Upper Silver Creek Watershed Plan

A Guide to Protecting and Restoring Watershed Health

June 2016
Review Draft

MADISON COUNTY
PLANNING & DEVELOPMENT
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HEARTLANDS CONSERVANCY
Investing In The Nature Of Southwestern Illinois

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Upper Silver Creek Watershed Plan

A Guide to Protecting and Restoring Watershed Health

June 2016

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Funding for this project provided by the Illinois Environmental Protection Agency through Section 604(b) of the Clean Water Act (#604132) and Madison County.

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ACKNOWLEDGMENTS

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National Great Rivers Research and Education Center (NGRREC)
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Village of Marine
City of Edwardsville
Village of Glen Carbon
Village of St. Jacob
City of Troy
Village of Hamel
Village of Worden
Village of Alhambra
US Department of Agriculture

Table of Contents

APPENDICES

EXECUTIVE SUMMARY

Executive Summary Contents

Introduction

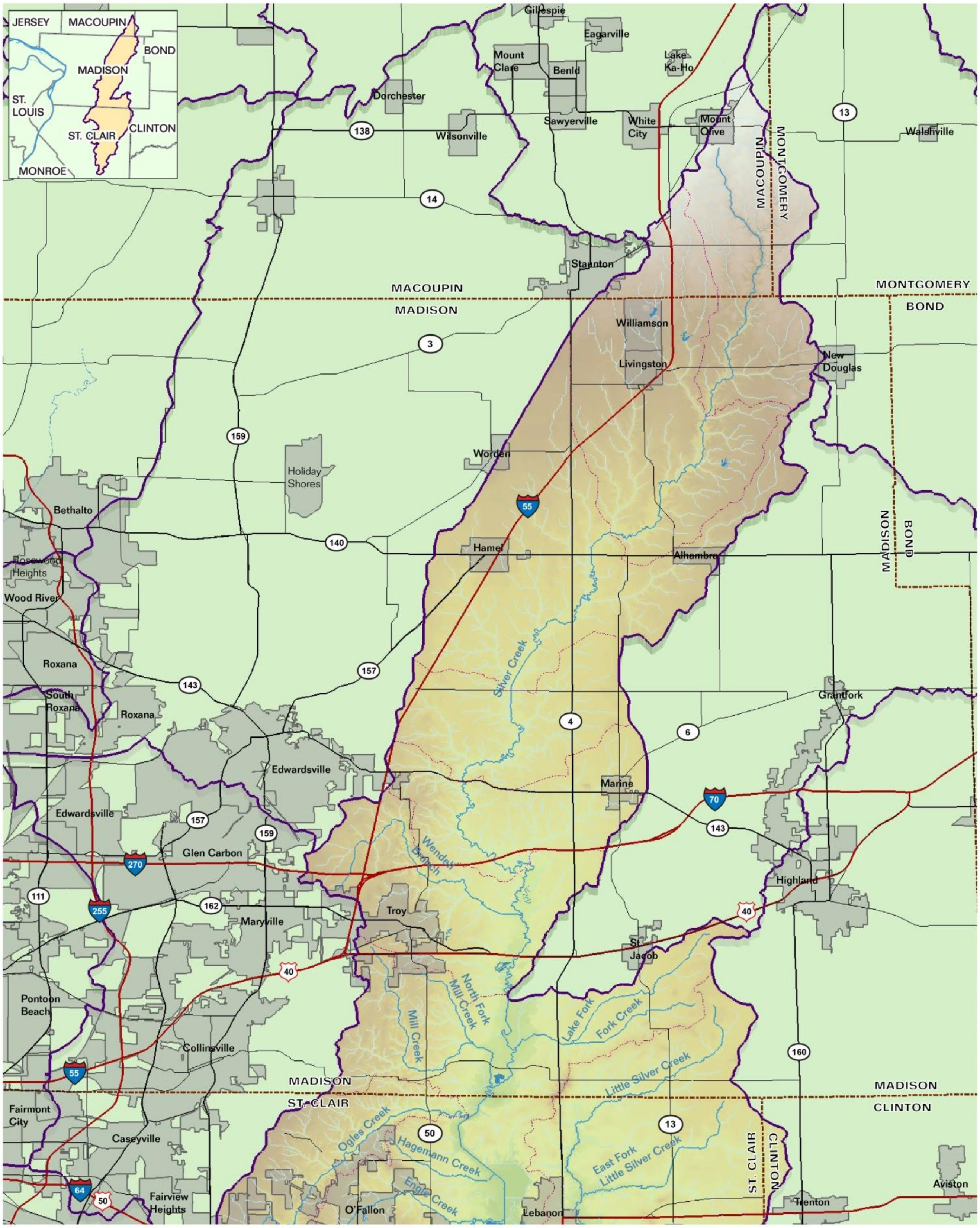
Stormwater management for Madison County is guided by the policy framework established in the Madison County Stormwater Management Plan, a county-wide document that seeks to address the effects of urbanization on stormwater drainage. The plan sets broad policy for Madison County as a whole, and plans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

In 2013, Madison County and HeartLands Conservancy received a grant from the Illinois Environmental Protection Agency (IEPA) to develop a Watershed Plan for upper Silver Creek, a tributary of the Kaskaskia River. The intent was to fully analyze the watershed and make recommendations toward improving water quality, mitigate adverse effects of flooding, and provide watershed-level recommendations for stormwater management.

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

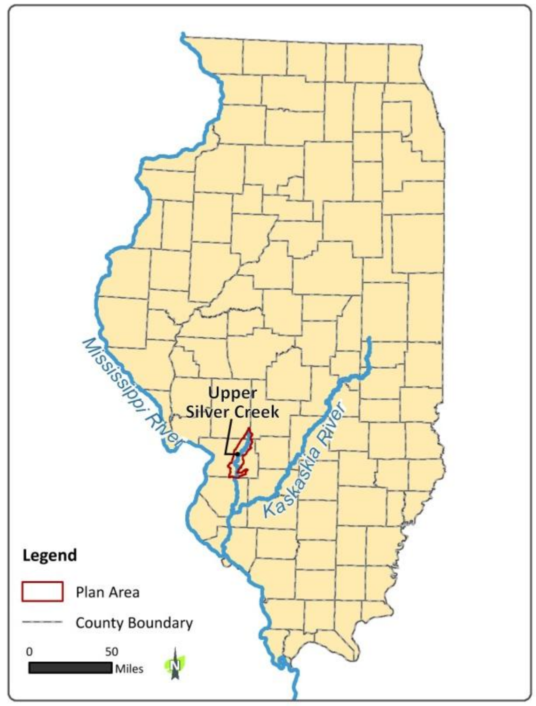
The Watershed Plan offers guidance for managing watershed resources on public property, as well as providing a platform to encourage other watershed stakeholders (landowners, residents, businesses, developers, public agencies, and non-profits) to participate. The plan is not regulatory, meaning it does 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.

Watershed Location



The Upper Silver Creek Watershed

The upper Silver Creek watershed is located 20 miles northeast of St. Louis, Missouri. The majority of the watershed lies within Madison County, Illinois, and small portions lie within Macoupin and Montgomery counties. The watershed's 480 miles of streams drain roughly 120,000 acres of land. Silver Creek flows south from the project area to join the Kaskaskia River, which ultimately drains into the Mississippi River.



Location of the upper Silver Creek watershed in Illinois.

The upper 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 26,200 residents live in unincorporated areas where farming is the primary land use. Agricultural land makes up 75% of the watershed, with most of that land in row crop farming. Thirteen municipalities, fourteen 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 2025 (based on Illinois Nutrient Loss Reduction Strategy), a 20% reduction in sediment loading (based on estimated impacts of proposed BMPs) by 2045, and a 68% reduction in fecal coliform loading (based on 35 Ill. Adm. Code 302) by 2045.

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 117 field locations, 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, Dissolved Oxygen (DO), and manganese.
- **Soil Erosion from Agricultural Land.** With 75% 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 63% 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 highly common both inside and outside of floodplains, with frequent damage to homes, businesses, and crops, leading to health impacts and monetary loss.
- **Extensive Floodplain.** Almost 11% 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 9% of the riparian area, the area directly adjacent to streams on either side, is in "poor" ecological condition (Appendix A, p.87).

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 to achieve the goals of this plan.

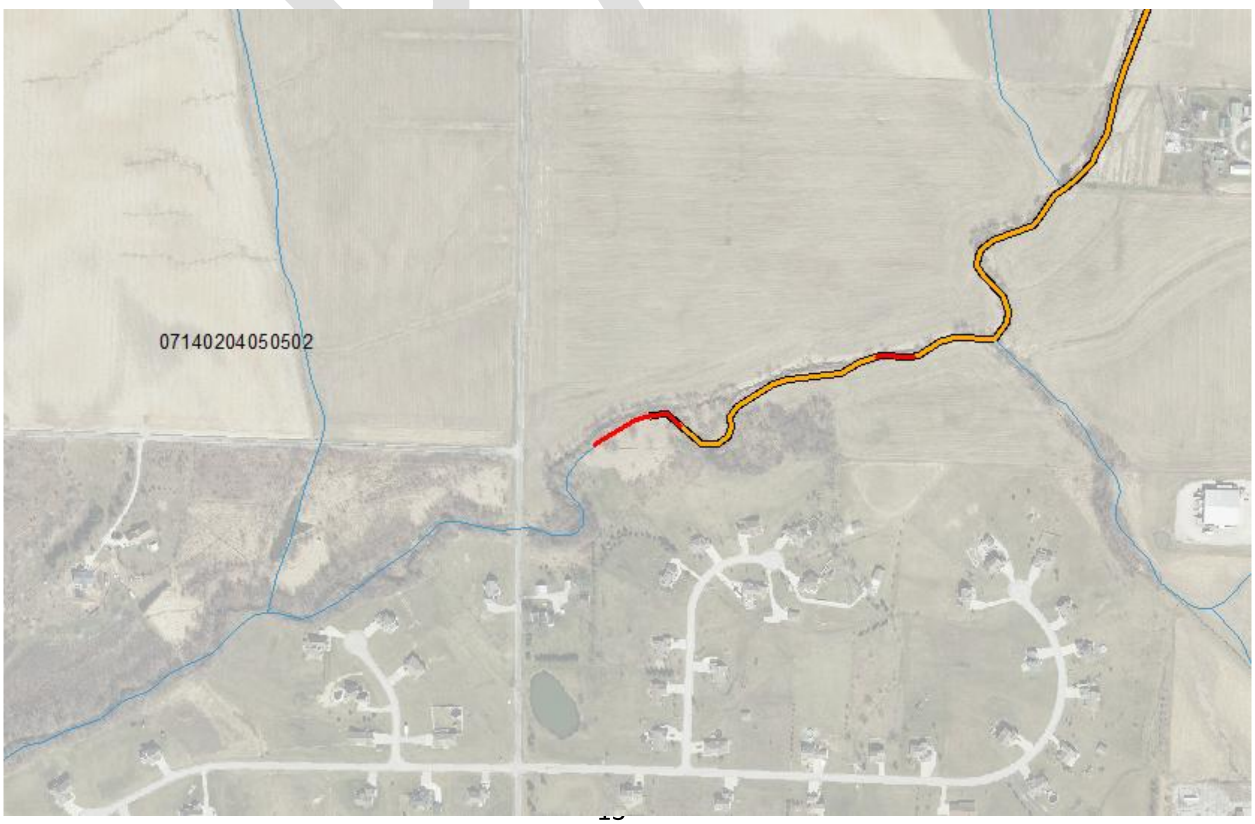
Critical Areas

"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 a difference in making improvements 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 (2.75 miles)
2. Critical Logjam Areas: Stream reaches with high susceptibility to logjams (37.5 miles)
3. Critical Riparian Areas: Highly degraded riparian areas (34.7 miles)
4. Critical Flooding Areas: Areas of prevalent flooding (HUC14s ranked by flood damage impact)
5. Critical Wetland Areas: Areas suitable for wetland restoration (500 acres)

This image is an example of Critical Riparian Areas (orange) and Critical Stream Areas (red) on a tributary east of Troy.



Implementation

The “Action Plan” is designed to provide partners with recommended actions, known as Management Measures, that address the plan’s goals, objectives, and targets.

Recommended Management Measures

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

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

Programmatic Measures

Protection and management of natural areas

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

Restoration of natural areas

- In-lieu fee ecological mitigation, a type of program that funds the restoration of ecologically sensitive wetlands and streams to mitigate for the losses of those features to new development.
- Native landscaping, which encourages the use of native plants on public and private property.
- Stream Cleanup Team, which removes litter and debris from streams and waterbodies.

Wastewater management

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

Natural resource policy

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

Funding

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

Site-Specific Measures

Agricultural

- 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.
- Ponds, which store stormwater, settle out sediments, and allow nutrient uptake by aquatic organisms.
- Reduced tillage (conservation tillage/no-till), which leads to a reduction in soil erosion and the transport of associated nutrients, such as phosphorus, to the waterways.
- 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.
- Waste (manure) management through a Comprehensive Nutrient Management Plan and waste storage structures can eliminate unwanted runoff, incorporate manure nutrients into crop nutrient budgets, and efficiently apply manure to cropland, reducing water pollution and increasing soil health.
- 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.

Urban areas

- 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.

In-stream

- Streambank and channel restoration, which includes stabilization and grade control structures. These reduce erosion and, in some cases, provide flood storage.
- Logjam removal, which removes debris from the stream channel, reducing scouring in the stream channel and the risk of floods overtopping the channel.

Measuring Success

Water quality monitoring will be conducted by the National Great Rivers Research and Education Center (NGRREC), as funding allows, on a 3-5 year cycle through the year 2025. A set of Progress Report Cards is included in Appendix H, and it includes milestones for short-term (1-10 years; 2016-2026), medium-term (10-20 years; 2026-2036), and long-term (20+ years; 2036+) timeframes. The report card can be used to identify and track plan implementation and effectiveness. Checking in at appropriate milestones helps watershed partners make corrections and ensure that progress is being made towards achieving the plan's goals.

Information and Education Plan

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

Recommended information and outreach activities include:

- Municipal outreach;
- Watershed plan outreach;
- An Agricultural BMP Workshop;
- A BMP or Demonstration Project Tour;
- A public events booth;
- Field days;
- Educational signs;
- School projects; and
- Watershed protection awareness.

SECTION 1: INTRODUCTION

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

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

The upper 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 the creek earned Silver Creek 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 in urban areas (i.e., "flash flooding").

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

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

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

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

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

Based on these principles, the county will incorporate watershed-level stormwater management plans for all of the major watersheds in the county. In 2013, Madison County and HeartLands Conservancy received a grant from the Illinois Environmental Protection Agency (IEPA) to develop a Watershed Plan for upper Silver Creek.

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.

Upper Silver Creek Watershed

The upper Silver Creek watershed is located 20 miles northeast of St. Louis, Missouri, in southwestern Illinois. The majority of the watershed lies within Madison County, and small portions lie within Macoupin and Montgomery counties. The watershed's 480 miles of streams drain roughly 120,000 acres of land. Silver Creek flows south from the project area to join the Kaskaskia River, which ultimately drains into the Mississippi River.

The upper 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.

Wendell Branch, Mill Creek, and Lake Fork are major tributaries to Silver Creek in the watershed project area. Wendell Branch drains the Troy area, Mill Creek drains the area south of Troy, and Lake Fork drains the area south of St. Jacob. East Fork Silver Creek joins the watershed between Highland and St. Jacob, bringing water from Highland and Silver Lake.

The watershed is home to approximately 26,245 people. The majority live in unincorporated areas where farming is the primary land use. Agricultural land makes up 75% of the watershed, with most of that land in row crop farming. All or portions of thirteen municipalities, fourteen townships, and three counties are located within the watershed (Table 1).

Table 1. Jurisdictions in the watershed.

Jurisdiction	**Area within watershed (acres)**
County (including municipalities)	120,089
Macoupin	10,408
Madison	107,943
Montgomery	1,738
Municipalities	6,685
Alhambra	428
Edwardsville	100
Glen Carbon	61
Hamel	746
Livingston	683
Marine	453
Mount Olive	392
New Douglas	33
St Jacob	53
Staunton	113
Troy	2,496
Williamson	994
Worden	135
Unincorporated Areas	113,428
Macoupin County	9,904
Madison County	101,786
Montgomery County	1,738
Township (County)	120,089
Cahokia (Macoupin)	223
Mount Olive/Staunton (Macoupin)	10,172
Alhambra (Madison)	15,582
Edwardsville (Madison)	260
Hamel (Madison)	11,726
Jarvis (Madison)	18,953
Leef (Madison)	277
Marine (Madison)	8,849
New Douglas (Madison)	4,629
Olive (Madison)	19,475
Omphghent (Madison)	1,888
Pin Oak (Madison)	18,576
St. Jacob (Madison)	7,596
Walshville (Montgomery)	1,725

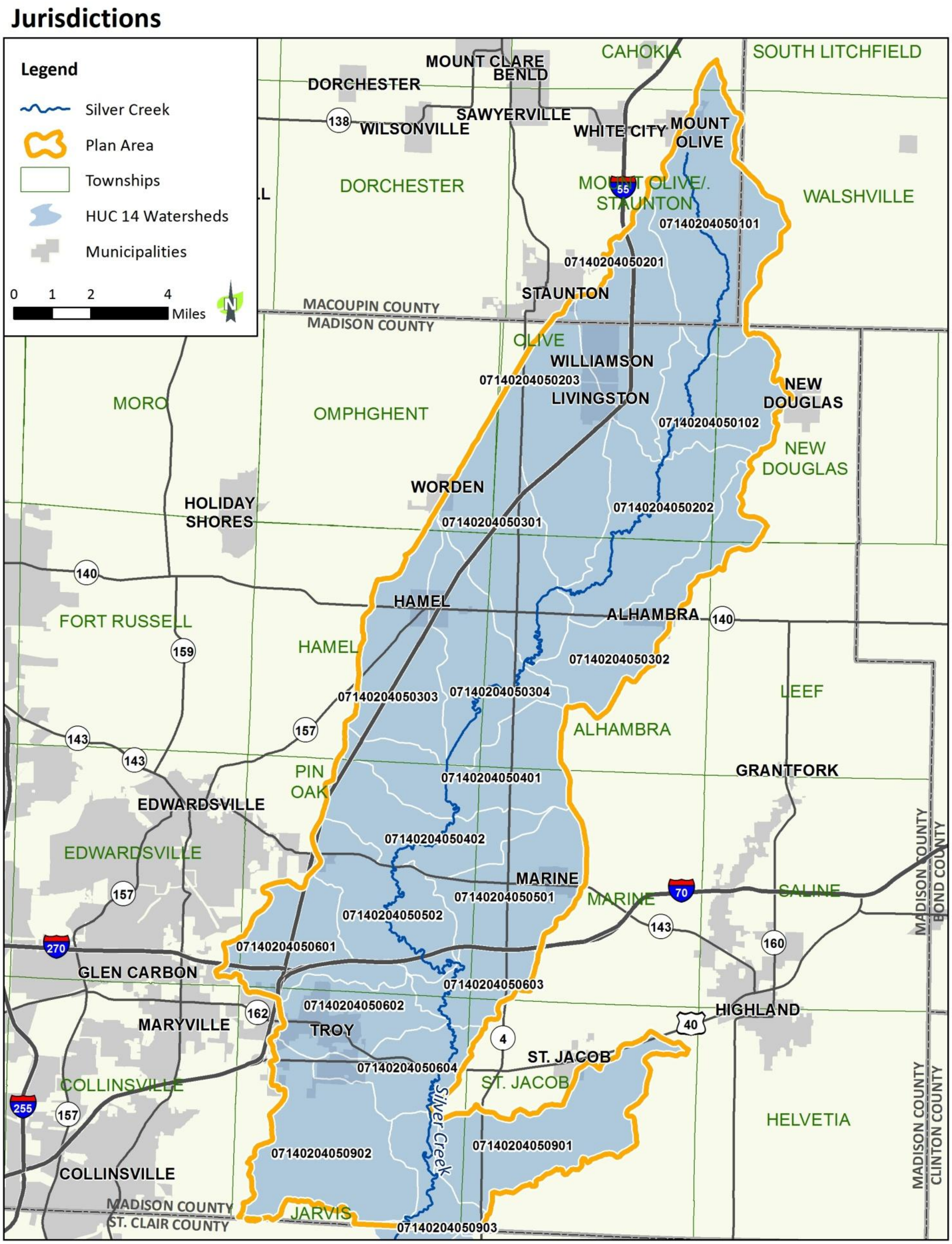


Figure 2. The upper Silver Creek watershed, containing 20 HUC14 subwatersheds and all or portions of 13 municipalities.

Purpose

The purpose of the Upper 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 Silver Creek and its tributaries and managing stormwater in floodplains and communities. The plan should enhance, manage, and protect the watershed's human, natural, and socio-economic resources by identifying strategies and resources that promote the health and safety of human inhabitants, improve surface and groundwater quality, prevent flood damage, protect wildlife, and increase environmental education.

Madison County Stormwater Plan

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

The Madison County Stormwater Plan also references stormwater runoff which is transported through Municipal Separate Storm Sewer Systems (MS4s). Madison County acts as the Coordinator for the MS4 Co-Permittee Group which consists of 26 communities (including the county itself). MS4 members within the upper 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 Upper Silver Creek watershed.

Municipalities
City of Edwardsville
City of Troy
Village of Glen Carbon
Townships
Edwardsville Township
Jarvis Township
Pin Oak 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. Madison County's MS4 activities in 2014 included technical training, outreach at public events, and hazardous waste collection.

Authority

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

(55/ILCS 5/5-1062.2) Stormwater management. … The purpose of this Section shall be achieved by:

(1) *Consolidating the existing stormwater management framework into a united, countywide structure.*
(2) *Setting minimum standards for floodplain and stormwater management.*
(3) *Preparing a countywide plan for the management of natural and man-made drainageways. The countywide plan may incorporate watershed plans.*

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

Methodology

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

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

Watershed Data Collection and Analysis

A Watershed Resource Inventory (Appendix A) was developed, 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 Spreadsheet Tool for Estimating Pollutant Loads (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 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 (276 miles or 57.2% of the total stream miles in the watershed). Midwest Streams viewed the videotapes to assess three parameters for each stream: streambank erosion, degree of channelization, and condition of the riparian area. Later, Midwest Streams followed up with field checks at 117 locations in order 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, to identify detention and retention basins. A point was created for each basin located in or very close to a group of 5 or more buildings, to avoid classifying natural ponds as detention basins. Sixty-seven (67) detention or retention basins were identified in the watershed, with the majority in the lower portion. Site visits were made with Madison County in April 2015 to 10 of the 44 accessible basins identified, in order to determine their condition.

Delineation of subwatersheds

At the start of the process, the project area had already been divided into seven subwatersheds, or hydrologic units (HUCs), called HUC12s. To provide more detailed analysis and recommendations for the watershed, the HUC12s were further divided into 20 even smaller HUC14 subwatersheds. The project team used USGS methodology for defining watersheds in the Watershed Boundary Dataset (WBD), a component of the

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
Infrastructure in floodplains
National Flood Insurance Program (NFIP) communities
IEPA 303(d) impaired waters
Other water quality data
Spreadsheet for Estimating Pollutant Loads (STEPL) analysis

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

Stakeholder engagement
Open House Events
Stakeholder meetings
Flood Survey

National Hydrography Dataset (NHD). During the development of the Watershed Resources Inventory (WRI), the HUC14 subwatersheds were given draft HUC codes for submission to the WBD. Some of the HUC14 codes changed as a result of review by USGS. The final codes and names are used for the Plan, but the draft codes are used in the Watershed Resource Inventory (Appendix A).

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

Technical Committee

A Technical Committee consisting of experts in stormwater management, water quality, stream and soil health, conservation, and urban planning guided data collection and analysis. The Committee was represented by Madison County Planning and Development, HeartLands Conservancy, National Great Rivers Research and Education Center (NGRREC), Madison County Soil and Water Conservation District, and Midwest Streams. The Technical Committee helped to guide the process and formulate the Watershed Resources Inventory (Appendix A), and provided technical guidance on recommendations and subsequent drafts of the plan. Specifically, the Committee reviewed the aerial assessment methodology and results, the Spreadsheet Tool for Estimating Pollutant Loads (STEPL) use, draft nutrient reduction targets and other targets, the Flood Survey design and analysis, and milestones for Plan implementation.

Stakeholder Engagement

Early on and throughout the planning process, the planning team interviewed numerous stakeholders including townships, the Madison County Farm Bureau, County Board members, and nine of the 13 municipalities in the watershed. Four 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.

Stakeholder meeting with farmers, summer 2014. Photo: HeartLands Conservancy.

Flood Survey

Another component of stakeholder outreach, the Madison County Community Flood Survey for the upper Silver Creek watershed was sent to 2,000 randomly selected addresses in the watershed, and put online, following the initial stakeholder meetings in 2014. More than 500 responses were received. The results revealed trends in flooding locations, frequency, and impacts (Appendix B). The survey found that 26% of respondents experienced flooding in the last decade, and those respondents experience and average of 2.7 floods per year.

Key Issue Identification and Goal Setting

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

Management Measures and Targets

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

Spreadsheet Tool for Estimating Pollutant Loads (STEPL)

The National Great Rivers Research and Education Center (NGRREC) used the Spreadsheet Tool for Estimating Pollutant Loads (STEPL), which uses land cover, precipitation, and elevation data to estimate nitrogen, phosphorus, and sediment runoff from specific drainage areas. The tool created estimates for current land use conditions and future land cover scenarios incorporating Management Measures. The Technical Committee used these numbers to set targets for pollutant load reduction in the watershed.

Agricultural Conservation Planning Framework (ACPF)

HeartLands Conservancy used the Agricultural Conservation Planning Framework (ACPF), a set of GIS tools developed by the U.S. Department of Agriculture (USDA) to identify locations where certain Best Management Practices (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 Upper Silver Creek Watershed is one of the first watersheds in the State of Illinois to make use of the ACPF for planning purposes.

Implementation Plan

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

Water quality monitoring

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 X).

Stormwater Commission and County Board Review

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

Integration into Madison County Stormwater Management Plan

Upon adoption by the County Board, the Upper Silver Creek Watershed Plan will become a part of the county-wide Stormwater Management Plan.

SECTION 2: GOALS, OBJECTIVES, AND TARGETS

Goals and Objectives

A set of long-term goals and objectives were developed to address the challenges and issues associated with maintaining a healthy, functioning watershed (Table 3). These goals address the issues identified in the Watershed Resources Inventory, Community Flood Survey, and input from residents, land owners, businesses, and government officials.

Each goal and objective aligns with a challenge/issue to be addressed, a set of recommended Best Management Practices (BMPs), the roles of organizations implementing those BMPs, specific and general projects using those BMPS, and ranking of the priority of the recommended BMPs.

Table 3. Goals and objectives of the Watershed Plan.

Goals	Objectives
Improve Surface Water Quality	• Decrease pollutant loading to Silver Creek. • Reduce phosphorus by 25% by 2025. • Reduce sediment by 20%. • Reduce nitrogen by 15% by 2025. • Maintain Dissolved Oxygen (DO) levels above standard minimums. • Maintain manganese concentrations below 1,000 µg/L. • Reduce fecal coliform by 68%. • 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 upper Silver Creek watershed, so that the streams can be safely used by residents, and to remove Silver Creek and its tributaries from IEPA's 303(d) list of impaired waters.

The upper Silver Creek watershed has been a source of excessive phosphorus and sediment to Silver Creek, earning it a place on the Illinois EPA 303(d) list of impaired waters for several successive years. For this plan, numerical reductions for impairments in the watershed are based on observed conditions and monitoring data, as well as Illinois water quality standards. The main water quality parameters of concern are sediment, phosphorus, and fecal bacteria (E. coli). The Watershed Impairment Reduction Targets table on page 32 (Table 4) provides details on the sources of these reduction targets.

Water Quality Objectives:

1.1 Decrease overall pollutant loading to Silver Creek.

1.2 Achieve a 25% reduction in phosphorus from the watershed by 2025. (i.e., a 25% reduction in the annual total phosphorus load by 2025, based on the Illinois Nutrient Loss Reduction Strategy.)

1.3 Achieve a 20% reduction in sediment from the watershed by 2045. (i.e., a 20% reduction in the annual sediment load by 2045 (the long-term watershed planning horizon), 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 2025. (i.e., a 15% reduction in the annual total nitrogen load by 2025, 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 different for March to July and August to February.)

1.6 Maintain manganese concentrations no higher than 1,000 µg/L. (i.e., maintain samples no higher than Illinois' "general use" water quality standard of 1,000µg/L, and achieve a general reduction.)

1.7 Achieve a 68% reduction in fecal coliform from the watershed by 2045. (i.e., achieve a 68% reduction by 2045 in order to reach the Illinois Pollution Control Board standard of 200 cfu/100ml.)

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 upper 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.

<u>Development Objectives:</u>

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

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

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

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

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

GOAL 4: SUPPORT HEALTHY FISH AND WILDLIFE HABITAT

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

<u>Habitat Objectives:</u>

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

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

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

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

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

GOAL 5: DEVELOP ORGANIZATIONAL FRAMEWORKS TO IMPLEMENT WATERSHED GOALS

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

Organizational Framework Objectives:

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

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

GOAL 6: CONDUCT EDUCATION AND OUTREACH

Promote public awareness, understanding, and stewardship of the watershed and the Watershed Plan.

Education and Outreach Objectives:

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

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

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

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

Watershed Impairment Reduction Targets

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

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

Table 4. 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	264,952 lbs/year of phosphorus loading, based on STEPL model	**25%** or 66,238 lbs/year reduction in phosphorus loading by 2025, based on the Illinois Nutrient Loss Reduction Strategy	6,194 lbs/year reduction from critical stream reaches and other poor condition stream reaches 11,561 lbs/year reduction from critical riparian areas and other riparian areas 600 lbs/year reduction from critical wetland areas 60,224 lbs/year reduction from other agricultural areas 5,345 lbs/year reduction from other urban areas
TOTAL			**77,330 lbs/year or 29.3% total phosphorus reduction**
Water Quality/Aquatic Life: Sediment	60,230 tons/year of sediment loading, based on STEPL model	**20%** or 12,046 tons/year reduction in sediment loading by 2045 (the long-term watershed planning horizon), based on estimated impacts of proposed BMPs. Similar target to phosphorus; sediment is its primary transport mechanism.	567 tons/year reduction from critical stream reaches and other poor condition stream reaches 1,207 tons/year reduction from critical riparian areas and other riparian areas 90 tons/year reduction from critical wetland areas 10,258 tons/year reduction from other agricultural areas 645 tons/year reduction from other urban areas
TOTAL			**12,199 tons/year or 20.3% total sediment reduction**
Water Quality/Aquatic Life: Nitrogen	1,178,496 lbs/year of nitrogen loading, based on STEPL model	**15%** or 176,774 lbs/year reduction in nitrogen loading by 2025, based on the Illinois Nutrient Loss Reduction Strategy	26,648 lbs/year reduction from critical stream reaches and other poor condition stream reaches 43,889 lbs/year reduction from critical riparian areas and other riparian areas 1,173 lbs/year reduction from critical wetland areas 299,509 lbs/year reduction from other agricultural areas 22,345 lbs/year reduction from other urban areas
TOTAL			**366,917 lbs/year or 31.1% total nitrogen reduction**
Water Quality/Aquatic Life: Dissolved Oxygen	Minimum 2 mg/L (mean 7.7 mg/L) dissolved oxygen, based on samples collected from the Silver Creek between 1972 and 2011 by the Illinois Water Science Center and IEPA	**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).	72,600 feet streambank and channel restoration, including riffle pools and other structures that increase re-aeration 57,394 feet (99%) of 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: Manganese	Mean 417 µg/L, median 290 µg/L, and maximum 3200 µg/L dissolved manganese, based on samples collected from Silver Creek (1972-2011, Illinois Water Science Center and IEPA)	**No samples higher than the general use water quality standard** of 1,000 µg/L, and a general reduction in the mean concentration.* Source: Lower Kaskaskia River TMDL Report, 2012.	Soil erosion control practices also reducing manganese: 49 acres contour buffer strips 29,032 acres cover crops 494 acres grassed waterways 29,032 acres reduced tillage (conservation tillage/no-till) 100,000 feet terraces 881 acres Water and Sediment Control basins
Water Quality/Aquatic Life: Fecal coliform	Median 630 cfu/100ml fecal coliform concentrations, based on samples collected from Silver Creek (1972-2011, Illinois Water Science Center and IEPA)	**68%** or 430 cfu/100 ml reduction by 2045, to reach geometric mean of 200 cfu/100 ml in a minimum of 5 samples taken over ≤30 days; based on 35 Ill. Adm. Code 302 (IPCB, 2011).	Reductions following maintenance and replacement as a result of private sewage inspections Reductions following waste (manure) management systems installation
Flood Damage: Flooding inside and outside floodplain	26% of Flood Survey respondents experienced flooding in the last 10 years, reporting a total of >$330,016 in costs over that time	**100 acres dry detention basins** installed **100 acres wet detention basins** installed **Retrofits & maintenance** of existing detention basins **Critical Flooding Areas** prioritized	100 acres dry detention basins installed 100 acres wet detention basins installed Retrofits & maintenance on all 67 identified existing detention basins (average size: 1.4 acres) Single property flood reduction strategies
Habitat Degradation: Invasive/non-native plant species in riparian areas; hydrologic changes due to loss of wetlands; logjams	57,918 feet of riparian areas are currently in poor condition, per the aerial assessment results. Of this, 183,036 feet are Critical Riparian Areas. 37.5 miles Critical Logjam Area identified.	**100% Critical Riparian Areas** restored **Majority of riparian areas in poor condition** restored **100% Critical Logjam Areas** assessed **5% Critical Logjam areas** have logjams removed	57,394 feet (99%) of poor condition riparian areas ecologically restored, including 100% Critical Riparian Areas 100% Critical Logjam Areas assessed 9,900 feet or 5% Critical Logjam areas have logjams removed
Wetland Loss: Flood storage and filtration functions	Thousands of acres of wetlands lost since pre-settlement; loss of ecosystem functions	**100% Critical Wetlands Areas** restored	500 acres (100%) Critical Wetlands Areas restored
Reduced infiltration to groundwater	Current 3% impervious cover; 2.8% annual increase in impervious cover (2006-2011); current 6,981 acres developed open space (2011 NLCD) or 1,289 acres open space (EWG)	**Preservation of open space and infiltration measures** used in new and redevelopment **Increase in rain gardens** **Increase in pervious surfaces** in new and redevelopment	Preservation of open space and infiltration measures in all new and redevelopment, e.g. designed for Conservation Development and green infrastructure 20,000 sq. ft of rain gardens installed 100 rain barrels/cisterns installed
Fecal Coliform: Private sewage	Over 3,000 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 inspection programs for private sewage, beyond complaint-based assessment

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

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.41).

__Surface water quality__

Objectives addressing this issue:
♦ Decrease pollutant loading to Silver Creek.
♦ Reduce phosphorus by 25% by 2025.
♦ Reduce sediment by 20% by 2045.
♦ Reduce nitrogen by 15% by 2025.
♦ Maintain DO levels above standard minimums.
♦ Maintain manganese levels below 1,000 µg/L.
♦ Monitor water quality and identify trends.

Issue: IEPA Primary Sources of Impairment. The primary sources of impairment to Silver Creek listed on the IEPA 303(d) list are: animal feeding operations (non-point source pollution), crop production (crop land or dry land), and municipal point source discharges (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 500 acres of Critical Wetland Areas have been identified in the watershed, in locations which are highly suitable for restoration/construction of wetlands (see p.43).

Additional surface water issues reported by municipalities include turbidity (from high concentrations of suspended solids) and duckweed growth on ponds. (None of the municipalities interviewed had conducted surface water quality testing.) Point sources of pollution come from ten 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 do not typically use surface water for their water supply. Most communities purchase surface water originating in the Mississippi River from suppliers such as the Bond-Madison Water Company (which buys water from Illinois American Water).

Objectives addressing this issue:
♦ Reduce sediment by 20% by 2045.

Issue: Soil Erosion from Agricultural Land. Because 75% 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 32% of sediment and 87% of phosphorus in the watershed comes from cropland (see Appendix A, p.144). In Madison County, 75% of corn and 37% of soybeans are produced using conventional tillage practices, which contribute to high soil erosion. Conservation tillage (reduced tillage) and no-till practices contribute significantly less sediment and nutrients. Only 1% of corn and 7% of soybeans in Madison County are in no-till crop production. Marine and Edwardsville highlighted soil erosion issues within their municipal boundaries. Both municipalities, and several townships, mentioned instances where row crops are consistently planted up to the edge and into drainage ditches, leading to greater soil erosion and widening the ditch.

Table 5. 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 & 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 & 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	Manganese (known impairment)*	Naturally high manganese levels in soil and rocks; Atmospheric deposition from industry (e.g. primarily coal-fired power plants); Discharges from industrial operations;	1
Water Quality - Aquatic Life	Fecal coliform (potential impairment)	Failing private sewage systems; Wastewater treatment plants; Livestock operations (manure)	1
Habitat Degradation	Invasive/non-native plant species & degradation in riparian and other natural areas (known impairment)	Existing and introduced invasive species populations; Logjams, trash/debris, and other obstructions in streams; Level of public education	3, 4, 6
Habitat Degradation	Loss and fragmentation of open space/wetlands/natural habitat (known impairment)	Inadequate protection policy; Lack of land acquisition funds; Traditional development design; Streambank, channel, and riparian area modification; Lack of restoration and maintenance funds; Wetland & riparian buffer loss	3, 4, 5
Structural Flood Damage	Encroachment in 100-year floodplain (known impairment)	Channelized streams; Agricultural drain tiles; Wetland & riparian buffer loss; Logjams and other obstructions in streams; Existing and future urban impervious surfaces;	2, 3, 5
Structural Flood Damage	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

* Manganese may not be a significant impairment. Manganese measurements taken before 1997 are higher than those taken recently, perhaps due to better measurement procedures and a more accurate detection level.

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. 264,525 feet of streams assessed in the watershed had high streambank erosion (including Critical Stream Reaches, which had high streambank erosion and high channelization – see p.41). An additional 283,512 ft of streams assessed had moderate streambank erosion. Streambanks contribute an estimated 63% of sediment in the watershed to streams (see Appendix A, p.144). 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. Marine and Hamel reported unstable streambanks and erosion issues upstream of their water and wastewater treatment facilities, respectively, threatening the viability of those facilities in the event of a bank blow-out. Several Open House attendees also reported erosion on their properties from widening ditches, tributaries, and creeks.

Objectives addressing this issue:
♦ Reduce sediment by 20% by 2045.

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

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. Over 37 miles of Critical Logjam Areas (identified at locations of concentrated logjams) were identified in the watershed (see p.41). Logjams can be both a cause and a result of streambank erosion. They can alter flow, directing water outwards to the streambanks, increasing scouring and bank erosion. Logjams result from streambank erosion when a stream is incising or meandering excessively, causing large woody vegetation on the banks to be undercut and fall into the stream. Several stakeholders identified beavers as a cause of logjams along Silver Creek.

Objectives addressing this issue:
♦ Reduce sediment by 20% by 2045.

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

Issue: Contamination from Private Sewage and Animal Waste. Large spikes in fecal coliform levels have occurred at monitoring gauges on Silver Creek. The watershed has more than 3,000 private sewage systems (i.e. septic systems). USEPA uses a figure from the U.S. Census Bureau that at least 10% of septic systems nationwide have stopped working, while local government officials estimate that the failure rate in this watershed is actually much higher (up to 90% in older developments). Several municipalities and Open House attendees reported occurrences of and bad odors from failing systems. 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.

Objectives addressing this issue:
♦ Create a private sewage assessment strategy.
♦ Reduce fecal coliform by 68%.

Issue: Infiltration into Sanitary Sewers (De Facto Combined Sewers)
All of the municipalities in the watershed have separate storm and sanitary sewer systems. 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.
♦ Decrease fecal coliform by 68%.
♦ Promote ongoing maintenance of stormwater storage and conveyance infrastructure.

Issue: Dumping and Littering. Trash and debris is an issue in places where roads cross the 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. Several 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.
♦ Increase awareness of consequences of littering/illegal dumping.

<u>**Flooding**</u>

Issue: Prevalent Flooding. Flooding is highly prevalent in the upper Silver Creek watershed, both inside and outside of floodplains, and in rural and urban areas. Urban flooding was probably the most important to the municipalities interviewed; all of them had experienced at least some flooding in developed areas. Open House attendees and Flood Survey respondents reported flooding on their properties and on the roads around them. The Madison County Community Flood Survey, administered in 2014, revealed significant and widespread flooding problems affecting residents and property owners in the watershed (Appendix B). Frequent flooding damaged homes and businesses, causing health and safety impacts, as well as monetary loss. See Table 5 for causes and sources associated with flooding.

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

Road overtopping near Marine, 2013.
Photo: Village of Marine.

Issue: Extensive Floodplain. FEMA has identified almost 11% of the watershed as 100-year floodplain. This area is almost entirely riverine floodplain around Silver Creek and its larger tributaries. Five communities in the watershed are enrolled in the National Flood Insurance Program, but seven are not fully covered by a Flood Insurance Rate Map (FIRM). A 2010 Oates Associates report for Madison County found seven road overtopping locations in the watershed based on FIRMs, mostly where roads cross Silver Creek (Appendix A).

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 flatter, higher ground at the edges of the watershed is not in the floodplain, but it has still been flooded by flash floods/urban flooding from time to time. This flooding is a result of increased impervious surfaces (developed areas), changes in local hydrology (such as ditches installed or filled in), and severe storm events with heavy rainfall. Sixty-two percent of the flooding reported in the Madison County Community Flood Survey did not occur in floodplains (Appendix B). Lack of stormwater infrastructure, inadequate infrastructure (such as undersized culverts), aging infrastructure, and inadequate maintenance of infrastructure all contribute to the issue of flooding outside of floodplains. Critical Flooding Areas were identified through analysis of available flood data, leading to a flood risk/impact ranking for each of the HUC14 subwatersheds (see p.42).

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

<u>**Land Cover and Development**</u>

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

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

Development in the Metro East is occurring at a rapid pace. Madison and St. Clair counties combined lose 1/3 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 over the next few decades. New development will likely occur within and around municipalities and in unincorporated areas in the watershed, consuming as much as 40,000 acres of farmland and 7,000 acres of forest/grassland. New impervious surfaces will compound the problems of flooding, lack of infiltration, and poor water quality. Without changes in policy, local flash flooding will pose significant risks to both new and existing development. Furthermore, maintenance agreements are not always put in place for new development to ensure stormwater features continue to function. (See the issue, "Need for Updated Operations".) Municipalities in the watershed need stronger policies to maintain stormwater infrastructure, protect steep slopes, and preserve native vegetation as development occurs.

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 – urban sprawl – 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, which covers most of the area in the watershed, 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 1,193 water wells in the watershed, including municipal water supply, irrigation, industrial, and commercial wells. Reductions to aquifer replenishment may become an issue for the several municipalities and private residences that use these wells for their drinking water supply and other purposes. (Only one municipality – Alhambra – uses groundwater from within the watershed for its water supply, and even then, only as a portion of its supply.) No wellhead protection plan is known to be in place in the watershed.

<u>**Habitat**</u>

Issue: Invasive Species. Invasive species, such as bush honeysuckle, tree-of-heaven, garlic mustard, and climbing euonymous (wintercreeper), are threats to many natural areas because they crowd out native trees and shrubs that protect streambanks from erosion. Invasives also crowd out food sources of animals and insects, further degrading the ecosystem. See Table 5 for causes and sources associated with habitat degradation.

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

Issue: Endangered Species. Endangered species such as the Indiana bat and leafy prairie clover may be present in the watershed. Removing invasive species and protecting native habitat around streams will provide locations for endangered species to thrive.

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

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 holes or gaps, which encourage nest predators such as raccoons, opossums, skunks, and cowbirds. Approximately 9% of the riparian area along streams is in "poor" ecological condition (Appendix A, p.87). Over 34 miles of streams were identified as Critical Riparian Areas (see p.42).

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 upper 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.

<u>Organizational needs/issues</u>

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.

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 BMPs to its operations schedules and budgets, those BMPs become much easier to implement. Madison 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 will lay out the responsibilities of the parties involved in maintaining a functioning drainage system. There are few maintenance agreements in effect in the watershed at present on private land.

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; all of the MS4 municipalities in the watershed already conduct regular street sweeping (Edwardsville, Troy, and Glen Carbon). Townships that do street sweeping on oil and chip roads in the watershed (such as Jarvis, Edwardsville, and Pin Oak) 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), Conservation Reserve Enhancement Program (CREP), Environmental Quality Incentives Program (EQIP), Conservation Stewardship Program (CSP), foundation grants, and various other programs.

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

<u>Information and Outreach</u>

Issue: Need for Communication. The public engagement process for the plan revealed a need for education on water quality and flooding for the general public. For example, the Flood Survey revealed a need for further education about flooding and flood insurance. Ten percent of Flood Survey respondents did not know that all or part of their property was in the floodplain. The majority of flooding reported in the survey (87%) was outside of FEMA-designated floodplains, and several property owners had flood insurance policies on structures outside of the floodplain. Over half of respondents who had flooding did not report it to anyone. Given that a quarter of respondents experienced flooding over the last ten years, there is a clear mandate to further educate residents on flood damage prevention and mitigation.

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. The Madison County Stormwater Coordinator received an average of 17 complaints about drainage and flooding per year between 2012 and 2015 (Appendix A), a very small number compared to the number of flooded properties in the county identified in the Flood Survey. 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

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

same goal. Many people will work hard to help make the watershed better if they understand what to do and how it will help.

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 a difference in making improvements towards one or more of the Watershed Plan goals. The following Critical Areas were identified:

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

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

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

Critical Stream Reaches

Critical stream reaches exhibit highly eroded banks or stream beds, or degraded channel conditions, that are a major source of total suspended solids (sediment), phosphorus and nitrogen carried with it. **2.75 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 Logjam Areas

Critical areas for logjams were delineated from known locations of logjams identified in the aerial stream assessment for this Watershed Plan, from the stakeholder engagement process, and in the 2008-2009 Madison County Stream Cleanup project. The Critical Areas are stream reaches that are within 0.25 mile of another reported logjam along the same stream. These areas represent current or likely locations of logjams, but not where they would cause the greatest flood impacts or damage. **37.5 miles** of stream reaches have been identified as Critical Logjam Areas. Localized assessment is recommended for these reaches to determine whether logjam removal is appropriate and cost-effective at specific locations. The American Fisheries Society's 1983 "Stream Obstruction Removal Guidelines" are a reliable source for determining what types of logjams should be removed.

Critical Riparian Areas

Critical riparian areas are areas adjacent to stream reaches that:

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

Along the stream corridors, **183,036 feet (34.7 miles)** were identified as Critical Riparian Areas. Removal of invasive species and revegetation of these areas with appropriate native vegetation will increase surface water infiltration and reduce sediment and nutrient flows to the streams.

Critical Flooding Areas

For flooding, instead of individual locations being identified as critical areas, a flood risk/impact ranking was applied to the HUC14 subwatersheds using the following criteria:

1) Flooding and flood impacts reported from the Madison County Community Flood Survey (specifically, flood prevalence, frequency, neighbors' flooding, and flood damage);
2) Extent of the 100-year floodplain;
3) Areas between 90 and 100% impervious cover; and
4) Flooding events reported by stakeholders at small group meetings and Open House events.

Flood overtopping a road that crosses Silver Creek, 2013. Photo: Village of Marine.

The **top 10 of the 20 ranked HUC14 subwatersheds** for flooding are shown in Figure 4 on page 47, with different colors denoting flood risk/impacts. In these subwatersheds, which often see repeated flooding in specific locations, best practices include structural detention basin systems and wetlands, along with multiple non-structural elements that increase infiltration of surface runoff. Topographic maps should be consulted to determine the most effective BMP locations. The southern half of the watershed is weighted more heavily for flood risk/impact because there is more floodplain area, more impervious cover, and a greater population there (three of the ranking criteria above).

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). And because the MoRAP wetland restoration assessment used hydric soils and proximity to existing wetlands as criteria for its algorithms, the areas with high restoration rank values are largely in or close to the stream corridor. 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.

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

All of the Critical Areas identified in the watershed are shown in Figure 4. Pages 48 to 67 show the Critical Areas in more detail in each HUC14 subwatershed. Each individual type of Critical Area is shown in maps in Appendix D, 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.

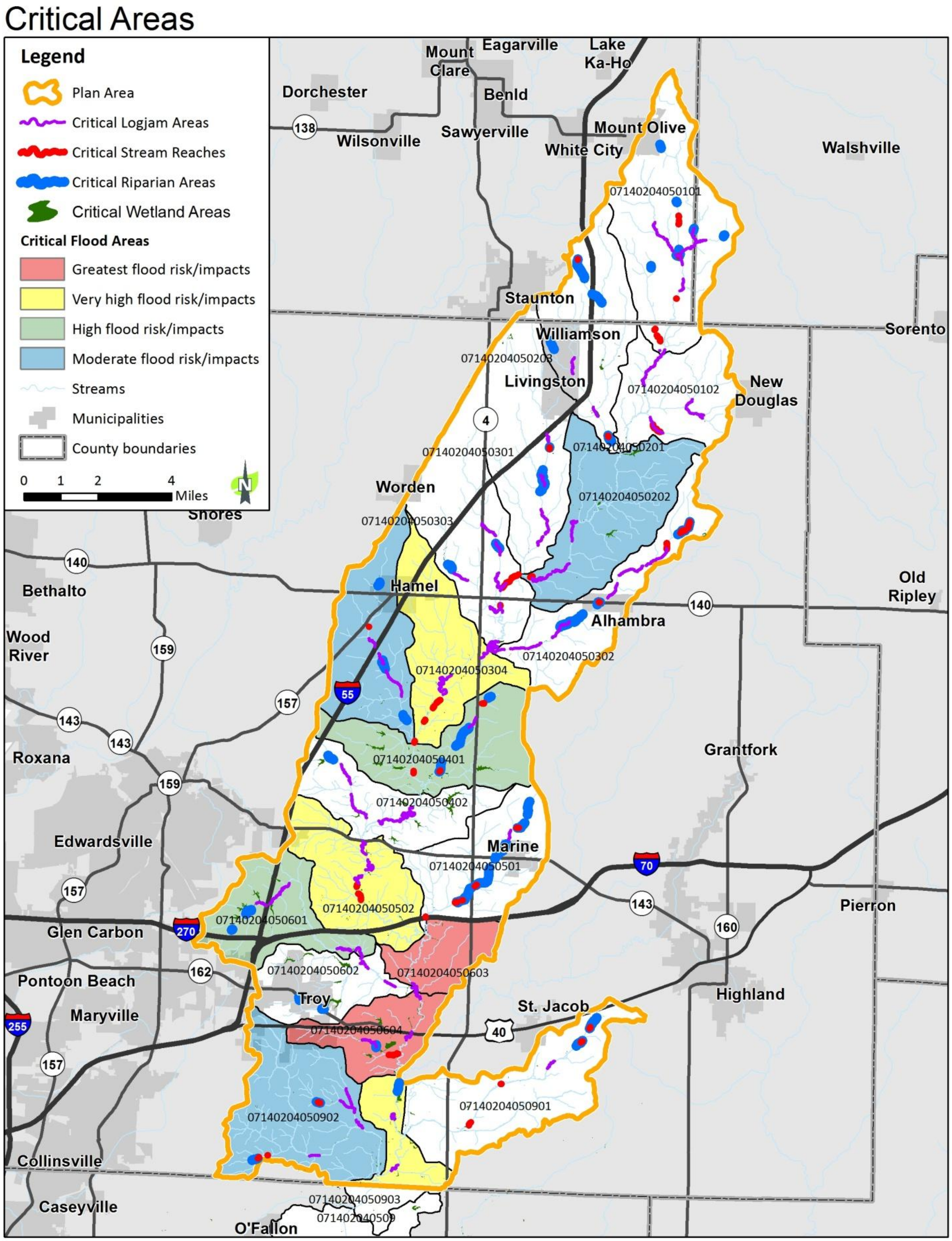
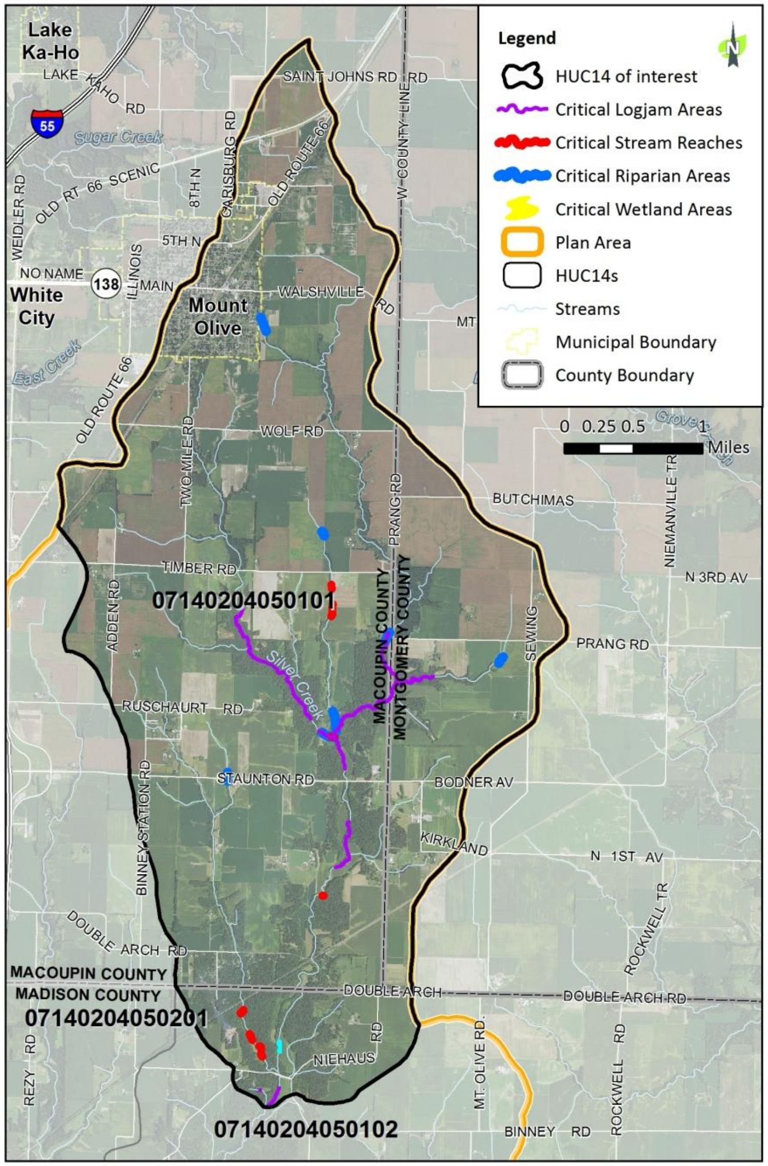


Figure 4. Critical Areas for stream reaches, logjams, riparian areas, wetlands, and flooding. See Appendix D for maps of each individual Critical Area type.



HUC 07140204050101: **Heeren Pond-Silver Creek** (Mount Olive Area)

This subwatershed is a long, diamond-shaped drainage area at the northern end of the upper Silver Creek watershed. It extends from Mount Olive in the north to below the Macoupin-Madison county line in the south.

Area: 9,613 acres
Named streams: Silver Creek
Counties: Macoupin, Madison, and Montgomery
Municipalities: Mount Olive
Townships: Mount Olive/Staunton, Walshville, Olive, and New Douglas

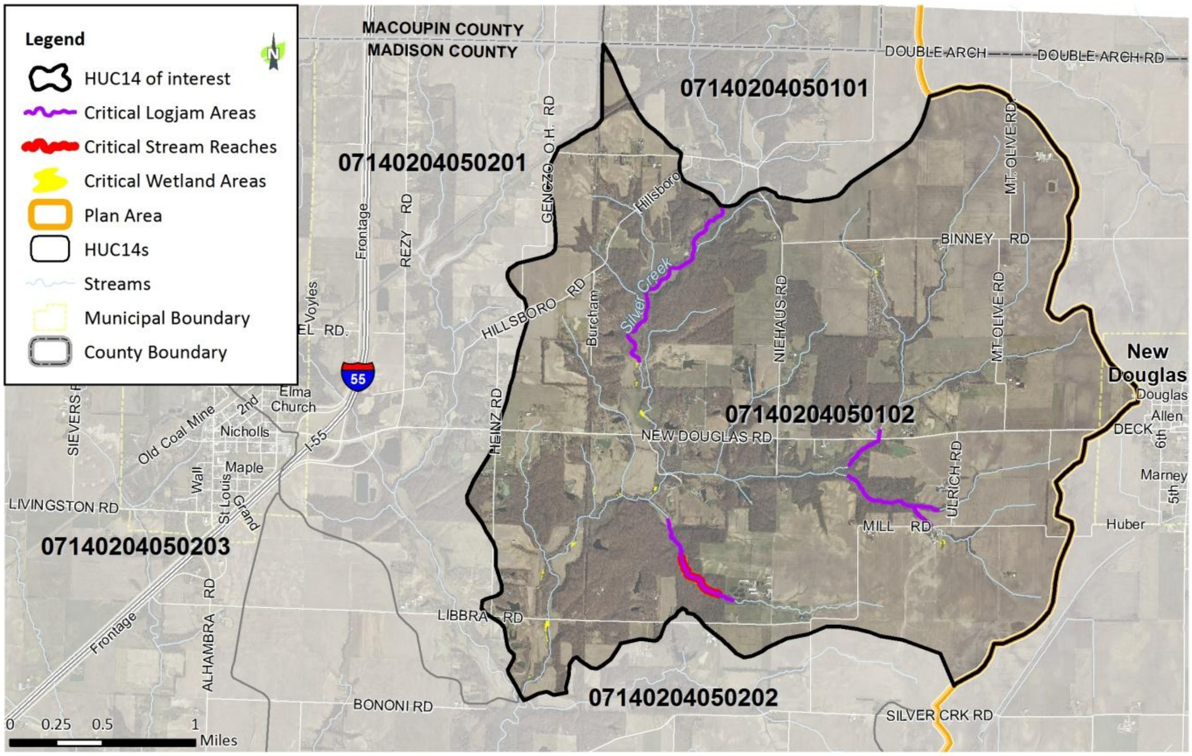
Critical Logjam Areas: 19,034 feet (3.6 miles) of Critical Logjam Areas were identified. They are largely in the forested area at the confluence of three tributaries at the north end of Silver Creek.

Critical Stream Reaches: 1,435 feet (0.27 miles) of Critical Stream Reaches were identified. Some are on a tributary to Silver Creek north of Staunton Road, one section is on Silver Creek south of Staunton Road, and three sections are on a tributary just south of the Madison-Macoupin county border.

Critical Riparian Areas: 2,988 feet (0.6 miles) of Critical Riparian Areas were identified on several tributaries, with some overlap with Critical Logjam Areas.

Critical Wetland Areas: One 0.38-acre Critical Wetland Area was identified directly adjacent to Silver Creek near the outflow of the subwatershed.

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



HUC 07140204050102: **Binney-Silver Creek** (West of New Douglas)

This subwatershed is an approximately square-shaped drainage area bisected by New Douglas Road near the northern end of the upper Silver Creek watershed. It is entirely within Madison County.

Area: 5,273 acres
Named streams: Silver Creek
Counties: Madison
Municipalities: New Douglas
Townships: Olive and New Douglas

Critical Logjam Areas: 14,884 feet (2.8 miles) of Critical Logjam Areas were identified. This includes a large section along Silver Creek itself, and segments of three tributaries to the east.

Critical Stream Reaches: 1,442 feet (0.27 miles) of Critical Stream Reaches were identified. It is all along a tributary to Silver Creek south of New Douglas Road. It overlaps a segment of the Critical Logjam Areas in this subwatershed.

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

Critical Wetland Areas: 2.95 acres of Critical Wetland Areas were identified, largely along the Silver Creek corridor.

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

HUC 07140204050201: **Big Four Reservoir** (Williamson Area)

This subwatershed is a long, diamond-shaped drainage area bisected by 1-55. Half is in Macoupin County, draining to the other half in Madison County.

Area: 6,518 acres
Named streams: None (tributaries to Silver Creek)
Counties: Macoupin and Madison
Municipalities: Williamson and Livingston
Townships: Mount Olive/Staunton and Olive

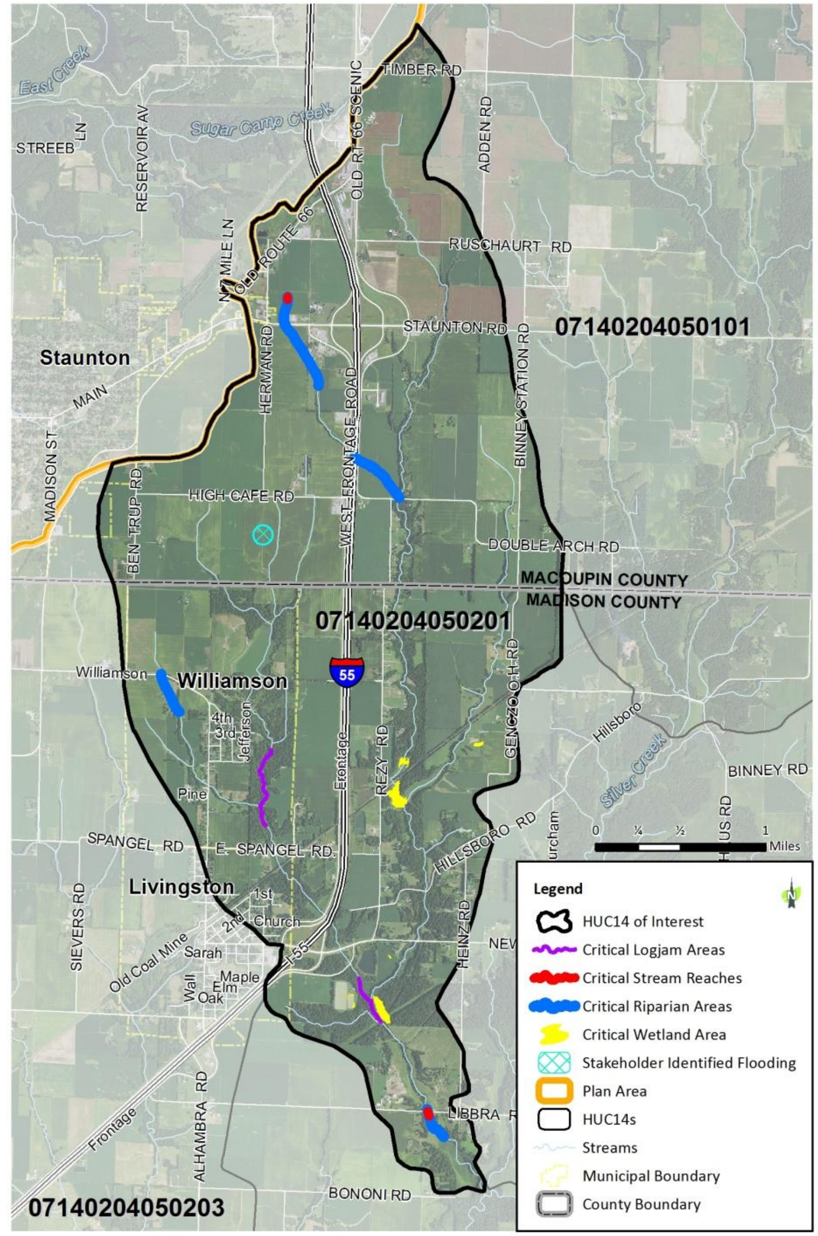
Critical Logjam Areas: 4,310 feet (0.8 miles) of Critical Logjam Areas were identified. They are in two main segments: one running north-south through Williamson, and another east of Livingston.

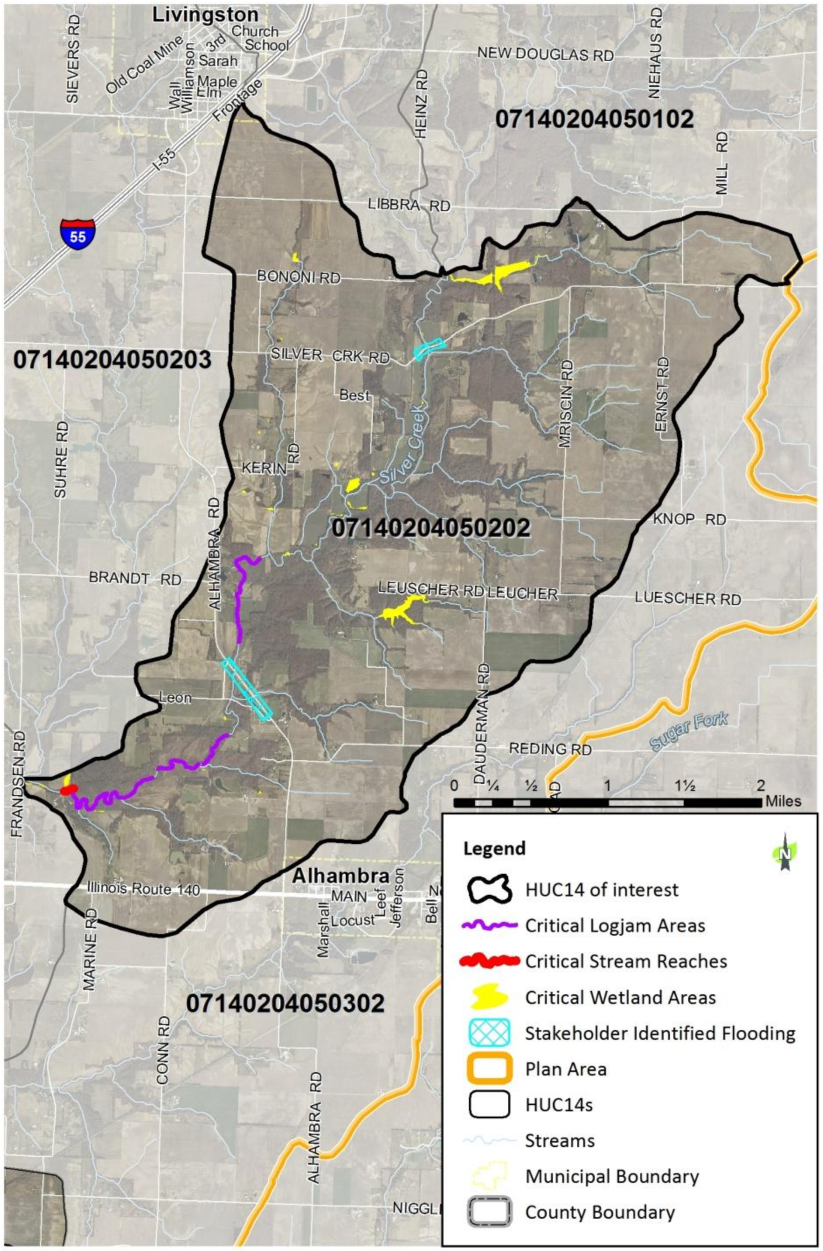
Critical Stream Reaches: 256 feet (0.05 miles) of Critical Stream Reaches were identified. This small stream reach is located near the outflow of the subwatershed, and overlaps a Critical Riparian Area.

Critical Riparian Areas: 7,433 feet (1.4 miles) of Critical Riparian Areas were identified along tributaries, including a 0.2 mile segment in Williamson.

Critical Wetland Areas: 13.49 acres of Critical Wetland Areas were identified, including two large areas on forested land adjacent to the tributary east of Williamson and Livingston.

Flooding locations identified by stakeholders are also shown. Only one flooding location of approximately 6 acres was identified on agricultural land adjacent to a tributary north of Williamson.





HUC 07140204050202: **Village of Livingston-Silver Creek (Between Livingston and Alhambra)**

This subwatershed includes the Silver Creek corridor towards the northern end of the watershed and a small segment of Route 140.

Area: 7,750 acres
Named streams: Silver Creek
Counties: Madison
Municipalities: Livingston and Alhambra (very small areas of each)
Townships: Olive, New Douglas, and Alhambra

Critical Logjam Areas: 12,297 feet (2.3 miles) of Critical Logjam Areas were identified, all along Silver Creek.

Critical Stream Reaches: 348 feet (0.07 miles) of Critical Stream Reaches were identified.

Critical Riparian Areas: No Critical Riparian Areas were identified.

Critical Wetland Areas: 37.34 acres of Critical Wetland Areas were identified along the Silver Creek corridor and on tributaries.

Flooding locations were **identified by stakeholders** on approximately 27 acres in three locations (Frandsen Road, Alhambra Road, and Silver Creek Road). Flood water overtopping the road was the issue at each location.

Critical Flood Area: This subwatershed is a Critical Flood Area that has high flood risk/impacts (#8 out of 20 HUC14 subwatersheds in the upper Silver Creek watershed).

HUC 07140204050203: **Village of** Livingston

This long subwatershed drains southward from Livingston into Silver Creek. It is bounded by Route 4 to the west and a railway berm to the north. I-55 runs through it.

Area: 7,756 acres
Named streams: None (tributaries to Silver Creek)
Counties: Madison and Macoupin
Municipalities: Livingston and Williamson
Townships: Mount Olive/Staunton, Olive, and Alhambra

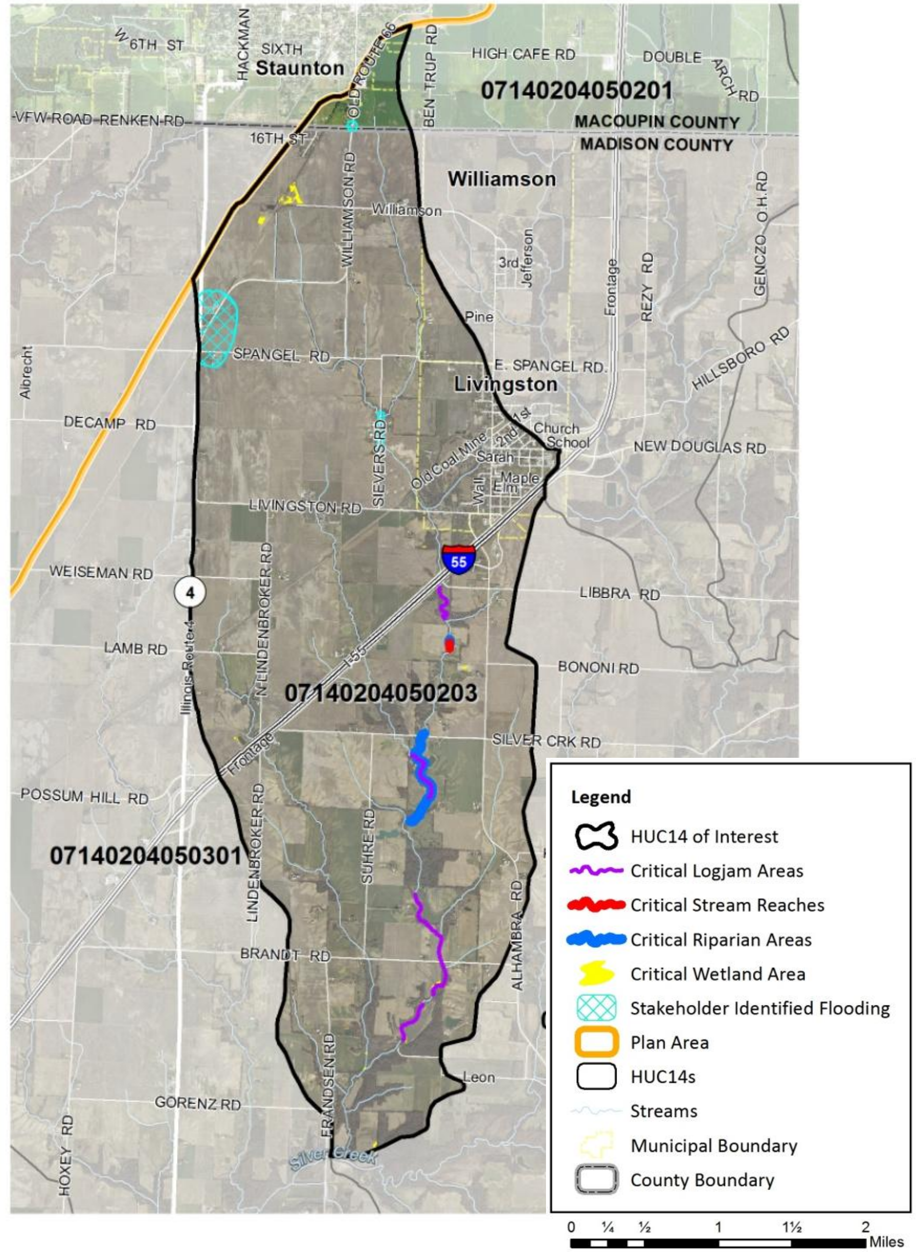
Critical Logjam Areas: 9,753 feet (1.8 miles) of Critical Logjam Areas were identified. They are all found on stream segments south of I-55. One of the Critical Logjam Areas overlaps with a long Critical Riparian Area.

