	5,923		**5,923**
C	582C2	Homen silt loam, 5 to 10 percent slopes, eroded	No	570		**570**
B	585F	Negley loam, 18 to 35 percent slopes	No	26		**26**
B	587B	Terril loam, 2 to 5 percent slopes	No	12		**12**
B	630D3	Navlys silty clay loam, 10 to 18 percent slopes,	No	26		**26**
C/D	657A	Burksville silt loam, 0 to 2 percent slopes	Yes		139	**139**
C/D	6B2	Fishhook silt loam, 2 to 5 percent slopes, eroded	No	897		**897**
C/D	6C2	Fishhook silt loam, 5 to 10 percent slopes, eroded	No	278		**278**

Hydrologic Soil Group	Map Symbol Code	Soil Type (SSURGO map unit name)	Hydric Soil?	Non-Hydric Soils area (acres)	Hydric Soils area (acres)	Total area (acres)
B	701F	Menfro-Hickory silt loams, 18 to 35 percent slopes	No	1,465		**1,465**
B	702F	Ruma-Hickory silt loams, 18 to 35 percent slopes	No	1,136		**1,136**
B/D	7037B	Worthen silt loam, 2 to 5 percent slopes, rarely	No	4		**4**
D	703A	Pierron-Burksville silt loams, 0 to 2 percent	Yes		459	**459**
A	7053B	Bloomfield loamy fine sand, 2 to 5 percent	No	69		**69**
B/D	7075B	Drury silt loam, 2 to 5 percent slopes, rarely	Yes		39	**39**
C/D	7081A	Littleton silt loam, 0 to 2 percent slopes, rarely	Yes		13	**13**
C/D	7122B	Colp silt loam, 2 to 5 percent slopes, rarely	No	105		**105**
C/D	7122C	Colp silty clay loam, 5 to 10 percent slopes,	No	132		**132**
A	7150A	Onarga sandy loam, 0 to 2 percent slopes, rarely	No	58		**58**
A/D	7151A	Ridgeville fine sandy loam, 0 to 2 percent slopes,	No	26		**26**
D	7338A	Hurst silty clay loam, 0 to 2 percent slopes, rarely	No	92		**92**
B	7430A	Raddle silt loam, 0 to 2 percent slopes, rarely	No	24		**24**
C/D	7432A	Geff silt loam, 0 to 2 percent slopes, rarely	No	310		**310**
B	7434B	Ridgway silt loam, 2 to 5 percent slopes, rarely	No	282		**282**
C	7445A	Newhaven loam, 0 to 2 percent slopes, rarely	No	88		**88**
A	7741B	Oakville fine sand, 2 to 5 percent slopes, rarely	No	16		**16**
A	7741C	Oakville fine sand, 5 to 10 percent slopes, rarely	No	72		**72**
B	79B	Menfro silt loam, 2 to 5 percent slopes	No	952		**952**
B	79C2	Menfro silt loam, 5 to 10 percent slopes, eroded	No	484		**484**
B	79C3	Menfro silty clay loam, 5 to 10 percent slopes,	No	3		**3**
B	79D2	Menfro silt loam, 10 to 18 percent slopes, eroded	No	1,138		**1,138**
B	79D3	Menfro silty clay loam, 10 to 18 percent slopes,	No	365		**365**

Hydrologic Soil Group	Map Symbol Code	Soil Type (SSURGO map unit name)	Hydric Soil?	Non-Hydric Soils area (acres)	Hydric Soils area (acres)	Total area (acres)
B	79F	Menfro silt loam, 18 to 35 percent slopes	No	1,877		**1,877**
B	801B	Orthents, silty, undulating	No	242		**242**
C	801D	Orthents, silty, hilly	No	309		**309**
C	802B	Orthents, loamy, undulating	No	141		**141**
C	802D	Orthents, loamy, hilly	No	70		**70**
C	802E	Orthents, loamy, hilly	No	9		**9**
B/D	8070A	Beaucoup silty clay loam, 0 to 2 percent slopes,	Yes		262	**262**
D	8071L	Darwin silty clay, 0 to 2 percent slopes,	Yes		1,220	**1,220**
B	8078A	Arenzville silt loam, 0 to 2 percent slopes,	No	13		**13**
B/D	8284A	Tice silty clay loam, 0 to 2 percent slopes,	No	587		**587**
C/D	8302A	Ambraw silty clay loam, 0 to 2 percent slopes,	Yes		163	**163**
A	8304B	Landes very fine sandy loam, 2 to 5 percent	No	7		**7**
D	8591A	Fults silty clay, 0 to 2 percent slopes,	Yes		13	**13**
C/D	878C3	Coulterville-Grantfork silty clay loams, 5 to 10 percent	No	470		**470**
C/D	880B2	Coulterville-Darmstadt silt loams, 2 to 5 percent	No	538		**538**
C/D	882B	Oconee-Coulterville-Darmstadt silt loams, 2 to	No	409		**409**
C/D	885A	Virden-Fosterburg silt loams, 0 to 2 percent	Yes		1,681	**1,681**
C/D	894A	Herrick-Biddle-Piasa silt loams, 0 to 2 percent	No	5,665		**5,665**
C/D	897C2	Bunkum-Atlas silt loams, 5 to 10 percent slopes,	No	2,239		**2,239**
C/D	897C3	Bunkum-Atlas silty clay loams, 5 to 10 percent	No	120		**120**
C/D	897D2	Bunkum-Atlas silt loams, 10 to 18 percent slopes,	No	795		**795**
C/D	897D3	Bunkum-Atlas silty clay loams, 10 to 18 percent	No	531		**531**
B	8D2	Hickory silt loam, 10 to 18 percent slopes, eroded	No	1,175		**1,175**

Hydrologic Soil Group	Map Symbol Code	Soil Type (SSURGO map unit name)	Hydric Soil?	Non-Hydric Soils area (acres)	Hydric Soils area (acres)	Total area (acres)
B	8D3	Hickory clay loam, 10 to 18 percent slopes, severely	No	2,142		**2,142**
B	8F	Hickory silt loam, 18 to 35 percent slopes	No	10,514		**10,514**
B	8F2	Hickory silt loam, 18 to 35 percent slopes, eroded	No	1,940		**1,940**
B	8G	Hickory silt loam, 35 to 60 percent slopes	No	147		**147**
B/D	90A	Bethalto silt loam, 0 to 2 percent slopes	No	1,182		**1,182**
D	914C3	Atlas-Grantfork silty clay loams, 5 to 10 percent	No	250		**250**
D	914D3	Atlas-Grantfork silty clay loams, 10 to 18 percent	No	208		**208**
C/D	9279B	Rozetta silt loam, terrace, 0 to 2 percent slopes	Yes		24	**24**
B	962D2	Sylvan-Bold silt loams, 10 to 18 percent slopes,	No	195		**195**
B	962F2	Sylvan-Bold silt loams, 18 to 35 percent slopes,	No	357		**357**
B	967F	Hickory-Gosport silt loams, 18 to 35 percent slopes	No	14		**14**
C/D	993A	Cowden-Piasa silt loams, 0 to 2 percent slopes	Yes		7,486	**7,486**
	M-W	Miscellaneous water		73		**73**
	W	Water		1,567		**1,567**
	Total			**101,408**	**20,865**	**122,274**

Hydric soils by HUC14

Table A.72: Hydric and non-hydric soil areas by HUC14 in the Indian-Cahokia Creek watershed.

HUC14	Area of Non-Hydric Soils (acres)	Area of Hydric Soils (acres)	Total area (acres)
07140101020101	3,151	1,729	**4,880**
07140101020102	1,376	1,152	**2,528**
07140101020103	3,672	542	**4,214**
07140101020201	3,152	1,440	**4,592**
07140101020202	3,281	1,580	**4,861**
07140101020203	4,156	1,172	**5,328**
07140101020301	4,402	746	**5,148**
07140101020302	6,722	353	**7,075**
07140101020303	3,635	306	**3,941**
07140101020401	6,659	1,191	**7,850**
07140101020402	4,440	1,306	**5,746**
07140101020403	2,501	470	**2,971**
07140101020404	6,106	545	**6,651**
07140101020501	2,604	442	**3,046**
07140101020502	2,549	1,102	**3,651**
07140101020503	2,198	1,229	**3,427**
07140101020504	7,121	712	**7,833**
07140101020601	4,717	411	**5,128**
07140101020602	5,251	119	**5,370**
07140101020603	4,041	157	**4,198**
07140101020604	4,908	762	**5,670**
07140101020605	4,524	403	**4,927**
07140101020701	3,611	889	**4,500**
07140101020702	5,047	144	**5,191**
07140101020703	1,599	1,968	**3,567**
Total	**101,423**	**20,870**	**122,293**

Table A.73: Hydric and non-hydric soil areas by HUC14 in the Indian-Cahokia Creek watershed.

HUC14	Area of Non-Hydric Soils (acres)	Area of Hydric Soils (acres)	Total area (acres)
07140101030101	5,696	7,829	**13,525**
07140101030102	4,573	9,122	**13,695**
07140101030103	6,924	720	**7,644**
07140101030104	6,805	4,122	**10,927**
07140101030201	8,018	1,144	**9,162**
07140101030202	12,139	170	**12,309**
07140101030203	27,635	33	**27,668**
07140101030301	13,686	3,218	**16,904**
07140101030302	15,963	5,007	**20,970**
07140101030303	8,726	1,689	**10,415**
Total	**110,165**	**33,054**	**143,219**

Highly erodible soils by HUC14

Table A.74: Area of highly erodible and non-highly erodible soils by HUC14 in the Indian-Cahokia Creek watershed.

HUC14	Highly erodible soils (acres)	Not highly erodible soils (acres)	Unclassified	Total area (acres)
07140101020101	6,415	1,208	487	**8,110**
07140101020102	3,556	542	97	**4,195**
07140101020103	5,486	1,455	43	**6,984**
07140101020201	6,344	1,138	132	**7,614**
07140101020202	7,045	1,190	82	**8,317**
07140101020203	8,487	1,168	52	**9,707**
07140101020301	6,621	1,894	31	**8,546**
07140101020302	8,832	2,738	128	**11,698**
07140101020303	3,796	2,211	516	**6523**
07140101020401	9,881	3,077	64	**13,022**
07140101020402	7,661	1,807	62	**9,530**
07140101020403	4,980	753	75	**5,808**
07140101020404	8,236	3,139	81	**11,456**
07140101020501	4,279	1,238	77	**5,594**
07140101020502	5,236	836	49	**6,121**
07140101020503	4,668	920	79	**5,667**
07140101020504	10,610	2,515	336	**13,461**
07140101020601	5,156	3,234	128	**8,518**
07140101020602	5,847	3,265	59	**9,171**
07140101020603	5,496	2,012	37	**7,545**

HUC14	Highly erodible soils (acres)	Not highly erodible soils (acres)	Unclassified	Total area (acres)
07140101020604	7,097	2,272	46	**9,415**
07140101020605	6,150	2,199	52	**8,401**
07140101020701	6,233	1,102	112	**7,447**
07140101020702	6,789	1,556	438	**8,783**
07140101020703	6,151	63	157	**6,371**
Total	**161,052**	**43,532**	**3,420**	208,004

Land use/land cover by HUC14

Table A.75: Land use/land cover in the uppermost HUC14s of the Indian-Cahokia Creek watershed.

HUC14		7140101020101	7140101020102	7140101020103	7140101020201	7140101020202	7140101020203	7140101020301	7140101020303	7140101020401	7140101020402	7140101020403	7140101020404
Barren Land	Acres	0	0	0	0	0	0	0	0	0	0	0	0
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Cultivated crop	Acres	3073	1543	1188	977	71	2213	3020	44	3633	2806	54	108
	%	62%	61%	28%	21%	10%	38%	59%	7%	46%	49%	9%	14%
Deciduous forest	Acres	1095	583	2055	1708	75	2316	790	107	2508	1635	59	101
	%	22%	23%	49%	37%	11%	40%	15%	16%	32%	28%	10%	13%
Developed, High Intensity	Acres	1	0	1	49	10	1	14	8	2	1	4	3
	%	0%	0%	0%	1%	1%	0%	0%	1%	0%	0%	1%	0%
Developed, Low Intensity	Acres	87	107	46	657	134	76	272	225	149	82	153	162
	%	2%	4%	1%	14%	19%	1%	5%	33%	2%	1%	25%	21%
Developed, Medium Intensity	Acres	13	8	6	128	75	8	38	54	12	11	31	39
	%	0%	0%	0%	3%	11%	0%	1%	8%	0%	0%	5%	5%
Developed, Open Space	Acres	291	162	148	515	254	232	514	189	474	199	255	232
	%	6%	6%	4%	11%	36%	4%	10%	28%	6%	3%	41%	31%
Emergent herbaceuous wetlands	Acres	0	0	0	1	0	0	0	0	0	1	0	1
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Evergreen forest	Acres	0	0	0	2	0	0	0	0	0	2	0	0
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Hay/Pasture	Acres	301	108	751	469	70	977	481	31	1016	986	35	82
	%	6%	4%	18%	10%	10%	17%	9%	5%	13%	17%	6%	11%
Herbaceous	Acres	0	0	7	27	8	20	0	0	37	0	14	9
	%	0%	0%	0%	1%	1%	0%	0%	0%	0%	0%	2%	1%
Mixed forest	Acres	0	0	0	0	0	0	0	0	0	0	0	0
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Open Water	Acres	16	10	10	56	13	17	15	16	16	22	12	21
	%	0%	0%	0%	1%	2%	0%	0%	2%	0%	0%	2%	3%
Shrub/Scrub	Acres	0	0	0	0	0	0	0	0	0	0	0	0
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Woody wetlands	Acres	87	1	1	0	0	0	1	0	0	0	0	0
	%	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total Area (Acres)		**4964**	**2522**	**4213**	**4589**	**710**	**5860**	**5145**	**674**	**7847**	**5745**	**617**	**758**

Table A.76: Land use/land cover in the lowermost HUC14s of the Indian-Cahokia Creek watershed ("Grand Total" column includes land use in the uppermost HUC14s).

HUC14		7140101020501	7140101020502	7140101020503	7140101020504	7140101020601	7140101020602	7140101020603	7140101020604	7140101020605	7140101020701	7140101020702	7140101020703	Grand Total
Barren Land	Acres	0	0	0	0	2	0	0	0	9	0	1	0	12
	%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%
Cultivated crop	Acres	139	1920	165	243	246	211	34	405	75	51	443	1619	3698
	%	41%	52%	48%	30%	48%	38%	4%	71	7%	5%	8%	42%	41%
Deciduous forest	Acres	836	909	709	145	762	137	82	459	145	99	1862	96	2182
	%	25%	25%	21%	18%	15%	25%	9%	8%	13%	11%	35%	2%	24%
Developed, High Intensity	Acres	1	2	3	127	13	7	35	7	25	18	176	220	728
	%	0%	0%	0%	2%	0%	0%	4%	0%	2%	2%	3%	6%	1%
Developed, Low Intensity	Acres	93	110	171	142	303	169	244	177	263	241	1073	553	6969
	%	3%	3%	5%	17%	6%	3%	26%	3%	24%	26%	20%	14%	8%
Developed, Medium Intensity	Acres	9	12	9	449	47	32	169	57	100	143	503	325	2278
	%	0%	0%	0%	6%	1%	1%	18%	1%	9%	15%	9%	8%	3%
Developed, Open Space	Acres	104	184	294	965	398	217	314	394	338	323	932	553	8481
	%	3%	5%	9%	12%	8%	4%	34%	7%	31%	34%	18%	14%	9%
Emergent herbaceuous wetlands	Acres	1	0	0	3	0	1	0	2	5	5	7	7	34
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%
Evergreen forest	Acres	0	0	1	0	2	0	0	0	0	0	0	0	7
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Hay/Pasture	Acres	911	550	565	111	105	158	35	519	78	52	177	107	1205
	%	27%	15%	16%	14%	21%	29%	4%	9%	7%	6%	3%	3%	13%
Herbaceous	Acres	7	3	3	39	7	10	2	0	2	1	1	0	197
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mixed forest	Acres	0	0	0	0	0	0	0	0	0	0	0	0	0
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Open Water	Acres	33	17	19	151	80	24	6	25	2	8	96	85	770
	%	1%	0%	1%	2%	2%	0%	1%	0%	0%	1%	2%	2%	1%
Shrub/Scrub	Acres	0	0	0	0	0	0	0	0	0	0	0	0	0
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Woody wetlands	Acres	0	0	0	0	0	0	8	7	64	0	49	283	501
	%	0%	0%	0%	0%	0%	0%	1%	0%	6%	0%	1%	7%	1%
Total Area		**338**	**3707**	**343**	**816**	**513**	**553**	**929**	**569**	**1106**	**941**	**5320**	**3848**	**9084**

Future land use/land cover by HUC14

Table A.77: Existing and predicted future land use/land cover by HUC14 in the Indian-Cahokia Creek watershed. Predicted land use/land cover is based on zoning identified in the Comprehensive Plans of municipalities in the watershed for the 1.5-mile zone outside their current boundaries.

Land Use/Land Cover Description	Land Use Code	Current Area (Acres)	Current Area (%)	Predicted Area (acres)	Predicted area (%)	Change (acres)	Percent Change
07140101020101		**11701**	**100%**	**11701**	**100%**	**0.0**	
Barren Land	31	0	0%	0	0%	0	0%
Cultivated crop	82	7931	68%	149	1%	-7782	-98%
Deciduous forest	41	2869	25%	115	1%	-2754	-96%
Developed, High	24	1	0%	22	0%	21	2095%
Developed, Low	22	154	1%	3381	29%	3227	2095%
Developed, Medium	23	15	0%	329	3%	314	2095%
Developed, Open	21	351	3%	7705	66%	7354	2095%
Emergent herbaceous wetlands	95	0	0%	0	0%	0	0%
Evergreen forest	42	0	0%	0	0%	0	0%
Hay/Pasture	81	364	3%	0	0%	-364	-100%
Herbaceous	71	0	0%	0	0%	0	0%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	16	0%	0	0%	-16	-100%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	0	0%	0	0%	0	0%
07140101020102		**5503**	**100%**	**5503**	**100%**	**0.0**	
Barren Land	31	0.0	0%	0.0	0%	0.0	0%
Cultivated crop	82	2474.2	47%	1053.6	20%	-	-57%
Deciduous forest	41	1670.6	32%	771.9	15%	-898.7	-54%
Developed, High	24	0.0	0%	0.0	0%	0.0	0%
Developed, Low	22	58.7	1%	1921.0	36%	1862.3	3173%
Developed, Medium	23	12.0	0%	953.1	18%	941.1	7840%
Developed, Open	21	276.3	5%	117.7	2%	-158.7	-57%
Emergent herbaceous wetlands	95	0.0	0%	0.0	0%	0.0	0%
Evergreen forest	42	0.0	0%	0.0	0%	0.0	0%
Hay/Pasture	81	713.6	14%	394.6	7%	-319.0	-45%
Herbaceous	71	42.9	1%	18.3	0%	-24.6	-57%
Mixed forest	43	0.0	0%	0.0	0%	0.0	0%
Open Water	11	20.0	0%	23.6	0%	3.6	18%
Shrub/Scrub	52	0.0	0%	0.0	0%	0.0	0%
Wood wetlands	90	1.1	0%	15.6	0%	14.5	1304%
07140101020103		**25256**	**100%**	**25256**	**100%**	**0**	
Barren Land	31	0	0%	0	0%	0	0%
Cultivated crop	82	6176	24%	3841	15%	-2335	-38%

Land Use/Land Cover Description	Land Use Code	Current Area (Acres)	Current Area (%)	Predicted Area (acres)	Predicted area (%)	Change (acres)	Percent Change
Deciduous forest	41	16185	64%	12723	50%	-3462	-21%
Developed, High	24	1	0%	15	0%	14	1350%
Developed, Low	22	101	0%	1465	6%	1364	1350%
Developed, Medium	23	7	0%	102	0%	95	1350%
Developed, Open	21	321	1%	4655	18%	4334	1350%
Emergent herbaceous wetlands	95	0	0%	0	0%	0	0%
Evergreen forest	42	0	0%	0	0%	0	0%
Hay/Pasture	81	2447	10%	2439	10%	-8	0%
Herbaceous	71	7	0%	7	0%	0	0%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	10	0%	10	0%	0	0%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	1	0%	1	0%	0	0%
07140101020201		**8344**	**100%**	**8344**	**100%**	**0**	
Barren Land	31	0	0%	0	0%	0	0%
Cultivated crop	82	1795	22%	852	10%	-943	-53%
Deciduous forest	41	4268	51%	2954	35%	-1314	-31%
Developed, High	24	51	1%	139	2%	88	172%
Developed, Low	22	861	10%	2344	28%	1483	172%
Developed, Medium	23	134	2%	365	4%	231	172%
Developed, Open	21	552	7%	1503	18%	951	172%
Emergent herbaceous wetlands	95	1	0%	0	0%	-1	-100%
Evergreen forest	42	2	0%	2	0%	0	0%
Hay/Pasture	81	596	7%	186	2%	-410	-69%
Herbaceous	71	28	0%	0	0%	-28	-100%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	56	1%	0	0%	-56	-100%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	0	0%	0	0%	0	0%
07140101020202		**10881**	**100%**	**10881**	**100%**	**0**	
Barren Land	31	0	0%	0	0%	0	0%
Cultivated crop	82	3021	28%	2049	19%	-972	-32%
Deciduous forest	41	4933	45%	4049	37%	-884	-18%
Developed, High	24	8	0%	20	0%	12	149%
Developed, Low	22	897	8%	2233	21%	1336	149%
Developed, Medium	23	47	0%	117	1%	70	149%

Land Use/Land Cover Description	Land Use Code	Current Area (Acres)	Current Area (%)	Predicted Area (acres)	Predicted area (%)	Change (acres)	Percent Change
Developed, Open	21	520	5%	1295	12%	775	149%
Emergent herbaceous wetlands	95	0	0%	0	0%	0	0%
Evergreen forest	42	0	0%	0	0%	0	0%
Hay/Pasture	81	1389	13%	1072	10%	-317	-23%
Herbaceous	71	33	0%	13	0%	-20	-61%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	33	0%	33	0%	0	0%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	0	0%	0	0%	0	0%
07140101020203		**8344**	**100%**	**8344**	**100%**	**0**	
Barren Land	31	0	0%	0	0%	0	0%
Cultivated crop	82	4089	22%	3000	16%	-1089	-27%
Deciduous forest	41	12392	66%	8998	48%	-3394	-27%
Developed, High	24	1	0%	11	0%	10	968%
Developed, Low	22	150	1%	1602	9%	1452	968%
Developed, Medium	23	9	0%	96	1%	87	968%
Developed, Open	21	375	2%	4005	21%	3630	968%
Emergent herbaceous wetlands	95	0	0%	0	0%	0	0%
Evergreen forest	42	0	0%	0	0%	0	0%
Hay/Pasture	81	1612	9%	941	5%	-671	-42%
Herbaceous	71	20	0%	6	0%	-14	-70%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	17	0%	6	0%	-11	-65%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	0	0%	0	0%	0	0%
07140101020301		**10573**	**100%**	**10573**	**100%**	**0**	
Barren Land	31	3	0%	0	0%	-3	-100%
Cultivated crop	82	7708	73%	1263	12%	-6445	-84%
Deciduous forest	41	792	7%	1	0%	-791	-100%
Developed, High	24	21	0%	134	1%	113	537%
Developed, Low	22	642	6%	4088	39%	3446	537%
Developed, Medium	23	50	0%	318	3%	268	537%
Developed, Open	21	745	7%	4744	45%	3999	537%
Emergent herbaceous wetlands	95	0	0%	0	0%	0	0%

Land Use/Land Cover Description	Land Use Code	Current Area (Acres)	Current Area (%)	Predicted Area (acres)	Predicted area (%)	Change (acres)	Percent Change
Evergreen forest	42	0	0%	0	0%	0	0%
Hay/Pasture	81	596	6%	25	0%	-571	-96%
Herbaceous	71	0	0%	0	0%	0	0%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	15	0%	0	0%	-15	-100%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	1	0%	0	0%	-1	-100%
07140101020302		**20487**	**100%**	**20487**	**100%**	**0**	
Barren Land	31	0	0%	0	0%	0	0%
Cultivated crop	82	10628	52%	9958	49%	-670	-6%
Deciduous forest	41	5100	25%	4750	23%	-350	-7%
Developed, High	24	4	0%	8	0%	4	107%
Developed, Low	22	568	3%	1173	6%	605	107%
Developed, Medium	23	42	0%	87	0%	45	107%
Developed, Open	21	585	3%	1209	6%	624	107%
Emergent herbaceous wetlands	95	0	0%	0	0%	0	0%
Evergreen forest	42	1	0%	1	0%	0	0%
Hay/Pasture	81	3513	17%	3272	16%	-241	-7%
Herbaceous	71	3	0%	3	0%	0	0%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	43	0%	26	0%	-17	-40%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	0	0%	0	0%	0	0%
07140101020303		**7348**	**100%**	**7348**	**100%**	**0**	
Barren Land	31	0	0%	0	0%	0	0%
Cultivated crop	82	3710	50%	3710	50%	0	0%
Deciduous forest	41	820	11%	820	11%	0	0%
Developed, High	24	3	0%	3	0%	0	0%
Developed, Low	22	528	7%	528	7%	0	0%
Developed, Medium	23	22	0%	22	0%	0	0%
Developed, Open	21	591	8%	591	8%	0	0%
Emergent herbaceous wetlands	95	0	0%	0	0%	0	0%
Evergreen forest	42	0	0%	0	0%	0	0%
Hay/Pasture	81	1387	19%	1387	19%	0	0%
Herbaceous	71	0	0%	0	0%	0	0%
Mixed forest	43	0	0%	0	0%	0	0%

Land Use/Land Cover Description	Land Use Code	Current Area (Acres)	Current Area (%)	Predicted Area (acres)	Predicted area (%)	Change (acres)	Percent Change
Open Water	11	287	4%	287	4%	0	0%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	0	0%	0	0%	0	0%
07140101020401		**16766**	**100%**	**16766**	**100%**	**0**	
Barren Land	31	0	0%	0	0%	0	0%
Cultivated crop	82	9614	57%	3833	23%	-5781	-60%
Deciduous forest	41	4460	27%	4314	26%	-146	-3%
Developed, High	24	2	0%	17	0%	15	757%
Developed, Low	22	195	1%	1670	10%	1475	757%
Developed, Medium	23	12	0%	103	1%	91	757%
Developed, Open	21	597	4%	5114	31%	4517	757%
Emergent herbaceous wetlands	95	0	0%	0	0%	0	0%
Evergreen forest	42	0	0%	0	0%	0	0%
Hay/Pasture	81	1833	11%	1666	10%	-167	-9%
Herbaceous	71	37	0%	37	0%	0	0%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	16	0%	12	0%	-4	-25%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	0	0%	0	0%	0	0%
07140101020402		**13457**	**100%**	**13457**	**100%**	**0**	
Barren Land	31	0	0%	0	0%	0	0%
Cultivated crop	82	8954	67%	4385	33%	-4569	-51%
Deciduous forest	41	2052	15%	1969	15%	-83	-4%
Developed, High	24	1	0%	10	0%	9	924%
Developed, Low	22	178	1%	1822	14%	1644	924%
Developed, Medium	23	11	0%	113	1%	102	924%
Developed, Open	21	333	2%	3409	25%	3076	924%
Emergent herbaceous wetlands	95	1	0%	1	0%	0	0%
Evergreen forest	42	2	0%	1	0%	-1	-50%
Hay/Pasture	81	1903	14%	1725	13%	-178	-9%
Herbaceous	71	0	0%	0	0%	0	0%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	22	0%	22	0%	0	0%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	0	0%	0	0%	0	0%
07140101020403		**10902**	**100%**	**10902**	**100%**	**0**	

Land Use/Land Cover Description	Land Use Code	Current Area (Acres)	Current Area (%)	Predicted Area (acres)	Predicted area (%)	Change (acres)	Percent Change
Barren Land	31	0	0%	0	0%	0	0%
Cultivated crop	82	3040	28%	1064	10%	-1976	-65%
Deciduous forest	41	6508	60%	3271	30%	-3237	-50%
Developed, High	24	2	0%	19	0%	17	861%
Developed, Low	22	289	3%	2778	25%	2489	861%
Developed, Medium	23	20	0%	192	2%	172	861%
Developed, Open	21	351	3%	3374	31%	3023	861%
Emergent herbaceous wetlands	95	0	0%	0	0%	0	0%
Evergreen forest	42	0	0%	0	0%	0	0%
Hay/Pasture	81	625	6%	182	2%	-443	-71%
Herbaceous	71	29	0%	16	0%	-13	-45%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	38	0%	6	0%	-32	-84%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	0	0%	0	0%	0	0%
07140101020404		**16953**	**100%**	**16953**	**100%**	**0**	
Barren Land	31	0	0%	0	0%	0	0%
Cultivated crop	82	9132	54%	8146	48%	-986	-11%
Deciduous forest	41	4372	26%	4372	26%	0	0%
Developed, High	24	2	0%	5	0%	3	129%
Developed, Low	22	302	2%	691	4%	389	129%
Developed, Medium	23	16	0%	37	0%	21	129%
Developed, Open	21	471	3%	1077	6%	606	129%
Emergent herbaceous wetlands	95	2	0%	2	0%	0	0%
Evergreen forest	42	0	0%	0	0%	0	0%
Hay/Pasture	81	2570	15%	2538	15%	-32	-1%
Herbaceous	71	34	0%	34	0%	0	0%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	52	0%	52	0%	0	0%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	0	0%	0	0%	0	0%
07140101020501		**10990**	**100%**	**10990**	**100%**	**0**	
Barren Land	31	0	0%	0	0%	0	0%
Cultivated crop	82	6902	63%	6180	56%	-722	-10%
Deciduous forest	41	2149	20%	2148	20%	-1	0%
Developed, High	24	1	0%	4	0%	3	284%

Land Use/Land Cover Description	Land Use Code	Current Area (Acres)	Current Area (%)	Predicted Area (acres)	Predicted area (%)	Change (acres)	Percent Change
Developed, Low	22	115	1%	442	4%	327	284%
Developed, Medium	23	10	0%	38	0%	28	284%
Developed, Open	21	154	1%	591	5%	437	284%
Emergent herbaceous wetlands	95	1	0%	1	0%	0	0%
Evergreen forest	42	0	0%	0	0%	0	0%
Hay/Pasture	81	1618	15%	1547	14%	-71	-4%
Herbaceous	71	7	0%	7	0%	0	0%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	33	0%	32	0%	-1	-3%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	0	0%	0	0%	0	0%
07140101020502		**7933**	**100%**	**7933**	**100%**	**0**	
Barren Land	31	0	0%	0	0%	0	0%
Cultivated crop	82	1417	18%	1364	17%	-53	-4%
Deciduous forest	41	1931	24%	1931	24%	0	0%
Developed, High	24	4	0%	4	0%	0	8%
Developed, Low	22	300	4%	323	4%	23	8%
Developed, Medium	23	15	0%	16	0%	1	8%
Developed, Open	21	365	5%	393	5%	28	8%
Emergent herbaceous wetlands	95	0	0%	0	0%	0	0%
Evergreen forest	42	0	0%	0	0%	0	0%
Hay/Pasture	81	3879	49%	3879	49%	0	0%
Herbaceous	71	3	0%	3	0%	0	0%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	19	0%	19	0%	0	0%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	0	0%	0	0%	0	0%
07140101020503		**6440**	**100%**	**6440**	**100%**	**0**	
Barren Land	31	0	0%	0	0%	0	0%
Cultivated crop	82	3148	49%	2380	37%	-768	-24%
Deciduous forest	41	1764	27%	919	14%	-845	-48%
Developed, High	24	4	0%	14	0%	10	248%
Developed, Low	22	351	5%	1220	19%	869	248%
Developed, Medium	23	17	0%	59	1%	42	248%
Developed, Open	21	356	6%	1237	19%	881	248%

Land Use/Land Cover Description	Land Use Code	Current Area (Acres)	Current Area (%)	Predicted Area (acres)	Predicted area (%)	Change (acres)	Percent Change
Emergent herbaceous wetlands	95	0	0%	0	0%	0	0%
Evergreen forest	42	1	0%	0	0%	-1	-100%
Hay/Pasture	81	777	12%	590	9%	-187	-24%
Herbaceous	71	3	0%	3	0%	0	0%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	19	0%	18	0%	-1	-5%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	0	0%	0	0%	0	0%
07140101020504		**13190**	**100%**	**13190**	**100%**	**0**	
Barren Land	31	0	0%	0	0%	0	0%
Cultivated crop	82	4528	34%	1530	12%	-2998	-66%
Deciduous forest	41	2840	22%	174	1%	-2666	-94%
Developed, High	24	176	1%	456	3%	280	159%
Developed, Low	22	2585	20%	6694	51%	4109	159%
Developed, Medium	23	639	5%	1655	13%	1016	159%
Developed, Open	21	1014	8%	2626	20%	1612	159%
Emergent herbaceous wetlands	95	3	0%	0	0%	-3	-100%
Evergreen forest	42	0	0%	0	0%	0	0%
Hay/Pasture	81	1215	9%	55	0%	-1160	-95%
Herbaceous	71	39	0%	0	0%	-39	-100%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	151	1%	0	0%	-151	-100%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	0	0%	0	0%	0	0%
07140101020601		**8461**	**100%**	**8461**	**100%**	**0**	
Barren Land	31	3	0%	0	0%	-3	-100%
Cultivated crop	82	4568	54%	1629	19%	-2939	-64%
Deciduous forest	41	974	12%	620	7%	-354	-36%
Developed, High	24	18	0%	61	1%	43	241%
Developed, Low	22	861	10%	2938	35%	2077	241%
Developed, Medium	23	68	1%	232	3%	164	241%
Developed, Open	21	740	9%	2525	30%	1785	241%
Emergent herbaceous wetlands	95	0	0%	0	0%	0	0%
Evergreen forest	42	2	0%	0	0%	-2	-100%

Land Use/Land Cover Description	Land Use Code	Current Area (Acres)	Current Area (%)	Predicted Area (acres)	Predicted area (%)	Change (acres)	Percent Change
Hay/Pasture	81	1141	13%	407	5%	-734	-64%
Herbaceous	71	4	0%	-1	0%	-5	-125%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	82	1%	49	1%	-33	-40%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	0	0%	0	0%	0	0%
07140101020602		**9032**	**100%**	**9032**	**100%**	**0**	
Barren Land	31	0	0%	0	0%	0	0%
Cultivated crop	82	3977	44%	3744	41%	-233	-6%
Deciduous forest	41	1902	21%	1902	21%	0	0%
Developed, High	24	8	0%	12	0%	4	48%
Developed, Low	22	253	3%	375	4%	122	48%
Developed, Medium	23	34	0%	50	1%	16	48%
Developed, Open	21	290	3%	430	5%	140	48%
Emergent herbaceous wetlands	95	1	0%	1	0%	0	0%
Evergreen forest	42	0	0%	0	0%	0	0%
Hay/Pasture	81	2533	28%	2483	27%	-50	-2%
Herbaceous	71	10	0%	10	0%	0	0%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	24	0%	24	0%	0	0%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	0	0%	0	0%	0	0%
07140101020603		**10029**	**100%**	**10029**	**100%**	**0**	
Barren Land	31	0	0%	0	0%	0	0%
Cultivated crop	82	6287	63%	4349	43%	-1938	-31%
Deciduous forest	41	1526	15%	1207	12%	-319	-21%
Developed, High	24	30	0%	86	1%	56	186%
Developed, Low	22	620	6%	1776	18%	1156	186%
Developed, Medium	23	175	2%	501	5%	326	186%
Developed, Open	21	556	6%	1593	16%	1037	186%
Emergent herbaceous wetlands	95	0	0%	0	0%	0	0%
Evergreen forest	42	0	0%	0	0%	0	0%
Hay/Pasture	81	805	8%	506	5%	-299	-37%
Herbaceous	71	5	0%	5	0%	0	0%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	17	0%	6	0%	-11	-65%

Land Use/Land Cover Description	Land Use Code	Current Area (Acres)	Current Area (%)	Predicted Area (acres)	Predicted area (%)	Change (acres)	Percent Change
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	8	0%	0	0%	-8	-100%
07140101020604		**12178**	**100%**	**12178**	**100%**	**0**	
Barren Land	31	0	0%	0	0%	0	0%
Cultivated crop	82	10007	82%	6727	55%	-3280	-33%
Deciduous forest	41	548	4%	215	2%	-333	-61%
Developed, High	24	9	0%	52	0%	43	477%
Developed, Low	22	249	2%	1438	12%	1189	477%
Developed, Medium	23	65	1%	375	3%	310	477%
Developed, Open	21	497	4%	2869	24%	2372	477%
Emergent herbaceous wetlands	95	2	0%	0	0%	-2	-100%
Evergreen forest	42	0	0%	0	0%	0	0%
Hay/Pasture	81	768	6%	491	4%	-277	-36%
Herbaceous	71	0	0%	0	0%	0	0%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	25	0%	11	0%	-14	-56%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	8	0%	0	0%	-8	-100%
07140101020605		**9937**	**100%**	**9937**	**100%**	**0**	
Barren Land	31	29	0%	0	0%	-29	-100%
Cultivated crop	82	6580	66%	1273	13%	-5307	-81%
Deciduous forest	41	712	7%	34	0%	-678	-95%
Developed, High	24	10	0%	62	1%	52	521%
Developed, Low	22	346	3%	2150	22%	1804	521%
Developed, Medium	23	235	2%	1460	15%	1225	521%
Developed, Open	21	771	8%	4791	48%	4020	521%
Emergent herbaceous wetlands	95	2	0%	0	0%	-2	-100%
Evergreen forest	42	0	0%	0	0%	0	0%
Hay/Pasture	81	1021	10%	166	2%	-855	-84%
Herbaceous	71	3	0%	0	0%	-3	-100%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	8	0%	0	0%	-8	-100%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	220	2%	0	0%	-220	-100%
07140101020701		**21257**	**100%**	**21257**	**100%**	**0**	
Barren Land	31	0	0%	0	0%	0	0%

Land Use/Land Cover Description	Land Use Code	Current Area (Acres)	Current Area (%)	Predicted Area (acres)	Predicted area (%)	Change (acres)	Percent Change
Cultivated crop	82	14753	69%	12367	58%	-2386	-16%
Deciduous forest	41	2710	13%	526	2%	-2184	-81%
Developed, High	24	98	0%	264	1%	166	170%
Developed, Low	22	1873	9%	5049	24%	3176	170%
Developed, Medium	23	222	1%	598	3%	376	170%
Developed, Open	21	653	3%	1760	8%	1107	170%
Emergent herbaceous wetlands	95	3	0%	0	0%	-3	-100%
Evergreen forest	42	0	0%	0	0%	0	0%
Hay/Pasture	81	926	4%	682	3%	-244	-26%
Herbaceous	71	2	0%	2	0%	0	0%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	17	0%	8	0%	-9	-53%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	0	0%	0	0%	0	0%
07140101020702		**9225**	**100%**	**9225**	**100%**	**0**	
Barren Land	31	10	0%	0	0%	-10	-100%
Cultivated crop	82	1848	20%	0	0%	-1848	-100%
Deciduous forest	41	2474	27%	0	0%	-2474	-100%
Developed, High	24	253	3%	542	6%	289	114%
Developed, Low	22	2190	24%	4689	51%	2499	114%
Developed, Medium	23	730	8%	1563	17%	833	114%
Developed, Open	21	1136	12%	2432	26%	1296	114%
Emergent herbaceous wetlands	95	12	0%	0	0%	-12	-100%
Evergreen forest	42	0	0%	0	0%	0	0%
Hay/Pasture	81	347	4%	0	0%	-347	-100%
Herbaceous	71	1	0%	0	0%	-1	-100%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	96	1%	0	0%	-96	-100%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	128	1%	0	0%	-128	-100%
07140101020703		**5171**	**100%**	**5171**	**100%**	**0**	
Barren Land	31	5	0%	0	0%	-5	-100%
Cultivated crop	82	2761	53%	0	0%	-2761	-100%
Deciduous forest	41	127	2%	0	0%	-127	-100%
Developed, High	24	220	4%	650	13%	430	196%
Developed, Low	22	562	11%	1662	32%	1100	196%

Land Use/Land Cover Description	Land Use Code	Current Area (Acres)	Current Area (%)	Predicted Area (acres)	Predicted area (%)	Change (acres)	Percent Change
Developed, Medium	23	326	6%	964	19%	638	196%
Developed, Open	21	641	12%	1895	37%	1254	196%
Emergent herbaceous wetlands	95	7	0%	0	0%	-7	-100%
Evergreen forest	42	0	0%	0	0%	0	0%
Hay/Pasture	81	127	2%	0	0%	-127	-100%
Herbaceous	71	0	0%	0	0%	0	0%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	86	2%	0	0%	-86	-100%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	309	6%	0	0%	-309	-100%

Stream reach data

Table A.78: NHD stream reaches in the Indian-Cahokia Creek watershed with length in feet and the corresponding HUC14. Some reaches are present in more than one HUC14.

HUC14 & Reach Code	Length (ft)
07140101020101	**65291**
07140101000079	116
07140101000080	7155
07140101000082	4731
07140101000083	15320
07140101001905	60
07140101001910	6835
07140101001911	13511
07140101002587	3403
07140101002588	1138
07140101002589	2149
07140101002596	1636
07140101002598	3831
07140101002628	1424
07140101006891	2482
07140101006892	1283
07140101006893	218
07140101020102	**44769**
07140101000079	13
07140101001905	2684
07140101001906	12058
07140101001907	5970
07140101001908	11355
07140101001909	9510
07140101002606	3179
07140101020103	**97616**
07140101000078	1234
07140101000079	35635
07140101001912	5664
07140101002637	2658
07140101002648	2592
07140101002650	6065
07140101002657	3919
07140101002661	4769
07140101002664	4425
07140101002666	2029
07140101002674	5534
07140101002682	1015

HUC14 & Reach Code	Length (ft)
07140101002687	4535
07140101002693	2793
07140101002716	3614
07140101002732	2824
07140101002743	88
07140101002762	876
07140101002764	1436
07140101002765	870
07140101002775	590
07140101002787	1246
07140101002796	905
07140101002797	308
07140101002834	1990
07140101020201	**87826**
07140101000055	635
07140101000056	2722
07140101000057	10963
07140101000058	951
07140101001860	6397
07140101001861	6235
07140101001862	11108
07140101001902	6921
07140101001903	14078
07140101002647	2313
07140101002654	2582
07140101002662	4081
07140101002669	4168
07140101002675	5338
07140101002677	6044
07140101002686	3290
07140101020202	**88289**
07140101000054	4607
07140101000055	6770
07140101001857	1478
07140101001858	6489
07140101001859	22522
07140101001904	15802
07140101002673	3009
07140101002690	2497
07140101002694	4398
07140101002708	2349

HUC14 & Reach Code	Length (ft)
07140101002718	870
07140101002750	7241
07140101002751	2842
07140101002754	4335
07140101002756	1504
07140101002783	1579
07140101020203	**128838**
07140101000049	3433
07140101000050	3459
07140101000051	12147
07140101000052	4992
07140101000053	6065
07140101000054	860
07140101000078	115
07140101001852	115
07140101001853	7200
07140101001854	15064
07140101001855	10625
07140101001856	9650
07140101001857	1204
07140101001913	7720
07140101002780	4287
07140101002790	2024
07140101002807	1513
07140101002808	754
07140101002825	2119
07140101002834	2201
07140101002836	3854
07140101002856	224
07140101002857	1029
07140101002864	679
07140101002866	559
07140101002871	565
07140101002872	643
07140101002879	1622
07140101002881	7900
07140101002889	1746
07140101002902	3568
07140101002906	977
07140101002918	2753
07140101002919	3552
07140101002921	614

HUC14 & Reach Code	Length (ft)
07140101002922	3006
07140101020301	**78169**
07140101000087	14
07140101000088	19807
07140101000089	14334
07140101001924	9606
07140101001925	14085
07140101002605	3514
07140101002614	4058
07140101002619	1042
07140101002632	3563
07140101002652	3270
07140101002659	970
07140101002665	1101
07140101002676	2806
07140101002783	1579
07140101020302	**207560**
07140101000043	15
07140101000044	52
07140101000084	7690
07140101000085	29544
07140101000086	24096
07140101000087	4861
07140101000309	20
07140101001923	14168
07140101001926	4699
07140101002681	2151
07140101002684	651
07140101002685	1582
07140101002695	2780
07140101002698	1976
07140101002700	1257
07140101002703	1187
07140101002717	1218
07140101002719	380
07140101002723	1920
07140101002724	414
07140101002728	516
07140101002729	1186
07140101002730	2879
07140101002731	545

HUC14 & Reach Code	Length (ft)
07140101002733	1632
07140101002734	363
07140101002735	108
07140101002739	343
07140101002740	2616
07140101002746	1743
07140101002755	393
07140101002757	1160
07140101002759	331
07140101002771	3173
07140101002773	3782
07140101002776	1496
07140101002777	413
07140101002799	1242
07140101002800	380
07140101002802	1282
07140101002805	323
07140101002809	1015
07140101002810	2108
07140101002811	283
07140101002813	1689
07140101002826	1977
07140101002832	1788
07140101002833	283
07140101002835	557
07140101002837	670
07140101002838	745
07140101002840	1123
07140101002845	524
07140101002846	628
07140101002855	1687
07140101002860	709
07140101002869	891
07140101002876	1034
07140101002878	974
07140101002904	609
07140101002908	2911
07140101002915	2337
07140101002930	911
07140101002931	1051
07140101002936	62
07140101002939	322

HUC14 & Reach Code	Length (ft)
07140101002944	1532
07140101002952	1758
07140101002962	762
07140101002964	1555
07140101002968	2987
07140101002969	1827
07140101002970	202
07140101002972	639
07140101002976	2696
07140101002975	7163
07140101002976	2696
07140101002979	877
07140101002982	1790
07140101002984	4052
07140101002986	1264
07140101002989	348
07140101002990	548
07140101002991	458
07140101002992	3705
07140101002994	484
07140101002995	508
07140101002996	1653
07140101002999	1524
07140101003000	3452
07140101003002	1336
07140101003003	1737
07140101003004	3382
07140101003007	1312
07140101020303	**94983**
07140101000309	1729
07140101000311	17883
07140101001922	6091
07140101002816	560
07140101002830	3702
07140101002839	1899
07140101002844	684
07140101002849	2094
07140101002851	459
07140101002852	671
07140101002853	202
07140101002859	3695
07140101002884	2097

HUC14 & Reach Code	Length (ft)
07140101002887	1463
07140101002888	2512
07140101002893	437
07140101002894	623
07140101002897	2391
07140101002901	101
07140101002910	3599
07140101002911	1040
07140101002913	4452
07140101002914	2381
07140101002916	197
07140101002917	1072
07140101002927	55
07140101002928	2116
07140101002929	1869
07140101002932	761
07140101002933	1403
07140101002935	51
07140101002940	2204
07140101002941	830
07140101002951	545
07140101006911	289
07140101006912	148
07140101006913	71
07140101006914	138
07140101006915	213
07140101006916	439
07140101006918	2224
07140101006919	619
07140101006920	1489
07140101006921	1008
07140101006922	2700
07140101006923	2104
07140101006924	1378
07140101006925	2819
07140101006928	1065
07140101006929	2545
07140101006930	3864
07140101020401	**170382**
07140101001914	4344
07140101001915	11631
07140101001916	40490

HUC14 & Reach Code	Length (ft)
07140101001917	7063
07140101001918	26986
07140101002599	2832
07140101002603	3950
07140101002608	3148
07140101002610	2910
07140101002611	2031
07140101002618	4035
07140101002624	4076
07140101002633	2812
07140101002643	5024
07140101002655	2669
07140101002656	923
07140101002658	5309
07140101002660	2961
07140101002670	3891
07140101002671	2761
07140101002688	1786
07140101002691	4740
07140101002696	1222
07140101002697	269
07140101002704	2485
07140101002713	1636
07140101002722	3408
07140101002736	1763
07140101002737	1940
07140101002738	508
07140101002743	2936
07140101002747	621
07140101002782	1012
07140101002785	3563
07140101002786	1341
07140101002789	1306
07140101020402	**111461**
07140101000380	4290
07140101000381	42987
07140101001919	8032
07140101002638	2633
07140101002642	5265
07140101002649	4345
07140101002667	3232
07140101002692	4584

HUC14 & Reach Code	Length (ft)
07140101002701	1550
07140101002702	391
07140101002705	1017
07140101002706	1725
07140101002709	4726
07140101002721	3391
07140101002741	931
07140101002742	3872
07140101002748	1263
07140101002749	688
07140101002752	927
07140101002753	2139
07140101002772	2682
07140101002781	3212
07140101002788	2006
07140101002791	2555
07140101002792	336
07140101002793	1096
07140101002798	1588
07140101020403	**128838**
07140101000047	9428
07140101000048	6687
07140101000049	32
07140101001850	4217
07140101001852	12053
07140101002907	680
07140101002925	3151
07140101002942	3837
07140101002945	2640
07140101002946	798
07140101002949	3508
07140101002953	3966
07140101002954	1565
07140101002957	664
07140101002958	1560
07140101002959	5030
07140101002960	598
07140101002961	3082
07140101002965	2376
07140101002971	4076
07140101002973	4379
07140101002974	3731

HUC14 & Reach Code	Length (ft)
07140101002977	1452
07140101020404	**207575**
07140101000044	9722
07140101000045	9706
07140101000046	2438
07140101000047	1149
07140101000377	5976
07140101000378	3366
07140101000379	8361
07140101000380	5740
07140101001849	13321
07140101001850	1762
07140101001914	5869
07140101001920	17881
07140101001921	7591
07140101002812	1351
07140101002815	1466
07140101002817	222
07140101002818	2700
07140101002819	2486
07140101002820	1673
07140101002821	706
07140101002822	1164
07140101002823	450
07140101002824	859
07140101002827	256
07140101002828	1262
07140101002829	2132
07140101002831	3070
07140101002841	1503
07140101002842	1469
07140101002843	194
07140101002847	346
07140101002848	404
07140101002854	1465
07140101002858	746
07140101002861	5287
07140101002862	795
07140101002867	1984
07140101002870	2592
07140101002873	855
07140101002874	3366

HUC14 & Reach Code	Length (ft)
07140101002875	1380
07140101002877	1197
07140101002883	2023
07140101002885	523
07140101002886	2264
07140101002890	2687
07140101002891	833
07140101002892	1981
07140101002895	1156
07140101002898	6782
07140101002899	1725
07140101002912	3634
07140101002920	3005
07140101002923	2277
07140101002924	3348
07140101002934	1498
07140101002943	1327
07140101002947	3045
07140101002948	1373
07140101002950	1621
07140101002956	3073
07140101002965	563
07140101002967	5807
07140101002977	1001
07140101002981	1026
07140101002985	1655
07140101002987	5773
07140101002997	2723
07140101002998	568
07140101003004	204
07140101003005	1950
07140101003006	3847
07140101003012	309
07140101003013	1685
07140101003015	27
07140101020501	**72846**
07140101000041	2001
07140101000042	1954
07140101000043	6580
07140101001846	13481
07140101001847	6105
07140101001848	6256

HUC14 & Reach Code	Length (ft)
07140101001927	5641
07140101002473	521
07140101003007	3266
07140101003008	509
07140101003009	428
07140101003010	1039
07140101003011	1087
07140101003015	257
07140101003016	81
07140101003017	215
07140101003019	3781
07140101003021	1138
07140101003022	2188
07140101003023	1474
07140101003024	1085
07140101003026	495
07140101003028	426
07140101003030	231
07140101003031	2204
07140101003032	1795
07140101003034	811
07140101003035	1318
07140101003037	1748
07140101003040	3352
07140101003041	295
07140101003042	285
07140101003043	797
07140101020502	**82133**
07140101000039	2273
07140101000040	5450
07140101000041	1
07140101001845	21694
07140101001928	3678
07140101003047	4593
07140101003048	1307
07140101003049	659
07140101003050	449
07140101003052	766
07140101003054	1098
07140101003055	1034
07140101003057	3030
07140101003058	885

HUC14 & Reach Code	Length (ft)
07140101003059	377
07140101003060	4022
07140101003061	782
07140101003062	1954
07140101003063	406
07140101003064	2135
07140101003065	1434
07140101003066	2112
07140101003068	3774
07140101003069	4162
07140101003071	3799
07140101003074	5031
07140101003077	5228
07140101020503	**59858**
07140101000035	62
07140101000039	35
07140101000554	68
07140101001832	5
07140101001843	14388
07140101001928	22
07140101003084	5061
07140101003086	6785
07140101003092	3006
07140101003093	2363
07140101003094	3443
07140101003096	2594
07140101003101	8368
07140101003102	3311
07140101003103	5299
07140101003105	5048
07140101020504	**171744**
07140101001832	8176
07140101001833	2065
07140101001834	7875
07140101001837	4506
07140101001838	6637
07140101001839	21029
07140101001840	3447
07140101001841	6729
07140101001842	10228
07140101003106	3575

HUC14 & Reach Code	Length (ft)
07140101003107	3281
07140101003108	5309
07140101003111	3498
07140101003113	2719
07140101003117	1226
07140101003118	1031
07140101003120	1187
07140101003123	2247
07140101003128	2831
07140101003139	2535
07140101003141	5086
07140101003144	1578
07140101003145	1232
07140101003146	798
07140101003149	3053
07140101003155	4531
07140101003157	5517
07140101003158	1519
07140101003168	1432
07140101003172	498
07140101003174	3787
07140101003182	4415
07140101003183	1529
07140101003195	2289
07140101003196	3686
07140101006840	10332
07140101006849	7634
07140101006994	1894
07140101006995	3242
07140101006996	3399
07140101006997	1050
07140101006998	2143
07140101006999	44
07140101007000	923
07140101020601	**109823**
07140101000104	14442
07140101000105	5554
07140101000106	11477
07140101001943	8657
07140101001944	7155
07140101002641	378
07140101002653	3429

HUC14 & Reach Code	Length (ft)
07140101002663	2239
07140101002668	3001
07140101002672	4809
07140101002678	3270
07140101002679	3017
07140101002680	2857
07140101002683	1327
07140101002689	1877
07140101002699	3693
07140101002707	866
07140101002710	465
07140101002711	317
07140101002712	1037
07140101002714	2313
07140101002715	3231
07140101002720	1392
07140101002725	1596
07140101002726	1264
07140101002727	452
07140101002744	2575
07140101002745	1254
07140101002758	504
07140101002760	1817
07140101002761	106
07140101002763	704
07140101002766	548
07140101002767	1303
07140101002768	2889
07140101002769	2245
07140101002770	262
07140101002774	1488
07140101002778	4012
07140101020602	**130743**
07140101000098	16
07140101000099	8728
07140101000100	2977
07140101000101	2830
07140101000102	2868
07140101000103	3073
07140101000104	9023
07140101001937	1252
07140101001938	7540

HUC14 & Reach Code	Length (ft)
07140101001939	3298
07140101001940	9807
07140101001941	4832
07140101001942	7068
07140101001945	7636
07140101001946	2602
07140101001947	4508
07140101001948	5327
07140101002784	2571
07140101002795	3747
07140101002801	1226
07140101002803	2054
07140101002804	1626
07140101002806	1186
07140101002814	1425
07140101002850	4203
07140101002863	569
07140101002865	1674
07140101002868	1175
07140101002880	6181
07140101002882	578
07140101002896	2762
07140101002900	539
07140101002903	2786
07140101002905	3635
07140101002909	4173
07140101002926	1437
07140101002937	720
07140101002938	678
07140101002955	2414
07140101020603	**77343**
07140101000097	4142
07140101000098	7399
07140101000553	8987
07140101000571	14904
07140101001936	11240
07140101001949	8620
07140101002049	5560
07140101002963	2779
07140101002964	218
07140101002966	806
07140101002978	1987

HUC14 & Reach Code	Length (ft)
07140101002980	1222
07140101002983	2869
07140101002988	586
07140101002993	3698
07140101003001	2328
07140101020604	**98620**
07140101000093	5725
07140101000094	3165
07140101000553	45
07140101001930	1800
07140101001931	7007
07140101001932	7972
07140101001933	9083
07140101001934	7111
07140101001950	13267
07140101001951	11826
07140101002049	471
07140101003014	182
07140101003020	2840
07140101003025	1874
07140101003027	2080
07140101003029	3048
07140101003033	2592
07140101003036	2303
07140101003038	3571
07140101003039	2836
07140101003044	2215
07140101003045	1684
07140101003046	663
07140101003056	1939
07140101003067	3323
07140101020605	**111110**
07140101000030	105
07140101000031	171
07140101000090	18675
07140101000091	8765
07140101000092	3917
07140101000093	57
07140101001930	71
07140101001952	12045
07140101001953	3979

HUC14 & Reach Code	Length (ft)
07140101001954	4999
07140101001955	4642
07140101003070	1456
07140101003072	1340
07140101003073	1716
07140101003075	1310
07140101003076	1045
07140101003078	309
07140101003079	1189
07140101003080	2356
07140101003081	1587
07140101003082	621
07140101003083	1736
07140101003085	2020
07140101003087	2453
07140101003088	479
07140101003089	405
07140101003090	2432
07140101003091	1710
07140101003095	3438
07140101003097	7683
07140101003098	2938
07140101003099	3610
07140101003104	1468
07140101003109	10383
07140101020701	**71070**
07140101000035	7555
07140101000257	6456
07140101000258	21831
07140101001831	11321
07140101001929	5945
07140101003110	4256
07140101003112	1147
07140101003114	2512
07140101003115	1092
07140101003116	9
07140101003119	5110
07140101003122	3837
07140101020702	**79642**
07140101000031	8227
07140101000032	12428

HUC14 & Reach Code	Length (ft)
07140101000257	4
07140101001825	3548
07140101001826	4541
07140101001827	3350
07140101001829	3266
07140101001830	13285
07140101002475	592
07140101003116	3217
07140101003121	2891
07140101003129	881
07140101003140	3377
07140101003147	4967
07140101003150	8592
07140101006826	309
07140101006991	1084
07140101006992	3169
07140101006993	1915
07140101020703	**58746**
07110009006892	621
07110009006901	298
07140101000030	413
07140101000576	11862
07140101000584	5994
07140101003124	2507
07140101003126	900
07140101003127	5778
07140101003131	398
07140101003132	2437
07140101003133	3320
07140101003134	2816
07140101003135	7153
07140101003138	294
07140101005286	1536
07140101005287	9882
07140101006861	1203
07140101006865	1269
07140101007102	66

Streambank erosion by stream reach

Table A.79: Streambank erosion along stream reaches in the Indian-Cahokia Creek watershed.

