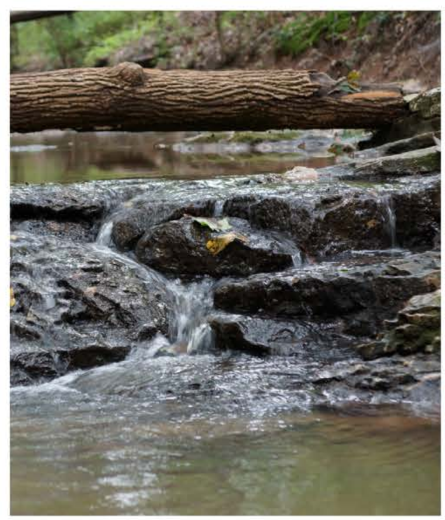
LOWER SILVER CREEK WATERSHED PLAN

A Guide to Protecting and Restoring Watershed Health



September 2018

HEARTLANDS CONSERVANCY
Investing In The Nature Of Southwestern Illinois

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APPENDICES

Silver Creek Nature Preserve. Photo: HeartLands Conservancy.

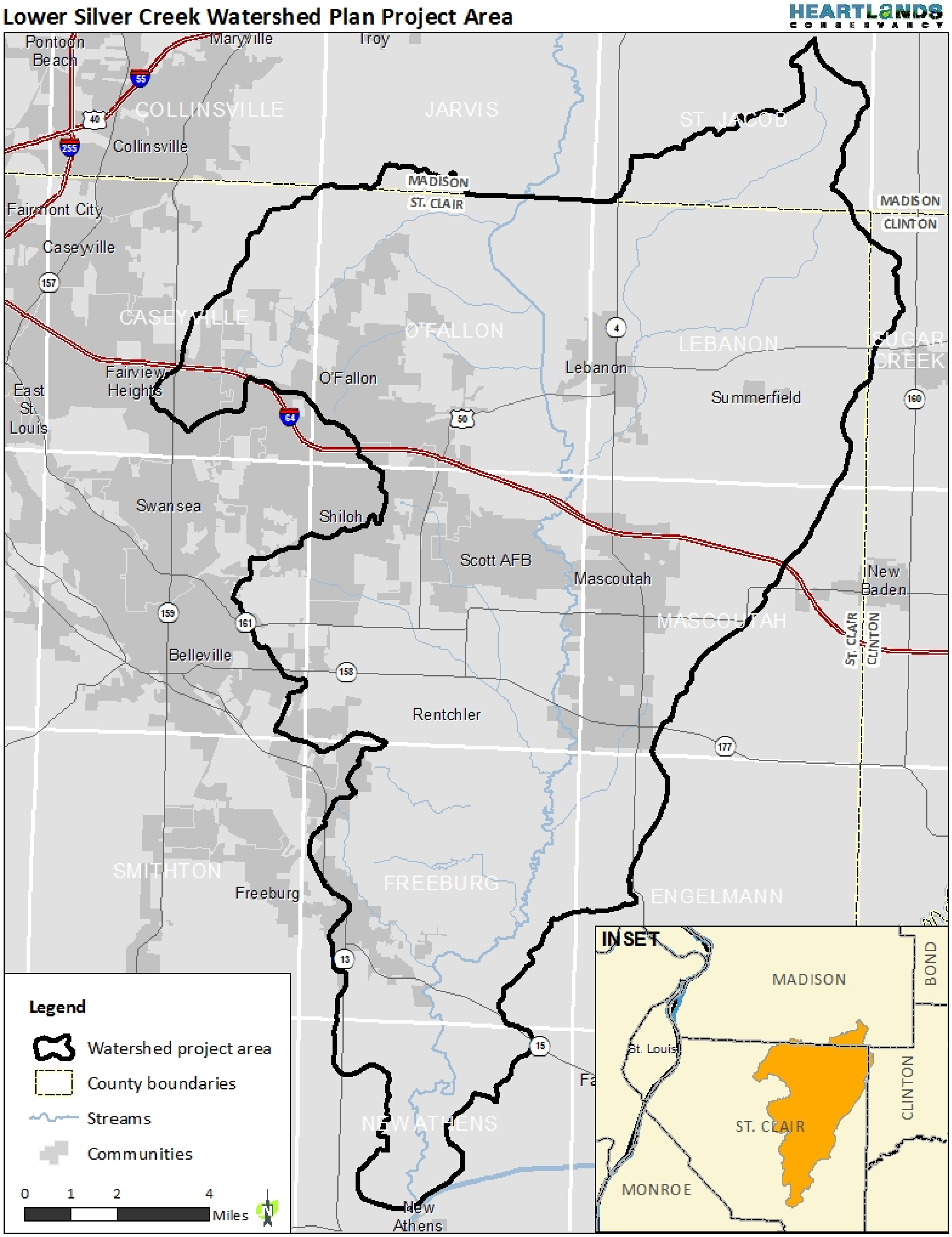
EXECUTIVE SUMMARY

Introduction

In 2016, HeartLands Conservancy received a grant from the Illinois Environmental Protection Agency (IEPA) to develop a Watershed Plan for the Lower Silver Creek watershed, which drains to the Kaskaskia River. The intent was to fully analyze the watershed and make recommendations toward improving water quality, mitigating adverse effects of flooding, and providing watershed-level recommendations for stormwater management.

The Lower Silver Creek watershed is the area of land which drains into Silver Creek in St. Clair County. The watershed includes surface water bodies (e.g., streams), groundwater (e.g., aquifers), and the surrounding landscape, which is largely agricultural land. Eight municipalities fall within the watershed boundaries.

The 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.


Lower Silver Creek Watershed Plan Project Area
HEARTLANDS CONSERVANCY
Pontoon Beach
Maryville
Troy
COLLINSVILLE
JARVIS
ST. JACOB
Collinsville
MADISON
ST. CLAIR
Fairmont City
Caseyville
CASEYVILLE
O'FALLON
LEBANON
SUGAR CREEK
Fairview Heights
O'Fallon
Lebanon
Summerfield
East St. Louis
Swansea
Shiloh
Scott AFB
Mascoutah
New Baden
MASCOUTAH
Belleville
Rentchler
SMITHTON
Freeburg
FREEBURG
ENGELMANN
NEW ATHENS
New Athens
CLINTON
INSET
MADISON
BOND
St. Louis
ST. CLAIR
CLINTON
MONROE
Legend
Watershed project area
County boundaries
Streams
Communities
0 1 2 4
Miles

The Lower Silver Creek Watershed

The Lower Silver Creek watershed is located 20 miles east and south of St. Louis, Missouri. The majority of the watershed lies within St. Clair County, Illinois, and small portions lie within Madison and Clinton counties. The watershed's 454 miles of streams drain roughly 126,000 acres of land. Silver Creek flows south from the project area to join the Kaskaskia River, which ultimately drains into the Mississippi River.

The Lower Silver 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 77,500 residents live in unincorporated areas where farming is the primary land use. Agricultural land makes up 63% of the watershed, with most of that land in row crop farming. Eight municipalities, thirteen townships, and three counties are located within the watershed.

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: Improve Surface Water Quality
GOAL 2: Reduce Flooding/Mitigate Flood Damage
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), and a 15% reduction in sediment loading (based on estimated impacts of proposed BMPs) 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 USEPA's Spreadsheet Tool for Estimating Pollutant Loads (STEPL), conducting an aerial assessment of stream and riparian conditions, field checks at stream sites, and stakeholder engagement. From this research, the following issues were identified:

Surface water issues

- **Primary Sources of Water Quality Impairment.** The primary causes of impairment identified by the IEPA to Silver Creek and its tributaries are phosphorus, sediment, and dissolved oxygen (DO).
- **Soil Erosion from Agricultural Land.** With 63% of the watershed in agricultural use, soil erosion is common, carrying nutrients and sediments from fields to waterways.
- **Soil Erosion from Streams.** Streambank and channel erosion contributes approximately 53% of the sediment loading.
- **Logjams.** Logjams contribute to soil erosion as stream flow acts to erode the stream channel.
- **Private Sewage and Animal Waste.** Poorly maintained private sewer systems and runoff of animal waste contribute bacteria such as *E. coli* to surface water.
- **Infiltration into sanitary sewers (de facto combined sewers).** Aging sanitary sewer infrastructure leaks cause sewer backups and combined sewer overflows, leading to higher water treatment costs.
- **Dumping and Littering.** Trash and debris is an issue in places where roads cross the creek and its tributaries.

Flooding issues

- **Prevalent Flooding.** Flooding is common both inside and outside of floodplains, with frequent damage to homes, businesses, and crops, and loss of road access.
- **Extensive Floodplain.** Almost 20% of the watershed is in the 100-year floodplain.
- **Flooding Outside of Floodplains.** The flatter, higher ground at the edges of the watershed experiences flash floods/urban flooding, often as a result of large areas of impervious surfaces, changes in local hydrology, and severe storm events. Lack of stormwater infrastructure, inadequate infrastructure, aging infrastructure, and inadequate maintenance of infrastructure contribute to the problem.

Land cover and development issues

- **Poorly Planned Development.** Population growth in the watershed will likely be accompanied by new development on agricultural land or forest. Many older developments did not include well-designed or adequate drainage infrastructure, which has exacerbated water quality and flooding issues.
- **Poor Aquifer Replenishment.** Replenishment of aquifers has declined as impervious surfaces increased.

Habitat issues

- **Invasive Species Present**. Invasive species crowd out native plants that protect streambanks from erosion.
- **Unprotected Habitat for Endangered Species.** Where their native habitat is not preserved as open space, endangered species cannot be expected to thrive over the long term.
- **Poor Riparian Conditions.** Approximately six miles of the riparian area, the area directly adjacent to streams on either side, is in "poor" ecological condition (Appendix A, p.78).

Organizational needs/issues

- **Need for Partnerships.** A network of partners is needed to improve water quality and flooding issues and implement this plan.
- **Need for Updated Operations.** Existing municipal, township, and county operations would benefit from changes that then become routine and long-lived.
- **Need for Funding.** Leveraging funding from government and other programs is needed to fully implement the plan and ensure landowners have ongoing support.

Information and outreach issues

- **Need for Communication.** More communication about funding and technical resources is needed between potential partners.
- **Lack of Access to Technical Resources and Funding.** There is a need to connect and assist potential partners, with technical resources and funding opportunities.
- **Need for Outreach to Key Stakeholders.** A large group of landowners and other key stakeholders working together is needed to achieve the goals of this plan.

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 degraded stream reaches (8.9 miles)
2. Critical Riparian Areas: Highly degraded riparian areas (14.1 miles)
3. Critical Wetland Areas: Areas suitable for wetland restoration (671 acres)

Implementation

Recommended actions, identified as Management Measures, that address the plan's goals, objectives, and targets are provided to partners.

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), and management procedures for these areas.
- 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 (e.g., planting street trees).
- Monitoring of water quality, flow, and stream health to help measure progress.
- Hydrologic/flood studies, to properly identify the floodplain and update floodplain maps.

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 created, such as a Stormwater Utility, which is dedicated to upgrades and maintenance of detention basins, ditches, and other conveyance structures.

Site-Specific Measures

Agricultural

- Animal waste storage/treatment systems, which reduce nutrient and bacteria pollution from livestock waste.
- Bioreactors, also known as denitrifying bioreactors, which are ditches filled with wood chips that contain denitrifying bacteria that remove nitrogen from water coming from tile drainage systems.
- Comprehensive Nutrient Management Plans, which lead to reduced nutrient pollution from livestock operations.
- 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, which lead to reduced nutrient pollution from land on which crops are grown.
- 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, adding street trees in the public right-of-way, or on private property, to help control stormwater runoff.

Streams and lakes

- 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, grade control structures (e.g. riffles and pools), and re-meandering where appropriate. These reduce erosion and can provide flood storage.

Measuring Success

Activities in the watershed plan will be assessed over time, to measure the success of the watershed plan and its implementation. A set of Progress Report Cards is included in Appendix F, and it includes milestones for short-term (one to 10 years; 2018-2028), medium-term (10 to 20 years; 2028-2038), and long-term (20+ years; 2038+) 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

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, including information on websites and social media;
- 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.

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SECTION 1: INTRODUCTION

Simply stated, a "watershed" is the area of land that drains into a common water body, 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 Lower Silver Creek watershed is a largely agricultural area in southwestern Illinois that drains to the Kaskaskia River (Figure 1). Rain falling on the watershed collects phosphorus and sediment on its way downhill to Silver Creek. Excessively high concentrations in Little Silver Creek, Loop Creek, and Ogles Creek earned them a place on the Illinois EPA 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 on roads in and near urban areas (i.e., "flash flooding").

Figure 1.Location of the Lower Silver Creek watershed in Illinois.

In 2016, HeartLands Conservancy received a grant from the IEPA to develop a Watershed Plan for the Lower Silver Creek watershed. A Watershed Plan is a strategy for managing watershed resources on public property, as well as providing a platform to encourage other watershed stakeholders (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.

Lower Silver Creek Watershed

The Lower Silver Creek watershed is located approximately 20 miles east of St. Louis, Missouri, in southwestern Illinois. The majority of the watershed is in St. Clair County, and small portions are in Madison (6,683 acres) and Clinton (835 acres) counties. The watershed's 454 miles of streams drain roughly 126,000 acres of land. Silver Creek flows south from the project area to join the Kaskaskia River, which ultimately drains into the Mississippi River.

The Lower Silver Creek watershed project area contains numerous subwatersheds, called HUC14s (Figure 2). "HUC" stands for Hydrologic Unit Code, a number that indicates the general location and size of the watershed.

Little Silver Creek, Loop Creek, Ogles Creek, and Engle Creek are major tributaries to Silver Creek in the watershed project area. Little Silver Creek drains the Village of Lebanon and the area to the northeast. Loop Creek drains the area south of Shiloh and east of Belleville. Ogles Creek drains parts of O'Fallon and Fairview Heights, and Engle Creek also drains a large portion of O'Fallon.

The watershed is home to approximately 77,568 people, the majority of which live in unincorporated areas where farming is the primary land use. Agricultural land makes up 63% of the watershed, with most of that land is in row crop farming.

All or portions of eight municipalities, thirteen townships, and three counties are located within the watershed (Table 1).

Table 1. Jurisdictions in the watershed.

Jurisdiction	**Area within watershed (acres)**
County (inclusive of municipalities)	124,331
St. Clair	116,814
Madison	6,683
Clinton	835
Municipalities	24,389
Belleville	1723
Fairview Heights	1391
Freeburg	2150
Lebanon	1584
Mascoutah	6178
O’Fallon	7443
Shiloh	3632
Summerfield	273
Census-designated Place	15
Rentchler	15
Unincorporated Areas	99,942
St. Clair County	92,425
Madison County	6,683
Clinton County	835
Townships	124,347
Jarvis	1,630
St. Jacob	6,436
Caseyville	3,371
O'Fallon	18,545
Lebanon	557
Sugar Creek	22,658
St. Clair	14,967
Belleville	6,186
Shiloh Valley	22,355
Mascoutah	18,948
Freeburg	1,733
Engelmann	6,149
New Athens	814
Scott Air Force Base	2,781

Purpose

The purpose of the Lower Silver Creek Watershed Plan is to promote a healthy, functioning watershed that sensitively balances farming, development, and natural ecosystems, including restoring surface water quality to streams 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.

Methodology

HeartLands Conservancy developed a watershed planning approach based on guidance from IEPA's Nonpoint Source Program, USEPA's nine elements of watershed planning, and other local and regional watershed plans. The process included the following components:

1. Watershed area data collection and analysis
2. Delineation of subwatersheds
3. Stakeholder engagement
4. Key issue identification and goal setting
5. Critical Areas identification
6. Management Measure and target development
7. Implementation Schedule development

Watershed Data Collection and Analysis

A Watershed Resource Inventory (Appendix A) was developed, which reviews the existing conditions within the watershed. The inventory documents existing conditions in Silver 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 U.S. Environmental Protection Agency (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 previously 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 (116 miles or 26% of the total stream miles in the watershed). Midwest Streams, a firm with expertise in stream health, viewed the videotapes to assess three parameters for each stream: streambank erosion, degree of channelization, and condition of the riparian area. Later, Midwest Streams followed up with field checks at 52 locations to collect bank height data for erosion calculations.

Detention basin survey

The project team looked at aerial photographs of the watershed, along with USGS topographic maps, an elevation dataset, and the National Hydrography Dataset (NHD), to identify detention and retention basins. A point was created for each basin located within 500 feet of a group of four or more buildings, to avoid classifying natural ponds as detention basins. Three hundred and ninety-four (394) detention or retention basins were identified in the watershed.

Delineation of subwatersheds

At the start of the process, the project area was already divided into six subwatersheds, or hydrologic units (HUCs), called HUC12s. To provide more detailed analysis and recommendations for the watershed, the HUC12s were further divided into 22 smaller HUC14 subwatersheds. The project team used USGS methodology for defining watersheds in the Watershed Boundary Dataset (WBD), a component of the NHD.

Throughout this plan, the term "subwatershed" refers to the HUC14 subwatershed level.

Planning inputs

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
Critical infrastructure
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
Open House Events
Stakeholder meetings

Community Partnership Group

Wetland area surrounding MidAmerica Airport.
Photo: HeartLands Conservancy

The Scott Air Force Base Community Partnership Group provided technical guidance on the watershed planning process. The group consisted of professionals in stormwater management, water quality, stream and soil health, conservation, and urban planning, representing municipalities, Scott Air Force Base, and other entities (Table 3).

The group helped to guide data collection and analysis, goal and target setting, and recommendations. Specifically, the group reviewed the aerial assessment methodology and results, the STEPL use, draft nutrient reduction targets and other targets, and milestones for Plan implementation. The group met four times during the planning period and provided comments on the draft Plan in a meeting, via email and one-on-one meetings, and Open Houses.

Table 3. Community Partnership Group members. Not all representatives attended each meeting.

Entity	**Representative(s)**
Scott Air Force Base	Water Program Manager, Planner, and others
MidAmerica Airport	Airport Engineer, Director of Engineering and Planning
U.S. Army Corps of Engineers	Strategic Planning Coordinator, Plan Formulator, Project Manager
East-West Gateway Council of Governments	Director of Community Planning
HeartLands Conservancy	President & CEO, Project Manager, Associate Planner
City of Belleville	Planner & GIS Coordinator, Director of Economic Development, Planning & Zoning
City of Fairview Heights	Director of Public Works, Director of Land Use & Development
Village of Freeburg	Village Administrator
City of Lebanon	Mayor
City of Mascoutah	City Manager
City of O'Fallon	Community Development Director
Village of Shiloh	Village Administrator, Director of Public Works
Village of Summerfield	Mayor pro tem
St. Clair County	Floodplain Manager, County Engineer
St. Clair County Board	District 19 Board Member
St. Clair County Soil and Water Conservation District	Board Member
Madison County Planning & Development	Stormwater Coordinator
USDA - Wildlife Services	Biological Science Technician
U.S. Fish and Wildlife Service	Fish Biologist
CDI, Inc.	Water Resources Group Leader, Business Development Manager
Midwest Streams	President
National Great Rivers Research & Education Center	Watershed Scientist

MS4 Co-Permittee Group, St. Clair County

Several communities in the watershed are members of the St. Clair County Municipal Separate Storm Sewer Systems (MS4) group. Engineering firm RJN Group acts on behalf of the county as the Coordinator for the MS4 Co-Permittee Group, which consists of 22 communities (including the county itself). The eight MS4 members within the Lower Silver Creek watershed are shown in Table 2. The group works together to help the individual communities and townships meet the 6 minimum control measures of their ILR40 permits.

Table 2.Municipal Separate Storm Sewer System (MS4) Co-Permittee Group members in the Lower Silver Creek watershed.

County
St. Clair County
Municipalities
City of Belleville
City of Fairview Heights
City of O'Fallon
Village of Shiloh
Townships
Caseyville Township
O'Fallon Township
St. Clair Township

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.

Stakeholder Engagement

Early on and throughout the planning process, the planning team interviewed numerous stakeholders including the St. Clair County Soil and Water Conservation District and seven of the eight municipalities in the watershed. Two Open House events were also used to gather input and get feedback from the general public. 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.

Key Issue Identification and Goal Setting

Using the results of the stakeholder outreach process, the project team 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 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)

The National Great Rivers Research and Education Center (NGRREC) 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 Community Partnership Group reviewed these numbers to set targets for pollutant load reduction in the watershed.

Agricultural Conservation Planning Framework (ACPF)

HeartLands Conservancy and NGRREC used the ACPF, a set of GIS tools developed by the USDA to identify locations where certain BMPs (such as terraces and 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. The Lower Silver Creek watershed is one of the first watersheds in the State of Illinois to make use of the ACPF for planning purposes (perhaps the second watershed after the Upper Silver Creek watershed).

Implementation Schedule

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

Water quality monitoring

NGRREC staff collected existing water quality monitoring data for the watershed (from ISGS, IEPA, and other sources), and created a monitoring plan for the coming years (Appendix D).

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 4). These goals address the issues identified in the Watershed Resources Inventory 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 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 4.Goals and objectives of the Watershed Plan.

Goals	Objectives
Improve Surface Water Quality	• Decrease pollutant loading to Silver Creek and its tributaries. • Reduce phosphorus by 25% by 2030. • Reduce sediment by 15% by 2030. • Reduce nitrogen by 15% by 2030. • Maintain DO levels above standard minimums. • Create a private sewage assessment strategy. • Monitor water quality and identify trends. • Increase awareness of consequences of littering/illegal dumping.
Reduce Flooding/Mitigate Flood Damage	• Increase stormwater captured, stored, and infiltrated. • Limit development in the 100-year floodplain. • 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.
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.
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	• Formalize 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 in watershed matters. • Develop public recognition programs focused on the watershed plan’s goals.

GOAL 1: IMPROVE SURFACE WATER QUALITY

This plan aims to improve surface water quality in the Lower Silver Creek watershed, so that the streams can be safely used by residents, and to remove Little Silver Creek, Loop Creek, and Ogles Creek from IEPA's 303(d) list of impaired waters.

The Lower Silver Creek watershed receives excessive phosphorus and sediment. High levels of these pollutants, and low levels of dissolved oxygen in Little Silver Creek, earned Little Silver Creek, Loop Creek, and Ogles Creek a place on the Illinois EPA 303(d) list of impaired waters for several successive years. (Lower Silver Creek itself was assessed as "fully supporting" aquatic life and aesthetic quality in 2016). For this plan, numerical reductions for impairments in the watershed are based on modeled pollution data, historical monitoring data, and the Illinois Nutrient Loss Reduction Strategy. The main water quality parameters of concern are sediment, phosphorus, and DO. The Watershed Impairment Reduction Targets table on page 27(Table 5) provides details on the sources of these reduction targets.

Water Quality Objectives:

1.1 *Decrease overall pollutant loading to Silver Creek and its tributaries, and remove Little Silver Creek, Loop Creek, and Ogles Creek from the Illinois EPA 303(d) list of impaired waters.*

1.2 *Achieve a 25% reduction in phosphorus from 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.)*

1.3 *Achieve a 15% reduction in sediment from the watershed by 2030. (i.e., a 15% reduction in the annual sediment load, based on estimates from a suite of BMPs that also address the needed phosphorus reduction.)*

1.4 *Achieve a 15% reduction in nitrogen from 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.)*

1.5 *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). These standards are as follows: 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.*

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

1.7 *Monitor the Lower Silver Creek watershed's water quality to identify trends and evaluate the success of watershed management activities.*

GOAL 2: 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 Lower Silver Creek 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:

2.1 *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.*

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

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

2.4 *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.*

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

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

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, those with highly erodible soils, forested lands adjacent to waterways (riparian areas), and steep slopes.

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 update 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, protect, and restore 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 Formalize a network of partners dedicated to implementing the watershed plan and other water quality and stormwater management issues in the watershed and 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 Impairment Reduction Targets for nutrients in this Watershed Plan are based on the Illinois Nutrient Loss Reduction Strategy, published by IEPA in 2015. The Strategy describes a comprehensive suite of Best Management Practices (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 uses these reduction targets but extends the deadline to 2030, and adds a target of a 15% reduction in sediment (Table 5). The estimated reduction in phosphorus and nitrogen loads based on the BMPs recommended in this plan exceeds the 25% targets, because the Management Measures recommended to meet the 15% reduction in sediment reduced those nutrient loads by a greater proportion.

Additional watershed-wide impairment reduction targets were established for dissolved oxygen, flood damage, habitat degradation, wetlands, surface water infiltration, and private sewage (Table 5).

Table 5.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	166,316lbs/year of phosphorus loading, based on STEPL model. Phosphorus is a 303(d) listed impairment for Little Silver Creek, Loop Creek, and Ogles Creek for 2016.	**25%** or 41,579lbs/year reduction in phosphorus loading by 2030, based on the Illinois Nutrient Loss Reduction Strategy	11,087 lbs/year reduction from Critical Stream Reaches and other poor condition stream reaches 4,633 lbs/year reduction from Critical Riparian Areas and other riparian areas 494 lbs/year reduction from Critical Wetland Areas 29,132 lbs/year reduction from other agricultural areas 1,522 lbs/year reduction from urban and forested areas
TOTAL			**50,889 lbs/year or 30.6% total phosphorus reduction**
Water Quality/Aquatic Life: Sediment	64,483 tons/year of sediment loading, based on STEPL model Sedimentation/siltation is a 303(d) listed impairment for Little Silver Creek and Loop Creek for 2016.	**15%** or 9,672 tons/year reduction in sediment loading by 2030, based on estimated impacts of proposed BMPs. Similar target to phosphorus; sediment is its primary transport mechanism.	2,278 tons/year reduction from Critical Stream Reaches and other poor condition stream reaches 1,085 tons/year reduction from Critical Riparian Areas and other riparian areas 166 tons/year reduction from Critical Wetland Areas 4,228 tons/year reduction from other agricultural areas 407 tons/year reduction from urban and forested areas
TOTAL			**9,815 tons/year or 15.2% total sediment reduction**
Water Quality/Aquatic Life: Nitrogen	775,661 lbs/year of nitrogen loading, based on STEPL model	**15%** or 116,349 lbs/year reduction in nitrogen loading by 2030, based on the Illinois Nutrient Loss Reduction Strategy	49,202 lbs/year reduction from Critical Stream Reaches and other poor condition stream reaches 18,139 lbs/year reduction from Critical Riparian Areas and other riparian areas 996 lbs/year reduction from Critical Wetland Areas 179,516 lbs/year reduction from other agricultural areas 7,047 lbs/year reduction from urban and forested areas
TOTAL			**268,353 lbs/year or 34.6% total nitrogen reduction**
Water Quality/Aquatic Life: Dissolved Oxygen	Minimum 3.4 mg/L (median 7.8 mg/L) dissolved oxygen, based on samples collected from Silver Creek between 1972 and 1997 by the Illinois Water Science Center and IEPA. Dissolved oxygen is a 303(d) listed impairment for Little Silver Creek for 2016.	**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).	228,254 feet streambank and channel restoration, including riffle pools and other structures that increase re-aeration (33% of all streams with high streambank erosion) 464acres (201,960 feet) of moderate or poor condition riparian areas ecologically restored, including 100% 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 200 cfu/100ml fecal coliform concentrations, based on samples collected from Silver Creek (1972-2011, Illinois Water Science Center and IEPA)	**Private sewage assessment strategy** created, identifying improvements and connection opportunities	Reductions following maintenance and replacement as a result of private sewage inspections, and tap-ons to municipal wastewater systems Reductions following improved manure application and livestock waste management systems installation
Flood Damage: Flooding inside and outside floodplain	Flood damage and road closures reported by municipalities, residents, and others both inside and outside the 100-year floodplain.	**100 acres dry detention basins** installed **100 acres wet detention basins** installed **Retrofits & maintenance** of existing detention basins	100 acres dry detention basins installed 100 acres wet detention basins installed Retrofits and maintenance on 67 existing detention basins (assumed 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	There are 14.1 miles of Critical Riparian Area, including 6 miles of riparian areas in poor condition per the aerial assessment, and 8.4 miles identified as Critical Zones by the ACPF Riparian Function Assessment tool (there is some overlap).	**100% Critical Riparian Areas** restored **Other riparian areas in moderate condition** restored	464 acres (201,960 feet) of moderate or poor condition riparian areas ecologically restored, including 100% Critical Riparian Areas 500 feet of stream 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	671 acres (100%) Critical Wetlands Areas restored
Reduced infiltration to groundwater	Current 2.8% impervious cover; current 9,732 acres developed open space (2011 NLCD) or 2,695 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 10,000 trees planted in urban areas
Fecal coliform: Private sewage	Over 3,000 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 coordination for private sewage, beyond complaint-based assessment

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.37).

__Surface water quality__

Issue: IEPA Primary Sources of Impairment. The primary sources of impairment to streams in the watershed listed on the IEPA 303(d) list are: agriculture, crop production (crop land or dry land), streambank modifications/destabilization, municipal point source discharges (storm sewers), and urban runoff/storm sewers. Fertilizers and erosion on crop land contribute to significant phosphorus and sediment loading. The 2015 Illinois Nutrient Loss Reduction Strategy identified the need for statewide reductions in nutrient pollution (including phosphorus) in Illinois waterways. Wetlands, which act as natural filters and remove nutrients and other pollutants, were once widespread in the watershed but are now scarce. Over 600 acres of Critical Wetland Areas have been identified in the watershed, in locations which are highly suitable for restoration/construction of wetlands (see p.38).

Objectives addressing this issue:
♦ Decrease pollutant loading to Silver Creek and its tributaries.
♦ Reduce phosphorus by 25% by 2030.
♦ Reduce sediment by 15% by 2030.
♦ Reduce nitrogen by15% by 2030.
♦ Maintain DO levels above standard minimums.
♦ Monitor water quality and identify trends.

Additional surface water issues reported by municipalities include bad odor in a stream near suspected failing private sewage systems, and litter and dumping in and near streams. Water quality monitoring at two locations on Ogles Creek in 2017, required for St. Clair County's MS4 reporting, showed high fecal coliform levels. Point sources of pollution come from nine facilities that require a NPDES permit discharging wastewater into the watershed. Table 5 lists the known water quality impairments in the watershed and their associated causes and sources. Municipalities in the watershed use purchased surface water from Illinois American Water (for O'Fallon, Shiloh, Belleville, and Scott Air Force Base) and Summerfield-Mascoutah-Lebanon (SLM) (for Summerfield, Mascoutah, Lebanon, Freeburg, and the MidAmerica Airport). Illinois American Water draws its water from the Mississippi River, while SLM draws from the Kaskaskia River.

Issue: Soil Erosion from Agricultural Land. Because 63% of the watershed is agricultural (and most is row crops), farming practices factor significantly in the amount and type of pollutants reaching the waterways. An estimated 37% of sediment and 74% of phosphorus in the watershed comes from cropland (see Appendix A, p.123). According to the 2015 Illinois Department of Agriculture Soil Conservation Survey, St. Clair County farmers used some form of conservation tillage on more than 98% of corn fields and nearly 100% of soybean fields. Conservation tillage (reduced tillage) and no-till practices contribute significantly less sediment and nutrients than traditional tillage. However, tillage is not the only source of soil erosion on agricultural land. Municipalities and residents identified instances where row crops are consistently planted up to the edge of fields and into drainage ditches, leading to greater soil erosion and widening the ditch.

Objectives addressing this issue:
♦Reduce sediment by 20% by 2030.

Many farmers in the watershed have adopted glyphosate-resistant crops. When spraying these crops with the herbicide, overspray onto adjacent ditches can occur. Plant cover is frequently absent along the steep slopes of road ditches, which increases erosion and sedimentation in both the ditch and downstream and contributes to flooding. Similarly, urban ditches are contributing sediment to waterways when mowers are set too low, scraping up the dirt and vegetation in the ditch. This sediment and vegetation debris accumulates in the ditches, creating dams and leading to flooding. Glyphosate is occasionally used intentionally to kill vegetation in ditches, which encourages the growth of weedy plants and invasives (e.g., poison hemlock, giant ragweed, and Johnson grass) and increases erosion.

Table 6.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
Water Quality - Aquatic Life	**Nutrients**: Phosphorus (known impairment) and Nitrogen (potential impairment)	Streambank and channel erosion; Agricultural row crop runoff; Failing private sewage systems; Wastewater treatment plants; Lawn fertilizer; Level of landowner education; Livestock operations (manure)	1
Water Quality - Aquatic Life	**Sediment**: Total Suspended Solids / Turbidity (known impairment)	Streambank and channel erosion; Agricultural row crop runoff; Construction sites; Livestock operations (manure)	1
Water Quality - Aquatic Life	Low **dissolved oxygen** (known impairment)	Heated stormwater runoff from urban areas; Lack of natural riffles in streams (incl. channelized streams)	1
Water Quality - Aquatic Life	**Fecal coliform** (potential impairment)	Failing private sewage systems; Livestock operations (manure); Wastewater treatment plants	1
Habitat Degradation	**Invasive/non-native plant species** and **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 and riparian buffer loss	3, 4, 5
Flood Impacts	**Encroachment in 100-year floodplain** (known impairment)	Channelized streams; Agricultural drain tiles; Wetland and riparian buffer loss; Logjams and other obstructions in streams; Existing and future urban impervious surfaces;	2, 3, 5
Flood Impacts	**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	2, 5

Objectives addressing this issue:
♦ Reduce sediment by 15% by 2030.

Severe streambank erosion on Silver Creek near Troy, spring 2014. Photo: HeartLands Conservancy

Issue: Soil Erosion from Streams. 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. Sixty-two miles of streams assessed in the watershed had high streambank erosion (including Critical Stream Reaches, which had high streambank erosion and high channelization – see p.37). An additional 45 miles of streams assessed had moderate streambank erosion. Streambanks contribute an estimated 53% of sediment in the watershed to streams (see Appendix A, p.123). 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. Several municipalities highlighted soil erosion issues within their municipal boundaries along creeks and ditches. O'Fallon noted that its streams are getting wider but not deeper, as the water reaches shale bedrock on the streambed. Summerfield and Belleville identified areas of high streambank erosion where trees have been cut down next to streams to expand row crop agriculture, causing the streambanks to collapse and the creeks to widen. Southwestern Illinois College (SWIC)-Belleville identified high erosion areas on the southwest side of its campus. Several Open House attendees also reported erosion on their properties from widening ditches, tributaries, and creeks.

Objectives addressing this issue:
♦ Reduce sediment by 15% by 2030.

Logjam in the Silver Creek watershed, summer 2014. Photo: NGRREC

Issue: Logjams. Streambank erosion is also exacerbated by logjams, which are woody vegetation and/or other debris which obstructs a stream channel and backs up stream water. 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 in the Silver Creek corridor increase flooding upstream, causing roads to be covered with water in the City of Lebanon (e.g., Highway 50, a major route into the city). 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. Changes in forest tree species composition can also increase logjams; in the forest east of Scott Air Force Base, several older bottomland hardwood trees are dying and falling into the floodplain and creek at the same time. Several stakeholders identified beavers as a cause of logjams along Silver Creek.

Objectives addressing this issue:
♦Create a private sewage assessment strategy.

Issue: Contamination from Private Sewage and Animal Waste. Large spikes in fecal coliform levels have occurred at monitoring gauges on Silver Creek between 1979 and 1997. The watershed likely has over 3,000 private sewage systems (i.e., septic systems), most of which are in the unincorporated area. USEPA uses a figure from the U.S. Census Bureau that at least 10% of septic systems nationwide have stopped working. Madison County officials estimate that the failure rate in the area is actually much higher (up to 90% in older developments). Municipalities and Open House attendees reported occurrences of and bad odors from failing systems.

The St. Clair County Health Department reports that a lack of access to municipal sewer systems is the major sewer issue for the county. There are several areas in the watershed where older development has small lots, inadequate private sewer systems, and no easy way to connect to a public system. New residential development located within 300 feet of an existing public system is required by the county to connect to that system; for commercial development (including some subdivisions), that distance is 1,000 feet. For existing development, there is no such requirement unless the private sewer system fails. And many older private systems are physically too far from a public system to make connecting cost-effective. St. Clair County used to have grants to assist with connection to public sewers, but funding has been reduced or eliminated. Funding to assist in connecting older development to public sewer, and to help maintain private sewer systems, would be beneficial.

Waste from livestock and other animal feeding operations (AFOs) can also contribute nutrients and bacteria to surface water. Private sewage and animal waste are considered point sources of pollution that emanate from specific locations. Municipal wastewater is largely treated at facilities within the watershed, and residents are encouraged to tap on to municipal sewer lines when feasible.

Issue: Infiltration into Sanitary Sewers (De Facto Combined Sewers)

All of the municipalities in the watershed have separate storm and sanitary sewer systems. (The City of Belleville does have combined sewers, but these are located outside the watershed.) However, several municipalities report that aging 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 results in property damage, raw sewage draining into surface water, and increased costs of cleanup and sewage treatment for municipalities.

Objectives addressing this issue:
♦Decrease pollutant loading to Silver Creek and its tributaries.
♦Promote ongoing maintenance of stormwater storage and conveyance infrastructure.

Issue: Dumping and Littering. Trash and debris is an issue in places where roads cross Silver Creek and its tributaries. People throwing trash out of car windows or dumping unwanted or hazardous materials leads to debris deposits that are eyesores, harm fish and wildlife, and create 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 Silver Creek and its tributaries.
♦Increase awareness of consequences of littering/illegal dumping.

Flooding

Issue: Prevalent Flooding. Flooding is highly prevalent in the Lower Silver Creek watershed, both inside and outside of floodplains, and in rural and urban areas. Urban flooding was probably the most important issue to the municipalities interviewed; all of them had experienced at least some flooding in developed areas or on roads. Open House attendees reported flooding on their properties and on the roads around them. Some floods occur as a result of backup from the Kaskaskia River; when river levels are high, the water from Silver Creek has nowhere to go and causes stream levels to rise.

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

Issue: Extensive Floodplain. FEMA has identified almost 20% of the watershed as 100-year floodplain. This area is almost entirely riverine floodplain around Silver Creek and its larger tributaries. Over time, the floodplain surrounding Silver Creek has filled with sediment in some places, for example, where I-64 and Route 50 cross Silver Creek. This has caused a reduction in flood storage and extended the reach of floodwaters. All of the municipalities in the watershed are enrolled in the National Flood Insurance Program, as are St. Clair, Madison, and Clinton counties.

Objectives addressing this issue:
♦Limit development in the 100-year floodplain.
♦ Preserve the natural flow of streams and slow peak stream flow.
♦ Provide information about flood damage prevention and insurance.

Issue: Flooding Outside of Floodplains. The area outside the floodplain is impacted by flash floods/urban flooding from time to time. This flooding is a result of increased impervious surfaces (e.g., pavement and roofs in developed areas), changes in local hydrology (such as ditches installed or filled in), and severe storm events with heavy rainfall. Lack of stormwater infrastructure, inadequate infrastructure (such as undersized culverts), aging infrastructure, and inadequate maintenance of infrastructure all contribute to the issue of flooding outside of floodplains.

Objectives addressing this issue:
♦Institute development standards that minimize impervious surfaces.
♦Promote ongoing maintenance of stormwater storage and conveyance infrastructure.

Land Cover and Development

Issue: Poorly Planned Development. 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 2007-2012. The population in the watershed is also projected to increase (slowly) over the next few decades. New development will likely occur within and around municipalities in the watershed, consuming as much as 19,000 acres of farmland and 5,000 acres of forest. New impervious surfaces will compound the problems of flooding, lack of infiltration, and poor water quality. Without changes in policy to encourage greater detention and green infrastructure, local flash flooding will pose significant risks to both new

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.

and existing development and infrastructure. Municipalities in the watershed need stronger policies to maintain stormwater infrastructure, protect steep slopes, and preserve native vegetation as development occurs.

Issue: Poor Aquifer Replenishment. The water table is very shallow over much of the watershed, and rainfall slowly replenishes groundwater supplies removed by people or evapotranspiration. However, replenishment of aquifers has declined as impervious surfaces have increased in area. Continued development outside municipalities has added impervious surface which does not allow infiltration and replenishment of the water table. Future development is likely to continue this trend.

Objectives addressing this issue:
♦Work with municipalities to amend policies and regulations to include conservation, native landscaping, stormwater management, and low-impact design.
♦Prioritize "green" stormwater management approaches.

Additionally, conventional row crop agriculture results in less infiltration of rainwater compared to conservation and no-till farming practices due to the destruction of natural soil structure. The Illinois State Geological Survey has documented 1,217 water wells in the watershed, including industrial and commercial wells and wells. Reductions to aquifer replenishment may become an issue for the businesses and private residences that use wells for their drinking water supply and other purposes. No wellhead protection plan is known to be in place in the watershed.

Habitat

Issue: Invasive Species. Invasive species, such as bush honeysuckle, Phragmites, tree-of-heaven, Bradford Pear trees, and garlic mustard 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 6 for causes and sources associated with habitat degradation.

Objectives addressing this issue:
♦Create an invasive species removal strategy.
♦Work with municipalities to update 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: Threatened and Endangered Species. The Indiana Bat, a federally endangered species, has been observed in the forest at Scott Air Force Base. Two state-listed endangered bird species were also observed: the Snowy Egret and the Little Blue Heron. Eleven other species federally listed as endangered, threatened, or proposed as threatened may be present in the watershed. Removing invasive species, restoring wetlands, and protecting native habitat around streams will help provide habitat and food sources 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.

Issue: Poor Riparian Conditions. The forested corridor (or riparian area) along Silver Creek 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 gaps, which discourage nest predators such as raccoons, opossums, skunks, and cowbirds. Approximately 6 miles of the riparian area along streams is in “poor” ecological condition (Appendix A, p.78). Over 12 miles of streams were identified as Critical Riparian Areas (see p.37).

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: Poor Macroinvertebrate Diversity. The quality and diversity of macroinverterbate populations indicates the health of the ecosystem and quality of water for human consumption. Macroinvertebrates (animals without a backbone that are large enough to be viewed through a microscope) are an important part of the aquatic food chain and serve as indicators of stream health. Monitoring of macroinvertebrate populations within the Lower Silver Creek watershed indicate very poor to fair conditions over time, and the watershed lacks diversity of macroinvertebrate populations.

Objectives addressing this issue:
♦ Monitor fish and aquatic macroinvertebrate communities.

__**Organizational needs/issues**__

Issue: Lack of Coordination/Partnerships. 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. The Scott AFB Community Partnership Program is a great starting point.

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

Issue: Need for Updated Operations. The plan can be most effective when its goals, strategies, and recommendations are integrated into the operations of partner organizations. When an organization or community has made a commitment to the plan by adding its recommended Best Management Practices (BMPs) to its operations schedules and budgets, those BMPs become much easier to implement. St. Clair County’s MS4 program is a good source of information about stormwater BMPs. Maintenance agreements are an indispensable tool to help municipalities, Homeowners Associations, and others with the operation and maintenance of stormwater infrastructure. A detailed maintenance agreement lays out the responsibilities of the parties involved in maintaining a functioning drainage system.

Objectives addressing this issue:
♦ Identify opportunities to assist stakeholders with watershed management.

Street sweeping is an important municipal operation that improves the water quality of urban runoff. It is not included in this plan as a separate Management Measure; the MS4 municipalities in the watershed already conduct regular street sweeping. Townships that do street sweeping on oil and chip roads in the watershed are able to reclaim the excess rock swept up and reuse it the next time the roads are oiled.

Issue: Need for Funding. 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), 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.

<u>Information and Outreach</u>

Issue: Need for Communication. Public engagement and education on water quality and flooding issues and solutions can greatly increase the progress towards watershed improvement. Communication to and between stakeholders and the general public helps increase buy-in and connects people with technical resources to protect the watershed.

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

Issue: Lack of Access to Technical Resources and Funding. The public engagement process also revealed that many land owners in the watershed want to help. Many 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 within city limits.

Objectives addressing this issue:
♦ 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. Critical Stream Reaches - Highly degraded stream reaches (8.9 miles);
2. Critical Riparian Areas - Highly degraded riparian areas (14.1 miles); and
3. Critical Wetland Areas - Areas suitable for wetland restoration (671 acres).

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; as well as through information collected during stakeholder engagement. The Agricultural Conservation Planning Framework (ACPF), a Geographic Information Systems (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. **8.9 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 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 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 B).

Along the stream corridors, **14.1 miles** were identified as Critical Riparian Areas. Revegetation of these areas with appropriate native trees and vegetation and removal of invasive species in these areas 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, include:

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; and
2) Areas identified as having a high restoration rank (8 to 13 on a scale of -2 to 13) from the Missouri Resource Assessment Partnership (MoRAP) assessment of wetland importance.

Because the ACPF tool is directed at agricultural land, the nutrient removal wetlands output by the model are all in agricultural fields. They also tended to be large areas (greater than 1 acre each).

The MoRAP wetland restoration assessment used hydric soils and proximity to existing wetlands as criteria for its algorithms, so the areas with high restoration rank values are largely in or close to stream corridors. The MoRAP-generated wetland areas tended to be much smaller areas (less than a tenth of an acre in size), but several such areas were often close together. They are difficult to see on the maps on the following pages because they are so small in size. Also, the MoRAP assessment area only covered the northern end of the Lower Silver Creek watershed - approximately down to Scott Air Force Base as its southern boundary - so there are more Critical Wetland Areas identified in the northern end of the watershed.

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 **671 acres** of Critical Wetland Areas in the watershed.

All of the Critical Areas identified in the watershed are shown in Figure 4. Pages 40 to 83 show the Critical Areas in more detail in each HUC14 subwatershed. Each individual type of Critical Area is shown in maps in Appendix B, with more information about the sources of data behind the selection of Critical Area locations.

The planning team expected to see more overlap between Critical Stream Reaches, Riparian Areas, and Logjams, but these areas are largely geographically separate. This illustrates the conservative nature of the assessments used to find these areas—stringent criteria used to identify each type of Critical Area that created very narrowly defined/small areas of each. It is important to note that a measure taken to address one of these problems, such as streambank restoration, will likely address logjam issues and improve riparian conditions as well.

Critical Areas

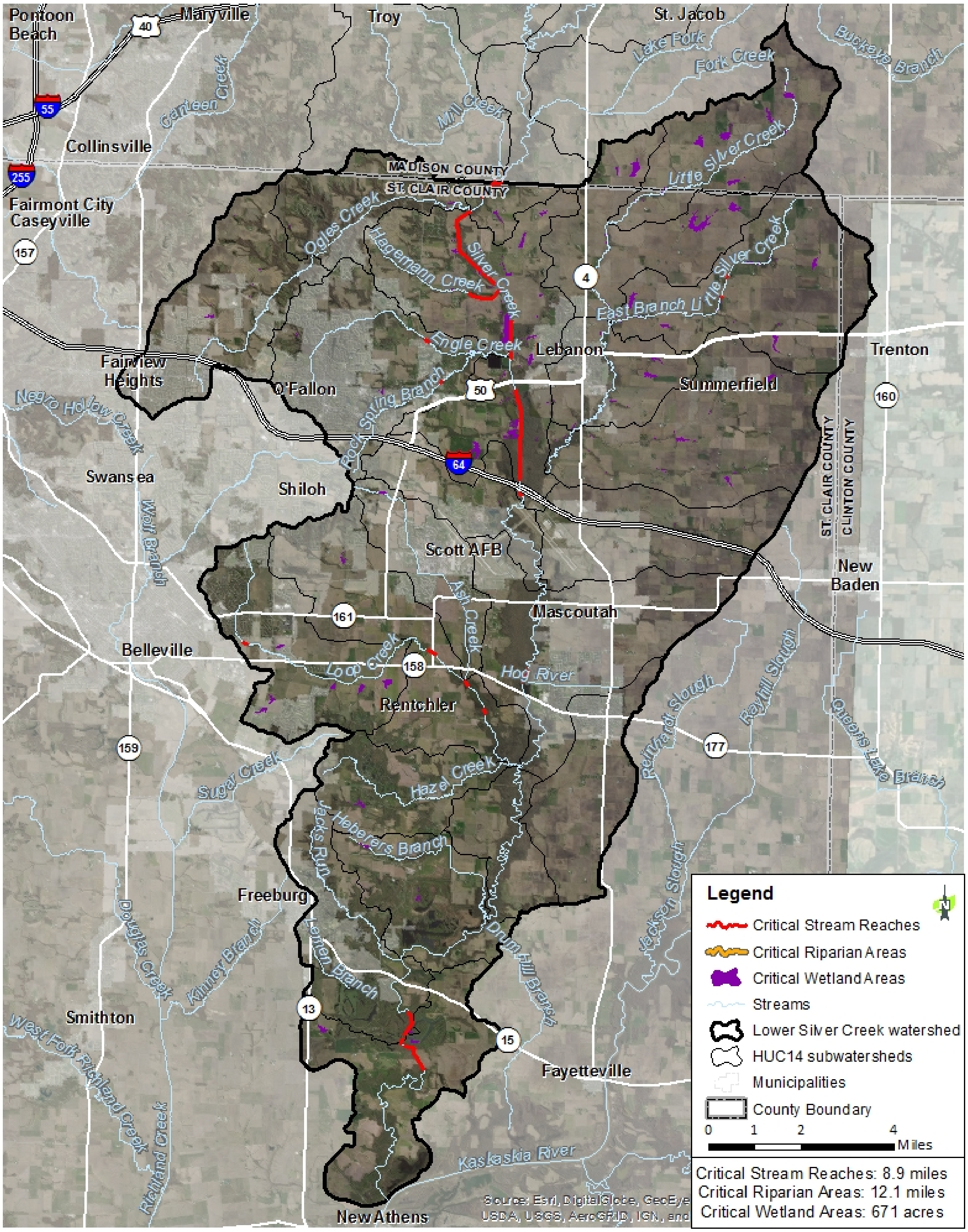


Figure 4. Critical Areas for stream reaches, riparian areas, and wetlands. See Appendix B for maps of each individual Critical Area type.

HUC 071402040507**01: Upper Ogles Creek**(Fairview Heights area)

This subwatershed is a long, rectangular-shaped drainage area in the northwestern portion of the Lower Silver Creek watershed, draining the upper portion of Ogles Creek. It extends approximately from the Madison-St. Clair county line in the north to south of I-64 in Fairview Heights to the south. It is located entirely in St. Clair County.

Area: 6,611 acres
Named streams: Ogles Creek
Counties: St. Clair
Municipalities: O'Fallon and Fairview Heights
Townships: Caseyville, O'Fallon

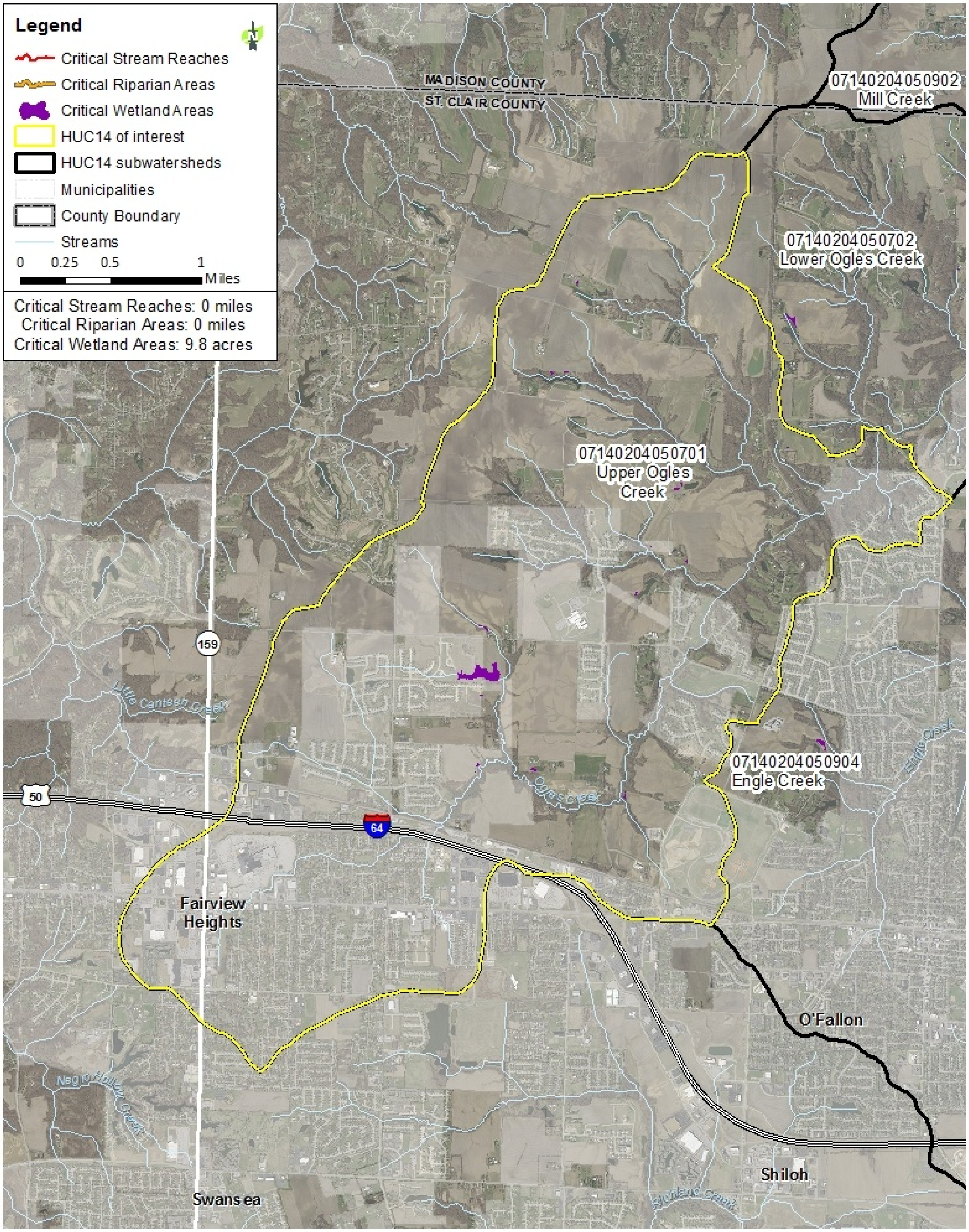
Critical Stream Reaches: No Critical Stream Reaches were identified in this subwatershed.

Critical Riparian Areas: No Critical Riparian Areas were identified in this subwatershed.

Critical Wetland Areas: A 9.8-acre Critical Wetland Areas as identified at the east end of Savannah Hill Trail off Savannah Hills Blvd in northern Fairview Heights.

No **flooding locations** were **identified by stakeholders** in this subwatershed.

HUC 07140204050701 - Upper Ogles Creek



HUC 071402040507**02**: **Lower Ogles Creek** (north of O'Fallon)

This subwatershed drains the lower portion of Ogles Creek and flows into Silver Creek just south of the Madison-St. Clair county line. It extends from just above the Madison County line down into St. Clair County and includes a portion of the City of O'Fallon.

Area: 3,745 acres
Named streams: Ogles Creek
Counties: Madison and St. Clair
Municipalities: O'Fallon
Townships: Caseyville, Jarvis, O'Fallon

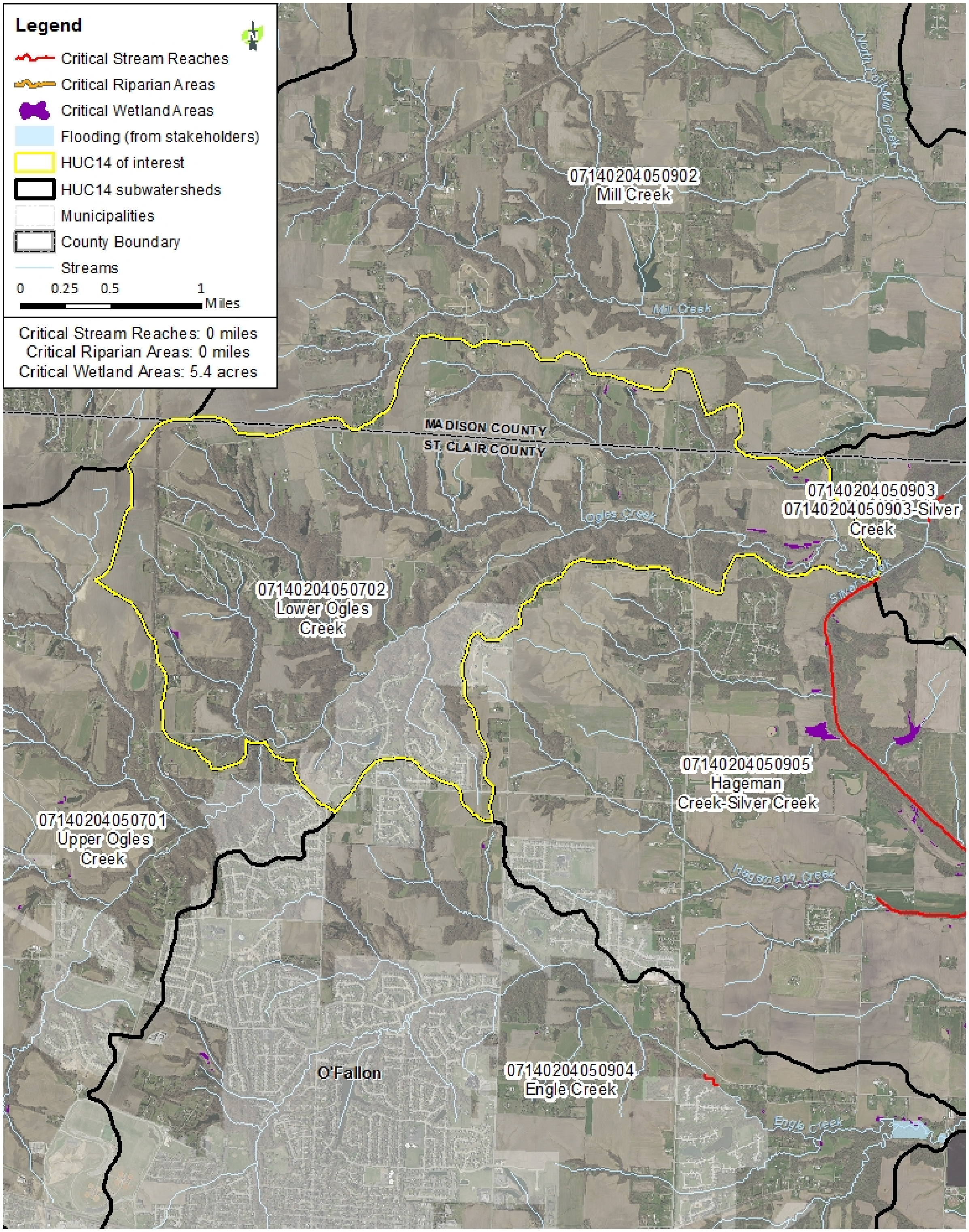
Critical Stream Reaches: No Critical Stream Reaches were identified in this subwatershed.

Critical Riparian Areas: No Critical Riparian Areas were identified in this subwatershed.

Critical Wetland Areas: 5.4 acres of Critical Wetland Area were identified at 17 locations in the watershed, most of which are in the Silver Creek corridor.

No **flooding locations** were **identified by stakeholders** in this subwatershed.

HUC 07140204050702 - Lower Ogles Creek



HUC 071402040508 01:07140204050801-Little Silver Creek

This subwatershed drains the upper portion of Little Silver Creek in the northeastern corner of the Lower Silver Creek watershed. It is primarily located in Madison County, but extends slightly into St. Clair County.

Area: 5,765 acres
Named streams: Little Silver Creek
Counties: Madison and St. Clair
Municipalities: None
Townships: Lebanon, St. Jacob

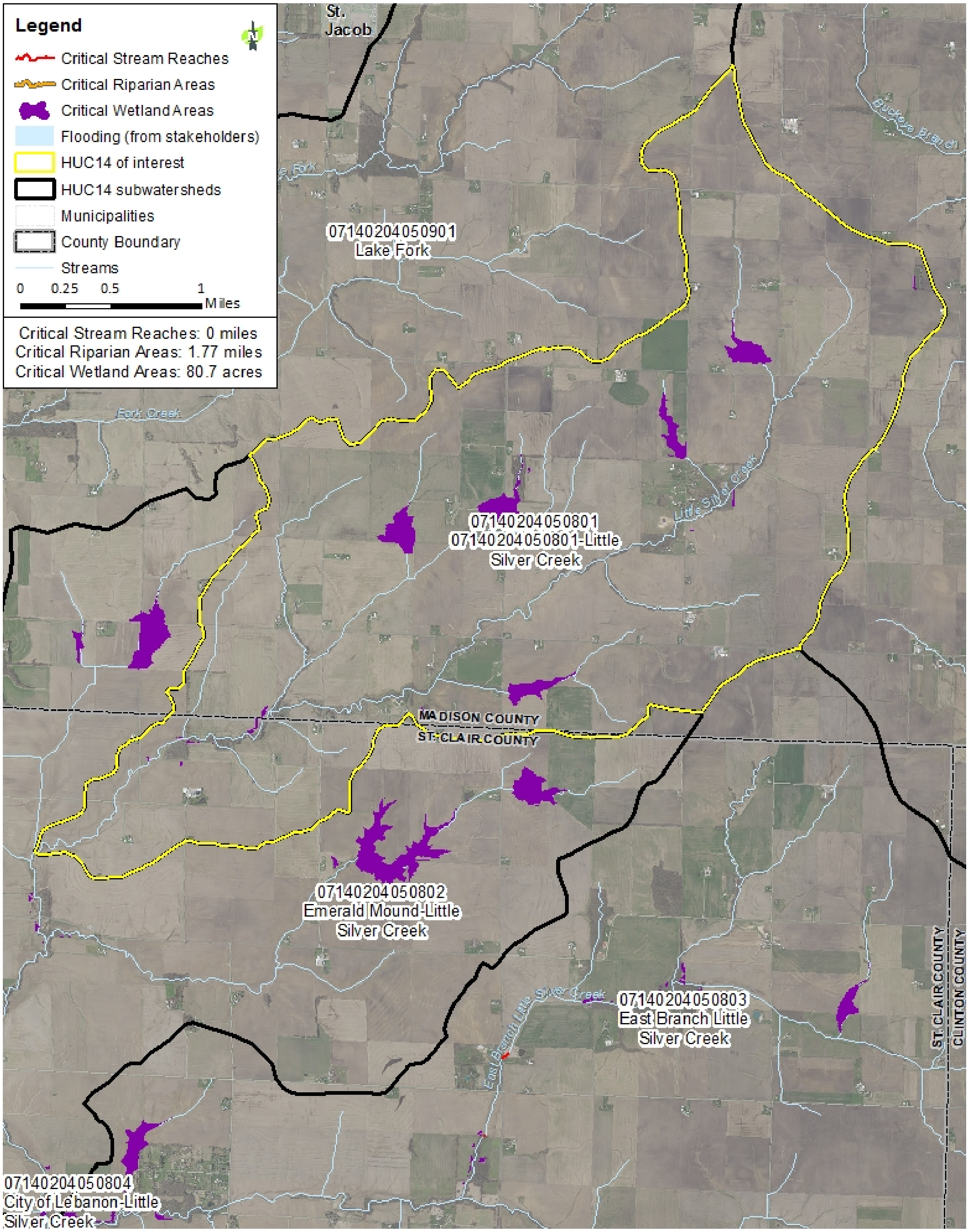
Critical Stream Reaches: No Critical Stream Reaches were identified in this subwatershed.

Critical Riparian Areas: 9,346 feet (1.77 miles) of Critical Riparian Areas were identified along Little Silver Creek.

Critical Wetland Areas: 80.7 acres of Critical Wetland Areas were identified in five locations on tributaries to Little Silver Creek.

No **flooding locations** were **identified by stakeholders** in this subwatershed.

HUC 07140204050801 - 07140204050801-Little Silver Creek



HUC 07140204050802: **Emerald Mound-Little Silver Creek** (north of Lebanon)

This v-shaped subwatershed in the northeast of the Lower Silver Creek watershed receives water from the headwaters of Little Silver Creek. It is located primarily in St. Clair County, but extends slightly into Madison County.

Area: 5,765 acres
Named streams: Little Silver Creek
Counties: Madison and St. Clair
Municipalities: Lebanon
Townships: Lebanon, O'Fallon, St. Jacob

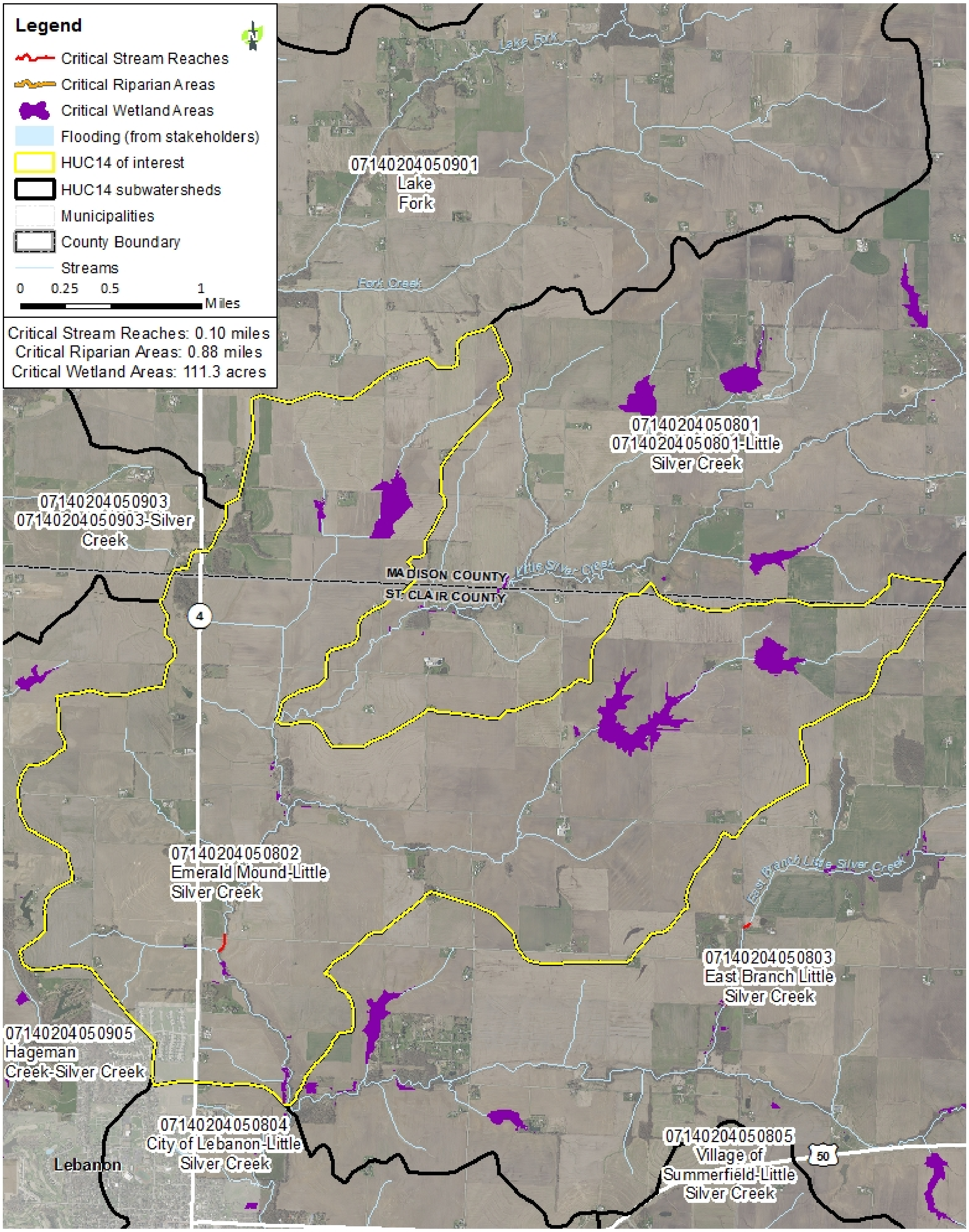
Critical Stream Reaches: 546 feet (0.10 miles) of Critical Stream Reaches were identified on Little Silver Creek.

Critical Riparian Areas: 1,879 feet (0.36 miles) of Critical Riparian Areas were identified on Little Silver Creek and one of its highly channelized tributaries.

Critical Wetland Areas: 111.3 acres of Critical Wetland Areas were identified at several locations in the subwatershed, including in the Little Silver Creek corridor.

No **flooding locations** were **identified by stakeholders** in this subwatershed.

HUC 07140204050802 - Emerald Mound-Little Silver Creek



HUC 071402040508 03: **East Branch Little Silver Creek** (north of Summerfield)

This subwatershed drains the headwaters of East Branch Little Silver Creek. It is located primarily in St. Clair County, with small portions extending north into Madison County and east into Clinton County.

Area: 8,253 acres
Named streams: East Branch Little Silver Creek
Counties: Clinton, Madison and St. Clair
Municipalities: None
Townships: Lebanon, St. Jacob, Sugar Creek

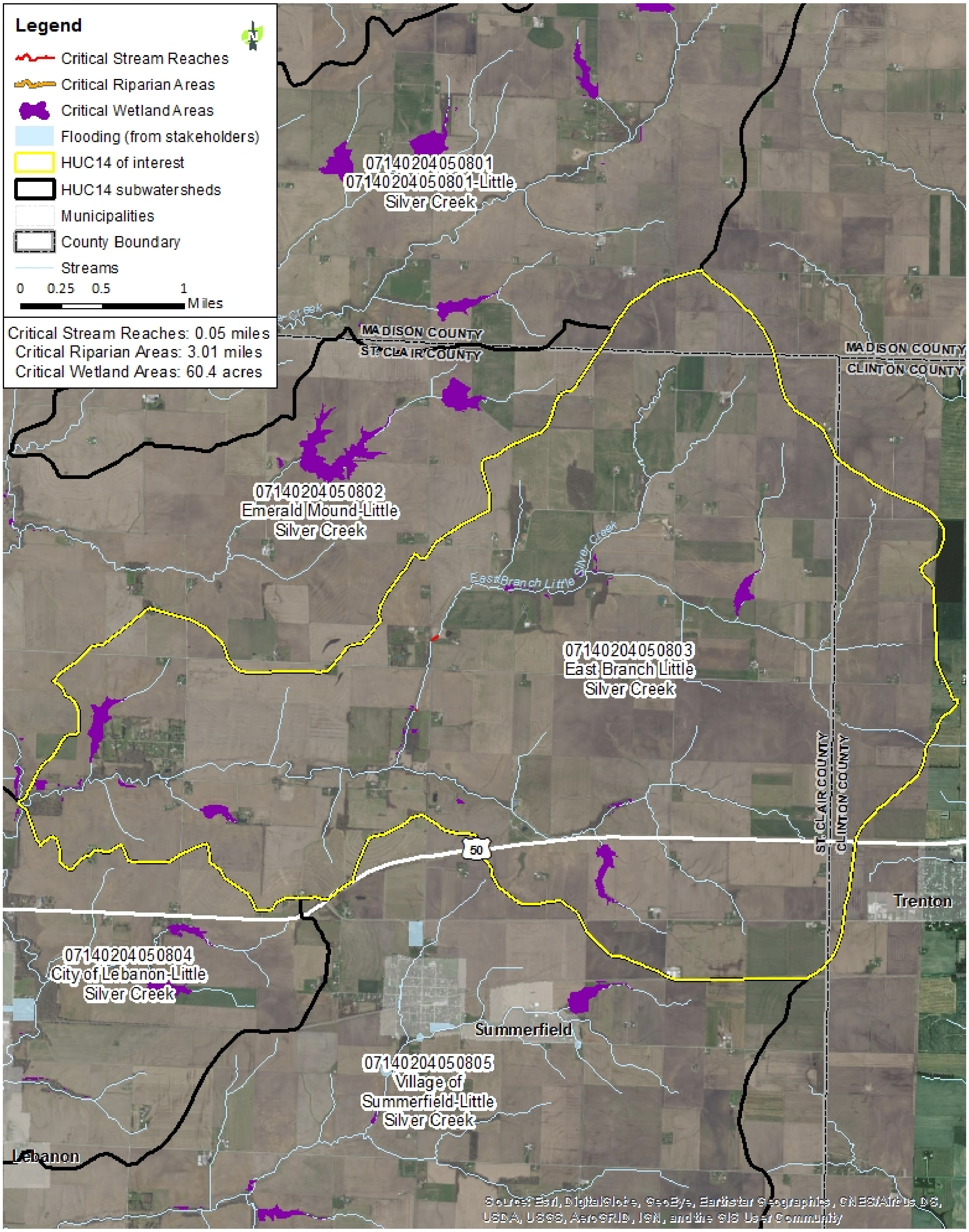
Critical Stream Reaches: 256 feet (0.05 miles) of Critical Stream Reaches were identified on East Branch Little Silver Creek.

Critical Riparian Areas: 15,892.8 feet (3.01 miles) of Critical Riparian Areas were identified, largely along East Branch Little Silver Creek.

Critical Wetland Areas: 60.4 acres of Critical Wetland Areas were identified throughout the subwatershed, mostly on small unnamed tributaries.

No **flooding locations** were **identified by stakeholders** in this subwatershed.

HUC 07140204050803 - East Branch Little Silver Creek



HUC 07140204050804: **City of Lebanon-Little Silver Creek** (southeast Lebanon)

This oval-shaped subwatershed is located entirely in St. Clair County, and covers the southeast side of the City of Lebanon. Route 4 and Highway 50 run through the subwatershed.

Area: 3,437 acres
Named streams: Little Silver Creek
Counties: St. Clair
Municipalities: Lebanon
Townships: Lebanon, O'Fallon

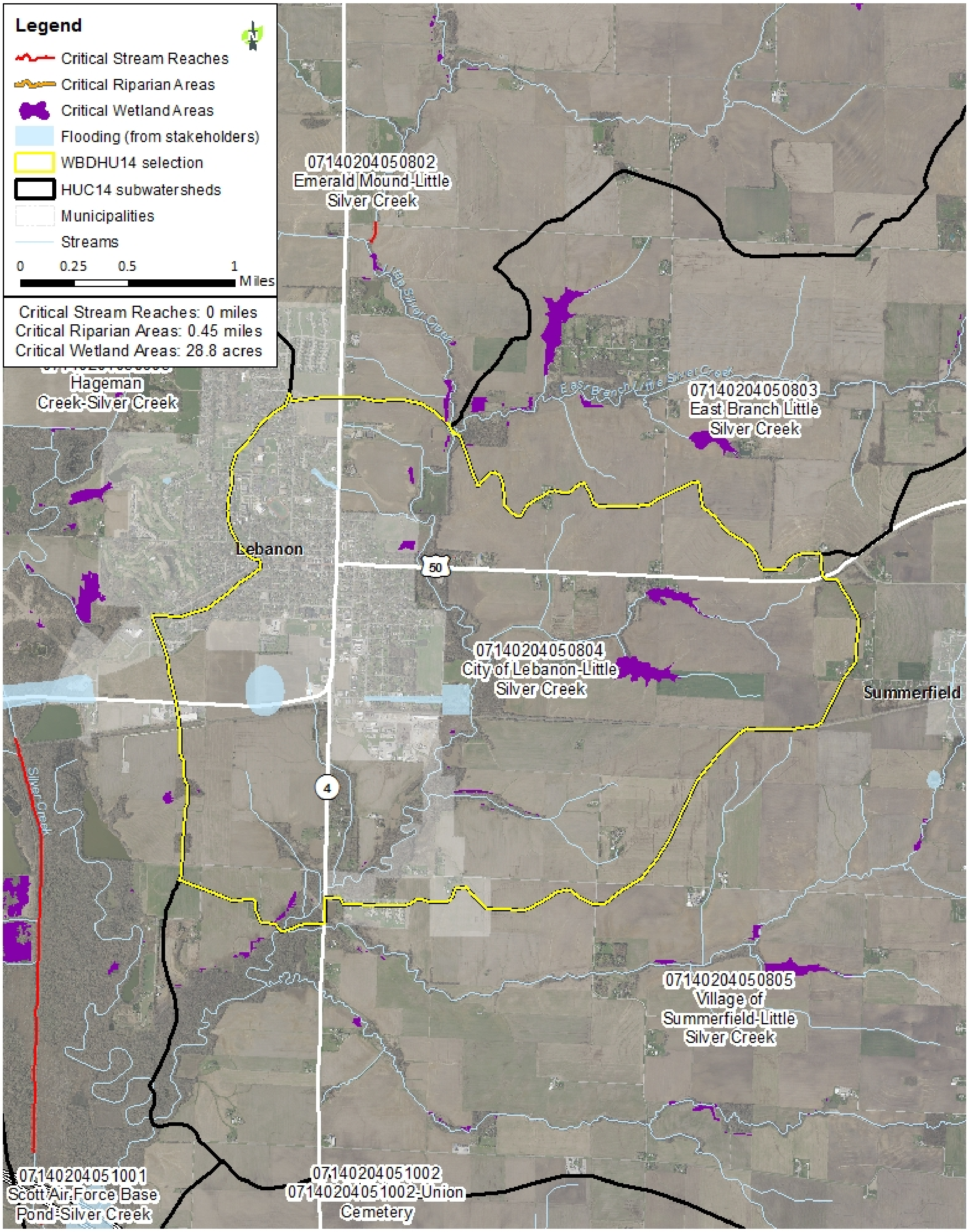
Critical Stream Reaches: No Critical Stream Reaches were identified in this subwatershed.

Critical Riparian Areas: 2,376 feet (0.45 miles) of Critical Riparian Areas were identified along Little Silver Creek.

Critical Wetland Areas: 28.8 acres of Critical Wetland Areas were identified along Little Silver Creek and unnamed tributaries.

Flooding locations were **identified by stakeholders** in three locations in the City of Lebanon, including serious and persistent road overtopping at Route 50 near where it meets Route 4.