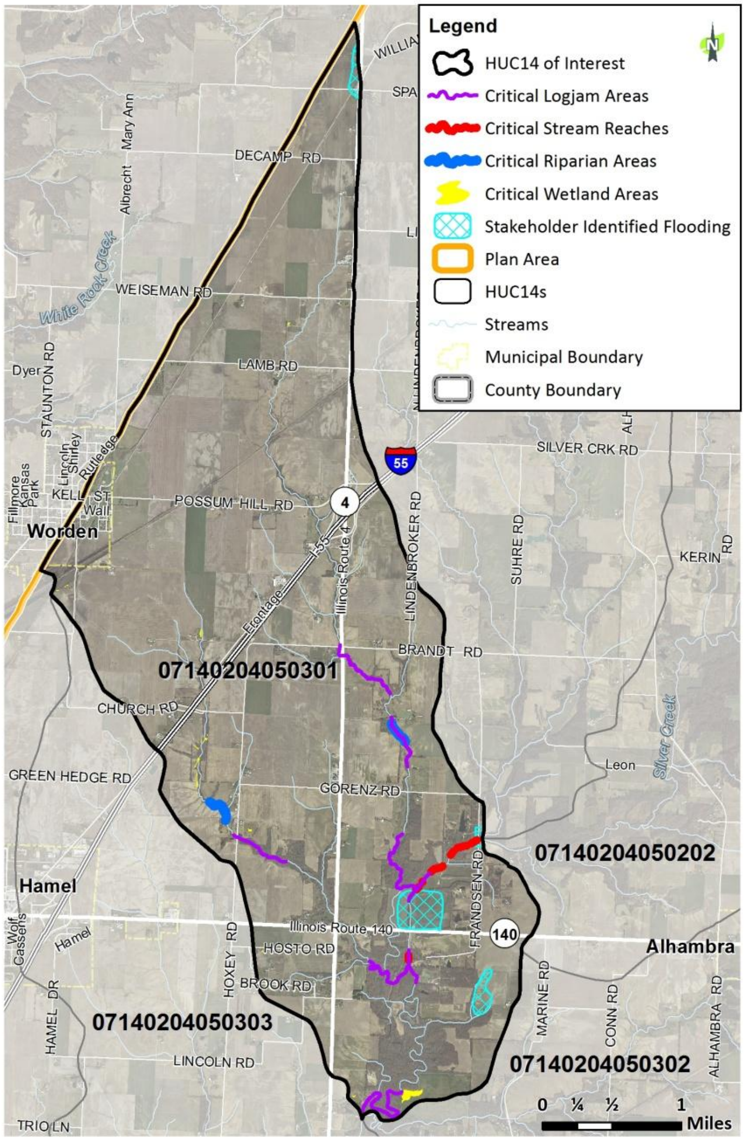
Critical Stream Reaches: 214 feet (0.04 miles) of Critical Stream Reaches were identified. This small section overlaps with a Critical Riparian Area south of I-55.

Critical Riparian Areas: One 4,113-ft (0.8 mile) Critical Riparian Area was identified on a tributary. It entirely overlaps a Critical Logjam Area.

Critical Wetland Areas: 7.91 acres of Critical Wetland Areas were identified. The greatest concentration of these areas is on agricultural land at the north end of the subwatershed south of Staunton.

Flooding locations were **identified by stakeholders** on approximately 80 acres in four locations, including an area adjacent to Route 4 where the flood waters occasionally overtop the road. The three other locations also relate to road overtopping (Sievers Rd, Frandsen Rd, and Renken Rd).





HUC 07140204050301: **Village of Worden-Silver Creek** (East of Worden)

Bounded by a railway berm along its northwest side, this subwatershed drains east and south from Worden. I-55 and Routes 4 and 140 run through it. Silver Creek runs through the southern end of this area.

Area: 8,050 acres
Named streams: Silver Creek
Counties: Madison
Municipalities: Worden
Townships: Mount Olive/Staunton and Olive

Critical Logjam Areas: 21,703 feet (4.1 miles) of Critical Logjam Areas were identified in six areas. A particularly long and meandering stream segment prone to logjams can be found at the intersection of the tributary with Silver Creek.

Critical Stream Reaches: 1,530 feet (0.29 miles) of Critical Stream Reaches were identified, all along Silver Creek near Route 140. There is some overlap with Critical Logjam Areas.

Critical Riparian Areas: 2,089 feet (0.4 miles) of Critical Riparian Areas were identified on two tributaries north of Route 140. One Critical Riparian Area overlaps with a Critical Logjam Area.

Critical Wetland Areas: 7.91 acres of Critical Wetland Areas were identified along tributaries and in one large area adjacent to Silver Creek near the south end of the subwatershed.

Flooding locations were **identified by stakeholders** on approximately 90 acres in four locations, including an area adjacent to Route 4 where the flood waters occasionally overtop the road, two other road overtopping locations (e.g. Frandsen Rd), and cropland flooding (near the intersection of Route 140 and Frandsen Rd).

HUC 07140204050302: **Village of** Alhambra

This long and narrow subwatershed represents the area drained by the tributary that runs through Alhambra.

Area: 5,797 acres
Named streams: None (tributary to Silver Creek)
Counties: Madison
Municipalities: Alhambra
Townships: Alhambra, Olive, New Douglas, and Leef

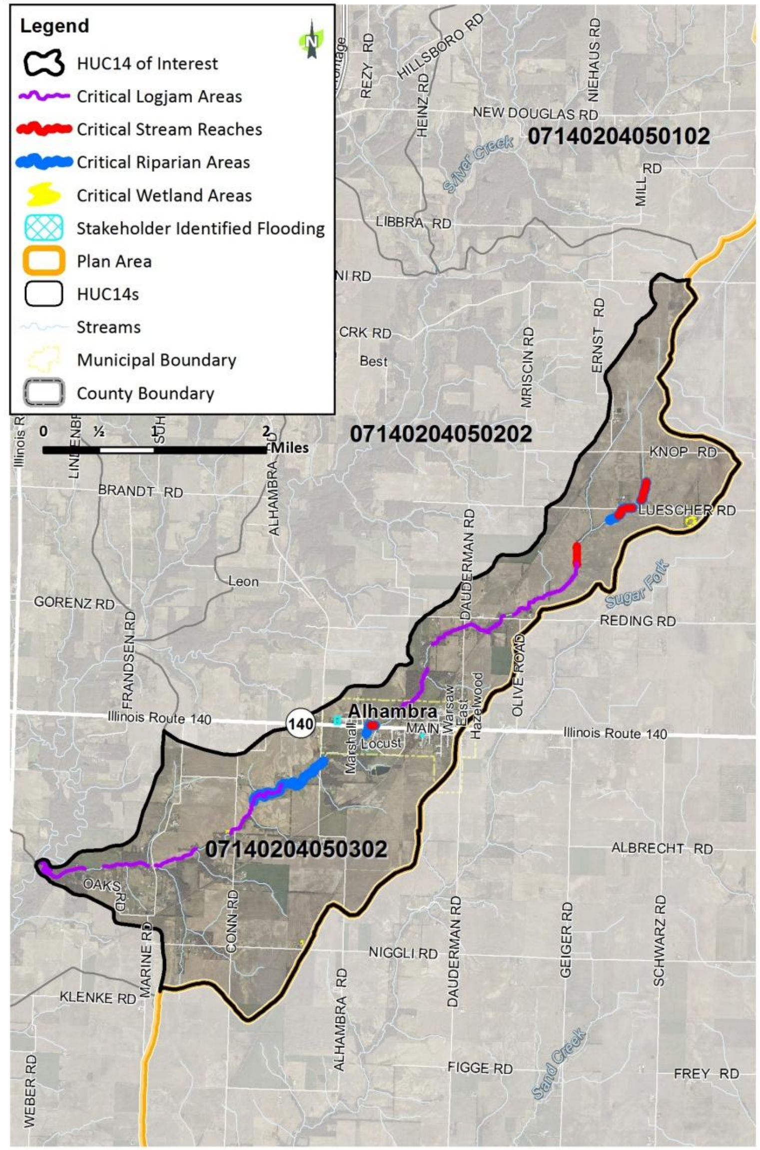
Critical Logjam Areas: 24,131 feet (4.6 miles) of Critical Logjam Areas were identified, covering the majority of the tributary. This is the greatest length of Critical Logjam Areas of any of the subwatersheds. There is some overlap with Critical Riparian Areas and Critical Stream Areas.

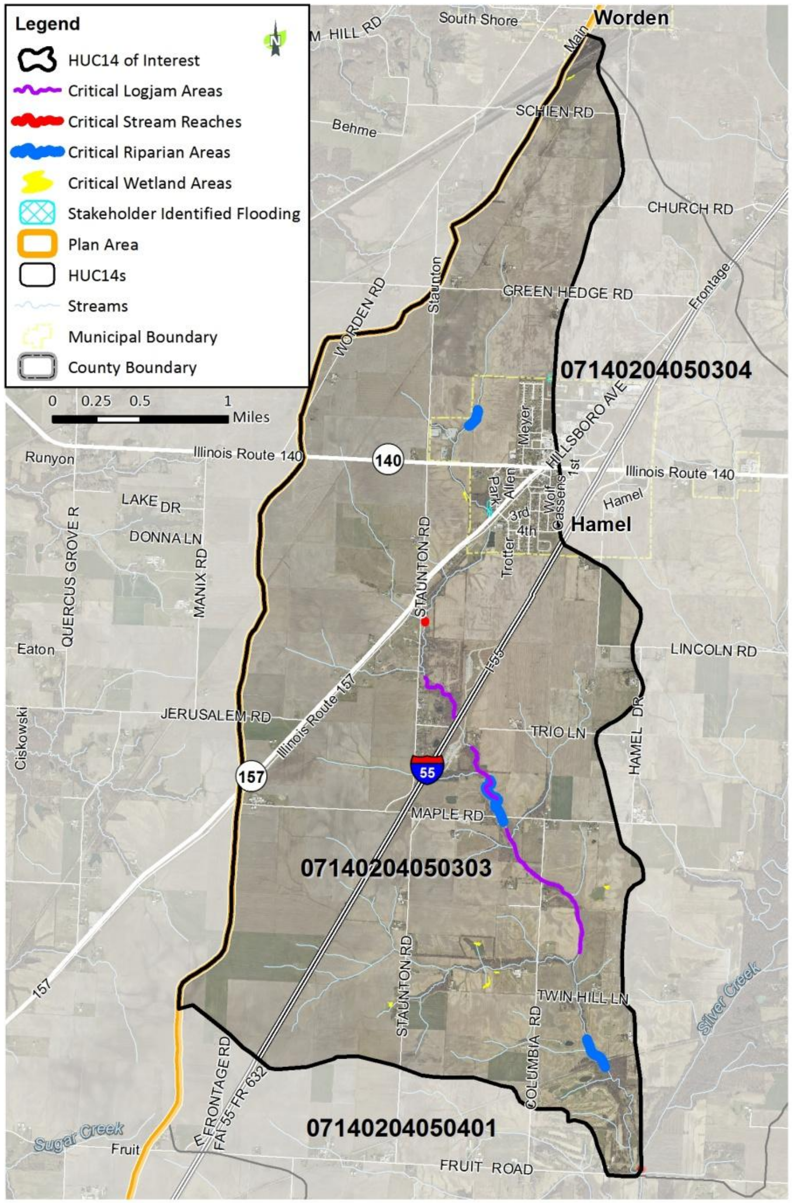
Critical Stream Reaches: 2,145 feet (0.46 miles) of Critical Stream Reaches were identified, located at the northern end of the tributary and just north of Route 140 in Alhambra. This is the greatest length of Critical Stream Reaches of any of the subwatersheds. All Critical Stream Reaches in this subwatershed overlap Critical Riparian Areas.

Critical Riparian Areas: 7,605 feet (1.4 miles) of Critical Riparian Areas were identified along the tributary, upstream, within, and below Alhambra. They overlap significantly with Critical Stream Reaches and Critical Logjam Areas.

Critical Wetland Areas: 6.46 acres of Critical Wetland Areas were identified along the tributary and on agricultural land at the edges of the subwatershed.

Flooding locations were **identified by stakeholders** on approximately 2 acres over two locations in Alhambra. One stakeholder reported a flash flood reaching into a residential basement (Walnut Street); another stakeholder identified flooding on the west side of West Street as water comes in from fields to the north.





HUC 07140204050303: Village of Hamel

(Draft Code used in Appendix A: 07140204050304)

This subwatershed includes the west side of Hamel and portions of I-55, Route 140, and Route 157.

Area: 6,225 acres
Named streams: None (tributary of Silver Creek)
Counties: Madison
Municipalities: Hamel
Townships: Hamel and Omphghent

Critical Logjam Areas: 8,801 feet (1.7 miles) of Critical Logjam Areas were identified along three sections of the main tributary to Silver Creek. There is some overlap with a Critical Riparian Area south of I-55.

Critical Stream Reaches: One 42-foot (0.01-mile) Critical Stream Reach was identified at the intersection of two tributaries south of Route 157.

Critical Riparian Areas: 3,278 feet (0.6 miles) of Critical Riparian Areas were identified along three sections of a tributary. One section overlaps a Critical Logjam Area.

Critical Wetland Areas: 2.69 acres of Critical Wetland Areas were identified in small areas of agricultural land around the tributaries.

Flooding locations were **identified by stakeholders** on approximately 2 acres in two locations in Hamel: one on the north side where basement flooding has occurred (flooded area sits on the watershed boundary and extends to HUC 07140204050304/Village of Hamel – Silver Creek (Southeast of Hamel), and one on a corner lot on Park Avenue where flooded areas reach 3 feet deep.

Critical Flood Area: This subwatershed is a Critical Flood Area that has moderate flood risk/impacts (#10 out of 20 HUC14 subwatersheds in the upper Silver Creek watershed).

HUC 07140204050304: Village of Hamel – Silver Creek (Southeast of Hamel)

(Draft Code used in Appendix A: 07140204050303)

This subwatershed includes the intersection of I-55 and Route 140 at Hamel, a portion of Route 4, and a significant meandering segment of Silver Creek.

Area: 6,064 acres
Named streams: Silver Creek
Counties: Madison
Municipalities: Hamel
Townships: Hamel, Alhambra, Omphghent, and Pin Oak

Critical Logjam Areas: 9,574 feet (1.8 miles) of Critical Logjam Areas were identified in the subwatershed, along two segments of Silver Creek. The Critical Logjam Area at the north end of the subwatershed is adjacent to the Critical Logjam Area at the south end of HUC 07140204050302/Village of Alhambra.

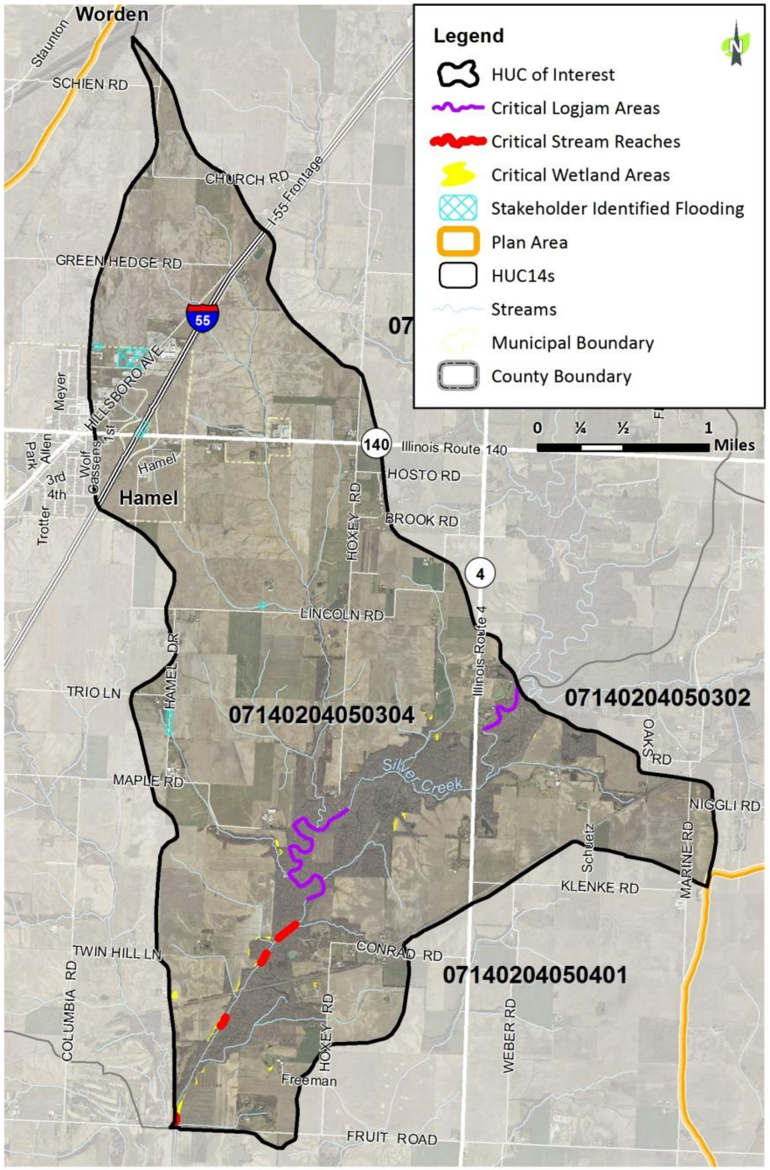
Critical Stream Reaches: 1,411 feet (0.27 miles) of Critical Stream Reaches were identified, all on Silver Creek at the southern end of the subwatershed, and all closely adjacent to Critical Wetland Areas.

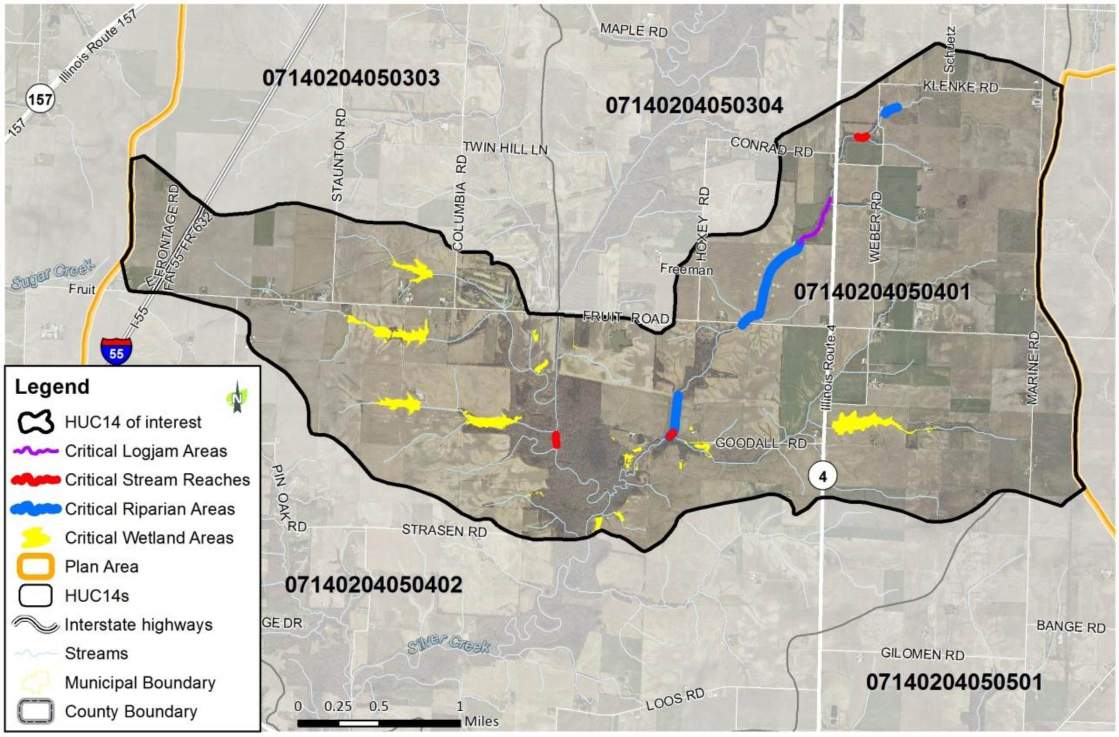
Critical Riparian Areas: No Critical Riparian Areas were identified.

Critical Wetland Areas: 6.73 acres of Critical Wetland Areas were identified, almost entirely within the forested Silver Creek corridor.

Flooding locations were **identified by stakeholders** on approximately 19 acres in five locations, including three in Hamel: a subdivision on the north side of Hamel (flooded basements), a flat area in front of the Hamel firehouse, and the I-55 highway. Other reported flooding in the subwatershed included road overtopping on Hamel Drive and on a private driveway crossing a tributary.

Critical Flood Area: This subwatershed is a Critical Flood Area that has very high flood risk/impacts (#4 out of 20 HUC14 subwatersheds in the upper Silver Creek watershed).





HUC 07140204050401: **Grigsby Lake – Silver Creek** (Fruit Road Area)

This subwatershed spans the width of the watershed northwest of Marine, roughly along Fruit Road, including Silver Creek and a few tributaries. Sections of I-55 and Route 4 are included.

Area: 6,291 acres
Named streams: Silver Creek
Counties: Madison
Municipalities: None
Townships: Hamel, Alhambra, Pin Oak, and Marine

Critical Logjam Areas: One 1,928-foot (0.4-mile) Critical Logjam Area was identified, on a tributary directly west of Route 4.

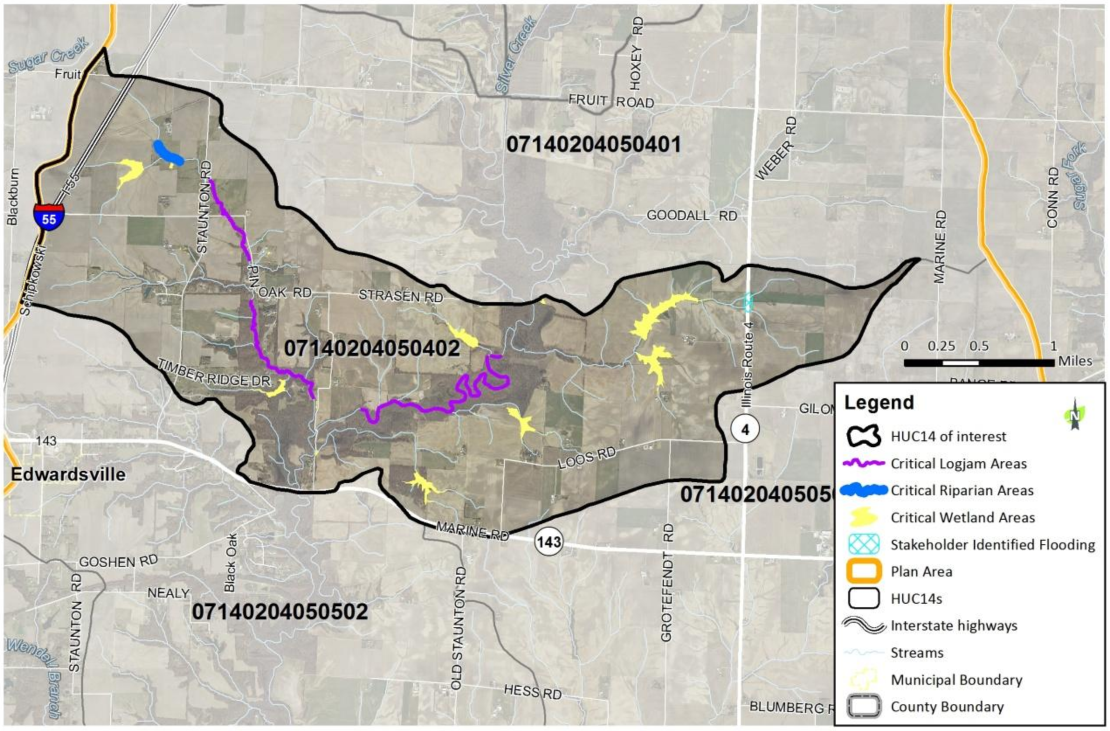
Critical Stream Reaches: 780 feet (0.15 miles) of Critical Stream Reaches were identified in three segments; one along Silver Creek, one close by on a tributary overlapping a Critical Riparian Area, and one near Route 4.

Critical Riparian Areas: 5,345 feet (1.0 mile) of Critical Riparian Areas were identified in three sections on one tributary to Silver Creek.

Critical Wetland Areas: 83.11 acres of Critical Wetland Areas were identified. This is the greatest area of Critical Wetland Areas of any of the subwatersheds. There are opportunities for large wetland areas on four of the tributaries in this watershed, as well as smaller areas along Silver Creek.

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

Critical Flood Area: This subwatershed is a Critical Flood Area that has moderate flood risk/impacts (#7 out of 20).



HUC 07140204050**402**: **Willaredt Lake-Silver Creek** (Pin Oak Road Area)

This subwatershed spans the width of the watershed northeast of Edwardsville, including a slice of Silver Creek and a few short tributaries. I-55 cuts through the northwest corner.

Area: 5,188 acres
Named streams: Silver Creek
Counties: Madison
Municipalities: None
Townships: Pin Oak, Marine, and Hamel

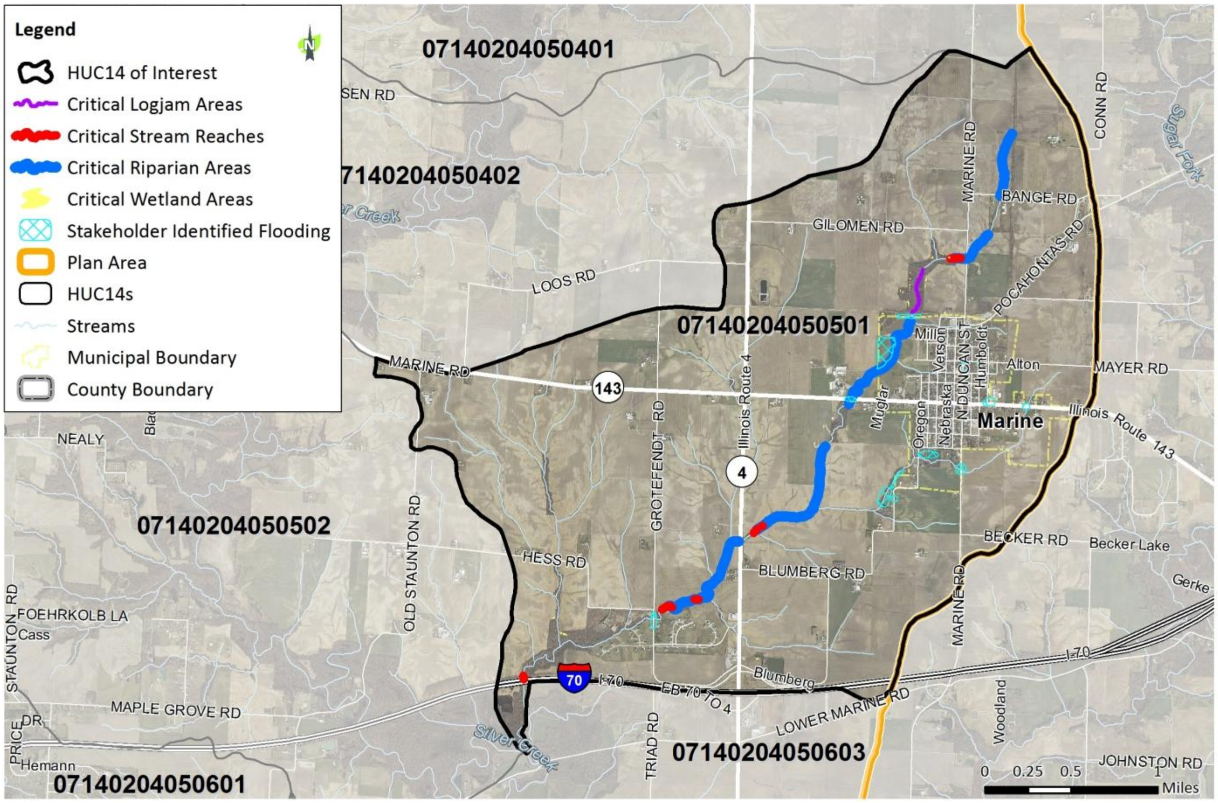
Critical Logjam Areas: 19,884 feet (3.8 miles) of Critical Logjam Areas were identified. This includes two segments of Silver Creek and two segments on a tributary on the west side of Silver Creek.

Critical Stream Reaches: No Critical Stream Reaches were identified.

Critical Riparian Areas: One 1,050-foot (0.2-mile) Critical Riparian Area was identified on a tributary near I-55.

Critical Wetland Areas: 75.65 acres of Critical Wetland Areas were identified. As with the subwatershed to the north, Grigsby Lake – Silver Creek (Fruit Road Area), there are opportunities for very large wetland areas on several tributaries to Silver Creek, in addition to smaller areas.

Flooding locations were **identified by stakeholders** on approximately 3 acres at one location where flood waters overtop Route 4 northwest of Marine.



HUC 07140204050501: **Neudeckers Mountain** (Marine Area)

(Draft Code used in Appendix A: 07140204050502)

This subwatershed drains all of Marine and includes the intersection of Routes 4 and 143. I-70 is its southern boundary.

Area: 5,843 acres
Named streams: None (tributaries to Silver Creek)
Counties: Madison
Municipalities: Marine
Townships: Marine and Pin Oak

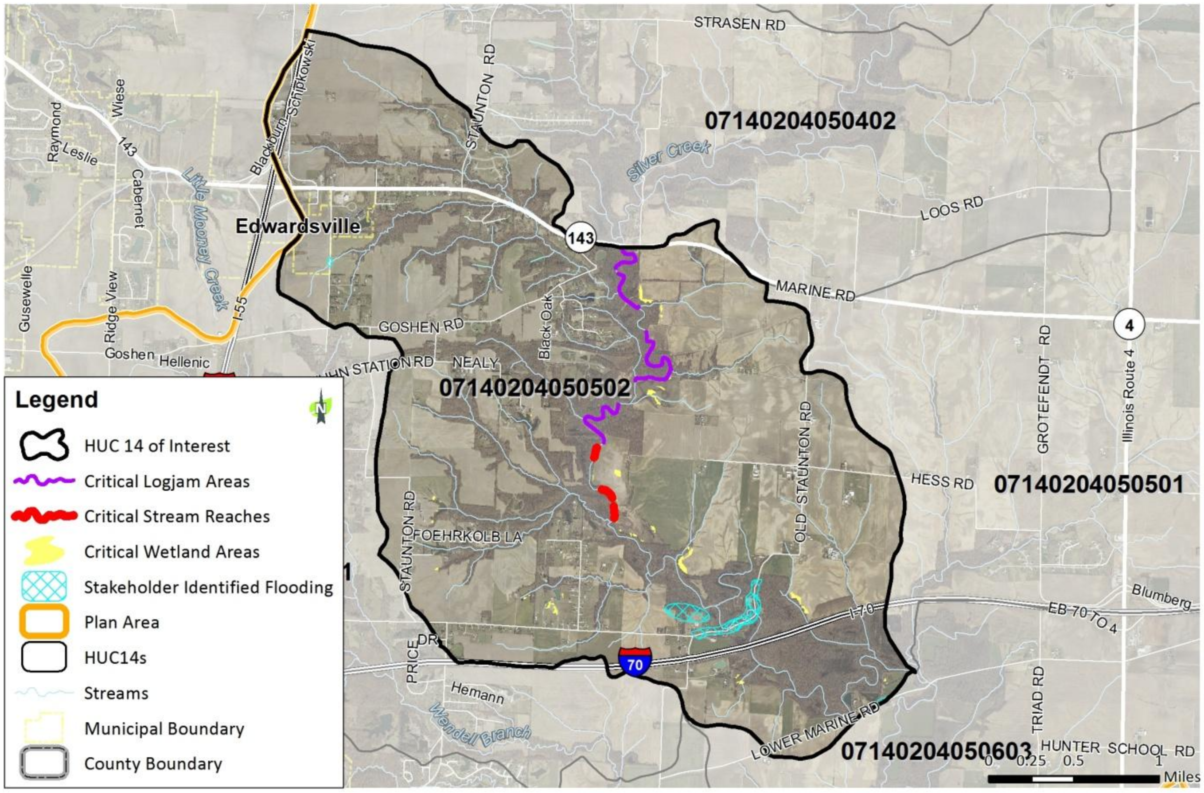
Critical Logjam Areas: One 1,457-foot (0.3-mile) Critical Logjam Area was identified on a tributary north of Marine.

Critical Stream Reaches: 1,094 feet (0.21 miles) of Critical Stream Reaches were identified in six locations along the tributary, most of which overlap with Critical Riparian Areas.

Critical Riparian Areas: 14,503 feet (2.7 miles) of Critical Riparian Areas were identified, covering the majority of the major tributary in this subwatershed. This is the greatest length of Critical Riparian Areas of any of the subwatersheds. There is some overlap with Critical Stream Reaches.

Critical Wetland Areas: 1.46 acres of Critical Wetland Areas were identified, in small sections of forested area along the tributary. Some of these small areas are on the north side of Marine.

Flooding locations were **identified by stakeholders** on approximately 27 acres in 11 locations in and around Marine. These include road overtopping at 6 locations (Route 143, Grotefendt Rd, Division St, Marine Rd, and Duncan Rd), flooding in the public park in the northwest corner of Marine, floodwater next to Division Street at Mawdesley Street, and flooded land in the stream corridor.



<u>HUC 07140204050502: **Dale Twin Lakes –South Lake – Silver Creek** (East of Edwardsville)</u>

(Draft Code used in Appendix A: 07140204050501)

This subwatershed is bisected by Silver Creek as it flows southwards on the east side of Edwardsville.

Area: 5,799 acres
Named streams: Silver Creek
Counties: Madison
Municipalities: Edwardsville
Townships: Pin Oak

Critical Logjam Areas: 9,411 feet (1.8 miles) of Critical Logjam Areas were identified on Silver Creek.

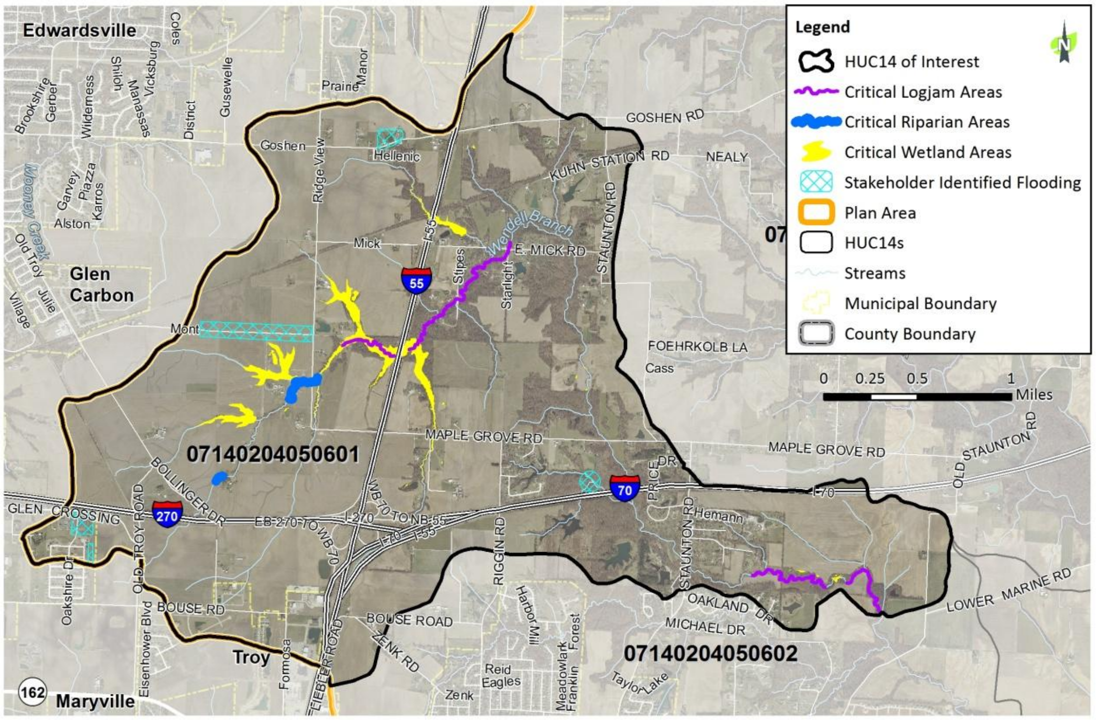
Critical Stream Reaches: 1,074 feet (0.20 miles) of Critical Stream Reaches were identified in three segments along Silver Creek in the center of the subwatershed. These segments are closely adjacent to Critical Wetland Areas.

Critical Riparian Areas: No Critical Riparian Areas were identified.

Critical Wetland Areas: 12.13 acres of Critical Wetland Areas were identified, largely within the Silver Creek corridor, but also along smaller tributaries.

Flooding locations were **identified by stakeholders** on approximately 43 acres in five locations, four of which were road overtopping (Old Staunton Road, Staunton Road, and Lower Marine Road). The fifth location was flooded farm and forest land adjacent to Silver Creek.

Critical Flood Area: This subwatershed is a Critical Flood Area that has very high flood risk/impacts (#3 out of 20 HUC14 subwatersheds in the upper Silver Creek watershed).



HUC 07140204050601: **Headwaters Wendell Branch** (North of Troy)

(Draft Code used in Appendix A: 07140204050602)

This subwatershed covers the headwaters of Wendell Branch, a major tributary to Silver Creek, as it flows west to east on the north side of Troy. This area also includes highway interchanges between I-55, I-70, and I-270.

Area: 5,012 acres
Named streams: Wendell Branch
Counties: Madison
Municipalities: Troy, Glen Carbon, and Edwardsville (small portions of Glen Carbon and Edwardsville)
Townships: Pin Oak, Edwardsville, and Jarvis

Critical Logjam Areas: 12,683 feet (2.4 miles) of Critical Logjam Areas were identified in this subwatershed. There are two segments at the upper end of Wendell Branch either side of I-55. Two more segments are also on Wendell Branch near the outflow of the subwatershed, south of I-70.

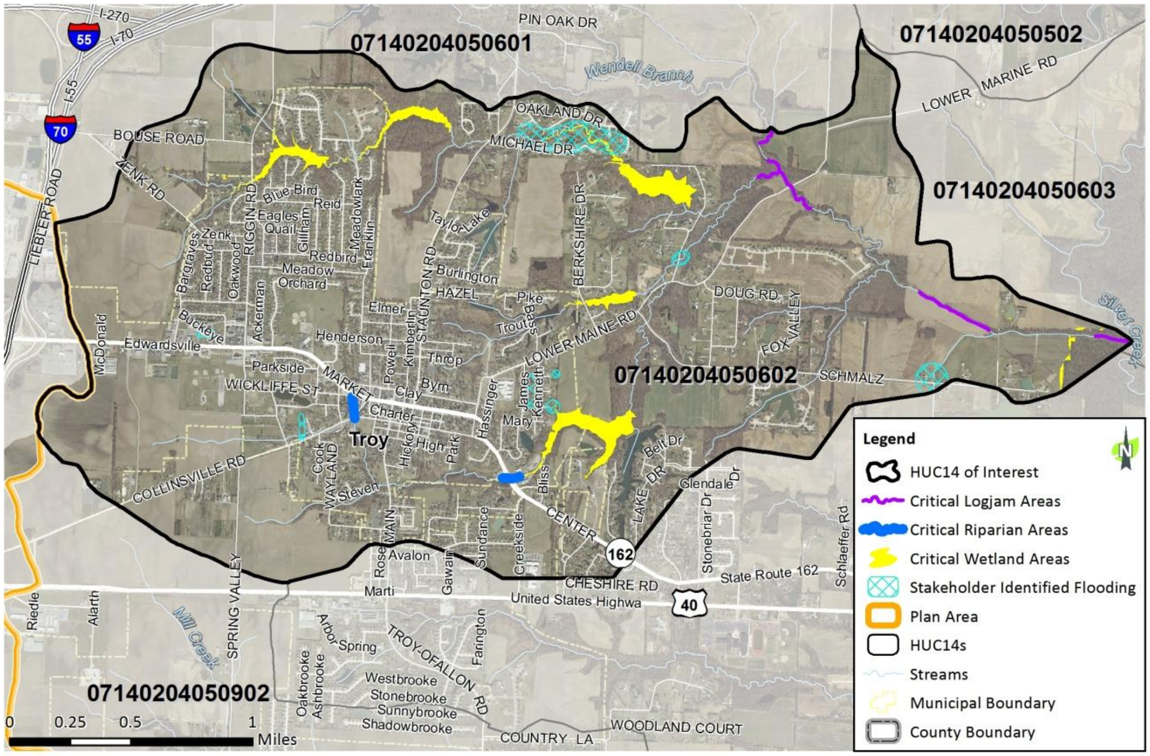
Critical Stream Reaches: No Critical Stream Reaches were identified.

Critical Riparian Areas: 1,627 feet (0.3 miles) of Critical Riparian Areas were identified in two sections in the headwaters of Wendell Branch.

Critical Wetland Areas: 67.64 acres of Critical Wetland Areas were identified at several locations on the upper reaches of Wendell Branch near I-55. There is significant overlap with Critical Logjam Areas.

Flooding locations were **identified by stakeholders** on approximately 55 acres in four locations: Mont Road, where floods overtopped the road and entered farm fields; lots north of Goshen Road, which received water from fields to the north; a tributary south of Maple Grove Road where the creek burst its banks; and flooding in yards and basements along the east side of Oakshire Drive.

Critical Flood Area: This subwatershed is a Critical Flood Area that has high flood risk/impacts (#6 out of 20 HUC14 subwatersheds in the upper Silver Creek watershed).



HUC 07140204050602: **Twin Lakes – Wendell Branch** (Troy Area)

(Draft Code used in Appendix A: 07140204050603)

This subwatershed covers almost all of Troy, and drains to the lower section of Wendell Branch. Route 162 is present.

Area: 4,046 acres
Named streams: Wendell Branch
Counties: Madison
Municipalities: Troy
Townships: Jarvis and Pin Oak

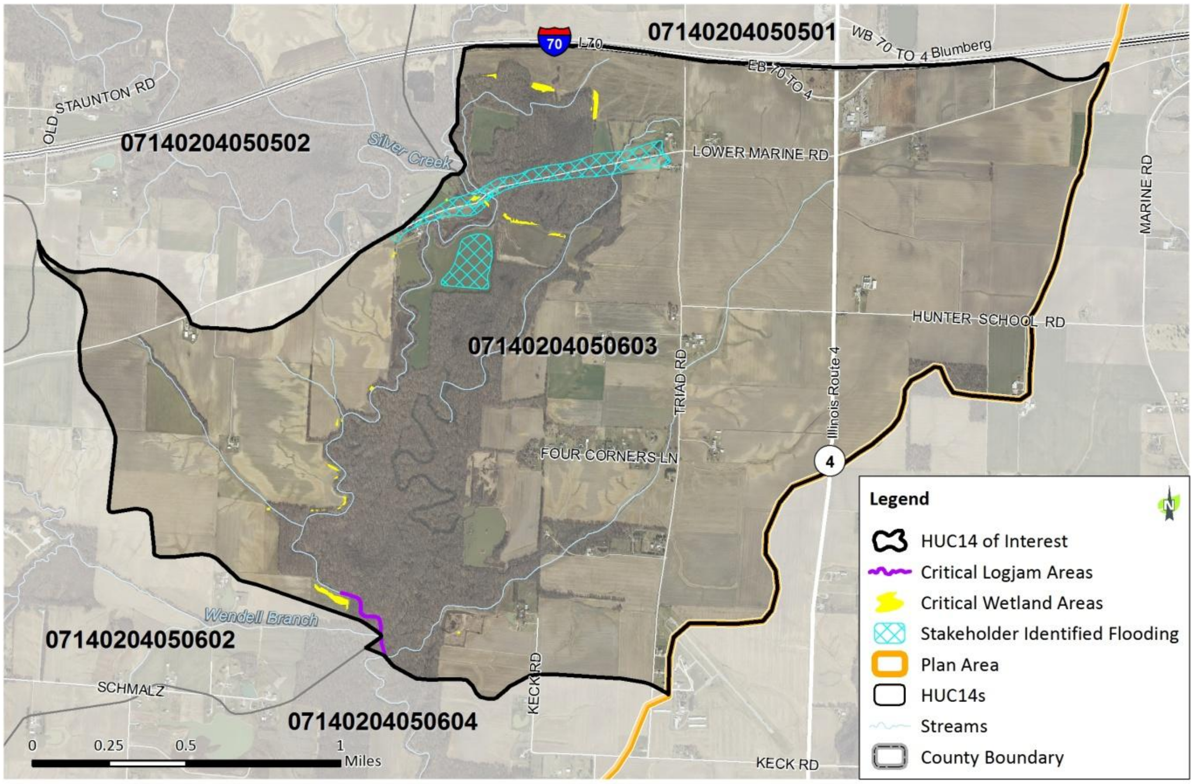
Critical Logjam Areas: 5,188 feet (1.0 mile) of Critical Logjam Areas were identified along three segments of Wendell Branch (and one tributary) east of Troy.

Critical Stream Reaches: No Critical Stream Reaches were identified.

Critical Riparian Areas: 846 feet (0.2 miles) of Critical Riparian Areas were identified in two sections of urban Troy, one of which crosses Route 162.

Critical Wetland Areas: 61.57 acres of Critical Wetland Areas were identified, including five large areas in and around Troy. Three Critical Wetland Areas are located on one long tributary to Wendell Branch on the north side of Troy, among subdivisions, forest, and agricultural land.

Flooding locations were **identified by stakeholders** on approximately 46 acres in six locations in and around Troy. Flooding within city boundaries was identified in a parking lot floods between Edwardsville and Buckeye Roads, on land between Kenneth and Wayne Roads, and in backyards and basements on Parkview Drive. North of the city, a large area of flooding was identified along Michael Drive when Hurricane Ike flooded land and basements in 2008. East of Troy, floods overtopped Timber Ridge Road and Schlaefer Road.



HUC 07140204050603: **07140204050603 – Silver Creek** (South of Marine)

(Draft Code used in Appendix A: 07140204050601)

This subwatershed covers the section of Silver Creek below I-270 south of Marine, including part of Route 4.

Area: 2,758 acres
Named streams: Silver Creek
Counties: Madison
Municipalities: None
Townships: Pin Oak, Marine, Jarvis, and St. Jacob

Critical Logjam Areas: One 1,537-foot (0.3-mile) Critical Logjam Area was identified on Silver Creek at the south end of the subwatershed.

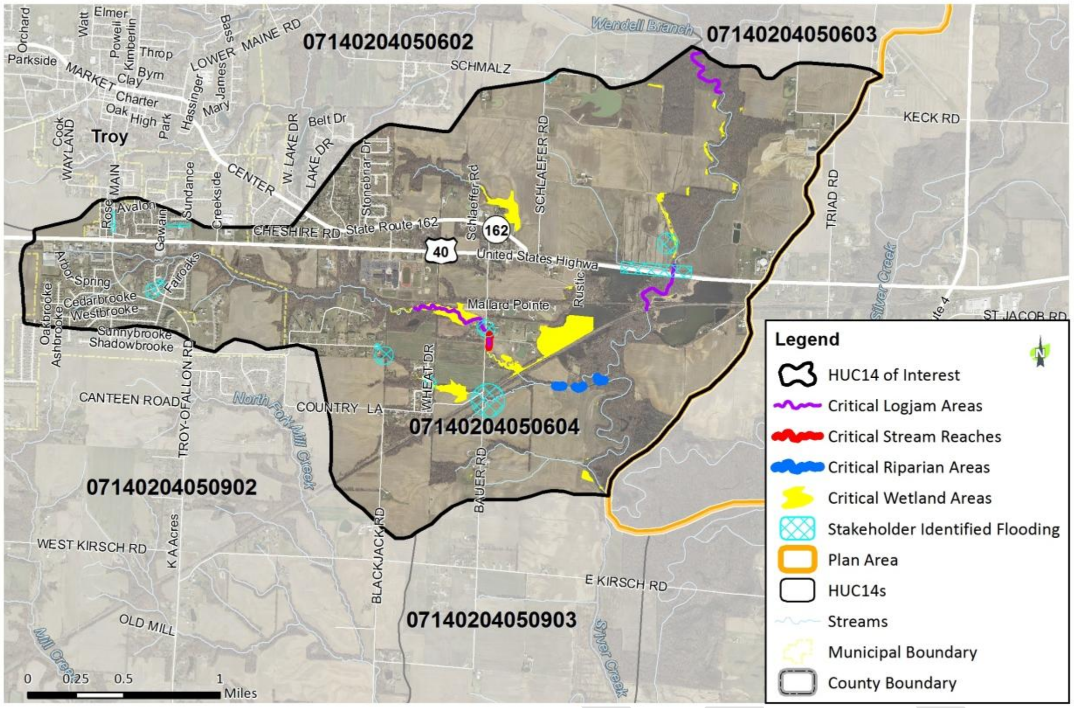
Critical Stream Reaches: No Critical Stream Reaches were identified.

Critical Riparian Areas: No Critical Riparian Areas were identified.

Critical Wetland Areas: 5.24 acres of Critical Wetland Areas were identified, all of which are located in the forested Silver Creek corridor. One long section is adjacent to a Critical Logjam Area.

Flooding locations were **identified by stakeholders** on approximately 45 acres in two locations in the Silver Creek floodplain where flood waters overtopped Lower Marine Road and a bridge over Silver Creek.

Critical Flood Area: This subwatershed is a Critical Flood Area that has the greatest flood risk/impacts (#1 out of 20 HUC14 subwatersheds in the upper Silver Creek watershed).



HUC 07140204050604: **City of Troy – Silver Creek** (East of Troy)

This subwatershed encompasses the section of Silver Creek east of Troy, and a tributary that runs from the south side of Troy. Route 140 runs east-west, connecting with Route 162 in the middle of the subwatershed.

Area: 3,682 acres
Named streams: Silver Creek
Counties: Madison
Municipalities: Troy
Townships: Jarvis and St. Jacob

Critical Logjam Areas: 6,994 feet (1.3 miles) of Critical Logjam Areas were identified in this area, including two segments on Silver Creek (one crossing Route 140), and one on the tributary south of Route 40. There is some overlap with Critical Riparian Areas.

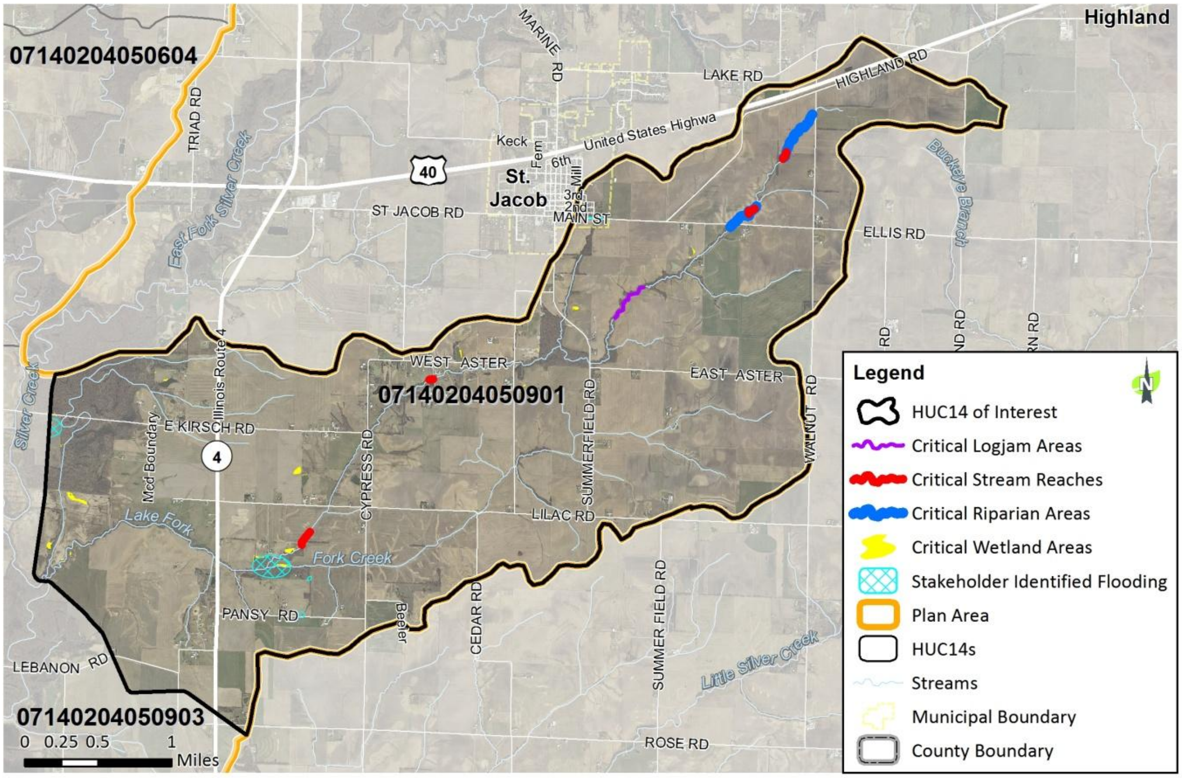
Critical Stream Reaches: 701 feet (0.13 miles) of Critical Stream Reaches were identified in three short sections on or close to Silver Creek (forested bottomland area).

Critical Riparian Areas: A 364-foot (0.1 mile) Critical Riparian Area was identified on a tributary, overlapped by a Critical Logjam Area.

Critical Wetland Areas: 63.11 acres of Critical Wetland Areas were identified, including one large area in the forested Silver Creek corridor, and four large areas along tributaries to Silver Creek on the east side of Troy.

Flooding locations were **identified by stakeholders** on approximately 52 acres in 11 locations. Several instances of road overtopping were reported (Route 40, Wheat Drive, Main Street, Schlaefer Road, and Bauer Road). Yards (Woodland Court and Pin Oak Road) and fields (near Woodland Court, and near Route 40 on the east side of the watershed) were also flooded.

Critical Flood Area: This subwatershed is a Critical Flood Area that has very high flood risk/impacts (#2 out of 20).



HUC 07140204050901: Lake Fork (South of St. Jacob)

(Draft Code used in Appendix A: 07140204050902)

This subwatershed is the watershed of Lake Fork, which drains the south side of St. Jacob. Fork Creek, a tributary of Lake Fork, is also included.

Area: 7,762 acres
Named streams: Lake Fork and Fork Creek
Counties: Madison
Municipalities: St. Jacob
Townships: St. Jacob and Jarvis

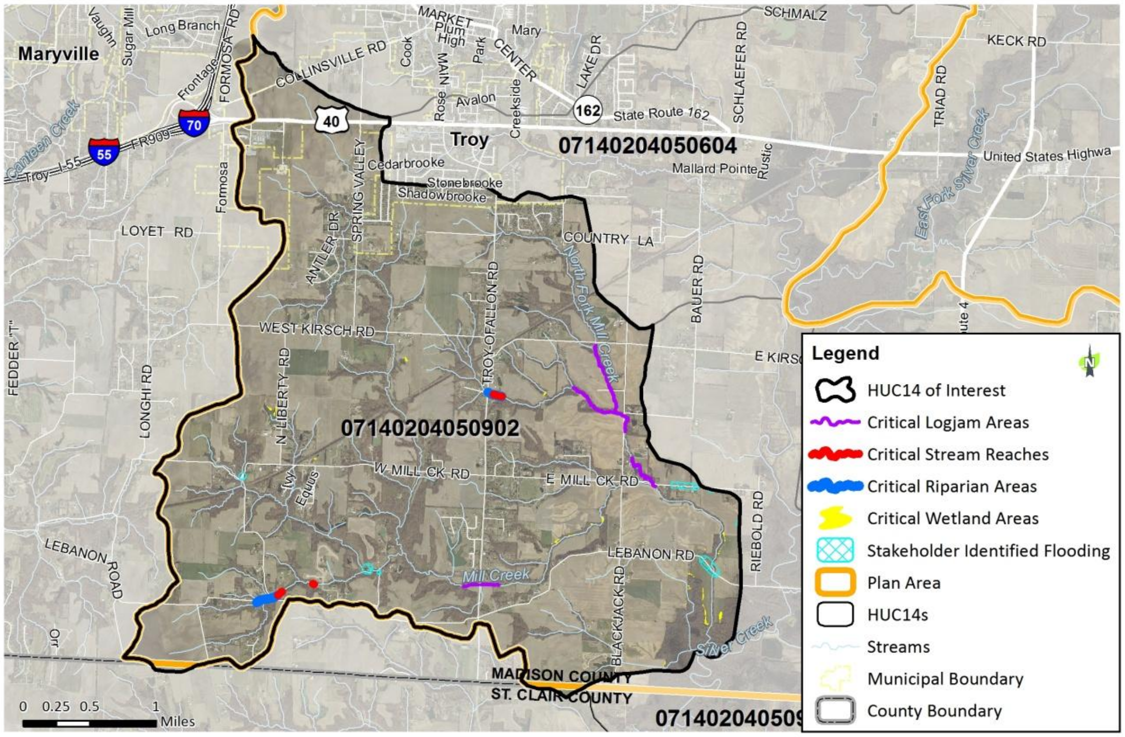
Critical Logjam Areas: One 1,798-foot (0.3-mile) Critical Logjam Area was identified on Lake Fork, south of St. Jacob.

Critical Stream Reaches: 1,335 feet (0.25 miles) of Critical Stream Reaches were identified on four sections of Lake Fork, two of which overlap with Critical Riparian Areas.

Critical Riparian Areas: 3,389 feet (0.6 miles) of Critical Riparian Areas were identified in three segments along Lake Fork.

Critical Wetland Areas: 8.65 acres of Critical Wetland Areas were identified in small areas on agricultural land and along Lake Fork itself.

Flooding locations were **identified by stakeholders** on approximately 27 acres in five locations. These include road overtopping at Pansy Road and Ellis Road and flooded fields at the intersection of Lake Fork and Fork Creek.



HUC 07140204050902: Mill Creek (South of Troy)

(Draft code used in Appendix A: 07140204050903)

This subwatershed is the watershed of Mill Creek, which drains the south side of Troy. North Fork Mill Creek drains into Mill Creek from the southeast side of Troy. Troy-O'Fallon Road bisects the subwatershed.

Area: 8,321 acres
Named streams: Mill Creek and North Fork Mill Creek
Counties: Madison
Municipalities: Troy
Townships: Jarvis

Critical Logjam Areas: 9,494 feet (1.8 miles) of Critical Logjam Areas were identified, in three areas. Two are on North Fork Mill Creek (and one of its tributaries), and a third is on Mill Creek on both sides of Troy-O'Fallon Road.

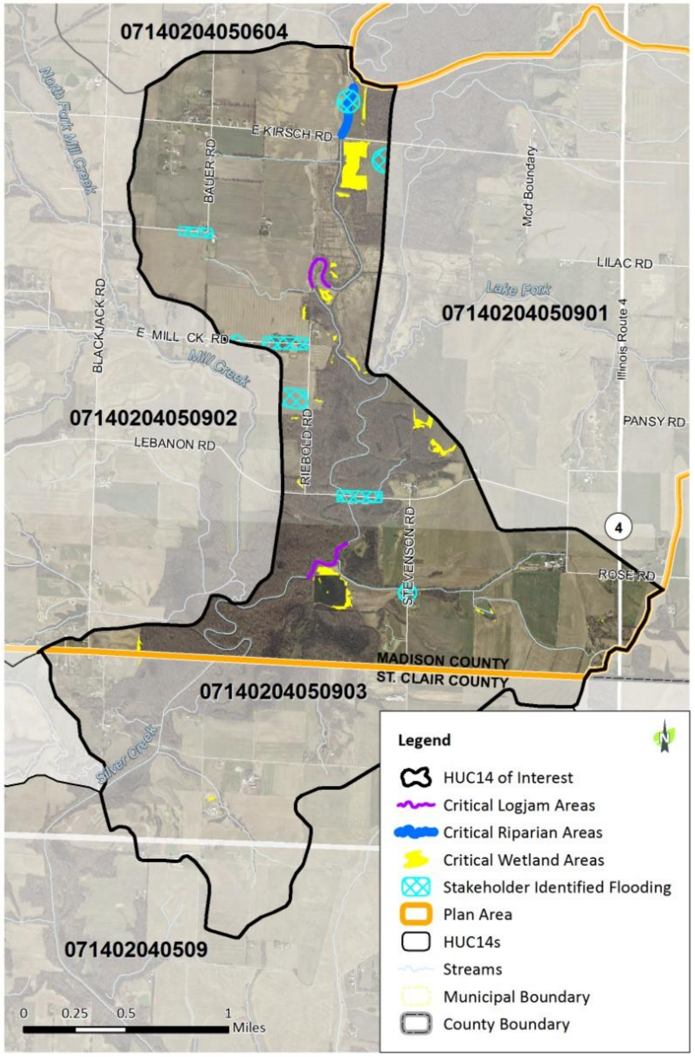
Critical Stream Reaches: 456 feet (0.09 miles) of Critical Stream Reaches were identified along tributaries to Mill Creek and North Fork Mill Creek, with some overlap with Critical Riparian Areas.

Critical Riparian Areas: 1,447 feet (0.3 miles) of Critical Riparian Areas were identified along tributaries to Mill Creek and North Fork Mill Creek, with some overlap with Critical Stream Reaches.

Critical Wetland Areas: 6.36 acres of Critical Wetland Areas were identified in small areas largely along the tributaries to Mill Creek and North Fork Mill Creek, and some areas on agricultural land.

Flooding locations were **identified by stakeholders** on approximately 21 acres in seven locations. These include road overtopping at Mill Creek Road, Lebanon Road, and Jordan Road, flooded yards by Mill Creek at E Mill Creek Rd, and flooded fields west of Riebold Road.

Critical Flood Area: This subwatershed is a Critical Flood Area that has moderate flood risk/impacts (#9 of 20 HUC14 subwatersheds in the upper Silver Creek watershed).



HUC 07140204050903: **07140204050903 – Silver Creek** (Stevenson Road Area/St. Clair County Line)

(Draft Code used in Appendix A: 07140204050901)

This subwatershed covers the Silver Creek corridor as the creek flows across the county line to St. Clair County, at the south end of the upper Silver Creek watershed.

Area: 3,394 acres
Named streams: Silver Creek
Counties: Madison
Municipalities: None
Townships: Jarvis and St. Jacob

Critical Logjam Areas: 3,354 feet (0.6 miles) of Critical Logjam Areas were identified in two segments on Silver Creek, both where the stream meanders significantly.

Critical Stream Reaches: 0 feet of Critical Stream Reaches were identified.

Critical Riparian Areas: One 1,297-foot (0.2-mile) Critical Riparian Area was identified on Silver Creek at the north end of the subwatershed.

Critical Wetland Areas: 31.68 acres of Critical Wetland Areas were identified, all of which are in the forested Silver Creek corridor.

Flooding locations were **identified by stakeholders** on approximately 42 acres in seven locations, including road overtopping (Bauer Road, Stevenson Road, and Lebanon Road), flooded fields (adjacent to Silver Creek), and flooded yards (E Mill Creek Road). All locations are in or near the Silver Creek floodplain corridor.

Critical Flood Area: This subwatershed is a Critical Flood Area that has very high flood risk/impacts (#5 out of 20 HUC14 subwatersheds in the upper Silver Creek watershed).

SECTION 4: OVERVIEW OF MANAGEMENT MEASURES

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

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

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

Site-Specific Measures, which are often structural, can be implemented on the ground to improve surface and groundwater quality, green infrastructure, and flooding. The Site-Specific Management Measures are divided into **agricultural**, **urban/other**, and **in-stream** categories.

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.

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 reimburse farmers and landowners for implementing practices that protect soil and water health.

Primary goal addressed: 1. Improve Surface Water Quality

Financial support for stormwater infrastructure

Maintenance of wastewater treatment systems imposes costs on communities that are usually recaptured through municipal property taxes or a sewer fee. Stormwater infrastructure, however, does not often have such dedicated funding, even as municipal separate storm sewer systems (MS4s) are required to meet minimum control measures. 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. One such approach is to create a Stormwater Utility that charges fees to landowners based on how much stormwater runs off their land.

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

Flood Damage Prevention Ordinance

All three counties and five communities in the watershed are members of the National Flood Insurance Program (NFIP), and as such, have a Floodplain Ordinance in effect. These ordinances require specific development standards for structures and activities in the 100-year floodplain (as designated by FEMA). Due to increasing flood risk and flood insurance rates due to climatic changes and inadequate policies, these ordinances would benefit from an update. In a 2014 report, HeartLands Conservancy reviewed flood prevention BMPs and recommended that Madison County adopt an updated, stand-alone Flood Damage Prevention Ordinance. Subsequently, HeartLands Conservancy created a draft ordinance based on state and regional best practices. The practices recommended include more stringent standards for development in floodplains so that flood damage becomes less likely and less severe. Ordinance effectiveness and implementation should be periodically reviewed.

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

Green infrastructure incentives

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. Green infrastructure results in a higher diversity of plants and animals, removal of non-point 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.

Primary goal addressed: 3. Promote Environmentally Sensitive Development

In-lieu fee ecological mitigation

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 wetlands off-site. The fee goes to a third-party

Primary goal addressed: 1. Improve Surface Water Quality organization which can direct the funds to high quality ecological sites for which restoration efforts will have the most environmental impact.

Long-term management of natural areas

Primary goal addressed: 5. Develop Organizational Frameworks

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

Monitoring

Primary goal addressed: 1. Improve Surface Water Quality

Monitoring of water quality, flow, and stream health in the upper 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. The National Great Rivers Research and Education Center (NGRREC), a partner on this plan, is well-situated to conduct this monitoring.

Continuous monitoring at the U.S. Geological Survey (USGS) gauge 05594450 located on the main stem of Silver Creek (near Route 40, east of Troy) will provide a broad assessment of the effect of land management practices in the watershed on surface water quality throughout the year. It will also allow trends to be identified by comparing new monitoring data to historical water quality data collected by USGS and the Illinois Water Sciences Center (IWSC) from this same location during several periods from 1974 to 2011.

In addition to continuous monitoring at the USGS gauge, secondary monitoring stations will be added upstream from the USGS gauge in order to identify the relative contributions of HUC14 subwatersheds to overall water quality in the larger watershed. Sampling locations will be identified near the outflow of each subwatershed and samples will be collected quarterly to determine seasonal variations in water quality. Additional sampling will be done during major storm events. See Appendix F for more detail on the recommended monitoring components. See Section 7 (Implementation) for the monitoring timeline. The estimated cost of monitoring by NGRREC over a three year period (through 2018) is $25,820.

ISCO sampler collecting water quality data. A sampler like this will be used for water quality monitoring in the upper Silver Creek watershed. Photo: University of Delaware.

The following parameters will 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)

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. For example, the Rock Hill Trails subdivision, east of Wood River in unincorporated Madison County, displays several species of native plants in landscaping put in place through an Illinois EPA 319 grant. Changes to weed control ordinances (or other ordinances that specify plant species to be used in landscaping) may be needed to allow appropriate growth of native plants. Ordinance effectiveness and implementation should be periodically reviewed. Likewise, the removal of invasive species is important in promoting biodiversity.

Open space and natural area protection

Primary goal addressed: 3. Promote Environmentally Sensitive Development

Several actions can be taken to encourage the protection of natural areas and open space in new development. These include establishing a dedicated source of funding for open space acquisition and management, creating agriculture zoning districts with very large minimum lot sizes, adopting an open space and parks plan, and 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 Madison County 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 3 to 5 years) should be considered by watershed jurisdictions. An intensive inspection of private septic systems in areas with recurring problems should also be considered. Data on private sewage violations and water quality parameter exceedances should be collected and mapped. Connections to public sewer systems should be encouraged in new development. Counties and municipalities can create a Special Service Area (SSA) to fund improvements to localized private sewage problems.

Riparian Buffer Ordinance

Primary goal addressed: 3. Promote Environmentally Sensitive Development

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

Sewage Treatment Plant upgrades

Primary goal addressed: 1. Improve Surface Water Quality

Upgrades to wastewater treatment plants in the watershed should be installed so that the limits set in state permits are not exceeded. The 2014 Madison County EMA All-Hazard Mitigation Plan recommends wastewater treatment facility upgrades in Hamel, by expanding the treatment lagoon and moving the lagoon dam (Appendix X – Management Measures). Other improvements include incorporating nutrient removal technologies. Additionally, Sewage Treatment Plants (STPs) can create agreements with a land conservation organization and IEPA to provide payments on a conservation easement that reduces nutrient discharge from agricultural land, in order to offset the plant's discharge. This is a form of Nutrient Credit Trading. 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.

Stream Cleanup Team

Primary goal addressed: 4. Support Healthy Habitat

A Stream Cleanup Team with funding and resources dedicated to stream cleanup in the watershed would help to improve water quality, reduce flood risk (by removing litter and debris), and monitor stream health. Many county residents were vocal in their support of the grant-funded Stream Cleanup Team that operated in 2008-2009. The program could be expanded from its previous scope to include an education component, roles for volunteers, and a stream inventory. The Team could inform local sheriffs' departments about sites with the most litter/debris so that they can more effectively enforce laws on littering and dumping.

Watershed Plan supported and integrated into community plans

Primary goal addressed: 5. Develop Organizational Frameworks

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

Site-Specific Management Measures

The following BMPs are recommended for agricultural, urban/other, and in-stream areas. See Appendix E for more detailed descriptions of these BMPs, including the amount, cost, and pollutant load reduction.

Agricultural Measures

Site-Specific Measures for agricultural land are either:

- **In-Field Practices**, including use of cover crops, reduced tillage techniques, and terraces; or
- **Edge-of-Field Practices**, including nutrient removal wetlands and riparian buffers (typically larger, sometimes structural practices that are terrain-dependent).

In-field Practices:

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: $228/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: 75% sediment, 29% P, 31% N
Cost: $53/acre

Reduced tillage (conservation 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 and reduced runoff and reduced overtopping of roads adjacent to farm fields.

Primary goal addressed: 1. Improve Surface Water Quality
Pollution reduction: 75% sediment, 45% P, 55% N
Cost: $33/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 neighboring St Clair County between 2010 and 2015 thanks to the efforts of NRCS and other partners.

Primary goal addressed: 1. Improve Surface Water Quality
ACPF areas identified: Yes
Pollution reduction: 58% sediment, 35% P, 28% N
Cost: $3.30/linear foot

Edge-of-Field Practices:

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: $4,000/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 through denitrification (i.e., reduction of nitrates via anaerobic bacteria) can also occur in ponds.

Primary goal addressed: 1. Improve Surface Water Quality
Pollution reduction: 58% sediment, 48% P, 31% N
Cost: $15,000/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: $10/linear foot

Animal Waste (Manure) Management

Livestock produce waste, primarily manure, which needs to be well-managed to maintain water quality. 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 (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. St. Clair county NRCS has implemented 91 acres of nutrient management between 2010 and 2015.

Primary goal addressed: 1. Improve Surface Water Quality
Pollution reduction: 75% sediment, 70% P, 65% N
Cost: $250,000/waste storage structure

Water and Sediment Control Basins (WASCOBs)

Water and Sediment Control Basins (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: $118/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: $23,153/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, removing 78% sediment, 44% phosphorus, and 20% nitrogen from runoff according to U.S. EPA's STEPL tool. 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.

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

Above: Terraces. Photo: NRCS.

Above: Contour buffer strips. Photo: NRCS.

Above: Grassed waterways. Photo: USDA

Above: Cover crops. Photo: USDA.