GNIS Name	Reach Code	Streambank Erosion
Cahokia Creek	07140101000030	Moderate
Cahokia Creek	07140101000031	Moderate
Cahokia Creek	07140101000032	Moderate
Cahokia Creek	07140101000035	Moderate
Cahokia Creek	07140101000039	Moderate
Cahokia Creek	07140101000039	Moderate
Cahokia Creek	07140101000040	Moderate
Cahokia Creek	07140101000040	Moderate
Cahokia Creek	07140101000040	Moderate
Cahokia Creek	07140101000041	Moderate
Cahokia Creek	07140101000042	Moderate
Cahokia Creek	07140101000043	Moderate
Cahokia Creek	07140101000044	Moderate
Cahokia Creek	07140101000044	Moderate
Cahokia Creek	07140101000044	Moderate
Cahokia Creek	07140101000045	Moderate
Cahokia Creek	07140101000045	Moderate
Cahokia Creek	07140101000045	Moderate
Cahokia Creek	07140101000045	Moderate
Cahokia Creek	07140101000045	Moderate
Cahokia Creek	07140101000046	Moderate
Cahokia Creek	07140101000046	Moderate
	07140101000047	Moderate
	07140101000048	Moderate
	07140101000048	Moderate
Cahokia Creek	07140101000049	None/Low
Cahokia Creek	07140101000049	None/Low
Cahokia Creek	07140101000050	None/Low
Cahokia Creek	07140101000050	Moderate
Cahokia Creek	07140101000050	None/Low
Cahokia Creek	07140101000051	None/Low
Cahokia Creek	07140101000051	Moderate
Cahokia Creek	07140101000051	Moderate
Cahokia Creek	07140101000052	None/Low
Cahokia Creek	07140101000053	None/Low
Cahokia Creek	07140101000053	None/Low
Cahokia Creek	07140101000053	None/Low
Cahokia Creek	07140101000053	Moderate
Cahokia Creek	07140101000053	None/Low
Cahokia Creek	07140101000054	Moderate
Cahokia Creek	07140101000054	Moderate

GNIS Name	Reach Code	Streambank Erosion
Cahokia Creek	07140101000054	Moderate
West Fork Cahokia Creek	07140101000078	Moderate
West Fork Cahokia Creek	07140101000078	Moderate
West Fork Cahokia Creek	07140101000079	None/Low
West Fork Cahokia Creek	07140101000079	Moderate
West Fork Cahokia Creek	07140101000079	Moderate
West Fork Cahokia Creek	07140101000079	None/Low
Paddock Creek	07140101000084	Moderate
Paddock Creek	07140101000084	Moderate
Paddock Creek	07140101000084	Moderate
Paddock Creek	07140101000084	Moderate
Paddock Creek	07140101000084	Moderate
Paddock Creek	07140101000084	Moderate
Paddock Creek	07140101000084	Moderate
Paddock Creek	07140101000085	None/Low
Paddock Creek	07140101000085	None/Low
Paddock Creek	07140101000085	None/Low
Paddock Creek	07140101000085	Moderate
Paddock Creek	07140101000085	Moderate
Paddock Creek	07140101000085	Moderate
Paddock Creek	07140101000085	Moderate
Paddock Creek	07140101000085	Moderate
Paddock Creek	07140101000085	Moderate
Paddock Creek	07140101000085	Moderate
Paddock Creek	07140101000085	Moderate
Paddock Creek	07140101000085	Moderate
Paddock Creek	07140101000085	Moderate
Paddock Creek	07140101000086	None/Low
Paddock Creek	07140101000086	None/Low
Paddock Creek	07140101000086	None/Low
Paddock Creek	07140101000086	None/Low
Paddock Creek	07140101000086	Moderate
Paddock Creek	07140101000086	Moderate
Paddock Creek	07140101000086	Moderate
Paddock Creek	07140101000086	None/Low
Paddock Creek	07140101000086	None/Low
Paddock Creek	07140101000086	Moderate
Paddock Creek	07140101000086	Moderate
Paddock Creek	07140101000086	None/Low
Paddock Creek	07140101000087	Moderate
Indian Creek	07140101000090	Null
Indian Creek	07140101000090	Moderate
Indian Creek	07140101000090	High
Indian Creek	07140101000090	Moderate

GNIS Name	Reach Code	Streambank Erosion
Indian Creek	07140101000090	High
Indian Creek	07140101000091	Moderate
Indian Creek	07140101000091	Moderate
Indian Creek	07140101000092	Moderate
Indian Creek	07140101000092	Moderate
Indian Creek	07140101000093	Moderate
Indian Creek	07140101000094	None/Low
Indian Creek	07140101000094	High
Indian Creek	07140101000097	Moderate
Indian Creek	07140101000097	High
Indian Creek	07140101000098	None/Low
Indian Creek	07140101000098	None/Low
Indian Creek	07140101000099	None/Low
Indian Creek	07140101000099	Moderate
Indian Creek	07140101000100	None/Low
Indian Creek	07140101000100	Moderate
Indian Creek	07140101000100	Moderate
Indian Creek	07140101000101	None/Low
Indian Creek	07140101000101	None/Low
Indian Creek	07140101000102	Moderate
Indian Creek	07140101000103	High
Indian Creek	07140101000104	None/Low
Indian Creek	07140101000104	None/Low
Indian Creek	07140101000104	None/Low
Indian Creek	07140101000104	High
Indian Creek	07140101000104	Moderate
Indian Creek	07140101000104	Moderate
Indian Creek	07140101000104	Moderate
Indian Creek	07140101000104	Moderate
Indian Creek	07140101000104	High
Indian Creek	07140101000104	High
Indian Creek	07140101000104	High
Indian Creek	07140101000104	High
Indian Creek	07140101000104	Moderate
Indian Creek	07140101000104	Moderate
Burroughs Branch	07140101000257	Null
Burroughs Branch	07140101000257	None/Low
Burroughs Branch	07140101000258	None/Low
Burroughs Branch	07140101000258	None/Low
Joulters Creek	07140101000309	Null
Joulters Creek	07140101000309	Moderate
Joulters Creek	07140101000311	None/Low
Joulters Creek	07140101000311	None/Low
Joulters Creek	07140101000311	None/Low

GNIS Name	Reach Code	Streambank Erosion
Joulters Creek	07140101000311	None/Low
Joulters Creek	07140101000311	None/Low
Joulters Creek	07140101000311	None/Low
Joulters Creek	07140101000311	None/Low
Joulters Creek	07140101000311	None/Low
Joulters Creek	07140101000311	None/Low
Joulters Creek	07140101000311	None/Low
Joulters Creek	07140101000311	None/Low
Sherry Creek	07140101000377	Moderate
Sherry Creek	07140101000377	Moderate
Sherry Creek	07140101000377	Moderate
Sherry Creek	07140101000377	Moderate
Sherry Creek	07140101000377	Moderate
Sherry Creek	07140101000378	High
Sherry Creek	07140101000378	High
Sherry Creek	07140101000379	Moderate
Sherry Creek	07140101000379	Moderate
Sherry Creek	07140101000379	Moderate
Sherry Creek	07140101000379	High
Sherry Creek	07140101000379	Moderate
Sherry Creek	07140101000380	None/Low
Sherry Creek	07140101000380	High
Sherry Creek	07140101000380	Moderate
Sherry Creek	07140101000380	Moderate
Sherry Creek	07140101000380	Moderate
Sherry Creek	07140101000380	High
Sherry Creek	07140101000381	None/Low
Sherry Creek	07140101000381	None/Low
Sherry Creek	07140101000381	None/Low
Sherry Creek	07140101000381	None/Low
Sherry Creek	07140101000381	None/Low
Sherry Creek	07140101000381	None/Low
Sherry Creek	07140101000381	None/Low
Cahokia Creek	07140101000554	None/Low
Cahokia Diversion Channel	07140101000576	None/Low
Cahokia Diversion Channel	07140101000576	None/Low
Mooney Creek	07140101001831	None/Low
Mooney Creek	07140101001831	None/Low
Mooney Creek	07140101001831	None/Low
Mooney Creek	07140101001831	Moderate
Mooney Creek	07140101001832	None/Low
Mooney Creek	07140101001832	None/Low
Mooney Creek	07140101001832	None/Low
Mooney Creek	07140101001833	None/Low

GNIS Name	Reach Code	Streambank Erosion
Mooney Creek	07140101001834	None/Low
Mooney Creek	07140101001834	None/Low
Mooney Creek	07140101001837	None/Low
Mooney Creek	07140101001837	None/Low
Mooney Creek	07140101001837	Moderate
Little Mooney Creek	07140101001839	Null
Little Mooney Creek	07140101001839	None/Low
Little Mooney Creek	07140101001839	None/Low
Little Mooney Creek	07140101001839	None/Low
Little Mooney Creek	07140101001839	None/Low
Little Mooney Creek	07140101001839	None/Low
Little Mooney Creek	07140101001839	None/Low
Little Mooney Creek	07140101001839	None/Low
Little Mooney Creek	07140101001839	None/Low
	07140101001843	None/Low
East Fork Sherry Creek	07140101001914	Moderate
East Fork Sherry Creek	07140101001914	Moderate
East Fork Sherry Creek	07140101001914	Moderate
East Fork Sherry Creek	07140101001914	Moderate
East Fork Sherry Creek	07140101001914	Moderate
East Fork Sherry Creek	07140101001914	High
East Fork Sherry Creek	07140101001915	None/Low
East Fork Sherry Creek	07140101001915	None/Low
East Fork Sherry Creek	07140101001915	None/Low
East Fork Sherry Creek	07140101001915	Moderate
East Fork Sherry Creek	07140101001915	Moderate
Dentons Branch	07140101001920	None/Low
Dentons Branch	07140101001920	None/Low
Dentons Branch	07140101001920	None/Low
Dentons Branch	07140101001920	None/Low
Dentons Branch	07140101001920	None/Low
Dentons Branch	07140101001920	Moderate
Dentons Branch	07140101001920	High
Dentons Branch	07140101001920	Moderate
Dentons Branch	07140101001920	Moderate
Indian Creek	07140101002049	None/Low
Indian Creek	07140101002049	High
Indian Creek	07140101002049	High
	07140101002691	Moderate
	07140101002830	None/Low
	07140101002901	Null
Cahokia Creek	07140101002953	None/Low
Indian Creek	07140101003027	Moderate
Indian Creek	07140101003036	Moderate

GNIS Name	Reach Code	Streambank Erosion
Cahokia Creek	07140101003103	Moderate
Cahokia Creek	07140101003115	Moderate
Cahokia Creek	07140101003116	Moderate
Mooney Creek	07140101003168	None/Low
Mooney Creek	07140101003172	None/Low
Cahokia Diversion Channel	07140101005286	None/Low
Cahokia Diversion Channel	07140101005287	None/Low
Cahokia Creek	07140101006861	Moderate
Cahokia Diversion Channel	07140101006865	None/Low
Joulters Creek	07140101006911	Null
Joulters Creek	07140101006913	Null
	07140101006914	Null
	07140101006915	Null
Joulters Creek	07140101006916	Null
Joulters Creek	07140101006918	Null
Joulters Creek	07140101006922	Null
Joulters Creek	07140101006924	Null
Joulters Creek	07140101006928	Null
Joulters Creek	07140101006930	Null
Mooney Creek	07140101006994	Null
Mooney Creek	07140101006995	Null
Mooney Creek	07140101006998	Null
Mooney Creek	07140101007000	Null

Channelization by stream reach

Table A.80: Degree of channelization along assessed stream reaches in the Indian-Cahokia Creek watershed.

GNIS Name	Reach Code	Channelization
Cahokia Creek	07140101000030	None/Low
Cahokia Creek	07140101000031	None/Low
Cahokia Creek	07140101000032	None/Low
Cahokia Creek	07140101000035	High
Cahokia Creek	07140101000039	Moderate
Cahokia Creek	07140101000039	Moderate
Cahokia Creek	07140101000040	Moderate
Cahokia Creek	07140101000040	Moderate
Cahokia Creek	07140101000040	Moderate
Cahokia Creek	07140101000041	Moderate
Cahokia Creek	07140101000042	Moderate
Cahokia Creek	07140101000043	None/Low
Cahokia Creek	07140101000044	None/Low
Cahokia Creek	07140101000044	None/Low
Cahokia Creek	07140101000044	None/Low
Cahokia Creek	07140101000045	None/Low
Cahokia Creek	07140101000045	None/Low
Cahokia Creek	07140101000045	None/Low
Cahokia Creek	07140101000045	None/Low
Cahokia Creek	07140101000045	Moderate
Cahokia Creek	07140101000046	None/Low
Cahokia Creek	07140101000046	None/Low
	07140101000047	None/Low
	07140101000048	None/Low
	07140101000048	None/Low
Cahokia Creek	07140101000049	None/Low
Cahokia Creek	07140101000049	Moderate
Cahokia Creek	07140101000050	None/Low
Cahokia Creek	07140101000050	None/Low
Cahokia Creek	07140101000050	Moderate
Cahokia Creek	07140101000051	None/Low
Cahokia Creek	07140101000051	None/Low
Cahokia Creek	07140101000051	None/Low
Cahokia Creek	07140101000052	None/Low
Cahokia Creek	07140101000053	None/Low
Cahokia Creek	07140101000053	None/Low
Cahokia Creek	07140101000053	None/Low
Cahokia Creek	07140101000053	None/Low
Cahokia Creek	07140101000053	High
Cahokia Creek	07140101000054	None/Low
Cahokia Creek	07140101000054	None/Low
Cahokia Creek	07140101000054	Moderate

GNIS Name	Reach Code	Channelization
West Fork Cahokia Creek	07140101000078	None/Low
West Fork Cahokia Creek	07140101000078	Moderate
West Fork Cahokia Creek	07140101000079	None/Low
West Fork Cahokia Creek	07140101000079	None/Low
West Fork Cahokia Creek	07140101000079	Moderate
West Fork Cahokia Creek	07140101000079	None/Low
Paddock Creek	07140101000084	None/Low
Paddock Creek	07140101000084	None/Low
Paddock Creek	07140101000084	None/Low
Paddock Creek	07140101000084	None/Low
Paddock Creek	07140101000084	None/Low
Paddock Creek	07140101000084	None/Low
Paddock Creek	07140101000084	High
Paddock Creek	07140101000085	None/Low
Paddock Creek	07140101000085	None/Low
Paddock Creek	07140101000085	None/Low
Paddock Creek	07140101000085	None/Low
Paddock Creek	07140101000085	None/Low
Paddock Creek	07140101000085	None/Low
Paddock Creek	07140101000085	None/Low
Paddock Creek	07140101000085	None/Low
Paddock Creek	07140101000085	None/Low
Paddock Creek	07140101000085	None/Low
Paddock Creek	07140101000085	None/Low
Paddock Creek	07140101000085	None/Low
Paddock Creek	07140101000085	None/Low
Paddock Creek	07140101000086	None/Low
Paddock Creek	07140101000086	None/Low
Paddock Creek	07140101000086	None/Low
Paddock Creek	07140101000086	None/Low
Paddock Creek	07140101000086	None/Low
Paddock Creek	07140101000086	None/Low
Paddock Creek	07140101000086	None/Low
Paddock Creek	07140101000086	None/Low
Paddock Creek	07140101000086	None/Low
Paddock Creek	07140101000086	None/Low
Paddock Creek	07140101000086	None/Low
Paddock Creek	07140101000086	Moderate
Paddock Creek	07140101000087	None/Low
Indian Creek	07140101000090	Null
Indian Creek	07140101000090	None/Low
Indian Creek	07140101000090	None/Low
Indian Creek	07140101000090	None/Low
Indian Creek	07140101000090	None/Low
Indian Creek	07140101000091	None/Low

GNIS Name	Reach Code	Channelization
Indian Creek	07140101000091	High
Indian Creek	07140101000092	High
Indian Creek	07140101000092	High
Indian Creek	07140101000093	Moderate
Indian Creek	07140101000094	None/Low
Indian Creek	07140101000094	None/Low
Indian Creek	07140101000097	None/Low
Indian Creek	07140101000097	None/Low
Indian Creek	07140101000098	None/Low
Indian Creek	07140101000098	None/Low
Indian Creek	07140101000099	None/Low
Indian Creek	07140101000099	Moderate
Indian Creek	07140101000100	None/Low
Indian Creek	07140101000100	None/Low
Indian Creek	07140101000100	None/Low
Indian Creek	07140101000101	None/Low
Indian Creek	07140101000101	None/Low
Indian Creek	07140101000102	None/Low
Indian Creek	07140101000103	None/Low
Indian Creek	07140101000104	None/Low
Indian Creek	07140101000104	None/Low
Indian Creek	07140101000104	None/Low
Indian Creek	07140101000104	None/Low
Indian Creek	07140101000104	None/Low
Indian Creek	07140101000104	None/Low
Indian Creek	07140101000104	None/Low
Indian Creek	07140101000104	None/Low
Indian Creek	07140101000104	None/Low
Indian Creek	07140101000104	None/Low
Indian Creek	07140101000104	None/Low
Indian Creek	07140101000104	None/Low
Indian Creek	07140101000104	Moderate
Indian Creek	07140101000104	Moderate
Burroughs Branch	07140101000257	Null
Burroughs Branch	07140101000257	None/Low
Burroughs Branch	07140101000258	None/Low
Burroughs Branch	07140101000258	None/Low
Joulters Creek	07140101000309	Null
Joulters Creek	07140101000309	None/Low
Joulters Creek	07140101000311	None/Low
Joulters Creek	07140101000311	None/Low
Joulters Creek	07140101000311	None/Low
Joulters Creek	07140101000311	None/Low
Joulters Creek	07140101000311	None/Low
Joulters Creek	07140101000311	None/Low

GNIS Name	Reach Code	Channelization
Joulters Creek	07140101000311	None/Low
Joulters Creek	07140101000311	None/Low
Joulters Creek	07140101000311	None/Low
Joulters Creek	07140101000311	Moderate
Joulters Creek	07140101000311	High
Sherry Creek	07140101000377	Moderate
Sherry Creek	07140101000377	None/Low
Sherry Creek	07140101000377	None/Low
Sherry Creek	07140101000377	Moderate
Sherry Creek	07140101000377	High
Sherry Creek	07140101000378	Moderate
Sherry Creek	07140101000378	Moderate
Sherry Creek	07140101000379	None/Low
Sherry Creek	07140101000379	Moderate
Sherry Creek	07140101000379	Moderate
Sherry Creek	07140101000379	None/Low
Sherry Creek	07140101000379	Moderate
Sherry Creek	07140101000380	None/Low
Sherry Creek	07140101000380	None/Low
Sherry Creek	07140101000380	Moderate
Sherry Creek	07140101000380	High
Sherry Creek	07140101000380	High
Sherry Creek	07140101000380	High
Sherry Creek	07140101000381	None/Low
Sherry Creek	07140101000381	None/Low
Sherry Creek	07140101000381	None/Low
Sherry Creek	07140101000381	None/Low
Sherry Creek	07140101000381	None/Low
Sherry Creek	07140101000381	None/Low
Sherry Creek	07140101000381	Moderate
Cahokia Creek	07140101000554	None/Low
Cahokia Diversion Channel	07140101000576	High
Cahokia Diversion Channel	07140101000576	High
Mooney Creek	07140101001831	None/Low
Mooney Creek	07140101001831	None/Low
Mooney Creek	07140101001831	None/Low
Mooney Creek	07140101001831	None/Low
Mooney Creek	07140101001832	None/Low
Mooney Creek	07140101001832	None/Low
Mooney Creek	07140101001832	None/Low
Mooney Creek	07140101001833	Moderate
Mooney Creek	07140101001834	None/Low
Mooney Creek	07140101001834	None/Low

GNIS Name	Reach Code	Channelization
Mooney Creek	07140101001837	None/Low
Mooney Creek	07140101001837	None/Low
Mooney Creek	07140101001837	Moderate
Little Mooney Creek	07140101001839	Null
Little Mooney Creek	07140101001839	None/Low
Little Mooney Creek	07140101001839	None/Low
Little Mooney Creek	07140101001839	None/Low
Little Mooney Creek	07140101001839	None/Low
Little Mooney Creek	07140101001839	None/Low
Little Mooney Creek	07140101001839	None/Low
Little Mooney Creek	07140101001839	None/Low
Little Mooney Creek	07140101001839	High
	07140101001843	None/Low
East Fork Sherry Creek	07140101001914	None/Low
East Fork Sherry Creek	07140101001914	None/Low
East Fork Sherry Creek	07140101001914	None/Low
East Fork Sherry Creek	07140101001914	None/Low
East Fork Sherry Creek	07140101001914	None/Low
East Fork Sherry Creek	07140101001914	None/Low
East Fork Sherry Creek	07140101001915	None/Low
East Fork Sherry Creek	07140101001915	None/Low
East Fork Sherry Creek	07140101001915	None/Low
East Fork Sherry Creek	07140101001915	None/Low
East Fork Sherry Creek	07140101001915	None/Low
Dentons Branch	07140101001920	None/Low
Dentons Branch	07140101001920	None/Low
Dentons Branch	07140101001920	None/Low
Dentons Branch	07140101001920	None/Low
Dentons Branch	07140101001920	None/Low
Dentons Branch	07140101001920	None/Low
Dentons Branch	07140101001920	None/Low
Dentons Branch	07140101001920	Moderate
Dentons Branch	07140101001920	High
Indian Creek	07140101002049	None/Low
Indian Creek	07140101002049	None/Low
Indian Creek	07140101002049	None/Low
	07140101002691	None/Low
	07140101002830	None/Low
	07140101002901	Null
Cahokia Creek	07140101002953	None/Low
Indian Creek	07140101003027	None/Low
Indian Creek	07140101003036	None/Low
Cahokia Creek	07140101003103	High
Cahokia Creek	07140101003115	Moderate
Cahokia Creek	07140101003116	None/Low

GNIS Name	Reach Code	Channelization
Mooney Creek	07140101003168	Moderate
Mooney Creek	07140101003172	None/Low
Cahokia Diversion Channel	07140101005286	High
Cahokia Diversion Channel	07140101005287	High
Cahokia Creek	07140101006861	None/Low
Cahokia Diversion Channel	07140101006865	High
Joulters Creek	07140101006911	Null
Joulters Creek	07140101006913	Null
	07140101006914	Null
	07140101006915	Null
Joulters Creek	07140101006916	Null
Joulters Creek	07140101006918	Null
Joulters Creek	07140101006922	Null
Joulters Creek	07140101006924	Null
Joulters Creek	07140101006928	Null
Joulters Creek	07140101006930	Null
Mooney Creek	07140101006994	Null
Mooney Creek	07140101006995	Null
Mooney Creek	07140101006998	Null
Mooney Creek	07140101007000	Null

Riparian condition by stream reach

Table A.81: Riparian condition along assessed stream reaches in the Indian-Cahokia Creek watershed.

GNIS Name	Reach Code	Riparian
Cahokia Creek	07140101000030	Good
Cahokia Creek	07140101000031	Fair
Cahokia Creek	07140101000032	Fair
Cahokia Creek	07140101000035	Fair
Cahokia Creek	07140101000039	Good
Cahokia Creek	07140101000039	Fair
Cahokia Creek	07140101000040	Good
Cahokia Creek	07140101000040	Fair
Cahokia Creek	07140101000040	Fair
Cahokia Creek	07140101000041	Poor
Cahokia Creek	07140101000042	Good
Cahokia Creek	07140101000043	Fair
Cahokia Creek	07140101000044	Fair
Cahokia Creek	07140101000044	Fair
Cahokia Creek	07140101000044	Fair
Cahokia Creek	07140101000045	Good
Cahokia Creek	07140101000045	Good
Cahokia Creek	07140101000045	Fair
Cahokia Creek	07140101000045	Fair
Cahokia Creek	07140101000045	Fair
Cahokia Creek	07140101000046	Good
Cahokia Creek	07140101000046	Good
	07140101000047	Fair
	07140101000048	Good
	07140101000048	Good
Cahokia Creek	07140101000049	Good
Cahokia Creek	07140101000049	Good
Cahokia Creek	07140101000050	Good
Cahokia Creek	07140101000050	Good
Cahokia Creek	07140101000050	Good
Cahokia Creek	07140101000051	Good
Cahokia Creek	07140101000051	Good
Cahokia Creek	07140101000051	Poor
Cahokia Creek	07140101000052	Poor
Cahokia Creek	07140101000053	Good
Cahokia Creek	07140101000053	Fair
Cahokia Creek	07140101000053	Fair
Cahokia Creek	07140101000053	Fair
Cahokia Creek	07140101000053	Fair
Cahokia Creek	07140101000054	Fair
Cahokia Creek	07140101000054	Fair
Cahokia Creek	07140101000054	Fair

GNIS Name	Reach Code	Riparian
West Fork Cahokia Creek	07140101000078	Poor
West Fork Cahokia Creek	07140101000078	Poor
West Fork Cahokia Creek	07140101000079	Good
West Fork Cahokia Creek	07140101000079	Fair
West Fork Cahokia Creek	07140101000079	Fair
West Fork Cahokia Creek	07140101000079	Poor
Paddock Creek	07140101000084	Good
Paddock Creek	07140101000084	Good
Paddock Creek	07140101000084	Fair
Paddock Creek	07140101000084	Fair
Paddock Creek	07140101000084	Fair
Paddock Creek	07140101000084	Fair
Paddock Creek	07140101000084	Fair
Paddock Creek	07140101000085	Good
Paddock Creek	07140101000085	Good
Paddock Creek	07140101000085	Good
Paddock Creek	07140101000085	Good
Paddock Creek	07140101000085	Good
Paddock Creek	07140101000085	Good
Paddock Creek	07140101000085	Good
Paddock Creek	07140101000085	Good
Paddock Creek	07140101000085	Good
Paddock Creek	07140101000085	Good
Paddock Creek	07140101000085	Fair
Paddock Creek	07140101000085	Fair
Paddock Creek	07140101000085	Fair
Paddock Creek	07140101000086	Good
Paddock Creek	07140101000086	Good
Paddock Creek	07140101000086	Good
Paddock Creek	07140101000086	Good
Paddock Creek	07140101000086	Good
Paddock Creek	07140101000086	Good
Paddock Creek	07140101000086	Good
Paddock Creek	07140101000086	Fair
Paddock Creek	07140101000086	Fair
Paddock Creek	07140101000086	Fair
Paddock Creek	07140101000086	Fair
Paddock Creek	07140101000086	Poor
Paddock Creek	07140101000087	Fair
Indian Creek	07140101000090	Null
Indian Creek	07140101000090	Good
Indian Creek	07140101000090	Fair
Indian Creek	07140101000090	Poor
Indian Creek	07140101000090	Poor
Indian Creek	07140101000091	Good

GNIS Name	Reach Code	Riparian
Indian Creek	07140101000091	Poor
Indian Creek	07140101000092	Poor
Indian Creek	07140101000092	Poor
Indian Creek	07140101000093	Poor
Indian Creek	07140101000094	Good
Indian Creek	07140101000094	Poor
Indian Creek	07140101000097	Fair
Indian Creek	07140101000097	Poor
Indian Creek	07140101000098	Good
Indian Creek	07140101000098	Good
Indian Creek	07140101000099	Good
Indian Creek	07140101000099	Fair
Indian Creek	07140101000100	Good
Indian Creek	07140101000100	Good
Indian Creek	07140101000100	Fair
Indian Creek	07140101000101	Good
Indian Creek	07140101000101	Fair
Indian Creek	07140101000102	Good
Indian Creek	07140101000103	Fair
Indian Creek	07140101000104	Good
Indian Creek	07140101000104	Good
Indian Creek	07140101000104	Good
Indian Creek	07140101000104	Fair
Indian Creek	07140101000104	Poor
Indian Creek	07140101000104	Poor
Indian Creek	07140101000104	Poor
Indian Creek	07140101000104	Poor
Indian Creek	07140101000104	Poor
Indian Creek	07140101000104	Poor
Indian Creek	07140101000104	Poor
Indian Creek	07140101000104	Poor
Indian Creek	07140101000104	Poor
Indian Creek	07140101000104	Poor
Burroughs Branch	07140101000257	Null
Burroughs Branch	07140101000257	Poor
Burroughs Branch	07140101000258	Fair
Burroughs Branch	07140101000258	Fair
Joulters Creek	07140101000309	Null
Joulters Creek	07140101000309	Fair
Joulters Creek	07140101000311	Good
Joulters Creek	07140101000311	Good
Joulters Creek	07140101000311	Good
Joulters Creek	07140101000311	Good
Joulters Creek	07140101000311	Good
Joulters Creek	07140101000311	Good

GNIS Name	Reach Code	Riparian
Joulters Creek	07140101000311	Good
Joulters Creek	07140101000311	Good
Joulters Creek	07140101000311	Good
Joulters Creek	07140101000311	Poor
Joulters Creek	07140101000311	Poor
Sherry Creek	07140101000377	Good
Sherry Creek	07140101000377	Fair
Sherry Creek	07140101000377	Fair
Sherry Creek	07140101000377	Fair
Sherry Creek	07140101000377	Poor
Sherry Creek	07140101000378	Poor
Sherry Creek	07140101000378	Poor
Sherry Creek	07140101000379	Fair
Sherry Creek	07140101000379	Fair
Sherry Creek	07140101000379	Fair
Sherry Creek	07140101000379	Poor
Sherry Creek	07140101000379	Poor
Sherry Creek	07140101000380	Good
Sherry Creek	07140101000380	Fair
Sherry Creek	07140101000380	Poor
Sherry Creek	07140101000380	Poor
Sherry Creek	07140101000380	Poor
Sherry Creek	07140101000380	Poor
Sherry Creek	07140101000381	Good
Sherry Creek	07140101000381	Good
Sherry Creek	07140101000381	Good
Sherry Creek	07140101000381	Good
Sherry Creek	07140101000381	Good
Sherry Creek	07140101000381	Good
Sherry Creek	07140101000381	Fair
Cahokia Creek	07140101000554	Good
Cahokia Diversion Channel	07140101000576	Fair
Cahokia Diversion Channel	07140101000576	Fair
Mooney Creek	07140101001831	Good
Mooney Creek	07140101001831	Good
Mooney Creek	07140101001831	Poor
Mooney Creek	07140101001831	Poor
Mooney Creek	07140101001832	Good
Mooney Creek	07140101001832	Fair
Mooney Creek	07140101001832	Poor
Mooney Creek	07140101001833	Fair
Mooney Creek	07140101001834	Good
Mooney Creek	07140101001834	Good
Mooney Creek	07140101001837	Good
Mooney Creek	07140101001837	Good

GNIS Name	Reach Code	Riparian
Mooney Creek	07140101001837	Poor
Little Mooney Creek	07140101001839	Null
Little Mooney Creek	07140101001839	Good
Little Mooney Creek	07140101001839	Good
Little Mooney Creek	07140101001839	Good
Little Mooney Creek	07140101001839	Good
Little Mooney Creek	07140101001839	Good
Little Mooney Creek	07140101001839	Good
Little Mooney Creek	07140101001839	Good
Little Mooney Creek	07140101001839	Poor
	07140101001843	Good
East Fork Sherry Creek	07140101001914	Good
East Fork Sherry Creek	07140101001914	Good
East Fork Sherry Creek	07140101001914	Fair
East Fork Sherry Creek	07140101001914	Fair
East Fork Sherry Creek	07140101001914	Fair
East Fork Sherry Creek	07140101001914	Poor
East Fork Sherry Creek	07140101001915	Good
East Fork Sherry Creek	07140101001915	Good
East Fork Sherry Creek	07140101001915	Good
East Fork Sherry Creek	07140101001915	Fair
East Fork Sherry Creek	07140101001915	Fair
Dentons Branch	07140101001920	Good
Dentons Branch	07140101001920	Good
Dentons Branch	07140101001920	Good
Dentons Branch	07140101001920	Good
Dentons Branch	07140101001920	Good
Dentons Branch	07140101001920	Fair
Dentons Branch	07140101001920	Fair
Dentons Branch	07140101001920	Poor
Dentons Branch	07140101001920	Poor
Indian Creek	07140101002049	Good
Indian Creek	07140101002049	Fair
Indian Creek	07140101002049	Poor
	07140101002691	Poor
	07140101002830	Good
	07140101002901	Null
Cahokia Creek	07140101002953	Fair
Indian Creek	07140101003027	Good
Indian Creek	07140101003036	Fair
Cahokia Creek	07140101003103	Good
Cahokia Creek	07140101003115	Fair
Cahokia Creek	07140101003116	Fair
Mooney Creek	07140101003168	Good
Mooney Creek	07140101003172	Good

GNIS Name	Reach Code	Riparian
Cahokia Diversion Channel	07140101005286	Good
Cahokia Diversion Channel	07140101005287	Poor
Cahokia Creek	07140101006861	Good
Cahokia Diversion Channel	07140101006865	Fair
Joulters Creek	07140101006911	Null
Joulters Creek	07140101006913	Null
	07140101006914	Null
	07140101006915	Null
Joulters Creek	07140101006916	Null
Joulters Creek	07140101006918	Null
Joulters Creek	07140101006922	Null
Joulters Creek	07140101006924	Null
Joulters Creek	07140101006928	Null
Joulters Creek	07140101006930	Null
Mooney Creek	07140101006994	Null
Mooney Creek	07140101006995	Null
Mooney Creek	07140101006998	Null
Mooney Creek	07140101007000	Null

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APPENDIX C – LANDOWNER/FARMER SURVEY RESULTS

In the spring of 2018, HeartLands Conservancy and Madison County Planning and Development collaborated to mail a survey to over 600 landowners and farmers who own parcels of land greater than or equal to five acres in size in the Indian-Cahokia Creek watershed and the Canteen-Cahokia Creek watershed. The survey was also made available online at www.surveymonkey.com. The goal of the survey was to increase awareness among rural landowners about the types of grants available for BMP implementation assistance following the completion of the watershed plans. The survey included information about the watershed plans, the types of grants available for BMP implementation, and a list of BMPs that may be eligible for grant funding.

Sixty-six people have replied to the survey as of July 2018. A summary of landowner responses is included in the table below.

Table C1. A summary of the 2018 Cahokia Creek Watershed Landowner/Farmer Survey results (as of July 2018).

Which of these issues have you noticed on your land/cropland?		
Soil erosion		61.90%
Gullies getting deeper		50.79%
Loss of topsoil/thin topsoil		26.98%
Ponds/detention basins filling up with sediment		26.98%
Cropland floods		11.11%
Other issues* *Example responses included poor water quality, invasive species, and increased runoff.		36.51%
Which of these issues have you noticed in the creeks and streams on or adjacent to your land?		
Muddy water		67.27%
Unstable streambanks		49.09%
Overtopping/stream flooding out of its banks		49.09%
Streams getting deeper		43.64%
Logjams		40.00%
Other issues* *Example responses included flooding on property, clogged drainage canals, and none.		12.73%
Which of the following is present on your land?		
Forested areas		77.19%
Steep slopes		59.65%
Highly erodible soil		47.37%
Wetlands/marsh/swamp/bog		26.32%
Floodplain		22.81%
Which of the following program areas are you participating in? And which program(s) might you be interested in participating in?		
Program:	*Participating in:*	*Interested in:*
Agricultural Conservation Easement Program	0%	100%
Conservation Reserve Program	9.09%	90.91%
Conservation Stewardship Program	14.29%	90.48%
Environmental Quality Incentives Program	0%	100%
Streambank Stablization and Restoration Program	3.85%	96.15%
EPA 319 Grant	0%	100%

Table C1, continued. A summary of the 2018 Cahokia Creek Watershed Landowner/Farmer Survey results (as of July 2018).

If you are aware of any or all of the programs above, what concerns prevented you from applying/participating?	
My costs would be too high	31.91%
The problems on my land aren't that severe	29.79%
Too much time and paperwork to enroll	27.66%
I didn't want to take cropland out of production	8.51%
The project/BMP wouldn't have a big enough impact	0%
Other* *Example responses included not knowing about opportunities, enrollment denial, and it not being worth the hassle for smaller properties.	44.68%
What type(s) of projects might you be interested in implementing on your land?	
Streambank/stream channel restoration	40.35%
Pond	35.09%
Pollinator habitat	33.33%
Cover crops	29.82%
Grassed waterways	22.81%
Filter strips	19.30%
Riparian buffer	15.79%
Water and sediment control basins	14.04%
Conservation tillage	14.04%
Wetland/wetland restoration	10.53%
Terraces/contour farming	10.53%
Other* *Example responses included riprap, tree/shrub establishment, and raingardens or bioswales.	59.65%

At the end of the survey, landowners were given the opportunity to note any additional issues on their land that they would like assistance in resolving. Examples given included invasive species management, community education/outreach about watershed issues (e.g., fertilizer use), and BMP recommendations. Landowners were also asked whether they would like HeartLands Conservancy and Madison County to follow up about the survey and potential project funding, to which 69.09% replied yes.

APPENDIX D – CRITICAL AREAS

This appendix includes descriptions of the source data used to delineate Critical Areas, and maps of each Critical Area. Maps of Best Management Practices (BMPs) as outputs from the Agricultural Conservation Planning Framework (ACPF) are also included.

How locations were identified

Several sources of information were used to identify Critical Area locations. These include wetland restoration ranking values from the Missouri Resource Assessment Partnership (MoRAP) and results from the U.S. Department of Agriculture (USDA) ACPF tools.

Wetland restoration ranking values

Wetland restoration ranking values and wetland importance values were created for the watershed by the MoRAP. Several layers of data—especially topography, soil type, and land cover—were used to create maps of existing wetlands, which it is highly important to protect, and areas which were formerly wetlands which it would be highly beneficial to restore.

Agricultural Conservation Planning Framework (ACPF)

The ACPF is a set of GIS-based tools developed by the USDA Research Service (USDA-ARS) that can substantially enhance watershed planning capabilities on agricultural land. The ACPF is currently available for Minnesota, Iowa, and Illinois, and uses new high-resolution data sources, such as soils, land use, crop rotations, and elevation (from LiDAR). The tools determine slope, flow accumulation, and other factors by HUC12, allowing analysis at watershed and field scales. Among the outputs of the tools are possible beneficial locations for different types of practices placed in fields, at field edges, and in riparian zones. No recommendations are made. The aim is to create a planning resource to use in watershed planning and consultation with landowners.

The BMPs recommended by the model include grassed waterways, contour buffer strips, drainage water management, appropriate riparian vegetation, and nutrient management wetlands. Many of the tools within the ACPF have parameters that can be adjusted by the user to change their output. For example, the user can define the width of contour buffer strips generated and the minimum distance between buffer strips. Table D.1 shows the user-defined or modifiable values used for this assessment.

Table D.1. Values entered into ACPF tools to generate BMP locations for user-defined or modifiable parameters.

ACPF BMP	Values used for user-defined or modifiable parameters
Edge-of-Field Bioreactors	No modifiable parameters
Contour buffer strips	Buffer strip width: 15 feet Minimum distance between buffer strips: 90 feet (default)
Drainage water management	Tile-drained agricultural fields where a 1 meter (3.3 ft) contour interval comprises more than 30% of the field (representing the addition of 2 control gate structures on the tile drain), with a default minimum of 20 acres
Grassed waterways – SPI Threshold	Drainage threshold: >6 acres Standard deviations: 2
Nutrient Removal Wetlands	Suggested spacing distance: 250 meters (default) Impoundment height: 0.9 meters (default) Buffer height: 1.5 meters (default) Road file used to avoid roads: Madison County roads shapefile
WASCOBs	Embankment height: 1.5 meters (default) Road file used to avoid roads: Madison County roads shapefile WASCOB basin depth raster (optional): left blank
Riparian function assessment	No modifiable parameters

The data analysis capabilities of the model also allow for further, independent assessment of different BMPs. Planning scenarios can be generated from the results and compared/evaluated in a simple way without additional input.

The results of the ACPF modeling were combined into one map in ArcMap. They were printed on 30 x 40 inch zoomed-in maps covering the whole watershed. These maps will be useful for the county Soil and Water Conservation Districts and Natural Resources Conservation Service (NRCS) staff to explore BMP options with farmers interested in implementing a soil conservation or waterway protection project. The ACPF results were also useful in setting the numeric targets for this watershed plan.

The ACPF is focused on reducing runoff and preventing nutrient pollution from farmlands. It focuses on the value of wetlands as nutrient sinks and for flood control (as compared with the MoRAP assessment which considers wetland value as potential for restoration). Together, the ACPF and the MoRAP wetlands mitigation importance values will overlap in several places, showing wetlands of extremely high restoration and protection importance.

The following table (Table D.2) and maps show the ACPF results for several BMPs.

Table D.2. ACPF results for several BMPs by HUC 14.

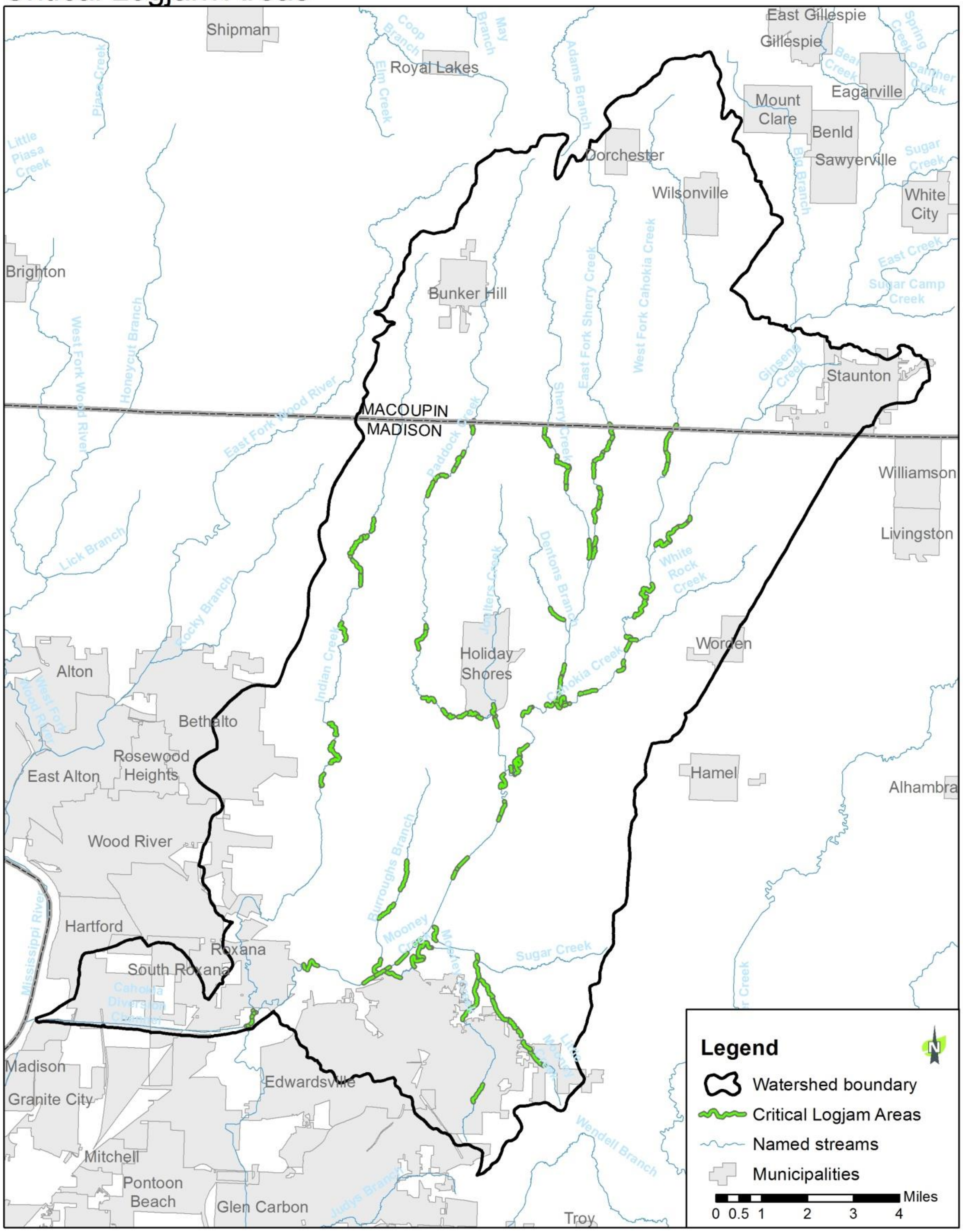
ACPF Results	**HUC14 (last three digits)**												
	101	**102**	**103**	**201**	**202**	**203**	**301**	**302**	**303**	**401**	**402**	**403**	**404**
# bioreactors	7	4	0	2	5	5	9	4	11	8	4	3	6
Total area bioreactors (sq m)	5,954	5,498	0	1,887	5,155	4,975	8,485	2,481	9,146	7,428	4,265	1,838	3,994
# contour buffer strips	5	0	7	1	4	31	6	52	93	22	25	44	66
Total area contour buffer strips (sq m)	2,968	0	4,667	665	4,620	27,242	3,719	41,847	76,997	14,358	19,954	37,184	58,974
Grass waterways total length (m)	6,197	1,463	5,173	1,562	1,092	2,731	8,259	3,010	5,989	**10,848**	7,357	1,802	3,834
# drainage management polygons	52	37	12	25	51	**62**	48	26	34	31	59	24	46
Area drainage management fields (sq m)	**7,697,121**	4,613,416	1,262,619	2,225,771	5,111,180	6,187,643	5,467,303	1,974,866	2,727,581	3,443,875	6,280,721	1,307,135	3,852,607
# nutrient removal wetlands	10	10	20	24	10	6	0	0	0	0	0	0	8
Nutrient removal wetlands area (wetland & buffers) (sq m)	242,811	226,624	218,530	**457,295**	186,155	113,312	0	0	0	0	0	0	101,171
Wetland area only (sq meters)	80,937	109,265	93,078	**198,296**	97,125	52,609	0	0	0	0	0	0	44,515
Area draining to nutrient removal wetlands (sq m)	245,768	221,682	225,694	**453,197**	186,102	108,776	0	0	0	0	0	0	97,665
Riparian area: # Critical Zone segments (CZ)	0	0	182	498	1,002	0	0	0	0	0	0	0	1,263
Riparian area: # Multi Species Buffer (MSB)	434	6	1,724	4,442	2,028	1,097	4,380	0	3,561	3,315	1,547	0	1,272
Riparian area: # Stiff Stemmed Grasses (SSG)	304	5	2,362	3,804	5,522	21,800	9,823	7,585	**35,238**	9,340	12,298	13,063	13,152
Riparian area: # Deep Rooted Vegetation (DRV)	192	0	2,179	11,357	4,507	3,540	4,458	0	2,567	5,032	1,949	0	7,601
Riparian area: # Stream Bank Stabilization (SBS)	797	188	7,289	6,581	15,180	71,718	18,464	24,404	76,915	19,430	20,678	29,447	53,293
# WASCOBs	7	2	10	3	7	16	15	42	52	29	44	29	55
Area WASCOB basins when filled (sq m)	12,141	0	4,047	4,047	20,234	48,562	12,141	121,406	198,296	44,515	141,640	97,125	165,921

Table D.2., continued. ACPF results for several BMPs by HUC 14.