HUC 07140204050804 - City of Lebanon-Little Silver Creek



HUC 07140204050805: **Village of Summerfield-Little Silver Creek** (Summerfield area)

This subwatershed is located in the eastern portion of the Lower Silver Creek watershed and includes the village of Summerfield. The majority of the area lies south of Highway 50 and east of Route 4.

Area: 8,437 acres
Named streams: None
Counties: St. Clair
Municipalities: Lebanon, Summerfield
Townships: Lebanon, Mascoutah, O'Fallon, Shiloh Valley

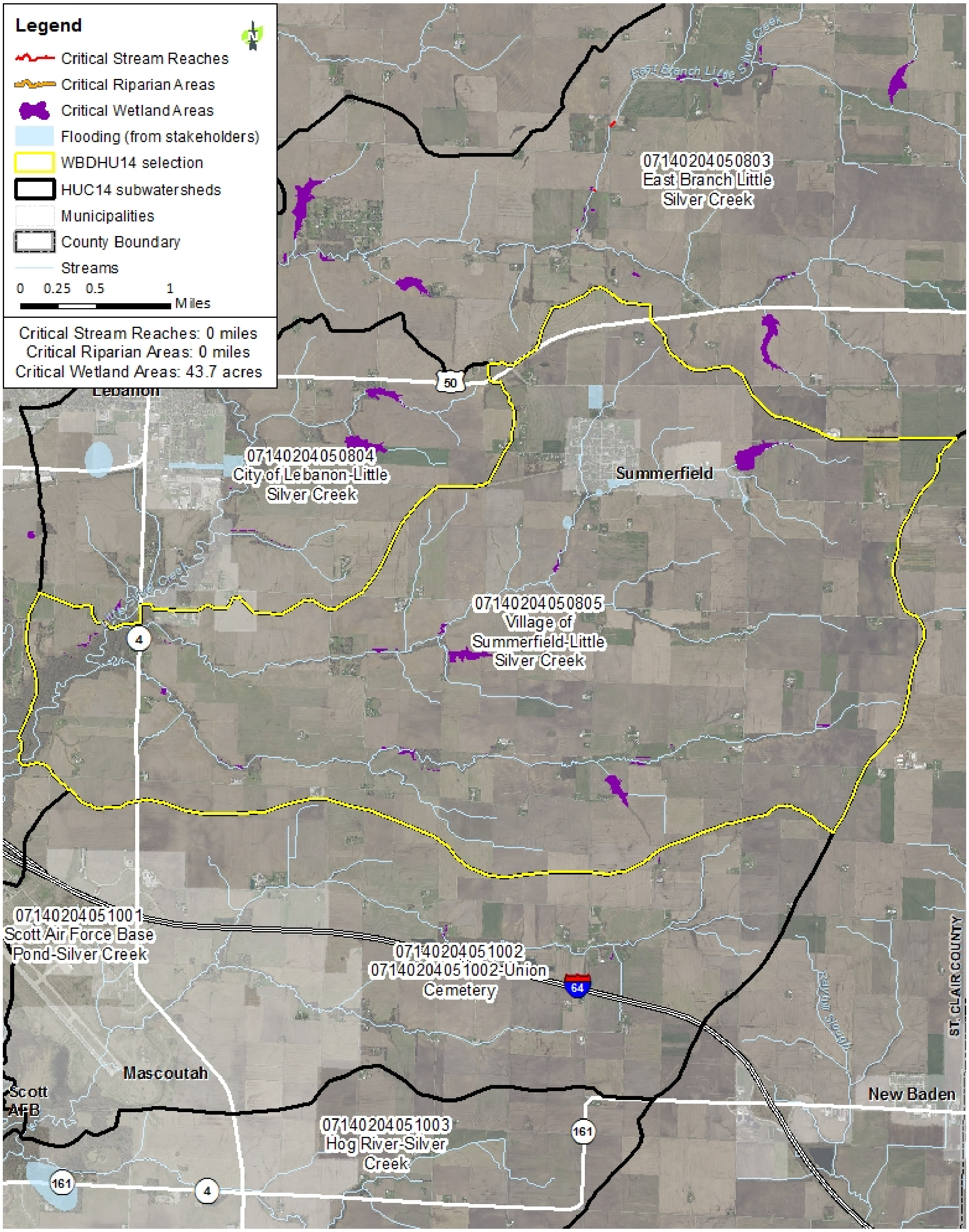
Critical Stream Reaches: No Critical Stream Reaches were identified in this subwatershed.

Critical Riparian Areas: No Critical Riparian Areas were identified in this subwatershed.

Critical Wetland Areas: 43.7 acres of Critical Wetland Areas were identified along the unnamed tributaries, including a large area upstream of the Village of Summerfield.

Flooding locations were **identified by stakeholders** at several locations in and around the Village of Summerfield, including two road overtopping locations on Summerfield St Jacob Road both north and south of the village.

HUC 07140204050805 - Village of Summerfield-Little Silver Creek



HUC 071402040509903:07140204050903-Silver Creek (Silver Creek at the county line)

This long subwatershed extends along Silver Creek from Madison County in the north to St. Clair County in the south. Only the St. Clair portion of the subwatershed is included in the Lower Silver Creek watershed.

Area: 3,323 acres
Named streams: Silver Creek
Counties: Madison and St. Clair
Municipalities: None
Townships: Jarvis, Lebanon, O'Fallon, St. Jacob

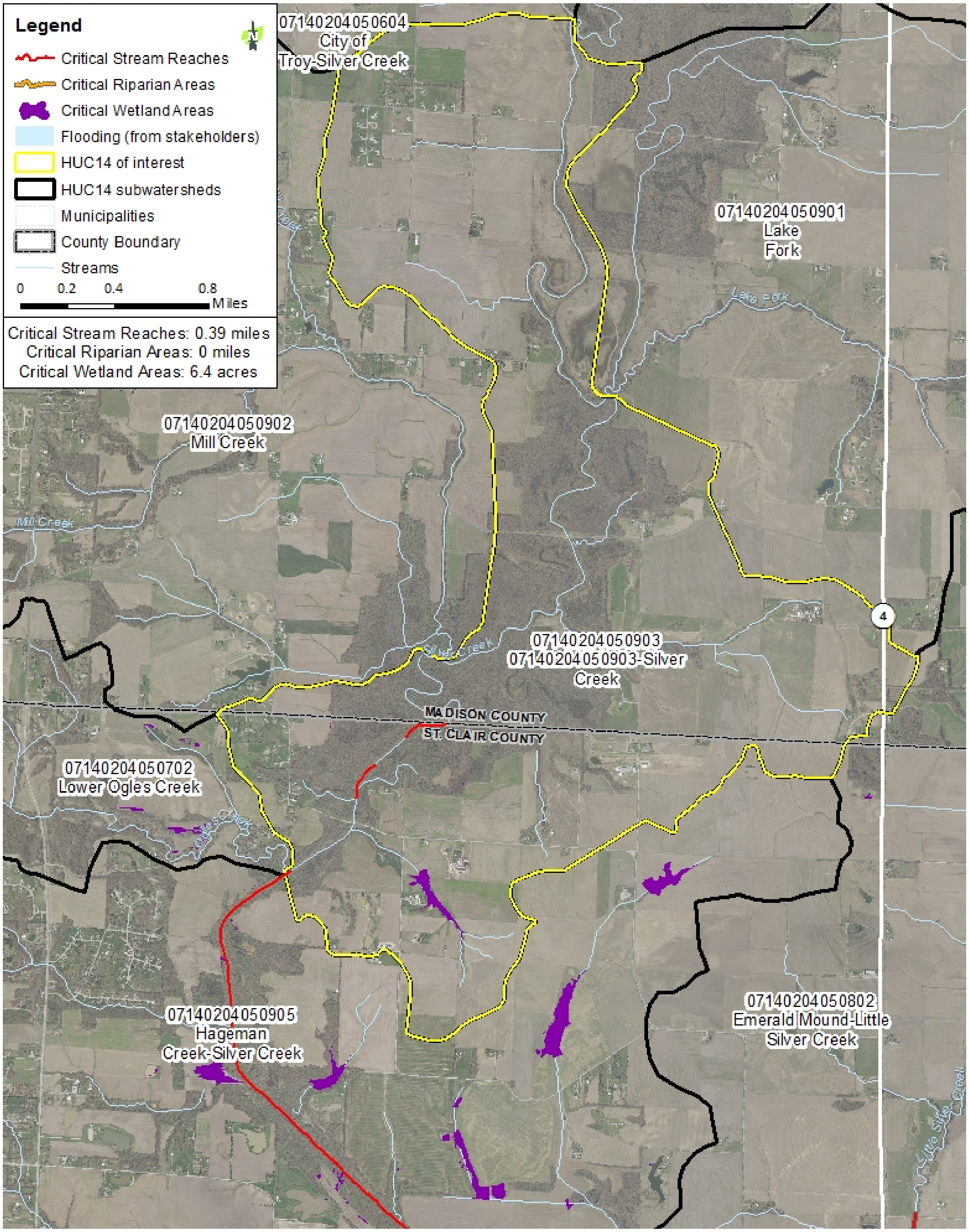
Critical Stream Reaches: 2,052 feet (0.39 miles) Critical Stream Reaches were identified along Silver Creek.

Critical Riparian Areas: No Critical Riparian Areas were identified in this subwatershed.

Critical Wetland Areas: A 6.4-acref Critical Wetland Area was identified on a tributary to Silver Creek.

No **flooding locations** were **identified by stakeholders** in this subwatershed.

HUC 07140204050903 - 07140204050903-Silver Creek (St. Clair County portion only)



HUC 071402040509904: **Engle Creek** (O'Fallon area)

This subwatershed drains a large portion of the City of O'Fallon and includes Engle Creek and Rock Spring Branch. It lies primarily north of I-64 and northwest of Highway 50.

Area: 7,434 acres
Named streams: Engle Creek, Rock Spring Branch
Counties: St. Clair
Municipalities: O'Fallon, Shiloh
Townships: Caseyville, O'Fallon, Shiloh Valley

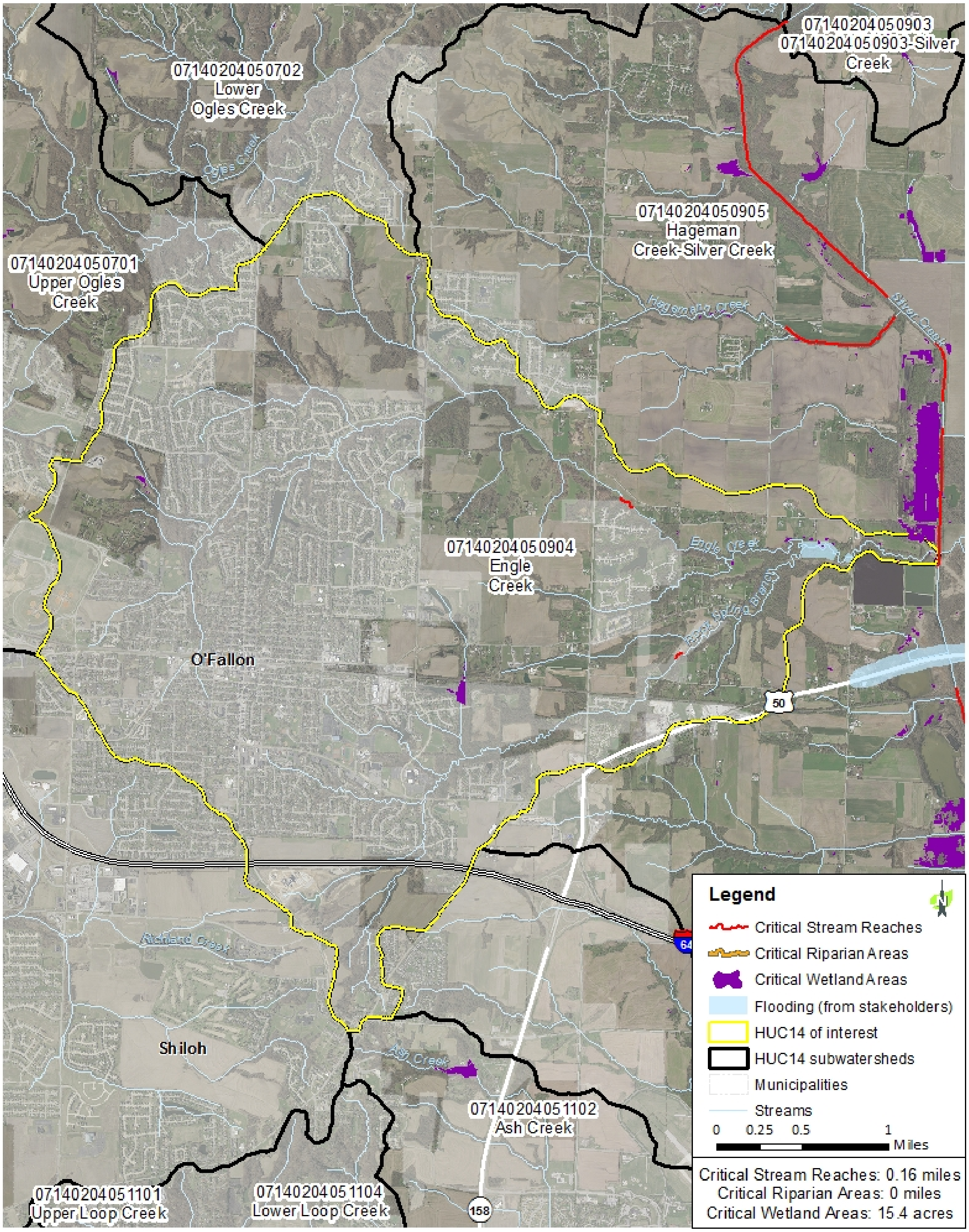
Critical Stream Reaches: 866 feet (0.16 miles) of Critical Stream Reaches were identified on Engle Creek and Rock Spring Branch.

Critical Riparian Areas: No Critical Riparian Areas were identified.

Critical Wetland Areas: 15.4 acres of Critical Wetland Areas were identified, largely in the lower Engle Creek corridor near Silver Creek.

Flooding locations were **identified by stakeholders** at two areas on downstream Engle Creek, near its confluence with Silver Creek.

HUC 07140204050904 - Engle Creek



HUC 071402040509 05: **Hageman Creek – Silver Creek** (Silver Creek north of SAFB)

This large subwatershed includes Hagemann Creek and a long segment of Silver Creek north of Scott Air Force Base. It also covers small portions of the City of O'Fallon and a large portion of the western side of the City of Lebanon.

Area: 10,664 acres
Named streams: Silver Creek, Hageman Creek
Counties: St. Clair
Municipalities: Lebanon, O'Fallon, Shiloh
Townships: Lebanon, Mascoutah, O'Fallon, Shiloh Valley

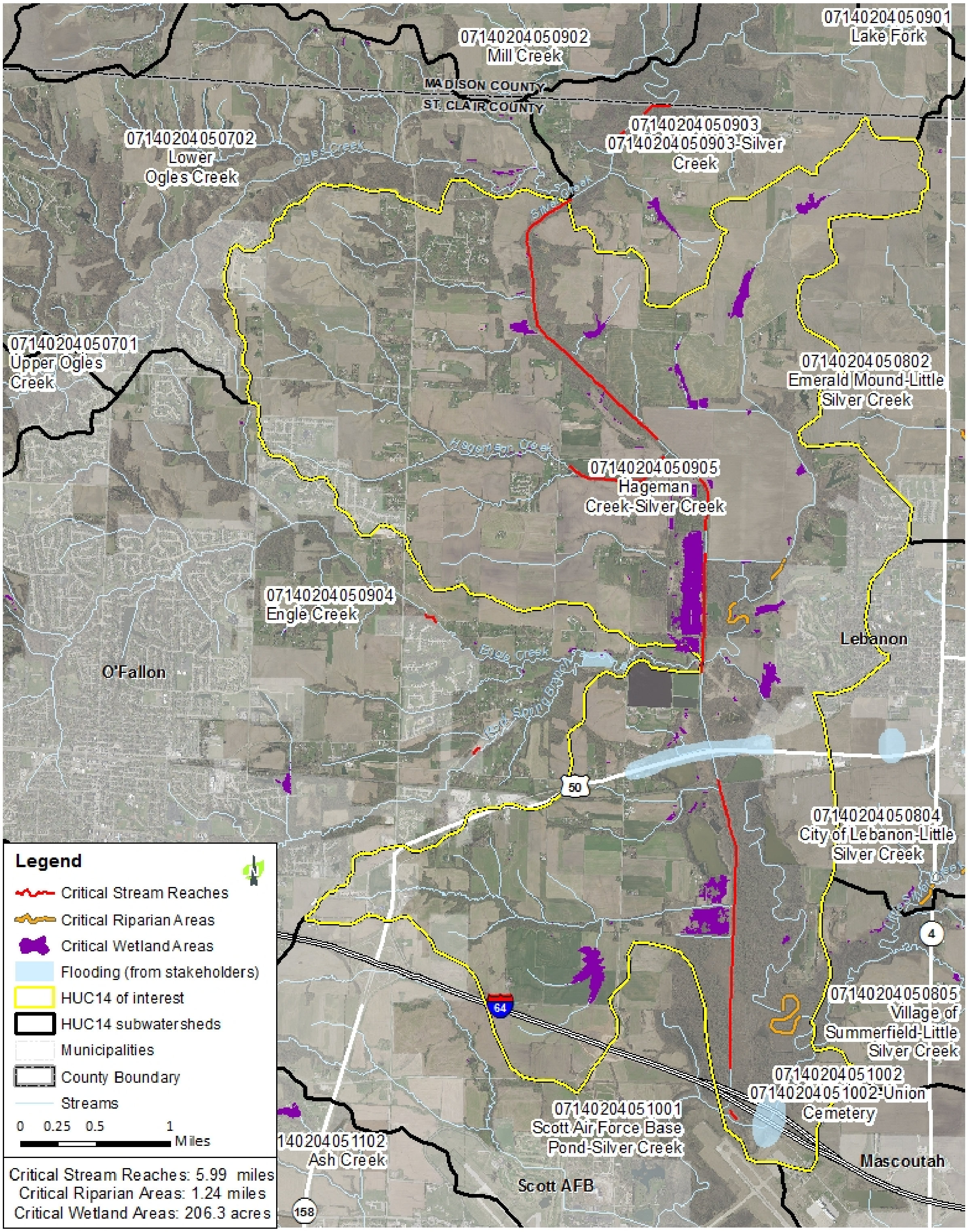
Critical Stream Reaches: 31,632 feet (5.99 miles) of Critical Stream Reaches were identified on Silver Creek and Hagemann Creek.

Critical Riparian Areas: 6,538 feet (1.24 miles) of Critical Riparian Areas were identified on tributaries and old remnant channels contributing to Silver Creek.

Critical Wetland Areas: 206.3 acres of Critical Wetland Areas were identified at several locations along Silver Creek and its tributaries.

Flooding locations were **identified by stakeholders** at Highway 50 and at I-64.

HUC 07140204050905 - Hageman Creek-Silver Creek



HUC 071402040510**01**: **Scott Air Force Base Pond-Silver Creek** (Shiloh and north side of SAFB)

This subwatershed includes unnamed tributaries draining the eastern side of the Village of Shiloh, flowing through the north side of SAFB to join Silver Creek.

Area: 4,249 acres
Named streams: Silver Creek
Counties: St. Clair
Municipalities: Mascoutah, O'Fallon, Shiloh
Townships: Mascoutah, O'Fallon, Shiloh Valley

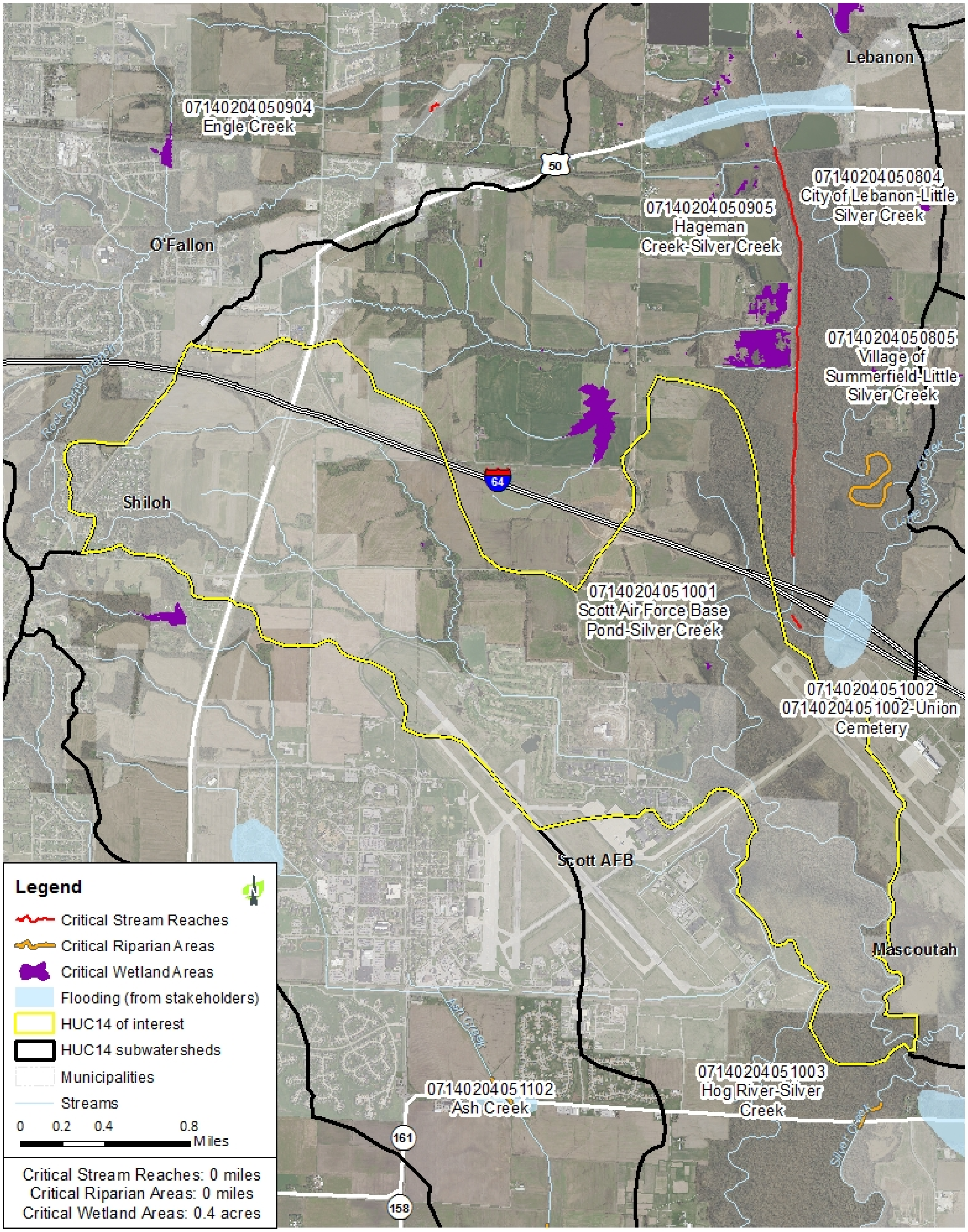
Critical Stream Reaches: No Critical Stream Reaches were identified.

Critical Riparian Areas: No Critical Riparian Areas were identified.

Critical Wetland Areas: A 0.4-acre Critical Wetland Area was identified northwest of the MidAmerica Airport runway adjacent to a tributary stream.

No **flooding locations** were **identified by stakeholders** in this subwatershed.

HUC 07140204051001 - Scott Air Force Base Pond-Silver Creek



HUC 071402040510020:**071402040510002-Union Cemetery** (MidAmerica Airport and north side of Mascoutah)

This rectangular-shaped subwatershed is bisected by I-64. It includes much of MidAmerica Airport and the north side of the City of Mascoutah.

Area: 5,467 acres
Named streams: None (tributaries to Silver Creek)
Counties: St. Clair
Municipalities: Mascoutah
Townships: Mascoutah

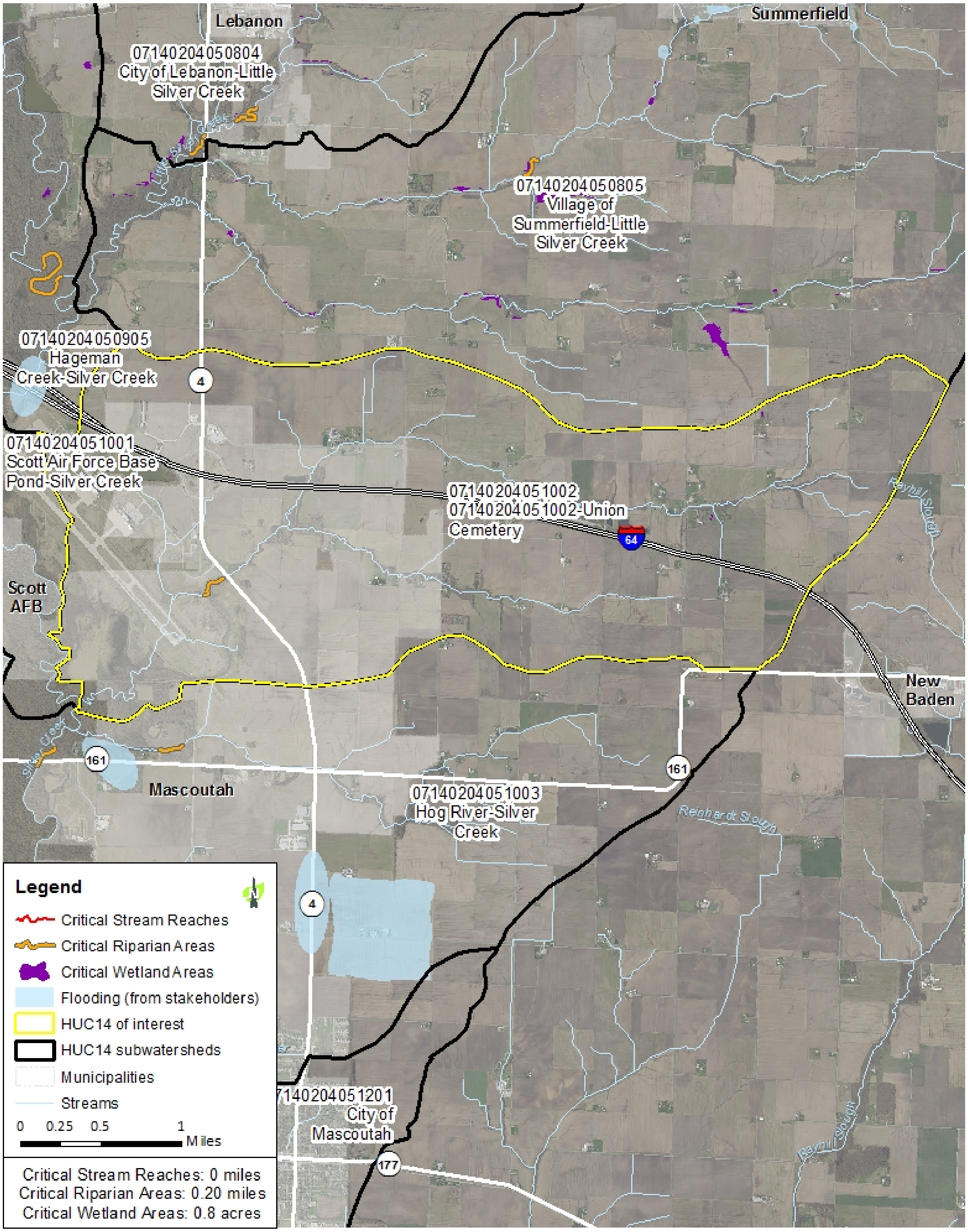
Critical Stream Reaches: No Critical Stream Reaches were identified.

Critical Riparian Areas: 1,057 feet (0.2 miles) of Critical Riparian Areas were identified, just east of MidAmerica Airport.

Critical Wetland Areas: One 0.8-acre Critical Wetland Area was identified on an unnamed tributary just north of I-64 (close to the "64" label on this map).

No **flooding locations** were **identified by stakeholders** in this subwatershed.

HUC 07140204051002 - 07140204051002-Union Cemetery



HUC 071402040510003: **Hog River-Silver Creek** (Mascoutah, SAFB)

This triangular-shaped subwatershed includes a large portion of the city of Mascoutah and a portion of Scott Air Force Base. Parts of Routes 4, 161, and 177 run through it.

Area: 7,061 acres
Named streams: Silver Creek, Hog River
Counties: St. Clair
Municipalities: Mascoutah
Townships: Engelmann, Freeburg, Mascoutah, Shiloh Valley

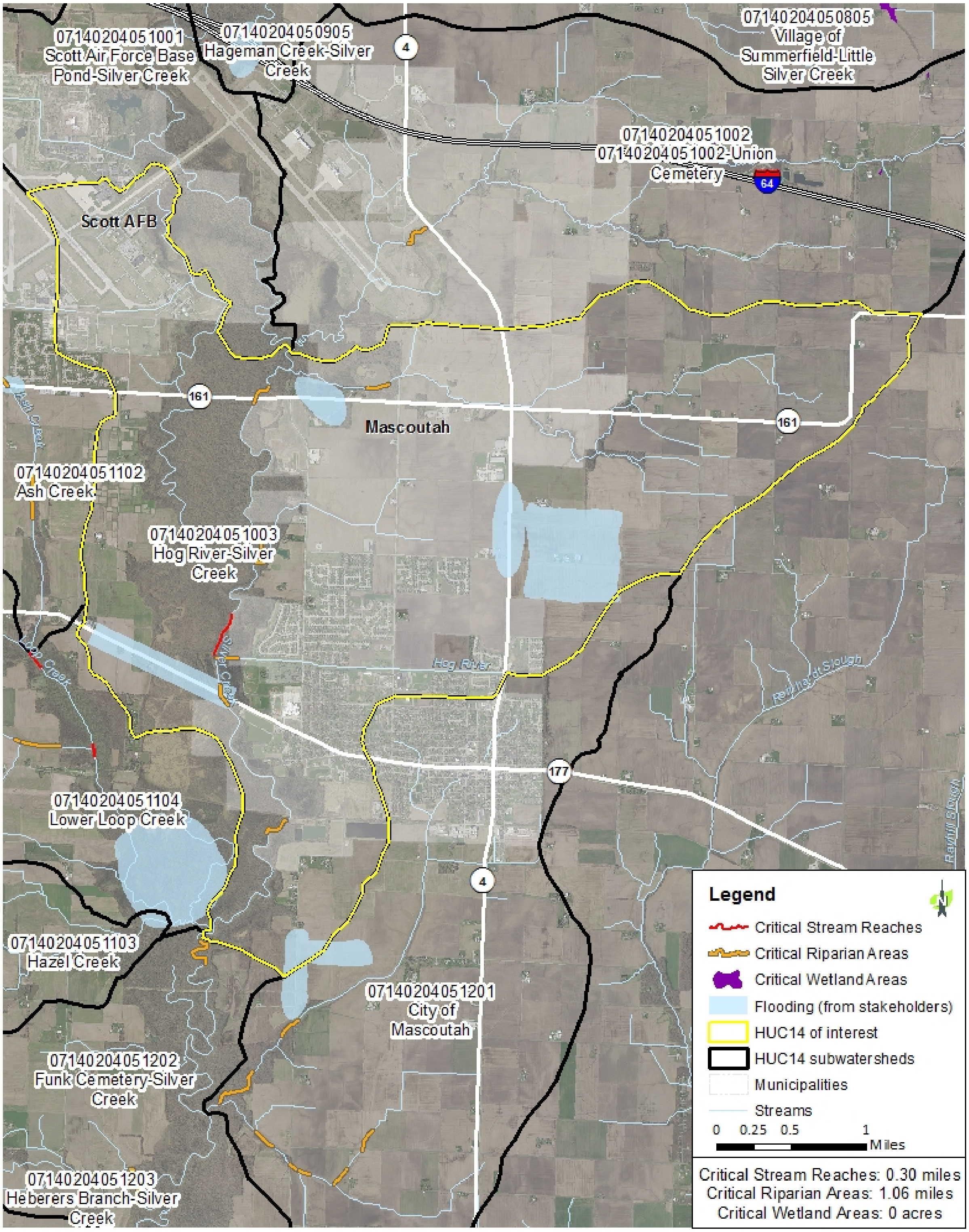
Critical Stream Reaches: A 1,571-foot (0.30-mile) Critical Stream Reach was identified along Silver Creek.

Critical Riparian Areas: 5,573 feet (1.06 miles) of Critical Riparian Areas were identified along Silver Creek and a tributary.

Critical Wetland Areas: No Critical Wetland Areas were identified in this subwatershed.

Flooding locations were **identified by stakeholders** in several locations, including road overtopping on Route 4 north of Mascoutah and Route 161 northeast of Mascoutah near Silver Creek.

HUC 07140204051003 - Hog River-Silver Creek



HUC 071402040511101: **Upper Loop Creek** (eastern Belleville area)

This subwatershed drains the upper reaches of Loop Creek as it flows eastward through Shiloh and Belleville. Route 161 and Route 158 run through it.

Area: 6,446acres
Named streams: Loop Creek
Counties: St. Clair
Municipalities: Belleville, Freeburg, Shiloh
Townships: Belleville, Freeburg, Shiloh Valley

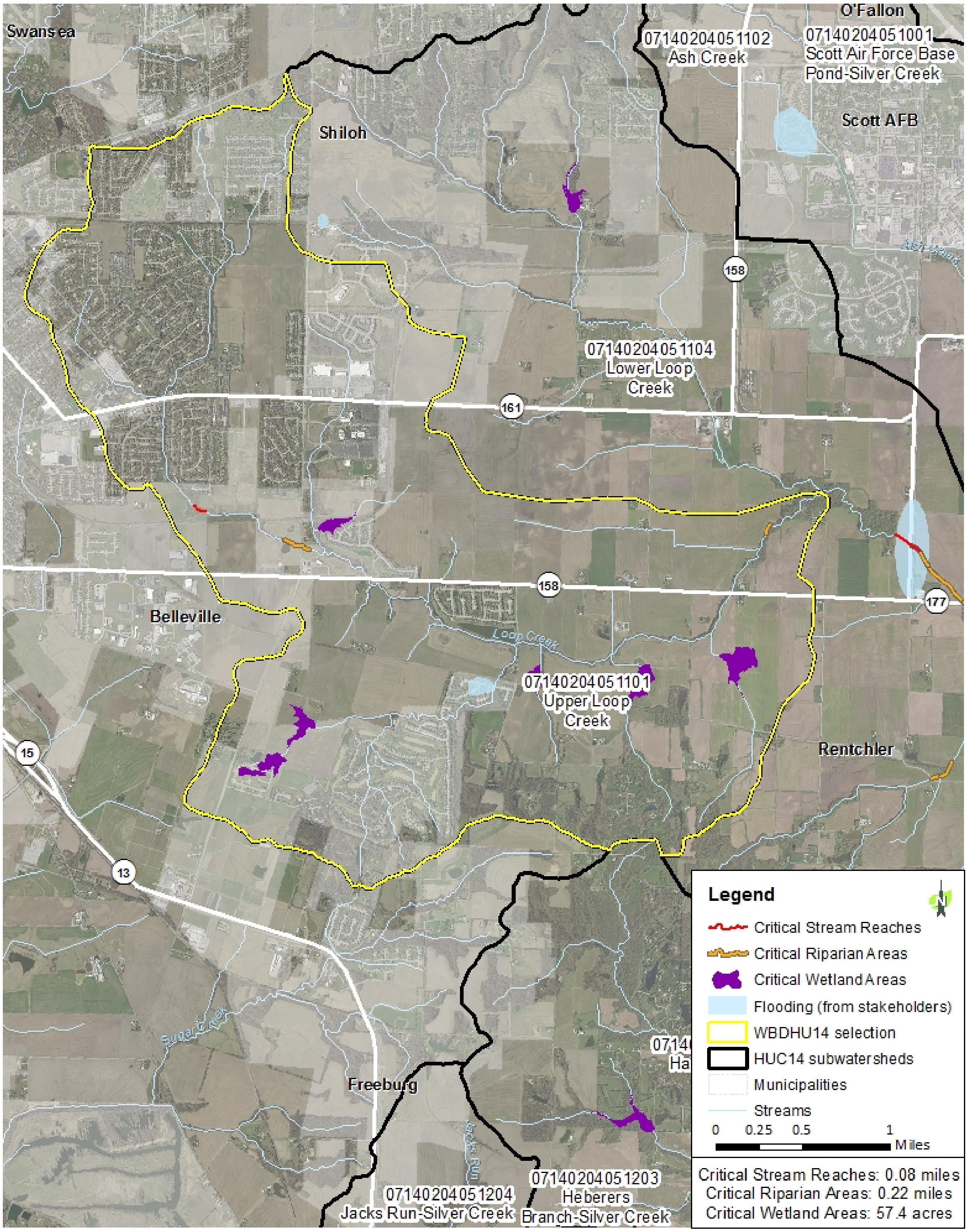
Critical Stream Reaches: A 414-foot (0.08-mile) Critical Stream Reach was identified on Loop Creek.

Critical Riparian Areas: 1,147 feet (0.22 miles) of Critical Riparian Areas were identified on Loop Creek.

Critical Wetland Areas: 57.4 acres of Critical Wetland Areas were identified, including areas within municipal boundaries.

No **flooding locations** were **identified by stakeholders** in this subwatershed.

HUC 07140204051101 - Upper Loop Creek



HUC 071402040511102: **Ash Creek** (Shiloh, SAFB area)

This subwatershed includes Ash Creek, which drains the western side of SAFB. Route 158 and Route 161 pass through it.

Area: 3,463 acres
Named streams: Ash Creek
Counties: St. Clair
Municipalities: O'Fallon, Shiloh
Townships: Shiloh Valley

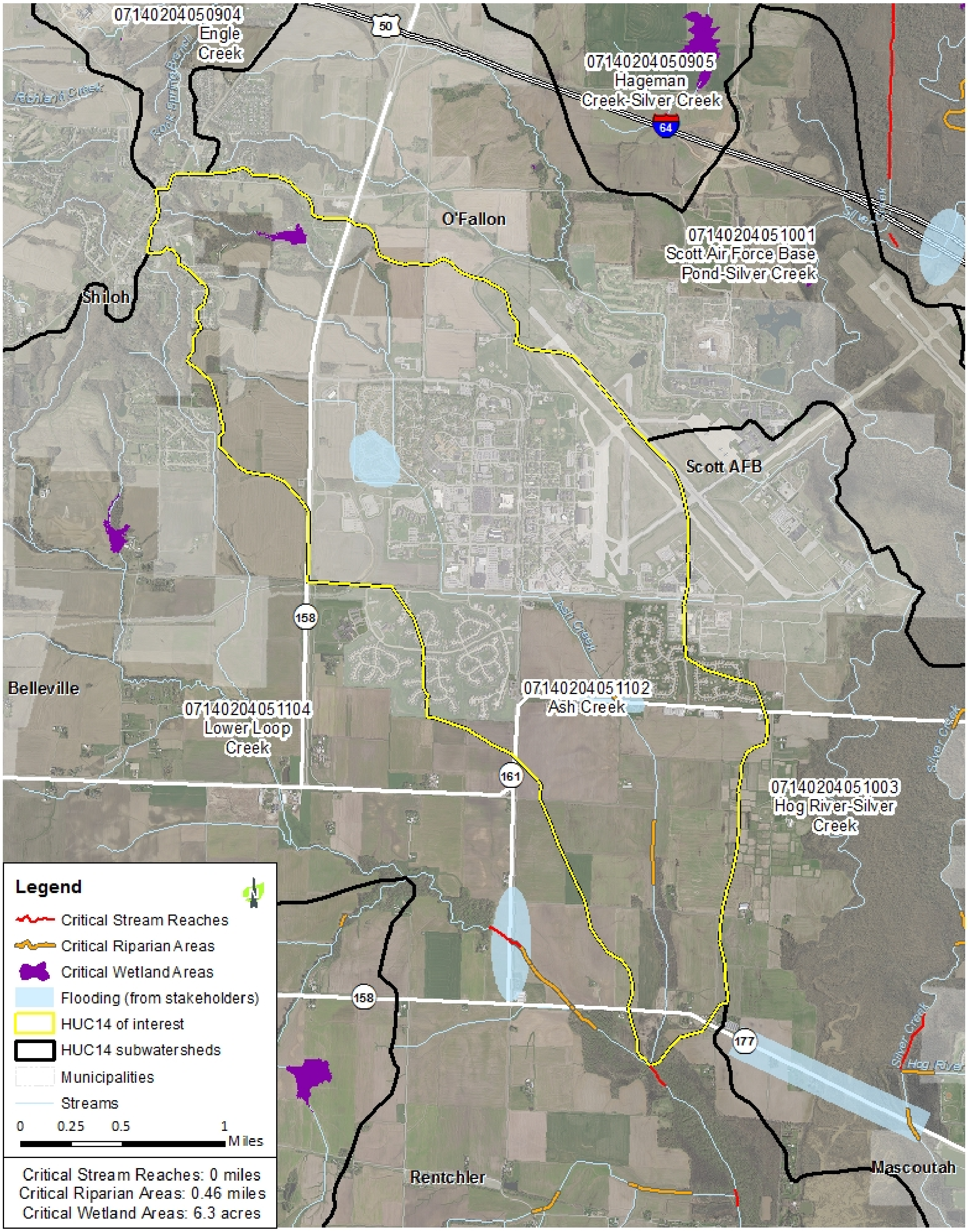
Critical Stream Reaches: No Critical Stream Reaches were identified.

Critical Riparian Areas: 2,450 feet (0.46 miles) of Critical Riparian Areas were identified in two sections of urban Troy, one of which crosses Route 162.

Critical Wetland Areas: A 6.3-acre Critical Wetland Area was identified in the northwest of the watershed within the boundary of the Village of Shiloh.

Flooding locations were **identified by stakeholders** at two locations: an SAFB subdivision (containing Greenfield Circle), and Route 161 across Ash Creek.

HUC 07140204051102 - Ash Creek



HUC 071402040511103: **Hazel Creek** (east of Freeburg)

This subwatershed encompasses Hazel Creek and drains the land east of the Village of Freeburg.

Area: 3,932 acres
Named streams: Hazel Creek
Counties: St. Clair
Municipalities: Freeburg
Townships: Freeburg, Shiloh Valley

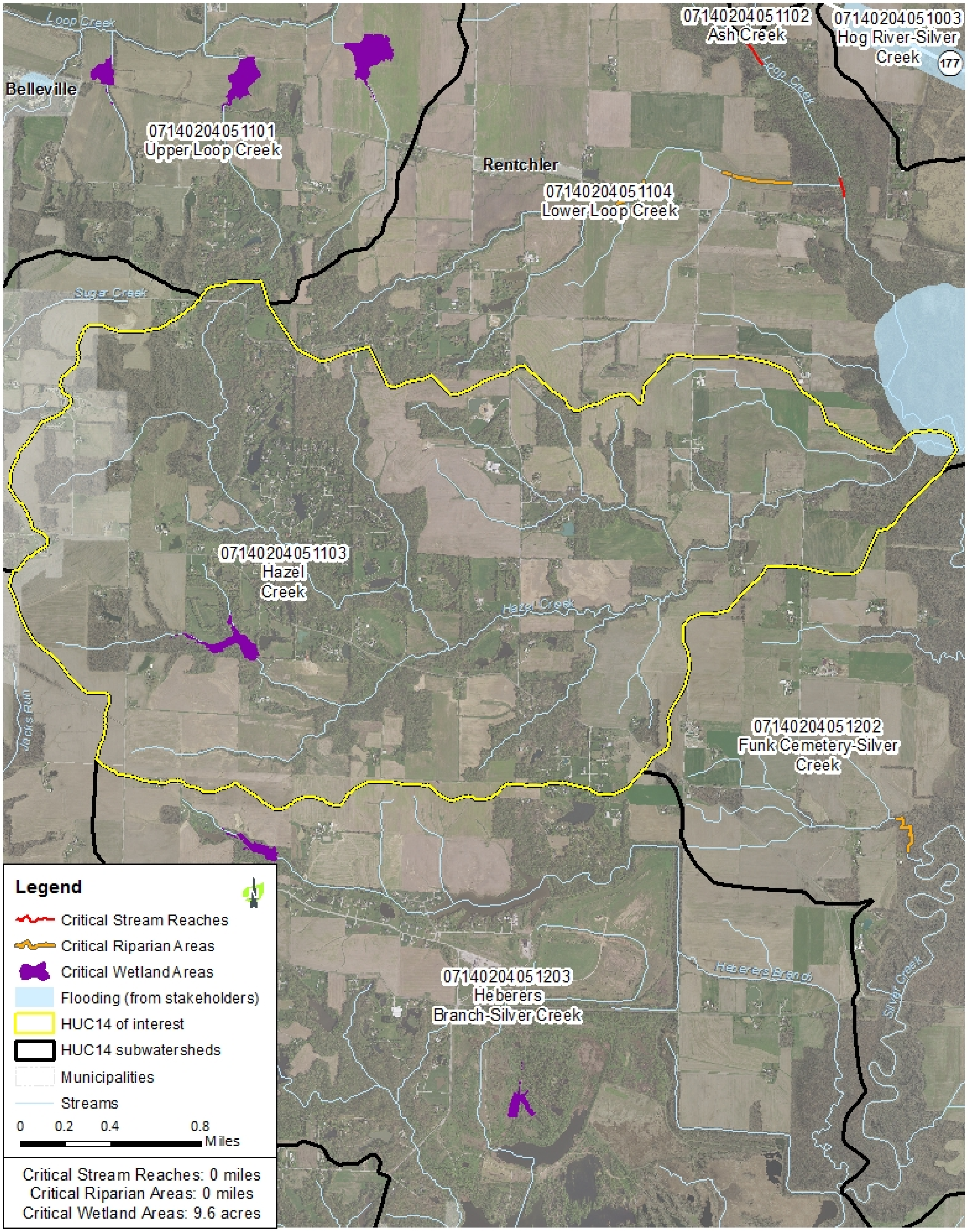
Critical Stream Reaches: No Critical Stream Reaches were identified.

Critical Riparian Areas: No Critical Riparian Areas were identified.

Critical Wetland Areas: A 9.6-acre Critical Wetland Area was identified upstream (west) in the subwatershed.

A **flooding location** was **identified by stakeholders** where Hazel Creek meets Loop Creek and joins Silver Creek, with floodwaters covering the land around the bridge and rising up to the level of the bridge.

HUC 07140204051103 - Hazel Creek



HUC 071402040511104: **Lower Loop Creek** (southeast Shiloh, Rentchler)

This subwatershed is located in the west-central portion of the Lower Silver Creek watershed and includes the downstream portion of Loop Creek and its tributaries. It drains the southeast corner of Shiloh and the southwest corner of SAFB, and encompasses the unincorporated community of Rentchler. Route 158, Route 177, and Route 161 run through it.

Area: 7,662 acres
Named streams: Loop Creek
Counties: St. Clair
Municipalities: Belleville, Mascoutah, Shiloh (also SAFB and the unincorporated community of Rentchler)
Townships: Belleville, Freeburg, Shiloh Valley, St. Clair

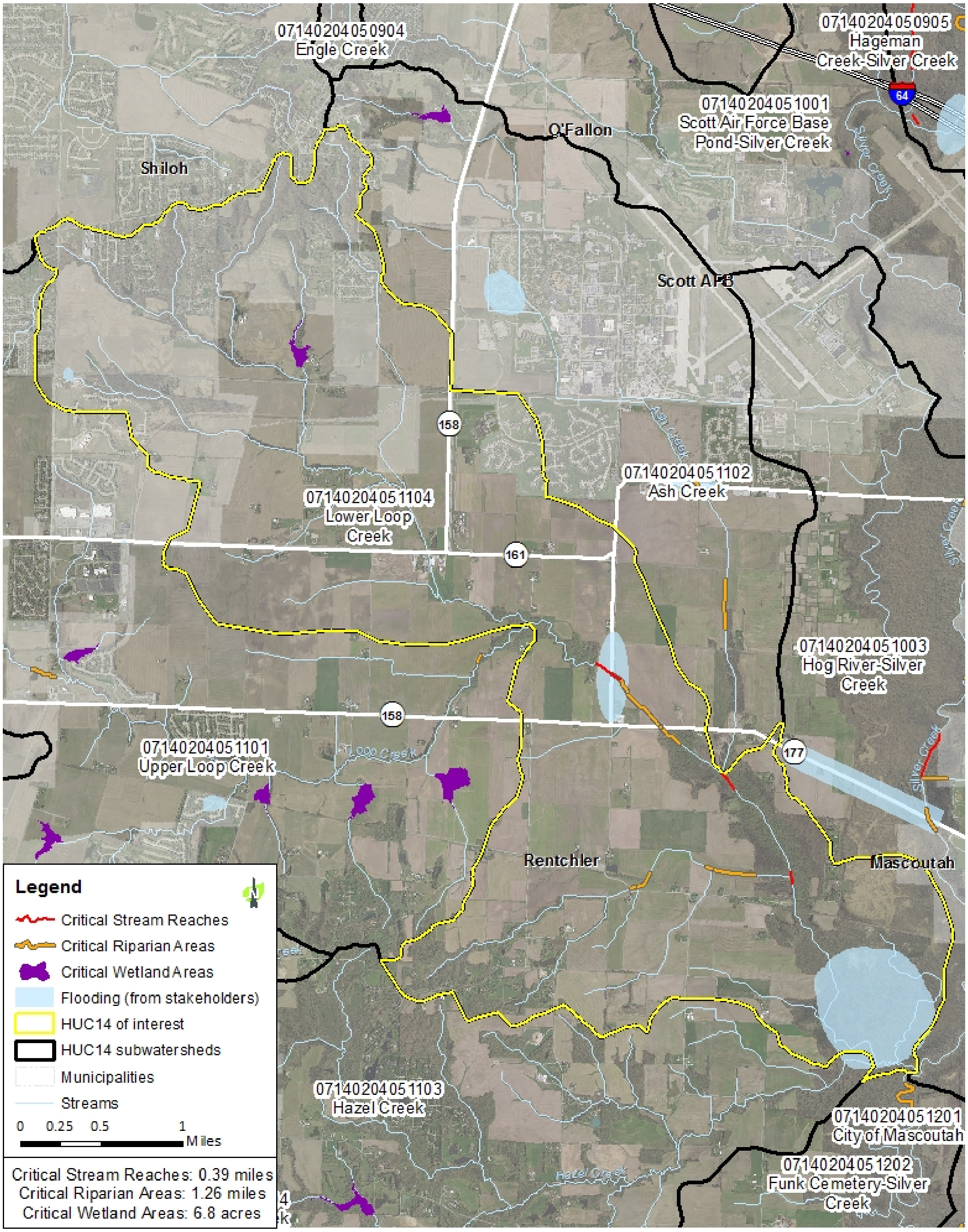
Critical Stream Reaches: 2,064 feet (0.39 miles) of Critical Stream Reaches were identified in three locations on Loop Creek, including where Route 158 crosses Loop Creek.

Critical Riparian Areas: 6,633 feet (1.26 miles) of Critical Riparian Areas were identified on Loop Creek and on a tributary passing close to Rentchler.

Critical Wetland Areas: A 6.8-acre Critical Wetland Area was identified on agricultural land outside the Village of Shiloh.

Flooding locations were **identified by stakeholders** at three locations: at a road/railroad crossing at Shiloh Station West, at Route 158, and where Loop Creek and joins Silver Creek.

HUC 07140204051104 - Lower Loop Creek



HUC 07140204051201: **City of Mascoutah** (southern Mascoutah)

This long, narrow subwatershed drains southwestern Mascoutah and land to the south of the city. Route 177 and Route 4 intersect within the subwatershed.

Area: 7,061 acres
Named streams: None (tributaries to Silver Creek)
Counties: St. Clair
Municipalities: Mascoutah
Townships: Engelmann, Freeburg, Mascoutah

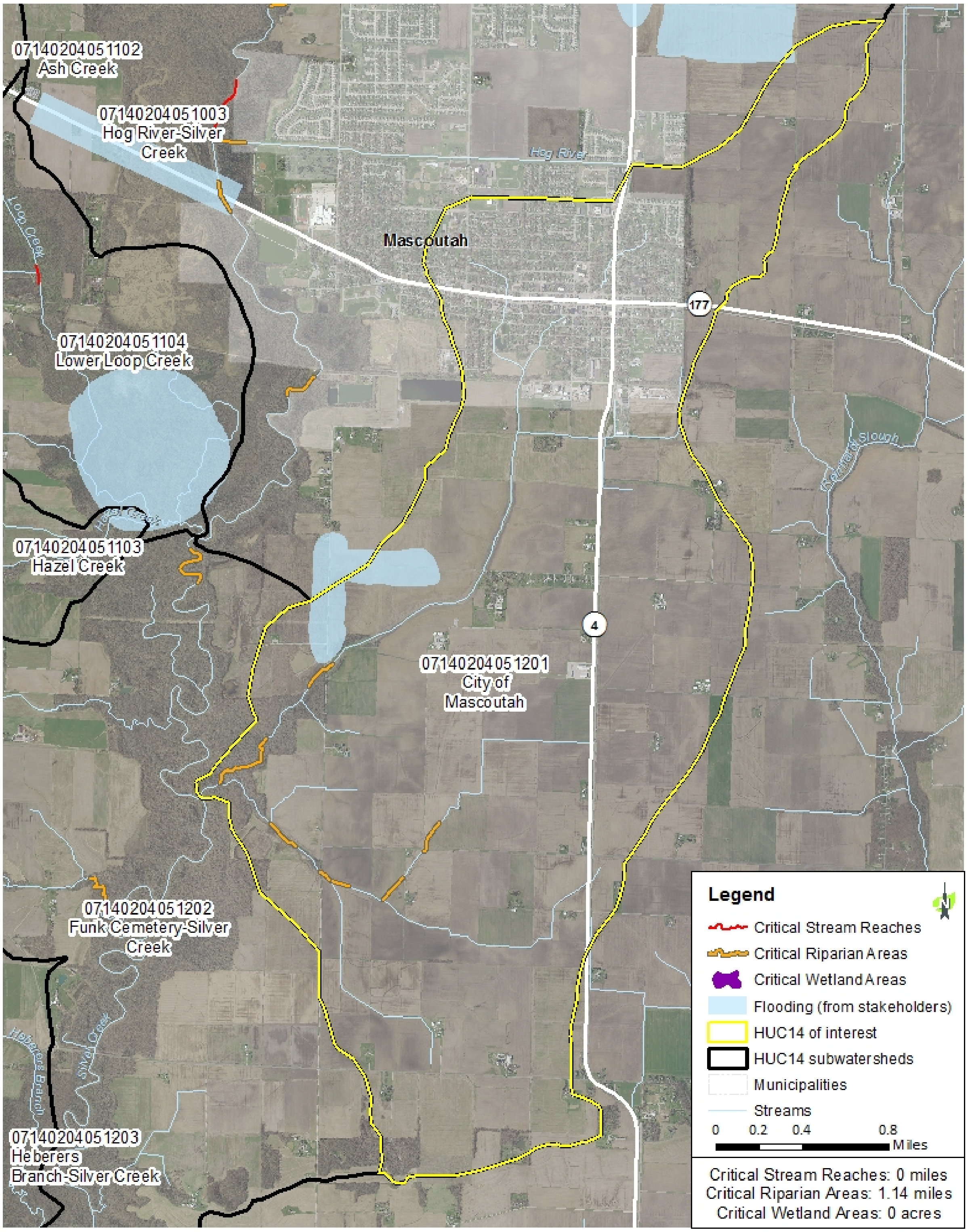
Critical Stream Reaches: No Critical Stream Reaches were identified.

Critical Riparian Areas: 6,045 feet (1.14 miles) of Critical Riparian Areas were identified on unnamed tributaries near Silver Creek.

Critical Wetland Areas: No Critical Wetland Areas were identified.

A **flooding location** was **identified by stakeholders** where floodwaters overtop Grodeon Road at its intersection with Brickyard Road just east of the Silver Creek Preserve.

HUC 07140204051201 - City of Mascoutah



HUC 071402040512O2: **Funk Cemetery-Silver Creek** (southwest of Mascoutah)

This rectangular-shaped subwatershed includes a long segment of Silver Creek. It is located to the southwest of the City of Mascoutah.

Area: 2,881 acres
Named streams: None (tributaries to Silver Creek)
Counties: St. Clair
Municipalities: None
Townships: Engelmann, Freeburg

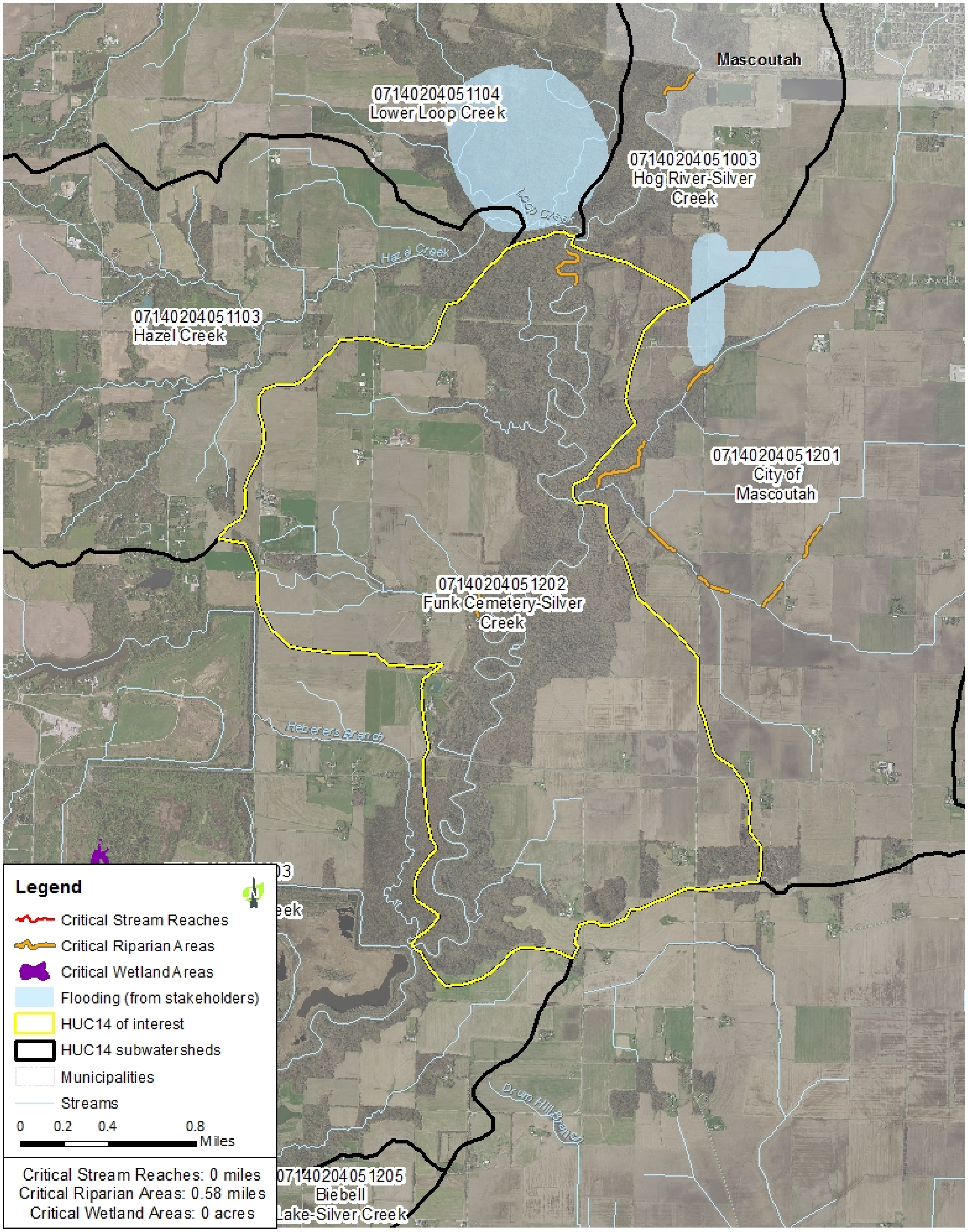
Critical Stream Reaches: No Critical Stream Reaches were identified.

Critical Riparian Areas: A 3,067-foot (0.58-mile) Critical Riparian Area was identified on Silver Creek just south of the confluence of Loop Creek and Silver Creek.

Critical Wetland Areas: No Critical Wetland Areas were identified.

No **flooding locations** were **identified by stakeholders** in this subwatershed.

HUC 07140204051202 - Funk Cemetery-Silver Creek



HUC 071402040512O3: **Heberers Branch-Silver Creek** (northeast of Freeburg)

This subwatershed includes Heberers Branch and a segment of Silver Creek east of Freeburg. It includes land previously used for mining, and contains several lakes and ponds that formed as a result of mining and subsidence.

Area: 4,673 acres
Named streams: Silver Creek, Heberers Branch
Counties: St. Clair
Municipalities: Freeburg
Townships: Freeburg

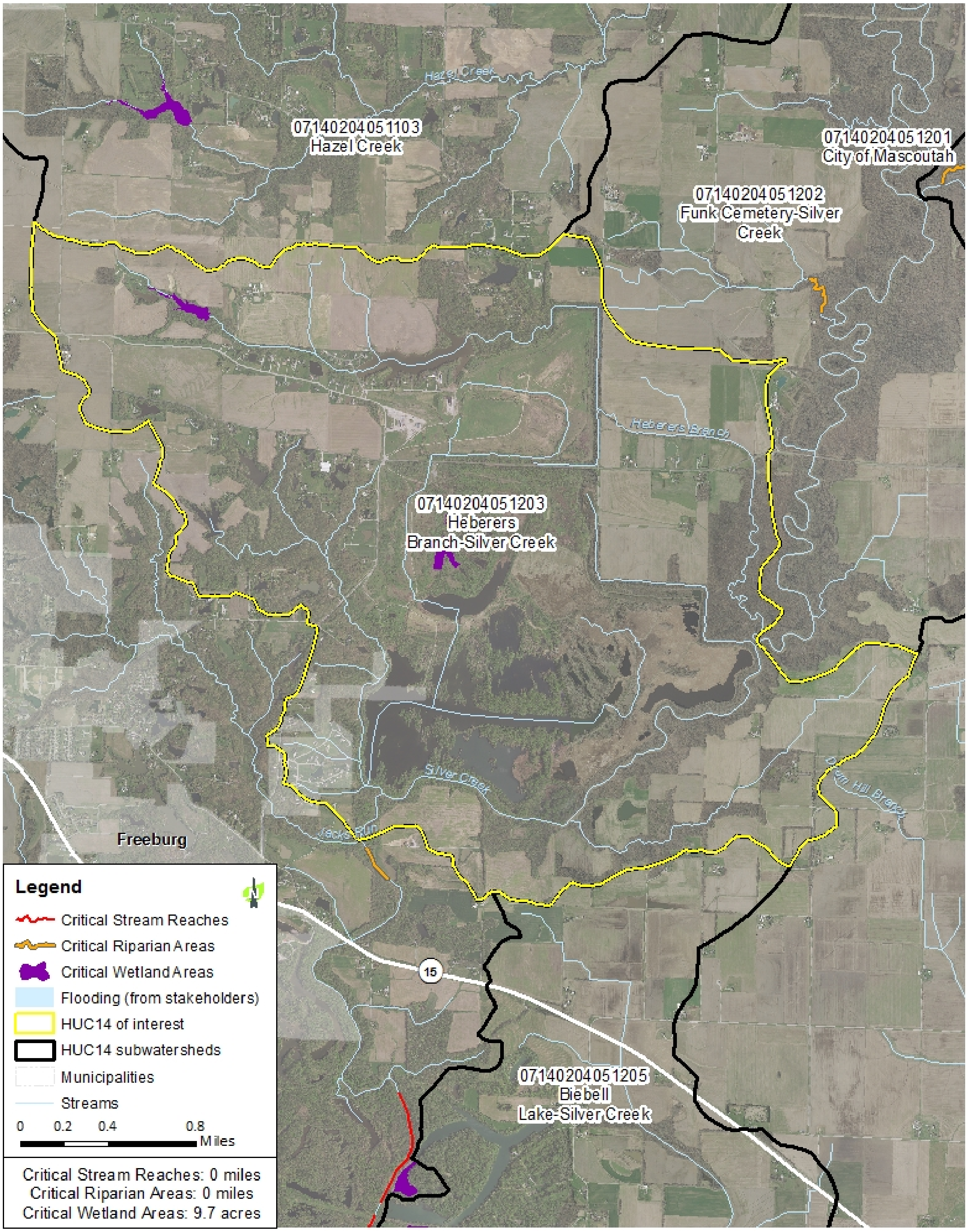
Critical Stream Reaches: No Critical Stream Reaches were identified.

Critical Riparian Areas: No Critical Riparian Areas were identified.

Critical Wetland Areas: A 9.7-acre Critical Wetland Area was identified.

No **flooding locations** were **identified by stakeholders** in this subwatershed.

HUC 07140204051203 - Heberers Branch-Silver Creek



HUC 071402040**51204**: **Jacks Run-Silver Creek** (Freeburg area)

This subwatershed contains a large portion the Village of Freeberg, and drains to Jacks Run, Lemen Branch, and Silver Creek. Routes 13 and 15 run through it. It includes land previously used for mining, and contains several lakes and ponds that formed as a result of mining and subsidence.

Area: 5,416 acres
Named streams: Jacks Run, Lemen Branch
Counties: St. Clair
Municipalities: Freeburg
Townships: Freeburg, New Athens

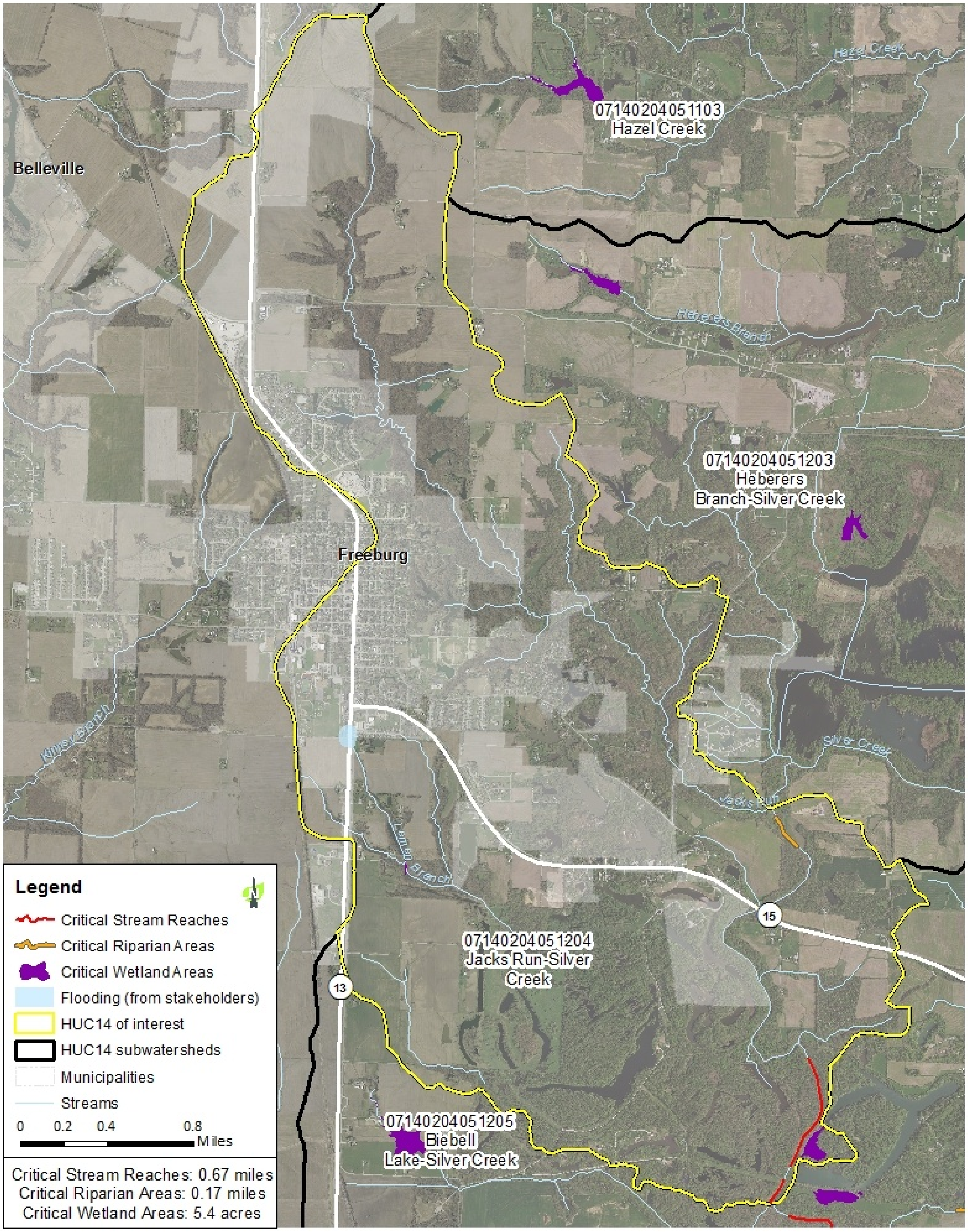
Critical Stream Reaches: 3,561 feet (0.67 miles) Critical Stream Reaches were identified along Silver Creek.

Critical Riparian Areas: 898 feet (0.17 miles) Critical Riparian Areas were identified along Silver Creek.

Critical Wetland Areas: 5.4 acres of Critical Wetland Areas were identified directly adjacent to Silver Creek.

A **flooding location** was **identified by stakeholders** at the intersection of Lemen Branch and Route 13, south of Freeburg.

HUC 07140204051204 - Jacks Run-Silver Creek



HUC 071402040512O5: **Biebell Lake-Silver Creek** (north of New Athens)

This y-shaped subwatershed comprises the southernmost stretch of Silver Creek in the watershed, where Silver Creek drains to the Kaskaskia River. Route 15 runs through the top portion of the subwatershed.

Area: 6,602 acres
Named streams: Silver Creek
Counties: St. Clair
Municipalities: None
Townships: Freeburg, New Athens

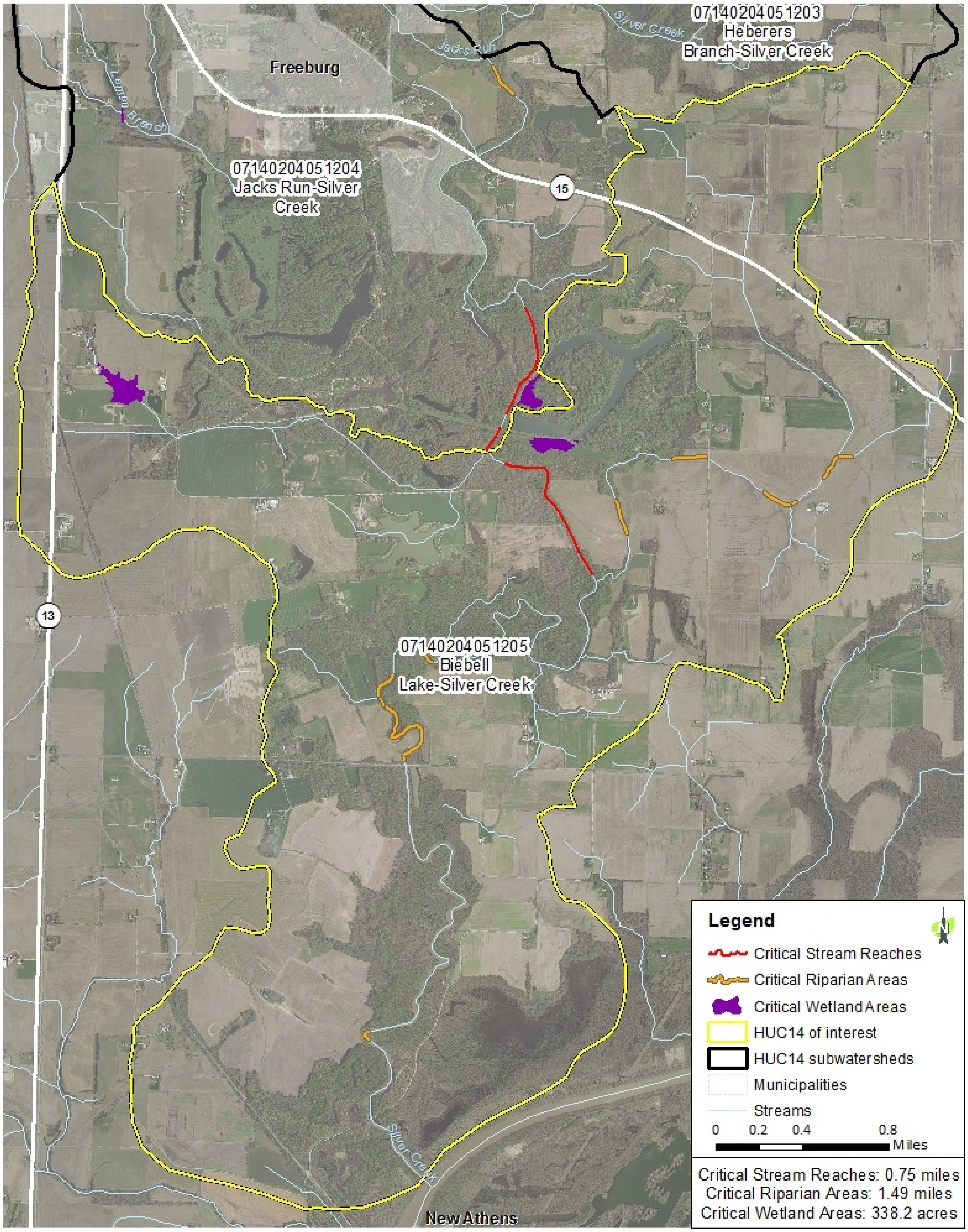
Critical Stream Reaches: 3,955 feet (0.75 miles) Critical Stream Reaches were identified on Silver Creek.

Critical Riparian Areas: 7,844 feet (1.49 miles) Critical Riparian Areas were identified on Silver Creek and its tributaries.

Critical Wetland Areas: 338.2 acres of Critical Wetland Areas were identified.

No **flooding locations** were **identified by stakeholders** in this subwatershed.

HUC 07140204051205 - Biebell Lake-Silver Creek



SECTION 4: OVERVIEW OF MANAGEMENT MEASURES

The term “Management Measures” or “Best Management Practices” (BMPs) 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, forest, urban, and streams and lakes**.

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

Programmatic Management Measures

Programmatic Management Measures are general remedial, preventive, and policy Management Measures that can be applied across the watershed by various stakeholders, including policy-makers.

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.

Federal and State Programs

Primary goal addressed: 1. Improve Surface Water Quality

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.

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 C.

Flood Damage Prevention Ordinance

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

All of the counties and municipalities 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 the Federal Emergency Management Agency (FEMA). Due to increasing flood risk and flood insurance rates due to 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). 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, such as 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.

Monitoring

Primary goal addressed: 1. Improve Surface Water Quality

Monitoring of water quality, flow, and stream health in the Lower Silver Creek 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 type of monitoring.

Continuous monitoring at the U.S. Geological Survey (USGS) gage 05594800 located on the main stem of Silver Creek (near Freeburg) would provide a broad assessment of surface water quality throughout the year. It will also allow trends to be identified by comparing new data to historical data collected by USGS and the Illinois Water Sciences Center (IWSC) at this location from 1974 to 1997.

In addition, secondary monitoring stations could be added upstream from the USGS gage in order to identify the relative contributions of HUC14 subwatersheds to overall water quality in the larger watershed. Samples could be collected quarterly to determine seasonal variations in water quality. Additional sampling could be done during major storm events. See Section 7 (Implementation) for the monitoring timeline and Appendix D for more detail on the recommended monitoring components.

The following parameters could be monitored:

- Flow
- Sediment (Total Suspended Solids)
- 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)

ISCO sampler collecting water quality data. A sampler like is currently being used for water quality monitoring by NGRREC in the Upper Silver Creek watershed. Photo: University of Delaware.

Native landscaping

Primary goal addressed: 4. Support Healthy Habitat

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. Native plants can be used in rainscaping, flower gardens, roadside ditches, and many other locations. 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. 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 (including conservation easements), creating agriculture zoning districts with very large minimum lot sizes, adopting an open space and parks plan, and adopting 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.

Open space and natural area protection / land conservation. Photo: USEPA.

Private sewage monitoring

Primary goal addressed: 1. Improve Surface Water Quality

Private sewage inspections are required by St. Clair and Madison counties during real estate transactions and are performed following complaints, but these 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. One option for financing sewer improvements is to create a Special Service Area (SSA) on a problem area to collect funds from property owners to collectively fund repairs or connections to municipal wastewater systems.

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. The ACPF GIS tools produced suggested vegetation types for each side of the streams in the watershed (see Appendix C). 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. The program could 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 (2013-2016), 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. 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).

Hydrologic/Flood Study

Primary goal addressed: 2. Reduce flooding and mitigate flood damage

The most recent FEMA Flood Insurance Study in St. Clair County was completed in 2003. Since then, significant development has occurred in the watershed, resulting in increased runoff and a more complex stormwater drainage network. Increased runoff usually comes with increased flood heights. In an effort to reduce impacts from flooding, the Lower Silver Creek watershed would greatly benefit from an updated hydrologic study and updated floodplain maps. Once the updated floodplain has been properly identified, a follow up step to help with flood risk reduction and awareness would be identifying critical facilities (e.g., fire stations, police stations, schools, hospitals) and infrastructure that are in the floodplain and other flooding locations. As significant flooding has been noted outside of mapped floodplains, it is reasonable to assume that some of that flooding is from outdated maps which no longer properly represent the one percent annual chance exceedance floodplain.