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

Urban Area Measures

Detention basins

Primary goal addressed: 2. Reduce Flooding/Mitigate Flood Damage
Pollution reduction: 58% sediment, 19% (dry) or 48% (wet) P, 31% N
Cost: $41-46,000/acre

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 and peak. Many are also designed to treat stormwater during storage by removing sediments, nutrients, and other pollutants. Older detention basins may no longer function properly due to inadequate maintenance. Some would benefit from improvements that improve function, such as extended detention outlet structures, planting vegetation, removing sediment, and altering flow-through patterns. Retrofitting existing detention basins can be cheaper than constructing new detention basins. New detention basins (dry and wet), retrofits to existing detention basins (e.g. addition of native vegetation, volume increases), and maintenance of existing basins (e.g. removing silt) are recommended in this plan. Detention basins are recommended for municipalities in the 2014 Madison County EMA All-Hazard Mitigation Plan (Appendix X – Management Measures).

Pervious pavement

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

Pervious pavement. Photo: Philadelphia Water.

Primary goal addressed: 2. Reduce Flooding/Mitigate Flood Damage
Pollution reduction: 70% sediment, 55% P, 60% N
Cost: $72,500/acre

Rain gardens

Primary goal addressed: 1. Improve Surface Water Quality
Pollution reduction: 67% sediment, 27% P, 35% N
Cost: $7.99/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.

Rain garden. Photo: USEPA.

Rainwater harvesting and reuse

Primary goal addressed: 2. Reduce Flooding/Mitigate Flood Damage
Pollution reduction: n/a
Cost: $225 per barrel/small cistern

Rainwater harvesting is the collection of rainwater from roofs in structures such as rain barrels or cisterns, so that it can be used or released at a later time. Harvesting and re-using water is a great way of decreasing stormwater runoff during times of peak flow, minimizing water use, and lowering 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: $1,000 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 2014 Madison County EMA All-Hazard Mitigation Plan recommends several actions to mitigate flood damage: 1) full or partial buyouts to relieve homeowners in frequently flooded areas, 2) elevating structures in frequently flooded areas, 3) making informational materials about the National Flood Insuarnce Program (NFIP) available, 4) participating in the Community Rating System, and 5) sanitary sewer line repairs to prevent stormwater infiltration and sewer backups in Worden and Marine (Appendix X – Management Measures).

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. These include structural inspections, drain tile, downspout disconnection, rain gardens, and pervious pavement. Information from this Report is located in Appendix E.

Stormwater and sanitary sewer system maintenance and expansion

Primary goal addressed: 2. Reduce Flooding/Mitigate Flood Damage
Pollution reduction: n/a
Cost: $77/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 2014 Madison County EMA All-Hazard Mitigation Plan identified several storm drain system improvement projects in municipalities in the watershed including Alhambra, Hamel, Marine, and Worden (Appendix E – Management Measures). Culverts, ditches, and detention basins that often overflow should be assessed for potential enlargement. Upgrades should be made in response to storm drain system inspections, citizen complaints, and/or updated modeling of the system. In addition, sanitary sewer systems should be maintained in order to prevent infiltration and combined sewer overflows. Expansion of sanitary sewers to new development and existing buildings (already a common practice among municipalities) should continue wherever feasible.

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

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

Stone toe protection, one form of streambank restoration that prevents streambank erosion. Photo: Montgomery County, Maryland.

In-Stream Measures

Streambank and channel restoration

Streambank and channel restoration includes several practices. Streambed erosion (incision) is the first consideration for treatment, and 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).

Streambank stabilization methods use a combination of bioengineering with native vegetation and hard armoring. These practices are typically implemented together, and often with 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. Riffle-pool sequences help support healthy fish and wildlife habitat by increasing water depth, maintaining water depths during low flow periods, and increasing dissolved oxygen (DO).

Primary goal addressed: 1. Improve Surface Water Quality
Addresses Critical Stream Reaches
Pollution reduction: 98% sediment, 90% P, 90% N
Cost: $75/linear foot

Logjams – assessment and removal

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 were made by residents in the southern end of the watershed along Silver Creek. 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.

Primary goal addressed: 1. Improve Surface Water Quality
Addresses Critical Logjam Areas
Pollution reduction: n/a
Cost: $30/linear foot

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.

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

SECTION 5: MANAGEMENT MEASURES ACTION PLAN

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 E.

The Management Measures were selected based on the following factors:

- Performance: Research-based pollutant reduction estimates and flood mitigation attributes 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 and flow/flooding reduction values associated with the Management Measures were identified from several sources, including the U.S. Environmental Protection Agency's Region 5 Load Estimation Model Users Manual and the International Stormwater Best Management Practices (BMP) Database (see Appendix E).

Cost estimates were assembled from several sources, including the Illinois Nutrient Loss Reduction Strategy draft (2014), experienced local contractors, and other watershed-based plans (see Appendix E).

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

Table 6 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.

Summary of all Management Measures recommended

Table 6. 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				
Long-term management of natural areas	5	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						
Site-Specific Management Measures							
Agricultural management practices							
In-Field Practices							
Contour buffer strips	1	4		53%	53%	61%	53%
Cover crops	1			75%	75%	29%	31%
Reduced tillage (conservation tillage/no-till)	1			75%	75%	45%	55%
Terrace	1			58%	58%	35%	28%
Waste (manure) management	1			75%	75%	70%	65%
Edge-of-Field Practices							
Grassed waterways	1			80%	80%	45%	55%
Ponds	1	2		58%	67%	48%	31%
Riparian buffers	1	4		53%	53%	43%	38%
Water and sediment control basins (WASCOBs)	1	2		58%	58%	35%	28%
Wetlands	1	2	4	78%	78%	44%	20%
Urban Area Measures							
Dry detention basins, new	2	1		58%	61%	19%	31%
Wet detention basins, new	2	1		58%	67%	48%	31%
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			70%	18%	55%	60%
Rain gardens	1	4	2	67%	67%	27%	35%
Rainwater harvesting & reuse	2	1		n/a	n/a	n/a	n/a
Single property flood reduction strategies	2			n/a	n/a	n/a	n/a
Storm & sanitary sewer maintenance & expansion	2	1		n/a	n/a	n/a	n/a
In-stream Measures							
Streambank & channel restoration	1	4		98%	90%	90%	90%
Logjam removal	1	2	4	n/a	n/a	n/a	n/a

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

Once appropriate Management Measures/BMPs were selected for the watershed, the next step was to estimate the extent to which they could be implemented to achieve goals, objectives, and targets, and to identify locations for implementation wherever possible.

Note: All recommendations in this section are for guidance only, and are not required by any federal, state, or local agency. Funding for BMPs will be consistent with IEPA's nonpoint source management plan.

Summary of Site-Specific Management Measures recommended

This Action Plan provides quantities for implementing Site-Specific Management Measures. Table 7 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 2045, the long-term watershed planning horizon.

Agricultural management practices recommended over large swaths of land include *cover crops* and *reduced tillage (conservation tillage/no-till)*, at 29,032 acres each (33% of the agricultural land in the watershed). These practices are highly effective at improving water quality, and are highly compatible with one another; a farmer planting cover crops will often find it more beneficial to till less or not at all.

Water and Sediment Control Basins (WASCOBs) are recommended for 881 acres on agricultural land with Critical, Very High, or High runoff risk. 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 D for more information on this assessment process.

Wetlands are recommended to be installed or restored on 500 acres in the watershed. This represents 100% of the Critical Wetland Areas identified using the ACPF and MoRAP's wetland assessment.

Grassed waterways are recommended for 494 acres for drainage areas greater than 6 acres on agricultural land with Critical, Very High, or High runoff risk. Grassed waterways are a well-known practice in the watershed.

Contour buffer strips are recommended to cover 49 acres with Critical, Very High, or High runoff risk, and with buffer strips 15 feet wide with a 90 foot minimum distance between them. Only 15% was used because the practice is not well-known in this area, it involves taking land out of production, many of the slopes in the watershed are irregular and not well-suited, and there are not many local animal operations that could use the hay produced by the buffer strip vegetation.

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

Table 7. Summary of the BMPs (Site-Specific Management Measures) recommended, including amount, cost (over 30 years – until 2045), and pollutant load reduction. Information and Education Plan and monitoring costs are also shown. Note: Some BMPs are more effective at pollutant reduction when implemented in a treatment train (e.g., a terrace leading to a wetland). The Spreadsheet Tool for Estimating Pollutant Loads (STEPL) can assess the efficiency of several BMP combinations.

BMP Name	Amount	Unit	Cost	Sediment (tons/yr)	Total Suspended Solids (lbs/yr)**	Phosphorus (lbs/yr)	Nitrogen (lbs/yr)
Agricultural management practices							
Contour buffer strips	49	acres	$ 11,081	6	11,757	81	302
Cover crops	29,032	acres	$ 1,550,023	5,014	10,028,700	22,943	105,520
Grassed waterways	494	acres	$ 1,976,161	91	182,036	606	3,186
Ponds	100	acres	$ 1,500,000	13	30,859	131	363
Reduced tillage (conservation tillage/no-till)	29,032	acres	$ 967,639	5,014	10,028,700	35,602	187,213
Riparian buffers	286,968	linear feet	$ 2,878,289	1,207	2413753	11,561	43,889
Terraces	100,000	inear feet	$ 330,000	0.3	608	2	7
Waste (manure) management	10	structures	$ 2,500,000	2	3,454	19	76
Water and sediment control basin	881	acres	$ 104,015	117	233,446	841	2,842
Wetlands	500	acres	$ 11,585,871	90	179,770	600	1,173
Urban area measures							
Dry detention basins, new	100	acres	$ 4,160,000	158	335,330	618	4,338
Wet detention basins, new	100	acres	$ 4,570,000	158	368,314	1,561	4,338
Detention basin retrofits	94	acres	$ 1,356,001	135	376,417	1,373	5,250
Detention basin maintenance	94	acres	$ 88,290	n/a	n/a	n/a	n/a
Pervious pavement	100	acres	$ 7,250,000	192	98,950	1,789	8,396
Rain gardens	20,000	sq. ft	$ 159,800	1	1,691	4	22
Rainwater harvesting and reuse	100	rain barrels/cisterns	$ 22,500	n/a	n/a	n/a	n/a
Single property flood reduction strategies	168	properties	$ 168,000	n/a	n/a	n/a	n/a
Stormwater and sanitary sewer system maintenance and expansion	10,000	linear feet	$ 765,000	n/a	n/a	n/a	n/a
In-stream							
Streambank & channel restoration	72,600	linear feet	$ 5,445,000	567	1,046,837	6,194	26,648
Logjam removal	9,900	linear feet	$ 297,000	n/a	n/a	n/a	n/a
*Information and Education Plan**			$ 20,000				
Monitoring (water quality, flow, & stream health)			$ 25,820***				
TOTAL			$ 47,730,491	**12,199**	**24,293,785**	**77,730**	**366,917**
% Reduction From Current Total:				**20.3%**	**20.2%**	**29.3%**	**31.1%**

* Amount estimated for information and outreach activities over 20 years, inclusive of materials but not staff time. Final costs will vary.

** TSS pollutant reduction estimates were used where available. If a separate TSS value could not be found, sediment values in tons/year were converted to lb/year TSS.

*** Cost estimate for three years of monitoring of water quality, flow, and stream health.

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 been created on farmland in neighboring St Clair County between 2010 and 2015.

Riparian buffers are recommended for 286,968 linear feet along streams. This includes 100% of the Critical Riparian Areas in the watershed (10.87 miles or 57,394 feet) which include "poor" riparian areas identified in the aerial assessment and areas identified in the ACPF as Critical Zones (see Appendix D). In addition to Critical Riparian Areas, 306,648 ft of riparian areas assessed in the watershed had "moderate" riparian condition, so an additional 229,574 ft is recommended for restoration to bring the total area restored (286,968 ft) to 500% of the total area of the Critical Riparian Areas.

Ten (10) *waste (manure) management* structures are recommended for the watershed. This number reflects the high cost of such structures. There are at least 285 farms with livestock in Madison County.

Urban area measures include 100 acres of *new dry detention basins* and 100 acres of *wet detention (or retention) basins*. New detention and retention basins are anticipated to be constructed alongside new residential, suburban, commercial, and industrial development in the watershed. The average size of detention basins visited in the on-site detention basin survey in the Watershed Resources Inventory was 1.4 acres; using this value, 200 acres of basins represents 143 new basins in total.

Detention basin retrofits are recommended for 94 acres of existing detention/retention basins, which represents 100% of the 67 detention basins identified from aerial photographs in the watershed, assuming an average basin size of 1.4 acres. Twenty percent of the basins visited for the detention basin survey were in poor condition, but it is anticipated that all existing basins will benefit from upgrades by 2045. Several have already filled with sediment and fallen into disrepair, especially in older subdivisions. *Detention basin maintenance* for those 94 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 3% of the total current impervious area in the watershed (approximately 3,600 acres). Pervious pavement is an increasingly popular paving choice, but it has been slow to gain acceptance among municipalities and developers because of maintenance concerns.

Storm drain system maintenance and expansion is recommended for 10,000 linear feet of stormwater ditches and storm sewers in the watershed. This includes cleaning out culverts, ditches, drains, and storm inlets, and expanding stormwater infrastructure to new development and increasing culverts and other features that are not appropriately sized to accommodate the flow received. If divided equally among the 13 municipalities in the watershed, the 100,000 feet of maintenance and expansion comes to 7,692 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 harvesting and reuse is recommended through the installation of 100 rain barrels or cisterns. This number would serve 0.09% of the 10,490 households in the watershed. These rainwater harvesting features have seen an increase in appreciation in the watershed, but the abundant rainfall in the region will continue to limit the demand for them as collectors of water for irrigation.

Single-property flood reduction projects are recommended for 168 properties. In the watershed Flood Survey, 54 responses (11%) said flooding damaged their primary home or business. Extrapolating this percentage to the 10,490 households in the watershed, an estimated 168 homes/businesses have had flood damage over the last 10 years. Many more respondents reported damage to auxiliary buildings and landscaping as well, which can also be addressed by single-property flood reduction projects.

In-stream Management Measures recommended include 72,600 linear feet of *streambank and channel restoration*. This number includes 100% of Critical Stream Reaches with high streambank erosion and high channelization (2.75 miles or 14,520 feet), and an additional 58,080 ft outside of the Critical Stream Reach areas with high streambank erosion (all identified by the aerial assessment). The total area recommended for restoration (72,600 ft) is 500% of the total Critical Stream Reach area length. Streambank erosion is a major source of sediment and nutrient loading in the watershed.

Logjam removal is recommended for 9,900 linear feet in the watershed, which represents 5% of the Critical Logjam Areas identified using the aerial assessment and the 2008-2009 Madison County Stream Cleanup operation. Some stream reaches with many trees and unstable streambanks may need to have multiple logjams removed.

Locations of Site-Specific Management Measures

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

Critical Areas and areas recommended for Management Measures through the USDA's Agricultural Conservation Planning Framework (ACPF) are provided in a spreadsheet with longitude and latitude data in Appendix I. Table 8 summarizes the Site-Specific Management Measures provided in Appendix I by HUC14 subwatershed.

Table 8. Area and length of six Site-Specific Management Measures at known locations, divided by HUC14 subwatershed (summary of Appendix I, but using up-to-date HUC14 codes), alongside four Critical Areas with known locations (summary of Critical Areas information in Section 3). Riparian buffers and wetlands are recommended for the exact locations for which Critical Areas were identified. Greatest values in each category are shown in **bold red font**.

HUC14 (up-to-date)	Contour buffer strips (acres)	Grassed waterways (feet)	WASCOBs (acres)	Riparian buffers (feet)	*Critical Riparian Areas (feet)*	Wetlands (acres)	*Critical Wetland Areas (acres)*	Streambank and channel restoration (miles)	*Critical Stream Reaches (miles)*	*Critical Logjam Areas (miles)*
07140204050101	0.9	177,169	28.7	2,988	*2,988*	0.4	*0.4*	0.7	*0.27*	*3.6*
07140204050102	2.2	51,594	7.6	0	*0*	3.0	*3.0*	0.7	*0.27*	*2.8*
07140204050201	1.6	84,519	12.3	7,433	*7,433*	13.5	*13.5*	0.1	*0.05*	*0.8*
07140204050202	5.5	122,035	26.7	0	*0*	37.3	*37.3*	0.2	*0.07*	*2.3*
07140204050203	12.6	144,683	52.4	4,113	*4,113*	7.9	*7.9*	0.1	*0.04*	*1.8*
07140204050301	9	168,545	25.2	2,089	*2,089*	7.9	*7.9*	0.8	*0.29*	*4.1*
07140204050302	9.5	105,482	26.2	7,605	*7,605*	6.5	*6.5*	**1.2**	***0.46***	***4.6***
07140204050303	17.9	150,108	31.9	3,278	*3,278*	2.7	*2.7*	0.1	*0.01*	*1.7*
07140204050304	14.3	122,091	45	0	*0*	6.7	*6.7*	0.6	*0.27*	*1.8*
07140204050401	19.5	90,686	65.8	5,345	*5,345*	**83.1**	***83.1***	0.4	*0.15*	*0.4*
07140204050402	18.6	66,562	**129.3**	1,050	*1,050*	75.7	*75.7*	0	*0*	*3.8*
07140204050501	24.7	156,607	30.7	**14,503**	***14,503***	1.5	*1.5*	0.5	*0.21*	*0.3*
07140204050502	19.1	71,088	59	0	*0*	12.1	*12.1*	0.5	*0.2*	*1.8*
07140204050601	20.5	85,233	44	1,627	*1,627*	67.6	*67.6*	0	*0*	*2.4*
07140204050602	8.3	51,206	25.8	846	*846*	61.6	*61.6*	0	*0*	*1.0*
07140204050603	7.1	56,359	31.1	0	*0*	5.2	*5.2*	0	*0*	*0.3*
07140204050604	10.4	44,184	23.9	364	*364*	63.1	*63.1*	0.3	*0.13*	*1.3*
07140204050901	**49.8**	**216,585**	92.7	3,389	*3,389*	8.7	*8.7*	0.3	*0.25*	*0.3*
07140204050902	31.5	101,518	100.6	1,447	*1,447*	6.4	*6.4*	0.6	*0.09*	*1.8*
07140204050903	13.2	66,252	25	1,297	*1,297*	31.7	*31.7*	0	*0*	*0.6*
Grand Total	**296.1**	**2,132,505**	**883.8**	**57,375**	***57,375***	**502.5**	***502.5***	**7.1**	***2.76***	***37.5***

Specific project locations

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

The locations were identified using the following information:

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

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

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

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

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

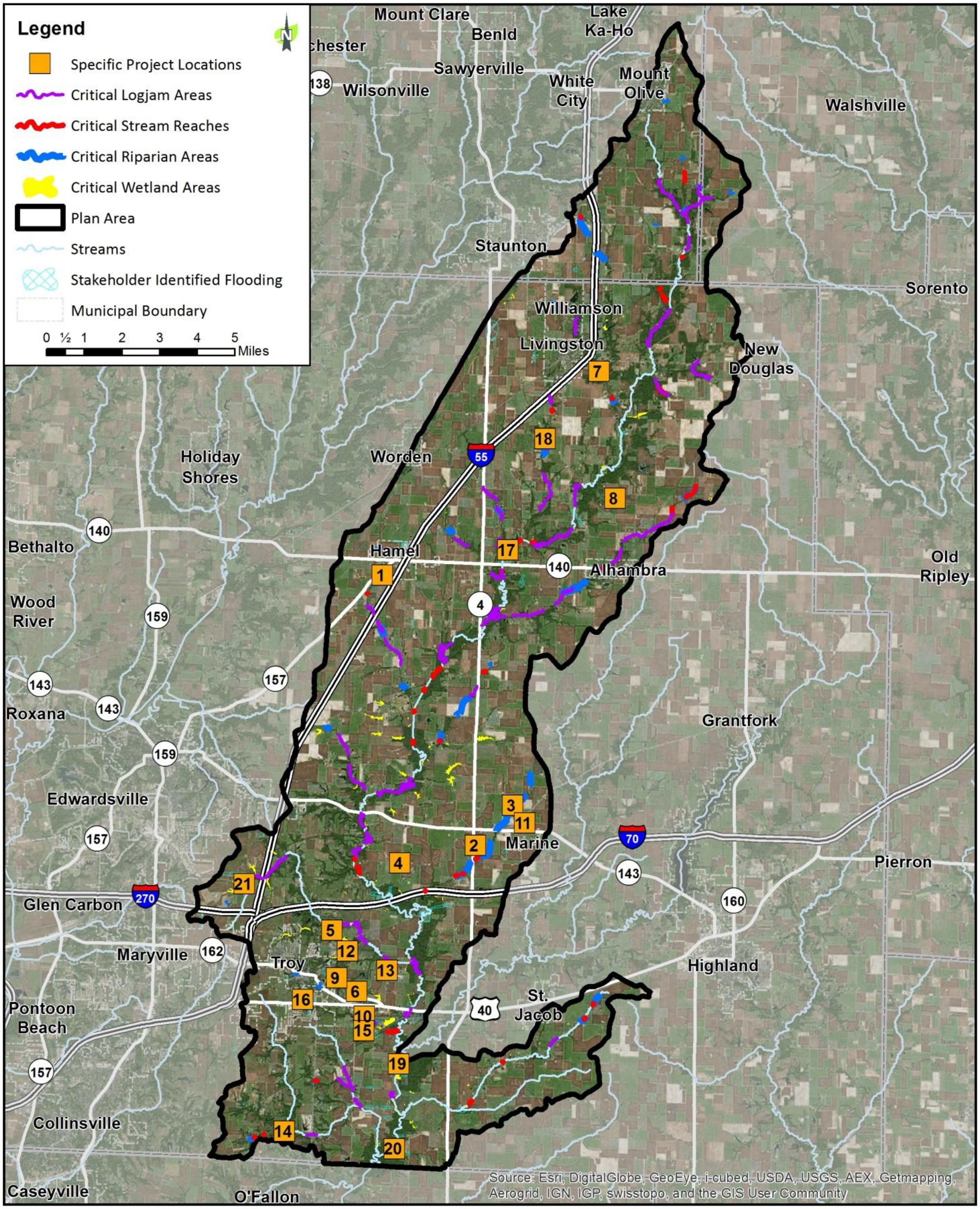


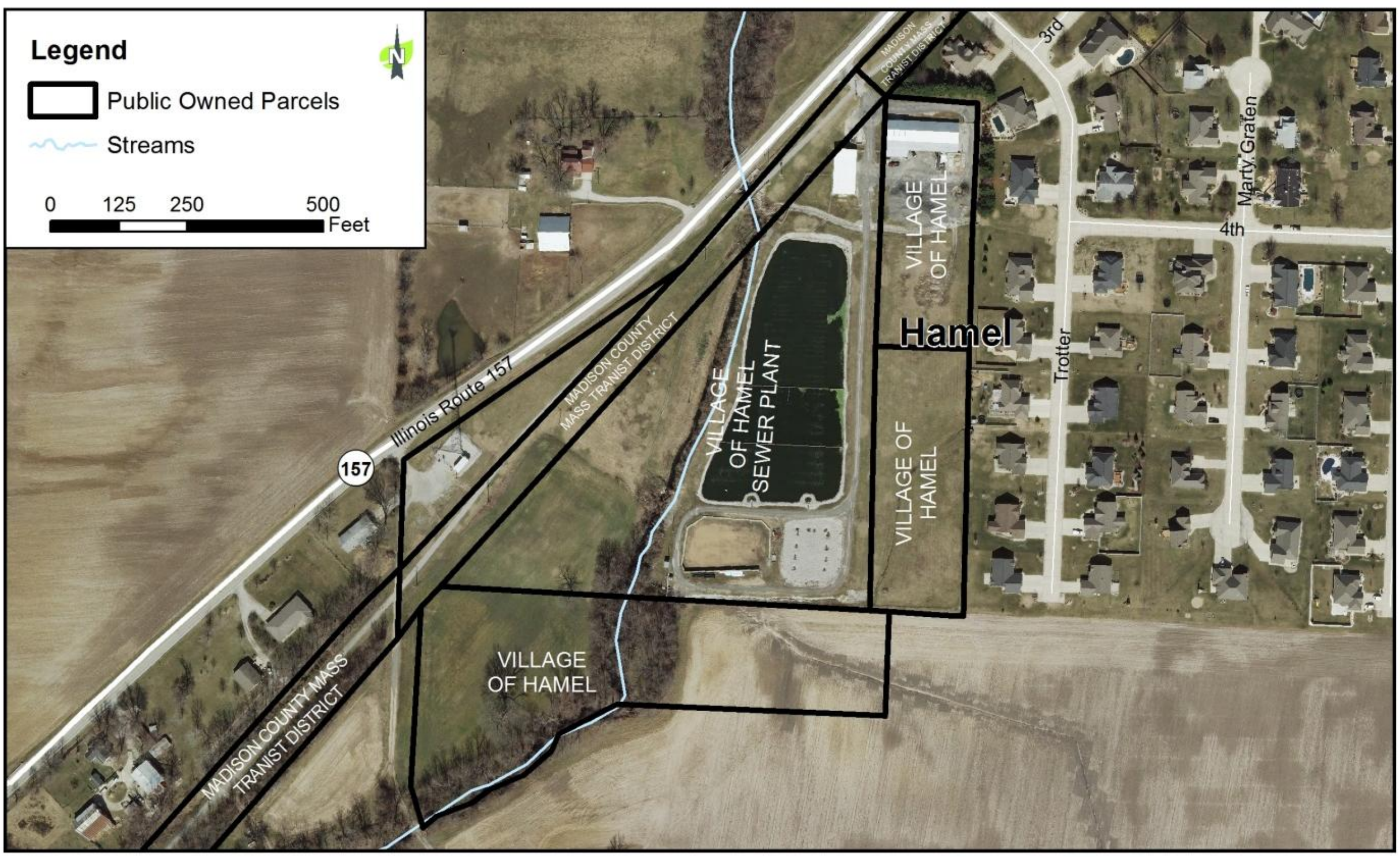
Figure 5. Map of specific project locations. Numbered squares relate to project numbers in the following pages.

Project #1: Streambank stabilization near the Hamel sewage treatment facility

A tributary to Silver Creek flows southwards close to the Hamel sewage treatment facility. During heavy rain, water has almost reached the top of the ditches protecting the sewer lagoon. If the banks are overtopped, the sewer treatment facility may not be able to function effectively, and untreated sewage may be carried downstream with stormwater. Also, over time, the levees/stream banks have started to move into the creek. Hamel officials identified this problem in a stakeholder meeting. The project is located in a Critical Flood Area, ranked at #10 out of 20 for flood impacts.

The village is looking to stabilize the streambanks and prevent any future overflow and water quality issues. The municipality's preliminary site assessment recommends stabilization of over 6,000 feet of streambank. Potential stabilization practices may include riprap, stone toe protection, and grade control structures that will reduce bank erosion, scouring, and incision. A site-level assessment would be needed to select the most appropriate practice(s) for the stream. Beyond the benefits of sediment and nutrient pollutant reduction, this streambank stabilization project would have the considerable additional benefit of decreasing the risk of untreated sewer water entering the stream during a high water event. This is the only project proposed for the Village of Hamel, and the only one within the HUC 07140204050503 subwatershed.

Figure 6. Hamel wastewater treatment plant, where deteriorating streambank stability in the nearby stream threatens to flood the facility, in HUC 07140204050303 (Village of Hamel).



Project #2: Drainage ditch stabilization near the Marine drinking water treatment facility

In 2015, water in the drainage ditch adjacent to Marine's water treatment facility came within inches of overtopping the ditch and contaminating the water in the facility. The area upstream of the stream/ditch is almost all cropland.

This issue could be solved by adding detention structures or features such as WASCOBs or grassed waterways upstream to reduce and/or slow the flow of water to the ditch. Additionally, the ditch itself could be made wider or deeper to carry more volume without overtopping.

Figure 7. Marine water treatment facility, which was almost contaminated by stormwater from an adjacent ditch, in HUC 07140204050501 (Neudeckers Mountain).

Project #3: Streambank stabilization north of Marine Heritage Park

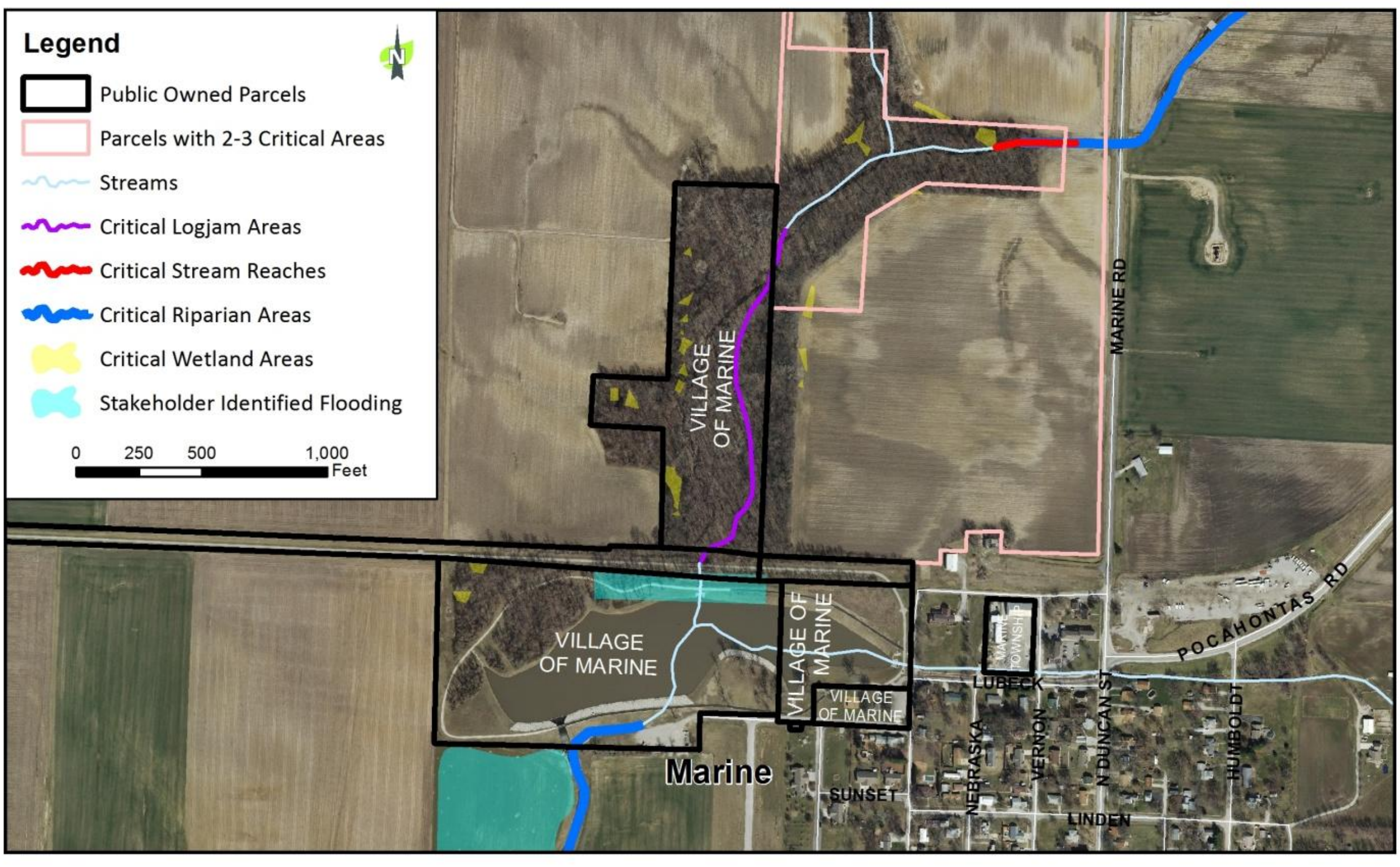
A stream flows into Marine Heritage Park from the north. A long section of it is a Critical Logjam Area, and small fragments of Critical Wetland Areas are also located in the stream corridor. The village acquired the parcel with the forested stream corridor to protect the stream corridor, which has arguably helped prevent streambank erosion and loss of sediment downstream.

In one heavy storm, floodwater overtopped the levee at the top of the park and water came down the spillway, reaching depths of 10 feet. This information was provided by the Village of Marine in a stakeholder meeting.

The riparian function assessment (modeled with the ACPF) identified Critical Zones along the stream stream in this parcel where there is a high water table and high runoff delivery.

The village doesn't necessarily want to take the logjams out, if they are slowing the flow of water coming into the park. Site assessments will be necessary to identify whether the logjams are beneficial and whether other structures such as weirs might be effective. Streambank stabilization and conversion of some of the stream corridor to wetlands would improve this stream corridor and increase storage of floodwater during heavy rains. The length of the stream in this parcel to be restored is approximately 0.4 km.

Figure87. Critical Logjam Area in the stream north of Marine Heritage Park, in HUC 07140204050602.



Project #4: Agricultural waste management at a dairy farm

The owner of a dairy farm located upstream of a stream gauge that has measured spikes in fecal coliform levels in the past has identified an agricultural waste management project that would both improve the water quality of the farm's runoff and improve his operations. The site is in unincorporated Madison County, northeast of Troy. The dairy farmer's goal is to manage both liquid and solid manure separately, increase waste storage for a minimum of 180 days, eliminate lot runoff, reduce rainfall on the lots, and efficiently apply manure to the cropland without runoff from land application. These practices would follow a Comprehensive Nutrient Management Plan.

The project is located in a Critical Flood Area, ranked at #3 out of 20 for flood impacts. Several practices were identified on the land in and around this farm (modeled by the ACPF), including grass waterways, drainage management, WASCOBs, and contour buffer strips. The waste management practices proposed may incorporate elements of these practices, or achieve the same nutrient loss reduction and flood reduction as these practices.

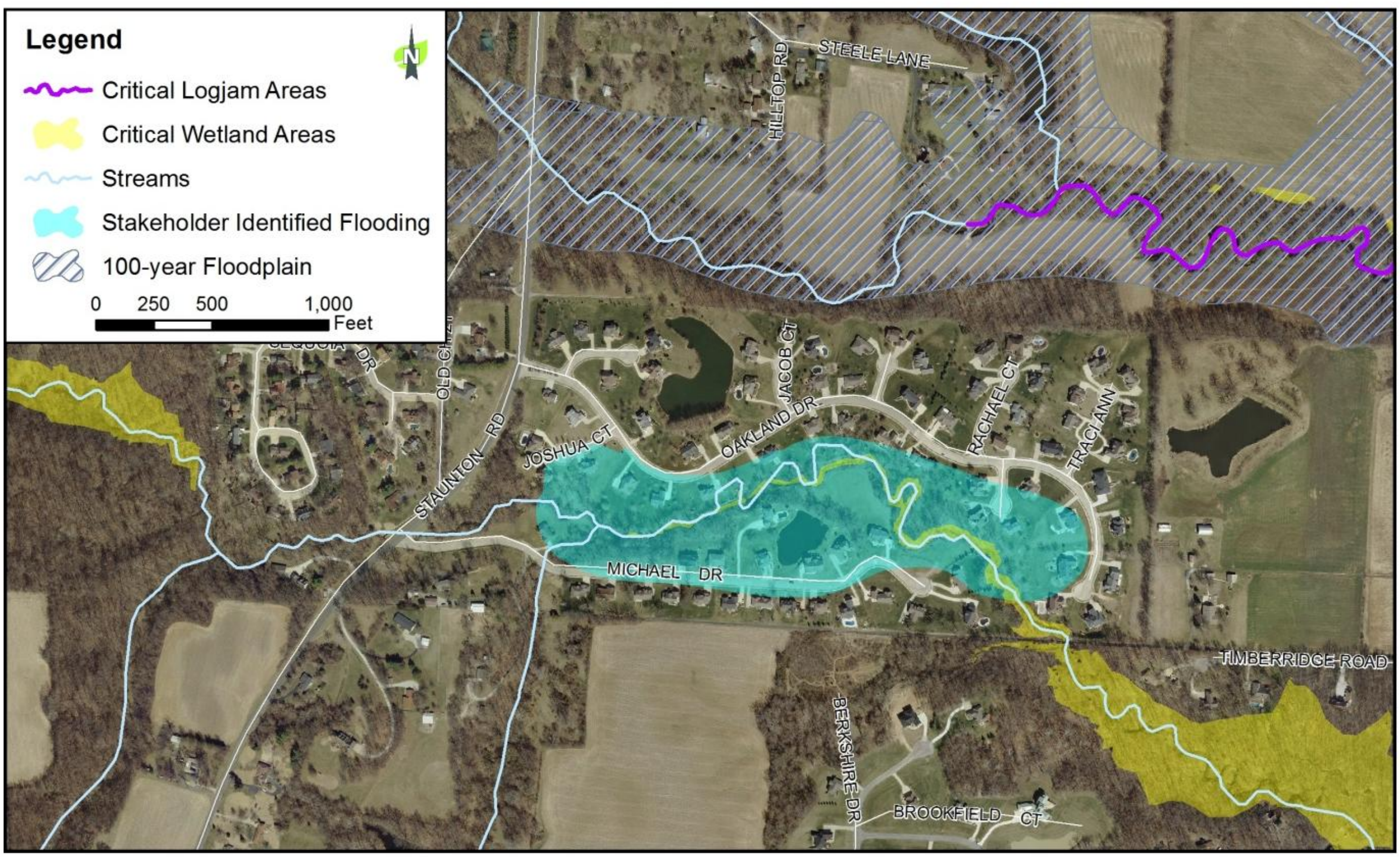
Figure 9. Dairy farm where agricultural waste management projects would improve operations, in HUC 07140204050502 (Dale Twin Lakes-South Lake-Silver Creek).

Project #5: Neighborhood stream stabilization at Oakland subdivision in Troy (Michael Dr)

Backyards adjacent to the creek at the back of Michael Drive northeast of Troy have been flooded about twice in twelve years (an average of 0.17 times per year). The houses on this street range between about $350,000 and $750,000 in value. During Hurricane Ike in 2008, flooding caused $30,000-worth of damage to a walkout basement on one property alone. The culvert under Red Oak Lane at the end of the development, which is the outlet for the stream, may be too small. This flood location was identified by a Troy city official, and by a respondent to the Madison County Community Flood Survey.

Potential Management Measures to address the issue include widening the culvert at Red Oak Lane, to let the water flow out more quickly during heavy rain events, streambank stabilization to prevent bank erosion (on about 1.1 km of stream), and establishing a wetland along the stream corridor. The Critical Wetland Area identified is 17.7 acres in size, extending beyond this subdivision into the Timber Ridge subdivision to the southeast. There are also stormwater detention opportunities further upstream and of the development that would relieve the pressure on this area.

Figure 10. Stakeholder-identified flood location on the stream flowing behind Michael Drive in the Oakland subdivision northeast of Troy (in unincorporated Madison County), in HUC 07140204050602 (Twin Lakes-Wendell Branch).



Project #6: Detention basin retrofit at the Oakshire subdivision east of Troy

During heavy rain, the detention basin on the east side of Oakshire Drive, located east of Troy, has overtopped and flooded yards and basements of homes on the street. The area has a high water table, and homeowners use sump pumps somewhat regularly. This problem was identified by a Troy city official. Four households returned the Madison County Flood Survey from this subdivision; none of them had experienced flooding in the last ten years, but one of them had flood insurance. (Some of these residents may have moved to the subdivision within the last ten years.)

The houses in the neighborhood range in value from about $50,000 to $1.2 million and most are new (built within the last five years). Several lots are currently for sale. There is no Homeowners Association, and no neighborhood agreement on maintenance of the detention basin. Township staff have mowed the vegetation from time to time, although this is not their responsibility.

Potential solutions to this issue include increasing the size of the conveyance structures to the basin and the size of the basin itself. The basin is currently about 0.7 acres in size. These changes could increase the speed at which the water flows away from the houses and increase the storage capacity of the basin, reducing flood damage to properties. Adding native vegetation (and removing invasive plant species) is another important aspect of the basin renovation. Native vegetation will create wildlife habitat, allow infiltration, and create a pleasing aesthetic in the neighborhood. A maintenance agreement should also be created for the basin.

Figure 11. Stakeholder-identified flood location around the detention basin on the east side of Oakshire Drive (east of Troy), in HUC 07140204050604 (City of Troy-Silver Creek).

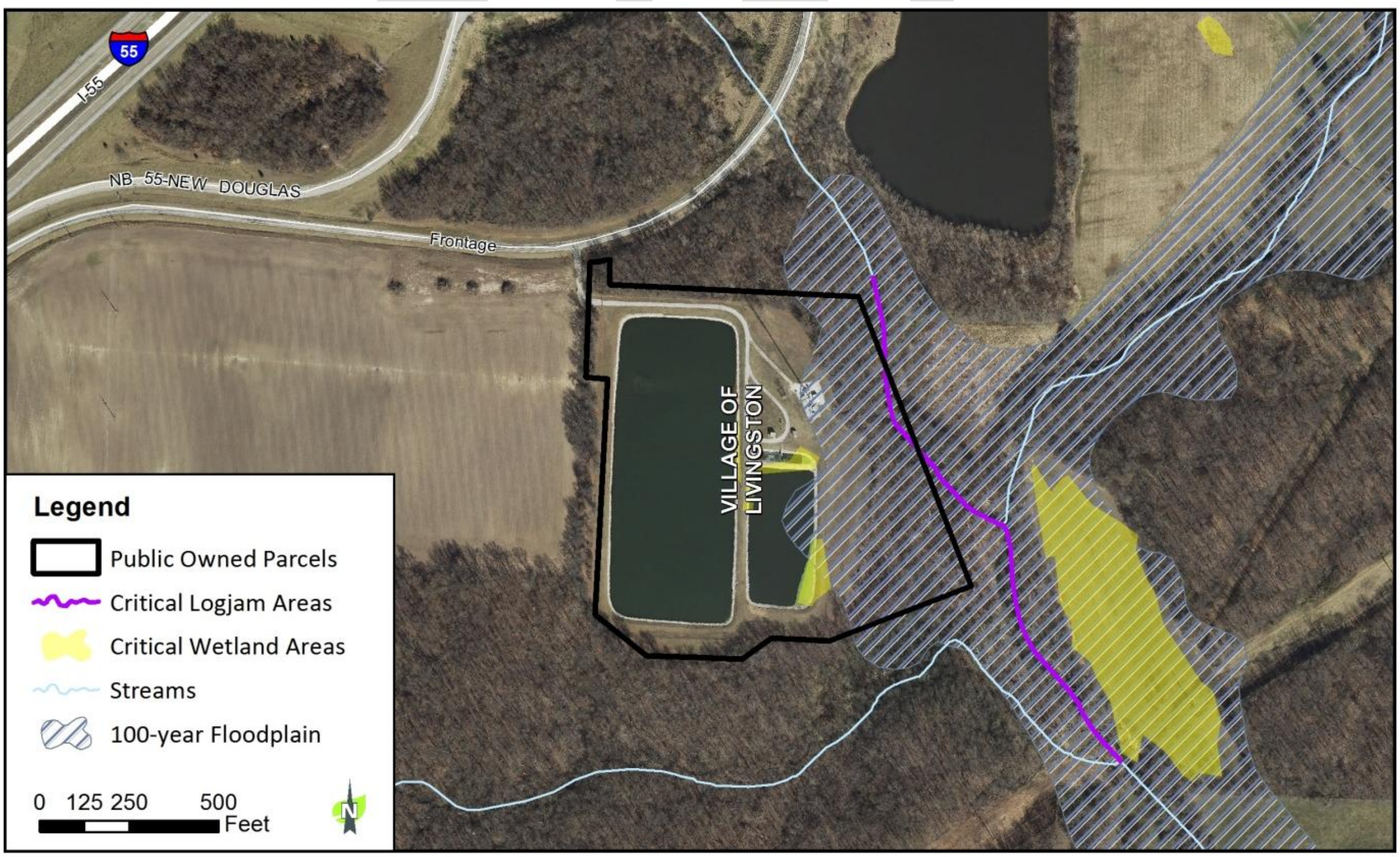
Project #7: Streambank stabilization adjacent to the Livingston sewage treatment facility

There is a 0.5-km (0.3-mile) Critical Logjam Area on an unnamed stream running north-south on the east side of Livingston's sewage treatment facility. The 100-year floodplain extends out of the stream and into the facility, according to the GIS map layer available; the facility may actually have been raised out of the floodplain. A 4.7-acre Critical Wetland Area was identified on the east side of the stream corridor. Critical Wetland Areas that had not been site-checked with aerial photographs were also identified directly adjacent to the treatment ponds.

This project location was identified by overlaying Critical Areas with public land parcels. The watershed planning team was not able to meet with officials at the Village of Livingston, so there is no feedback on whether floodwater from this stream has affected the facility in the past. This is the only specific project location identified on land owned by Livingston.

The riparian function assessment modeled through the ACPF identified riparian areas that would be well-suited for streambank stabilization and stiff-stemmed grasses along the stream. These practices would decrease the threat of flooding to the critical facility and improve the condition of the stream and its habitat. Furthermore, the 4.7-acre Critical Wetland Area in the stream corridor could be restored to wetland, increasing the floodwater storage capacity of the channel and relieving pressure on the wastewater treatment facility. Communication with village officials and a site assessment would be necessary to establish the best course of action for this site.

Figure 12. Critical Logjam Area and Critical Wetland Area on a stream adjacent to Livingston's sewage treatment facility, in HUC 07140204050201 (Big Four Reservoir).

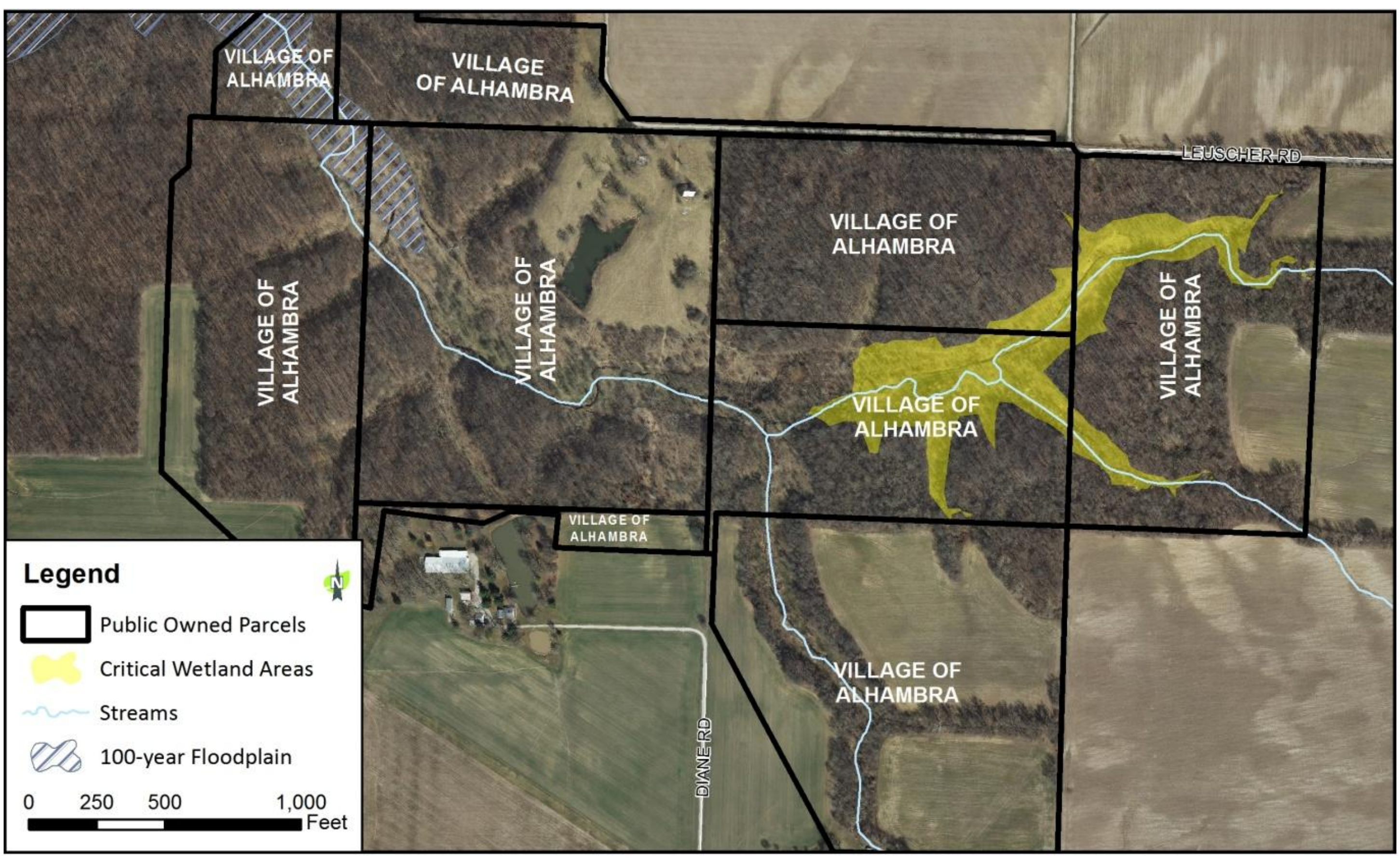


Project #8: Wetland area owned by Alhambra

Approximately 1.8 miles north of the Village of Alhambra, the Village owns nine contiguous parcels on and around an unnamed tributary to Silver Creek. An 11.6-acre Critical Wetland Area was identified along this tributary as a prime location for wetland restoration. This area falls entirely within the parcels owned by the village. The project is located in a Critical Flood Area, ranked at #8 out of 20 for flood impacts. The project was identified by overlapping Critical Areas with public land. This is the only specific project location identified for land owned by Alhambra. The closest access to the proposed wetland site is from Leuscher Road, 265 feet from the stream.

If a wetland is created on this tributary, especially if that wetland is close to the 11.6-acre size identified, it will greatly improve floodwater storage and water quality. The water reaching Silver Creek from this tributary would enter more slowly, and would have less sediment and nutrients, which would have settled out or been metabolized by organisms in the wetland. Since the village already owns the land, it would be simple to coordinate restoration efforts across the three parcels.

Figure 13. Critical Wetland Area on a tributary to Silver Creek north of Alhambra, in HUC 07140204050202 (Village of Livingston-Silver Creek).

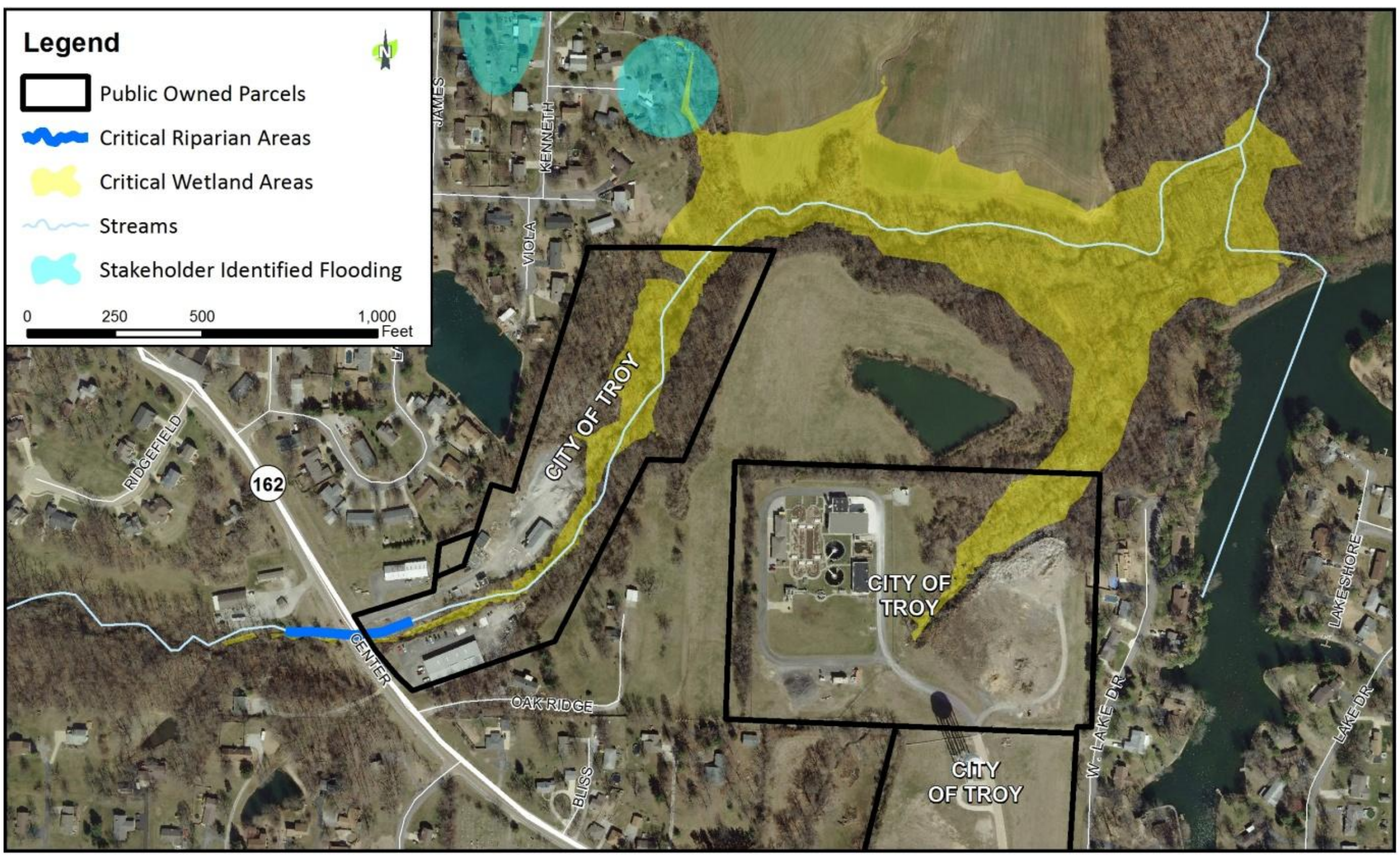


Project #9: Wetland area(s) in east Troy, north of Route 162

A Critical Wetland Area was identified on the eastern side of Troy, north of Route 162 and west of Twin Lakes, on the unnamed stream that flows around the sewage treatment plant. The Critical Wetland Area overlaps two city-owned parcels. The project location was found by overlapping Critical Areas with public land (the City of Troy did not identify any issues at this site). One stakeholder-identified flood location at the end of Nancy Court intersects with a branch of the Critical Wetland Area. Two households adjacent to the western Troy-owned parcel returned the Flood Survey; neither had been flooded in the last 10 years. The riparian function assessment from the ACPF identified streambank stabilization and stiff-stemmed grasses as recommendations for the riparian area (if a wetland is not created).

The city could restore one or both of the parts of the Critical Wetland Areas currently on city land (total of 3.9 acres), and/or purchase more parcels to create a larger contiguous wetland (up to 20 acres). This would help to clean and slow down the water leaving the east side of Troy before it reaches Wendell Branch, and ultimately Silver Creek. Alternatively, the city could stabilize the streambanks and provide a detention basin near the end of Nancy Drive, to relieve the flooding at the end of that road.

Figure 14. Critical Wetland Area on Troy city property north of Route 162 near the sewage treatment facility, in HUC 07140204050602 (Twin Lakes-Wendell Branch).

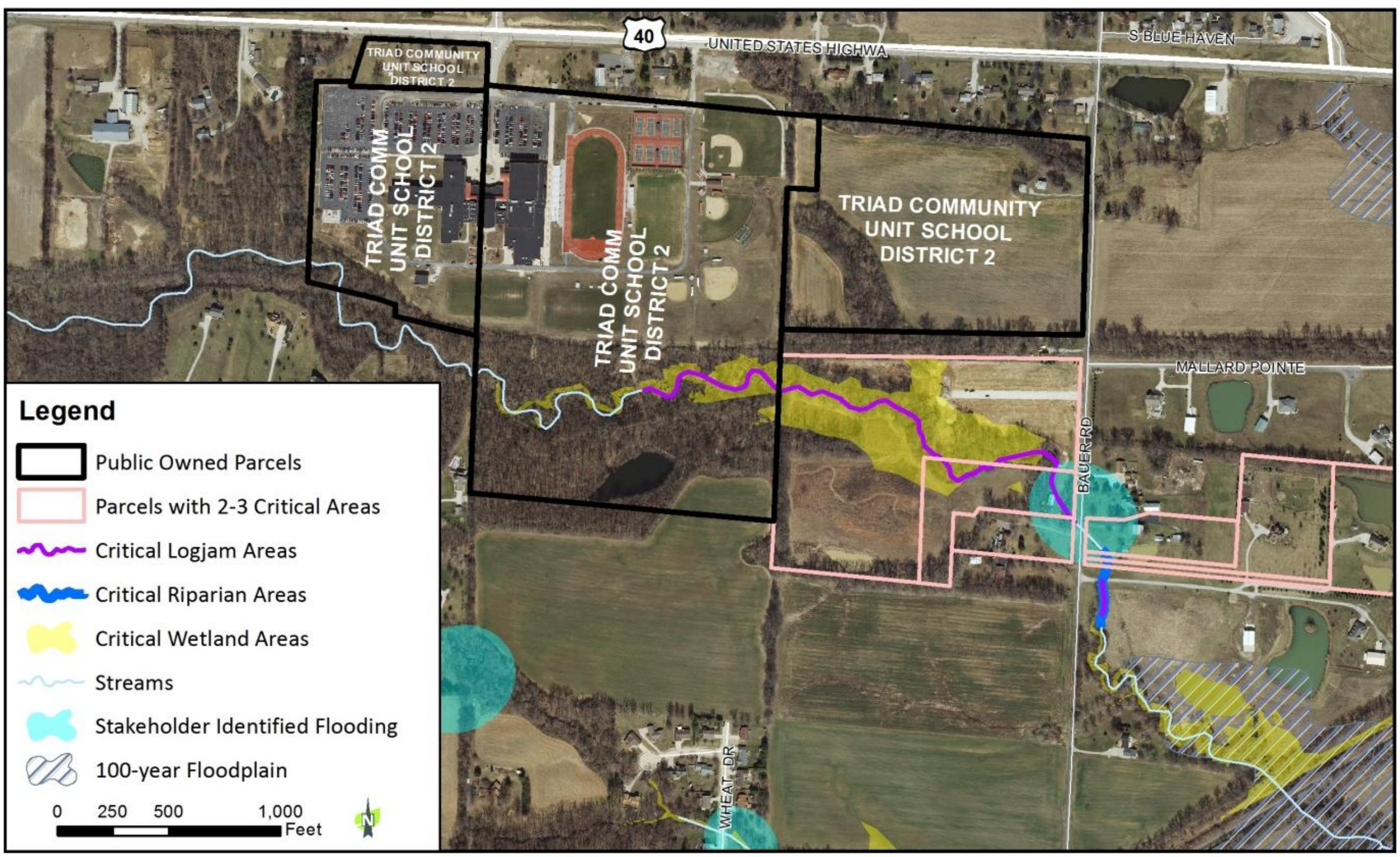


Project #10: Stream restoration and/or creation of wetlands behind Triad High School

A 10.7-acre Critical Wetland Area and a 0.8 km (2,600-foot) Critical Logjam Area were identified on the unnamed stream behind Triad High School (south of Route 40). At the outflow of this Critical Wetland Area, a flood location was identified by Troy officials where water overtops Bauer Road. The Triad High School Ecology Club has conducted stream monitoring using Illinois Riverwatch protocols at this stream, which they call Knights Creek after the school mascot, for several years. As measured by these volunteers, the stream ranged in width between 3.2 ft and 17 ft between 2000 and 2014, had habitat scores lower than the Illinois average, and had poor diversity of macroinvertebrates. The stream is in a Critical Flood Area, ranked at #2 out of 20 HUC14 subwatersheds.

A stream or wetland restoration project could be done on the portion of the stream and stream corridor owned by the Triad School District. The parcel to the east of the school-owned property could also be purchased (or a land use agreement made) to extend the stream restoration and/or the wetland to Bauer Road. The benefits of stream restoration and wetland creation here would include the usual benefits of habitat improvement and reduction in streambank erosion and loss of sediment, and would also bring educational benefits to the school, as students would have the opportunity to monitor changes in stream health and biodiversity at the site. The culvert at Bauer Road could also be enlarged, as needed, to prevent road overtopping.

Figure 15. Critical Wetland Area, Critical Logjam Area, and stakeholder-identified flood location on a tributary to Silver Creek south of Triad High School, in HUC 07140204050604 (City of Troy-Silver Creek).



Project #11: Fixing stormwater drainage in Marine City Park

A Madison County board member and Marine officials identified stormwater overtopping roads at all four corners of Marine City Park during heavy rain, because surrounding roads were raised. A respondent to the Flood Survey also reported basement flooding at a residence on the east side of the park, at a frequency of one to two times in ten years. The park is about 3 acres in size.

This issue could be solved by changing the grades of the roads and adding or expanding culverts and drainage ditches. A detention or retention basin could be installed in the park to help detain the flow of stormwater and create an attractive public feature. A site assessment and input from the village is needed to identify the most appropriate solutions.

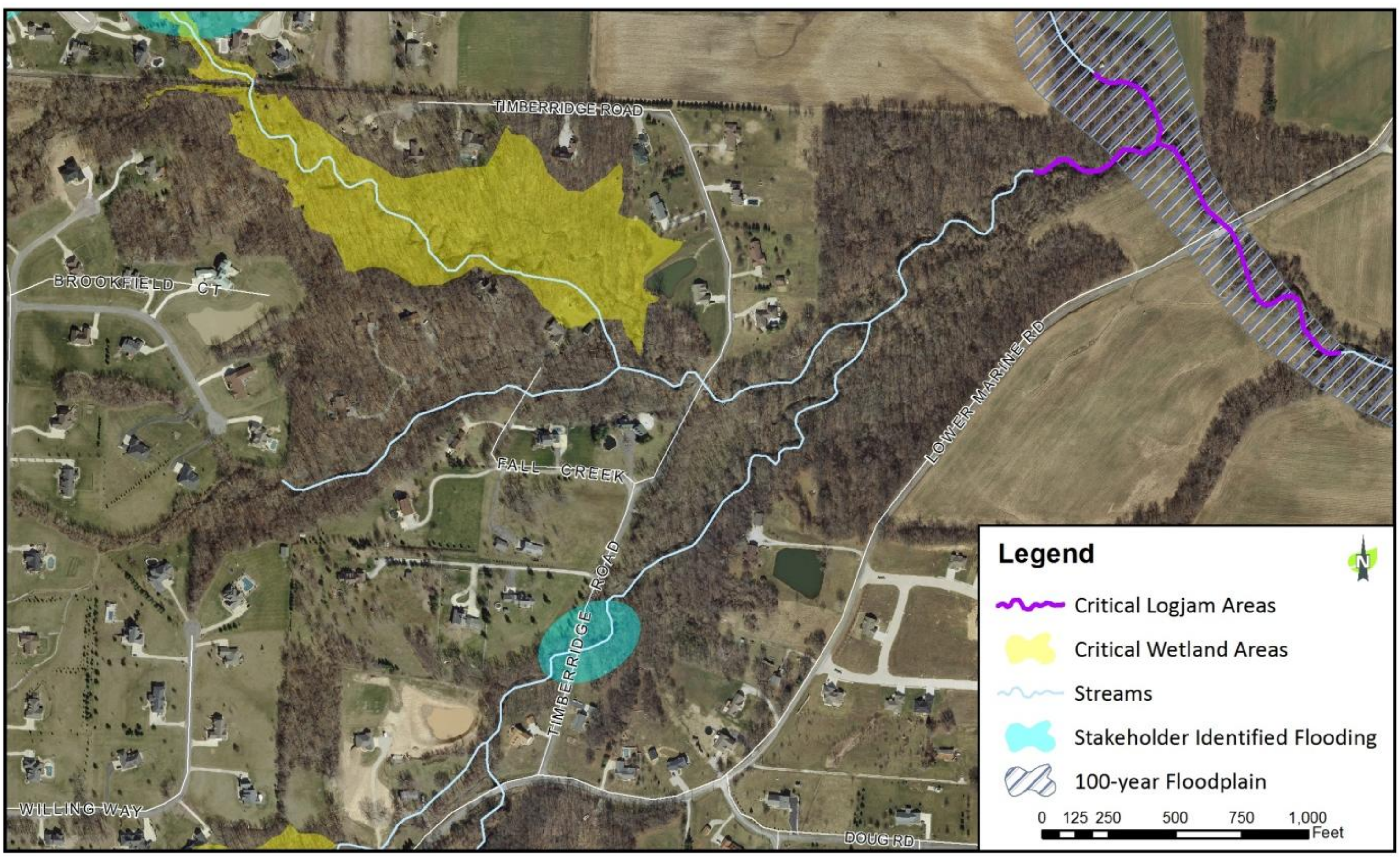
Figure 16. Stakeholder-identified flood locations where stormwater overtopped roads at Marine City Park, in HUC 07140204050501 (Neudeckers Mountain).

Project #12: Fixing road overtopping on Timber Ridge Road, protecting access to 21 homes

As identified in a meeting with Jarvis Township Highway staff, floods have overtopped Timber Ridge Road northeast of Troy, cutting off access to 21 homes. Timber Ridge Road used to be a private road, and was later accepted to township maintenance. It was poorly built and has small culverts. The north culvert (under Timber Creek Rd) has been enlarged and no longer causes problems, but the southern culvert (under Timber Ridge Rd) is still not large enough. Two out of five households that returned a Flood Survey reported that they had been flooded in the last 10 years. The flooding reached their yards, and occurred between one and nine times over 10 years.

To fix the road overtopping issue, the culvert under Timber Ridge Road should be enlarged. Additionally, the retention basin upstream of the road could be enlarged to reduce the high flow volumes reaching the road. A site assessment is needed to better understand the problem and potential solutions.

Figure17. Stakeholder-identified flood location at Timber Ridge Road northeast of Troy, where road overtopping cuts off access to about 21 houses, in HUC 07140204050602 (Twin Lakes-Wendell Branch).

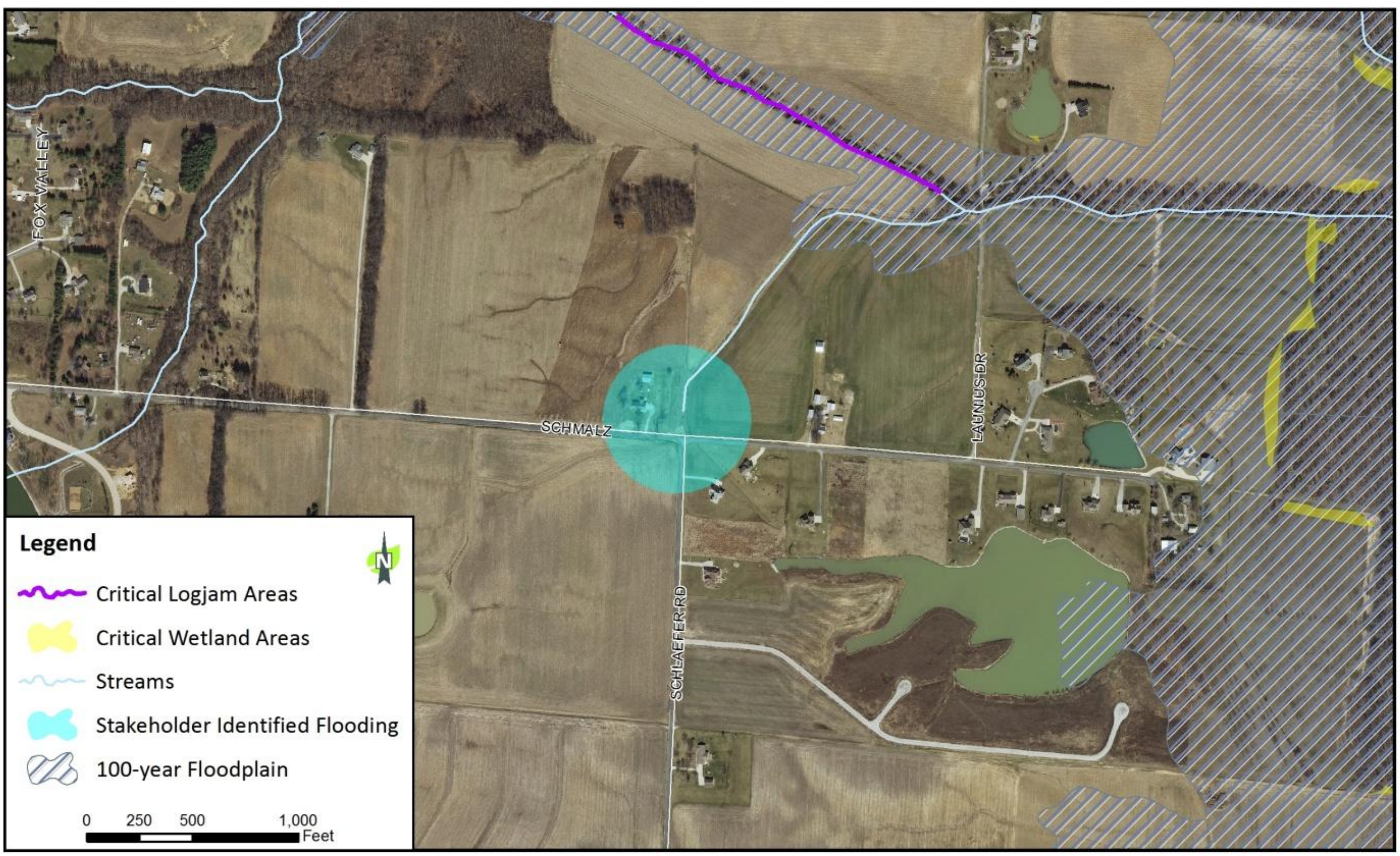


Project #13: Fixing road overtopping at Schlaefer Road, protecting access to 19 homes

As identified in a meeting with Jarvis Township Highway staff, floods sometimes overtop Schlaefer Road at or near its intersection with Schmalz Road east of Troy, cutting off road access to about 17 houses. The direction of flow is south to north, leading to Wendell Branch north of Launius Dr.

A larger culvert could be installed which would take a larger volume of stormwater across the road without overtopping it. Additionally, practices such as grassed waterways, WASCOBs, or farm ponds could be installed in the field southwest of the intersection, so that more stormwater has a chance to infiltrate into the ground before it reaches the road. These practices will also help prevent sediment from being deposited at the culvert and reducing the amount of flow it will admit.

Figure 18. Stakeholder-identified flood location at Schlaefer Road east of Troy, where road overtopping cuts off access to 19 houses, in HUC 07140204050602 (Twin Lakes-Wendell Branch).