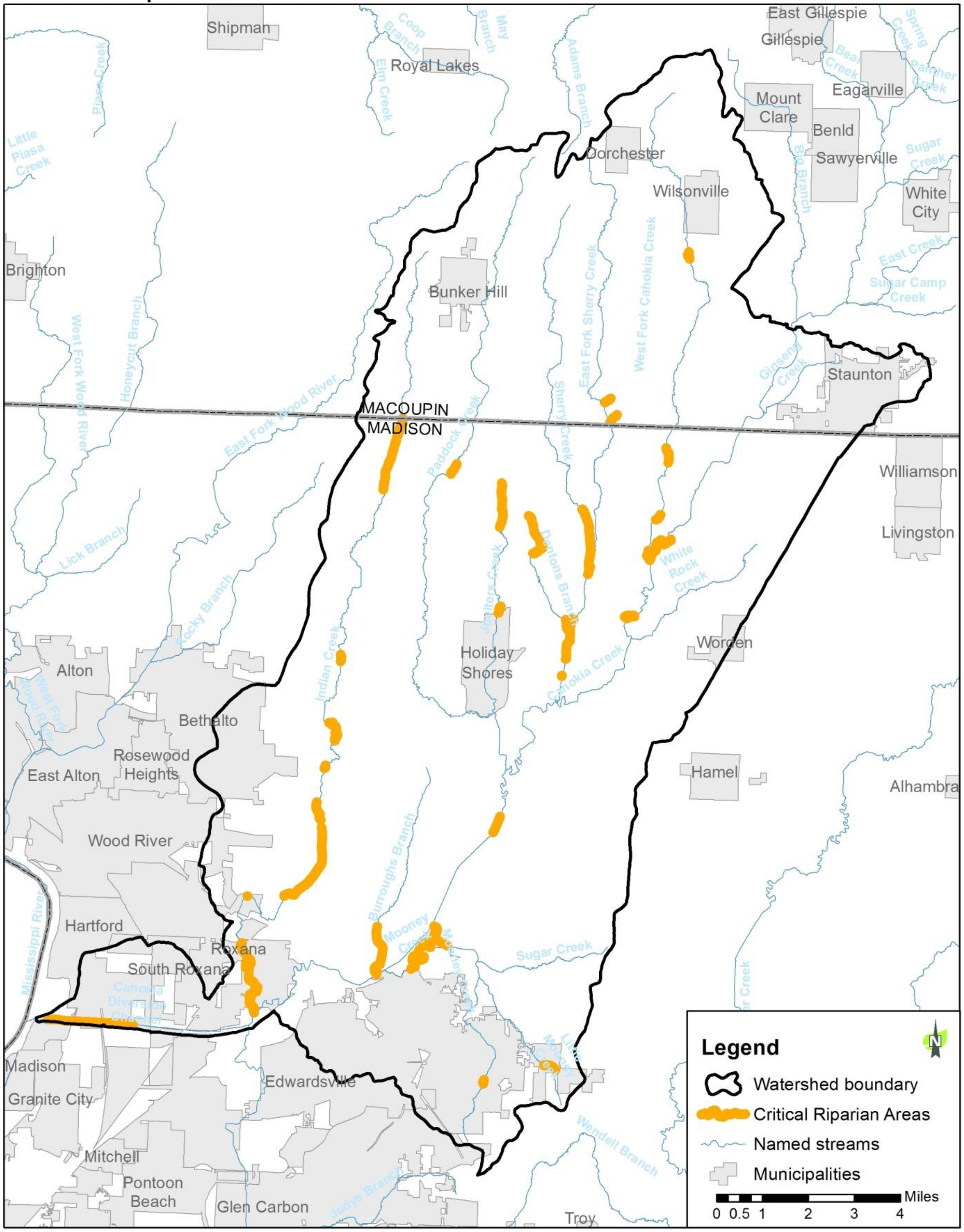
ACPF Results	HUC14 (last three digits)														
	501	502	503	504	505	506	601	602	603	604	605	701	702	703	TOTAL
# bioreactors	4	**15**	1	1	2	0	7	3	4	9	2	6	0	3	**125**
Total area bioreactors (sq m)	4,049	10,819	411	477	1,279	0	5,257	2,169	2,880	**11,569**	2,331	6,593	0	3,100	**112,040**
# contour buffer strips	44	66	16	15	9	8	28	124	59	**144**	100	26	14	0	**1,009**
Total area contour buffer strips (sq m)	32,780	58,069	11,197	10,533	8,482	7,335	22,033	111,081	49,170	**139,258**	101,600	23,535	13,982	0	**882,250**
Grass waterways total length (m)	3,257	3,736	754	1,327	488	1,081	10,234	9,593	2,062	7,050	8,792	2,862	1,237	0	**111,790**
# drainage management polygons	25	44	7	8	9	7	22	12	14	21	10	16	0	28	**730**
Area drainage management fields (sq m)	2,759,956	4,552,713	829,606	1,477,103	878,168	882,215	2,055,803	841,746	1,108,839	1,902,023	1,355,697	1,610,649	0	4,714,588	**77,120,943**
# nutrient removal wetlands	8	8	2	10	6	2	12	**28**	14	10	14	6	4	0	**212**
Nutrient removal wetlands area (wetland & buffers) (sq m)	113,312	101,171	20,234	169,968	93,078	28,328	206,390	408,732	352,077	254,952	327,795	364,217	40,469	0	**4,026,622**
Wetland area only (sq m)	56,656	56,656	12,141	76,890	40,469	12,141	109,265	182,109	129,499	97,125	137,593	101,171	20,234	0	**1,707,773**
Area drainage to nutrient removal wetlands (sq m)	108,760	97,045	18,294	168,694	89,434	28,104	206,861	410,590	349,533	256,739	330,585	360,358	41,259	0	**4,005,140**
Riparian area: # Critical Zone segments (CZ)	0	0	0	**1,651**	0	0	0	0	0	0	0	0	0	0	**4,596**
Riparian area: # Multi Species Buffer (MSB)	0	0	0	0	4,603	0	2,993	0	2,511	0	0	0	0	**5,694**	**39,607**
Riparian area: # Stiff Stemmed Grasses (SSG)	13,328	15,561	17,366	0	27,732	6,174	8,230	27,196	15,961	18,902	23,222	5,926	32,020	7,012	**352,926**
Riparian area: # Deep Rooted Vegetation (DRV)	0	0	0	3,170	4,559	0	3,336	0	3,741	1,190	0	0	0	**12,113**	**71,491**
Bank Stabilization (SBS)	41,059	46,583	36,499	9,906	72,399	18,130	19,885	35,352	39,497	35,040	64,267	34,364	88,978	**100,094**	**986,437**
#WASCOBs	36	27	22	15	9	10	28	64	54	**69**	55	24	6	1	**731**
Area WASCOB basins when filled (sq m)	97,125	89,031	80,937	40,469	40,469	24,281	36,422	182,109	230,671	**295,421**	169,968	64,750	28,328	8,094	**2,258,146**

Critical Areas Maps – Watershed-wide

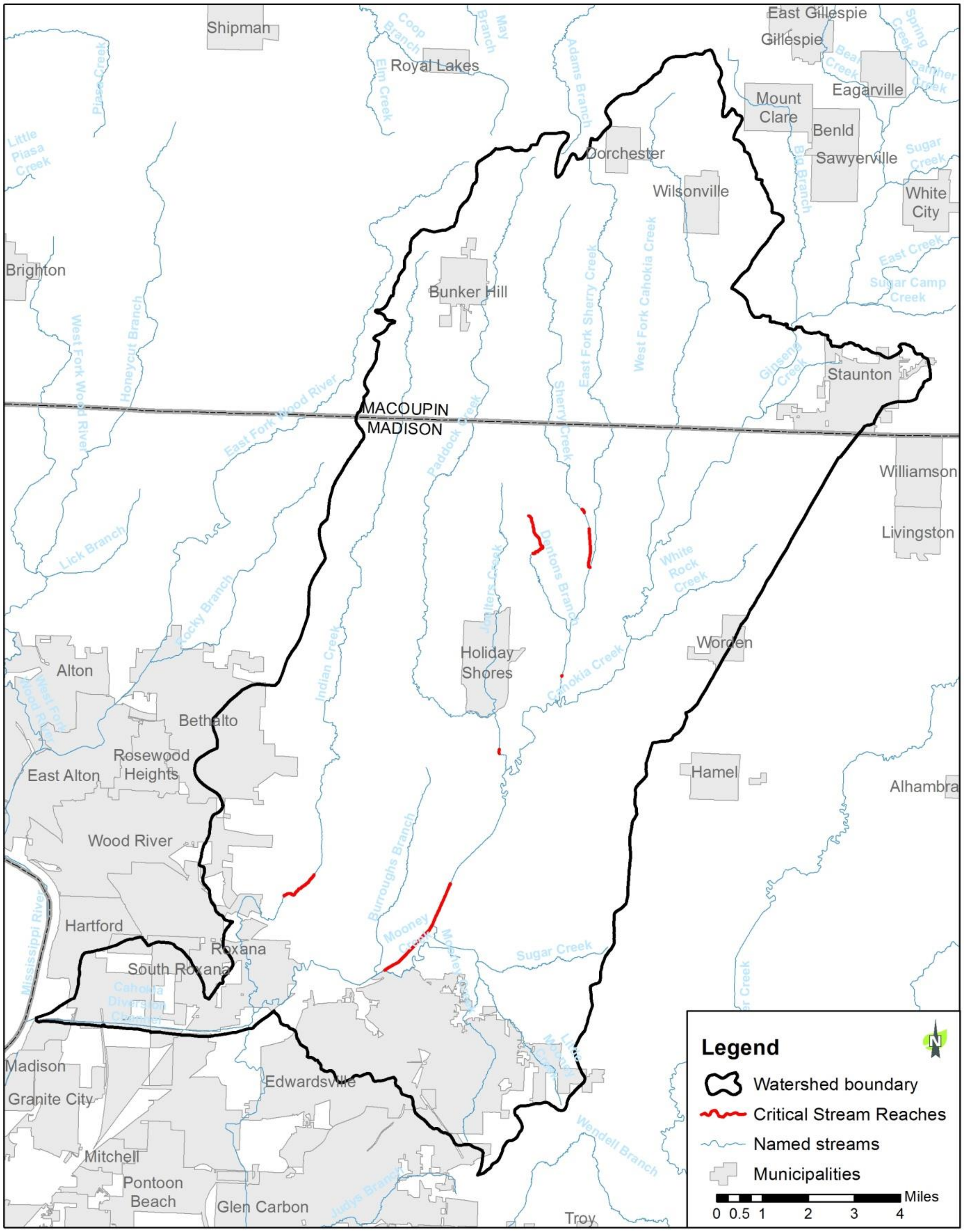
Critical Logjam Areas



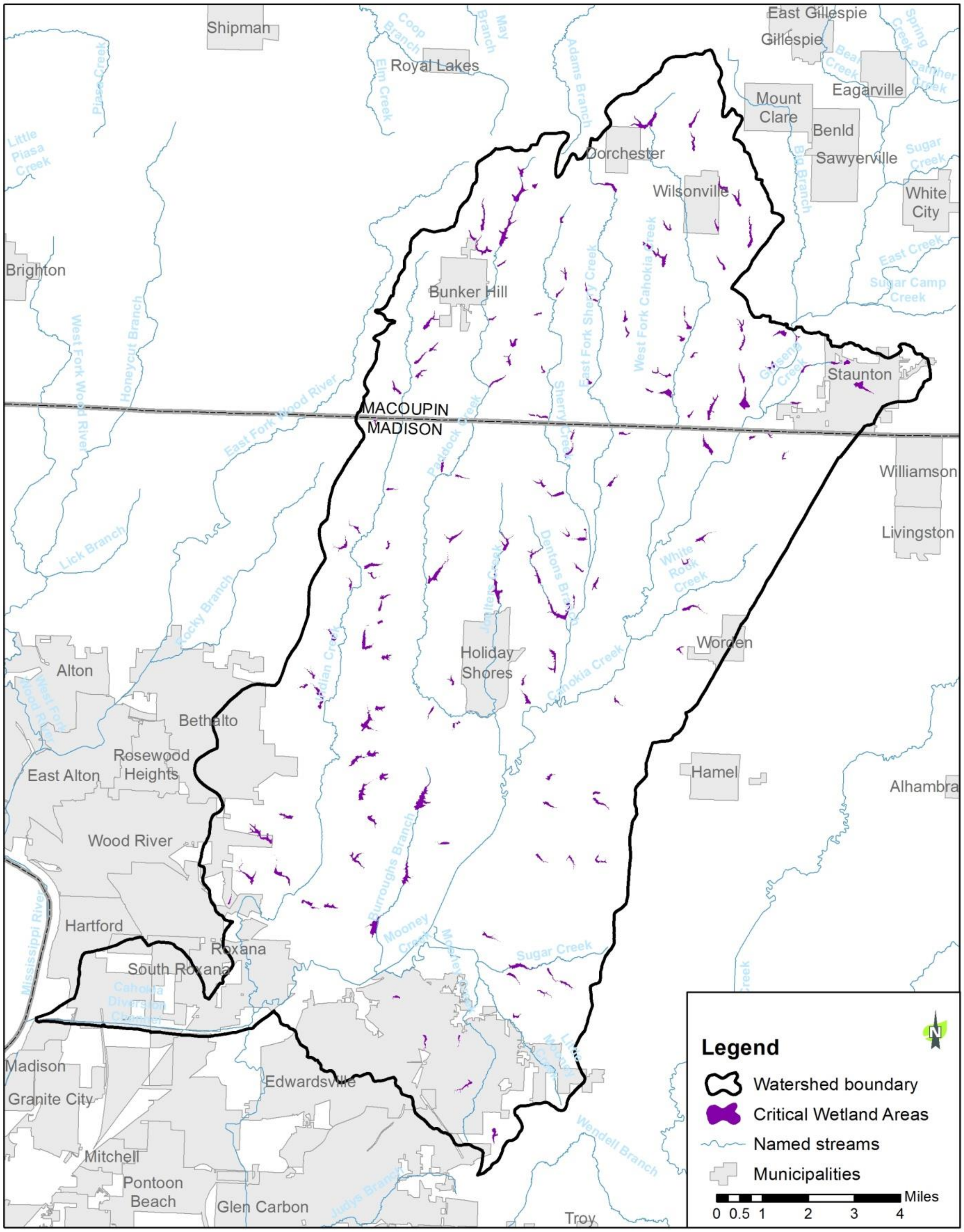
Critical Riparian Areas



Critical Stream Reaches



Critical Wetland Areas



Critical Areas Maps – HUC14 Subwatersheds

HUC 07140101020101: Upper West Fork Cahokia Creek (Dorchester, Wilsonville area)

This subwatershed drains the headwaters of West Fork Cahokia Creek in Macoupin County. It includes portions of Dorchester and Wilsonville.

Area: 4,881 acres
Named streams: West Fork Cahokia Creek
Counties: Macoupin
Municipalities: Dorchester, Wilsonville
Townships: Gillespie, Dorchester

Critical Logjam Areas: No Critical Logjam Areas were identified in this subwatershed.

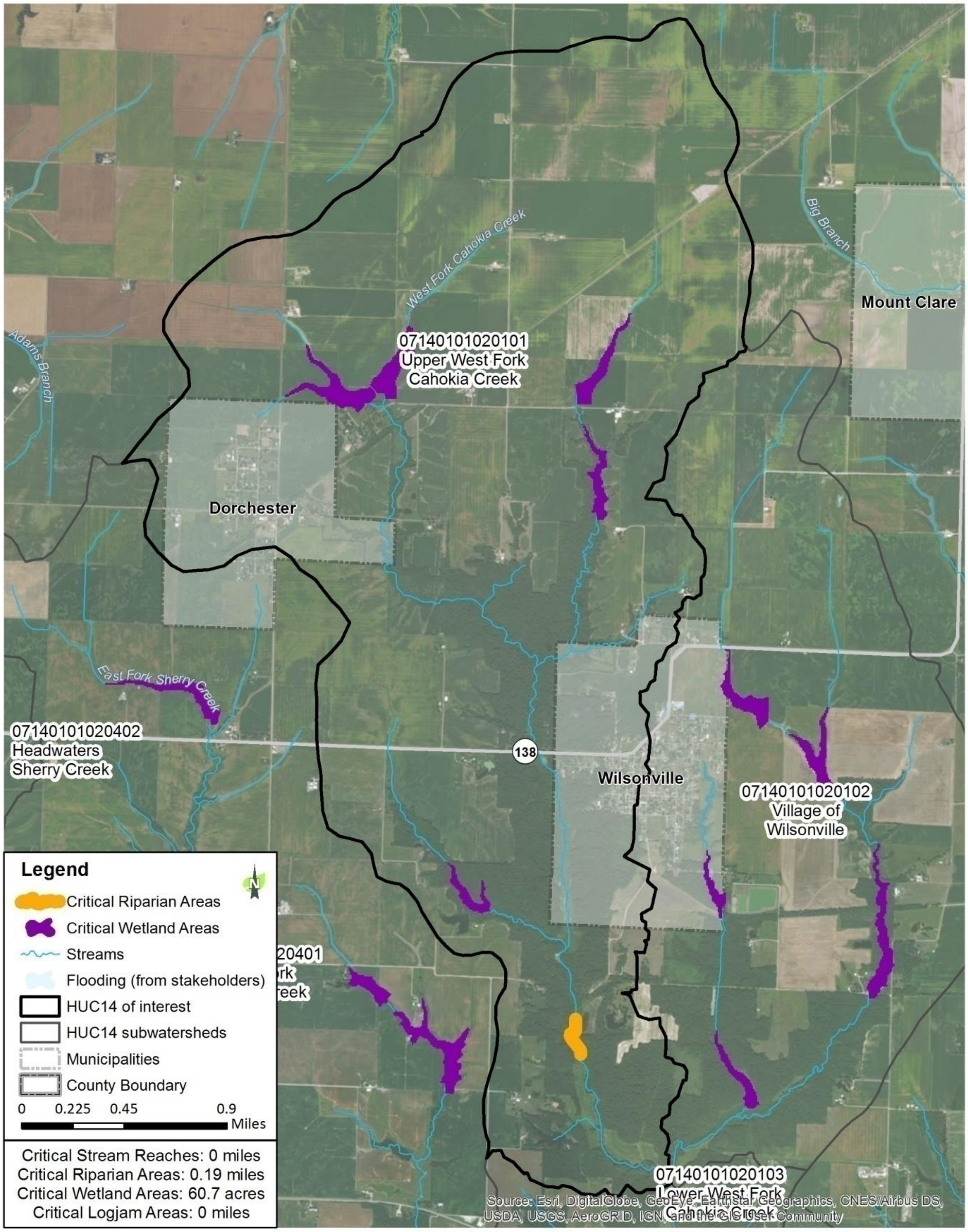
Critical Stream Reaches: No Critical Stream Reaches were identified in this subwatershed.

Critical Riparian Areas: A 979-foot (0.19 mile) Critical Riparian Area was identified on West Fork Cahokia Creek.

Critical Wetland Areas: 60.7 acres of wetlands were identified along the upper reaches of four tributaries.

No **flooding locations** were **identified by stakeholders** in this subwatershed.

HUC 07140101020101: Upper West Fork Cahokia Creek



HUC 0714010102**0102: Village of Wilsonville** (east side of Wilsonville)

This subwatershed drains the area east of Wilsonville in Macoupin County into West Fork Cahokia Creek.

Area: 2,528 acres
Named streams: None
Counties: Macoupin
Municipalities: Wilsonville
Townships: Gillespie, Dorchester

Critical Logjam Areas: No Critical Logjam Areas were identified in this subwatershed.

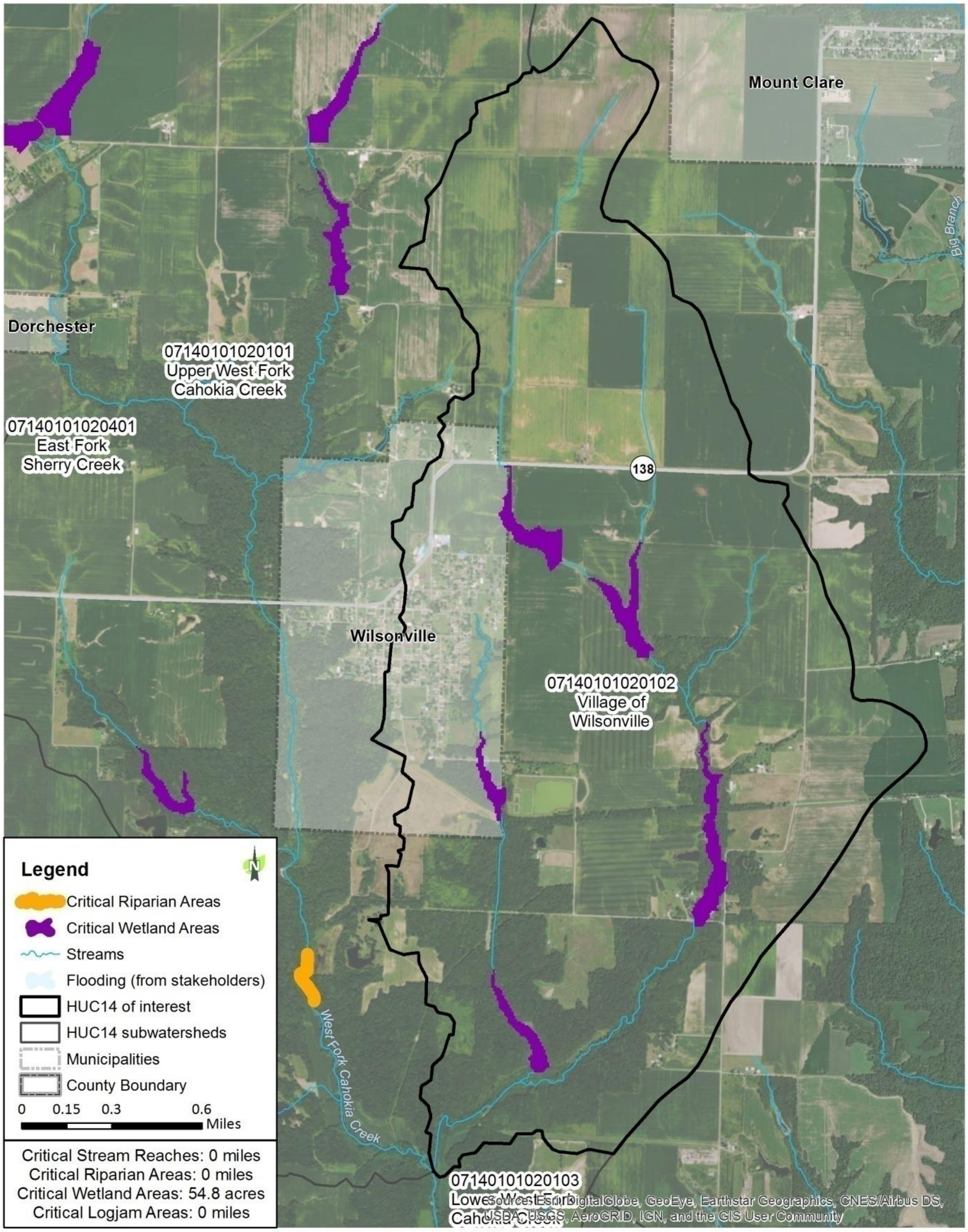
Critical Stream Reaches: No Critical Stream Reaches were identified in this subwatershed.

Critical Riparian Areas: No Critical Riparian Areas were identified in this subwatershed.

Critical Wetland Areas: 54.8 acres of Critical Wetland Areas were identified at several locations on the unnamed tributaries in this subwatershed.

No **flooding locations** were **identified by stakeholders** in this subwatershed.

HUC 07140101020102: Village of Wilsonville



HUC 071401010**2**0103: **Lower West Fork Cahokia Creek** (west of Staunton, along West Fork Cahokia Creek)

This subwatershed is a long, rectangular-shaped drainage area along West Fork Cahokia Creek. About half of the subwatershed falls in Macoupin County, with the other half in Madison County.

Area: 4,214 acres
Named streams: West Fork Cahokia Creek
Counties: Macoupin, Madison
Municipalities: None
Townships: Dorchester, Omphghent

Critical Logjam Areas: 6,365 feet (1.2 miles) of Critical Logjam Areas were identified in one segment running north-south in the center of the subwatershed.

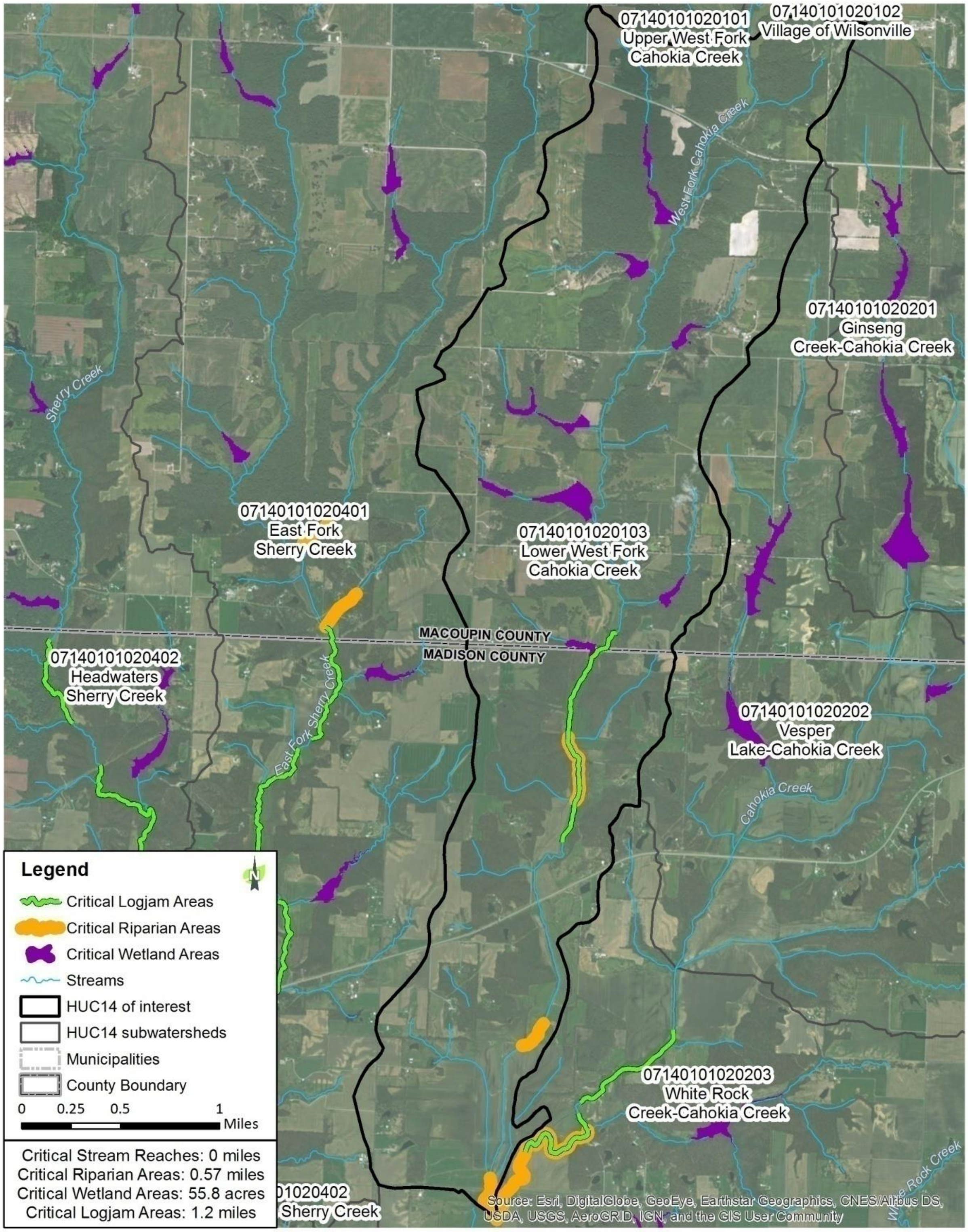
Critical Stream Reaches: No Critical Stream Reaches were identified in this subwatershed.

Critical Riparian Areas: 3,014 feet (0.57 miles) of Critical Riparian Areas were identified along West Fork Cahokia Creek.

Critical Wetland Areas: 55.8 acres of Critical Wetland Areas were identified in the Macoupin County portion of the subwatershed, near West Fork Cahokia Creek.

No **flooding locations** were **identified by stakeholders** in this subwatershed.

HUC 07140101020103: Lower West Fork Cahokia Creek



HUC 0714010**20201: Ginseng Creek-Cahokia Creek** (Staunton area)

This subwatershed drains much of the Village of Staunton in Macoupin County. It includes the uppermost section of Cahokia Creek in this HUC10 watershed, receiving water from the upstream HUC10, Big Branch-Cahokia Creek (0714010101). It also includes Ginseng Creek, which drains the west side of Staunton.

Area: 7,750 acres
Named streams: Cahokia Creek, Ginseng Creek
Counties: Macoupin
Municipalities: Staunton
Townships: Dorchester, Staunton

Critical Logjam Areas: No Critical Logjam Areas were identified in this subwatershed.

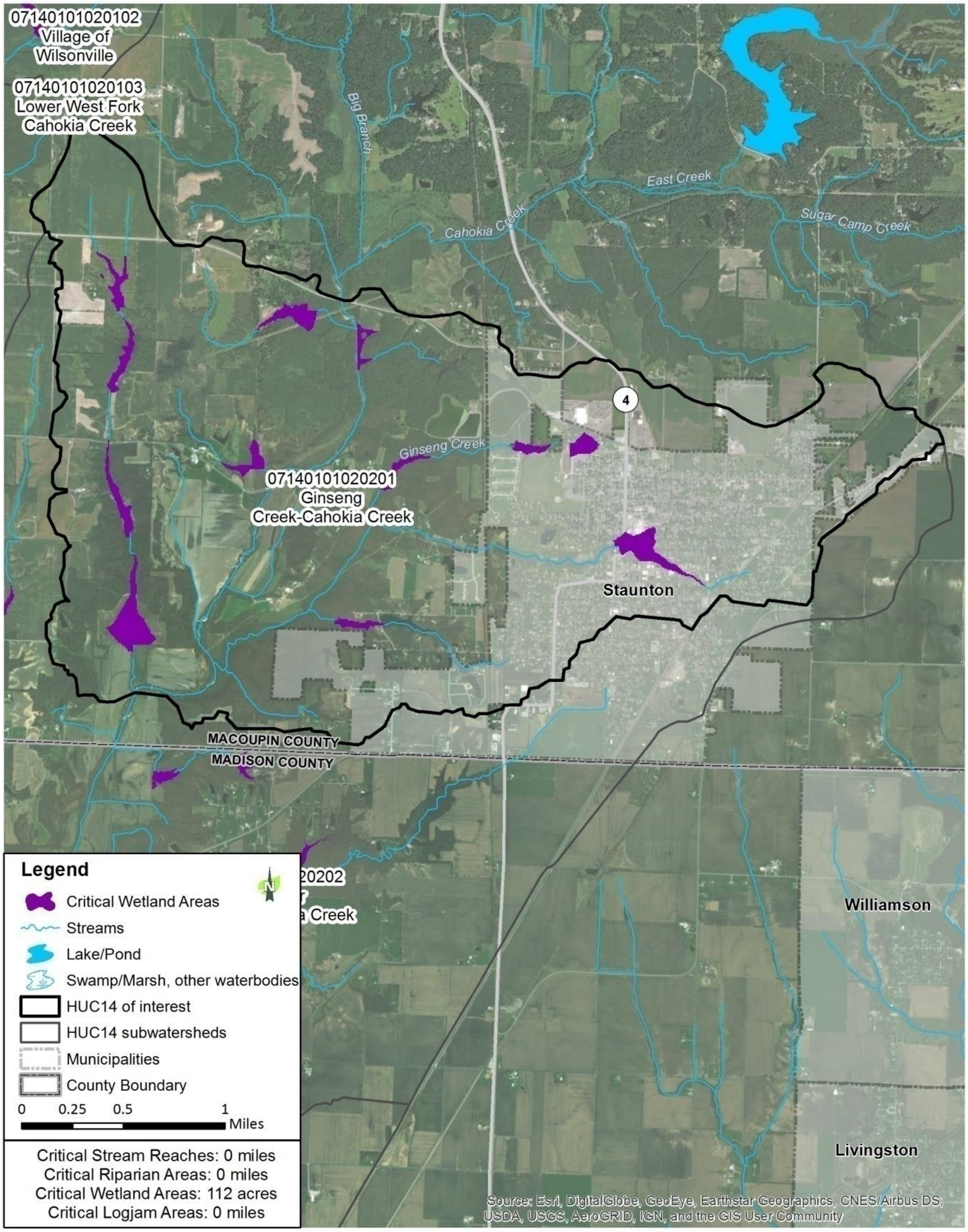
Critical Stream Reaches: No Critical Stream Reaches were identified.

Critical Riparian Areas: No Critical Riparian Areas were identified.

Critical Wetland Areas: 112.0 acres of Critical Wetland Areas were identified both on unnamed tributaries and within the Village of Staunton (these are already developed and unlikely to be restored).

No **flooding locations** were **identified by stakeholders** in this subwatershed.

HUC 07140101020201: Ginseng Creek-Cahokia Creek



HUC 071401020202: **Vesper Lake-Cahokia Creek** (west of Williamson)

This U-shaped subwatershed lies at the border of Macoupin County and Madison County, with the majority of its area in Madison County. It drains the area west of Williamson and I-55. Illinois State Route 4 bisects the eastern portion of the watershed.

Area: 5,100 acres
Named streams: Cahokia Creek
Counties: Madison, Macoupin
Municipalities: Staunton
Townships: Omphghent, Olive, Staunton, Dorchester

Critical Logjam Areas: No Critical Logjam Areas were identified in this subwatershed.

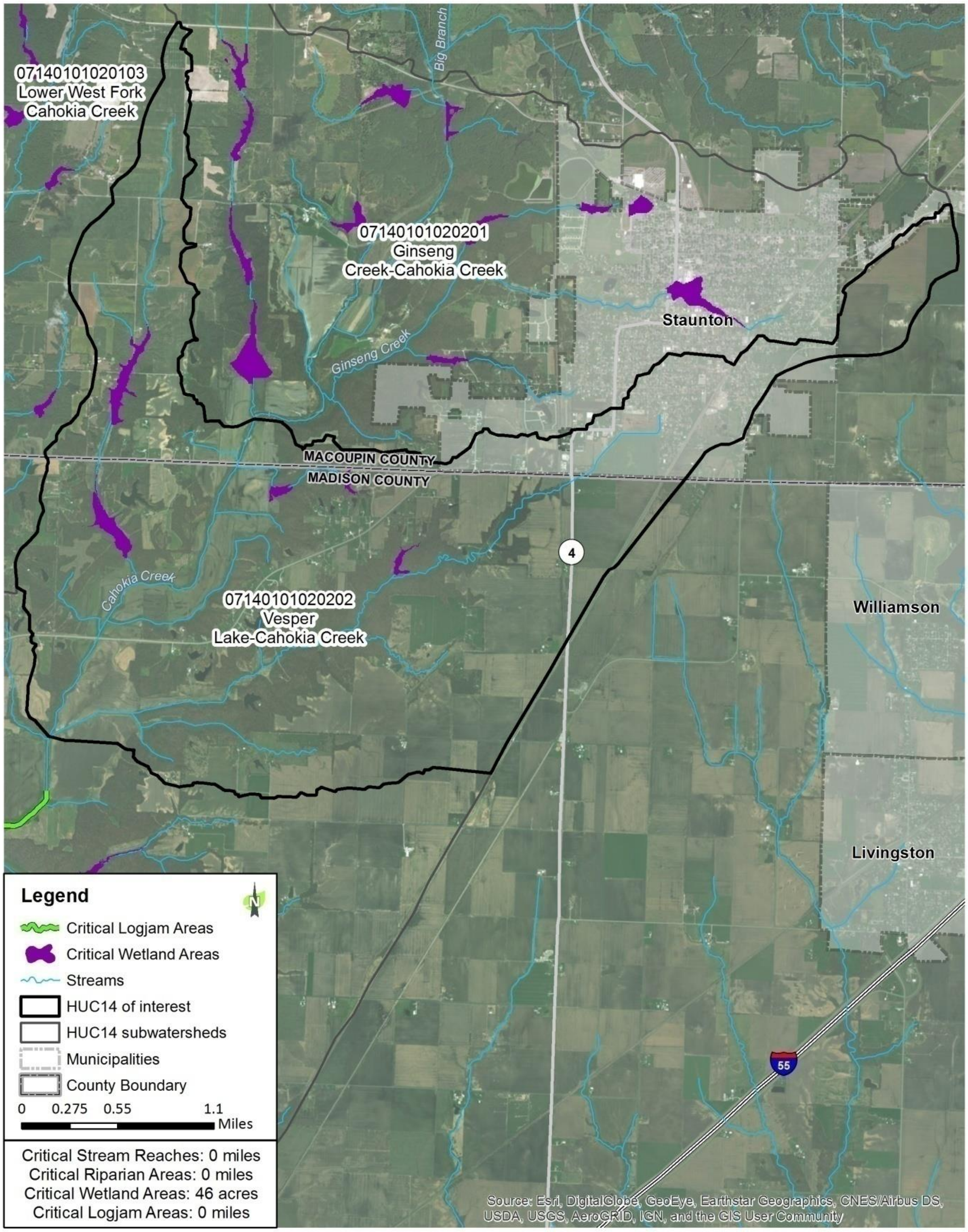
Critical Stream Reaches: No Critical Stream Reaches were identified.

Critical Riparian Areas: No Critical Riparian Areas were identified.

Critical Wetland Areas: 46.0 acres of Critical Wetland Areas were identified. The greatest concentration of these areas is in the northwest portion of the watershed.

No **flooding locations** were **identified by stakeholders** in this subwatershed.

HUC 07140101020202: Vesper Lake-Cahokia Creek



HUC 071401020203: **White Rock Creek-Cahokia Creek** (north of Worden)

This subwatershed lies north of Worden and west of Illinois State Route 4. It contains primarily agricultural and forested land, and drains the headwaters of White Rock Creek.

Area: 5,820 acres
Named streams: Cahokia Creek, White Rock Creek, West Fork Cahokia Creek
Counties: Madison
Municipalities: Worden
Townships: Omphghent

Critical Logjam Areas: 17,006 feet (3.2 miles) of Critical Logjam Areas were identified, primarily in the western portion of the subwatershed.

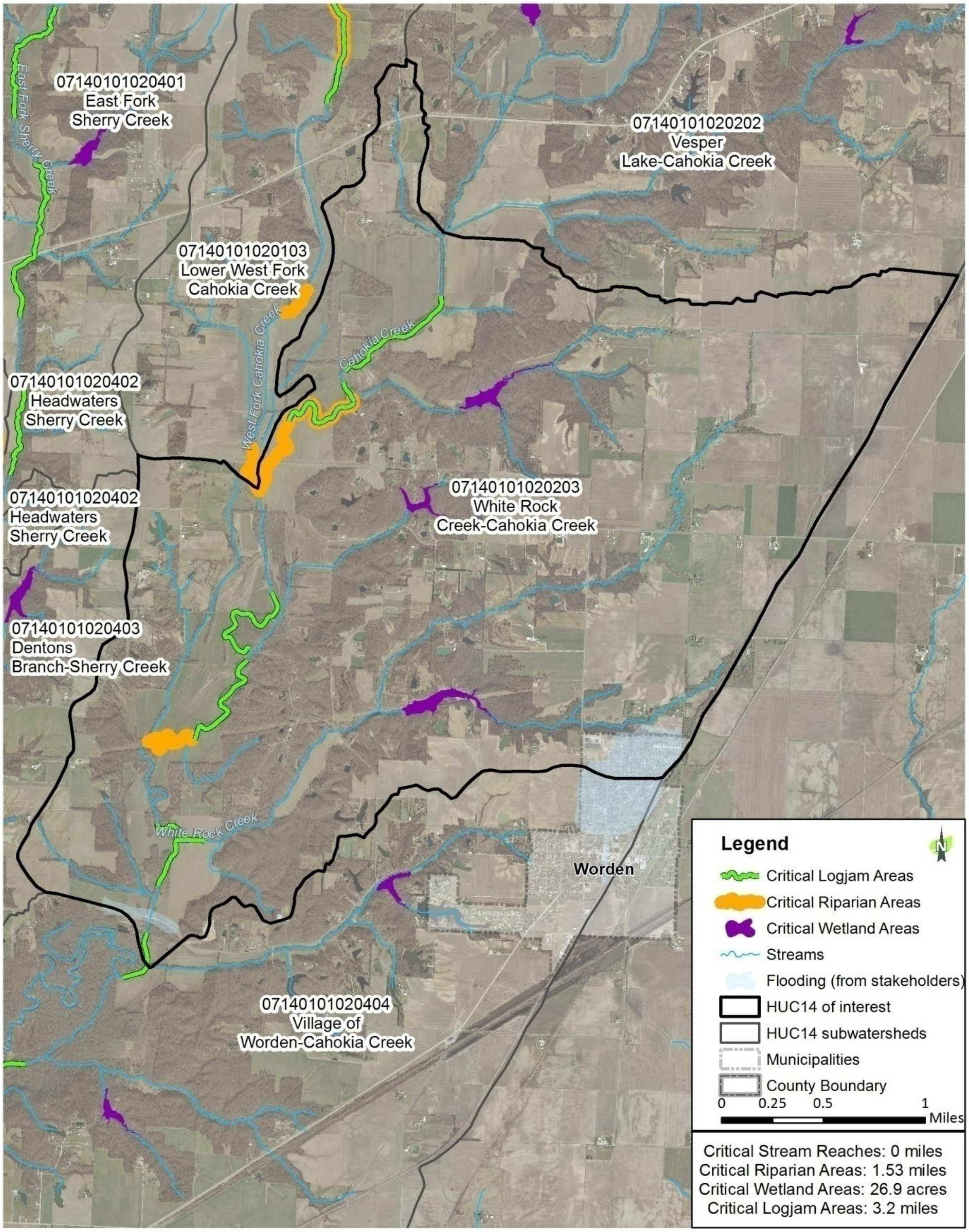
Critical Stream Reaches: No Critical Stream Reaches were identified.

Critical Riparian Areas: 8,067 feet (1.53 miles) of Critical Riparian Areas were identified on two tributaries in the western portion of the subwatershed; one segment occurring along Cahokia Creek north of its convergence with West Fork Cahokia Creek, and the other along Cahokia Creek in the southwest portion of the watershed.

Critical Wetland Areas: 26.9 acres of Critical Wetland Areas were identified in three large areas; two along tributaries of Cahokia Creek, and one along a tributary of White Rock Creek.

Flooding locations were **identified by stakeholders** in three locations, including two areas in the northern portion of Worden where flooding and road overtopping occurs, and one area in the southwestern portion of the watershed.

HUC 07140101020203: White Rock Creek-Cahokia Creek



HUC 071401020301: **Upper Paddock Creek** (Bunker Hill area)

This long, narrow subwatershed is located in the northwest portion of the watershed. It drains the headwaters of Paddock Creek and the eastern portion of Bunker Hill. State Routes 159 and 138 run through it.

Area: 5,148 acres
Named streams: Paddock Creek
Counties: Macoupin
Municipalities: Bunker Hill
Townships: Bunker Hill, Dorchester

Critical Logjam Areas: No Critical Logjam Areas were identified in this subwatershed.

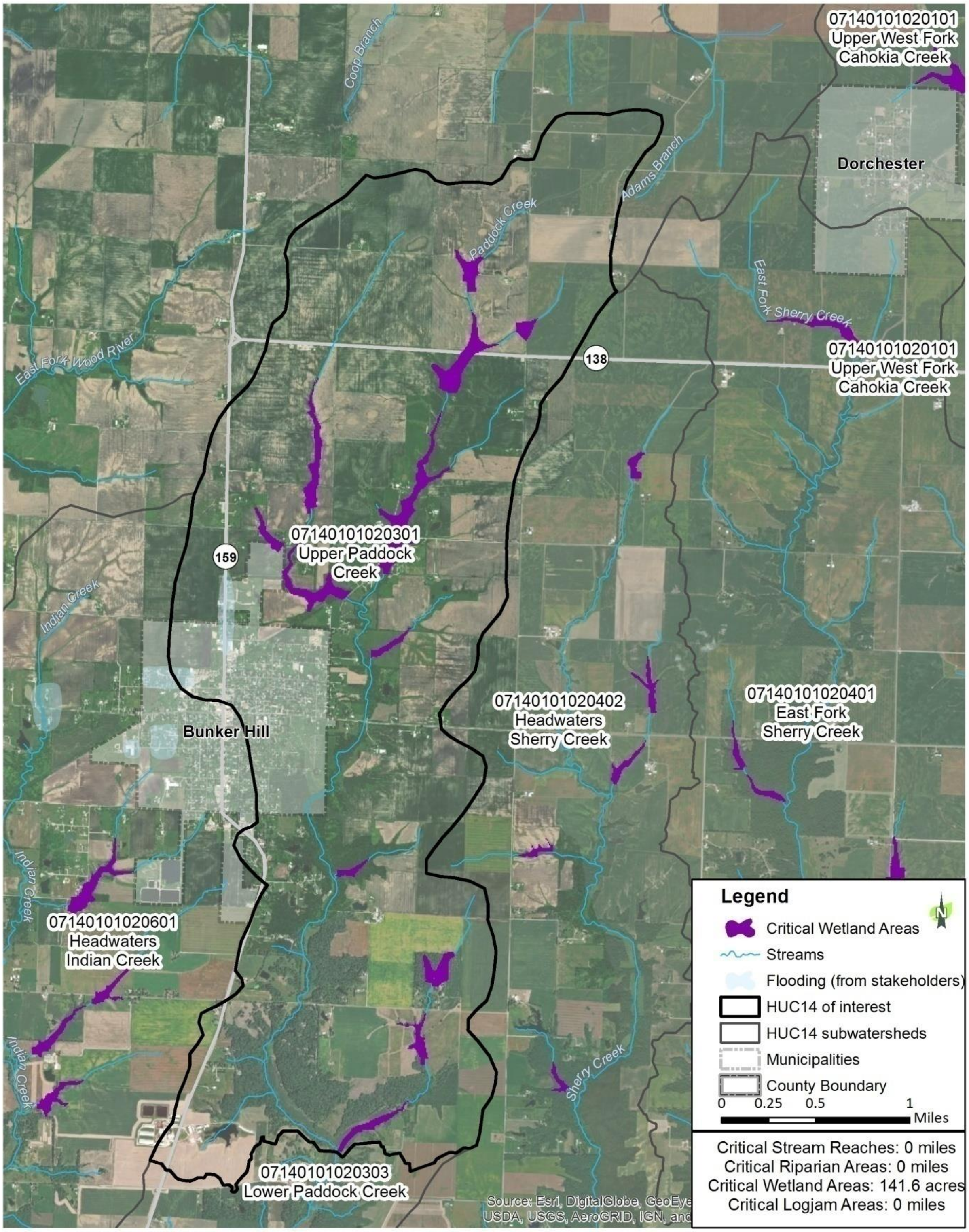
Critical Stream Reaches: No Critical Stream Reaches were identified.

Critical Riparian Areas: No Critical Riparian Areas were identified.

Critical Wetland Areas: 141.6 acres of Critical Wetland Areas were identified along Paddock Creek and its tributaries throughout the watershed.

Flooding locations were **identified by stakeholders** in two locations throughout the watershed, including 20 acres of road overtopping along State Route 159 north of Bunker Hill. The remaining portion of flooding occurred in a subdivision in Bunker Hill.

HUC 07140101020301: Upper Paddock Creek



HUC 071401020302: **Joulters Creek** (Holiday Shores area)

This diamond-shaped subwatershed drains Holiday Shores and the headwaters of Joulters Creek.

Area: 3,940 acres
Named streams: Joulters Creek
Counties: Madison
Municipalities: Holiday Shores
Townships: Moro, Omphghent

Critical Logjam Areas: 1,379 feet (0.3 miles) of Critical Logjam Areas were identified in one small segment at the southern tip of the subwatershed.

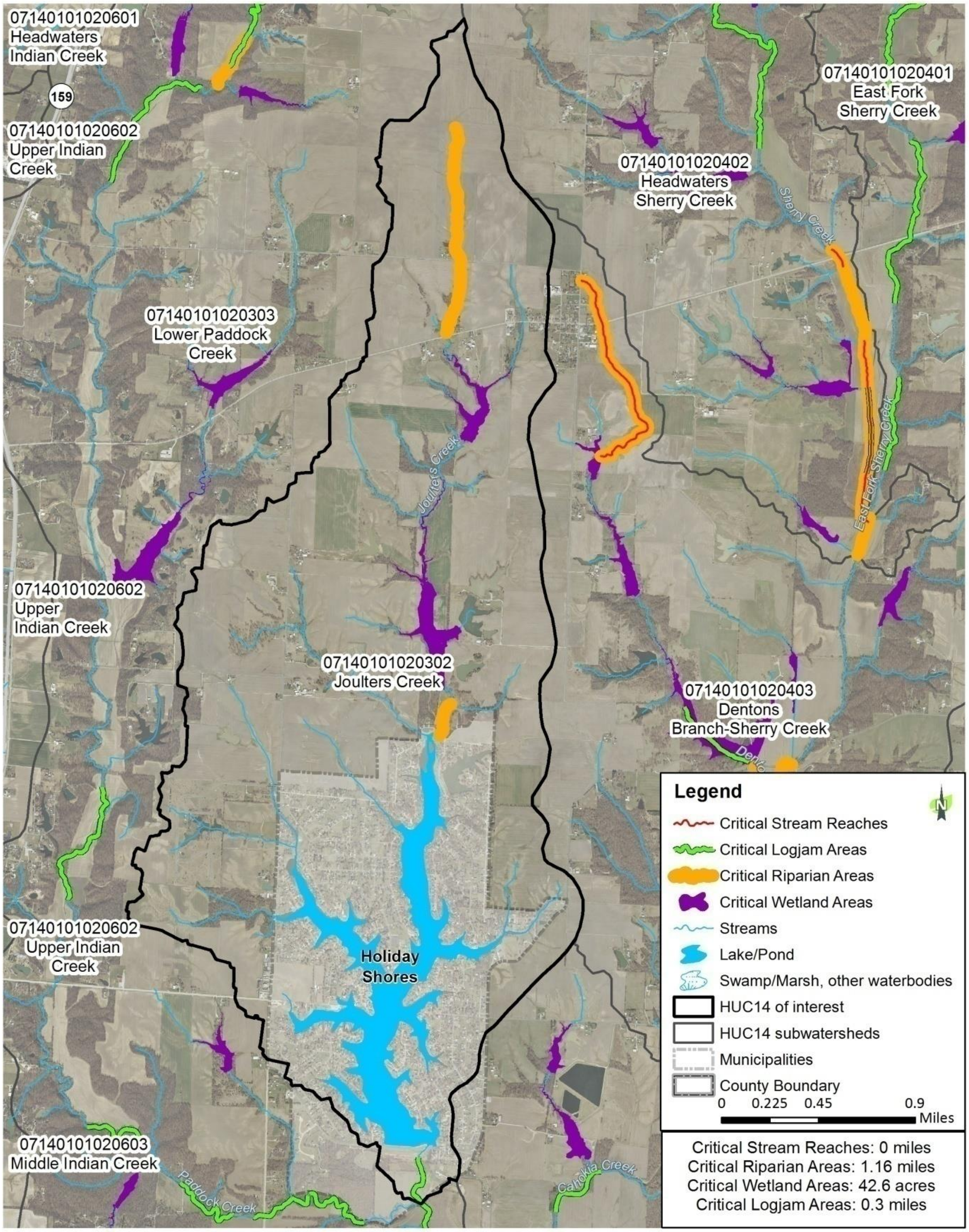
Critical Stream Reaches: No Critical Stream Reaches were identified.

Critical Riparian Areas: 6,145 feet (1.16 miles) of Critical Riparian Areas were identified along two sections of Joulters Creek., both near a Critical Wetland Area.

Critical Wetland Areas: 42.6 acres of Critical Wetland Areas were identified in agricultural areas around Joulters Creek.

No **flooding locations** were **identified by stakeholders** in this subwatershed.

HUC 07140101020302: Joulters Creek



HUC 071401020303: **Lower Paddock Creek** (west of Holiday Shores)

This long, narrow subwatershed is located primarily in Madison County, to the west of Holiday Shores. Its western border parallels Illinois State Route 159, and Illinois State Route 140 bisects its southern portion.

Area: 7,066 acres
Named streams: Paddock Creek
Counties: Macoupin, Madison
Municipalities: Holiday Shores
Townships: Bunker Hill, Moro, Fort Russell

Critical Logjam Areas: 22,424 feet (4.2 miles) of Critical Logjam Areas were identified in the subwatershed along Paddock Creek.