Site-Specific Management Measures

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

Agricultural Management 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 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)

ACNMP 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, such as swamp areas in the Silver Creek corridor, can be dredged to improve flood storage while retaining wildlife habitat.

Wetlands at the Silver Creek Nature Preserve. Photo: HeartLands Conservancy

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 (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

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

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.

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. The city also studied two pilot locations for a six-month period to establish baseline flow data in existing concrete roadside swales. The feasibility study encouraged the implementation of bioswales and other stormwater BMPs in areas of new development, particularly in residential parcels, through identified marketing strategies; recommended that city ordinances allow for the utilization of BMPs in both existing and new development; and identified high-priority areas (i.e., residential streets) where existing concrete swales could be retrofitted to bioswales, specifically when the current infrastructure is being repaired or replaced, to cut costs.

Detention basins

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)

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.

Older detention basins may no longer function properly, and would benefit from adding extended detention outlet structures and vegetation, removing sediment, and altering 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. Repair and/or improvement of retention areas are recommended across the county in the St. Clair County Multi-Hazard Mitigation Plan (Appendix C).

Large, regional detention basins serving several municipalities/entities may be an effective option for reducing flood impacts to communities in the Silver Creek corridor. For example, if regional detention basins could store stormwater draining towards Scott Air Force Base from the west during heavy storm events, the flood impacts on the Base would be reduced.

Pervious pavement

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

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.

Rain gardens

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

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 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

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

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.

Single property flood reduction strategies

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

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 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 C. Additional mitigation activities include elevating structures in frequently flooded areas and sanitary sewer line repairs to prevent stormwater infiltration and sewer backups (Appendix C – Management Measures).

To aid homeowners in making decisions about flood risk to their homes, materials about the National Flood Insurance Program (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

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

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 1980's.

The 2011St. Clair County Multi-Hazard Mitigation Plan identified storm drain system improvement projects (Appendix C– 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.

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.

Rain garden. Photo: USEPA.

Pervious pavement. Photo: Philadelphia Water.

Tree planting (e.g.,street trees)

Primary goal addressed: 1. Improve Surface Water Quality
Pollution reduction: 31% sediment, 31% P, 27% N
Cost: $2.78/sq. ft. canopy

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 reduction of stormwater runoff, filtration of 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.

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.

Stream and Lake Management Measures

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 the Silver Creek corridor 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

One of the mitigation actions in the St. Clair County Hazard Mitigation Plan is to "Conduct stream maintenance in Silver Creek" in order to lessen the impacts of flooding on new and existing infrastructure. 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).

Creating a new meandering course for a stream, or reconnecting a cut-off meander, is known as stream re-meandering. This stream restoration practice is appropriate where streams have been highly channelized or where slower flow would be helpful in reducing erosion.

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

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

SECTION 5: MANAGEMENT MEASURES

Management Measure Selection

Best Management Practices (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 C.

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 C).

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 C).

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 7 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, Total Suspended Solids, 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 7. All Management Measures recommended, goals addressed (see goal numbers in Section 2), and pollutant load reduction efficiency.

	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				
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						
Hydrologic/Flood Study	2						
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	3	31%	31%	31%	27%
Stream and Lake Management Measures							
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 8 shows the Site-Specific Management Measures recommended, along with associated costs and estimated pollutant reductions for sediment, Total Suspended Solids (TSS), phosphorus, and nitrogen. All recommendations are for implementation by 2050, the long-term watershed planning horizon.

Agricultural Management Measuresinclude100 acres of *animal waste storage/treatment systems* for livestock waste management. This represents 1.3% of the approximately 7,708 acres of farms with livestock in the watershed.

Bioreactors are recommended at 323 locations, draining approximately 70 acres per bioreactor, for a total of 22,610 acres drained. The locations of 323 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 900 acres of farmland.

Conservation tillage is recommended for 7,738 acres of land. This number is relatively low because conservation tillage is already a popular practice—the 2015 Illinois Department of Agriculture Soil Conservation Survey reported that farmers in St. Clair County used some form of conservation tillage on more than 98% of corn fields and nearly 100% of soybeans fields in 2015.

Contour buffer strips are recommended to cover 167 acres with Critical, Very High, or High runoff risk. This represents 33% of the 507 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 38,692 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 3,063 acres on agricultural land with Critical, Very High, or High runoff risk, as identified in the ACPF. This figure represents 75% 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 200 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 464 acres along streams(assuming a 100-foot buffer width), or 38.3 miles, representing 75% of the 51 miles of streams identified as having poor or moderate riparian condition. The recommended area includes 100% of the Critical Riparian Areas in the watershed (14.1 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 100,000 feet (18.9 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. Over 140,000 feet of terraces have already been created on farmland in St. Clair County between 2010 and 2015.

WASCOBs are recommended for 584 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 671 acres in the watershed. This represents 100% of the Critical Wetland Areas identified using the ACPF and MoRAP's wetland assessment. Much of the area surrounding Silver Creek is suitable for wetlands, including several areas identified as Critical Wetland Areas north of Scott Air Force Base and Route 50. Existing wetlands and sloughs that have filled with sediment over time could also be dredged to improve flood storage and as a part of habitat restoration.

Table 8. 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	$260,000.00	$26,000,000	239	477,566	1,175	4,842
Bioreactors	22,610	acres drained	$ 157.81	$3,568,100	-	-	-	67,101
Comprehensive Nutrient Mgmt Plans (CNMPs)	900	acres	$ 54.97	$49,475	-	-	-	-
Conservation tillage	7,738	acres	$ 58.65	$453,828	1,439	2,878,425	6,747	11,483
Contour buffer strips	167	acres	$ 175.11	$29,272	28	55,658	170	657
Cover crops	38,692	acres	$30.54	$1,181,522	1,840	3,680,850	19,407	86,120
Grassed waterways	3,063	acres	$ 8,653.00	$26,507,503	777	1,554,295	2,305	12,501
Nutrient Management Plans (NMPs)	2,000	acres	$ 13.83	$27,669	-	-	-	-
Ponds	200	acres	$ 15,270.00	$3,054,000	36	84,986	161	460
Riparian buffers	464	acres	$ 52.65	$24,410	1,085	2,170,806	4,633	18,139
Terraces	100,000	feet	$ 3.36	$335,940	0	582	1	4
Water and sediment control basin	584	acres	$ 366.48	$213,861	106	212,809	341	1,191
Wetlands	671	acres	$ 13,162.50	$8,832,038	166	331,939	494	996
Forest related practices								
Forest stand improvement	40	acres	$ 356.30	$14,252	3	5,306	14	62
Urban/Other Measures								
Bioswales	10,000	sq. ft.	$18.12	$ 181,200	0	539	0	4
Dry detention basins, new	100	acres	$ 43,804.80	$4,380,480	88	175,344	209	1,070
Wet detention basins, new	100	acres	$ 48,122.10	$4,812,210	91	182,968	362	1,249
Detention basin retrofits (native vegetation buffers, etc.)	79	acres	$ 15,236.94	$1,200,671	63	175,417	285	1,124
Detention basin maintenance (dredging, mowing, burning, invasives, etc.)	79	acres	$ 992.09	$78,177	n/a	n/a	n/a	n/a
Pervious pavement	100	acres	$100,557.50	$10,055,750	137	274,451	523	3,032
Rain gardens	20,000	sq. ft	$ 9.27	$185,440	0	938	1	6
Rainwater harvesting and reuse	100	rain barrels/ cisterns	$ 236.93	$23,693	n/a	n/a	n/a	n/a
Single property flood reduction strategies	150	properties	$ 2,000.00	$ 300,000	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	25	49,480	128	499
Waterways								
Logjam removal	500	feet	$ 31.20	$15,600	n/a	n/a	n/a	n/a
Shoreline stabilization	4,589	feet	$ 83.48	$383,101	1,411	2,821,985	2,846	8,612
Streambank & channel restoration	228,254	feet	$ 78.00	$17,803,843	2,278	4,205,898	11,087	49,202
TOTAL				**$ 86,793,176**	**9,815**	**19,340,242**	**50,889**	**268,353**
% Reduction From Current Total:					**15.2%**	**15.0%**	**30.6%**	**34.6%**

Forest Management Measures consist of 40 acres of *forest stand improvement.* This represents 0.22% of the forested area in the watershed (18,499 acres).

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

New dry detention basins (100 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 1 acre, 200 acres of basins represents 200 new basins in total.

Detention basin retrofits are recommended for 79 acres of existing detention/retention basins, which represents 20% of the 394 detention basins identified from aerial photographs in the watershed, assuming an average basin size of 1 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 79 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 2.8% of the total current impervious area in the watershed (approximately 3,527 acres). 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 10,000feet 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 eight municipalities in the watershed, the 100,000 feet of maintenance and expansion comes to 1,250 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 150 properties. This number is a best estimate of properties with moderate to serious flooding/groundwater issues requiring upgrades by 2050. 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.

Storm drain system maintenance and expansion is recommended for 10,000 feet of storm drains, ditches, and sanitary sewers (expansion of 10,000 feet plus maintenance of all existing systems).

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. This is approximately 4% of the "high" and "very high" priority planting locations identified by Davey Resource Group in a 2018 analysis (see Appendix A).

Stream and Lake Management Measures recommended include 500 feet of *logjam removal*s, which represents 0.02% of the streams in the watershed. Some stream reaches with many trees and unstable streambanks may need to have multiple logjams removed.

Shoreline stabilization is recommended for 4,589 feet of lake shoreline. This represents 10% of the total perimeter of the shorelines of named, major lakes in the watershed.

*Streambank and channel restoration*s recommended for 228,254 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 ACPF are provided in a spreadsheet with longitude and latitude data in Appendix G. Table 9 summarizes the Site-Specific Management Measures provided in Appendix G by HUC14 subwatershed.

Table 9.Area/length of three Site-Specific Management Measures (summary of Appendix G), and area/length of Critical Areas (summary of Critical Areas information in Section 3), organized by HUC14 subwatersheds. Greatest values in each category are shown in **bold red font**.

HUC14 code	HUC14 name	Contour buffer strips (acres)	Grassed waterways (feet)	WASCOBs (acres)	Riparian area restoration (Critical Riparian Areas) (feet)	Wetland restoration (Critical Wetland Areas) (acres)**	Streambank stabilization (miles)***	Critical Stream Reaches (miles)
07140204050701	Upper Ogles Creek	46	122,717	48		9.8	1.13	
07140204050702	Lower Ogles Creek	30	54,158	12		5.4	3.69	
07140204050801	07140204050801-Little Silver Creek	24	527,173	30	9,346	80.7	2.13	
07140204050802	Emerald Mound-Little Silver Creek	53	**647,881**	16	4,639	111.3	4.04	0.10
07140204050803	East Branch Little Silver Creek	22	631,631	48	**15,902**	60.4	1.16	0.05
07140204050804	City of Lebanon-Little Silver Creek	5	252,983	15	2,374	28.8	2.23	
07140204050805	Village of Summerfield-Little Silver Creek	17	390,986	37	942	43.7	1.19	
07140204050903	07140204050903-Silver Creek	13	51,013	3		6.4	0.39	0.39
07140204050904	Engle Creek	15	105,147	17		15.4	3.94	0.16
07140204050905	Hageman Creek-Silver Creek	**75**	371,436	**60**	6,538	206.3	8.44	**5.99**
07140204051001	Scott Air Force Base Pond-Silver Creek	22	397,924	10	0	0.4	3.95	
07140204051002	07140204051002-Union Cemetery	1	200,451	12	1,057	0.8	0.91	
07140204051003	Hog River-Silver Creek	2	207,797	17	5,573		0.70	0.30
07140204051101	Upper Loop Creek	11	2,624	19	1,147	57.4	0.18	0.08
07140204051102	Ash Creek	7	141,739	1	2,450	6.3	5.07	
07140204051103	Hazel Creek	29	307	21		9.6	2.08	
07140204051104	Lower Loop Creek	17	152,054	22	6,633	6.8		0.39
07140204051201	City of Mascoutah	3	39,800	8	6,045		**7.08**	
07140204051202	Funk Cemetery-Silver Creek	6	54,586	2	3,067		4.18	
07140204051203	Heberers Branch-Silver Creek	20	133,067	33		9.7	6.90	
07140204051204	Jacks Run-Silver Creek	14	133,067	13	898	5.4	6.30	0.67
07140204051205	Biebell Lake-Silver Creek	33	224,122	27	7,844	**338.2**	65.69	0.75
TOTAL*		466	1,476,043	470	74,456	1002.7	131.39	8.89

* Totals for BMPs may be lower than the sum of those identified in each HUC14 because some BMPs overlap two or more HUC14 subwatersheds.
** Includes Nutrient Wetland Areas identified by the ACPF and wetland areas identified by MORAP wetland assessment.
*** Areas where aerial assessment showed "poor" streambank condition.

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 Lower Silver Creek watershed and the Watershed Plan.”

The Lower Silver Creek watershed faces challenges and threats from high nutrient and sediment loads, streambank erosion and channelization, increasing development and land use changes, invasive species, and widespread flooding. 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 Lower Silver Creek watershed is held as private property, education and outreach efforts to engage those 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 staffs, 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 Silver Creek and its tributaries. As these stakeholders take action, the water quality and overall health of the watershed will improve.

Open House, February 2017

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 10. 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

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

- St. Clair County government departments and elected officials
- Municipal staff, township staff, and elected officials (including MS4 Co-Permittee Group Members)
- Community Partnership Group members
- Home Owners' Associations (HOAs)
- Developers
- Residents with property adjacent to Silver Creek and its tributaries
- Residents throughout the watershed
- NRCS and Soil and Water Conservation Districts (SWCDs)
- Farmers and farm groups
- Students and schools/universities
- 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. St. Clair County staff, members of the Community Partnership Group, and watershed residents can be messengers to reach the decision-maker audience.

Jurisdictions with Phase II MS4sare 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 health of the soil and the landscape for the next generation is likely to resonate with this audience.

Residents with property adjacent to Silver 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 HeartLands Conservancy's website at www.heartlandsconservancy.org/silvercreek.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.

After the plan is complete

Table 10 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 meetings may be held annually to include more stakeholders and the public. Plan revision should be considered at five-year intervals.

The Education Plan strategies 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 Implementation Schedule also uses these timeframe options.

Table 10. 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; CRP: Conservation Reserve 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, and flooding • 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	St. Clair County, Madison County, Clinton 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 5-year intervals.	Short-Term, Mid-Term	Community Partnership Group, 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, NRCS, 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	SWCD, NRCS, Farm Bureau, NGRREC	• 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	St. Clair County, Madison County, Clinton 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	Medium-Term	HLC, St. Clair County, municipalities, 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 and named streams with signs • Post warning signs about littering and illegal dumping	Medium-Term	St. Clair County, Madison County	• People better understand the term "watershed." • Littering and illegal dumping is reduced. • Awareness of the watershed's boundaries is increased.	$2,000 (20 signs)
School Projects	Students, Parents, Teachers, Administrators	• Develop age-appropriate project opportunities for schools or colleges such as rain gauge maintenance, rainscaping, wildlife habitat restoration, and geocaching.	Long-term	Schools, colleges	• 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

Program	Target Audience(s)	Strategies	Schedule	Lead & Supporting Orgs	Desired Outcomes/Issues Addressed	Est. Cost
Objective 6.4: Develop public recognition programs focused on the Watershed Plan’s goals.						
Watershed Protection Awareness	All Stakeholders	• Develop messaging based on goals in the Watershed Plan and disseminate the message using news media, social media, brochures, and other materials.	Medium-term	St. Clair County, Madison County, Clinton County	• 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 11.

Table 11. 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 stream flow, water quality, and groups working on environmental protection in your watershed, from USEPA. http://cfpub.epa.gov/surf/locate/index.cfm
Storm drain stenciling	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: https://sustainablebackyard.org/ 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. Successful implementation will require stakeholders working separately and 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 timeframe 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 12).

Table 12. 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	High	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 12 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 12 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	Municipalities, townships, counties	Medium	Municipalities, arborists, contractors, NRCS	Short term
Stream and Lake Management Measures				
Logjam removal	Landowners/ farmers, residents, municipalities	High	Ecological consultant/ contractor	Short term
Streambank & channel 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 13 shows some of the potential funding sources for agricultural and stream and lake BMPs recommended in this plan. Table 14 provides a longer list of funding opportunities for management measures in this plan. More detail about these opportunities is included in Appendix E.

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 13. 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, USFWS
Stream and Lake Management Measures	
Shoreline restoration	EQIP, 319
Streambank & channel restoration	SSRP, 319

Table 14. Funding sources for management measures recommended. See Appendix E 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 Defense	Readiness and Environmental Protection Integration Program (REPI)	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 14. (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 Plan

As funding allows, the collection and analysis of monitoring data should be expanded in the watershed. For example, sampling at Silver 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 D). Monitoring can be conducted on a 3-5 year cycle through the year 2030 (Table 14). Quality Assurance Project Plans (QAPP) should be developed for those monitoring opportunities that are selected for implementation in support of the watershed plan.

Table 14. 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 15).

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 5-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 (1-10 years; 2018-2028), medium-term (10-20 years; 2028-2038), 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:

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 F.

Table 15. 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 F.

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 Little Silver Creek, Loop Creek, and Ogles 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 mainstem Silver Creek, plus flow data collected from monitoring at other HUC14 locations. Data correlated with rainfall.
	Flood Protection Ordinances: Enacting local ordinances to restrict construction in floodplains and flood-prone 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 15 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 CREP, 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 who rate watershed-related presentations and other public education and outreach activities and good or excellent and percent who commit to action or follow-up with the county. Percent of schools that incorporate a watershed-based project or learning session.

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 C 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 C 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 C 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 C 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 C 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 C 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 C 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, etc.).

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 C 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 C 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 C 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 C for more detail.

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

LOWER

SILVER CREEK

WATERSHED PLAN

HEARTLANDS

CONSERVANCY

Investing In The Nature Of Southwestern Illinois

APPENDIX A -

LOWER SILVER CREEK WATERSHED

WATERSHED RESOURCES INVENTORY (WRI)

Table of Contents

Introduction

The Lower Silver Creek watershed is located east of St. Louis, Missouri in southwestern Illinois. The watershed drains parts of Madison, Clinton, and St. Clair Counties, with most of its area in St. Clair County. The watershed is part of the Silver Creek HUC10 watershed (HUC 0714020405) which covers over 240,000 acres in five counties. The watershed includes 454 stream miles which drain to the Kaskaskia River and then to the Mississippi River.

As of the 2010 census, there were approximately 77,568 residents in the Lower Silver Creek watershed. The majority of this population resides in municipalities such as O'Fallon, Shiloh, Lebanon, Mascoutah, and Freeburg.

The Illinois Environmental Protection Agency (IEPA) has designated three streams in the Lower Silver Creek watershed as impaired (Ogles Creek, Little Silver Creek, and Loop Creek). These waterways have been classified as impaired because of high concentrations of phosphorous and sediment/silt, as well as low levels of dissolved oxygen. In addition to water quality issues, the watershed experiences flooding issues. Properties in both watersheds have experienced recurring flooding both within and outside the 100-year floodplain, causing risk and damage to property and threatening life safety.

The watershed plan for the Lower Silver Creek watershed aims to address these issues and others. Funded by Illinois EPA through a 604(b) grant authorized under the Clean Water Act, the watershed plan aims to focus efforts on protection and restoration of water resources within the watershed to reduce non-point source pollution. The plan will aid stakeholders in identifying and implementing water quality and flood mitigation improvements within the watersheds.

This Watershed Resources Inventory constitutes the first step of the plan. Existing conditions in several categories are identified and explored, including watershed boundaries, climate, geology, soils, watershed jurisdictions, demographics, land use and land cover, watershed drainage, flooding, and water quality.

Several challenges and threats to the watershed are identified in this Inventory. Manmade changes to the waterways and the landscape have contributed to declining surface water quality and problematic flooding issues. Approximately 22% of the streams in the watershed are highly channelized. Streambank erosion is high along 56% of the stream length assessed in the watershed, causing sedimentation and siltation in the waterways. Fertilizer use on agricultural, commercial, and residential land is contributing to phosphorus loading, and increased development is contributing to both water quality and flooding issues.

Stakeholder outreach complemented the data collection for this Inventory and educated watershed residents and business owners about the aims of the Plan. More than 50 key stakeholders from 25 entities have attended meetings with the planning team individually or in small groups, and approximately 24 people attended two informational Open House events about the Plan.

This Inventory contains the data to be used in identifying and prioritizing Best Management Practices (BMPs) in the next phase of the watershed plan development.

Watershed Boundaries

The U.S. Geological Survey (USGS) has established the hydrologic units system to delineate, locate and define watershed 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 Lower Silver Creek watershed is in the larger Lower Kaskaskia watershed (HUC 07140204; Figure A.1) and HUC 0714020405, a HUC10 that extends from Macoupin and Montgomery counties in the north, through Madison County, and into St. Clair County. Table A.1 shows the contributing area for the HUC8 and HUC10 watersheds as well as the project area.

Table A.1. Area of the hydrologic units associated with the Lower Silver Creek Watershed Plan project area

Watershed	Area (acres)
Project area	125,978
HUC10 level (Silver Creek, HUC 0714020405)	244,252
HUC8 level (Lower Kaskaskia, HUC 07140204)	1,028,836

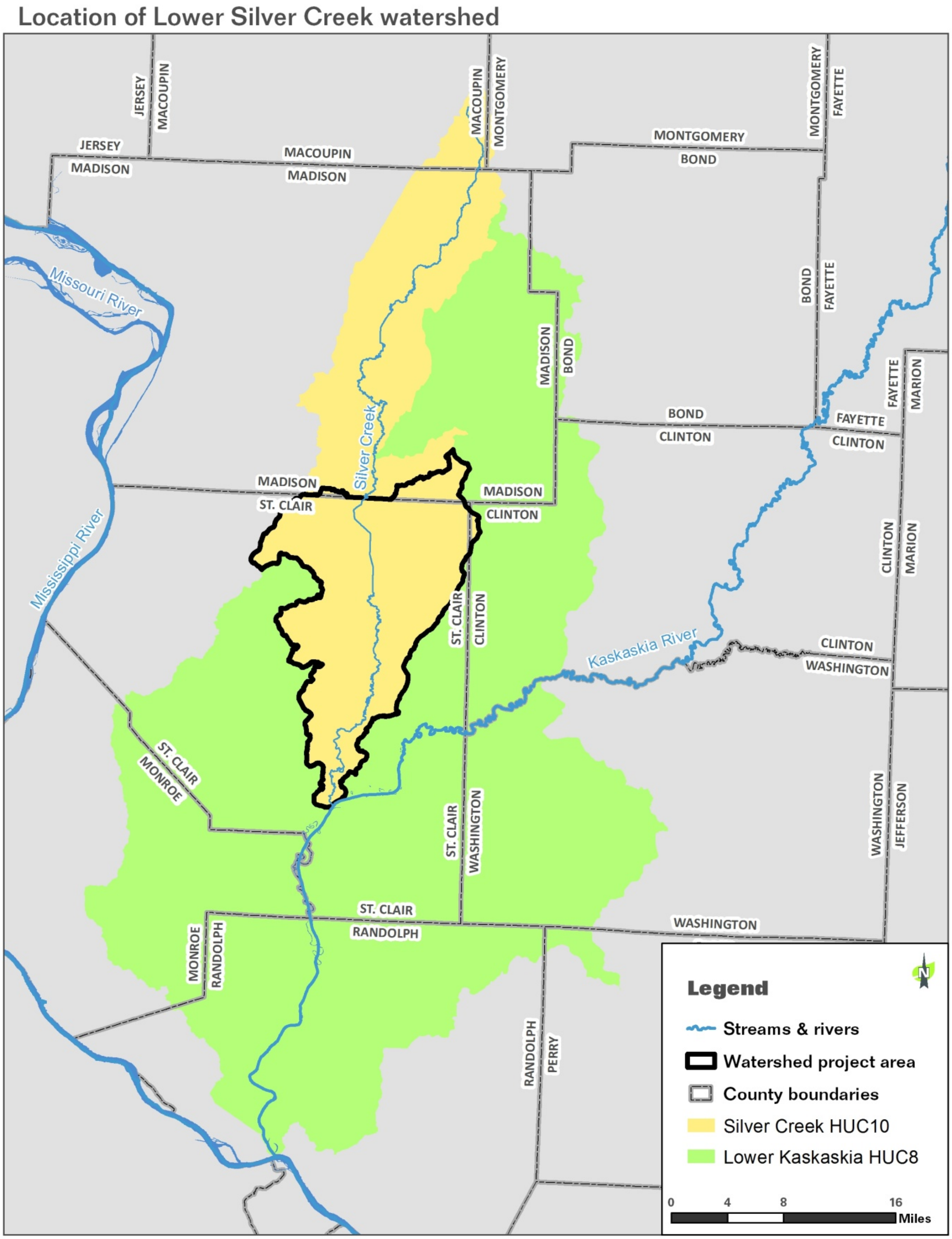


Figure A.1. The Lower Silver Creek Watershed Plan project area in context of the Lower Kaskaskia HUC8 watershed.

Subwatersheds

The project area contains numerous smaller subwatersheds, or hydrologic units, including seven HUC12s and 22 HUC14s (Table A.2 and Figure A.2). The HUC14s were delineated using methods employed by USGS to define watersheds in the Watershed Boundary Dataset (WBD), a component of the National Hydrography Dataset (NHD). Each HUC12 contains 2-5 HUC14s ranging between 2,800 and 10,600 acres in size. The following pages show the seven HUC12s with their component HUC14s and waterbodies.

Table A.2. HUC14 codes and names for the subwatersheds, as submitted to the WBD.

HUC14 code	HUC14 name	Area (acres)
07140204050701	Upper Ogles Creek	6,611
07140204050702	Lower Ogles Creek	3,745
07140204050801	07140204050801-Little Silver Creek	5,685
07140204050802	Emerald Mound-Little Silver Creek	5,765
07140204050803	East Branch Little Silver Creek	8,253
07140204050804	City of Lebanon-Little Silver Creek	3,437
07140204050805	Village of Summerfield-Little Silver Creek	8,437
07140204050903	07140204050903-Silver Creek	3,323
07140204050904	Engle Creek	7,434
07140204050905	Hageman Creek-Silver Creek	10,664
07140204051001	Scott Air Force Base (AFB) Pond-Silver Creek	4,249
07140204051002	07140204051002-Union Cemetery	5,467
07140204051003	Hog River-Silver Creek	7,061
07140204051101	Upper Loop Creek	6,446
07140204051102	Ash Creek	3,463
07140204051103	Hazel Creek	3,932
07140204051104	Lower Loop Creek	7,662
07140204051201	City of Mascoutah	7,061
07140204051202	Funk Cemetery-Silver Creek	2,881
07140204051203	Heberers Branch-Silver Creek	4,673
07140204051204	Jacks Run-Silver Creek	5,416
07140204051205	Biebell Lake-Silver Creek	6,602

Subwatersheds: HUC12s & HUC14s

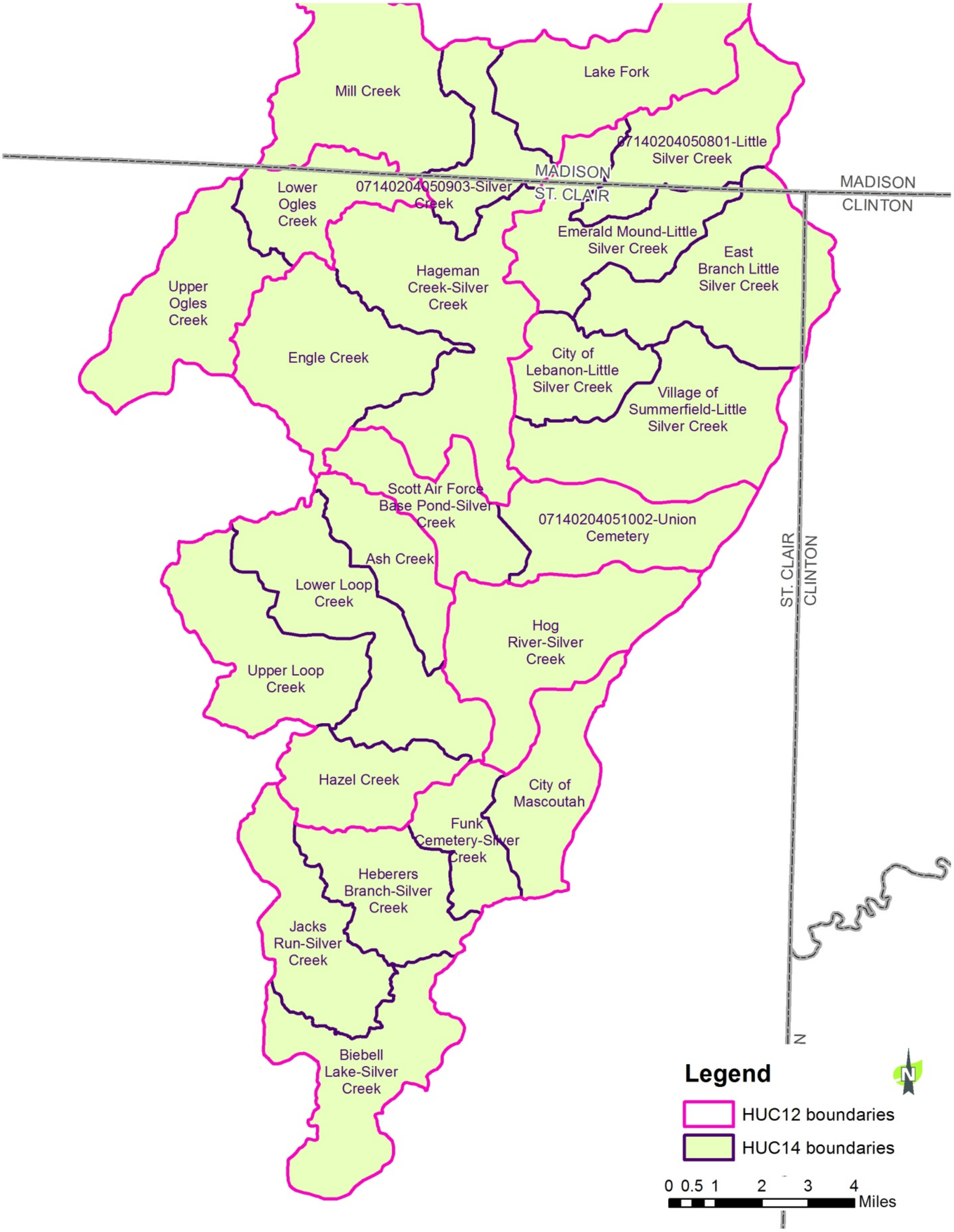
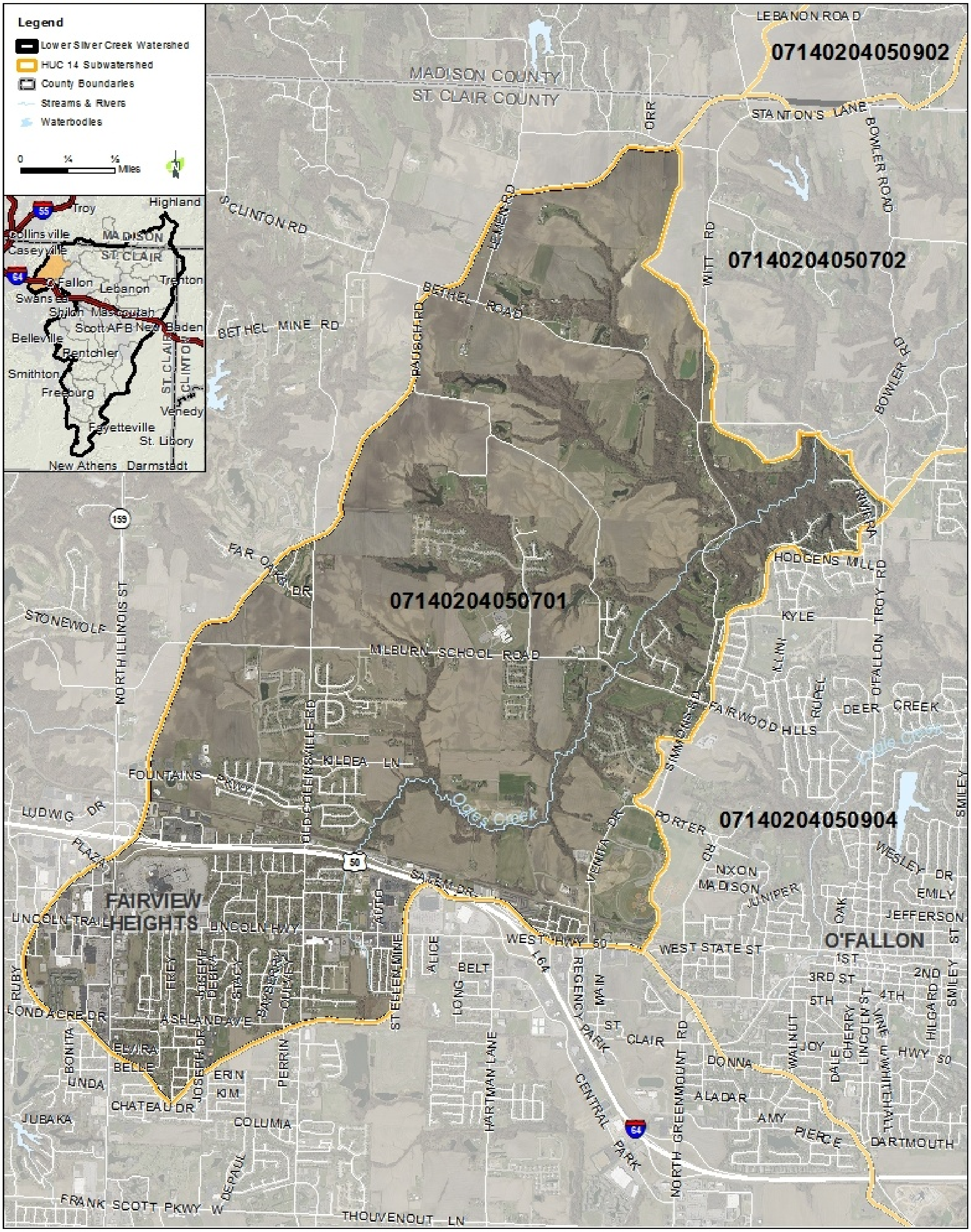
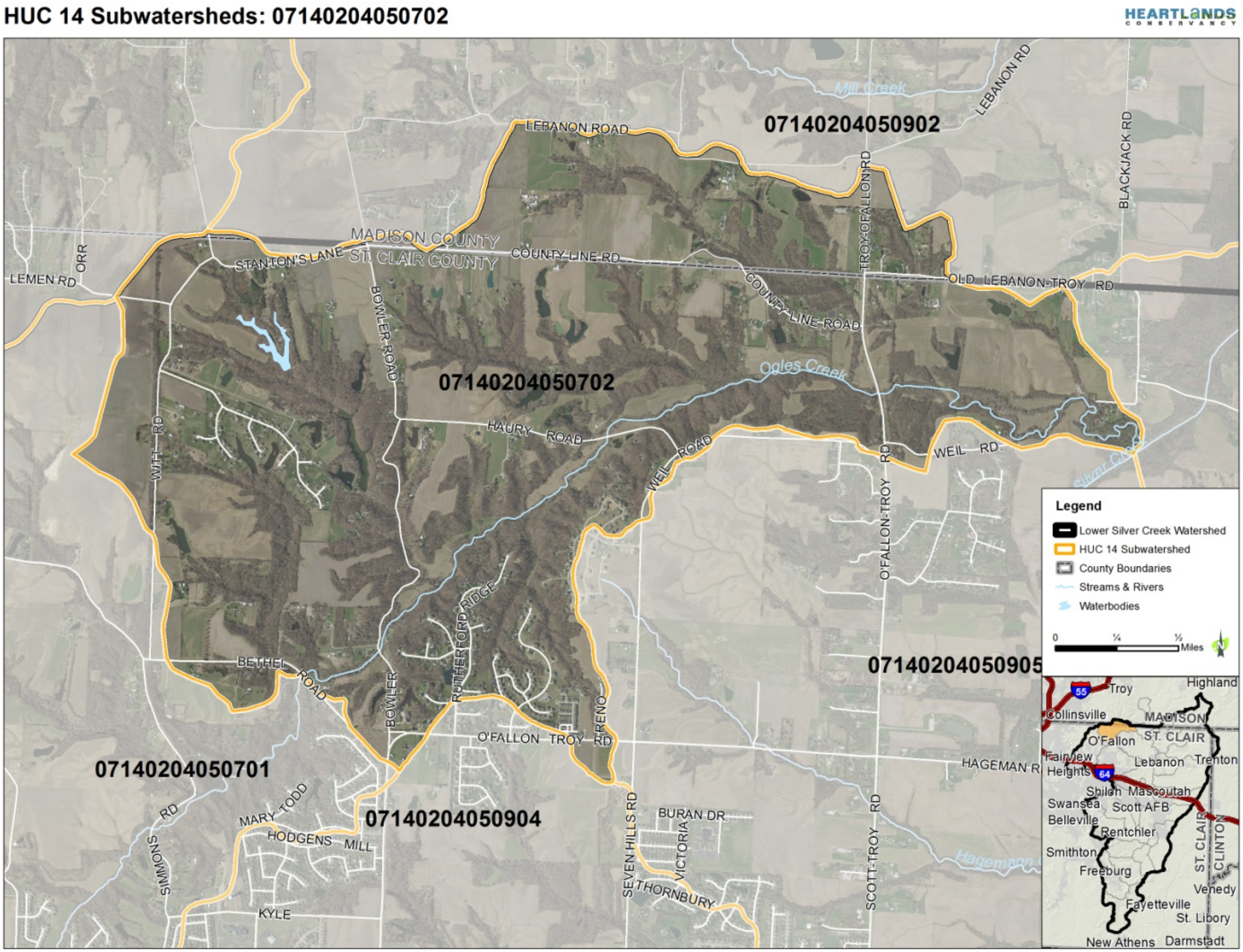


Figure A.2. Subwatersheds map.

HUC 14 Subwatersheds: 07140204050701



HUC 14 Subwatersheds: 07140204050702



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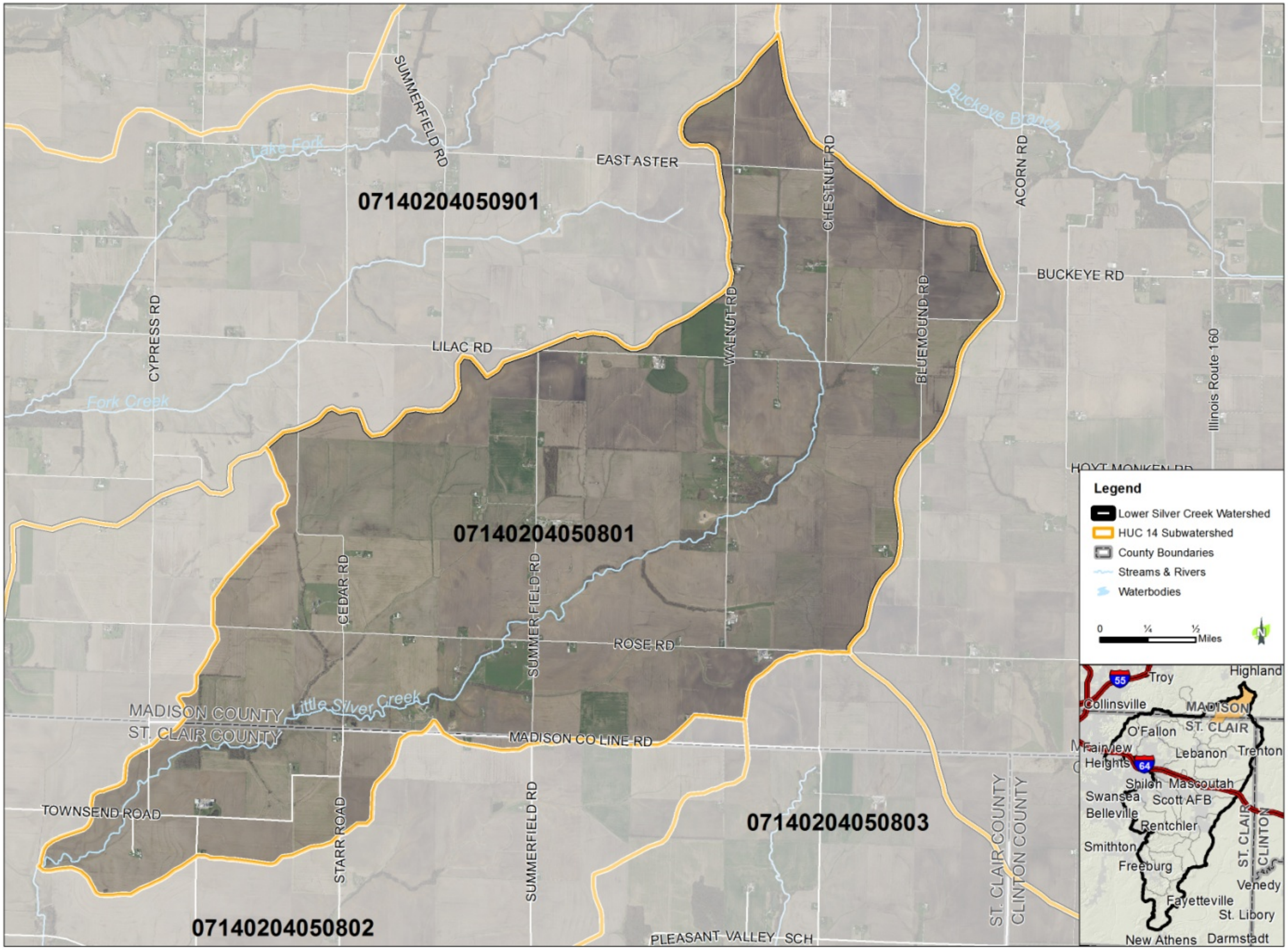

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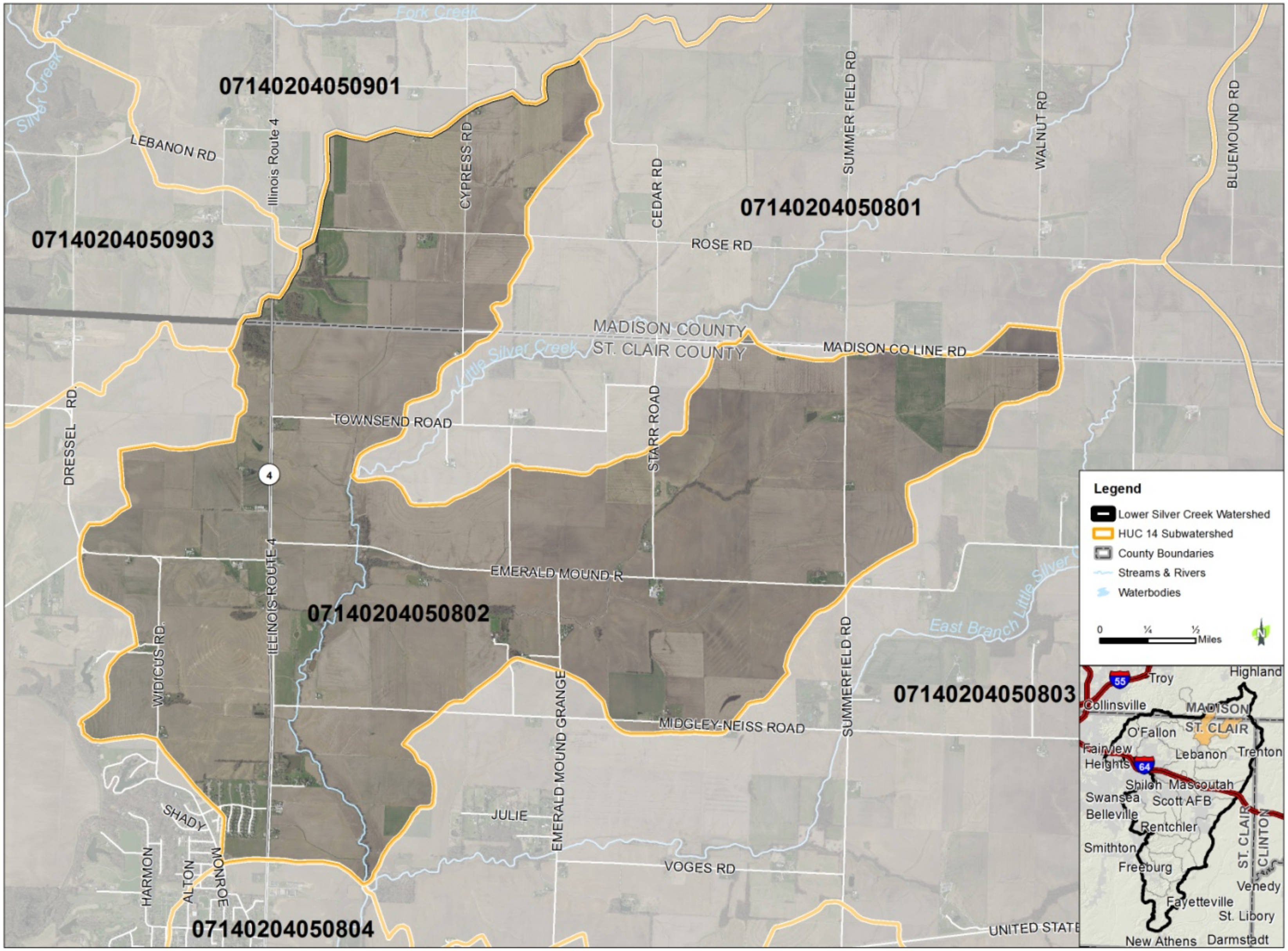

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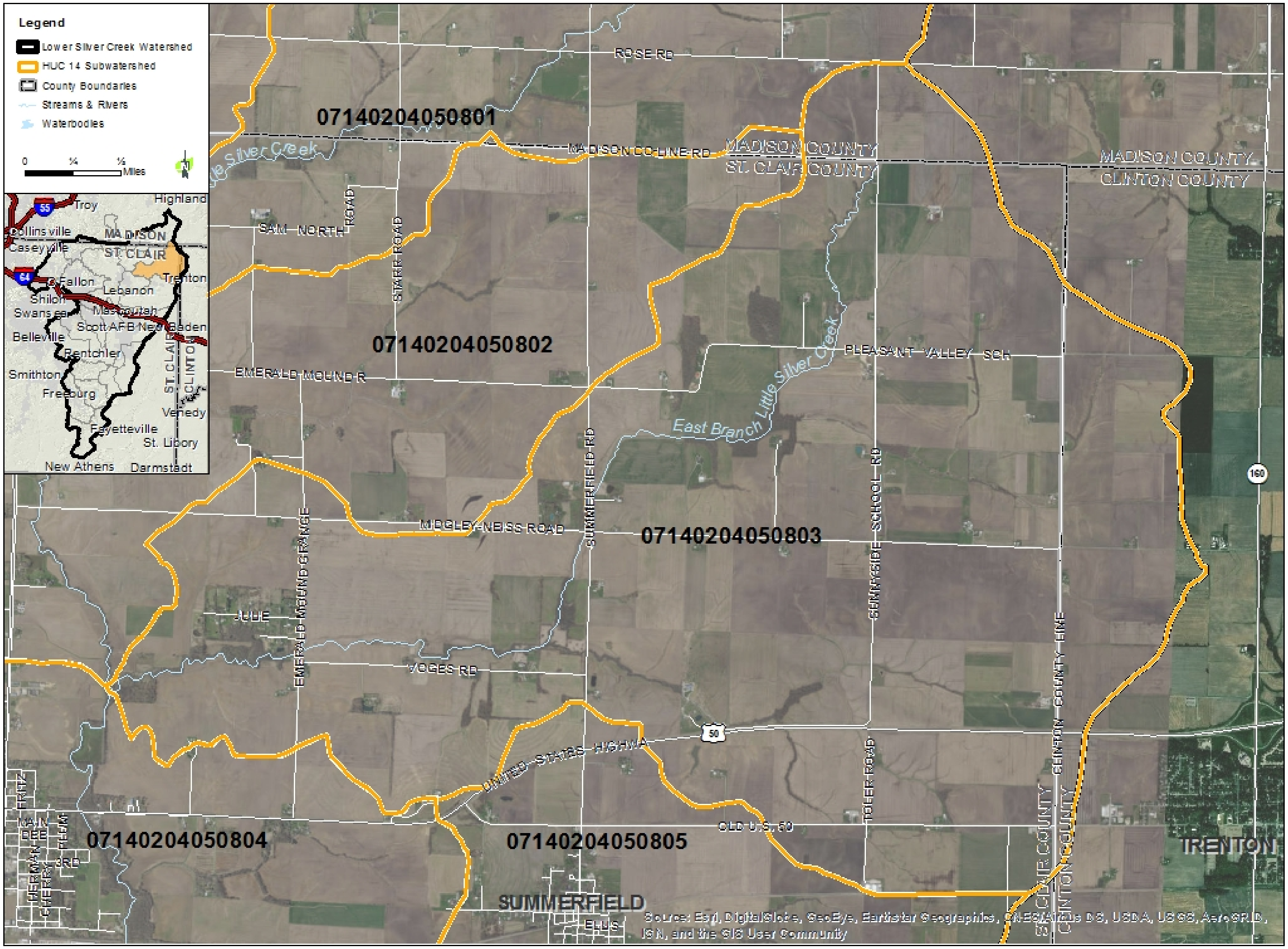

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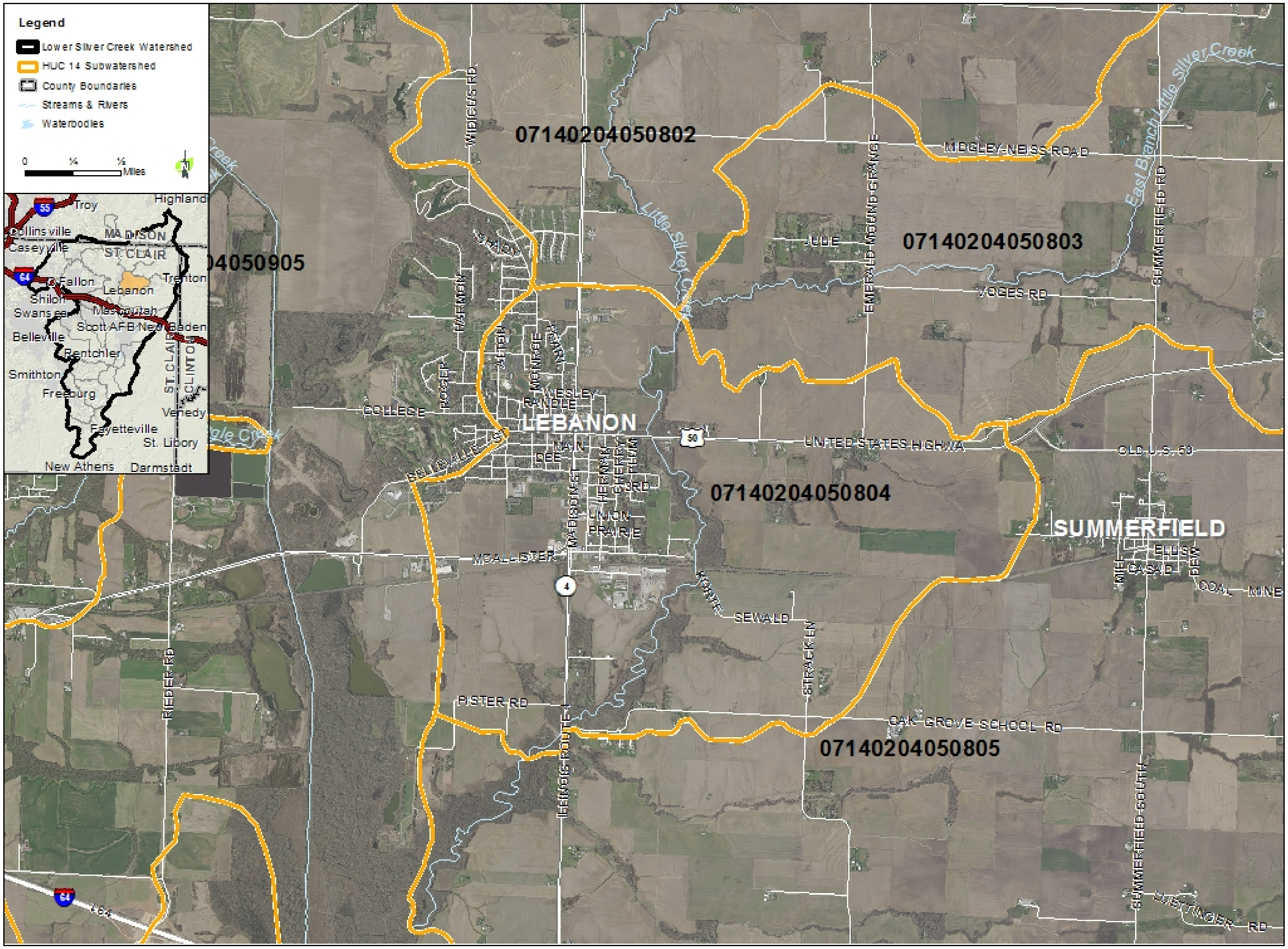

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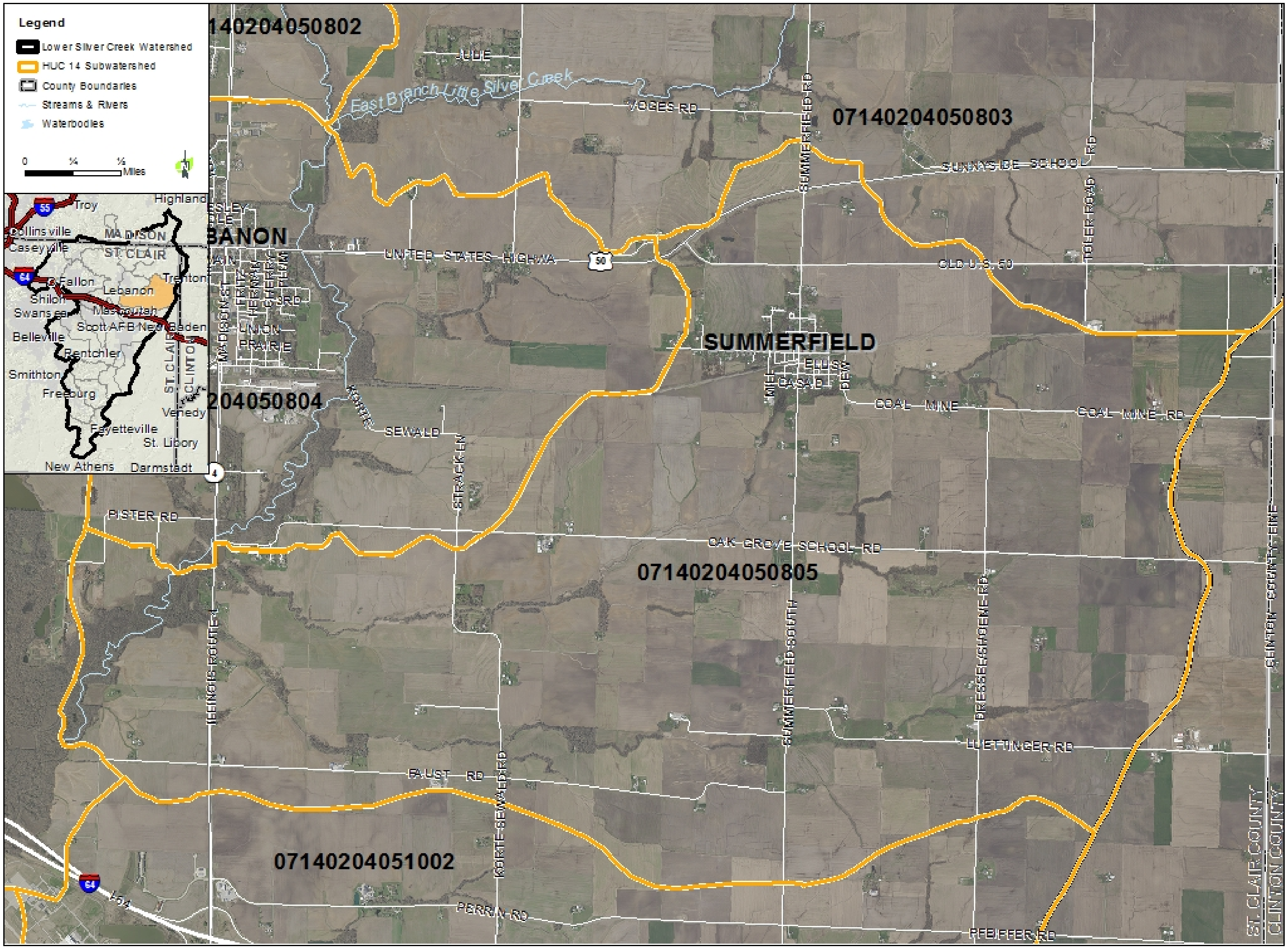

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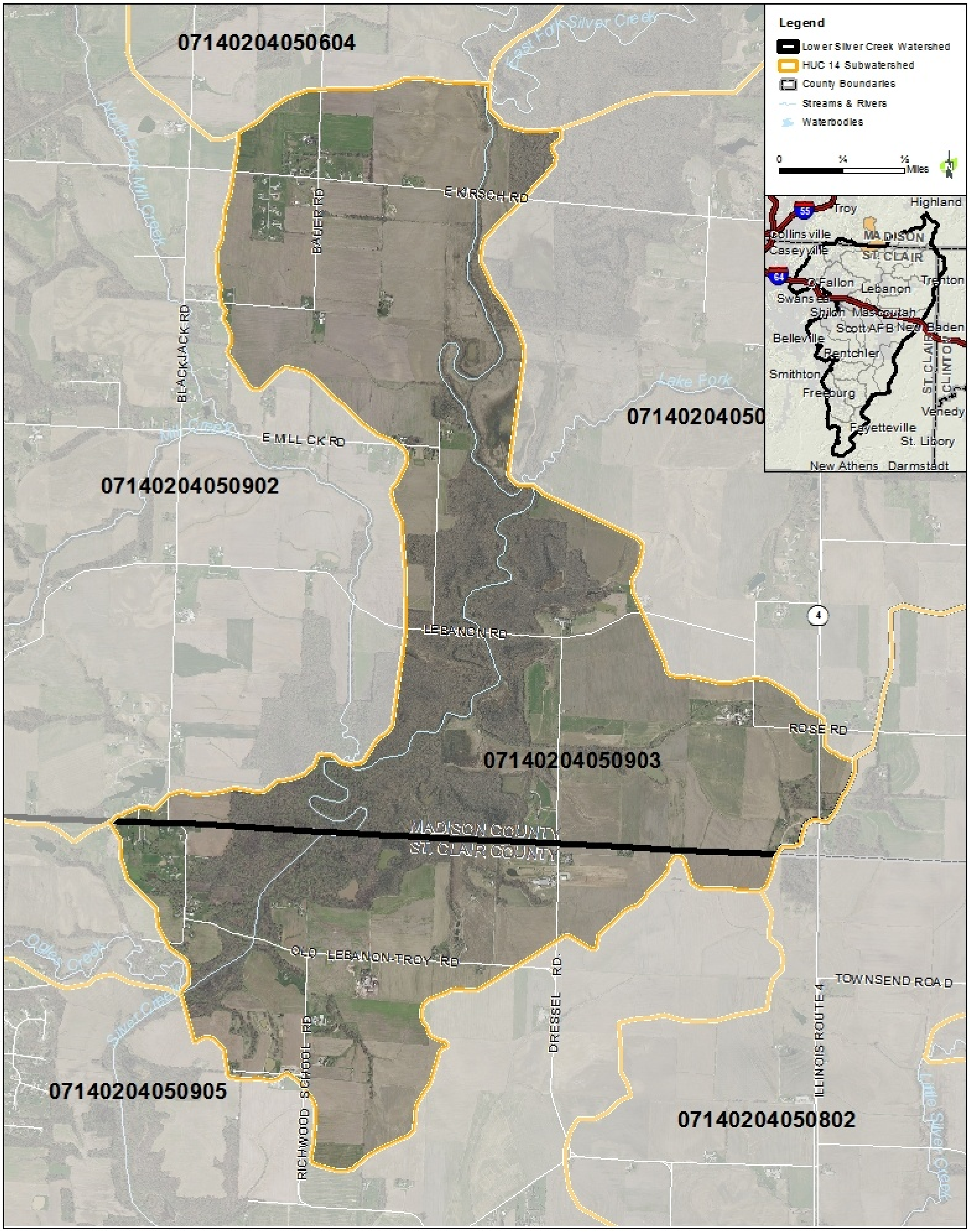

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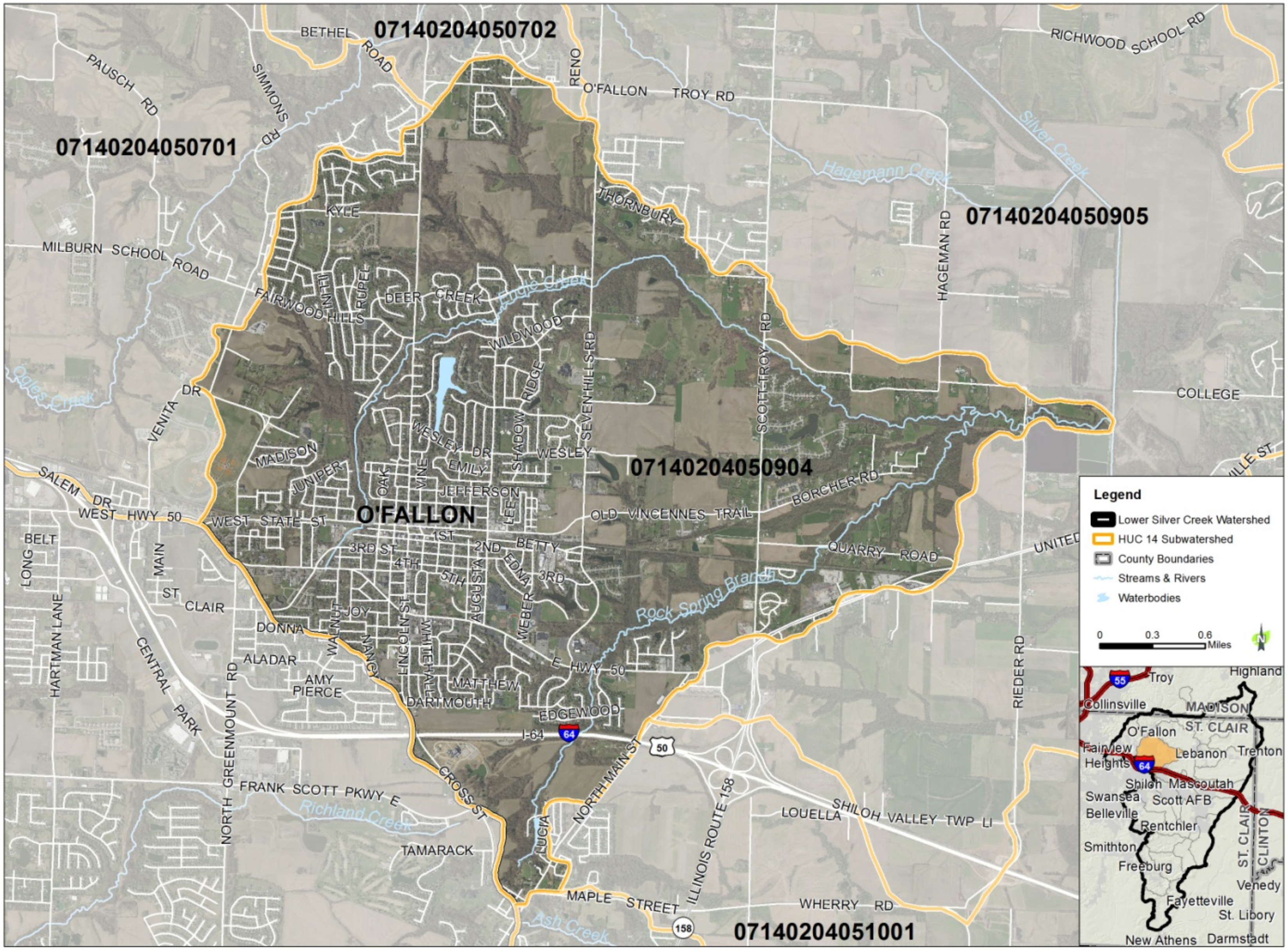

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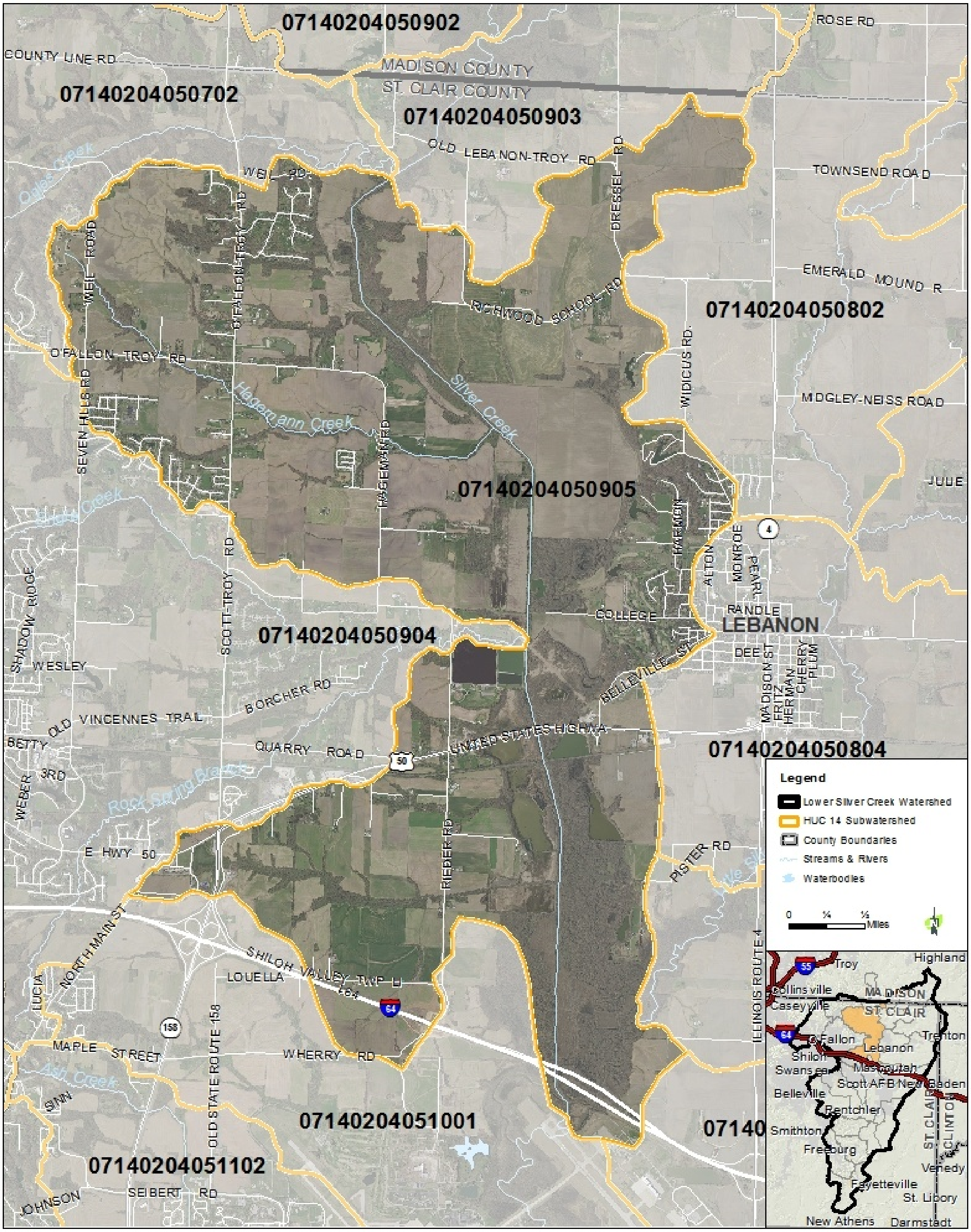

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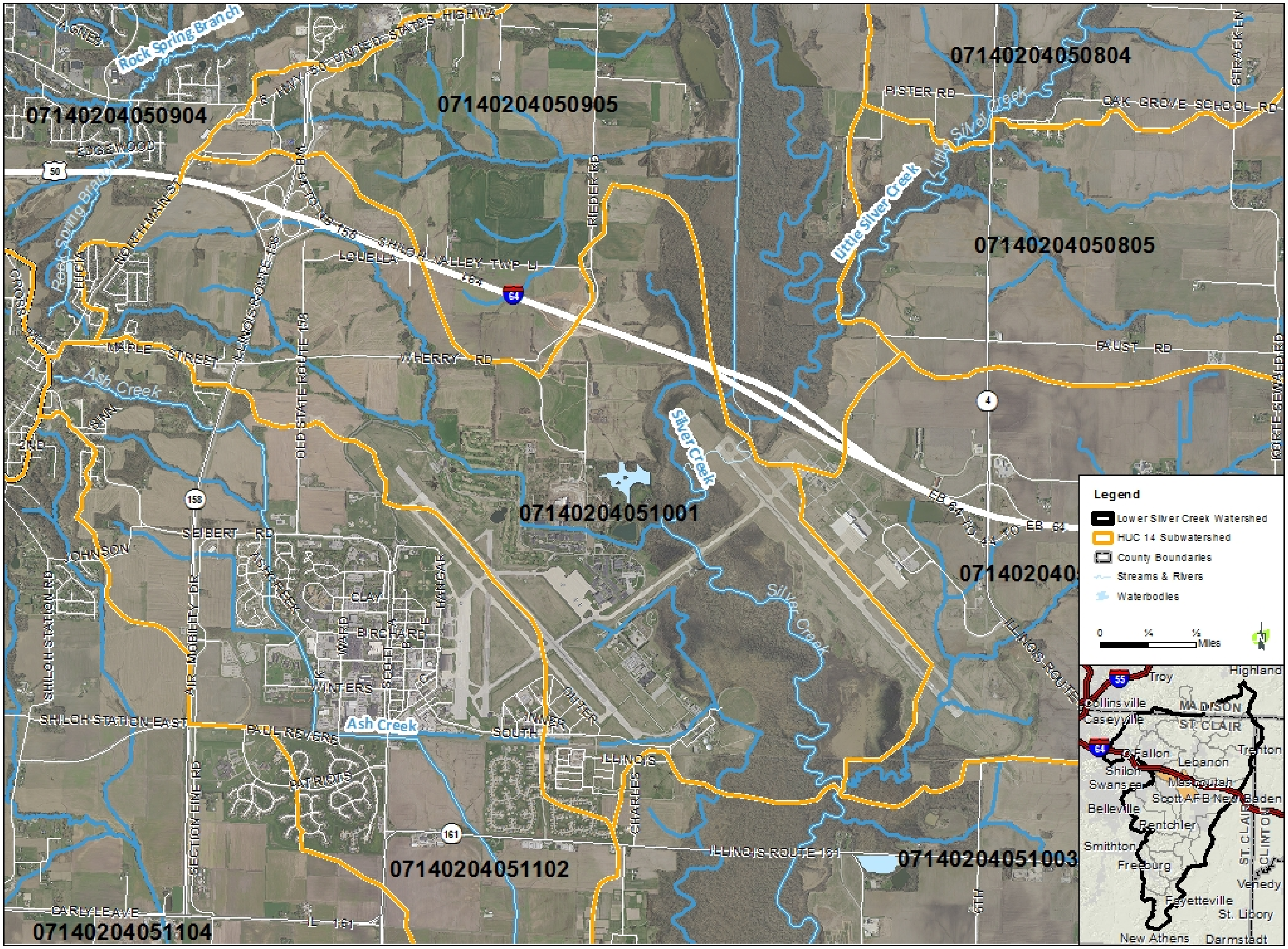
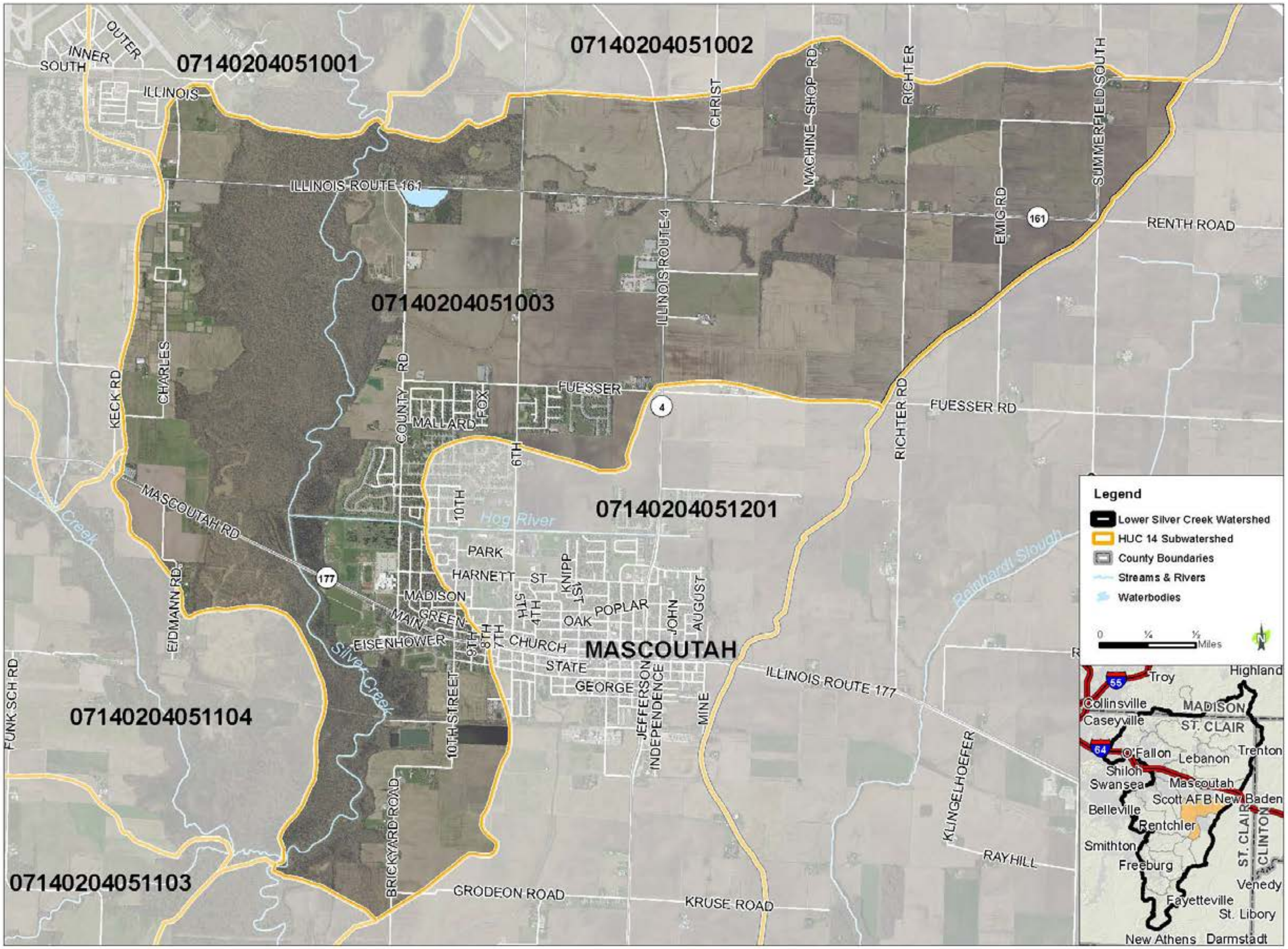
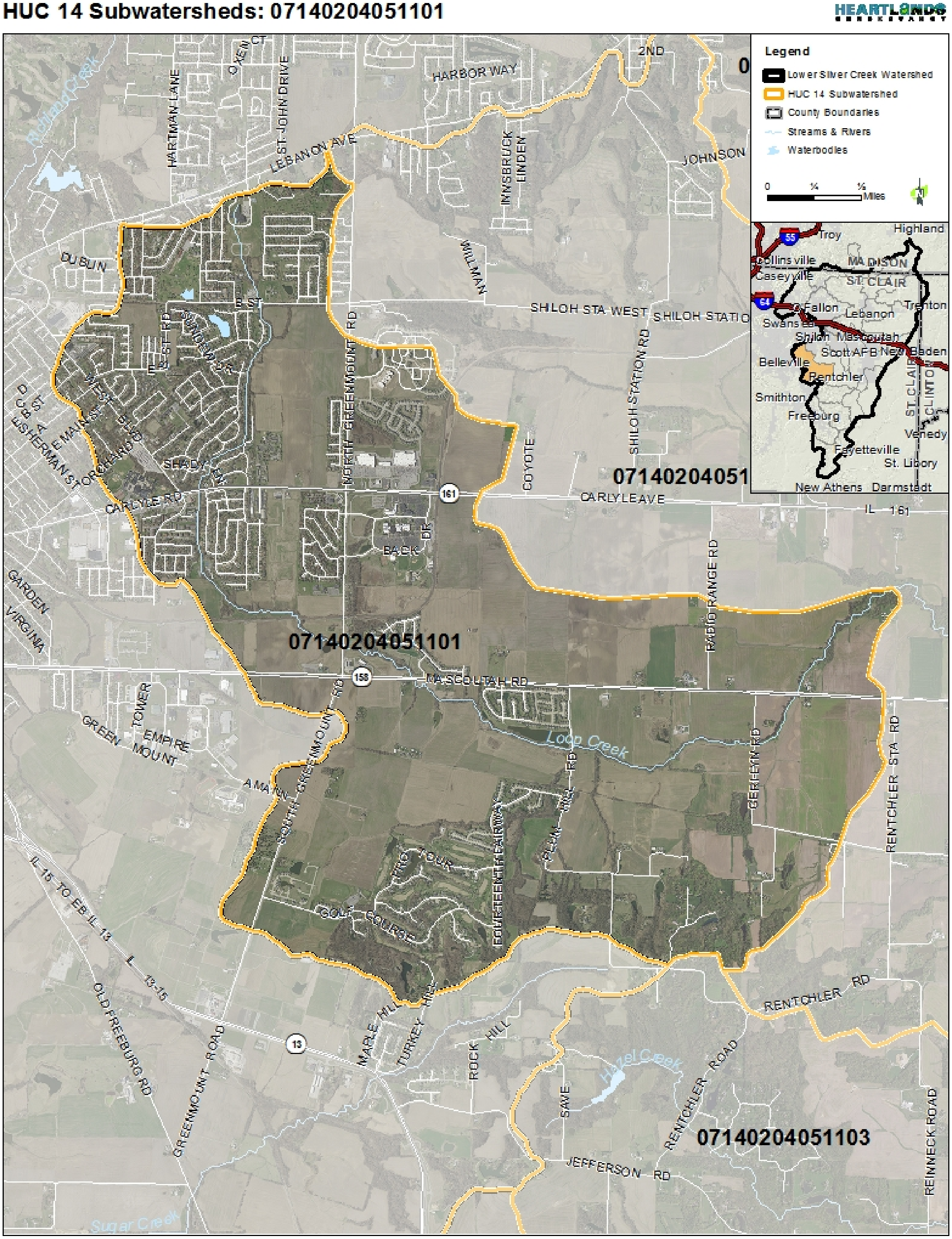