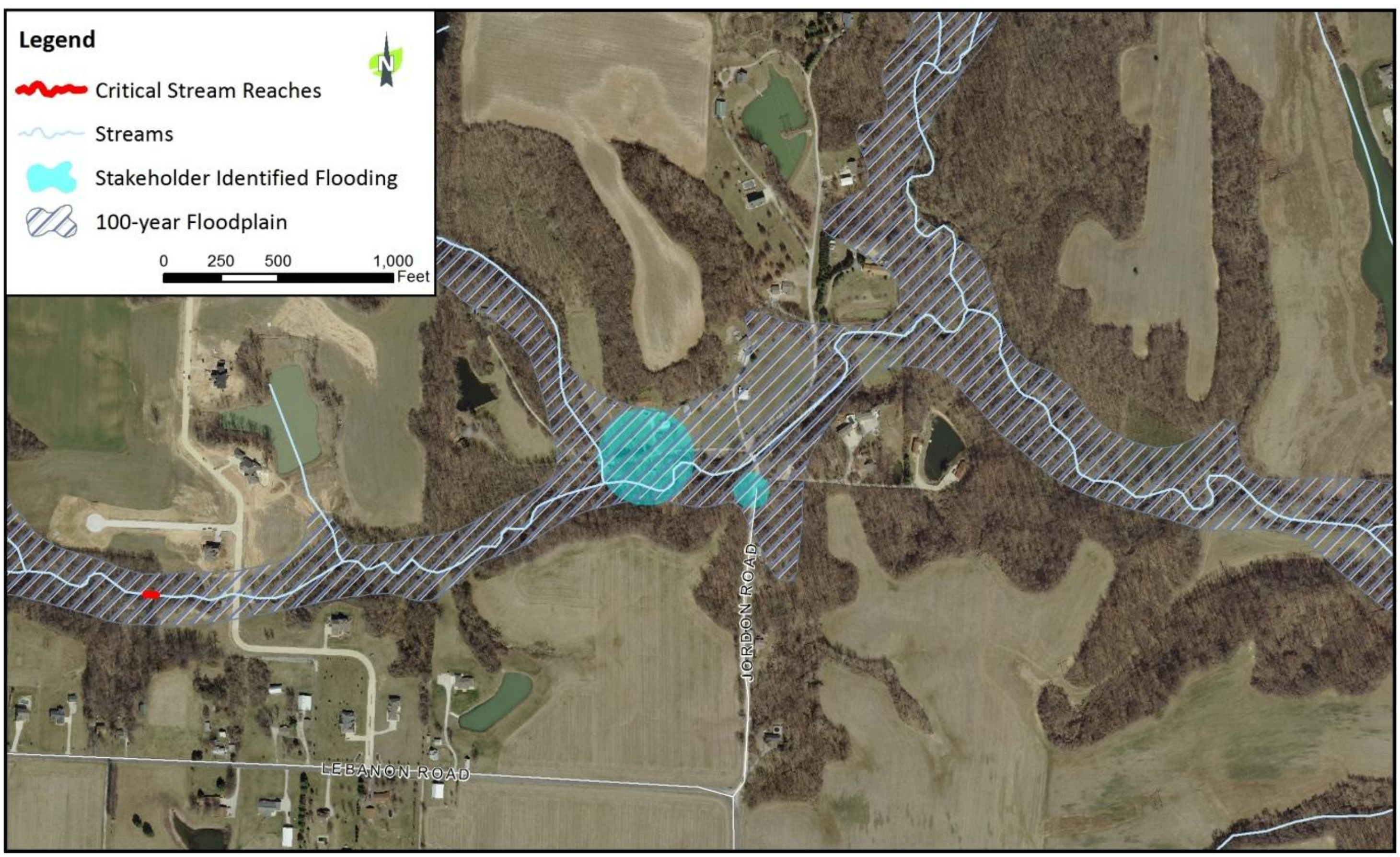


Project #14: Fixing road overtopping on Jordon Road, protecting access to 14 homes

Floods have overtopped Jordon Road (south of Troy near the county line) twice in ten years, cutting off access to about 14 houses. This issue was identified by a stakeholder at an Open House event. The road and the stream corridors are in the 100-year floodplain, and the project is located in a Critical Flood Area, ranked at 9 out of the 20 HUC14 subwatersheds. One household upstream of the road crossing, and adjacent to the stream, returned a Flood Survey, saying that flooding occurs there more than six times per year and reached their yard. This is the only specific project location in the HUC 07140204050902 (Mill Creek) subwatershed.

The culvert beneath Jordon Road could be enlarged to accommodate larger volumes of flow. Additionally, increased detention capacity upstream would help relieve the pressure on the culvert, through practices such as wetlands, farm ponds, and detention basins. A site-level assessment is needed to suggest suitable practices.

Figure 19. Stakeholder-identified flood location at Jordon Road south of Troy, where road overtopping cuts off access to about 14 houses, in HUC 07140204050902 (Mill Creek).



Project #15: Fixing road overtopping at Wheat Drive, protecting access to 12 homes

Stakeholders identified the location where floodwater overtops Wheat Drive southeast of Troy, cutting off road access to 12 homes. A 6.2-acre Critical Wetland Area was identified along the stream upstream and downstream of the road, with the larger wetland area in the field downstream. Further east, the same stream creates another area of flooding where Bauer Road crosses railroad tracks. This project is located in a Critical Flood Area ranked at #2 out of 20 HUC14 subwatersheds. Three out of seven Flood Survey responses received from nearby/upstream households reported flooding over the last 10 years. One respondent said that floods reached the first floor of their home. Flood frequency reported was three to five times per year for one household, and one or two times over 10 years for another household.

To fix the road overtopping, the culvert under Wheat Drive could be enlarged. Additionally, a wetland could be created upstream and/or downstream of the road crossing, to help slow down the water, improve water quality, and reduce further flooding downstream on Bauer Road and the railroad track.

Figure 20. Stakeholder-identified flood location at Wheat Drive southeast of Troy, where road overtopping cuts off access to 12 houses, in HUC 07140204050604 (City of Troy-Silver Creek).

Project #16: Fixing road overtopping on Main Street in Troy

Stakeholders identified floods overtopping Main Street in Troy for approximately 0.2 km (600 ft) just north of Route 40, with floodwaters reaching 1.5 inches in depth. This is a road hazard and an inconvenience to Troy drivers, and may cause a loss of or a reduction in access to up to 13 homes or businesses. This project is located in a Critical Flood Area ranked at #2 out of 20 HUC14 subwatersheds. A Flood Survey was returned from a property on the west side of Main Street within the identified flood location, and the respondent reported that their property floods once or twice per year, and that floodwater reaches the basement. Their monetary loss was less than $5,000.

To fix this drainage issue, an on-site assessment would be needed to determine whether roadside ditches or culverts should be enlarged, upstream stormwater storage facilities should increase in capacity, or a combination of these changes. The source(s) of the floodwater and the direction(s) from which it comes should be ascertained.

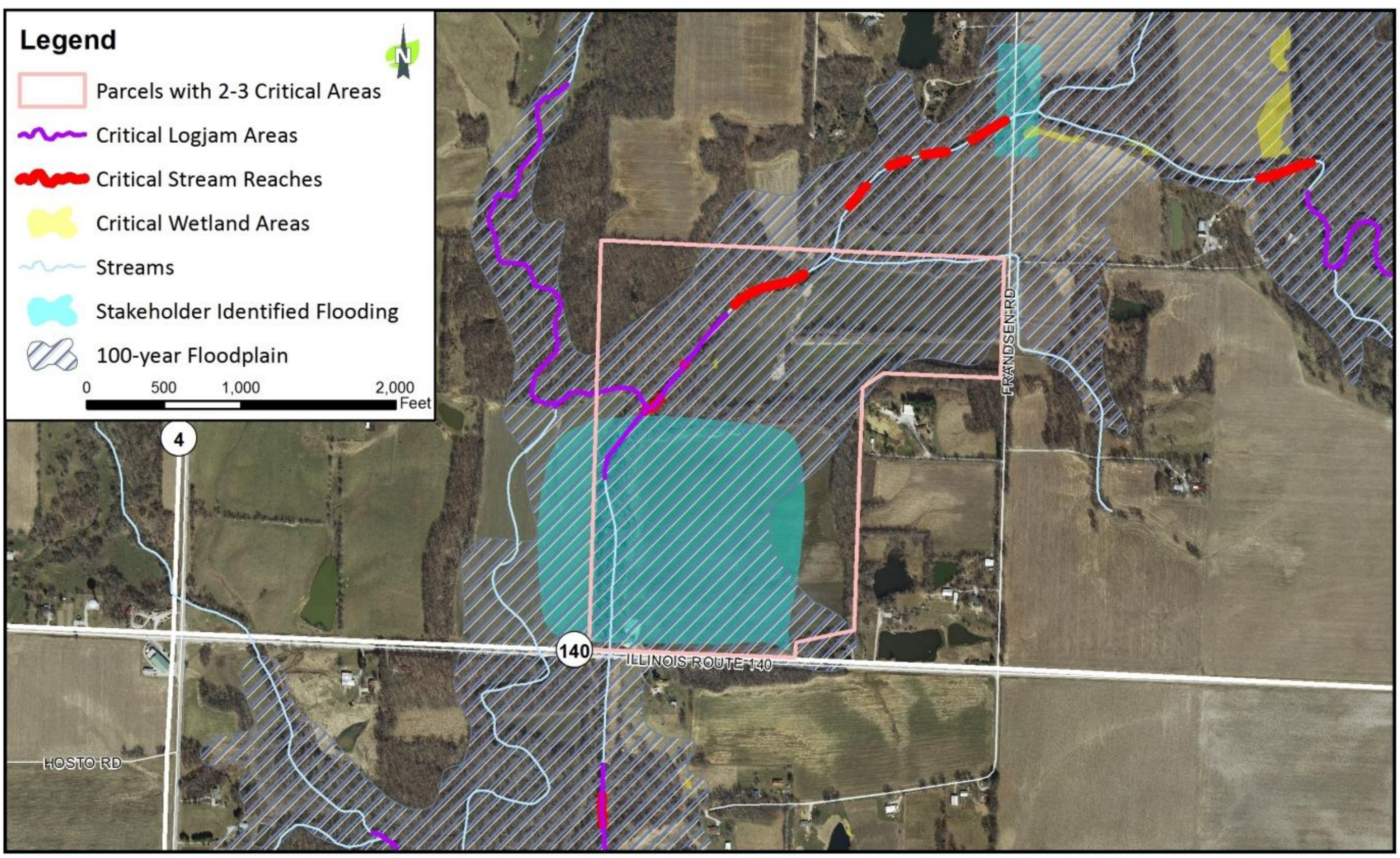
Figure 21. Stakeholder-identified flood location on Main Street in Troy, where road overtopping creates a hazard for many drivers and potentially cuts off access to homes and businesses, in HUC 07140204050604 (City of Troy-Silver Creek).

Project #17: Streambank stabilization at Frandsen Rd and Route 140

A parcel near the intersection of Frandsen Road and Route 140 contains Critical Logjam Areas, a Critical Stream Reach, a small Critical Wetland Area, and stakeholder-identified flooding. It is located at the confluence of Silver Creek and an unnamed tributary, and the majority of the parcel (about 99 acres) is in the 100-year floodplain. The riparian corridor around the 1.1 km-long stream is mostly forested, and the rest of the parcel is in row crop agriculture. The ACPF identified grass waterways as being suited for the field to the east of the stream, and a Critical Zone along the riparian area at the north end of the parcel where planting a forested riparian corridor would be highly beneficial.

This parcel presents an opportunity for streambank stabilization in the Critical Logjam Areas and the Critical Stream Reaches, expansion of the forested riparian buffer around the streams, and/or enrollment of the agricultural land in CRP or another program to restore the agricultural land in the floodplain to, for example, forest or wetlands. This is the only specific project location in the HUC 07140204050301 (Village of Worden-Silver Creek) subwatershed.

Figure 22. Parcel of privately owned land near the intersection of Route 140 and Frandsen Road, where a Critical Logjam Area, Critical Stream Reach, and a stakeholder-identified flood location are present, in HUC 07140204050301 (Village of Worden-Silver Creek).



Project #18: Streambank stabilization at Silver Creek Rd and Alhambra Rd

An unnamed stream flows north to south across Silver Creek Road west of its intersection with Alhambra Road. In the parcel south of this road crossing, the 0.7-km length of stream is almost entirely within a Critical Riparian Area and a Critical Logjam Area. A small Critical Wetland Area was also identified in the stream corridor on the west side of the stream. All of these Critical Areas are within the 100-year floodplain. This project location was found by identifying parcels with multiple Critical Areas (no stakeholder input was involved). This is the only specific project location in the HUC 07140204050203 (Village of Livingston) subwatershed.

This stream corridor could be improved by planting a wider forest buffer, removing detrimental logjams, and/or restoring a small wetland area.

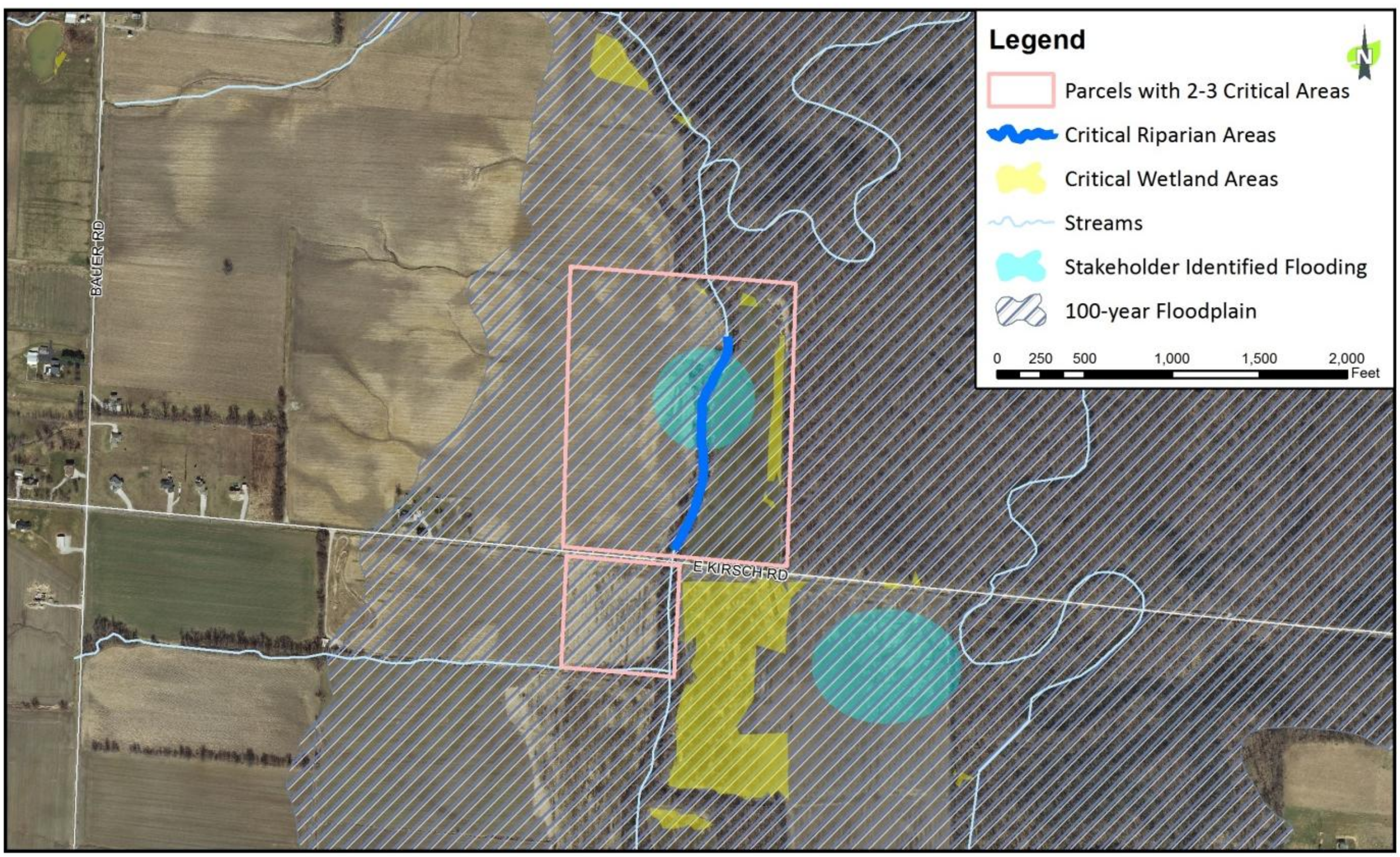
Figure 23. Parcel of privately owned land near the intersection of Silver Creek Road and Alhambra Road, where a Critical Logjam Area, Critical Riparian Area, and a Critical Wetland Area are present, in HUC 07140204050203 (Village of Livingston).

Project #19: Riparian buffer expansion below the confluence of East Fork Silver Creek and Silver Creek

East Fork Silver Creek brings a lot of water from Highland and eastern Madison County into Silver Creek. Just south of the confluence of these two streams, a parcel north of East Kirsch Road near its intersection with Bauer Road was identified in which a 0.4 km Critical Riparian Area was identified on Silver Creek. Three Critical Wetland Areas totaling 1.4 acres were also identified close to the stream channel. Jarvis Township Highway staff reported that the stream has overtopped its banks at this location in the past, flooding the adjacent cropland. The project is located in a Critical Flood Area, ranked at #5 out of 20 HUC14 subwatersheds. The entire parcel is in the 100-year floodplain.

This stream corridor could be improved by planting a wider forest buffer, which would reduce the amount of soil from the agricultural land being lost to the stream, improve water quality, and increase wildlife habitat. Wetland areas in the stream corridor could also be restored, in order to improve water quality and retain floodwaters so that downstream “flashiness” of flooding is reduced. The agricultural land in the 100-year floodplain could be enrolled in the CRP or a similar program, so that the landowner can be reimbursed for taking the land out of production in order to protect it.

Figure 24. Parcel of privately owned land south of the confluence of East Fork Silver Creek and Silver Creek where a Critical Riparian Area, Critical Wetland Area, and stakeholder-identified flood location are present, in HUC 07140204050903 (07140204050903-Silver Creek). Note: the parcel shown south of East Kirsch Road has the same identifying information as the one north of the road. It contains no Critical Areas.

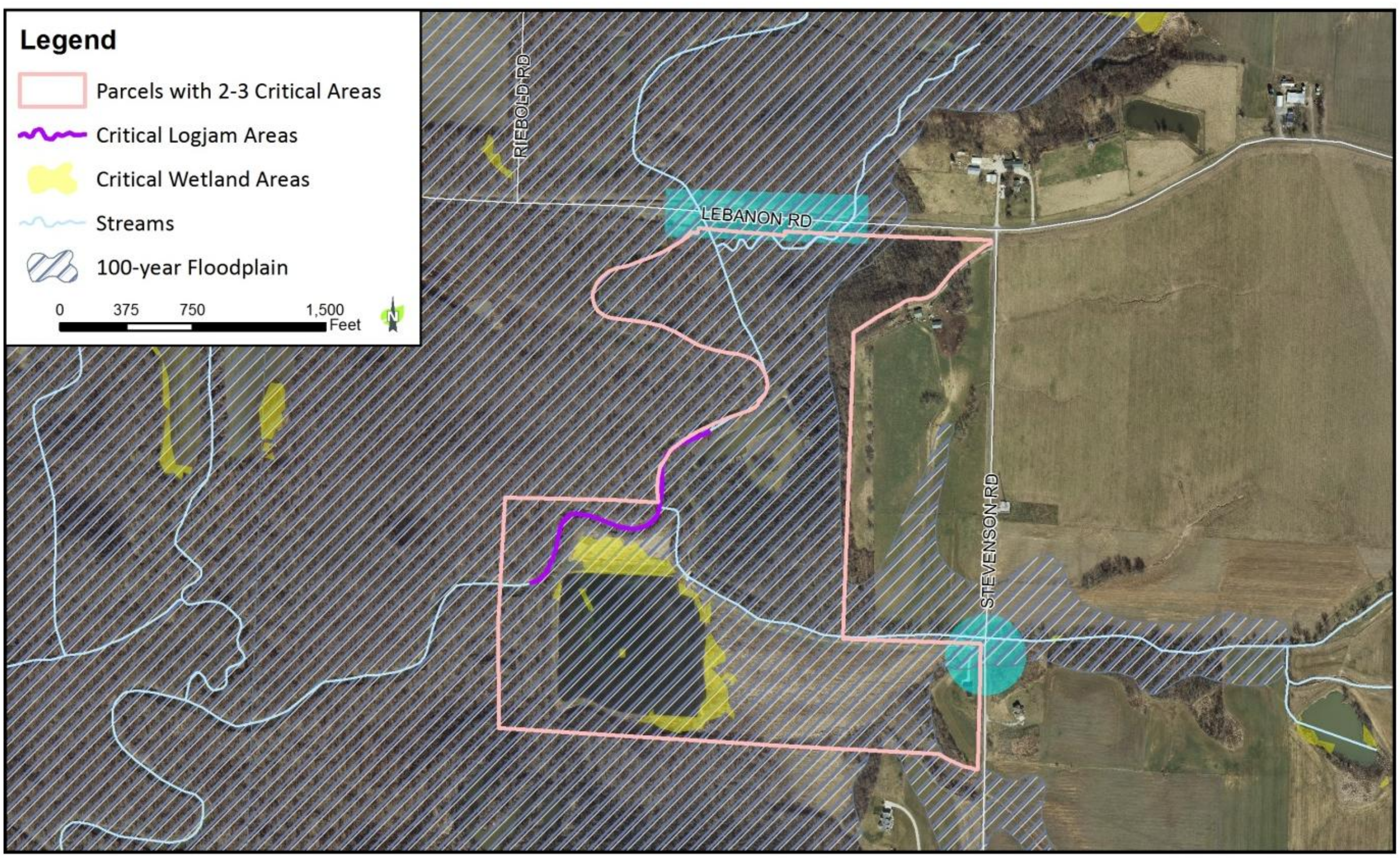


Project #20: Wetland in the Silver Creek corridor at Lebanon Road and Stevenson Road

Southwest of the intersection of Lebanon Road and Stevenson Road, 0.8 km north of the Madison-St. Clair county line, Silver Creek flows through a large parcel. The parcel is almost entirely within the 100-year floodplain, and contains Critical Wetland Areas (4.3 acres in total) and a Critical Logjam Area (0.5 km) adjacent to a pond or basin. Stakeholders identified road overtopping where Silver Creek crosses Lebanon Road at the north end of the parcel, and where a tributary crosses Stevenson Road on the east side of the parcel. The project is located in a Critical Flood Area, ranked at #5 out of 20 HUC14 subwatersheds.

To increase floodwater storage, the existing pond/basin could be enlarged and/or restored to wetland. Any area converted from cropland could be enrolled in the CRP program or another program. The stream could be restored to remove any harmful logjams and to increase streambank stabilization where necessary. Additionally, the culverts at Lebanon Road and Stevenson Road could be enlarged.

Figure 25. Parcel of privately owned land near the intersection of Lebanon Road and Stevenson Road, where a Critical Wetland Area, Critical Logjam Area, and stakeholder-identified flood locations are present, in HUC 07140204050903 (07140204050903-Silver Creek).

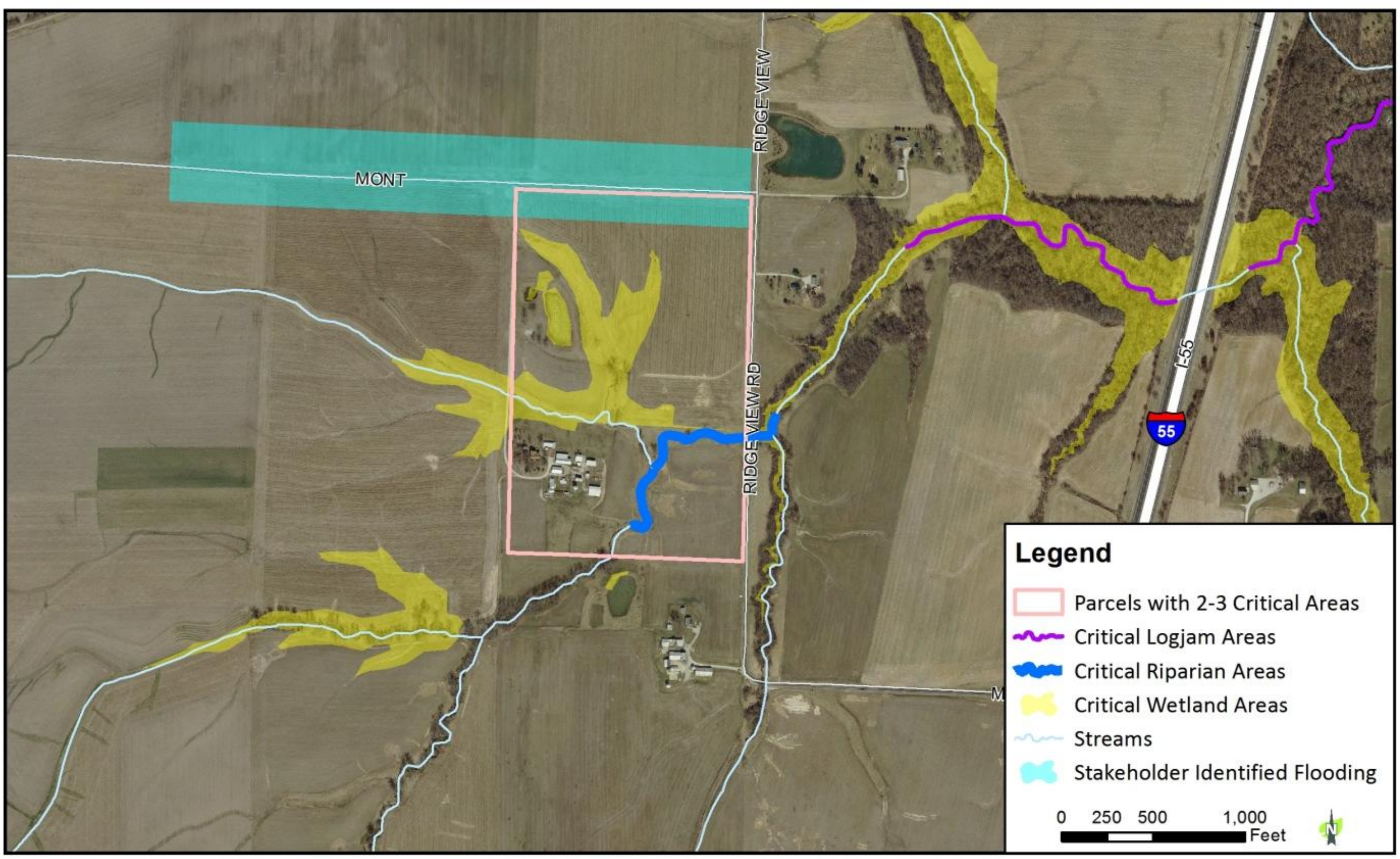


Project #21: Wetland restoration and riparian buffer expansion on farm at Mont Road and Ridge View Road

A parcel southwest of the intersection of Mont Road and Ridge View Road contains 13.7 acres of Critical Wetland Area and 0.3 km of Critical Riparian Area along an unnamed tributary to Silver Creek. The parcel includes cropland and farm buildings. Madison County Board members also identified flooding along Mont Road at the north side of the parcel. This is the only specific project location in the HUC 07140204050601 (Headwaters Wendel Branch) subwatershed.

To decrease soil and sediment loss to the stream, the area around the tributary could be planted with trees to create a forested riparian buffer. Additionally, some or all of the Critical Wetland Area could be restored to wetland, which would help clean and slow the flow of runoff from the fields. The area converted from cropland could be enrolled in the CRP program or another program. To reduce the flooding along Mont Road, ditches, culverts, and other drainage infrastructure may be suitable. An onsite assessment would be needed to make better recommendations for this site.

Figure 26. Parcel of privately owned land southwest of the intersection of Mont Road and Ridge View Road, where a Critical Wetland Area, Critical Riparian Area, and stakeholder-identified flood location are present, in HUC 07140204050601 (Headwaters Wendell Branch).



Management Measures on Public Land

To increase the ease with which this plan can be implemented when funds become available for the counties and municipalities in the watershed, it is recommended that a shortlist of 5-10 projects are identified for implementation on public land. These projects should improve life safety, address multiple goals of this plan, involve multiple partners, and implement a range of Management Measure types when possible. A shortlist of these projects will help Madison County in its efforts to help communities in the watershed address the needs they identified in the stakeholder engagement process, and provide a near-term jumping off point for plan implementation by and for local government.

SECTION 6: INFORMATION & EDUCATION PLAN

This section is designed to provide an Information & 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 upper Silver Creek watershed and the Watershed Plan."

The upper 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 upper 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 become aware of the creek's location and needs and adopt specific behaviors to improve its health, the threats and challenges in the watershed will decrease. Public information and stakeholder education efforts will ultimately inspire watershed residents and community members to adopt recommended behaviors that improve the water quality and overall health of the watershed.

Information and Education Process

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

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

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

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 9. 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:

- Madison County Government Departments and elected officials
- Municipal staff, township staff, and elected officials (including Municipal Separate Storm Sewer System (MS4) Co-Permittee Group Members)
- Homeowners associations (HOAs)
- Developers
- Residents with property adjacent to Silver Creek and its tributaries
- Residents throughout the watershed
- Farmers and farm groups
- Students and schools/universities

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

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

Some of the homeowners' associations (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 1800's. Outreach with messages that emphasize sustaining the rich soil and the landscape for the next generation is likely to resonate with this audience.

Residents with property adjacent to 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 the Watershed Plan website hosted by HeartLands Conservancy, www.heartlandsconservancy.org/uppersilvercreek. Printed copies of the Executive Summary and the full

Plan will also be shared with key watershed stakeholders. Emails to stakeholders engaged in the planning process provided updates on the Plan's progress and point to the website for all Plan materials.

Landowner/farmer survey

Another key component of the Information and Education Plan is a survey to that was sent out to over 1,000 landowners in the watershed who own parcels of at least 5 acres in size. HeartLands Conservancy and Madison County collaborated to send out this survey in summer 2015, and responses continue to be received. The aim of the survey was to create awareness among landowners about the types of grants that are available to them to implement the BMPs recommended in this Watershed Plan. This will help in creating a seamless transition between the planning and implementation processes, and will keep momentum going after the Plan is complete. See Appendix C for the Landowner/Farmer Survey and its preliminary results.

After the plan is complete

Table 9 outlines each objective followed by recommended strategies that can be implemented to achieve the goals/objectives. For each activity, a target audience, suggested strategies, schedule, lead and supporting agencies, the desired outcomes and issues addressed, and estimated costs to implement is provided. Periodic review of the Watershed Plan is recommended, with meetings of the plan partners held twice a year, at six month intervals. Larger annual meetings may be held to include stakeholders and the public. Plan revision should be considered at 5-year intervals.

Table 9. Information and Education Plan recommended programs and strategies. Acronyms used: HLC: HeartLands Conservancy; NGRREC: National Great Rivers Research and Education Center; SWCD: Soil and Water Conservation District; CREP: Conservation Reserve Enhancement Program.

Program	Target Audience(s)	Strategies	Schedule	Lead & Supporting Orgs	Desired Outcomes/Issues Addressed	Est. Cost
Objective 6.1: Identify opportunities to assist local, state, and federal agencies and stakeholders with watershed management and conservation efforts.						
Municipal Outreach	Municipalities	• Connect officials and staff to resources about water quality, best practices for stormwater management, 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	Madison 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	Madison County, HLC, other partners	• Majority of watershed residents have knowledge of watershed conditions, possible behavior improvements, and key contacts to get involved and implement projects. • The public begins to alter activities leading to watershed improvement.	Printing: $200

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

Program	Target Audience(s)	Strategies	Schedule	Lead & Supporting Orgs	Desired Outcomes/Issues Addressed	Est. Cost
Objective 6.3: Offer opportunities for education, training, and participation in watershed matters.						
Field Days	Residents, Students, Non Profits, Volunteer Groups	• Organize stream cleanup volunteer opportunities. • Promote volunteer field days through media, social media, and community groups. • “Adopt a Stream” program (similar to Adopt a Road) • HOA Basin/Pond Maintenance Field Days	Medium-Term	HLC, Madison County, Sierra Club, existing volunteer groups	• Amount of debris is reduced in streams. • People develop an interest in watershed protection and conservation. • Invasive species are removed and participants learn how to manage invasives on their own. • Leverages in-kind donations for future grants. • Riparian area and habitat conditions improve. • Stormwater storage features are maintained/capacity is increased.	$500 per event
Educational Signs	Residents, Visitors	• Mark watershed boundaries with signs • Post warning signs about littering and illegal dumping	Medium-Term	Madison County	• People better understand the term “watershed”. • Littering and illegal dumping is reduced. • Awareness of the watershed’s boundaries are increased.	$2,000 (20 signs)
School Projects	Students, Parents	• Develop age-appropriate project opportunities for schools or colleges such as rain gauge maintenance, rainscaping, wildlife habitat restoration, and geocaching.	Long-term	Madison County	• Students and parents develop interest in watershed protection and conservation.	Equip-ment costs and staff time
Objective 6.4: Develop public recognition programs focused on the Watershed Plan’s goals.						
Watershed Protection Awareness	All County Stakeholders	• Develop messaging based on goals in the Watershed Plan and disseminate the message using media, social media, collateral (e.g. pencils, bumper stickers, temporary tattoos), and other materials.	Medium-term	Madison County	• 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 10.

Table 10. Resources and tools for activities/campaigns.

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

SECTION 7: IMPLEMENTATION

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

Implementation Schedule

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

The Management Measures are recommended for the short term (1-10 years), medium term (10-20 years), long-term (20+ years), ongoing (for maintenance activities), or as-needed. The “Information and Education Plan” also uses these schedule options. The schedule was arranged to accommodate practices based on practice type, available funds, technical assistance needs, and timeframe for each recommendation. Higher priority was given to practices that address an issue in a Critical Area, greater amount of the practice recommended, greater eligibility for state and federal programs, and perceived general knowledge of the practices. Projects in Critical Areas are given highest priority in the schedule, and planned for the short term where feasible (Table 11).

Table 11. 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; 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
SITE-SPECIFIC MANAGEMENT MEASURES				
Agricultural management practices				
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
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
Ponds	Landowners/ farmers	Medium	NRCS, SWCD, contractor	Medium term
Reduced tillage (conservation tillage/no-till)	Landowners/ farmers	Medium	NRCS, SWCD, contractor	Ongoing
Terraces	Landowners/ farmers	Medium	NRCS, SWCD, contractor	Long term
Waste storage structure	Landowners/ farmers	Medium	NRCS, SWCD, contractor	Medium term
Water and sediment control basin	Landowners/ farmers	Medium	NRCS, SWCD, contractor	Medium term
Urban/Other Measures				
Single property flood reduction strategies	Residents, industry/ commercial	High: Critical Areas	FEMA, contractors	Short 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
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 harvesting & reuse	Residents, industry/ commercial	Low	NGRREC, IEPA	Long term
Stormwater and sanitary sewer system maintenance and expansion	Municipalities, HOAs	Medium	Contractors	Ongoing/ As needed

Table 11 continued.

In-stream Measures				
Streambank & channel restoration	Landowners/ farmers, residents, municipalities	High: Critical Areas	Ecological consultant/ contractor	Short term
Logjam removal	Landowners/ farmers, residents, municipalities	High: Critical Areas	Ecological consultant/ contractor	Short term
PROGRAMMATIC MANAGEMENT MEASURES				
Conservation Development	Counties, municipalities, developers	Medium	Urban planners, planning resources, HLC	Medium term
Federal and state programs (CRP, CREP, etc.)	Landowners/farmers, NRCS, SWCD	Medium	NRCS, SWCD, NGRREC	Medium term
Financial support for stormwater infrastructure	Counties, municipalities	Medium	Regional/statewide community examples	Long term
Flood Damage Prevention Ordinance	Counties, municipalities	Medium	IDNR, FEMA, HLC	Medium term
Green infrastructure incentives	Counties, municipalities, developers	Low	IEPA, HLC, regional/statewide community examples	Long term
In-lieu fee mitigation	Developers, Counties, NGOs	Medium	USACE, IDNR	Ongoing (as development occurs)
Long-term management of natural areas	Developers, HOAs, conservation organizations	Medium	IDNR, HLC	As needed
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, HLC	Ongoing
Monitoring (water quality, flow, etc.)	USGS, IEPA, NGRREC	High	USGS, IEPA, NGRREC, SIU-Carbondale	Ongoing

Funding Sources

Many opportunities are available to secure funding for the varied and diverse Management Measure recommendations 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 12 shows just some of the potential funding sources for agricultural and in-stream BMPs recommended in this plan. A longer list of potential funding programs and opportunities is included in Appendix G.

Funds may come from existing grant programs run by a public agency or other organization. An application must be submitted, and if the project meets the program criteria, funds may be awarded. Funds can also come from partner organizations through other avenues. Partners may wish to become involved if the project helps to achieve their objectives, is a priority, is attractive, or is a networking opportunity. Partnerships are critical for leveraging not only funds, but also other assets including political support; partners can leverage valuable goodwill and relationships that have the potential to lead to other support from secondary sources. Neighborhood associations, homeowner associations (HOAs), and others that live nearby should be involved if the project is to be successful over the long term. Their goodwill can be very important in leveraging funding and maintaining an effective project.

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. Because of the differences between partner organizations, the process for one project will not often be fully replicable. Given this fact, it is a wise practice to maintain relationships and communication with and between partners. This will help partners to enrich grant applications and identify other funding opportunities which might not readily be apparent. Each partner organization should have 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 12. 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 practices	
Contour buffer strips	CRP, CPP, EQIP, 319
Cover crops	EQIP, CPP, CSP, 319
Grassed waterways	CRP, EQIP, CPP, 319
Ponds	EQIP (if sole livestock drinking water source), 319
Reduced tillage (conservation tillage/no-till)	EQIP (no-till only), CSP, 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
In-stream Measures	
Streambank & channel restoration	SSRP, 319

Monitoring Timeline

NGRREC's sampling schedule began in October 2015 with the selection of discrete HUC14 subwatershed sampling sites (Table 13). As funding allows, the collection and analysis of monitoring data should be continued on a 3-5 year cycle through the year 2025. 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. Quality Assurance Project Plans (QAPP) should be developed for those monitoring opportunities that are selected for implementation in support of the Watershed Plan.

Table 13. Water quality monitoring timeline. Monitoring activities likely to be conducted primarily by NGRREC and Illinois RiverWatch.

		2015			2016												2017						2018 - 2025
	Monitoring Activity	Se	O	N	Ja	F	M	A	M	J	J	A	S	O	N	D	Ja	F	M	A	M	J	
	Develop Standard Operating Procedures for collection and laboratory analysis of samples																						
	Bi-weekly sampling of USGS gage site 05594450																						
2.1	Install continuous monitoring equipment																						
2.2	Monitor TSS, TP, TN, NPOC																						
2.3	Evaluate and adjust continous monitoring plan																						
2.4	Monitor TSS, TP, TN, NPOC based on revised plan																						
	Discrete sampling at the HUC14 level																						
3.1	Establishment HUC 14 discrete sampling sites																						
3.2	TSS, TP, TN, NPOC, SRP, inorganic N																						
3.3	Analyze for soluble Mn																						
3.4	Evaluate and adjust discrete monitoring plan																						
3.5	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:

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

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

Measurement indicators

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

Interim milestones

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

Meetings of the watershed plan partners should be held twice a year, at six month intervals, in order to assess the progress of the plan and address deficiencies in its implementation. The partners may also hold a larger annual meeting to which stakeholders and the public will be invited. The need for a plan revision will be assessed at 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; 2016-2026), medium-term (10-20 years; 2026-2036), and long-term (20+ years; 2036+) 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 H.

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

Goal(s) Addressed	Measure of Success	Measurement Indicators
All goals	Projects & 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 Silver Creek and Troy 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. New 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: Enaction of local ordinances to restrict construction in floodplains and floodprone areas.	Number and extent of flood damage prevention ordinances, riparian buffer ordinances, and other actions by local governments to restrict construction in floodplains and riparian areas.
Environmentally Sensitive Development Practices	Infiltration: Practices allowing stormwater to infiltrate to groundwater.	Area of impervious surfaces in new development (see NLCD Percent Developed Impervious Surface dataset) and number of detention basins or other stormwater infrastructure constructed and retrofitted to allow more infiltration.

Table 14 continued.

Goal(s) Addressed	Measure of Success	Measurement Indicators
Environmentally Sensitive Development Practices	Land Conservation: Preservation of sensitive lands.	Acreage of land enrolled in conservation easements including CRP and 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, eg 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 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, eg 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 (eg 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 its 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 (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.

Animal Feeding Operation (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.

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

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

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

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.

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

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

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

Conservation Reserve Program: A land conservation program administered by the Farm Service Agency (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 G 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 G for more detail.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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.

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 E for more detail.

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

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

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

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

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

Macroinvertebrate Biotic Index (MBI): Index method/calculation used to rate water quality using macroinvertebrate taxa tolerance to organic pollution in streams.

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.

National Wetland Inventory (NWI): U.S. Fish and Wildlife Service program that provides information on the characteristics, extent, and status of U.S. wetlands and deepwater habitats.

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

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

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

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

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

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

Open space parcel: Any parcel of land that is not developed and is set aside for recreation or conservation purposes.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Streambank stabilization: Techniques used for stabilizing eroding streambanks.

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

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

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

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

Topography: The relative elevations of a landscape describing the configuration of its surface.
Total Maximum Daily Load (TMDL): The highest amount of discharge of a particular pollutant that a waterbody can handle safely per day.

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

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

United States 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.

United States 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.

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

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

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

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

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

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

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

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

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

APPENDIX A: WATERSHED RESOURCE INVENTORY

Table of Contents

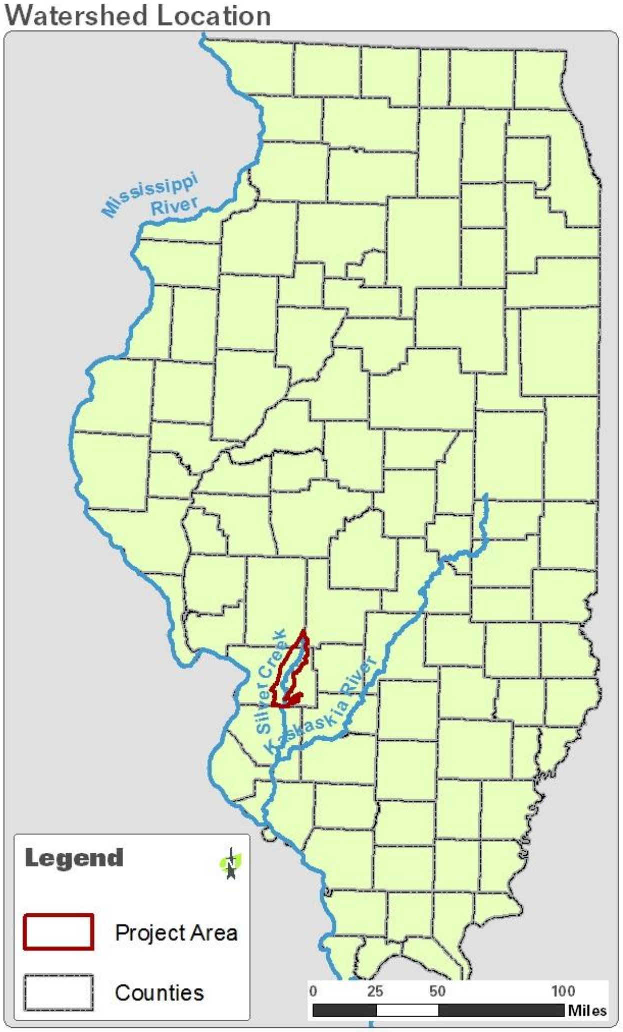
Introduction

The Upper Silver Creek watershed is located 20 miles northeast of St. Louis, Missouri in southwestern Illinois. The majority of the watershed is in Madison County, and small portions fall within Macoupin and Montgomery counties. Waterways in the project area account for approximately 480 stream miles that drain roughly 120,000 acres of land. Silver Creek flows south from the project area to join the Kaskaskia River, which ultimately drains into the Mississippi River.

The majority of the watershed's population lives in unincorporated areas where farming is the primary land use. Portions of 13 municipalities are also present, of which Troy, Mount Olive, Marine, and Livingston have the largest population.

Silver Creek and a portion of Troy Creek appear on the Illinois Environmental Protection Agency's 303(d) impaired waters list. The causes identified for these impairments include dissolved oxygen, manganese, total phosphorus, and sedimentation/siltation. The named sources of these pollutants are animal feeding operations, municipal point source discharges, urban runoff, and crop production. In addition, the watershed experiences flooding inside and outside of its designated 100-year floodplains, causing damage to property and threatening life safety.

Watershed Location



The Upper Silver Creek Watershed-Based Plan (Plan) aims to respond to these issues. Funded through a grant from the Illinois Environmental Protection Agency through Section 604(b) of the Clean Water Act and matching funds from Madison County, the Plan is directed towards guiding efforts to protect and restore surface water quality in the Upper Silver Creek watershed. Flood damage mitigation is also a priority in this planning effort thanks to additional support from Madison County. The Plan will aid stakeholders in implementing water quality and flooding solutions and help recommended improvement projects become eligible for state and federal grants.

This Watershed Resources Inventory (Inventory) constitutes the first step of the Plan. Existing conditions in several categories are identified:

- Watershed boundaries
- Topography and slope
- Climate
- Geology and soils
- Jurisdictions and demographics
- Land use/land cover and impervious cover
- Streambank and streambed erosion
- Channelization and riparian condition
- Flooding locations and impacts
- Water quality, including pollutant loads

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 unforeseen flooding issues. Approximately 15% of the streams studied in the watershed are highly channelized, and impervious cover in the watershed has been increasing at 2.8% per year on average. Streambank erosion is severe along 17% of the stream length assessed, causing sedimentation and siltation in the waterways. Fertilizer use on agricultural, commercial, and residential land is contributing to phosphorus loading, and old, failing, and improperly maintained septic systems are potential nutrient and bacteria threats.

Stakeholder outreach complemented the data collection for this Inventory and educated watershed residents and business owners about the aims of the Plan. Seventy-six key stakeholders have attended meetings with the planning team individually or in small groups, and more than 65 people attended two informational Open House events about the Plan. In a flood-themed survey to residents in the watershed, 512 people (so far) have provided feedback on their experiences with flooding over the past 10 years. Preliminary survey results show that the vast majority of respondents place “high” or “very high” importance on clean drinking water, prevention of flood damage, waterbodies suitable for recreation, and a healthy watershed that supports a wide variety of plant and animal life.

This Inventory contains the data to be used in identifying and prioritizing Best Management Practices (BMPs) in the next phase of the Watershed-Based Plan.

Watershed Boundaries

The Upper Silver Creek Watershed Plan project area is 120,091 acres in size (Table A.1). It is nested within the larger Lower Kaskaskia Watershed (HUC 07140204; Figure A.1) and HUC 0714020405, a HUC10 that extends from Macoupin and Montgomery counties south through Madison County into St. Clair County. “HUC” stands for Hydrologic Unit Code, the number that indicates the general location and size of the watershed and follows the term.

Table A.1. Area of the hydrologic units nested in the Upper Silver Creek Watershed Plan project area.

Watershed	**Area**
Project area	120,091 acres
HUC10 level (Silver Creek), HUC 0714020405)	244,252 acres
HUC8 level (Lower Kaskaskia, HUC 07140204)	1,028,836 acres

Watershed Boundaries

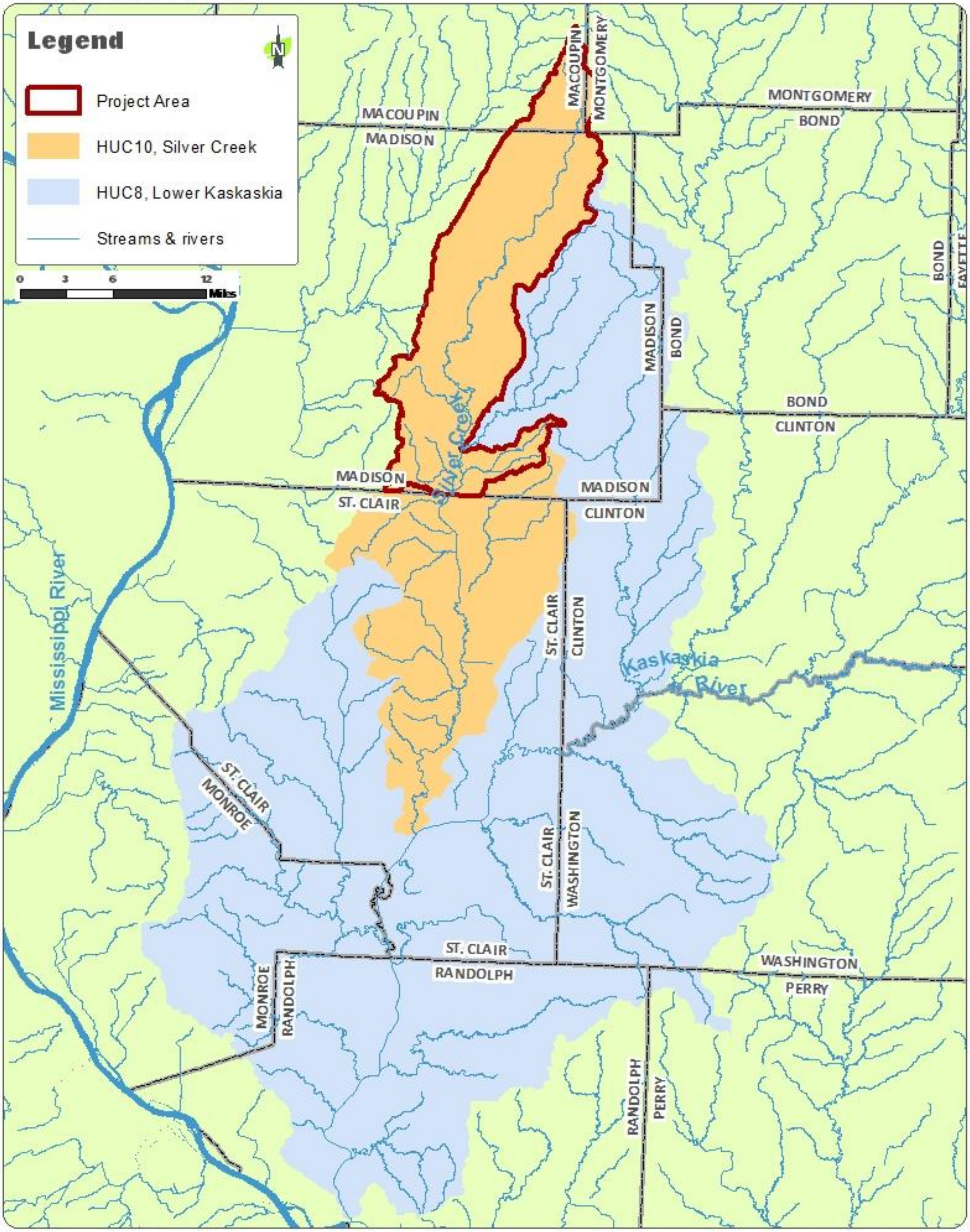


Figure A.1. The Upper Silver Creek Watershed Plan project area in context of the Lower Kaskaskia HUC8 watershed.

Subwatersheds

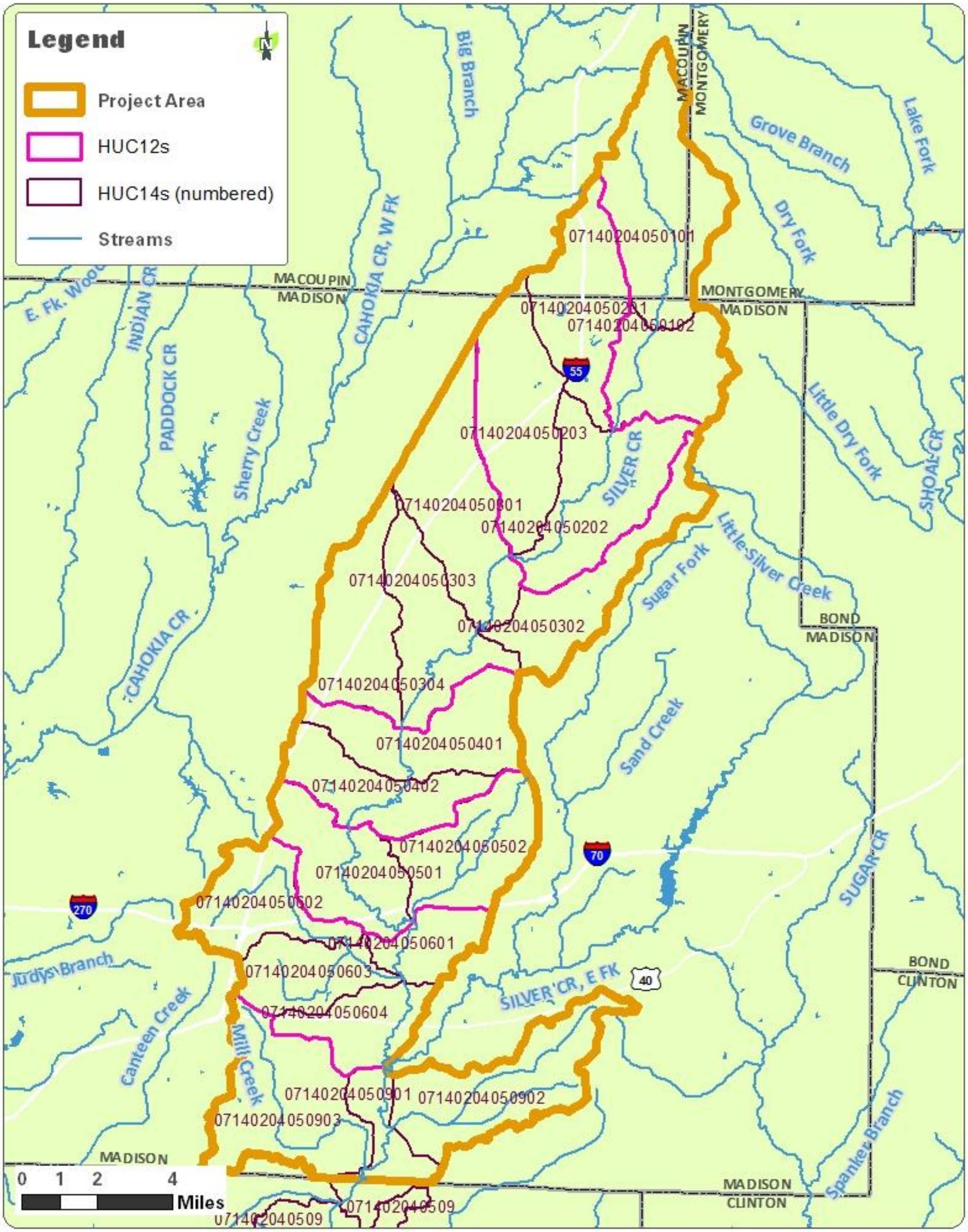
The project area contains numerous smaller subwatersheds, or hydrologic units, including seven HUC12s and twenty HUC14s (Figure A.2). The HUC14s were delineated using methods employed by USGS to define watersheds in the Watershed Boundary Dataset (WBD), a component of the National Hydrography Dataset (NHD). Each HUC12 contains 2-4 HUC14s ranging between 2,758 and 9,613 acres in size. The following pages show the seven HUC12s with their component HUC14s and waterbodies (Figures A.4 through A.10).

NOTE: The HUC14s delineated for this Watershed-Based Plan have been given new HUC codes and names subsequently to the submission of this Watershed Resources Inventory. The new codes and names were assigned so that the HUC14s can be submitted to the USGS Watershed Boundary Dataset (WBD). The old, draft HUC14s (Figure A.2) are used throughout this Watershed-Based Plan. Figure A.3 and Table A.2 show the old and new HUC14 names and codes.

Table A.2. Old (draft) and new HUC14 codes and new HUC14 names for the HUC14 subwatersheds. 10 out of 20 HUC14 codes were changed for submission to the Watershed Boundary Dataset (WBD).

Old HUC14 code (used in this WRI)	Final HUC14 code for submission to WBD (used in Watershed Plan)	Final HUC14 name for submission to WBD (used in Watershed Plan)	Same/different code?
7140204050101	7140204050101	Heeren Pond-Silver Creek	Same
7140204050102	7140204050102	Binney-Silver Creek	Same
7140204050201	7140204050201	Big Four Reservoir	Same
7140204050202	7140204050202	Village of Livingston-Silver Creek	Same
7140204050203	7140204050203	Village of Livingston	Same
7140204050301	7140204050301	Village of Worden-Silver Creek	Same
7140204050302	7140204050302	Village of Alhambra	Same
7140204050303	7140204050304	Village of Hamel-Silver Creek	Different
7140204050304	7140204050303	Village of Hamel	Different
7140204050401	7140204050401	Grigsby Lake-Silver Creek	Same
7140204050402	7140204050402	Willaredt Lake-Silver Creek	Same
7140204050501	7140204050502	Dales Twin Lakes-South Lake-Silver Creek	Different
7140204050502	7140204050501	Neudeckers Mountain	Different
7140204050601	7140204050603	07140204050603-Silver Creek	Different
7140204050602	7140204050601	Headwaters Wendell Branch	Different
7140204050603	7140204050602	Twin Lakes-Wendell Branch	Different
7140204050604	7140204050604	City of Troy-Silver Creek	Same
7140204050901	7140204050903	07140204050903-Silver Creek	Different
7140204050902	7140204050901	Lake Fork	Different
7140204050903	7140204050902	Mill Creek	Different

Subwatersheds: HUC12s & HUC14s



FigureA.2. The Upper Silver Creek Watershed Plan project area, with its 20 component HUC14s (old codes), seven component HUC12s, named streams from the NHD, and interstates.

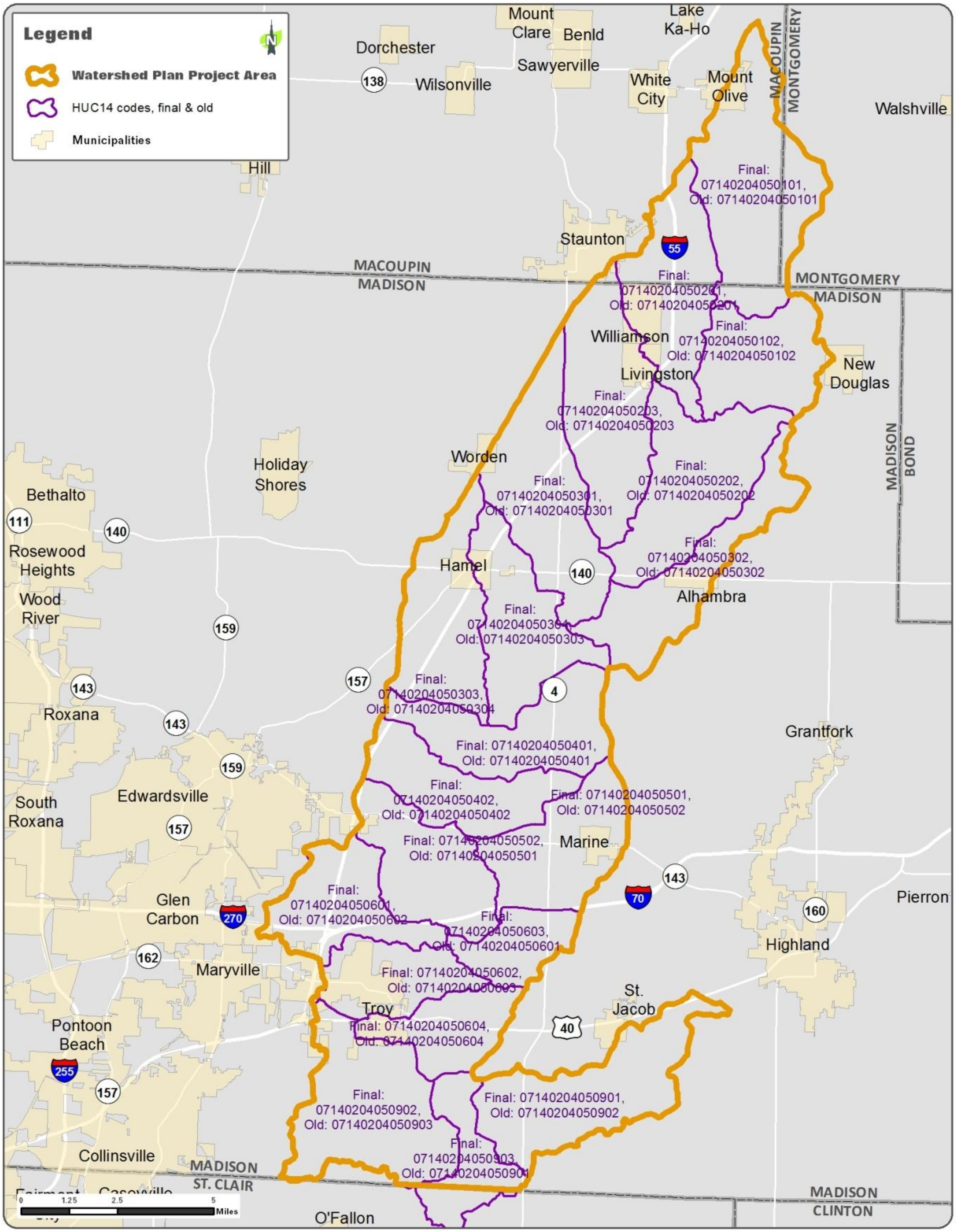
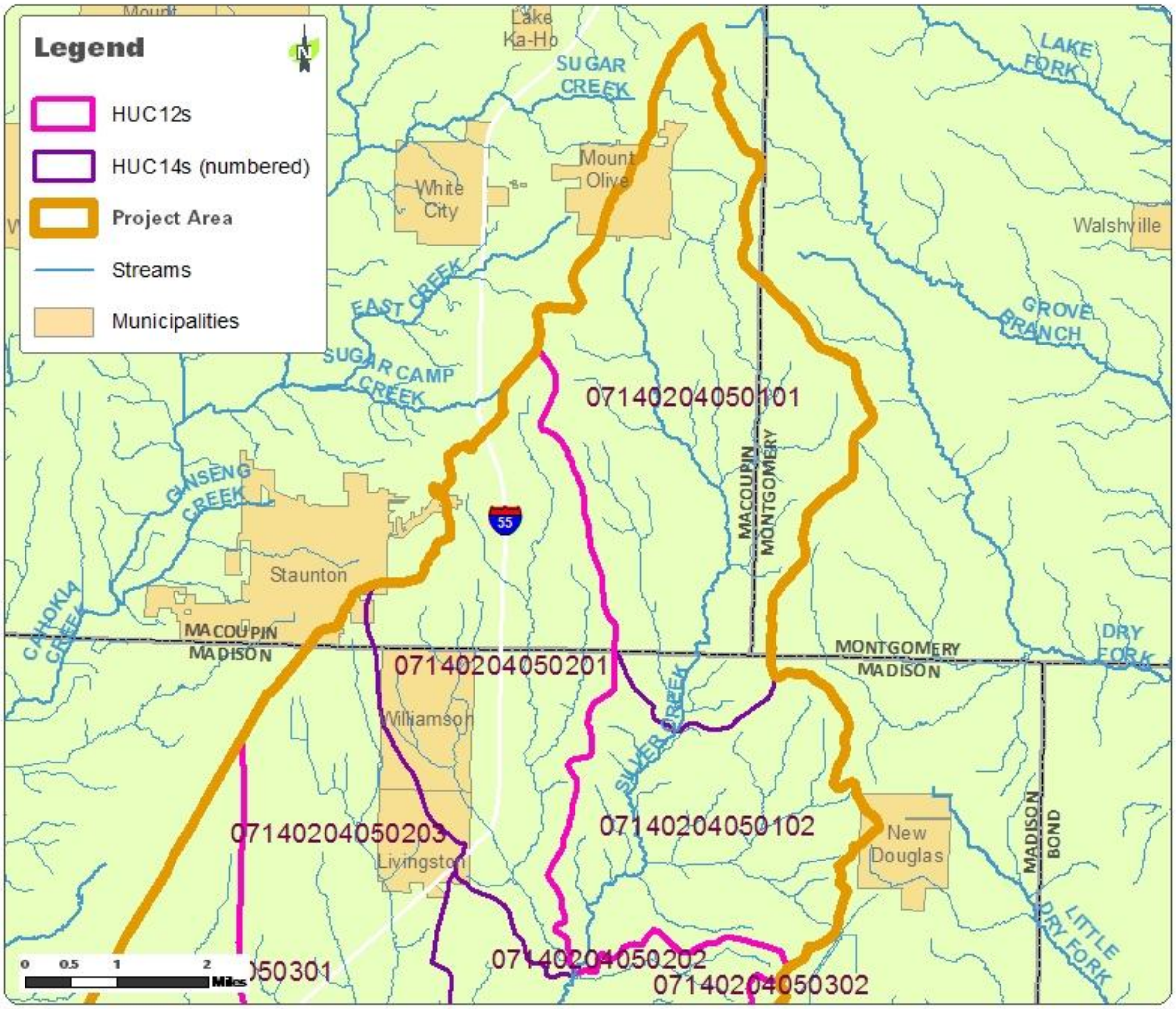


Figure A.3. Final and draft (old) HUC14 codes for each HUC14. The codes were reordered to reflect updated elevation data used in delineation. The "old" draft codes are used throughout this Plan (the final codes being confirmed too late in the planning process to update all of the modeling, maps, and tables).

HUC12: 071402040501



FigureA.4. HUC 071402040501 and HUC14s (draft codes), streams, and municipalities present.

Table A.3. Area of HUC14 watersheds within HUC 071402040501 and municipalities wholly or partially within it.

HUC14 watershed	Area in acres	Municipalities present
07140204050101	9,613.0	Mount Olive
07140204050102	5,272.6	New Douglas

HUC12: 071402040502

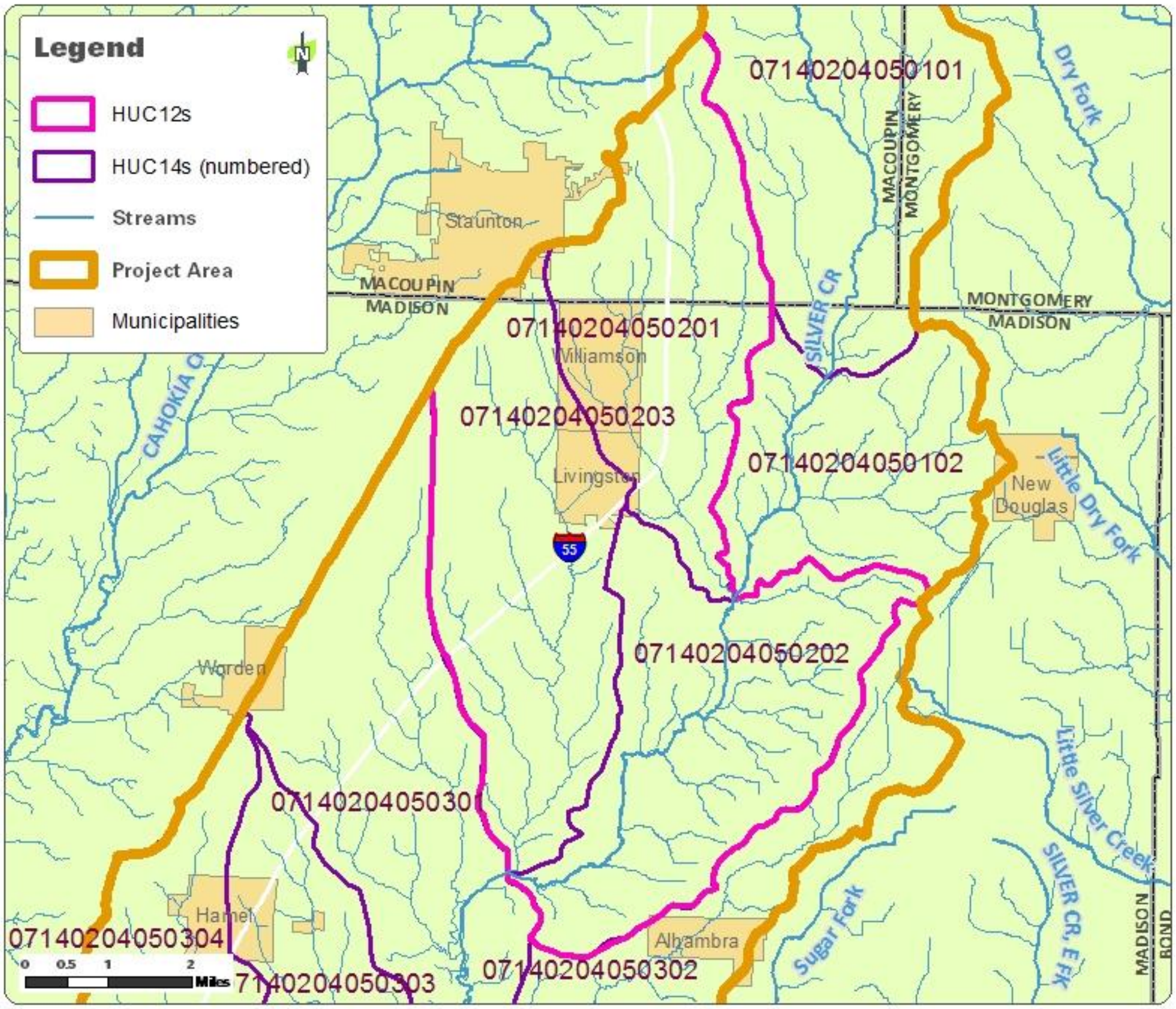


Figure A.5. HUC 071402040502 and HUC14s, streams, and municipalities present.

Table A.4. Area of HUC14 watersheds within HUC 071402040502 and municipalities wholly or partially within it.

HUC14 watershed	Area in acres	Municipalities present
07140204050201	6,517.6	Williamson, Livingston, Staunton
07140204050202	7,750.1	Livingston, Alhambra
07140204050203	7,755.7	Williamson, Livingston, Staunton

HUC12: 071402040503

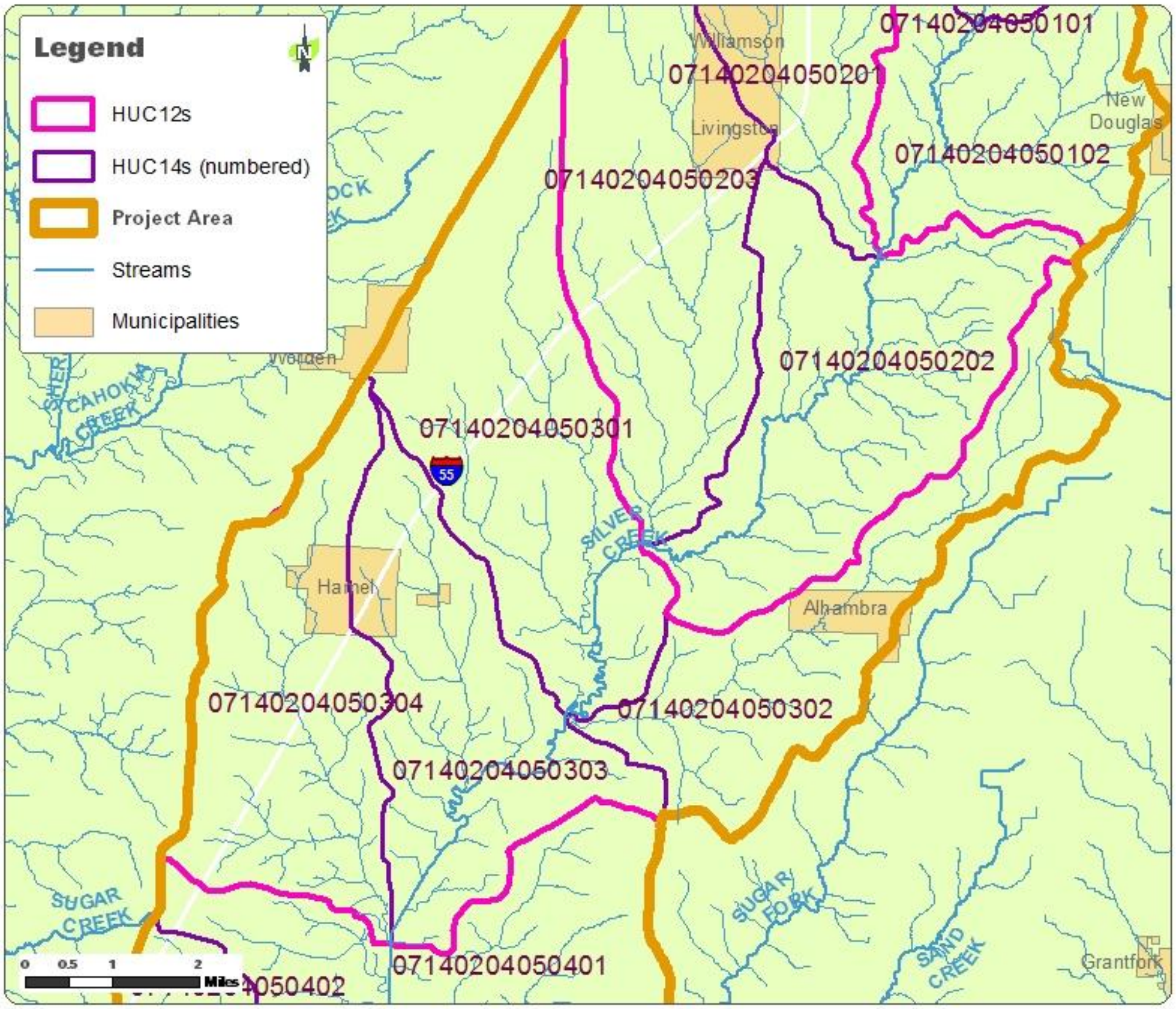


Figure A.6. HUC 071402040503 and HUC14s, streams, and municipalities present.

Table A.5. Area of HUC14 watersheds within HUC 071402040503 and municipalities wholly or partially within it.