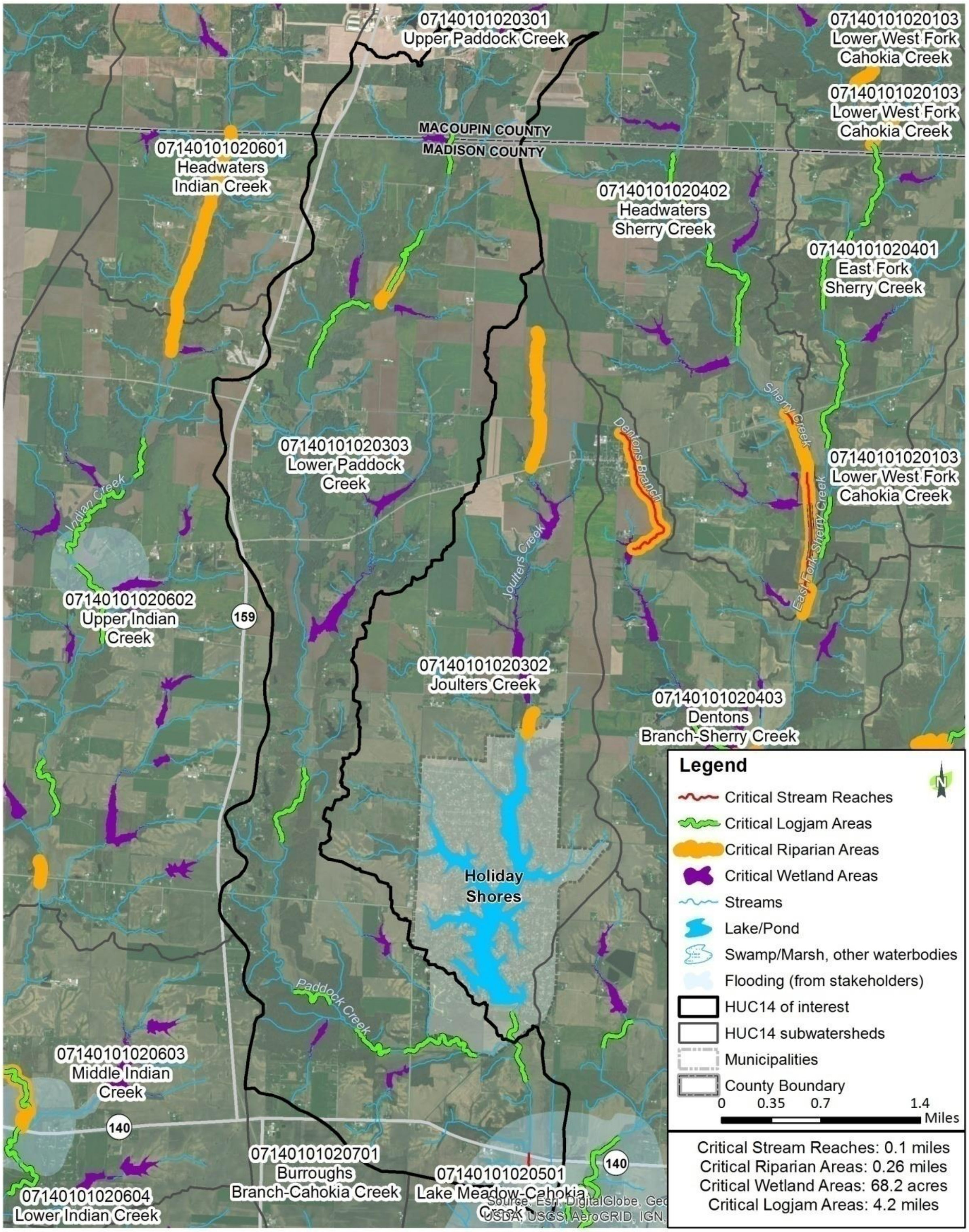
Critical Stream Reaches: 531 feet (0.10 miles) of Critical Stream Reaches were identified on a tributary in the southern portion of the subwatershed. It overlaps with a flooding location identified by stakeholders.

Critical Riparian Areas: 1,389 feet (0.26 miles) of Critical Riparian Areas were identified along Paddock Creek in the northern portion of the watershed.

Critical Wetland Areas: 68.2 acres of Critical Wetland Areas were identified, primarily in forested areas throughout the subwatershed.

Flooding locations were **identified by stakeholders** in one location at the southern portion of the subwatershed.

HUC 07140101020303: Lower Paddock Creek



HUC 071401020401: **East Fork Sherry Creek** (south of Dorchester)

This rectangular-shaped subwatershed is located in both Macoupin and Madison counties. It drains the southern portions of Dorchester. Illinois State Route 138 runs through the northern portion of the subwatershed.

Area: 8,208 acres
Named streams: East Fork Sherry Creek
Counties: Macoupin, Madison
Municipalities: Dorchester
Townships: Dorchester, Omphghent

Critical Logjam Areas: 14,623 feet (2.8 miles) of Critical Logjam Area were identified in the southern portion of the subwatershed.

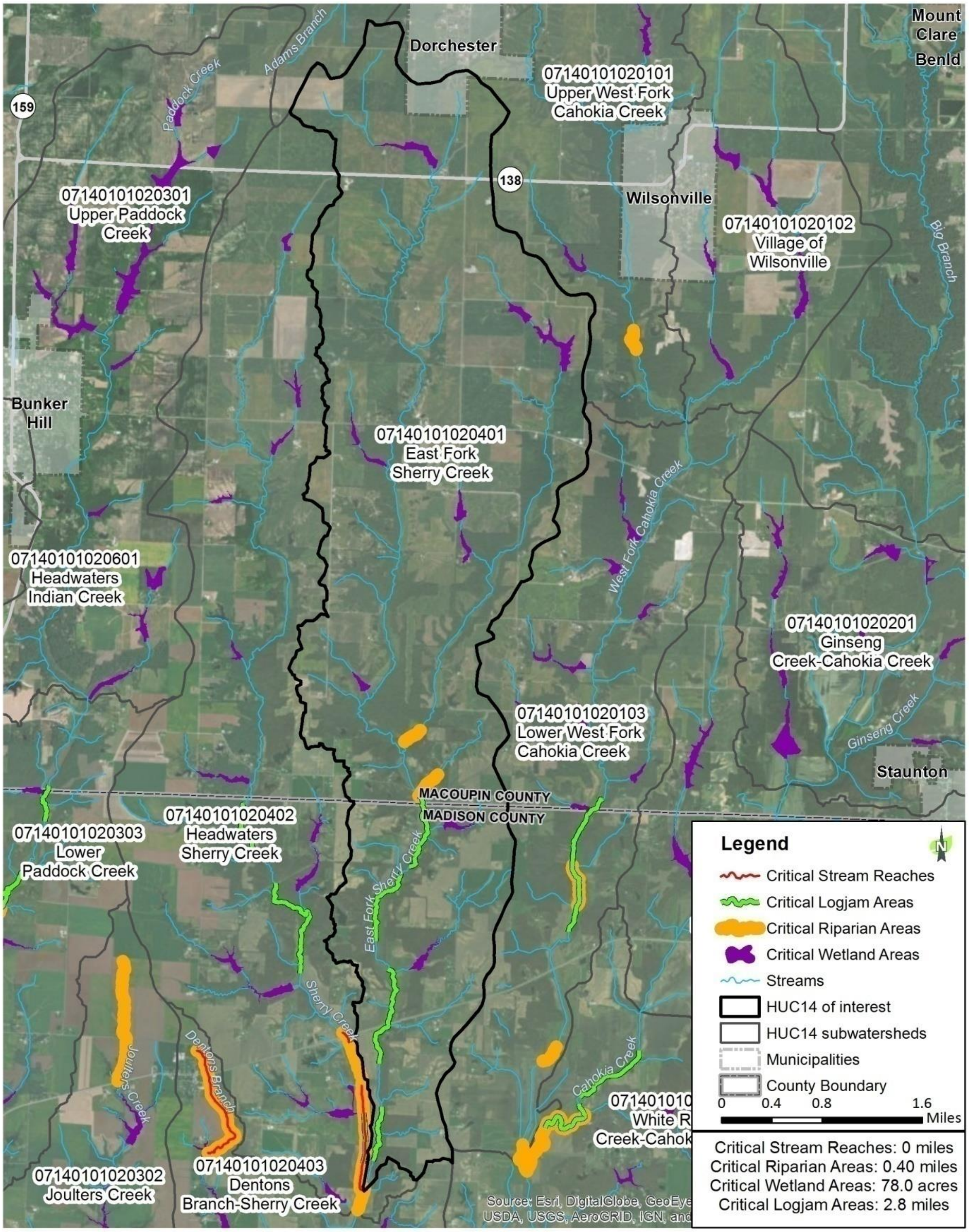
Critical Stream Reaches: No Critical Stream Reaches were identified.

Critical Riparian Areas: 2,086 feet (0.40 mile) of Critical Riparian Areas were identified in two locations along tributaries in the central portion of the subwatershed in Macoupin County.

Critical Wetland Areas: 78.0 acres of Critical Wetland Areas were identified in ten locations along East Fork Sherry Creek and its tributaries.

No **flooding locations** were **identified by stakeholders** in this subwatershed.

HUC 07140101020401: East Fork Sherry Creek



HUC 071401020402: **Headwaters Sherry Creek** (east of Bunker Hill)

This long, narrow subwatershed is bisected by the Macoupin-Madison County line. Illinois State Route 138 runs through the northern portion. It drains the headwaters of Sherry Creek and consists of mainly agricultural and forested land.

Area: 6,522 acres
Named streams: Sherry Creek
Counties: Macoupin, Madison
Municipalities: None
Townships: Moro, Dorchester, Bunker Hill, Omphghent

Critical Logjam Areas: 10,470 feet (2 miles) of Critical Logjam Areas were identified in two segments along Sherry Creek in the central portion of the watershed.

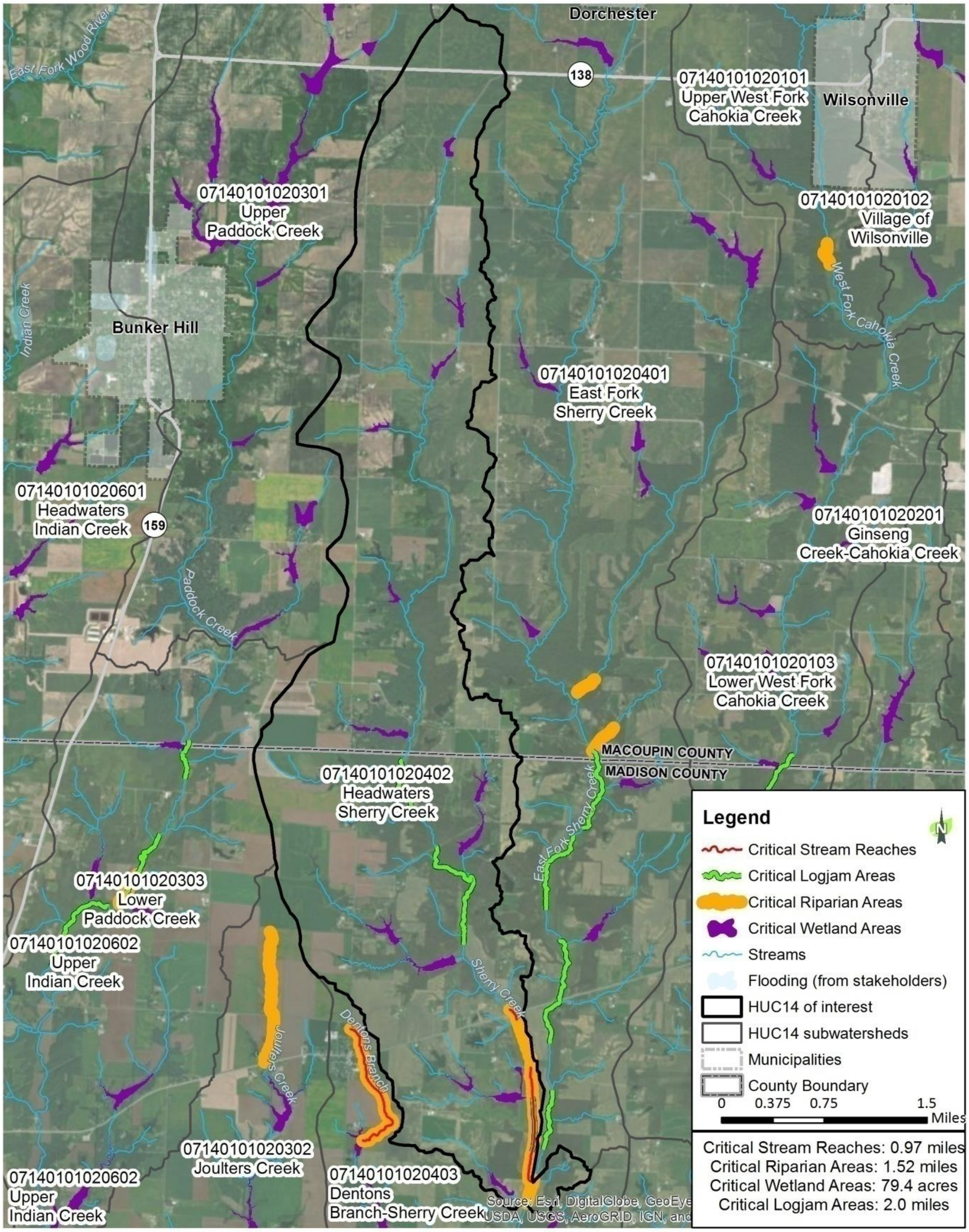
Critical Stream Reaches: 5,100 feet (0.97 mile) Critical Stream Reaches were identified in the southern portion of the watershed along Sherry Creek. This area overlaps with a Critical Riparian Area.

Critical Riparian Areas: 8,021 feet (1.52 miles) Critical Riparian Areas were identified in the southern portion of the watershed along Sherry Creek. This area overlaps with a Critical Stream Reach area.

Critical Wetland Areas: 79.4 acres of Critical Wetland Areas were identified along Sherry Creek and its tributaries throughout the subwatershed.

No **flooding locations** were **identified by stakeholders** in this subwatershed.

HUC 07140101020402: Headwaters Sherry Creek



HUC 071401020403: **Dentons Branch-Sherry Creek** (east of Holiday Shores)

This triangular-shaped subwatershed is located in the central portion of the watershed area. It is made of up primarily agricultural and forested land.

Area: 3,216 acres
Named streams: Sherry Creek, Dentons Branch
Counties: Madison
Municipalities: None
Townships: Omphghent, Hamel

Critical Logjam Areas: 7,188 feet (1.4 miles) of Critical Logjam Area were identified in two segments in the subwatershed: one along Dentons Branch, and one along Sherry Creek.

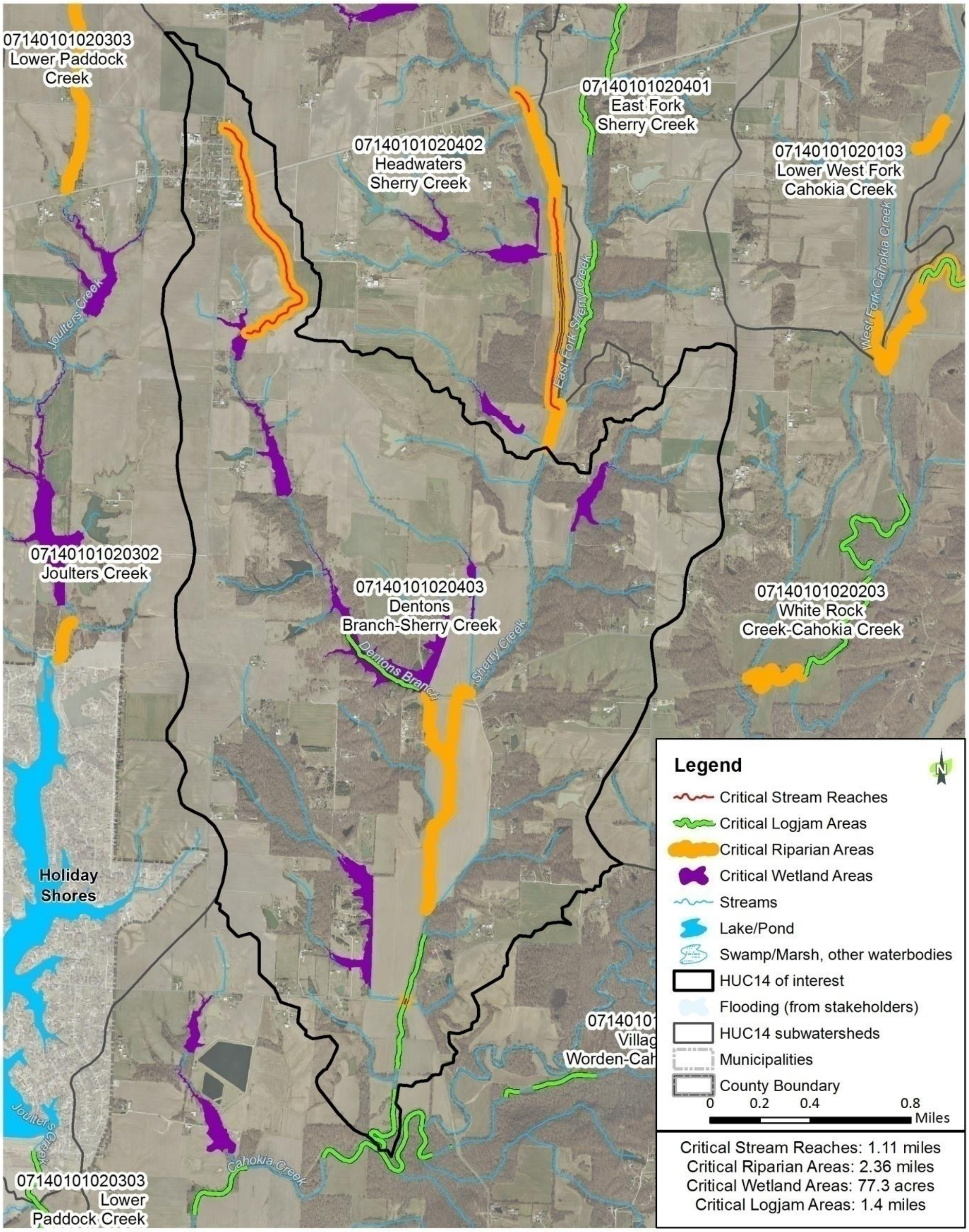
Critical Stream Reaches: 5,869 feet (1.11 miles) of Critical Stream Reaches were identified, primarily along Dentons Branch in the northwest portion of the subwatershed. A small area also identified in the southern portion of the subwatershed.

Critical Riparian Areas: 12,467 feet (2.36 miles) of Critical Riparian Areas were identified along Sherry Creek in an agricultural area of the central portion of the subwatershed. Another location occurs in the northern portion of the subwatershed along Dentons Branch, which was also identified as a Critical Stream Reach.

Critical Wetland Areas: 77.3 acres of Critical Wetland Areas were identified along Dentons Branch and Sherry Creek tributaries throughout the subwatershed, primarily in forested areas.

No **flooding locations** were **identified by stakeholders** in this subwatershed.

HUC 07140101020403: Dentons Branch-Sherry Creek



HUC 071401020404: **Village of Worden-Cahokia Creek** (southwest of Worden)

This subwatershed is located in the east-central portion of the watershed and drains the Village of Worden. Illinois State Route 140 runs through its southern portion.

Area: 6,084 acres
Named streams: Cahokia Creek
Counties: Madison
Municipalities: Worden, Holiday Shores
Townships: Omphghent, Hamel

Critical Logjam Areas: 30,381 feet (5.8 miles) of Critical Logjam Areas were identified on Cahokia Creek.

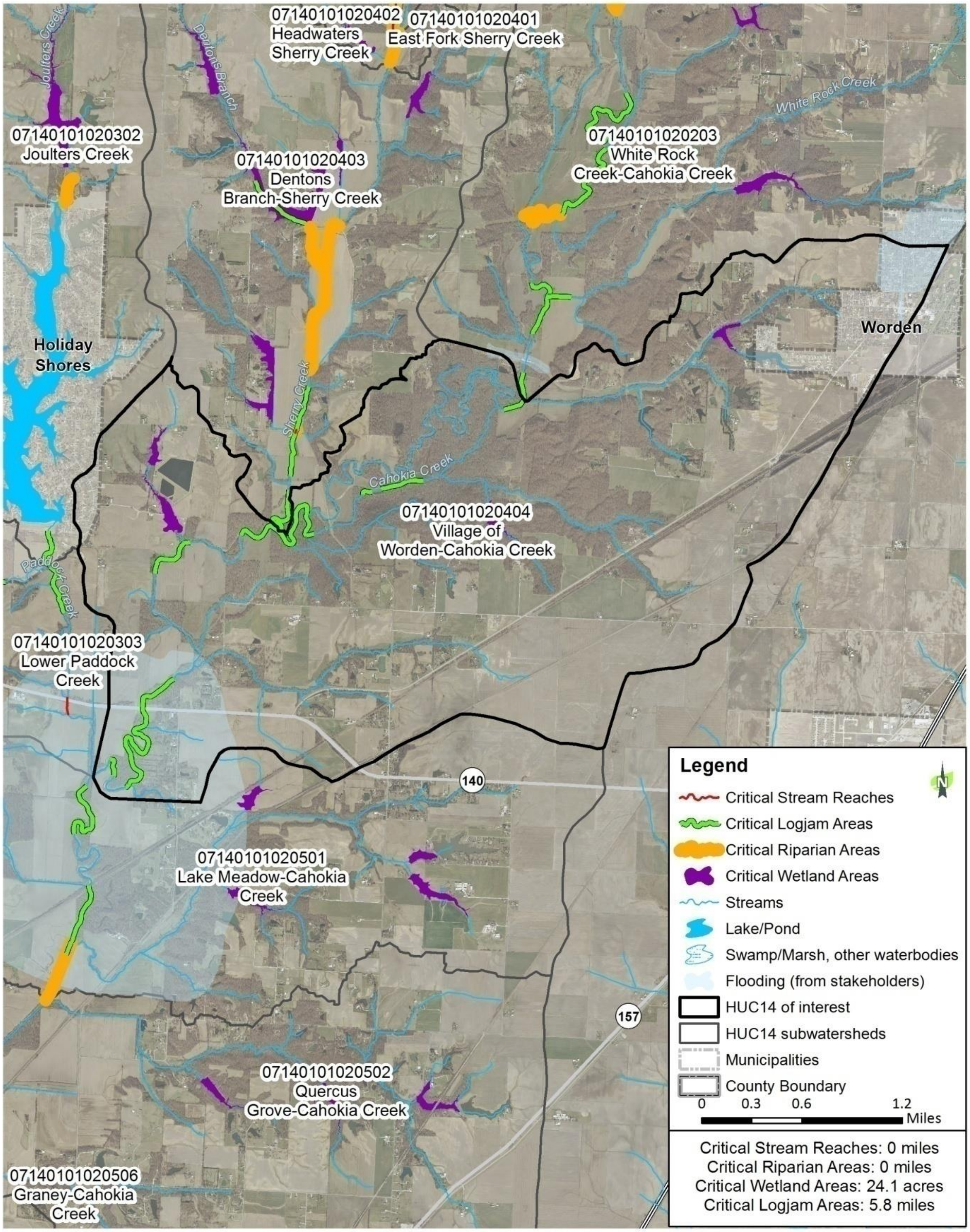
Critical Stream Reaches: No Critical Stream Reaches were identified.

Critical Riparian Areas: No Critical Riparian Areas were identified.

Critical Wetland Areas: 24.1 acres of Critical Wetland Areas were identified in four locations in the subwatershed, all of which were in forested areas.

Flooding locations were **identified by stakeholders**, primarily in two locations. The first area is located in the Village of Worden, where stakeholders reported ponding and road overtopping. The second area is in the southwest portion of the subwatershed, which includes a section of Illinois State Route 140.

HUC 07140101020404: Village of Worden-Cahokia Creek



HUC 071401020501: **Lake Meadow-Cahokia Creek** (west of Hamel)

This rectangular-shaped subwatershed is located in the southeastern portion of the watershed. It lies to the west of I-55 and primarily to the south of Illinois State Route 140. The majority of this subwatershed is agricultural and forested land.

Area: 3,388 acres
Named streams: Cahokia Creek
Counties: Madison
Municipalities: None
Townships: Fort Russell, Hamel

Critical Logjam Areas: 5,112 feet (0.9 miles) of Critical Logjam Areas were identified in the western portion of the subwatershed.

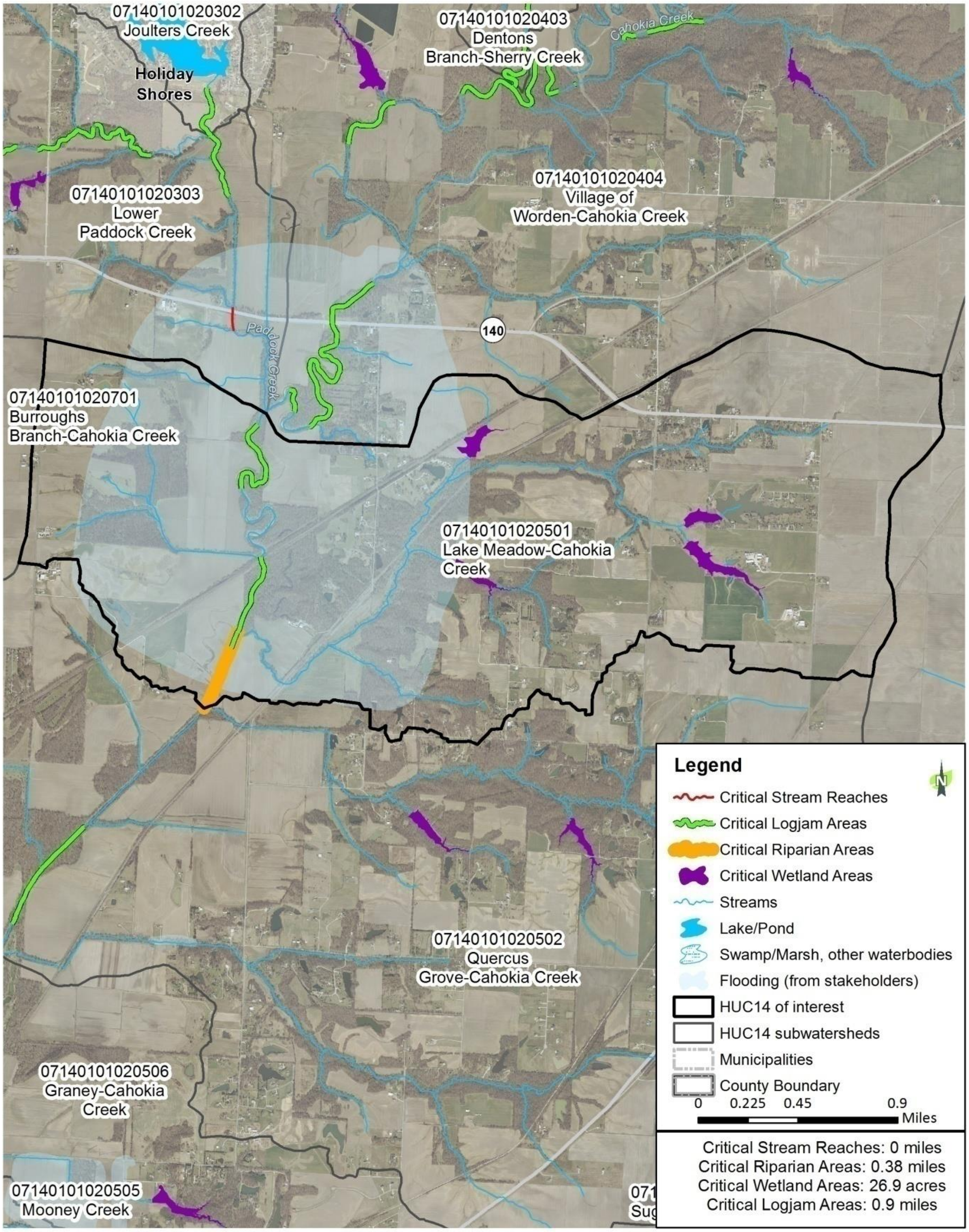
Critical Stream Reaches: No Critical Stream Reaches were identified.

Critical Riparian Areas: 1,999 feet (0.38 miles) of Critical Riparian Areas were identified along Cahokia Creek in an agricultural area of the southern portion of the subwatershed.

Critical Wetland Areas: 26.9 acres of Critical Wetland Areas were identified in four locations in the subwatershed; three in agricultural areas, and one in a forested area.

Flooding locations were **identified by stakeholders** in the subwatershed. The area identified encompasses almost half of the subwatershed area.

HUC 07140101020501: Lake Meadow-Cahokia Creek



HUC 071401020502: **Quercus Grove-Cahokia Creek** (southwest of Hamel)

This rectangular-shaped subwatershed is located in the southeastern portion of the watershed. It is located to the West of I-55 and Illinois State Routes 157 and 159 run through it. The subwatershed drains portions of Cahokia Creek and its tributaries.

Area: 5,785 acres
Named streams: Cahokia Creek
Counties: Madison
Municipalities: None
Townships: Fort Russell, Hamel

Critical Logjam Areas: 2,954 feet (0.6 miles) of Critical Logjam Areas were identified in the western portion of the subwatershed in one segment along Cahokia Creek.

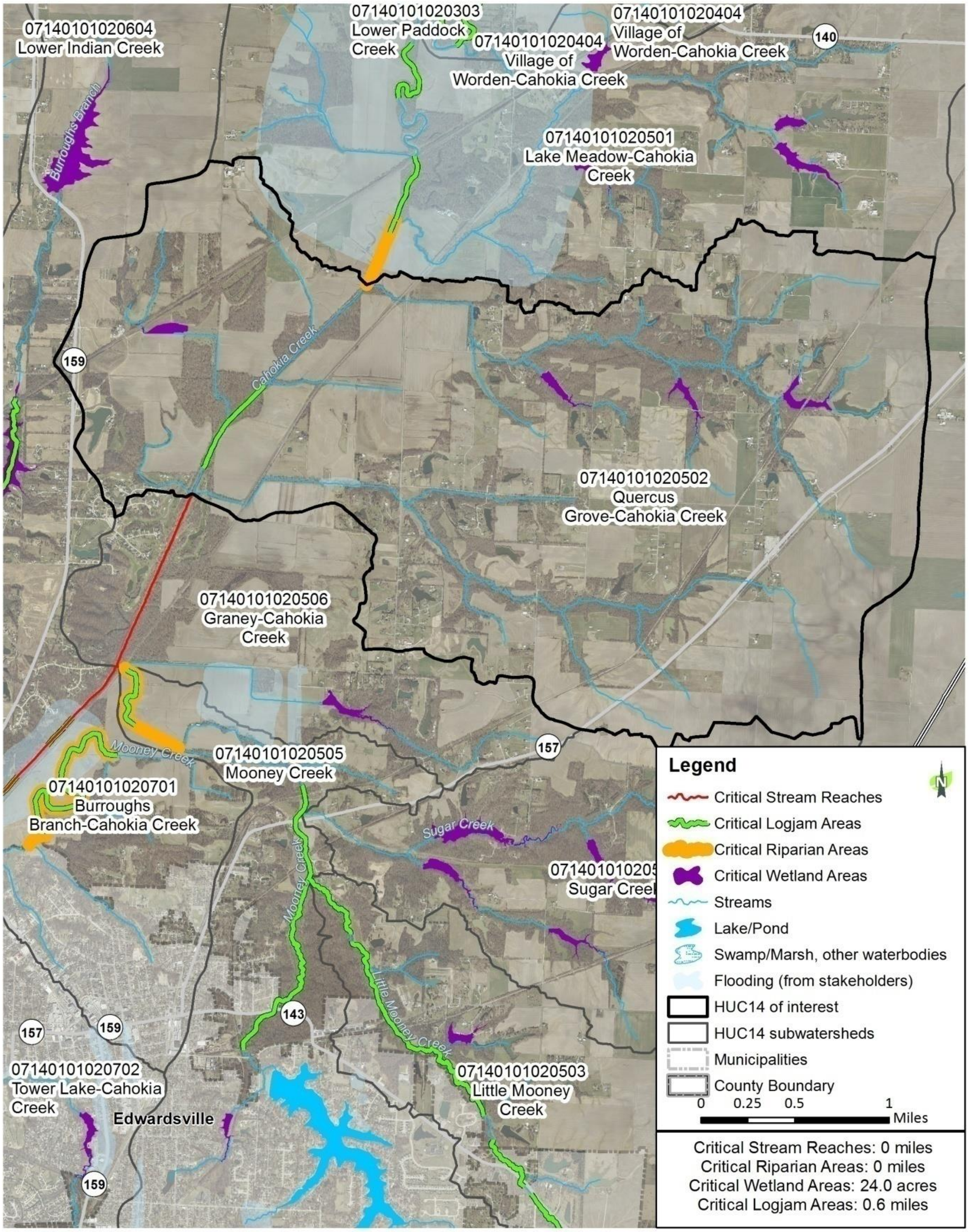
Critical Stream Reaches: No Critical Stream Reaches were identified.

Critical Riparian Areas: No Critical Riparian Areas were identified.

Critical Wetland Areas: 24.0 acres of Critical Wetland Areas were identified: three forested areas in the eastern portion of the subwatershed, and one agricultural area in the western portion.

Flooding locations were **identified by stakeholders**, including a small area in the northwest portion of the subwatershed and another small area along a tributary in an agricultural area.

HUC 07140101020502: Quercus Grove-Cahokia Creek



HUC 071401020503: **Little Mooney Creek** (northeast of Edwardsville)

This subwatershed drains the northeastern portion of Edwardsville. Illinois State Route 143 and I-55 run through it.

Area: 2,141 acres
Named streams: Little Mooney Creek
Counties: Madison
Municipalities: Edwardsville
Townships: Edwardsville, Pin Oak

Critical Logjam Areas: 14,246 feet (2.7 miles) of Critical Logjam Area was identified along Little Mooney Creek in the center of the subwatershed.

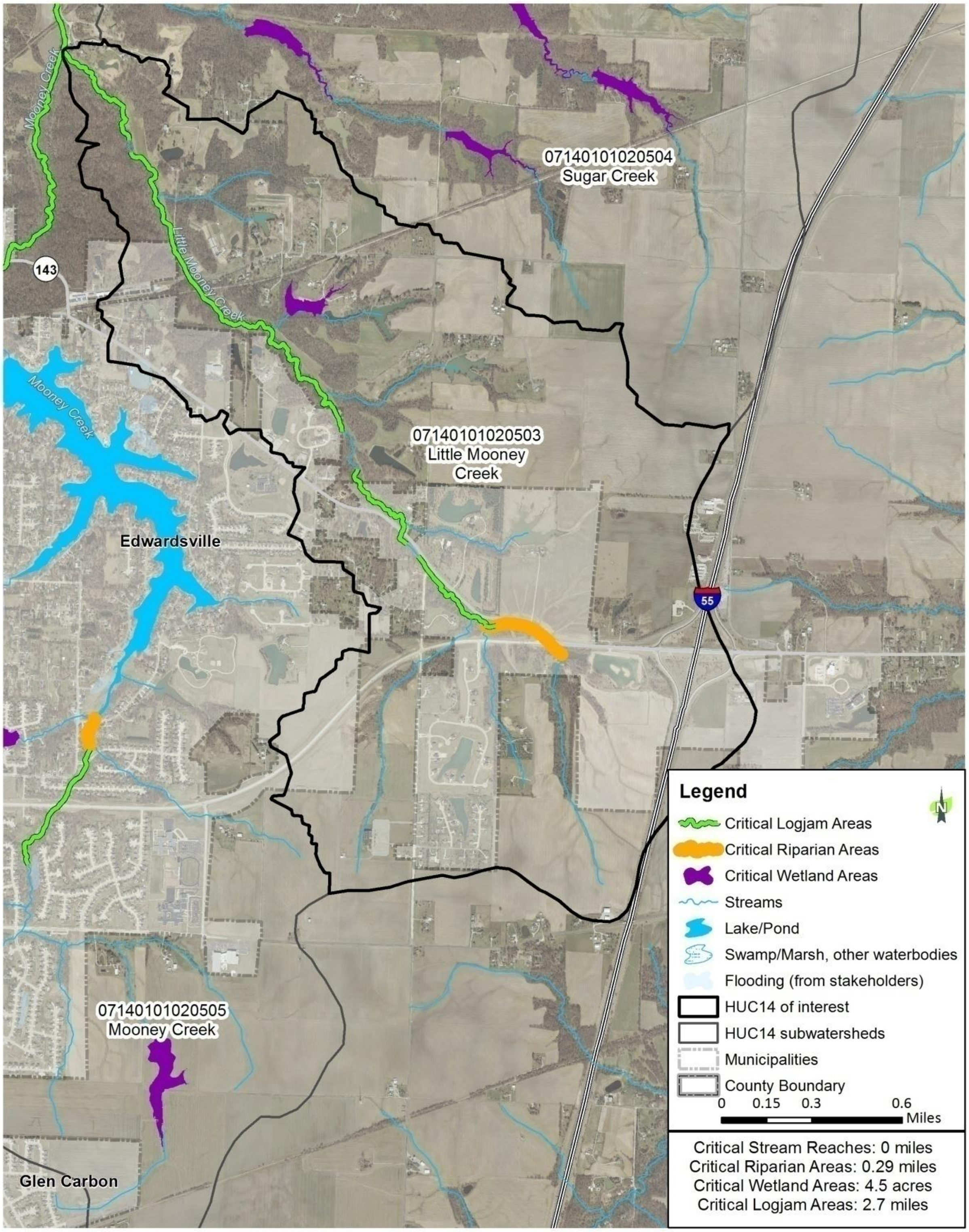
Critical Stream Reaches: No Critical Stream Reaches were identified.

Critical Riparian Areas: 1,537 feet (0.29 miles) of Critical Riparian Areas were identified along Little Mooney Creek paralleling Illinois State Route 143 in the south-central portion of the subwatershed.

Critical Wetland Areas: 4.5 acres of Critical Wetland Areas were identified in one location—a forested area in the northern portion of the subwatershed.

Flooding locations were **identified by stakeholders** in three residential locations in the southern portion of the subwatershed.

HUC 07140101020503: Little Mooney Creek



HUC 071401020504: **Sugar Creek** (southwest of Hamel)

This triangular-shaped subwatershed is located to the west of I-55 and drains the headwaters of Sugar Creek. Illinois State Route 157 runs through the northwestern portion. The subwatershed is predominately agricultural and forested land.

Area: 2,063 acres
Named streams: Sugar Creek
Counties: Madison
Municipalities: None
Townships: Hamel

Critical Logjam Areas: No Critical Logjam Areas were identified in this subwatershed.

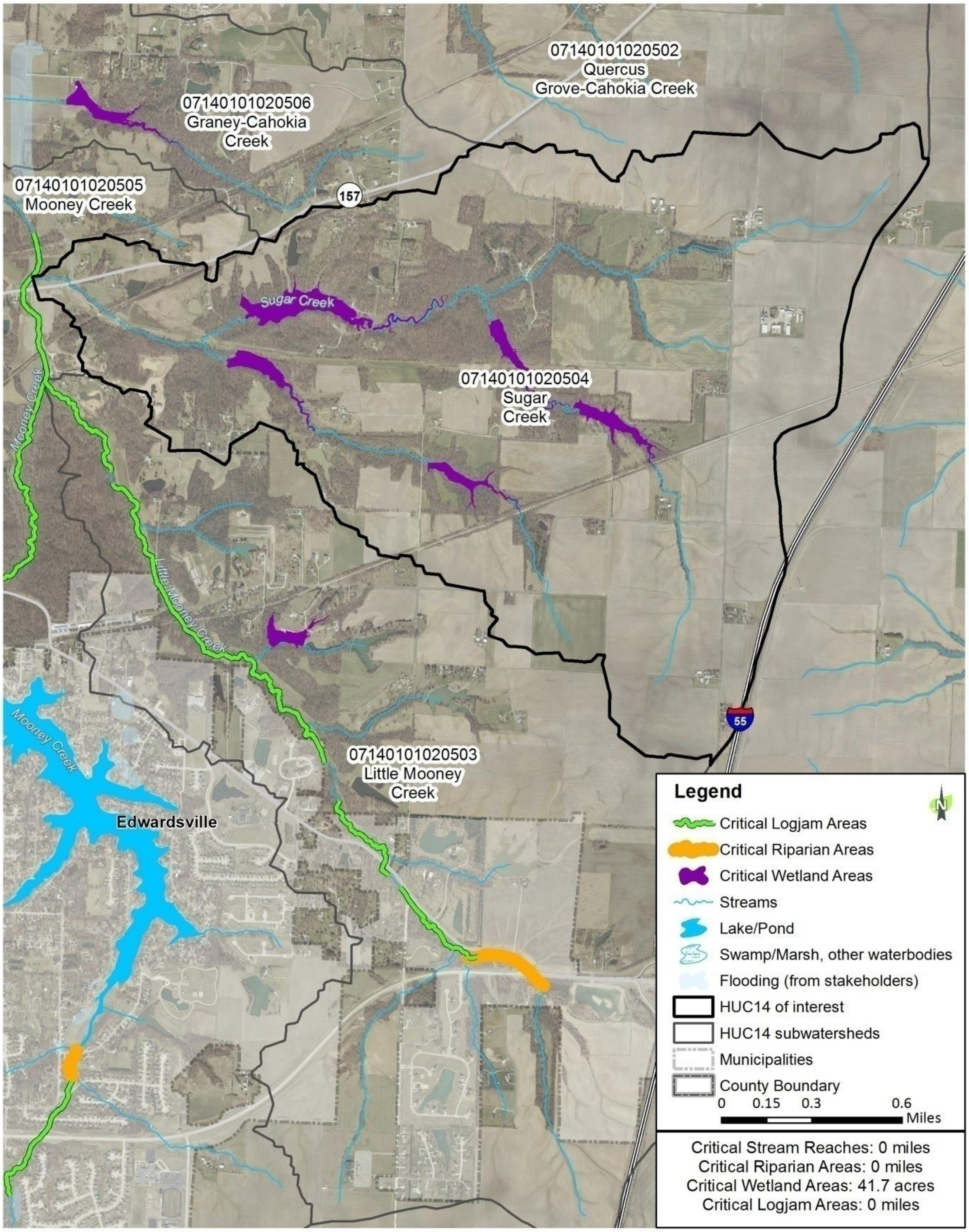
Critical Stream Reaches: No Critical Stream Reaches were identified.

Critical Riparian Areas: No Critical Riparian Areas were identified.

Critical Wetland Areas: 41.7 acres of Critical Wetland Areas were identified in four locations along Sugar Creek and its tributaries. These locations all occur in forested areas.

No **flooding locations** were **identified by stakeholders** in this subwatershed.

HUC 07140101020504: Sugar Creek



HUC 0714010**20505**: **Mooney Creek** (Edwardsville area)

This fish-shaped subwatershed drains the eastern portion of Edwardsville and is predominately urban. Illinois State Routes 157, 159, and 143 run through it.

Area: 3,964 acres
Named streams: Mooney Creek
Counties: Madison
Municipalities: Edwardsville, Glen Carbon
Townships: Edwardsville, Pin Oak

Critical Logjam Areas: 13,947 feet (2.6 miles) of Critical Logjam Area was identified in areas along Mooney Creek in the subwatershed.

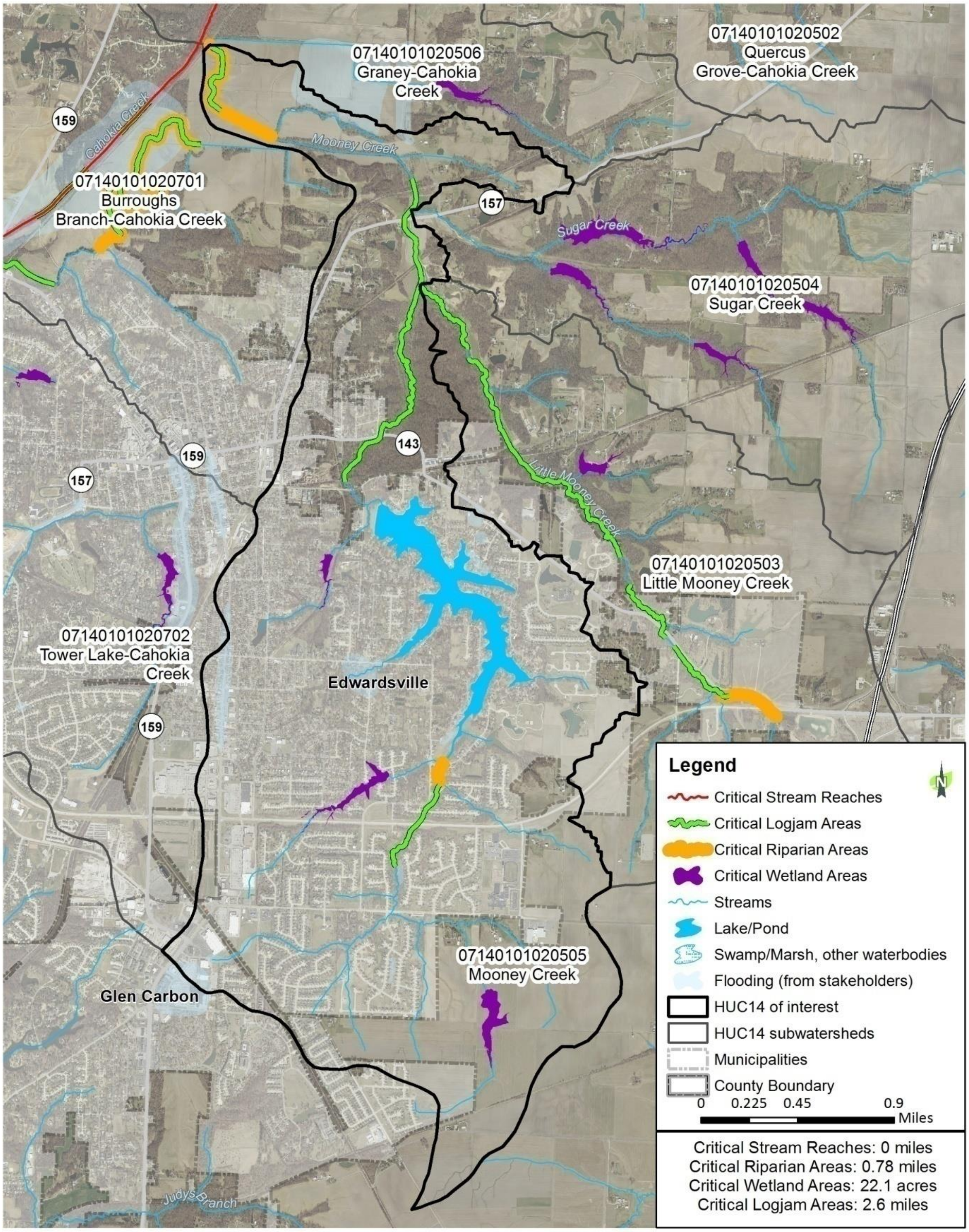
Critical Stream Reaches: No Critical Stream Reaches were identified.

Critical Riparian Areas: 4,094 feet (0.78 miles) of Critical Riparian Areas were identified in two locations along Mooney Creek: one in an agricultural area of the northwestern portion, and the other in an urban area of the southern portion of the subwatershed.

Critical Wetland Areas: 22.1 acres of Critical Wetland Areas were identified. Two of the areas were in urban locations, and the third was in an agricultural area in the southern portion of the subwatershed.

Flooding locations were **identified by stakeholders** in the eastern-central portion of the subwatershed.

HUC 07140101020505: Mooney Creek



HUC 071401020506: **Graney-Cahokia Creek** (east of Roxana)

This subwatershed is primarily made up of agricultural land. It lies to the east of Illinois State Route 159 and to the north of Illinois State Route 157, which runs through its southeastern portion.

Area: 1,355 acres
Named streams: Cahokia Creek
Counties: Madison
Municipalities: None
Townships: Fort Russell, Hamel

Critical Logjam Areas: No Critical Logjam Areas were identified in this subwatershed.

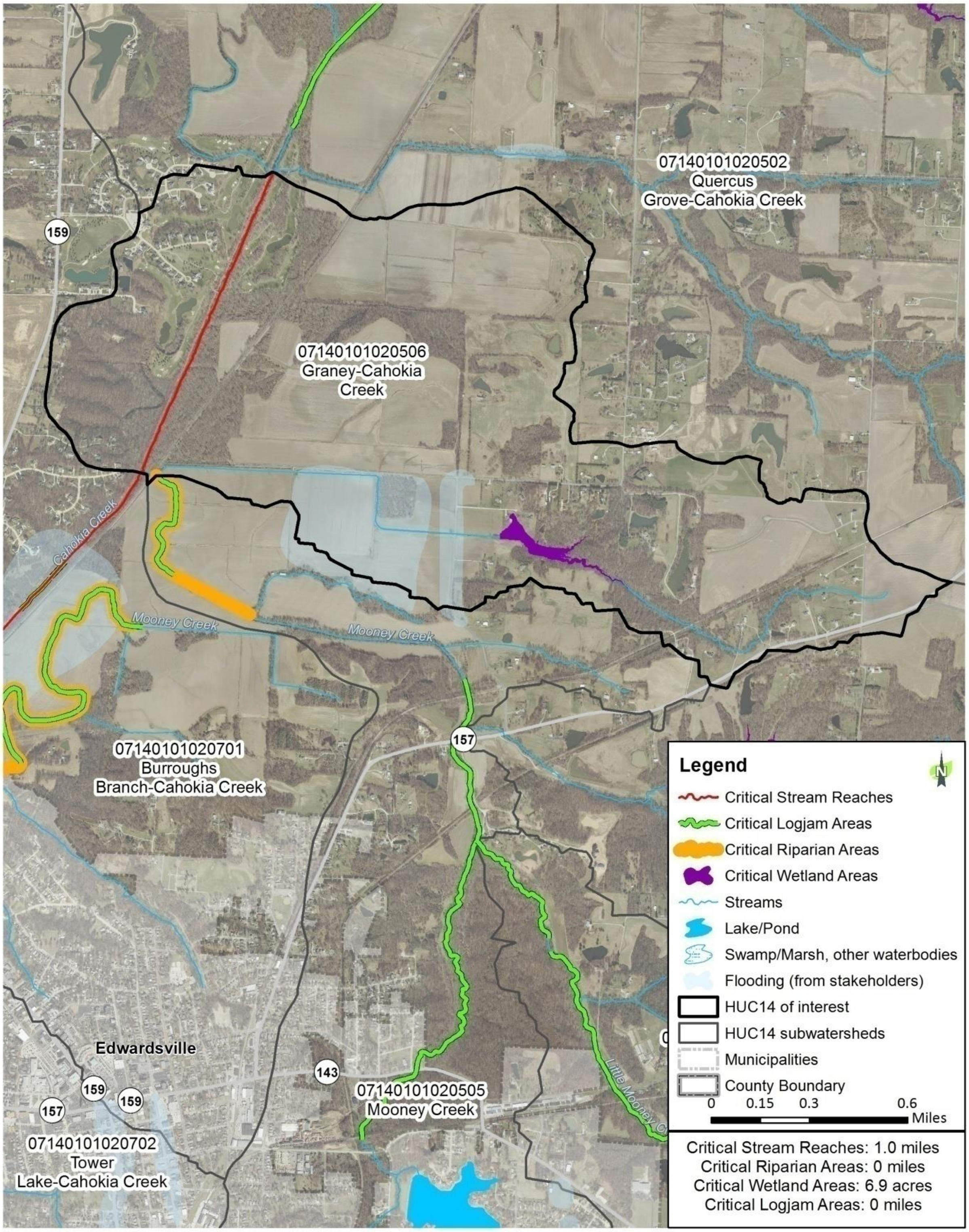
Critical Stream Reaches: 5,301 feet (1.0 miles) of Critical Stream Reaches were identified along Cahokia Creek in the western portion of the subwatershed.

Critical Riparian Areas: No Critical Riparian Areas were identified.

Critical Wetland Areas: 6.9 acres of Critical Wetland Areas were identified in one area along a tributary in the southern portion of the watershed.

Flooding locations were **identified by stakeholders** in two locations in the southern portion of the subwatershed.

HUC 07140101020506: Graney-Cahokia Creek



HUC 071401020601: **Headwaters Indian Creek** (south of Bunker Hill)

This rectangular-shaped subwatershed drains the western half of Bunker Hill and the headwaters of Indian Creek. Illinois State Route 159 parallels its eastern border and runs through it in two locations. The subwatershed is located in the northwestern portion of the watershed.

Area: 5,138 acres
Named streams: Indian Creek
Counties: Macoupin, Madison
Municipalities: Bunker Hill
Townships: Bunker Hill, Moro

Critical Logjam Areas: No Critical Logjam Areas were identified in this subwatershed.