HUC 14 Subwatersheds: 07140204051002

HUC 14 Subwatersheds: 07140204051003



HUC 14 Subwatersheds: 07140204051101



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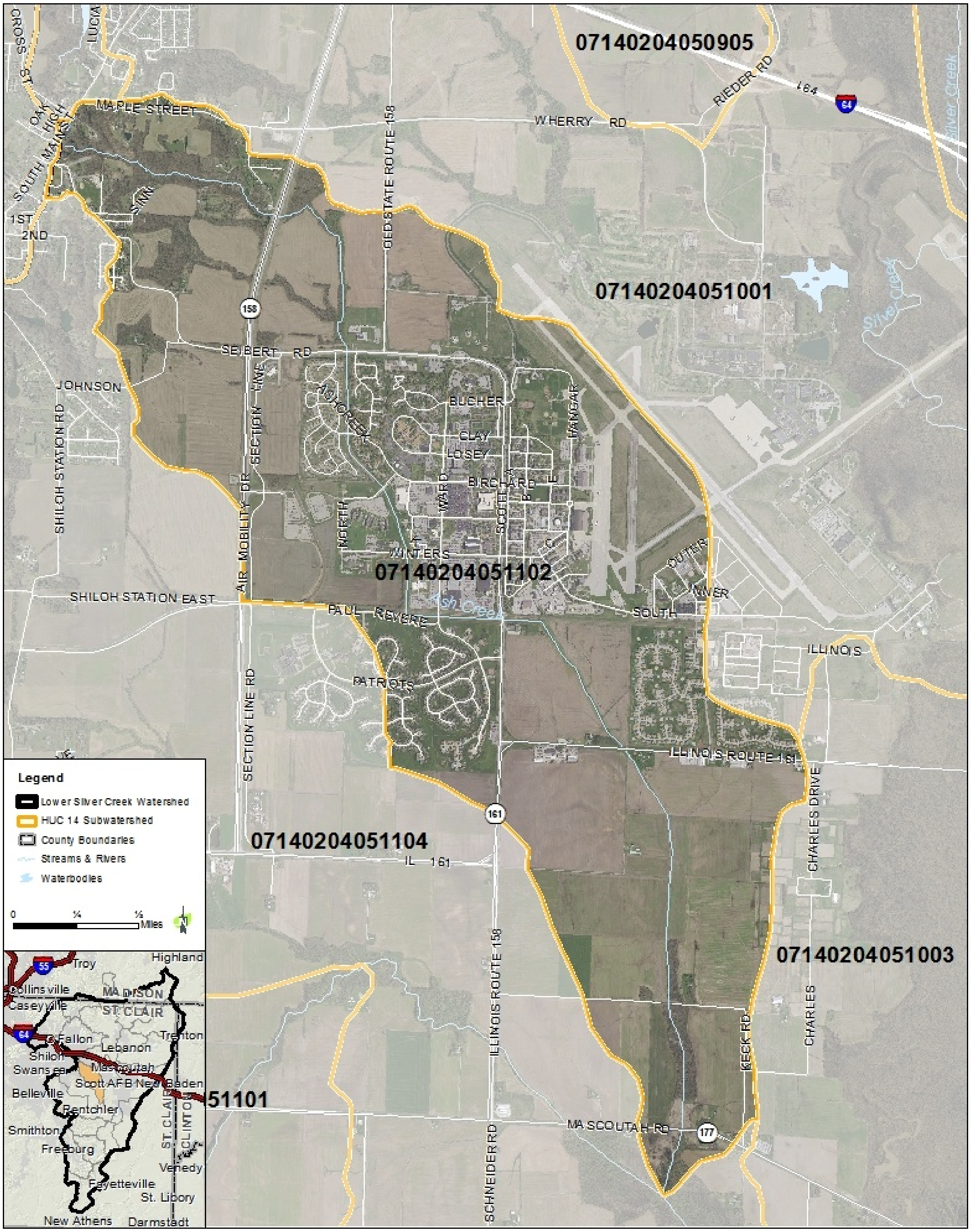

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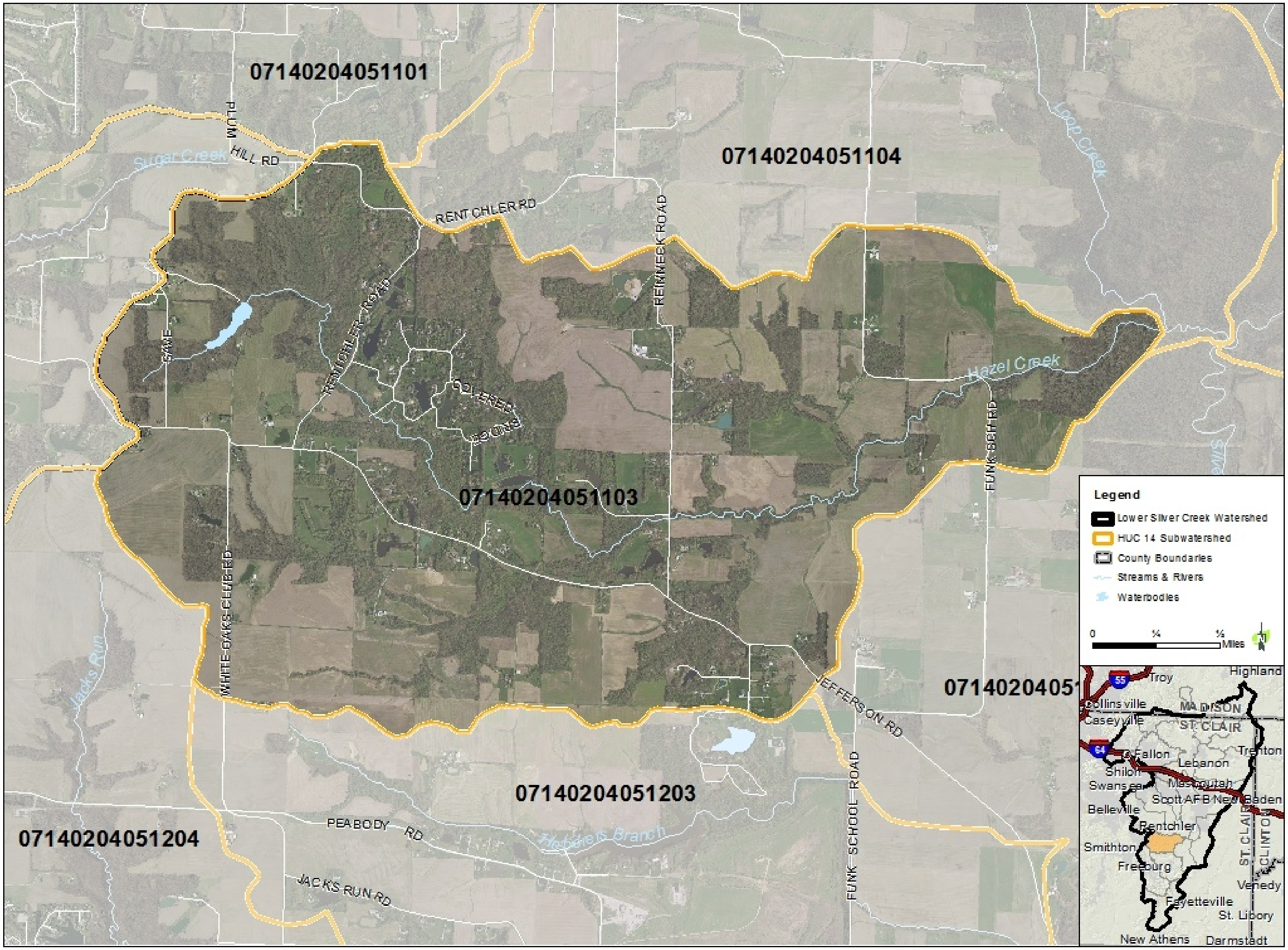

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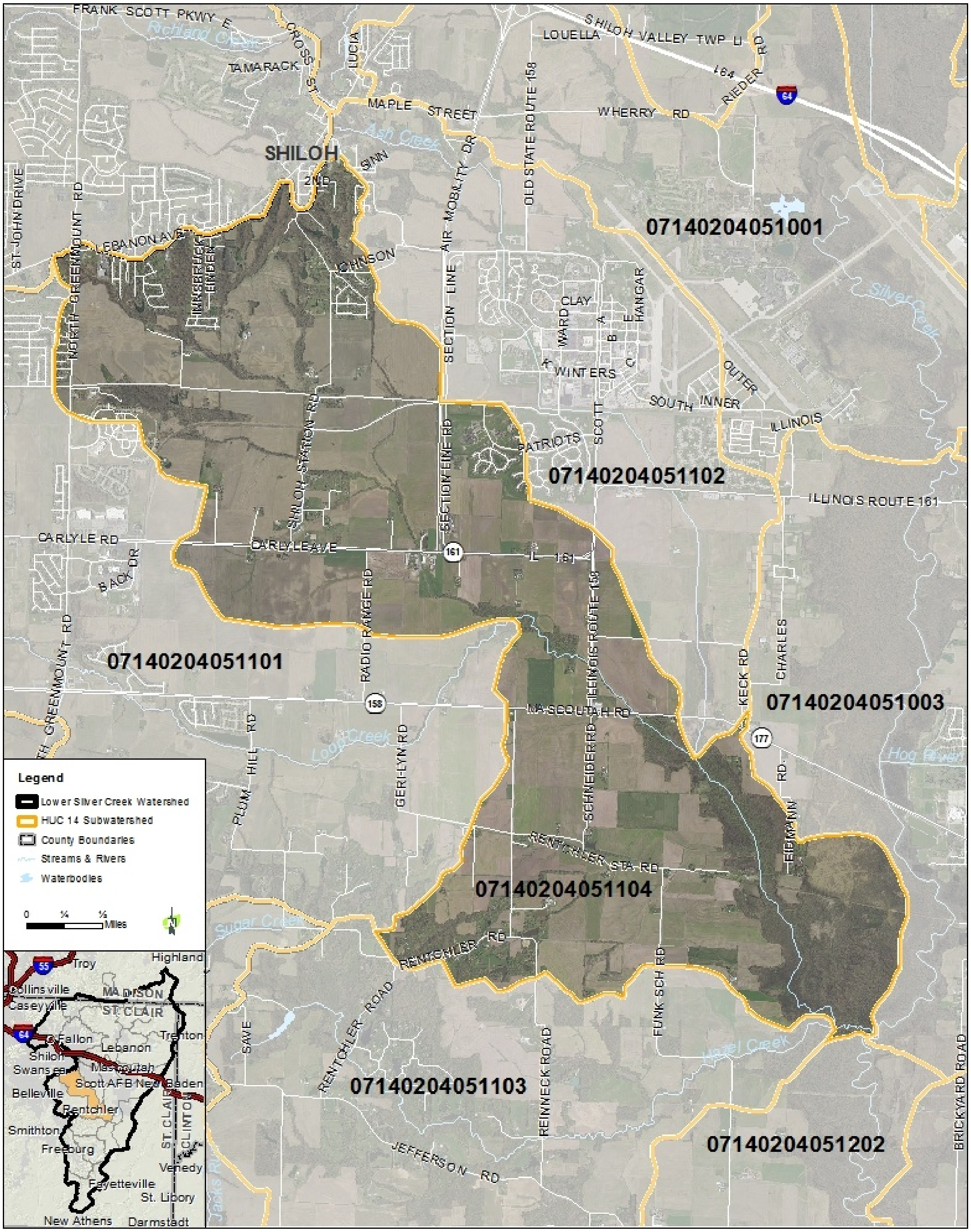

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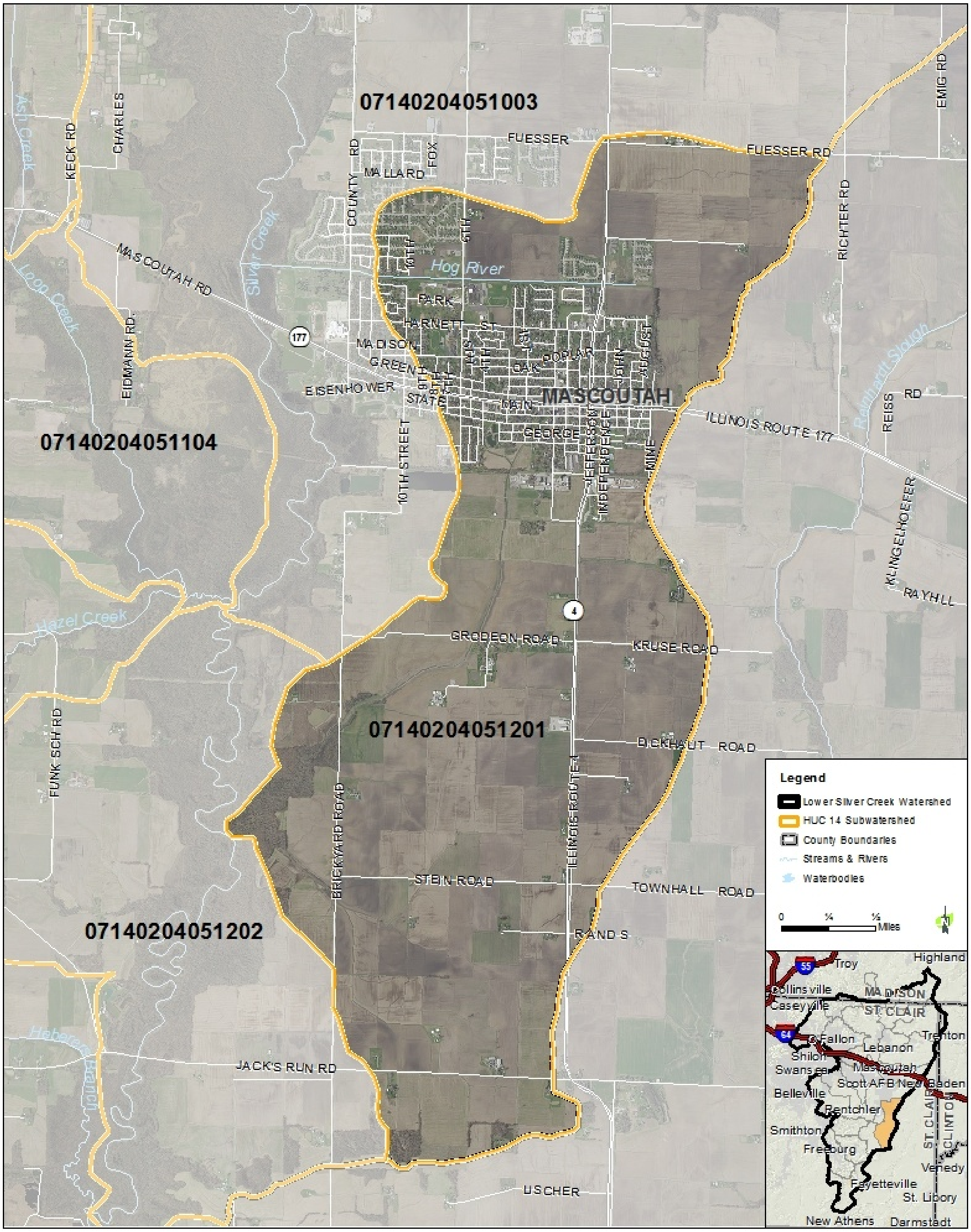

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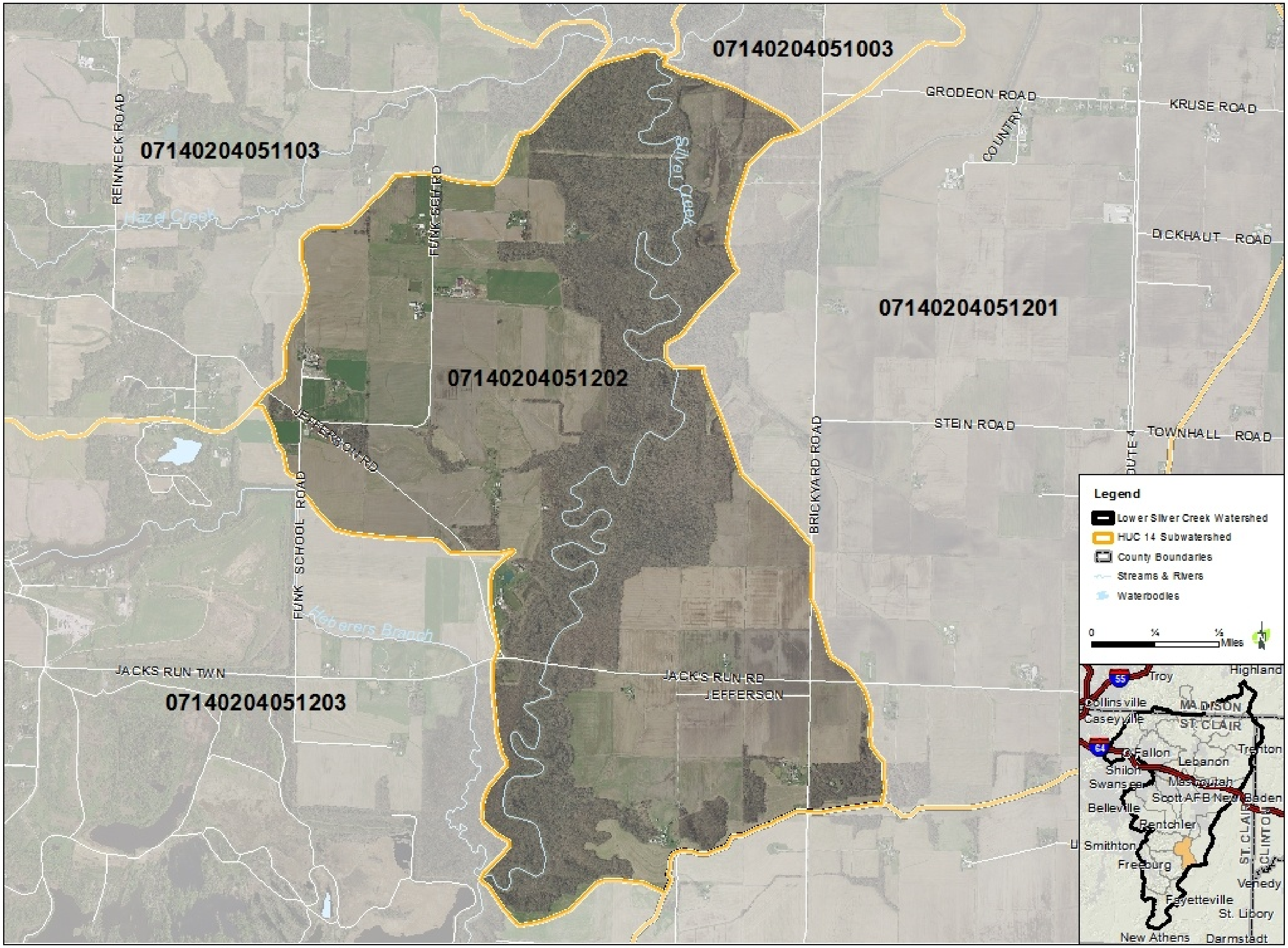

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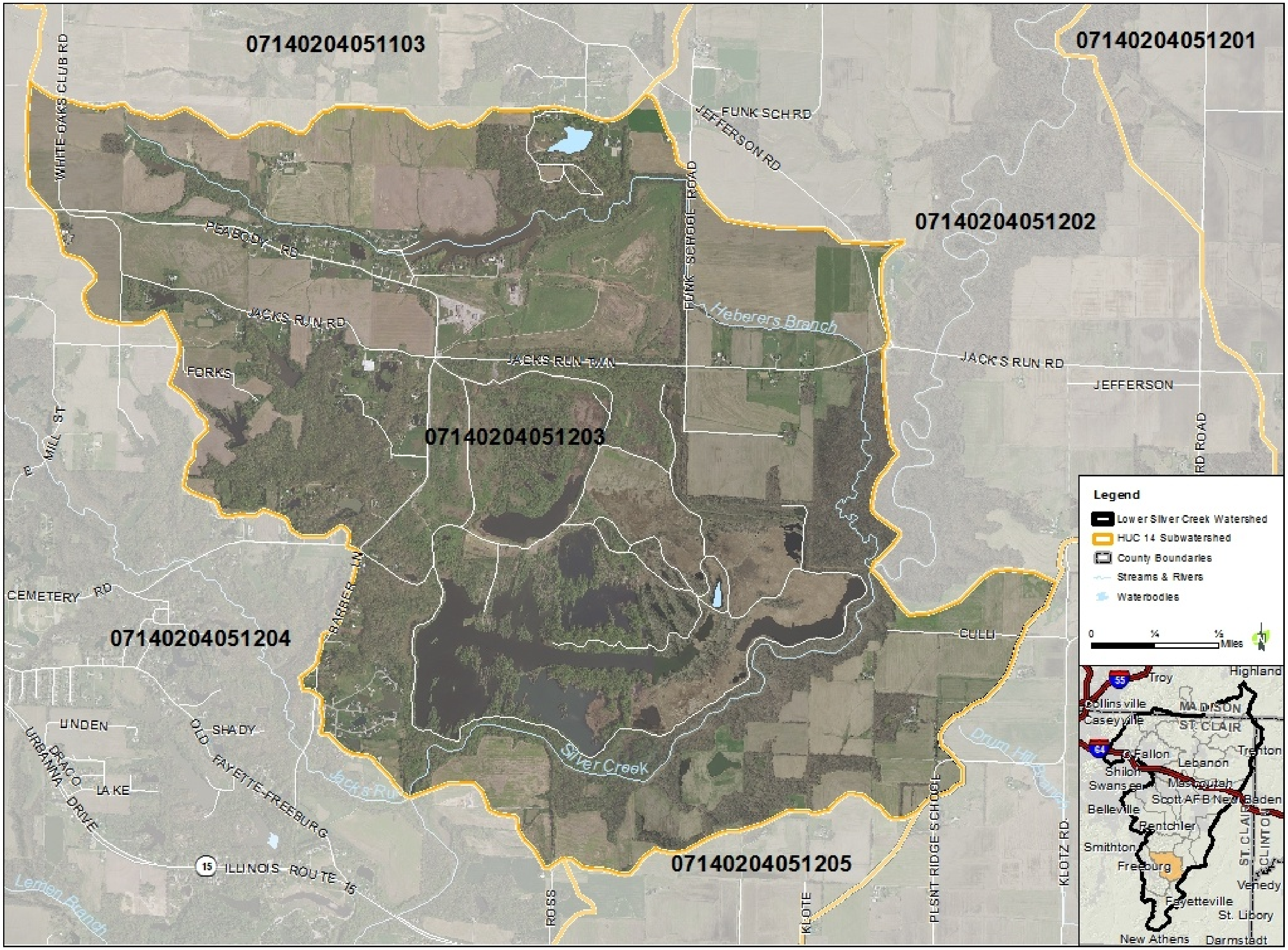

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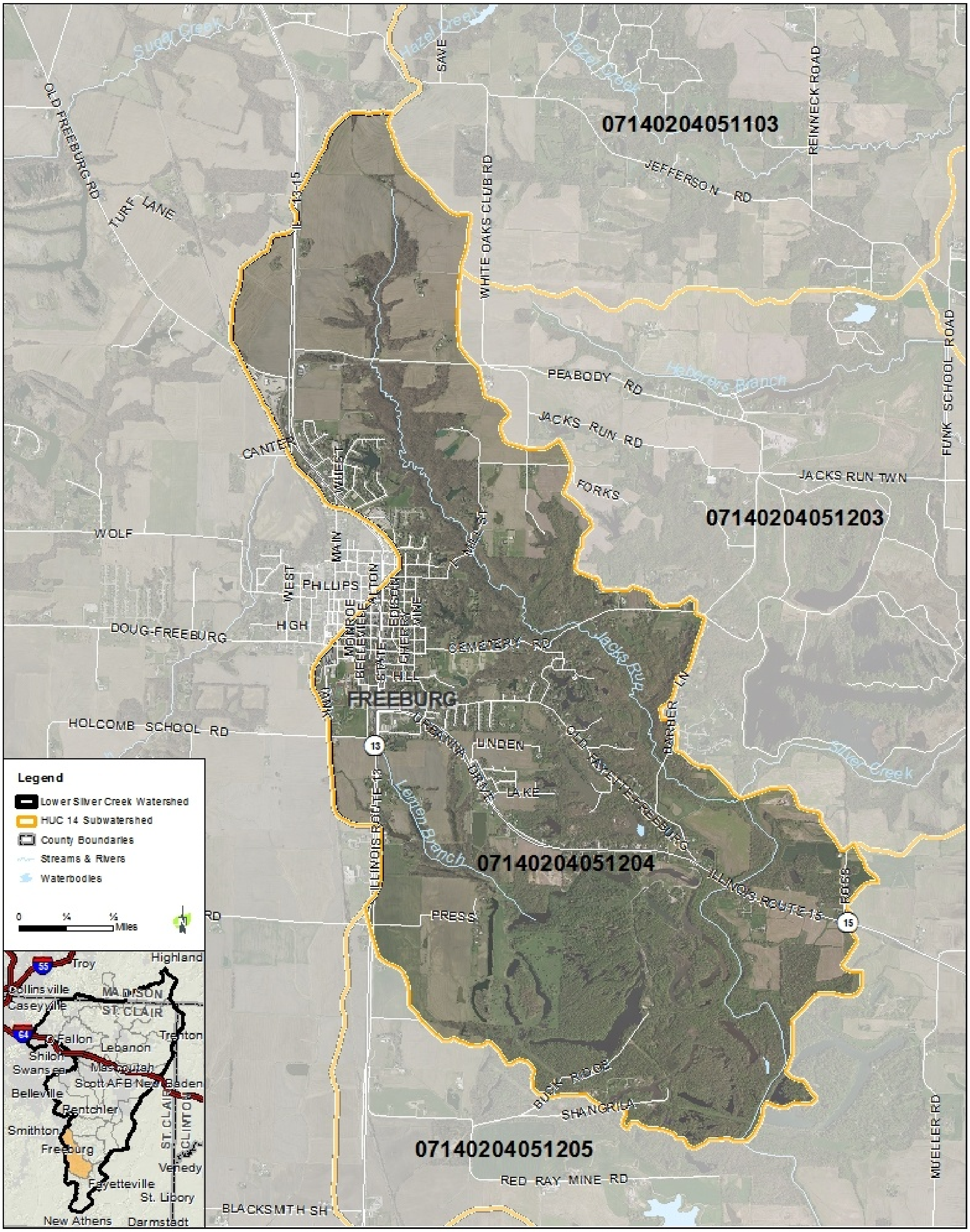

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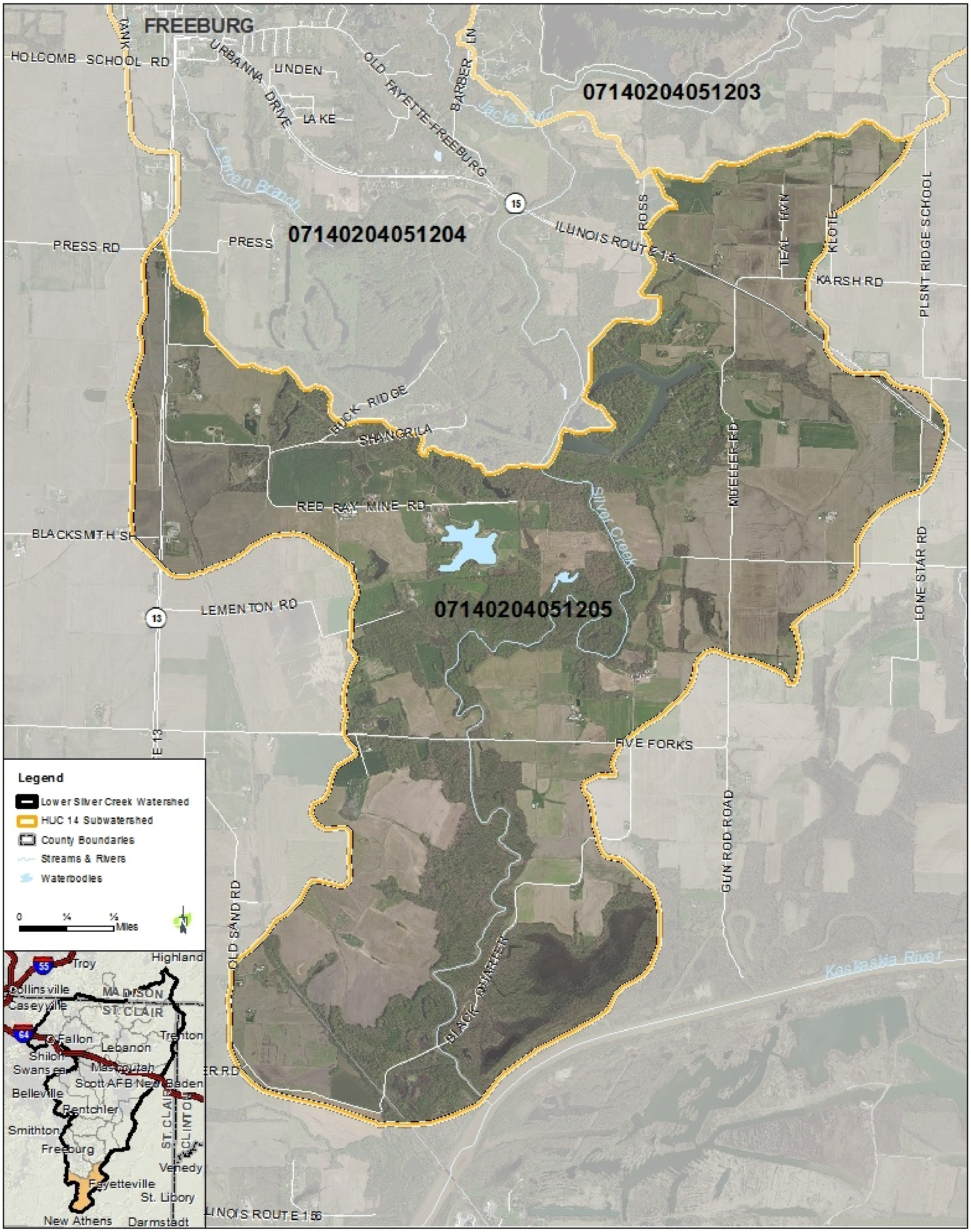

Stream miles

The Lower Silver Creek watershed contains 454 miles of streams, as identified in the NHD maintained by the United States Geologic Survey (USGS). The stream reaches in the watershed are designated as perennial stream/river, intermittent stream/river, artificial path, canal ditch, or connector. “Artificial path” and “connector” segments represent non-specific connections between non-adjacent segments.

Direction of flow and major tributaries

Water generally flows north to south in the watershed. A large amount of flow comes from the Upper Silver Creek watershed to the north. Within the watershed, the largest tributaries are Little Silver Creek, Loop Creek, Ogles Creek, and Engle Creek. Silver Creek drains to the Kaskaskia River north of New Athens, which empties into the Mississippi River in Randolph County.

Waterbodies

There are 1,075 waterbodies in the Lower Silver Creek watershed covering 2,264 acres, according to the NHD. These waterbodies include intermittent and perennial lakes and ponds, swamps and marshes, and reservoirs for water treatment and storage. The average area of waterbodies in the watershed is 2.8 acres. There are only 14 named lakes in the watershed. The largest of these is Biebell Lake (27 acres), located south of Freeburg. Other large lakes include Fairwood Lake (16 acres, on a tributary to Engle Creek), Scott AFB Pond (12 acres), and Mascoutah Lake (11 acres).

Topography

Topography in the watershed is fairly flat, with gradual slopes throughout most of the watershed, except for a few areas such as the Ogles Creek corridor, the east bank of Silver Creek near Lebanon, and the hills around Freeburg. The highest point in the watershed has an elevation of 669 feet (204 meters). Shiloh and a ridge area north of Freeburg have the highest elevations in the watershed. Silver Creek enters St. Clair County and the watershed at 430 feet. The watershed drains to the Kaskaskia River where the river is at an elevation of 364 feet (Figure A.3).

The watershed has slopes ranging between 0%-189%, with an average slope of around 4% over the majority of the watershed (Figure A.4).

Elevation

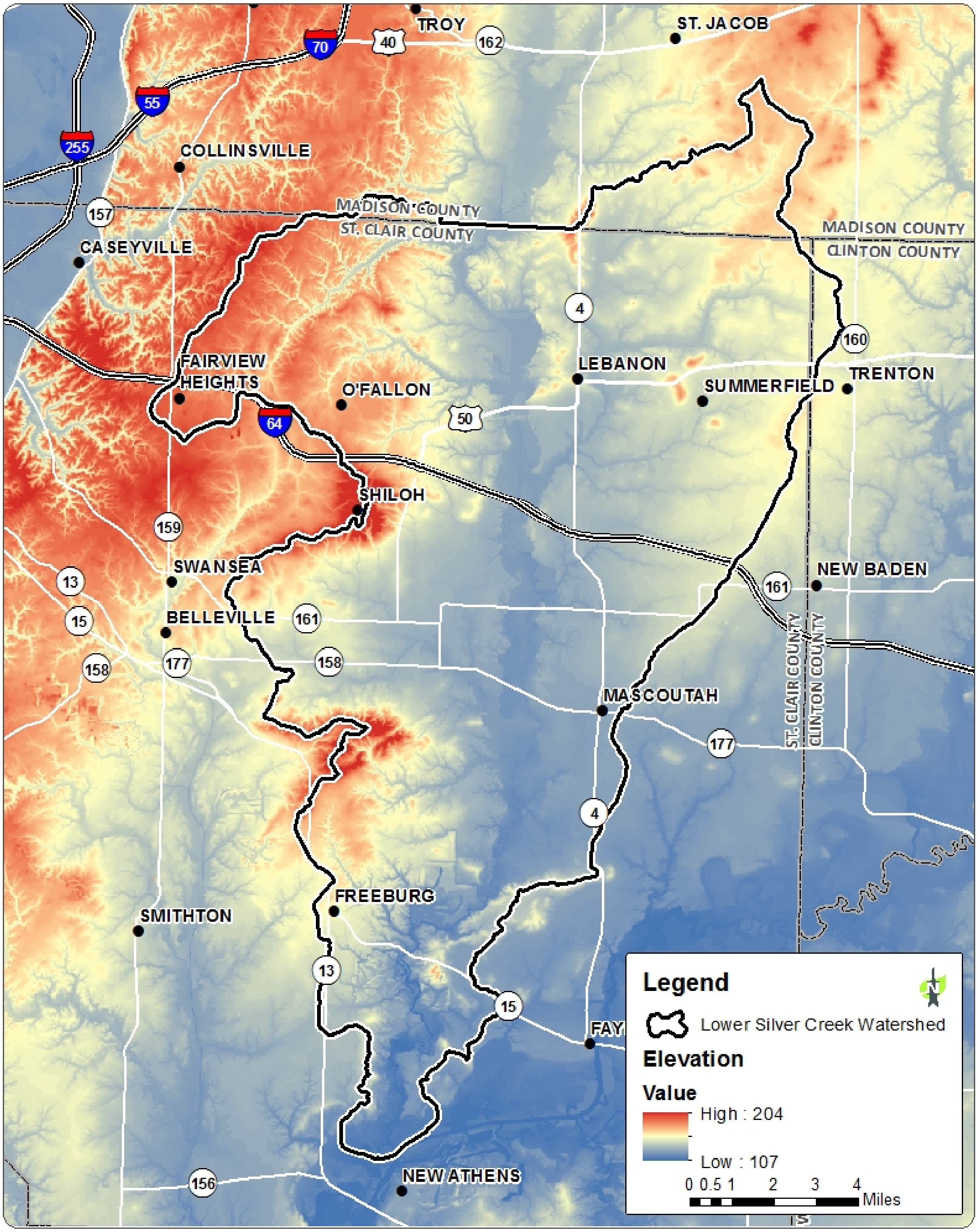

Figure A.3. Topography/elevation in the Lower Silver Creek watershed project area, from the Digital Elevation Model (DEM) in the USGS National Elevation Dataset.

Slope

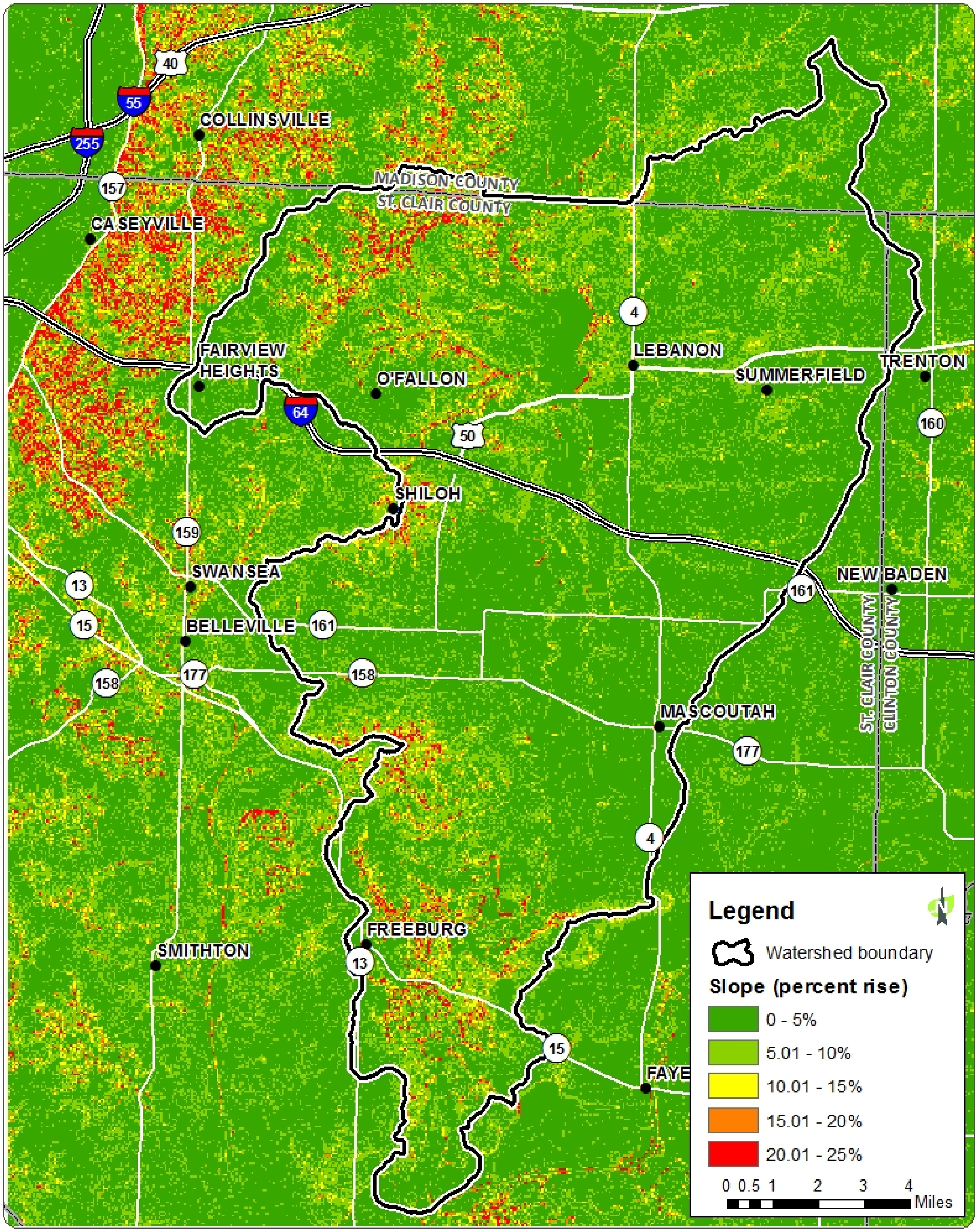

Figure A.4. Slope in the Lower Silver Creek watershed project area, in percent.

Climate

The Lower Silver Creek 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 2 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.5).

Between 1988 and 2013, southern Illinois 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, Madison County. The minimum recorded temperature in the three counties between 1988 and 2014 was 0°F at the Alton and Belleville gauges in December 2016.

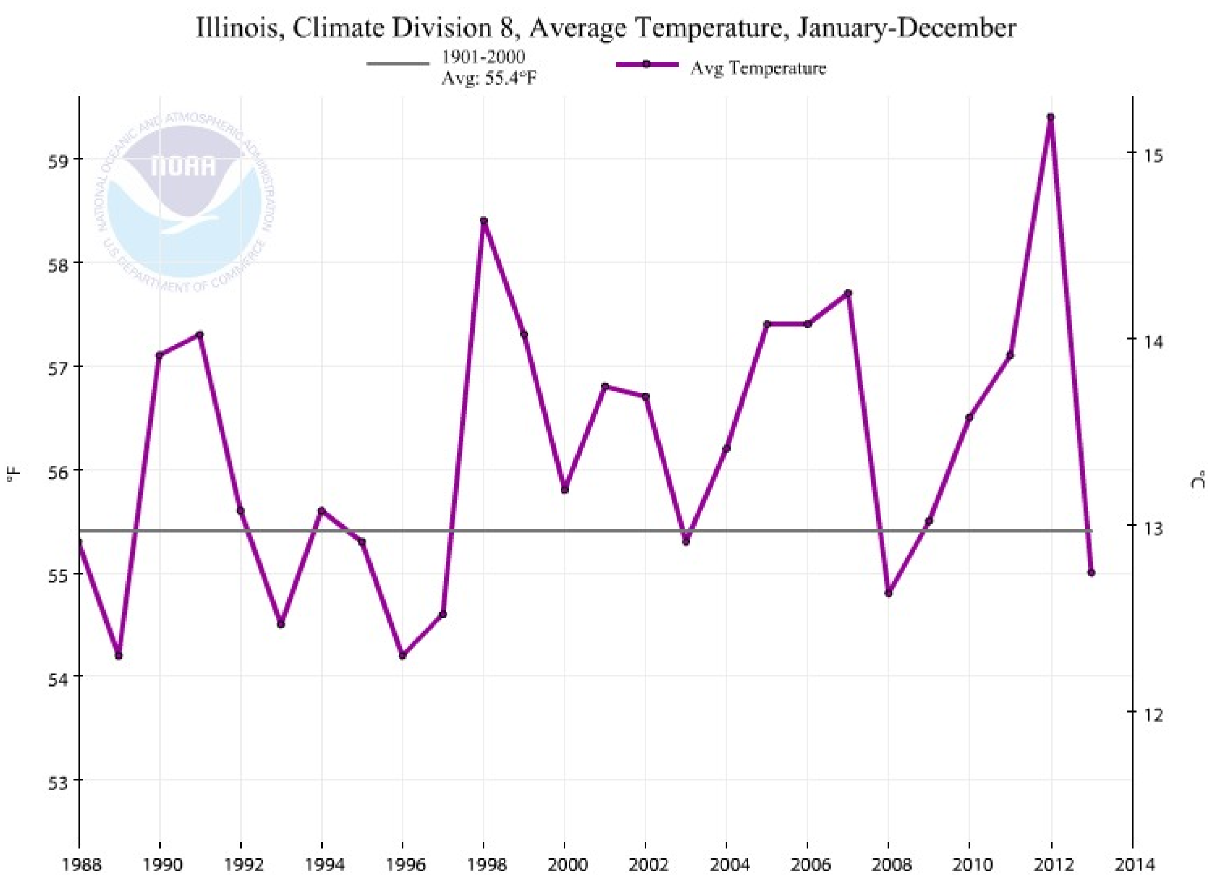

Figure A.5. Average annual temperatures in southwestern Illinois between 1988 and 2014, from NOAA's Climate At-A-Glance Time Series. The leftmost y axis shows average annual temperature in degrees Fahrenheit.

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. A precipitation gauge station in Belleville measured an average annual precipitation of between 38 and 45 inches between 1986 and 2016 (30% chance). May is typically the wettest month and January is the driest. Total annual snowfall recorded at the Belleville gauge was 12.9 inches on average between 1986 and 2016.[1]

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 4 to 8 inches of rainfall in a few hours in localized areas. The greatest recorded 24-hour precipitation event recorded between 1893 and 2014 in Edwardsville, Madison County is 7.05 inches of rain in August 1915. Flash floods can occur at any time of year in Illinois, but they are most common in the spring and summer months. See "Flooding" section for more information on occurrences of flash flooding and general flooding.

Drought

There has been considerable variability in precipitation in the state over time, including major multi-year droughts in the 1930's and 1950's and major multi-year wet periods in the 1970's and 1980's. The National Climatic Data Center (NCDC) database reported 30 drought/heat wave events in St. Clair County between 1994 and 2010. These drought and extreme heat events have been attributed with 22 deaths, 502 injuries and $55,000 in property damage in St. Clair and adjacent counties. A recent example of extreme heat wave occurred August 4-16, 2007 when high temperatures were consistently from the middle 90's to around 100°F with the Heat Index from 105°F to 110°F. Two deaths were reported in Madison County and one in St. Clair County.[2]

Tornadoes

Illinois experiences about 29 tornadoes annually, 63% of which occur in peak months April, May, and June. In Madison County, 39 tornadoes were reported between 1950 and 2006, and in St. Clair County, 34 occurrences were reported between 1952 and 2006.[3] The greatest recorded magnitude among these events was an F4 on the Fujita Scale for Madison and St. Clair counties. Typically, the area impacted by tornadoes was less than four square miles.[4]

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 the watershed resulted in the present bedrock surface topography.[5]

Much of the watershed is covered by Peoria and Roxana silts (labeled "pr").The stream channels have deposits of mainly silt, silty clay, and fine sand (labeled "c") beneath them. Cross-sections of the landscape at lines A and B in Figure A.6 (shown in Figure A.7) show that the rock layers underlying the Lower Silver Creek channel are, from bedrock to surface: Glasford formation - pebbly loam diamicton (labeled "g"), Pearl formation - sand with some gravel (labeled "pl-m"), and Cahokia formation – mainly silt, silty clay, and fine sand (labeled "c").

The thickness of the loess (windblown silt) in the watershed is shown on the map with contours. The loess layer becomes thinner as you move eastward from the Mississippi River. The loess is 15-20 feet thick in the Silver Creek channel, but becomes less than 15 feet thick on the eastern side of the watershed.

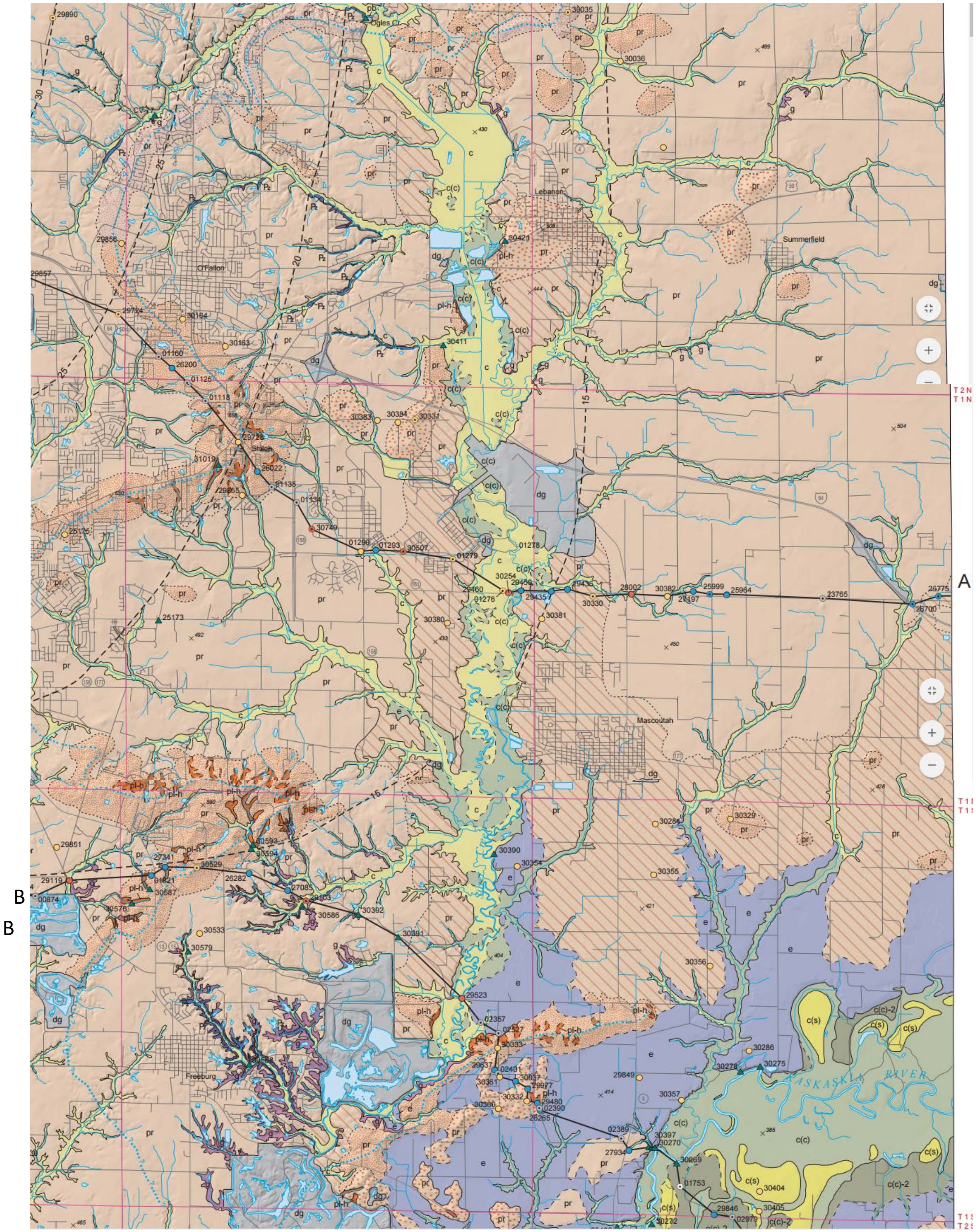

Figure A.6. (Legend on following page) Cross-sections at lines A' and B' are shown in Figure A.7.

Legend to Figures A.6 and A.7.[6]

QUATERNARY DEPOSITS

Description	Unit	Interpretation
HUDSON EPISODE (~12,000 years before present (B.P.) to today)[1]		
Fill or removed earth; various sediment types; generally, but not exclusively, fine-grained deposits; up to 50 feet thick; excavations up to hundreds of feet deep	Disturbed ground dg	**Man-made fill or excavations;** includes former strip mines for coal, levee fills, dredged channel fill (Kaskaskia River valley), urban rubble; quarries, interstate interchanges, and road fill
Mainly silt, silty clay, and fine sand; weakly to well stratified; includes some coarser beds, especially in basal portions; mainly noncalcareous; up to 30 feet thick	Cahokia Formation (undivided) c	**Alluvium (stream deposits);** mapped in floodplains of small to medium-sized tributary valleys; not mapped in Mississippi and Kaskaskia valleys
Silt loam with thin fine sand beds; weakly stratified; noncalcareous; up to 25 feet thick	Cahokia Formation (fan facies) c(f)	**Alluvial fan deposits;** mainly derived from resedimentation of thick, erodible loess deposits on east side of Mississippi River valley
Silty clay loam, silty clay, and silty loam; massive to stratified; some fine sand lenses; soft and saturated; noncalcareous; up to 60 feet thick in Mississippi River valley	Cahokia Formation (clayey facies) c(c)	**Overbank alluvium, abandoned channel and swale fills;** mapped in Mississippi and Kaskaskia valley floodplains and in valleys tributary to the Kaskaskia
Very fine, fine, and medium sand; capped by up to 5 feet of silt and clay; crudely to well stratified; moderately to well sorted; noncalcareous; up to 35 feet thick	Cahokia Formation (sandy facies) c(s)	**Alluvium;** point bar, natural levee, and channel deposits; mapped only in Mississippi and Kaskaskia valley floodplains
Silty clay loam to silt loam; massive to weakly stratified; noncalcareous; soft; up to 20 feet thick	Cahokia Formation (clayey facies–high level) c(c)-2	**Overbank alluvium;** within early to middle Holocene terrace at ~395 feet asl; mapped only in Kaskaskia River valley and adjacent tributaries
WISCONSIN EPISODE (~60,000–12,000 years B.P.)[1]		
Silt loam to silty clay loam with some fine sand; massive to laminated; leached to calcareous; may contain mollusk shells (<1 cm) or conifer wood fragments; up to 50 feet thick	Equality Formation e	**Lacustrine deposits;** large area of deposits in glacial Lake Kaskaskia; slackwater origin during high levels of Mississippi River aggradation; in terraces at 410 to 425 feet asl in Kaskaskia River valley
Fine, medium, and coarse sand; stratified; generally coarsens with depth; some basal gravelly zones in Mississippi River valley, mainly fine to medium sand in Kaskaskia River valley; leached to calcareous; up to 70 feet thick	Henry Formation (cross sections only) h	**Outwash (glacial meltwater deposits);** extensive in subsurface in the Mississippi River valley, localized deposits in the Kaskaskia River valley
Silt loam; massive; upper 3/5 of unit is typically more tan or gray (Peoria Silt); lower portion has pinkish hue (Roxana Silt); leached to dolomitic; thickness contours shown on map	Peoria and Roxana Silts pr	**Loess (windblown silt);** blankets all uplands; thins eastward from Mississippi River valley bluffs; thickest adjacent to broad portion of valley

ILLINOIS AND SANGAMON EPISODES (~150,000–60,000 years B.P.)

Silty clay to silt loam to clay loam; may contain fine sandy or loamy beds; mottling or iron oxide staining in upper portion; leached to calcareous; faintly stratified to rhythmically laminated locally; up to 20 feet thick	Berry Clay Member and/or Teneriffe Silt bct (beneath >5 feet loess)	**Accretionary deposits, alluvium, lake deposits, and loess;** upper portions contain strong pedogenic alteration of the Sangamon Geosol (interglacial); diagonal line pattern shown for subsurface occurrences of late Illinois Episode lake or stream deposits (mainly Teneriffe Silt) below loess cover and where Pearl Formation is not present

ILLINOIS EPISODE (~190,000–130,000 years B.P.)

Sand with some gravel; stratified; may include silty or clayey zones, especially near surface; leached to calcareous; up to 55 feet thick	Pearl Formation (Mascoutah facies) pl(m) (where buried by loess in terraces)	**Outwash;** common in loess-covered terraces along Silver Creek and along Kaskaskia River valley; below Cahokia Formation or in terraces ~430 to 440 feet asl; may contain Sangamon Geosol in upper portions
Mixture of loam, fine to coarse sand, fine gravel, silt loam, and diamicton (mixed facies); locally comprising thick sand and gravel with few fine interbeds (sandy facies); poorly to well-sorted sands; weakly stratified; may be fractured or faulted by glacial tectonics; may contain inclusions of older sediment; leached to calcareous; up to 120 feet thick	Hagarstown Member, Pearl Formation pl-h (mixed facies where buried by >5' loess) (sandy facies where buried by >5 feet loess)	**Ice-contact sediments;** in ice-marginal areas, kames, or ice-walled channels; includes debris flows interspersed with subglacial or supraglacial outwash; locally includes ice-dammed lacustrine deposits and glaciotectonically faulted or deformed beds; stippled areas distinguish mainly sandy facies (ice-walled channels, fans) from mixed facies (moraines, kames, other); contains Sangamon Geosol in upper 5 to 10 feet
Pebbly loam diamicton (mixture of clay, silt, sand, and gravel); generally massive; includes some sand and gravel lenses up to 10 feet thick; leached and weathered in upper part (Sangamon Geosol); calcareous and very stiff in lower part; up to 90 feet thick	Glasford Formation (<5 feet of loess cover) g (morainic areas beneath >5 feet loess)	**Till and ice-marginal deposits;** includes subglacial and supraglacial deposits; contains Sangamon Geosol alteration in upper 5 to 10 feet; morainic areas stippled on map may contain sheared inclusions of older paleosol, sediments, or bedrock in the till
Fine sand to gravelly sand; up to 20% gravel; yellowish brown to grayish brown; stratified; loose; well sorted; calcareous; up to 50 feet thick	Grigg tongue, Pearl Formation (cross sections only) pl-g	**Outwash;** proglacial deposits from advancing Illinois Episode glaciers, subsequently buried by Glasford Formation diamicton
Silt loam to silty clay loam; massive to weakly stratified; calcareous to leached; locally may contain conifer wood and small terrestrial or freshwater mollusk shells (<1 cm); up to 90 feet thick	Petersburg Silt pb	**Lacustrine sediment or loess;** mainly slackwater lake deposits caused by aggradation in the Mississippi River valley or ice-marginal proglacial lakes caused by glacial ice blockage; loess occurs in western uplands and typically <10 feet thick

YARMOUTH EPISODE (~420,000–190,000 years B.P.)

Silty clay loam to silty clay to clay loam; yellowish brown to pale olive; can contain strong soil structure with clay skins, iron and manganese oxide staining; few pebbles; may be faintly stratified; leached; stiff to very stiff; up to 15 feet thick	Lierle Clay Member, Banner Formation (cross sections only) b-l	**Accretionary deposits, alluvium, and lake sediment;** accumulated in closed depressions or lowlands; deposited and strongly weathered during the Yarmouth interglacial episode

PRE-ILLINOIS EPISODE (~700,000–420,000 years B.P.)

Pebbly silty clay loam diamicton; generally massive; may include sand and gravel lenses or zones of stratified fine-grained deposits; leached to calcareous; stiff; up to 70 feet thick	Banner Formation, (undivided) (cross sections only) b	**Till and ice-marginal deposits;** includes subglacial till and supraglacial debris flows; may include lake sediment or glaciofluvial sediment; includes Yarmouth Geosol alteration in upper part but commonly truncated in the east
Silt loam, silty clay loam, and sandy loam; laminated to bedded; may contain conifer wood fragments and small terrestrial or freshwater aquatic mollusk shells (<1 cm); calcareous; up to 30 feet thick	Harkness Silt Member, Banner Formation (cross sections only) b-h	**Lacustrine deposits with deltaic and alluvial zones;** deposited in slackwater lakes resulting from pre-Illinois Episode glacial aggradation in the Mississippi River valley; typically found below 370 feet asl in bedrock valleys; alluvial and deltaic materials deposited during periods of lower lake levels
Silty clay loam, silty clay, silt loam, and sandy loam; weakly stratified; may contain some fine sand beds; noncalcareous to weakly calcareous; soft to stiff; may contain subangular platy pebbles of local origin; up to 35 feet thick	Canteen member, Banner Formation (cross sections only) b-c	**Preglacial alluvium and colluvium;** occurs mainly in preglacial bedrock valleys generally below 350 feet asl; matrix mineral composition and pebble lithology reflect local bedrock

TERTIARY AND EARLY QUATERNARY DEPOSITS

Clay, cherty clay, silty clay, and silty clay loam; pebbles primarily of local angular sedimentary bedrock; rare erratics	Oak formation (cross sections only) To	**Residuum (bedrock weathered in situ) or paleosol complex;** may include some Quaternary loess, dust, and perhaps thin till deposits that are highly weathered and indistinguishable from the residuum

PALEOZOIC BEDROCK

Shale, siltstone, limestone, and sandstone; less common beds of coal and underclay; laminated, bedded or massive; up to 150-feet-thick exposures of limestone in bluffs east of Dupo; upper portion may be more weathered; rocks may contain marine or terrestrial fossils	Pennsylvanian or Mississippian bedrock Pz	**Bedrock outcrops or bedrock within 5 feet of land surface;** most common in western areas of the county and localized along courses of east-flowing tributaries to Silver Creek; includes Pennsylvanian and Mississippian rock

[1]The time periods for the Wisconsin Episode and the Hudson Episode are reported as calibrated radiocarbon years and can be directly compared to calendar years before 1950 (Stuiver et al. 2005).

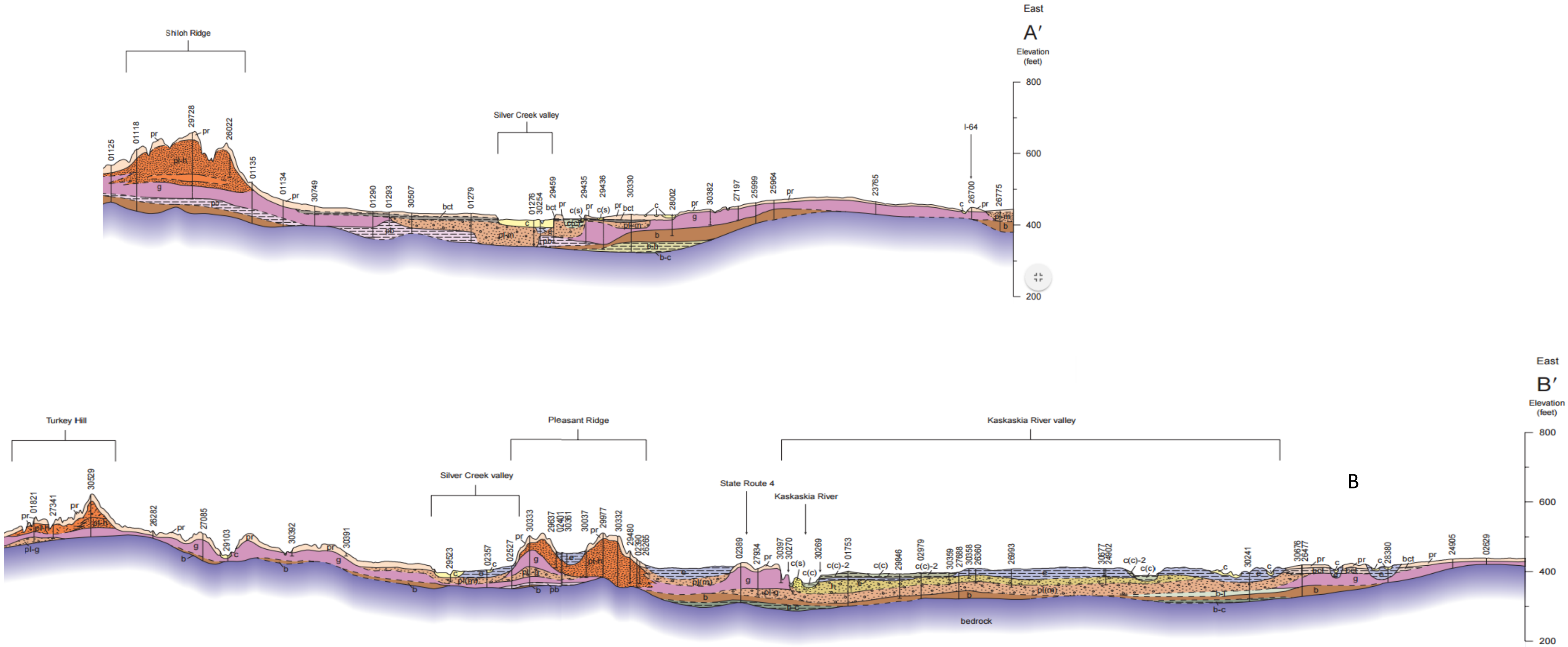

Figure A.7. Cross-sections of surficial geology over the Lower Silver Creek watershed at lines A and B in Figure A.6.

This cross-section A includes the Silver Creek corridor and extends from Shiloh Ridge in the west to the county line in the east. The cross-section B extends from Turkey Hill in the west to the Kaskaskia River in the southeast. (See legend on previous pages.)

Aquifers

There are four types of aquifers in the watershed as defined by the Illinois State Geological Survey: potential shallow aquifers, major sand and 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 Shallow Aquifers

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 fifteen feet thick with a lateral extent of at least one square mile.

Shallow aquifers 50 ft or less below the ground surface may underlie 59,398 acres (48%) of the watershed area, as shown with blue/grey diagonal lines in Figure A.8. 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.

Major Sand and Gravel Aquifers

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.

There is one major sand and gravel aquifer in the watershed, shown in dark blue in Figure A.8. It is situated below Scott AFB and Mascoutah. It underlies 18,429 acres (15%) of the watershed, and its volume is unknown. Also, a small portion of a sand and gravel aquifer extends from Madison County into the northern end of the watershed at the county line.

Deep major bedrock aquifers

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 the watershed do not yield potable water (containing less than 2,500 milligrams per liter of TSS). They largely yield water containing more than 10,000 milligrams per liter of TSS, shown in dark brown. In some areas they yield water containing 2,500 to 10,000 milligrams per liter of TSS, shown in light brown in Figure A.8.

Aquifers

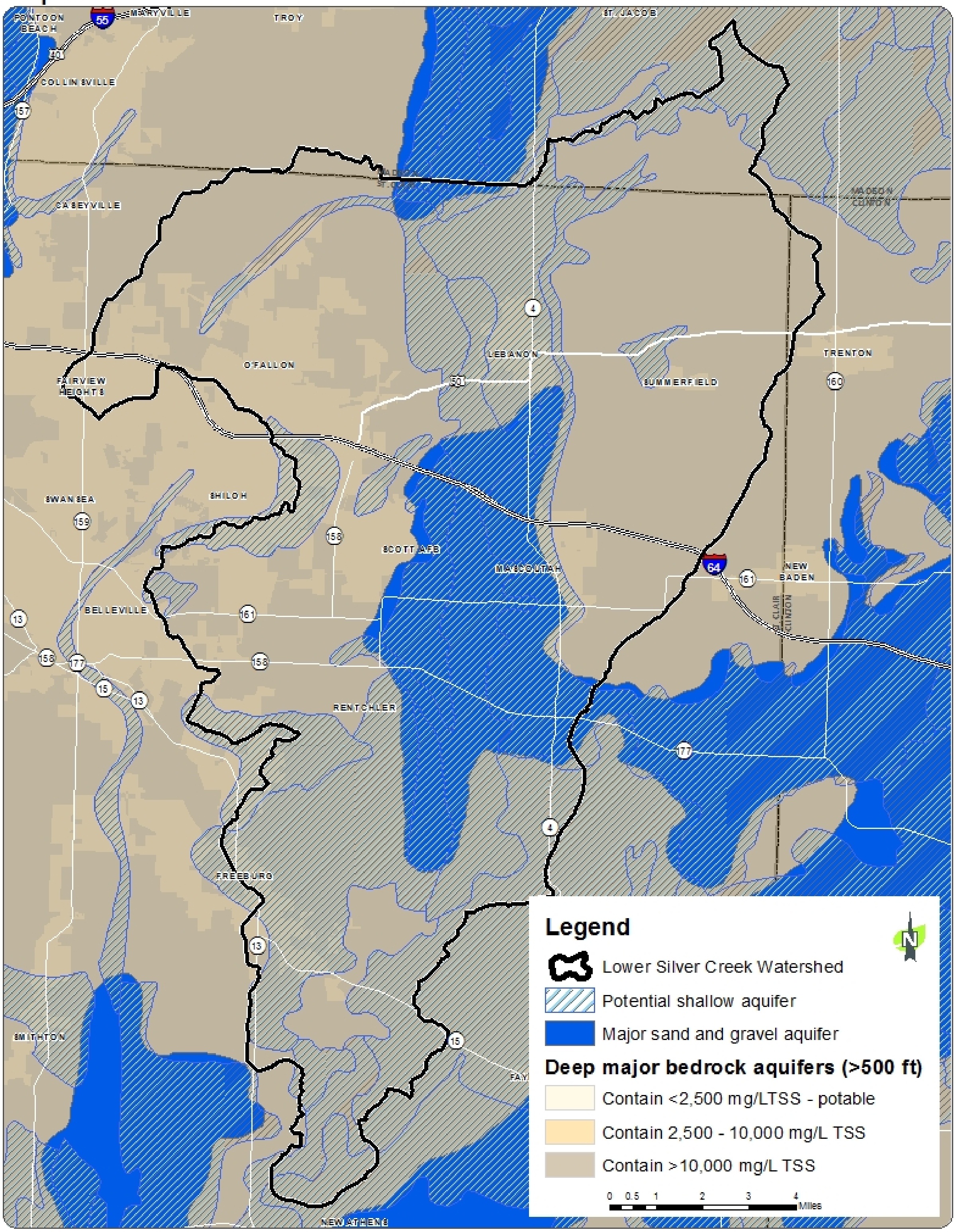

Figure A.8. Aquifers in the Lower Silver Creek watershed.

Wells

The Illinois State Geological Survey (ISGS) has documented 2,450 wells and borings in the watershed, of which 1,217 are water wells (Figure A.9).

Water Wells

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

Wells

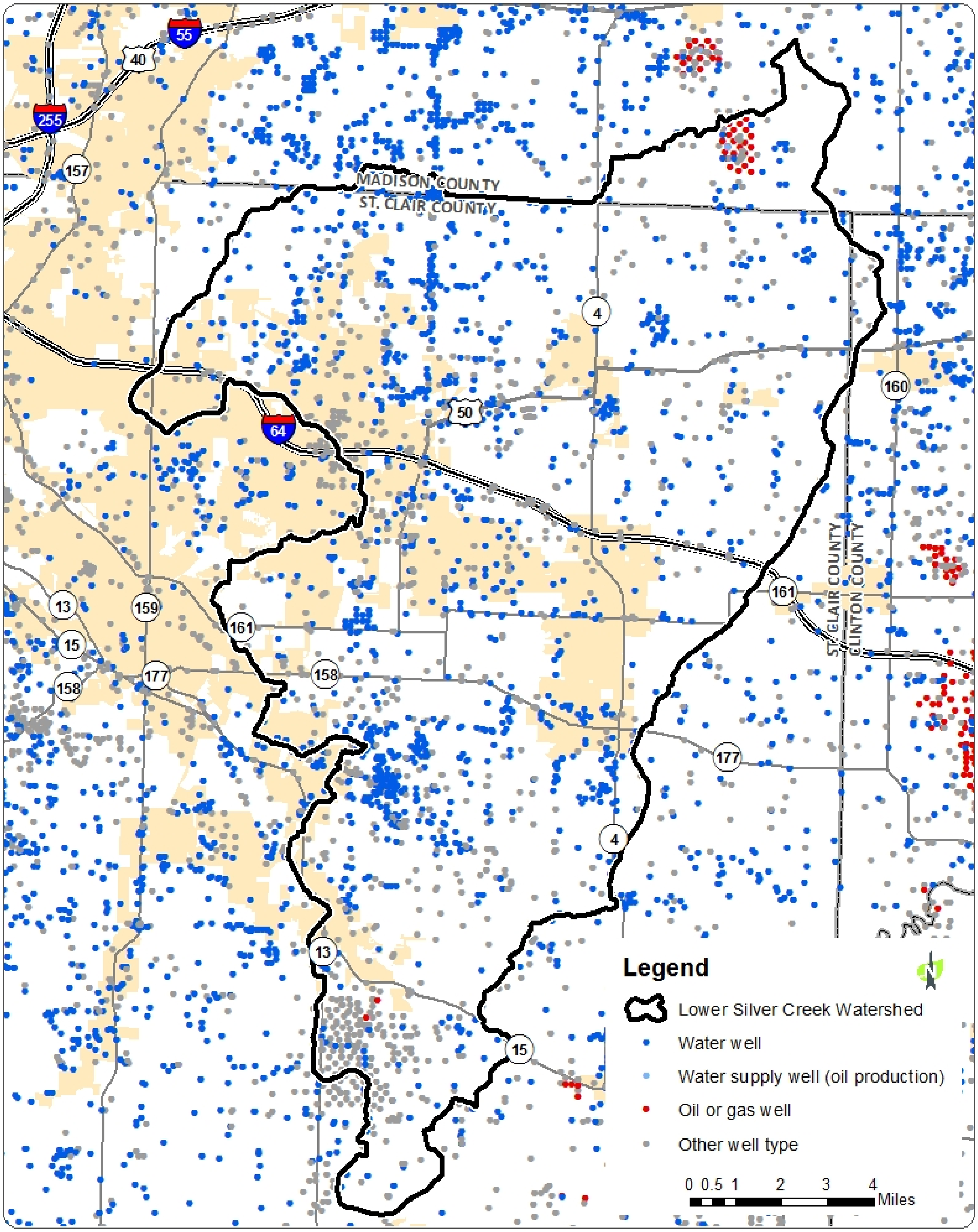

Figure A.9. Wells and water wells.[7]

Drinking water

There are seven drinking water systems in the watershed that supply water to more than 82,000 people. This water comes from surface water and is purchased by the communities (Table A.3).

Table A.3. Water supply systems with records in US EPA's Safe Drinking Water Information System.

System Type	Water System ID	Water System Name	County Served	Population Served	Primary Water Source Type*
Community	IL1635237	American Water - SAFB	St. Clair	6,779	Surface water purchased
Community	IL1630600	Freeburg	St. Clair	5,107	Surface water purchased
Community	IL1630650	Lebanon	St. Clair	4,418	Surface water purchased
Community	IL1630800	Mascoutah	St. Clair	9,002	Surface water purchased
Community	IL1631100	O'Fallon	St. Clair	43,596	Surface water purchased
Community	IL1631350	Summerfield	St. Clair	471	Surface water purchased
Non-Community	IL3002485	American Legion Freedom Farm	St. Clair	100	Ground water

*Water intake locations are unknown; some systems may withdraw water from outside the watershed.

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 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 over 100 soil types present in the watershed, each of which has a designated hydrologic soil group, hydric soil category, and erodible soil category.

Hydrologic soil groups

Soils are classified by the NRCS 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.4. Sandy type A soils drain much better and allow more infiltration than clay type D soils, while types B and C lie in the middle.

Soil type data was acquired from the USDA Soil Survey Geographic database (SSURGO) file. The SSURGO data for the project area included 118 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.4. The four primary 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 group C/D, which drains somewhat poorly, is the most prevalent HSG in the watershed, covering 26% of its area (Figure A.10). Hydrologic soil groups B/D and C, which drain moderately poorly, are the next most prevalent HSGs, each covering 24% of the watershed (Table A.5). Soil group B is not far behind with 22% of the watershed. HSG A is most common in the northwest of the watershed; HSG B is most common in the streams and floodplains; HSG C is commonly found between the floodplains and uplands; and HSGs C/D and D are commonly found on the uplands in the eastern and southern areas in the watershed.

Table A.5. Hydrologic soil groups including acreage and percent of watershed. Unranked soil group areas include open water, miscellaneous water, urban land, or dumps.