HUC14 watershed	Area in acres	Municipalities present
07140204050301	8,049.7	Worden
07140204050302	5,796.8	Alhambra
07140204050303	6,064.0	Hamel
07140204050304	6,224.9	Hamel

HUC12: 071402040504

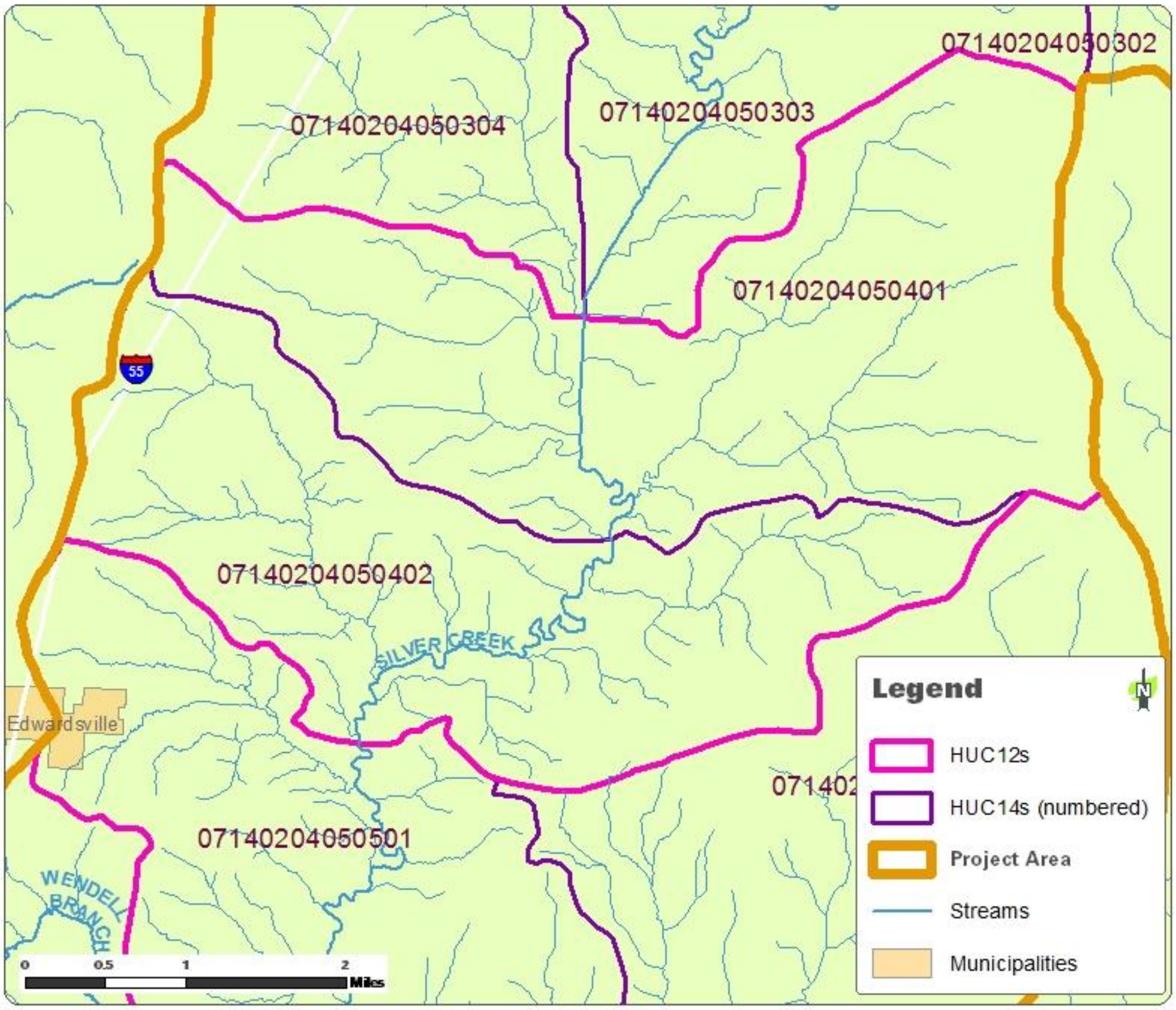


Figure A.7. HUC 071402040504 and HUC14s, streams, and municipalities present.

TableA.6. Area of HUC14 watersheds within HUC 071402040504 and municipalities wholly or partially within it.

HUC14 watershed	Area in acres	Municipalities present
07140204050401	6,291.0	
07140204050402	5,188.4	

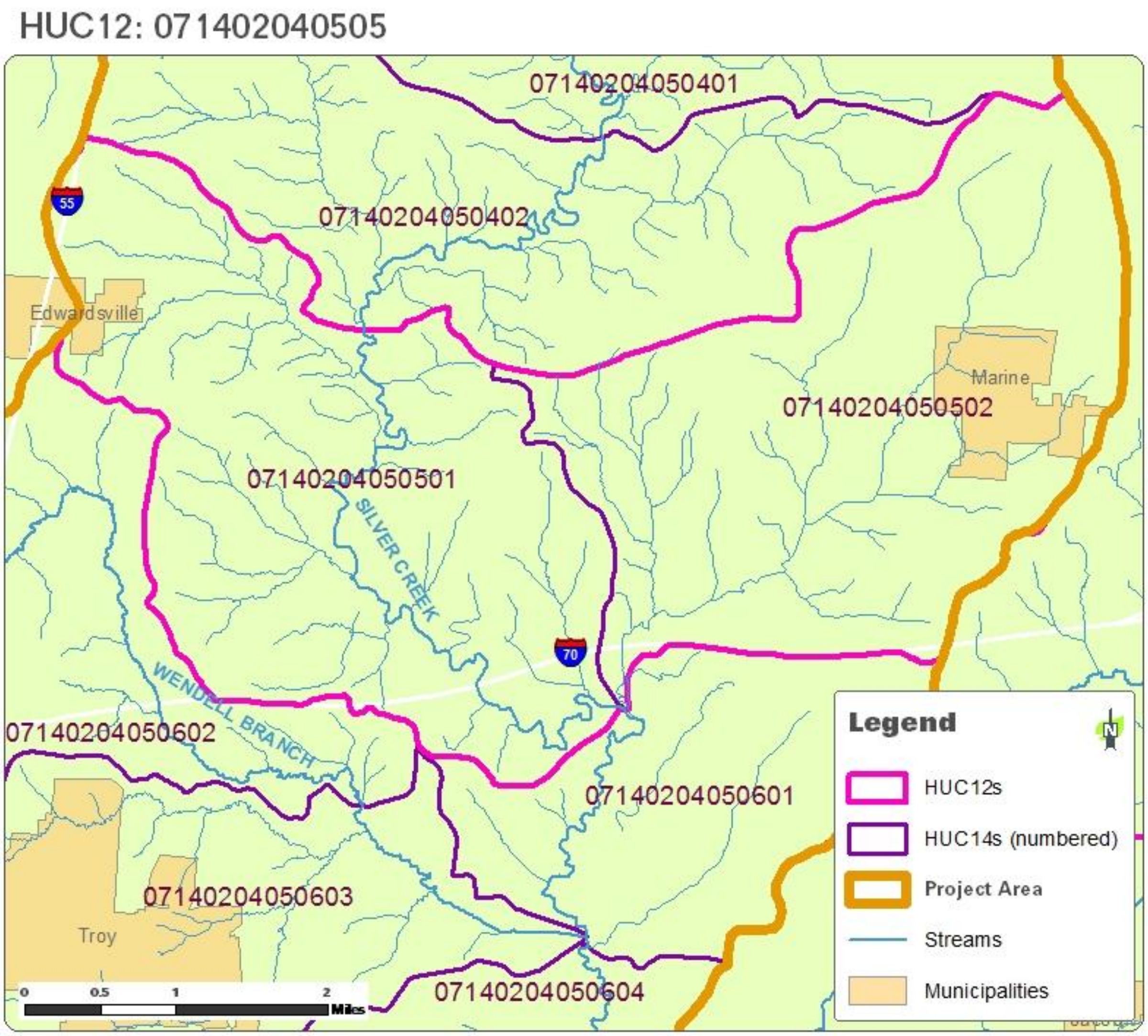


Figure A.8. HUC 071402040505 and HUC14s, streams, and municipalities present.

Table A.7. Area of HUC14 watersheds within HUC 071402040505 and municipalities wholly or partially within it.

HUC14 watershed	Area in acres	Municipalities present
07140204050501	5,798.8	Edwardsville
07140204050502	5,842.8	Marine

HUC12: 071402040506

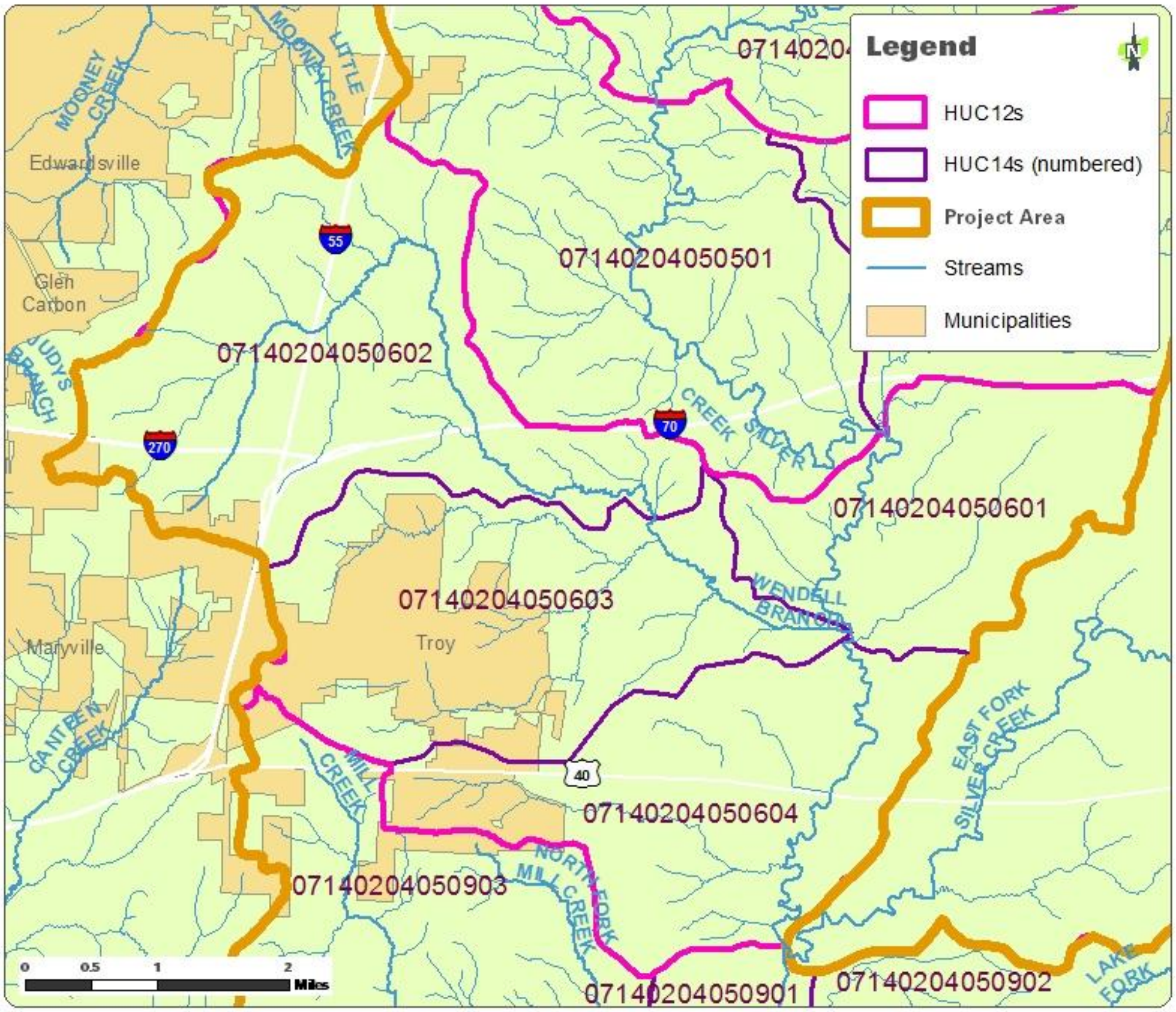


Figure A.9. HUC 071402040506 and HUC14s, streams, and municipalities present.

Table A.8. Area of HUC14 watersheds within HUC 071402040506 and municipalities wholly or partially within it.

HUC14 watershed	Area in acres	Municipalities present
07140204050601	2,758.4	
07140204050602	5,011.9	Troy, Glen Carbon, Edwardsville
07140204050603	4,045.7	Troy
07140204050604	3,681.5	Troy

HUC12: 071402040509

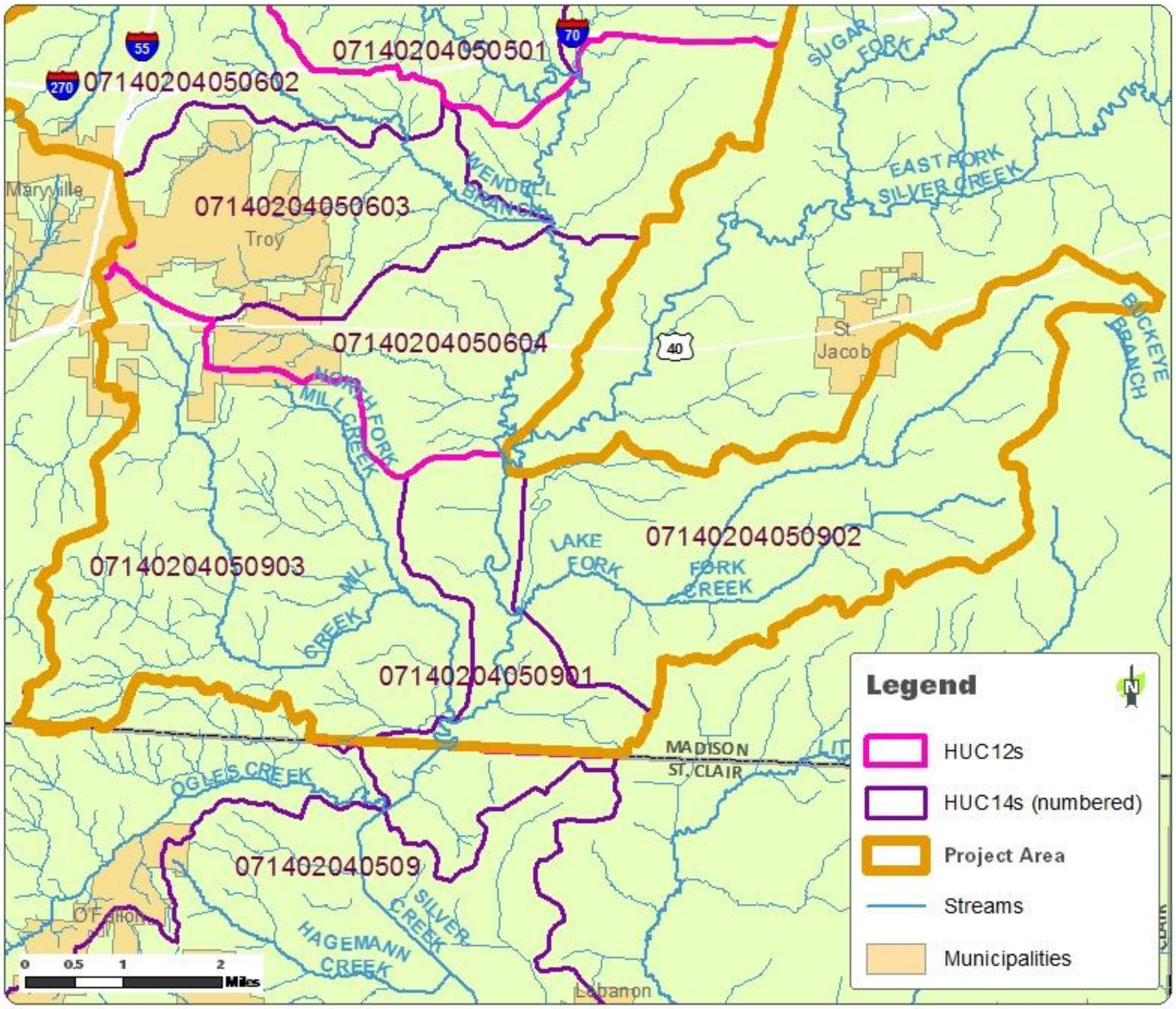


Figure A.10. HUC 071402040509 and HUC14s, streams, and municipalities present.

Table A.9. Area of HUC14 watersheds within HUC 071402040509 and municipalities wholly or partially within it.

HUC14 watershed	Area in acres	Municipalities present
07140204050901	3,394.4	
07140204050902	7,762.3	St. Jacob
07140204050903	8,321.3	Troy

Stream miles

There are 476 stream miles in the Upper Silver Creek Watershed Plan project area, as identified in the National Hydrography Dataset (NHD). The stream reaches are designated perennial and intermittent streams, or given a “connector” or “artificial path” designation. There are no canals or ditches identified in the NHD in the Upper Silver Creek watershed. See Watershed Drainage section for more information on stream reach delineation.

The tributaries in the watershed flow into the mainstem of Silver Creek, which eventually discharges into the Kaskaskia River, and ultimately into the Mississippi River in Randolph County (Figure A.1).

Direction of flow and major tributaries

Water flows from north to south in the watershed, with the northernmost tributary beginning in Macoupin County in HUC 07140204050101. The largest tributary to Silver Creek within the project area is Wendell Branch, which flows west to east from Edwardsville, Glen Carbon, and Troy.

East Fork Silver Creek is a separate HUC10 watershed to the east of the Upper Silver Creek watershed. It contains 215 stream miles and Highland Silver Lake, an impaired waterbody in the municipality of Highland, and flows into HUC 071402040509 approximately 3 miles west of St Jacob. Except for this addition of flow, Upper Silver Creek is a hydrologically self-contained watershed. The outflow of the watershed from the project area occurs in HUC 07140204050901, at the boundary line of Madison and St Clair counties.

Waterbodies

There are 732 identified waterbodies in the Upper Silver Creek watershed, with a mean area of 1.0 acre. The largest waterbody identified in the NHD within the project area is a swamp/marsh area 33 acres in size. The largest non-swamp/marsh waterbody is a perennial lake/pond 20 acres in size just east of Williamson.

Topography

In general, the land in the watershed is fairly flat or gently sloping, making it suitable for crop cultivation. The watershed has a gentle north-south slope of less than 7.5% (4.4 degrees), decreasing in elevation in the south (Figure A.11). Along Silver Creek itself, slopes are often as steep as 10% or more (visible in yellow, orange, and red in Figure A.12).

The highest point in the watershed, at its northern edge in Macoupin County, is an unnamed hill with an elevation of 690 feet. The highest tributaries to Silver Creek, including ephemeral streams, begin at elevations of around 675 feet. The outflow of Silver Creek from the watershed project area, the lowest point in the watershed, is at 433 feet (Figure A.11).

The moderate to steeply sloping terrain in the upper reaches of the watershed drains to a wider, flatter area approximately where East Fork Silver Creek meets the Upper Silver Creek in HUC 071402050409. This flat area is an important feature because it provides more flood storage than the upper reaches.

Topography

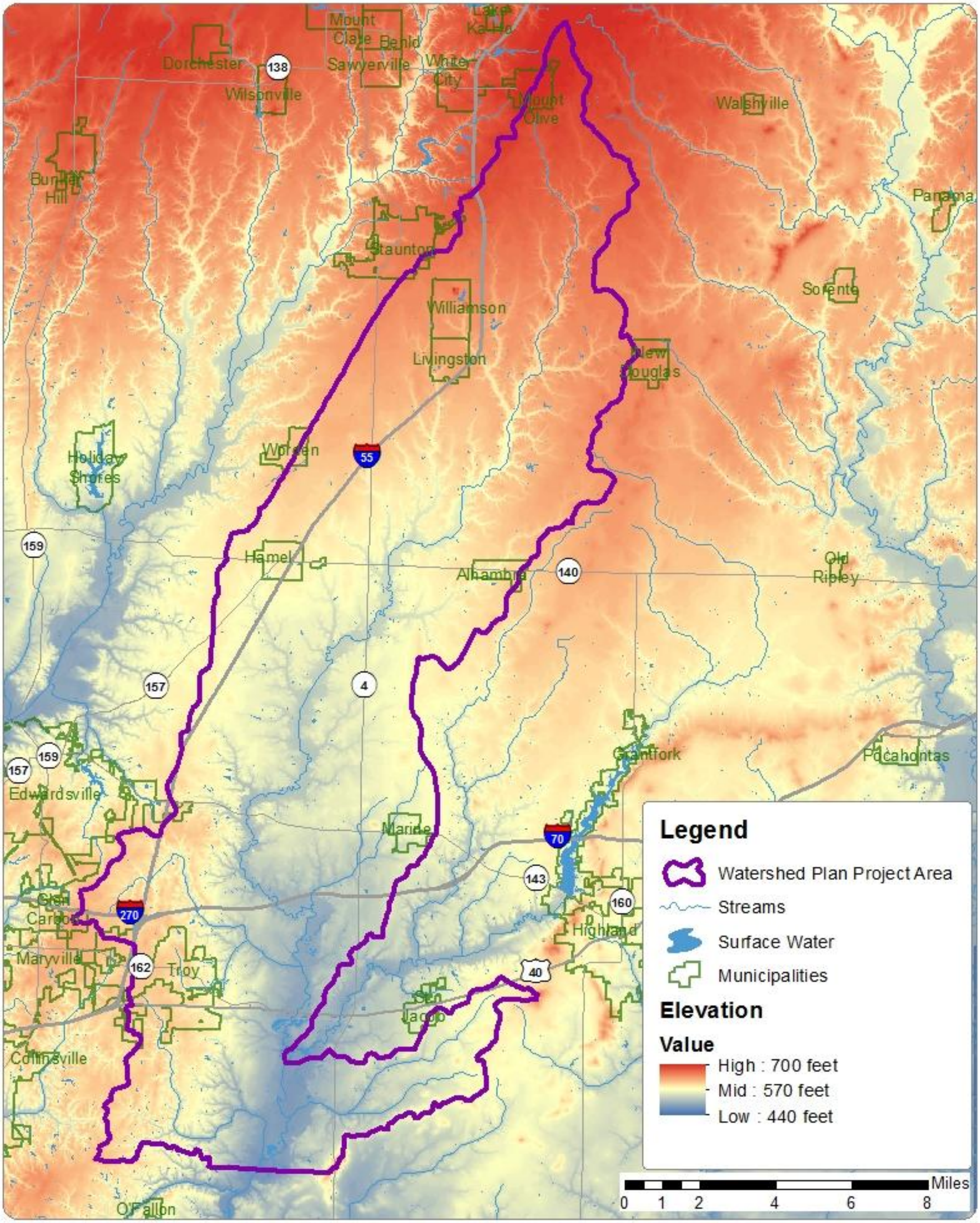


Figure A.11. Topography/elevation in the Upper Silver Creek watershed project area, from the Digital Elevation Model (DEM) in the USGS National Elevation Dataset.[1]

Slope

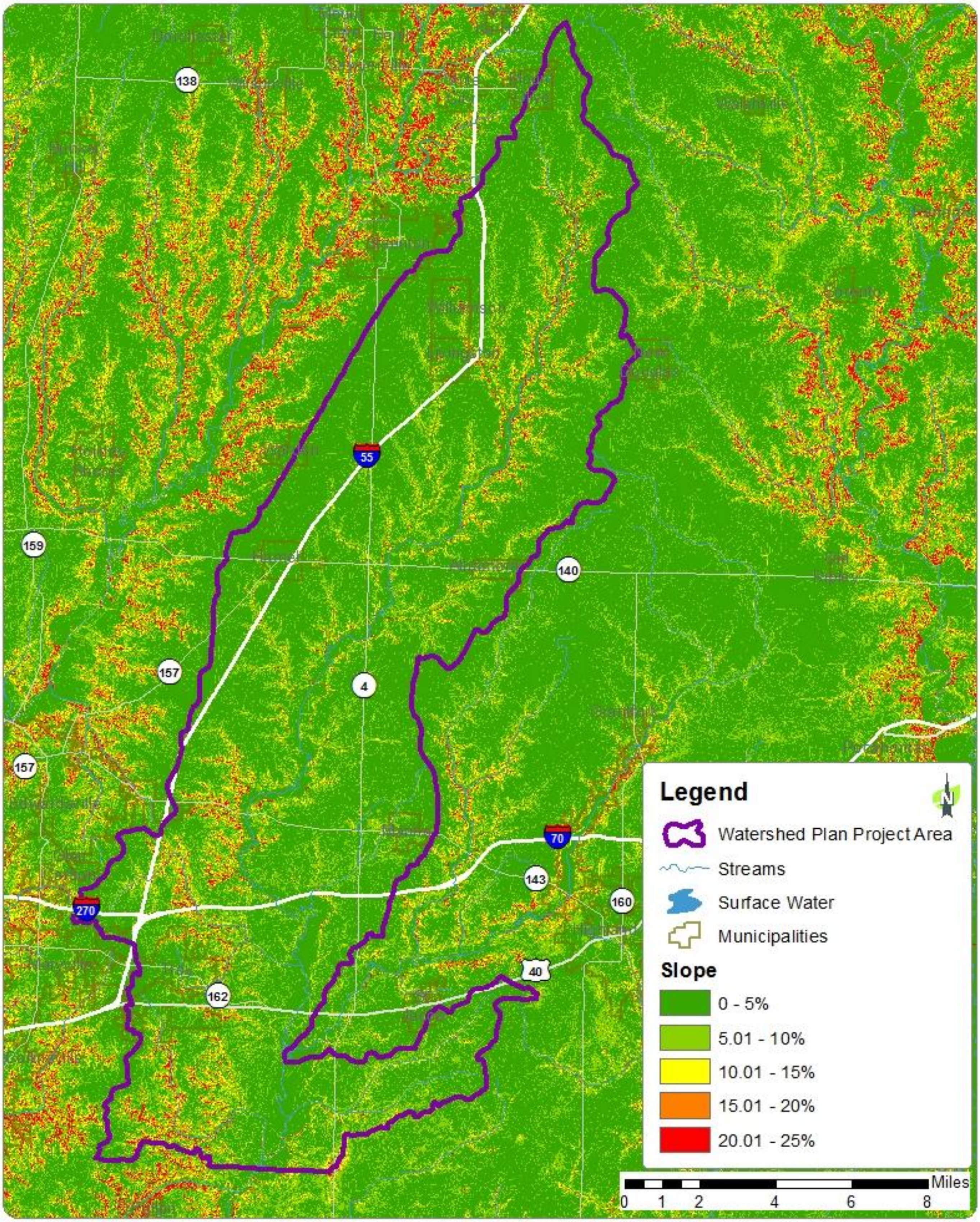


Figure A.12. Slope in the Upper Silver Creek watershed project area, in percent.[2]

Climate

The Upper Silver Creek Watershed study area 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.13).

Between 1988 and 2013, southern Illinois has experienced 853.2 days of maximum temperature equal to or greater than 90°F. This equates to an average of 32.8 days per year of temperatures over 90°F (data from monthly averages from gaging stations in all three counties).[3] 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 -20°F in December 1989 at two gauge stations in Macoupin County.[4]

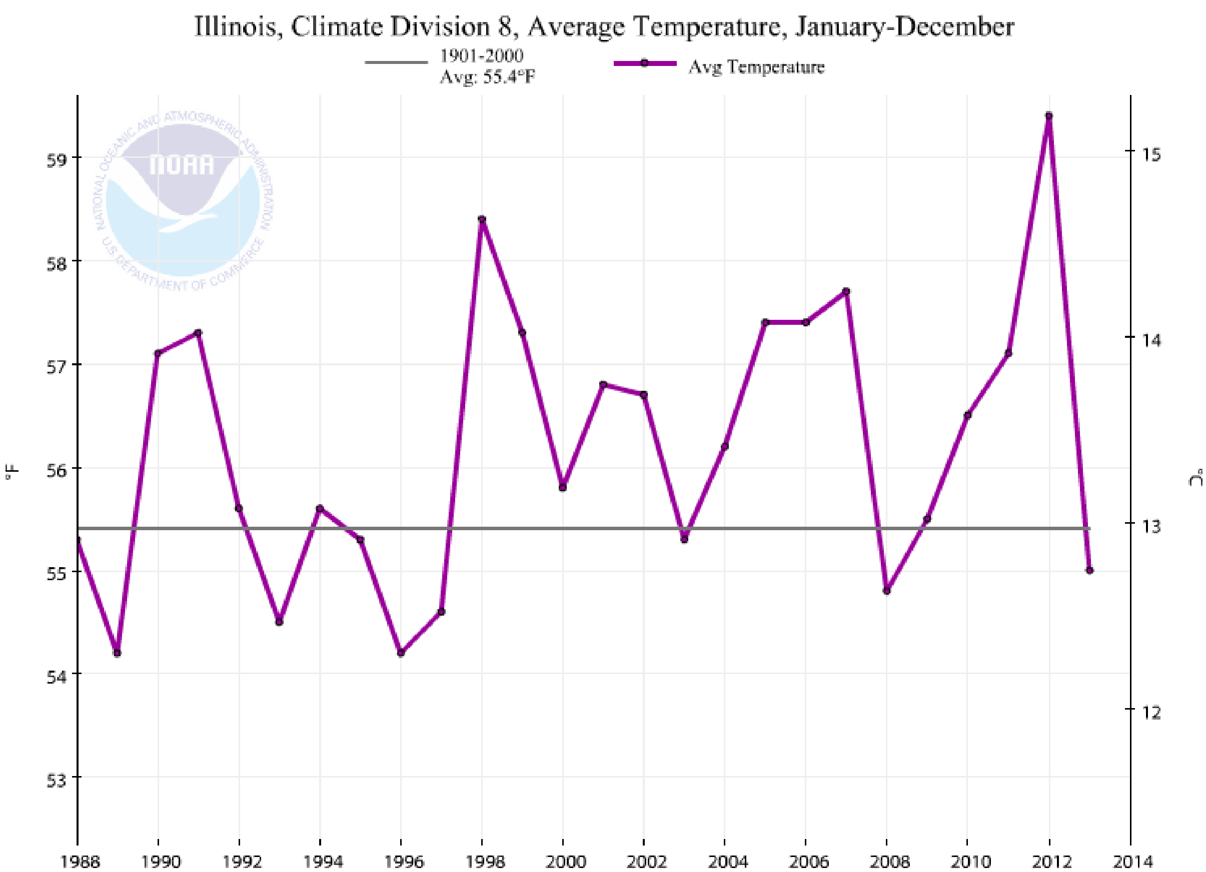


Figure A.13. Average annual temperatures in southwestern Illinois between 1988 and 2014, from NOAA's Climate At-A-Glance Time Series. The leftmost y axis shows average annual temperature in degrees Fahrenheit.[5]

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.[6] Precipitation gauge stations in Mount Olive and Edwardsville measured an average annual precipitation of 40.21 inches and 38.73 inches, respectively, between 1971 and 2000, and 40.10 and 44.77 inches between 1981 and 2010. The average annual number of days with 0.1 inch or more of precipitation was 62 days (averaged between recorded data from the two stations between 1971 and 2000), with May as the wettest month and January as the driest. The average annual total snowfall recorded was 18.5 inches (between 1971 and 2000).[7]

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.[8] The greatest recorded 24-hour precipitation event recorded in Edwardsville and Mount Olive is 7.05 inches of rain in August 1915 (Table A.10). Flash floods can occur at any time of year in Illinois, but they are most common in the spring and summer months.[9] See Flooding section for more information on occurrences of flash flooding and general flooding.

TableA.10. Highest daily precipitation over 24 hours between 1893 and 2014 at gauge stations located in Edwardsville and Mount Olive.[10]

Rank	Daily Precipitation (inches)	Date	Gauge Station
1	7.05	8/20/1915	Edwardsville
2	6.43	5/26/2009	Edwardsville
3	6.00	7/14/1912	Edwardsville
4	5.97	5/17/1943	Edwardsville
5	5.86	8/16/1946	Edwardsville
6	5.13	4/22/1944	Edwardsville
7	5.10	9/17/1969	Mt Olive*
8	4.87	4/22/1944	Mt Olive*
9	4.63	8/24/1977	Edwardsville
10	4.57	8/10/1961	Edwardsville

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

Drought

There has been considerable variability in precipitation in the state over time, including major multi-year droughts in the 1930's and 1950's and major multi-year wet periods in the 1970's and 1980's.[11] The National Climatic Data Center (NCDC) database reported 26 drought/heat wave events in Macoupin County from 1995 to 2010, with the most recent event in June 2009.[12] Madison County experienced four drought events between 1983 and 2012, three of which occurred in 2005 or later.[13] There were three reported drought events in Montgomery County between 1983 and 2008.[14] Extreme heat often accompanied rainfall and surface water shortages during these events.

Tornadoes

Illinois experiences about 29 tornadoes annually, 63% of which occur in peak months April, May, and June.[15] A significant recent tornado struck down in the city of Mount Olive in May 2013, damaging more than 40 homes and businesses in the downtown area, including City Hall.[16] It was not declared a presidential disaster.[17] In Madison County, 39 tornadoes were reported between 1950 and 2006. In Montgomery County, 31 tornadoes/funnel clouds were reported between December 1950 and 2010, and in Montgomery County, 28 occurrences were reported between 1950 and 2008. The greatest recorded magnitude among these events is F4 on the Fujita Scale (one event in Madison County). Typically, the area impacted by tornadoes in the three counties was less than four square miles. Montgomery County has calculated that the probability of a tornado hitting somewhere in the county in any given year is 47%.[18,19,20]

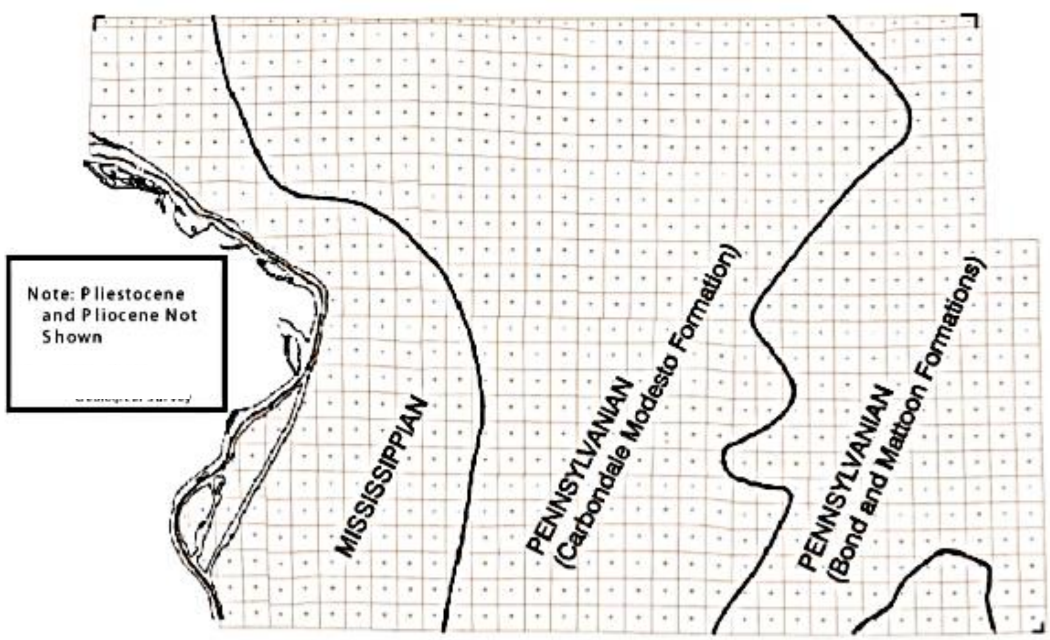
Geology

The bedrock underlying Southwestern Illinois is composed of Cambrian, Ordivician, Silurian, Devonian, Mississippian, and Pennsylvanian sedimentary rocks (i.e., sandstone, shale, dolomite, and limestone) resting on crystalline basement rocks consisting mainly of granite. Tilting and folding of the bedrock surface below Madison County resulted in the present bedrock surface topography. Figure A.14 shows the generalized bedrock geology beneath Madison County.[21]

Directly below the glacial drift in the central and eastern portions of the county, including below the Upper Silver Creek watershed, are Pennsylvanian rocks (Figure A.15). These rocks have relatively low permeability and consist mainly of shales, sandstone, thin limestone, and coal. The water-yielding character of these Pennsylvanian formations is variable but generally very low; the sandstones are the only formations that yield any appreciable amounts of water. The sandstones differ laterally in permeability and are not water-yielding at all sites. In some locations, small, local supplies of suitable groundwater may be obtained from shallow sandstone and creviced limestone, but the probability of obtaining a well in the Pennsylvanian aquifers yielding more than 20 gallons per minute (gpm) is low. Furthermore, as the depth of large aquifers increases, the water's mineral content also increases, limiting the uses of the groundwater.[22]

Blanketing the bedrock are unconsolidated deposits from glacial drift, ranging in thickness from two to 200 feet across Southwestern Illinois. The glacial materials in the watershed and Madison County were deposited during the Pleistocene Epoch by the Illinoian glacial advance. The Illinoian Till Plain comprises much of the area east of the Mississippi River bluffs. A second glacial movement (Wisconsinan) did not advance on the area, but its deposits were widely transported here by wind and water. After the glaciers had receded and the deposits had dried, the wind picked up many of the fine-grained sand, silt, and clay (mostly silt) sediments and deposited them on the uplands in uniform layers known as loess. Since winds were generally from the northwest, the loess deposits are thicker on the uplands adjacent to the Mississippi River flood plain. The thickness of the glacial drift is highly variable.[23]

Figure A.14. Generalized Bedrock Geology in Madison County, Illinois. Data from Illinois State Geological Survey.[24]



A map of Madison County's surficial geology reveals that the county is largely covered by loess deposits (Figure A.15). Near and in the Upper Silver Creek watershed, the deposits are mainly silt, silty clay, and fine sand.

Cross-sections of the landscape at lines A and B in Figure A.15 (shown in Figure A.16) show that the rock layers underlying the Silver Creek channel are, from bedrock to surface: Pennsylvanian bedrock; a mixture of loam, sand and gravel, and diamicton (Illinois; common in loess-covered terraces along Silver Creek); silt loam to silty clay loam with some fine sand (Wisconsin; lake deposits); mainly silt, silty clay, and fine sand (Hudson episode; river deposits); and on the stream banks, silt loam or loess (Wisconsin; loess). The thickness of the loess (windblown silt) is shown on the map as contours. The loess layer becomes thinner as you move eastward from the Mississippi River. The loess thickness is 20 feet thick in the lower part of the Upper Silver Creek watershed near Troy, but only five to 10 feet thick at the northern end of the watershed.

The valley fill material along Silver Creek is an important source of groundwater for industries and municipalities on the floodplain. Wells reaching to sand and gravel aquifers in underlying till plain deposits produce moderate amounts of water for small communities and rural households. Drinking water for most rural households using wells comes from low-yielding wells 35 to 150 feet deep. The numerous ponds throughout the watershed supply ample water for livestock and wildlife.[25]

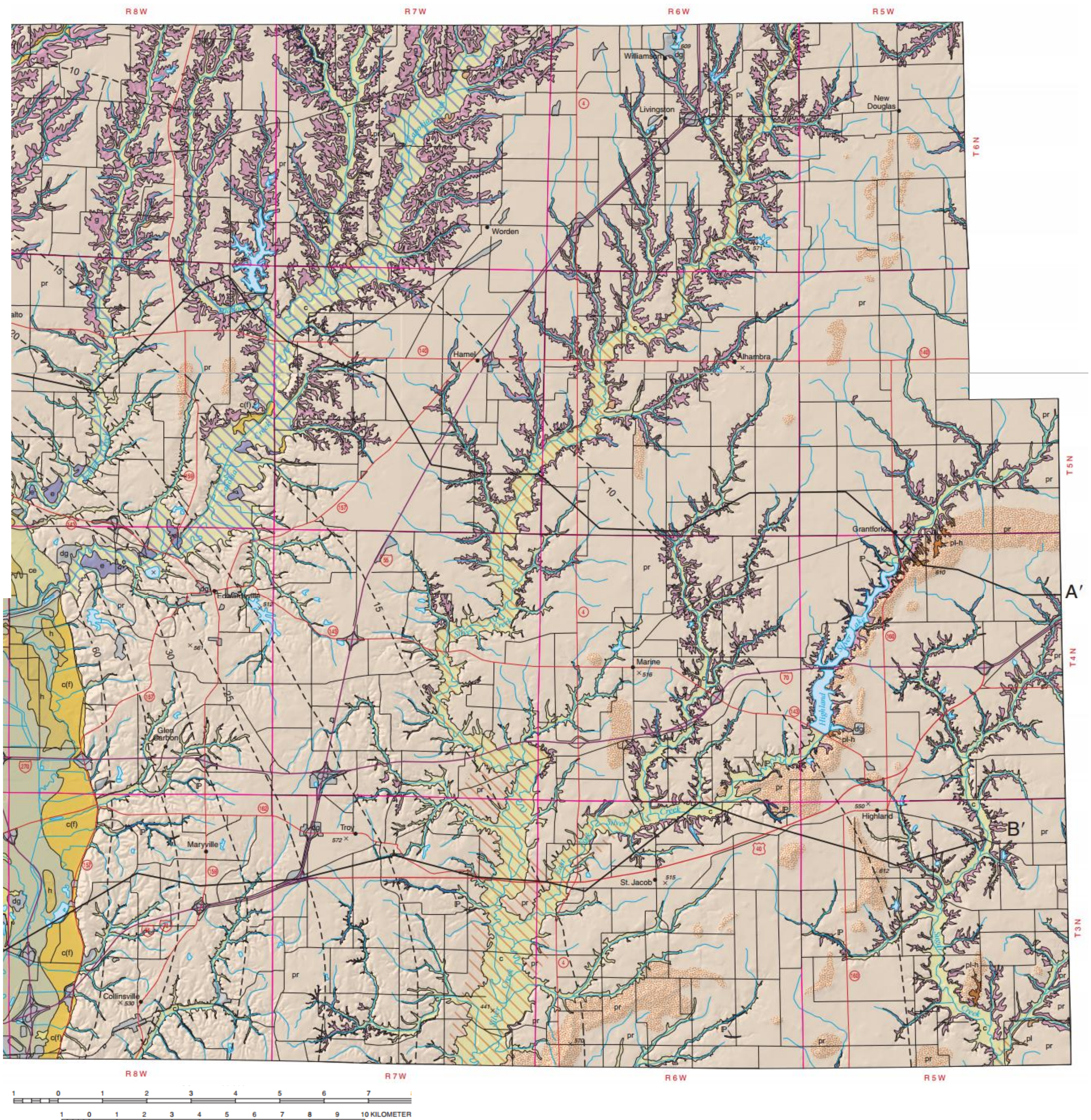


Figure A.15. Surficial geology of the Upper Silver Creek watershed area in Madison County. [26]

Legend on following page. Cross-sections at lines A′ and B′ are shown in Figure A.16. Maps of surficial geology for the portions of the watershed in Macoupin and Montgomery Counties were not available.

QUATERNARY DEPOSITS

HUDSON EPISODE (~12,000 years before present (B.P.) to today)

Description	Unit	Interpretation
Fill or removed earth; various sediment types	Disturbed ground dg	**Man-made fill or excavations**
Mainly silt, silty clay and fine sand; weakly to well stratified; includes some coarser beds	Cahokia Formation (undivided) c	**River deposits (alluvium);** mapped in valleys tributary to the Mississippi Valley
Silt loam with thin fine sand beds; weakly stratified	Cahokia Formation (fan facies) c(f)	**Alluvial fan deposits;** mainly reworked loess from bluffs east of American Bottoms
Silty clay loam, silty clay, and silty loam; massive to stratified; some fine sand lenses	Cahokia Formation (clayey facies) c(c)	**Overbank alluvium, abandoned channel and swale fills;** mapped only in Mississippi Valley
Very fine, fine and medium sand; stratified; moderately to well sorted	Cahokia Formation (sandy facies) c(s)	**Alluvium;** point bar and channel deposits; mapped only in Mississippi Valley
Silt loam, pebbly silt loam or pebbly silty clay diamicton	Peyton Formation py	**Sediments moved downslope by gravity (colluvium);** creep layers, slumps, or landslides
Silty clay to silt with some fine sand; massive to stratified	Cahokia or Equality Formation (undifferentiated) ce	**Overbank alluvium or lake deposits;** occurs on or near the Wood River Terrace

WISCONSIN EPISODE (~75,000–12,000 years B.P.)

Description	Unit	Interpretation
Silt loam to silty clay loam with some fine sand; massive to stratified	Equality Formation e (hachures on map where buried)	**Lake deposits;** of slackwater origin during peak Mississippi River aggradation
Fine, medium and coarse sand; stratified; generally coarsens at depth; some gravelly zones	Henry Formation h	**Outwash (glacial meltwater deposits);** on Wood River Terrace in northern American Bottoms
Silt loam; massive; upper 3/5 of unit is more tan or gray (Peoria); lower portion has pinkish hue (Roxana)	Peoria and Roxana Silts pr	**Loess (windblown silt);** blankets all uplands; thickness contours shown on map; thins eastward from Mississippi Valley bluffs

ILLINOIS EPISODE (~200,000–130,000 years B.P.)

Description	Unit	Interpretation
Mixture of loam, sand and gravel, and diamicton; weakly stratified; poorly to well sorted sands; may be fractured or faulted (from glacial processes)	Hagarstown Member, Pearl Formation pl-h (stipples on map where buried)	**Ice-contact sediments;** deposited mainly in ice-marginal, subglacial, or supraglacial channels; locally includes glaciotectonic faulting and deformation
Sand with some gravel; stratified; may include silty or clayey zones, especially near surface	Pearl Formation (outwash facies) pl (hachures on map where buried)	**Outwash;** common in loess-covered terraces along Silver Creek
Pebbly loam diamicton (mixture of clay, silt, sand, and gravel); generally massive; includes some sand and gravel lenses (especially in upper portion)	Glasford Formation (< 5 feet of loess cover) g	**Till and ice marginal deposits;** includes subglacial and supraglacial deposits
Silt loam to silty clay loam; massive to weakly stratified; locally fossiliferous.	Petersburg Silt (cross sections only) pb	**Lake sediment;** deposited under slackwater conditions or ice marginal setings.

PRE-ILLINOIS EPISODE (~700,000–400,000 years B.P.)

Description	Unit	Interpretation
Pebbly silty clay loam diamicton; generally massive; include sand and gravel lenses, zones of stratified silt near base	Banner Formation, (undivided) (cross sections only) b	**Till and ice marginal deposits;** includes subglacial fill and supraglacial debris flows; may include lake sediment
Silty clay loam, silty clay, and silt loam; weakly stratified; contains some fine sand beds	Banner Formation, Canteen member (cross sections only) b-c	**Preglacial alluvium and lake deposits;** may include some residuum or colluvium at base; occurs mainly in preglacial bedrock valleys

PRE-QUATERNARY DEPOSITS

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

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

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

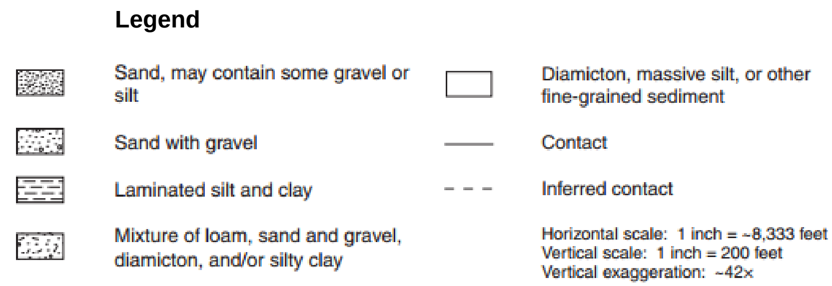
A—A′ Line of cross section

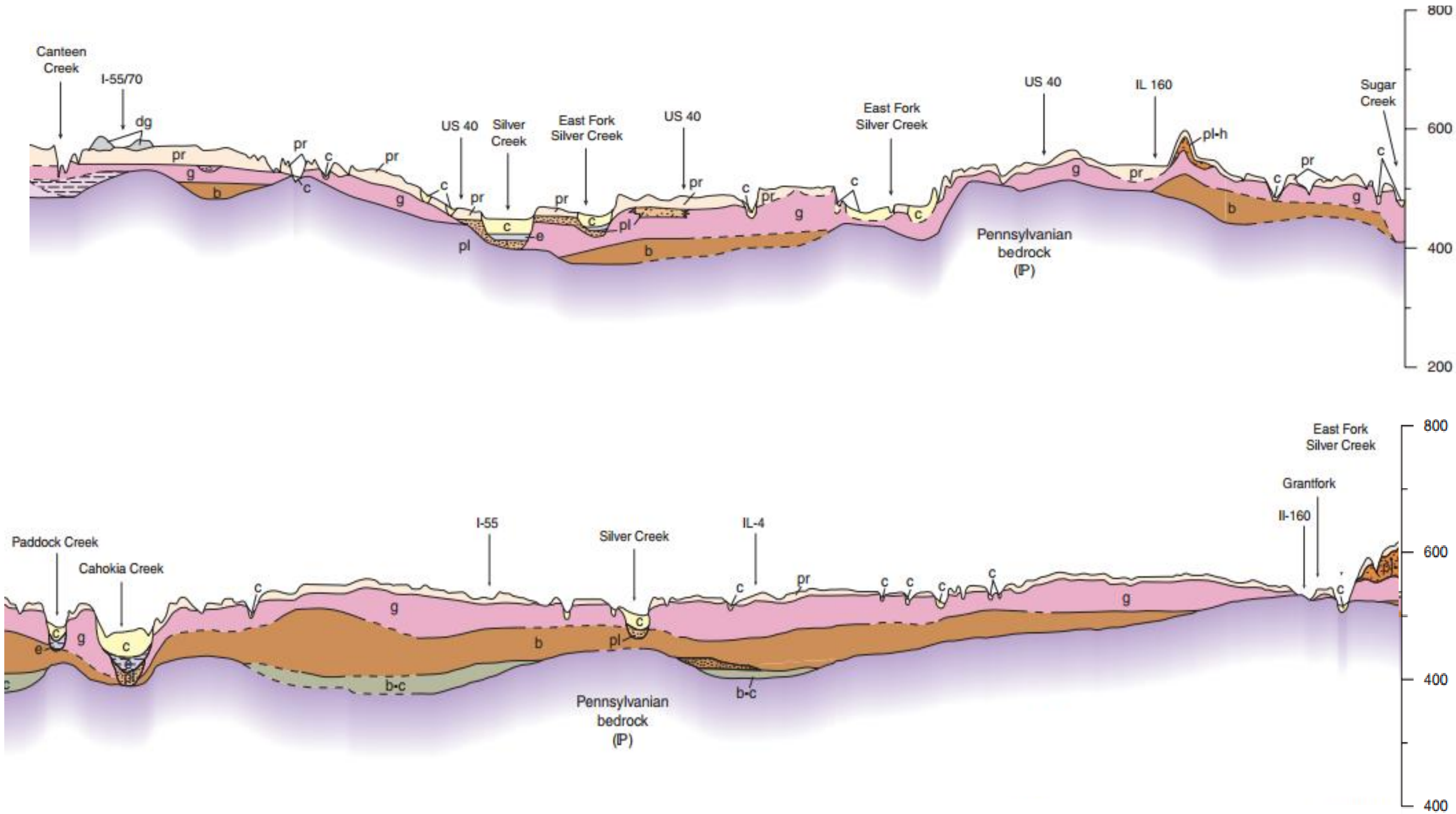
Note: Loess contours show the combined thickness of Peoria and Roxana Silts on uneroded upland areas. The actual thickness at a given spot may be much less, especially along valley slopes where post-depositional erosion of loess has been significant (see cross sections).

Legend. Surficial geology of the Upper Silver Creek watershed area in Madison County.[27]

Figure A.16. Cross-sections of surficial geology at lines A and B in Figure A.15.

This excerpt of cross-section A extends from Canteen Creek to Sugar Creek, including Silver Creek. The excerpt of cross-section B extends from Cahokia Creek to East Fork Silver Creek, including Silver Creek.[28] See legend for Figure A.15.





Aquifers

There are three major sand and gravel aquifers in the Upper Silver Creek watershed, shown in dark blue in Figure A.17. Two of these are on the mainstem of Silver Creek, and the third is situated directly below Marine. They underlie 17,462 acres (15%) of the watershed (volume is unknown). Generally, the tops of such aquifers lie within 300 feet of the surface and the bases occur within 500 feet. The 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 may be several potential aquifers 50 ft or less below the ground surface in the watershed, underlying 57,402 acres (48%) of the watershed area, as shown in the areas with blue/grey diagonal lines in Figure A.17. 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. These 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. Minor aquifers typically yield from five to seventy gallons of potable water per minute. Potable water is defined as water containing less than 2,500 mg/L of total dissolved solids (TSS).

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). Instead, they yield water containing 2,500 to 10,000 milligrams per liter of TSS, shown in light brown in Figure A.17, or water containing greater than 10,000 milligrams per liter of TSS, shown in darker brown.

Aquifers

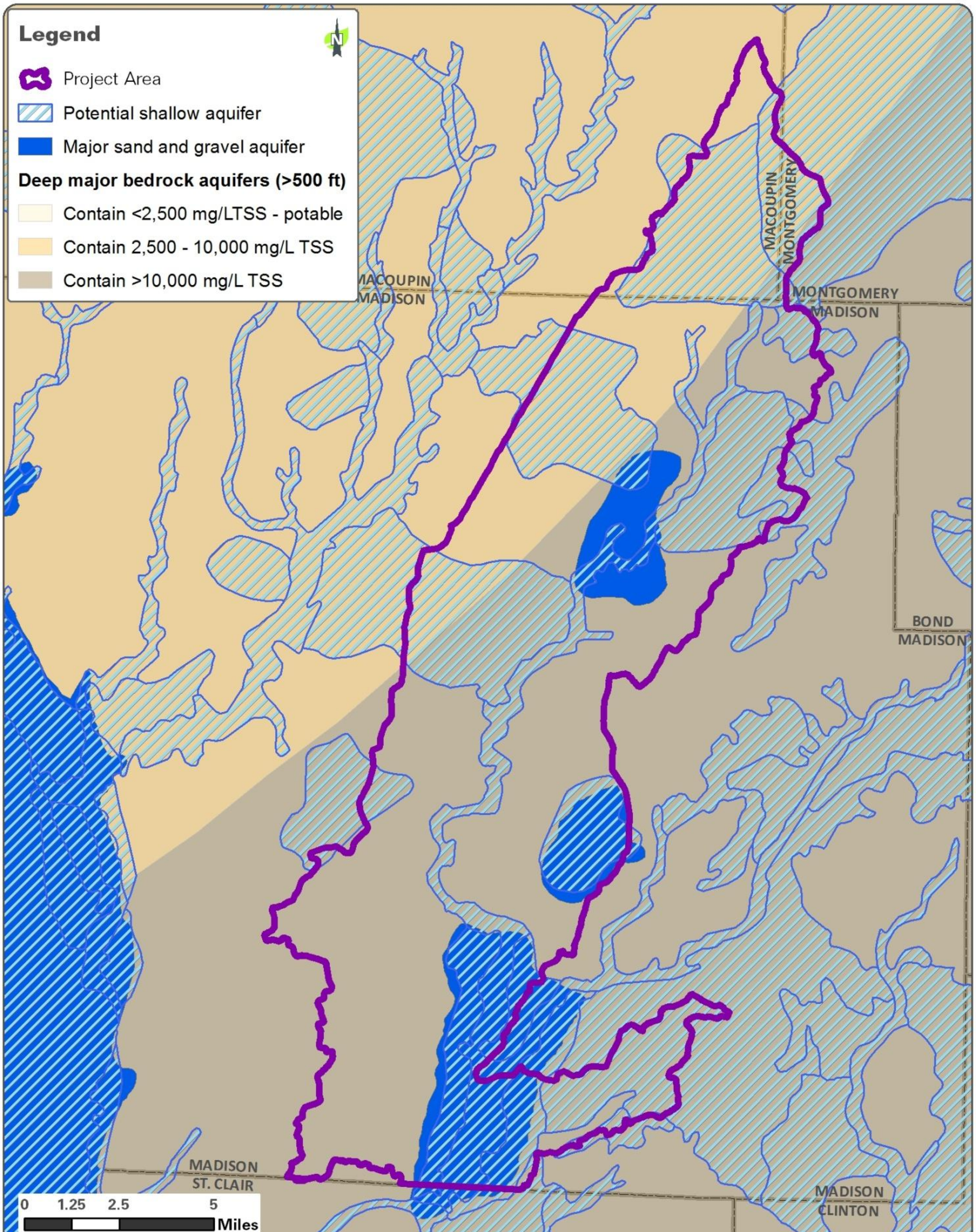


Figure A.17. Known and potential aquifers underlying the Upper Silver Creek watershed at various depths.[29] These can be viewed online in Illinois SGS's Illinois Water Well (ILWATER) Interactive Map.[30]

Wells

Illinois State Geological Survey has documented 2,917 wells and borings in the Upper Silver Creek watershed, of which 1,193 are water wells (Figure A.18). There are also over 500 abandoned wells, over 500 test wells, and over 450 wells related to oil and gas production. Permits for drilling have been issued for 16 wells.[31]

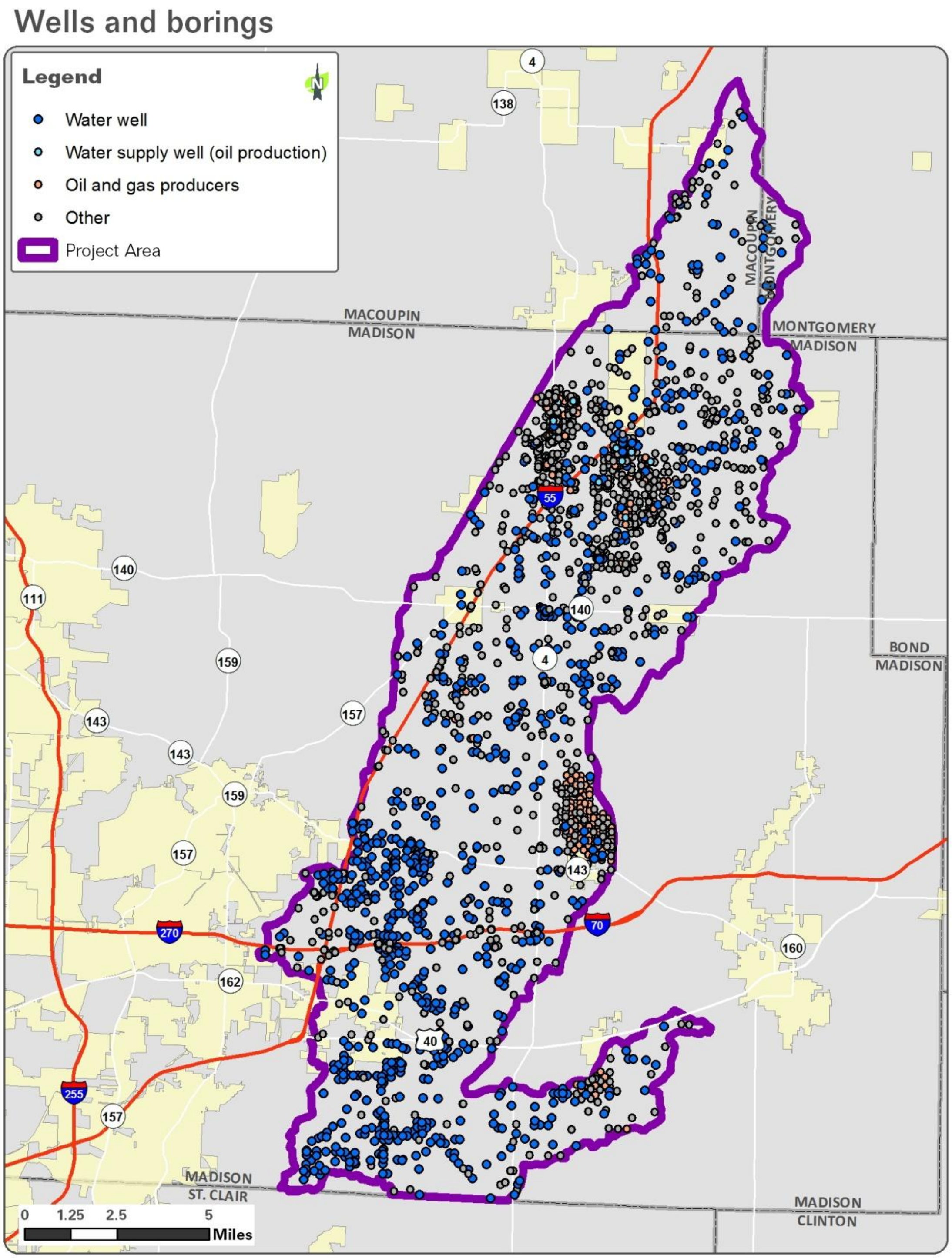


Figure A.18. Wells and borings from ISGS's Wells and Borings Database.

The water wells are fairly evenly distributed across the watershed, with the exception of clusters of wells to the north and south of Troy (Figure A.19).[32] 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.)[33]

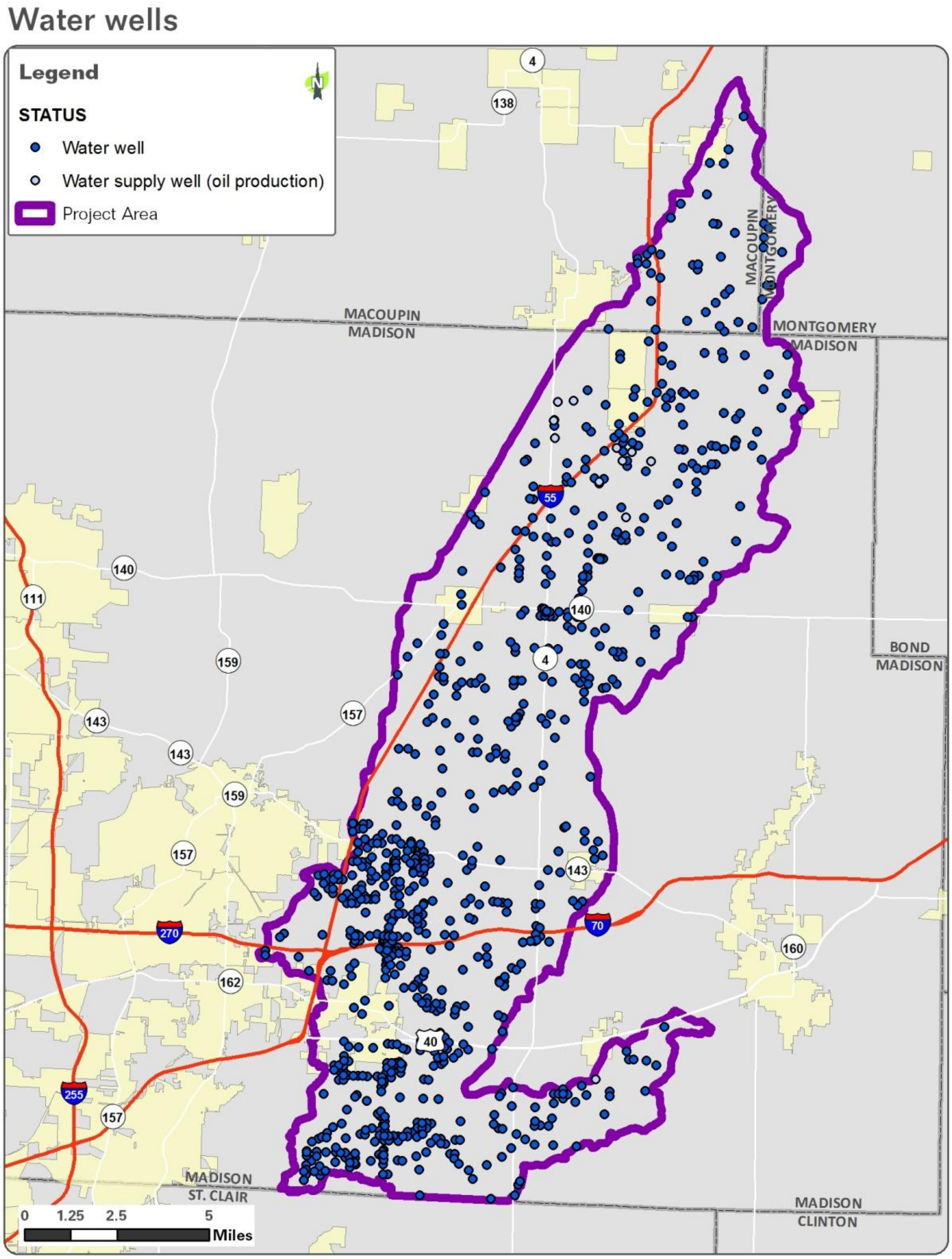


Figure A.19. Water wells and water supply wells for gas production from the ISGS Wells and Borings Database.

Drinking water

Thirteen drinking water supply systems are reported in the US EPA's Safe Drinking Water Information System (SDWIS) for the watershed (Table A.11). Edwardsville, Troy, and Ren Barn Rendezvous RV Park in Edwardsville withdraw groundwater for public supplies. Staunton and Mount Olive use surface water. Other communities purchase groundwater and surface water from entities such as the Bond Madison Water Company and Tri-Township Water District.

In 2012, Staunton and Mount Olive were identified in the Kaskaskia Basin and Vicinity 2050 Water Supply Assessment as having "at-risk" water supply systems, meaning that there is a 10-50% chance the systems will not meet expected demands during a drought of record.[34]

TableA.11. Water supply systems with records in US EPA's Safe Drinking Water Information System.[35]

System	Water System ID	Water System Name	County(s) Served	Population Served	Primary Water Source Type*
Community Water System	IL1190250	Edwardsville	MADISON	24900	Groundwater
Community Water System	IL1191000	Troy	MADISON	16800	Groundwater
Transient Non-Community Water Systems	IL3141887	Red Barn Rendevous	MADISON	25	Groundwater
Community Water System	IL1190300	Glen Carbon	MADISON	11500	Purch_groundwater
Community Water System	IL1190950	St. Jacob	MADISON	1602	Purch_surface_water
Community Water System	IL1190700	Marine	MADISON	960	Purch_surface_water
Community Water System	IL1191200	Worden	MADISON	936	Purch_surface_water
Community Water System	IL1190600	Livingston	MADISON	825	Purch_surface_water
Community Water System	IL1190050	Alhambra	MADISON	800	Purch_surface_water
Community Water System	IL1190450	Hamel	MADISON	800	Purch_surface_water
Community Water System	IL1175250	Staunton Reservoir Road Water Coop	MACOUPIN	63	Purch_surface_water
Community Water System	IL1171050	Staunton	MACOUPIN	5030	Surface_water
Community Water System	IL1170700	Mount Olive	MACOUPIN	2150	Surface_water

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

Soils

A combination of physical, chemical, and biological variables such as topography, climate, drainage patterns, and vegetation have interacted over centuries to form the complex variety of soils found in the Upper Silver Creek watershed. Data provided by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) was used to identify the soil types in the watershed. There are 123 soil types present in the watershed, each of which has a designated hydrologic soil group, hydric soil category, and erodible soil category. See full table of soil types and their attributes in the Data Tables section.

Hydrologic soil groups

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

HSGs are classified into four primary categories, A, B, C, and D, and three dual classes, A/D, B/D, and C/D. The soil texture, drainage description, runoff potential, infiltration rate, and transmission rate of the four primary categories are identified in Table A.12. Sandy type A soils drain much better and allow more infiltration than clay type D soils.

Soil type data was acquired from the U.S. Department of Agriculture's Soil Survey Geographic database (SSURGO) file.[36] The SSURGO data for the project area included 123 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.12. The four primary Hydrologic Soil Groups (HSGs) and their texture, drainage description, runoff potential, infiltration rate, and transmission rate.

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

TableA.13. Hydrologic soil groups including acreage and percent of watershed. Unclassified soil group areas are listed as water, miscellaneous water, urban land, or dumps.[37, 38, 39, 40]

Hydrologic Soil Group	Area (acres)	Percent of watershed
Unclassified	935	1%
A (fast infiltration; low runoff potential)	1,720	1%
B	56,217	47%
B/D	11,993	10%
C	22,803	19%
C/D	9,488	8%
D (very slow infiltration; high runoff potential)	16,926	14%
Grand Total	120,082	100%

Hydrologic soil group B, which drains moderately well to well, is the most prevalent HSG in the watershed, covering 47% of its area (Table A.13). See Data Tables section for a breakdown of hydrologic soil groups by HUC14 subwatershed. Group D soils are most prevalent in the northern half of the watershed, occupying much of the upland area (FigureA.20). Group B/D soils cover large swaths of land in the middle of the watershed, as the soils transition down to Group B soils covering the majority of the lower watershed. Group C soils, which drain somewhat poorly and have low infiltration, are distinctly located along the waterways of Silver Creek and its tributaries. Unclassified soil group areas include water, miscellaneous water, urban land, or dumps.

Hydrologic Soil Group

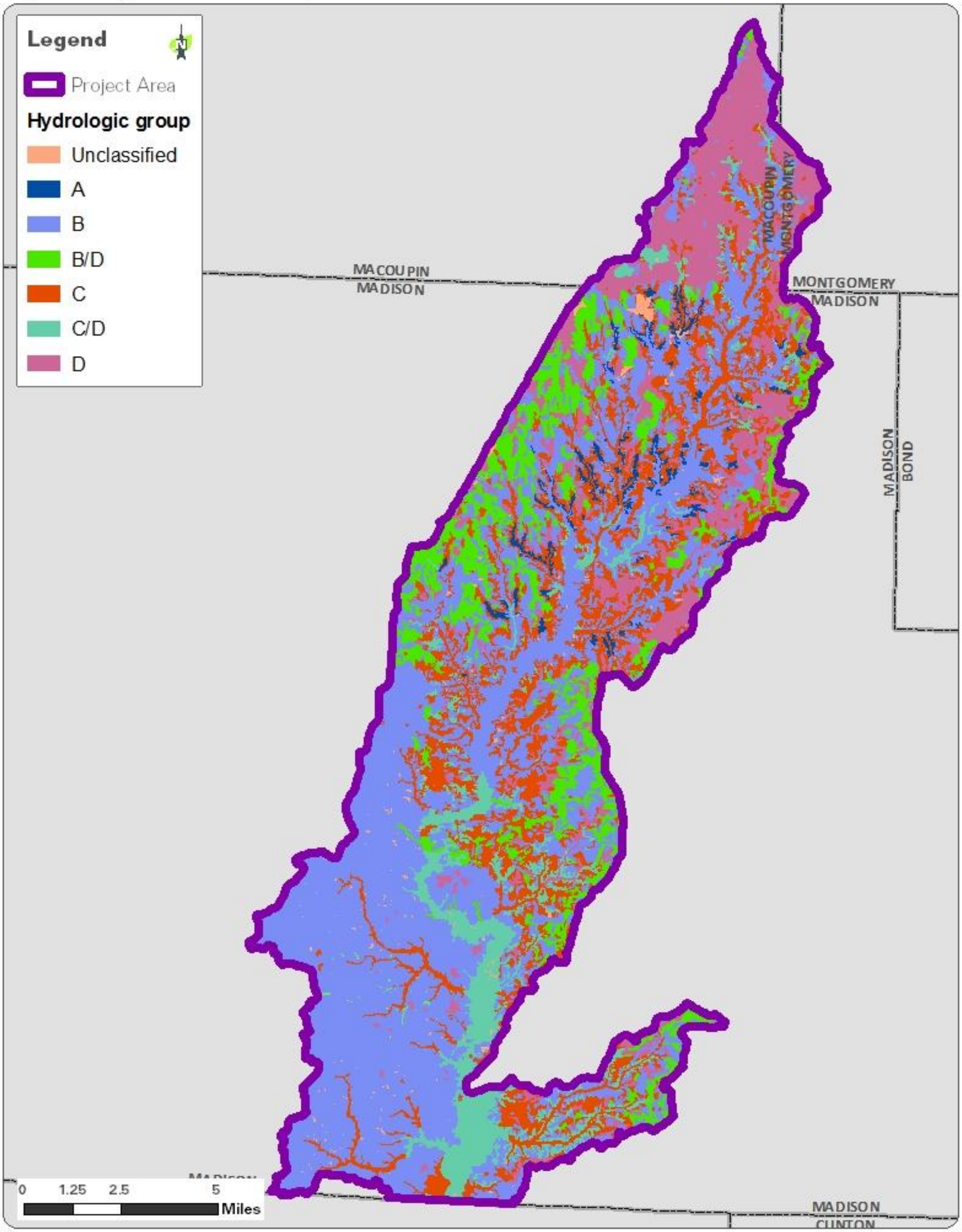


Figure A.20. Hydrologic soil groups in the watershed.