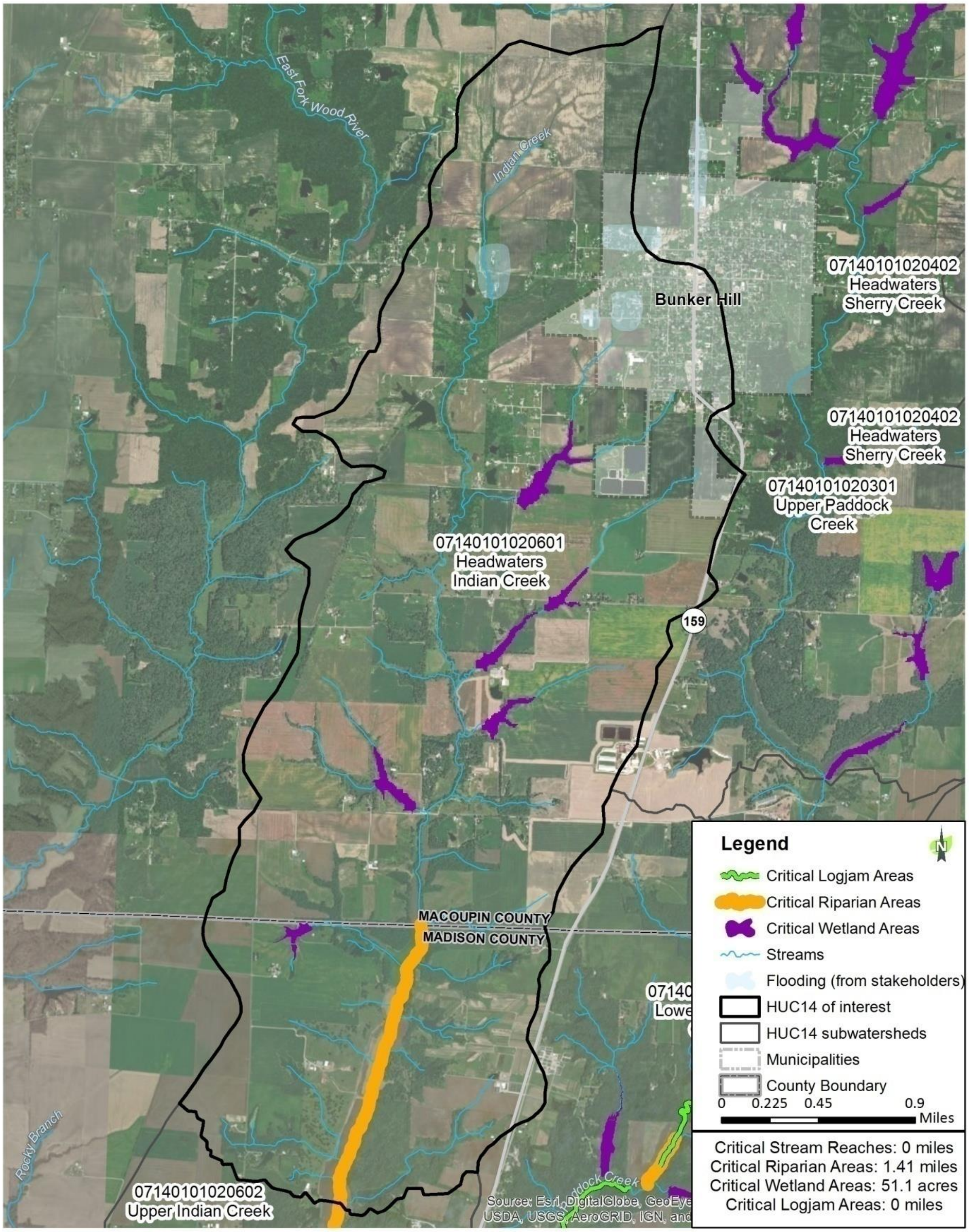
Critical Stream Reaches: No Critical Stream Reaches were identified.

Critical Riparian Areas: 7,437 feet (1.41 miles) of Critical Riparian Area were identified along Indian Creek at the southern end of the subwatershed.

Critical Wetland Areas: 51.1 acres of Critical Wetland Areas were identified in six locations, all of which are primarily agricultural areas.

Flooding locations were **identified by stakeholders** in four locations. Three of these areas are located in urban portions of Bunker Hill, while the fourth is located in an agricultural area along Indian Creek.

HUC 07140101020601: Headwaters Indian Creek



HUC 071401020602: **Upper Indian Creek** (west of Holiday Shores)

This subwatershed is located entirely in Madison County. Its eastern boarder parallels Illinois State Route 159, which runs through portions of its southern half.

Area: 5,541 acres
Named streams: Indian Creek
Counties: Madison
Municipalities: None
Townships: Moro

Critical Logjam Areas: 12,715 feet (2.4 miles) of Critical Logjam Areas were identified along Indian Creek in the central portion of the subwatershed.

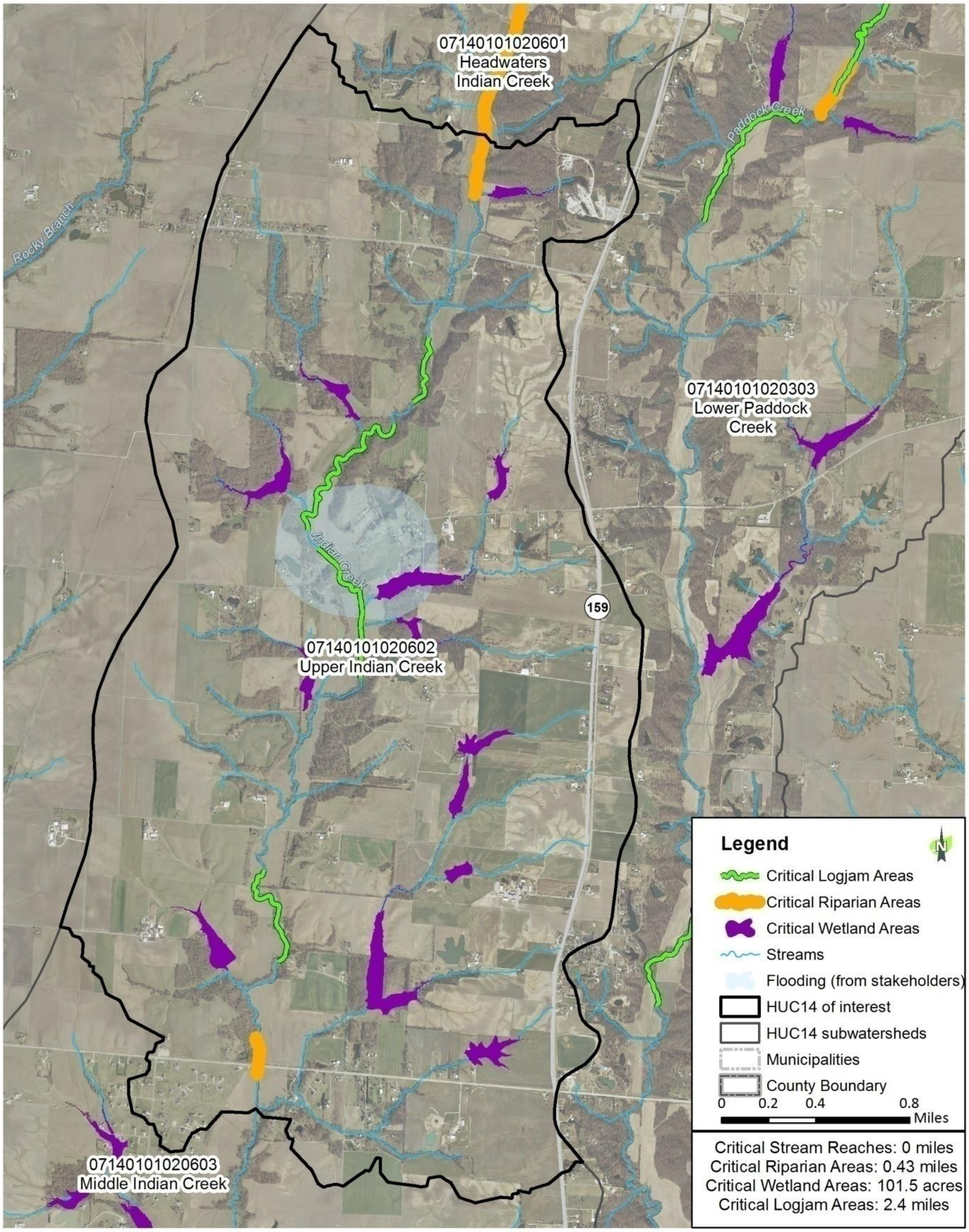
Critical Stream Reaches: No Critical Stream Reaches were identified.

Critical Riparian Areas: 2,267 feet (0.43 miles) of Critical Riparian Area were identified in two locations on Indian Creek: one area in the northern portion and one area in the southern portion of the watershed.

Critical Wetland Areas: 101.5 acres of Critical Wetland Areas were identified along tributaries of Indian Creek throughout the watershed.

Flooding locations were **identified by stakeholders** in one location in the center of the watershed.

HUC 07140101020602: Upper Indian Creek



HUC 071401020603: **Middle Indian Creek** (west of Holiday Shores)

This square-shaped subwatershed drains the northeastern portion of Bethalto. Illinois State Routes 140 and 159 run through it.

Area: 4,574 acres
Named streams: Indian Creek
Counties: Madison
Municipalities: Bethalto
Townships: Fort Russell

Critical Logjam Areas: 7,094 feet (1.3 miles) of Critical Logjam Areas were identified in three segments along Indian Creek.

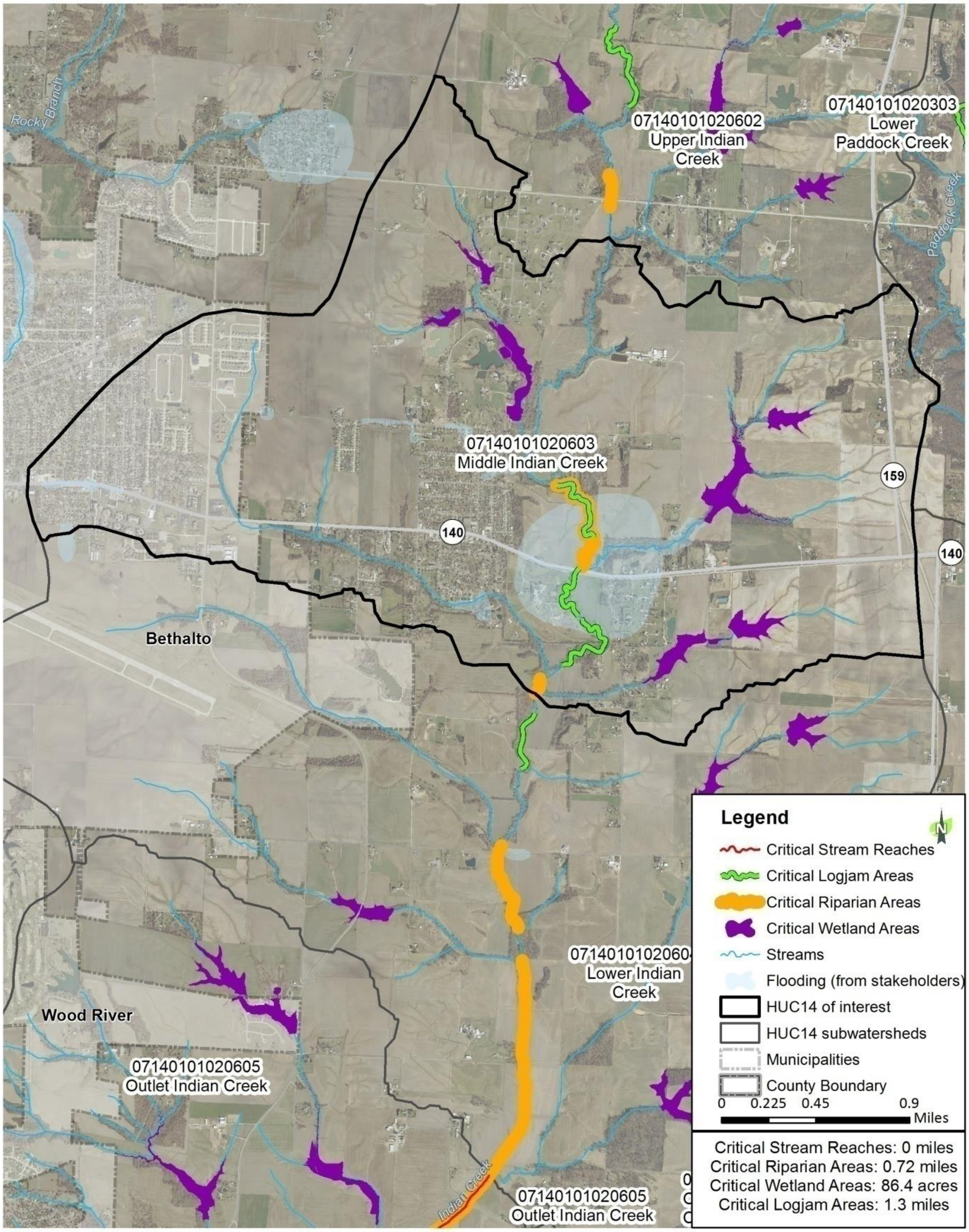
Critical Stream Reaches: No Critical Stream Reaches were identified.

Critical Riparian Areas: 3,825 feet (0.72 miles) of Critical Riparian Area were identified in two locations on Indian Creek in the southern portion of the subwatershed.

Critical Wetland Areas: 86.4 acres of Critical Wetland Areas were identified along tributaries of Indian Creek throughout the watershed.

Flooding locations were **identified by stakeholders** in eight locations throughout the watershed. The largest area occurred around Illinois State Route 140, and road overtopping was reported.

HUC 07140101020603: Middle Indian Creek



HUC 071401020604: **Lower Indian Creek** (Bethalto area)

This rectangular-shaped subwatershed drains the southeastern portion of Bethalto. It lies south of Illinois State Route 140.

Area: 5,658 acres
Named streams: Indian Creek
Counties: Madison
Municipalities: Bethalto
Townships: Fort Russell

Critical Logjam Areas: 1,821 feet (0.3 miles) of Critical Logjam Areas were identified along Indian Creek where it enters the subwatershed.

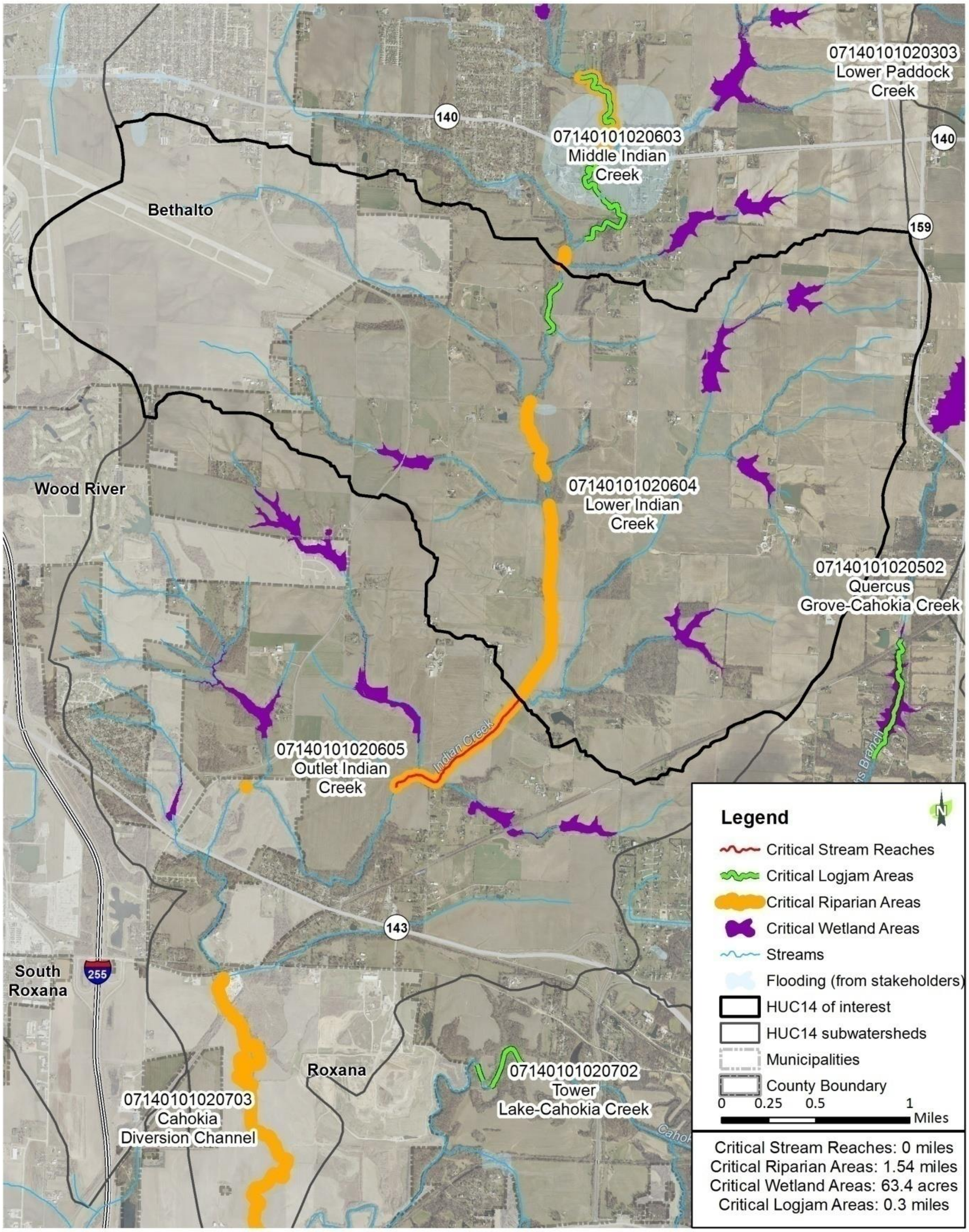
Critical Stream Reaches: No Critical Stream Reaches were identified.

Critical Riparian Areas: 8,113 feet (1.54 miles) of Critical Riparian Area were identified in two locations on Indian Creek.

Critical Wetland Areas: 63.4 acres of Critical Wetland Areas were identified along tributaries of Indian Creek in five locations throughout the watershed.

Flooding locations were **identified by stakeholders** in two locations. One location was in the northwest corner of the subwatershed near the Bethalto residential area, and the other was in an agricultural area near one of the Critical Riparian Areas along Indian Creek.

HUC 07140101020604: Lower Indian Creek



HUC 071401020605: **Outlet Indian Creek** (east of Roxana)

This triangular-shaped subwatershed drains portions of Wood River and Roxana. Illinois State Route 143 bisects its southern half. It lies to the east of I-255.

Area: 5,122 acres
Named streams: Indian Creek
Counties: Madison
Municipalities: Bethalto, Wood River, Roxana
Townships: Fort Russell

Critical Logjam Areas: 518 feet (0.1 miles) of Critical Logjam Areas were identified in one segment in the southern portion of the subwatershed.

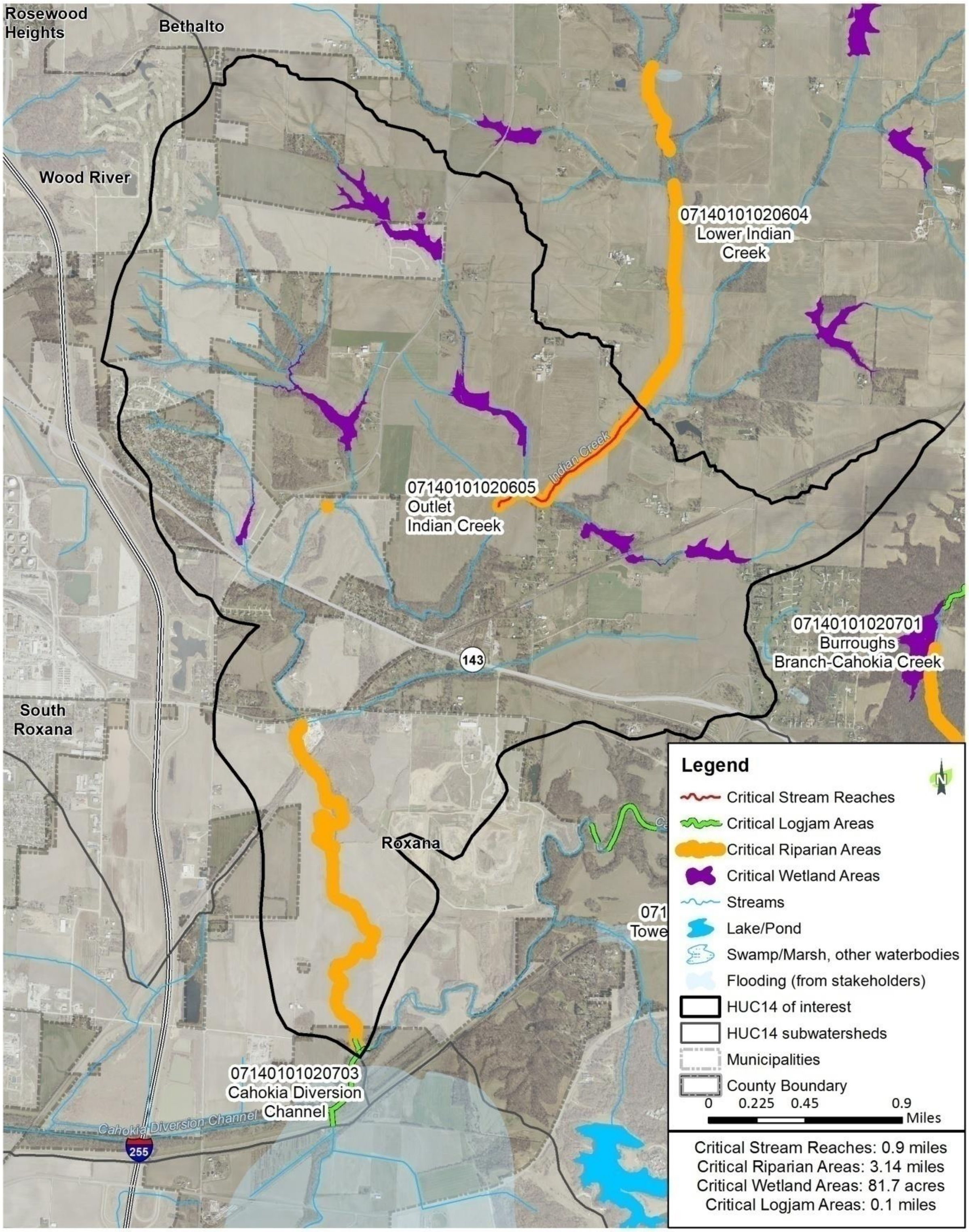
Critical Stream Reaches: 4,735 feet (0.90 miles) of Critical Stream Reaches were identified in an agricultural area along Indian Creek in the northern portion of the watershed.

Critical Riparian Areas: 16,594 feet (3.14 miles) of Critical Riparian Area were identified in an agricultural area along Indian Creek, south of Illinois State Route 143.

Critical Wetland Areas: 81.7 acres of Critical Wetland Areas were identified along tributaries of Indian Creek throughout the watershed.

Flooding locations were **identified by stakeholders** in one location—the southern tip of the subwatershed near the Critical Riparian Area and where Indian Creek meets Cahokia Creek.

HUC 07140101020605: Outlet Indian Creek



HUC 071401020701: **Burroughs Branch-Cahokia Creek** (north of Edwardsville)

This L-shaped subwatershed drains the northern portions of Edwardsville and the headwaters of Burroughs Branch. Illinois State Routes 140, 159, 143, and 157 run through it.

Area: 4,510 acres
Named streams: Burroughs Branch, Mooney Creek, Cahokia Creek
Counties: Madison
Municipalities: Edwardsville
Townships: Edwardsville, Fort Russell

Critical Logjam Areas: 22,870 feet (4.3 miles) of Critical Logjam Areas were identified in three segments along Burroughs Branch, two segments along Mooney Creek, and three segments along Cahokia Creek.

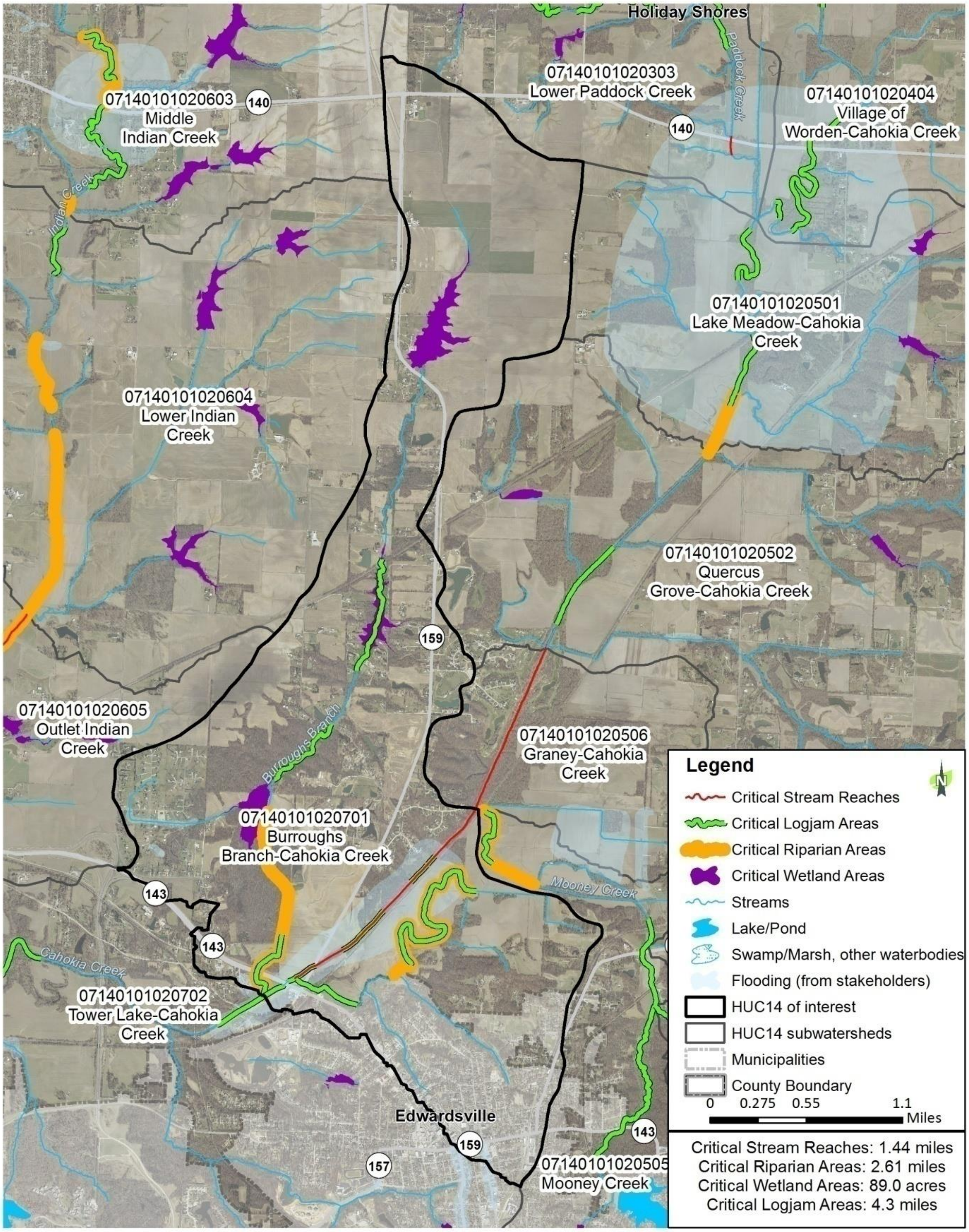
Critical Stream Reaches: 7,621 feet (1.44 miles) of Critical Stream Reaches were identified along Cahokia Creek near Illinois State Route 159 in the southern portion of the subwatershed.

Critical Riparian Areas: 13,796 feet (2.61 miles) of Critical Riparian Areas were identified in two locations in the southern portion of the subwatershed: one along Burroughs Branch to the west of Illinois State Route 159, and one along Mooney Creek to the east of Illinois State Route 159.

Critical Wetland Areas: 89.0 acres of Critical Wetland Areas were identified in three locations along Burroughs Branch.

Flooding locations were **identified by stakeholders** in 10 locations throughout the subwatershed. The largest of these areas occurs along the Critical Stream Reach in Cahokia Creek.

HUC 07140101020701: Burroughs Branch-Cahokia Creek



HUC 071401020702: Tower Lake-Cahokia Creek (Edwardsville area)

This subwatershed is located at the southern end of the watershed and drains the majority of Edwardsville. Illinois State Route 157 bisects its eastern half, and Illinois State Route 143 runs along its northern border. The subwatershed is made up of primarily urban areas.

Area: 5,325 acres
Named streams: Cahokia Creek
Counties: Madison
Municipalities: Edwardsville, Roxana, Glen Carbon
Townships: Edwardsville

Critical Logjam Areas: 4,876 feet (0.9 miles) of Critical Logjam Areas were identified in three segments along Cahokia Creek in the northern portion of the subwatershed.

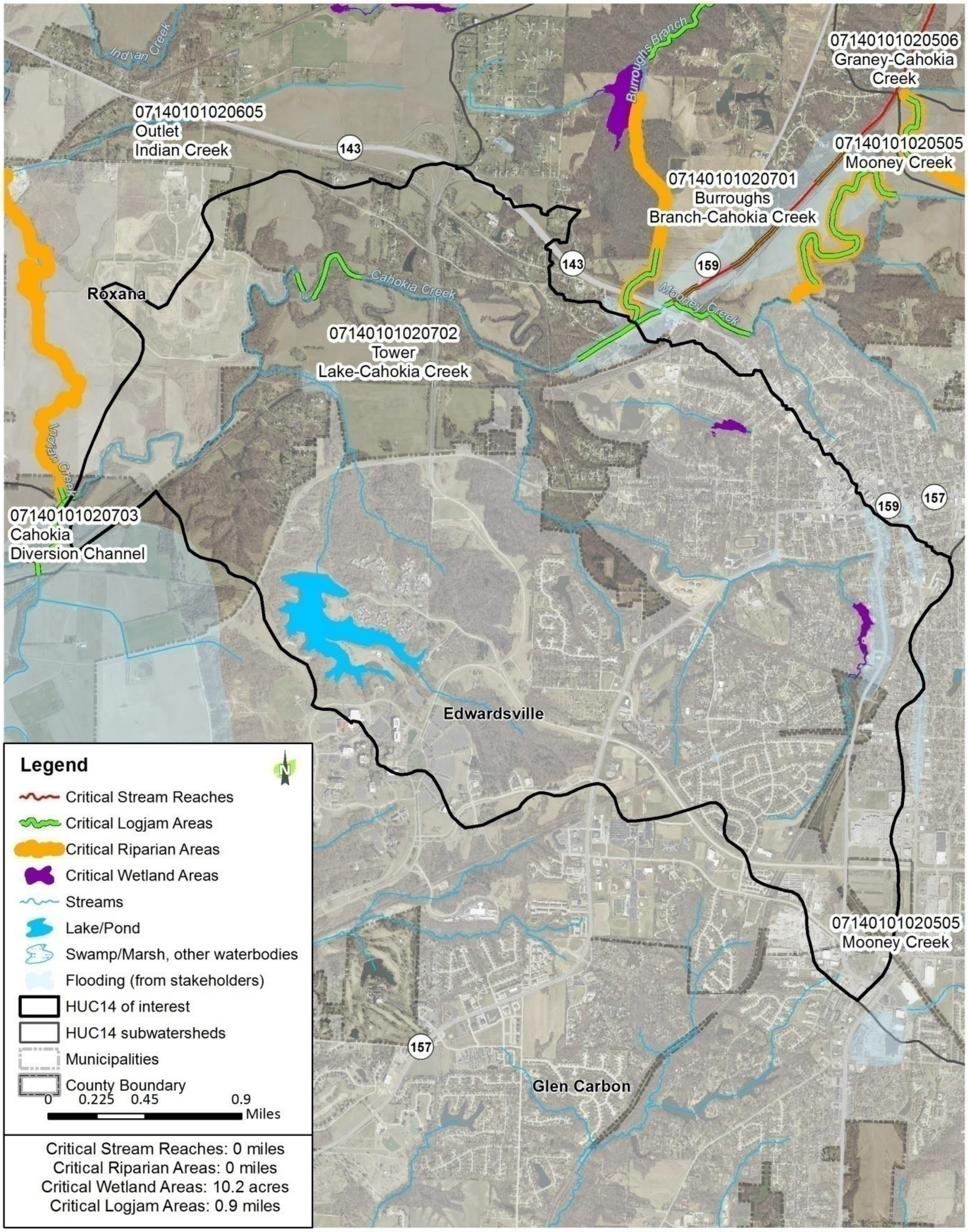
Critical Stream Reaches: No Critical Stream Reaches were identified.

Critical Riparian Areas: No Critical Riparian Areas were identified.

Critical Wetland Areas: 10.2 acres of Critical Wetland Areas were identified in two locations in urban areas in the eastern portion of the subwatershed. One area is located near Union Street, and the other to the west of Illinois State Route 159.

Flooding locations were **identified by stakeholders** in 11 locations throughout the subwatershed. One of the larger areas runs along Illinois State Route 159.

HUC 07140101020702: Tower Lake-Cahokia Creek



HUC 071401020703: **Cahokia Diversion Channel** (Hartford area)

This smaller subwatershed lies at the southwestern corner of the watershed and drains Hartford and South Roxana. Illinois State Route 111 and I-255 run through it.

Area: 3,866 acres
Named streams: Cahokia Diversion Channel
Counties: Madison
Municipalities: Hartford, Roxana, South Roxana
Townships: Chouteau

Critical Logjam Areas: 2,120 feet (0.4 miles) of Critical Logjam Areas were identified in two segments in the southwestern portion of the subwatershed. One occurred along the Cahokia Diversion Channel, and the other along Cahokia Creek.

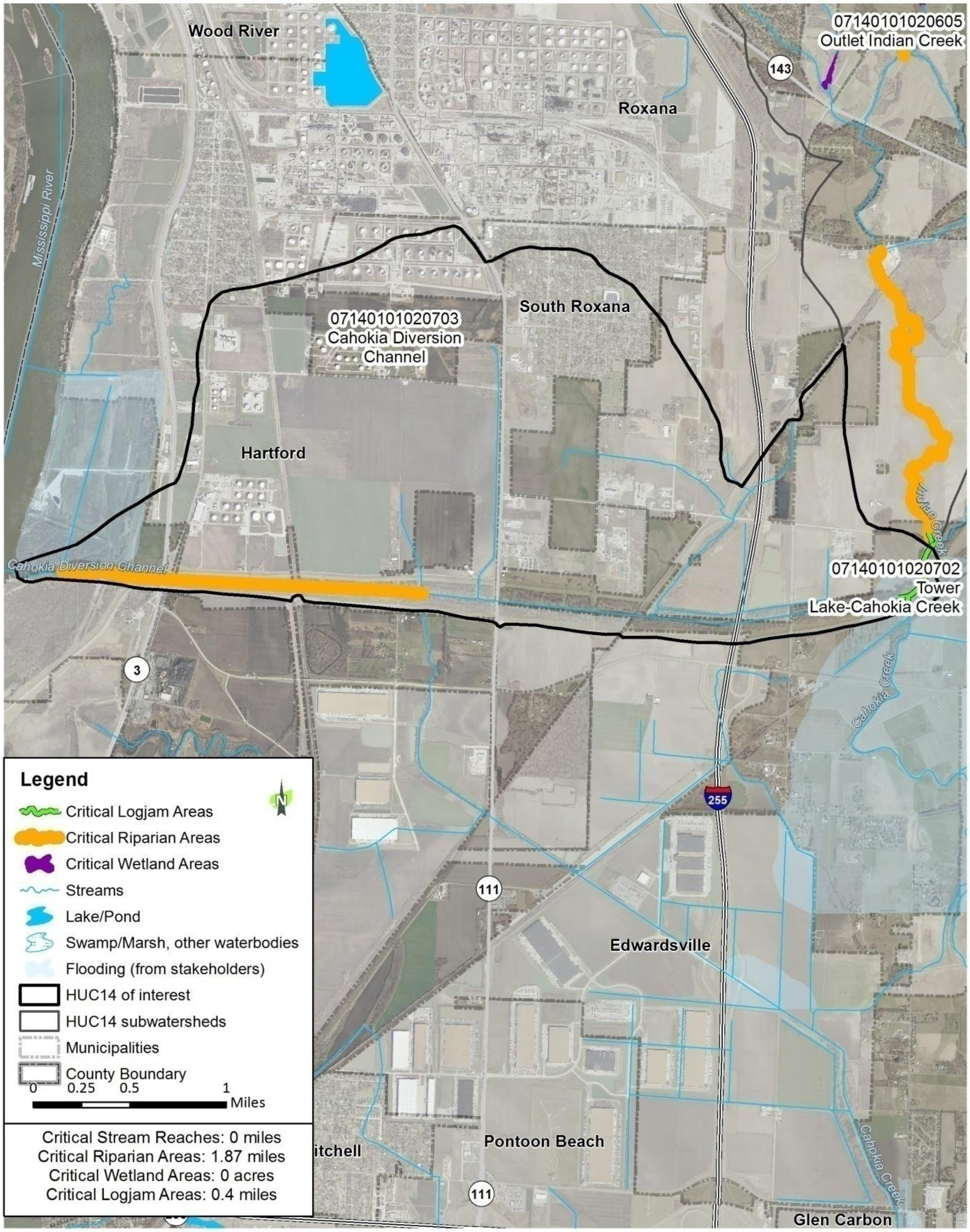
Critical Stream Reaches: No Critical Stream Reaches were identified.

Critical Riparian Areas: 9,888 feet (1.87 miles) of Critical Riparian Areas were identified along the Cahokia Diversion Channel.

Critical Wetland Areas: No Critical Wetland Areas were identified.

Flooding locations were **identified by stakeholders** in two locations in the subwatershed.

HUC 07140101020703: Cahokia Diversion Channel



APPENDIX E – MANAGEMENT MEASURES

Quantifying the impacts of potential management measures

Quantifying pollutant reduction

Several sources were used to identify typical pollutant and flow reduction associated with each Best Management Practice (BMP) recommended, where possible. These include:

- U.S. Environmental Protection Agency (USEPA) Region 5 Load Estimation Model Users Manual, Figure E6-2
- Pigeon Creek Watershed Plan, Table 67 (Waste Basin Treatment System)
- Spreadsheet Tool for Estimating Pollutant Loads (STEPL) 4.4 BMP calculator, available at http://it.tetratech-ffx.com/steplweb/models$docs.htm
- Long Run Creek Watershed Plan, Table 40, Table 41
- Illinois Nutrient Loss Reduction Strategy (2015)
- Green Values National Stormwater Management Calculator, http://greenvalues.cnt.org/national/cost_detail.php
- Minnesota Department of Transportation - Table 2.2 in the report: "Comparing Properties of Water Absorbing/Filtering Media for Bioslope/Bioswale Design," 2017 http://www.dot.state.mn.us/research/reports/2017/201746.pdf
- National Pollutant Removal Performance Database, seen in Lower Meramec Watershed Plan, Table 20 and Table 21
- Illinois Urban Flooding Awareness Act report, 2015, https://www.dnr.illinois.gov/waterresources/documents/final_ufaa_report.pdf
- Low Impact Development Urban Design Tools website, https://www.lid-stormwater.net/
- Southwestern Illinois Resource Conservation District, (SWIRCD), Thinking Outside the Pipe, seen in Lower Meramec Watershed Plan, Table 20
- Stormwater Management Center fact sheets, seen in Lower Meramec Watershed Plan, Table 20 and Table 21
- Iowa Nutrient Reduction Strategy, Table 2 and Table 3
- International Stormwater BMPs Database Pollutant Category Summary Statistical Addendum: Total Suspended Solids, Bacteria, Nutrients, and Metals, www.bmpdatabase.org, linked to by USEPA

Quantifying the costs of management measures

The implementation costs of the management measures recommended were assembled from several sources, including the following primary sources:

- Natural Resources Conservation Service (NRCS) Practice Component List FY2014
- Iowa State University, 2011, 'Woodchip Bioreactors for Nitrate in Agricultural Drainage,' page 2
- Long Run Creek Watershed Plan, Table 41 and Table 42
- Illinois Nutrient Reduction Strategy (2015), Page B-3, B-4, B-7
- Green Values National Stormwater Management Calculator, http://greenvalues.cnt.org/national/cost_detail.php

- National Pollutant Removal Performance Database, seen in Lower Meramec Watershed Plan, Table 20 and Table 21
- Illinois Urban Flooding Awareness Act report, 2015, https://www.dnr.illinois.gov/waterresources/documents/final_ufaa_report.pdf
- Low Impact Development Urban Design Tools website, https://www.lid-stormwater.net/
- Southwestern Illinois Resource Conservation District (SWIRCD), Thinking Outside the Pipe, seen in Lower Meramec Watershed Plan, Table 20
- Stormwater Management Center fact sheets, seen in Lower Meramec Watershed Plan, Table 20 & Table 21
- Iowa Nutrient Reduction Strategy, Table 2 and Table 3
- International Stormwater BMP Database Pollutant Category Summary Statistical Addendum: TSS, Bacteria, Nutrients, and Metals, www.bmpdatabase.org, linked to by USEPA
- Technical estimates from Midwest Streams Inc and Andreas Consulting Inc., 2017

Since these costs were assembled, an additional valuable resource for costs was identified: the Green Values National Stormwater Management Calculator, available online at http://greenvalues.cnt.org/national/cost_detail.php. This site includes information on construction costs, maintenance costs, and component lifespan.

The final costs used, and their sources, are shown in Table E.1. The costs were adjusted for inflation to 2018 dollars using the conversion rates given in Table E.2 from www.usinflationcalculator.com.

Table E.1. Costs of recommended BMPs and sources of cost data

Management measure	Cost	Cost unit	Cost data source(s)	URL
Animal waste/storage treatment system	$260,000	/acre	2016 Andreas Consulting cost for one large flushing and treatment system on dairy farm, 2016. Also see this NRCS factsheet for more detail.	https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_012400.pdf
Bioreactors (denitrifying)	$157.81	/acre drained	2011 Iowa State University PDF, 2011, 'Woodchip Bioreactors for Nitrate in Agricultural Drainage'. Cost is $7k to $10k for treating 30 to 100 acres, so average of $8,500 per bioreactor treating an average of 65 acres, so 8,500/65 = $130.76/acre in 2011, adjusted for inflation is $142.30 in 2017.	https://store.extension.iastate.edu/product/13691
Comprehensive Nutrient Management Plans (CNMPs)	$54.97	/acre planned for	2017 Mike Andreas (Andreas Consulting), 2017. Further information available at the NRCS webpage ($32 average annual per animal or $6,748 average annual cost of implementation)	https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_012173.pdf
Conservation tillage	$58.65		2017 Andreas Consulting, professional estimate	
Contour buffer strips	$175.11	/acre	2015 Iowa State University fact sheet, cost example table on page 2, sum of costs except foregone income cost	http://www.nutrientstrategy.iastate.edu/documents
Cover crops	$30.54	/acre	2015 Illinois Nutrient Reduction Strategy, page B-6 under "Planting Cover Crops"	http://www.epa.illinois.gov/Assets/iepa/water-quality/watershed-management/nlrs/nlrs-final-revised-083115.pdf
Grassed waterways	$8,653	/acre	2017 Andreas Consulting, professional estimate	
Nutrient Management Plan (NMP)	$13.83	/acre	2017 Andreas Consulting, professional estimate	
Ponds	$15,270	/acre	2017 Andreas Consulting, professional estimate	
Riparian buffers	$52.65	/acre	2015 Illinois Nutrient Reduction Strategy, page B-3 - B-4 under "Installing Stream Buffers", cost of planting grass only	http://www.epa.illinois.gov/Assets/iepa/water-quality/watershed-management/nlrs/nlrs-final-revised-083115.pdf
Terraces	$3.36	/linear foot	2017 Andreas Consulting, professional estimate	
Water and sediment control basin (WASCOB)	$366.48	/acre	2017 Andreas Consulting, professional estimate	
Wetlands	$13,162.50	/acre	2015 Illinois Nutrient Reduction Strategy, page B-7, "Constructing Wetlands", upfront cost (no design cost and not amortized)	http://www.epa.illinois.gov/Assets/iepa/water-quality/watershed-management/nlrs/nlrs-final-revised-083115.pdf
Forest stand improvement	$356.30	/acre	2017 Andreas Consulting, professional estimate	
Bioswales	$18	/acre	2007 Water Environment Research Federation Low Impact Development Best Management Practices Whole Life Cost Model, as listed in Green Values National Stormwater Management Calculator	http://greenvalues.cnt.org/national/cost_detail.php
Dry detention basins, new	$43,8054.80	/acre	2015 USEPA BMPs webpage, now archived at the following link	https://castlehillstx.files.wordpress.com/2015/07/dry-detention-ponds-_-best-management-practices-_-us-epa.pdf
Wet detention basins, new	$48,122 .10	/acre	2015 USEPA BMPs webpage, no longer available	http://water.epa.gov/polwaste/npdes/swbmp/Wet-Ponds.cfm
Detention basin retrofits (vegetated buffers, etc.)	$15,236.94	/acre	2014 Long Run Creek Watershed-Based Plan, Table 41	http://www.longruncreek.org/watershedplan

Detention basin maintenance (dredging, invasives, etc.)	$992.09	/acre	2014 Long Run Creek Watershed-Based Plan, Table 42	http://www.longruncreek.org/watershedplan
Pervious pavement	$100,557.50	/acre	2002, LID Stormwater Center, seen in Lower Meramec Watershed Plan, Table 21	http://www.ewgateway.org/environment/waterresources/Watersheds/LowerMeramec/lowermeramec.htm
Rain gardens	$9.27	/sq. ft.	2008, Iowa Rain Garden Design & Installation Manual - midway value between estimates on page 15, also used in Upper Silver Creek plan from 4 cost sources, https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_007154.pdf	https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_007154.pdf
Rainwater collection	$236.93	per barrel/small cistern	2015, Low Impact Development Urban Design Tools website	https://www.lid-stormwater.net/
Single property flood reduction strategies	$1,053	per property	2015 Approximately, based on 2015 Illinois Urban Flooding Awareness Act report	https://www.dnr.illinois.gov/waterresources/documents/final_ufaa_report.pdf
Stormwater and sanitary sewer maintenance and expansion	$80.55	/linear foot	2015 US EPA BMPs page, Ferguson et al (1997) $3.90 estimate for cleaning, added to $72.60 2001(?) Olympia WA Pipe Evaluation and Replacement Options	http://olympiawa.gov/city-utilities/storm-and-surface-water/policies-and-regulations/~/media/Files/PublicWorks/Water-Resources/SSWPAppendix%20J.ashx
Tree planting (e.g., street trees)	$2.78	/sq. ft. tree canopy	Center for Neighborhood Technology mid value estimate PER TREE, MULTIPLIED BY 114 sq ft/tree at 10 years old (from Recommendations of the Expert Panel to Define BMP Effectiveness for Urban Tree Canopy Expansion report)	http://greenvalues.cnt.org/national/cost_detail.php https://www.chesapeakebay.net/documents/Urban_Tree_Canopy_EP_Report_WQGIT_approved_final.pdf
Lake and stream dredging	$27	/cubic yard dredged	1998 Illinois EPA Lake Notes publication, giving estimates of between $5 and $30 per cubic yard dredged	http://www.epa.state.il.us/water/conservation/lake-notes/lake-dredging.pdf
Logjam assessment and removal	$31.20	/linear foot	2016 Midwest Streams, professional estimate	
Shoreline stabilization	$83.48	/foot	2017 Andreas Consulting, professional estimate	
Streambank & channel restoration	$78	/linear foot	Midwest Streams, professional estimate	

Table E.2. Inflation rates used to convert BMP costs to 2018 U.S. dollars from www.usinflationcalculator.com, accessed May 2018.

Inflation rates to convert to 2018 dollars (usinflationcalculator.com)	
2001	41.0%
2002	38.7%
2007	20.8%
2008	15.9%
2010	15.4%
2011	10.9%
2012	8.7%
2014	5.4%
2015	5.3%
2016	4.0%
2017	1.8%

Descriptions of Management Measures (Best Management Practices, or BMPs)

Programmatic Management Measures

Conservation Development

Conservation Development is a design method that attempts to mitigate the environmental impacts of urbanization by conserving natural areas and their functions. In a Conservation Development subdivision, the aim is to allow for the maximum number of residences permitted under zoning laws, while disturbing as little land area as possible. This is especially important in areas containing floodplains, groundwater recharge areas, wetlands, woodlands, and streams. Developers assess the natural topography, natural drainage patterns, soils and vegetation on the site in the design stage. The result is compact, clustered lots surrounding a common open space.

The open space is typically preserved or restored natural areas that maintain natural hydrological processes and are integrated with newer natural stormwater features and recreational trails. This allows residents to feel like they have larger lots because most lots adjoin the open space. Conservation Development can also be used to integrate agricultural land uses harmoniously into the subdivision design.

The steps below are generally followed when designing a Conservation Development site:

1. Identify all natural resources, conservation areas, open space areas, physical features, and scenic areas and preserve and protect these areas from negative impacts from the development.
2. Locate building sites to take advantage of open space and scenic views by requiring smaller lot sizes or cluster housing in a way that protects the development rights of the property owner and maximizes the number of occupancy units permitted by zoning.
3. Design the transportation system. Roads should provide access to building sites, allow movement throughout the site and onto adjoining lands, and should not cross sensitive natural areas. Street design focuses on narrower widths, infiltration opportunities, eliminating curbs and gutters, adjusting the vehicular level of service (LOS), creating LOS for other modes of transportation, and designing connected street networks to support multiple uses.
4. Prepare engineering plans to show how each building site can be served by essential public utilities.

Conservation Development also provides provisions for long-term and permanent resource protection. Mechanisms such as conservation easements and transfer of development rights can ensure that measures protecting the open space are more than just temporary.

The St. Clair County Stormwater Control Code includes measures to protect the landscape from erosion, by avoiding areas of steep slopes (greater than 3:1) and retaining existing natural watercourses, lakes, ponds, sinkholes, and wetlands wherever possible.[1]

> 33-4-47 SOIL EROSION AND SEDIMENT CONTROL.
>
> The following principles shall apply to all development or redevelopment activities within the County and to the preparation of the submissions required under this Code:

> (A) Development or redevelopment shall be related to the topography and soils of the site so as to create the least potential for erosion. Areas of steep slopes greater than three to one (3:1) where high cuts and fills may be required are to be avoided wherever possible, and natural contours should be followed as closely as possible.
> (B) Natural vegetation shall be retained and protected wherever possible. Areas immediately adjacent to natural watercourses, lakes, ponds, sinkholes, and wetlands are to be left undisturbed wherever possible.

Many communities' zoning ordinances do not yet permit Conservation Development design, because of code requirements for features such as minimum lot sizes, setbacks, and frontage distances. These ordinances should be amended to allow for Conservation Development design.

Federal and state programs

Federal and state agricultural easement and working lands programs such as the Conservation Reserve Program (CRP), the Conservation Reserve Enhancement Program (CREP), the Environmental Quality Incentives Program (EQIP), and the Agricultural Conservation Easement Program (ACEP) are designed to recompense farmers and landowners for practices that protect soil and water health. More information on these programs is available in Appendix E, Funding Sources.

Financial support for stormwater infrastructure

Stormwater infrastructure, including green infrastructure, does not have a dedicated funding mechanism in many of the communities in the watershed. Maintenance and replacement of ageing infrastructure is a significant concern for these communities, and infrastructure failures such as pipe bursts can end up costing them more than timely repairs and replacement would have cost.

Consistent funding at an appropriate level enables communities to create stormwater management programs that reduce urban flood risk and improve water quality. There are several policy options that assign dedicated funding for stormwater infrastructure that prevents flooding and allows infiltration. With all of these options, a certain amount of public resistance can be expected—people generally don't like paying taxes and fees. This is why public outreach and education, and input, is important. Where there is a demonstrated need for infrastructure investment, the benefits can be shown to outweigh the costs and people will understand the need for the program.

For **counties**, the State of Illinois Counties Code (55 ILCS 5/) allows "management and mitigation of the effects of urbanization on stormwater drainage" in St. Clair County, Madison County, and seven other counties (55/ILCS 5/5-1062.2) (see below). Stormwater Plans created by these counties can include elements such as rules for floodplain and stormwater management, fees or taxes from new development, and incentives for using green infrastructure and other approved drainage structures. Illinois **municipalities** also have the authority to adopt stormwater plans (65 ILCS/ Art 11 prec Div 110 – Flood Control and Drainage).

The 2015 Illinois Report for the Urban Flooding Awareness Act prepared by IDNR includes the following USEPA recommendations for stormwater management financing options:[2]

- Stormwater utility (or service fees),
- Property taxes/general funds,
- Sales tax,
- Special assessment districts,
- System development charges,

- Municipal bonds and state grants, and
- Low-interest loans.

A *stormwater utility* is dedicated to recover the costs of stormwater infrastructure regulatory compliance, planning, maintenance, capital improvements, and repair and replacement. The utility imposes its fees based on how much stormwater is being generated from a parcel, which can be readily calculated from the amount of impervious surface on the parcel and the annual average precipitation. Stormwater diverted from the sewer system through infiltration or temporary retention (e.g., into a rain garden or rain barrels) can be given a credit against the utility fee equal to the volume of water averted and its treatment costs. This system offers the public greater transparency as to the true societal costs of managing stormwater runoff, and offers them an economic incentive to employ practices that divert more stormwater from the stormwater collection system.

As of 2015, 21 communities in Illinois have utility fee assessments. This is a smaller number than in many neighboring Midwestern states. The communities include home rule and non-home rule communities. The Illinois Municipal Code allows communities to operate utilities, and townships also have the ability to create a stormwater program and assess a user fee per Public Works Statutes, Article 205 of the Township Code in the Illinois Compiled Statutes (60 ILCS).

A small proportion of *property taxes or general funds* can be set aside for stormwater management. An additional *sales tax*, or a proportion of an existing sales tax, can also be used.

A s*pecial assessment district*, also known as a special service area (SSA), is set up to benefit a specific portion of a municipality or county where there are specific problems to be addressed. Fees assessed only to those properties within that area. The district is often a small portion of a municipality or county. Special assessment districts can be created to address problems with stormwater, flooding, and other issues.

Low-interest loans may be secured under the **Water Pollution Control Loan Program**, which funds both wastewater and stormwater projects. Funding for the loan program comes from the state revolving fund. Eligible projects include upgrading or rehabilitating existing infrastructure, stormwater-related projects that benefit water quality, and a wide-variety of other projects that protect or improve the quality of Illinois's rivers, streams, and lakes. The **Water & Waste Water Disposal Loan & Grant Program** provides funding drinking water systems, sanitary sewage systems, and stormwater drainage to households and businesses in eligible rural areas. The program assists applicants who are not otherwise able to obtain commercial credit on reasonable terms for these projects. Areas served must be rural or towns populated with 10,000 people or fewer. Long-term, low interest loans are the primary funding type available. Grants may be combined with a loan if necessary and if funds are available.