Hydrologic Soil Group	Area (acres)	Percent of watershed
Unranked	2,189	2%
A	853	1%
B	27,203	22%
B/D	29,739	24%
C	29,404	24%
C/D	32,507	26%
D	2,436	2%
Grand Total	124,331	99%

Hydrologic Soil Groups

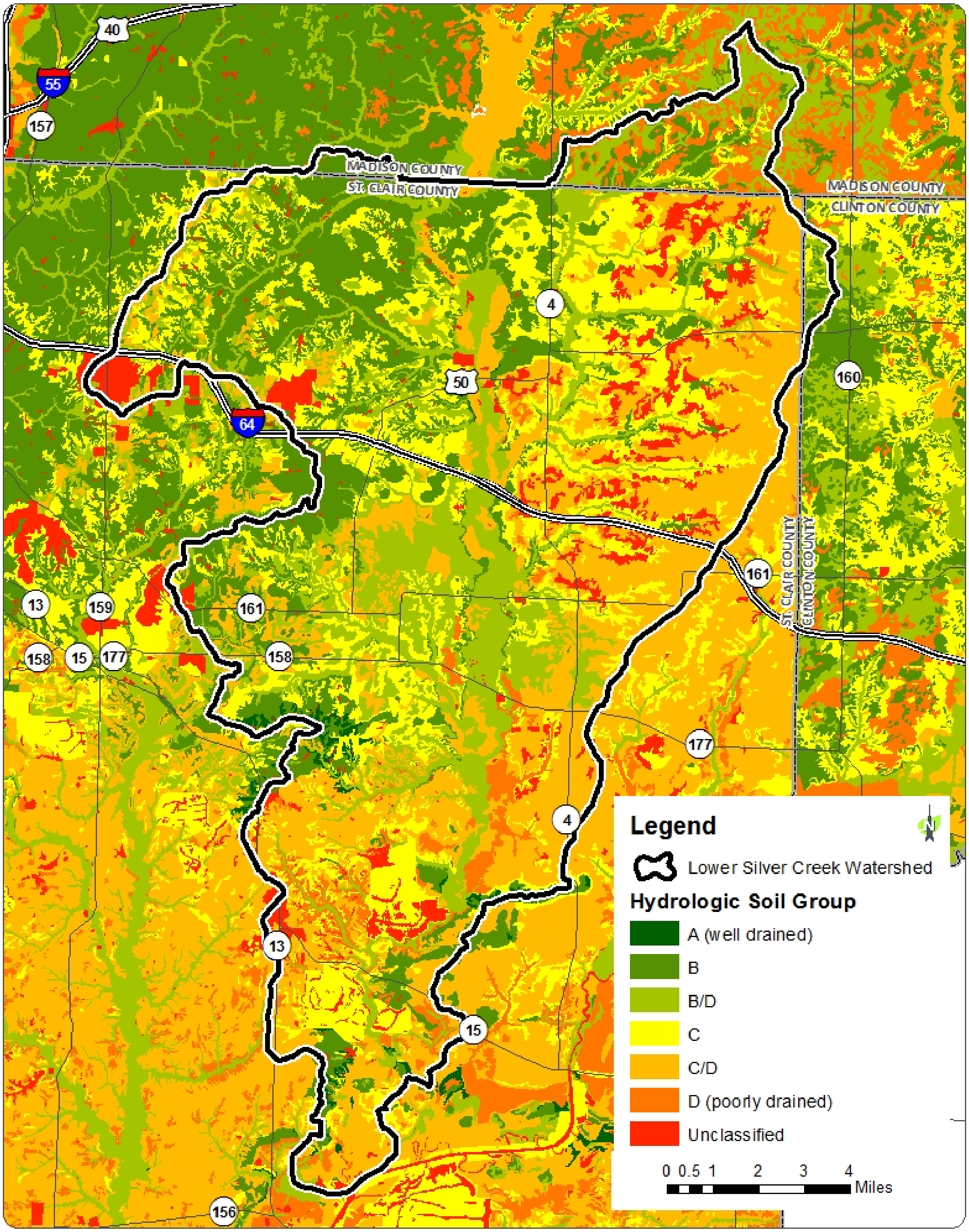

Figure A.10. Hydrologic Soil Groups in the watershed.

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.11). Forty soil types in the watershed were identified as hydric soils, covering a total area of 27,382 acres or 22% of the soils in the watershed (Table A.6). Soils in areas of water, urban land, and dumps were considered to be non-hydric.
Full data on soil types in the watershed and their hydric status is included in the Data Tables section.

Table A.6. Hydric soils by acreage and percentage.

Hydric Soil	Area (acres)	Percent of Watershed (%)
Unranked	1,737	1%
Hydric Soils	27,382	22%
Non-Hydric Soils	95,215	77%
Total	124,333	100%

Hydric soils

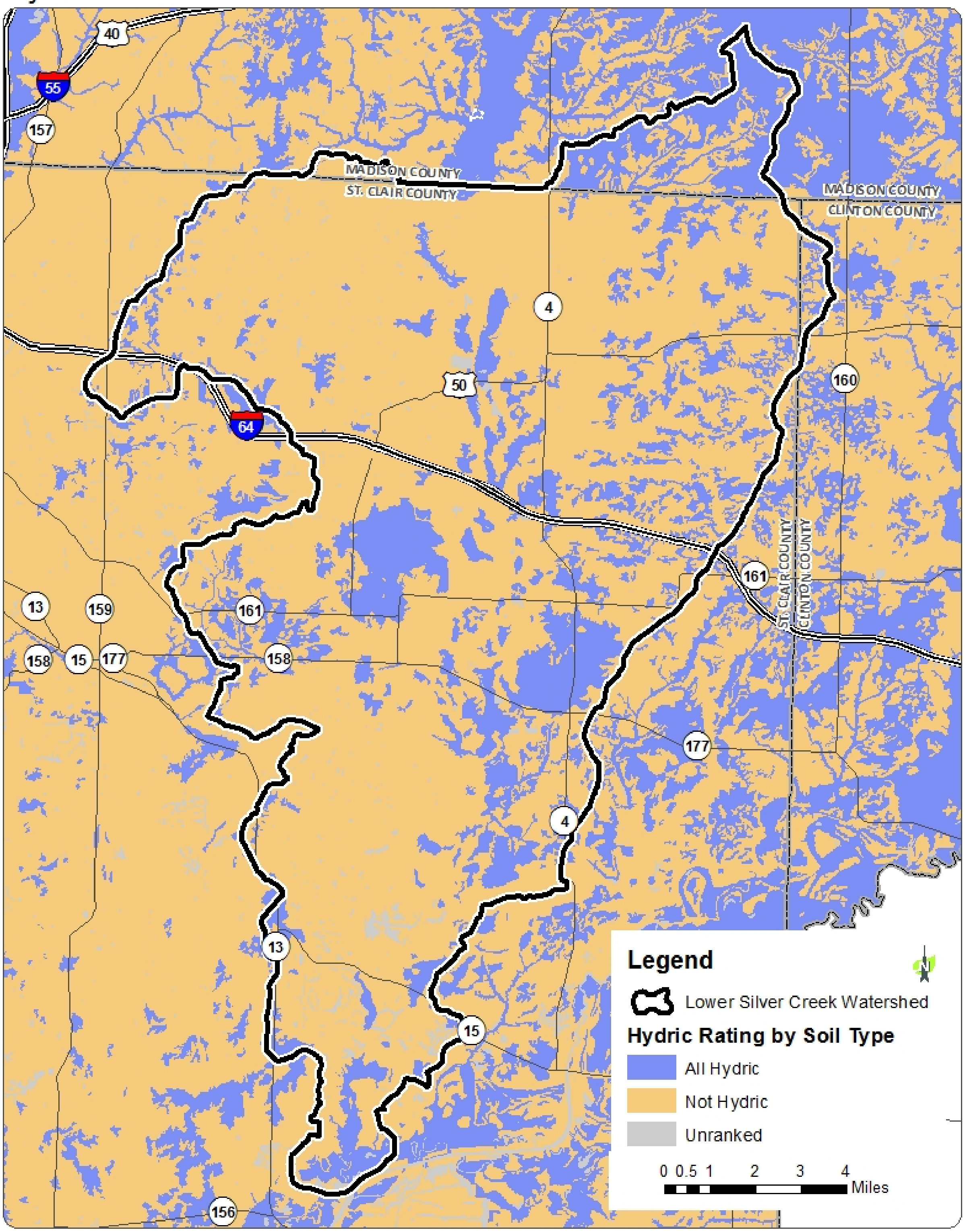

Figure A.11. Hydric soils in the watershed.

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 Natural Resources Conservation Service 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 St. Clair County Soil Survey was used as the primary reference for identifying highly erodible soils in the 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 St. Clair County Soil Survey identifies which soils are currently classified as eroded or severely eroded. These soils all shared the similar properties of steep slopes (5 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 watershed (Figure A.12). The Soil Erodibility Factor ranges between 24 and 49, with a median of 36. Over 13,000 acres (11% of the watershed) have an erodibility factor of 46 or higher (Table A.7). A strong correlation between slope and high erodibility can be seen in the maps for these factors.

Soils in the Silver Creek corridor and other stream corridors are more highly erodible than others in the watershed. On the upland areas, soils tend to be less highly erodible.

Table A.7. Soil erodibility by area and percentage in the watershed.

Erodibility factor	Area (acres)	Percentage of watershed
24 to 29	403	0.3%
31 to 35	10,857	9%
36 to 40	85,847	68%
41 to 45	15,663	12%
46 to 50	13,240	11%
TOTAL	125,978	100%

Soil Erodiblilty

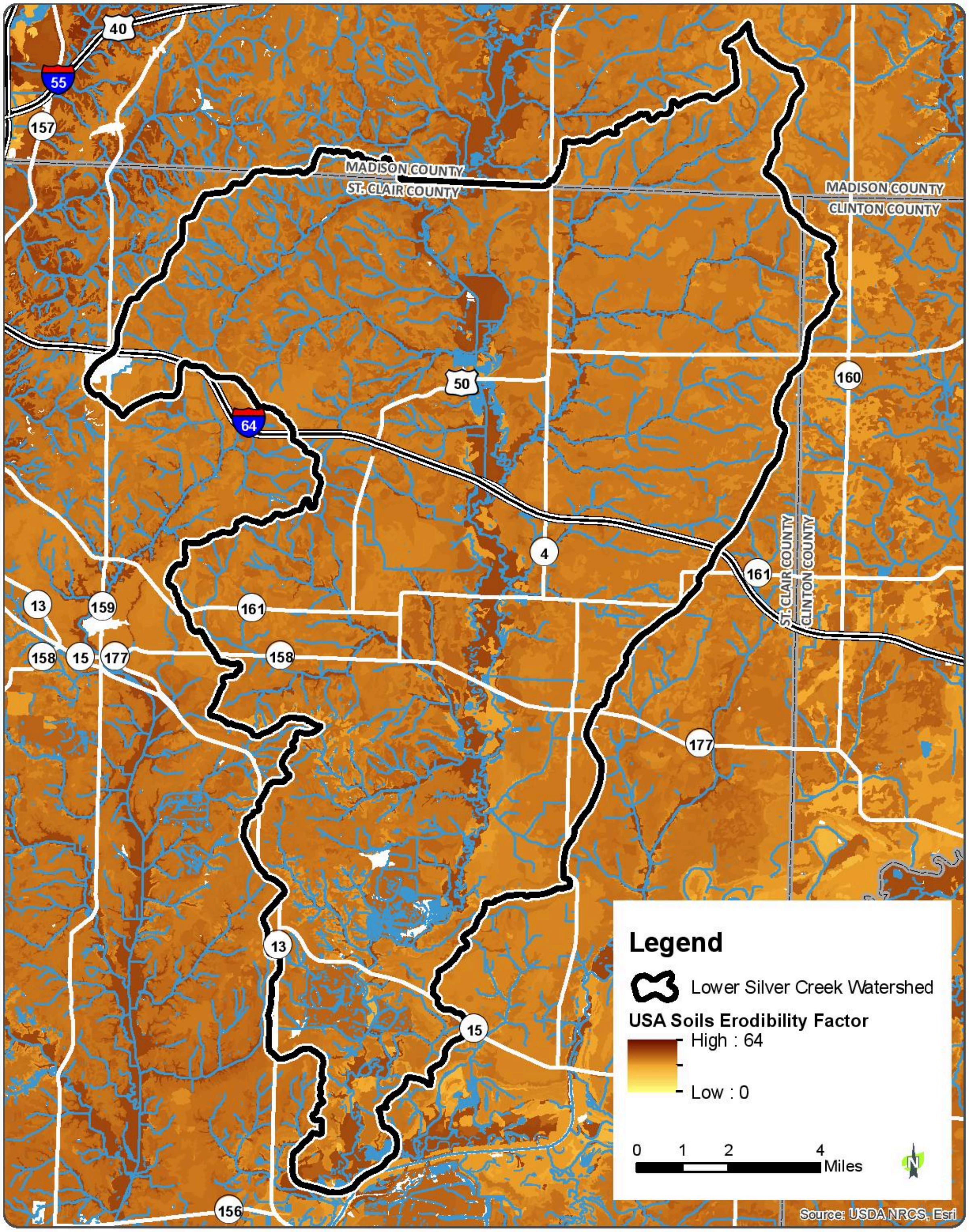

Figure A.12. Erodibility of soils in the watershed.

Water table

The depth of the water table is between 30 and 59 centimeters (12-23 inches) from the ground surface in 41% of the soils in the watershed (Table A.8 and Figure A.13.). The water table is closer to the surface at various locations along the Silver Creek channel and in the floodplains.

Table A.8. Water table depth in the watershed.

Depth of water table	Percent of Watershed (%)
0-29 cm	31%
30-59cm	41%
60-89 cm	21%
120-153 cm	6%
Total	98%

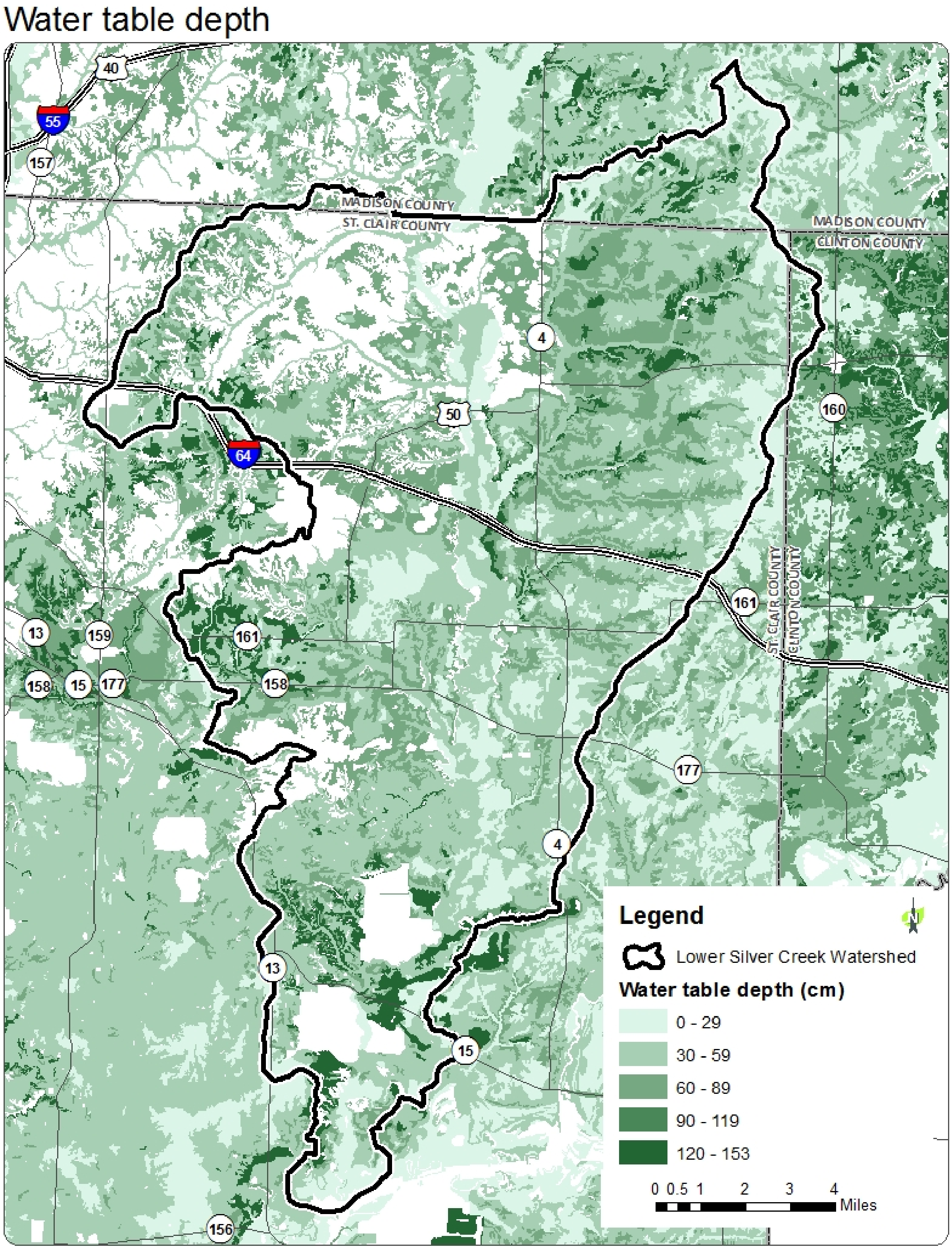

Figure A.13. Water table depth in the watershed.

Watershed Jurisdictions

The Lower Silver Creek watershed is located in 3 counties, 13 townships, and nine municipalities (Table A.9, Figure A.14, Figure A.15).

Table A.9. County, municipal, unincorporated, and township jurisdictions within the watershed.

Jurisdiction	Area (acres)	Area within watershed (acres)	% of jurisdiction in watershed
County (inclusive of municipalities)	1,227,891	124,331	
St. Clair	431,669	116,814	27%
Madison	474,065	6,683	2%
Clinton	322,157	835	0%
Municipalities	50,943	24,389	
Belleville	14739	1723	12%
Fairview Heights	7365	1391	19%
Freeburg	4501	2150	48%
Lebanon	1584	1584	100%
Mascoutah	6178	6178	100%
O’Fallon	9272	7443	80%
Shiloh	7016	3632	52%
Summerfield	273	273	100%
Census-designated Place	15	15	
Rentchler	15	15	100%
Unincorporated Areas	973,325	99,942	
St. Clair County	323,646	92,425	29%
Madison County	337,815	6,683	2%
Clinton County	311,864	835	0%
Townships	277,250	124,347	
Jarvis	14,473	1,630	11%
St. Jacob	22,553	6,436	29%
Caseyville	19,047	3,371	18%
O'Fallon	23,153	18,545	80%
Lebanon	23,033	557	2%
Sugar Creek	23,362	22,658	97%
St. Clair	25,223	14,967	59%
Belleville	22,994	6,186	27%
Shiloh Valley	22,937	22,355	97%
Mascoutah	20,464	18,948	93%
Freeburg	13,560	1,733	13%
Engelmann	23,051	6,149	27%
New Athens	23,401	814	3%
Scott AFB	2,781	2,781	100%

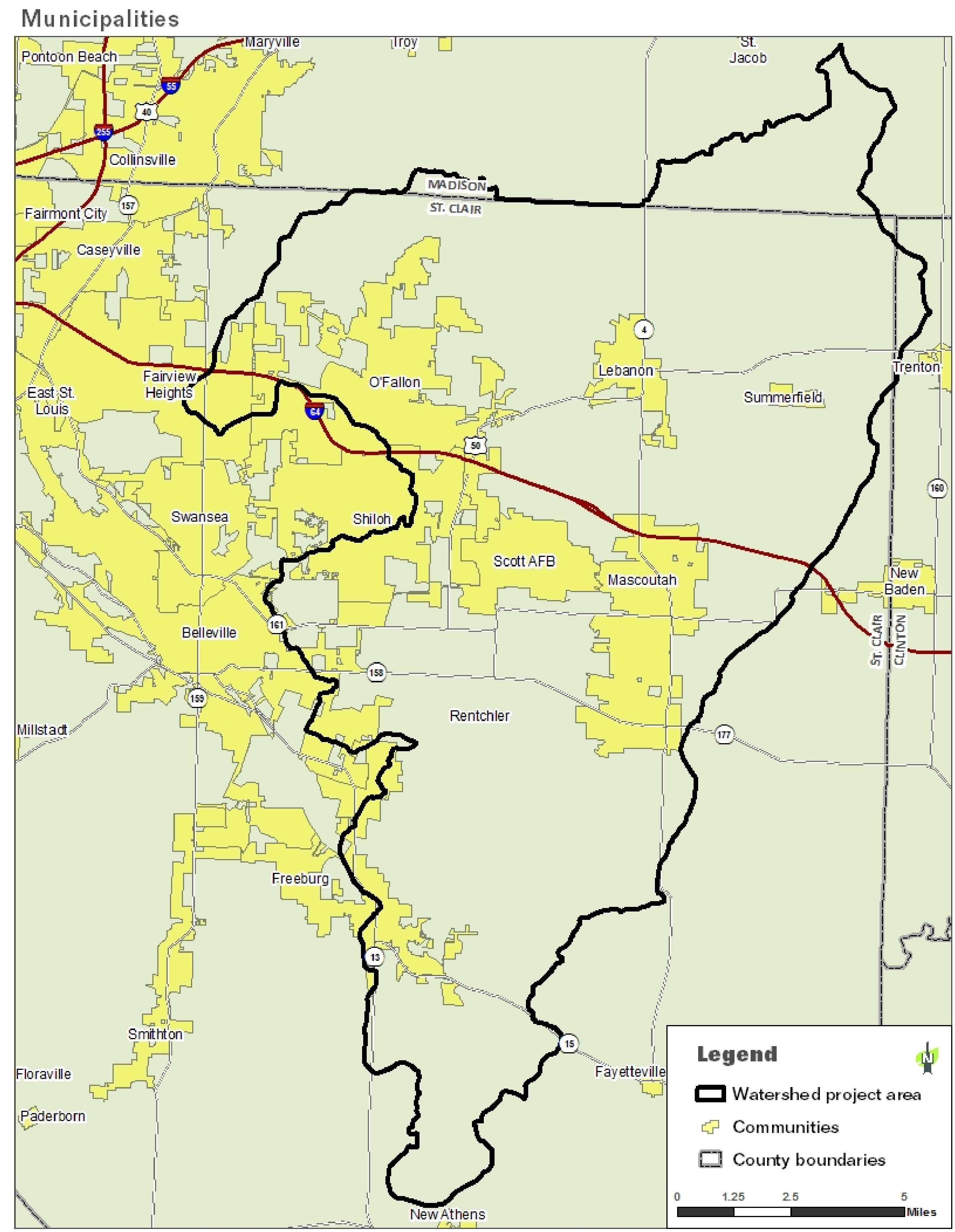

Figure A.14. Municipalities in the watershed.

Townships

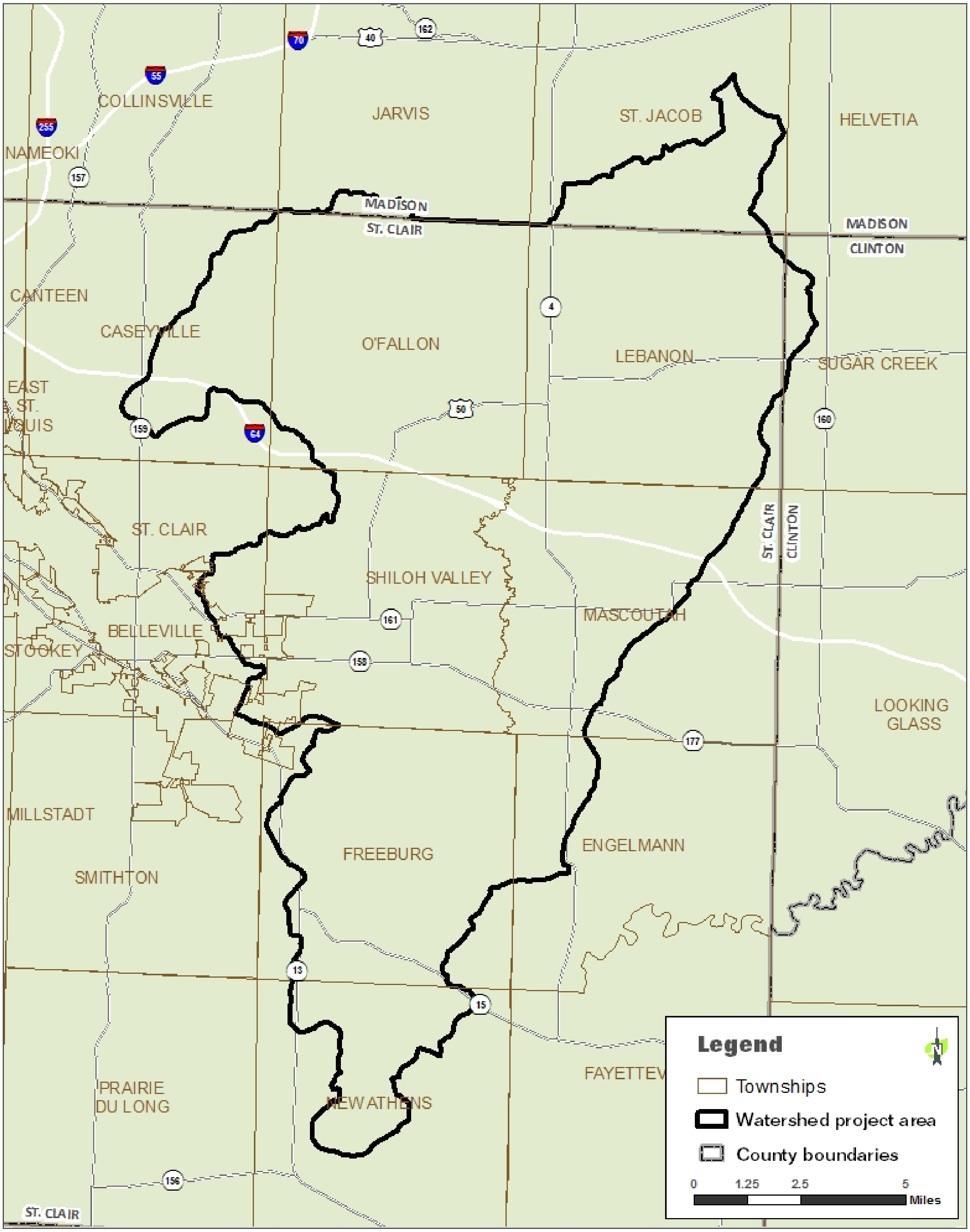

Figure A.15. Townships in the watershed.

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.[8]

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 Federal Emergency Management Agency (FEMA) operates the National Flood Insurance Program (NFIP), and is able to coordinate the response to a disaster that overwhelms state and local governments. The agency is also able to provide funds and training towards activities such as flood mitigation and preparedness.

The IEPA Bureau of Water regulates wastewater and stormwater discharges to streams, rivers, and lakes through the National Pollutant Discharge Elimination System. The National Pollutant Discharge Elimination System (NPDES) Phase I Stormwater Program applies to large and medium-sized Municipal Separate Storm Sewer Systems (MS4), several industrial categories, and construction sites hydrologically disturbing 5 acres of land or more. The NPDES Phase II program covers additional MS4 categories, additional industrial coverage, and construction sites hydrologically disturbing more than 1 acre of land. Under the NPDES Phase II program, all municipalities with small, medium, and large MS4 are required to complete a series of BMPs and measure goals for six minimum control measures, including public education and participation, illicit discharge detention, construction site runoff control, and pollution prevention.[9]

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 Lower Silver Creek watershed have been issued NPDES permits by Illinois for stormwater discharges to MS4. Table A.10 shows the municipalities and townships enrolled in the St. Clair County Co-Permittee Group, which joins forces in complying with the NPDES for MS4 Phase II requirements.

Table A.10. MS4 Co-Permittee Group members in the Lower Silver Creek watershed.

County
St. Clair County
Municipalities
City of Belleville
City of Fairview Heights
City of O'Fallon
Village of Shiloh
Townships
Caseyville Township
O'Fallon Township
St. Clair Township

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.

Scott AFB, located centrally in the watershed adjacent to Silver Creek, is home to several command and control elements that represent logistics for the U.S. Army, Navy, Air Force, Marines and Coast Guard.[10] Scott AFB is approximately 2,560 acres and has 1,029 acres of easements and right-of way. The Scott runway is 8,000 feet long and shares a taxiway with the MidAmerica St. Louis Airport. The total Scott AFB community, on- and off-base, comprises approximately 39,952 military and civilian personnel and their families. Scott AFB has its own stormwater pollution prevention plan. A 1992 wetland delineation and evaluation determined that a majority of the bottomland bordering Silver Creek, approximately 390 acres, is wetland. [11]

Local Government

Watershed protection in St. Clair, Madison, and Clinton 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 St. Clair County is regulated by the St. Clair County Building and Zoning Department. St. Clair County does not have a Subdivision Ordinance, nor a separate Zoning Ordinance or Drainage Ordinance. It does have a Floodplain Zoning Ordinance, adopted in 2003, which regulates floodplain development.[12] It also has a Stormwater Control Code which regulates stormwater and erosion control activities in new development and redevelopment.[13] St. Clair County has a conservation ordinance, which applies to all lands within the 100-year floodplain or in stormwater retention basins.[14] The county also maintains maps of existing land use and infrastructure.[15]

St. Clair County and Madison County are among the Illinois counties with increased authority over stormwater management. 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." Stormwater Plans created by these counties 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 precDiv 110 – Flood Control and Drainage). As of the time of writing, neither St. Clair or Madison Counties have adopted a countywide Stormwater Plan. This watershed plan may be incorporated into St. Clair County's countywide plan if and when a countywide Stormwater Plan is created.

St. Clair County is a member of the National Flood Insurance Program (NFIP). The county has a Floodplain Manager who coordinates the county's membership in the Community Rating System (CRS), a program of the NFIP. The County's Environment Committee oversees the Building and Zoning Department and its role includes cooperation on long-range land use planning and review of floodplain codes.[16]

St. Clair County adopted its current Comprehensive Plan in April 1991. A draft plan update was developed in April, 2008 by Woolpert Consultants, but this has not yet been completed or adopted by the County.[17]

The MidAmerica St. Louis Airport (airport) is operated by St. Clair County. It currently hosts commercial service to nine destinations including Las Vegas, Nevada and Orlando, Florida, and also provides charter, general aviation, and cargo services. The airport is co-located with Scott AFB and shares airfield facilities under a joint-use agreement.[18] The 2008 Joint Land Use Study (JLUS) has the long-term goal of reducing potential encroachment (negative operational impacts on adjacent communities), accommodating growth and sustaining the regional economy. The JLUS recommendations that may affect watershed planning the most are those concerning light and sound pollution (which affect wildlife habitat) and land use development codes and tools such as cluster development. One of the recommendations is to "Limit land uses that pose a higher risk of bird strikes to aircraft. Solid waste landfills, recycling centers, large bodies of open water that are two surface acres or larger should be prohibited" in the Planning Influence Area. St. Clair County, O'Fallon, Mascoutah and the Village of Shiloh have all adopted an Airport Overlay ordinance addressing land use planning and noise attenuation within a Noise Zone in the area. A Regional Advisory Board makes land use decisions about new permits/applications within the Planning Influence Area.[19]

Scott AFB recently adopted an Installation Complex Encroachment Management Action Plan (ICEMAP) in February 2017. An ICEMAP is an internal Air Force document designed to identify encroachment challenges and the resources required to manage those challenges in a way that is complementary with surrounding communities. The ICEMAP includes a catalog of immediate, mid-term, and long-term strategies to address current encroachment challenges regarding local land development surrounding the base. Encroachment challenges relevant to watershed planning include urban growth, endangered species and critical habitat, and water resources. The ICEMAP is designed to provide tools to minimize the likelihood of future incompatible development surrounding the base and thus address encroachment challenges. One of the "Suggested Actions for Scott AFB and Local Communities to Continue Encroachment Management in the Future" in the ICEMAP is to "Galvanize support for a regional stormwater management plan. Using the RAB [Regional Advisory Board for the JLUS] as the first platform, Scott AFB must work with regional partners and local communities to support and produce a regional stormwater management plan to address flooding issues throughout the region." [20]

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. Development activities are overseen by the Planning and Development Department. Clinton County's Zoning Department is responsible for the Floodplain Ordinance, Subdivision Ordinances, and Zoning Ordinance.

Municipalities in St. Clair County have passed similar ordinances to the county's ordinances. The Village of Shiloh created a Conservation Overlay district in their Development Code which includes for conservation lands in the floodplain, or characterized with steep slopes, wetlands and forests.[21] Many municipalities in the watershed are also members of the NFIP and have passed floodplain ordinances (see Flooding section for more information). The St. Clair County Multi-Hazard Mitigation Plan includes a summary of planning documents in effect for the county and municipalities (Table A.11).

Township governments are responsible for several maintenance activities in the watershed, including road and roadside maintenance and sewer treatment. The Caseyville Township Sewer District receives and treats wastewater from a large area in the northwestern part of the Lower Silver Creek watershed.

Local Homeowners' Associations, such as the Fairwood Lake Association, are responsible for maintenance activities outlined in their by-laws, which often include mowing, planting, and cleaning water features in the neighborhood. Not all Homeowners' Associations are active, and in some cases, crucial maintenance activities are simply not performed.

Table A.11. Existing planning documents by jurisdiction, if known, from Table 1-4 in the St. Clair County Multi-Hazard Mitigation Plan. [SOURCE: St. Clair County Multi Hazard Mitigation Plan]

Author(s)	**Year**	**Title**	**Description**
Woolpert Consultants with Thouvenot, Wade & Moerchen	1991	Comprehensive Plan, St. Clair County, Illinois	Comprehensive plan for land use, transportation, and public facilities.
Woolpert Consultants	Not yet adopted	St. Clair County, Illinois (Draft) Comprehensive Plan Update – 2008	Background information for planning
St. Clair County	2004	Revised Code of Ordinances of St. Clair County Illinois	This codebook includes ordinances for floodplain, and planning / zoning.
St. Clair County	1993	Flood Plain Management Plan	Coordinated Plan for reducing impact of flood emergencies
City of Fairview Heights		Land Use and Development Code	This code includes ordinances for floodplain, planning / zoning, land subdivision, and development standards.
City of Lebanon		Lebanon Municipal Code	Municipal code including Chapters 14 Planning and Chapter 7 Civil Defense
City of Mascoutah		Unified Development Code	This code includes ordinances for floodplain, planning / zoning, land subdivision, and development standards.
City of O'Fallon	2006	O'Fallon Comprehensive Plan	Comprehensive plan for land use, transportation, and public facilities.
Village of Shiloh		Code of Ordinances	Title XV, Land Usage includes ordinances for floodplain
East-West Gateway Council of Governments By Region Wise	2003	"Green Illinois: Building a Healthy Future for the Residents of St. Clair, Illinois"	Summary report from November, 2003 public prioritization forum.
East-West Gateway Council of Governments		Regional All-Hazard Mitigation Plan	Liquefaction Analysis for the St. Clair County Floodplain
Southwestern Illinois Metro and Regional Planning Commission	2003-2008	Comprehensive Economic Development Strategy (CEDS)	Lists economic and community projects for local governments. Includes mitigation to prevent developing in floodplain and building safer structures to withstand a potential earthquake.

Stakeholder Outreach to Municipalities

The planning team met with more than 64 individuals from 23 governments, non-governmental organizations, and businesses between August 2016 and May 2017. 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.

Drinking water supply

The water supply for municipalities interviewed is provided by Illinois American Water (to O'Fallon, Shiloh, Belleville, and Scott AFB) and Summerfield-Mascoutah-Lebanon (SLM) (to Summerfield, Mascoutah, Lebanon, Freeburg, and the MidAmerica Airport). Illinois American Water draws its water from the Mississippi River, while SLM draws from the Kaskaskia River.

Wastewater treatment

Municipal wastewater treatment in the watershed is largely conducted at facilities within municipal boundaries. Six of the municipalities have their own wastewater treatment facility. Shiloh sends its wastewater to three different destinations for treatment (Caseyville Township Sewer District, the City of Belleville, and the City of O'Fallon).

Belleville is the only municipality in the watershed with known 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.

Private sewage systems, such as septic systems, are present within municipal boundaries as well as in the unincorporated area. Several municipalities indicated plans to extend public sewer lines to these properties in future. 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.

Road overtopping was reported as a regular occurrence at Routes 4, 13, 158, and 177, and on U.S. Highway 50 after heavy rainfall. Road floods have restricted access to homes in Lebanon and Belleville.

The December 2015/January 2016 floods overtopped the Summerfield WWTP, which has been flooded before. Summerfield is seeking funds to upgrade its WWTP facility. The same rain event also almost flooded the O'Fallon WWTP in the Silver Creek corridor.

Erosion

Several municipalities highlighted soil erosion issues within their municipal boundaries along creeks and ditches. O'Fallon noted that its streams are getting wider but not deeper, as the water reaches shale bedrock on the streambed. Summerfield and Belleville identified areas of high streambank erosion where trees have been cut down next to streams to expand row crop agriculture, causing the streambanks to collapse and the creeks to widen. SWIC-Belleville identified high erosion areas on the southwest side of its campus.

Logjams

Two municipalities and several landowners mentioned logjams as an issue in the stream corridors, which are a contributing factor to erosion problems. The City of Lebanon is particularly affected by logjams where blockages of Silver Creek cause water to back up towards the city, overtopping Highway 50 and other roads and blocking entry and exit from the city.

Siltation and Sedimentation

Summerfield, Belleville, and Lebanon reported a reduction in the capacity of retention basins and ditches as a result of increasing silt and sediment deposition. In Lebanon, the ditch adjacent to U.S. Highway 50 has to be cleaned out often to prevent road flooding. The city is working on calculations of sediment deposition to determine whether the problem area qualifies for TIF funds.

Surface water quality issues

Several municipalities knew about local streams that were listed as impaired on the Illinois EPA 303(d) list, but local water issues were not known. Shiloh identified a potential issue with fecal coliform bacteria where a subdivision on private sewer sits adjacent to a creek that has had odor issues. Several property owners who attended open house events noted litter or trash as an issue within the watershed.

Recreation

Water-based recreation takes place on and around several of the larger lakes and ponds in the watersheds. Sportsman Lake, Prairie Lake Park, Freeburg Park, Freeburg Sportsman's Club, and other lakes and ponds in subdivisions often offer boating and fishing opportunities to neighborhood residents.

The input from municipalities can be found in Table A.12.

Table A.12. Summary of municipal input from stakeholder engagement on topics including water supply, wastewater treatment, flooding, and other issues.

	Drinking water supply		**Wastewater treatment systems**			**Flooding**		**Other issues**			
Municipality	Municipal groundwater (wells) or surface water, or purchased groundwater	Purchased surface water	Municipal WWTP	Private sewage	Combined sewers	Urban flooding	Riverine flooding	Erosion	Siltation	Surface water quality issues	Water-based recreation
Belleville		x	x	x	x	x		x	x		x
Freeburg		x	x	x		x		x	x	x	x
Lebanon		x	x			x			x		
Mascoutah		x	x	x		x			x		x
O'Fallon		x	x	x		x		x	x	x	x
Shiloh		x	x	x		x		x		x	x
Summerfield		x	x	x		x	x	x	x		
SWIC-Belleville						x		x			

Demographics

Population

St. Clair County is the most populous of the three project area counties, with more than 270,056 people as of 2010, followed by Madison at 269,282. Clinton County has less than a seventh of that population, with approximately 37,845, as of 2010.

The 2010 US Census found a population of approximately 77,568 in the Lower Silver Creek watershed (the sum of blocks overlapping the watershed area).

Of the municipalities represented within the project area, Belleville has the largest population, with 44,077 people as of the 2010 Census. O'Fallon and Fairview Heights are the next most populous municipalities, respectively. The least populous municipalities in the project area include Summerfield, Freeburg, and Lebanon. The approximate population living in municipalities in the watershed is 52,525 (Table A.13).

Table A.13. 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.

Municipality	Population (2010 Census)	Population (2015 Estimate)	Approx. Population in the watershed (2010 Census multiplied by % municipality in the watershed)
Belleville	44,077	42,898	5,289
Fairview Heights	17,107	17,014	3,250
Freeburg	4,357	4,226	2,091
Lebanon	4,469	4,259	4,469
Mascoutah	7,552	7,801	7,552
O'Fallon	28,706	29,144	22,965
Shiloh	12,455	12,902	6,477
Summerfield	432	581	432
Total	119,155	118,825	52,525

Population density varies throughout the watershed. The Census blocks with the lowest population density is 100 or less people per square mile on much of the eastern side of the watershed, and the highest population density is 1,001 to 10,000 people in Lebanon, Shiloh, O'Fallon, and Belleville (Figure A.16).

Population Density (2012)

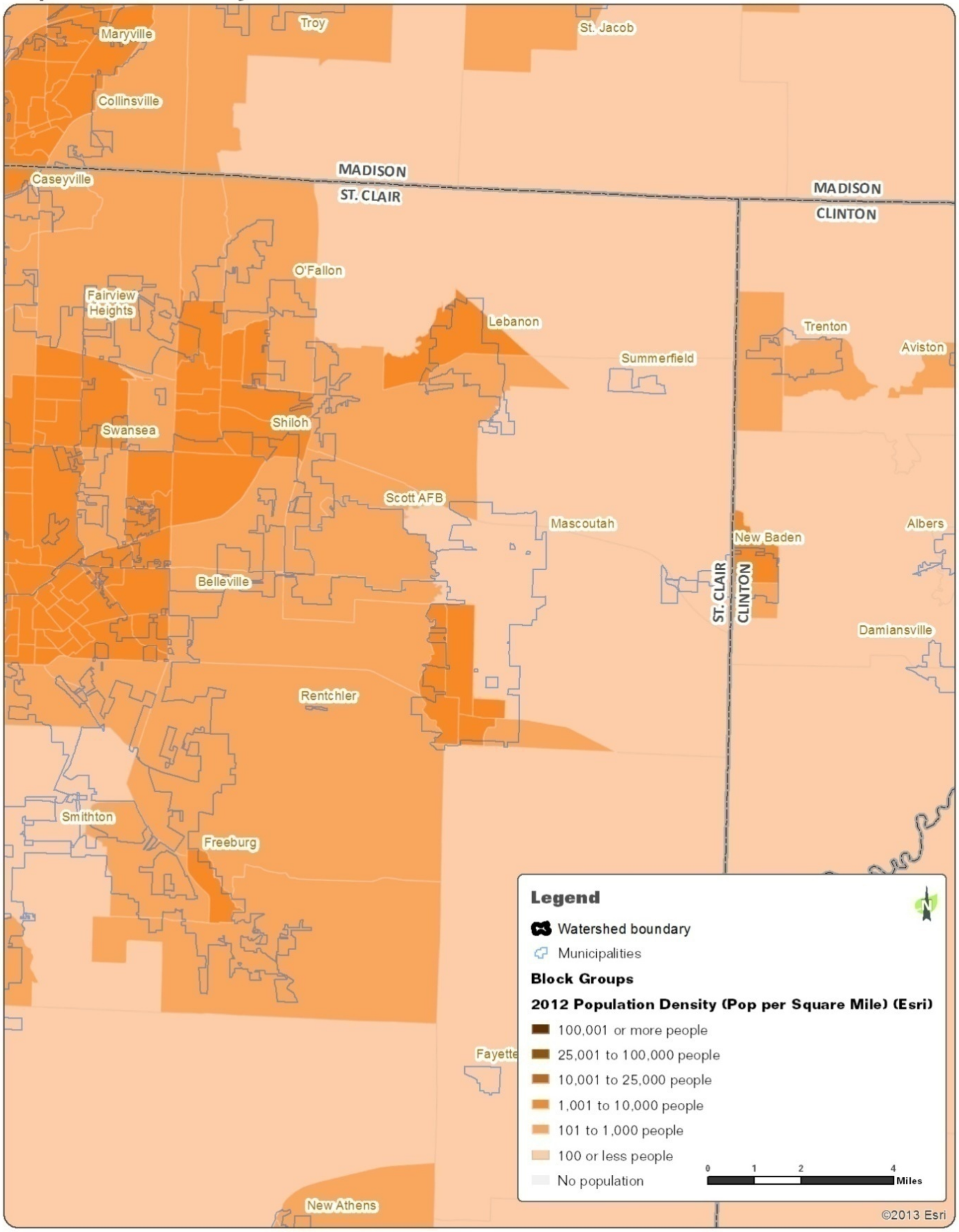

Figure A.16. Population density (2012) by Census block group.

Population Change

Recent population growth in the three counties from 2000 to 2010 was 3.8% in Madison County, 5.5% in St. Clair County, and 6.5% Clinton County.

All three of the counties in the watershed are expected to increase in population by the year 2025. Madison County is projected to experience the largest actual growth (2,866 people), while Clinton County is projected to experience the greatest percentage increase in population (3.2%) (Table A.14).

Table A.14. 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.[22]

Total Population	2000 Census	2010 Census	2015 Estimate	2025 Forecast	Change from 2015-2025 (# of people)	Percent Change from 2015-2025
St. Clair County	256,082	270,056	268,167	266,648	1,519	0.6%
Madison	259,391	269,282	270,121	272,987	2,866	1.1%
Clinton County	35,536	37,845	37,929	39,130	1,201	3.2%

Five-year population growth estimates show varying population growth between 2012 and 2017 in the watershed (Figure A.17). The Census block groups north of Lebanon, and in parts of Shiloh, Mascoutah, and Freeburg had negative or 0% population growth, while adjacent areas in Fairview Heights, Belleville, and Scott AFB saw estimated growth of 2.6% or more.

Population Growth 2012-2017

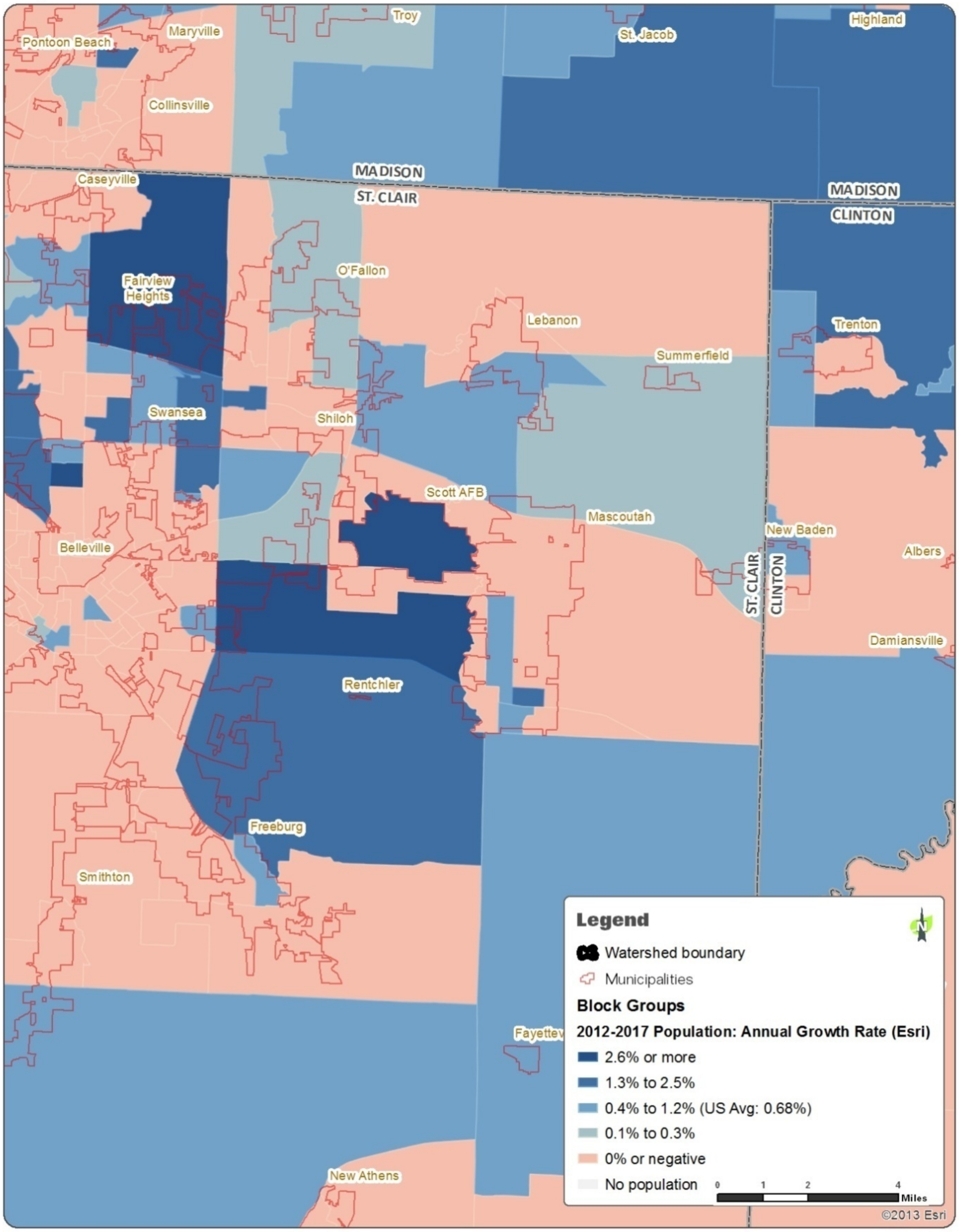

Figure A.17. Projected population growth in the watershed 2012-2017.

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 St. Clair County is $64,168. In Madison and Clinton counties, the median family income is $67,860 and $78,929 respectively (Table A.15).[23]

The municipalities with the highest median family income (upwards of $90,000) are Freeburg, O'Fallon, and Shiloh. The municipalities with the lowest proportion of people with income below the poverty level are Freeburg and Shiloh.

The municipalities with the lowest median family income (less than $70,000) are Belleville, Lebanon, and Mascoutah. Belleville and Lebanon also had the highest percentages of people with income below the poverty level.

Table A.15. Median family income and poverty in the municipalities and counties in the project area.

Community	Median Family Income (2011-2015)	Percentage of people whose income in the past 12 months is below the poverty level (2011-2015)
Belleville	$60,766	14.1%
Fairview Heights	$71,936	6.6%
Freeburg	$102,303	3.8%
Lebanon	$69,028	12.7%
Mascoutah	$69,419	9.8%
O'Fallon	$97,576	6.7%
Rentchler CDP	-	-
Shiloh	$109,506	1.2%
Summerfield	$70,833	5.3%
AVERAGE	$81,421	7.5%
St. Clair County	$64,186	14.7%
Madison County	$67,860	9.6%
Clinton County	$78,929	6.2%
AVERAGE	$70,325	10.2%

Figure A.18. shows the median household income by Census tract in the watershed area. The north and central tracts in the watershed (including parts of O'Fallon and Freeburg) have the highest household income, while Mascoutah and the area north of Scott AFB have lower incomes that are more in line with the U.S. national median for 2012, $50,157.

Household Income

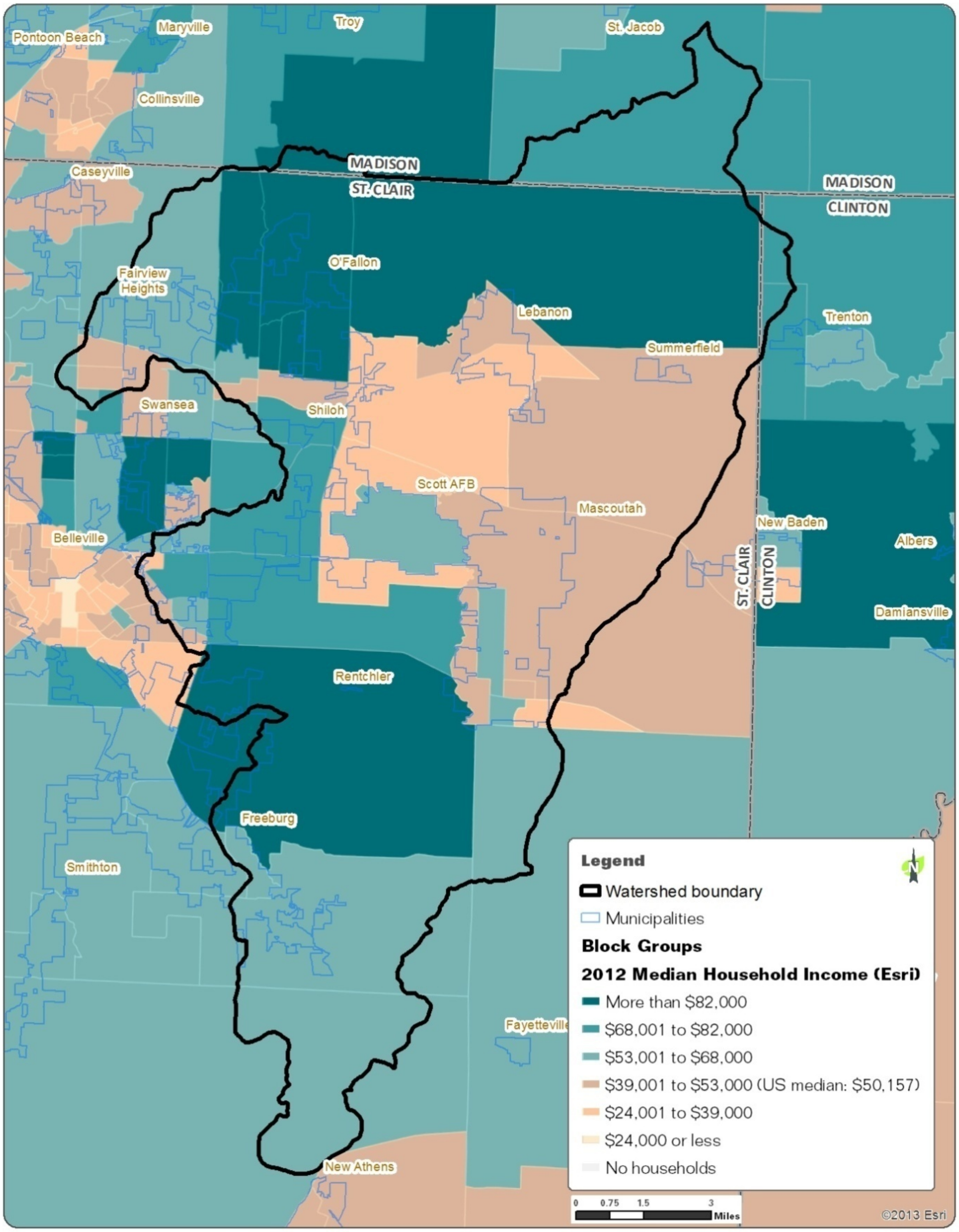

Figure A.18. 2012 median household income by Census tract.

Employment

Employment can be an indicator of future growth and development in an area. St. Clair County experienced a 2.9% decrease in the number of employed adults between 2011 and 2015 (Table A.16.). In 2015, the industry sector with the largest number of jobs was educational services, healthcare, and social assistance (28,398 jobs), followed by retail trade (13,016 jobs). The changes in employment were relatively small within each market sector (less than 1.1%).

Madison County experienced a 0.7% decrease in the number of jobs between 2011 and 2015. The industry with the largest number of jobs in 2015 was educational services, healthcare, and social assistance (28,446 jobs), followed by manufacturing (16,569 jobs). The professional, scientific, and management, and administrative and waste services sector grew from 1.3% to 9.7% of the total number of jobs in the county, the largest increase of any sector.

Clinton County experienced a 39% increase in the number of jobs between 2011 and 2015. The industry with the largest number of jobs in 2015 was educational services, healthcare, and social assistance (4,457 jobs), followed by manufacturing (2,245 jobs). The changes in employment were relatively small within each market sector (less than 1.8%).

Table A.16. Percentage of the workforce working in non-services, services, and government sectors in 2011 and 2015, & percentage change in that time.[24]

	St. Clair County		**Madison County**		**Clinton County**	
	2007-2011 5-yr estimates	**2011-2015 5-yr estimates**	**2007-2011 5-yr estimates**	**2011-2015 5-yr estimates**	**2007-2011 5-yr estimates**	**2011-2015 5-yr estimates**
Civilian employed population 16 years and over	120,077	116,537	125,974	125,030	18,530	19,250
Agriculture, forestry, fishing & hunting, mining	0.9%	0.6%	0.7%	0.7%	2.6%	4.0%
Construction	5.3%	5.4%	5.9%	5.5%	9.2%	9.4%
Manufacturing	8.7%	8.8%	12.3%	13.3%	13.5%	11.7%
Wholesale trade	2.2%	2.3%	2.8%	2.2%	3.4%	3.6%
Retail trade	11.4%	11.2%	11.5%	11.8%	10.5%	11.0%
Transportation and warehousing, and utilities	6.6%	6.8%	6.7%	6.3%	5.8%	5.8%
Information	1.8%	1.3%	1.8%	1.9%	1.5%	1.3%
Finance and insurance, and real estate and rental and leasing	7.0%	6.4%	6.9%	6.3%	7.0%	6.3%
Professional, scientific, and management, and administrative and waste management services	10.0%	11.0%	1.3%	9.7%	8.0%	6.6%
Educational services, and health care and social assistance	24.4%	24.4%	22.8%	22.8%	21.8%	23.2%
Arts, entertainment, and recreation, and accommodation and food services	10.0%	9.3%	9.8%	10.3%	5.6%	7.1%
Other services, except public administration	4.9%	4.7%	5.4%	4.8%	3.8%	3.6%
Public administration	6.7%	7.8%	4.0%	4.4%	7.2%	6.4%
Percent change	-2.9%		-0.7%		3.9%	

Home Values

Investment and development in the Lower Silver 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 based on Census tract show that median home values in the watershed are generally higher in the north end of the watershed and around Freeburg and north of New Athens (Figure A.19). According to data from housing website Zillow.com, the average median home price in the municipalities in the project area is $135,414 (Table A.17). All of the municipalities experienced an increase in home values over the past year, and the prediction for next year is a 3.2% increase.[25]

Approximately 0.2% of homes in the watershed have negative equity, meaning that the market value of the property has fallen below the outstanding amount of the mortgage secured on it. This percentage is similar to the U.S. average of 0.1% (as of September 2016). Approximately 0.0% of homes are delinquent on their mortgages in the municipalities and the three counties. The U.S. average is also 0.0% (as of September 2016).

Table A.17. Home values, recent and predicted change in home values, and percentages of homes with negative equity and that are delinquent on their mortgages.

Community	Median home value (as of 3/17)	Change in home values 3/16 to 3/17	Predicted change in home values 3/17 to 3/18	Homes with negative equity	Delinquent on mortgage
Belleville	$83,200	10.5%	3.4%	0.2%	0.0%
Fairview Heights	$111,000	7.4%	3.1%	0.2%	0.0%
Freeburg	$138,400	12.8%	4.2%	0.1%	0.0%
Lebanon	$107,400	9.5%	3.1 %	0.2%	0.0%
Mascoutah	$145,700	6.0%	2.7%	0.1%	0.0%
O'Fallon	$182,100	7.8%	3.1%	0.2%	0.0%
Rentchler	No data	No data	No data	No data	No data
Shiloh	$180,100	7.1%	2.7%	0.2%	0.0%
Summerfield	No data	No data	No data	0.4%	0.0%
AVERAGE	$135,414	8.7%	3.2%	0.2%	0.05%
St. Clair	$94,200	7.2%	2.8%	0.2%	0.0%
Madison	$107,200	No data	No data	0.1%	0.0%
Clinton	$127,500	No data	No data	0.1%	0.0%
AVERAGE	$109,633	n/a	n/a	n/a	n/a

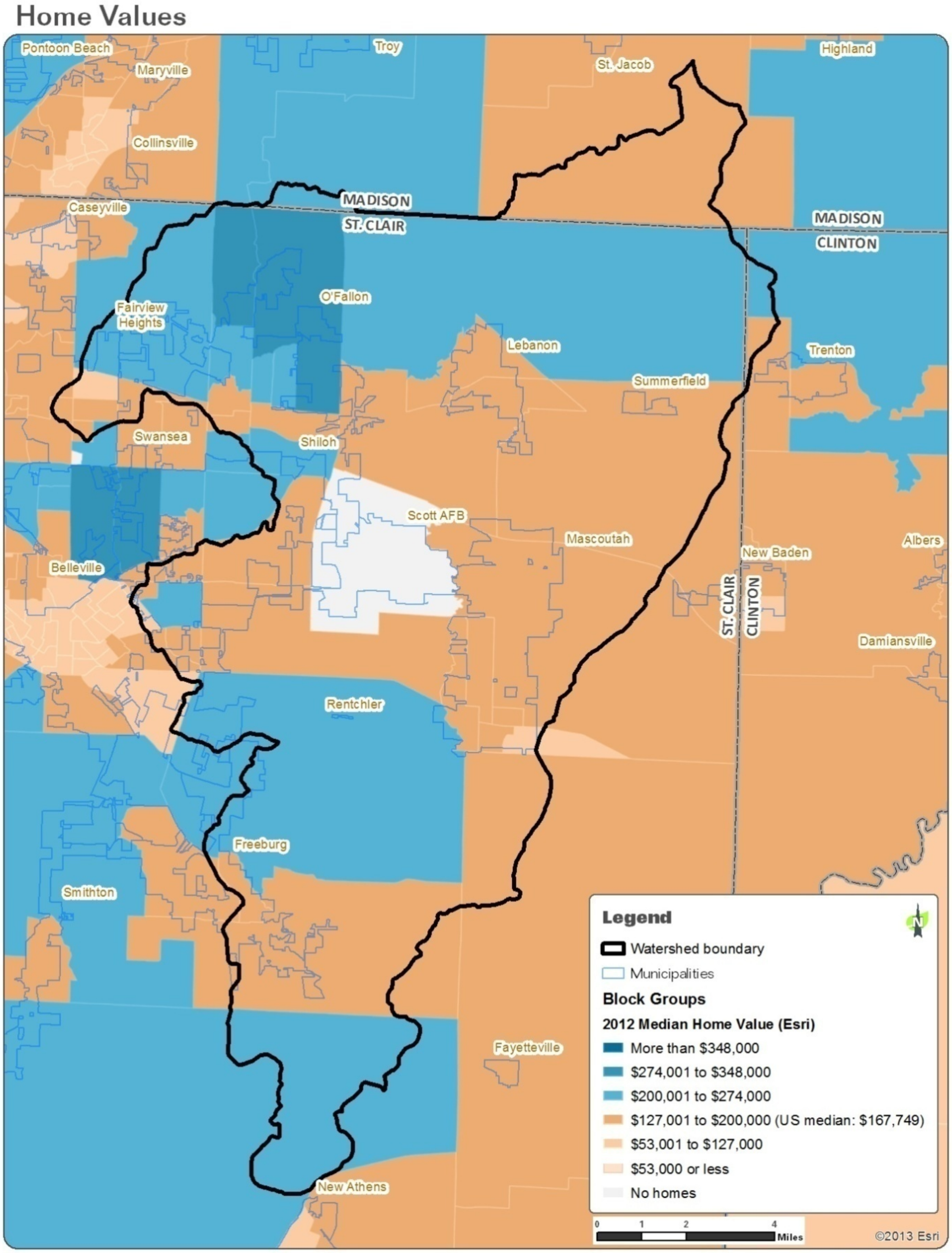

Figure A.19. 2012 median home values in the watershed, based on total owner-occupied units, by Census tract.

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 both St Louis and 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-2000's and the tendency for the millennial generation to rent homes instead of purchasing.

Owner occupied housing rates are at 76% or more across most of the watershed as of 2012, which is higher than the national average of 57% and the St. Louis Metropolitan Area average of 71.2%. Rates are lower in municipalities such as Lebanon and Belleville, presumably as a result of the increased availability and demand for rental housing available in more urbanized areas, particularly those with colleges such as McKendree University (approximately 3,000 students in 2009) and Southwestern Illinois College (SWIC) (approximately 25,638 students in 2009) (Figure A.20). Scott AFB has similarly low owner-occupied housing rates as a result of personnel turnover at the Base.

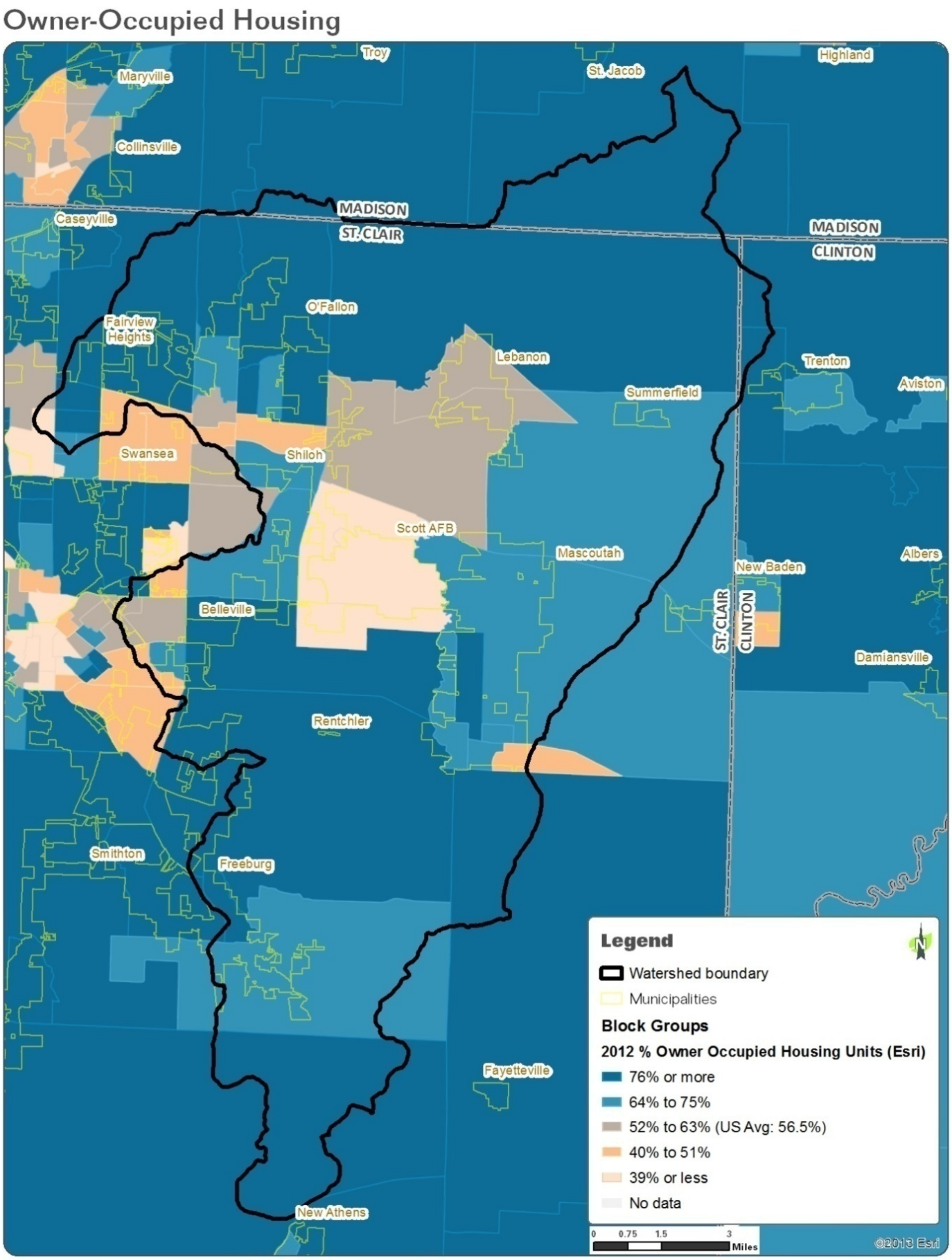

Figure A.20. Percent of housing that was owner-occupied in 2012 in the watershed, by Census block group.

Land Use/Land Cover

Land use/land cover data for the watershed was collected from the 2011 National Land Cover Database (NLCD). Cultivated crops are the most common land cover in the watershed at 64,592 acres or 53% (Table A.18). Other common land cover includes deciduous forest (13,281 acres, 11%), hay/pasture (12,791 acres, 10%), developed, low intensity (11,588 acres, 9%), and developed, open space (9,732 acres, 8%). Urbanized areas are distributed throughout the watershed, but the largest urbanized area is located in the northern portion of the watershed in municipalities along the highways (Figure A.21). Other land cover types such as high intensity development, open water, and emergent herbaceous wetlands are present in smaller areas.

Table A.18. 2011 land cover classifications and acreage.[26]

Land Cover	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.	64,592	53%
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.	12,791	10%
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.	9,732	8%
Developed, Low Intensity	Areas with a mixture of constructed materials and vegetation. E.g. single family houses. Impervious surfaces cover 20-40% area.	11,588	9%
Developed, Medium Intensity	Areas with a mixture of constructed materials and vegetation. E.g. single family houses. Impervious surfaces cover 50-79% area.	3,682	3%
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.	824	1%
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.	13,281	11%
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.	973	1%
Shrub/Scrub	Areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation.	3	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.	286	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.	5,218	4%
Barren Land	Areas of bedrock, desert pavement, scarps, and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.	10	0%
Open Water	Areas of open water, generally with<25% of vegetation or soil.	1,245	1%

Land cover

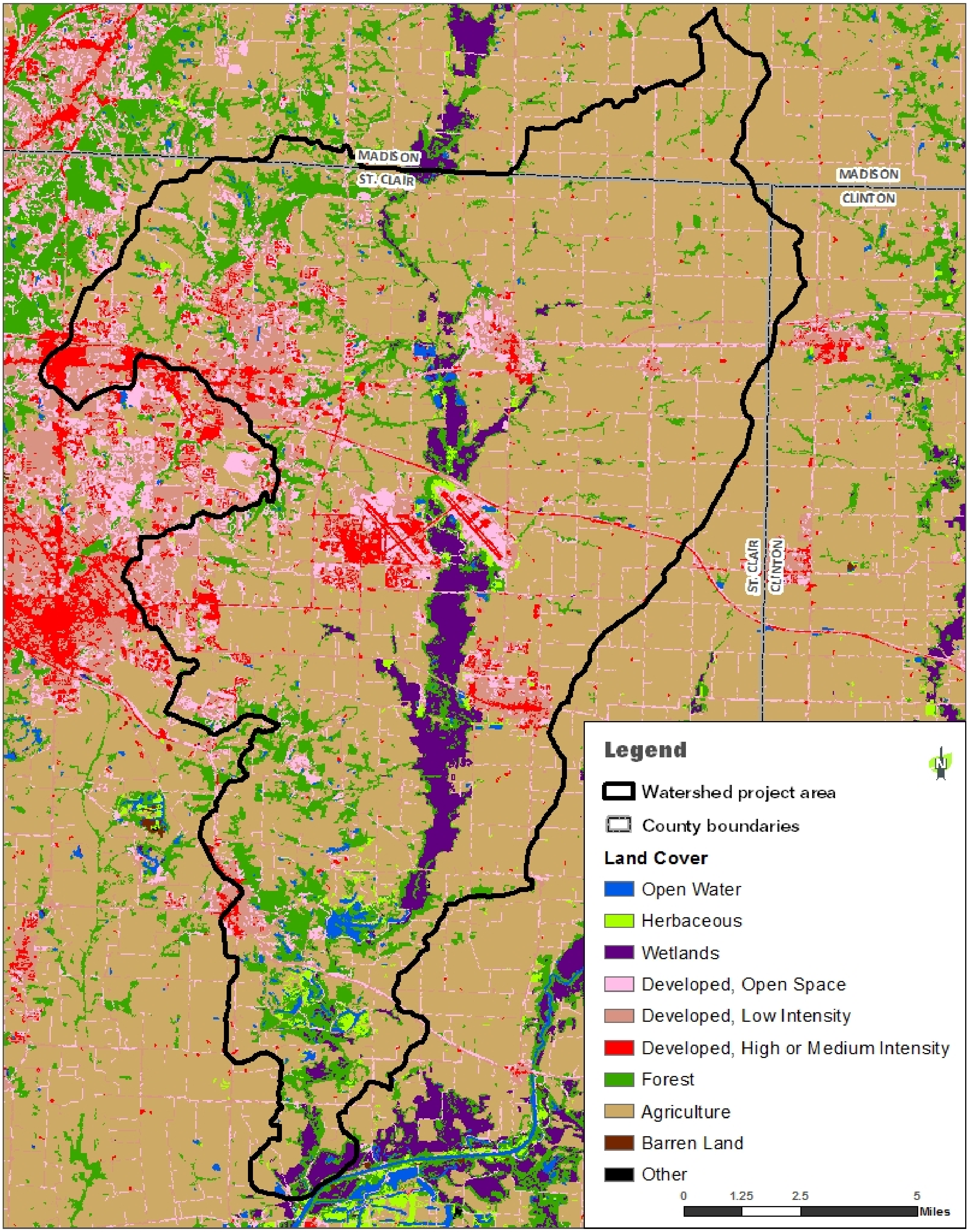

Figure A.21. Land cover (2011) in the watershed.

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, box elder and ash tend to dominate. Forest covers approximately 11% of the watershed at present.

Illinois RiverWatch volunteers collected data on vegetation at eight (8) stream sites in the watershed between 1996 and 2013. The riparian vegetation at these sites includes trees such as silver maple, sycamore, oak, elm, box elder, cottonwood, ash, and dogwood. Invasive species including bush honeysuckle (*Lonicera maackii and L. morrowii*), Japanese honeysuckle (*Lonicera japonica*), and multiflora rose (*Rosa multiflora*) were also recorded.[27]

Davey Resource Group conducted an analysis of tree cover in Madison and St. Clair counties 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 Lower Silver Creek watershed, there were 513,245,341 sq ft of "high" and "very high" priority planting areas, with 64,131,351 sq ft of these within municipal boundaries.[28]

Wetlands

Historically, Illinois lost 90% of its wetlands between the 1780's and 1980's, 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.22 shows the wetlands in the Lower Silver Creek watershed, as reported in the NWI.

According to the NWI, freshwater forested/shrub wetland is the most prevalent wetland type in the watershed, with a few lakes and ponds 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 5,504 acres of the Lower Silver Creek watershed contains wetlands.

In 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.

The Missouri Resource Assessment Parternship (MoRAP) created wetlands mitigation importance values and wetland restoration importance values for the northern end of the watershed in 2015. 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. Figure A.23 shows these areas. The 2015 report, "Ecological Approach to Infrastructure Development: Wetlands Mapping and Analysis for the Mississippi and Mississippi River Floodplains" describes the methodology of this assessment and provides information on other wetlands in the region.[29]

Wetlands

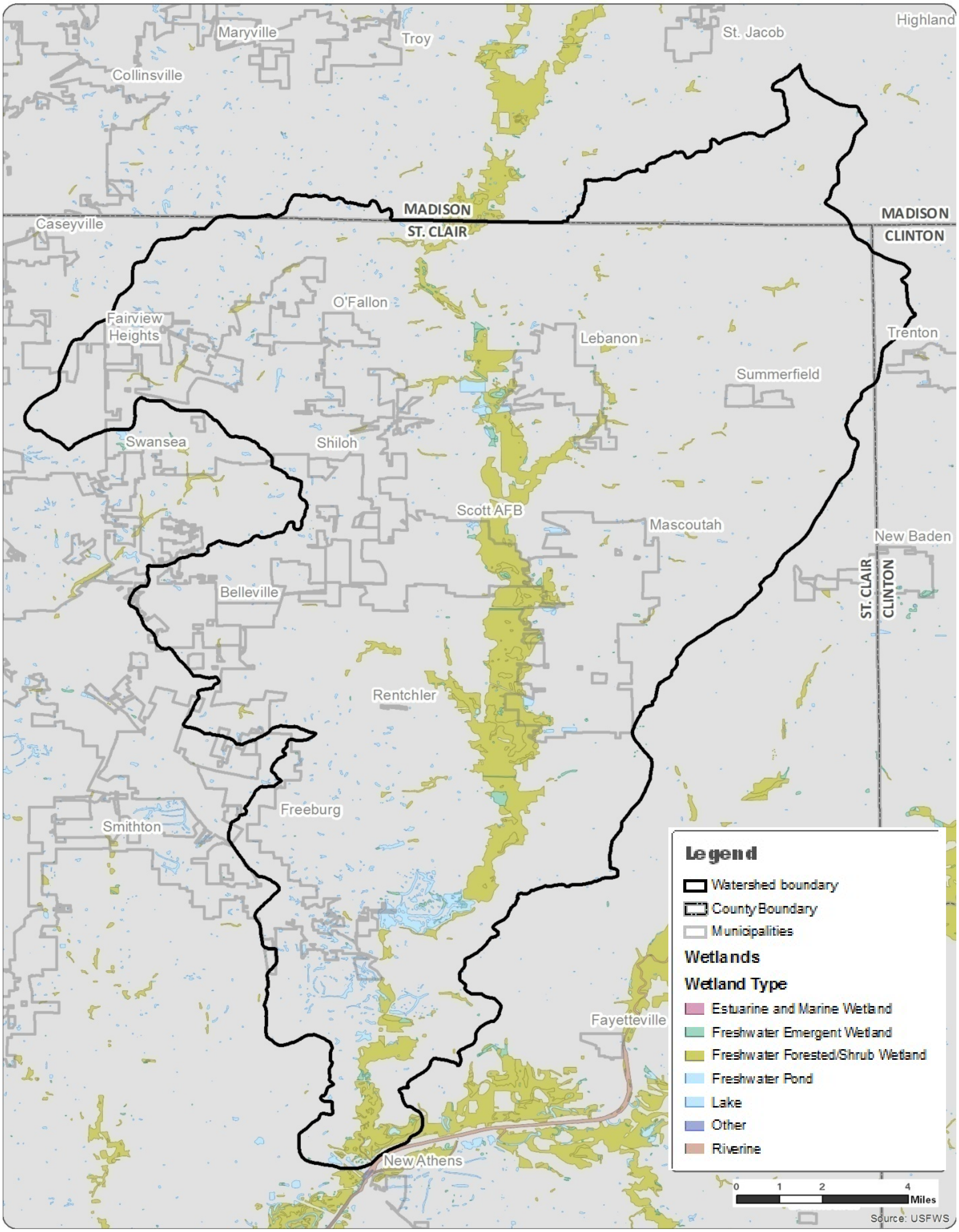

Figure A.22. Wetlands in the watershed identified in the National Wetlands Inventory.