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.21). Fifteen soil types in the watershed were identified as hydric soils, covering a total area of 35,104 acres (Table A.14). Full data on soil types in the watershed and their hydric status is included in the Data Tables section.

Hydric soils constitute 29% of the soils in the watershed (Table A.15). Soils in areas of water, urban land, and dumps were considered to be non-hydric. See Data Tables section for a breakdown of hydric soils by HUC14 subwatershed. Areas of hydric soils of significant size are located in along the Silver Creek waterway and along the upland edges of the watershed to the north (Figure A.21).

TableA.14. Soil types and their hydric status and acreage in the watershed.

Map Symbol Code	Soil Type (SSURGO map unit name)	Hydric Soil?	Hydric Soils area (acres)
3070A	Beaucoup silty clay loam 0-2% slope frequently flooded	Yes	1,544
1070L	Beaucoup silty clay loam undrained 0-2% slope occasionally flooded long duration	Yes	122
3334A	Birds silt loam 0-2% slope frequently flooded	Yes	5,078
657A	Burksville silt loam 0-2% slope	Yes	1383
112A	Cowden silt loam 0-2% slope	Yes	36
993A	Cowden-Piasa silt loam 0-2% slope	Yes	10,402
385A	Mascoutah silty clay loam 0-2% slope	Yes	1,457
474A	Piasa silt loam 0-2% slope	Yes	691
31A	Pierron silt loam 0-2% slope	Yes	1,163
703A	Pierron-Burksville silt loams 0-2% slope	Yes	862
16A	Rushville silt loam 0-2% slopes	Yes	32
50A	Virden silt loam 0-2% slope	Yes	1,903
885A	Virden-Fosterburg silt loams 0-2% slope	Yes	10,059
165A	Weir silt loam 0-2% slope	Yes	302
90A	Bethalto silt loam 0-2% slope	Some*	71
Total			**35,104**

Table A.15. Hydric soils by acreage and percentage.[41, 42, 43, 44]

Hydric Soil	Area (acres)	Percent of watershed
Hydric Soils	35,104	29%
Non-Hydric Soils	84,978	71%
Total	120,082	100%

Hydric Soils

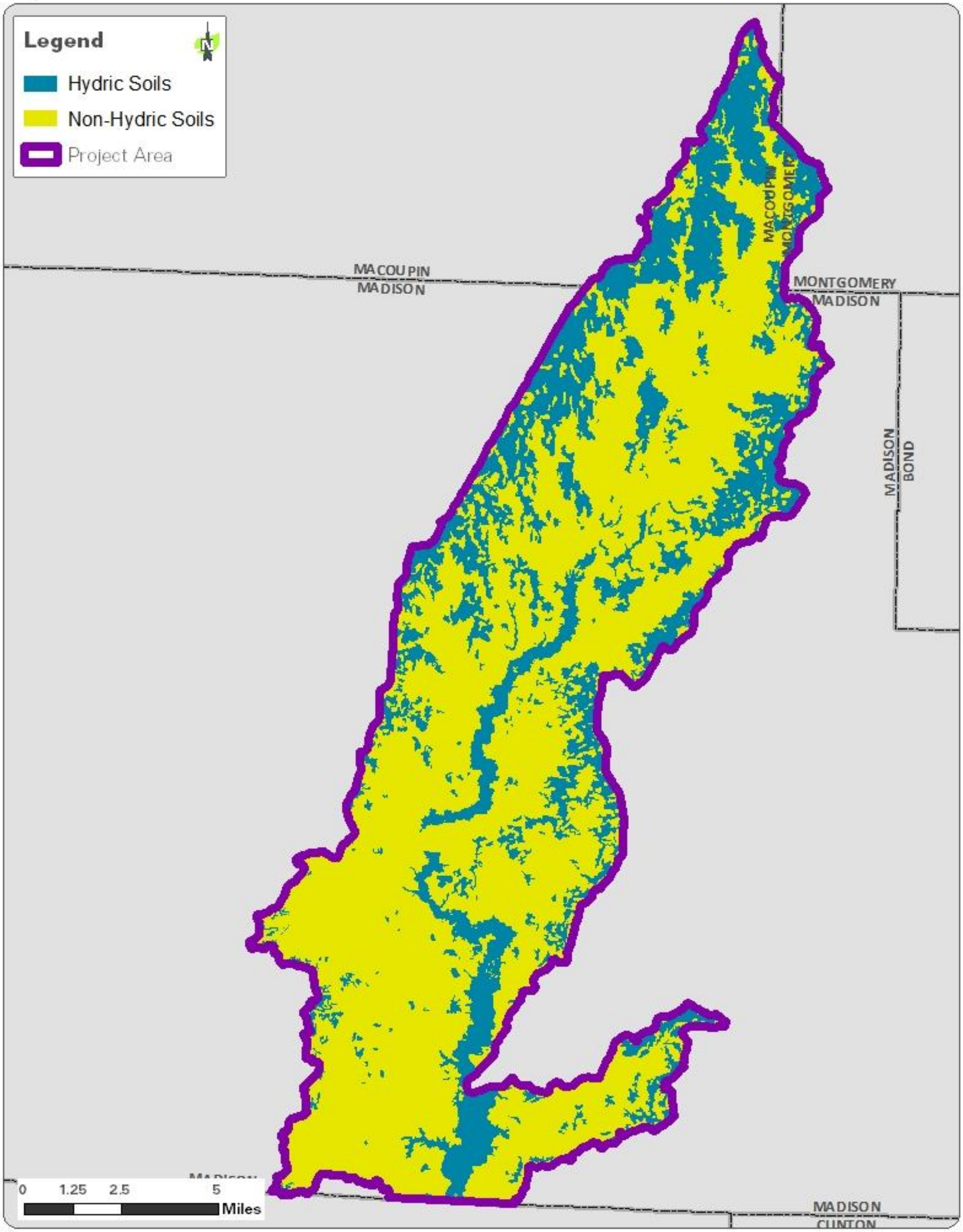


Figure A.21. Hydric and non-hydric soils in the watershed.

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 Madison 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 Madison County Soil Survey identifies which soils are currently classified as eroded or severely eroded. These soils all shared the similar properties of steep slopes (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, particularly on steep slopes (Figure A.22). A strong correlation between slope and high erodibility can be seen in the maps for these factors (Figure A.12 and Figure A.22). Large areas of highly erodible soils are present in the southwestern part of the watershed. Approximately 29% of soils in the watershed are highly erodible, according to Madison County Soil Survey data (Table A.16).

Table A.16. Soil erodibility by area and percentage in the watershed.

Soil erodibility	Area (acres)	Percentage of watershed
Highly erodible	34,832	29%
Not highly erodible	85,250	71%
Grand Total	120,082	100%

Highly Erodible Soils

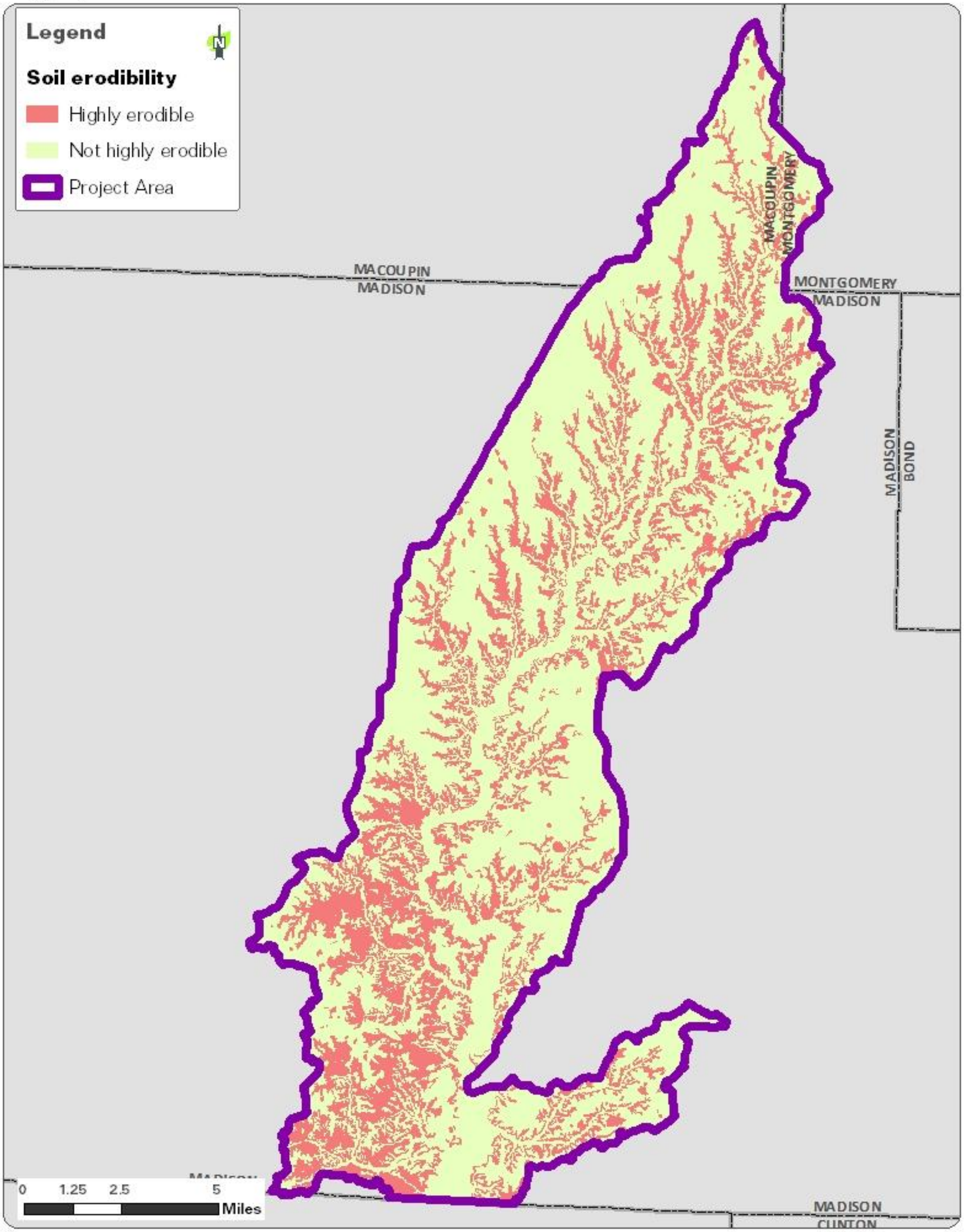


Figure A.22. Highly erodible soils, identified using erodibility classifications from the Madison County Soil Survey.

Water table

The depth of the water table is <50 centimeters in the soils covering 74% of the watershed (Figure A.23).[45, 46] The soils in 9% of the watershed have a water table 200 cm or more below the surface. These soils are concentrated in the southwest of the watershed.

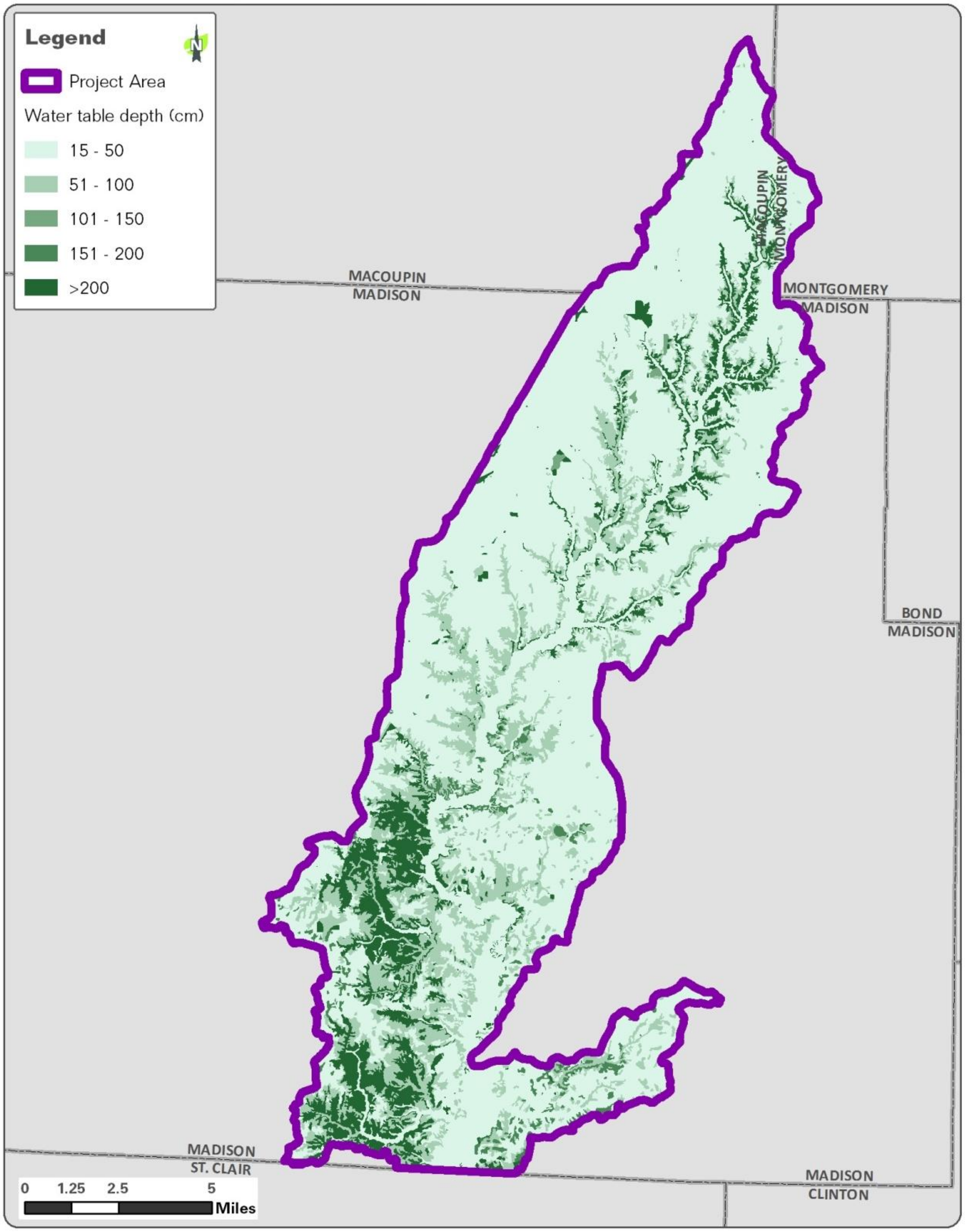


Figure A.23. Water table depth by soil type, according to county soil surveys.[47, 48]

Watershed Jurisdictions

The Upper Silver Creek watershed is located in three counties, 14 townships, and 13 municipalities (Table A.17 and Figure A.24).

Table A.17. County, township, unincorporated, and municipal jurisdictions within the watershed.

Jurisdiction	Area (acres)	Area within watershed (acres)	% of Watershed
County (inclusive of municipalities)	1,483,963	120,089	100%
Macoupin	555,563	10,408	9%
Madison	474,065	107,943	90%
Montgomery	454,335	1,738	1%
Municipalities	30,591	6,685	6%
Alhambra	490	428	0%
Edwardsville	12,919	100	0%
Glen Carbon	6,524	61	0%
Hamel	746	746	1%
Livingston	683	683	1%
Marine	454	453	0%
Mount Olive	740	392	0%
New Douglas	683	33	0%
St Jacob	492	53	0%
Staunton	1,979	113	0%
Troy	3,427	2,496	2%
Williamson	994	994	1%
Worden	460	135	0%
Unincorporated Areas	1,310,454	113,428	94%
Macoupin County	537,098	9,904	8%
Madison County	337,819	101,786	85%
Montgomery County	435,538	1,738	1%
Township	305,385	120,089	100%
Cahokia (Macoupin County)	23,588	223	0%
Mount Olive/Staunton (Macoupin County)	23,406	10,172	8%
Alhambra (Madison County)	22,393	15,582	13%
Edwardsville (Madison County)	23,047	260	0%
Hamel (Madison County)	23,464	11,726	10%
Jarvis (Madison County)	22,992	18,953	16%
Leef (Madison County)	18,791	277	0%
Marine (Madison County)	22,728	8,849	7%
New Douglas (Madison County)	13,403	4,629	4%
Olive (Madison County)	20,307	19,475	16%
Omphghent (Madison County)	21,556	1,888	2%
Pin Oak (Madison County)	23,130	18,576	15%
St. Jacob (Madison County)	23,033	7,596	6%
Walshville (Montgomery County)	23,548	1,725	1%

Jurisdictions

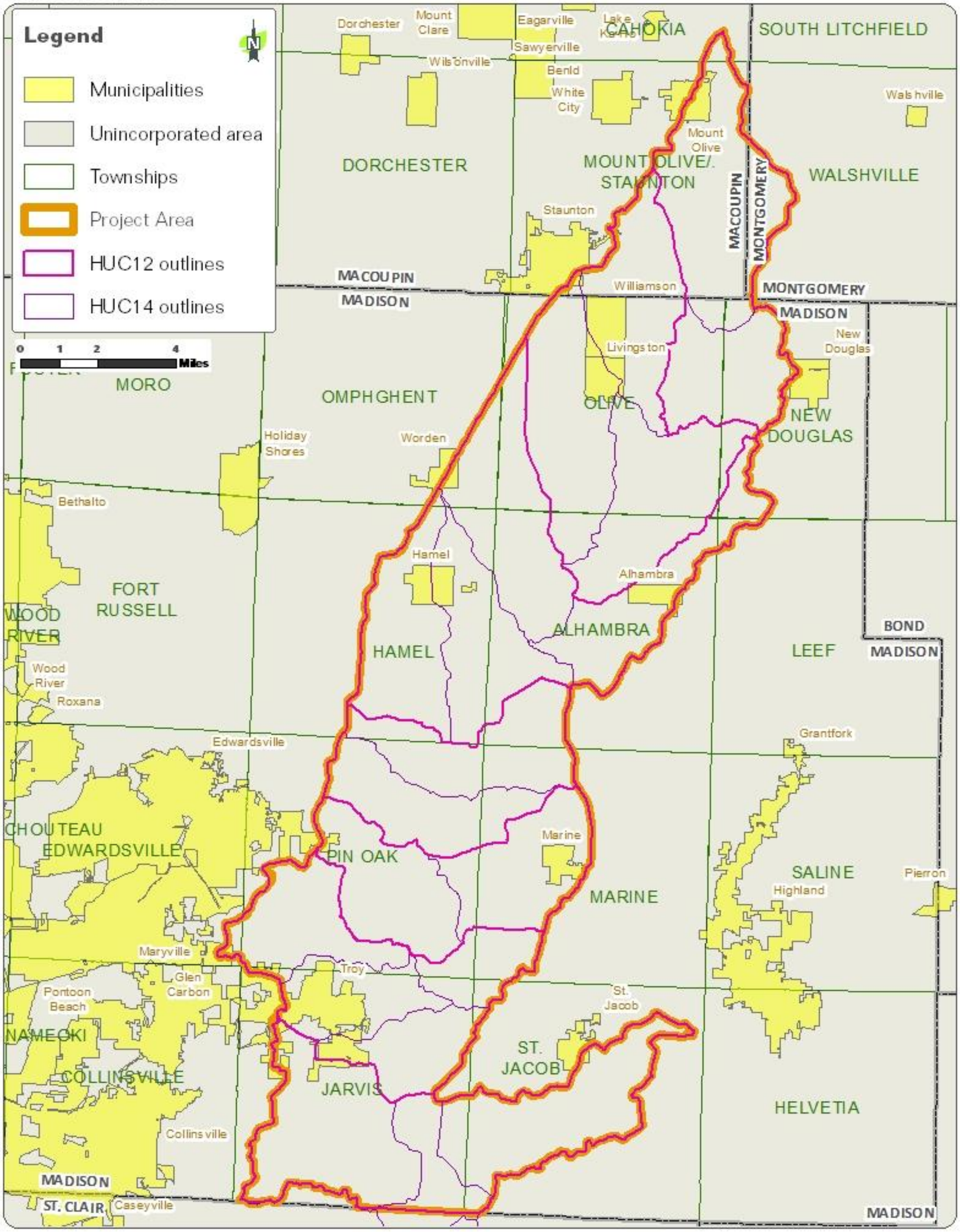


Figure A.24. County, township, unincorporated, and municipal jurisdictions within the watershed.

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.

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

The Illinois Environmental Protection Agency (IEPA) Bureau of Water regulates wastewater and stormwater discharges to streams, rivers, and lakes through the National Pollutant Discharge Elimination System. The NPDES Phase I Stormwater Program applies to large and medium-sized Municipal Separate Storm Sewer Systems (MS4's), several industrial categories, and construction sites hydrologically disturbing 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's are required to complete a series of Best Management Practices (BMPs) and measure goals for six minimum control measures, including public education and participation, illicit discharge detention, construction site runoff control, and pollution prevention.[49]

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 Upper Silver Creek watershed have been issued NPDES permits by Illinois for stormwater discharges to MS4s.

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

Local government

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

Land development in unincorporated Madison County, which constitutes 85% of the Upper Silver Creek Watershed Plan project area, is regulated by the Madison County Planning and Development Department. Madison County enforces floodplain development regulations in its Zoning Ordinance, construction and fill activities in its Fill Ordinance, future development in its Land Use Plan, regulations on new housing subdivisions in its Subdivision Ordinance, and stormwater management regulations in its Stormwater Ordinance. Madison County is also a member of the National Flood Insurance Program (NFIP). Madison County's Stormwater Ordinance (amended in 2007) regulates development activities which alter stormwater flows and enables the County to comply with National Pollutant Discharge Elimination System (NPDES) regulations. The ordinance requires several types of development activity proposed in the unincorporated area of the county to obtain a permit, including any land disturbing activity if the activity is within 25 feet of a river, lake, pond, stream, sinkhole, or wetland. Madison County is also currently in the process of adopting a Stormwater Plan, which will guide future stormwater management activities.

Several municipalities in Madison County in the Upper Silver Creek watershed have passed similar ordinances. Alhambra, Edwardsville, Glen Carbon, Hamel, Marine, Troy, and Worden have passed Subdivision Ordinances and Zoning Ordinances. Alhambra, Edwardsville, Hamel, and Troy have also passed Drainage Ordinances. (Other municipalities in Madison County may have passed these ordinances as well; these were the participating jurisdictions in the draft Madison County Multi-Jurisdictional All Hazards Mitigation Plan.)[50] Many municipalities in the watershed are also members of the NFIP and have passed floodplain ordinances (see Flooding section for more information).

Macoupin County passed a Subdivision Control Ordinance in 2005, which governs review and construction procedures for new subdivisions. The County Soil and Water Conservation District is one of the parties with review of new subdivisions. Macoupin County and its municipalities have no standalone stormwater management ordinance, flood damage prevention ordinance, zoning ordinance, land use plan, or erosion management program/policy as of 2010. The county is a member of the NFIP. Two cities in the county, one of which is the City of Staunton, have passed a Zoning Ordinance (in 2009) which regulates aspects of zoning including land use, building regulations, and procedures for approval of new construction. Staunton also passed a Subdivision Control Ordinance in 2005.[51]

Montgomery County has a Subdivision Ordinance, but no separate Zoning Ordinance or Drainage Ordinance. It does have a Floodplain Zoning Ordinance, adopted in 1999, and it is a member of the NFIP. The county also maintains maps of existing land use and infrastructure.[52]

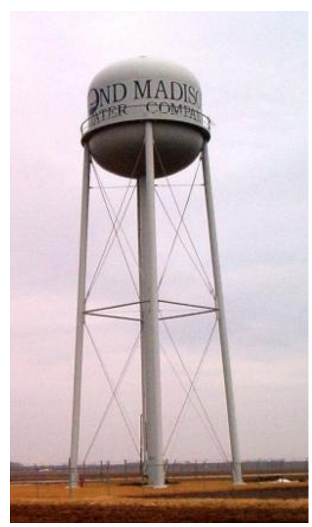
The Madison County All-Hazard Mitigation Plan also included a summary of planning documents in effect for the county and municipalities (Table A.18).

Table A.18. Existing planning documents by jurisdiction, of the municipalities in the Upper Silver Creek watershed that participated in the Hazard Mitigation Plan.[53] Excerpt from Table 7 in that plan.

Existing Planning Documents	Madison County	Alhambra	Edwardsville	Glen Carbon	Hamel	Marine	Troy	Worden
Plans								
Comprehensive Plan	x	x	x	x	x	x	x	x
Emergency Management Plan	x	x	x		x	x	x	
Land Use Plan	x	x	x	x	x		x	
Codes and Ordinances								
Building Codes	x	x	x	x	x	x	x	x
Drainage Ordinances	x	x	x		x	x	x	x
Historic Preservation Ordinance	x	x	x		x		x	
Subdivision Ordinance(s)	x	x	x	x	x	x	x	x
Zoning Ordinances	x	x	x	x	x	x	x	x
Maps								
Existing Land Use Map	x	x	x	x	x		x	
Infrastructure Map	x	x	x	x	x	x	x	x
Zoning Map	x	x	x	x	x	x	x	x
Flood-Related								
Flood Ordinance(s)	x		x	x	x			x
Flood Insurance Rate Maps (FIRMs)	x		x					
Repetitive Flood Loss List	x		x					
Elevation Certificates for Buildings	x		x		x			

Stakeholder outreach to municipalities

The planning team interviewed numerous nine of the 13 municipalities in the watershed. Mayors, aldermen, and municipal staff were asked about drinking water source(s), wastewater treatment system(s), and flooding, as well as other issues such as erosion, siltation, and water quality issues.



Bond-Madison water tower west of Livingston. Photo: Bond Madison Water Company.

Drinking water

Municipalities do not typically use surface water or for their drinking water supplies. Only one community – Alhambra – uses groundwater from within the watershed, and even then, only as a portion of its supply. Most communities purchase surface water originating in the Mississippi River from suppliers such as the Bond-Madison Water Company (which purchases water from Illinois American Water).

Private wells supply many individual residences with water throughout the watershed, and particularly in unincorporated areas.

Wastewater treatment
Municipal wastewater treatment in the watershed is largely conducted at facilities within municipal boundaries. At least seven of the thirteen municipalities have their own wastewater treatment facility. At least two municipalities send their wastewater to a facility in another jurisdiction for treatment.

None of the municipalities interviewed had combined sewers (sanitary and stormwater system combined). However, many 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 commonplace within municipal boundaries, and several municipalities mentioned plans to extend public sewer lines to these properties in future. Outside of municipal boundaries, nearly all properties have individual private sewage treatment systems. Some Open House attendees reported bad smells from private sewage systems, which may indicate malfunctioning systems.

Flooding
Urban flooding was probably the most important issue to the municipalities interviewed; all of them had experienced at least some flooding in developed areas. None of the municipalities mentioned riverine flooding as a problem.

Open House attendees and Flood Survey respondents reported flooding on their properties and on the roads around them. Flood locations identified in the Flood Survey were used to create rankings for flood damage “hotspot” subwatersheds. The “hotspot” rankings were based on survey results for flood prevalence, frequency, monetary loss, and area of influence (see Appendix B).

The Flood Survey revealed a need for further education about flooding and flood insurance. Ten percent of Flood Survey respondents did not know that all or part of their property was in the floodplain. The majority of flooding reported in the survey (87%) was outside of FEMA-designated floodplains, and several property owners had flood insurance policies on structures outside of the floodplain. Over half of respondents who had flooding did not report it to anyone. Given that a quarter of respondents experienced flooding over the last ten years, there is a clear mandate to further educate residents on flood damage prevention and mitigation.

Road overtopping near Marine, 2013. Photo: Village of Marine.

Erosion
Marine and Edwardsville highlighted soil erosion issues within their municipal boundaries. Both municipalities, and several townships, mentioned instances where row crops are consistently planted up to the edge and into drainage ditches, leading to greater soil erosion and widening the ditch. Marine and Hamel reported unstable streambanks and erosion issues upstream of their water and wastewater treatment facilities, respectively, threatening the viability of those facilities in the event of a bank blow-out.

Muddy water flows into Heritage Lake in Marine. Photo: Village of Marine.

Several Open House attendees reported erosion on their properties from widening ditches, tributaries, and creeks. One individual reported brown water rushing off a field and over a road (and over a blocked culvert), carrying a heavy load of sediment with it.

Logjams
Several municipalities and landowners mentioned logjams as an issue in Silver Creek and its tributaries. Some identified beavers as an exacerbating factor, especially at the southern end of the watershed where there is more flat, wooded land in the floodplain.

Siltation
Siltation was an issue for Glen Carbon residents with a pond that had filled with silt and was no longer functioning as a stormwater basin, and for areas around Troy where agricultural land abuts residential areas (subdivisions).

Surface water quality issues
Water quality issues were noted in four communities, and include turbidity (from high concentrations of suspended solids) and duckweed growth on ponds. None of the municipalities had conducted surface water quality testing in the watershed. Several property owners attending the Open House events mentioned litter/trash as an issue on their land and in the creeks and streams they drive past, from sources including illegal dumping of large items and smaller trash being thrown out of car windows.

Recreation
Water-based recreation is uncommon in the watershed, partly because so much of the creek and waterbodies are only accessible from private land. However, four municipalities did relate that fishing and boating took place on lakes and ponds in their jurisdictions. Others related that they had played and swum in a creek in their youth, but no longer do so because the creek is now steeper, wider, and more dangerous. Some had heard that the creek had water quality issues.

Lake/detention basin where recreation is not allowed. Photo: HeartLands Conservancy.

A table summarizing the input from municipalities can be found in Table A.19.

Table A.19. Summary of municipal input from stakeholder engagement. Gray cells indicate that the watershed planning team was not able to meet with the municipality. Information on water supply and wastewater treatment for communities not met with is from the Safe Drinking Water Information System (SDWIS) and the Integrated Compliance Information System (ICIS) from U.S. EPA.

	Drinking water supply				**Wastewater treatment system(s)**			**Flooding**		**Other issues**			
Municipality	**Municipal groundwater (wells)**	**Municipal surface water**	**Purchased groundwater**	**Purchased surface water**	**Municipal WWTP**	**Private sewage**	**Combined sewers**	**Urban flooding**	**Riverine flooding**	**Erosion**	**Siltation**	**Surface water quality issues known**	**Water-based recreation**
Alhambra	x			x	x	x		x					
Edwardsville	x*				unknown	x		x		x		x	x
Glen Carbon			x			x		x			x		
Hamel				x	x	x		x					
Livingston				x	unknown								
Marine				x	x	x		x		x			
Mount Olive		x**			x								
New Douglas	unknown				unknown								
St. Jacob	x*			x	x	x		x				x	
Staunton		x**		x	x	x		x				x	x
Troy	x*				x	x		x				x	x
Williamson	unknown				unknown								
Worden				x	x	x		x					x

*Wells are located outside the watershed.

**Surface water source is outside the watershed.

Demographics

Population

The 2010 US Census found a population of approximately 26,245 in the Upper Silver Creek watershed, with a population of 103,808 in the entire Silver Creek watershed.[54] (Note: the 2014 draft Watershed Resources Inventory used a larger population estimate of 61,994 people.) There are approximately 10,490 households in the Upper Silver Creek watershed, and 11,961 parcels (parcel data from Madison County).

Madison County is the most populous of the three project area counties, with more than 267,000 people as of 2012. Macoupin and Montgomery counties have less than a fifth of that population, with approximately 47,000 and 30,000 people respectively, as of 2012.[55]

Of the municipalities represented within the project area, Edwardsville has the largest population, with 24,293 people as of the 2010 Census. Glen Carbon, Troy, Staunton, and Mount Olive are the next most populous municipalities, respectively. The least populous municipalities in the project area include Williamson, New Douglas, and Alhambra. Troy has the largest number and the largest proportion of its population in the watershed (Table A.20).

Population density varies throughout the watershed. The average population density within the project area is 100 or fewer people per square mile. The lowest population density is 101 to 1,000 people per square mile in several of the municipalities, and the highest population density is 1,001 to 10,000 people in Troy and Staunton (Figure A.25).

Table A.20. Population of the municipalities represented in the project area from the 2010 Census, official 2012 population estimate, and approximate population in each municipality living in the watershed.[56]

Municipality	Population (2010 Census)	Population (2012 Estimate)	Approx. Population in the watershed (2010 Census)
Troy	9,888	9,946	11,216
Mount Olive	2,099	2,075	1,505
Marine	960	949	1,120
Hamel	816	815	945
Livingston	858	846	867
Alhambra	681	673	827
Glen Carbon	12,934	12,922	732
Edwardsville	24,293	24,457	515
St. Jacob	1,098	1,127	351
Staunton	5,139	5,143	294
Williamson	230	228	230
Worden	1,044	1,036	175
New Douglas	319	318	55

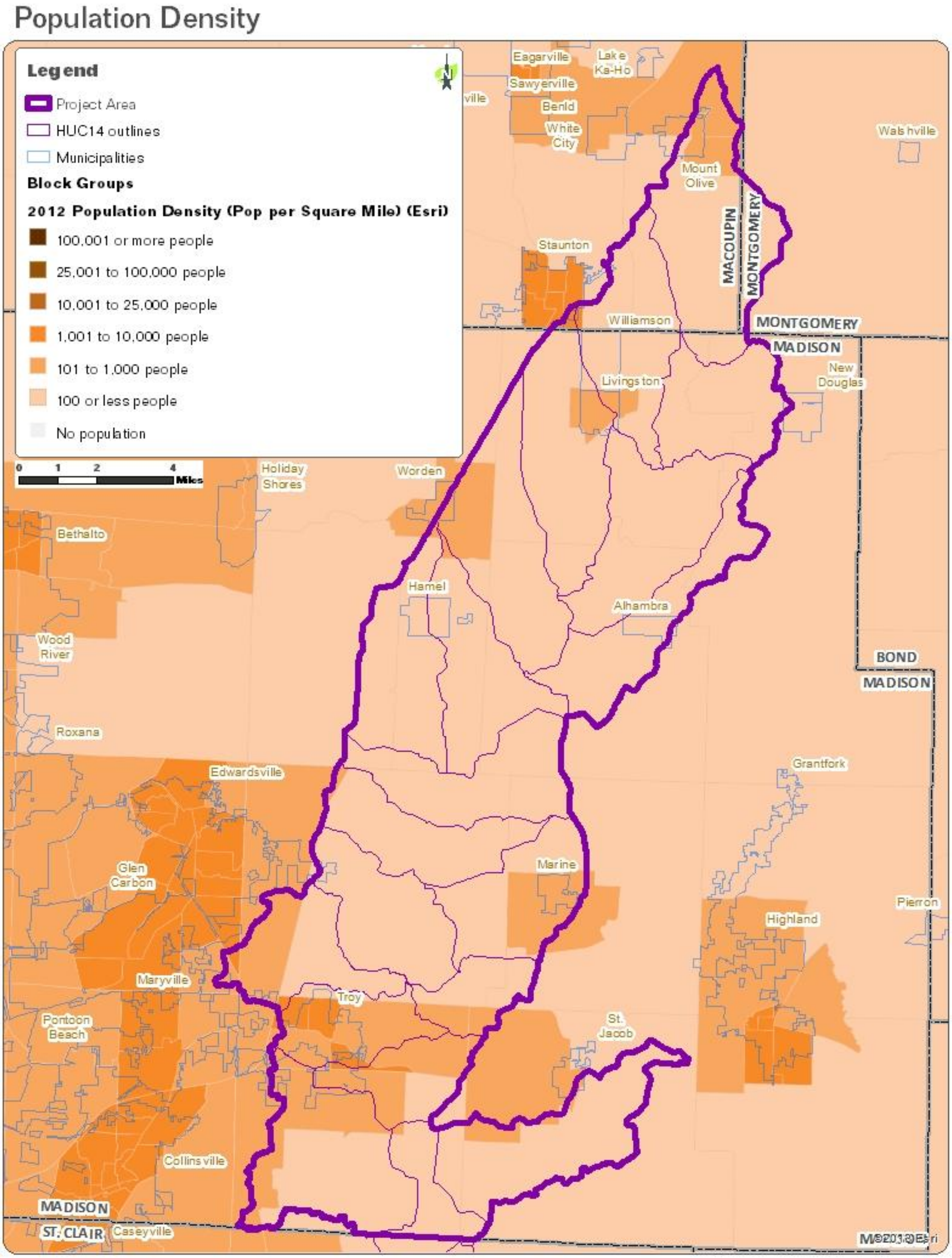


Figure A.25. Population density by Census block in the watershed, according to 2012 estimates. [57]

Population change

Recent population growth in the three counties from 2000 to 2010 has varied between 10.9% (Madison County) and 26.8% (Macoupin County). The greatest recent population growth occurred mostly on the east side of the watershed, in tracts including St. Jacob and New Douglas.

All three counties in the project area are expected to increase in population by the year 2030. Madison County is projected to experience the largest actual growth (more than 29,000 people), while Macoupin County is projected to experience the greatest percentage increase in population (26.8%) (Table A.21). A different estimate of Madison County's population growth under a slow-growth scenario by the East-West Gateway Council of Governments puts Madison County's population at 290,143 in 2030, a smaller 8.6% increase from 2013.[58]

Five-year population growth estimates show 0.4% to 1.2% population growth between 2012 and 2017 over much of the project area area (Figure A.26). This growth estimate follows the national average annual growth rate for this time period (0.68%). Pockets of the watershed will experience higher growth of 1.3% to 2.5%, while other areas (for example, Alhambra, Marine, and parts of Troy) are expected not to grow or to lose population.

Table A.21. Population of the counties represented in the project area from the 2000 and 2010 Censuses, with official 2013 population estimates and 2030 population forecasts, and percent change between 2013 and 2030.[59, 60]

Total Population	2000 Census	2010 Census	2013 Estimate	2030 Forecast	Change from 2013-2030 (# of people)	Percent Change from 2013-2030
Madison County	259,391	269,282	267,225	296,342	29,117	10.9%
Macoupin County	49,103	47,765	46,880	59,442	12,562	26.8%
Montgomery County	30,704	30,104	29,654	33,124	3,470	11.7%

Projected Population Growth 2012-2017

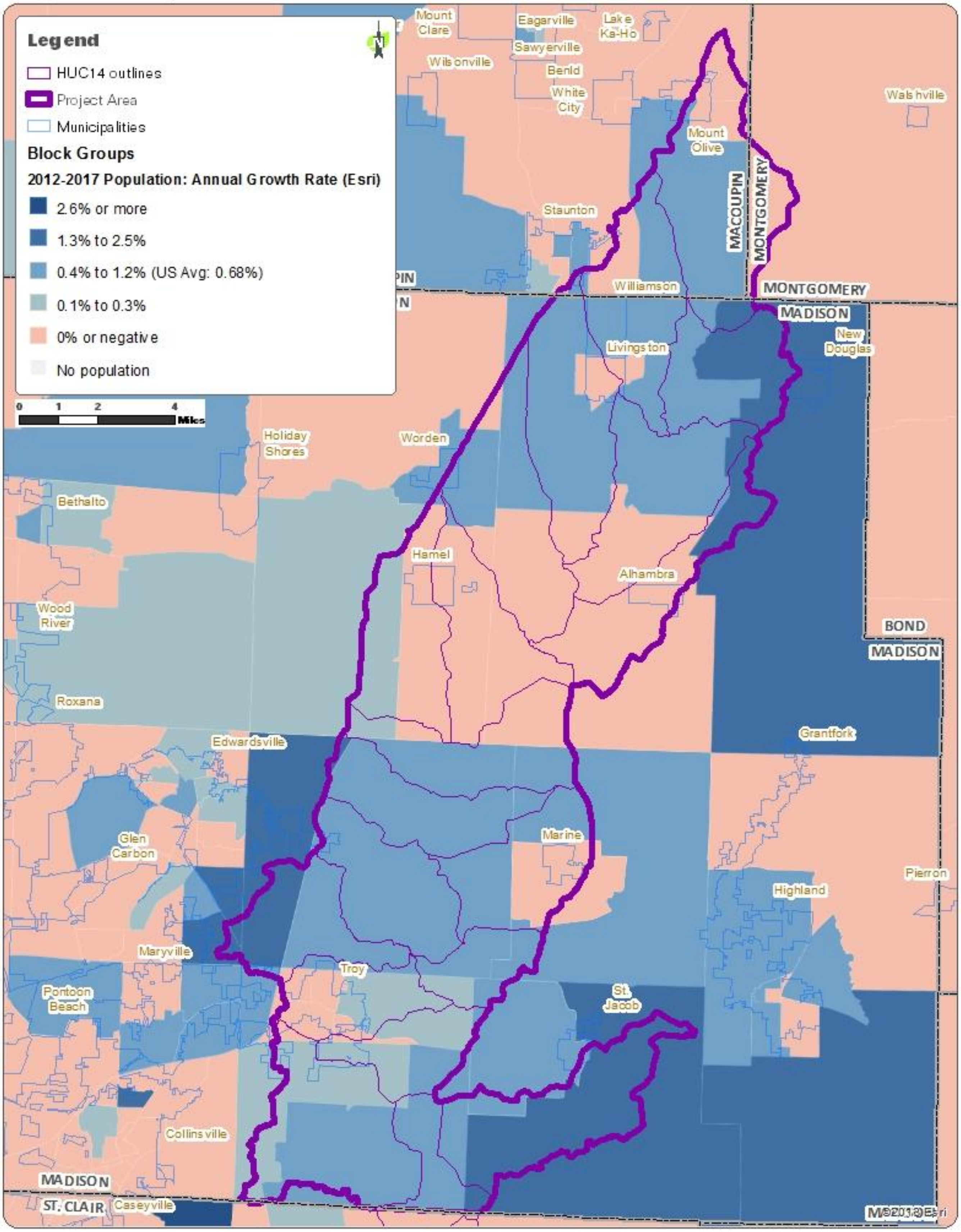


Figure A.26. Projected population growth between 2012 and 2017 (U.S. Census 5-year population estimates).[61]

Median income

Median income can be an indicator of financial ability to make improvements to property, such as improved septic systems. The median family income in Madison County is $52,756. In Macoupin and Montgomery counties, the median family income is $48,788 and $42,261 respectively (Table A.22). In the watershed, there is a general north-south income gradient when assessed by Census block, with the highest median household income south of Troy in the south of the watershed (Figure A.27).

The municipalities with the highest median family income (upwards of $70,000) are Troy, St. Jacob, Hamel, and Edwardsville. The municipalities with the lowest proportion of people with income below the poverty level are St. Jacob, Hamel, and Marine, each with 5% or less.

The municipalities with the lowest median family income (less than $46,000) are Williamson, Alhambra, Livingston, and Mount Olive. Williamson, Alhambra, Livingston, and Worden had the highest percentages of people with income below the poverty level.

Table A.22. Median family income and poverty in the municipalities and counties in the project area. [62]

Community	Median Family Income (2012 inflation-adjusted dollars)	Percentage of people whose income in the past 12 months is below the poverty level
Alhambra	$39,688	15.2%
Edwardsville	$73,759	11.6%
Glen Carbon	$66,296	10.5%
Hamel	$76,250	5.0%
Livingston	$42,383	15.1%
Marine	$54,911	5.0%
Mount Olive	$45,250	14.7%
New Douglas	$49,306	17.8%
St. Jacob	$77,500	4.3%
Staunton	$45,633	12.6%
Troy	$90,094	9.5%
Williamson	$33,750	16.4%
Worden	$53,125	16.8%
AVERAGE	$57,534	11.9%
Macoupin County	$48,788	12.1%
Madison County	$52,756	13.8%
Montgomery County	$42,261	14.2%
AVERAGE	$47,935	13.4%

Household Income

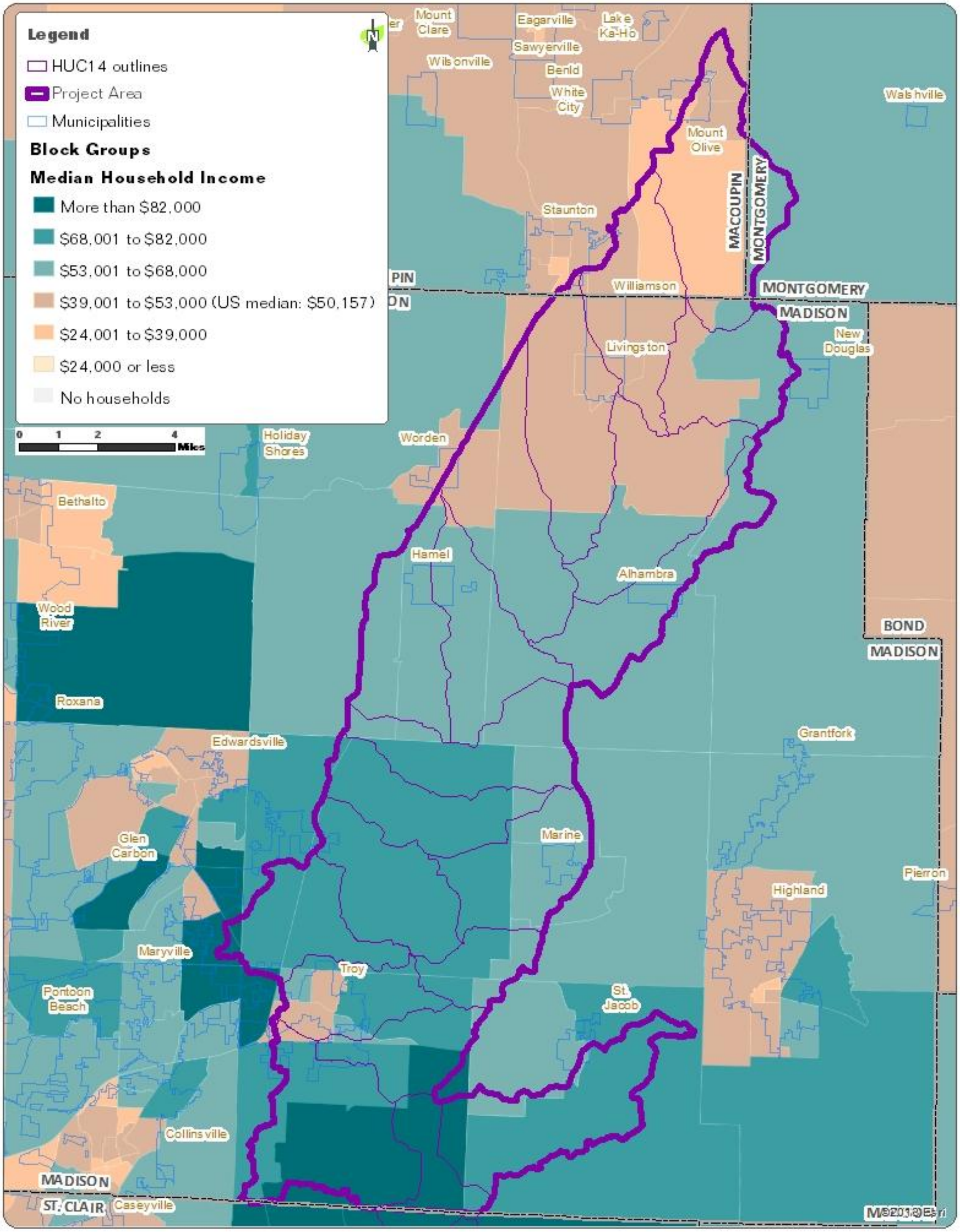


Figure A.27. Median household income by Census block.

Employment

Employment can be an indicator of future growth and development in an area. Madison County experienced a 2.7% increase in the number of jobs between 2001 and 2011 (Table A.23). In 2011, the three industry sectors with the largest number of jobs were government (17,177 jobs), retail trade, (14,993 jobs), and health care/social assistance (14,946 jobs). From 2001 to 2011, jobs in service industries grew 15%. The sectors that added the most new jobs were transportation and warehousing (1,790 new jobs), finance and insurance (1,748 new jobs), and accommodation/food services (1,538 new jobs). The number of government jobs was relatively static, increasing 1%. Jobs in non-service industries shrank 27%, from 30,672 to 22,495 jobs.[63]

Macoupin County experienced a 12.7% decrease in the number of jobs between 2001 and 2011. Non-service industry jobs decreased the most, from 4,025 to 3,057 (a -24% decrease), followed by government jobs (a -16% decrease) and service industry jobs (a -9% decrease). The sectors that added the most jobs between 2001 and 2011 were finance and insurance (115 new jobs), real estate/rental and leasing (98 new jobs), and utilities (15 new jobs).[64]

Montgomery County also experienced an overall decrease in the number of jobs (-10.7%) between 2001 and 2011. The greatest decrease was in non-service industries, which shrank from 3,452 to 2,792 (a -19% decrease). Jobs in service industries shrank from 9,464 to 8,703 (a -8% decrease), and government jobs shrank from 2,005 to 1,949 (a -3% decrease). The sectors with the most new jobs were mining (200 new jobs), construction (106 new jobs), and health care/social assistance (100 new jobs).[65]

Table A.23. Percentage of the workforce working in non-services, services, and government sectors in 2000 and 2011, & percentage change in that time.[66, 67, 68]

	Madison County			Macoupin County			Montgomery County		
	2001	2011	% Change 2001-2011	2001	2011	% Change 2001-2011	2001	2011	% Change 2001-2011
Percent of Total			*2.7%*			*-12.7%*			*-10.7%*
Non-services related	**24.7%**	**17.6%**	**-26.7%**	**~21.7%**	**~18.9%**	**-24.0%**	**22.9%**	**~20.7%**	**-19.1%**
Farm	1.4%	1.2%	-13.1%	8.2%	7.0%	-25.3%	7.8%	7.1%	-18.4%
Forestry, fishing, & related activities	0.1%	0.1%	19.0%	na	na	na	0.4%	~0.4%	-1.9%
Mining (including fossil fuels)	0.3%	0.4%	30.0%	na	na	na	0.8%	3.5%	73.5%
Construction	6.8%	6.0%	-9.6%	7.3%	6.8%	-19.3%	4.1%	5.4%	17.1%
Manufacturing	16.1%	10.0%	-36.4%	6.1%	5.1%	-28.1%	8.8%	4.4%	-56.1%
Services related	**61.6%**	**68.9%**	**14.9%**	**~47.6%**	**~49.8%**	**-8.6%**	**~62.7%**	**~64.5%**	**-8.0%**
Utilities	0.3%	0.3%	-12.6%	0.3%	0.5%	23.8%	na	na	na
Wholesale trade	2.7%	2.7%	2.8%	5.3%	5.9%	-3.0%	~4.2%	3.9%	-15.9%
Retail trade	12.1%	11.8%	-0.6%	11.8%	11.6%	-14.0%	11.9%	13.1%	-1.8%
Transportation & warehousing	3.9%	5.2%	36.9%	4.0%	3.6%	-20.0%	4.2%	~3.5%	-26.1%
Information	1.0%	0.8%	-24.1%	1.2%	0.9%	-35.3%	1.1%	1.2%	-1.9%
Finance & insurance	4.0%	5.3%	35.3%	4.6%	5.9%	13.6%	4.7%	5.6%	5.9%
Real estate & rental and leasing	2.5%	3.5%	41.1%	2.0%	2.9%	26.1%	2.1%	2.4%	1.2%
Professional & technical services	3.8%	4.9%	32.8%	3.3%	3.0%	-20.9%	3.2%	3.0%	-16.5%
Management of companies & enterprises	0.2%	0.7%	330.6%	~0.1%	~0.0%	-53.9%	0.2%	0.7%	145.9%
Administrative & waste services	3.1%	4.1%	38.9%	~1.6%	~1.7%	-6.4%	2.6%	3.4%	20.5%
Educational services	0.9%	1.2%	31.6%	na	na	na	0.4%	~0.9%	79.5%
Health care and social assistance	11.0%	11.7%	9.6%	na	na	na	11.3%	~13.3%	5.9%
Arts, entertainment, & recreation	2.9%	2.4%	-14.3%	1.4%	1.6%	-1.6%	0.8%	0.9%	-0.6%
Accommodation & food services	7.0%	8.0%	17.8%	5.1%	5.4%	-7.5%	8.9%	6.6%	-33.0%
Other services, except public admin.	6.1%	6.3%	6.4%	7.0%	6.8%	-15.4%	7.1%	5.9%	-24.9%
Government	**13.70%**	**13.5%**	**0.9%**	**15.8%**	**15.2%**	**-15.9%**	**13.3%**	**14.5%**	**-2.8%**

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

Home values

Investment and development in the Upper 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 2013 show that median home values in the watershed are generally higher in the southern part of the watershed than in the north (Figure A.28).[69] According to data from housing website Zillow.com, the average median home price in the municipalities in the project area is $146,000 (Table A.24). All of the municipalities experienced a decrease in home values over the past year, and the prediction for next year is a 0.1% decrease. Overall, the market in the watershed is a buyer's market. [70]

Many homes in the watershed have negative equity – the market value of the property has fallen below the outstanding amount of the mortgage secured on it – but the percentage is similar to the U.S. average of 18.8% (as of March 2014). Approximately 3.3% of homes are delinquent on their mortgages in the three counties, which is much lower than the 7.2% U.S. average (as of March 2014).

Table A.24. Home values, recent and predicted change in home values, and percentages of homes with negative equity and that are delinquent on their mortgages. [71]

Community	Median home value (as of 5/14)	Change in home values 5/13 to 5/14	Predicted change in home values 5/14 to 5/15	Homes with negative equity	Delinquent on mortgage
Alhambra	$ 122,100	-7.1%	-0.6%	19.4%	2.0%
Edwardsville	$ 152,000	-5.4%	-0.1%	12.2%	4.3%
Glen Carbon	$ 166,300	-4.3%	0.6%	11.5%	4.7%
Hamel	No data	No data	No data	18.2%	5.0%
Livingston	No data	No data	No data	16.7%	0.0%
Marine	$ 127,000	-4.7%	0.4%	13.4%	2.9%
Mount Olive	No data	No data	No data	27.7%	5.8%
New Douglas	No data	No data	No data	19.9%	3.2%
St. Jacob	$ 152,500	-6.9%	-0.6%	18.8%	4.9%
Staunton	No data	No data	No data	22.8%	2.4%
Troy	$ 158,700	-4.9%	-0.2%	15.4%	3.5%
Williamson	No data	No data	No data	No data	No data
Worden	$ 143,400	-4.0%	0.0%	11.6%	0%
AVERAGE	$ 146,000	-5.3%	-0.1%	17.3%	3.2%
Macoupin County	No data	No data	No data	20.5%	3.3%
Madison County	$ 98,700	-6.2%	-0.7%	18.4%	5.4%
Montgomery County	No data	No data	No data	21.0%	1.3%
AVERAGE	n/a	n/a	n/a	18.8%	3.3%

Home Values

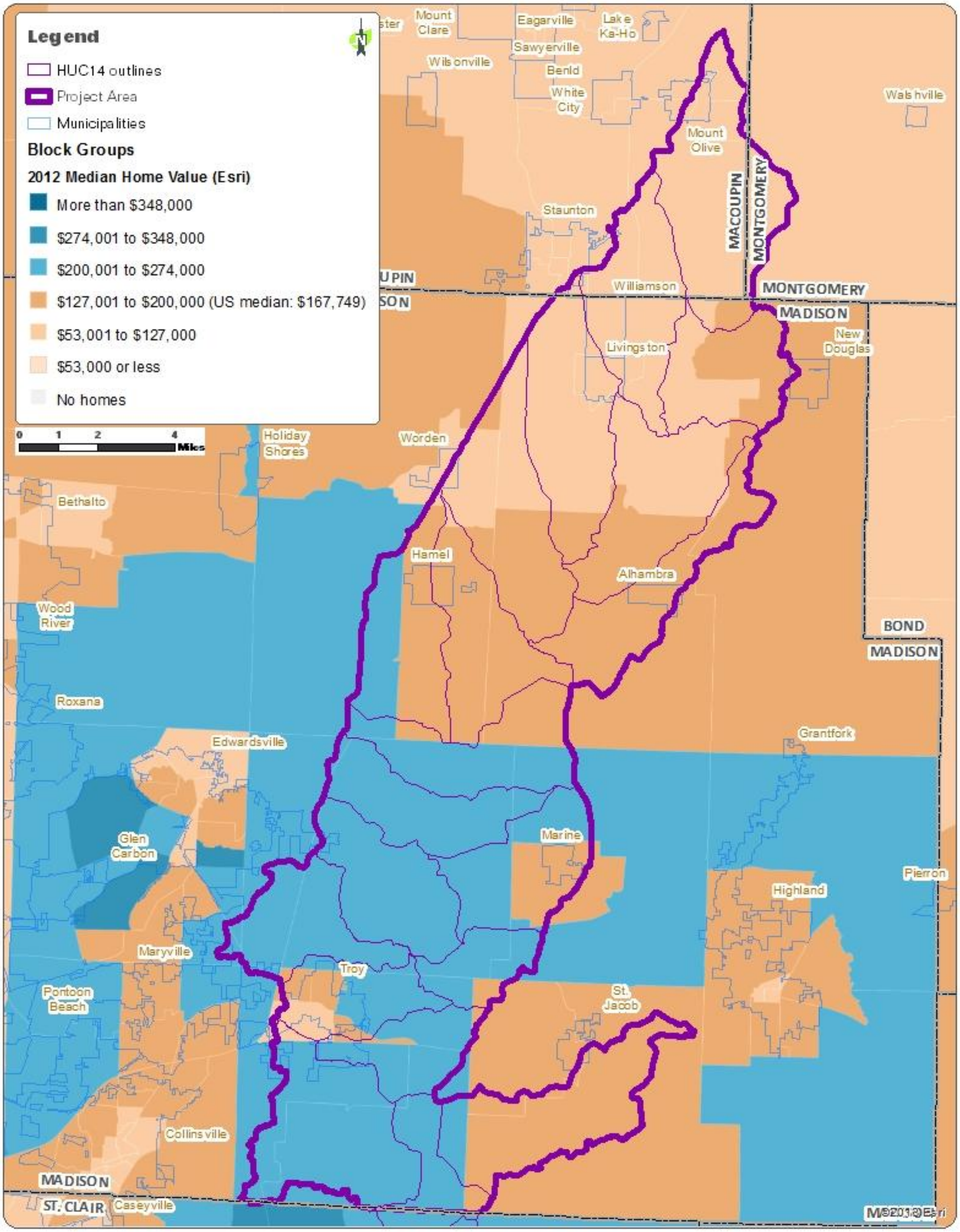


Figure A.28. Median home values from 2012 by Census block. [72]

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, presumably as a result of the increased availability and demand for rental housing available in more urbanized areas (Figure A.29).[73]

Owner-Occupied Housing

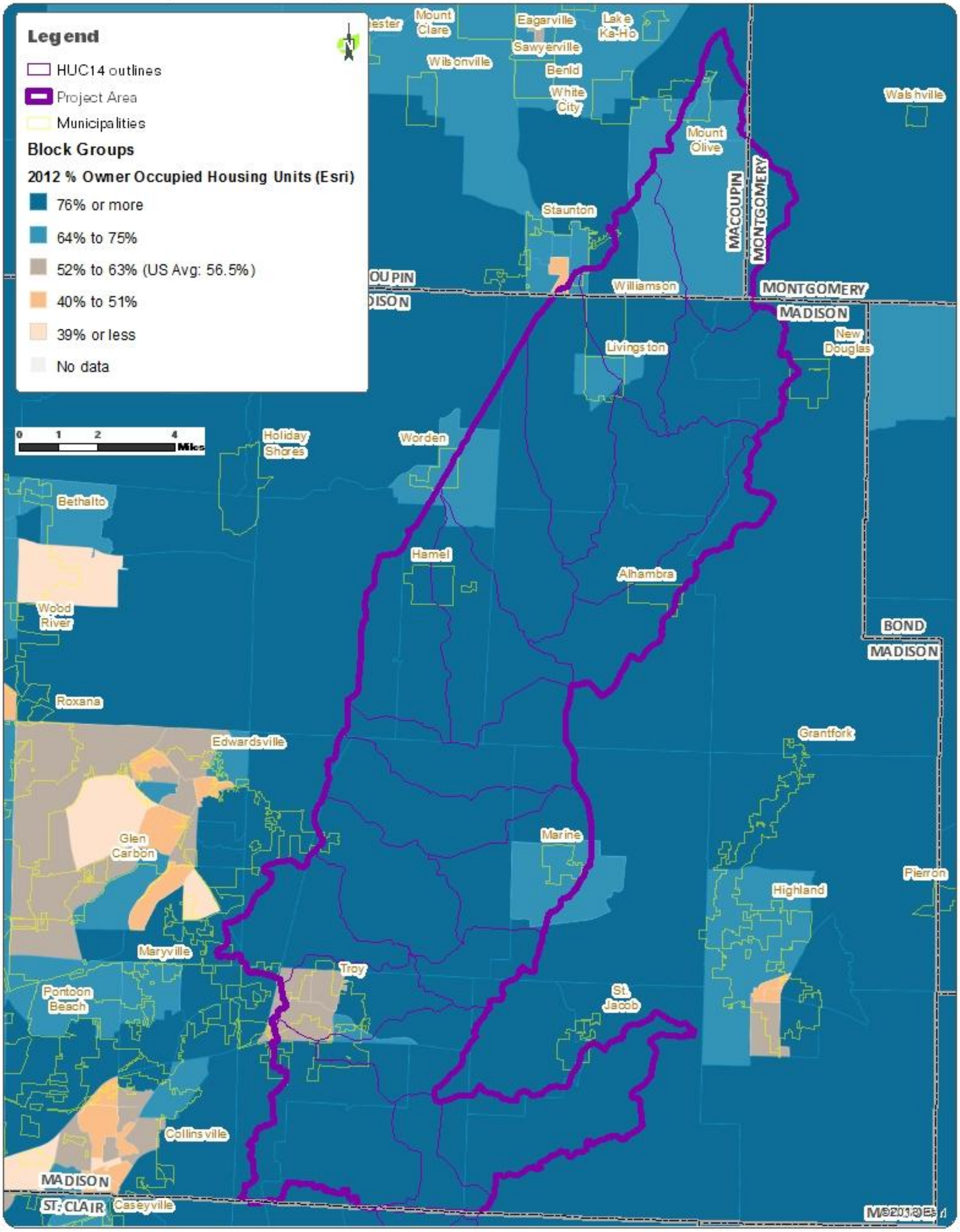


Figure A.29. Percentage of owner-occupied housing in 2012, by Census block.[74]

Land Use/Land Cover

2011 land use/land cover

Land use/land cover data for the Upper Silver Creek watershed was collected from the 2011 National Land Cover Database (NLCD). Cultivated crops are the most common land use in the watershed at 70.572 acres or 58% (Table A.25). Other common land uses include hay/pasture (17,404 acres, 14%), deciduous forest (16,470 acres, 14%), developed open space (6,981 acres, 6%), and low intensity developed (6,148 acres, 5%). The urbanized areas are distributed throughout the watershed, but there is more urbanized area in the southwest of the watershed (Figure A.30; codes/descriptions are aggregated for simplicity). There is little or no high intensity developed space, barren land, evergreen forest, mixed forest, or shrub/scrub land use/land cover in the watershed.

The proportions of land use/land cover types are fairly consistent among HUC14 watersheds, ranging between 30% and 75% for agricultural land and 0% and 24% for the four types of developed space. The HUC14 with the most agricultural land is 07140204050401, south of Hamel in the middle of the watershed. The HUC14 with the most developed land is 07140204050603 by a wide margin. Located to include much of Troy, it has 24% low intensity developed space and 5% medium density developed space. See Data Tables section for a detailed breakdown of land use by HUC14.

Most of the watershed's wood wetlands occur in HUCs 07140204050601 and 07140204050901, both of which encompass swaths of the Silver Creek channel and associated low-lying floodplain areas. Deciduous forest is to be found in all of the HUC14s, ranging between 2% and 32% of their area. The highest percentage of deciduous forest is in HUC 0714020450102 in the north of the watershed.

Table A.25. 2011 land use/land cover classifications and acreage. [75]

Land Use	Description	Area (acres)	Percent of watershed (%)
Barren Land	Areas of bedrock, desert pavement, scarps, and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.	23	0%
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.	70,572	58%
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.	16,470	14%
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.	155	0%
Developed, Low Intensity	Areas with a mixture of constructed materials and vegetation. E.g. single family houses. Impervious surfaces cover 20-40% area.	6,148	5%
Developed, Medium Intensity	Areas with a mixture of constructed materials and vegetation. E.g. single family houses. Impervious surfaces cover 50-79% area.	1,068	1%

Table A.25 continued.

Land Use	**Description**	**Area (acres)**	**Percent of watershed (%)**
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.	6,981	6%
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.	95	0%
Evergreen forest	Areas dominated by trees generally greater than 5 meters tall, and >20% of total vegetation cover. More than 75% of the tree species maintain leaves all year. Canopy is never without green foliage.	18	0%
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.	17,404	14%
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.	368	0%
Mixed forest	Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75% of total tree cover.	0	0%
Open Water	Areas of open water, generally with<25% of vegetation or soil.	466	0%
Shrub/Scrub	Areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation.	0	0%
Woody wetlands	Areas where forest or shrubland vegetation accounts for >20% of vegetative cover and the soil or substrate is periodically saturated or covered with water.	1,411	1%
Grand Total		**121,179**	100%

Land Use/Land Cover

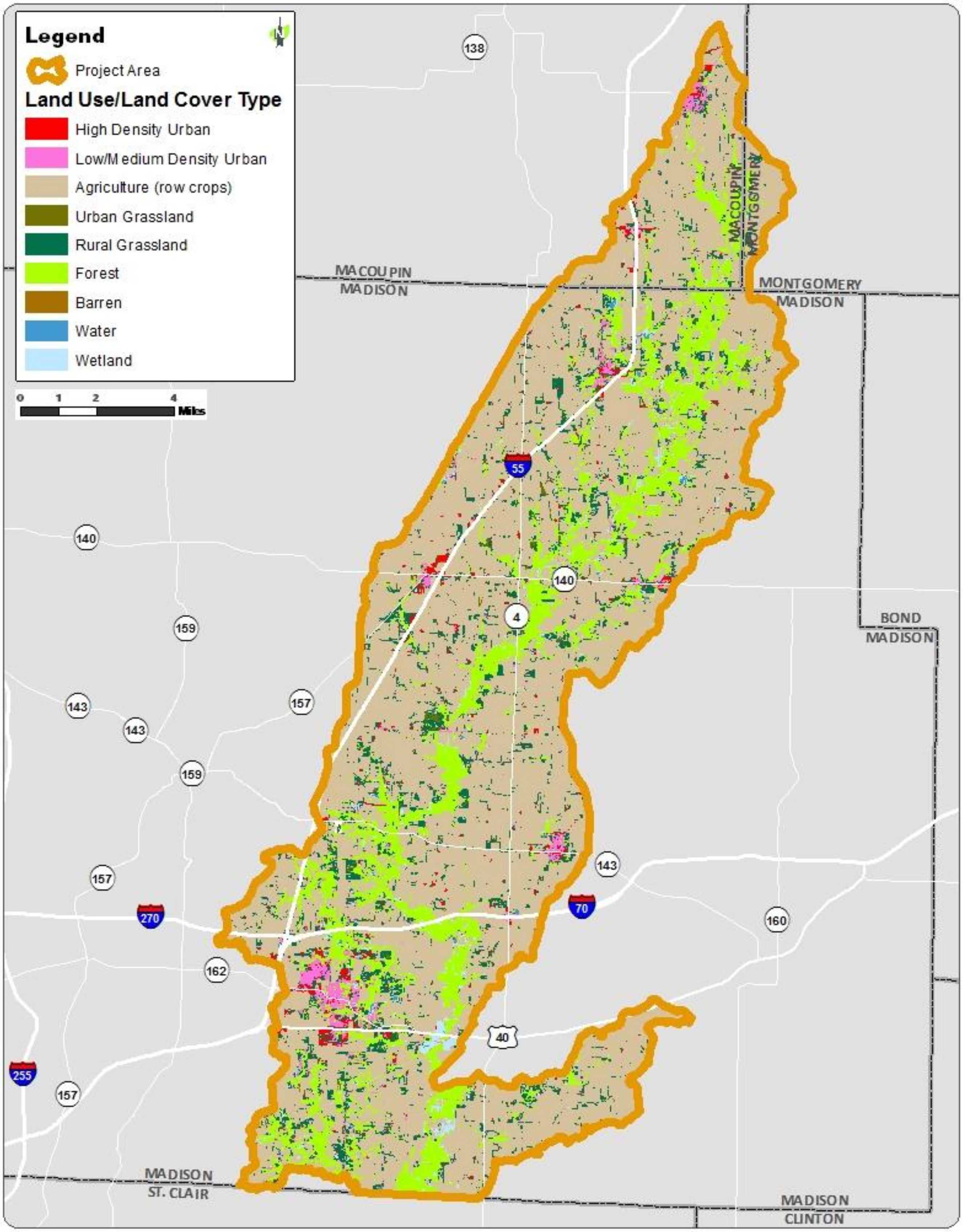


Figure A.30. Land use/land cover categories. [76]

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, and ash tend to dominate. [77] Forest covers approximately 13.6% of the watershed at present.

The forested corridor 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 holes or gaps, which encourage nest predators such as raccoons, opossums, skunks, and cowbirds. No endangered or threatened species has been documented in the study area, but since this watershed has not been extensively studied or recently inventoried to find them, this is not proof of their absence. The bottomland forest along Silver Creek may support species that rely on this habitat, such as the Indiana Bat.[78]

Illinois RiverWatch volunteers collected data on vegetation at two stream sites in the watershed between 1996 and 2014. This riparian vegetation includes trees such as silver maple, slippery elm, box elder, ash, red oak, and Osage orange. Invasive species including bush honeysuckle (*Lonicera maackii and L. morrowii*), Japanese honeysuckle (*Lonicera japonica*), and multiflora rose (*Rosa multiflora*) were also recorded.[79]

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.[80] The National Wetlands Inventory represents the current extent, approximate location and type of wetlands in the United States, as determined using aerial imagery. According to this Inventory, bottomland forest is the most prevalent wetland type in the project area (Figure A.31). A few pockets of marshland are also found in this area, along with scattered open water wetlands (ponds). Field checks are needed to more accurately assess the extent of wetlands in the watershed and support the general inventory provided by the National Wetlands Inventory. Approximately 1.2% of the watershed currently contains wetlands.[81]

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.[82]

Wetlands mitigation importance values and wetland restoration importance values were created for the watershed by MoRAP. Several layers of data, especially topography, soil type, and land cover, were used to create maps of existing wetlands which it is highly important to protect, and areas which were formerly wetlands which it would be highly beneficial to restore. This work has been done previously for other areas in this region, as seen in the 2013 report, "Ecological Approach to Infrastructure Development: Wetlands Mapping and Analysis for the Mississippi and Mississippi River Floodplains".[83]

Wetlands

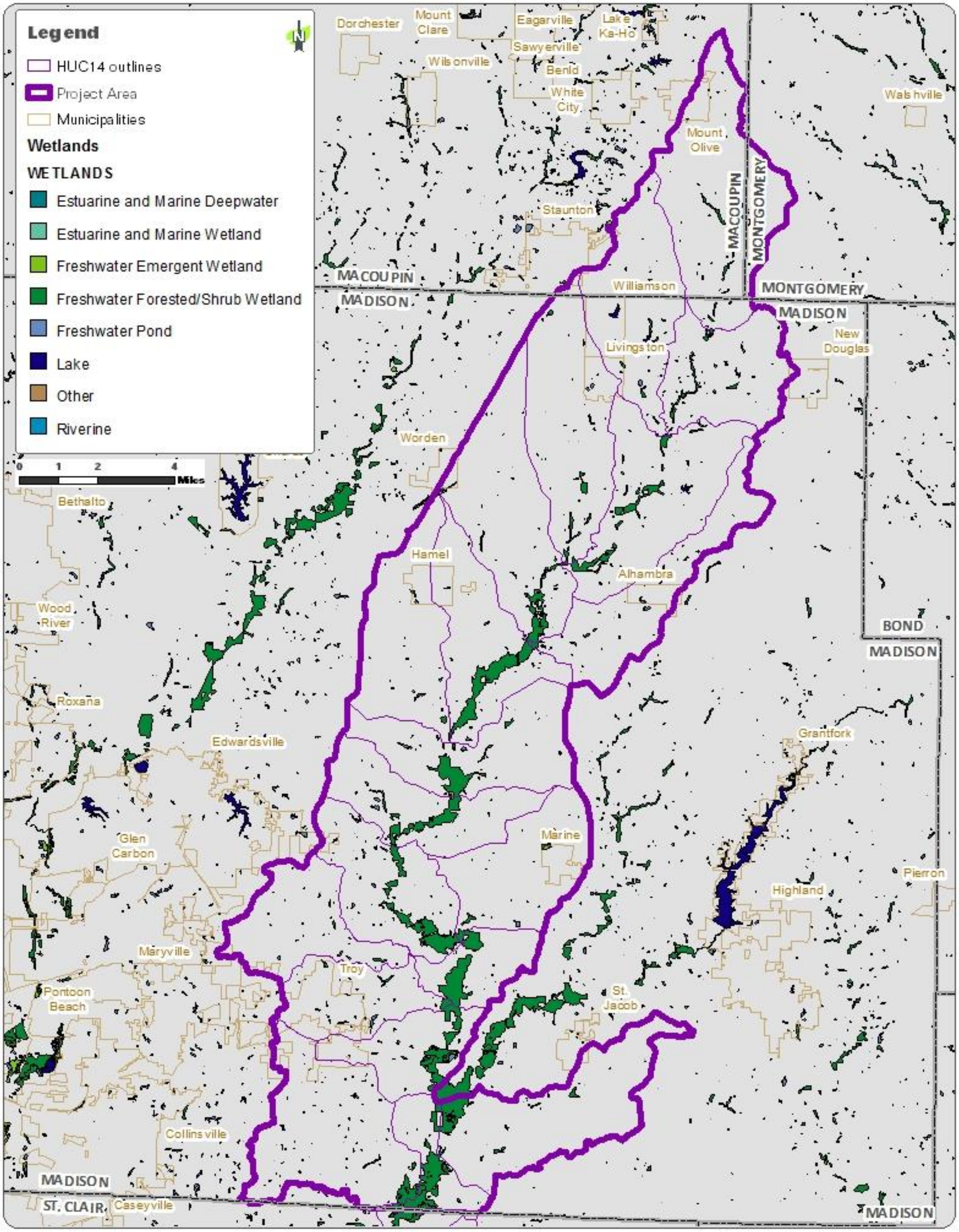


Figure A.31. Wetlands in the watershed as determined by the National Wetlands Inventory. [84]

Ecological Significance

The Missouri Resource Assessment Partnership (MoRAP) and the East-West Gateway Council of Governments (EWG) created an ecological significance GIS data layer for EWG's eight-county planning region in 2010. The attribute variables important to ecological significance included the results of existing aquatic conservation assessments, vegetation type, vegetation patch size, natural diversity, occurrence of rare species, and land ownership (public/private). Eight tiers of importance were identified from high to low ecological significance.[85] Areas of high ecological significance include the Silver Creek corridor and some of its major tributaries, and the wetland bottoms area where East Fork Silver Creek enters Silver Creek (Figure A.32).