Flood Damage Prevention Ordinance

St. Clair County and eight communities in the watershed are members of the National Flood Insurance Program (NFIP). Madison County and Clinton County are also members. As NFIP members, these communities have a Floodplain Ordinance in effect. Several features of the floodplain ordinances are based on Illinois Department of Natural Resources' Model Flood Damage Prevention Ordinance (a previous or current version).

Further steps can be taken to update communities' floodplain ordinances to protect residents and businesses from flood risk and unnecessary mitigation costs. HeartLands Conservancy prepared a draft

Flood Damage Prevention Ordinance for Madison County containing options for strengthening existing floodplain codes to protect property owners and communities, based on FEMA's Community Rating System (CRS). These options include:

- Requiring applicants for a development permit to obtain all other required local, state, and federal permits before the development permit is issued.
- Defining "substantial improvement" (which triggers compliance) as development which equals or exceeds 50% of the market value of the building before the improvement or repair is started, or increases the floor area of a building by more than 20%.
- Requiring two feet of freeboard (height above the Base Flood Elevation, or BFE) for structures in the floodplain.
- Allowing accessory structures in floodplain that are non-habitable, if they are used only for the storage of vehicles and tools (and follow several other requirements).
- Requiring all new and substantially improved critical facilities to be located outside the floodplain, unless infeasible, in which case they must be elevated or flood proofed to the 500-year flood elevation. Access routes must also be elevated to the BFE. Toxic substances must be sealed off from floodwaters.

The State of Illinois also has a Model Stormwater Management Ordinance that is intended to be an independent, stand-alone, self-sufficient ordinance for Illinois communities to adopt. For local governments without independent stormwater ordinances, the model stormwater provisions can be added to their subdivision ordinance, building code, or zoning ordinance, excluding language which is redundant with existing local government codes.[3]

Green infrastructure incentives

Green infrastructure is a vital concept that incorporates and informs many of the recommended practices in this Watershed-Based Plan. Green infrastructure can be defined as our region's natural resources, including open space, woodlands, wetlands, gardens, trees, and agricultural land. It can also be defined as the nodes and corridors of vegetation over the region, or the site-scale structures and landscaping that recreate natural processes. A regionally connected system of green infrastructure results in a higher diversity of plants and animals, removal of non-point source pollution, infiltration of stormwater, and healthier ecosystems. Corridors of green infrastructure along streams are extremely important because they provide biological conduits between hubs. However, most parcels forming corridors are not ideal green infrastructure until landowners and residents embrace the idea of managing stream corridors or creating backyard habitats.

Various regulatory incentives can be used to encourage the design and implementation of green infrastructure in new development. These incentives can include flexible implementation of regulations, fee waivers, tax abatement, access to municipal utilities, and a streamlined development review process. The incentives can be granted on a case-by-case basis.

In-lieu fee migitation

An in-lieu fee mitigation program can help to protect and restore critical wetland areas while other areas are developed. In-lieu fee mitigation is an opportunity to assist developers in meeting their mitigation needs while directing mitigation to high quality sites in the watershed. Under an in-lieu fee program, a developer can pay a fee in lieu of having to restore or protect wetland on the development site, or to mitigate losses of those sites by protecting or restoring wetland off-site. The fee goes to a third party organization which can direct the funds to high quality ecological sites for which restoration efforts will have the most environmental impact. Mitigation sites can include both wetlands and streams. The USEPA Water Quality Scorecard recommends compensation for damage to riparian/wetland areas to be on a minimum 2:1 basis on- or off-site.

Monitoring

Appendix D - Monitoring Plan outlines an appropriate strategy for water quality monitoring in the watershed.

Naming Unnamed Tributaries

Naming unnamed tributaries throughout the watershed is one way to raise awareness for stream health. Names are typically given to geographic features of importance. Assigning a name to a stream can increase its visibility within a community, and as a result improve public engagement (e.g., cleanups, monitoring) and water quality.

When attempting to name a previously unnamed stream, a proposal must be submitted to the U.S. Board on Geographic Names Domestic Names Committee. Before submitting a proposal, interested parties must verify that the feature has in fact not been named before. Obtaining local support of the proposed name is also highly encouraged before submitting a proposal, as local acceptance of the name is important. Evidence of local approval should be submitted alongside a proposal, and can include letters or emails of support from government agencies, municipalities, tribes, civic organizations, property owners, etc.

At a minimum, a proposal for an unnamed feature must include[4]:

- The full form of the geographic name being proposed.
- The requested action.
- Descriptive information, including:
    - The applicable state and county.
    - The precise location of the feature to be named (i.e., map with geographic coordinates or a detailed written description).
- The meaning or significance of the proposed name.
- Basis of knowledge that the feature is unnamed.

Proposed names that are commemorative or descriptive require additional documentation. Detailed information on proposal requirements can be found in the U.S. Board on Geographic Names Principals, Policies, and Procedures, Domestic Geographic Names document[5].

To raise public support for a new stream name, interested parties can conduct outreach efforts such as writing news articles or creating surveys/petitions. Or, municipalities can engage the public from the start by asking for assistance in determining the new name. For example, the City of Wentzville, Missouri held a *Stream Naming Contest* in 2012[6], which challenged residents to propose names for all unnamed streams in the Dry Branch Watershed (a total of 15 streams at the time). Contest rules encouraged participants to be creative, provided a map of the streams to be named, and listed tips on picking names that would be easily approved. Similarly, the Deer Creek Watershed Alliance, a project of the Missouri Botanical Garden, conducted the 2010 *Tributaries Naming Project*, during which St. Louis residents were invited to help name unnamed tributaries. The project resulted in 13 streams being named in the Deer Creek watershed[7].

Native landscaping

Weed control ordinances, whose purpose is primarily to maintain a pleasing aesthetic in community landscaping, often directly or inadvertently discourage or prohibit the use of native plants. Native landscaping can look "messier" than traditional landscaping, depending on the plants used. But when native plants are well chosen and well maintained, planting areas look very pleasing and offer many water quality and wildlife benefits. Garden nurseries and other native plant providers can be involved in educating customers and displaying the different "look" that native plants offer. Weed control ordinances can be amended to allow and encourage the use of these plants and provide guidance on species and maintenance.

Open space and natural area protection

Several actions can be taken to encourage the protection of natural areas and open space in new development. Some are regulatory, including the following practices from the U.S. EPA Water Quality Scorecard:

- Establish a dedicated source of funding for open space acquisition and management (e.g., bond proceeds, sales tax).
- Adopt regulations to protect steep slope, hillsides, and other sensitive natural lands (e.g., by limiting development on slopes > 30% or requiring larger lot sizes in sensitive areas).
- Create agriculture resource zoning districts (e.g., minimum lot size of 80 acres and larger) to preserve agricultural areas.
- Adopt neighborhood policies and ordinances that work to create neighborhood open space amenities that are within 0.25-mile to 0.5-mile walking distance from every residence.

Other actions are non-regulatory:

- Provide financial support to or collaborate with land trusts or other conservation organizations to acquire critical natural areas.
- Adopt a community-wide open space and parks plan.
- Identify key natural resource areas for protection in jurisdiction's parks and open space plan.
- Allow and encourage retrofits of abandoned or underutilized public lands to serve as permanent or temporary open space and green infrastructure sites.

Private sewage monitoring

Private, residential septic systems are often not maintained properly, leading to failure. The U.S. Census Bureau has indicated that at least 10% of septic systems have stopped working. Failed septic systems can leach bacteria and nutrients into ground water or allow these contaminants to be exposed at the surface and washed into receiving streams during storm events. Currently, inspections and enforcement of private septic systems are complaint-driven—there is no plan or resources for further enforcement.

Septic inspections are required during real estate transactions, but these are often many years apart. More regular inspections should be considered by the counties and municipalities, regardless of property ownership turnover. A rule in Jefferson County, Missouri requires that homeowners annually have their sewer system serviced and submit certification of it to the county.

Private sewage data on violations and water quality parameter exceedences should be collected and mapped. Additionally, an intensive inspection of private septic systems should be considered to determine the location of any illicit discharges and to assess the condition of all septic systems in the watershed. This effort, commonly referred to as a sanitary sweep, could be eligible for grant funding. Following the identification of failing septic systems a course of action to correct these systems will need to be coordinated with the landowners, municipalities, counties, and relevant state agencies.

The U.S. EPA provides an excellent guide for septic system owners called "A Homeowner's Guide to Septic Systems" (USEPA, 2005), which explains how septic systems work, why and how they should be maintained, and what makes a system fail.

Riparian buffer ordinance

"Riparian," in its most general sense, means "adjoining a body of water." A riparian buffer is an undisturbed naturally vegetated strip of land adjacent to a body of water, such as a stream or lake. Among their many benefits, riparian buffers store floodwater, allow lateral stream movement, reduce streambank erosion, trap and remove sediment in runoff, mitigate stream warming through shade, provide habitat for wildlife, and increase property values. The literature indicates that forest provides more benefits in a riparian buffer than grassland does—with benefits including more wildlife habitat, stream shading and temperature control, and more debris as a food source for the stream—so oak-hickory forest should be the first choice in riparian buffer vegetation.

A riparian buffer ordinance protects a riparian area of a certain width from new development and other disturbances, and promotes revegetation/reforestation. As a graduate student intern, Janet Buchanan (one of the authors of this Watershed-Based Plan) created a draft Riparian Buffer Ordinance for Madison County that would protect the riparian area in the unincorporated area of the county from certain kinds of development and activities. The ordinance has not yet been passed.

A riparian buffer ordinance may restrict the following activities and structures in the riparian buffer:

- Buildings, accessory structures, roads, parking lots, driveways, and other impervious surfaces
- Disturbance of vegetation (through clearing, construction, or other practices)
- Disturbance of soil (through grading, stripping of topsoil, plowing, cultivating, or other practices)
- Grazing of animals
- Filling or dumping
- Storage of hazardous materials

Sewage Treatment Plant upgrades/advanced treatment

Sewage treatment plants (STPs) are subject to National Pollutant Discharge Elimination System (NPDES) permit requirements. Upgrades to wastewater treatment plants in the watershed should be installed so that the limits set in these permits are not exceeded. According to recent studies, upgrades can reduce total phosphorus in plant effluent to below 1.0 mg/l and reduce total nitrogen in plant effluent to less than 5.5 mg/L. These would be significant improvements over the existing phosphorus and nitrogen concentrations in effluent from several of the sewage and wastewater treatment plants in the watershed. Funding for sewage treatment plant upgrades may be available from USEPA's Source Reduction grant program.

USEPA has published a report on advanced wastewater treatment methods to reduce phosphorus in effluent ("Advanced Wastewater Treatment to Achieve Low Concentration of Phosphorus"). The most effective treatment is the addition of aluminum- or iron-based coagulants followed by tertiary filtration, which reduces the final phosphorus level in effluent to near or below 0.01 mg/L. This treatment is affordable; monthly residential sewer fees charged by the facilities ranged between $18 and $46. Other pollutants such as BOD, TSS, and fecal coliform were also significantly reduced. Another treatment is enhanced biological nutrient removal (EBNR) in the secondary treatment process, which can often reduce total P to 0.3 mg/L or less prior to tertiary filtration. The process reduces operating costs for the tertiary filtration process and removes other pollutants as well.

Additionally, nutrient credit trading is a way to reduce overall nutrient discharge from the vicinity of the treatment plant. The plant pays for a conservation easement that reduces nutrient discharge from agricultural land, thus offsetting the plant's discharge. The two parties can agree with the state (Illinois EPA) that this amount of nutrient reduction can count against the treatment plant's discharge. These agreements have been made at several locations across the U.S.A., including Lancaster County, PA and the American Farmland Trust 3-state pilot project (Ohio, Indiana, and Kentucky). The agreement typically lasts for 10 years.

Stream Cleanup Team

A Stream Cleanup Team operated between 2008 and 2009 in Madison County and removed debris from selected streams in the county about which they received complaints. The cleanup team therefore contributed to improving water quality, reducing flooding, and monitoring stream health. The work was funded by a grant from the U.S. Department of Housing and Urban Development; the team was comprised of paid workers. During the course of the cleanup operations, logjam locations were entered into a handheld GPS unit, and later processed by the county's IT department. Many county residents were vocal in their support of the Stream Cleanup Team, and said they would like to see a reprise of the program.

The program could be replicated and expanded from its previous scope into St. Clair County. The program could include an education component and opportunities for volunteer involvement, mimicking other cleanup programs such as Missouri Stream Team, the Open Space Council's Operation Clean Stream, or Missouri River Relief Trash Bash.

Watershed-Based Plan integrated into community efforts

Copies of this Watershed-Based Plan will be made available to communities in the watershed. However, for maximum effectiveness, the plan should be adopted and/or supported (via a resolution). The plan will be most effective when its goals, objectives, and recommended actions are integrated with community policy.

Agricultural Management Measures

Animal waste storage/treatment system

Proper livestock waste management is very important in maintaining water quality, especially for bacteria levels. Writing a Comprehensive Nutrient Management Plan helps farmers to integrate waste management into overall farm operations. Such a plan can recommend waste storage structures and strategies that increase waste storage time, eliminate unwanted runoff, incorporate manure nutrients into crop nutrient budgets, and efficiently apply manure to cropland without runoff.

The following is a general approach to addressing bacterial pollution in streams as a result of animal manure.

- Identify known sources of bacteria to waterbodies (e.g., areas where livestock have access to streams), using local knowledge, windshield surveys, interviews with landowners, etc.

- Conduct monitoring of stream reaches, adding additional monitoring to help pinpoint potential sources of bacteria.
- Promote good manure application practices such as:
    - Using manure injection rather than surface application;
    - Applying manure to relatively dry fields;
    - Avoiding steep slopes;
    - Avoiding areas near waterbodies or drain tile intakes;
    - Avoiding areas prone to flooding; and
    - Avoiding application on frozen soil.

See the NRCS "Agricultural Waste Management Field Handbook" (AWMFH) for specific guidance on planning, designing, and managing systems that involve agricultural wastes.

Bioreactors (denitrifying)

Bioreactors, also known as denitrifying bioreactors, are ditches filled with wood chips that contain denitrifying bacteria. The bioreactor is placed at the outlet of a tile drainage system, and the bacteria remove nitrogen from water leaving the system. Research has shown an estimated bioreactor lifespan of 15 to 20 years, after which the woodchips would be replaced if treatment was to be continued.

Comprehensive Nutrient Management Plans (CNMPs)

A CNMP is a strategy for farmers to integrate livestock waste management into overall farm operations. Such a plan can recommend waste storage structures and strategies that increase waste storage time, eliminate unwanted runoff, incorporate manure nutrients into crop nutrient budgets, and efficiently apply manure to cropland without runoff (e.g., manure injection). When these structures and strategies are in place, manure is a useful asset to cropland that provides benefits to soil health.

Conservation tillage

Converting intensive tillage to conservation tillage consists of switching from moldboard to chisel plowing, which leaves at least 30% crop residue on the fields before and after planting to reduce soil erosion. Converting conservation tillage to no-till consists of switching existing chisel plowing to no-till where the ground is not tilled so as to not disturb the soil. This increases water infiltration, organic matter retention, and nutrient cycling, and reduces soil erosion.

Farmers may find that, initially, less tilling leads to growth of glyphosate-resistant (Roundup-resistant) weeds. Approximately ten species of weeds in the U.S. are known to have become resistant to the herbicide. To avoid this, crop rotation and diversification is the best strategy to disrupt the weeds' emergence, following a long-term weed management plan. This plan should focus on the proper use of each herbicide, using diverse herbicide modes of action (MOA), and the rotation of both herbicides used and crops planted. See the Penn State Extension webpage for more information about how this can be achieved[8].

Contour buffer strips

Contour buffer strips are strips of perennial vegetation that alternate with strips of row crops on sloped fields. Contour buffers strips are usually narrower than the cultivated strips. The strips of perennial vegetation, which consist of adapted species of grasses or a mixture of grasses and legumes, slow runoff and remove from it sediment, nutrients, pesticides, and other contaminants. Buffer strips can also provide food and habitat (e.g., nesting cover) for wildlife. Contour buffer strips are most suited to uniform, non-undulating slopes of between four and eight percent, but can also be used on steeper land. Contour buffer strips should be mown to maintain appropriate vegetative density and height for trapping sediment, and/or for providing habitat for target wildlife species. They should not be mown during critical erosion periods.

Cover crops

Cover crops provide both annual and long-term benefits to agricultural land. On an annual basis, they protect soil from water and wind erosion by providing a vegetative cover between the fall harvest and spring planting. They take up residual fertilizer nutrients and then release them back into the soil for the subsequent spring crop. Cover crops also suppress winter annual weeds. With consistent use of cover crops, the soil organic matter content will increase, and this provides many benefits to the soil, including improved soil tilth and health, increased porosity and infiltration, and sustained biological activity. Cereal grains, annual rye grass, and radish are common cover crops for this purpose, but many other types are available. Some crops, such as radish and turnips, are selected to help break through compacted soil layers. Cover crops are often planted as a mix of multiple species that mutually provide a range of benefits[9].

Grassed waterways

Grassed waterways are vegetated channels designed to prevent gully erosion by slowing the flow of surface water with vegetation. Grassed waterways should be used where gully erosion is a problem. These areas are commonly located between hills and other low-lying areas on hills where water concentrates as it runs off the field. Grassed waterways trap sediment entering them via field surface runoff and in this manner perform similarly to riparian buffer strips.

The size and shape of a grassed waterway is based on the amount of runoff that the waterway must carry, the slope, and the underlying soil type. NRCS design standards for grassed waterways specify that the minimum capacity convey the peak runoff expected from the 10-year frequency, 24-hour duration storm. Enough freeboard above the designed depth should be provided to prevent damage to crops. The vegetation in the channel should be native plants suited to the site conditions and intended uses.

Nutrient Management Plans (NMPs)

A NMP is a strategy for obtaining the maximum return from on- and off-farm fertilizer resources in a manner that protects the quality of nearby water resources. Creating an NMP involves reviewing soil maps, field boundaries, and nutrient uptake of crops to determine nutrient needs for each field and the types and amounts of fertilizers to meet those needs.

Ponds

Ponds are popular features that also have significant pollutant removal benefits when well sited and designed. Also known as wet ponds, stormwater ponds, or wet retention ponds, they are constructed basins that have a permanent pool of water throughout the year (or at least throughout the wet season). As stormwater runoff enters the pond, the sediment settles out and some nutrient uptake takes place. Nitrogen removal through denitrification (i.e., reduction of nitrates via anaerobic bacteria) can also occur in ponds.

Riparian buffers

A riparian buffer is a vegetated area along a shoreline, wetland, or stream where development and row cropping is restricted. The buffer physically protects and separates the waterbody from future disturbance or encroachment, and reduces the amounts of pollutants that reach it. If properly designed, a buffer can sustain the integrity of stream ecosystems and habitats. As conservation areas, aquatic buffers are part aquatic ecosystem and part urban forest.

Different grading and vegetation at different locations can affect water quality in different ways. Where vegetation roots can interact with the water table, carbon cycling and denitrification may be enhanced. In areas where the water table depth exceeds the rooting depth, and overland runoff is high, stiff-stemmed grasses may be beneficial to intercept and reduce runoff and sediment from reaching the stream. Where appreciable amounts of neither runoff nor groundwater can be intercepted, streambank stabilization has great benefits. Locations where these practices would be most suitable were identified by using USDA's ACPF model.

A riparian buffer ordinance is an important tool that communities can use to restrict new development in buffer areas in order to ensure that land adjacent to streams continues to protect water quality and moderate stormwater flow.

Terraces

Terraces are a soil conservation practice applied to prevent rainfall runoff on sloping land from accumulating and causing serious erosion. The term "terraces" often brings to mind "contour terraces" such as those in various mountainous regions of the world that follow contours in wavy lines. However, parallel terraces are the type of terrace used most commonly on agricultural land in the U.S. They are constructed parallel to each other in straight lines, and parallel to the direction of field operations as much as possible. Some terraces are constructed with steep backslopes that are kept in grass, but most are broad-based with gently sloped ridges that are cultivated as part of the field. Parallel terraces that discharge runoff through subsurface tile drains are known as parallel tile outlet (PTO) terraces. With this setup, water that accumulates behind a terrace ridge is discharged through a surface inlet into a subsurface drain. Some of the runoff is temporarily stored for long enough that sediment settles out of the water, but not so long as to damage the crop.

The major benefit of terraces is the conservation of soil and water, which in turn allows more intensive cropping than would otherwise be possible. There are additional benefits for PTO terraces: the total area can be farmed (no grassed waterways are needed); no interruptions in tilling or applying herbicide because there are no grassed waterways; reduced peak discharges; and the settling out of sediment and other contaminants before it reaches a receiving waterbody. Terraces are best suited to fields with long, fairly-uniform slopes that are not too steep (generally less than eight percent), and where the soil is not too shallow (more than six inches). See the Purdue University Cooperative Extension Service[10] page for more information on terraces.

Water and Sediment Control Basins (WASCOBs)

WASCOBs are small earthen ridge-and-channel or embankments built across a small watercourse or area of concentrated flow in a field. WASCOBs hold field runoff that would otherwise create a gully or leave the field without sediment settling out. WASCOBs are usually straight, vegetated with grass, and just long enough to bridge an area of concentrated flow. The water detained in a WASCOB is released slowly via infiltration or a pipe outlet and tile line. The ACPF model identified locations where WASCOBs would be the most effective.

Wetlands

Wetlands, or Nutrient Removal Wetlands, provide significant water quality benefits. Wetland plants, soils, and microbes cleanse the water entering the wetland, removing approximately 78% sediment, 44% phosphorus, and 20% nitrogen from runoff, according to USEPA's STEPL tool. This is achieved through settling and biological update by wetland plants and organisms. They also recharge groundwater, store stormwater, reduce high water flows, provide food and habitat for wildlife, and increase carbon sequestration. They are appropriate for agricultural and semi-urban land only, where there is limited development.

Natural wetlands should be protected from increased stormwater runoff from development, so as to continue functioning. Wetland vegetation should consist of native aquatic plant species.

Constructed wetlands are shallow, vegetated ponds that are engineered and constructed to mimic the structure, water quality function, wildlife habitat, and aesthetic value of naturally occurring wetlands. In some cases, they occur on sites that were historically wetlands, and can be considered wetland restoration projects. Since constructed wetlands need a somewhat constant water level to sustain their functions, the soils underlying the wetland must allow limited infiltration.

Wetland restoration is the rehabilitation of a degraded wetland or the re-establishment of a wetland so that the soils, hydrology, vegetative community, and habitat are an approximation of the original natural condition that existed prior to historic modification.

The USDA's ACPF tool identified suitable locations for nutrient removal wetlands in areas with high runoff risk in the Indian-Cahokia Creek watershed. The MoRAP assessment of wetland restoration ranking identified wetland areas suitable for wetland restoration.

Forest Management Measure

Forest stand improvement

Forest stand improvement is an approach to forest management that prioritizes forest health and wildlife habitat. Trees within the stand that are a desirable species, age class, and form are retained while those competing with these trees are "culled" (i.e., cut or girdled). This decreases competition for the desirable trees, increases growth rates, and allows managers to shape the future forest. Forest management can favor trees that produce more hard and soft mast (nuts, seeds and fruit) to support wildlife populations. Additionally, forest stand improvement can help improve water quality by removing undesirable species, including invasive species such as honeysuckle, that increase soil erosion on the forest floor by suppressing ground cover vegetation.

Urban Management Measures

Urban runoff management is somewhat different from agricultural settings in that the larger areas of impervious surfaces cause higher runoff volumes and, often, high nutrient concentrations. Structural infrastructure designed and constructed to collect, store, infiltrate, and treat storm water are some of the most expensive watershed improvement tools to implement and require consistent maintenance. According to Schueler and Holland (2000), the cost to maintain a storm water practice over 20 to 25 years can be equal to the initial construction costs. Nevertheless, structural storm water practices can be effective tools for pollutant removal, runoff reduction, and peak flow reduction when properly designed, constructed, and maintained.

Many of these Urban Management Measures fall under the definitions/categories of Low Impact Development (LID) and green infrastructure. They include design, construction, and post-construction (retrofit) practices. The following practices have been recommended for the Indian-Cahokia Creek watershed.

Bioswales

Bioswales are swaled (sloped) drainage courses designed to remove debris and reduce pollution from surface water. The sides of the swale are less than six percent slope and the swale may be filled with vegetation, compost, and/or riprap. The design of the swale should maximize the time water spends there, which aids in infiltration (for groundwater recharge) and pollutant removal. Bioswales are often effective when sited adjacent to parking lots. They can capture and treat stormwater during the "first flush" of rain on the parking lot, which carries substantial automotive pollution.

In 2012, the City of O'Fallon, Illinois and HeartLands Conservancy conducted a feasibility study to determine optimal locations for implementing bioswales—including retrofitting existing concrete swales and identifying future installation areas—to reduce the volume of stormwater runoff and related pollutants and sediments. In order to analyze potential vegetative swale sites, the planning area was split into two smaller watersheds and then analyzed using two tools, Long Term Hydrological Impact Analysis and ArcGIS, to determine the potential benefits of implementation. In addition, the city studied two pilot locations for a six-month period to establish baseline flow data in existing concrete roadside swales. To encourage participation, regulatory barriers were removed that could potentially impede private property owners, the city, and developers from voluntarily implementing green infrastructure. Marketing strategies were also developed to facilitate the introduction of bioswales to the community. Overall, O'Fallon and HeartLands Conservancy recommended:

- Encouraging the implementation of bioswales and other stormwater BMPs in areas of new development, particularly in residential parcels.
- Ensuring that city ordinances allow for the utilization of BMPs for both existing and new development.
- Retrofitting existing concrete swales with bioswales in high-priority areas (i.e., residential streets), specifically when the current infrastructure is being repaired or replaced to cut costs.

Detention basins

Detention basins are human-made depressions for the temporary storage of stormwater runoff with controlled release following a rain event. Wet bottom basins are essentially ponds planted with turf grass on their side slopes. Dry detention ponds (i.e., dry ponds or extended detention basins) are designed to detain stormwater runoff for some minimum time (e.g., 24 hours) to allow particles and associated pollutants to settle, but do not have a large permanent pool of water. They are often lined with concrete. These basins do not provide much, if any, infiltration, wildlife habitat, or water quality improvements.

When designed for multiple functions, however, detention basins can improve water storage, wildlife habitat, natural aesthetics, and water quality. According to USEPA, properly designed wet bottom basins designed to have wetland characteristics reduce total suspended solids (sediment) by 77.5%, total phosphorus by 44% and total nitrogen by 20%. Dry bottom infiltration basins reduce total suspended solids (sediment) by 75%, but have lower nutrient removal reduction of total phosphorus (65%), and total nitrogen (60%).

New basins should be:

- Located in natural depressions or drained hydric soil areas (especially when native vegetation is used);
- Located adjacent to existing green infrastructure (especially when native vegetation is used);

- Oriented/located so that outlets do not enter sensitive ecological areas.
- Designed to serve multiple development sites, so that several smaller basins are not needed;
- Designed with shallow side slopes and appropriate native vegetation;
- Designed with a shelf planted with native wet prairie vegetation, if a wet bottom basin; and
- Planted with mesic or wet-mesic prairie, if a dry bottom basin.

The St. Clair County Stormwater Control Code protects wetlands, streams, and steep slopes in new development and redevelopment (see *Conservation Development*). The Madison County Stormwater and Erosion Control Ordinance contains several requirements for new detention basins in floodplains, floodways, and connected to wetlands, rivers, streams, and ponds.

Retrofits to existing basins can also attain these benefits, through minor engineering changes, addition of extended detention basins/ponds, and the use of native vegetation. Many of the dry, wet, and wetland bottom basins in the watershed present excellent retrofit opportunities. Generally speaking, three years of management are needed to establish native plant communities. During the first two growing seasons following seeding, mowing and spot herbicide applications are needed to reduce annual and biennial weeds and eliminate problematic non-native/invasive species such as thistle, reed canary grass, and emerging unwanted saplings. In addition, the inlet and outlet structures should be checked for erosion and clogging during every site visit.

Maintenance of detention basins is of vital importance in sustaining their functions and extending the life of the infrastructure. Maintenance practices include regular dredging, mowing or burning (an in-place controlled burn of native grasses) of the vegetation, and removal of invasive species. These practices are recommended in the watershed plan, and will be referenced for these sites as they are proposed for new projects.

For existing subdivisions and areas already developed, it is unusual to have a long-term maintenance agreement in place. When detention basins get full of sediment, there is no clearly identified party responsible for dredging and maintenance. Outreach is needed to educate HOAs about taking on responsibility for dredging and other maintenance, and potentially change their byelaws to reflect this responsibility. For new development, Madison County recently began the best practice of including the transfer of authority for maintenance of the detention basin from the developer to the Homeowners Association once the subdivision is 90% complete. The HOA then has a maintenance responsibility for the detention basin for the life of the project. Alternatively, developers should be encouraged to donate naturalized detention basins and other natural areas to a local municipality or conservation organization for long term management that can be funded by a mechanism such as a SSA tax.

Regional detention basins collecting stormwater from a large area may be an effective option for reducing flood impacts to Scott Air Force Base in particular. Partners including the Village of Shiloh and others in the Community Partnership Group may be able to move forward with detention facilities that slow the flow of water to the base during heavy storms so that the flood impacts are reduced. Further hydrologic analysis of the discharge and direction of runoff to the base would be needed to set this planning in motion.

Pervious pavement

Pervious pavement is also referred to as porous or permeable pavement. Areas paved with pervious pavement allow water to infiltrate through small holes to a below-ground storage area, or to a pipe that leads to such an area. Pervious pavements reduce runoff rates and volumes from traditional impervious pavements, and can be used in almost every capacity in which traditional asphalt, concrete, or pavers are used. Below ground, the stormwater can be treated through soil biology and chemistry, and the water is returned to groundwater and aquifers rather than increasing flows in streams. It is important to note that there are limitations to using pervious pavement based on subsoil composition, and that it requires annual maintenance (such as vacuuming with a specialized machine) to remain effective over time.

Design options for pervious pavement include:

- Porous pavement with underground storage/recharge beds;
- Concrete pavers infilled with soil/gravel and vegetated with grass; or
- Plastic or metal grid infilled with gravel or equivalent.

Rain gardens

Rain gardens, vegetated depressions that clean and infiltrate stormwater from rooftops and sump pump discharges, have become popular garden features. They work best when located in existing depressions or near gutters and sump pump outlets, and are typically planted with deep-rooted native wetland vegetation. Rain gardens significantly slow the flow of water, improve water quality, and provide food and shelter for birds, butterflies, and insects.

Rain gardens work well in combination with the disconnection of roof downspouts and the redirection of that water to the garden. This results in a significant increase in the infiltration of rainwater over a direct connection to the storm drain or to impervious surfaces.

Bioretention facilities are sometimes referred to as rain gardens, but the term rain garden is typically used to describe a small, planted depression on an individual homeowner's property, while a bioretention facility typically describes larger projects in community common areas as well as non-residential applications.

See "Thinking Outside the Pipe" from HeartLands Conservancy for more specifics on rain garden design and bioretention facilities.

Rainwater collection

Rainwater collection and re-use via rain barrels and cisterns is a straightforward and useful way to decrease the amount and intensity of stormwater runoff in a watershed and reduce the amount of water consumed from municipal sources. On most homes and buildings, rainwater flows from roofs into downspouts and then onto streets or into storm sewers. Reconnecting the downspouts to either rain barrels or cisterns can reduce the flood levels in local streams and make water available to the building owner for irrigation and other uses. Water re-use differs based on the type of storage and water treatment.

Rain barrels sit above ground, and are connected to downspouts. A typical rain barrel stores 55 gallons of water. The water collected is often used for irrigation, which can result in significant cost savings; in many areas, residential irrigation can account for almost 50 percent of residential water consumption. Car washing and window cleaning are other common uses of the collected rainwater.

Cisterns are larger, sealed tanks that can sit above or below ground, and also collect rooftop runoff from downspouts. If installed below ground, a cistern requires a pump to bring the water up. With appropriate sanitation treatments, the "gray water" from cisterns can be reused for toilets, housecleaning, dishwashers, laundry, and even showers. Cisterns and rain barrels both reduce water demand in the summer months by reducing the potable water used for irrigation or other household uses.

Single property flood reduction strategies

A number of practices can be used to reduce flood damage on single properties. The key to successfully mitigating future damages is to identify the source(s) of flooding at the site scale. It is important to educate property owners about possible sources of flooding, flood mitigation practices, and the costs of those practices. Coordination with local community officials is often required to identify and confirm the most appropriate flood reduction strategy.

The Illinois Urban Flooding Awareness Act Final Report, published in June 2015, identified typical causes of basement flooding (overland flow, infiltration, or sewer backup), and mitigation options available to address these causes. Table E.3 is taken from this report, and shows these causes, along with mitigation options and their costs.

Table E.3. Flood damage mitigation options and the causes of flooding that they address, along with estimated costs. From the IDNR Urban Flooding Awareness Act report (June 2015), Table 9.1.

	Cause of Flooding				
Mitigation Options	**Overland**	**Infiltration**	**Sewer backup**	**Damage reduction**	**Estimated Cost**
Structural Inspection					$250-$800 each
Raise utilities and other valuable items				x	
Insurance				x	Based on coverage
Gutter maintenance	o	x	o		
Downspout disconnection			x		
Site grading, downspout extension	o	x			
Rain gardens	o				$3-40 per square foot
Permeable/porous pavement	x				$2-$10 per square foot
Exterior drain tile		x			$185 per foot
Interior drain tile		x	x		$40-50 per foot
Seal wall and floor cracks		x	o		$300-$600 each
Sump pump with check valve	x	x	x		$400-$1,000 each
Sewer backup valves			x		$3,000-$5,000
Overhead sewer installation			x		$2,000-$10,000
x - primary reduction o - secondary reduction					

Stormwater and sanitary sewer maintenance and expansion

Storm drain systems are vital for the timely removal of stormwater from areas where it would cause damage if it accumulated. When clogged, storm drains, culverts, and other stormwater infrastructure can cause overflows that lead to erosion and property damage. Cleaning this infrastructure increases dissolved oxygen and reduces levels of bacteria in the receiving waters. Cleaning storm drains by flushing is more successful for pipes smaller than 36 inches in diameter. Wastewater must be collected and treated once flushed through the system. For larger pipes, long pipes (700 feet or more), areas with relatively flat grades, and areas with low flows, flushing may be less effective.

In some cases, stormwater infrastructure is found to be too small to accommodate the flow it receives. Often, new development upstream has altered the watershed hydrology in some way, often increasing the amount of impervious surface and surface runoff flowing to it. In such cases, existing infrastructure such as road culverts and detention basins should be assessed and resized to accommodate the increased flows. The Madison County Stormwater and Erosion Control Ordinance requires that culvert crossings are sized to "consider entrance and exit losses as well as tailwater conditions" (3.4.12.3).

The 2014 Madison County EMA All-Hazard Mitigation Plan recommended several storm drain system improvement projects in municipalities in the watershed, including Bethalto, Edwardsville, Roxana, Wood River, and Worden. Culverts, ditches, and detention basins that often overflow should be assessed for potential enlargement. Upgrades should be made in response to storm drain system inspections, citizen complaints, and/or updated modeling of the system. In addition, sanitary sewer systems should be maintained in order to prevent infiltration and combined sewer overflows. Expansion of sanitary sewers to new development and existing buildings (already a common practice among municipalities) should continue wherever feasible.

Tree planting (e.g., street trees)

Street trees are trees that are planted in the public right-of-way. They are an important component of municipal green infrastructure and provide benefits including reducing stormwater runoff, filtering pollutants in air and water, mitigating high "urban heat island" air temperatures, and providing pleasing aesthetics that increase property values.

When planting new street trees, site evaluations should be conducted to evaluate site considerations. Then, a suitable native tree species is selected. Factors such as growth rate, ornamental traits, size, canopy shape, shade potential, wildlife benefits, and leaf litter production should all be considered when choosing a tree species.[11]

Municipalities with a strong tree program can become a member of Tree City USA, a program operated by the Arbor Day Foundation. It is a nationwide movement that provides the necessary framework to manage and expand public tree inventory. Cities can achieve Tree City USA status by meeting four core standards of sound urban forestry management: (1) maintaining a tree board or department, (2) having a community tree care ordinance, (3) spending at least $2 per capita on urban forestry, and (3) celebrating Arbor Day.

Pollutant removal efficiencies for specific types of trees planted can be estimated with the Pollutant Load Reduction Credit Tool developed by the Center for Watershed Protection in 2017.[12] More general pollutant reduction efficiencies were calculated or cited by the Chesapeake Bay Program[13] and the Pigeon Creek Watershed Plan.[14]

Stream and Lake Management Measures

Lake and stream dredging

Dredging is performed to remove sediments and debris from water bodies. Dredging routinely prevents sedimentation from filling in stream channels.

The 2010 Oates Associates report for Madison County recommended routine sediment and debris removal from the following stream channels:

- Dunlap Lake
- Cahokia Diversion Canal (15,000 linear feet of stream channel)
- Delaplaine Branch Stream Channel (15,000 linear feet of stream channel) (near Georgia St, Edwardsville)
- Old Alton/Edwardsville Road Ditch, Roxana (15,000 linear feet of stream channel)

Logjam assessment and removal

A logjam is any woody vegetation, with or without other debris, which obstructs a stream channel and backs up stream water like a natural dam. Logjams occur naturally, providing beneficial stream structure and cover for fish and wildlife and allowing nutrient-rich sediments to be deposited on adjacent floodplain. However, logjams also impede the ability of streams in the watershed to drain and convey water from the land in a timely manner.

Logjams commonly form when a relatively large object, often a tree, falls into a stream channel and becomes wedged or blocked across the streambed. Populations of beavers in the watershed also contribute to the felling of trees in riparian areas. Sometimes human activities induce stream obstructions, like when yard trimmings or large appliances and other litter are dumped in a stream or left in a floodplain and subsequently are carried into the stream.

Logjams contribute to flooding by making less natural storage available in the stream channel, elevating the water out of its banks during periods of high flow. This can be significant to farm fields and residences in the floodplain and to particularly low-lying, flood-prone areas. A logjam can also lengthen the duration of inundation during these floods, which can have a significant impact on crops planted in floodplain fields. However, this does not make a big difference to overall flood elevation during large-scale floods. Removing logjams is generally only considered an effective measure to mitigate small-scale flooding.

Water quality is also affected when a logjam is created. As sediment is deposited behind the obstruction, the water that flows on down the stream has less total suspended solids. Water is oxygenated as it stirs and mixes while cascading over, around, and through the logjam. However, not all the water quality impacts are beneficial. As the water moves around the logjam along the route of least resistance, it scours away the streambanks, introducing more sediment and debris to the water. When the stream flow is powerful enough, a streambank ”blow-out” can occur around it, taking large amounts of soil and debris from the bank into the stream channel as the stream creates a new path.

Stream channel changes resulting from water being redirected around a logjam can lead to the creation of a series of meanders. In an area where the riparian zone is vegetated, and development or cropland is not directly adjacent to the stream, this meandering and stream relocation is not really a problem. In developed or row cropped areas, these changes can inflict significant property damage and necessitate an expensive channel restoration project.

Logjams affect the habitat of species living in and near the stream. When a logjam forms, it slows the flow behind the obstruction, allowing sediment suspended in the water to settle out. The sediment adds to the obstruction and causes additional debris to become trapped there as well, enlarging and compacting the obstruction. This can create new habitat for fish and aquatic plants and macroinvertebrates. However, a tightly packed stream obstruction can act as a barrier to fish migration.

Determining whether a certain logjam should be removed requires these factors to be taken into account. Where logjams and potential channel changes would be detrimental to riparian property owners and stream water quality, property owners should be prepared to conduct routine stream inspections twice a year and after significant storm events to identify obstructions that need to be removed. The easiest way to deal with logjams is to remove them before significant sediment and debris has been deposited. A useful source for determining whether a logjam should be removed is "Stream Obstruction Removal Guidelines," prepared by the Stream Renovation Guidelines Committee, The Wildlife Society, and the American Fisheries Society in 1983[15].

Shoreline stabilization

The shoreline provides habitat for fish and wildlife, supports recreation for humans, and cleans stormwater runoff before it enters the water. Shoreline erosion is a natural process that occurs on lakes and rivers and along the coast. It is the gradual, although sometimes rapid, removal of sediments from the shoreline. It is caused by a number of factors including storms, wave action, rain, ice, winds, runoff, and loss of trees and other vegetation. Stabilizing the shoreline of lakes in the watershed can reduce sediment erosion and support vegetation and wildlife habitat.

A shoreline's natural vegetation acts as a filter, preventing sediment and unnecessary nutrients from entering the waterbody. This runoff leads to poor water quality and upsets the balance needed for a healthy shoreline habitat. In the case of lawns, this runoff can include fertilizers, pesticides, lawn clippings, and pet waste. Geese are attracted to lawns, and their waste can add to this runoff.

Shorelines can provide excellent habitat for fish and wildlife. Fish and frogs often spawn in the silt in shallow water at the shore. Shoreline vegetation provides nesting spots for birds and food for insects, waterfowl and aquatic mammals. Fallen logs and branches provide shelter and hunting areas for fish and mammals, while turtles use them to sunbathe.

Shoreline stabilization methods should include deep-rooted native vegetation (particularly trees), gentle slopes to absorb the energy of waves, and "soft armoring" of live plants, logs, root wads, vegetative mats, and other methods (to complement unavoidable "hard armoring," such as rock rip-rap, stone blocks, sheet-pile or other hard materials) where possible.

Streambank and channel restoration

Streambank and channel restoration includes streambank stabilization and stream channel improvements. These practices are typically done together alongside riparian buffer improvements. The USEPA reports that as much as 90% of sediment, phosphorus, and nitrogen can be reduced following stream restoration. Bank stabilization helps to preserve the stream environment in a natural state, building a strong, long-lasting natural system of deep rooted vegetation that will protect the topsoil from heavy wind and rain.

"Traditional" or "hard" methods of stabilization involve materials such as rip-rap, concrete, and steel. By utilizing bioengineering (natural mimicry or "soft") methods that incorporate vegetation, the project is often cheaper, provides more effective stabilization, and reduces overall pollution going into the stream. Targeting the outer bends of stream sections with poor riparian vegetation cover where most stream erosion occurs increases the effectiveness of streambank stabilization practices. Streambank bioengineering, which uses vegetative materials in combination with structural tools such as rock at the toe of the streambank, are most needed in areas of excessive streambank erosion or loss of farmland.

Streambank and channel restoration practices appropriate for the streams in this watershed include:

- Vegetative bioengineering;
- Stone toe protection;
- Two-stage channels;
- Riffle/pool complexes;
- Rock riprap; and
- Gabions (rock and wire baskets).

Stream restoration projects present some challenges for those implementing them. First, the development patterns that created the problem are not addressed. Second, the solutions are often technical and expensive, requiring permitting and construction from a qualified contractor. And third, routine maintenance is often not maintained as landowners lack the knowledge or capability to do the needed work. Several resources are available to landowners to help them navigate these challenges. St. Clair County NRCS has helped implement 938 ft of streambank and shoreline restoration between 2010 and 2015.

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[2] Illinois Department of Natural Resources, June 2015, Report for the Urban Flooding Awareness Act (PDF), available at https://www.dnr.illinois.gov/WaterResources/Documents/Final_UFAA_Report.pdf

[3] Illinois Department of Natural Resources, Model Stormwater Management Ordinance (PDF), 2015, https://www.dnr.illinois.gov/WaterResources/Documents/IL_Model_Stormwater_Ordinance.pdf

[4] U.S. Board on Geographic Names Principals, Policies, and Procedures, Domestic Geographic Names. 2016. Available online at https://geonames.usgs.gov/docs/PPP%202016.pdf.

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[7] Deer Creek Watershed Alliance, Tributaries Naming Project. 2010. Available online at http://www.deercreekalliance.org/2010tributaries

[8] Penn State Extension, Forage and Food Crops, available at http://extension.psu.edu/plants/crops/soil-management/no-till/preventing-herbicide-resistant-weeds-in-a-no-till-system

[9] Natural Resources Conservation Service, Cover Crops and Soil Health, available at http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/climatechange/?cid=stelprdb1077238

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[11] United States Environmental Protection Agency (USEPA), September 2016, Stormwater Trees: Technical Memorandum, PDF, available at https://www.epa.gov/sites/production/files/2016-11/documents/final_stormwater_trees_technical_memo_508.pdf

[12] Center for Watershed Protection, December 2017, Pollutant Load Reduction Credit Tool, downloadable Excel spreadsheet, available at https://owl.cwp.org/mdocs-posts/pollutant-load-reduction-credit-tool/

[13]Karen Cappiella, Sally Claggett, Keith Cline, Susan Day, Michael Galvin, Peter MacDonagh, Jessica Sanders, Thomas Whitlow, and Qingfu Xiao, September 2016, Recommendations of the Expert Panel to Define BMP Effectiveness for Urban Tree Canopy Expansion, PDF, available at https://www.chesapeakebay.net/documents/Urban_Tree_Canopy_EP_Report_WQGIT_approved_final.pdf

[14]Northwater Consulting, 2014, Pigeon Creek Watershed Management Plan, PDF, available at https://www.in.gov/idem/nps/files/wmp_pigeoncreek_2014_sects_1-4.pdf

[15] Stream Renovation Guidelines Committee, The Wildlife Society, American Fisheries Society, 1983, Stream Obstruction Removal Guidelines, available at https://www.fws.gov/southeast/pdf/guidelines/stream-obstruction-removal-guidelines.pdf

APPENDIX E – MANAGEMENT MEASURES

Quantifying the impacts of potential management measures

Quantifying pollutant reduction

Several sources were used to identify typical pollutant and flow reduction associated with each Best Management Practice (BMP) recommended, where possible. These include:

- U.S. Environmental Protection Agency (USEPA) Region 5 Load Estimation Model Users Manual, Figure E6-2
- Pigeon Creek Watershed Plan, Table 67 (Waste Basin Treatment System)
- Spreadsheet Tool for Estimating Pollutant Loads (STEPL) 4.4 BMP calculator, available at http://it.tetratech-ffx.com/steplweb/models$docs.htm
- Long Run Creek Watershed Plan, Table 40, Table 41
- Illinois Nutrient Loss Reduction Strategy (2015)
- Green Values National Stormwater Management Calculator, http://greenvalues.cnt.org/national/cost_detail.php
- Minnesota Department of Transportation - Table 2.2 in the report: "Comparing Properties of Water Absorbing/Filtering Media for Bioslope/Bioswale Design," 2017 http://www.dot.state.mn.us/research/reports/2017/201746.pdf
- National Pollutant Removal Performance Database, seen in Lower Meramec Watershed Plan, Table 20 and Table 21
- Illinois Urban Flooding Awareness Act report, 2015, https://www.dnr.illinois.gov/waterresources/documents/final_ufaa_report.pdf
- Low Impact Development Urban Design Tools website, https://www.lid-stormwater.net/
- Southwestern Illinois Resource Conservation District, (SWIRCD), Thinking Outside the Pipe, seen in Lower Meramec Watershed Plan, Table 20
- Stormwater Management Center fact sheets, seen in Lower Meramec Watershed Plan, Table 20 and Table 21
- Iowa Nutrient Reduction Strategy, Table 2 and Table 3
- International Stormwater BMPs Database Pollutant Category Summary Statistical Addendum: Total Suspended Solids, Bacteria, Nutrients, and Metals, www.bmpdatabase.org, linked to by USEPA

Quantifying the costs of management measures

The implementation costs of the management measures recommended were assembled from several sources, including the following primary sources:

- Natural Resources Conservation Service (NRCS) Practice Component List FY2014
- Iowa State University, 2011, 'Woodchip Bioreactors for Nitrate in Agricultural Drainage,' page 2
- Long Run Creek Watershed Plan, Table 41 and Table 42
- Illinois Nutrient Reduction Strategy (2015), Page B-3, B-4, B-7
- Green Values National Stormwater Management Calculator, http://greenvalues.cnt.org/national/cost_detail.php

- National Pollutant Removal Performance Database, seen in Lower Meramec Watershed Plan, Table 20 and Table 21
- Illinois Urban Flooding Awareness Act report, 2015, https://www.dnr.illinois.gov/waterresources/documents/final_ufaa_report.pdf
- Low Impact Development Urban Design Tools website, https://www.lid-stormwater.net/
- Southwestern Illinois Resource Conservation District (SWIRCD), Thinking Outside the Pipe, seen in Lower Meramec Watershed Plan, Table 20
- Stormwater Management Center fact sheets, seen in Lower Meramec Watershed Plan, Table 20 & Table 21
- Iowa Nutrient Reduction Strategy, Table 2 and Table 3
- International Stormwater BMP Database Pollutant Category Summary Statistical Addendum: TSS, Bacteria, Nutrients, and Metals, www.bmpdatabase.org, linked to by USEPA
- Technical estimates from Midwest Streams Inc and Andreas Consulting Inc., 2017

Since these costs were assembled, an additional valuable resource for costs was identified: the Green Values National Stormwater Management Calculator, available online at http://greenvalues.cnt.org/national/cost_detail.php. This site includes information on construction costs, maintenance costs, and component lifespan.

The final costs used, and their sources, are shown in Table E.1. The costs were adjusted for inflation to 2018 dollars using the conversion rates given in Table E.2 from www.usinflationcalculator.com.

Table E.1. Costs of recommended BMPs and sources of cost data

Management measure	Cost	Cost unit	Cost data source(s)	URL
Animal waste/storage treatment system	$260,000	/acre	2016 Andreas Consulting cost for one large flushing and treatment system on dairy farm, 2016. Also see this NRCS factsheet for more detail.	https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_012400.pdf
Bioreactors (denitrifying)	$157.81	/acre drained	2011 Iowa State University PDF, 2011, 'Woodchip Bioreactors for Nitrate in Agricultural Drainage'. Cost is $7k to $10k for treating 30 to 100 acres, so average of $8,500 per bioreactor treating an average of 65 acres, so 8,500/65 = $130.76/acre in 2011, adjusted for inflation is $142.30 in 2017.	https://store.extension.iastate.edu/product/13691
Comprehensive Nutrient Management Plans (CNMPs)	$54.97	/acre planned for	2017 Mike Andreas (Andreas Consulting), 2017. Further information available at the NRCS webpage ($32 average annual per animal or $6,748 average annual cost of implementation)	https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_012173.pdf
Conservation tillage	$58.65		2017 Andreas Consulting, professional estimate	
Contour buffer strips	$175.11	/acre	2015 Iowa State University fact sheet, cost example table on page 2, sum of costs except foregone income cost	http://www.nutrientstrategy.iastate.edu/documents
Cover crops	$30.54	/acre	2015 Illinois Nutrient Reduction Strategy, page B-6 under "Planting Cover Crops"	http://www.epa.illinois.gov/Assets/iepa/water-quality/watershed-management/nlrs/nlrs-final-revised-083115.pdf
Grassed waterways	$8,653	/acre	2017 Andreas Consulting, professional estimate	
Nutrient Management Plan (NMP)	$13.83	/acre	2017 Andreas Consulting, professional estimate	
Ponds	$15,270	/acre	2017 Andreas Consulting, professional estimate	
Riparian buffers	$52.65	/acre	2015 Illinois Nutrient Reduction Strategy, page B-3 - B-4 under "Installing Stream Buffers", cost of planting grass only	http://www.epa.illinois.gov/Assets/iepa/water-quality/watershed-management/nlrs/nlrs-final-revised-083115.pdf
Terraces	$3.36	/linear foot	2017 Andreas Consulting, professional estimate	
Water and sediment control basin (WASCOB)	$366.48	/acre	2017 Andreas Consulting, professional estimate	
Wetlands	$13,162.50	/acre	2015 Illinois Nutrient Reduction Strategy, page B-7, "Constructing Wetlands", upfront cost (no design cost and not amortized)	http://www.epa.illinois.gov/Assets/iepa/water-quality/watershed-management/nlrs/nlrs-final-revised-083115.pdf
Forest stand improvement	$356.30	/acre	2017 Andreas Consulting, professional estimate	
Bioswales	$18	/acre	2007 Water Environment Research Federation Low Impact Development Best Management Practices Whole Life Cost Model, as listed in Green Values National Stormwater Management Calculator	http://greenvalues.cnt.org/national/cost_detail.php
Dry detention basins, new	$43,8054.80	/acre	2015 USEPA BMPs webpage, now archived at the following link	https://castlehillstx.files.wordpress.com/2015/07/dry-detention-ponds-_-best-management-practices-_-us-epa.pdf
Wet detention basins, new	$48,122 .10	/acre	2015 USEPA BMPs webpage, no longer available	http://water.epa.gov/polwaste/npdes/swbmp/Wet-Ponds.cfm
Detention basin retrofits (vegetated buffers, etc.)	$15,236.94	/acre	2014 Long Run Creek Watershed-Based Plan, Table 41	http://www.longruncreek.org/watershedplan

Detention basin maintenance (dredging, invasives, etc.)	$992.09	/acre	2014 Long Run Creek Watershed-Based Plan, Table 42	http://www.longruncreek.org/watershedplan
Pervious pavement	$100,557.50	/acre	2002, LID Stormwater Center, seen in Lower Meramec Watershed Plan, Table 21	http://www.ewgateway.org/environment/waterresources/Watersheds/LowerMeramec/lowermeramec.htm
Rain gardens	$9.27	/sq. ft.	2008, Iowa Rain Garden Design & Installation Manual - midway value between estimates on page 15, also used in Upper Silver Creek plan from 4 cost sources, https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_007154.pdf	https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_007154.pdf
Rainwater collection	$236.93	per barrel/small cistern	2015, Low Impact Development Urban Design Tools website	https://www.lid-stormwater.net/
Single property flood reduction strategies	$1,053	per property	2015 Approximately, based on 2015 Illinois Urban Flooding Awareness Act report	https://www.dnr.illinois.gov/waterresources/documents/final_ufaa_report.pdf
Stormwater and sanitary sewer maintenance and expansion	$80.55	/linear foot	2015 US EPA BMPs page, Ferguson et al (1997) $3.90 estimate for cleaning, added to $72.60 2001(?) Olympia WA Pipe Evaluation and Replacement Options	http://olympiawa.gov/city-utilities/storm-and-surface-water/policies-and-regulations/~/media/Files/PublicWorks/Water-Resources/SSWPAppendix%20J.ashx
Tree planting (e.g., street trees)	$2.78	/sq. ft. tree canopy	Center for Neighborhood Technology mid value estimate PER TREE, MULTIPLIED BY 114 sq ft/tree at 10 years old (from Recommendations of the Expert Panel to Define BMP Effectiveness for Urban Tree Canopy Expansion report)	http://greenvalues.cnt.org/national/cost_detail.php https://www.chesapeakebay.net/documents/Urban_Tree_Canopy_EP_Report_WQGIT_approved_final.pdf
Lake and stream dredging	$27	/cubic yard dredged	1998 Illinois EPA Lake Notes publication, giving estimates of between $5 and $30 per cubic yard dredged	http://www.epa.state.il.us/water/conservation/lake-notes/lake-dredging.pdf
Logjam assessment and removal	$31.20	/linear foot	2016 Midwest Streams, professional estimate	
Shoreline stabilization	$83.48	/foot	2017 Andreas Consulting, professional estimate	
Streambank & channel restoration	$78	/linear foot	Midwest Streams, professional estimate	

Table E.2. Inflation rates used to convert BMP costs to 2018 U.S. dollars from www.usinflationcalculator.com, accessed May 2018.