Wetland Importance Rank (MoRAP assessment 2015)

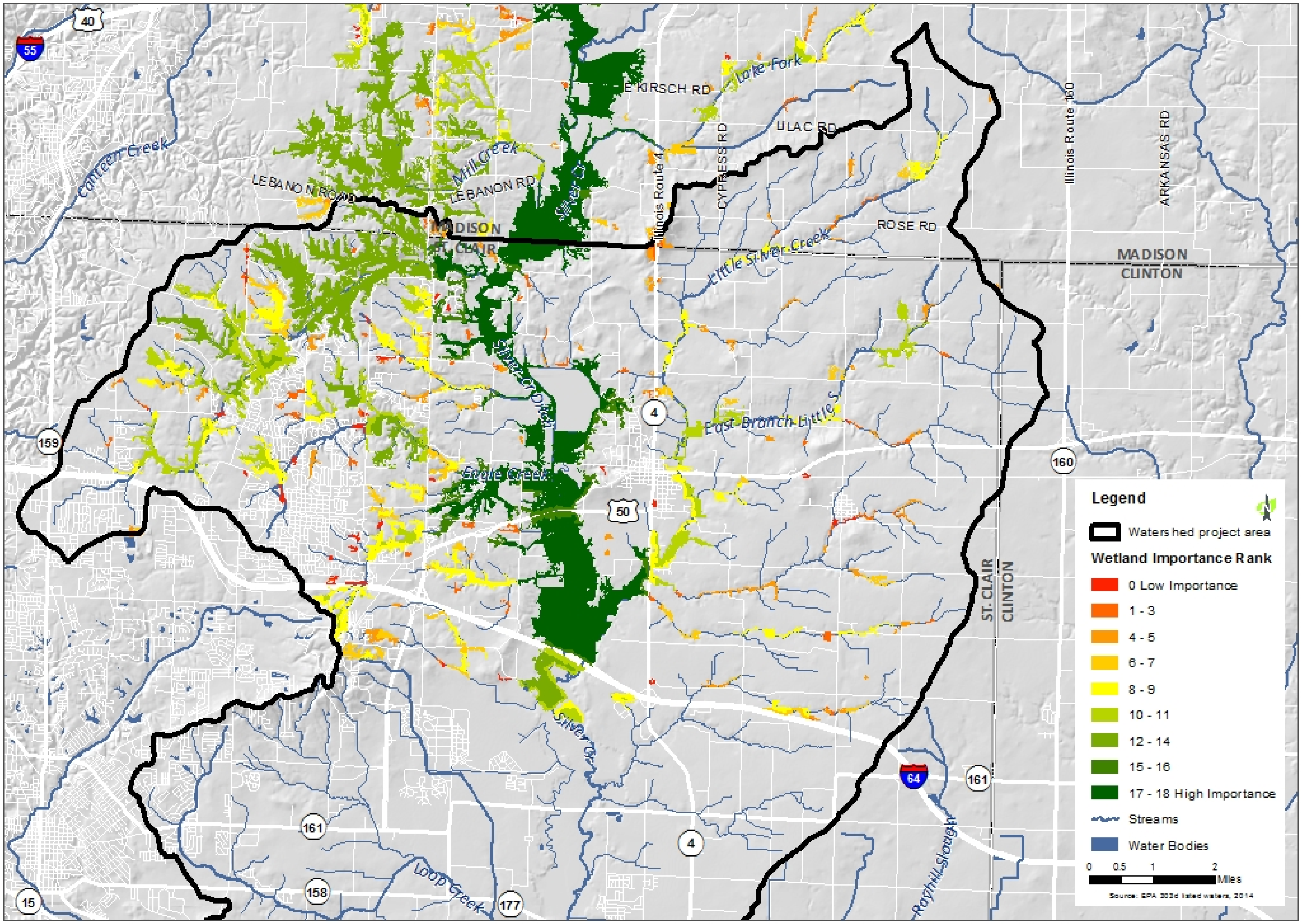

Figure A.23. Wetlands identified in the northern part of the watershed in the 2015 MoRAP assessment.

Ecological Significance

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.[30]

Most of the area in the Silver Creek corridor was assessed for ecological significance (Figure A.24). The area around the confluence of Loop Creek and Silver Creek is considered to have somewhat high ecological significance, as is the area around the confluence of Silver Creek and the Kaskaskia River. Areas along Silver Creek further north have lower ecological significance.

Areas of Ecological Significance in the Lower Silver Creek Watershed

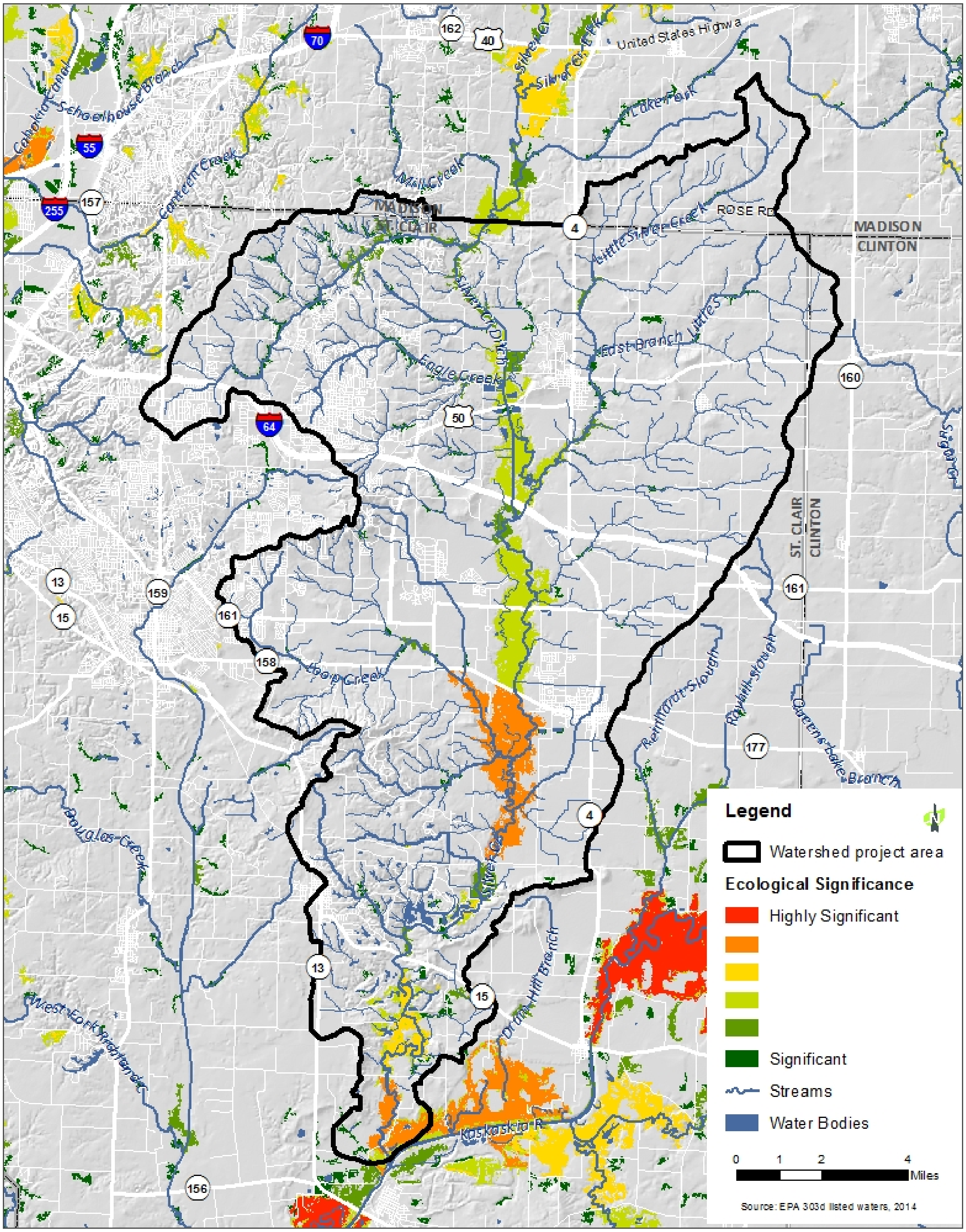

Figure A.24. Areas of ecological significance.

Bird species observed at Scott Air Force Base

USDA - Wildlife Services staff observe bird populations at Scott AFB. Figure A.25 is a density map containing one year's worth of observational data (2016-2017) at the base. Bird species observed at Scott AFB 01-10-2016 through 02-10-2017:[31]

- Mixed Blackbirds
- Red-winged Blackbird
- Eastern Bluebird
- Northern Cardinal
- American Crow
- White-tailed Deer
- Mourning Dove
- Mallard
- Blue-winged Teal
- Green-winged Teal
- Wood Duck
- Bald Eagle
- Snowy Egret
- Great Egret
- American Kestrel
- Canada Goose
- Common Grackle
- Ring-billed Gull
- Northern Harrier
- Cooper's Hawk
- Red-shouldered Hawk
- Red-tailed Hawk
- Great Blue Heron
- Green Heron
- Killdeer
- Horned Lark
- Eastern Meadowlark
- Hooded Merganser
- American Robin
- Northern Shoveler
- Common Snipe
- Fox Sparrow
- House Sparrow
- European Starling
- Barn Swallow
- Cliff Swallow
- Chimney Swift
- Wild Turkey
- Turkey Vulture
- Pileated Woodpecker

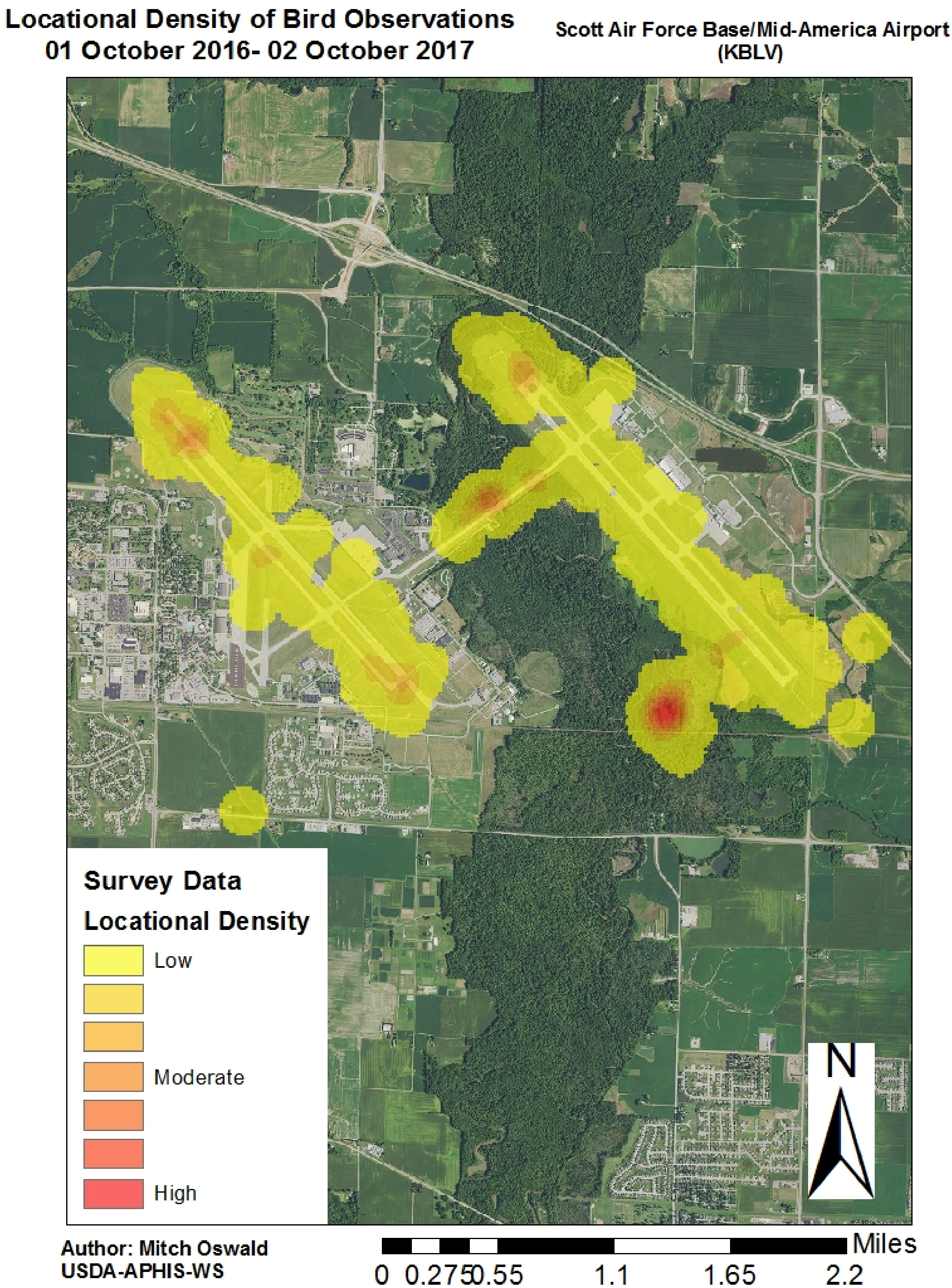

Figure A.25. Locational density of birds observed at Scott AFB/MidAmerica Airport between October 2016 and October 2017.

Threatened and Endangered Species

Fourteen animal and plant species which are federally listed as threatened, endangered or proposed as threatened in the counties may be present in the study area. The most likely present species include the Northern long-eared bat, the Indiana Bat, the decurrent false aster, and the eastern prairie fringed orchid (Table A.19).

Scott AFB completed an Environmental Assessment of Selected Fauna and their Habitats in 2001. The assessment included bird surveys, bat surveys, and botanical surveys of the majority of the high quality habitats. The Scott AFB botanical survey did not identify the presence of any state or federally listed endangered/threatened plant species on the installation, although suitable habitats for these species do exist within Scott AFB boundaries. The survey identified the presence of the federally endangered Indiana Bat (*Myotis sodalis*) (USAERDC 2002).[32] In addition to the Indiana Bat, studies at the Base have documented two state endangered bird species, as designated by the Illinois Endangered Species Protection Board (IESPB), in 2001 and in 2004: the Snowy Egret (*Egretta thula*) and the Little Blue Heron (*Egretta caerulea*).[33]

Table A.19. 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 Lower Silver Creek watershed.[34] *Two birds identified by the IESPB that have been identified at Scott AFB have been added to the table (in italics).*

Species	Status	Range	Habitat
Mammals			
Indiana Bat (*Myotis sodalis*)	Endangered	Potential habitat statewide; Known occurrences in 28 counties in Illinois, including Madison, St. Clair, & Clinton.	Caves, mines (hibernacula); small stream corridors with well developed riparian woods; upland forests (foraging). *(Sighted at Scott AFB in 2001)*
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, including St. Clair	Bare alluvial and dredged spoil islands
Piping plover (*Charadrius melodus*)	Endangered	2 counties, plus 7 counties for migration, including Clinton	Lake Michigan beaches
Snowy Egret *(Egretta thula)*	*Endangered (state)*		*(Sighted at Scott AFB in 2001)*
Little Blue Heron *(Egretta caerulea)*	*Endangered (state)*		*(Sighted at Scott AFB in 2001)*
Reptile			
Eastern Massasauga (*Sistrurus catenatus*)	Proposed as Threatened	7 counties in Illinois, including Madison & Clinton	Graminoid dominated plant communities (fens, sedge meadows, peatlands, wet prairies, open woodlands, and shrublands)

Species	Status	Range	Habitat
Fish			
Pallid Sturgeon (*Scaphirhynchus albus*)	Endangered	7 counties in Illinois, including Madison & St. Clair	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, including St. Clair	Cave streams in Illinois sinkhole plain
Plants			
Decurrent false aster (*Boltonia decurrens*)	Threatened	20 counties in Illinois, including Madison & St. Clair	Disturbed alluvial soils
Eastern prairie fringed orchid (*Platanthera leucophaea*)	Threatened	82 counties in Illinois, including Madison, St. Clair, & Clinton	Mesic to wet prairies
Leafy prairie clover (*Dalea foliosa*)	Endangered	9 counties in Illinois, including Madison	Prairie remnants on thin soil over limestone

Fish

The Illinois Natural History Survey (INHS) keeps records of fish sampling in Illinois. Samples were taken in the Lower Silver Creek watershed at four locations. Sampling occurred in 1962, 1963, 1966, and 2000. Twenty-four species of fish were found, and 1,002 individuals collected.[35] Six of the 24 species are tolerant of various environmental perturbations, one is moderately tolerant, and one is rare intolerant, according to Ohio EPA tolerance scores (the other species were not scored).[36]

Crustaceans

The INHS Crustacean Collection database keeps records of crustaceans sampled in Illinois. Crustaceans were sampled at seven locations in the Lower Silver Creek watershed. Sampling occurred in 1974, 1975, 1976, 1988, 2000, and 2004. Five species of crustaceans were found, and 16 individuals collected.[37]

Mussels

The INHS Mussel Collection database keeps records of mussels sampled in Illinois. Mussels were sampled at ten locations in the Lower Silver Creek watershed. Sampling occurred in 1978, 1988, 1997, 2000, 2001, 2004, and 2011. Eighteen species were found, and 58 individuals collected.[38] Illinois RiverWatch volunteers found fingernail clams several times at the Engle Creek, Loop Creek, and Ogles Creek sites between 1996 and 2013. No native mussels, Asiatic clams, or Zebra mussels were found at any of the sites.[39]

Livestock and Domestic Animals

Animal (livestock) data is available from the USDA 2012 Agricultural Census database at the county level.[40] The watershed has no Concentrated Animal Feeding Operations (CAFOs) with a NPDES permit, according to the IEPA data layer in the Resource Management Mapping Service (RMMS).[41]

Agricultural Land Use/Land Cover

Illinois, and the Lower Silver Creek watershed, 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 50-90% of the original top soil layer is gone, and farmers are increasingly farming the heavier clay subsoils. The resulting 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 watershed has 77,383 acres (63%) in agricultural use, of which 53% is used for cultivated crops and 10% is used for hay/pasture. Corn, soybeans, barley, and wheat are grown extensively. Sorghum, sweet corn, and other crops are also grown (Figure A.26). The average farm size in the three counties is 311 acres. Madison County farms are typically smaller than farms in the other two counties (Table A.20).

Table A.20. Data about agriculture in Clinton, Madison, and Montgomery counties from the 2012 Agricultural Census.[42]

	Clinton	Madison	St Clair
Farms (number)	915	1,110	732
Land in farms (acres)	285,489	307,135	251,931
Average size of farms (acres)	312	277	344
Total cropland (acres)	259,554	276,513	227,432
Irrigated land (acres)	1,873	2,364	24
Average market value of ag products sold per farm (dollars)	$225,183	$127,692	$162,816
Net cash farm income of operation (average	$51,486	$24,246	$30,777
Farms harvesting corn for grain	485	491	390
Acres farmed for corn for grain	98,864	116,881	98,610
Farms with hired farm labor	257	286	283
Number of hired farm labor workers	717	1,328	932
Farms enrolled in Conservation Reserve, Wetlands Reserve, Farmable Wetlands, or Conservation Reserve Enhancement Programs	325	179	124
Land enrolled in Conservation Reserve, Wetlands Reserve, Farmable Wetlands, or Conservation Reserve Enhancement Programs (acres)	5,884	3,785	2,661

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 St. Clair and Madison counties.

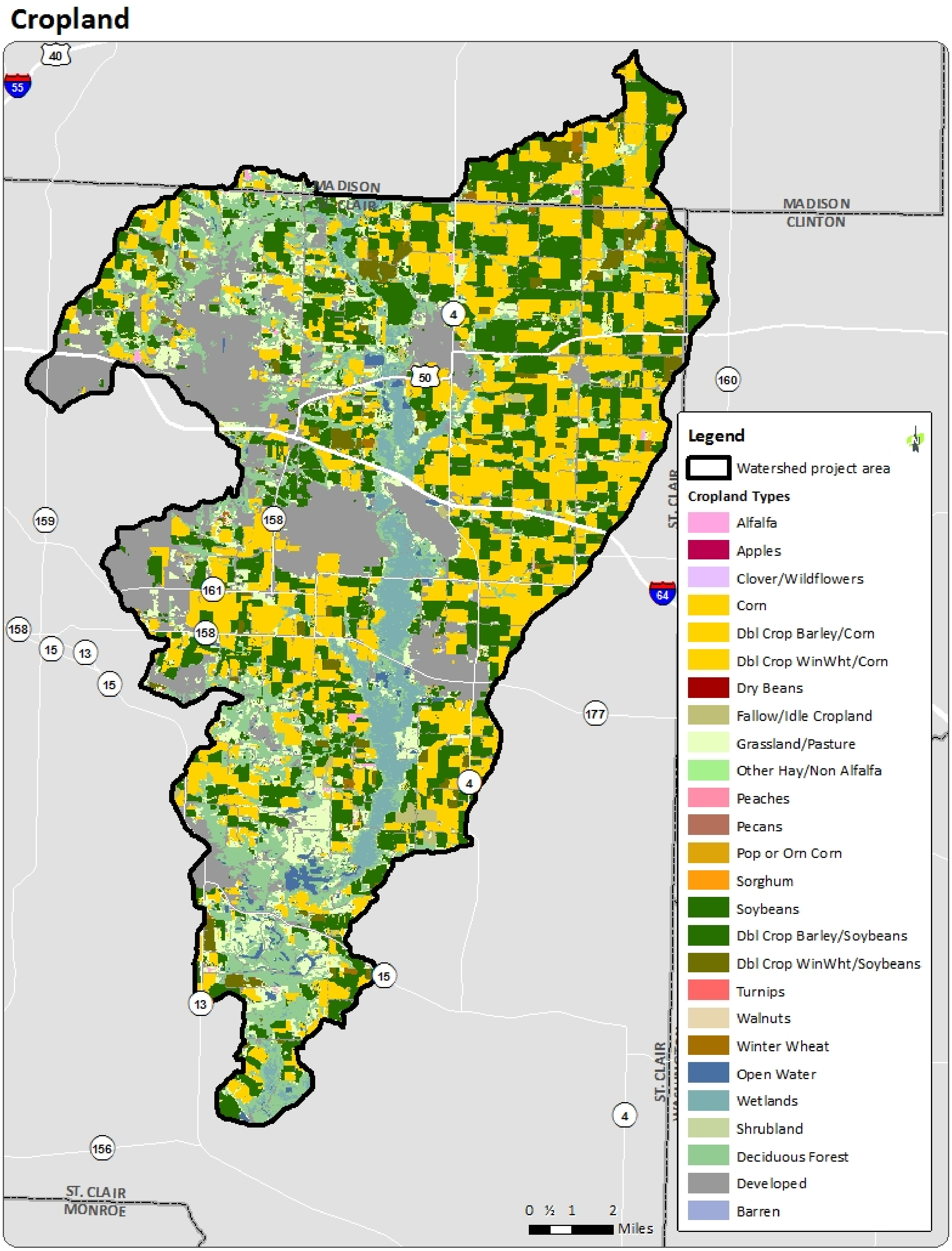

Figure A.26. Cropland types in the watershed.

Open space

There are 67 areas of open space covering 2,695 acres (2% of the watershed), as identified in 2009 by the East-West Gateway Council of Governments (Figure A.26). These open spaces include municipal parks, a nature preserve (Silver Creek Nature Preserve), a fee fishing lake, a rifle and pistol club, athletic complexes, and golf courses.

Hazardous Sites

According to the Department of Defense (DOD), 31 sites at Scott AFB are considered to be contaminated and hazardous. Cleanup efforts at these locations are ongoing. The related contamination may also affect a much larger area, including public and private lands. The DOD has determined risk levels for each site through a relative risk assessment, which prioritized cleanup efforts of those areas that pose the greatest threat to safety, human health, and the environment.[43] Table A.21 displays active sites (i.e., those with ongoing cleanup) that have associated risks.

Table A.21. Active hazardous sites at Scott AFB with associated DOD-assigned risk levels.

Medium Risk Areas			
Site Location	**Contaminated Area**	**Cost** In 2015 plus expected future cost.	**Final Cleanup Action Date**
National Imagery and Mapping Agency, 2nd St. *Mixed Waste Area**	Groundwater • Receptors of potential concern include the Mississippi River and the local sanitary/storm water systems. Soil • Impacted soils have the potential to leach contaminants into the groundwater. Site has minimal green space.	$6.52M	September 2038; ongoing monitoring until 2080.
Landfill	Groundwater • Flow is generally toward the adjacent wetland, which is remote with limited access. Sediment • In constant contact with groundwater. Stream animals are present. Exposure can occur through ingestion of animals or dermal contact with sediment. Soil • Landfill is vegetated, limiting erosion. Receptors have access to adjacent wetlands and surface waters, which could be impacted by runoff. Surface water • Detected metals may be naturally occurring. Discharges to Silver Creek.	$9.71M	March 2016; ongoing monitoring until September 2075.
Fire Training Area #3 *Fire/Crash Training Area*	Groundwater • Contaminants have migrated about 300 feet from the source area. Not used as a potable water source. Limited impacts to nearby wetland. Soil • Soil beneath aircraft mockup has impacted the groundwater. Site is located near a munitions storage area.	$6.42M	May 2018; ongoing monitoring until September 2043.
Former Defense Reutilization and Marketing Office *Spill Site Area*	Soil • Contaminants present in surface soil; however, low probability of migrating into groundwater.	$950K	July 2018; ongoing monitoring until September 2021.

Low Risk Areas			
Site Location	**Contaminated Area**	**Cost** In 2015 plus expected future cost.	**Final Cleanup Action Date**
Fire Training Area #3 *Fire/Crash Training Area*	Sediment • Potential migration with heavy rain or flooding. Surface Water • No clear correlation between groundwater contaminants and surface water detections. Limited access to surface water. Potential ecological receptors (e.g., fish).	$6.42M	May 2018; ongoing monitoring until September 2043.
Former Defense Reutilization and Marketing Office *Spill Site Area*	Groundwater • Contaminated water does not appear to be migrating.	$950K	July 2018; ongoing monitoring until September 2021.
Cardinal Creek Military Family Housing *Spill Site Area*	Groundwater • Not used as a potable water source. Additional downgradient wells needed to determine if water is migrating. Soil • Migration pathway appears to be confined. Does not appear to pose a risk to receptors.	$3.14M	January 2017; ongoing monitoring until September 2075.
Abandoned Gas Station *Spill Site Area*	Groundwater • Contamination appears to be localized (i.e., only detected in one well). Not used as a potable water source. Soil • Contaminants not leaching to groundwater.	$14K	October 2017; ongoing monitoring until September 2018.
Basewide Petroleum Sites *Spill Site Area*	Groundwater • Detected contaminants have not been delineated. Not used as a potable water source. Soil • Contamination occurs under pavement and within the clear zone at the southern end of the runway, producing limited receptors.	$893K	October 2017; ongoing monitoring until May 2025.

*This site is included in the list of sites for Scott Air Force Base but may not be located there.

Of the 31 active sites, 24 have risks that have not yet been evaluated or the DOD has determined that a risk designation is not required. These sites are listed in Table A.22.

In addition to the 31 active sites listed in Table A.22, Scott AFB has 28 inactive sites where DOD cleanup actions are complete. However, the DOD placed many of the inactive sites under long-term monitoring or other restrictions to reduce potential hazards.

Table A.22. Active hazardous sites at Scott AFB that do not require a DOD-assigned risk level or that have not yet been evaluated.

Site Location	Cost In 2015 plus expected future cost.	Final Cleanup Action Date
Risk Not Evaluated		
Scott Club *Unknown Site Type*	$387K	September 2018; ongoing monitoring until September 2020.
South Ditch *Unknown Site Type*	$1.59M	September 2018; ongoing monitoring until September 2020.
Building 48 Underground Storage Tanks 23 *Underground Storage Tanks*	$1.03M	September 2017
Grease Rack *Spill Site Area*	$2.37M	September 2019
Building 48 Underground Storage Tanks 25 *Underground Storage Tanks*	$969K	September 2017
Building 508 Underground Storage Tanks 27 *Underground Storage Tanks*	$1.01M	September 2017
Building 1534 Underground Storage Tanks 83 *Underground Storage Tanks*	$109K	September 2018
Building 39 *Unknown Site Type*	$1.78M	September 2019; ongoing monitoring until September 2043.
Building 48 Underground Storage Tanks 14 *Underground Storage Tanks*	$969K	September 2017
Mystic Star *Spill Site Area*	$497K	December 2018
Lead-Based Paint in Soil, Colonial and Georgian Housing *Spill Site Area*	$653K	September 2018
South Drive *Spill Site Area*	$2.53M	September 2018; ongoing monitoring until September 2043.
Site Never Existed (Site ID SS025)	Unknown	
Risk Not Required		
Underground Storage Tanks Basewide *Underground Storage Tanks*	$710K	March 2011
Bulk Fuel Facility *Spill Site Area*	$2.03M	May 2014; ongoing monitoring until September 2055.
Former Coal Piles Basewide *Storage Area*	$1.99M	July 2014; ongoing monitoring until September 2045.
Former Cams Facility *Spill Site Area*	$4.85M	December 2012; ongoing monitoring until September 2075.
Building 508 Underground Storage Tanks 20 *Underground Storage Tanks*	$207K	June 2011
Building 508 Underground Storage Tanks 21 *Underground Storage Tanks*	$207K	June 2011
Building 53 *Spill Site Area*	$1.21M	June 2012
Civil Engineering Storage Yard *Storage Area*	$1.57M	June 2014
Spill Site #6 *Spill Site Area*	$1.58M	July 2007; ongoing monitoring until September 2036.
Army Reserve Bulk Fuel Facility *Surface Impoundment/Lagoon*	$1.86M	October 2013; ongoing monitoring until September 2043.
Pagelow Military Family Housing *Spill Site Area*	$299K	July 2014; ongoing monitoring until August 2017.

Mining

The watershed has a history of mining. Municipalities in the watershed reported that collapsing underground mine shafts and subsidence have posed problems for buildings and infrastructure on the surface throughout the watershed. Several mining-related pools of water can be seen on the landscape in the area east of Freeburg near Silver Creek.

Transportation infrastructure

Interstate highway 64 runs east-west through the watershed and several state routes are also present (Figure A.28). State Route 4 runs north-south through much of the watershed. Five railroad lines are present, three of which run east-west through the watershed. (Note about the map: may not currently be in use.) MidAmerica Airport is an air transportation hub near Mascoutah, and Scott AFB is a military air transportation base providing services to the U.S. Air Force throughout the country. At the south end of the watershed, the Kaskaskia River is a navigable waterway used to transport goods in barges in and out of the state of Illinois. The river connects with the Mississippi River and provides transportation connections to other states in the Mississippi River watershed and to the Gulf of Mexico.

Transportation networks play a major role in shaping future growth, along with other infrastructure such as sewer and water. Major new roads offer strong indications about future development patterns. The East West Gateway Council of Governments is responsible for planning transportation projects in the St. Louis region. The Joint Land Use Study for Scott AFB and MidAmerica Airport identified several planned and potential projects that could create shifts in future land use, such as the MetroLink extension to MidAmerica Airport and a new I-64 interchange that was recently completed. These projects were identified from a review of the Long Range Transportation Plan Legacy 2035 and the Transportation Improvement Plan 2008-2011.[44]

Cultural/historic resources

The region in which the Lower Silver Creek watershed is located is a hotspot of archaeological interest. Cahokia, a pre-Columbian Native American city about 16 miles northwest of the watershed, 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 Lower Silver Creek watershed, such as Emerald Mound near Lebanon. These mounds 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.[45]

Eighteen (18) mound sites have been identified in the watershed. They are all located in the northern portion of the watershed near Silver Creek and Little Silver Creek. The primary mound center, Emerald Mound in the City of Lebanon, illustrates the natural and cultural themes of our nation’s heritage. In ancient times, the town of Emerald 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. The mounds that are a visible part of today’s landscape stand as earthen monuments commemorating this ancient town and our local heritage. In present day, Emerald Mound offers opportunities for recreation, public use and enjoyment, and scientific study. Currently, Emerald Mound is designated as a State Historic Site and a National Registered Historic Site, and is owned privately and by the State of Illinois (Illinois Historic Preservation Agency). Through its feasibility study, HeartLands Conservancy determined that Emerald Mound could potentially be part of a National Historical Park with Cahokia.

Table A.23. Prioritization for an elevated national designation for Emerald Mound.

National Park Service (NPS) criteria as related to Priority Mound Sites	Priority Mound Site: Emerald/Lebanon, IL
Current designation	State Historic Site, National Registered Historic Site
Potential NPS designation	Part of a National Historical Park with Cahokia
Ownership	Private/State (IHPA)
Opportunities	Agricultural interpretation, ancient trace trails/recreation, park, existing mounds
Primary challenge	Land acquisition

Open Space

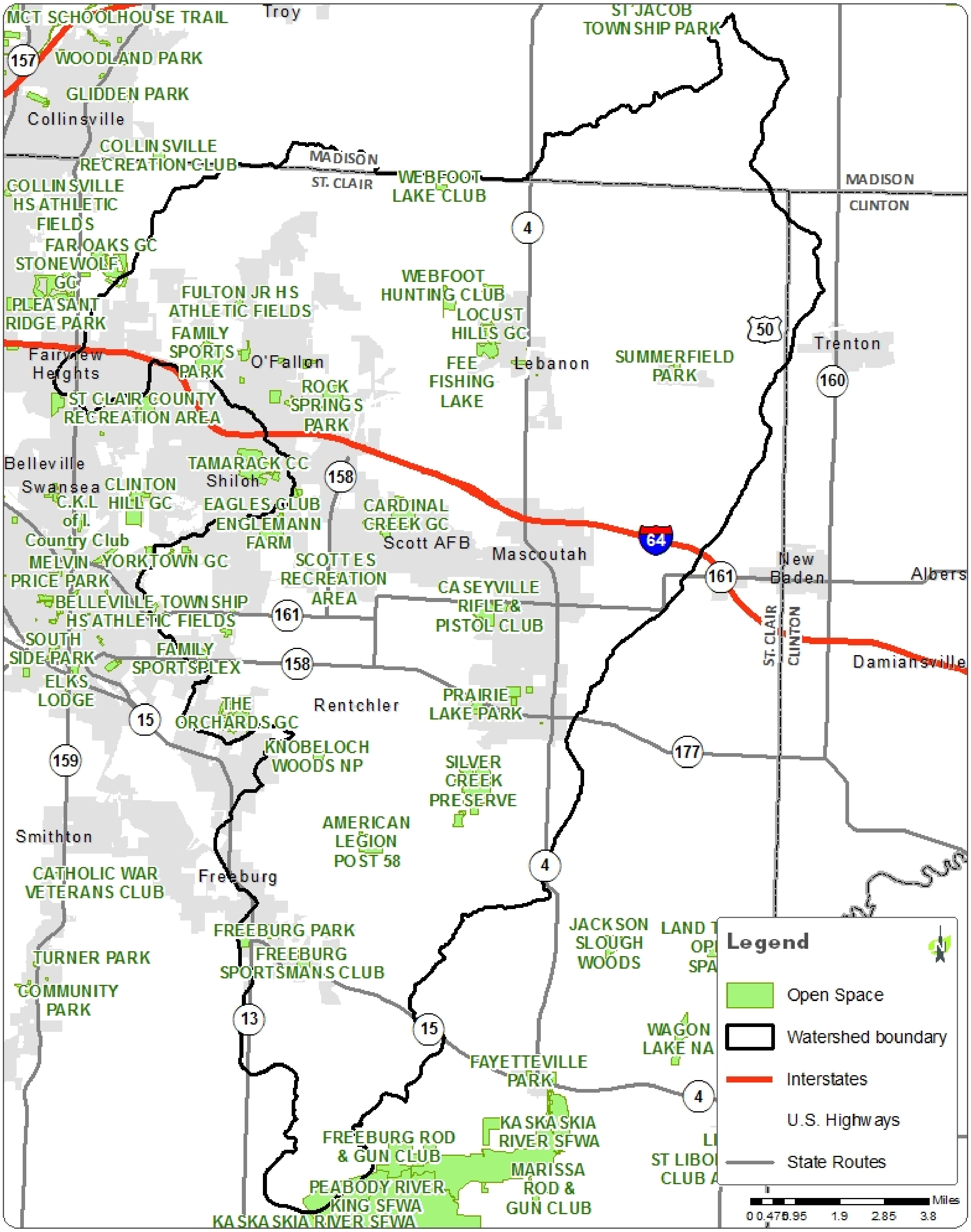

Figure A.27. Open space in the watershed, as identified by East-West Gateway Council of Governments.[46]

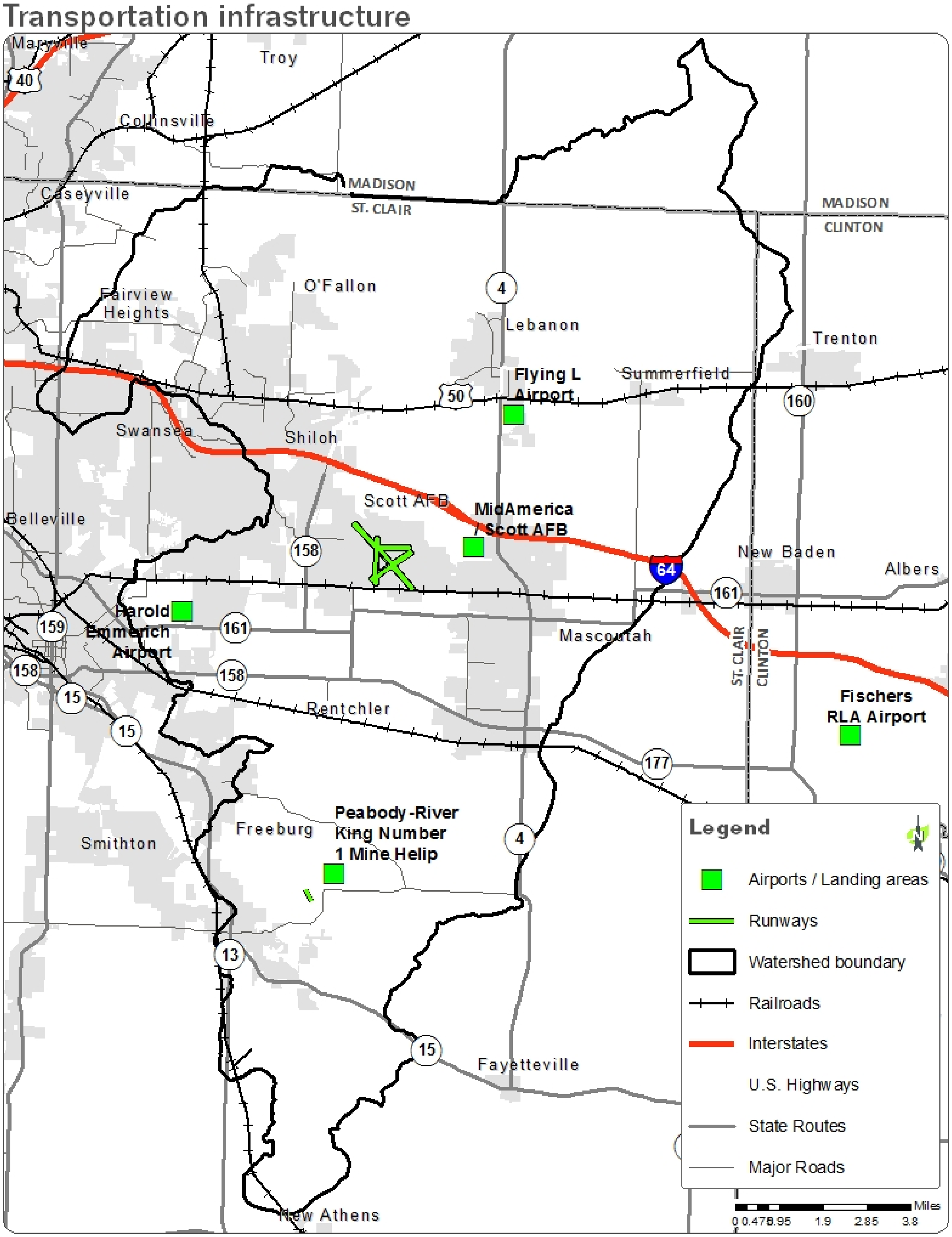

Figure A.28.Transportation infrastructure.

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 percentage was applied to the buffer. 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 12,927 acres or 10% decrease in cultivated crops and a 6,171 acres or 5% decrease in hay/pasture across the watershed. (Table A.24). Deciduous forest is expected to shrink by 4% (5,291 acres). In total, approximately 26,523 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.

Table A.24. Future projected land cover 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
Barren Land	31	10	0%	10	0%	-	0%
Cultivated crop	82	64,592	52%	51,665	42%	(12,927)	-10%
Deciduous forest	41	13,281	11%	7,990	6%	(5,291)	-4%
Developed, High Intensity	24	824	1%	17,068	14%	5,480	13%
Developed, Low Intensity	22	11,588	9%	16,409	13%	12,727	4%
Developed, Medium Intensity	23	3,682	3%	9,140	7%	8,315	4%
Developed, Open Space	21	9,732	8%	9,916	8%	184	0%
Emergent herbaceous wetlands	95	286	0%	208	0%	(78)	0%
Hay/Pasture	81	12,791	10%	6,620	5%	(6,171)	-5%
Herbaceous	71	973	1%	414	0%	(559)	0%
Open Water	11	1,245	1%	675	1%	(570)	0%
Shrub/Scrub	52	3	0%	3	0%	-	0%
Woody wetlands	90	5,218	4%	4,107	3%	(1,111)	-1%

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, macro invertebrate, 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 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 0 to 100 percent, indicating the degree to which the area is covered by impervious features.

In the Lower Silver Creek watershed, the mean percent imperviousness is 2.8%. Most of the watershed is covered with low percent impervious cover (Table A.25, Figure A.29). The watershed's impervious surfaces come from development in and around the municipalities, Scott AFB, and MidAmerica Airport.

Table A.25. Existing impervious cover by HUC14, as assessed from the NLCD Percent Developed Impervious Surface dataset.

HUC14	Mean impervious cover (%)
07140204050701	15.2%
07140204050702	3.3%
07140204050801	0.8%
07140204050802	1.1%
07140204050803	1.0%
07140204050804	8.0%
07140204050805	1.7%
07140204050903	1.4%
07140204050904	18.4%
07140204050905	3.7%
07140204051001	10.7%
07140204051002	5.8%
07140204051003	7.6%
07140204051101	13.4%
07140204051102	21.3%
07140204051103	1.6%
07140204051104	4.5%
07140204051201	6.5%
07140204051202	0.9%
07140204051203	1.9%
07140204051204	6.8%
07140204051205	1.4%

Impervious Cover

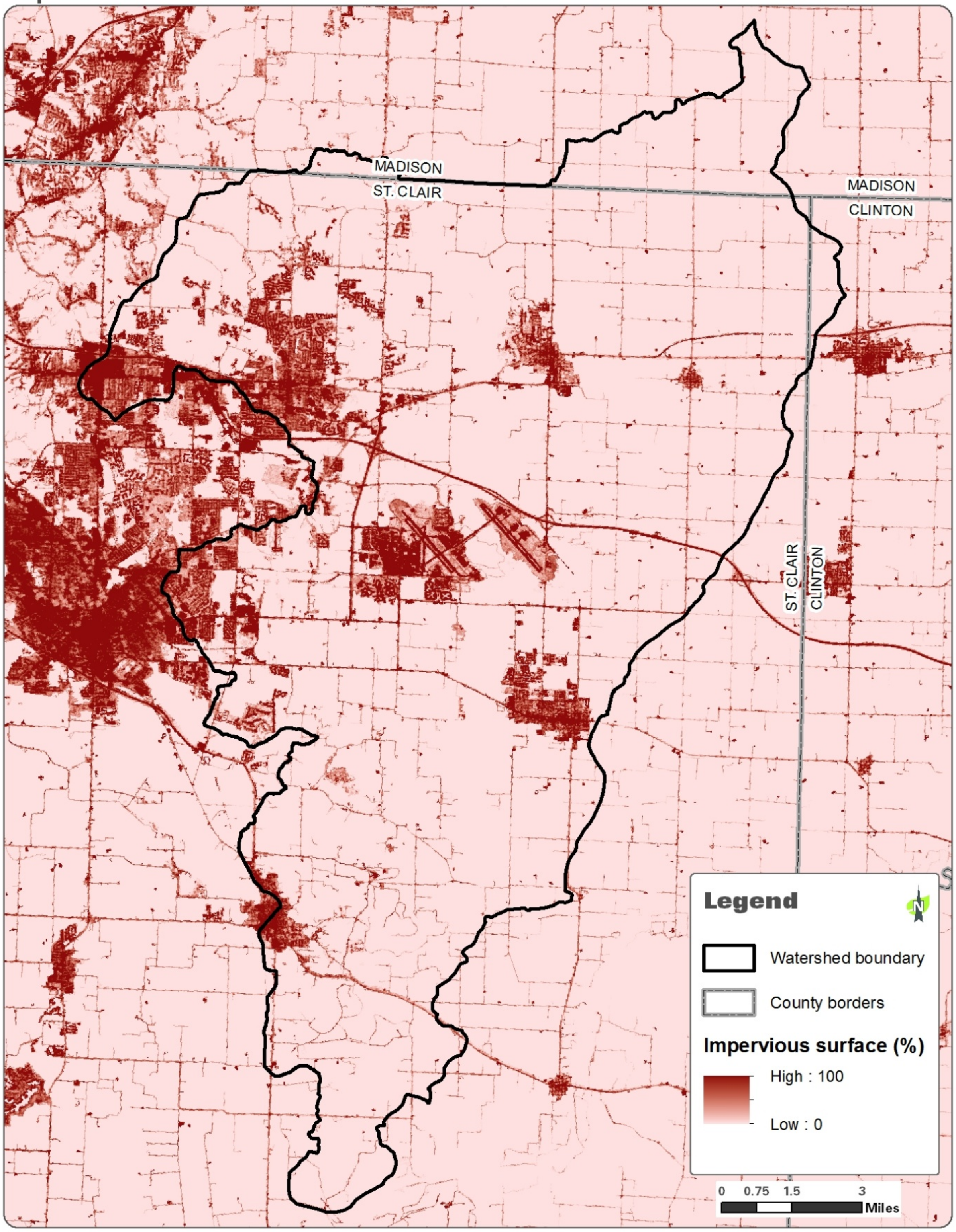

Figure A.29. Existing impervious cover in the watershed.

Future impervious cover

As with predicted future land use, no digitized maps of future zoning around municipalities in the watershed were available to shape assessments of future impervious cover in the watershed. Educated assumptions were made about future changes in impervious cover based on the future land use estimates, which were translated to imperviousness percentages using NLCD definitions for developed land uses (of which definitions impervious cover percentages are a component) and imperviousness percentages derived from land use/land cover in a Maryland EPA study.[47]

Based on a review of hundreds of studies, scientists at the Center for Watershed Protection (CWP) in Maryland developed an "Impervious Cover Model". This model classifies the relationship between percentage of impervious cover in a watershed and stream quality. Streams are grouped into one of three categories: sensitive, impacted, and non-supporting (Table A.26). Streams in non-supporting subwatersheds generally have greater than 25% impervious cover, highly degraded channels, degraded habitat, poor water quality, and poor-quality biological communities. Sensitive subwatersheds have less than 10% impervious cover, stable channels, good habitat, good water quality, and diverse biological communities.[48]

The full build-out scenario assessed in the "Future land use/land cover predictions" section of this Inventory was used to generate future impervious cover estimates for each HUC14 subwatershed (Table A.27).

Table A.26. Impervious category and corresponding stream conditions per the Impervious Cover Model from the Center for Watershed Protection.

Impervious Cover Management Category	**Percent Impervious**
Sensitive	<10%
Impacted	> 10% but <25%
Non-supporting	>25%

Table A.27. Current and future imperviousness by HUC14, based on future land use calculations outlined in the "Future land use/land cover predictions" section. Impervious Classification categories from the Center for Watershed Protection's Impervious Cover Model.

HUC14	Mean impervious cover (%)	Existing Impervious %	Existing (2012) Impervious Classification	Future impervious cover (%)	Future Impervious Classification
07140204050701	15.22464	15.2%	Impacted	49.98%	Non-supporting
07140204050702	3.27206	3.3%	Sensitive	31.67%	Non-supporting
07140204050801	0.7548	0.8%	Sensitive	7.06%	Sensitive
07140204050802	1.13159	1.1%	Sensitive	21.78%	Impacted
07140204050803	1.02761	1.0%	Sensitive	16.10%	Impacted
07140204050804	7.96914	8.0%	Sensitive	22.68%	Impacted
07140204050805	1.68384	1.7%	Sensitive	22.05%	Impacted
07140204050903	1.3772	1.4%	Sensitive	1.36%	Sensitive
07140204050904	18.40841	18.4%	Impacted	59.96%	Non-supporting
07140204050905	3.67869	3.7%	Sensitive	81.14%	Non-supporting
07140204051001	10.71019	10.7%	Impacted	19.82%	Impacted
07140204051002	5.84266	5.8%	Sensitive	11.26%	Impacted
07140204051003	7.57965	7.6%	Sensitive	19.41%	Impacted
07140204051101	13.40368	13.4%	Impacted	39.96%	Non-supporting
07140204051102	21.32739	21.3%	Impacted	20.04%	Impacted
07140204051103	1.64617	1.6%	Sensitive	6.37%	Sensitive
07140204051104	4.46552	4.5%	Sensitive	27.33%	Non-supporting
07140204051201	6.47856	6.5%	Sensitive	17.84%	Impacted
07140204051202	0.88187	0.9%	Sensitive	3.41%	Sensitive
07140204051203	1.94083	1.9%	Sensitive	8.33%	Sensitive
07140204051204	6.84153	6.8%	Sensitive	15.73%	Impacted
07140204051205	1.36285	1.4%	Sensitive	9.72%	Sensitive

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 Lower Kaskaskia watershed (07140204). The next six digits are sequential numbers that are unique within the HUC8 watershed.

There are 208 NHD stream reaches in the Lower Silver Creek watershed, comprising 454 miles of streams. 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.

Aerial assessment

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 (December 2016) when leaf cover was absent and vegetation was dormant in order to increase the visibility of the streams flown. A total of 116 miles or 26% of the total NHD 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.

The video images were viewed to assess four different parameters for each stream. These parameters were streambank erosion, degree of channelization, condition of the riparian area and logjams.

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. 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.[49]

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, 110 miles of streams were successfully assessed for streambank erosion using geo-referenced video footage. Of the assessed length, 3% had none or low/slight erosion, 41% had moderate erosion, and 56% had high/severe erosion (Table A.29).

The majority of Silver Creek has severe streambank erosion (Figure A.30). The lower ends of most of the tributaries also have high streambank erosion. The headwaters of the tributaries often have moderate streambank erosion. A few miles of streambanks with little bank erosion are located at Ash Creek, Hog River, and East Branch Little Silver Creek.

Table A.29. Streambank erosion along assessed stream reaches in the Lower Silver Creek watershed

	Stream Length Assessed (miles)	**None or Low Erosion ("good")**		**Moderate Erosion ("fair")**		**High Erosion ("poor")**	
		miles	%	miles	%	miles	%
Total	110	3		45		62	
Average			3%		41%		56%

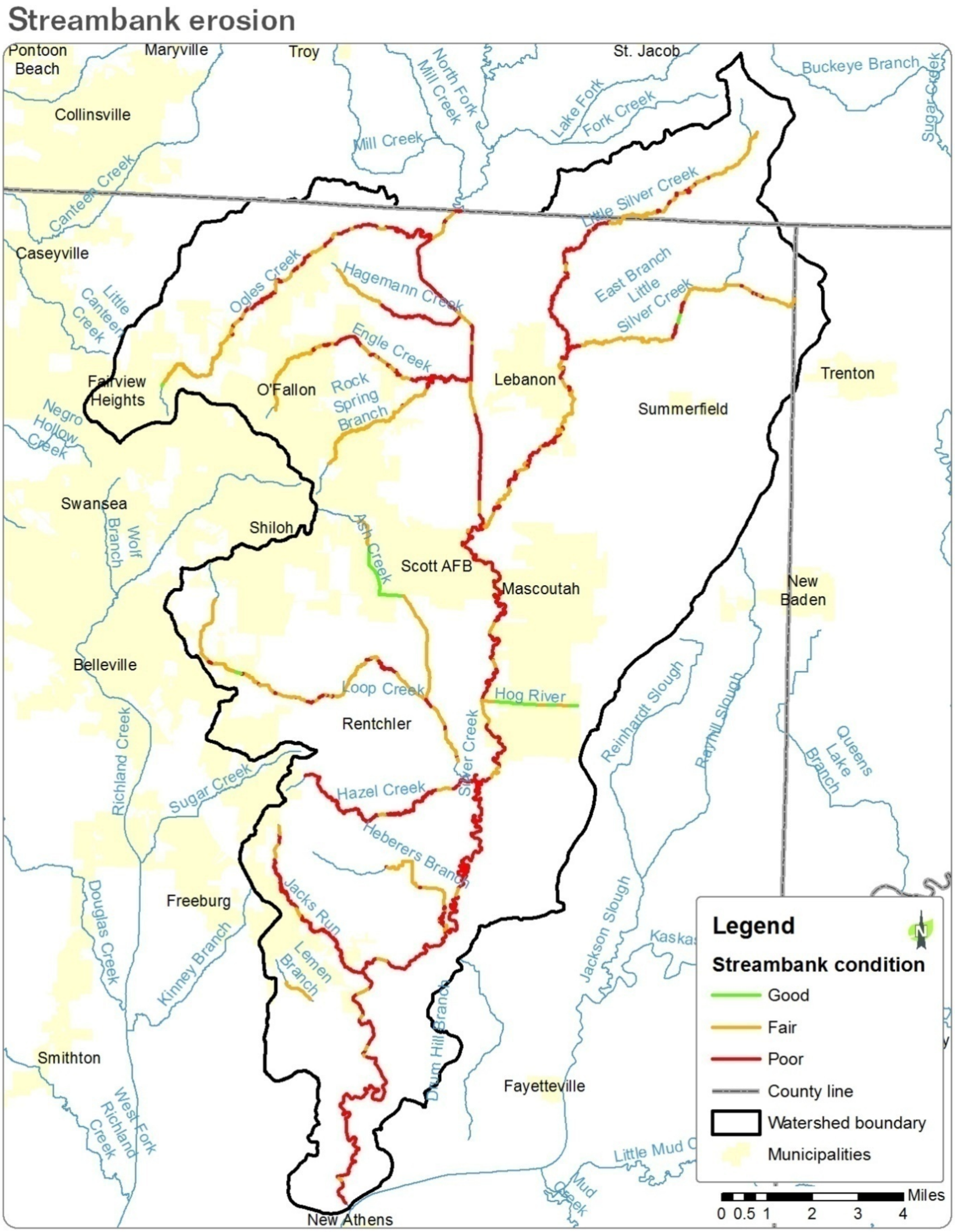

Figure A.30. Streambank erosion conditions assessed from video footage of an aerial survey of the Lower Silver Creek watershed.

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, 116 miles of streams were successfully assessed for channelization using geo-referenced video footage. Of the assessed length, 64% had none or low channelization, 15% had moderate channelization, and 22% had high channelization (Table A.31).

Silver Creek is highly channelized in the northern third of the watershed (Figure A.31). Additionally, large stretches of Ash Creek, Loop Creek, and Hog River are highly channelized. In the southern two-thirds of the watershed, Silver Creek is channelized very little.

Table A.31. Degree of channelization along assessed stream reaches in Lower Silver Creek watershed

	Stream Length Assessed (miles)	**None or Low Channelization**		**Moderate Channelization**		**High Channelization**	
		miles	%	miles	%	miles	%
Total	116	74		17		25	
Average			64%		15%		22%

Channelization

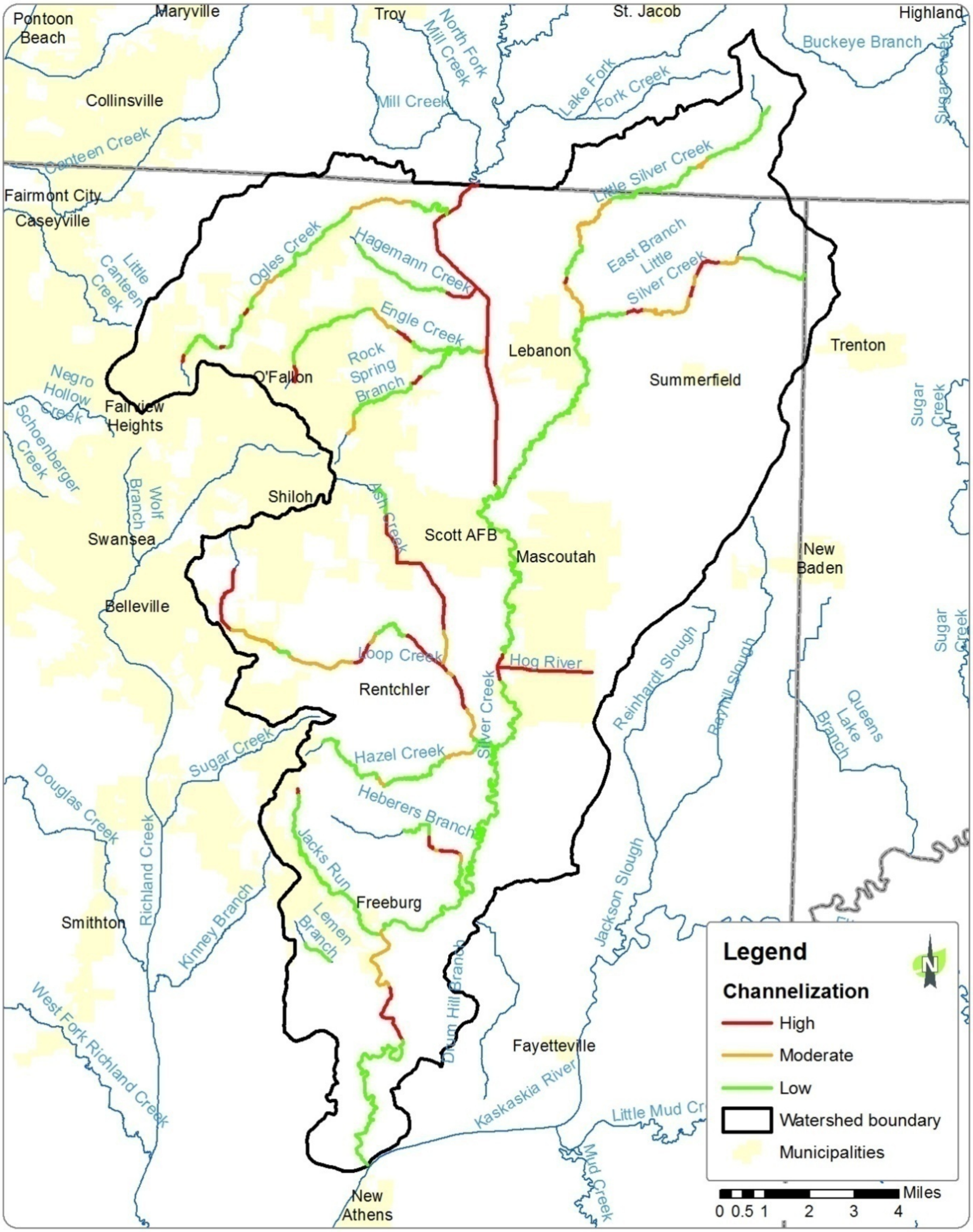

Figure A.31. Channelization condition assessed from video footage of an aerial survey of the Lower Silver Creek watershed (December 2016).

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, 116 miles of streams were successfully assessed for riparian condition using geo-referenced video footage. Of the assessed length, 56% had good riparian condition, 39% had fair riparian condition, and 5% had poor riparian condition (Table A.33).

Almost the entire length of Silver Creek in the watershed has a riparian area that is in good condition (Figure A.32). Much of the riparian area around Engle Creek, Ogles Creek, Little Silver Creek, and East Branch Little Silver Creek is in fair or poor condition.

Aerial imagery of the watershed suggests that the smaller tributaries, which were not assessed in the video aerial assessment, have poorer riparian conditions than the larger creeks, with row-cropped land extending all the way to the creeks in some cases.

Table A.33. Riparian condition along assessed stream reaches in the Lower Silver Creek watershed

	Stream Length	**Good Condition**		**Fair Condition**		**Poor Condition**	
	Assessed (miles)	miles	%	miles	%	miles	%
Total	116	65		45		6	
Average			56%		39%		5%

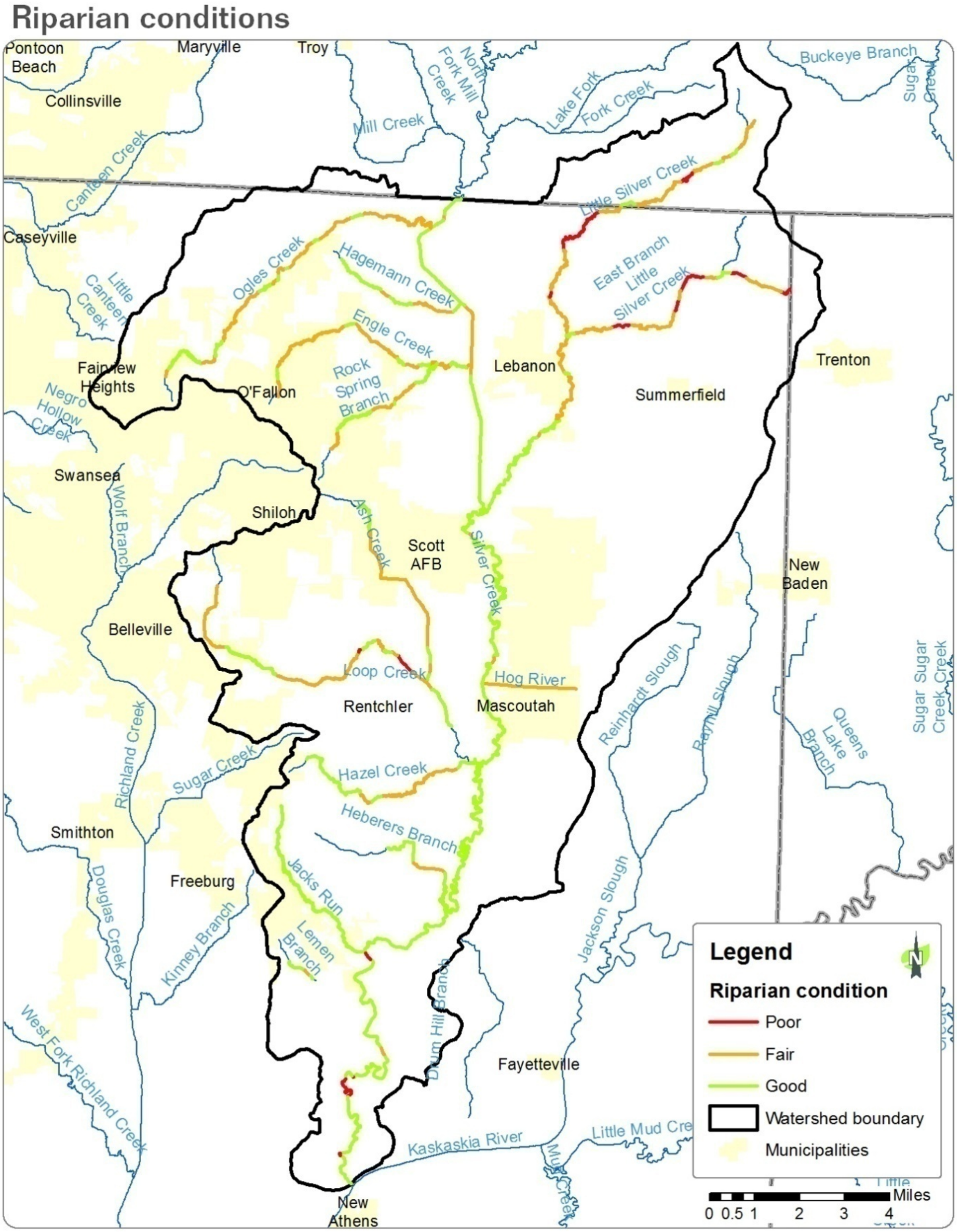

Figure A.32. Riparian condition assessed from video footage of an aerial survey of the Lower Silver Creek watershed (December 2016).

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.

Twenty-one (21) logjams were identified in the watershed along Silver Creek. Table A.34 identifies the number of logjams in each HUC14 subwatershed, and Figure A.33 shows logjam locations.

The City of Lebanon also identified logjams in the Silver Creek floodplain south of the city as a cause of water backing up to cover Highway 50.

Table A.34. Logjams identified in the Lower Silver Creek watershed in video footage from the aerial survey (December 2016)

HUC14	**Logjams identified in aerial survey (number)**
07140204051001	2
07140204051003	19
Total	21

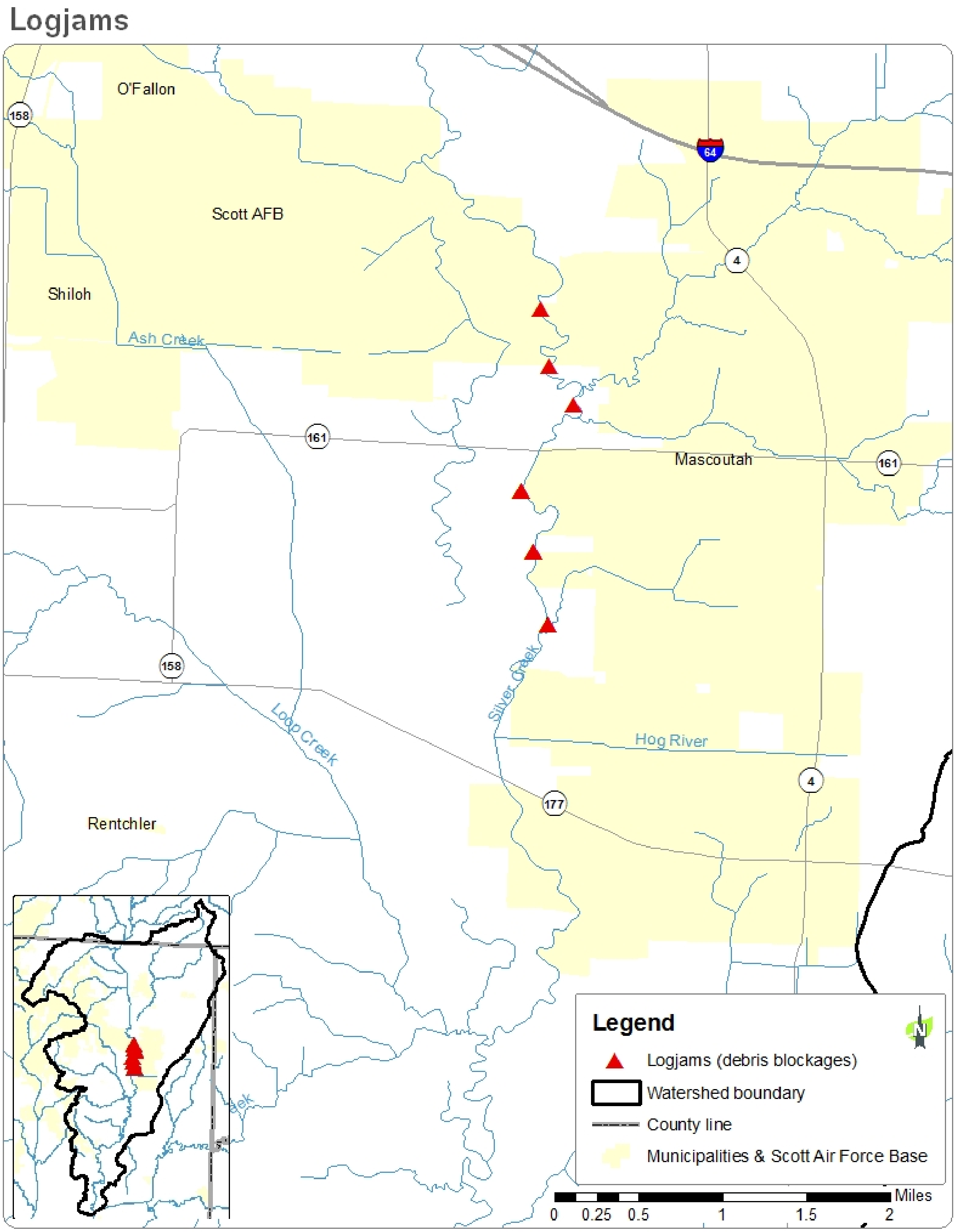

Figure A.33. Logjams in the Lower Silver Creek watershed as identified from video footage from the aerial survey (December 2016). Twenty-one (21) logjams were identified at six general locations on Silver Creek.

Streambed Erosion

In order to calculate streambed erosion and sediment loading, "eroding" bank heights needed to be determined throughout the watershed. To make these determinations, field checks were completed at 52 locations in the watershed on 50-500 ft per site, assessing an average of 200 ft per site (Figure A.34). These locations were primarily a hundred feet or more upstream of road crossings to circumvent the impacts of bridges and culverts on local erosion conditions. At these points three conditions were assessed: 1) eroding bank height (height of active erosion as caused by streamflow), 2) degree of streambed erosion and 3) field assessment of lateral recession.

At each field check location, a streambed erosion category of low, moderate, or high erosion was assigned, using categories detailed in Table A.35. In total, approximately 10,400 ft (2.0 miles) of streams were successfully assessed for degree of streambed erosion during field checks. Of the assessed length, 44% had low streambed erosion, 38% had moderate streambed erosion, and 17% had high streambed erosion (Table A.36).

Table A.35. 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.

Table A.36. Degree of streambed erosion along assessed stream reaches in the watershed

	Stream Length Assessed (miles)	Low streambed erosion		Moderate streambed erosion		High streambed erosion	
		miles	%	miles	%	miles	%
Total	2.0	0.87		0.76		0.34	
Average			44%		38%		17%

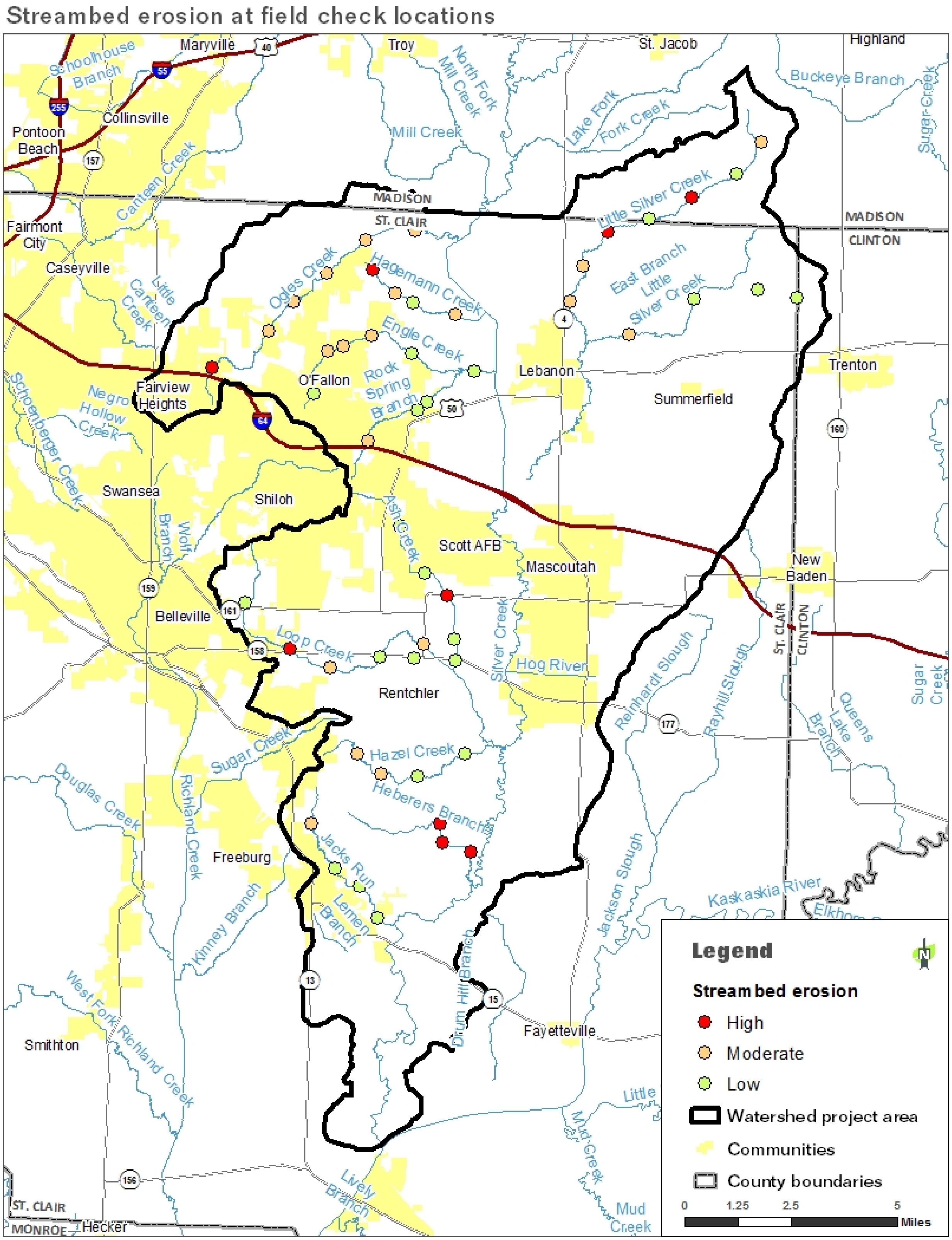

Figure A.34. Streambed erosion conditions noted in the Lower Silver Creek watershed

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, Clinton and St. Clair Counties have low ephemeral erosion (0% and 3% respectively), while Madison County has a higher than state average (12.6%) rate of 45% (Table A.37).

Table A.37. Percent and number of fields with indicated ephemeral/gully erosion by county as of 2015.[50]

County	**Ephemeral/gully erosion sites reported**		**Total sites checked**
	Percentage (%)	Number	
Clinton	0	3	706
Madison	45	162	364
St. Clair	3	9	310
Total		192	1173

Detention and Retention Basins

HeartLands Conservancy looked at aerial photographs of the watershed 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.

A point was created for each basin located 500 feet or less from a group of 4 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 basin conditions noted were 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 material or vegetation on the side slopes, whether the basin was already in the National Hydrography Dataset, and the accessibility of the basin from nearby roads or public land.

Three hundred and ninety-four (394) detention or retention basins were identified in the watershed, with the majority clustered in the more populated areas on the western side (Table A.38, Figure A.35). Most of the basins identified have water in them (97%); however, it was much easier to identify basins containing water than dry basins, so wet basins may be overrepresented. Sixty-one percent (61%) 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 84% of the basins identified. Trees are present on the slopes of 49% of the basins, and riprap (large rock) is present on the slopes of 13% of the basins.

Table A.38. Number of detention and retention basins identified in each HUC14 in the Lower Silver Creek watershed.

HUC14	No. of basins identified
07140204050701	21
07140204050702	12
07140204050801	7
07140204050802	6
07140204050803	8
07140204050804	9
07140204050805	12
07140204050903	3
07140204050904	44
07140204050905	24
07140204051001	5
07140204051002	15
07140204051003	15
07140204051101	37
07140204051102	2
07140204051103	42
07140204051104	27
07140204051201	5
07140204051202	11
07140204051203	24
07140204051204	56
07140204051205	9
Total	394

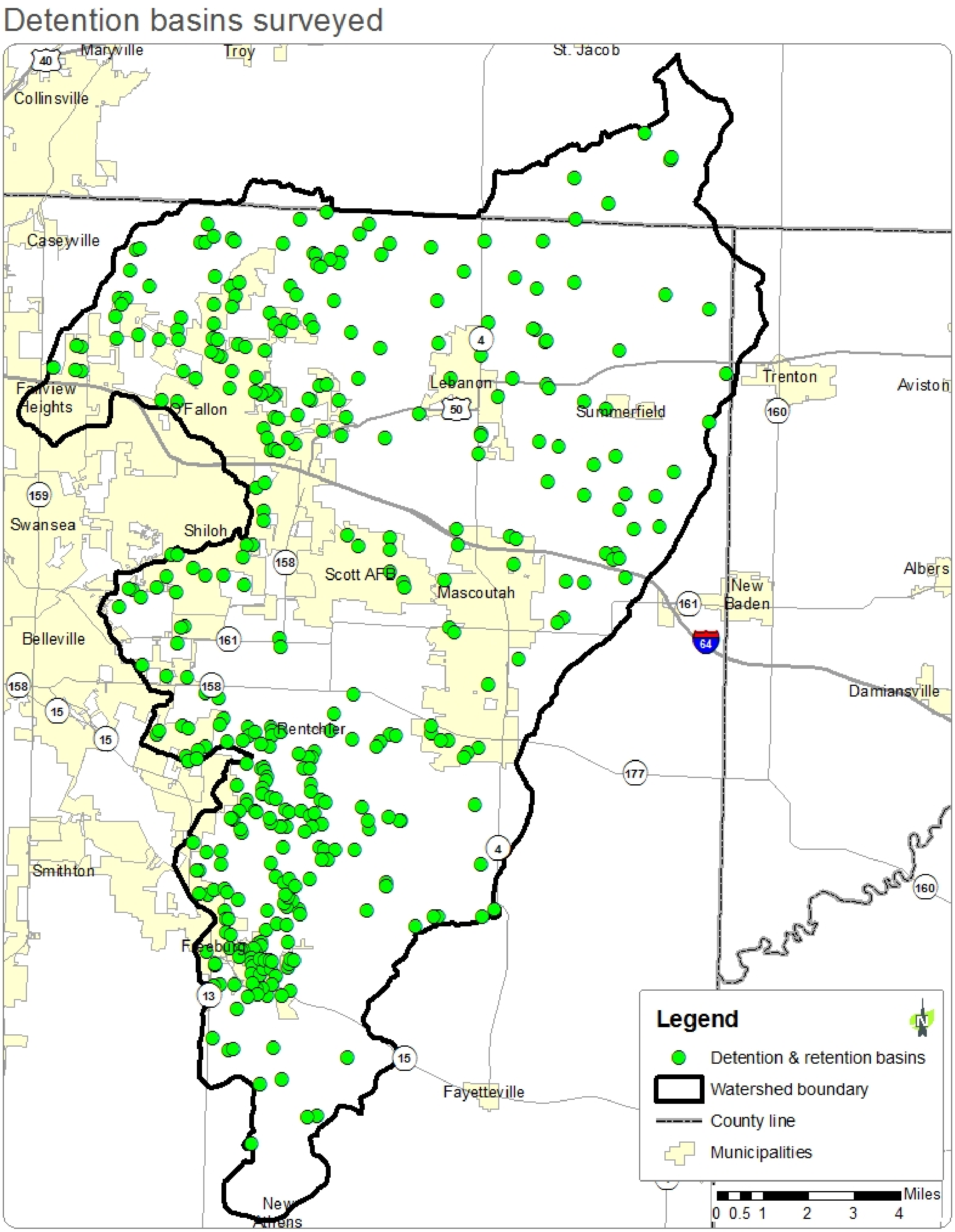

Figure A.35. Location of detention and retention basins identified by assessment of 2012 aerial imagery provided by East-West Gateway Council of Governments.