Ecological Significance (natural and semi-natural vegetation)

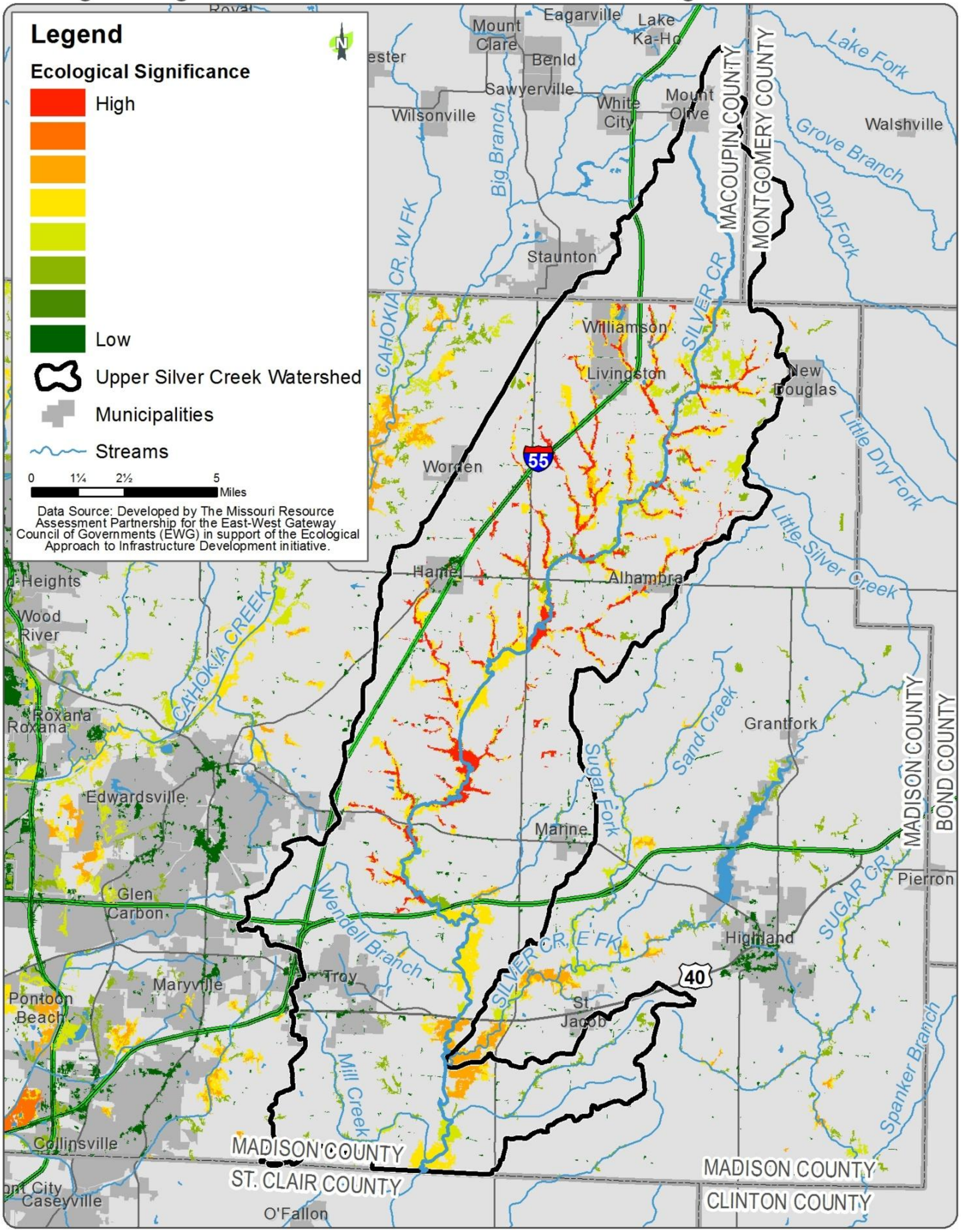


Figure A.32. Ecological significance attributes (out of eight tiers of importance) calculated by the MoRAP and EWG.

Threatened and endangered species

No endangered or threatened species has been documented in the study area, but since this watershed has not been extensively studied or recently inventoried to find them, this is not proof of their absence. The bottomland forest along Silver Creek may support species that rely on this habitat.[86] Eight animal and plant species listed as threatened or endangered may be present in the Upper Silver Creek watershed (Table A.26). The most likely species present are the Indiana bat, based on its habitat of stream corridors with well-developed riparian woods, and upland forests), and the leafy prairie clover, which grows in prairie remnants on thin soil over limestone.

Table A.26. 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 Upper Silver Creek watershed.[87]

	Species	Status	Range	Habitat
Mammal	Indiana bat (Myotis sodalis)	Endangered	Potential Habitat Statewide; Known Occurences in 27 counties in Illinois, including Madison and Macoupin counties. Neither county has hibernacula.	Caves, mines (hibernacula); small stream corridors with well developed riparian woods; upland forests (foraging)
Bird	Least tern *(Sterna antillarum*)	Endangered	10 counties in Illinois including Madison County.	Bare alluvial and dredged spoil islands
Reptile	Eastern Massasauga *(Sistrurus catenatus)*	Candidate*	10 counties in Illinois including Madison County.	Shrub wetlands
Fish	Pallid sturgeon *(Scaphirynchus albus*)	Endangered	7 counties in Illinois including Madison County.	Large rivers
Mussel	Spectaclecase mussel *(Scaphirynchus albus*)	Endangered	7 counties in Illinois including Madison County.	Large rivers
Plant	Decurrent false aster *(Boltonia decurrens*)	Threatened	20 counties in Illinois including Madison County.	Disturbed alluvial soils
Plant	Eastern prairie fringed orchid *(Platanthera leucophaea*)	Threatened	82 counties in Illinois including Madison, Macoupin, and Montgomery counties.	Mesic to wet prairies
Plant	Leafy prairie clover *(Dalea foliosa)*	Endangered	9 counties in Illinois including Madison County.	Prairie remnants on thin soil over limestone

* "Candidate" means the species is a candidate for listing as endangered or threatened.

Fish

The Illinois Natural History Survey (INHS) keeps records of fish sampling in Illinois. Samples were taken in the Upper Silver Creek watershed at three locations a total of four times in 1963, 1966, and 2000. Sixteen species of fish were found, and 195 individuals collected. [88] Six of the 16 species are tolerant of various environmental perturbations, three are moderately tolerant, and two are moderately intolerant (the other five were not rated by U.S. EPA).[89] These small, separate sampling events therefore indicate that there is moderate pollution/environmental disturbance at the sampling locations on or tributary to Silver Creek.

In the Intensive River Basin Survey of 2007 at the USGS gauge on Silver Creek, Illinois EPA found a fish IBI score of 45, indicating no impairment (a score above 41 is "fully supporting" of aquatic life). The impairment was determined through the low macroinvertebrate IBI score and water quality data.

Crustaceans

The INHS Crustacean Collection database keeps records of crustaceans sampled in Illinois. Crustaceans were sampled at seven locations in Silver Creek (not necessarily Upper Silver Creek), Mill Creek, or Lake Fork over four days in 1975 and 1977. Four species and 40 individuals were collected.[90]

Mussels

The INHS Mussel Collection database keeps records of mussels sampled in Illinois. Mussels were sampled once per year in Silver Creek (not necessarily Upper Silver Creek) in 1999, 2004, 2007, and 2010. Eight species were found, and more than 53 individuals collected.[91] Illinois RiverWatch volunteers found no mussels at the two sites they monitored in the watershed between 1996 and 2014, except for one fingernail clam at the Wendell Branch site in 1999.[92]

Livestock and domestic animals

Animal (livestock) data is available from the USDA 2012 Agricultural Census database at the county level (Table A.27).[93] Stakeholders have noted cattle, sheep, and horses in the watershed, including two stables and a mustang ranch (Legendary Mustang Sanctuary). The watershed has no Concentrated Animal Feeding Operations (CAFOs) according to the Resource Management Mapping Service (RMMS).[94]

Table A.27. Livestock in Madison and Macoupin counties, from the 2012 Agricultural Census.[95]

Livestock	Number of farms and number of animals
Cattle and calves	285 farms, 11,044 head (Madison County, 2012) 303 farms, 23,071 head (Macoupin County, 2012)
Hogs and pigs	14 farms, 8,885 head (Madison County, 2012) 26 farms, 34,373 head (Macoupin County, 2012)
Sheep and lambs	33 farms, 413 head (Madison County, 2012) 23 farms, 702 head (Macoupin County, 2012)
Goats	30 farms, 542 head (Madison County, 2012) 33 farms, 433 head (Macoupin County, 2012)
Equine	170 farms, 1,065 head (Madison County, 2012) 76 farms, 323 head (Madison County, 2012)
Poultry	87 farms (Madison County, 2012) 53 farms (Macoupin County, 2012)

Agricultural land use/land cover

Illinois, and the Upper Silver Creek watershed, lies 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.[96] 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.[97]

The total watershed acreage of land in agricultural use is 87,976 acres (72%), of which 58% is used for cultivated crops and 14% is used for hay/pasture (Table A.25). Corn, soybeans, and wheat are grown extensively in the watershed. Sorghum, horseradish, sweet corn, tomatoes, onions, potatoes, berries, and fruits are also grown.[98] The average farm size in the three counties is 340 acres, while the median size is 97 acres, indicating that there are a few very large farms. Madison County farms are typically smaller than farms in the other two counties (Table A.28).

Table A.28. Data about agriculture in Macoupin, Madison, and Montgomery counties.[99]

	Macoupin	Madison	Montgomery
Farms	1,190	1,110	1,021
Land in farms (acres)	438,592	307,135	382,388
Average size of farms (acres)	369	277	375
Median size of farms (acres)	115	66	110
Total cropland (acres)	371,038	276,513	346,716
Irrigated land (acres)	30	2,364	(D)*
Avg market value of ag products sold per farm (dollars)	$ 186,369	$ 127,692	$ 22,582
Average net farm cash income (dollars)	$ 44,417	$ 1,474	$ 4,706
Farms harvesting corn for grain	601	491	543
Acres farmed for corn for grain	220,412	116,881	180,222
Farms with hired farm labor	312	286	283
Number of hired farm labor workers	886	1,328	729
Farms enrolled in Conservation Reserve, Wetlands Reserve, Farmable Wetlands, or Conservation Reserve Enhancement Programs	495	179	430
Land enrolled in Conservation Reserve, Wetlands Reserve, Farmable Wetlands, or Conservation Reserve Enhancement Programs (acres)	16,995	3,785	12,425

* (D): figure is withheld to avoid disclosing data for individual farms.

The pressures of urbanization have led to encroachment on/conversion of farmland in Illinois over time. There are fewer farms and fewer acres in agricultural production in the state than at any time since the 1982 USDA's Agricultural Census. Between 1997 and 2003, 50,000 acres was converted to urban use in the Metro Area of St. Louis, which includes Madison County. The population, while relatively stagnant in overall size, shifted eastward onto larger lots and "farmettes", but often did not take up farming.[100] The Upper Silver Creek watershed appears to have a lower proportion of owner-farmers than southwestern Illinois as a whole, as much of the land is rented out to be farmed (based on anecdotal information). The average age of farmers in the three counties is 55 years.

Corn and soybeans are the major crops grown in the watershed (or were in 2011), followed by double cropped winter wheat and soybeans and grassland/pasture (Figure A.33). The USDA-NASS Cropland Data Layer also shows large areas of developed land and deciduous forest in the watershed.

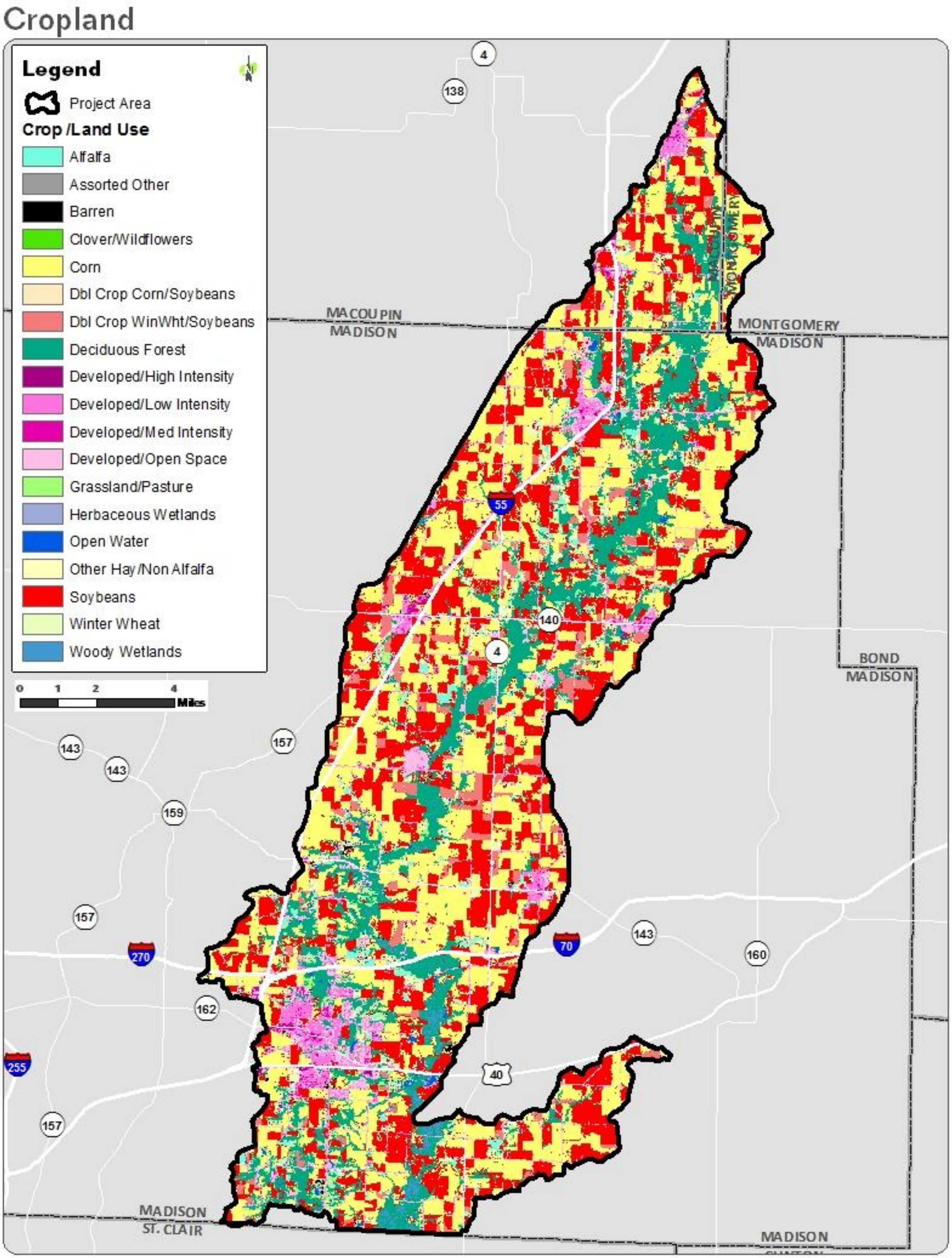


Figure A.33. Cropland types and land use from the 2011 USDA-NASS Cropland Data Layer. [101]

Open space

There is no federally- or IDNR-owned open space in the watershed. However, there are 26 areas of open space covering 1,289 acres (1% of the watershed). These open spaces include municipal parks, bike trails, campgrounds, and athletic fields (Figure A.34). There is one golf course in the watershed.[102] The watershed's one campground is Bur Oaks Campground, located southwest of Alhambra. The 35-acre private campground features RV sites accommodating 76 visitors, and two lakes used for swimming. The tributary that passes through the campsite is often 50 feet wide and floods about twice a year.[103]

Subdivisions

Madison County is currently working on assembling data on all subdivisions in the unincorporated area, with a particular focus on those subdivided in the last 10 years. The total "developed" area in the unincorporated county is 6,513 acres (650 lots), which includes major and minor subdivisions, private access subdivisions, single lot subdivisions, and single lot additions.[104] Plat years are recorded for some, but not all, major and minor subdivisions. There are many more subdivisions in the south than in the north, particularly around and to the south of Troy (Figures A.35 and A.36).

Transportation infrastructure

The watershed contains several important components of Illinois' transportation network, including Interstates 55 and 70, and several state routes (Figure A.34). State Route 4 runs north-south through much of the watershed. A railroad runs northeast to southwest through Livingston in the north of the watershed, and there is a small airport, the St. Louis Metro East/Shafer Field Airport, near St. Jacob. (Note about the map: Railroads and open spaces identified by the East-West Gateway Council of Governments are only available for Madison County. Some railroads are not currently in use.)

Cultural/historic resources

Cahokia, a pre-Columbian Native American city, covered about 6 square miles in its heyday (1200's 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 Upper Silver Creek watershed. They were identified by HeartLands Conservancy in "The Mounds – America's First Cities: A Feasibility Study" in 2014, which mapped over 550 mound sites in the St. Louis region. Four mounds sites were identified by this study in the watershed (MS228, MS152, MS187, and MS29). All are in "unknown" condition (Figure A.37).[105] The Bur Oaks Camprgound has also attracted student groups from SIUE to look for arrowheads in the streambed, based on previous finds there. [106]

Route 66, also known as the Mother Road, was one of the original highways in the U.S. highway system. First established in 1926, the highway became one of the most famous roads in America, and was a major route for those migrating west during the Dust Bowl of the 1930's. Today, much of the road has been designated as a National Scenic Byway and given the name "Historic Route 66". The road ran through the watershed, passing through Mount Olive, Staunton, Hamel (as US 157), Livingston, Troy (as US 40), Marine, and St. Jacob (as US 40). (The route changed considerably over the years, including and excluding these places at different times.) These municipalities still make the most of this history, welcoming motorists through the year and in mid-June for the Illinois Route 66 Mother Road Tour. Historic Route 66 also passes through Edwardsville, outside of the watershed area; Edwardsville will mark this heritage with "The Edwardsville Route 66 Conference" in October 2015.[107]

Transportation Infrastructure & Open Space

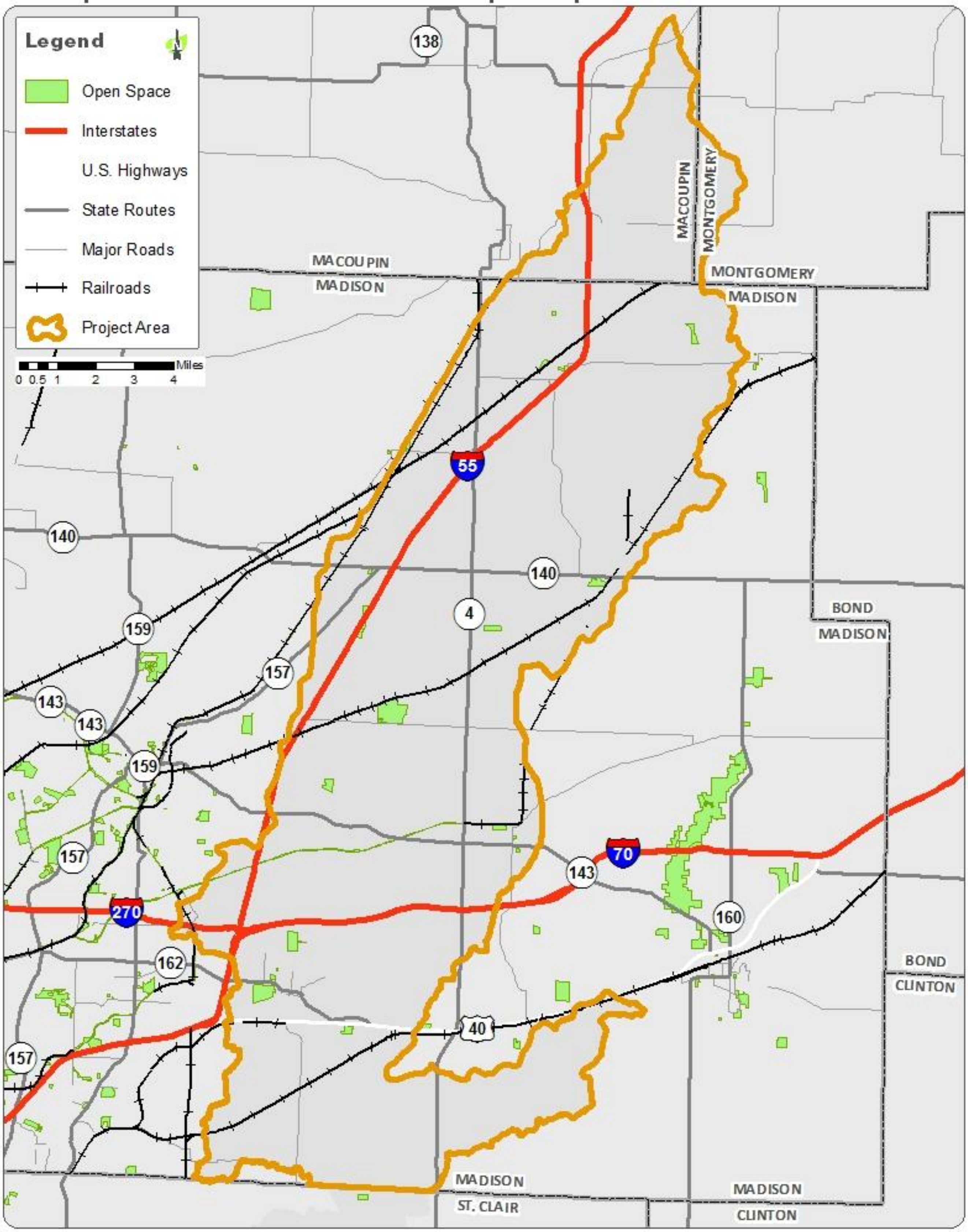


Figure A.34. Transportation infrastructure and open space.

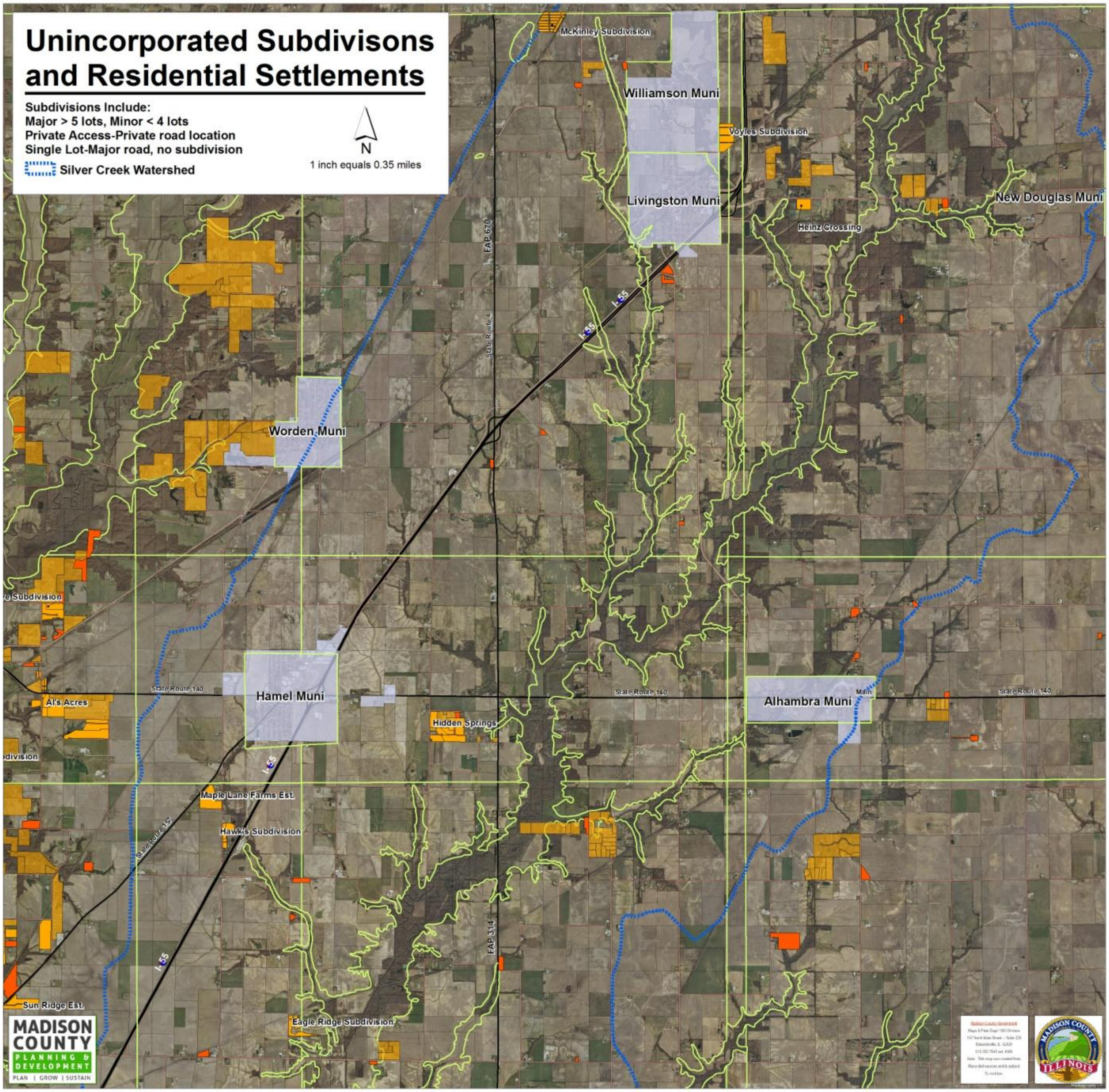


Figure A.35. Subdivisions in the north of the watershed. Maps and data from Madison County. [108]

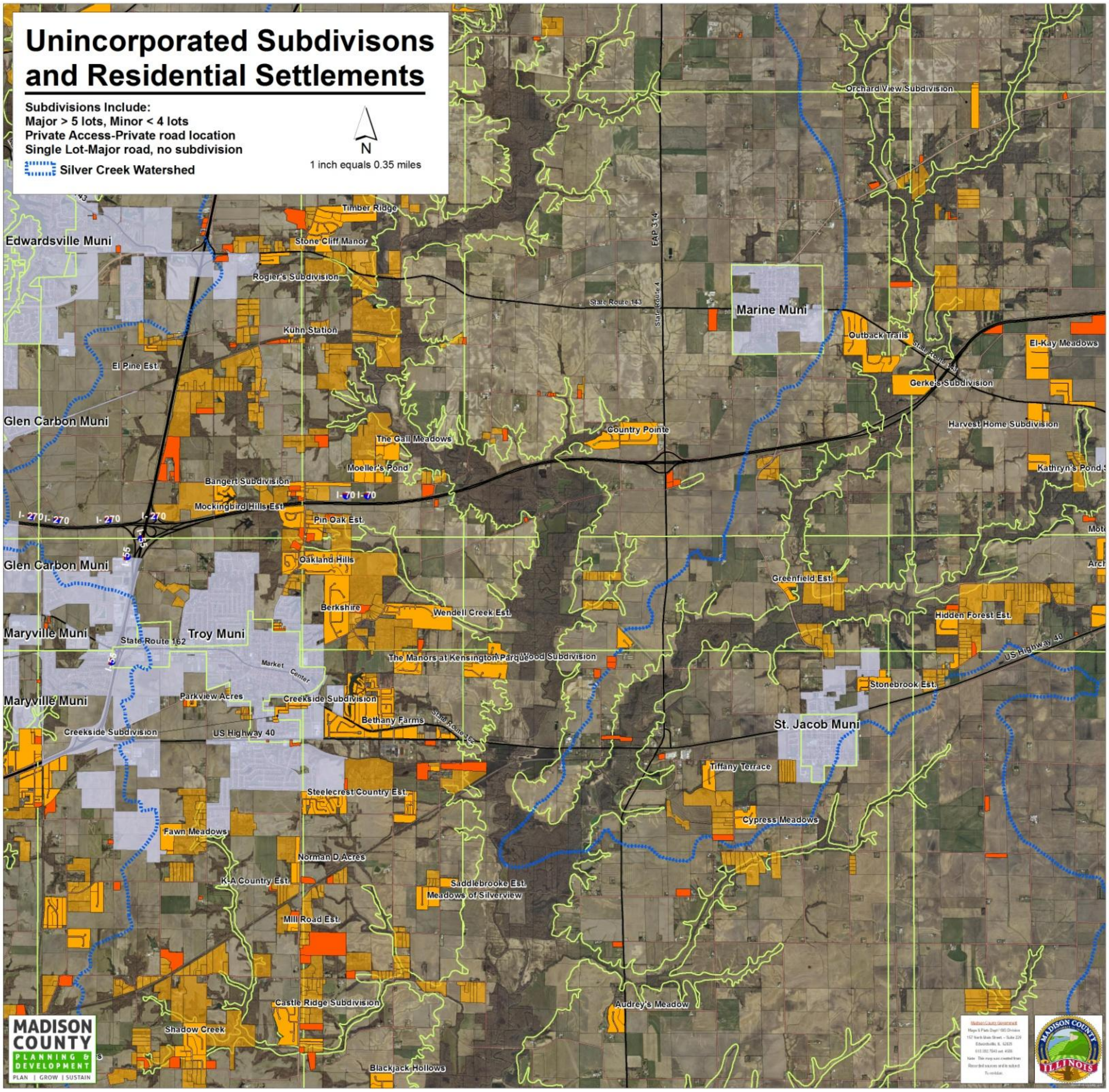


Figure A.36. Subdivisions in the south of the watershed. Maps and data from Madison County. [109]

Mound sites

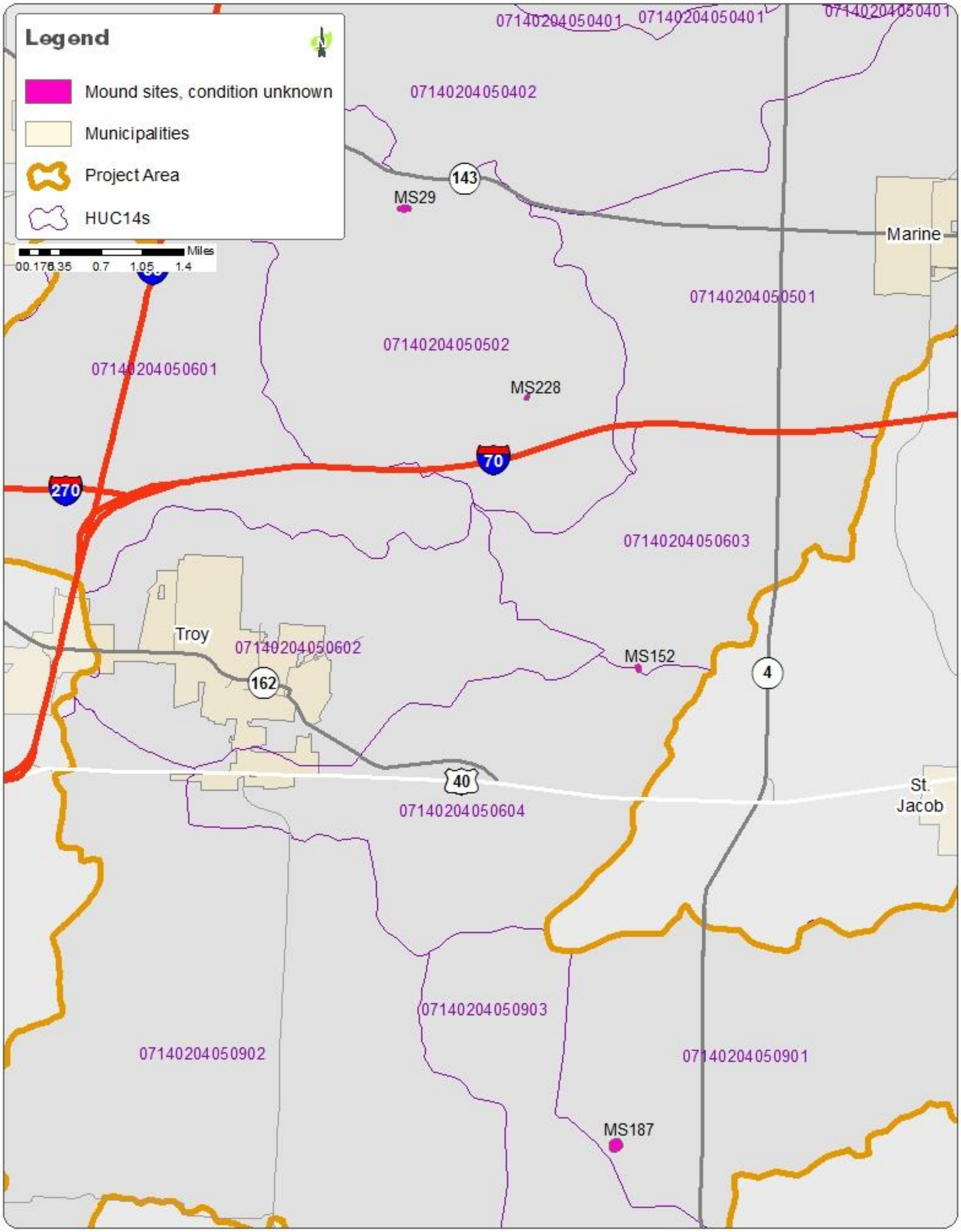


Figure A.37 Location of four pre-Colombian mound sites.

Future land use/land cover predictions

Changes to land use/land cover in the watershed were projected from municipal Comprehensive Plans, where available. Using these Plans, percentages of the different land uses under a future build-out scenario were estimated for the 1.5 mile zone outside each municipality. A 1.5 mile buffer around the municipalities was created in ArcGIS, a Geographic Information System (GIS) software program, and the new land use/land cover percentages 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 a 32,726 acre or 46% decrease in cultivated crops and a 6,776 acre or 39% decrease in hay/pasture across the watershed. This land is largely expected to be converted to low intensity and medium intensity developed land uses (Table A.29). Deciduous forest is expected to shrink by 41%. In total, approximately 46,295 acres of existing open space within 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. The HUC14s with the largest municipal areas will likely see the most growth and resulting loss of agricultural land. For example, the HUC14 containing Troy, 07140204050603, is predicted to lose 698 acres of cultivated cropland, a 58% change. See Data Tables section for a detailed breakdown of future land use/land cover by HUC14.

Table A.29. Existing and predicted future land use/land cover.

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	22.7	0%	11.9	0%	-10.8	-48%
Cultivated crop	82	70,571.9	58%	37,846.2	31%	-32,725.7	-46%
Deciduous forest	41	16,470.1	14%	9,767.7	8%	-6,702.4	-41%
Developed, High Intensity	24	154.6	0%	667.6	1%	513.0	332%
Developed, Low Intensity	22	6,148.3	5%	37,485.6	31%	31,337.3	510%
Developed, Medium Intensity	23	1,067.5	1%	18,679.9	15%	17,612.4	1,650%
Developed, Open Space	21	6,981.4	6%	3,938.5	3%	-3,042.9	-44%
Emergent herbaceous wetlands	95	94.7	0%	58.2	0%	-36.5	-39%
Evergreen forest	42	17.6	0%	5.5	0%	-12.1	-69%
Hay/Pasture	81	17,404.5	14%	10,628.5	9%	-6,776.0	-39%
Herbaceous	71	367.7	0%	203.2	0%	-164.5	-45%
Mixed forest	43	0.0	0%	0.0	0%	0.0	0%
Open Water	11	466.4	0%	517.4	0%	51.0	11%
Shrub/Scrub	52	0.0	0%	0.0	0%	0.0	0%
Wood wetlands	90	1,411.2	1%	1,368.7	1%	-42.5	-3%

* Predicted land use/land cover is based on zoning identified in the Comprehensive Plans of municipalities in the watershed for the 1.5 mile zone outside their current boundaries.

Impervious cover

Impervious cover is the surfaces of an urban landscape that prevent infiltration of precipitation and runoff into the ground. Imperviousness is a useful indicator of the impacts of urban land use/land cover on water quality, hydrology, and flooding. Runoff over impervious surfaces warms the water and collects pollutants causing receiving stream to experience a shift in plant, macroinvertebrate, and fish communities. Sensitive species can no longer thrive, and pollution-tolerant species begin to dominate. Higher impervious cover also translates to greater runoff volumes, resulting in changes to stream hydrology.

The National Land Cover Database (NLCD) Percent Developed Impervious Surface file provides nationally consistent estimates of the amount of man-made impervious surfaces present over a given area. The values are derived from Landsat satellite imagery, using classification and regression tree analysis. Values range from 0 to 100 percent, indicating the degree to which the area is covered by impervious features. In the Upper Silver Creek watershed, the mean imperviousness is 3.0% with a standard deviation of 9.9% (Table A.30). Most of the watershed is not highly impervious. However, selected areas have a lot of impervious cover, up to 100% (Figure A.38). These areas correlate with developed land use/land cover as seen in Figure A.30.

Table A.30. Existing impervious cover by HUC14, as assessed from the NLCD Percent Developed Impervious Surface dataset.

HUC14	Existing Impervious %
07140204050101	2.2%
07140204050102	0.9%
07140204050201	4.3%
07140204050202	0.8%
07140204050203	2.8%
07140204050301	2.2%
07140204050302	2.2%
07140204050303	2.7%
07140204050304	3.3%
07140204050401	1.6%
07140204050402	1.2%
07140204050501	2.3%
07140204050502	3.6%
07140204050601	1.4%
07140204050602	4.9%
07140204050603	13.1%
07140204050604	6.9%
07140204050901	1.0%
07140204050902	1.1%
07140204050903	2.6%
AVERAGE	3.0%

Impervious Cover

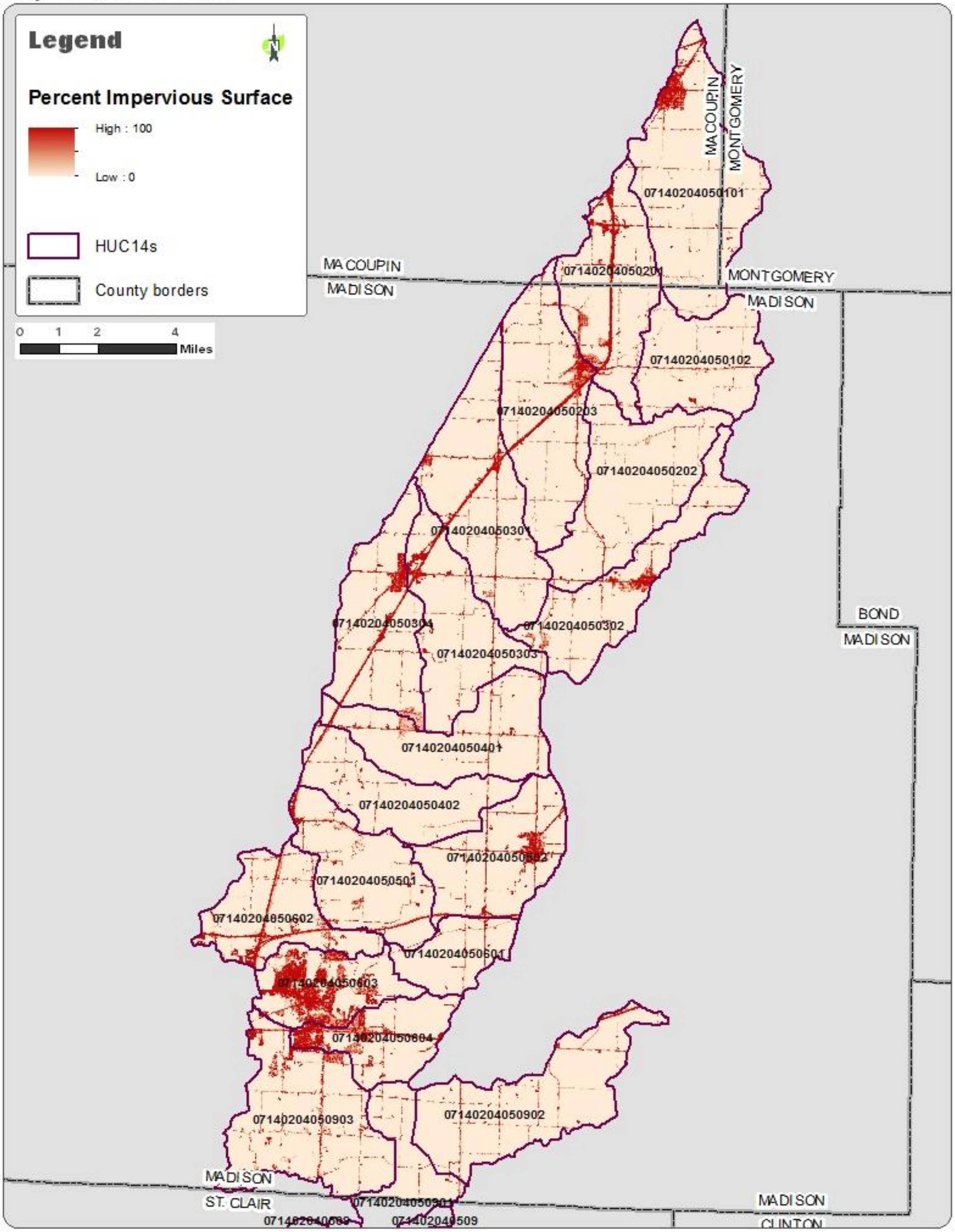


Figure A.38. Impervious cover in the watershed.

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. [110]

Based on the impervious cover coefficients assigned to land use/land cover described above, the future land use scenario for the watershed will increase impervious cover in the watershed from 3.0% to 24.0% in a future full-buildout scenario (Table A.31). The highest future impervious cover percentage is 43.5% in HUC 07140204050602. These figures represent a significant increase in imperviousness. As a comparison, USGS data indicates that impervious cover increased 2.8% in the watershed between 2006 and 2011. [111] If we assume that an annual increase of 2.8% remains constant, this assessment's future impervious cover of 24.0% will be reached in 76 years, representing a long period of slow increases in developed land and impervious surfaces.

Table A.31. Current and future imperviousness by HUC14, with Impervious Classification categories from the Center for Watershed Protection's Impervious Cover Model.

HUC14	Existing Impervious %	Existing (2012) Impervious Classification	Predicted Impervious %	Predicted Impervious Classification
07140204050101	2.2%	Sensitive	20.2%	Impacted
07140204050102	0.9%	Sensitive	27.3%	Non-supporting
07140204050201	4.3%	Sensitive	36.7%	Non-supporting
07140204050202	0.8%	Sensitive	22.1%	Impacted
07140204050203	2.8%	Sensitive	27.9%	Non-supporting
07140204050301	2.2%	Sensitive	27.7%	Non-supporting
07140204050302	2.2%	Sensitive	25.7%	Non-supporting
07140204050303	2.7%	Sensitive	24.3%	Impacted
07140204050304	3.3%	Sensitive	27.7%	Non-supporting
07140204050401	1.6%	Sensitive	9.1%	Sensitive
07140204050402	1.2%	Sensitive	19.4%	Impacted
07140204050501	2.3%	Sensitive	23.5%	Impacted
07140204050502	3.6%	Sensitive	33.2%	Non-supporting
07140204050601	1.4%	Sensitive	9.7%	Impacted
07140204050602	4.9%	Sensitive	43.5%	Non-supporting
07140204050603	13.1%	Impacted	33.9%	Non-supporting
07140204050604	6.9%	Sensitive	28.8%	Non-supporting
07140204050901	1.0%	Sensitive	8.7%	Sensitive
07140204050902	1.1%	Sensitive	23.0%	Impacted
07140204050903	2.6%	Sensitive	24.7%	Impacted
AVERAGE	3.0%	Sensitive	24.8%	Impacted

Table A.32. Impervious category & corresponding stream conditions per the Impervious Cover Model from the Center for Watershed Protection.[112]

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

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.32). 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.[113]

Out of 19 “sensitive” subwatersheds (less than 10% impervious cover), two are projected to remain sensitive, eight will become “impacted”, and nine will become “non-supporting”. The HUC14 subwatershed with the highest current impervious cover, which includes much of Troy (HUC 07140204050603), will change from “impacted” to “non-supporting” (Table A.31).

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 8 digits are the same as the HUC8 code for the Lower Kaskaskia watershed (07140204). The next six digits are randomly assigned, sequential numbers that are unique within the HUC8 watershed.

There are 708 NHD stream reaches in the Upper Silver Creek watershed, comprising 481.7 miles of perennial and intermittent streams. The average length of an NHD stream reach is 0.4 miles, while the range of stream lengths is 0.0052 miles (28 feet) to 2.7 miles. The segments are all listed as perennial or intermittent streams/rivers, with the exception of certain "artificial path" or "connector" segments, which represent non-specific connections between non-adjacent segments. A full table of NHD stream reaches in the Upper Silver Creek watershed can be found in the Data Tables section.

In this assessment/project, we used the NHD stream reaches as our stream units. We did not subdivide the reaches further, as we had no way to assess homogenous stream conditions on a smaller scale than the NHD within the bounds of the project.

There was little existing information about the condition of the streams in the project area. To gather information about the stream reaches, geo-referenced video footage was taken on low level helicopter flights over the larger streams in the watershed. Fostaire Helicopter was selected to gather the flight data, using Red Hen software to collect and store the video in a GIS database. The video was collected during the winter (February 2014) when leaf cover was absent and vegetation was dormant in order to increase the visibility of the streams flown. A total of 275.9 miles or 57.2% of the total stream miles in the watershed were flown and videotaped.

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

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 Illinois EPA (IEPA) guidelines (Table A.33), 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 (Table 28).[114] The very severe erosion category was not used in this assessment.

Table A.33. Lateral recession category guidelines used in classifying streambank erosion in the assessment of the video footage of the aerial assessment. [115]

Lateral Recession Rate* (ft/yr)	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 streamcourse or gully may be meandering.

* Lateral Recession Rate is a rate quantifying how much the streambank is estimated to erode annually.

** The very severe erosion category was not used in this assessment.

In total, 1,456,952 ft (276 miles) of streams were successfully assessed for streambank erosion using geo-referenced video footage. Of the assessed length, 65% had none or low/slight erosion, 18% had moderate erosion, and 17% had high/severe erosion (Table A.34). A full breakdown of streambank erosion conditions by reach code can be found in the Data Tables section.

Lengths of moderate and severe streambank erosion were identified throughout the watershed in tributaries and on the main branches (Figure A.39). Many headwater streams show up as having “none or low” erosion, but this is because they were left unmarked in several instances where visibility was poor and no erosion category could be assigned. Headwater streams often have a steeper gradient and may in fact have a higher degree of bank erosion due to higher velocities, even though flow is low.

Illinois RiverWatch volunteers assessed stream width at two sites in the watershed between 1996 and 2014. At both sites, stream width varied greatly over time, suggesting the occurrence of streambank erosion and/or measurement differences. At the Silver Creek site near the USGS gauge (“Knights Creek”, 38.7162, -89.8181), the stream was recorded as 7.1 ft wide in 2000, and 7.9 ft wide in 2014, but measurements of 3.2 ft and 17 ft occurred in the intervening years. At the Wendell Branch site (38.7578, -89.8181), stream width ranged between 18 and 21.6 ft. Neither site showed a clear and definitive increase or decrease in stream width over time.[116]

Table A.34. Streambank erosion along assessed stream reaches in the watershed (total stream length assessed and average streambank erosion conditions).

	Stream Length Assessed (ft)	None or Low Erosion		Moderate Erosion		High Erosion	
		(ft)	(%)	(ft)	(%)	(ft)	(%)
TOTAL	145,6952.1	908,914.2		283,512.7		264,525.2	
AVERAGE			65%		18%		17%

Streambank Erosion

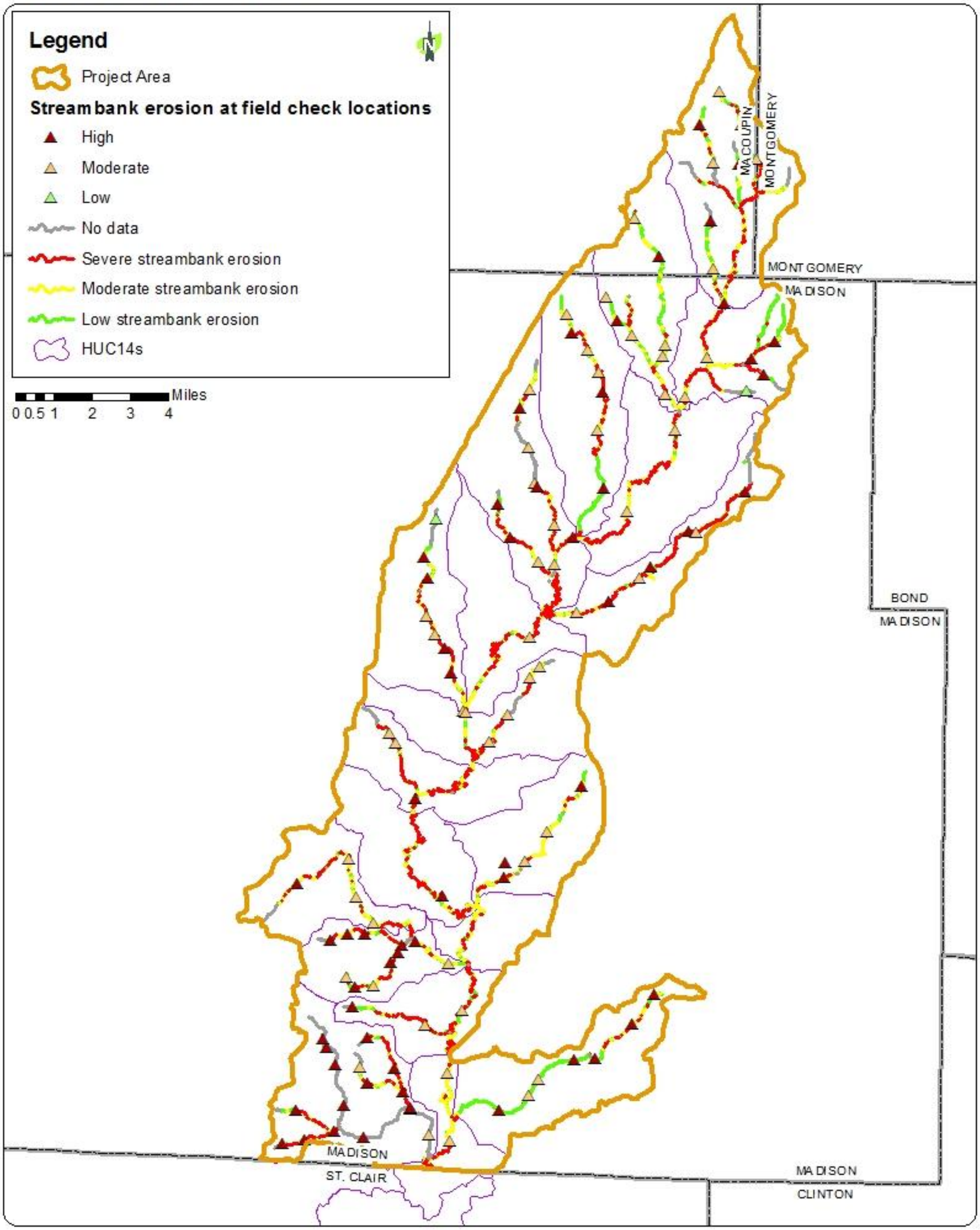


Figure A.39. Streambank erosion conditions assessed from video footage of an aerial survey of the watershed (shown as lengths of stream reach in red, yellow, or green) and assessed at 117 field check locations (shown as red, yellow, or green triangles).

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.35).

In total, 759,477.0 ft (143.84 miles) of streams were successfully assessed for streambank erosion using geo-referenced video footage. Of the assessed length, 68% had none or low channelization, 16% had moderate channelization, and 15% had high channelization (Table A.36). A full breakdown of degree of channelization by reach code can be found in the Data Tables section.

Lengths of moderate and high channelization were identified throughout the watershed (Figure A.40). The headwaters often showed high channelization, likely because of their beginnings in farm fields as drainage ditches, where stream size is much smaller and channelization less expensive. Moderately and highly channelized streams appear to be interspersed elsewhere with lengths of low channelization.

Table A.35. Criteria used to assess degree of channelization. [117]

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

Table A.36. Degree of channelization along assessed stream reaches in the watershed (total stream length assessed and average channelization conditions).

	Stream Length Assessed (ft)	None or Low Channelization		Moderate Channelization		High Channelization	
		(ft)	(%)	(ft)	(%)	(ft)	(%)
TOTAL	759,477.0	511,793.0		127,952.0		119,732.0	
AVERAGE			68%		16%		15%

Channelization

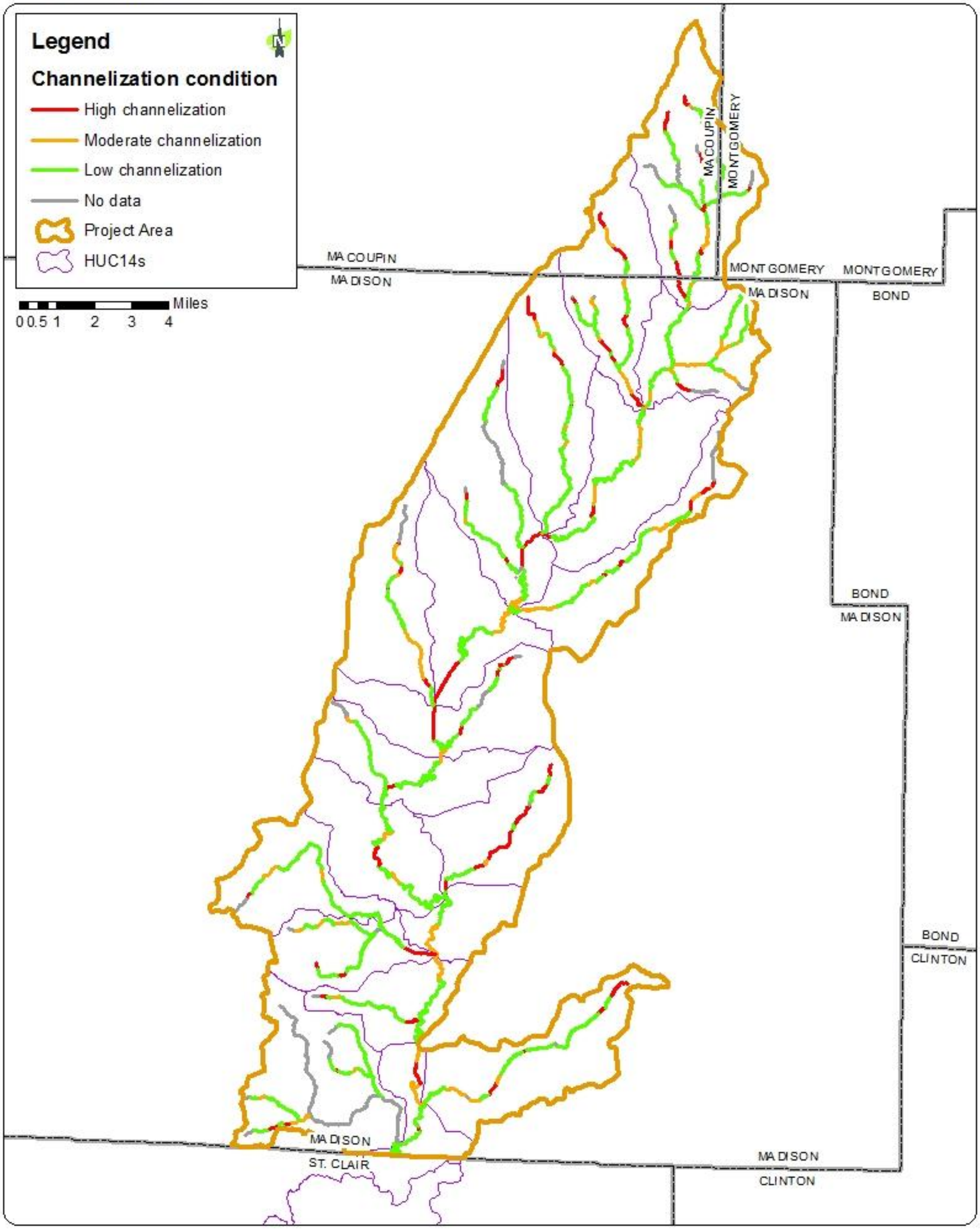


Figure A.40. Channelization condition assessed from video footage of an aerial survey of the watershed.

Riparian condition

Riparian condition was assessed from the video review by geo-referencing in a feature table each location where type and extent of woody cover changed. The riparian area between geo-referenced points was then considered the same for the area between marked locations. Lengths of good, fair and poor riparian area were then determined by measurement between marked boundaries. The criteria used to assess riparian condition are based on width of vegetative cover on both sides of the waterway, extent of vegetative cover, and type of vegetation (woody plants or grass) (Table A.37).

In total, 739,602 ft (140 miles) of streams were successfully assessed for riparian condition using geo-referenced video footage. Of the assessed length, 50% had good riparian condition, 42% had fair riparian condition, and 9% had poor riparian condition (Table A.38). A full breakdown of riparian condition by reach code can be found in the Data Tables section.

The stream lengths with good and fair riparian conditions are spread throughout the watershed (Figure A.41). Lengths of poor riparian condition are largely concentrated in three tributaries on the east side of the watershed (located in HUCs 07140204050302, 07140204050401, and 07140204050502). These subwatersheds are largely agricultural, but two municipalities are also present (Alhambra and Marine). Vegetative and tree cover is poor wherever farm fields or urban development extend out to or close to the streambank.

Table A.37. Criteria used to assess riparian condition. [118]

Condition	Description
Good	Wide (minimum of two stream widths) vegetative cover w/ 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 (less than 10 ft.) grass or herbaceous cover on one or both banks.

Table A.38. Riparian condition along assessed stream reaches in the watershed (total stream length assessed and average riparian conditions).

	Stream Length Assessed (ft)	Good Condition		Fair Condition		Poor Condition	
		(ft)	(%)	(ft)	(%)	(ft)	(%)
TOTAL	739,602	375,036		306,648		57,918	
AVERAGE			50%		42%		9%

Riparian Condition

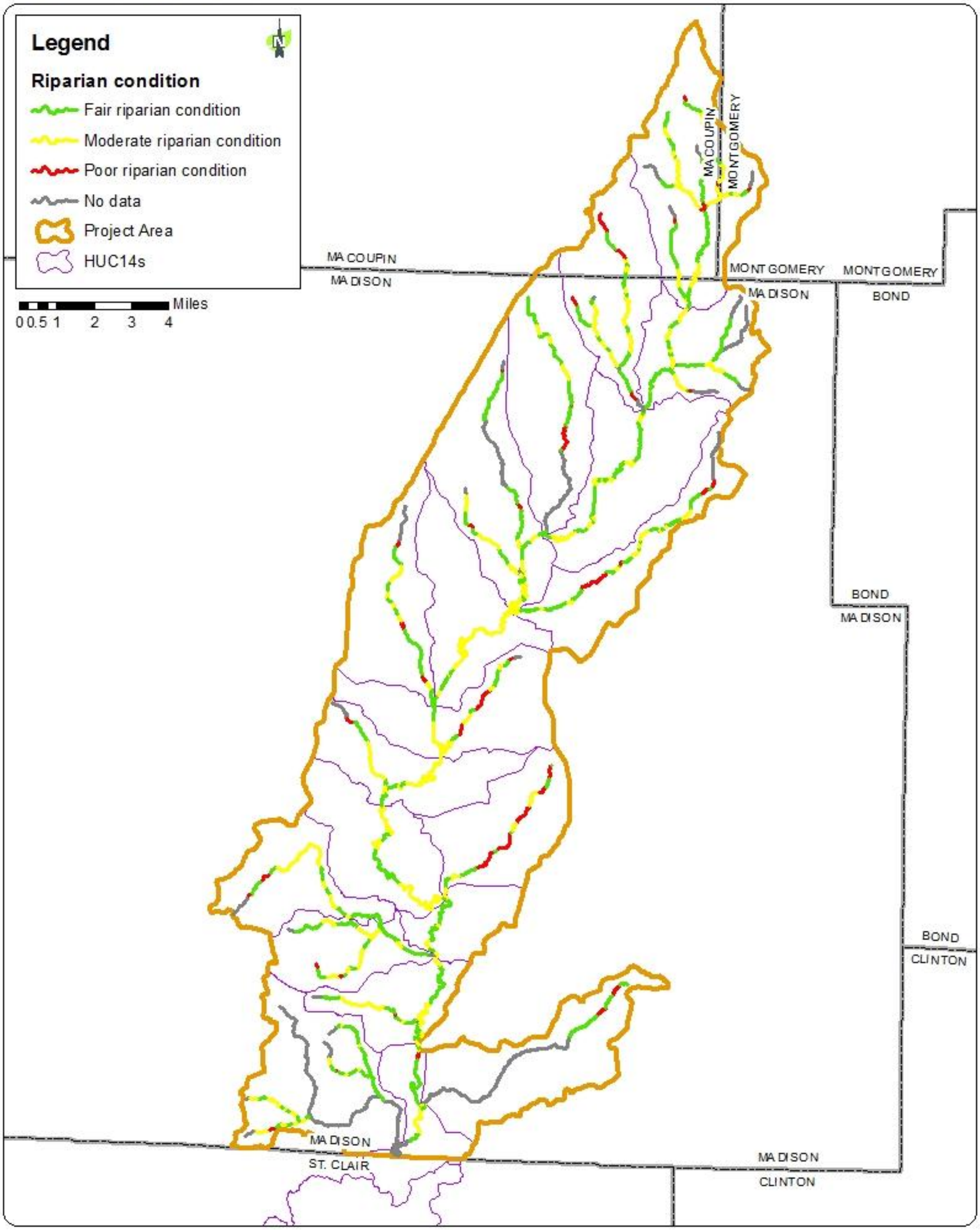


Figure A.41. Riparian condition assessed from video footage of an aerial survey of the watershed.

Visibility and data collection

Limitations on visibility affected the collection of streambank erosion, channelization, and riparian condition data from the flight video. The video imaging seemed to work 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.

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 117 locations in the watershed on 50-500 ft per site, constituting an assessment of approximately 16,675 feet or 3.2 miles. 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.39. In total, 16,675 ft (3.2 miles) of streams were successfully assessed for degree of streambed erosion during field checks. Of the assessed length, 53% had low streambed erosion, 30% had moderate streambed erosion, and 17% had high streambed erosion (Table A.40). A full breakdown of riparian condition by reach code can be found in the Data Tables section.

Table A.39. Criteria used to assess degree of streambed erosion. [119]

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.40. Degree of streambed erosion along assessed stream reaches in the watershed (total stream length assessed and average streambed erosion conditions).

	Stream Length Assessed (ft)	Low Streambed Erosion		Moderate Streambed Erosion		High Streambed Erosion	
		(ft)	(%)	(ft)	(%)	(ft)	(%)
TOTAL	16,675	8,175		4,950		3,550	
AVERAGE			53%		30%		17%

Streambed erosion was generally lower in the northern part of the watershed and at the headwaters of several streams (Figure A.42). Thirteen of the 20 HUC14s returned only low or moderate streambed erosion, while two of the southernmost HUC14s (07140204050902 and 07140204050903) have the most locations with high streambed erosion.

Illinois RiverWatch volunteers documented streambed composition 22 times at two sites in the watershed between 1996 and 2014. The presence of bedrock, boulders, clay, cobble, gravel, sand, and silt in the streambed were estimated in percent ranges. At the Silver Creek site near the Troy USGS gauge ("Knights Creek", 38.7162, -89.8181), the substrate was often mixed, with the silt as the highest percentage component. At the Wendell Branch site (38.7578, -89.8181), bedrock was consistently reported as the dominant substrate component, comprising over 50% of the substrate.[120]

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.[121] According to the 2013 transect survey, Madison and Montgomery counties have a relatively high rate of ephemeral erosion (47% and 40%, respectively) compared to the overall state average (19.6%) (Table A.41). Macoupin County had a significantly lower ephemeral/gully erosion rate (4%).[122]

Table A.41. Percent and number of fields with indicated ephemeral/gully erosion by county in 2013. [123]

County	Yes		No		Total
	Percent	Number	Percent	Number	
Macoupin	4%	18	96%	481	499
Madison	47%	174	53%	196	370
Montgomery	40%	189	60%	278	467
Illinois Total	20%		80%		

Streambed Erosion

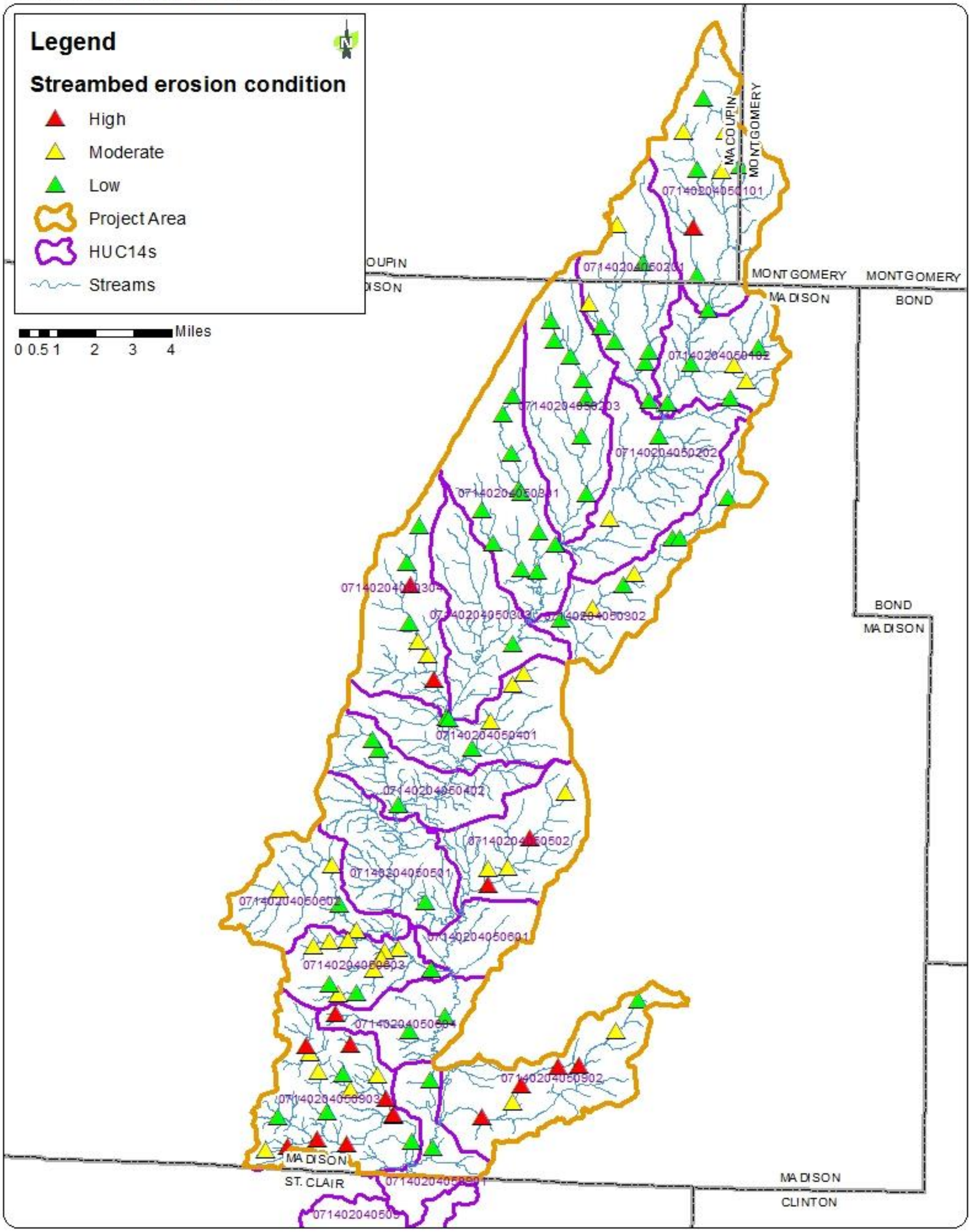


Figure A.42. Streambed erosion conditions noted in 117 field check locations.

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 both the video footage of the aerial survey along streams in the watershed (see Watershed Drainage section for methods) and in a ground assessment by a Madison County Stream Cleanup team (Table A.42). The Stream Cleanup team operated between 2008 and 2009 and removed debris from selected streams in the county about which they received complaints. When a logjam was identified in the field, a data point was entered using a handheld GPS unit and later processed by the county's IT department. Logjams were identified at five distinct locations in the Upper Silver Creek watershed by the Stream Cleanup team (Figure A.43). Two or more instances were identified in close proximity to each other at each location.

Table A.42. Logjams identified in the Upper Silver Creek in video footage from the aerial survey (2/2014) and by the Madison County Stream Cleanup team (6/2008 – 5/2009).