Inflation rates to convert to 2018 dollars (usinflationcalculator.com)	
2001	41.0%
2002	38.7%
2007	20.8%
2008	15.9%
2010	15.4%
2011	10.9%
2012	8.7%
2014	5.4%
2015	5.3%
2016	4.0%
2017	1.8%

Descriptions of Management Measures (Best Management Practices, or BMPs)

Programmatic Management Measures

Conservation Development

Conservation Development is a design method that attempts to mitigate the environmental impacts of urbanization by conserving natural areas and their functions. In a Conservation Development subdivision, the aim is to allow for the maximum number of residences permitted under zoning laws, while disturbing as little land area as possible. This is especially important in areas containing floodplains, groundwater recharge areas, wetlands, woodlands, and streams. Developers assess the natural topography, natural drainage patterns, soils and vegetation on the site in the design stage. The result is compact, clustered lots surrounding a common open space.

The open space is typically preserved or restored natural areas that maintain natural hydrological processes and are integrated with newer natural stormwater features and recreational trails. This allows residents to feel like they have larger lots because most lots adjoin the open space. Conservation Development can also be used to integrate agricultural land uses harmoniously into the subdivision design.

The steps below are generally followed when designing a Conservation Development site:

1. Identify all natural resources, conservation areas, open space areas, physical features, and scenic areas and preserve and protect these areas from negative impacts from the development.
2. Locate building sites to take advantage of open space and scenic views by requiring smaller lot sizes or cluster housing in a way that protects the development rights of the property owner and maximizes the number of occupancy units permitted by zoning.
3. Design the transportation system. Roads should provide access to building sites, allow movement throughout the site and onto adjoining lands, and should not cross sensitive natural areas. Street design focuses on narrower widths, infiltration opportunities, eliminating curbs and gutters, adjusting the vehicular level of service (LOS), creating LOS for other modes of transportation, and designing connected street networks to support multiple uses.
4. Prepare engineering plans to show how each building site can be served by essential public utilities.

Conservation Development also provides provisions for long-term and permanent resource protection. Mechanisms such as conservation easements and transfer of development rights can ensure that measures protecting the open space are more than just temporary.

The St. Clair County Stormwater Control Code includes measures to protect the landscape from erosion, by avoiding areas of steep slopes (greater than 3:1) and retaining existing natural watercourses, lakes, ponds, sinkholes, and wetlands wherever possible.[1]

> 33-4-47 SOIL EROSION AND SEDIMENT CONTROL.
>
> The following principles shall apply to all development or redevelopment activities within the County and to the preparation of the submissions required under this Code:

(A) Development or redevelopment shall be related to the topography and soils of the site so as to create the least potential for erosion. Areas of steep slopes greater than three to one (3:1) where high cuts and fills may be required are to be avoided wherever possible, and natural contours should be followed as closely as possible.
(B) Natural vegetation shall be retained and protected wherever possible. Areas immediately adjacent to natural watercourses, lakes, ponds, sinkholes, and wetlands are to be left undisturbed wherever possible.

Many communities' zoning ordinances do not yet permit Conservation Development design, because of code requirements for features such as minimum lot sizes, setbacks, and frontage distances. These ordinances should be amended to allow for Conservation Development design.

Federal and state programs

Federal and state agricultural easement and working lands programs such as the Conservation Reserve Program (CRP), the Conservation Reserve Enhancement Program (CREP), the Environmental Quality Incentives Program (EQIP), and the Agricultural Conservation Easement Program (ACEP) are designed to recompense farmers and landowners for practices that protect soil and water health. More information on these programs is available in Appendix E, Funding Sources.

Financial support for stormwater infrastructure

Stormwater infrastructure, including green infrastructure, does not have a dedicated funding mechanism in many of the communities in the watershed. Maintenance and replacement of ageing infrastructure is a significant concern for these communities, and infrastructure failures such as pipe bursts can end up costing them more than timely repairs and replacement would have cost.

Consistent funding at an appropriate level enables communities to create stormwater management programs that reduce urban flood risk and improve water quality. There are several policy options that assign dedicated funding for stormwater infrastructure that prevents flooding and allows infiltration. With all of these options, a certain amount of public resistance can be expected—people generally don't like paying taxes and fees. This is why public outreach and education, and input, is important. Where there is a demonstrated need for infrastructure investment, the benefits can be shown to outweigh the costs and people will understand the need for the program.

For **counties**, the State of Illinois Counties Code (55 ILCS 5/) allows "management and mitigation of the effects of urbanization on stormwater drainage" in St. Clair County, Madison County, and seven other counties (55/ILCS 5/5-1062.2) (see below). Stormwater Plans created by these counties can include elements such as rules for floodplain and stormwater management, fees or taxes from new development, and incentives for using green infrastructure and other approved drainage structures. Illinois **municipalities** also have the authority to adopt stormwater plans (65 ILCS/ Art 11 prec Div 110 – Flood Control and Drainage).

The 2015 Illinois Report for the Urban Flooding Awareness Act prepared by IDNR includes the following USEPA recommendations for stormwater management financing options:[2]

- Stormwater utility (or service fees),
- Property taxes/general funds,
- Sales tax,
- Special assessment districts,
- System development charges,

- Municipal bonds and state grants, and
- Low-interest loans.

A *stormwater utility* is dedicated to recover the costs of stormwater infrastructure regulatory compliance, planning, maintenance, capital improvements, and repair and replacement. The utility imposes its fees based on how much stormwater is being generated from a parcel, which can be readily calculated from the amount of impervious surface on the parcel and the annual average precipitation. Stormwater diverted from the sewer system through infiltration or temporary retention (e.g., into a rain garden or rain barrels) can be given a credit against the utility fee equal to the volume of water averted and its treatment costs. This system offers the public greater transparency as to the true societal costs of managing stormwater runoff, and offers them an economic incentive to employ practices that divert more stormwater from the stormwater collection system.

As of 2015, 21 communities in Illinois have utility fee assessments. This is a smaller number than in many neighboring Midwestern states. The communities include home rule and non-home rule communities. The Illinois Municipal Code allows communities to operate utilities, and townships also have the ability to create a stormwater program and assess a user fee per Public Works Statutes, Article 205 of the Township Code in the Illinois Compiled Statutes (60 ILCS).

A small proportion of *property taxes or general funds* can be set aside for stormwater management. An additional *sales tax*, or a proportion of an existing sales tax, can also be used.

A s*pecial assessment district*, also known as a special service area (SSA), is set up to benefit a specific portion of a municipality or county where there are specific problems to be addressed. Fees assessed only to those properties within that area. The district is often a small portion of a municipality or county. Special assessment districts can be created to address problems with stormwater, flooding, and other issues.

Low-interest loans may be secured under the **Water Pollution Control Loan Program**, which funds both wastewater and stormwater projects. Funding for the loan program comes from the state revolving fund. Eligible projects include upgrading or rehabilitating existing infrastructure, stormwater-related projects that benefit water quality, and a wide-variety of other projects that protect or improve the quality of Illinois's rivers, streams, and lakes. The **Water & Waste Water Disposal Loan & Grant Program** provides funding drinking water systems, sanitary sewage systems, and stormwater drainage to households and businesses in eligible rural areas. The program assists applicants who are not otherwise able to obtain commercial credit on reasonable terms for these projects. Areas served must be rural or towns populated with 10,000 people or fewer. Long-term, low interest loans are the primary funding type available. Grants may be combined with a loan if necessary and if funds are available.

Flood Damage Prevention Ordinance

St. Clair County and eight communities in the watershed are members of the National Flood Insurance Program (NFIP). Madison County and Clinton County are also members. As NFIP members, these communities have a Floodplain Ordinance in effect. Several features of the floodplain ordinances are based on Illinois Department of Natural Resources' Model Flood Damage Prevention Ordinance (a previous or current version).

Further steps can be taken to update communities' floodplain ordinances to protect residents and businesses from flood risk and unnecessary mitigation costs. HeartLands Conservancy prepared a draft

Flood Damage Prevention Ordinance for Madison County containing options for strengthening existing floodplain codes to protect property owners and communities, based on FEMA's Community Rating System (CRS). These options include:

- Requiring applicants for a development permit to obtain all other required local, state, and federal permits before the development permit is issued.
- Defining "substantial improvement" (which triggers compliance) as development which equals or exceeds 50% of the market value of the building before the improvement or repair is started, or increases the floor area of a building by more than 20%.
- Requiring two feet of freeboard (height above the Base Flood Elevation, or BFE) for structures in the floodplain.
- Allowing accessory structures in floodplain that are non-habitable, if they are used only for the storage of vehicles and tools (and follow several other requirements).
- Requiring all new and substantially improved critical facilities to be located outside the floodplain, unless infeasible, in which case they must be elevated or flood proofed to the 500-year flood elevation. Access routes must also be elevated to the BFE. Toxic substances must be sealed off from floodwaters.

The State of Illinois also has a Model Stormwater Management Ordinance that is intended to be an independent, stand-alone, self-sufficient ordinance for Illinois communities to adopt. For local governments without independent stormwater ordinances, the model stormwater provisions can be added to their subdivision ordinance, building code, or zoning ordinance, excluding language which is redundant with existing local government codes.[3]

Green infrastructure incentives

Green infrastructure is a vital concept that incorporates and informs many of the recommended practices in this Watershed-Based Plan. Green infrastructure can be defined as our region's natural resources, including open space, woodlands, wetlands, gardens, trees, and agricultural land. It can also be defined as the nodes and corridors of vegetation over the region, or the site-scale structures and landscaping that recreate natural processes. A regionally connected system of green infrastructure results in a higher diversity of plants and animals, removal of non-point source pollution, infiltration of stormwater, and healthier ecosystems. Corridors of green infrastructure along streams are extremely important because they provide biological conduits between hubs. However, most parcels forming corridors are not ideal green infrastructure until landowners and residents embrace the idea of managing stream corridors or creating backyard habitats.

Various regulatory incentives can be used to encourage the design and implementation of green infrastructure in new development. These incentives can include flexible implementation of regulations, fee waivers, tax abatement, access to municipal utilities, and a streamlined development review process. The incentives can be granted on a case-by-case basis.

In-lieu fee migitation

An in-lieu fee mitigation program can help to protect and restore critical wetland areas while other areas are developed. In-lieu fee mitigation is an opportunity to assist developers in meeting their mitigation needs while directing mitigation to high quality sites in the watershed. Under an in-lieu fee program, a developer can pay a fee in lieu of having to restore or protect wetland on the development site, or to mitigate losses of those sites by protecting or restoring wetland off-site. The fee goes to a third party organization which can direct the funds to high quality ecological sites for which restoration efforts will have the most environmental impact. Mitigation sites can include both wetlands and streams. The USEPA Water Quality Scorecard recommends compensation for damage to riparian/wetland areas to be on a minimum 2:1 basis on- or off-site.

Monitoring

Appendix D - Monitoring Plan outlines an appropriate strategy for water quality monitoring in the watershed.

Naming Unnamed Tributaries

Naming unnamed tributaries throughout the watershed is one way to raise awareness for stream health. Names are typically given to geographic features of importance. Assigning a name to a stream can increase its visibility within a community, and as a result improve public engagement (e.g., cleanups, monitoring) and water quality.

When attempting to name a previously unnamed stream, a proposal must be submitted to the U.S. Board on Geographic Names Domestic Names Committee. Before submitting a proposal, interested parties must verify that the feature has in fact not been named before. Obtaining local support of the proposed name is also highly encouraged before submitting a proposal, as local acceptance of the name is important. Evidence of local approval should be submitted alongside a proposal, and can include letters or emails of support from government agencies, municipalities, tribes, civic organizations, property owners, etc.

At a minimum, a proposal for an unnamed feature must include[4]:

- The full form of the geographic name being proposed.
- The requested action.
- Descriptive information, including:
    - The applicable state and county.
    - The precise location of the feature to be named (i.e., map with geographic coordinates or a detailed written description).
- The meaning or significance of the proposed name.
- Basis of knowledge that the feature is unnamed.

Proposed names that are commemorative or descriptive require additional documentation. Detailed information on proposal requirements can be found in the U.S. Board on Geographic Names Principals, Policies, and Procedures, Domestic Geographic Names document[5].

To raise public support for a new stream name, interested parties can conduct outreach efforts such as writing news articles or creating surveys/petitions. Or, municipalities can engage the public from the start by asking for assistance in determining the new name. For example, the City of Wentzville, Missouri held a *Stream Naming Contest* in 2012[6], which challenged residents to propose names for all unnamed streams in the Dry Branch Watershed (a total of 15 streams at the time). Contest rules encouraged participants to be creative, provided a map of the streams to be named, and listed tips on picking names that would be easily approved. Similarly, the Deer Creek Watershed Alliance, a project of the Missouri Botanical Garden, conducted the 2010 *Tributaries Naming Project*, during which St. Louis residents were invited to help name unnamed tributaries. The project resulted in 13 streams being named in the Deer Creek watershed[7].

Native landscaping

Weed control ordinances, whose purpose is primarily to maintain a pleasing aesthetic in community landscaping, often directly or inadvertently discourage or prohibit the use of native plants. Native landscaping can look "messier" than traditional landscaping, depending on the plants used. But when native plants are well chosen and well maintained, planting areas look very pleasing and offer many water quality and wildlife benefits. Garden nurseries and other native plant providers can be involved in educating customers and displaying the different "look" that native plants offer. Weed control ordinances can be amended to allow and encourage the use of these plants and provide guidance on species and maintenance.

Open space and natural area protection

Several actions can be taken to encourage the protection of natural areas and open space in new development. Some are regulatory, including the following practices from the U.S. EPA Water Quality Scorecard:

- Establish a dedicated source of funding for open space acquisition and management (e.g., bond proceeds, sales tax).
- Adopt regulations to protect steep slope, hillsides, and other sensitive natural lands (e.g., by limiting development on slopes > 30% or requiring larger lot sizes in sensitive areas).
- Create agriculture resource zoning districts (e.g., minimum lot size of 80 acres and larger) to preserve agricultural areas.
- Adopt neighborhood policies and ordinances that work to create neighborhood open space amenities that are within 0.25-mile to 0.5-mile walking distance from every residence.

Other actions are non-regulatory:

- Provide financial support to or collaborate with land trusts or other conservation organizations to acquire critical natural areas.
- Adopt a community-wide open space and parks plan.
- Identify key natural resource areas for protection in jurisdiction's parks and open space plan.
- Allow and encourage retrofits of abandoned or underutilized public lands to serve as permanent or temporary open space and green infrastructure sites.

Private sewage monitoring

Private, residential septic systems are often not maintained properly, leading to failure. The U.S. Census Bureau has indicated that at least 10% of septic systems have stopped working. Failed septic systems can leach bacteria and nutrients into ground water or allow these contaminants to be exposed at the surface and washed into receiving streams during storm events. Currently, inspections and enforcement of private septic systems are complaint-driven—there is no plan or resources for further enforcement.

Septic inspections are required during real estate transactions, but these are often many years apart. More regular inspections should be considered by the counties and municipalities, regardless of property ownership turnover. A rule in Jefferson County, Missouri requires that homeowners annually have their sewer system serviced and submit certification of it to the county.

Private sewage data on violations and water quality parameter exceedences should be collected and mapped. Additionally, an intensive inspection of private septic systems should be considered to determine the location of any illicit discharges and to assess the condition of all septic systems in the watershed. This effort, commonly referred to as a sanitary sweep, could be eligible for grant funding. Following the identification of failing septic systems a course of action to correct these systems will need to be coordinated with the landowners, municipalities, counties, and relevant state agencies.

The U.S. EPA provides an excellent guide for septic system owners called "A Homeowner's Guide to Septic Systems" (USEPA, 2005), which explains how septic systems work, why and how they should be maintained, and what makes a system fail.

Riparian buffer ordinance

"Riparian," in its most general sense, means "adjoining a body of water." A riparian buffer is an undisturbed naturally vegetated strip of land adjacent to a body of water, such as a stream or lake. Among their many benefits, riparian buffers store floodwater, allow lateral stream movement, reduce streambank erosion, trap and remove sediment in runoff, mitigate stream warming through shade, provide habitat for wildlife, and increase property values. The literature indicates that forest provides more benefits in a riparian buffer than grassland does—with benefits including more wildlife habitat, stream shading and temperature control, and more debris as a food source for the stream—so oak-hickory forest should be the first choice in riparian buffer vegetation.

A riparian buffer ordinance protects a riparian area of a certain width from new development and other disturbances, and promotes revegetation/reforestation. As a graduate student intern, Janet Buchanan (one of the authors of this Watershed-Based Plan) created a draft Riparian Buffer Ordinance for Madison County that would protect the riparian area in the unincorporated area of the county from certain kinds of development and activities. The ordinance has not yet been passed.

A riparian buffer ordinance may restrict the following activities and structures in the riparian buffer:

- Buildings, accessory structures, roads, parking lots, driveways, and other impervious surfaces
- Disturbance of vegetation (through clearing, construction, or other practices)
- Disturbance of soil (through grading, stripping of topsoil, plowing, cultivating, or other practices)
- Grazing of animals
- Filling or dumping
- Storage of hazardous materials

Sewage Treatment Plant upgrades/advanced treatment

Sewage treatment plants (STPs) are subject to National Pollutant Discharge Elimination System (NPDES) permit requirements. Upgrades to wastewater treatment plants in the watershed should be installed so that the limits set in these permits are not exceeded. According to recent studies, upgrades can reduce total phosphorus in plant effluent to below 1.0 mg/l and reduce total nitrogen in plant effluent to less than 5.5 mg/L. These would be significant improvements over the existing phosphorus and nitrogen concentrations in effluent from several of the sewage and wastewater treatment plants in the watershed. Funding for sewage treatment plant upgrades may be available from USEPA's Source Reduction grant program.

USEPA has published a report on advanced wastewater treatment methods to reduce phosphorus in effluent ("Advanced Wastewater Treatment to Achieve Low Concentration of Phosphorus"). The most effective treatment is the addition of aluminum- or iron-based coagulants followed by tertiary filtration, which reduces the final phosphorus level in effluent to near or below 0.01 mg/L. This treatment is affordable; monthly residential sewer fees charged by the facilities ranged between $18 and $46. Other pollutants such as BOD, TSS, and fecal coliform were also significantly reduced. Another treatment is enhanced biological nutrient removal (EBNR) in the secondary treatment process, which can often reduce total P to 0.3 mg/L or less prior to tertiary filtration. The process reduces operating costs for the tertiary filtration process and removes other pollutants as well.

Additionally, nutrient credit trading is a way to reduce overall nutrient discharge from the vicinity of the treatment plant. The plant pays for a conservation easement that reduces nutrient discharge from agricultural land, thus offsetting the plant's discharge. The two parties can agree with the state (Illinois EPA) that this amount of nutrient reduction can count against the treatment plant's discharge. These agreements have been made at several locations across the U.S.A., including Lancaster County, PA and the American Farmland Trust 3-state pilot project (Ohio, Indiana, and Kentucky). The agreement typically lasts for 10 years.

Stream Cleanup Team

A Stream Cleanup Team operated between 2008 and 2009 in Madison County and removed debris from selected streams in the county about which they received complaints. The cleanup team therefore contributed to improving water quality, reducing flooding, and monitoring stream health. The work was funded by a grant from the U.S. Department of Housing and Urban Development; the team was comprised of paid workers. During the course of the cleanup operations, logjam locations were entered into a handheld GPS unit, and later processed by the county's IT department. Many county residents were vocal in their support of the Stream Cleanup Team, and said they would like to see a reprise of the program.

The program could be replicated and expanded from its previous scope into St. Clair County. The program could include an education component and opportunities for volunteer involvement, mimicking other cleanup programs such as Missouri Stream Team, the Open Space Council's Operation Clean Stream, or Missouri River Relief Trash Bash.

Watershed-Based Plan integrated into community efforts

Copies of this Watershed-Based Plan will be made available to communities in the watershed. However, for maximum effectiveness, the plan should be adopted and/or supported (via a resolution). The plan will be most effective when its goals, objectives, and recommended actions are integrated with community policy.

Agricultural Management Measures

Animal waste storage/treatment system

Proper livestock waste management is very important in maintaining water quality, especially for bacteria levels. Writing a Comprehensive Nutrient Management Plan helps farmers to integrate waste management into overall farm operations. Such a plan can recommend waste storage structures and strategies that increase waste storage time, eliminate unwanted runoff, incorporate manure nutrients into crop nutrient budgets, and efficiently apply manure to cropland without runoff.

The following is a general approach to addressing bacterial pollution in streams as a result of animal manure.

- Identify known sources of bacteria to waterbodies (e.g., areas where livestock have access to streams), using local knowledge, windshield surveys, interviews with landowners, etc.

- Conduct monitoring of stream reaches, adding additional monitoring to help pinpoint potential sources of bacteria.
- Promote good manure application practices such as:
  - Using manure injection rather than surface application;
  - Applying manure to relatively dry fields;
  - Avoiding steep slopes;
  - Avoiding areas near waterbodies or drain tile intakes;
  - Avoiding areas prone to flooding; and
  - Avoiding application on frozen soil.

See the NRCS "Agricultural Waste Management Field Handbook" (AWMFH) for specific guidance on planning, designing, and managing systems that involve agricultural wastes.

Bioreactors (denitrifying)

Bioreactors, also known as denitrifying bioreactors, are ditches filled with wood chips that contain denitrifying bacteria. The bioreactor is placed at the outlet of a tile drainage system, and the bacteria remove nitrogen from water leaving the system. Research has shown an estimated bioreactor lifespan of 15 to 20 years, after which the woodchips would be replaced if treatment was to be continued.

Comprehensive Nutrient Management Plans (CNMPs)

A CNMP is a strategy for farmers to integrate livestock waste management into overall farm operations. Such a plan can recommend waste storage structures and strategies that increase waste storage time, eliminate unwanted runoff, incorporate manure nutrients into crop nutrient budgets, and efficiently apply manure to cropland without runoff (e.g., manure injection). When these structures and strategies are in place, manure is a useful asset to cropland that provides benefits to soil health.

Conservation tillage

Converting intensive tillage to conservation tillage consists of switching from moldboard to chisel plowing, which leaves at least 30% crop residue on the fields before and after planting to reduce soil erosion. Converting conservation tillage to no-till consists of switching existing chisel plowing to no-till where the ground is not tilled so as to not disturb the soil. This increases water infiltration, organic matter retention, and nutrient cycling, and reduces soil erosion.

Farmers may find that, initially, less tilling leads to growth of glyphosate-resistant (Roundup-resistant) weeds. Approximately ten species of weeds in the U.S. are known to have become resistant to the herbicide. To avoid this, crop rotation and diversification is the best strategy to disrupt the weeds' emergence, following a long-term weed management plan. This plan should focus on the proper use of each herbicide, using diverse herbicide modes of action (MOA), and the rotation of both herbicides used and crops planted. See the Penn State Extension webpage for more information about how this can be achieved[8].

Contour buffer strips

Contour buffer strips are strips of perennial vegetation that alternate with strips of row crops on sloped fields. Contour buffers strips are usually narrower than the cultivated strips. The strips of perennial vegetation, which consist of adapted species of grasses or a mixture of grasses and legumes, slow runoff and remove from it sediment, nutrients, pesticides, and other contaminants. Buffer strips can also provide food and habitat (e.g., nesting cover) for wildlife. Contour buffer strips are most suited to uniform, non-undulating slopes of between four and eight percent, but can also be used on steeper land. Contour buffer strips should be mown to maintain appropriate vegetative density and height for trapping sediment, and/or for providing habitat for target wildlife species. They should not be mown during critical erosion periods.

Cover crops

Cover crops provide both annual and long-term benefits to agricultural land. On an annual basis, they protect soil from water and wind erosion by providing a vegetative cover between the fall harvest and spring planting. They take up residual fertilizer nutrients and then release them back into the soil for the subsequent spring crop. Cover crops also suppress winter annual weeds. With consistent use of cover crops, the soil organic matter content will increase, and this provides many benefits to the soil, including improved soil tilth and health, increased porosity and infiltration, and sustained biological activity. Cereal grains, annual rye grass, and radish are common cover crops for this purpose, but many other types are available. Some crops, such as radish and turnips, are selected to help break through compacted soil layers. Cover crops are often planted as a mix of multiple species that mutually provide a range of benefits[9].

Grassed waterways

Grassed waterways are vegetated channels designed to prevent gully erosion by slowing the flow of surface water with vegetation. Grassed waterways should be used where gully erosion is a problem. These areas are commonly located between hills and other low-lying areas on hills where water concentrates as it runs off the field. Grassed waterways trap sediment entering them via field surface runoff and in this manner perform similarly to riparian buffer strips.

The size and shape of a grassed waterway is based on the amount of runoff that the waterway must carry, the slope, and the underlying soil type. NRCS design standards for grassed waterways specify that the minimum capacity convey the peak runoff expected from the 10-year frequency, 24-hour duration storm. Enough freeboard above the designed depth should be provided to prevent damage to crops. The vegetation in the channel should be native plants suited to the site conditions and intended uses.

Nutrient Management Plans (NMPs)

A NMP is a strategy for obtaining the maximum return from on- and off-farm fertilizer resources in a manner that protects the quality of nearby water resources. Creating an NMP involves reviewing soil maps, field boundaries, and nutrient uptake of crops to determine nutrient needs for each field and the types and amounts of fertilizers to meet those needs.

Ponds

Ponds are popular features that also have significant pollutant removal benefits when well sited and designed. Also known as wet ponds, stormwater ponds, or wet retention ponds, they are constructed basins that have a permanent pool of water throughout the year (or at least throughout the wet season). As stormwater runoff enters the pond, the sediment settles out and some nutrient uptake takes place. Nitrogen removal through denitrification (i.e., reduction of nitrates via anaerobic bacteria) can also occur in ponds.

Riparian buffers

A riparian buffer is a vegetated area along a shoreline, wetland, or stream where development and row cropping is restricted. The buffer physically protects and separates the waterbody from future disturbance or encroachment, and reduces the amounts of pollutants that reach it. If properly designed, a buffer can sustain the integrity of stream ecosystems and habitats. As conservation areas, aquatic buffers are part aquatic ecosystem and part urban forest.

Different grading and vegetation at different locations can affect water quality in different ways. Where vegetation roots can interact with the water table, carbon cycling and denitrification may be enhanced. In areas where the water table depth exceeds the rooting depth, and overland runoff is high, stiff-stemmed grasses may be beneficial to intercept and reduce runoff and sediment from reaching the stream. Where appreciable amounts of neither runoff nor groundwater can be intercepted, streambank stabilization has great benefits. Locations where these practices would be most suitable were identified by using USDA's ACPF model.

A riparian buffer ordinance is an important tool that communities can use to restrict new development in buffer areas in order to ensure that land adjacent to streams continues to protect water quality and moderate stormwater flow.

Terraces

Terraces are a soil conservation practice applied to prevent rainfall runoff on sloping land from accumulating and causing serious erosion. The term "terraces" often brings to mind "contour terraces" such as those in various mountainous regions of the world that follow contours in wavy lines. However, parallel terraces are the type of terrace used most commonly on agricultural land in the U.S. They are constructed parallel to each other in straight lines, and parallel to the direction of field operations as much as possible. Some terraces are constructed with steep backslopes that are kept in grass, but most are broad-based with gently sloped ridges that are cultivated as part of the field. Parallel terraces that discharge runoff through subsurface tile drains are known as parallel tile outlet (PTO) terraces. With this setup, water that accumulates behind a terrace ridge is discharged through a surface inlet into a subsurface drain. Some of the runoff is temporarily stored for long enough that sediment settles out of the water, but not so long as to damage the crop.

The major benefit of terraces is the conservation of soil and water, which in turn allows more intensive cropping than would otherwise be possible. There are additional benefits for PTO terraces: the total area can be farmed (no grassed waterways are needed); no interruptions in tilling or applying herbicide because there are no grassed waterways; reduced peak discharges; and the settling out of sediment and other contaminants before it reaches a receiving waterbody. Terraces are best suited to fields with long, fairly-uniform slopes that are not too steep (generally less than eight percent), and where the soil is not too shallow (more than six inches). See the Purdue University Cooperative Extension Service[10] page for more information on terraces.

Water and Sediment Control Basins (WASCOBs)

WASCOBs are small earthen ridge-and-channel or embankments built across a small watercourse or area of concentrated flow in a field. WASCOBs hold field runoff that would otherwise create a gully or leave the field without sediment settling out. WASCOBs are usually straight, vegetated with grass, and just long enough to bridge an area of concentrated flow. The water detained in a WASCOB is released slowly via infiltration or a pipe outlet and tile line. The ACPF model identified locations where WASCOBs would be the most effective.

Wetlands

Wetlands, or Nutrient Removal Wetlands, provide significant water quality benefits. Wetland plants, soils, and microbes cleanse the water entering the wetland, removing approximately 78% sediment, 44% phosphorus, and 20% nitrogen from runoff, according to USEPA's STEPL tool. This is achieved through settling and biological update by wetland plants and organisms. They also recharge groundwater, store stormwater, reduce high water flows, provide food and habitat for wildlife, and increase carbon sequestration. They are appropriate for agricultural and semi-urban land only, where there is limited development.

Natural wetlands should be protected from increased stormwater runoff from development, so as to continue functioning. Wetland vegetation should consist of native aquatic plant species.

Constructed wetlands are shallow, vegetated ponds that are engineered and constructed to mimic the structure, water quality function, wildlife habitat, and aesthetic value of naturally occurring wetlands. In some cases, they occur on sites that were historically wetlands, and can be considered wetland restoration projects. Since constructed wetlands need a somewhat constant water level to sustain their functions, the soils underlying the wetland must allow limited infiltration.

Wetland restoration is the rehabilitation of a degraded wetland or the re-establishment of a wetland so that the soils, hydrology, vegetative community, and habitat are an approximation of the original natural condition that existed prior to historic modification.

The USDA's ACPF tool identified suitable locations for nutrient removal wetlands in areas with high runoff risk in the Indian-Cahokia Creek watershed. The MoRAP assessment of wetland restoration ranking identified wetland areas suitable for wetland restoration.

Forest Management Measure

Forest stand improvement

Forest stand improvement is an approach to forest management that prioritizes forest health and wildlife habitat. Trees within the stand that are a desirable species, age class, and form are retained while those competing with these trees are "culled" (i.e., cut or girdled). This decreases competition for the desirable trees, increases growth rates, and allows managers to shape the future forest. Forest management can favor trees that produce more hard and soft mast (nuts, seeds and fruit) to support wildlife populations. Additionally, forest stand improvement can help improve water quality by removing undesirable species, including invasive species such as honeysuckle, that increase soil erosion on the forest floor by suppressing ground cover vegetation.

Urban Management Measures

Urban runoff management is somewhat different from agricultural settings in that the larger areas of impervious surfaces cause higher runoff volumes and, often, high nutrient concentrations. Structural infrastructure designed and constructed to collect, store, infiltrate, and treat storm water are some of the most expensive watershed improvement tools to implement and require consistent maintenance. According to Schueler and Holland (2000), the cost to maintain a storm water practice over 20 to 25 years can be equal to the initial construction costs. Nevertheless, structural storm water practices can be effective tools for pollutant removal, runoff reduction, and peak flow reduction when properly designed, constructed, and maintained.

Many of these Urban Management Measures fall under the definitions/categories of Low Impact Development (LID) and green infrastructure. They include design, construction, and post-construction (retrofit) practices. The following practices have been recommended for the Indian-Cahokia Creek watershed.

Bioswales

Bioswales are swaled (sloped) drainage courses designed to remove debris and reduce pollution from surface water. The sides of the swale are less than six percent slope and the swale may be filled with vegetation, compost, and/or riprap. The design of the swale should maximize the time water spends there, which aids in infiltration (for groundwater recharge) and pollutant removal. Bioswales are often effective when sited adjacent to parking lots. They can capture and treat stormwater during the "first flush" of rain on the parking lot, which carries substantial automotive pollution.

In 2012, the City of O'Fallon, Illinois and HeartLands Conservancy conducted a feasibility study to determine optimal locations for implementing bioswales—including retrofitting existing concrete swales and identifying future installation areas—to reduce the volume of stormwater runoff and related pollutants and sediments. In order to analyze potential vegetative swale sites, the planning area was split into two smaller watersheds and then analyzed using two tools, Long Term Hydrological Impact Analysis and ArcGIS, to determine the potential benefits of implementation. In addition, the city studied two pilot locations for a six-month period to establish baseline flow data in existing concrete roadside swales. To encourage participation, regulatory barriers were removed that could potentially impede private property owners, the city, and developers from voluntarily implementing green infrastructure. Marketing strategies were also developed to facilitate the introduction of bioswales to the community. Overall, O'Fallon and HeartLands Conservancy recommended:

- Encouraging the implementation of bioswales and other stormwater BMPs in areas of new development, particularly in residential parcels.
- Ensuring that city ordinances allow for the utilization of BMPs for both existing and new development.
- Retrofitting existing concrete swales with bioswales in high-priority areas (i.e., residential streets), specifically when the current infrastructure is being repaired or replaced to cut costs.

Detention basins

Detention basins are human-made depressions for the temporary storage of stormwater runoff with controlled release following a rain event. Wet bottom basins are essentially ponds planted with turf grass on their side slopes. Dry detention ponds (i.e., dry ponds or extended detention basins) are designed to detain stormwater runoff for some minimum time (e.g., 24 hours) to allow particles and associated pollutants to settle, but do not have a large permanent pool of water. They are often lined with concrete. These basins do not provide much, if any, infiltration, wildlife habitat, or water quality improvements.

When designed for multiple functions, however, detention basins can improve water storage, wildlife habitat, natural aesthetics, and water quality. According to USEPA, properly designed wet bottom basins designed to have wetland characteristics reduce total suspended solids (sediment) by 77.5%, total phosphorus by 44% and total nitrogen by 20%. Dry bottom infiltration basins reduce total suspended solids (sediment) by 75%, but have lower nutrient removal reduction of total phosphorus (65%), and total nitrogen (60%).

New basins should be:

- Located in natural depressions or drained hydric soil areas (especially when native vegetation is used);
- Located adjacent to existing green infrastructure (especially when native vegetation is used);

- Oriented/located so that outlets do not enter sensitive ecological areas.
- Designed to serve multiple development sites, so that several smaller basins are not needed;
- Designed with shallow side slopes and appropriate native vegetation;
- Designed with a shelf planted with native wet prairie vegetation, if a wet bottom basin; and
- Planted with mesic or wet-mesic prairie, if a dry bottom basin.

The St. Clair County Stormwater Control Code protects wetlands, streams, and steep slopes in new development and redevelopment (see *Conservation Development*). The Madison County Stormwater and Erosion Control Ordinance contains several requirements for new detention basins in floodplains, floodways, and connected to wetlands, rivers, streams, and ponds.

Retrofits to existing basins can also attain these benefits, through minor engineering changes, addition of extended detention basins/ponds, and the use of native vegetation. Many of the dry, wet, and wetland bottom basins in the watershed present excellent retrofit opportunities. Generally speaking, three years of management are needed to establish native plant communities. During the first two growing seasons following seeding, mowing and spot herbicide applications are needed to reduce annual and biennial weeds and eliminate problematic non-native/invasive species such as thistle, reed canary grass, and emerging unwanted saplings. In addition, the inlet and outlet structures should be checked for erosion and clogging during every site visit.

Maintenance of detention basins is of vital importance in sustaining their functions and extending the life of the infrastructure. Maintenance practices include regular dredging, mowing or burning (an in-place controlled burn of native grasses) of the vegetation, and removal of invasive species. These practices are recommended in the watershed plan, and will be referenced for these sites as they are proposed for new projects.

For existing subdivisions and areas already developed, it is unusual to have a long-term maintenance agreement in place. When detention basins get full of sediment, there is no clearly identified party responsible for dredging and maintenance. Outreach is needed to educate HOAs about taking on responsibility for dredging and other maintenance, and potentially change their byelaws to reflect this responsibility. For new development, Madison County recently began the best practice of including the transfer of authority for maintenance of the detention basin from the developer to the Homeowners Association once the subdivision is 90% complete. The HOA then has a maintenance responsibility for the detention basin for the life of the project. Alternatively, developers should be encouraged to donate naturalized detention basins and other natural areas to a local municipality or conservation organization for long term management that can be funded by a mechanism such as a SSA tax.

Regional detention basins collecting stormwater from a large area may be an effective option for reducing flood impacts to Scott Air Force Base in particular. Partners including the Village of Shiloh and others in the Community Partnership Group may be able to move forward with detention facilities that slow the flow of water to the base during heavy storms so that the flood impacts are reduced. Further hydrologic analysis of the discharge and direction of runoff to the base would be needed to set this planning in motion.

Pervious pavement

Pervious pavement is also referred to as porous or permeable pavement. Areas paved with pervious pavement allow water to infiltrate through small holes to a below-ground storage area, or to a pipe that leads to such an area. Pervious pavements reduce runoff rates and volumes from traditional impervious pavements, and can be used in almost every capacity in which traditional asphalt, concrete, or pavers are used. Below ground, the stormwater can be treated through soil biology and chemistry, and the water is returned to groundwater and aquifers rather than increasing flows in streams. It is important to note that there are limitations to using pervious pavement based on subsoil composition, and that it requires annual maintenance (such as vacuuming with a specialized machine) to remain effective over time.

Design options for pervious pavement include:

- Porous pavement with underground storage/recharge beds;
- Concrete pavers infilled with soil/gravel and vegetated with grass; or
- Plastic or metal grid infilled with gravel or equivalent.

Rain gardens

Rain gardens, vegetated depressions that clean and infiltrate stormwater from rooftops and sump pump discharges, have become popular garden features. They work best when located in existing depressions or near gutters and sump pump outlets, and are typically planted with deep-rooted native wetland vegetation. Rain gardens significantly slow the flow of water, improve water quality, and provide food and shelter for birds, butterflies, and insects.

Rain gardens work well in combination with the disconnection of roof downspouts and the redirection of that water to the garden. This results in a significant increase in the infiltration of rainwater over a direct connection to the storm drain or to impervious surfaces.

Bioretention facilities are sometimes referred to as rain gardens, but the term rain garden is typically used to describe a small, planted depression on an individual homeowner's property, while a bioretention facility typically describes larger projects in community common areas as well as non-residential applications.

See "Thinking Outside the Pipe" from HeartLands Conservancy for more specifics on rain garden design and bioretention facilities.

Rainwater collection

Rainwater collection and re-use via rain barrels and cisterns is a straightforward and useful way to decrease the amount and intensity of stormwater runoff in a watershed and reduce the amount of water consumed from municipal sources. On most homes and buildings, rainwater flows from roofs into downspouts and then onto streets or into storm sewers. Reconnecting the downspouts to either rain barrels or cisterns can reduce the flood levels in local streams and make water available to the building owner for irrigation and other uses. Water re-use differs based on the type of storage and water treatment.

Rain barrels sit above ground, and are connected to downspouts. A typical rain barrel stores 55 gallons of water. The water collected is often used for irrigation, which can result in significant cost savings; in many areas, residential irrigation can account for almost 50 percent of residential water consumption. Car washing and window cleaning are other common uses of the collected rainwater.

Cisterns are larger, sealed tanks that can sit above or below ground, and also collect rooftop runoff from downspouts. If installed below ground, a cistern requires a pump to bring the water up. With appropriate sanitation treatments, the "gray water" from cisterns can be reused for toilets, housecleaning, dishwashers, laundry, and even showers. Cisterns and rain barrels both reduce water demand in the summer months by reducing the potable water used for irrigation or other household uses.

Single property flood reduction strategies

A number of practices can be used to reduce flood damage on single properties. The key to successfully mitigating future damages is to identify the source(s) of flooding at the site scale. It is important to educate property owners about possible sources of flooding, flood mitigation practices, and the costs of those practices. Coordination with local community officials is often required to identify and confirm the most appropriate flood reduction strategy.

The Illinois Urban Flooding Awareness Act Final Report, published in June 2015, identified typical causes of basement flooding (overland flow, infiltration, or sewer backup), and mitigation options available to address these causes. Table E.3 is taken from this report, and shows these causes, along with mitigation options and their costs.

Table E.3. Flood damage mitigation options and the causes of flooding that they address, along with estimated costs. From the IDNR Urban Flooding Awareness Act report (June 2015), Table 9.1.

	Cause of Flooding				
Mitigation Options	**Overland**	**Infiltration**	**Sewer backup**	**Damage reduction**	**Estimated Cost**
Structural Inspection					$250-$800 each
Raise utilities and other valuable items				x	
Insurance				x	Based on coverage
Gutter maintenance	o	x	o		
Downspout disconnection			x		
Site grading, downspout extension	o	x			
Rain gardens	o				$3-40 per square foot
Permeable/porous pavement	x				$2-$10 per square foot
Exterior drain tile		x			$185 per foot
Interior drain tile		x	x		$40-50 per foot
Seal wall and floor cracks		x	o		$300-$600 each
Sump pump with check valve	x	x	x		$400-$1,000 each
Sewer backup valves			x		$3,000-$5,000
Overhead sewer installation			x		$2,000-$10,000
x - primary reduction o - secondary reduction					

Stormwater and sanitary sewer maintenance and expansion

Storm drain systems are vital for the timely removal of stormwater from areas where it would cause damage if it accumulated. When clogged, storm drains, culverts, and other stormwater infrastructure can cause overflows that lead to erosion and property damage. Cleaning this infrastructure increases dissolved oxygen and reduces levels of bacteria in the receiving waters. Cleaning storm drains by flushing is more successful for pipes smaller than 36 inches in diameter. Wastewater must be collected and treated once flushed through the system. For larger pipes, long pipes (700 feet or more), areas with relatively flat grades, and areas with low flows, flushing may be less effective.

In some cases, stormwater infrastructure is found to be too small to accommodate the flow it receives. Often, new development upstream has altered the watershed hydrology in some way, often increasing the amount of impervious surface and surface runoff flowing to it. In such cases, existing infrastructure such as road culverts and detention basins should be assessed and resized to accommodate the increased flows. The Madison County Stormwater and Erosion Control Ordinance requires that culvert crossings are sized to "consider entrance and exit losses as well as tailwater conditions" (3.4.12.3).

The 2014 Madison County EMA All-Hazard Mitigation Plan recommended several storm drain system improvement projects in municipalities in the watershed, including Bethalto, Edwardsville, Roxana, Wood River, and Worden. Culverts, ditches, and detention basins that often overflow should be assessed for potential enlargement. Upgrades should be made in response to storm drain system inspections, citizen complaints, and/or updated modeling of the system. In addition, sanitary sewer systems should be maintained in order to prevent infiltration and combined sewer overflows. Expansion of sanitary sewers to new development and existing buildings (already a common practice among municipalities) should continue wherever feasible.

Tree planting (e.g., street trees)

Street trees are trees that are planted in the public right-of-way. They are an important component of municipal green infrastructure and provide benefits including reducing stormwater runoff, filtering pollutants in air and water, mitigating high "urban heat island" air temperatures, and providing pleasing aesthetics that increase property values.

When planting new street trees, site evaluations should be conducted to evaluate site considerations. Then, a suitable native tree species is selected. Factors such as growth rate, ornamental traits, size, canopy shape, shade potential, wildlife benefits, and leaf litter production should all be considered when choosing a tree species.[11]

Municipalities with a strong tree program can become a member of Tree City USA, a program operated by the Arbor Day Foundation. It is a nationwide movement that provides the necessary framework to manage and expand public tree inventory. Cities can achieve Tree City USA status by meeting four core standards of sound urban forestry management: (1) maintaining a tree board or department, (2) having a community tree care ordinance, (3) spending at least $2 per capita on urban forestry, and (3) celebrating Arbor Day.

Pollutant removal efficiencies for specific types of trees planted can be estimated with the Pollutant Load Reduction Credit Tool developed by the Center for Watershed Protection in 2017.[12] More general pollutant reduction efficiencies were calculated or cited by the Chesapeake Bay Program[13] and the Pigeon Creek Watershed Plan.[14]

Stream and Lake Management Measures

Lake and stream dredging

Dredging is performed to remove sediments and debris from water bodies. Dredging routinely prevents sedimentation from filling in stream channels.

The 2010 Oates Associates report for Madison County recommended routine sediment and debris removal from the following stream channels:

- Dunlap Lake
- Cahokia Diversion Canal (15,000 linear feet of stream channel)
- Delaplaine Branch Stream Channel (15,000 linear feet of stream channel) (near Georgia St, Edwardsville)
- Old Alton/Edwardsville Road Ditch, Roxana (15,000 linear feet of stream channel)

Logjam assessment and removal

A logjam is any woody vegetation, with or without other debris, which obstructs a stream channel and backs up stream water like a natural dam. Logjams occur naturally, providing beneficial stream structure and cover for fish and wildlife and allowing nutrient-rich sediments to be deposited on adjacent floodplain. However, logjams also impede the ability of streams in the watershed to drain and convey water from the land in a timely manner.

Logjams commonly form when a relatively large object, often a tree, falls into a stream channel and becomes wedged or blocked across the streambed. Populations of beavers in the watershed also contribute to the felling of trees in riparian areas. Sometimes human activities induce stream obstructions, like when yard trimmings or large appliances and other litter are dumped in a stream or left in a floodplain and subsequently are carried into the stream.

Logjams contribute to flooding by making less natural storage available in the stream channel, elevating the water out of its banks during periods of high flow. This can be significant to farm fields and residences in the floodplain and to particularly low-lying, flood-prone areas. A logjam can also lengthen the duration of inundation during these floods, which can have a significant impact on crops planted in floodplain fields. However, this does not make a big difference to overall flood elevation during large-scale floods. Removing logjams is generally only considered an effective measure to mitigate small-scale flooding.

Water quality is also affected when a logjam is created. As sediment is deposited behind the obstruction, the water that flows on down the stream has less total suspended solids. Water is oxygenated as it stirs and mixes while cascading over, around, and through the logjam. However, not all the water quality impacts are beneficial. As the water moves around the logjam along the route of least resistance, it scours away the streambanks, introducing more sediment and debris to the water. When the stream flow is powerful enough, a streambank ”blow-out” can occur around it, taking large amounts of soil and debris from the bank into the stream channel as the stream creates a new path.

Stream channel changes resulting from water being redirected around a logjam can lead to the creation of a series of meanders. In an area where the riparian zone is vegetated, and development or cropland is not directly adjacent to the stream, this meandering and stream relocation is not really a problem. In developed or row cropped areas, these changes can inflict significant property damage and necessitate an expensive channel restoration project.

Logjams affect the habitat of species living in and near the stream. When a logjam forms, it slows the flow behind the obstruction, allowing sediment suspended in the water to settle out. The sediment adds to the obstruction and causes additional debris to become trapped there as well, enlarging and compacting the obstruction. This can create new habitat for fish and aquatic plants and macroinvertebrates. However, a tightly packed stream obstruction can act as a barrier to fish migration.

Determining whether a certain logjam should be removed requires these factors to be taken into account. Where logjams and potential channel changes would be detrimental to riparian property owners and stream water quality, property owners should be prepared to conduct routine stream inspections twice a year and after significant storm events to identify obstructions that need to be removed. The easiest way to deal with logjams is to remove them before significant sediment and debris has been deposited. A useful source for determining whether a logjam should be removed is “Stream Obstruction Removal Guidelines,” prepared by the Stream Renovation Guidelines Committee, The Wildlife Society, and the American Fisheries Society in 1983[15].

Shoreline stabilization

The shoreline provides habitat for fish and wildlife, supports recreation for humans, and cleans stormwater runoff before it enters the water. Shoreline erosion is a natural process that occurs on lakes and rivers and along the coast. It is the gradual, although sometimes rapid, removal of sediments from the shoreline. It is caused by a number of factors including storms, wave action, rain, ice, winds, runoff, and loss of trees and other vegetation. Stabilizing the shoreline of lakes in the watershed can reduce sediment erosion and support vegetation and wildlife habitat.

A shoreline's natural vegetation acts as a filter, preventing sediment and unnecessary nutrients from entering the waterbody. This runoff leads to poor water quality and upsets the balance needed for a healthy shoreline habitat. In the case of lawns, this runoff can include fertilizers, pesticides, lawn clippings, and pet waste. Geese are attracted to lawns, and their waste can add to this runoff.

Shorelines can provide excellent habitat for fish and wildlife. Fish and frogs often spawn in the silt in shallow water at the shore. Shoreline vegetation provides nesting spots for birds and food for insects, waterfowl and aquatic mammals. Fallen logs and branches provide shelter and hunting areas for fish and mammals, while turtles use them to sunbathe.

Shoreline stabilization methods should include deep-rooted native vegetation (particularly trees), gentle slopes to absorb the energy of waves, and “soft armoring” of live plants, logs, root wads, vegetative mats, and other methods (to complement unavoidable "hard armoring," such as rock rip-rap, stone blocks, sheet-pile or other hard materials) where possible.

Streambank and channel restoration

Streambank and channel restoration includes streambank stabilization and stream channel improvements. These practices are typically done together alongside riparian buffer improvements. The USEPA reports that as much as 90% of sediment, phosphorus, and nitrogen can be reduced following stream restoration. Bank stabilization helps to preserve the stream environment in a natural state, building a strong, long-lasting natural system of deep rooted vegetation that will protect the topsoil from heavy wind and rain.

“Traditional” or “hard” methods of stabilization involve materials such as rip-rap, concrete, and steel. By utilizing bioengineering (natural mimicry or “soft”) methods that incorporate vegetation, the project is often cheaper, provides more effective stabilization, and reduces overall pollution going into the stream. Targeting the outer bends of stream sections with poor riparian vegetation cover where most stream erosion occurs increases the effectiveness of streambank stabilization practices. Streambank bioengineering, which uses vegetative materials in combination with structural tools such as rock at the toe of the streambank, are most needed in areas of excessive streambank erosion or loss of farmland.

Streambank and channel restoration practices appropriate for the streams in this watershed include:

- Vegetative bioengineering;
- Stone toe protection;
- Two-stage channels;
- Riffle/pool complexes;
- Rock riprap; and
- Gabions (rock and wire baskets).

Stream restoration projects present some challenges for those implementing them. First, the development patterns that created the problem are not addressed. Second, the solutions are often technical and expensive, requiring permitting and construction from a qualified contractor. And third, routine maintenance is often not maintained as landowners lack the knowledge or capability to do the needed work. Several resources are available to landowners to help them navigate these challenges. St. Clair County NRCS has helped implement 938 ft of streambank and shoreline restoration between 2010 and 2015.

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Appendix F - Monitoring Plan

This monitoring plan for the Indian-Cahokia Creek watershed outlines the monitoring activities that will provide ongoing water quality data to assess stream health, and by extension, watershed health.

Monitoring will be used to assess the effectiveness of agricultural and urban best management practices that are implemented as part of the watershed management plan. Continuous monitoring at or near the U.S. Geological Survey (USGS) gage 05587900, located on Cahokia Creek at Edwardsville, will provide an assessment of the effect of land management practices throughout the watershed on surface water quality throughout the year.