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 Lower Silver Creek watershed: 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. 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 and flow 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.

A shallow or overland flood is the pooling of water outside of a defined river or stream, for example, 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 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.[51] For the following sections, the regulatory definition of a floodplain will be used.

Extent of the Floodplain

In the Lower Silver Creek watershed, 19.7% of the land (24,472 acres) is designated as regulatory flood plain (Figure A.36).

Floodplain in the Lower Silver Creek Watershed

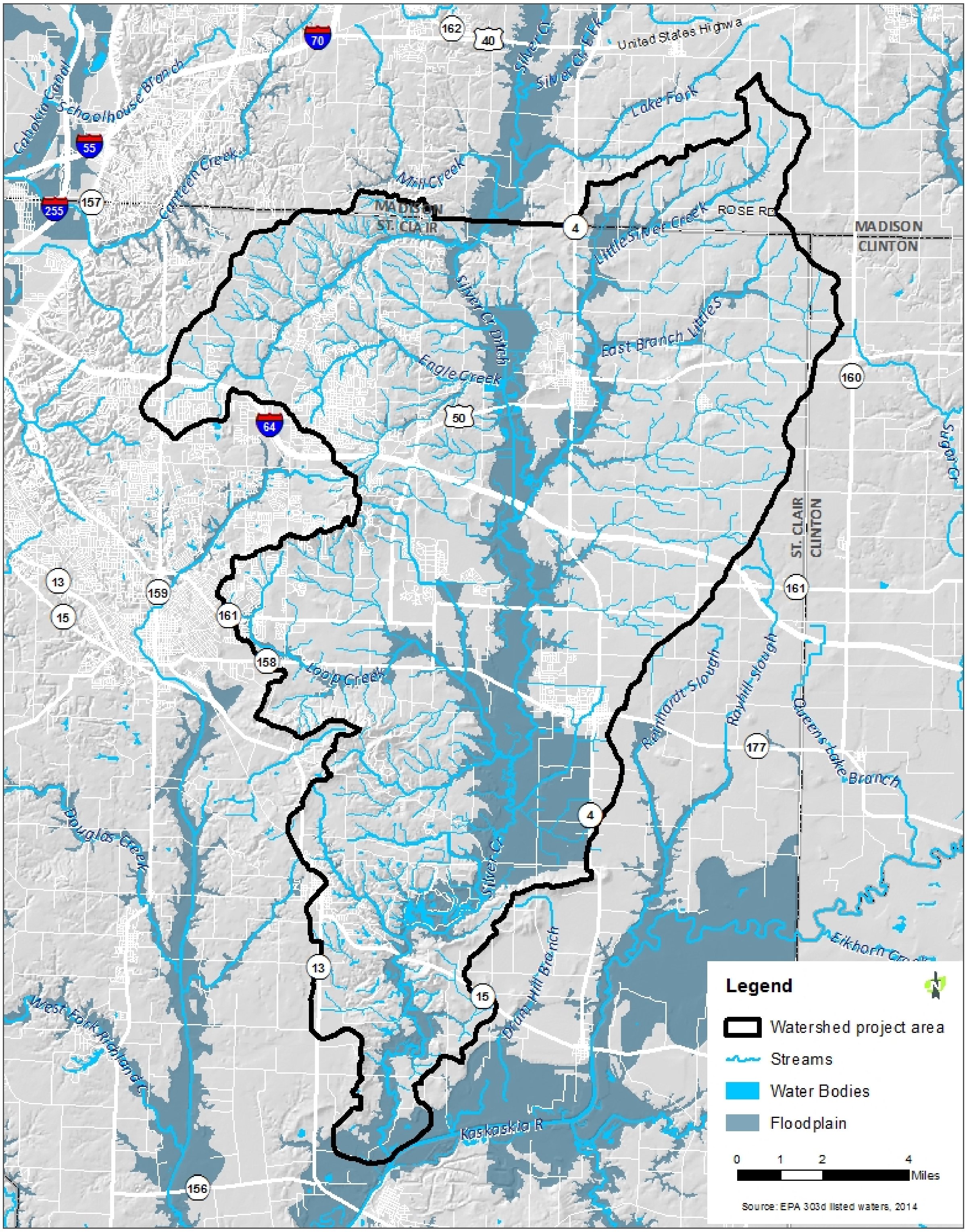

Figure A.36. FEMA-designated 100-year floodplain in the watershed (data not found for Clinton County outside the watershed).

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.

In the unincorporated area of St. Clair County, there are eight repetitive loss properties, which have claimed payments of over $82,000. The exact locations of these properties are kept on file with FEMA and are not eligible for publication. There are no repetitive loss structures within any of the municipalities in the watershed. A breakdown of buildings and number of losses by municipality are shown below in Table A.39.

Table A.39. Repetitive loss information for St. Clair County.[52]

	Buildings	Losses	Total Claim Amount
Unincorporated St. Clair County	8	19	$82,390.04

For the unincorporated area of St. Clair County, the data provided by FEMA includes all areas within the county, not just those in the watershed boundary.

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.

St. Clair County has 230 critical facilities, including care facilities, Emergency Operations Centers, fire stations, police stations, and schools, several of which are in the watershed.[53] It is not known how many of these facilities are located in the floodplain.

Locations Affected by Floods

Flooding Locations Identified at Stakeholder Meetings

Several meetings were held with municipalities and other stakeholders from August 2016 to April 2017. An Open House in February 2017 drew 25 attendees. Meeting attendees were invited to identify flooding locations within the watershed (Figure A.37). 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 in ArcGIS.

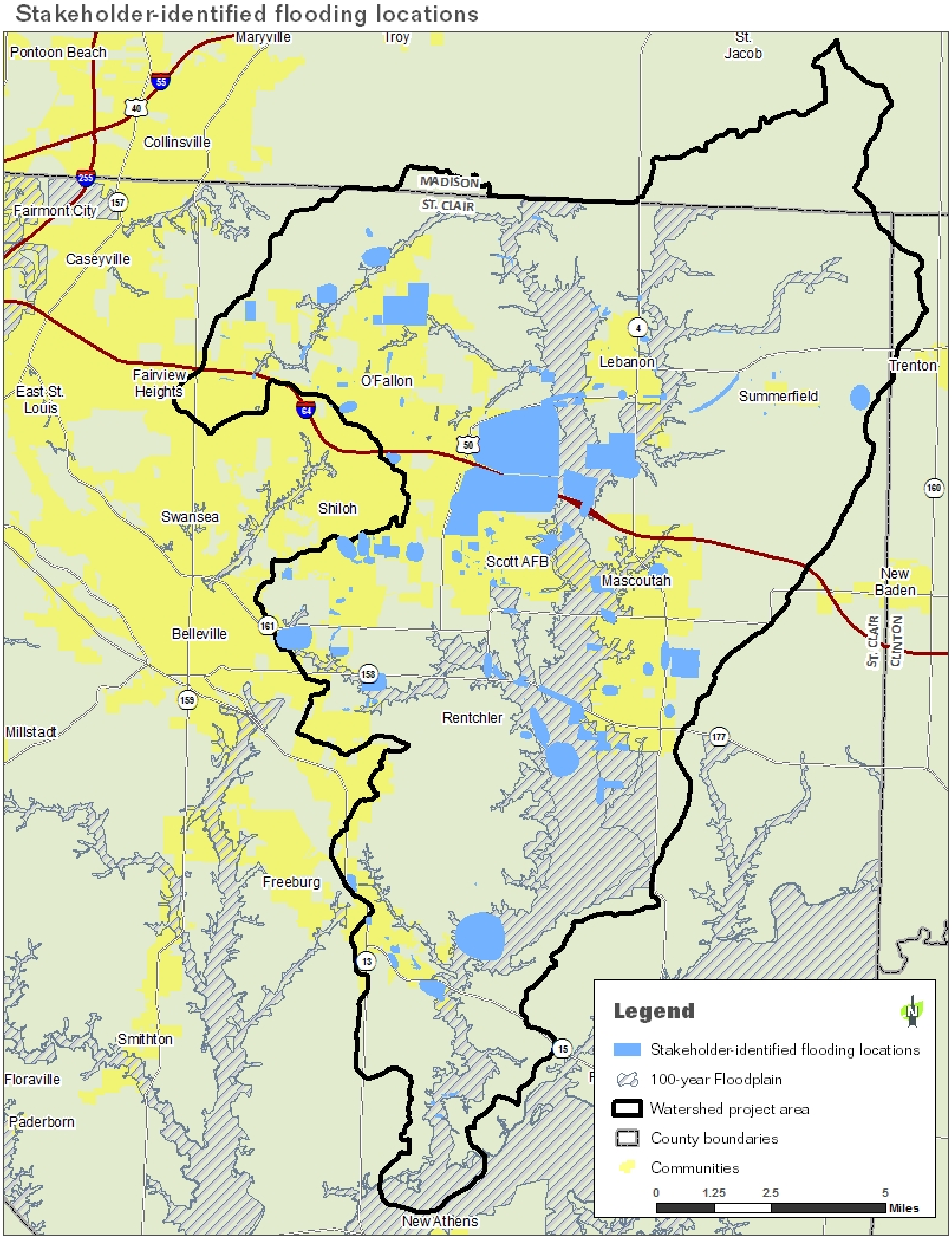

Figure A.37. Flooding locations identified at stakeholder meetings for the Lower Silver Creek Watershed Plan.

Federally declared disasters for flooding

Clinton, Madison, and St. Clair counties have experienced flash floods and riverine floods, which are discussed in their countywide hazard mitigation plans. St. Clair County has received Federal disaster aid for 14 declared disasters since 1969, 13 of which have been from either flooding and/or torrential rain. Madison County has had 11 federally declared disasters since 1965, 9 of which have been due, at least in part to flooding.[54]

Flooding on Roads

Several road overtopping locations were identified at stakeholder meetings. These include overtopping of State Routes 4, 13, 158, and 177, and U.S. Highway 50. Some road flooding restricts or eliminates access to residences while the flooding lasts (as identified by the City of Lebanon and the City of Belleville). Flooding has restricted access to the Village of Summerfield and the Village of Mascoutah when roads on either side of the municipalities have flooded.

History of Flooding in the Watershed

All three counties in the project area have identified flooding as a major hazard in their County Hazard Mitigation Plans. Clinton County has experienced 15 floods from 1993-2010, and St. Clair County has received Federal aid for 14 declared disasters from 1969 until the publication of their countywide hazard mitigation plan. Of the 14 disasters in St. Clair County, 12 of those have been due, at least in part, to flooding (Table A.40).

The greatest risk for flooding in the Lower Silver Creek watershed is in the spring and summer. The most likely month for flash floods in St. Clair County is May, and the most likely month for general floods is April.

Table A.40. Occurrences of flooding in the three counties in the project area.

	Clinton County (1993-2010)	**Madison County (1993-2012)**	**St. Clair County (1993-2008)**
Number of General Floods Reported	2	16 (1973-2012)	7
Number of Flash Floods Reported	13	23	24
Total Number of Floods Reported	15	$\geq$ 23	36

Impacts of Floods

Injury and Death

In Illinois, flooding causes an average of four deaths per year. Historically, the number of injuries and deaths from flooding in the three counties in the watershed has been very low. No injuries or deaths were reported as a result of any of the recorded floods in Madison or St. Clair counties. However, risk persists as there is often little to no warning for flash flood events.

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 1 foot of water typically exerts 500 pounds of lateral force on a vehicle. Local emergency services had to rescue passengers from cars that drove into floodwaters in neighboring Madison County in December 2015. 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 pollute floodwaters. In rural areas, agricultural chemicals may be found 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.

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. Floods can also cause a reduction in agricultural, commercial and industrial productivity and tourism.

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 (SFHA), 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 FEMA's Mitigation Division.

Communities Enrolled in the NFIP and Their Policies

In the watershed, eight municipalities participate in the NFIP (Table A.41). Clinton County, St. Clair County, and Madison County also participate in the program, so unincorporated portions of the county that are within a FEMA designated SFHA are also eligible for flood insurance.

Table A.41. Communities in the Lower Silver Creek watershed enrolled in the NFIP

Community	**Initial FIRM**	**Effective FIRM Date**
Belleville	11/19/1980	11/05/2003
Fairview Heights	06/03/1978	11/05/2003
Freeburg	01/18/1980	11/05/2003
Lebanon	07/02/1981	11/05/2003
Mascoutah	06/15/1981	11/05/2003
O'Fallon	10/15/1982	11/05/2003
Shiloh	11/05/2003	11/05/2003
Summerfield	08/10/1979	11/05/2003
Unincorporated St. Clair County	11/05/2003	11/05/2003
Unincorporated Madison County	04/15/1982	04/15/1982

St. Clair County and its communities have 1,567 policies in effect covering over $290 million in assets. The communities of O'Fallon and Belleville have the most policies in effect of all municipalities the watershed.[55] Table A.42 gives a breakdown of the policies in the watershed, including the entirety of municipalities wholly or partially within the watershed.

Terms included in Table A.42 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

Table A.42. NFIP policies in effect in the Lower Silver Creek watershed as of 2016.[56]

Municipality	No. of policies in-force (2/28/17)	Total losses	Closed losses	Open losses	Closed without payment	Total payments
Belleville	60	181	160	0	21	$ 6,923,640
Fairview Heights	21	9	4	0	5	$ 9,711
Freeburg	x	2	2	0	0	$ 15,958
Lebanon	5	3	2	0	1	$ 41,794
Mascoutah	34	4	4	0	0	$ 10,875
O'Fallon	68	14	8	0	6	$ 305,209
Shiloh	38	1	0	0	1	$ -
Summerfield	3	2	2	0	0	$ 18,710
St. Clair County (unincorporated)	422	x	x	x	x	x
Total	651	216	182	0	34	$ 7,325,896

x = no data

Water Quality

The Lower Silver Creek watershed is the hydrologic lower half of the Silver Creek watershed and as such, it shares most of the same water quality problems identified for the Upper Silver Creek watershed. The Upper Silver Creek Watershed Resources Inventory completed in 2015 identified sediments, phosphorus, and nitrogen as the primary parameters affecting water quality in the watershed. Those same impairments have been identified for parts of the Lower Silver Creek watershed, including the East Branch of Little Silver Creek (HUC 071402040508) and Loop Creek (071402040511). For the most part, land use in the Lower Silver Creek watershed is devoted to cultivated agriculture, especially the production of corn and soybeans. Developed land accounts for 21% of the watershed. However, at the smaller HUC14 level, there are sections of the watershed on the eastern side that are almost entirely agricultural (>80%), whereas some of the HUC14s on the northwestern side are highly urbanized (>40%). Urban watersheds are typically characterized by a high proportion of impervious surfaces and storm water drains that rapidly convey rainfall into local streams.

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 seven Designated Uses of streams in Illinois, of which two have been examined in streams in the watershed: Aquatic Life and Aesthetic Quality. The Aquatic Life designated use represents the waterway's ability to support fish and aquatic macro invertebrates. The Aesthetic Quality designated use represents 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. As of the 2016 Illinois Integrated Water Quality Report, three streams in the Lower Silver Creek watershed are impaired – Ogles Creek, Loop Creek, and Little Silver Creek (Table A.44 and Figure A.38).

Causes of impairments in streams in the Lower Silver Creek watershed have changed over time (Table A.43). In 2006, there were five causes: dissolved oxygen, total phosphorus, sedimentation/siltation, nitrogen, and alteration in stream-side or littoral vegetative covers. In 2016, the number of causes had decreased to three: dissolved oxygen, total phosphorus, and sedimentation/siltation. Total phosphorus and sedimentation have been consistent impairments over the last 10 years.

Table A.43. Impairments for streams in the Lower Silver Creek watershed between 2006 and 2016.

Year	**Impairment**				
	Dissolved Oxygen (DO)	Total Phosphorus (P)	Sedimentation/ Siltation	Nitrogen	Alteration in stream-side or littoral vegetative covers
2016	X	X	X		
2014	X	X	X		
2012	X	X	X		
2010		X	X		
2008		X	X		
2006	X	X	X	X	X

Table A.44. Illinois EPA Designated Uses and Impairments for stream reaches in the Lower Silver Creek watershed, 2016.

Name	Assessment Unit ID	Size (mi)	Designated Use(s) Assessed	Use Attainment	Impaired?	Cause of Impairment	Source of Impairment
Ash Creek	IL_ODEB	5.92	Not assessed	Not assessed	n/a	n/a	n/a
East Branch Little Silver Creek	IL_ODGA	6.8	Not assessed	Not assessed	n/a	n/a	n/a
Engle Creek	IL_ODFA	7.18	Not assessed	Not assessed	n/a	n/a	n/a
Hazel Creek	IL_ODEA	5.94	Not assessed	Not assessed	n/a	n/a	n/a
Hagemann Branch	IL_ODO	3.72	Not assessed	Not assessed	n/a	n/a	n/a
Heberers Branch	IL_ODC	4.62	Not assessed	Not assessed	n/a	n/a	n/a
Hog River	IL_ODD	3.14	Not assessed	Not assessed	n/a	n/a	n/a
Jacks Run	IL_ODB	5.15	Not assessed	Not assessed	n/a	n/a	n/a
Little Silver Creek	IL_ODG-01	15.71	Aquatic Life, Aesthetic Quality	Not supporting (Aq. Life), Fully Supporting (Ae. Quality)	Yes	Oxygen, Dissolved; Phosphorus (Total); Sedimentation/Siltation	Crop production (crop land or dry land); Agriculture
Loop Creek	IL_ODE-LN-A1	2.3	Aquatic Life	Not supporting	Yes	Phosphorus (Total)	Streambank modifications/destabilization; Urban runoff/Storm sewers
	IL_ODE-LN-C1	1.23	Aquatic Life	Not supporting	Yes	Phosphorus (Total)	Streambank modifications/destabilization; Municipal point source discharges; Urban runoff/Storm sewers
	IL_ODE-LN-C3	8.33	Aquatic Life, Aesthetic Quality	Not supporting	Yes	Phosphorus (Total); Sedimentation/Siltation	Streambank modifications/destabilization; Municipal point source discharges; Urban runoff/Storm sewers
Ogles Creek	IL_ODI-CE-C1	0.82	Aquatic Life	Not supporting	Yes	Phosphorus (Total)	Streambank modifications/destabilization; Municipal point source discharges; Crop production (crop land or dry land); Urban runoff/Storm sewers
	IL_ODI-CE-C2	2.56	Aquatic Life	Fully supporting	No	n/a	n/a
	IL_ODI-CE-C3	6.42	Aquatic Life	Fully supporting	No	n/a	n/a
	IL_ODI-CE-D1	1.76	Aquatic Life	Not supporting	Yes	Cause Unknown	No source identified
Silver Creek	IL_ODGA	33.65	Aquatic Life, Aesthetic Quality	Fully Supporting	No	n/a	n/a

Impaired Waters in the Lower Silver Creek Watershed

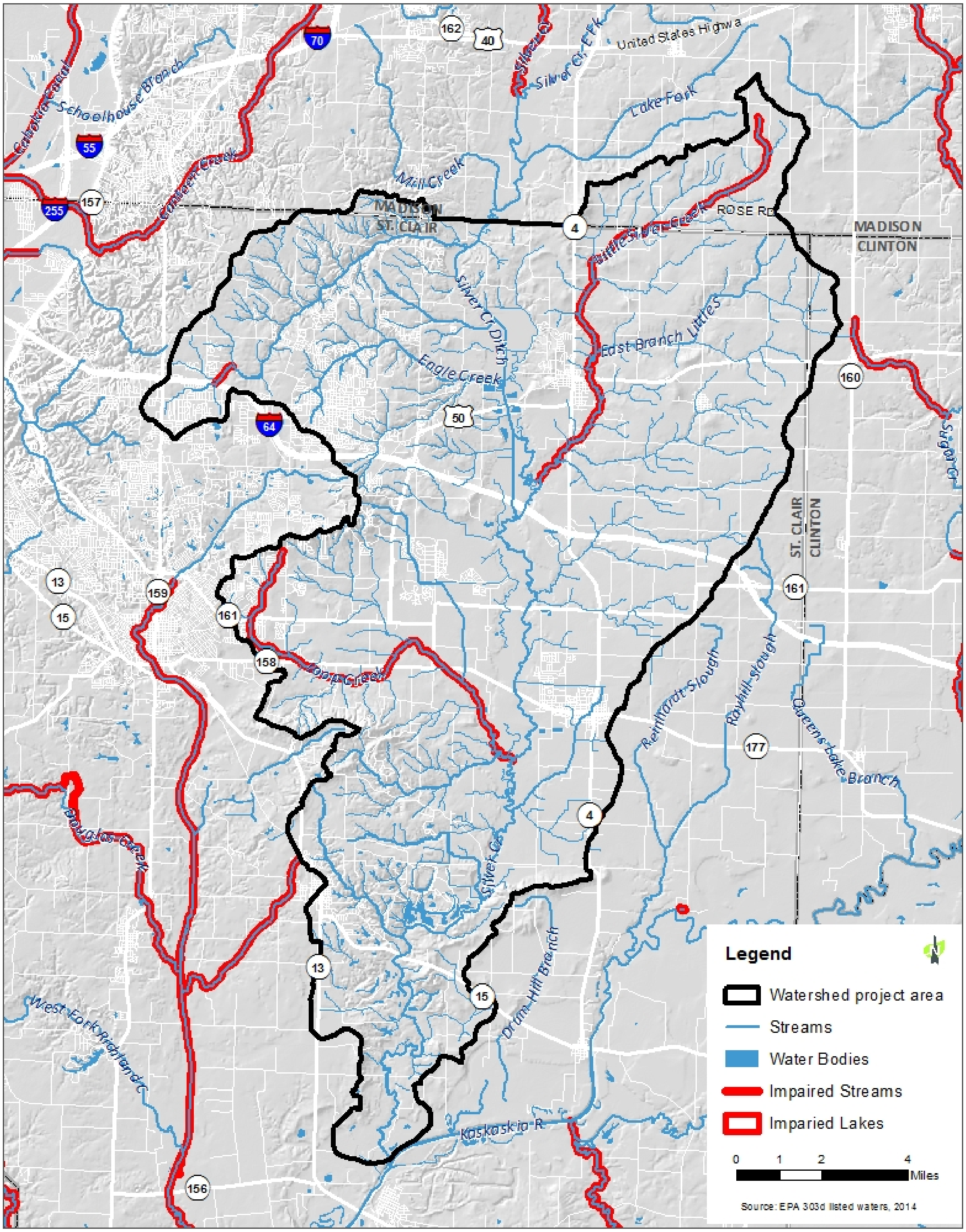

Figure A.38. Impaired waters in the Lower Silver Creek watershed (2016 IEPA303(d) List).

Sources of Data

The primary source of water quality data for the Lower Silver Creek watershed was the Water Quality Data Portal. The data was collected at the USGS Gage 05594800 on the main stem of Silver Creek near Freeburg, Illinois (38°24'22", -89°52'26"). The drainage area for this monitoring site includes most of the Lower Silver Creek watershed plus 100% of the Upper Silver Creek watershed and the East Fork Silver Creek watershed. Therefore, the data from this site provides a good overview of the overall status of water quality in the entire Silver Creek watershed. The data set consists of 384 records and covers the period from 10/10/1974 to 5/7/1997 (22 years, 209 days). The gaps in the dataset (i.e., time between sample collection) ranged from <1 day to 307 days, with a median gap of 15 days. Three agencies collected the samples including IEPA, the USGS-Atlanta Central Laboratory, GA (USGS-GAL) and the USGS - Illinois Water Science Center (USGSILWC). In addition to water quality data, the USGS has a complete record of daily discharge at this USGS gage dating from 1970 to present day.

Another source of data is the water quality testing conducted as a requirement of the St. Clair County NPDES permit, effective March 1, 2016. The permit requires MS4 permittees serving populations under 25,000 to conduct visual assessments of water quality. For permittees serving populations over 25,000 persons, quarterly laboratory testing of storm water discharge is required. St. Clair County, the City of O'Fallon, O'Fallon Township, and Caseyville Township banded together to share sampling costs and data. The partnership began sampling stormwater in the first quarter of 2017. The samples were tested for fecal coliform, oil & grease, Total Nitrogen, Total Phosphorous, Total Suspended Solids, and chloride. The partnership identified two locations for sampling each quarter within 48 hours of a ¼ inch or greater rainfall event in a 24-hour period.[57] The two sampling locations for the reporting year are:

1. Ogles Creek at Old Collinsville Rd (northeast side of creek) – ID Upstream Approximate coordinates 89° 57' 58.19" W 38° 35' 49.50" N
2. Ogles Creek at Scott Troy Rd (northeast side of creek) – ID Downstream Approximate coordinates 89° 52' 28.29" W 38° 38' 59.50" N

Further data is gathered by Illinois RiverWatch volunteers at five sites in the watershed between 1996 and 2013 (Table A.45, Figure A.39). 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.

Table A.45: Location, date and number of volunteers at RiverWatch sampling sites in the Lower Silver Creek watershed.

Stream Sampled	# Times Sampled	Years sampled
Engle Creek	17	1996-2004, 2006-2011, and 2013
Kellers Creek	5	1996-1999 and 2001
Loop Creek	6	1997, 2000-2004
Loop Creek tributary	1	1997
Ogles Creek	5	1996-1999 and 2001
Ogles Creek tributary	4	1996-1998 and 2001
Rock Spring	4	1996-1999
Silver Creek	1	2009

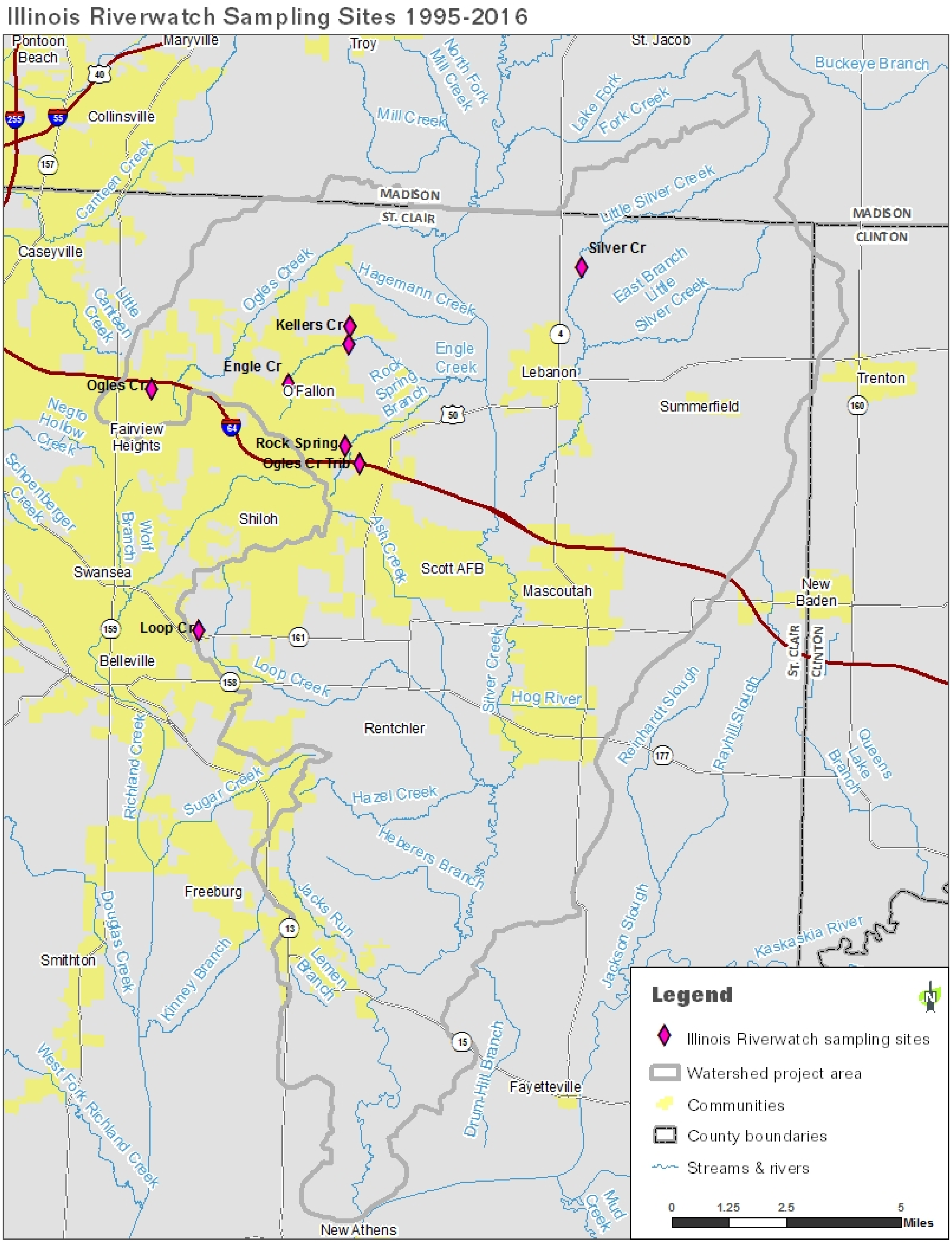

Figure A.39. Locations sampled by Illinois RiverWatch volunteers in the Lower Silver Creek watershed (1995-2016)

Stream Flow

Daily Mean Discharge: The mean daily discharge for the Lower Silver Creek measured at USGS gage 05594800 ranged from 0 to 9940 ft^3/sec. with a median value of 87 ft^3/sec and an average of 387 ft^3/sec (Table A.43). The corresponding gage heights ranged from 0 to 26 ft with a median value of 1.7 ft and an average of 3.0 ft. Occasionally extreme discharge events skewed average towards the higher values. The discharge data demonstrated that flow through the Lower Silver Creek was usually subdued and not likely to cause serious flooding or streambank erosion. Although the exact division between baseflow (fair weather flow) and stormflow is impossible to pinpoint, the 80th percentile value of 447 ft^3/sec was chosen for the purpose of identifying under what conditions water, sediments, and nutrients were transported through the watershed from 10/01/1970 through 04/30/2017. The 80^{th} percentile means 13,610 days during that period had flows below 447 ft^3/sec and 3,404 days had flows above that value (Table A.44). The total cumulative flow for that period was 16.026 km^3 of water of which 3.100 (19%) occurred during baseflow and 12.926 (81%) during stormflow. Clearly, most of the water and associated sediments and nutrients were transferred during high to extreme hydrological events.

Trends in Discharge: A simple linear regression of discharge versus time (Figure A.40) showed that there was a no significant trend in the mean daily discharge value (R^2=0.0028). However, it is worth noting that since 1994, a period of 22 years, there have been 6 mean daily discharge values greater than 8000 ft^3/sec, whereas from 1970 to 1994, a period of 24 years, there were only two events. It is possible that there is the beginning of a trend towards more frequent extreme discharge events, and this would be consistent with the predicted impacts of global climate change on rainfall patterns. Additional monitoring will be needed to determine whether or not this trend continues into the future, but should extreme rainfall and runoff events become more common in the Lower Silver Creek watershed, it will be important to implement landscape management practices that promote infiltration of precipitation and detain water on the landscape so that extreme discharge events will be minimized.

Annual Peak Discharge: The USGS also records the single highest annual discharge event each year. Those values are plotted in Figure A.41 for both the Upper Silver Creek (Gage 05594450) and Lower Silver Creek (Gage 05564800). These values represent actual discharge rates at a specific point in time, so they are relevant to specific watershed events such as runoff, flooding, and erosion (overland and streambank). Although there was no obvious trend in Daily Mean Discharge for the Lower Silver Creek as discussed in the previous paragraph, the Annual Peak Discharge for the Lower Silver Creek exhibited a general increase over time (R^2=0.1056) whereas the Upper Silver Creek did not. The Lower Silver Creek has a larger drainage area than the Upper Silver Creek, so it is more likely reflect rainfall and runoff conditions occurring throughout the watershed. Consistent with daily mean discharge values, the largest peak discharge events for the Lower Silver Creek have occurred since 1990 (red circles in Figure A.40) and this is further evidence that runoff events in the Silver Creek watershed have become more extreme in more recent years. It's worth noting that the most extreme peak discharge for the Upper Silver Creek Watershed occurred in 2015.

Table A.46. Percentile distribution of discharge and gage height data from The USGS gage 05594800 on Silver Creek near Freeburg, Illinois.

Percentile	Discharge (ft^3/sec)	Gage Ht. (ft.)	Discharge (m^3/day)
Min. Discharge	0	-0.17	-
25th Percentile	25	0.8	60,819
Median	87	1.7	211,651
75th Percentile	297	3.7	722,534
80th Percentile	447	4.8	1,087,450
99th Percentile	4,400	15.9	10,704,209
Max. Discharge	9,940	26	24,181,782
Average	387	3.0	941,909

Table A.47. Apportionment of Silver Creek streamflow between baseflow and storm flow from 1970 to 2017 using an 80 percentile threshold.

Flow Type	Days	Percent	Volume	Percent
Baseflow (km^3)	13,610	80%	3.100	19
StormFlow (km^3)	3,404	20%	12.926	81
Total Flow (km^3)	17,014	100%	16.026	100

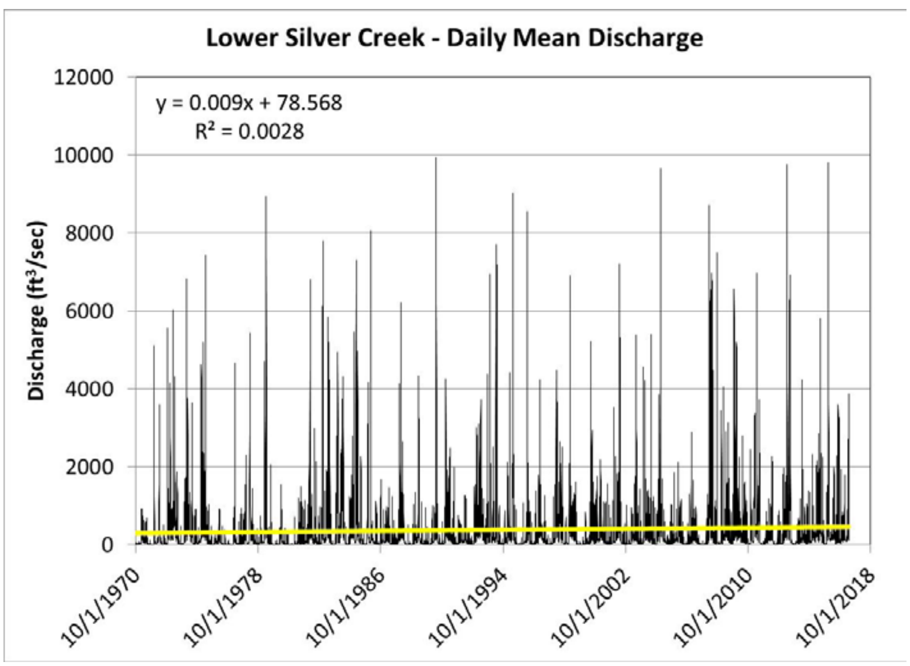

Figure A.40. Mean daily discharge measured on Lower Silver Creek at USGS gage 05564800 between 1970 and 2016.

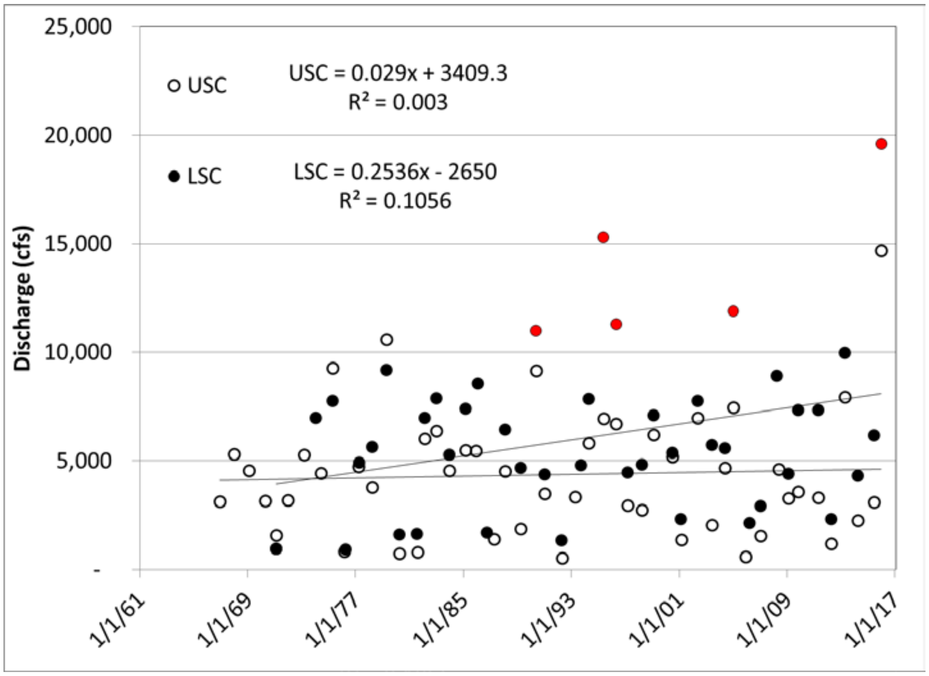

Figure A.41. Comparison of Annual Peak streamflows Upper Silver Creek and Lower Silver Creek measured at gages 05594450 and 05594800, respectively. Red circles represent the five highest peak discharges for the Lower Silver Creek watershed.

Annual peak streamflow in the watershed shows an increasing trend with time. Prior to 1990, (i.e., 1970 to 1989), there were no peak streamflows exceeding 10,000 cfs. In contrast, from 1990 to 2016, there were six peak streamflows exceeding 10,000 cfs, and the highest and third highest peak flows were recorded in 2016 and 2015, respectively. Increasing magnitudes and frequency of stormflow is consistent with the impacts of climate change and it is reasonable to predict that frequent, large stormflow events will continue or increase in the future.

Sediment Loads

Total suspended solids (TSS) at the USGS gage 05594800 were primarily measured by the IEPA from 1978 to 1997 at intervals ranging from a few weeks to a few months. Based on 163 samples, sediment loads ranged from 4 to 2,580 mg/L with a median value of 63 mg/L (Table A.49). Suspended sediments primarily consist of smaller sized silt and clay particles that require less energy to remain suspended whereas coarser sand particles settle to the bottom of the water column and are primarily suspended during periods of high flow velocity. Five suspended samples were analyzed to determine the particle size distribution (Table A.51) and the results showed that 99% of the suspended sediment sample was <62.5µm in diameter. Particles smaller than 62.5µm correspond to the silt and clay fraction of the soil, which tends to be the most easily eroded fraction of topsoil. A more thorough analysis of one suspended sediment sample showed that 56% of the suspended sediment concentration was due to clay-sized particles (<2µm). The suspended sediment content in Silver Creek clearly reflects the predominant silt loam and silty clay loam textures of soils throughout the watershed.

A graph of discharge versus suspended solids revealed multiple points from the period from 1981 to 1988 that seem inconsistent with the overall trend of increased suspended sediment concentration with discharge (Figure A.42). A closer examination of these outlying points reveals that for those samples, the concentrations of certain trace and heavy metal constituents in the unfiltered fraction were elevated (barium, cobalt, copper, chromium, manganese, strontium) whereas the alkali and alkali earth metals were reduced (Ca, Mg, Na) as were some of the anions (chloride boron). This suggests that there were activities in the watershed that sometimes released sediments with elevated concentrations of trace and heavy metals, possible some type of mining operation. In some instances, the high suspended sediment concentration also corresponded to fecal coliform concentrations that were above the 75th percentile, which suggests that the elevated TSS, heavy metals, and fecal bacteria originated with a waste water treatment facility.

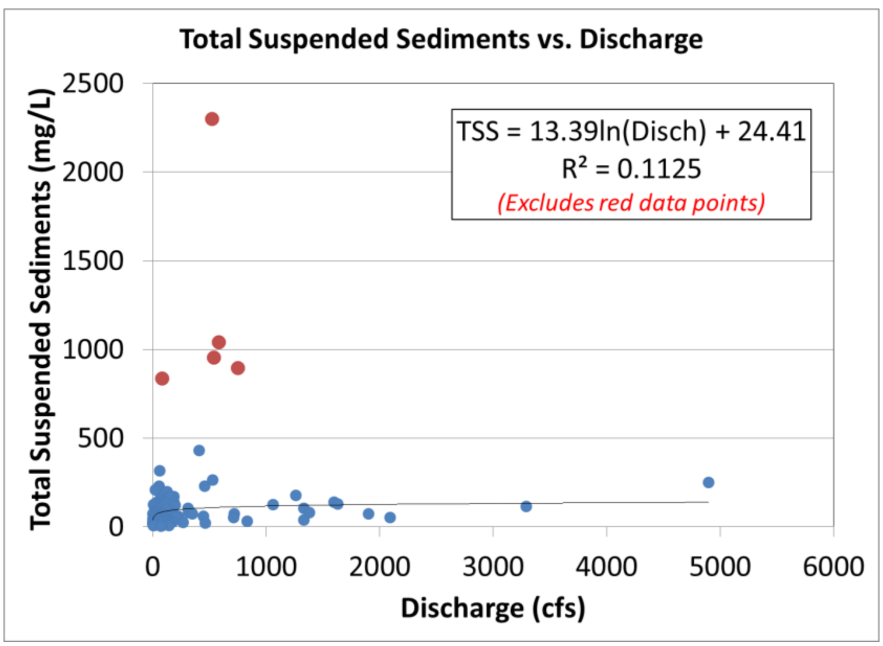

Figure A.42. Relationship between total suspended sediments and discharge for the Lower Silver Creek. Red points represent extreme values that were not included in the regression correlation.

Additional Total Suspended Solids data was collected from two samples at Ogles Creek as a requirement of the NPDES permit for St. Clair County MS4. The laboratory received two samples in March 2017 which had the following measurements (Table A.48). [58]

Table A.48. Total Suspended Solids data from Ogles Creek sampled in March 2017 for St. Clair County MS4 group under NPDES permit requirements.

Parameter	Location	Result	Units	Collection date
Total Suspended Solids	Upstream	10	mg/L	3/1/2017
	Downstream	217	mg/L	3/1/2017

Table A.49. Descriptive statistical summary of standard water quality parameters measured in samples collected from Silver Creek adjacent to the USGS gage 05594800 between 1974 and 1997 by the USGS Illinois Water Science Center and the IL-EPA.

Parameter	Units	*n*	Min	25th %	Median	75th %	Max
Standard measurements							
Temperature (Water)	C	265	0.0	6.5	14.0	22.0	31.5
pH		176	6.30	7.18	7.40	7.63	8.90
Specific Conductance	µS/cm	277	63	343	564	690	1,150
Chemical Oxygen Demand (COD)	mg/L	141	0	22	27	33	180
Dissolved Oxygen	mg/L	165	3.4	6.2	7.8	10.9	16.0
Turbidity	NTU	124	1.4	6.9	18.5	37.3	380
Total Hardness (as $CaCO_3$)	mg/L	123	71	160	240	280	350
Total Dissolved Solids	mg/L	116	62	218	362	426	965
Total Suspended Solids (TSS)	mg/L	163	4	33	63	124	2,580
Loss on ignition of suspended solids	mg/L	162	1	5	9	18	180
Suspended solids remaining after ignition	mg/L	162	3	27	52	100	2,410
Suspended Sediment Concentration (SSC)	mg/L	5	45	103	151	401	3,180
Suspended Sediment Concentration	tons/day	5	0.97	5	758	1,650	10,500

Table A.50. Statistical summary of nutrients and nutrient-related parameters measured in samples collected from Silver Creek adjacent to the USGS gage 05594450 between 1972 and 2011 by the Illinois Water Science Center and the IEPA.

Characteristic	Units	n	Min	25th %	Median	75th %	Max
Nutrients and Bacteria							
[NO3+NO2]-N, unfiltered	mg/L	165	0.1	1.3	1.7	2.4	13.0
[NO3+NO2]-N, filtered	mg/L	126	0.1	1.4	1.8	2.1	5.8
NH3-N, unfiltered	mg/L	163	0.00	0.10	0.14	0.32	1.20
Organic nitrogen, unfiltered	mg/L	5	1.00	1.20	1.20	1.40	2.90
Total nitrogen, unfiltered	mg/L	5	2.20	2.50	3.20	3.40	5.20
Phosphorus, unfiltered	mg/L	114	0.13	0.39	0.55	0.78	3.30
Phosphorus, filtered	mg/L	113	0.07	0.20	0.29	0.50	1.70
Fecal coliform	cfu/100mL	147	1	40	200	620	46,000

Table A.51. Particle size analysis of total suspended sediments isolated from Silver Creek. Note that for single measurements, no percentile distribution analysis is possible (Not Applicable).

Parameter	Units	*n*	Min	25th %	Median or single value	75th %	Max
Sediment Particle Size Distribution							
Suspended sediment, sieve diameter, <62.5 µm	%	5	99	99	99	100	100
Suspended sediment, diameter ,<62.5 µm	%	1	Not Applicable		99	Not Applicable	
Suspended sediment, diameter , <16 µm	%	1			70		
Suspended sediment, diameter , <4 µm	%	1			62		
Suspended sediment, diameter , <2 µm	%	1			56		

Parameter	Units	*n*	Min	25th %	Median or single value	75th %	Max
Sediment Texture			Not Applicable			Not Applicable	
Sand	%	1			1		
Medium to course silts	%	1			29		
fine silts	%	1			8		
very fine silts	%	1			6		
clay	%	1			56		

Nutrients and Bacteria

Nitrogen

The data set included five types of nitrogen values (Table A.46), but two of those types consisted of only five records. The bulk of the data was for NH_3-N in unfiltered samples and $[NO_3+NO_2]$-N in unfiltered and filtered samples. The median NH_3-N concentration was 0.1 mg/L which is well below the general use water standard of 15 mg/L. The median $[NO_3+NO_2]$-N concentrations were 1.7 and 1.8 mg/L in unfiltered and filtered samples, respectively, which is below the drinking water standard of 10 mg/L. Maximum values for these constituents were also mostly below the standard limits. Therefore, nitrogen pollution in the Lower Silver Creek watershed did not seem to be a common problem between 1979 and 1997 when this data was collected. Elevated nitrate concentrations in rivers and streams are typically associated with tile drainage of agricultural fields, but that practice is not widespread in the Lower Silver Creek watershed.

Additional Total Nitrogen data was collected from two samples at Ogles Creek as a requirement of the NPDES permit for St. Clair County MS4. The laboratory received two samples in March 2017 which had the following measurements (Table A.52). [59]

Table A.52. Total Nitrogen data from Ogles Creek sampled in March 2017 for St. Clair County MS4 group under NPDES permit requirements.

Parameter	Location	Result	Units	Collection date
Total Nitrogen	Upstream	0.78	mg/L	3/1/2017
	Downstream	6.07	mg/L	3/1/2017

Phosphorus

Total P in unfiltered samples ranged from 0.1 to 3.3 mg/L with a median value of 0.6 mg/L. The general use water quality standard is 0.05 mg/L in any reservoir or lake with a surface area of 8.1 hectares (20 acres) or more, or in any stream at the point where it enters any such reservoir or lake. Therefore, phosphorus appears to have exceeded that limit every time samples were collected between 1982 and 1997. Trends in soluble P concentrations (filtered samples) mirrored those for total P (unfiltered samples). Dissolved P accounted for 10 to 93% of the total P fraction, but was generally between 50 to 73% of total P. In general, soluble P accounted for a larger fraction of total P at low discharge rates in Silver Creek, but accounted for less of total P as discharge increased. Soluble P represents the fraction that is immediately bioavailable to aquatic organisms and can lead to algal blooms under certain environmental conditions (i.e., low turbidity, slow stream velocity, and warm temperatures).

Additional Total Phosphorus data was collected from two samples at Ogles Creek as a requirement of the NPDES permit for St. Clair County MS4. The laboratory received two samples in March 2017 which had the following measurements (Table A.53). [60]

Table A.53. Fecal coliform data from Ogles Creek sampled in March 2017 for St. Clair County MS4 group under NPDES permit requirements.

Parameter	Location	Result	Units	Collection date
Total Phosphorus (as P)	Upstream	0.108	mg/L	3/1/2017
	Downstream	0.735	mg/L	3/1/2017

Bacteria

Fecal coliform concentrations were measured 147 times between 3/7/79 and 5/7/97 (Figure A.43). Values ranged widely from 1 to 46,000 cfu/100mL, but the median value of 200 cfu/100mL indicated that half of the measurements exceeded the Illinois limit of 200 cfu/100mL based on a geometric mean calculated for 5 samples collected over a 30-day period (Title 35, Subtitle C, Chapter I, Sect. 302.209). The data used for this report did not meet the temporal criteria for calculating a geometric mean, but it demonstrates that fecal coliform concentrations tend to by elevated and are a potential problem in the watershed.

The interval between sample collection was not always consistent, but during this 18 year period, each month was represented by a similar number of samples (*n*) ranging from *n* = 7 to 16. This made it possible to calculate a pseudo geometric mean for each month of the year (Figure A.43). Representation of the data in this way shows that fecal coliform bacteria follow a seasonal trend with the highest populations occurring during the warmer months of the year. Although more recent data is not available, it was clear that from 1979 to 1997, bacterial contamination was a recurring problem in the Silver Creek watershed. The source of the bacteria is uncertain, but at least some of it is probably attributable to livestock operations (cattle, dairy, and hogs) within the watershed.

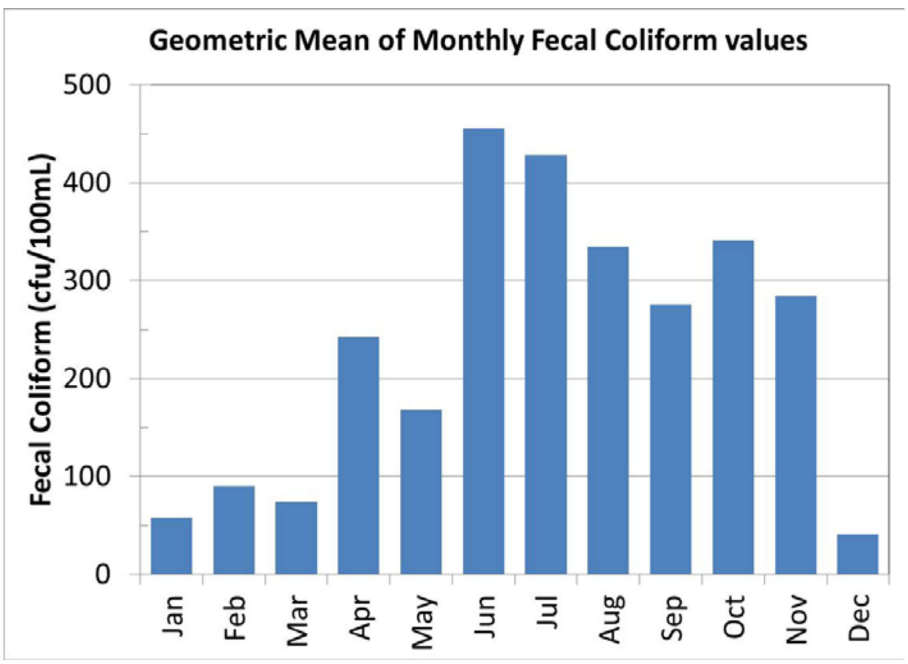

Figure A.43. Geometric mean of fecal coliform concentrations measured within the same month on different years at USGS gage 05594800 from 1979 to 1997. Each month is the average of ≥7 measurements.

Additional fecal coliform data was collected from two samples at Ogles Creek as a requirement of the NPDES permit for St. Clair County MS4. The laboratory received two samples in March 2017 which had the following measurements (Table A.54). [61]

Table A.54. Fecal coliform data from Ogles Creek sampled in March 2017 for St. Clair County MS4 group under NPDES permit requirements.

Parameter	Location	Result	Units	Collection date
Fecal Coliform	Upstream	1,100	CFL/100ml	3/1/2017
	Downstream	3,800	CFL/100ml	3/1/2017

Earth and Trace Metals

Metals, metalloids, and anions (Table A.55): Concentrations of earth metals in water samples collected at USGS Gage 05594800 were unremarkable in terms of their magnitude and distribution, and reflect the predominant soil types throughout the watershed. In most cases, samples were analyzed for both soluble (filtered) and total recoverable (unfiltered) concentrations. Dissolved fractions of the alkali (Na, K) and alkali earth metals (Ca, Mg) were generally 84 to 96 percent of the total concentration, reflecting the fact that these elements remain in fairly soluble forms in the soils. Other metals (aluminum) and metalloids (silica) are major components of clay minerals and tend to be less soluble in the environment under the alkaline conditions, so their concentrations were much higher in the total fraction as compared to the soluble fraction. Anions (fluoride, chloride, and sulfate) are very soluble in water and can demonstrate a wide range of concentrations. Fluoride concentrations ranged from 0.3 to 0.4 mg/L which is well below the Numeric Water Quality Standards of 4 mg/L for the Protection of Aquatic Organisms. Chloride ranged from 1 to 650 mg/L, but the median value of 37.3 was below the general standard of 500 mg/L. Sulfate ranged from 19 to 670 mg/L with a median value of 96 mg/L. The standard for sulfate ranges from 500 to 2000 mg/L and depends on the chloride and hardness concentrations of the water, but for the values reported in this data set, sulfate contamination was not a problem.

Trace and Heavy metals (Table A.56): Trace and heavy metals are also relatively ubiquitous in the natural environment, but they tend not to be found in high concentrations. With the exception of iron, the soluble (filtered) concentrations accounted for 50% or more of the total (unfiltered) concentrations. High concentrations of trace and heavy metals usually indicate some type of industrial contamination. There were several events from 1981 to 1988 where this occurred for barium, cobalt, copper, chromium, manganese, strontium, and those events were addressed in the previous section on sediment loads. They were probably due to mining activities or a waste water treatment facilities. Advancements in waste water treatment processes since the 1980s have greatly reduced their contributions of heavy metals to the environment. Other than during extreme events, heavy metal concentrations posed no serious threats to habitat or water quality. The heavy metals barium, cadmium, chromium, iron, lead, and manganese, all had median concentrations below their drinking water limits of 1000, 5, 100, 300, 50, and 1000 µg/L, respectively. All other heavy metals were similarly unremarkable in their range of concentrations. The heavy metals arsenic, silver, and mercury were measured with similar frequency to other trace metals shown in Table A.49, but the entire range of concentrations for each of those metals were below their drinking water standards of 50, 5, and 2 µg/L, respectively. All in all, trace and heavy metal contamination was not a significant problem and was only evident for isolated events, but more recent data is needed to confirm this.

Table A.55. Statistical summary of earth metal concentrations measured in samples collected from Silver Creek adjacent to the USGS gage 05594800 between 1974 and 1997 by the USGS Illinois Water Science Center and the IL-EPA. For each parameter, filtered samples correspond to dissolved fraction and unfiltered to the total fraction.

Characteristic	Units	n	Min	25th %	Median	75th %	Max
Earth metals, metalloids, and anions							
Sodium, filtered	mg/L	118	3.8	23.0	35.0	49.8	93.0
Sodium, unfiltered, recoverable	mg/L	146	5.7	24.5	39.5	54.0	139.0
Na fraction of major cations	%	118	9.00	21.00	24.50	33.00	41.00
Sodium adsorption ratio	unitless	118	0.29	0.77	1.00	1.45	2.43
Potassium, filtered	mg/L	118	1.8	3.9	5.4	6.9	10.0
Potassium, unfiltered, recoverable	mg/L	146	2.0	4.8	6.4	8.0	12.0
Magnesium, filtered	mg/L	118	2.9	13.0	21.0	25.0	35.0
Magnesium, unfiltered, recoverable	mg/L	146	6.5	17.0	22.5	27.0	36.0
Calcium, filtered	mg/L	118	8.5	36.3	58.0	64.0	83.0
Calcium, unfiltered, recoverable	mg/L	146	19.0	43.5	60.5	68.0	84.0
Aluminum, filtered	mg/L	107	0.05	0.05	0.10	0.12	0.53
Aluminum, unfiltered, recoverable	mg/L	107	0.10	0.75	1.20	2.75	38.70
Silica, filtered as SiO_2	mg/L	4	4.6	6.7	7.5	8.6	12.0
Fluoride, filtered	mg/L	4	0.25	0.29	0.35	0.41	0.42
Fluoride, unfiltered	mg/L	4	0.30	0.30	0.35	0.43	0.50
Chloride, filtered	mg/L	167	1	23	37	50	650
Sulfate, filtered	mg/L	171	19	65	96	119	670

Table A.56. Statistical summary of trace and heavy metal concentrations monitored in Silver Creek adjacent to the USGS Gage 05594450 between 1977 and 2011 by the Illinois Water Science Center and the IL-EPA. For each parameter, filtered samples correspond to dissolved fraction and unfiltered to the total fraction.

Characteristic	Units	*n*	Min	25th %	Median	75th %	Max
Trace and Heavy metals							
Boron, filtered	µg/L	115	30	55	90	140	320
Boron, unfiltered, recoverable	µg/L	147	30	70	100	160	350
Barium, filtered	µg/L	114	23	59	72	87	129
Barium, unfiltered, recoverable	µg/L	92	100	100	100	100	1,100
Cadmium, filtered	µg/L	105	3	3	3	3	5
Cadmium, unfiltered	µg/L	134	0	3	3	3	20
Chromium, filtered	µg/L	104	5	5	5	5	10
Chromium, unfiltered, recoverable	µg/L	147	0	5	5	6	100
Cobalt, filtered	µg/L	104	5	5	5	5	10
Cobalt, unfiltered, recoverable	µg/L	121	5	5	5	10	60
Copper, filtered	µg/L	102	5	5	5	5	10
Copper, unfiltered, recoverable	µg/L	124	0	5	5	10	60
Iron, filtered	µg/L	121	10	50	50	100	1,000
Iron, unfiltered, recoverable	µg/L	173	570	1,200	1,920	3,700	77,000
Lead, filtered	µg/L	108	5	5	5	50	100
Lead, unfiltered, recoverable	µg/L	142	0	5	5	50	400
Manganese, filtered	µg/L	120	20	158	250	368	880
Manganese, unfiltered, recoverable	µg/L	173	70	320	460	640	5,340
Nickel, filtered	µg/L	90	5	5	5	15	25
Nickel, unfiltered, recoverable	µg/L	86	0	5	5	15	25
Strontium, filtered	µg/L	115	5	120	160	190	290
Strontium, unfiltered, recoverable	µg/L	146	70	150	180	208	290
Vanadium, filtered	µg/L	115	5	5	5	5	13
Vanadium, unfiltered	µg/L	94	2	5	10	10	130
Zinc, filtered	µg/L	113	50	50	50	100	200
Zinc, unfiltered, recoverable	µg/L	164	0	50	50	100	350

Biological Indicators of Water Quality

Aquatic macroinvertebrate communities are also indicators of water quality. Macro invertebrates 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 macro invertebrates 43 times at eight sites in the watershed between 1996 and 2013. 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** – Macro invertebrate 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.

The metrics from the RiverWatch data indicate that the macro invertebrate species richness and habitat, and associated water quality at the twenty sites sampled is typically poor to fair (Table A.57). Taxa richness at the sites was typically poor/very poor, while EPT taxa richness was poor at most sites.

The average MBI scores indicated good or fair water quality, but those scores increased to high, "very poor" water quality ratings at some dates and sites over the monitoring period, particularly at Ogles Creek.

Table A.57. Metrics based on macroinvertebrate populations sampled by Illinois Riverwatch volunteers in the Lower Silver Creek watershed.

STREAM NAME	FIELD DATE	# ORGANISMS SAMPLED	TAXA RICHNESS	EPT TAXA RICHNESS	MBI
Engle Creek R0702001	6/9/1996	31	9	1	6.2
Engle Creek R0702001	6/1/1997	110	13	3	5.9
Engle Creek R0702001	5/24/1998	80	14	0	5.9
Engle Creek R0702001	5/30/1999	103	8	1	6.7
Engle Creek R0702001	6/4/2000	46	14	3	5.8
Engle Creek R0702002	5/22/2001	75	7	0	6.5
Engle Creek R0702001	6/3/2001	106	9	1	5.9
Engle Creek R0702001	6/2/2002	101	10	2	6.1
Engle Creek R0702001	5/25/2003	71	7	0	6.6
Engle Creek R0702001	6/27/2004	141	8	2	5.8
Engle Creek R0702001	5/28/2006	124	9	1	6.2
Engle Creek R0702001	6/24/2007	120	10	3	5.3
Engle Creek R0702001	5/25/2008	111	10	1	6.2
Engle Creek R0702001	6/14/2009	106	13	2	5.8
Engle Creek R0702001	5/30/2010	105	9	1	4.9
Engle Creek R0702001	6/5/2011	119	11	1	5.9
Engle Creek R0702001	6/26/2013	95	10	1	6.4
Average			**10**	**1**	**6.0**
Description of avg.			**Fair**	**Poor**	**Good**
Range			**7 to 14**	**0 to 3**	**4.9 to 6.7**
Kellers Creek R0720101	6/30/1996	22	6	0	9.6
Kellers Creek R0720101	6/5/1997	69	8	0	6.3
Kellers Creek R0720101	6/12/1998	8	3	2	7.0
Kellers Creek R0720101	5/30/1999	90	4	0	5.4
Kellers Creek R0720101	5/19/2001	88	6	0	6.2
Average			**5**	**0**	**6.9**
Description of avg.			**Very Poor**	**Poor**	**Fair**
Range			**3 to 8**	**0 to 2**	**5.4 to 9.6**

Table A.57, continued.

STREAM NAME	FIELD DATE	# ORGANISMS SAMPLED	TAXA RICHNESS	EPT TAXA RICHNESS	MBI
Loop Creek R0701701	6/4/1997	236	9	0	6.2
Loop Creek R0701701	6/22/2000	3	1	0	9.0
Loop Creek R0701701	6/28/2001	52	7	0	8.6
Loop Creek R0701701	6/22/2002	7	4	0	7.6
Loop Creek R0701701	6/25/2003	34	3	0	6.5
Loop Creek R0701701	7/9/2004	1	1	0	9.0
Average			**4**	**0**	**7.8**
Description of avg.			**Very Poor**	**Poor**	**Poor**
Range			**1 to 9**	**0**	**6.2 to 9.0**
Loop Creek Trib. R0701702	6/18/1997	98	8	0	6.6
Average			**8**	**0**	**6.6**
Description of avg.			**Poor**	**Poor**	**Fair**
Range					
Ogles Creek R0702101	6/16/1996	44	6	0	8.0
Ogles Creek R0702101	6/6/1997	8	5	0	8.9
Ogles Creek R0702101	6/11/1998	38	4	2	9.6
Ogles Creek R0702101	5/30/1999	46	7	0	8.7
Ogles Creek R0702101	5/19/2001	32	6	0	10.2
Average			**6**	**0**	**9.1**
Description of avg.			**Very Poor**	**Poor**	**Very Poor**
Range			**4 to 7**	**0 to 2**	**8.0 to 10.2**
Ogles Creek Trib. R0720301	6/8/1996	4	3	0	7.0
Ogles Creek Trib. R0720301	6/7/1997	109	5	0	5.9
Ogles Creek Trib. R0720301	6/25/1998	2	2	0	4.0
Ogles Creek Trib. R0720301	6/14/2001	143	6	1	4.3
Average			**4**	**0**	**5.3**
Description of avg.			**Poor**	**Poor**	**Good**
Range			**2 to 6**	**0 to 1**	**4.0 to 7.0**
Rock Spring R0720501	7/17/1996	30	4	0	6.7
Rock Spring R0720501	6/25/1997	31	7	1	5.7
Rock Spring R0720501	6/21/1998	3	2	0	6.0
Rock Spring R0720501	6/19/1999	49	7	2	5.8
Average			**5**	**1**	**6.0**
Description of avg.			**Very Poor**	**Poor**	**Good**
Range			**2 to 7**	**0 to 2**	**5.7 to 6.7**
Silver Creek R0701601	5/1/2009	55	6	3	6.0
Average			**6**	**3**	**6.0**
Description of avg.			**Very Poor**	**Moderate**	**Good**
Range					

Water Appearance

Water appearance documented by the Illinois RiverWatch volunteers at the eight sites in the watershed between 1996 and 2013 was described as clear, dark brown, foamy, milky, or oily sheen (Table A.58). The sites with the greatest proportion of assessments of non-clear water were Silver Creek (1 of 1 assessments), Ogles Creek (4 of 5 assessments), and Ogles Creek tributary (3 of 4 assessments).

When the worst weather in the last 48 hours included rain, 48% of the water appearance descriptions were not "clear." However, clear or overcast weather did not guarantee clear water; 6 out of 20 (30%) of the monitoring events with no rain in the last 48 hours had a dark brown, foamy, milky, or "other" appearance. The data show no clear trend of improvement or deterioration of water appearance over time.

Table A.58. Water appearance at the RiverWatch monitoring sites, compared with worst weather in the last 48 hours at those sites, based on 43 monitoring events.

Water Appearance	Not Recorded	Overcast	Rain (steady rain)	Showers (intermittent rain)	Storm (heavy rain)	Grand Total
Clear	2	12	8	2	2	26
Dark Brown		1	1	1	3	6
Foamy			1	1		2
Milky	1	1				2
Oily Sheen			1			1
Other	1	2	2		1	6
Grand Total	4	16	13	4	6	43

Table A.59 shows the results of the visual monitoring of water quality performed by communities and townships for the 2017 St. Clair County MS4 permit (as of June 5, 2018).

Table A.59. 2017 St. Clair County MS4 water quality visual monitoring results.

Community:	Sampling Outfall Location(s):	Date Collected:	Runoff Source:	Description:
City of Belleville[62]	*Visual monitoring was not included in the 2017 Annual Report. The City of Belleville will not begin laboratory testing of storm water discharge samples until the 2018-2019 reporting year due to budget constraints.*			
City of Fairview Heights[63]	Ogles Creek near Richmond Drive • Rip rap lined channel	3/28/17	Not a qualifying rain event	• Clear in color. • No oil sheen. • Odorless. • No floating solids or suspended solids. • No damage to the outfall structure. • Normal vegetation conditions. • No settled solids.
City of O'Fallon[64]	*Visual monitoring was not included in the 2017 Annual Report. The City of O'Fallon banded together with St. Clair County, O'Fallon Township, and Caseyville Township to perform sampling and laboratory testing for the first quarter of 2017.*			
Village of Shiloh[65]	3320 Green Mount Crossing Drive, behind Freddy's Frozen Custard • Drainage flows into the village from the north • Box culvert	10/12/17	Rainfall (.87")	• Clear in color. • No oil sheen. • Odorless. • No floating solids or suspended solids. • No damage to outfall structure. • Normal vegetation conditions. • No settled solids. • No foam.
		4/27/17	Rainfall (1.5")	• Clear in color. • No oil sheen. • Odorless. • No floating solids. • Suspended solids present (small, opaque). • No damage to outfall structure. • Normal vegetation conditions. • Settled solids present (dust). • No foam.
		6/15/17	Rainfall (.97")	• Clear in color. • No oil sheen. • Odorless. • No floating solids or suspended solids. • No damage to outfall structure. • Normal vegetation conditions. • No settled solids. • No foam.
		12/6/17	Rainfall (.34")	• No water (dry).
	Bridge on Frank Scott Pkwy East, 750 ft west of Fountain Lakes entrance • Drainage flows into the village from the north	10/12/17	Rainfall (.87")	• Clear in color. • No oil sheen. • Odorless. • No floating solids or suspended

	• Bridge, Creek			solids. • No damage to outfall structure. • Normal vegetation conditions. • No settled solids. • No foam.
		4/27/17	Rainfall (1.5”)	• Clear in color. • No oil sheen. • Odorless. • No floating solids or suspended solids. • Normal vegetation conditions. • No settled solids. • No foam.
		6/15/17	Rainfall (.97”)	• Clear in color. • No oil sheen. • Odorless. • No floating solids. • Suspended solids present (vegetation/dirt). • No damage to outfall structure. • Excessive vegetation conditions. • Settled solids present (dirt/leaves). • No foam.
		12/6/17	Rainfall (.34”)	• Clear in color. • No oil sheen. • Odorless. • No floating solids or suspended solids. • No damage to outfall structure. • Normal vegetation conditions. • No settled solids. • No foam.
	Behind the residence at 21 Prairie View Rd • Drainage flows out of the village to the southwest • Creek	10/12/17	Rainfall (.87”)	• Clear in color. • No oil sheen. • Odorless. • No floating solids. • Suspended solids present (dirt/sand). • No damage to outfall structure. • Normal vegetation conditions. • Settled solids present (sand-like particles). • No foam.
		4/27/17	Rainfall (1.5”)	• Clear in color. • No oil sheen. • Odorless. • No floating solids or suspended solids. • Normal vegetation conditions. • Settled solids present (smaller than sand). • No foam.
		6/15/17	Rainfall (.97”)	• Brown in color. • Cloudy. • No oil sheen. • Odorless.

				• No floating solids. • Suspended solids present (vegetation/dirt). • Normal vegetation conditions. • Settled solids present (dirt). • No foam.
		12/6/17	Rainfall (.34")	• Clear in color. • No oil sheen. • Odorless. • No floating solids or suspended solids. • No damage to outfall structure. • Normal vegetation conditions. • No settled solids. • No foam.
Caseyville Township and O'Fallon Township	*Caseyville Township, O'Fallon Township, St. Clair County, and The City of O'Fallon banded together to perform sampling and laboratory testing for the first quarter of 2017. The 2017 Annual Reports have not yet been posted.*			
St. Clair Township[66]	Loop Creek on Shady Lane • Concrete pipe	3/28/17	Rainfall (.33")	• Clear in color. • No oil sheen. • Odorless. • No floating solids or suspended solids. • No damage to the outfall structure. • Normal vegetation conditions. • No settled solids. • No foam.
	Loop Creek on Dahlia Lane • Concrete pipe	3/28/17	Rainfall (.33")	• Clear in color. • No oil sheen. • Odorless. • Floating solids. • Suspended solids. • No damage to outfall structure. • Normal vegetation conditions. • No settled solids. • No foam.
St. Clair County[67]	*Visual monitoring was not included in the 2017 Annual Report. St. Clair County banded together with The City of O'Fallon, O'Fallon Township, and Caseyville Township to perform sampling and laboratory testing for the first quarter of 2017.*			

Turbidity

Of the 43 monitoring occasions where turbidity was reported by RiverWatch volunteers in the watershed, 18 marked “clear,” 11 marked “slight,” 7 marked “medium,” and 2 marked “heavy.” Three of 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.[68]

Agriculture and Water Quality

Conventional grain agriculture requires the use of nitrogen and phosphorus fertilizers. This results in the annual application of soluble inorganic fertilizers which add 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).[69] Similarly, a 2011 study in the Journal of Environmental Quality reported that 75% of phosphorus inputs into Madison County came from fertilizer, 18% from manure, and 7% from sewage.[70]

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 2015 Illinois Department of Agriculture Soil Conservation Survey revealed that farmers in St. Clair County rank very high among Illinois counties for their use of conservation tillage. The Survey reported that farmers in St. Clair County used some form of conservation tillage on more than 98% of corn fields and nearly 100% of soybeans fields during 2015. Therefore it is not surprising to see that only 3% of the fields examined in St. Clair County exhibited signs of ephemeral erosion and 92.9% of the fields had soil losses below the tolerable (T) level established by the NRCS. The average soil loss from St. Clair County land in corn is 2.4 tons/acre, as compared with 8.6 tons/acre in Madison County, which has much more conventional tillage.[71] All things considered, farmers in St. Clair county rank among the most progressive farmers for their use of conservation practices and there is only limited opportunity to expand those practices.

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. 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. A 2011 study showed that during periods of base flow, both nitrate and orthophosphate concentrations in urban watersheds were higher than in agricultural watersheds in the Lower Kaskaskia River Watershed.[72] It is likely that sewer and septic systems in urban-dominated watersheds contribute significant amounts of nitrate and phosphate to base flow drainage.

NPDES Permitted Discharges

There are nine facilities with NPDES permits to discharge into the watershed, as listed (Table A.60). Four 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. Several pollutants are required to be monitored at these facilities, including suspended solids monitored (Table A.61). Caseyville Township East STP discharges the greatest amount of total suspended solids (114 lb/day on average).

Table A.60. NPDES permitted discharges into the Lower Silver Creek watershed.

Site Name	Permit Number	Permit Exp. Date
Belleville STP #1, City of	IL0021873	30-Sep-20
Belleville, City of	ILL021881	31-Dec-20
Caseyville Township East STP	IL0079499	30-Sep-21
Freeburg West STP, Village of	IL0032310	31-Jul-17
I-DOT I-64 Gateway Rest Area - St. Clair County	ILG551089	20-Jun-18
Lebanon STP, City of	IL0029483	31-Aug-18
St. Clair County Health Department	ILG870089	31-Oct-21
Surface Discharging System 63	ILG620063	9-Feb-19
Surface Discharging System 70	ILG620070	9-Feb-19

Table A.61. Total suspended solids as averages from measurements from the PCS/ICIS .[73]

Name of facility	Permit #	Average Total Suspended Solids (TSS) Discharge	Dates of data used
Belleville STP #1, City of	IL0021873	29 mg/L	31-JAN-2003 - 31-7-2014
Belleville, City of	ILL021881	no data	
Caseyville Township East STP	IL0079499	114 lb/d	30-APR-2009 - 31-JAN-2017 (data extends to 31-Aug-2000)
Freeburg West STP, Village of	IL0032310	34 lb/d	28-FEB-2009 - 31-JAN-2017 (data extends to 3-Oct-1999)
I-DOT I-64 Gateway Rest Area - St. Clair County	ILG551089	0.5 lb/d	31-DEC-2008 - 31-JAN-2017 (data extends to 31-Mar-2005)
Lebanon STP, City of	IL0029483	5.3 lb/d	31-MAY-2012 - 28-FEB-2017 (data extends to 30-SEP-1999)
St. Clair County Health Department	ILG870089	no data	
Surface Discharging System 63	ILG620063	no data	
Surface Discharging System 70	ILG620070	33 mg/L	31-JUL-2016 - 31-JAN-2017

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. NPDES outfall locations are available to download from Illinois’ RMMS. There are 15 outfalls within the watershed from 10 facilities (Table A.62, Figure A.44).

Table A.62. NPDES outfalls in the Lower Silver Creek watershed

HUC14	Facility name	NPID	Description(s)
07140204050701	CASEYVILLE TOWNSHIP EAST STP	IL0021083	STP OUTFALL; EXCESS FLOW (OVER 5.06 MDG)
07140204050801	CENTER POINT ENERGY-ST JACOB	IL0067695	COMPRESSOR BLDG; SW
07140204050905	CLANAHAN TRAILER PARK	IL0052256	STP OUTFALL
07140204051204	FREEBURG EAST STP	IL0020753	STP OUTFALL
07140204050805	LEBANON STP	IL0029483	STP OUTFALL
07140204051201	MASCOUTAH STP	IL0025291	STP OUTFALL
07140204050905	O'FALLON STP	IL0021636	STP OUTFALL
07140204051001	SCOTT AIR FORCE BASE	IL0026859	GOLF COURSE POND; SCOTT LAKE II; 0010 STP OUTFALL; EXCESS FLOW (FORMALLY 001A)
07140204051101	ST. CLAIR TWP	IL0048232	STP OUTFALL; EXCESS FLOW OUTFALL
07140204050804	SUMMERFIELD STP	IL0064220	STP OUTFALL (FORMERLY 0011)

NPDES-permitted outfall locations

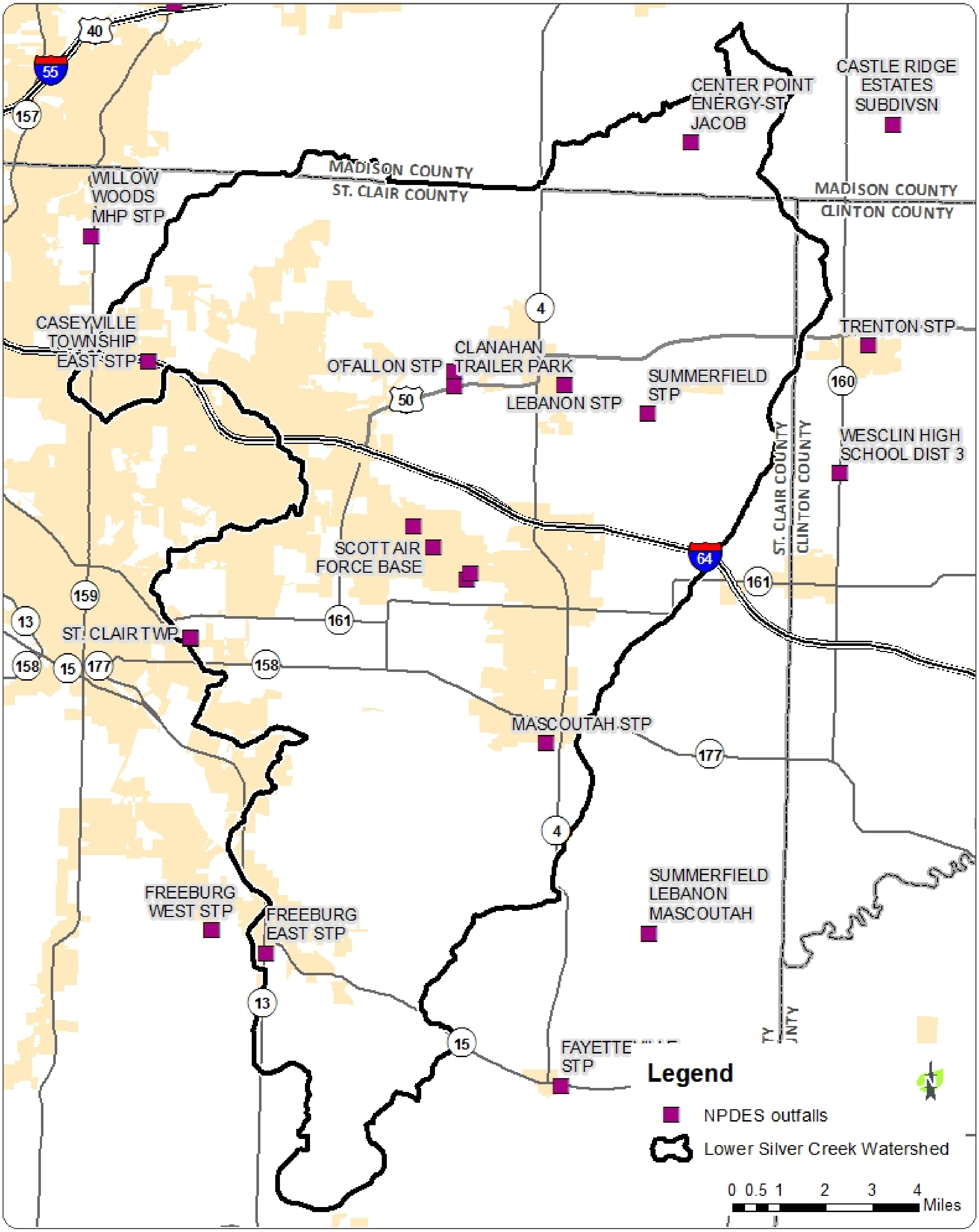

Figure A.44. NPDES outfall locations in the watershed.