In addition to continuous monitoring at the USGS gage, secondary monitoring stations will be added upstream from the USGS gage in order to identify the relative contributions of subwatersheds to overall water quality in the larger watershed. Sampling will be conducted from bridges during major stormflow conditions when the majority of nutrients and sediments are transported through the watershed.

Sample collection scheduling, monitoring equipment, and protocols

The sampling schedule begins in spring 2019 following installation of the continuous sample collection equipment at the USGS gage and the identification of bridges suitable for discrete sample collection from subwatersheds. The exact timing of sample collection and the number of samples collected will depend on the frequency and intensity of precipitation events in the watershed. Furthermore, the location of the discrete sample collection sites may be modified during the second and third years of the monitoring plan to better capture the impact of best management practices that are implemented in the watershed. Continuous collection of water samples at the USGS gage 05587900 will continue in the second year and third years with most of the samples being collected during major hydrological events.

The collection and analysis of monitoring data should be continued on a three- to five-year cycle through the year 2030, as funding allows. Opportunities for continuing or expanding the monitoring program should be evaluated periodically in order to further assess water quality conditions throughout the watershed, the causes and sources of pollution, the impact of nonpoint source pollution, and changes in water quality related to implementation of the watershed-based plan as well as social indicator data related to the watershed-based plan’s goals and objectives. Quality Assurance Project Plans (QAPP) should be developed for those monitoring opportunities that are selected for implementation in support of the watershed-based plan.

Continuous monitoring at the USGS gage will use a programmable, automatic sampler (e.g., Isco 6712) for collecting water samples. The automatic sample works in combination with a depth sensor (e.g., Isco 720 module) to determine the timing and intensity of sample collection. Most sediments and nutrients are transported during periods of elevated flow following major precipitation events. Therefore, sample collection will be more frequent during periods of elevated flow and less frequent during periods of baseflow. The automatic sampler can collect up to 24 samples of 1L volume. Each sample can consist of a single sampling event or a composite of multiple sampling events. Samples will be preserved in the bottles using standard U.S. Environmental Protection Agency (USEPA) methods until they can be retrieved and transported to the laboratory for chemical analysis.

Discrete water samples at the sub-watershed level will be collected from bridges by lowering either a Van Dorn or depth-integrated sampler into the stream. Instantaneous discharge at each discrete sampling site will be measured at the same time the discrete water sample is collected by using an Equal Width Increment (EWI) method. The EWI method requires multiple measurements of stream velocity and stream depth. Stream velocity will be measured with an area-velocity meter mounted on a bridgeboard allowing it to be lowered from the bridge into the stream regardless of flow conditions. Stream depth for each width increment will be measured with a sounding reel and weight. Discrete water samples will be preserved at 4°C and transferred to the laboratory on the same day of collection.

Parameters to be monitored

Discharge

The USGS gage 05587900 continuously monitors stream depth (ft) and discharge (ft^3/min) and records that information at 15-minute intervals. The drainage area for the USGS gauge is 212 square miles, which more than covers the project area, as this gauge also sees water from the East Creek-Cahokia Creek and Bear Creek-Cahokia Creek watersheds, which were not included in this study's project area. The National Great Rivers Research & Education Center (NGRREC) receives daily updates of instantaneous discharge at the USGS gage. Additionally, the data is available online at the following website: http://waterdata.usgs.gov/nwis/uv/?site_no=05594450.

Stream discharge at the discrete sample collection sites will be measured using the Equal Width Increment method described in a previous section. However, when stream conditions at the discrete monitoring sites are suitable for wading, a FlowTracker Acoustic Doppler Velocimeter will be used to calculate discharge.

Sediment and Nutrients

Water samples collected by NGRREC will analyzed in the Center's Environmental Chemistry Laboratory. Each water sample will be analyzed for those pollutants which have been identified by the Illinois Environmental Protection Agency (IEPA) as impairments. Samples collected with the Isco 6712 automatic sampler will be analyzed for total suspended sediments (TSS), total phosphorus (TP), and total nitrogen (TN). In addition to the above-mentioned parameters, the samples collected from the sub-watersheds will also be analyzed for soluble reactive phosphorus (SRP), nitrite+nitrate-nitrogen (NO_2+NO_3-N), and ammonium-nitrogen (NH_4-N). NGRREC will maintain a dataset of this data.

Biological data

Biological data related to macroinvertebrate populations in wadeable streams will be collected by Illinois RiverWatch citizen scientists at three pre-existing monitoring locations in the Indian-Cahokia Creek watershed. There are six potential sites where RiverWatch citizen scientists have collected biological data in previous years. Each of these locations is a perennial stream with flow year-round, at which a 200-ft reach is monitored. Data collected by RiverWatch volunteers is vetted by a professional aquatic biologist. It is then entered into and maintained in the Illinois RiverWatch database.

Monitoring schedule

Table F.1 shows the monitoring activities and month/year of monitoring activities to be undertaken by NGRREC and RiverWatch volunteers.

Future phased monitoring

If this initial monitoring reveals a need for further monitoring, another phase may be added. Smaller tributaries may be monitored to better pinpoint areas of high water pollution, or stream reaches that can be assessed to evaluate the performance of BMP implementation or restoration efforts on pollutant loading. Additionally, USEPA should be encouraged to resume water quality monitoring at the USGS gage 05587900 in Edwardsville, Illinois.

Table F.1. Timeline for water quality monitoring in the Indian-Cahokia Creek watershed.

	2019				2020				2021				2022-2030
Monitoring Activity	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	
Develop Standard Operating Procedures for collection and laboratory analysis of samples	■												
Sampling near USGS gage site 05594800													
Install continuous monitoring equipment		■											
Monitor TSS, TP, TN		■	■	■	■	■	■						
Evaluate and adjust continuous monitoring plan								■					
Monitor TSS, TP, and TN based on revised plan								■	■	■	■	■	■
Discrete sampling at the HUC14 level													
Identification of HUC14 discrete sampling sites	■												
Monitor TSS, TP, TN, SRP, NO3-N		■	■	■	■	■	■						
Evaluate and adjust discrete monitoring plan								■					
Continue discrete monitoring based on revised plan								■	■	■	■	■	■

APPENDIX G - FUNDING SOURCES

The following funding sources are available for watershed management efforts. All the sources listed here are linked to one or more of the issues identified in and practices recommended for this watershed.

These funding sources are summarized in Table G.2 at the end of this appendix.

State/federal government

Illinois Environmental Protection Agency (IEPA)

The **Section 319(h) Nonpoint Source Pollution Control Financial Assistance Program** implements Illinois' Nonpoint Source Management Program with federal funds through section 319(h) of the Clean Water Act. The funds can be for watershed planning, implementation of Best Management Practices (BMPs), or monitoring of water quality. Projects that address nonpoint source (NPS) pollution in Illinois waters that have impaired water quality are given priority.

The **State Revolving Fund Loan Program** includes the Public Water Supply Loan Program (PWSLP) for drinking water projects and the **Water Pollution Control Loan Program (WPCLP)** for wastewater and stormwater projects. Eligible projects include upgrading or rehabilitating existing infrastructure, stormwater-related projects that benefit water quality, and a wide-variety of other projects that protect or improve the quality of Illinois's rivers, streams, and lakes. Funds can be provided for flood relief if the projects are tied to water quality improvements. Green infrastructure projects such as street tree or urban forestry programs, stormwater harvesting programs, downspout disconnection projects, and street drainage practices that mimic natural hydrology may be funded.

Streambank Cleanup and Lakeshore Enhancement (SCALE) grants from EPA have been available in previous years (2013-2016) to support cleanup efforts under Section 319 of the Clean Water Act. The funds were paid to groups that "have already established a recurring streambank or lakeshore cleanup," and used for dumpster rental, landfill fees, and safety attire. Recipients such as Alton Marketplace/Main Street and the Village of Swansea received $500 (or more if more participants were involved). This program may be funded again in future.

Illinois Department of Agriculture (IDOA)

The **Streambank Stabilization and Restoration Program (SSRP)** is designed to demonstrate effective streambank stabilization at demonstration sites using inexpensive vegetative and bio-engineering techniques. Program funds may be used for labor, equipment, and materials. Recipients of the cost-share and project funding must maintain the streambank stabilization project for at least 10 years. This program is not currently funded, but funding may be reinstated in future.

The **Conservation Practice Program (CPP)** is implemented by the Soil and Water Conservation Districts (SWCDs) in Illinois. Cost-share funds are available through the SWCDs for various conservation practices including Filter Strips, Grassed Waterways, No-Till, and Terraces. A CPP-Special Project cost share program funds practices that meet local natural resource priorities but are not on the state-wide list of practices, such as stream crossings, rain gardens, and heavy area livestock use area protection.

Applications received are prioritized based on tons of soil saved, acres benefited, cost per acre of practice, and cost per ton of soil saved. This program is not currently funded, but funding may be reinstated in future.

The **Sustainable Agriculture Grant Program** funds research, education, and on-farm demonstration projects that address one or more purposes related to sustainable farming. These purposes include minimizing environmental degradation, clarifying the connections between specific agricultural practices and types of pollution, testing approaches to on-farm research, and identifying critical research and education needs related to sustainable agriculture.

Illinois Department of Natural Resources (IDNR)

The **Urban Flood Control Program** has been implemented for many years under the authority of the Flood Control Act of 1945. IDNR's Office of Water Resources (OWR) has typically applied the program to out-of-bank riverine flooding, and to the development and construction of projects that provide an outlet for stormwater systems.

Illinois Emergency Management Agency

The **Flood Mitigation Assistance (FMA) program** is a cost-share program (75% federal, 25% local match) through which communities can receive grants for the development of a comprehensive flood mitigation plan and the implementation of flood mitigation projects. Communities must be members of the National Flood Insurance Program (NFIP). (See Table G.1.)

The **Pre-Disaster Mitigation (PDM) program** makes grants available to state and local governments to implement cost-effective hazard mitigation activities that complement a comprehensive mitigation program. Funding is awarded for the development of an all-hazards mitigation plan or for a cost-effective hazard mitigation project. (See Table G.1.)

The **Hazard Mitigation Grant (HMG) program** makes grants available to state and local governments as well as eligible private, non-profit organizations to implement cost-effective, long-term mitigation measures following a major disaster declaration. A project does not have to be in a declared county to be eligible; every community that is vulnerable to natural hazards should consider applying. (See Table G.1.)

The **Severe Repetitive Loss program** provides funding to reduce or eliminate the long-term risk of flood damage to severe repetitive loss structures insured under the NFIP. These structures are residential properties insured under the NFIP that have had two or more large claims (see the Federal Emergency Management Agency website for details). (See Table G.1.)

Illinois Department of Commerce and Economic Opportunity (DCEO)

The **Illinois Community Development Assistance Program** administers funds through the Federal Community Development Block Grants: Small Cities program. The Community Development Assistance Program is designed to help communities meet their greatest economic and community development needs, with a focus on communities with low- to moderate-income populations. The public infrastructure component of the program is used to mitigate conditions that are detrimental to public health and welfare, primarily in residential areas. These projects can include the design and construction of storm sewers. (See Table G.1.)

The following table shows Illinois EMA and DCEO funding sources with their associated program outputs, participation requirements, and funding limits (Table G.1.).

Table G.1. Sources of funding, program outputs, and participation requirements for various types of flood hazard mitigation identified in the IDNR Urban Flooding Awareness Act draft report (adapted from Table 6.1 in that report).

	IDNR/OWR UFC	IEMA FMA	IEMA PDM	IEMA HMGP	Direct Legislative Action	DCEO CDAP Pl and Emergency Pl	DCEO CDP Pl + Design	IEPA Revolving Loan
Types of Projects/Outcomes								
Storm Sewer Improvements		x	x	x	x	x	x	x
Combined Sewer Improvements					x	x	x	x
Conveyance Improvements	x	x	x	x	x			
Levees	x				x			
Detention Basins	x	x	x	x	x			
Projects on Private Property		x	x	x				
Individual Basement Mitigation								
Repetitive Loss Structure Buyouts		x	x	x				
Planning Reports	x	x	x	x	x			
Program Outputs								
Project Specific Planning Documents	x				x		x	
Construction Documents	x				x	x	x	
Construction Funding	x	x	x	x	x	x	x	
Construction Engineering	x				x	x	x	
Local Participation Requirements								
Operation and Maintenance	x	x	x	x	x	x	x	x
Utility Relocations	x							
Land Rights Acquisition	x							
NFIP Participation	x	x	x	x		x	x	
Emphasis on Low to Moderate Income						x	x	
Pre-approved Planning		Mitigation Pl	Mitigation Pl	Mitigation Pl		x		x
Program Funding								
Federal Disaster Declaration Required				x				
Local Cost Share		25%	25%	25%		25%	25%	Low interest loan
B/C Ratio	≥ 1.0	≥ 1.0	≥ 1.0	≥ 1.0	None	None	None	None
Funding Limits						$450,000 or $200,000 for Emergency	$450,000 max with $150,000 Design Included	

Acronyms used in Table G.1:

IDNR/OWR – Illinois Department of Natural Resources, Office of Water Resources
IEMA – Illinois Emergency Management Agency
FMA – Flood Mitigation Assistance program
PDM – Pre-Disaster Mitigation program
HMG – Hazard Mitigation Grant program
DCEO – Department of Commerce and Economic Opportunity
CDAP Pl and Emergency Pl – Community Development Assistance Program – Planning and Emergency Planning
CDP Pl + Design - Community Development Assistance Program – Planning and Design
IEPA – Illinois Environmental Protection Agency
NFIP – National Flood Insurance Program
B/C ratio – Benefit/Cost ratio
Mitigation Pl – Mitigation Plan

U.S. Army Corps of Engineers

The **Continuing Authorities Program** is a group of 10 legislative authorities under which the Secretary of the Army, acting through the Chief of Engineers, is authorized to plan, design, and implement certain types of water resources projects without additional project specific congressional authorization. Water resource related problems that can be evaluated include bank instability that compromises public property or infrastructure, aquatic ecosystem degradation, and overbank flooding and structural damages. These problems are evaluated through a cost shared partnership addressed in two phases to include study and implementation. If you think you have a water resources problem that may fit into the stated examples, please contact the St. Louis District. The Continuing Authorities Program Manager will speak with you and, if warranted, will visit your problem area to ascertain whether or not your problem fits within this authority.

The **Flood Plain Management Services (FPMS) Program** provides the full range of technical services and planning guidance needed to support effective floodplain management. The program's authority stems from Section 206 of the 1960 Flood Control Act (PL 86-645), as amended. Its objective is to foster public understanding of the options for dealing with flood hazards and to promote prudent use and management of the Nation's flood plains. The program develops or interprets site-specific data on obstruction to flood flows, flood formation and timing; flood depths or stages; and flood water velocities.

Every year, each state, local government and tribe can provide the Corps its request for studies under the **Planning Assistance to States Program**, and the Corps then accommodates as many studies as possible within the funding allotment. Typical studies are only planning level of detail; they do not include detailed design for project construction. Section 22 of the Water Resources Development Act (WRDA) of 1974, as amended, provides authority for the Corps of Engineers to assist the States, local governments, Native American Tribes and other non-Federal entities, in the preparation of comprehensive plans for the development and conservation of water and related land resources.PAS studies are cost shared on a 50 percent federal — 50 percent non-federal basis. Also, all or a portion of the non-federal cost may be performed as in-kind work rather than having to pay all cash. This must be negotiated before the study agreement is finalized.

U.S. Department of Housing and Urban Development (HUD)

The **National Disaster Resilience Competition**, announced in June 2014, invited communities that have experienced natural disasters to compete for funds to help them rebuild and increase their resilience to future disasters. The competition supports innovative resilience projects at the local level while encouraging communities to adopt policy changes and activities that plan for the impacts of extreme weather and climate change. All states with counties that experienced a Presidentially Declared Major Disaster in 2011, 2012, or 2013, which includes Illinois, were eligible to apply. This competition may be renewed in future years.

U.S. Environmental Protection Agency

The **USEPA Source Reduction Assistance grant program** supports pollution prevention projects that will provide an overall benefit to the environment by preventing pollutants at the source (i.e., not treatment or cleanup programs). Applicants must demonstrate new or innovative techniques for education or training that promote pollution prevention and source reduction efforts. State and local governments and non-profits are eligible to receive funds or cooperative agreements.

The **Environmental Education Grants Program** supports environmental education projects that promote environmental awareness and stewardship and help provide people with the skills to take responsible actions to protect the environment. Grants are issued to organizations including local education agencies, state schools, colleges, and nonprofit organizations.

The **Environmental Justice Small Grants Program** supports communities working on solutions to local environmental and public health issues through collaborative partnerships. One focus of successful applications is community-based preparedness and resilience efforts, particularly for climate resiliency.

The **Urban Waters Small Grants Program** improves coordination among federal agencies and collaborates with community-led revitalization efforts to improve the Nation's water systems. Funds go to research, investigations, training, surveys, studies, and demonstrations that will advance the restoration of urban waters by improving water quality through activities that also advance community priorities. Sponsored projects receive support in a number of different ways. There is currently no open Request for Proposals.

EPA Regions will engage a contractor to provide technical assistance to states or local communities for pilot projects on two topics: (1) green stormwater management (low impact development/green infrastructure), and (2) protection of healthy watersheds. Funds are provided to the selected EPA Region for the Region to contract services to explore integrating the topics into local or state FEMA hazard mitigation plans.

U.S. Department of Agriculture

The **Conservation Reserve Program (CRP)** is a federally funded voluntary program that contracts with agricultural producers so that environmentally sensitive land, such as wetland and floodplain, is not farmed or ranched, but instead used for conservation benefits. Farmers enrolled in the program agree to remove environmentally sensitive land from agricultural production and plant species such as native prairie grasses that will improve environmental health and quality, in exchange for a yearly rental payment. The land must be eligible for one or more conservation practices, including grass waterways, filter strips, wetland restoration, riparian buffers, flood control structures, and sediment retention. Contracts for land enrolled in CRP are 10 to 15 years in length. The long-term goals of the program are to reestablish valuable land cover that will help improve water quality, prevent soil erosion, and reduce loss of wildlife habitat.

The **CRP – Grasslands** program is part of the CRP program. It conserves working grasslands, rangeland, and pastureland while maintaining the areas as livestock grazing lands. Participants who establish long-term, resource-conserving plant covers (i.e., approved grasses or trees) are provided with annual rental payments up to 75 percent of the grazing value of the land. Cost-share assistance also is available for up to 50 percent of the covers and other practices, such as cross fencing to support rotational grazing or improving pasture cover to benefit pollinators or other wildlife. Participants may still conduct common grazing practices, produce hay, mow, or harvest for seed production, conduct fire rehabilitation, and construct firebreaks and fences.

The **Conservation Reserve Enhancement Program (CREP)** is an offshoot of the CRP that addresses high priority environmental problems in a partnership between the state and federal government. It funds the removal of environmentally sensitive land (such as wetlands and highly erodible land) from crop production, and the introduction of conservation practices. The Kaskaskia River Watershed is eligible for CREP agreements.

The **Agricultural Conservation Easement Program (ACEP)** is a Natural Resources Conservation Service (NRCS) program. It repeals the Farm and Ranch Lands Protection Program (FRPP), the Grassland Reserve Program (GRP), and the Wetlands Reserve Program (WRP) and consolidates the purposes of these programs into one easement program. The two easement enrollment components of ACEP are agricultural land easements (ACEP-ALE) and wetland reserve easements (ACEP-WRE).

- Agricultural Land Easements (ALEs) prevent the conversion of productive farmland to non-agricultural uses. Land eligible for agricultural easements includes cropland, rangeland, grassland, pastureland and nonindustrial private forest land. NRCS will prioritize applications that protect agricultural uses and related conservation values of the land and those that maximize the protection of contiguous acres devoted to agricultural use.
- Wetland Reserve Easements (WREs) provide habitat for wildlife, improve water quality, and reduce flooding. Technical and financial assistance is provided to restore, protect, and enhance wetlands. Land may be enrolled in easements for various time periods. Land eligible for wetland reserve easements includes farmed or converted wetland that can be successfully and cost-effectively restored. NRCS will prioritize applications based the easement's potential for protecting and enhancing habitat for migratory birds and other wildlife.

The **Environmental Quality Incentive Program (EQIP)**, run by NRCS, provides financial and technical assistance to individuals and entities to address soil, water, air, plant, animal and other related natural resource concerns on their land. Funding can be provided for the implementation of structural and management practices, including conservation tillage, on eligible agricultural land.

The **Conservation Stewardship Program (CSP**) helps producers maintain and improve existing conservation systems and implement additional activities to address priority resources concerns. Payments made are based on performance of the practices. Two types of payments are provided through five-year contracts: annual payments for installing new conservation practices and maintaining existing practices, and supplemental payments for adopting a resource-conserving crop rotation.

The **Healthy Forests Reserve Program (HFRP)** aims to assist landowners in restoring, enhancing, and protecting forestland resources on private land through easements, 30-year contracts, and 10-year cost-share agreements. The land must restore, enhance, or measurably increase the recovery of threatened or endangered species, improve biological diversity, or increase carbon storage.

The **Regional Conservation Partnership Program (RCPP)** encourages partnerships with producers on installing and maintaining conservation projects that increase the restoration and sustainable use of soil, water, wildlife, and related natural resources. Contracts and easement agreements are implemented through other NRCS programs: ACEP, EQIP, CSP, or HFRP. The RCPP essentially provides more funding through these programs. There are three funding pools within the program: state, federal, and Critical Conservation Areas (CCAs).

Conservation Innovation Grants (CIG) is a voluntary program intended to stimulate the development and adoption of innovative conservation approaches and technologies in agricultural production. The program allows NRCS to work with other public and private entities to accelerate technology transfer and adoption. There have been funding opportunities at the national and state level.

The **Water & Waste Water Disposal Loan & Grant Program** provides funding for clean and reliable drinking water systems, sanitary sewage disposal, sanitary solid waste disposal, and stormwater drainage to households and businesses in eligible rural areas. The program assists applicants who are not otherwise able to obtain commercial credit on reasonable terms for these projects. Areas served must be rural or towns populated with 10,000 people or fewer. Long-term, low interest loans are the primary funding type available. Grants may be combined with a loan if necessary and if funds are available.

The **Forest Legacy Program** protects environmentally sensitive "working forests" that protect water quality, provide habitat, forest products, opportunities for recreation, and other public benefits. It is designed to encourage the protection of privately owned forest lands through conservation easements. Program participants must prepare a multiple resource management plan for the land.

U.S. Fish and Wildlife Service

The **Partners for Fish and Wildlife Program** is run by the U.S. Fish and Wildlife Service (USFWS) under the Department of the Interior (DOI). The Partners for Fish & Wildlife program works with private landowners to improve fish and wildlife habitat on their lands through voluntary, community-based stewardship. Noting that more than 90% of land in the Midwest is in private ownership, the program promotes high quality habitat through partnerships with private conservation organizations, state and federal agencies, and tribes to reach private landowners. Funding, materials, equipment, labor and expertise can be shared to meet shared restoration and conservation goals.

Non-Governmental Organizations (NGOs)

Several NGOs have programs or missions that support the recommendations in this plan.

Environmental non-profit groups

The following groups may have funds to help carry out their missions at any given time:

- **Ducks Unlimited (DU)** – DU's Living Lake Initiative is established to provide support in enhancing shallow lake complexes.
- **Pheasants Forever** – Local Chapters often provide food plot and native grass seed to landowners.
- **Trees Forever** – The Working Watersheds: Buffers and Beyond program provides a 50% cost share (up to a maximum of $2,000) to implement a water quality project or demonstration site. Riparian buffer plantings are the main focus of the program, but other innovative projects are also considered.
- **The Nature Conservancy (TNC)** – TNC works to protect diverse natural habitats including wetlands and forests.
- **The National Fish and Wildlife Foundation (NFWF)** – NFWF provides grants on a competitive basis to projects that support fish and wildlife. Its program areas include protecting critical habitat, capacity building for partner organizations, and wetland and forest stewardship.

- **The National Wildlife Federation (NWF)** – The NWF supports projects that protect and restore fish and wildlife habitat.
- **Water Environment Federation (WERF)** – The Water Environment Research Foundation funds water quality research and facilitates collaboration among partners. Currently, an open Request for Proposals solicits research projects on integrating water services planning with urban planning. Past projects have included innovative wastewater treatment plant upgrades.

Private Foundations/Companies

Companies such as Coca-Cola and Patagonia often have foundations or grant programs to support environmental missions. Some of these companies/foundations include:

- **Coca-Cola Foundation** – Coca-Cola's Community Support program supports funding for program areas including water stewardship and education.
- **McKnight Foundation** – The McKnight Foundation's environmental grantmaking is divided into projects that revolve around restoring water quality in the Mississippi River and that improve climate resilience in the Midwest.
- **Walton Family Foundation** – The Walton Foundation supports projects including freshwater projects that sustain healthy communities in the Mississippi River Basin.
- **Illinois American Water's 2018 Environmental Grant Program** – Illinois American Water supports innovative, community-based environmental projects that improve, restore or protect watersheds through partnerships. Watershed cleanups, reforestation efforts, biodiversity projects, wellhead protection and hazardous waste collection efforts are supported through grants of up to $10,000.

Other

In-Lieu Fee Mitigation Program

In-lieu fee mitigation is a type of mitigation banking that can be used to compensate for unavoidable impacts to wetlands while directing funds to sites with high ecological value. A permittee pays a fee to a third party instead of conducting project-specific mitigation or buying credits from a wetland mitigation bank. The fee represents the estimated cost of replacing the wetland functions lost or degraded as a result of the permittee's project. The in-lieu fee mitigation program gathers several such fees and uses them to finance an extensive mitigation project. HeartLands Conservancy is in the final stages of becoming an Approved Program Sponsor within the American Bottoms and Lower Kaskaskia River watersheds. Once approved, project implementation should begin in 2016. Mitigation sites will include both wetlands and streams, so fees will go towards both wetland and stream restoration.

Table G.2. Funding Sources for Watershed Management Efforts.

Funding Sources	**Grant Programs**	**Eligible Entities**	**Types of Practices Funded**	**Currently Funded** (As of June 2018)
State/Federal Government				
Illinois Environmental Protection Agency	Section 319(h) Nonpoint Source Pollution Control Financial Assistance Program	Local units of government and other organizations.	Watershed planning, implementing BMPs, or water quality monitoring.	Yes
	State Revolving Fund Loan Program, including: • Public Water Supply Loan Program • Water Pollution Control Loan Program	Communities and public or private entities.	Infrastructure upgrades, stormwater projects that benefit water quality, projects that improve Illinois' rivers, streams, and lakes.	Yes
	Streambank Cleanup and Lakeshore Enhancement Grants	Groups that have established a recurring streambank or lakeshore cleanup.	Dumpster rental, landfill fees, safety attire.	No. Funding may be reinstated in the future.
Illinois Department of Agriculture	Streambank Stabilization and Restoration Program	Landowners with severely eroded streambanks.	Labor, equipment, materials.	No. Funding may be reinstated in the future.
	Conservation Practice Program	N/A	Conservation practices including filter strips, grassed waterways, no-till, and terraces.	No. Funding may be reinstated in the future.
	Sustainable Agriculture Grant Program	Organizations, governmental units, educational institutions, non-profit organizations, and individuals.	Research, education, and on-farm demonstration projects that address sustainable farming.	Yes
Illinois Department of Natural Resources	Urban Flood Control Program	Citizens or local, state, or federal officials.	Out-of-bank riverine flooding initiatives and projects that provide an outlet for stormwater.	Yes

Table G.2., Continued. Funding Sources for Watershed Management Efforts.

Funding Sources	**Grant Programs**	**Eligible Entities**	**Types of Practices Funded**	**Currently Funded** (As of June 2018)
State/Federal Government (continued)				
Illinois Emergency Management Agency	Flood Mitigation Assistance Program	Communities that are members of the NFIP.	Development of a comprehensive flood mitigation plan, or implementation of flood mitigation projects.	Yes
	Pre-Disaster Mitigation Program	State and local governments.	Creation of an all-hazards mitigation plan or a cost-effective hazard mitigation project.	Yes
	Hazard Mitigation Grant Program	State and local governments and non-profit organizations.	Cost-effective, long-term mitigation measures following a major disaster.	Yes
	Severe Repetitive Loss Program	Residential properties insured under the NFIP that have had two or more large claims.	Initiatives that reduce or eliminate the long-term risk of flood damage.	Yes
Illinois Department of Commerce and Economic Opportunity	Illinois Development Assistance Program	Communities with low- to moderate-income populations.	Implementation of mitigation measures, primarily in residential areas, to address issues that are detrimental to public health and welfare (e.g., design and construction of storm sewers).	Yes

Table G.2., Continued. Funding Sources for Watershed Management Efforts.

Funding Sources	**Grant Programs**	**Eligible Entities**	**Types of Practices Funded**	**Currently Funded** (As of June 2018)
State/Federal Government (continued)				
U.S. Army Corps of Engineers	Continuing Authorities Program *(not a grant)*	U.S. Army Corps of Engineers	Planning, design, and implementation of certain types of water resources projects to address problems including bank instability that compromises public property or infrastructure, aquatic ecosystem degradation, and overbank flooding and structural damages. Cost share required.	Yes
	Flood Plain Management Services (FPMS) Program *(not a grant)*	U.S. Army Corps of Engineers	Develops or interprets site-specific data on obstruction to flood flows, flood formation and timing; flood depths or stages; and flood water velocities.	Yes
	Planning Assistance to States (PAS) Program *(not a grant)*	U.S. Army Corps of Engineers	Studies produced to a planning level of detail to assist States, local governments, Native American Tribes and other non-Federal entities in the preparation of comprehensive plans for the development and conservation of water and related land resources.	Yes
U.S. Department of Housing and Urban Development	National Disaster Resilience Competition	States with counties that experienced a Presidentially Declared Major Disaster in 2011, 2012, or 2013.	Innovative resilience projects at the local level that encourage the adoption of policy changes, and activities that prepare for impacts of extreme weather and climate change.	No. Funding may be reinstated in the future.
U.S. Environmental Protection Agency	USEPA Source Reduction Assistance Grant Program	State and local governments and non-profit organizations.	Pollution prevention projects that will benefit the environment by eliminating pollution at the source.	Yes
	Environmental Education Grants Program	Local education agencies, state schools, colleges, and non-profit organizations.	Environmental education projects that promote awareness and stewardship.	Yes

Table G.2., Continued. Funding Sources for Watershed Management Efforts.

Funding Sources	**Grant Programs**	**Eligible Entities**	**Types of Practices Funded**	**Currently Funded** (As of June 2018)
State/Federal Government (continued)				
U.S. Environmental Protection Agency (continued)	Environmental Justice Small Grants Program	Communities and community-based organizations.	Solutions to local environmental and public health issues (e.g., climate resiliency, community preparedness) through collaborative partnerships.	Yes
	Urban Waters Small Grants Program	Communities and community-based organizations.	Research, training, surveys, and demonstrations that advance the restoration of urban waters by improving water quality through activities that also advances community priorities.	No. Funding may be reinstated in the future.
	Technical assistance from EPA Regions	EPA Regions collaborate with FEMA and states or local communities.	Pilot projects that can be integrated into a state or local hazard mitigation plan on the topics of green stormwater management (low impact development/green infrastructure) and the protection of healthy watersheds.	Yes
U.S. Department of Agriculture	Conservation Reserve Program	Landowners or farmers with environmentally sensitive land (e.g., wetland, floodplain). Land must be eligible for one or more conservation practices, including grass waterways, wetland restoration, riparian buffers, and flood control structures.	Reestablish valuable land cover that will improve water quality, prevent soil erosion, and reduce loss of wildlife habitat.	Yes
	CRP—Grasslands	Landowners and operators.	Initiatives to conserve working grasslands, rangeland, and pastureland while maintaining livestock grazing land.	Yes
	Conservation Reserve Enhancement Program (CREP)	Farmers and ranchers that live in a state with a CREP agreement in place with the Farm Service Agency (FSA).	Removal of environmentally sensitive land (e.g., wetlands) from crop production and introduction of conservation practices.	Yes

Table G.2., Continued. Funding Sources for Watershed Management Efforts.

<table>
<tr><th>Funding Sources</th><th>Grant Programs</th><th>Eligible Entities</th><th>Types of Practices Funded</th><th>Currently Funded (As of June 2018)</th></tr>
<tr><td colspan="5">State/Federal Government (continued)</td></tr>
<tr><td rowspan="6">U.S. Department of Agriculture (continued)</td><td rowspan="2">Agricultural Conservation Easement Program, including:
• Agricultural Land Easements
• Wetland Reserve Easements</td><td>Agricultural Land Easement eligibility: cropland, rangeland, grassland, pastureland, and nonindustrial private forest.</td><td>Prevention of productive farmland conversion to non-agricultural uses.</td><td rowspan="2">Yes</td></tr>
<tr><td>Wetland Reserve Easement eligibility: farmed or converted wetland that can be successfully and cost-effectively restored.</td><td>Habitat creation, water quality improvement, flood reduction.</td></tr>
<tr><td>Environmental Quality Incentive Program</td><td>Individuals and entities.</td><td>Structural and management practices that address natural resource concerns on agricultural land.</td><td>Yes</td></tr>
<tr><td>Conservation Stewardship Program</td><td>Landowners in compliance with highly erodible land and wetland conservation requirements with current farm records with FSA.</td><td>Assistance in maintaining and improving existing conservation systems. Implementation of additional activities to address priority resource concerns.</td><td>Yes</td></tr>
<tr><td>Healthy Forests Reserve Program</td><td>Any landowner whose land restores, enhances, or increases the recovery of threatened or endangered species.</td><td>Restoration, enhancement, and protection of forestland resources on private lands through easements.</td><td>Yes</td></tr>
<tr><td>Regional Conservation Partnership Program</td><td>Partners of the Natural Resources Conservation Service.</td><td>Partnerships with producers to install and maintain conservation projects that increase the restoration and sustainable use of soil, water, wildlife, and related natural resources.</td><td>Yes</td></tr>
</table>

Table G.2., Continued. Funding Sources for Watershed Management Efforts.

Funding Sources	**Grant Programs**	**Eligible Entities**	**Types of Practices Funded**	**Currently Funded** (As of June 2018)
State/Federal Government (continued)				
U.S. Department of Agriculture (continued)	Conservation Innovation Grants	Public and private entities.	Development and adoption of innovative conservation approaches and technologies in agricultural production.	Yes
	Water and Waste Water Disposal Loan and Grant Program	Rural areas or towns populated with 10,000 people or fewer.	Creation of clean and reliable drinking water systems, sanitary sewage disposal, sanitary solid waste disposal, and stormwater drainage to households and businesses.	Yes
	Forest Legacy Program	Environmentally sensitive "working forests" that protect water quality, provide habitat, and public benefits. Must prepare a multiple resources management plan for the land.	Protect privately owned forest lands through conservation easements.	Yes
U.S. Fish and Wildlife Service	Partners for Fish and Wildlife Program	Private landowners	Improvements to fish and wildlife habitat through voluntary, community-based stewardship.	Yes

Table G.2., Continued. Funding Sources for Watershed Management Efforts.

Funding Sources	Grant Programs	Eligible Entities	Types of Practices Funded	Currently Funded (As of June 2018)
Non-Governmental Organizations (non-profit organizations, private foundations/companies, other) that support watershed management efforts.				
Ducks Unlimited	e.g. Living Lake Initiative	N/A	Support and enhance shallow lake complexes.	N/A
Pheasants Forever	N/A	Landowners	Local chapters provide food plot and native grass seed.	N/A
Trees Forever	Working Watersheds: Buffers and Beyond	Iowa landowners	Fifty-percent cost share to implement a water quality project or demonstration site.	Yes
The Nature Conservancy	N/A	N/A	Protect diverse natural habitats, including wetlands and forests.	N/A
The National Fish and Wildlife Foundation	N/A	N/A	Critical habitat protection, capacity building for partner organizations, and wetland and forest stewardship.	N/A
The National Wildlife Federation	N/A	N/A	Protection and restoration of fish and wildlife habitat.	N/A
Water Environment Federation	N/A	N/A	Water quality research and facilities collaboration among partners.	N/A
Coca-Cola Foundation	Community Support Program	Individuals, organizations, communities.	Water stewardship and education.	Yes
Illinois American Water	2018 Environmental Grant Program	Communities that have a source water or watershed protection need.	Community-based projects that improve or protect watersheds through partnerships. Watershed cleanups, reforestation, biodiversity, wellhead protection and hazardous waste collection are supported through grants of up to $10,000.	Yes
In-Lieu Fee Mitigation Program	N/A	N/A	Mitigation banking that can be used to compensate for unavoidable impacts to wetlands while directing funds to sites with high ecological value.	N/A
McKnight Foundation	N/A	Organizations that are invited to apply or that fit with funding strategies.	Projects that restore water quality in the Mississippi River and improve climate resilience in the Midwest.	Yes
Walton Family Foundation	N/A	Projects that match the foundation's funding criteria and priorities.	Freshwater projects that sustain healthy communities in the Mississippi River Basin.	Yes

Appendix H - Progress Report Cards

PM = Progress made; A = Achieved

Goal 1: Reduce Flooding and Mitigate Flood Damage

Existing Conditions

18% of land in the watershed in Madison County (15,220 acres) is in the 100-year floodplain. Flooding in this area is common.

21% of Flood Survey respondents experienced flooding in the last 10 years, resulting in a reported total of greater than $330,016 in damage costs.
Major roads have been inundated with floodwater during heavy rain events.
Thousands of acres of wetlands have been lost since pre-settlement; the associated loss of ecosystem functions has been great since that time.

Watershed Impairment Reduction Targets and recommendations

New dry detention basins installed

New wet detention basins installed

Retrofits & maintenance on existing detention basins

Critical Flooding Areas prioritized

100% Critical Wetlands Areas restored

Stream flow reduced peak discharge during storm events

Programmatic changes regarding flood damage prevention ordinances, riparian buffer ordinances, and stormwater infrastructure funding

Measurement Indicator	Milestone				Data source	Achieved?
	Short-term (1-10 years)	Medium-term (10-20 years)	Long-term (20+ years)			
Number and extent of Management Measures (BMPs) implemented	119	239	358	... acres of riparian areas ecologically restored, including 100% Critical Riparian Areas (cumulative)	SWCD, NRCS, farmers, contractors	
	492	985	1,477	... acres wetlands restored, enhanced, or created (100% of Critical Wetland Areas) (cumulative)		
	333	666	10,000	… feet storm drain system maintenance (cleaning) and expansion	Municipalities, contractors	
Flow data collected under the Monitoring Plan at other HUC14 locations. Data correlated with rainfall.	PM	PM	A	No measured increase in mean peak stream discharge / Measured reductions in peak stream discharge	USGS National Water Information System, NGRREC (monitoring results)	

Number and extent of flood damage prevention ordinances, riparian buffer ordinances, and other actions by local governments to restrict construction in floodplains and riparian areas.	PM	PM	A	Counties adopt updated Flood Damage Prevention Ordinance and Riparian Buffer Ordinance All municipalities engaged to inform about the ordinances and encourage adoption	Counties, municipalities, townships	
Number of counties/municipalities with dedicated funding for stormwater infrastructure, e.g., a Stormwater Utility. Dollar amount of revenue streams.	PM	PM	A	Counties adopt a mechanism for dedicated funding for stormwater infrastructure All municipalities engaged to inform about stormwater infrastructure funding options	Counties, municipalities	

GRADE	

Notes

Goal 2: Improve Surface Water Quality

Existing Conditions

149,598 lbs/year of phosphorus, 43,321 tons/year of sediment, and 717,606 lbs/yr of nitrogen enter the Indian-Cahokia Creek watershed every year, based on the STEPL model.

Cahokia Diversion Channel impaired for dissolved oxygen in 2018 and previous years.

Over 3,500 private sewage systems are present in the watershed. Given a national estimated failure rate of 10%, 350 systems are currently failing. The actual number may be higher because many of these systems are older.

Watershed Impairment Reduction Targets and recommendations

Decrease overall pollutant loading to Cahokia Creek and its tributaries. **Removal** of Cahokia Creek, Cahokia Diversion Channel, Holiday Shores Lake, Holiday Shores Creek, and Indian Creek from the IEPA 303(d) List.

25% reduction in phosphorus loading by 2030, based on the Illinois Nutrient Loss Reduction Strategy.

20% reduction in sediment loading by 2030, based on estimated impacts of proposed BMPs.

15% reduction in nitrogen loading by 2030, based on the Illinois Nutrient Loss Reduction Strategy.

No DO samples lower than the minimum concentration in streams: March – July: 5.0 mg/L at any time, 6.0 mg/L as a daily mean averaged over 7 days; August – February: 3.5 mg/L at any time, 4.0 mg/L as a daily mean averaged over 7 days, 5.5 mg/L as a daily mean averaged over 30 days. Based on 35 Ill. Adm. Code 302.

Create a strategy to improve the assessment and maintenance of private sewage systems (i.e., septic tanks) for correct functioning.

Monitor the watershed's water quality to identify trends and evaluate the success of watershed management activities.

Measurement Indicator	**Milestone**				**Data source**	**Achieved?**
	Short-term (1-10 years)	Medium-term (10-20 years)	Long-term (20+ years)			
Number and extent of Management Measures (BMPs) implemented	10.7	21.3	32	... acres contour buffer strips (15% of locations identified by the ACPF) (cumulative)	SWCD, NRCS, farmers, contractors	
	7,812.3	15,624.7	23,437	… acres cover crops (33% of total agricultural land area) (cumulative)		
	25.7	51.3	77	… acres grassed waterways (33% of locations identified by the ACPF) (cumulative)		
	33.33	66.67	100	... acres ponds (cumulative)		
	7,812.3	15,624.7	23,437	... acres conservation tillage (conservation tillage/no-till) (33% of total agricultural land area) (cumulative)		
	119	239	358	… acres of riparian areas ecologically restored, including 100% Critical Riparian Areas (cumulative)		
	26,666.7	53,333.3	80,000	... feet terraces (cumulative)		
	33.33	66.67	100	... acres waste storage structures/waste management systems (cumulative)		

	16.7	33.3	50	... acres Water and Sediment Control basins (100% of locations identified by the ACPF) (cumulative)		
	492	985	1,477	... acres wetlands restored, enhanced, or created (100% of Critical Wetland Areas) (cumulative)		
	166.7	333.3	500	... acres new dry detention basins (cumulative)	Counties, municipalities, SWCD	
	33.33	66.67	100	... acres new wet detention basins (cumulative)		
	6.7	13.3	20	... acres detention basin retrofits (native vegetation buffers, etc.) (approximately 40% of identified basins, which is the proportion that were in poor condition) (cumulative)		
	6.7	13.3	20	… detention basins maintained (dredging, mowing, burning, invasives, etc.) (approximately 40% of identified basins, which is the proportion that were in poor condition) (cumulative)		
	33.33	66.67	100	... acres pervious pavement (cumulative)	Counties, municipalities, contractors	
			20,000	... square feet rain gardens (cumulative)		
	33	67	100	... barrels/small cisterns for rainwater harvesting and reuse (cumulative)		
	612.3	1,224.7	1,837	... properties use single property flood reduction strategies (cumulative)		
	32,060	64,120	96,180	... feet streambank and channel restoration, including 100% Critical Stream Areas (cumulative)	NRCS, SWCD, contractors	
	1,230.7	2,461.3	3,692	... feet logjam removal sites (2% of Critical Logjam Areas)		
Removal of Cahokia Creek, Cahokia Diversion Channel, Holiday Shores (Holiday Lake), and Holiday Shores Creek from Illinois EPA 303(d) list.	PM	PM	A	All streams in the watershed removed from the 303(d) list	Illinois EPA 303(d) list	
Concentrations and loads of in-stream pollutants	PM	PM	A	Measured reductions in in-stream phosphorus, sediment, and nitrogen (see Monitoring Plan). Measured increases in in-stream dissolved oxygen (see Monitoring Plan).	NGRREC (water quality monitoring results)	
Nutrient removal technologies incorporated into upgrades of wastewater treatment plants	PM	PM	A	All wastewater treatment plants meet NPDES permit requirements; upgrades implemented as needed.	Individual treatment plants; US EPA Discharge Monitoring Report (DMR) Tool	
Percentage of new development projects with private sewer. Number of existing on-site treatment systems connected to public sewers.	10%	20%	30%	... new development projects have public sewer. Also, 350 on-site treatment systems connected to public sewers (~10% of private sewage systems in the watershed)	County, municipal records	

Number and extent of local ordinances and programs requiring regular inspection and maintenance of on-site sewage systems.	4	8	12	… municipalities and both counties require regular private sewage inspections (beyond complaint-based program)	Counties, municipalities	
Enrollment of land in conservation easements including CRP and CREP	0.8	1.7	2.5	... times the 2015 acreage enrolled in CRP and CREP	NRCS	

GRADE	

Notes

Goal 3: Promote Environmentally Sensitive Development Practices

Existing Conditions

Current 27.1% impervious cover; current 9,277 acres developed open space (2011 NLCD) or 5,888 acres open space (recognized parks, etc.)

Thousands of acres of wetlands lost since pre-settlement; loss of ecosystem functions.

Regulations and common practices in new development have not and generally still do not prioritize the protection of open space or natural features.

Watershed Impairment Reduction Targets and recommendations

Preservation of open space and infiltration measures in all new and redevelopment

Increase in rain gardens

Increase in pervious surfaces in new and redevelopment

Decrease in impervious surfaces in new and redevelopment

Increase in land in conservation easements

Programmatic changes including use of Conservation Development design, local ordinances, green infrastructure, and in-lieu fee mitigation

Measurement Indicator	**Milestone**				**Data source**	**Achieved?**
	Short-term (1-10 years)	Medium-term (10-20 years)	Long-term (20+ years)			
2Number and extent of Management Measures (BMPs) implemented	166.67	333.33	500	... acres new dry detention basins (cumulative)	Counties, municipalities, SWCD	
	33.33	66.67	100	... acres new wet detention basins (cumulative)	Counties, municipalities, SWCD	
	6.7	13.3	20	... acres detention basin retrofits (native vegetation buffers, etc.) (approximately 40% of identified basins, which is the proportion that were in poor condition) (cumulative)	Counties, municipalities, SWCD	
	6.7	13.3	20	… detention basins maintained (dredging, mowing, burning, invasives, etc.) (approximately 40% of identified basins, which is the proportion that were in poor condition) (cumulative)	Counties, municipalities, SWCD	
	33.33	66.67	100	... acres pervious pavement (cumulative)	Counties, municipalities, contractors	
	6,666.7	13,333.3	20,000	… square feet rain gardens (cumulative)	Counties, municipalities, contractors	
Area of impervious surfaces in new development	PM	PM	A	2% or less annual increase in impervious cover in the overall watershed	NLCD Percent Developed Impervious Surface dataset	

Enrollment of land in conservation easements including CRP and CREP	1.5	2	2.5	… times the 2018 acreage enrolled in CRP and CREP	NRCS	
Number of new development proposals using Conservation Development design to protect natural features.	20%	40%	60%	… of subdivision and other development proposals contain design elements from Conservation Development design, e.g., protection of open space	Counties, municipalities	
Number and extent of municipal ordinances that support: stormwater, flood management, green infrastructure, wetlands protection through in-lieu fee mitigation, and native landscaping.	PM	PM	A	Counties adopt updated Flood Damage Prevention Ordinance and Riparian Buffer Ordinance All municipalities engaged to inform about the ordinances and green infrastructure, in-lieu fee mitigation programs to encourage adoption	Municipalities	
Number of counties and municipalities implementing green infrastructure incentives. Number of ordinance changes to allow or encourage native landscaping.	4	6	8	... municipalities offer green infrastructure incentives such as flexible implementation of regulations, fee waivers, tax abatement, and streamlined development review process All municipalities allow and encourage native plants (e.g., changes to weed control ordinances)	Counties, municipalities	
Number of acres wetland restored and number of feet streambank restored under in-lieu fee mitigation program	PM	PM	A	In-lieu fee mitigation program established, covering the entire watershed Critical Wetland and Critical Stream Areas prioritized for restoration under in-lieu fee program	HeartLands Conservancy, U.S. ACE	

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Notes

Goal 4: Support Healthy Fish and Wildlife Habitat

Existing Conditions

21.1 miles of streams were identified as having poor riparian conditions (identified by aerial assessment).

111,725 feet are Critical Riparian Areas. 37.5 miles of Critical Logjam Areas noted.
Thousands of acres of wetlands have been lost since pre-settlement; the associated loss of ecosystem functions has been great since that time.

Watershed Impairment Reduction Targets and recommendations

100% Critical Riparian Areas restored

Majority of riparian areas in poor condition restored

100% Critical Wetlands Areas restored

Macroinvertebrate and fish samples showing increased stream health

Programmatic changes regarding stream cleanup activities

Measurement Indicator	Milestone				Data source	Achieved?
	Short-term (1-10 years)	Medium-term (10-20 years)	Long-term (20+ years)			
Number and extent of Management Measures (BMPs) implemented	119	239	358	... acres of riparian areas ecologically restored, including 100% Critical Riparian Areas (cumulative)	NRCS, SWCD, contractors	
	492.3	984.7	1,477	… acres wetlands restored, enhanced, or created (100% of Critical Wetland Areas) (cumulative)		
	1,320.7	2,641.3	3,962	… feet logjam removal sites		
Macroinvertebrate sampling results (diversity and stream health indicators) from RiverWatch volunteers and fish sample data collected by the Illinois Natural History Survey.	PM	PM	A	All Illinois RiverWatch samples indicate "Good", "Fair", or "Excellent" Taxa Richness, EPT Taxa Richness, and MBI water quality scores No decrease in water quality indicated by Illinois Natural History Survey fish sampling	Illinois RiverWatch, Illinois Natural History Survey	
Number of programs and participants for stream cleanup activities in the watershed.	PM	PM	A	Stream Cleanup Team (or similar program) established Over 50 participants annually	Counties, municipalities, non-profit organizations	

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Notes

Goal 5: Develop Organizational Frameworks to Implement Watershed Goals

Existing Conditions

There are several potential partners in the region dedicated to different aspects of water quality and stormwater management, including federal agencies, state agencies, non-profits, land trusts, and local governments.

Several potential partners have funding available for projects that would further the mission of more than one group.

Watershed Impairment Reduction Targets and recommendations

Continued support from watershed partners and stakeholders, including funding.

Programmatic changes regarding local development ordinances, and open space protection.

Measurement Indicator	**Milestone**				**Data source**	**Achieved?**
	Short-term (1-10 years)	Medium-term (10-20 years)	Long-term (20+ years)			
Number of watershed partners adopt and/or support (via a resolution) the Indian-Cahokia Creek Watershed Plan as a “guidance document.”	PM	PM	A	All watershed partners adopt and/or support (via a resolution) the Indian-Cahokia Creek Watershed Plan as a “guidance document.”Municipalities engaged and encouraged to adopt the Plan as a "guidance document."	Counties, municipalities, townships, other partners	
Number and extent of municipal ordinances that support: stormwater, flood management, green infrastructure, wetlands protection (in-lieu fee mitigation), native landscaping.	PM	PM	A	Counties adopt updated Flood Damage Prevention Ordinance and Riparian Buffer Ordinance. All municipalities engaged to inform about the ordinances and green infrastructure, in-lieu fee mitigation programs to encourage adoption.	Municipalities	
Number of new and redevelopment projects protecting sensitive natural areas/open space and creating naturalized stormwater systems. Area of land donated to a public agency/conservation organization for long-term management. Number of HOAs with rules about management of the natural areas in their bylaws.	20%	40%	60%	… of subdivision and other development proposals contain design elements from Conservation Development design, e.g., protection of open space and creating naturalized stormwater systems (green infrastructure)	HOAs, counties, communities, HeartLands Conservancy	
	10%	20%	30%	... new development projects donate land to a public agency/conservation organization		
	33%	67%	100%	... new HOAs' bylaws include rules about management and fees for natural areas		
	17%	33%	50%	… existing HOAs change their bylaws to include rules about management and fees for natural areas		

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Notes

Goal 6: Conduct Education and Outreach

Existing Conditions

The public engagement process for the watershed plan revealed a need for education on water quality and flooding for the general public.

Many landowners came to meetings requesting technical support and assistance with obtaining funding to implement BMPs on their land. Municipalities also need access to resources and funding to implement projects in city limits.

Watershed Impairment Reduction Targets and recommendations

Increase in number of people effectively reached by outreach efforts

Increase in resident/property owner participation watershed improvements

Measurement Indicator	**Milestone**				**Data source**	**Achieved?**
	Short-term (1-10 years)	Medium-term (10-20 years)	Long-term (20+ years)			
Numberof people reached by and involved in outreach efforts related to this Watershed-Based Plan.	PM	PM	A	1,200 people (2 times the ~600 people reached in the Watershed Planning process) engaged in implementation/outreach activities annually.	Counties, municipalities, townships, NGRREC, SWCD, other partners	
Percent of education/outreach session attendees who rate presentations and other activities and good or excellent.	75%	85%	95%	… of surveyed participants each year who rated outreach session(s) or presentation(s) as good or excellent.		
Percent of education/outreach session attendees who commit to action or follow-up with a watershed partner.	25%	50%	75%	… of surveyed participants who indicate a commitment to action or contact the county, SWCD, NGRREC, HLC or other partner to make improvements on their land.		
Percent of schools that incorporate a watershed-based project or learning session.	10%	20%	30%	… of schools that included at least one Indian-Cahokia Creek watershed-related learning experience or project each year.	Schools, School Districts, Counties	

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Notes