Pollutant Loading Analysis

Estimating Pollutant Loads by Source

Nutrient (total nitrogen and total phosphorus) and sediment loads (sheet and rill erosion) for the Lower Silver Creek watershed were calculated using the Spreadsheet Tool for Estimating Pollutant Loads (STEPL), a tool developed by the USEPA.[74] STEPL employs simple algorithms to calculate nitrogen, phosphorus, and sediment loads from different land uses.

Inputs for the STEPL model include county and weather data, land cover, agricultural animal populations, manure applications, and septic systems information. Weather data was acquired from the Southern Illinois University Experimental Station (38°31"06.14", -89°50'26.59"). County level agricultural statistics were obtained from the USDA National Agricultural Statistics Service (NASS). [75] Septic system information was derived from the National Land Cover data set and it was assumed that 2% of the systems were failing. Streambank erosion was calculated using the STEPL model using a conservative lateral recession rate of 0.03 ft/year and a bank height of 6 feet. The length of actively eroding streambank was based on scientific literature values and was estimated at 25% of the total streambank length.

The STEPL model for the watershed calculated nutrient loads for each of the primary land uses as used in the NLCD (Table A.63). Cropland was by far the greatest source of nutrients and sediment in the watershed. Cultivated cropland accounts for 53% of the total land cover in the watershed and contributes 65% of the nitrogen load, 74% of the phosphorus load, and 37% of the sediment load. Hay and pastureland covers 10% of the land surface in the watershed but tends to contribute smaller amounts of nutrients and sediments due to protection of the soil surface by a permanent vegetative cover.

Table A.63. Estimated current annual pollutant load by source at the watershed scale.

Sources	N Load		P Load		Sediment Load	
	(lb/yr)	(%)	(lb/yr)	(%)	(t/yr)	(%)
Urban	150,515	19%	23,164	14%	3,456	5%
Cropland	507,565	65%	123,492	74%	23,639	37%
Pastureland	66,566	9%	5,885	4%	900	1%
Forest	2,366	0%	1,159	1%	64	0%
Feedlots	33,450	4%	6,578	4%	0	0%
Wetlands	7,885	1%	3,217	2%	1,971	3%
Septic	632	0%	248	0%	0	0%
Gully	0	0%	0	0%	0	0%
Streambank	6,681	1%	2,572	2%	34,453	53%
Groundwater	0	0%	0	0%	0	0%
Total	775,661	100%	166,316	100%	64,483	100%

Forest covers 11% of the watershed but contributes less than 1% of the nitrogen, phosphorus, and sediment loads. Developed urban areas cover 21% of the watershed and contribute 19% of the nitrogen load, 14% of the phosphorus load, and 5% 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 a significantly large contributor of sediment (53%) in the watershed.

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 HUC14 subwatershed (Table A.64, Figures A.45, A.46, A.47).

Table A.64. Annual pollutant loads by subwatershed, and area of cropland in acres.

HUC14	**Total Area**	**Cropland**	**N Load**		**P Load**		**Sediment Load**	
	(acres)	(acres)	(lb/yr)	(lb/acre/yr)	(lb/yr)	(lb/acre/yr)	(ton/yr)	(ton/acre/yr)
07140204050701	6,611	2,553	38,495	5.82	7,627	1.15	5,886	0.89
07140204050702	3,745	1,008	17,518	4.68	3,438	0.92	2,051	0.55
07140204050801	5,685	4,636	43,165	7.59	9,860	1.73	2,969	0.51
07140204050802	5,765	4,776	44,174	7.66	10,135	1.76	2,774	0.48
07140204050803	8,253	6,723	61,373	7.44	14,109	1.71	3,688	0.45
07140204050804	3,437	1,947	24,791	7.21	5,222	1.52	1,810	0.53
07140204050805	8,437	6,710	62,319	7.39	14,291	1.69	4,907	0.58
07140204050903	3,323	462	6,352	1.91	1,281	0.39	469	0.14
07140204050904	7,434	1,028	40,419	5.44	6,861	0.92	2,983	0.40
07140204050905	10,664	5,519	59,516	5.58	13,101	1.23	4,884	0.46
07140204051001	4,249	1,181	21,324	5.02	4,240	1.00	2,012	0.47
07140204051002	5,467	3,802	39,838	7.29	8,941	1.64	3,063	0.56
07140204051003	7,061	3,701	43,335	6.14	9,840	1.39	3,906	0.55
07140204051101	6,446	2,700	39,883	6.19	7,936	1.23	2,170	0.34
07140204051102	3,463	1,391	21,725	6.27	4,333	1.25	1,015	0.29
07140204051103	3,932	1,650	21,620	5.50	4,481	1.14	2,485	0.63
07140204051104	7,662	4,022	44,788	5.85	9,802	1.28	5,475	0.71
07140204051201	7,061	5,122	52,222	7.40	11,706	1.66	4,026	0.57
07140204051202	2,881	1,453	16,497	5.73	3,893	1.35	1,637	0.57
07140204051203	4,673	1,385	22,601	4.84	4,327	0.93	1,770	0.38
07140204051204	5,416	1,161	21,532	3.98	4,002	0.74	1,281	0.24
07140204051205	6,602	2,801	32,175	4.87	6,889	1.04	3,224	0.49
Total	128,267	65,731	775,661		166,316		64,484	

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.64. This does not indicate that other nutrient and sediment sources are unimportant, but rather that the amounts contributed by non-crop land sources in the watershed are relatively small in comparison.

The largest HUC14, 07140204050905, has the greatest nitrogen loading (59,516 lb/year) and the greatest phosphorus loading (13,101 lb/year). The 071402050701 HUC14 has the most sediment loading (5,886 tons/year), and also the highest sediment load when adjusted for area (0.89 tons per acre per year). When adjusted for area, HUC 07140204050802 produces the most nitrogen per acre per year (7.66 lb/acre/year) and the most phosphorus per acre per year (1.76 lb/acre/year).

N load (modeled in STEPL)

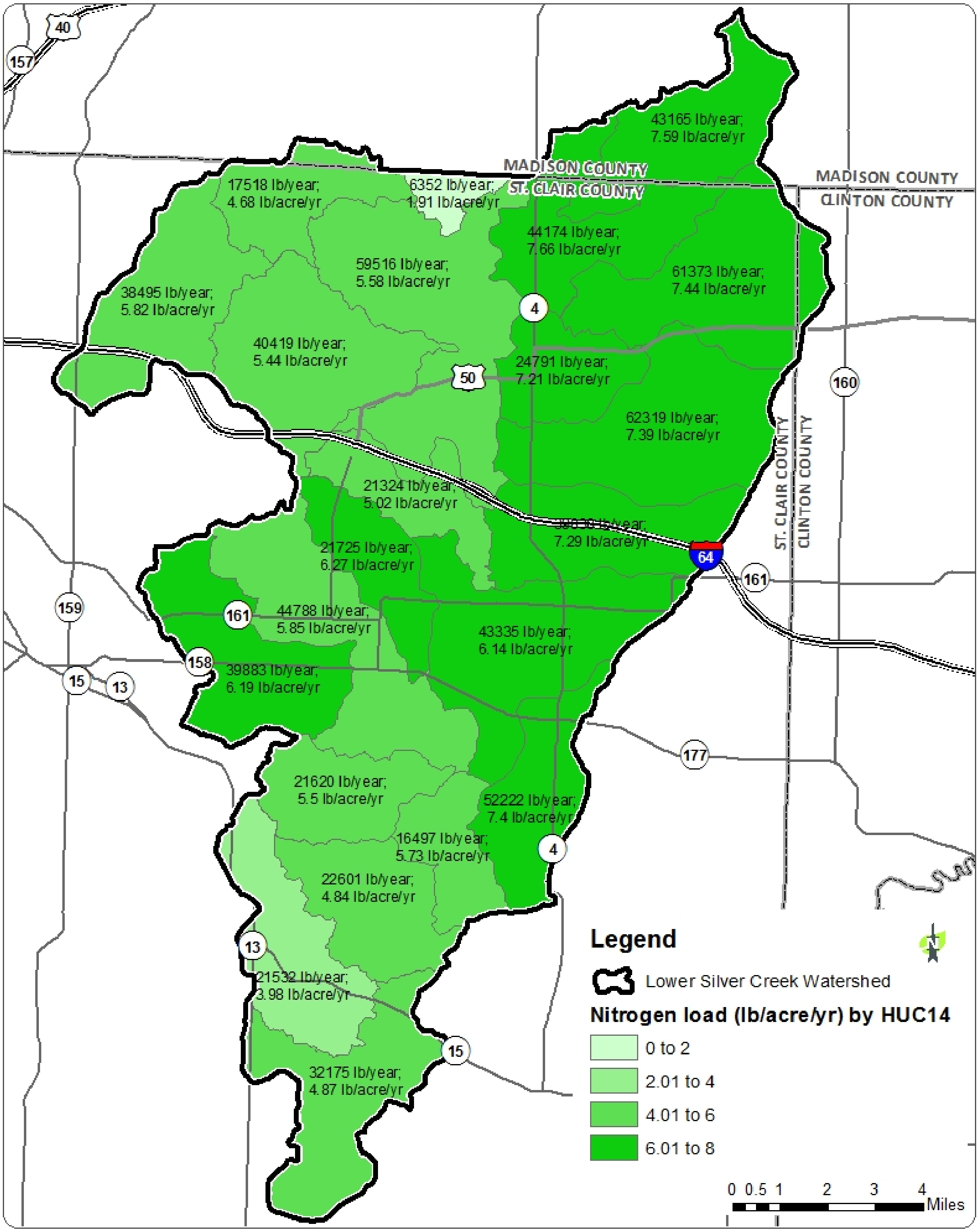

Figure A.45. Nitrogen loads by HUC 14 in the Lower Silver Creek watershed, as modeled using STEPL.

P load (modeled in STEPL)

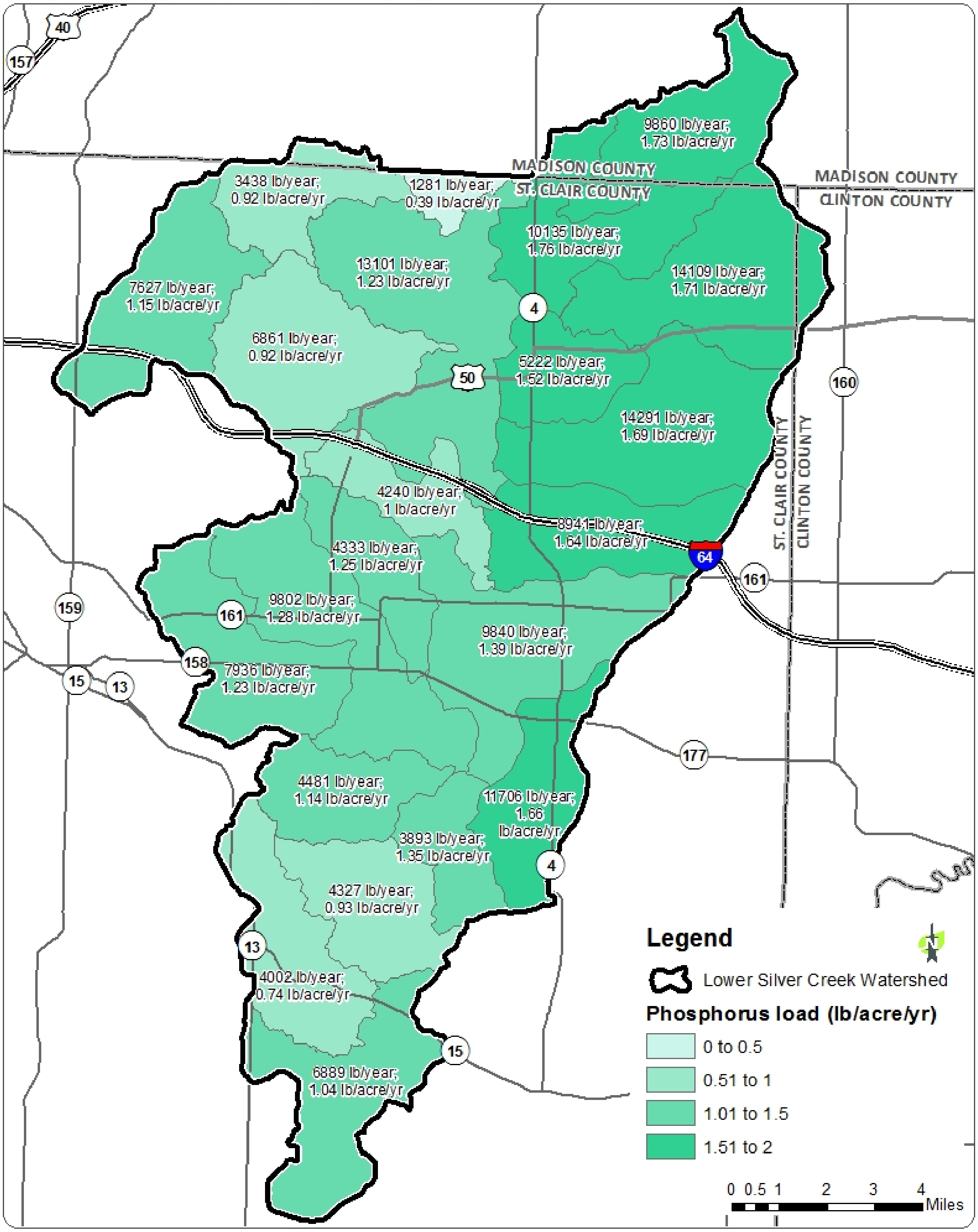

Figure A.46. Phosphorus loads by HUC14 in the watershed, as modeled using STEPL.

Sediment load (modeled in STEPL)

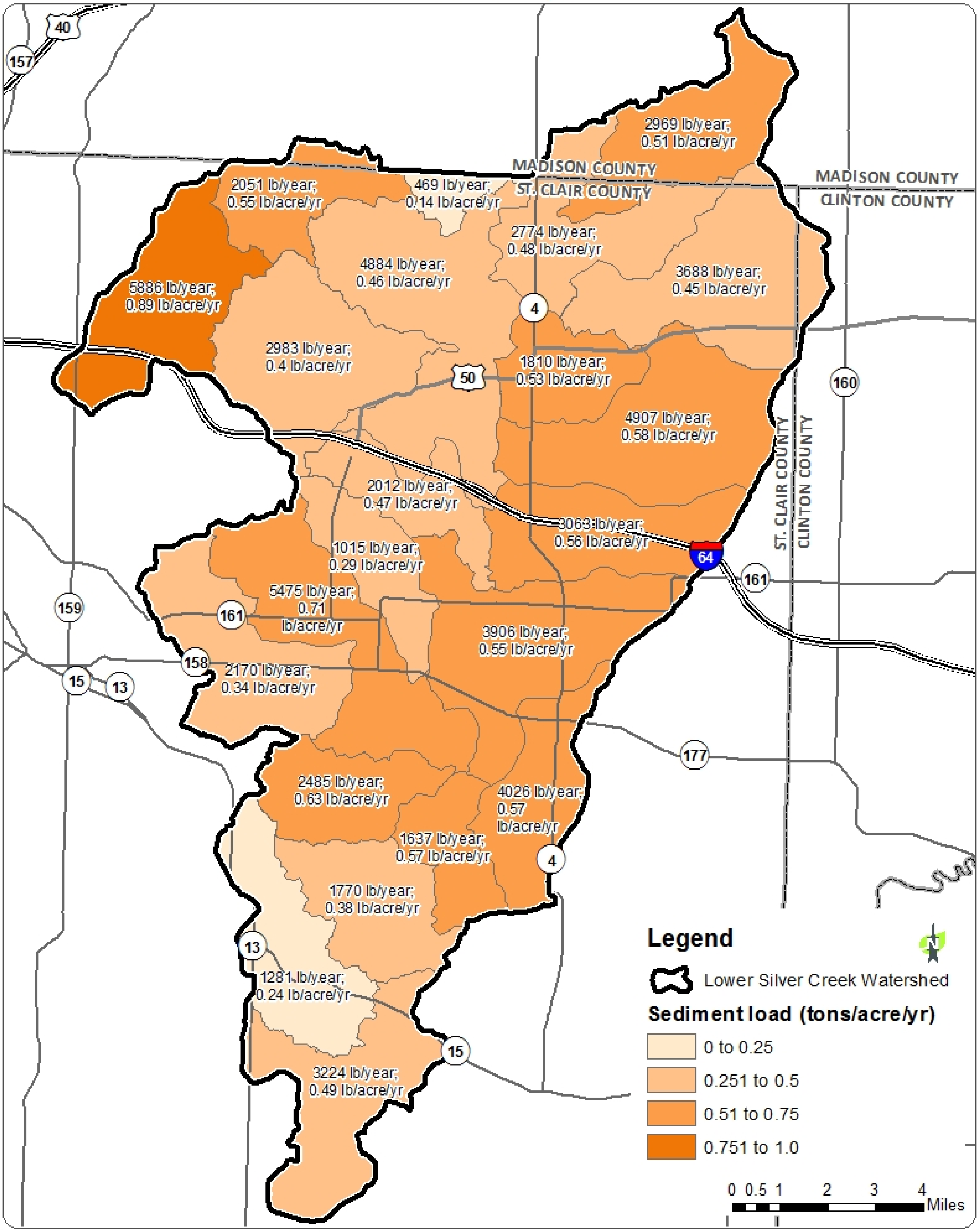

Figure A.47. Sediment loads by HUC14 in the watershed, as modeled using STEPL.

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 lays 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.

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.

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.

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. 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.

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).

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.

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APPENDIX B – 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 B.1 shows the user-defined or modifiable values used for this assessment.

Table B.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.

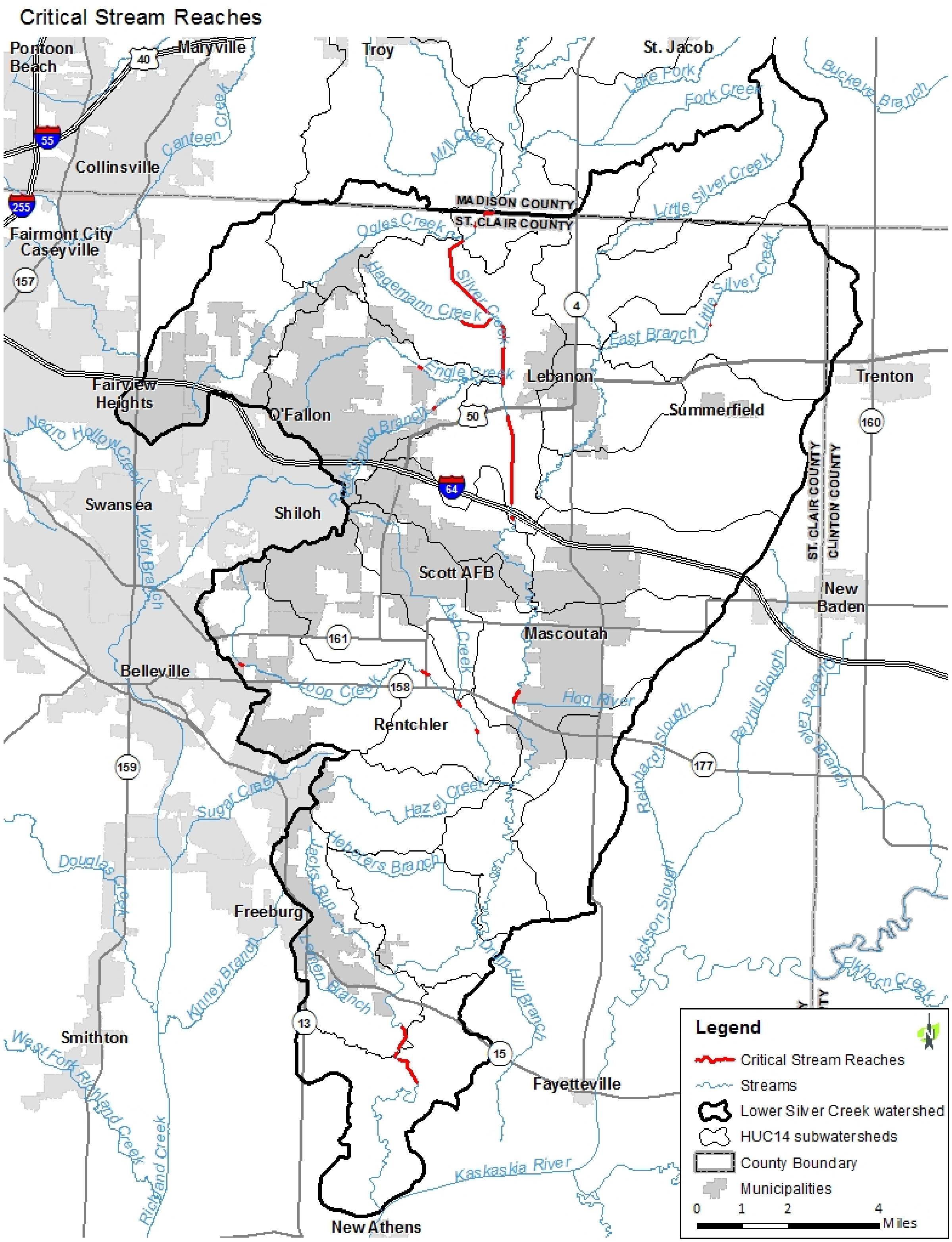
The ACPF is focused on reducing runoff and preventing nutrient pollution from farmlands. It focuses on the value of wetlands as nutrient sinks and for flood control (as compared with the MoRAP assessment which considers wetland value as potential for restoration. Together, the ACPF and the MoRAP wetlands mitigation importance values will overlap in several places, showing wetlands of extremely high restoration and protection importance.

The following table (Table B.2) and maps show the ACPF results for several Best Management Practices.

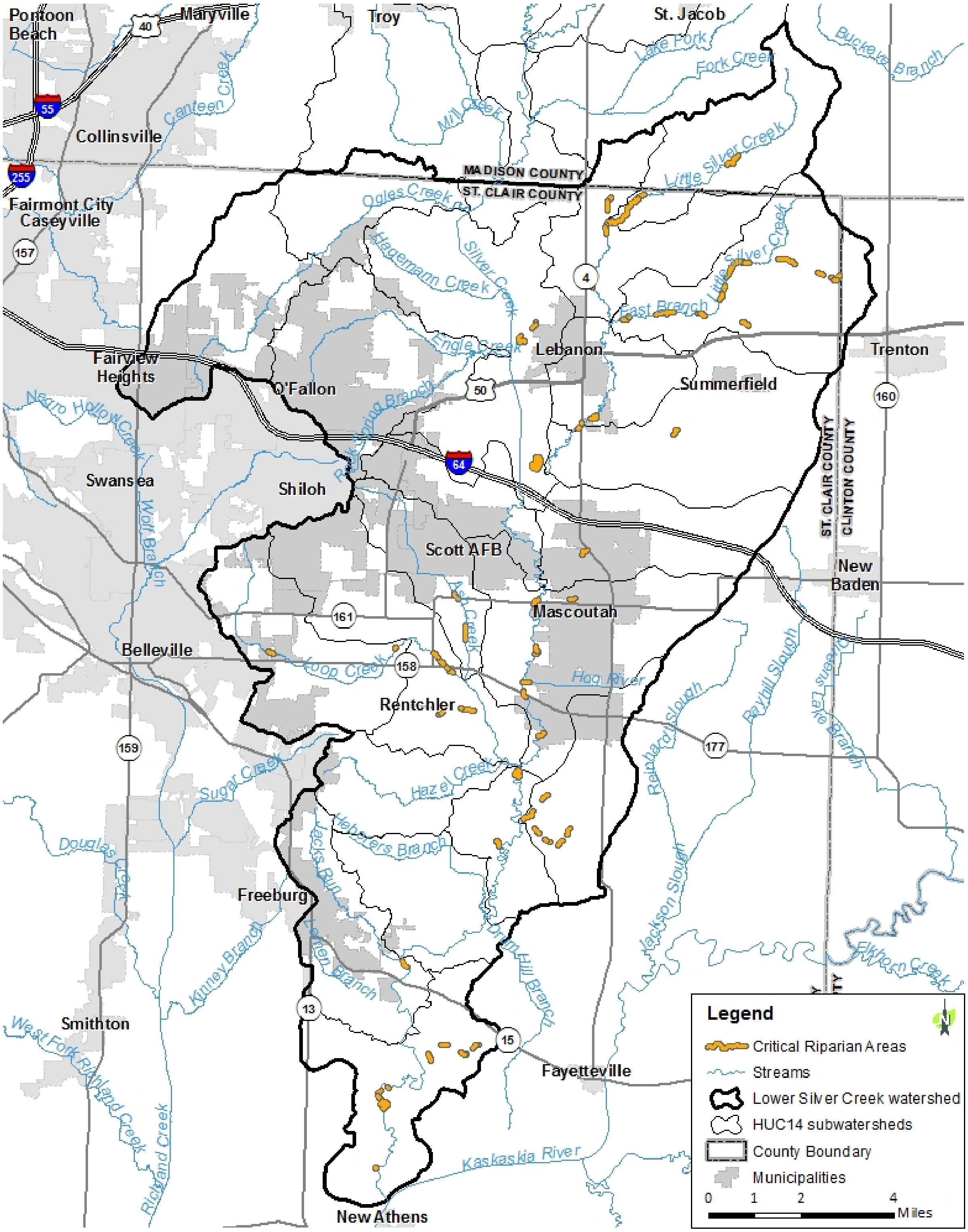
Table B.2. Summary data for the ACPF results by HUC12.

ACPF results	HUC12						TOTAL
	071402040507	071402040508	071402040509	071402040510	071402040511	071402040512	
# bioreactors	6	114	35	70	39	59	323
Total area bioreactors (sq m)	5736	113429	32230	60848	35764	53692	301698
# contour buffer strips	203	464	782	89	277	386	2201
Total area contour buffer strips (sq meters)	170758	452954	752605	79645	242285	351640	2049887
Grass waterways total length (m)	70118	822850	443237	312452	104546	218819	1972022
# drainage management polygons	7	219	67	126	48	110	577
Area drainage management fields (sq meters)	461	22324	8189	10832	4647	6856	53309
# nutrient removal wetlands	1	18	14	0	9	4	46
Nutrient removal wetlands area (wetland & buffers) (sq meters)	462	22342	8203	0	4656	6860	42523
Wetland area only (sq meters)	12941	334133	199363	0	109137	54181	709755
Area draining to nutrient removal wetlands (sq meters)	727000	23258300	18069948	0	8068028	3916480	54039756
Riparian area: # Critical Zone segments (CZ)		12	3	8	13	16	52
Riparian area: # Multi Species Buffer (MSB)	4	70	18	38	40	32	202
Riparian area: # Stiff Stemmed Grasses (SSG)	58	85	174	51	73	76	517
Riparian area: # Deep Rooted Vegetation (DRV)	12	126	152	177	116	147	730
Riparian area: # Stream Bank Stabilization (SBS)	200	237	532	155	192	313	1629
# WASCOBs	74	194	329	46	97	112	852
Area WASCOB basins when filled (sq meters)	245712	586496	790756	155741	253560	329301	2361565

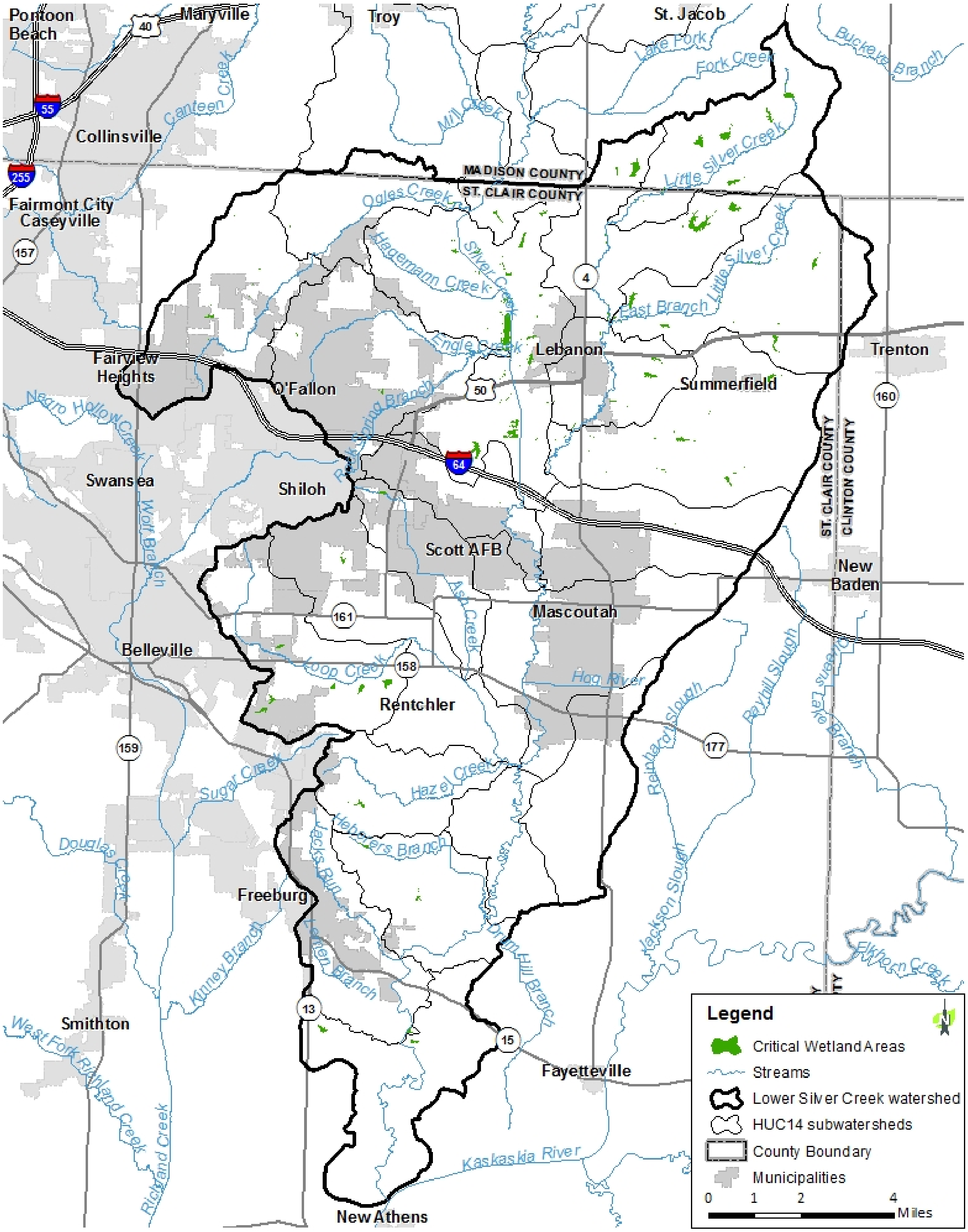
Critical Areas Maps – watershed-wide



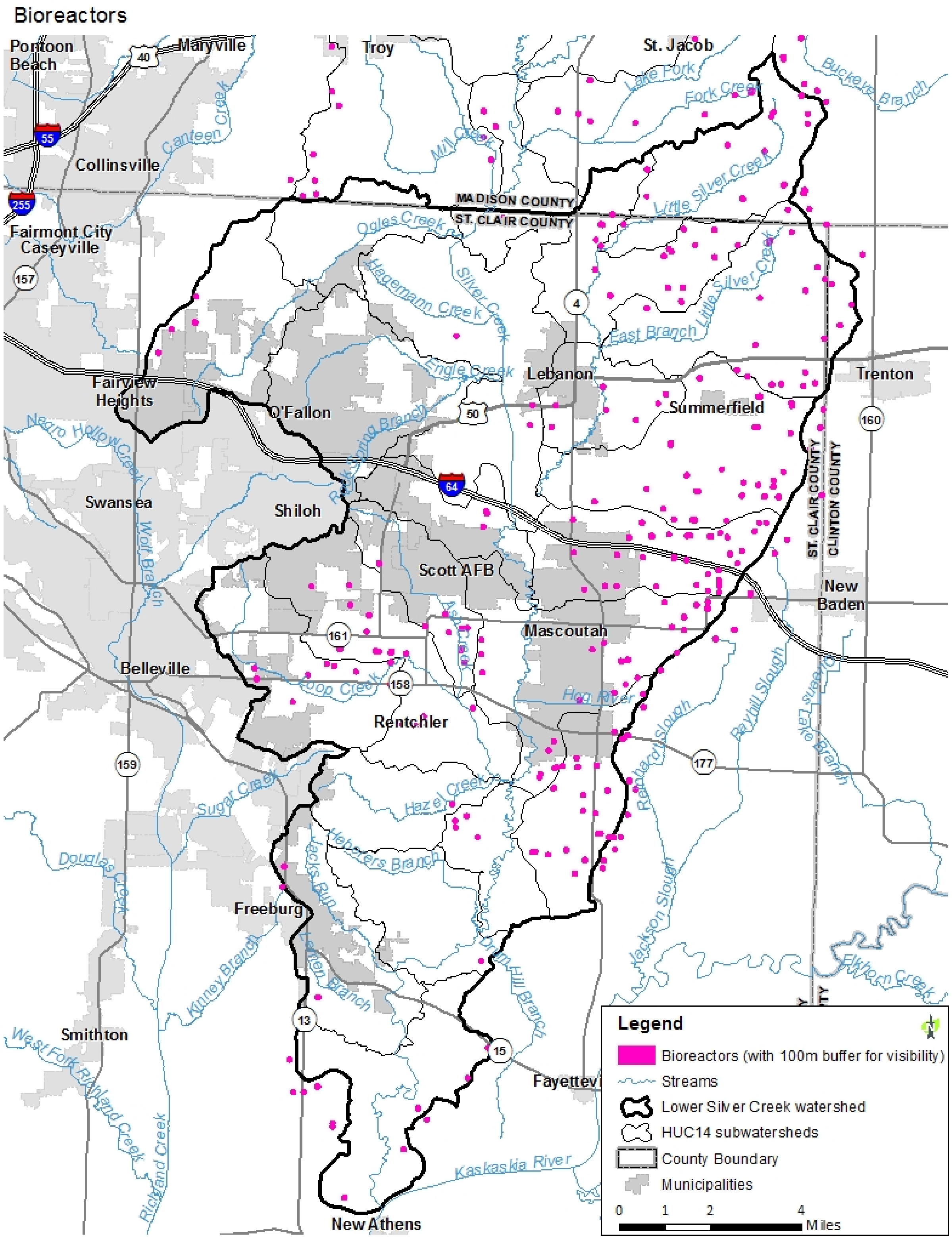
Critical Riparian Areas



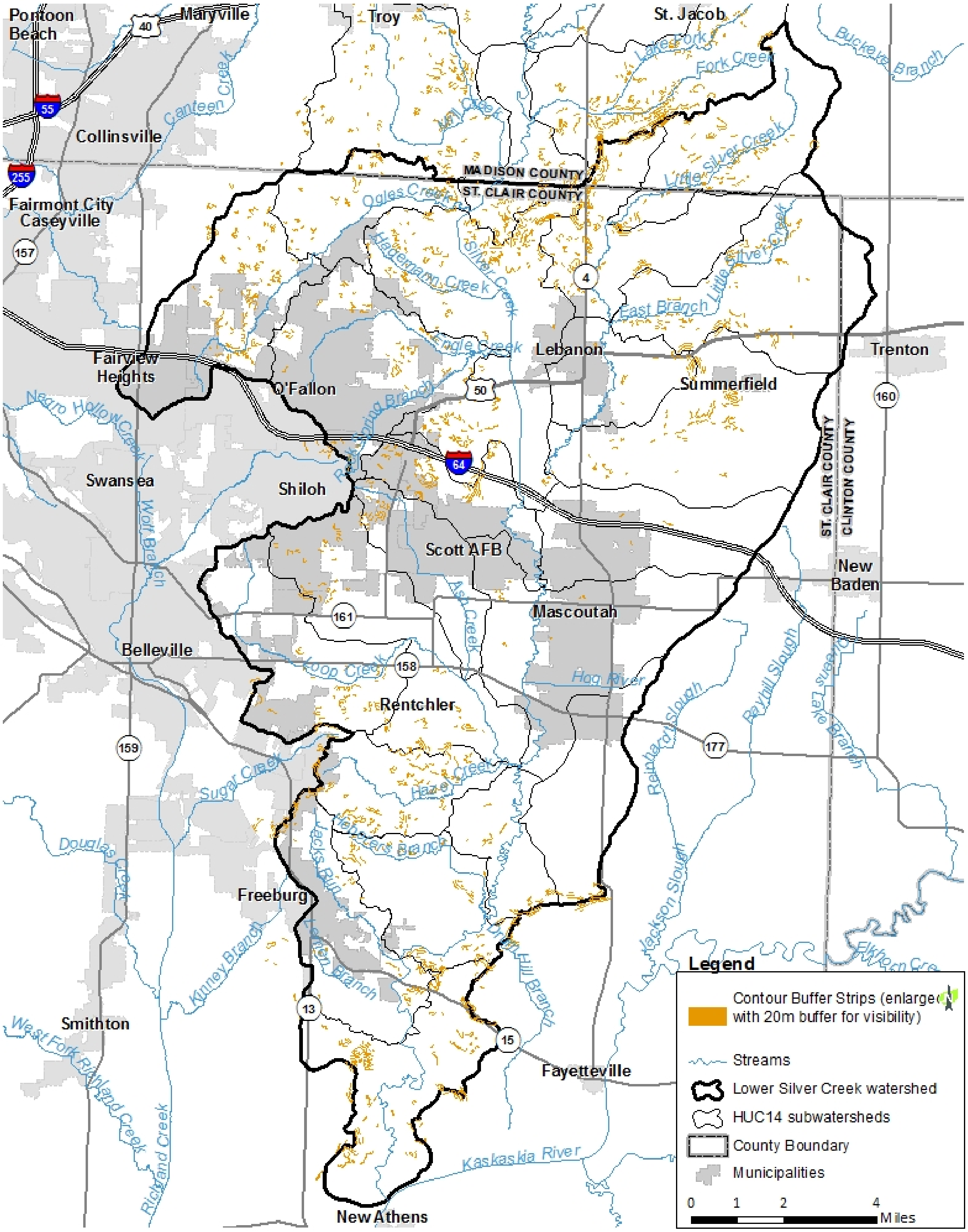
Critical Wetland Areas



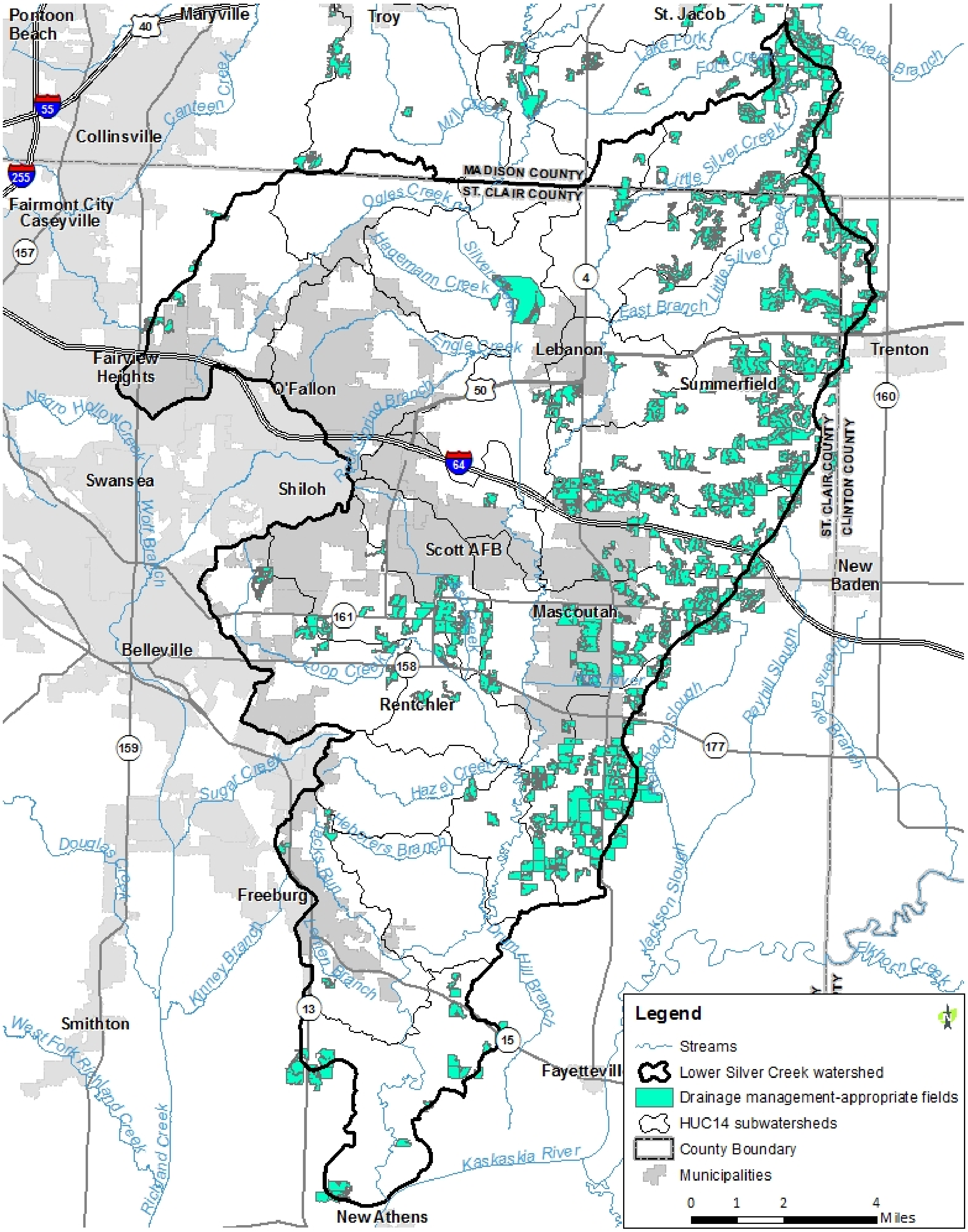
Agriculture Conservation Planning Framework (ACPF) output maps – BMPs



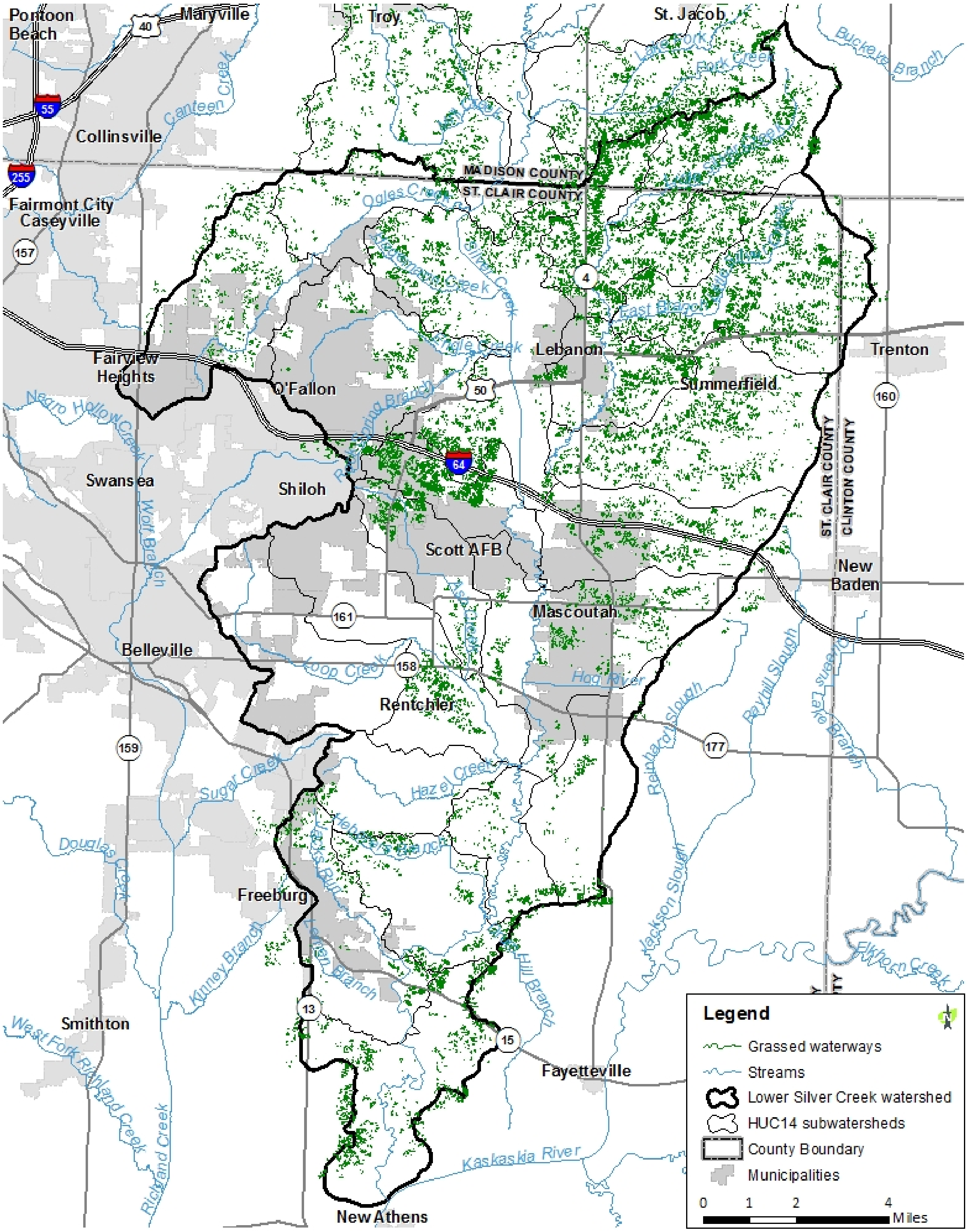
Contour Buffer Strips



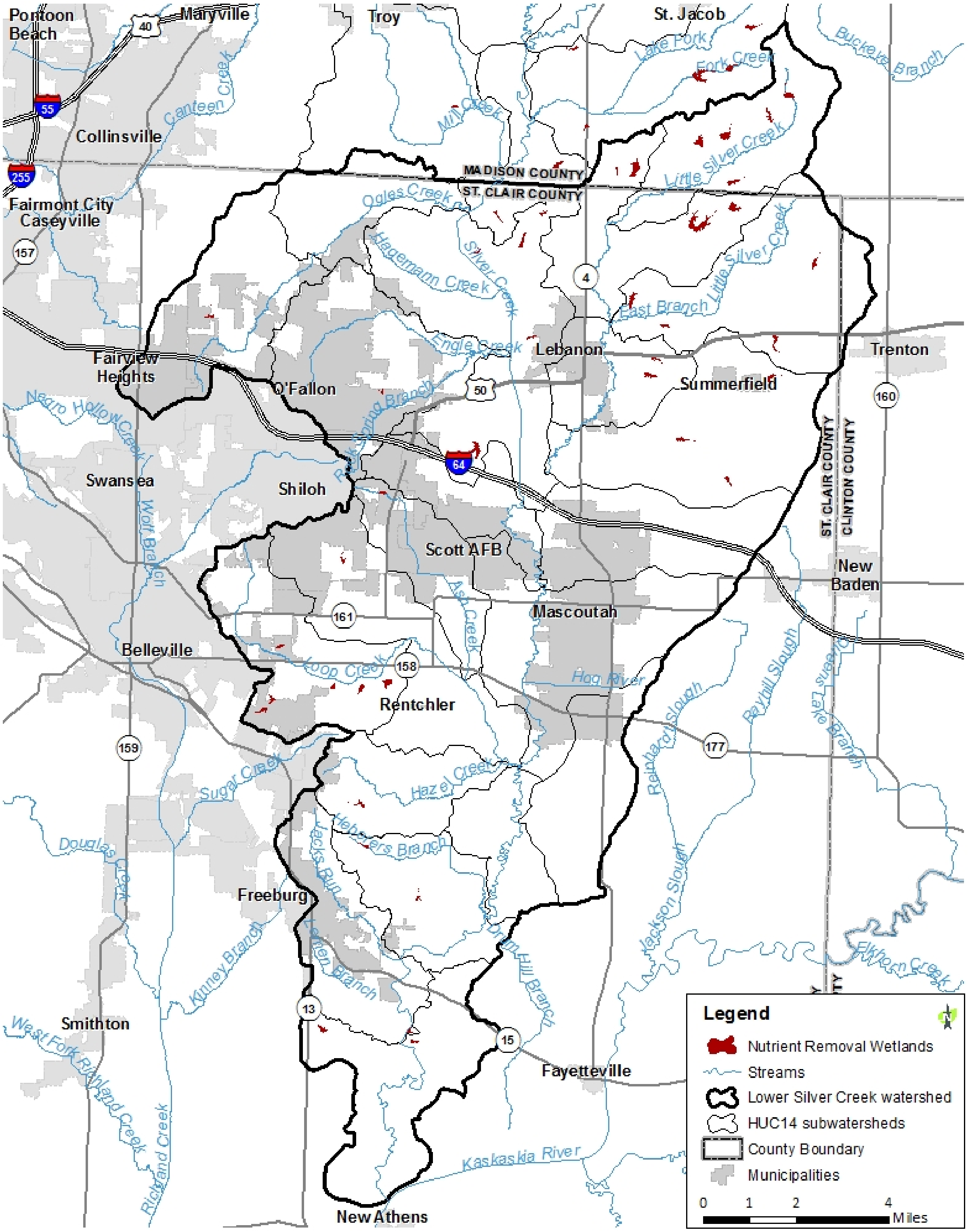
Drainage Management fields



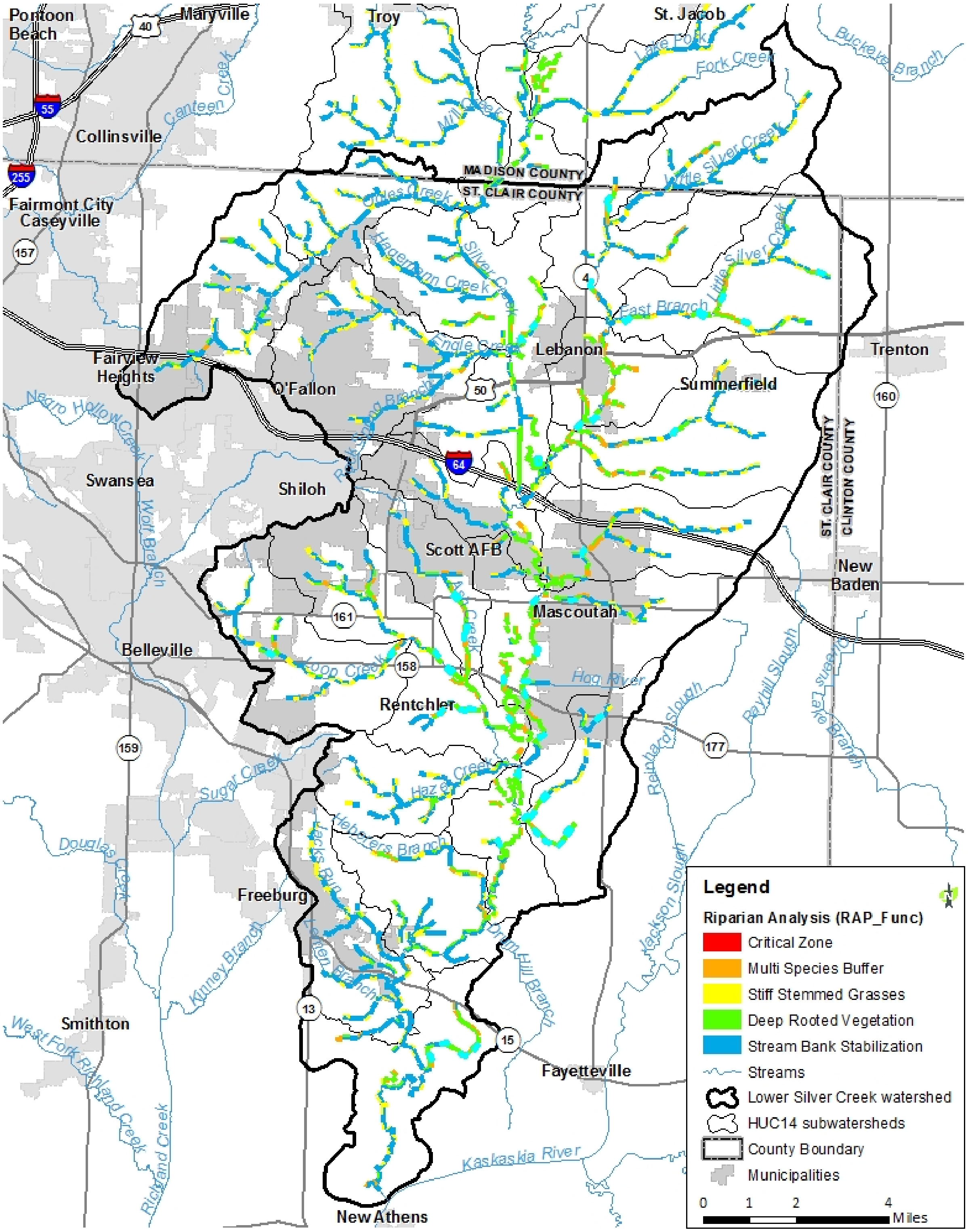
Grassed waterways



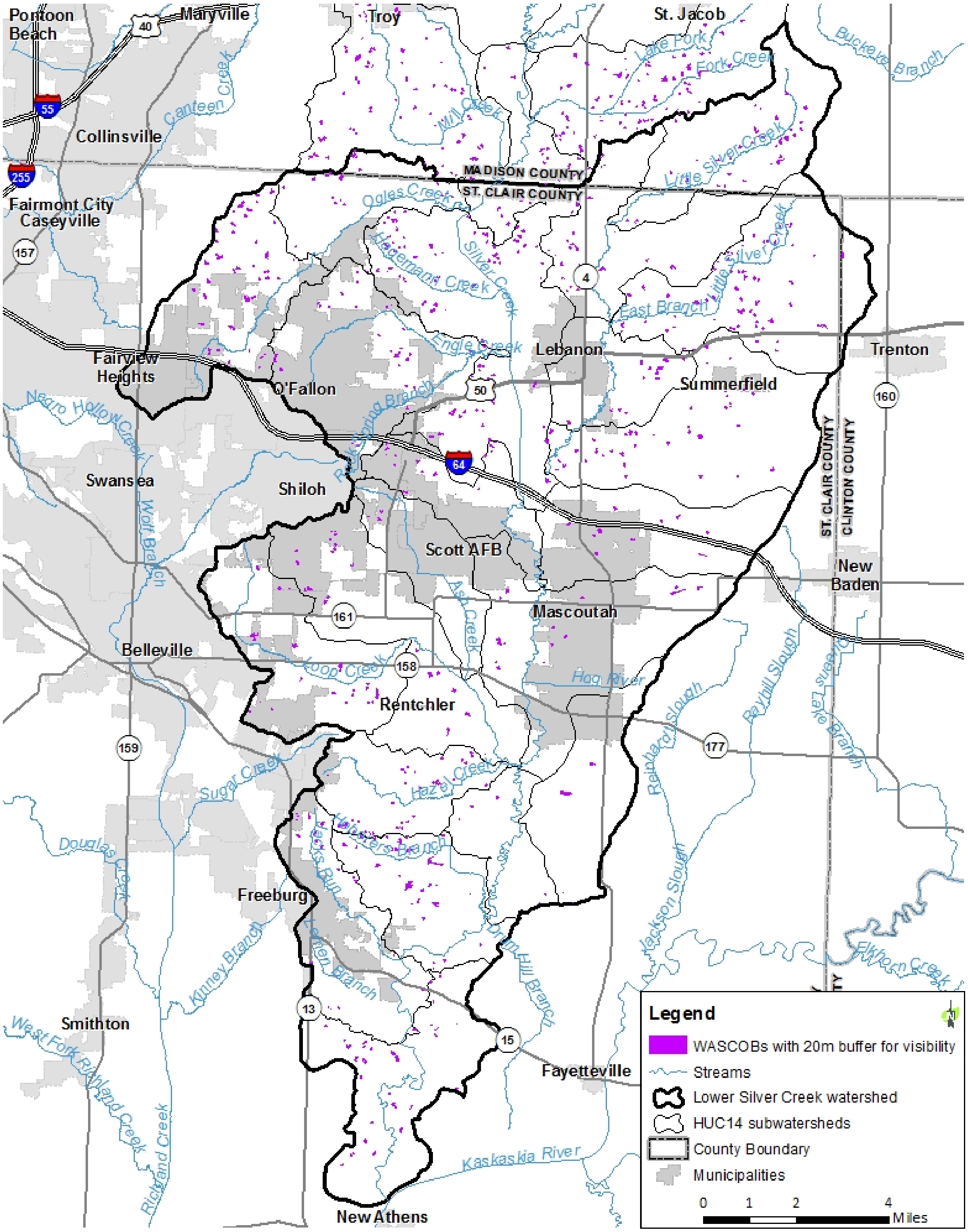
Nutrient Removal Wetlands



Riparian Function Analysis



Water and Sediment Control Basins (WASCOBs)



APPENDIX C – 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 and 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 C.1. The costs were adjusted for inflation to 2018 dollars using the conversion rates given in Table C.2 from www.usinflationcalculator.com.

Table C.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)	$158	/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)	$55	/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	$59	/acre	2017 Andreas Consulting, professional estimate	
Contour buffer strips	$175	/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	$31	/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)	$14	/acre	2017 Andreas Consulting, professional estimate	
Ponds	$15,270	/acre	2017 Andreas Consulting, professional estimate	
Riparian buffers	$53	/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
Terrace	$3.36	/linear foot	2017 Andreas Consulting, professional estimate	
Water and sediment control basin (WASCOB)	$366	/acre	2017 Andreas Consulting, professional estimate	
Wetlands	$13,163	/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	/acre	2017 Andreas Consulting, professional estimate	
Bioswales	$18	/sq ft	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

Table C.1., continued

Dry detention basins, new	$43,805	/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	/acre	2015 USEPA BMPs webpage, no longer available	http://water.epa.gov/polwaste/npdes/swbmp/Wet-Ponds.cfm
Detention basin retrofits (native vegetation buffers, etc.)	$15,237	/acre	2014 Long Run Creek Watershed-Based Plan, Table 41	http://www.lowerdesplaines.org/docs/LRC%20Report.pdf
Detention basin maintenance (dredging, mowing, burning, invasives, etc.)	$992	/acre	2014 Long Run Creek Watershed-Based Plan, Table 42	http://www.lowerdesplaines.org/docs/LRC%20Report.pdf
Pervious pavement	$100,558	/acre	2002, LID Stormwater Center, seen in Lower Meramec Watershed Plan, Table 21	https://www.ewgateway.org/community-planning/environmental/water-resources/lower-meramec-watershed-plan/
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	$237	per barrel/small cistern	2015, Low Impact Development Urban Design Tools website	https://www.lid-stormwater.net/
Single property flood reduction strategies	$2,000	per property	2015 Approximately, based on 2015 Illinois Urban Flooding Awareness Act report	https://www.dnr.illinois.gov/waterresources/documents/final_ufaa_report.pdf
Storm drain system cleaning and expansion	$81	/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)	$81	/linear foot	2010 Center for Neighborhood Technology mid value estimate PER TREE MULTIPLIED BY 114 sq ft/tree at 10 years old (from CWP report)	http://greenvalues.cnt.org/national/cost_detail.php https://www.chesapeakebay.net/documents/Urban_Tree_Canopy_EP_Report_WQGIT_approved_final.pdf
Logjam removal	$31	/linear foot	2016 Midwest Streams, professional estimate	
Shoreline stabilization	$83	/foot	2017 Andreas Consulting, professional estimate	
Streambank & channel restoration	$78	/linear foot	Midwest Streams, professional estimate	

Table C.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%
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 the Federal Emergency Management Agency (FEMA) 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 fifty percent (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 2 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 floodproofed 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.

Long-term management of natural areas

Conservation Development promotes the protection of sensitive natural areas and open space in new development, as well as incorporating green infrastructure into stormwater systems. In "traditional" development, too, there is often a piece of land set aside for a detention basin. Once set aside, this land can sometimes lose its ecosystem functions (such as water filtration, recreational value, and floodwater holding capacity) due to lack of maintenance.

Developers should be encouraged to donate those natural areas and systems to a public agency or conservation organization for long-term management. Donation can be by either fee simple purchase of undeveloped land, or by acquisition of the development rights and establishing a conservation easement. If a local government takes on ownership or maintenance of the land, it can choose to fund it through mechanisms such as Development Impact Fees and Special Service Area (SSA) taxes.

Alternatively, Homeowners Associations (HOAs) can explicitly take on the management of the natural areas, writing rules about maintenance and fees into their byelaws. The members of the HOA will then share in the costs and decisions about maintenance of the natural area. For detention basins, 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 a new subdivision is 90% complete. From then on, the HOA has a maintenance responsibility for the detention basin. (See "Detention basins")

Monitoring

Appendix D - Monitoring Plan outlines an appropriate strategy for water quality monitoring in the watershed.

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 ¼ to ½ 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 supported and integrated into community plans

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.

Wetland mitigation banking/In-lieu fee mitigation

A wetland mitigation bank or in-lieu fee 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 U.S. EPA Water Quality Scorecard recommends compensation for damage to riparian/wetland areas to be on a minimum 2:1 basis on- or off-site.

Hydrologic/Flood Study

The most recent FEMA Flood Insurance Study in St. Clair County was completed in 2003. Since then, significant development has occurred in the watershed, resulting in increased runoff and a more complex stormwater drainage network. Increased runoff usually comes with increased flood heights. In an effort to reduce impacts from flooding, the Lower Silver Creek watershed would greatly benefit from an updated hydrologic study and updated floodplain maps. As significant flooding has been noted outside of mapped floodplains, it is reasonable to assume that some of that flooding is from outdated maps which no longer properly represent the one percent annual chance exceedance floodplain.

Prior to updating of floodplain maps, a survey of large stormwater conveyance paths would greatly assist in properly identifying areas prone to flooding. Included in such a survey should be flow paths such as ditching and subsurface culverts as well as their condition. Over time these pathways tend to get consumed with sediment and debris which can greatly impact their conveyance potential. In the case of subsurface culverts, these can also become deformed overtime which makes them less effective.

Once the updated floodplain has been properly identified, a follow up step to help with flood risk reduction and awareness would be identifying critical facilities (e.g., fire stations, police stations, schools, hospitals) and infrastructure that are in the flood plain. Anticipating flood effects at these locations can greatly assist in future efforts to reduce flood risks and decrease response time for first responders in the event of a flood. FEMA also collects data on repetitive loss structures in areas insured with federal flood policies. Awareness of these structures by local officials can assist in buyout grant proposals and reduced flood risk to not only the property owner, but the community as a whole.

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 US 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 web page for more information about how this can be achieved.[4] No-till can also increase the need for pesticide use, at least at first. This must be taken into account in management activities.

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—consisting of adapted species of grasses or a mixture of grasses and legumes—slowly 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.[5]

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 page for more information on terraces.[6]

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 U.S. EPA'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 Upper Silver 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 Upper Silver 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 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.

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. There are at least 65 detention basins in the Upper Silver Creek watershed and most are associated with residential and commercial development (such as subdivisions and business parks). Many of the existing basins are wet bottom basins, which 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.

Ponds

Ponds are constructed basins with a permanent wet pool. Sediments settle out and nutrient uptake can occur with an active microbial community and healthy emergent and submerged aquatic vegetation. Widely used as a stormwater BMP, they can also have be stocked with fish and used for recreation. Ponds should be located at the outflow of a small drainage area in areas that are not highly urbanized. They may be used in conjunction with other measures such as erosion control, flood control or baseflow.

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 C.3 is taken from this report, and shows these causes, along with mitigation options and their costs.

Table C.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.

Mitigation Options	Cause of Flooding			Damage reduction	Estimated Cost
	Overland	Infiltration	Sewer backup		
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					

Storm drain system cleaning 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 2011 St. Clair County Multi-Hazard Mitigation Plan identified storm drain system improvement projects. 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 (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.[7]

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.[8] More general pollutant reduction efficiencies were calculated or cited by the Chesapeake Bay Program[9] and the Pigeon Creek Watershed Plan.[10]

Stream and Lake Management Measures

Logjams

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. The water is oxygenated as it mixes and cascades 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[11].

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.

[1] St. Clair County , County Code of Ordinances, Stormwater Control Code (PDF), available at http://www.co.st-clair.il.us/government/Pages/Ordinances.aspx

[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]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

[5]Natural Resources Conservation Service, Cover Crops and Soil Health, available at http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/climatechange/?cid=stelprdb1077238

[6] Rolland Z. Wheaton and Edwin, J. Monke, Agricultural Engineering Department, Purdue University, April 2001, Terracing as a 'Best Management Practice' for Controlling Erosion and Protecting Water Quality, available at https://www.extension.purdue.edu/extmedia/ae/ae-114.html

[7]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

[8]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/

[9]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

[10]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

[11]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 D – MONITORING PLAN

This monitoring plan for the Lower Silver 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 USGS gage 05594800 located on the main stem of Silver Creek at Illinois Route 15 southeast of Freeburg will provide a broad assessment of the effect of land management practices throughout 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 same location during several periods from 1974 to 2016.

In addition to continuous monitoring at the U.S. Geological Survey (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 05594800 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 3-5 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 1 L 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 05594800 continuously monitors stream depth (ft) and discharge (ft^3/min), and records that information at 15-minute intervals. The drainage area for discharge at this location is 464 square miles and includes the East Fork Silver Creek watershed and the entire Silver Creek watershed except for the area associated with the five-mile stream segment between the USGS gage and its confluence with the Kaskaskia River. 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 Lower Silver Creek watershed. There are 8 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 D.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 05564800 near Freeburg, Illinois.

Table D.1. Timeline for water quality monitoring in the Lower Silver 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 E - 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 E.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 Upper Silver Creek watershed is one of IEPA's High Priority Watersheds for funding the implementation of BMPs in FY2016.

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 E.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 E.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 E.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 E.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 E.1.)

The following table shows Illinois EMA and DCEO funding sources with their associated program outputs, participation requirements, and funding limits (Table E.1.).

Table E.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 E.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. Department of Defense (DOD)

The DOD **Readiness and Environmental Protection Integration (REPI) Program** protects the military's mission by removing or avoiding land use conflicts near installations and addressing regulatory restrictions that inhibit military activities. One goal of the REPI Program is to conserve land near military bases—including working land (e.g., farms, forests), wildlife habitat, water resources, natural spaces, and threatened and endangered species—with the intent of sustaining critical military mission capabilities. This is achieved through cost-sharing agreements between the Military Services and private conservation organizations or state and local governments. The program is administered through the Office of the Secretary of Defense (OSD), which evaluates potential projects based on the priority of the mission being protected, the benefits to the community and environment, and whether the project will strengthen partner cost-sharing.

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. In the Upper Silver Creek watershed, at least 44 parcels in the floodplain are already enrolled in the CRP, as of 2013. 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 10-15 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 5-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). The Upper Silver Creek watershed is within the Mississippi River CCA.

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 third party compensatory mitigation agreement with the U.S. Army Corps of Engineers that can be used to offset unavoidable impacts to streams and/or 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. Mitigation sites will include both wetlands and streams, so fees will go towards both wetland and stream restoration.

Table E.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 E.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 E.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 Defense	Readiness and Environmental Protection Integration (REPI) Program	Private conservation organizations and state and local governments through partnerships with the Military Services.	Conservation practices or easements, landscape partnerships, stakeholder engagement to develop policy and regulatory solutions.	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.

Table E.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	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
	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 (CRP)	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

Table E.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)	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
	Agricultural Conservation Easement Program, including: • Agricultural Land Easements • Wetland Reserve Easements	Agricultural Land Easement eligibility: cropland, rangeland, grassland, pastureland, and nonindustrial private forest.	Prevention of productive farmland conversion to non-agricultural uses.	Yes
		Wetland Reserve Easement eligibility: farmed or converted wetland that can be successfully and cost-effectively restored.	Habitat creation, water quality improvement, flood reduction.	
	Environmental Quality Incentive Program	Individuals and entities.	Structural and management practices that address natural resource concerns on agricultural land.	Yes
	Conservation Stewardship Program	Landowners in compliance with highly erodible land and wetland conservation requirements with current farm records with FSA.	Assistance in maintaining and improving existing conservation systems. Implementation of additional activities to address priority resource concerns.	Yes

Table E.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)	Healthy Forests Reserve Program	Any landowner whose land restores, enhances, or increases the recovery of threatened or endangered species.	Restoration, enhancement, and protection of forestland resources on private lands through easements.	Yes
	Regional Conservation Partnership Program	Partners of the Natural Resources Conservation Service.	Partnerships with producers to install and maintain conservation projects that increase the restoration and sustainable use of soil, water, wildlife, and related natural resources.	Yes
	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 E.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 F – PROGRESS REPORT CARDS

PM = Progress made; A = Achieved

Goal 1: Improve Surface Water Quality

Existing Conditions

166,316 lbs/year of phosphorus, 64,483 tons/year of sediment, and 775,661lbs/yr of nitrogen enter the Lower Silver Creek watershed every year, based on the STEPL model.
Fecal coliform levels in Silver Creek have spiked several times between 1972 and 2011; the median level was 200 cfu/100ml, indicating that half of the measurements exceeded the Illinois limit of 200 cfu/100mL (based on a geometric mean calculated for 5 samples collected over a 30-day period).
Over 3,000 private sewage systems are present in the neighboring Upper Silver Creek watershed, which is of a similar size. Given this number for the Lower Silver Creek watershed and a national estimated failure rate of 10%, 300 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 Silver Creek and its tributaries. **Removal** of Little Silver Creek, Loop Creek, and Ogles Creek from the Illinois EPA 303(d) list.
25% or 41,579 lbs/year reduction in phosphorus loading by 2030, based on the Illinois Nutrient Loss Reduction Strategy.
15% or 9,672 tons/year reduction in sediment loading by 2030, based on estimated impacts of proposed BMPs.
15% or 116,349 lbs/year 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	56	111	167	... acres contour buffer strips (33% of locations identified by the ACPF) (cumulative)	SWCD, NRCS, farmers, contractors	
	12,897	25,795	38,692	... acres cover crops (50% of total agricultural land area) (cumulative)		
	1,021	2,042	3,063	... acres grassed waterways (75% of locations identified by the ACPF) (cumulative)		
	67	133	200	... acres ponds (cumulative)		
	2,579	5,159	7,738	... acres reduced tillage (conservation tillage/no-till) (10% of total agricultural land area) (cumulative)		
	155	309	464	... acres of riparian areas ecologically restored, including 100% Critical Riparian Areas (cumulative)		

	33,333	66,667	100,000	... feet terraces (cumulative)		
	33	67	100	... acres waste storage structures/waste management systems (cumulative)		
	195	389	584	... acres Water and Sediment Control basins (100% of locations identified by the ACPF) (cumulative)		
	224	447	671	... acres wetlands restored, enhanced, or created (100% of Critical Wetland Areas) (cumulative)		
	33	67	100	... acres new dry detention basins (cumulative)	Counties, municipalities, SWCD	
	33	67	100	... acres new wet detention basins (cumulative)		
	26	53	79	... acres detention basin retrofits (native vegetation buffers, etc.) (assuming 20% of the 294 basins identified in the watershed were in poor condition/would require retrofits before 2050, with average basin size of 1 acre) (cumulative)		
	26	53	79	... detention basins maintained (dredging, mowing, burning, invasives, etc.) (assuming 20% of the 294 basins identified in the watershed were in poor condition/would require retrofits before 2050, with average basin size of 1 acre) (cumulative)		
	33	67	100	... acres pervious pavement (cumulative)	Counties, municipalities, contractors	
	6,667	13,333	20,000	... square feet rain gardens (cumulative)		
	33	67	100	... barrels/small cisterns for rainwater harvesting and reuse (cumulative)		
	50	100	150	... properties use single property flood reduction strategies (cumulative)		
	76,085	152,169	228,254	... feet streambank and channel restoration, including 100% Critical Stream Areas (cumulative)	NRCS, SWCD, contractors	
	167	333	500	... feet logjam removal sites		
Removal of Little Silver Creek, Loop Creek, and Ogles 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, 300 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	6	8	… municipalities and 3 counties require regular private sewage inspections (beyond complaint-based program)	Counties, municipalities	
Enrollment of land in conservation easements including CRP and CREP	1.5	2	2.5	... times the 2015 acreage enrolled in CRP and CREP	NRCS	

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Notes

Goal 2: Reduce Flooding and Mitigate Flood Damage

Existing Conditions

19.7% of land in the watershed (24,472 acres) is in the 100-year floodplain. Flooding in this area is common.

Major roads have been inundated with floodwater during heavy rain events, includingState Routes 4, 13, 158, and 177, and U.S. Highway 50. Some road flooding restricts or eliminates access to residences (in e.g. Lebanon and Belleville). Flooding has also restricted access to Summerfield and Mascoutah.

Scott Air Force Base has experienced significant flooding in the Silver Creek corridor, which has caused Base evacuation.

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 and 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	155	309	464	... acres of riparian areas ecologically restored, including 100% Critical Riparian Areas (cumulative)	SWCD, NRCS, farmers, contractors	
	224	447	671	... acres wetlands restored, enhanced, or created (100% of Critical Wetland Areas) (cumulative)		
	3,333	6,667	10,000	… feet storm drain system maintenance (cleaning) and expansion	Municipalities, contractors	
Stream flow data from the USGS gauge on mainstem Silver Creek, plus 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	St. Clair County adopts 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	St. Clair County adopts a mechanism for dedicated funding for stormwater infrastructure All municipalities engaged to inform about stormwater infrastructure funding options	Counties, municipalities	

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Notes

Goal 3: Promote Environmentally Sensitive Development Practices

Existing Conditions

Current 2.8% impervious cover; current 9,732 acres developed open space (2011 NLCD) or 2,695 acres open space (recognized parks etc.)
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)			
Number and extent of Management Measures (BMPs) implemented	33	67	100	... acres new dry detention basins (cumulative)	Counties, municipalities, SWCD	
	33	67	100	... acres new wet detention basins (cumulative)	Counties, municipalities, SWCD	
	26	53	79	... acres detention basin retrofits (native vegetation buffers, etc.) (assuming 20% of the 294 basins identified in the watershed were in poor condition/would require retrofits before 2050, with average basin size of 1 acre) (cumulative)	Counties, municipalities, SWCD	
	26	53	79	… detention basins maintained (dredging, mowing, burning, invasives, etc.) (assuming 20% of the 294 basins identified in the watershed were in poor condition/would require retrofits before 2050, with average basin size of 1 acre) (cumulative)	Counties, municipalities, SWCD	
	33	67	100	... acres pervious pavement (cumulative)	Counties, municipalities, contractors	
	6,667	13,333	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	St. Clair County adopts 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.	2	4	6	... 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, US ACE	

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Notes

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Goal 4: Support Healthy Fish and Wildlife Habitat

Existing Conditions

12.1 miles of streams were identified as having poor riparian conditions (with 6 miles identified by aerial assessment and 6.1 miles identified by the ACPF).
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
Macrointertebrate 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	155	309	464	... acres of riparian areas ecologically restored, including 100% Critical Riparian Areas (cumulative)	NRCS, SWCD, contractors	
	224	447	671	… acres wetlands restored, enhanced, or created (100% of Critical Wetland Areas) (cumulative)		
	167	333	500	… 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 20 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 Lower Silver Creek Watershed-Based Plan as a "guidance document."	PM	PM	A	All watershed partners adopt and/or support (via a resolution) the Lower Silver Creek Watershed-Based 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	St. Clair County adopts 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	300 people (3 times the ~100 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 Silver Creek watershed-related learning experience or project each year.	Schools, School Districts, Counties	

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