HUC14	Logjams identified in aerial survey (number)	Logjams identified by Stream Cleanup team (number of distinct locations)
07140204050101	28	
07140204050102	18	
07140204050201	9	
07140204050202	14	
07140204050203	14	
07140204050301	22	
07140204050302	38	
07140204050303	10	
07140204050304	14	
07140204050401	7	
07140204050402	19	
07140204050501	6	1
07140204050502	6	
07140204050601	4	
07140204050602	16	
07140204050603	5	1
07140204050604	4	1
07140204050901	3	1
07140204050902	23	
07140204050903	13	1
TOTAL	273	5

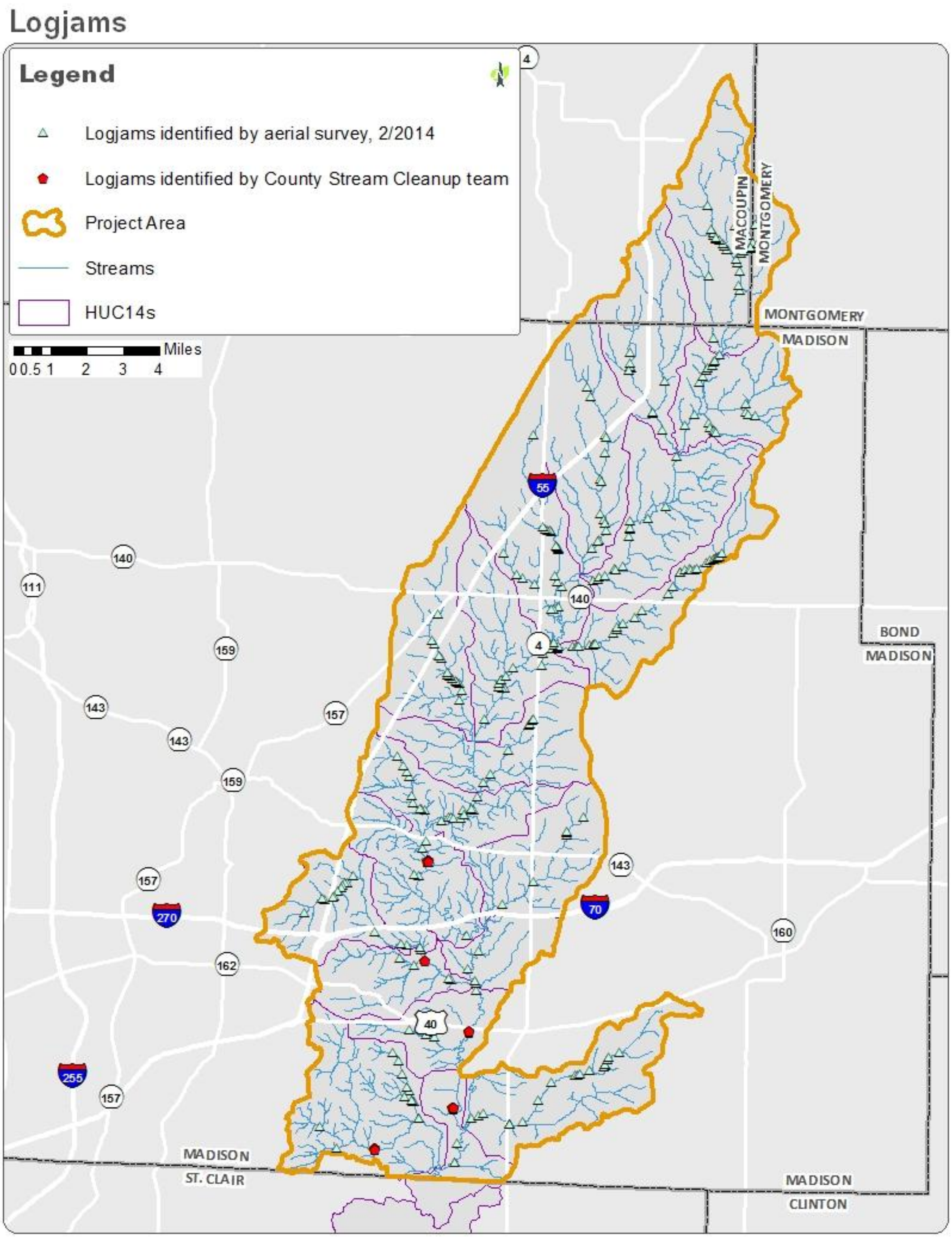


Figure A.43. Logjams in the Upper Silver Creek watershed as identified from video footage taken for the aerial survey (2/2014) and by the Madison County Stream Cleanup team (6/2008 – 5/2009).

Detention and retention basins

HeartLands staff looked at aerial photographs of the watershed, along with USGS topographic maps, an elevation dataset, and the National Hydrography Dataset, to identify detention and retention basins. A point was created for each basin located in or very close to a group of 5 or more buildings. This was in order to avoid classifying natural ponds as detention basins; with significant developed area near the basin, there was a higher likelihood that the basin had been engineered or altered by man in some way. It should be noted that detention and retention basins on agricultural land are very common, but they were not included in this inventory, partly because the Agricultural Conservation Planning Framework (ACPF) used to identify BMPs also identifies likely detention locations.

The data gathered includes whether the detention basin is in a subdivision, along with the year the subdivision was first developed and the year of latest development (from plat information from Madison County). Also noted was the presence of standing water, the number of visible inlets/outlets, whether the basin was “on-line” (on a stream or at the start of a stream) or “off-line” (outside the waterway), the type of side slope vegetation, whether the basin was already in the National Hydrography Dataset, and the accessibility of the basin from nearby roads or public land.

Sixty-seven (67) detention or retention basins were identified in the watershed, with the majority occurring in the lower portion of the watershed (Table A.43, Figure A.44). Most of the basins identified are off-line (70%), and most have water in them (82%). (Note: it was much easier to identify basins containing water than dry basins, so wet basins may be overrepresented.) Twenty-four percent (24%) 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 87% of the basins identified. Trees are present on 19% of the basins’ side slopes, and rock is present on 49% of the side slopes.

Table A.43. Number of detention and retention basins identified in each HUC14, and the number and condition of basins visited. HUC14s not listed had zero basins identified.

HUC14	# of basins identified	# basins visited	Condition of basins visited
07140204050201	1		
07140204050302	1	1	GOOD
07140204050303	1	1	AVERAGE
07140204050402	3		
07140204050501	9	1	POOR
07140204050502	2	1	GOOD
07140204050602	10	1	GOOD
07140204050603	19	2	GOOD
07140204050604	9	1	POOR
07140204050903	12	2	AVERAGE
Total	67	10	5 GOOD, 3 AVERAGE, 2 POOR

Detention basins

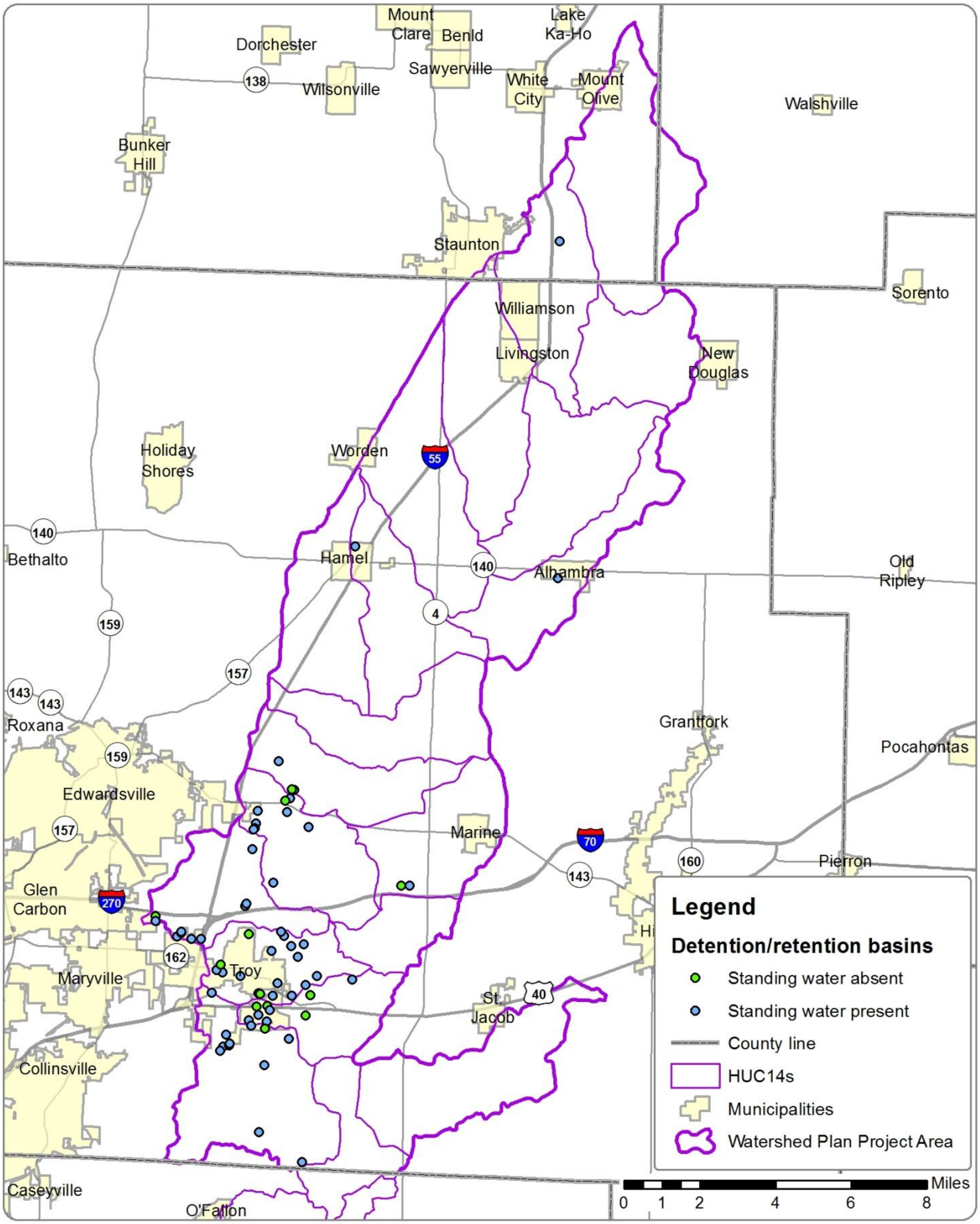


Figure A.44. Location of detention and retention basins identified by assessment of aerial photographs.

Site visits were made in April 2015 to 10 of the 44 accessible sites identified, in order to determine their condition. The sites were selected by geographic location (distributed somewhat evenly throughout the watershed) and by prioritizing basins about which the Madison County Stormwater Coordinator received complaints. On the site visits, location, type, and condition of the basins were confirmed. Basins visited ranged in size between 0.44 acre and 4.78 acres, with an average area of 1.4 acres. Eight were wet retention basins and two were dry detention basins. Eight had turf side slopes. None had native grasses in or immediately around the basin, although a few native trees were present at the water's edge in some cases.

Table A.44 shows a summary of the issues identified on the site visits (full results shown in the Data Tables section). Common maintenance and design issues identified included algae, sediment, bank erosion, and trash. Three of the basins had already been treated with copper sulfate or similar algasecides to kill algae (as evidenced by a blue tinge to the water). These chemicals can have harmful short- and long-term effects on fish and other aquatic life if incorrectly applied.

Table A.44. Summary of location, type, and condition of detention and retention basins inspected on site visits to 10 basins.

Issue	**# sites**
Algae (submerged or on surface)	5
Sediment (reduced basin capacity)	4
Bank erosion	3
Trash	3
Blocked culvert under road leading to basin; road floods	1
Murky, milky water appearance	1
Outlet pipe leads towards power station - potentially unsafe	1
Scouring of outlet channel	1
Submerged inlet pipe	1

Flooding

Flood 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.

A combination of topography, ground cover, precipitation and weather patterns, recent soil moisture, and the presence of streams and other waterbodies determine the severity of floods in a given location. Floods can cause utility damage and outages, infrastructure damage (both to transportation and communication systems), structural damage to buildings, crop loss, decreased land values and impediments to travel and emergency access.

Two main types of flooding affect the Upper 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, including the capability to induce mudslides.[124] Vulnerability to flash flooding changes most often with a change in land use, as, for example, agricultural land and open space is converted for residential and industrial uses, increasing the area of impervious surfaces (eg, roofs, parking lots, roads, and sidewalks). As impervious surface area increases, the risk of flash flooding increases, as rain and snowmelt can no longer infiltrate the ground slowly and flows quickly downstream.

General flooding can be broken down into two categories: riverine flooding and shallow or overland flooding. A **riverine flood** is the gradual rise of water in a river, stream, lake, or other waterway that results in the waterway overflowing its banks. This type of flooding generally occurs when storm systems remain in the area for extended periods of time, when winter or spring rains combine with melting snow to create higher flows, or when obstructions such as logjams block normal water flow. 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.[125] Vulnerability to riverine flooding in the National Flood Insurance Program (NFIP) member communities is low as long as existing floodplain ordinances are enforced. Floodplain ordinances are the major mechanism for ensuring that new structures either are not built in flood-prone areas or are elevated or protected from floodwaters to severely limit their potential flood damage.

The general definition of a **floodplain** is any land area susceptible to being inundated or flooded by water from any source (such as a river or stream). This general definition differs slightly from the regulatory definition of a floodplain, which may be found in the Madison County Hazard Mitigation Plan and under the NFIP along with further definitions of base floods, base floodplains, floodway, flood fringe, Special Flood Hazard Area, Flood Insurance Rate Maps, and flood zones.[126]

Extent of the floodplain

In the Upper Silver Creek project area within Madison County, 10.8% of the land, or 12,982 acres, is designated as floodplain (Figure A.45). [127] Another estimate found in the Madison County Hazard Mitigation Plan is 70,282 acres or 13.8% of the county's area.[128]

In Montgomery County, floodplains cover much less ground. Less than 3% of the area in Montgomery County is designated as being within the regulatory floodplain and susceptible to river floods. A large portion of this flood-prone area is in the unincorporated portion of the County, although several communities also are vulnerable to flooding. As a result of the limited riverine floodplain area and flat topography, a majority of the flooding experienced within the County is related to flash flood events. The 2007 Illinois Natural Hazard Mitigation Plan prepared by the Illinois Emergency Management Agency classifies Montgomery County's hazard rating for floods as "elevated."[129] This information was not available in Macoupin County's Multi-Hazard Mitigation Plan.

Development in the floodplain

In the Upper Silver Creek watershed, 113 structures are wholly or partly located in the 100-year floodplain within municipalities.[130] Glen Carbon and Worden have no structures in the floodplain (Table A.45). Seven of the communities in the watershed are not fully covered by a Flood Insurance Rate Map (FIRM), so the number of structures at risk of flooding within floodplains in these communities is unknown. Digitized structure data were not available for Macoupin or Montgomery counties. The estimated total building exposure to floods in Montgomery County is $3,200,553, with the majority of the exposure ($2,447,153) listed as residential exposure.[131]

Table A.45. Number of structures partially or wholly within floodplain (Zones A, AE, AO, and AH) in municipalities in the Upper Silver Creek watershed, in Madison County. [132] Some municipalities have limited floodplain information because all or part of their area is covered with a map panel marked Zone ANI (no flood information). Partly covered: Zone ANI covers up to 60% of the area of a municipality. Mostly covered: Zone ANI covers 60 to 95% of the municipality. Entirely covered: Zone ANI covers 95 to 100% of the municipality.[133]

Municipality	**Number of structures wholly/partly in the SHFA**	**Gap in map coverage?**
Alhambra	0	Yes; municipality mostly covered by Zone ANI
Edwardsville	104	No
Glen Carbon	0	No
Hamel	0	Yes; municipality mostly covered by Zone ANI
Livingston	9	No
Marine	0	Yes; municipality mostly covered by Zone ANI
New Douglas	0	Yes; municipality entirely covered by Zone ANI
St. Jacob	0	Yes; municipality mostly covered by Zone ANI
Troy	0	Yes; municipality partly covered by Zone ANI
Williamson	0	Yes; municipality entirely covered by Zone ANI
Worden	0	No

Floodplain

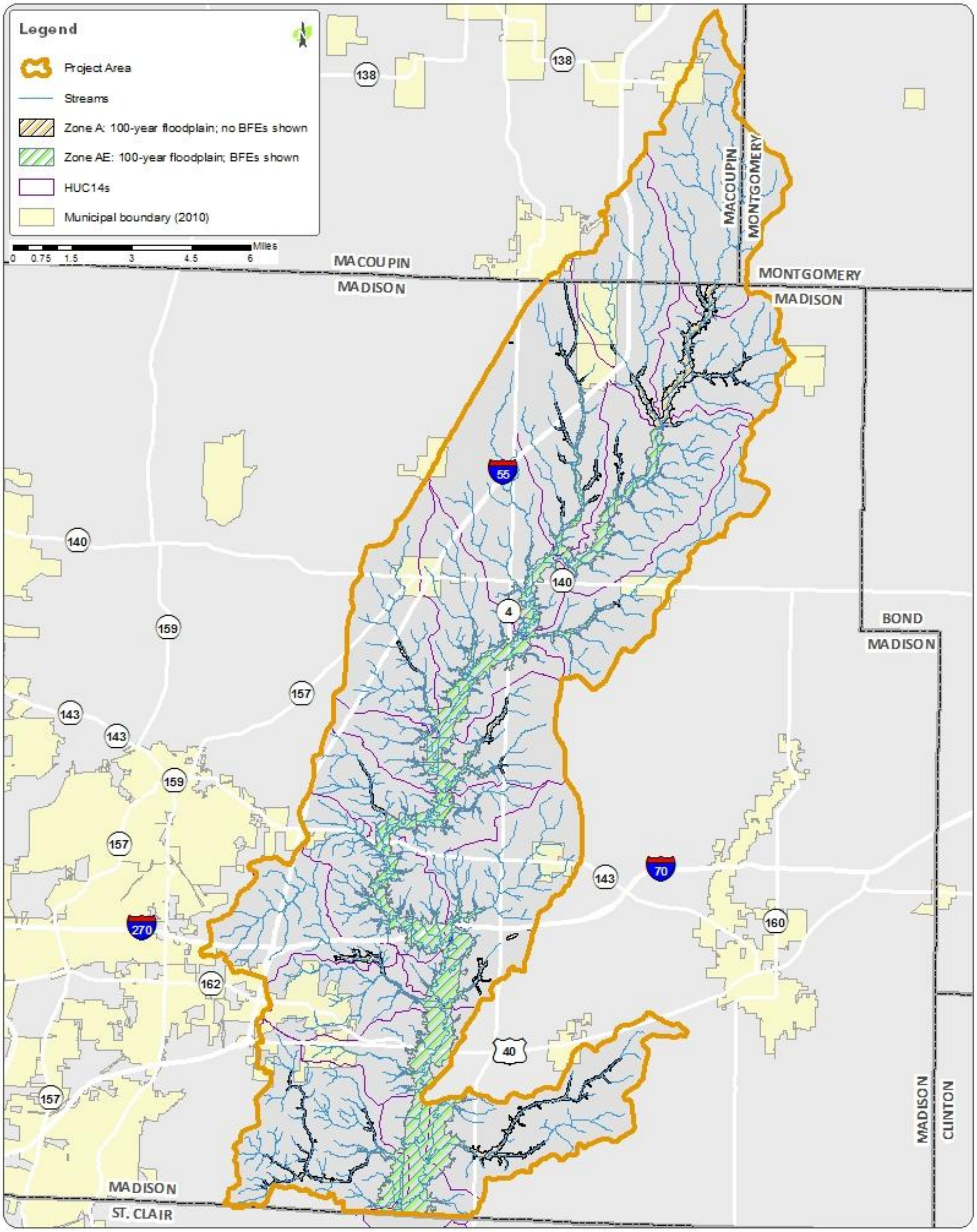


Figure A.45. FEMA-designated floodplain in Madison County in the Upper Silver Creek watershed. BFE is an abbreviation for Base Flood Elevation, the height reached by floodwaters in a 100-year flood..

Repetitive loss structures in the watershed

A repetitive loss structure is defined by FEMA as a structure covered by flood insurance issued under the NFIP which has suffered flood loss 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 25% of the market value of the structure at the time of each flood loss.

No municipalities within the Upper Silver Creek watershed contain repetitive loss structures.[134, 135, 136] However, the unincorporated area of Madison County contains 10 repetitive loss properties which have made 27 claim payments resulting in a total of $487,050 in claim payments. The exact location of these properties is kept private by FEMA, so it is unknown how many of these structures are in the watershed. Montgomery County has no repetitive loss structures as of July 2010.[137]

Critical facilities in the floodplain

Some structures require particular protection from floods to protect vulnerable populations and public health at large. 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.

Madison County also has the most critical facilities located in the 100-year floodplain of any county in Illinois (31), including schools, police stations, wastewater treatment facilities, and communications facilities.[138]

In Macoupin County, there are 79 "essential facilities", a subset of critical facilities including schools, medical care facilities, fire stations, police stations, and Emergency Operations Centers. It is unknown how many of these facilities are in the floodplain.[139] An accurate count of the number of buildings and critical facilities within the floodplain in Montgomery County could not be calculated for its most recent Hazard Mitigation Plan.[140]

Infrastructure in the floodplain

Roads, bridges, and buried power and communication lines are located within or adjacent to floodplains throughout the watershed. Additionally, almost all of the watershed is vulnerable to flash flooding. As a result, a majority of the buildings, infrastructure and critical facilities (including wastewater treatment plants, hospitals, schools, fire stations, and police stations) that may be impacted by flooding are located outside of the base floodplain and are not easily identifiable. Stakeholder outreach conducted for this Plan helped to highlight several other instances of flooding outside of floodplains, some of it threatening critical facilities including sewage treatment plants (see Flooding Locations section).

Locations affected by floods

Flooding locations identified at stakeholder meetings

At stakeholder meetings to introduce the Upper Silver Creek Watershed Plan, attendees were invited to provide input on where they knew of floods occurring. They looked at maps showing major roads, municipalities, parcels, structures, and the FEMA-designated floodplains, and drew or described locations of flooding of which they were aware. Later, these locations were digitized, along with other descriptive information from the attendees such as flood frequency and cause of inundation. Several flooding locations were outside of the 100-year floodplain in subdivisions, on farm fields, and on major and minor roads (Figure A.46).

Identified Flooding Locations in the Upper Silver Creek Watershed

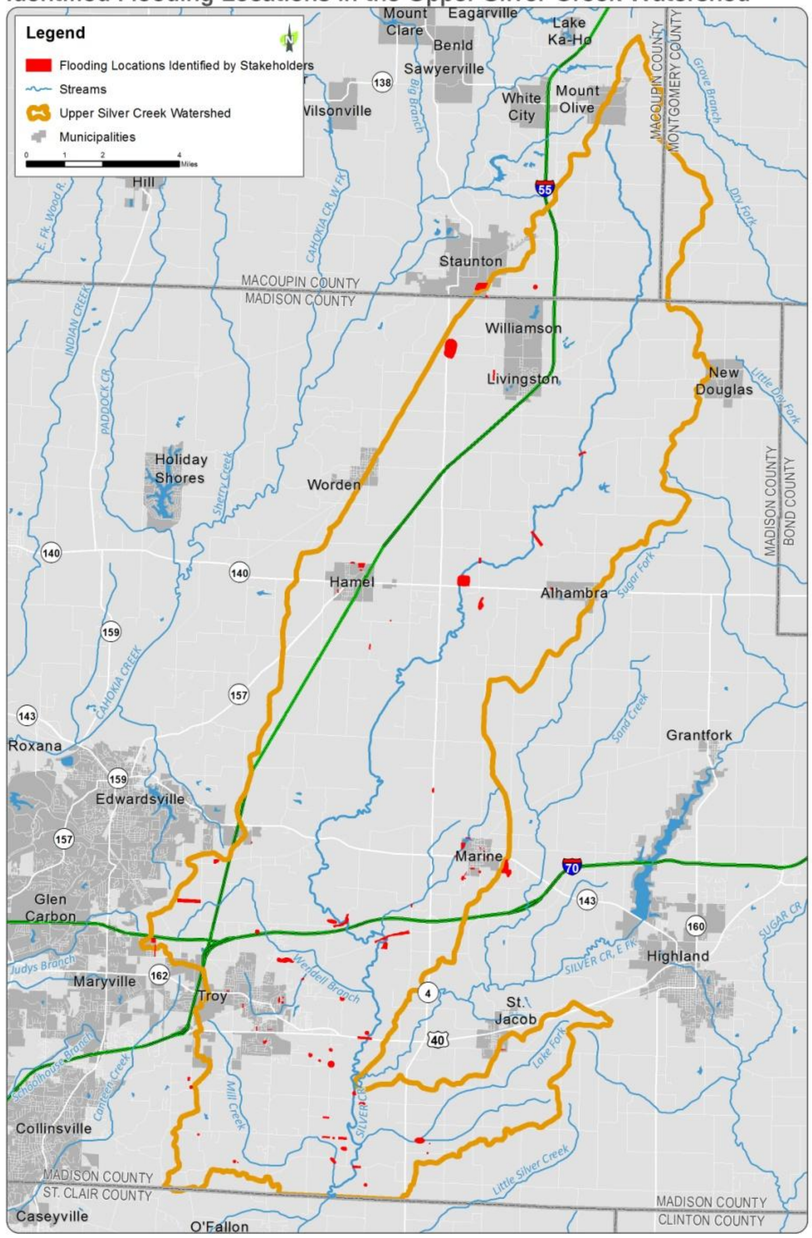


Figure A.46. Flooding locations identified at stakeholder meetings.

Flooding locations identified in the Community Flood Survey

The Madison County Community Flood Survey was created by HeartLands Conservancy and Madison County in the summer of 2014 and distributed to homeowners and business owners in the Upper Silver Creek Watershed to gather information about the location, extent, impacts, and causes of flooding in the watershed. A total of 477 surveys were completed from within the study area out of 2,000 mailed out, giving a response rate of 24%. Some of these were collected via an online survey.[141]

The results of the Community Flood Survey are shown in the Flood Survey Report in Appendix B. Since they pertain to this Inventory, some results are also included here. Over a quarter of respondents (25.8%) replied that they had experienced flooding in the last 10 years (Table A.46). HUC 07140204050603 (Troy and NW St. Jacob area) had the largest number of respondents with flooding in the last 10 years with 34 responses. HUCs 07140204050601 (Southern Marine and NW St. Jacob Area), 07140204050202 (northeastern Alhambra and southwestern New Douglas areas), and 07140204050101

(Mt. Olive/Walshville area) had the highest percentages of respondents who experienced flooding events in the last 10 years. The lowest percentage of respondents that had been flooded was for the watershed containing Williamson (HUC 07140204050201) (Figure A.47).

An assessment was made of flooding "hotspot" locations in the watershed based on four (4) attributes: 1) percentage of respondents who said they had been flooded, 2) flood frequency, 3) percentage who said that neighbors had been flooded, and 4) monetary loss as a result of flooding. (Note: the estimate of monetary loss due to flooding in the last 10 years across the whole watershed, $42.9 million, was calculated using a population estimate that was too high. The population estimate of 61,994 people was based on preliminary calculations made for the 2014 draft of the Watershed Resources Inventory (WRI). This final version of the WRI uses a lower population of 26,245 from U.S. Census Bureau data. The total estimated monetary loss from flooding in the watershed over 10 years, using the lowest estimated costs from respondents, is $18,157,798.)

The top three (3) flooding hotspots based on the survey results are HUCs 07140204050401, 07140204050304, and 07140204050101 (Table A.47; Figure A.48). However, these watersheds also had a small number of respondents (6, 17, and 2, respectively) and fewer respondents who said they had been flooded (1, 7, and 1, respectively).

Table A.46. Responses to the flood survey question, "Have you experienced flooding in the last 10 years?"

Have you experienced flooding in the last 10 years?	Number of responses	%
Yes	120	25.8%
No	345	74.2%
No Answer	12	2.5%

Table A.47. Flooding “hotspot” rankings of the HUC14s based on percent of respondents flooded, frequency of flooding, percent of respondents whose neighbors flooded, and monetary loss due to flooding, from the Madison County Community Flood Survey.

HUC14	Percent of respondents flooded in last 10 years	Frequency of flooding (times per year)	Percent of those flooded who said one or more neighbors also flooded	Monetary loss due to flooding	Ranking
07140204050401	0.17	7	1.00	$ 300,001	1
0140204050304	0.41	2.642857143	0.60	$ 101,667	2
07140204050101	0.50	0.7	1.00		3
07140204050202	0.50	2.333333333	0.67	$ 38,750	4
07140204050601	0.60	2.75	0.50	$ 2,500	5
07140204050901	0.20	7	0.50		6
07140204050502	0.45	1.111538462	0.64	$ 2,500	7
07140204050501	0.30	2.405	0.64	$ 5,000	8
07140204050303	0.33	3	0.50	$ 2,500	8
07140204050203	0.22	0.825	0.50	$ 38,750	9
07140204050302	0.29	1.2125	0.50	$ 7,500	10
07140204050603	0.23	1.59137931	0.50	$ 5,834	10
07140204050602	0.16	1.95	0.67	$ 2,500	10
07140204050102	0.22	3.85	0.25	$ 2,500	11
07140204050301	0.21	2.333333333	0.25	$ 2,500	11
07140204050402	0.21	2.783333333	0.33	$ 2,500	11
07140204050604	0.20	2.575	0.46	$ 5,000	11
07140204050903	0.17	2.6	0.35	$ 15,625	11
07140204050902	0.29	3.44	0.38		11
07140204050201	0.14	1.5	0.33		12

Percent of respondents flooded

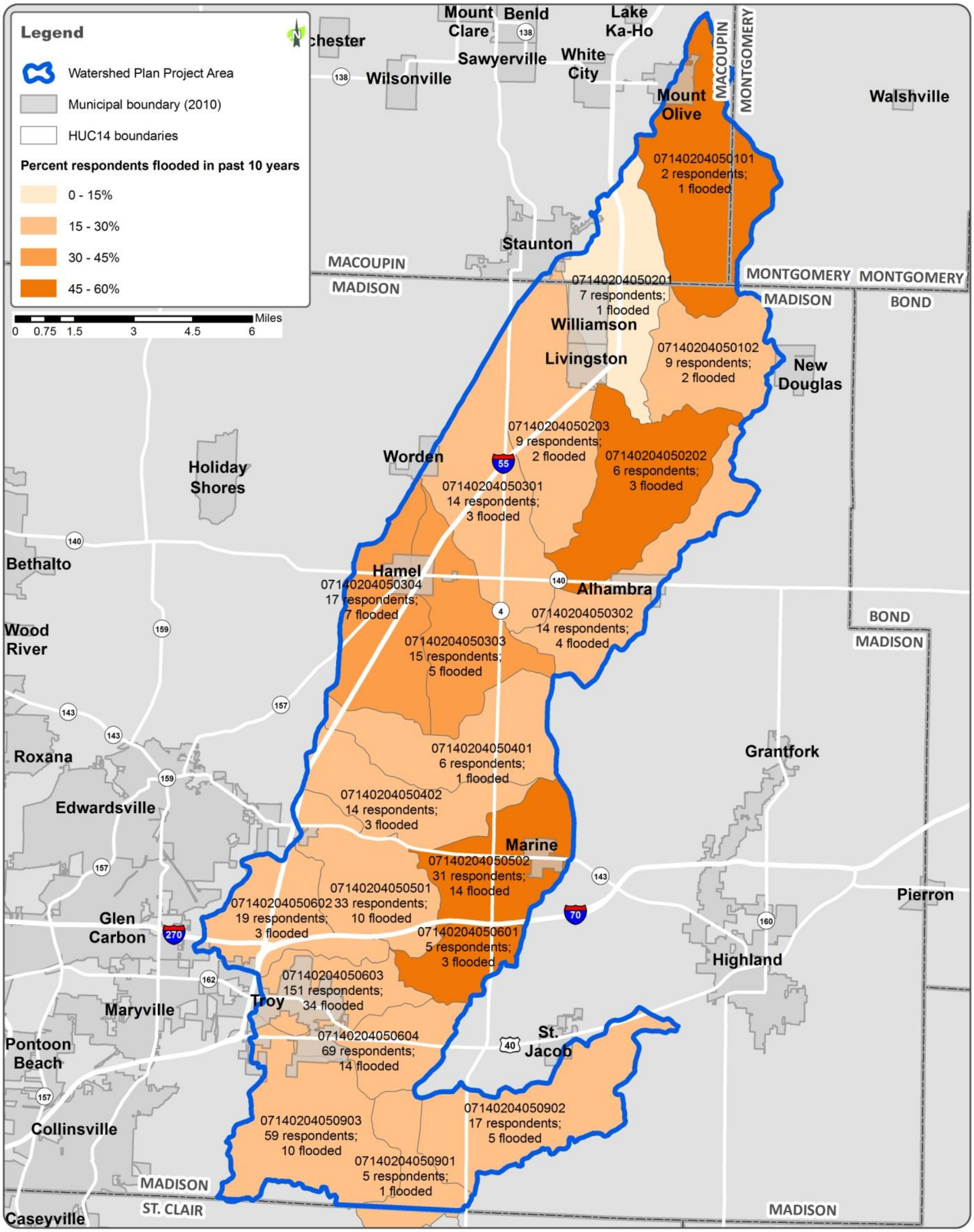


Figure A.47. Number and percent of respondents who experienced flooding in the last 10 years, by HUC14.

Flood damage hotspots

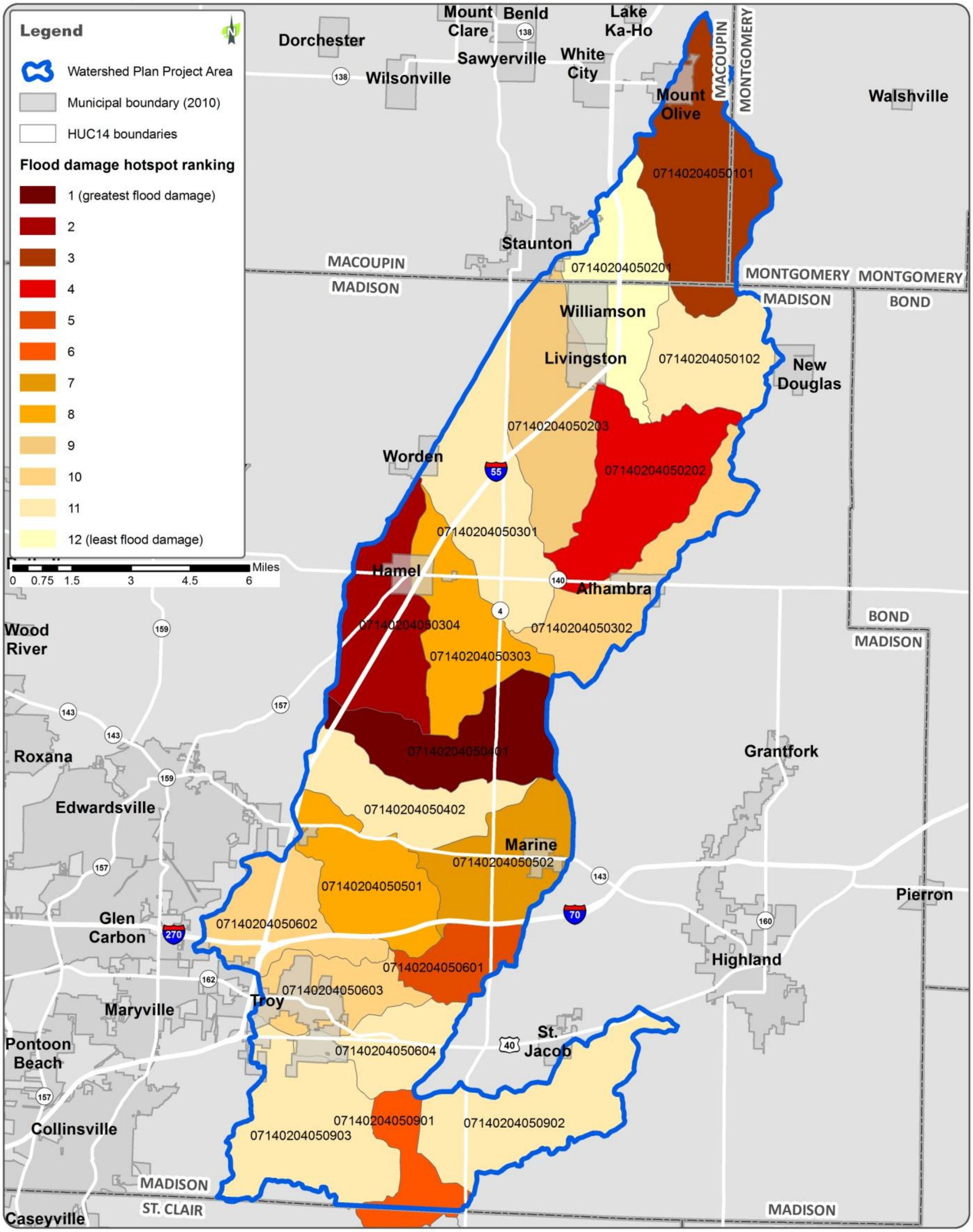


Figure A.48. Flood damage “hotspots”, by HUC14, based on percent of respondents flooded, frequency of flooding, percent of respondents whose neighbors flooded, and monetary loss due to flooding.

Flooding outside of floodplains

FEMA-designated floodplains cover close to 11% of the total acreage in the Upper Silver Creek watershed within Madison County. A similar proportion of survey responses, 13%, came from parcels wholly or partly within these floodplains. However, only 3% of survey respondents (13 people) responded that they lived in a FEMA-designated floodplain. Forty (40) respondents, or 10% of those who answered the survey question, unknowingly own property that is wholly or partly in a floodplain (Table A.48).

Respondents reported a total of approximately 146 events per year taking place outside of FEMA-designated floodplains over the last 10 years. Within floodplains, approximately 88 parcels per year were flooded.[142]

Table A.48. Frequency and location of flooding in and outside of floodplains, according to the mapped locations of responses.

Flood frequency	Average frequency, in times per year	Number of parcels in floodplain	Number of times per year parcels WITHIN floodplains are flooded	Number of parcels outside floodplain	Number of times per year parcels OUTSIDE floodplains are flooded
Only once or twice in 10 years.	0.15	0	0	22	3.3
Three to four times in 10 years.	0.35	1	0.35	11	3.85
Five to nine times in 10 years.	0.7	2	1.4	7	4.9
Once or twice a year.	1.5	6	9	20	30
Three to five times a year.	4	12	48	19	76
Six or more times a year.	7	4	28	4	28
Total		59	86.75	83	146.05

Flooding on roads (road overtopping)

Besides several road overtopping locations identified at stakeholder meetings, one other source offered data on known locations of flooding on roads. In 2010, Oates Associates worked with Madison County to develop a flooding assessment with which to advise the Stormwater Commission and contribute to the county Stormwater Plan. The flooding assessment used GIS data review and analysis, community data requests, meetings with individual communities, and FEMA's county Flood Insurance Study and flood maps to identify stormwater-related problems. The assessment identified several projects that municipalities had identified to improve their drainage, in categories such as maintenance, dam safety, localized flooding, stream channel flooding, combined sewers, and roadway overtopping. Only roadway overtopping projects were identified in the municipalities in the Upper Silver Creek watershed.

Seven road overtopping locations were identified from FEMA's 2008 Draft Flood Insurance Rate Maps (D-FIRMs) and the associated 2003 Flood Insurance Study (FIS) for Madison County (Table A.49). Of these, six were considered to have “major” flood severity, meaning that the stream profile indicated water was overtopping the roadway at a structure crossing in either the 100-year or 500-year storm event. One road overtopping location was considered to have “minor” flood severity, indicating merely a significant increase in the water surface elevation upstream of the road crossing structure.

Table A.49. Road overtopping locations identified in the Upper Silver Creek watershed in the Oates Associates Flooding Assessment.[143]

	WATERWAY NAME	FEMA STREAM PROFILE NUMBER	WATERSHED	CROSSING	APPROX. FLOWLINE ELEVATION (NAVD)	FLOOD SEVERITY
55	Silver Creek	68P	Kaskaskia	Interstate 70	470	Major
56	Silver Creek	68P	Kaskaskia	Old Staunton Rd.	463	Major
57	Silver Creek	69P	Kaskaskia	State Route 4	504	Major
58	Silver Creek	69P	Kaskaskia	Utle Rd.	524	Major
59	Silver Creek	69P	Kaskaskia	Alhambra Rd.	525	Major
60	Silver Creek Tributary No. 2	72P	Kaskaskia	East Frontage Rd.	553	Major
61	Silver Creek Tributary No. 3	72P	Kaskaskia	Veterans Memorial Dr.	564.5	Minor

Flooding and drainage complaints

The Madison County Stormwater Coordinator keeps a record of complaints received about drainage issues. Between 2012 and 2015, 70 complaints were received from property owners living in municipalities which are wholly or partly in the Upper Silver Creek watershed. On average, 17 complaints were received per year.

The number of complaints has increased slightly over time (Table A.50). Property owners in Edwardsville lodged the greatest number of complaints, followed by Troy and Glen Carbon. However, it should be noted that Edwardsville and Glen Carbon only have very small portions inside the watershed, so the greatest concentration of complaints in the watershed can be assumed to come from Troy.

Table A.50. Number of complaints received by year and by municipality, from 2012 to 2015.

Municipality	**2012**	**2013**	**2014**	**2015**	**Total**
Alhambra	1				**1**
Edwardsville	5	5	9	9	**28**
Glen Carbon	2	5	2	1	**10**
Marine				2	**2**
New Douglas		1			**1**
St. Jacob	1	1	1	2	**5**
Staunton			1		**1**
Troy	6	3	5	7	**21**
Total	**15**	**15**	**18**	**21**	**69**

History of flooding in the watershed

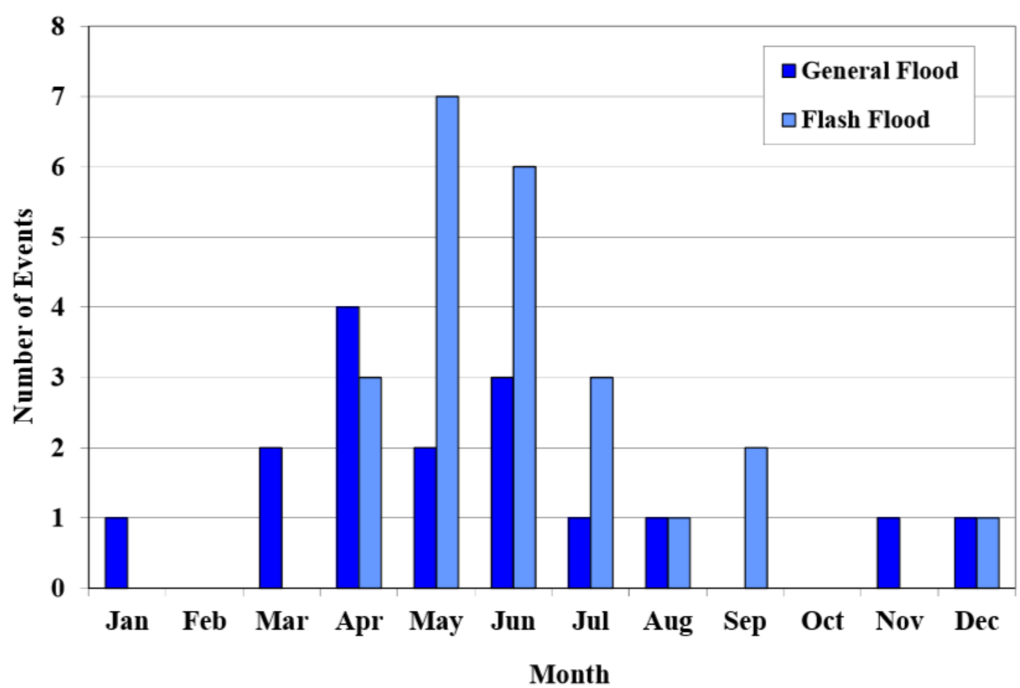
All three counties in the project area have records of general flooding and flash flooding events, as identified in their County Hazard Mitigation Plans. Macoupin County experienced 17 flood events between 1994 and 2013, and Montgomery County experienced at least 10 flood events between 1994 and 2008. Madison County experienced at least 23 flood events between 1993 and 2012, including historic Mississippi River floods such as the record-breaking flood of 1993 (Table A.51). All of the general flood events in Madison County, with one exception, were considered countywide events. No specific jurisdictions in Madison County experienced flash floods only in one municipality.

The spring and early summer have the greatest flood risk in the Upper Silver Creek. The most likely month for flash floods to occur in Madison County is April (56% of the events), and in Montgomery County, May (40%) (Figure A.49). The most likely month for general flooding in Madison County is May. NCDC data shows that none of the floods in Macoupin County were listed as affecting Staunton or Mount Olive specifically. However, five are listed as "countywide", meaning floods were recorded at several locations in the county. In Madison County, one flash flood occurred in the east of the county, and one in the north; either could be in the Upper Silver Creek watershed. In Montgomery County, seven of the ten flood events between 1994 and 2008 are listed as "countywide", with none listed for the southwest of the county.

Table A.51. Occurrences of floods and most likely months for flooding to occur in the three counties in the project area. [144, 145, 146]

	Macoupin County	Madison County	Montgomery County
Number of General Floods Reported	1 (1994-2013)	16 (1973-2012)	(unknown)
Number of Flash Floods Reported	16 (1994-2013)	23 (1993-2012)	10 (1994-2008)
Total Number of Floods Reported	17 (1994-2013)	≥ 23 (1993-2012)	≥ 10 (1994-2008)

Figure A.49. Reported flood events in Madison County by month. Note: Multi-month events are shown only in the month they began.



Impacts of floods

Injury and death

On average, four deaths per year result from flooding in Illinois. Fortunately, the historic number of injuries and deaths from flooding in Madison County has been very low. No injuries or deaths were reported as a result of any of the 16 recorded general or flash flood events between 1973 and 2012. However, a majority of the recorded flood events in the county are a result of flash flooding. Since there is often very little warning for flash flooding, the risk to public health and safety from flash flooding is "elevated to medium."[147]

The major cause of death during floods is drowning, with nearly half of all flash flood deaths occurring in vehicles as they are swept downstream.[148] Most of these deaths take place when people drive into flooded roadways. It only takes two feet of water to carry away most vehicles. Damage to roadways, bridges and other transportation structures can also affect mobility and the ability for injured or ill people to evacuate flooded areas.

Floodwaters containing biological and chemical contaminants also pose risks to public health. During floods, the risk of untreated sewage mixing with stormwater is increased, and floodwaters transport the biological contaminants into buildings and onto streets, and can serve as breeding grounds for bacteria and other disease-causing agents if left untreated. Chemical contaminants such as gasoline and oil can also enter floodwaters if underground storage tanks or pipelines crack and begin leaking during a flood event. Floodwaters may also contain significant concentrations of agricultural chemicals applied to farm fields, depending on the time of year.[149]

Once floodwaters have receded, mold and mildew can pose a health hazard in basements and buildings that are not thoroughly cleaned, especially affecting small children, the elderly and those with specific allergies. [150]

Financial impacts

Flooding is the single most financially damaging natural hazard in Illinois, with an estimated $257 million per year in property damage losses across the state since 1983. Structural damage to property can include warping of or cracks forming in a building's foundation, flooring, drywall and wood framing. Buildings' contents can also be seriously damaged. Losses in agricultural, industrial, and commercial productivity, as well as tourism, also impact the local economy in flooded areas.

Over a 35-year period (1978-2013), the National Flood Insurance Program paid out more than $3 million to Madison County policyholders, over $64,000 to Macoupin County policyholders, and over $68,000 to Montgomery County policyholders. Across the three counties, this works out to more than $89,000 per year per county paid in claims for flood damage.[151] See Table A.54 for a detailed breakdown of claims, policies, and losses in the municipalities in the Upper Silver Creek watershed and in the unincorporated area of the county as a whole.

Six of the 16 general flood events in Madison County between 1973 and 2012 caused $12,500,000 in crop damage and $36,995,996 in property damage (figure includes $20 million for the April 1994 and May 1995 general flood events representing losses sustained in multiple counties; a breakdown by county was unavailable). Four of these six events were part of federally-declared disasters. Damage information was either unavailable or not recorded for the remaining 10 reported occurrences.[152]

Six of the 23 flash flood events in Madison County between 1993 and 2012 caused $95,000 in crop damage and $7,279,150 in property damage (which figure includes $1,456,500 in verified infrastructure damage sustained by Edwardsville and the County as a result of two separate flash flood events outside of the Upper Silver Creek watershed). Damage information was either unavailable or none was recorded for the remaining 17 reported occurrences. [153] In Montgomery County, damages were only recorded for four of the 10 reported flash flooding events between 1994 and 2008: a 1994 event causing $50 million in property damage across eight counties (a breakdown by county was not available); a 1995 event causing approximately $800 in property damage; a 2008 event causing approximately $1,000 in property damage; and another 2008 event causing approximately $1 million in property damage within the county, which was included a presidential disaster declaration and was the most severe flash flooding event to occur in terms of property damage in recent memory. Damage information was either unavailable or not recorded for the rest of the reported occurrences.[154]

The Madison County Community Flood Survey asked questions about flooding frequency and cost of flood damages in the Upper Silver Creek watershed. Preliminary results as of September 29, 2014 show that more than a quarter of respondents said their home, business, or property had been flooded in the last 10 years. Of these, 30% had been flooded three to five times per year and 23% experienced damage to the primary home or business building(s) at the address given. Of those who suffered a monetary loss due to flooding over the last 10 years, 38% paid out less than $5,000, 13% paid $5-20,000, and 9% paid more than $20,000.

Other impacts

The most commonly reported impact of flooding from the Madison County Community Flood Survey was stress. Loss of access to the property was the next most common impact, with respondents commenting under “Other” that floods had restricted access on their own land (e.g., their driveway flooded) or blocked an entrance road to their subdivision. Several responses noted costs associated with repairing flood damage or replacing lost items (a combined 17%). Respondents also identified other specific effects including increases in homeowners’ insurance rates, the presence of mosquitoes in floodwater, and delays and difficulties with yard maintenance.[155]

The National Flood Insurance Program

The National Flood Insurance Program (NFIP) was created by Congress in 1968 through the National Flood Insurance Act. Communities participating in the NFIP agree to adopt a floodplain management ordinance to reduce flood risks to new construction in Special Flood Hazard Areas (SFHAs), which are subject to inundation by the base flood (also known as the 1 percent chance flood, 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.[156] The NFIP is managed within the Federal Emergency Management Agency (FEMA)’s Mitigation Division. Illinois is in Region V.

Communities enrolled in the NFIP and their policies

In Madison County, five communities in the Upper Silver Creek watershed are enrolled in the NFIP, as well as the County itself (representing the unincorporated areas). Staunton and Macoupin County are NFIP members in the Macoupin County portion of the watershed. Montgomery County is also a member. The date of the entry of these communities into the NFIP and their effective FIRM dates (typically between 1978 and 1984) are listed in Table A.52.[157] The FIRMs can be found on FEMA's Map Service Center website.[158] Since the 1980's, some updated, preliminary FIRMs have been created for the region, which are available on the Illinois Water Survey website.[159]

The county has 1,957 policies currently in force, with a total coverage amount of over $395 million (Table A.54). Between 1978 and May 2014, the average claim amount FEMA paid out to individuals in NFIP communities in the watershed was $14,042 (for 203 paid claims). Of the communities examined, Madison County has the most policies, insurance in force, and claim dollars paid, followed by Montgomery County. The communities of Glen Carbon and Edwardsville have the most policies and insurance in force in the project area.

The average premium among all the NFIP communities with policies in the watershed is $693 per year. The "average premium" column in Table A.54 does not closely reflect flood risk in each community; a smaller average premium might cover many inexpensive policies with contents-only coverage, while a larger average premium might reflect larger coverage amounts required on commercial properties. The column is provided solely to indicate a range of premiums paid by policyholders in the watershed.

Sixty-six respondents to the Madison County Community Flood Survey (14% of respondents) said that they have flood insurance. Of these respondents, three (11%) made a claim in the watershed in the last 10 years (Table A.53). Fifty-four (54), or 82%, of the survey respondents have flood insurance on structures that are not in a floodplain.

Table A.52. Communities in the Upper Silver Creek watershed enrolled in the NFIP, and the effective dates of their FIRMs.[160, 161] NSFA: No Special Flood Hazard Area – All Zone C. M: No elevation determined – All Zone A, C, and X. Program Enrollment Date: Date of entry into the Regular Program. E: Indicates date of entry in Emergency Program (initial phase of NFIP enrollment with limited coverage at less than actuarial rates; communities convert to the Regular Program upon issuance of a FIRM). CRS: Enrolled In Community Rating System (CRS).[162]

Communities enrolled in the NFIP	Initial FIRM identified	Current Effective Map Date	Program Enrollment Date
Edwardsville	01/18/84	01/18/84	01/18/84
Glen Carbon (NSFHA)			07/18/83
Livingston	02/27/84	02/27/84(M)	02/27/84
Macoupin County (unincorporated area)		01/06/78	09/18/96(E)
Madison County (unincorporated area)	04/15/82	04/15/82	04/15/82
Montgomery County (unincorporated area)		01/09/81	02/03/00(E)
Staunton	07/17/81	07/17/81(M)	12/21/84
Worden (NSFHA)			06/08/84

Table A.53. Number of respondents with flood insurance whose parcels are in a floodplain and who have made a claim.

Have flood insurance	Have made a claim	Parcel is in floodplain		
		Yes	No	Total
Yes	Yes	0	3	3
	No	10	51	61
No	Yes	1	1	2
	No	48	332	380
	(Blank - no answer)	0	4	4
(Blank - no answer)	No	0	16	16
	(Blank - no answer)		4	4
Total		59	411	470

*Those who responded that they did not have flood insurance and then left the claims question blank are assumed not to have made a claim.

*Two people said they did not have flood insurance but did make a claim – these respondents may be confused about the claim made; it may have been to their home insurance company instead of a flood insurance company.

Table A.54. NFIP policy coverage and loss statistics for municipalities enrolled in the NFIP in the Upper Silver Creek watershed, and unincorporated Madison County, between 01/01/1978 and 05/31/2014.[163,164] **Policies In Force**: Policies in force on the "as of" date of the report. **Insurance In Force**: The coverage amount for policies in force. **Written Premium In Force**: Total premiums paid for policies in force, per year. **Average premium:** Premiums in force divided by number of policies. **Total losses**: All losses (claims) submitted regardless of the status. **Closed losses**: Losses that have been paid. **Open losses**: Losses that have not been paid in full. **CWOP losses**: Losses that have been closed without payment. **Total Payments**: Total amount paid on losses.

Community name	Policies In Force	Insurance In Force	Written Premium In Force	Average premium	Total losses	Closed losses	Open losses	CWOP losses	Total payments
EDWARDSVILLE, CITY OF	13	$ 2,692,000	$ 10,214	$ 786	5	2	0	3	$ 38,360
GLEN CARBON, VILLAGE OF	12	$ 3,185,000	$ 4,682	$ 390					
LIVINGSTON, VILLAGE OF	1	$ 148,000	$ 1,376	$ 1,376	3	2	0	1	$ 23,587
MACOUPIN COUNTY *	7	$ 299,000	$ 3,180	$ 454					
MADISON COUNTY *	688	$ 156,729,500	$ 539,870	$ 785	227	169	0	58	$ 1,613,833
MONTGOMERY COUNTY *	76	$ 10,003,600	$ 33,166	$ 436	35	25	0	10	$ 547,130
STAUNTON, CITY OF	9	$ 1,207,500	$ 5,615	$ 624	5	5	0	0	$ 39,010

*Unincorporated area.

Communities not enrolled in the NFIP

Eight incorporated communities in the watershed are not enrolled in the NFIP (Table A.55). [165, 166] When the NFIP began, separate areas of government jurisdiction were shown on separate FIRMs. This is the case for several communities whose FIRMs were created in the 1980's. Some communities were not mapped, including those in Table A.55, and as a result, they do not currently face any sanctions for being flood-prone while not enrolled (such as no flood insurance, no federal mortgage insurance, and no federal grants or loans for development).[167] They may join the NFIP at any time, whether or not they have a FHBM or a FIRM.

Since the 1990's, FEMA has mapped all areas of a county on the same map to eliminate gaps and outdated information as municipalities grow and communities incorporate.[168] When the next FIRMs are created, current "holes in the map" will be eliminated and the entire county will be covered.

Impacts of recent federal flood insurance reform

The Biggert-Waters Flood Insurance Reform Act (Biggert-Waters, H.R.1309), passed in June 2012, is a landmark bill that aims to improve the NFIP's financial solvency, ensure flood insurance reflects real flood risks, and encourage floodproofing and mitigation activities. Biggert-Waters extended the NFIP for five years (until 2017) and made a number of changes related to flood insurance, flood risk mapping, and flood mitigation programs. For a fuller description of Biggert-Waters' reforms, see the H.R. 4348 Conference Report Summary.[169]

The Homeowner Flood Insurance Affordability Act of 2014 (HFIAA, H.R. 3370) was signed by President Obama on Friday 21st March, 2014. [170] The HFIAA made changes to several provisions of Biggert-Waters and also created new policies for the NFIP.

The greatest changes to the NFIP under these pieces of legislation affect subsidized flood insurance policies. In Madison County, most subsidized policies cover structures built before the communities' first Flood Insurance Rate Maps (FIRMs) were released (usually between 1978 and 1984). [171, 172] Subsidies for non-primary residences (including businesses and second homes) began to be phased out from October 2013 as the policies came up for renewal. The remaining subsidized structures, all primary residences, were allowed to keep their lower rates until a "trigger event" occurs, such as substantial damage or the sale of the property.

Table A.55. Incorporated communities in the Upper Silver Creek watershed not enrolled in the NFIP. All communities are unmapped by an effective FIRM. The panel number for the unmapped communities is given. [173]

Community	FIRM Panel Number
Alhambra	17X013
Hamel	17X144
Marine	17X205
Mount Olive	(unlisted)
New Douglas	17X233
St. Jacob	17X298
Troy	17X345
Williamson	17X371

Since the HFIAA was so recently passed and the rate-setting for it has not yet been completed, it is impossible to determine its final effects on property owners in the Upper Silver Creek watershed. However, it may be possible to make some generalized conclusions based on the trends in the two Acts and the number of NFIP policies affected in the County. For example, the rate increases under Biggert-Waters that were not repealed by the HFIAA may stunt the growth of local housing markets and economies over the medium term. New structures may cost more to build as developers must elevate them in order to make manageable flood insurance rates available, and certain older properties will prove more difficult to maintain or sell as premiums rise. However, these effects will likely not be highly pronounced in the Upper Silver Creek watershed, as not many subsidized policies are located there (they are more commonly clustered along the Mississippi River and in the American Bottoms). Furthermore, as premiums increase to actuarially-based levels, development and habitation will be redirected away from floodprone areas while flood mitigation activities are incentivized there, reducing flood risk to life and property.

See the recent HeartLands Conservancy report "Impacts of Federal Flood Insurance Reform Legislation on Madison County, Illinois" for more information on potential impacts on Madison County.[174]

Future development and flood ordinances

The 2008 Hazard Mitigation Plan for Madison County predicted little flood risk in current development trends in Madison County, as most residential growth was occurring in regions not prone to bottomland flooding, and development planned on the fringe of major drainage features would be discouraged by floodplain regulations.[175] Similarly, in Macoupin County, no construction was planned within the 100-year floodplain as of 2010, and the Macoupin County planning commission reviews all new subdivision development for compliance with its Subdivision Control Ordinance, which contains certain flood management provisions.[176] Montgomery County's floodplain ordinance also provides protection to any new building, infrastructure or critical facility built in a flood-prone area.[177] However, all three counties remain vulnerable to flash flooding depending on the amount of precipitation received, topography, land use, and other factors.

Prioritizing floods among other natural hazards

Some jurisdictions have tried to rank the various natural hazards with which they are faced, in order to more effectively direct their hazard mitigation efforts.

In Macoupin County's Multi-Hazard Mitigation Plan, Hazard Rankings are calculated for nine hazards: flooding, tornado, transportation hazardous material release, thunderstorms/high winds/hail/lightning, winter storms, subsidence, earthquake, fire/explosion, and dam/levee failure. For each community and each hazard, a probability value and a magnitude/severity value was assigned, resulting in a Risk Priority Index (RPI) value. These values were ranked for each community. Flooding was ranked as the #5 hazard in Staunton and at #8 in Mount Olive among the nine hazards.[178] No such hazard ranking assessment has been done in Montgomery County's Multi-Jurisdictional Natural Hazards Mitigation Plan or Madison County's most recent Draft Multi-Jurisdictional All Hazards Mitigation Plan.

Water Quality

Impaired waters

Under Section 305(b) of the Clean Water Act, Illinois EPA (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 in Illinois, of which five have been assigned to streams in the Upper Silver Creek watershed: Aquatic Life, Fish Consumption, Primary Contact, Secondary Contact, and Aesthetic Quality. When a Designated Use cannot be met, a waterbody is determined to be impaired, and IEPA must list the potential causes and sources for impairment in the 303(d) impaired waters list.

The Silver Creek watershed at the HUC10 level (HUC 0714020405) has four impairments as of the 2014 Illinois Integrated Water Quality Report (Table A.56). They occur at two distinct stretches of impaired waters in the Upper Silver Creek watershed – the main channel itself, and a small segment of a stream named Troy Creek that flows into Wendell Branch (Figure A.50). Both waterways were listed as impaired for Aquatic life, a "designated use" of a waterway that represents its ability to support fish and aquatic macroinvertebrates.

The Aquatic Life designated use is met when certain levels of water quality are achieved, as first determined by biological indices: the Macroinvertebrate Index of Biotic Integrity (mIBI) or Macroinvertebrate Biotic Index (MBI), and the Fish Index of Biotic Integrity (fIBI). If scores for these indexes are unavailable, water chemistry data from a three-year dataset typically available from an Ambient Water Quality Monitoring Network station is used. Habitat data from assessments such as an Intensive Basin Survey may also be required.[179] Designated Uses other than Aquatic Life were not assessed for any stream in the watershed. IEPA has not yet completed any Total Maximum Daily Load (TMDL) reports for streams in the Upper Silver Creek watershed.[180]

The 2014 303(d) listing for Silver Creek (IL_OD-06) was based on data collected in 2007 at the Troy USGS gauge site (Illinois EPA station OD-09) in 2007 as part of the Intensive River Basin Survey program and the Ambient Water Quality Monitoring Program. The Intensive Basin Survey program assesses sites on a five-year rotation; the Ambient Water Quality Monitoring Program collects data on a six week rotation. The assessments found a fish IBI score of 45 (fully supporting) and a macroinvertebrate score of 33.9 (moderate impairment), along with water quality data. The impaired 51 mile segment of Silver Creek was determined as "Not Supporting" for Aquatic Life, and the causes of impairment in this segment are Dissolved Oxygen, Manganese, Total Phosphorus (P), and Sedimentation/Siltation. The three sources of impairment are identified as Animal Feeding Operations (NPS), Municipal Point Source Discharges, and Crop Production (Crop Land or Dry Land) (Table A.56).

Troy Creek (Assessment ID IL_ODMA-TRC3) is also listed as impaired for Aquatic Life, with Phosphorus (Total) as the impairment. Two sources are listed: Municipal Point Source Discharges and Urban Runoff/Storm Sewers. For Troy Creek, the assessment data is from a 2002 Facility Related Stream Survey. A single macroinvertebrate sample was taken at station ODMA-TR-C3, yielding an MBI score of 6.0 (moderate impairment). A single water sample was also taken, which showed exceedances of the criteria formerly used to list total nitrogen and total phosphorus. Illinois RiverWatch MBI scores were not used in these determinations.

Table A.56. Illinois EPA Designated Uses and impairments for stream reaches in the Upper Silver Creek watershed.[181] Note: There is no record of reaches named "Marine Creek" or "Marine Effluent Creek" in the NHD in Illinois, but since these reaches fall within HUC 0714020405 and there is only one municipality named Marine in the state, it is assumed these reaches are in the Upper Silver Creek watershed.

Name and Assessment ID	Size (miles)	Designated Use	Use Attainment	Impaired?	Cause of Impairment	Source of Impairment
Fork Creek: IL_ODKA	4.12	(any)	*Not assessed*	-	-	-
Lake Fork: IL_ODK	8.16	(any)	*Not assessed*	-	-	-
Marine Creek: IL_ODP	5.7	Aquatic Life	**Supporting**	No	None	None
Marine Effluent Creek: IL_ODPA_MA-C2	1.1	Aquatic Life	**Supporting**	No	None	None
Marine Effluent Creek: IL_ODPA_MA-C3	1.05	Aquatic Life	**Supporting**	No	None	None
Mill Creek: IL_ODJ	8.87	(any)	*Not assessed*	-	-	-
Silver Creek: IL_OD-06	50.74	Aquatic Life	**Not supporting**	Yes	**Dissolved Oxygen, Manganese, Phosphorus (Total), Sedimentation/ Siltation**	**Animal Feeding Operations (NPS), Municipal Point Source Discharges, Crop Production (Crop Land or Dry Land)**
Silver Creek Ditch: IL_ODF-OF-C1	7.72	Aquatic Life	**Supporting**	No	None	None
Troy Creek: IL_ODMA-TR-C2	2.95	Aquatic Life	**Supporting**	No	None	None
Troy Creek: IL_ODMA-TR-C3	0.3	Aquatic Life	**Not supporting**	Yes	**Phosphorus (Total)**	**Municipal Point Source Discharges, Urban Runoff/Storm Sewers**
Wendell Branch: IL_ODM	10.01	Aquatic Life	**Supporting**	No	None	None

Causes of impairments in the Silver Creek watershed have changed over time. In 2004, there were eight causes, including five not currently present (Table A.57). Since then, pH, Total Nitrogen (N), Total Suspended Solids, Total Fecal Coliform, and Atrazine have disappeared from the list, Dissolved Oxygen has disappeared and then reappeared on the list, and Manganese has joined the list. Total Phosphorus and Sedimentation/Siltation have been constant impairments over the last 10 years.

Little Silver Creek (also in the East Fork Silver Creek watershed that feeds into Silver Creek) was on the 2014 303(d) list as well, with low DO, Phosphorus (Total), and Sedimentation/Siltation listed as the causes of impairment.

Table A.57. Impairments for the Silver Creek watershed (HUC 0714020405) between 2004 and 2014.[182] **DO**: dissolved oxygen. **P**: phosphorus. **N**: nitrogen. **TSS**: Total Suspended Solids. **Mn**: manganese.

	Impairment							
Year	pH	DO	Total P	Total N	Sedimentation/ Siltation	TSS	Mn	Total Fecal Coliform	Atrazine
2014		x	x		x		x		
2012		x	x		x		x		
2010			x		x		x		
2008	x		x		x	x			
2006	x	x	x	x	x	x			
2004	x	x	x	x	x	x		x	x

Highland Silver Lake, a lake in the East Fork Silver Creek (HUC 0714020404) watershed whose waters flow into the Upper Silver Creek watershed at HUC 07140204050901, is also impaired. Highland Silver Lake was on the 2014 303(d) list for pH and mercury.[183] Highland Silver Lake is a 550-acre impoundment constructed in 1962 which provides drinking water to Highland, St. Jacob, Grantfork, and Pierron. Point sources and water withdrawals may affect water quantity and quality in Highland Silver Lake. Odor and taste issues have been reported in Highland drinking water, which is supplied from the lake, as a result of algal blooms.[184] Two NPDES-permitted dischargers are located within the Highland Silver Lake watershed. There is also one landfill (Bertha Davis, ID 50200001) and three locations where there are one or more oil wells.[185] A watershed plan was completed for the Highland Silver Lake watershed in July 2011.[186] In 2005, three TMDLs were approved for Highland-Silver Lake, for phosphorus, aldrin, and chlordane. It was suspected that both aldrin and chlordane are widespread throughout the watershed, due to historical application of these pesticides to cropland and their use in controlling termites.[187]

The next determination of impairments for the Upper Silver Creek watershed for the 2016 303(d) list will be based on data from station OD-09 in the Intensive River Basin Survey of 2012. This data shows a fish IBI score of 29 (moderate impairment) and a macroinvertebrate IBI score of 36.7 (moderate impairment). There will be no new data for Troy Creek (IL_ODMA-TR-C3), and there are no plans to resample that segment; the existing assessment will remain in effect until new data are available to update it. The 2016 Integrated Report and 303(d) list will be made available for public review sometime in June or July of 2015.

Impaired Waters

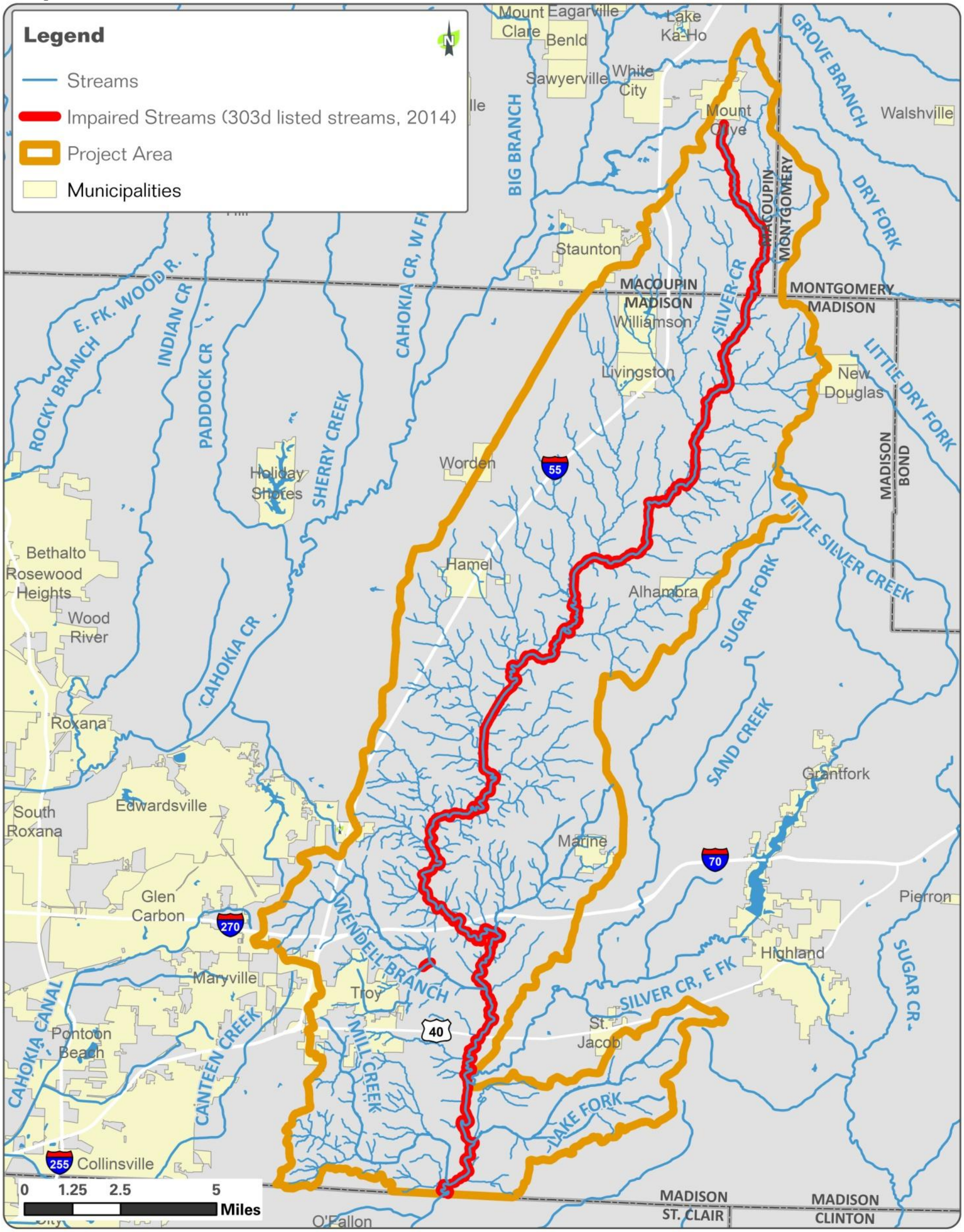


Figure A.50. Impaired waters in the Upper Silver Creek watershed, 2014.

Water quality indicators & research

Water quality in the Upper Silver Creek Watershed is impacted primarily by two land uses – 1) agriculture and 2) urban development. Agriculture, or more specifically, row crop farming, covers most of the land surface in the watershed. The National Land Cover Database indicates that 58% of the Upper Silver Creek watershed is covered by harvested row crops, consisting almost entirely of corn, soybeans, and wheat. Urban development occupies on average only 12% of the Upper Silver Creek watershed, but it is concentrated in certain subwatersheds such as HUC 07140204050603, at 46% urban land, which includes the City of Troy. Urbanization is expected to increase by 11% in Madison County during the next 15 years due to its location in the Metro East area of the Saint Louis metropolitan region.

Sources of data

Water quality monitoring in the Upper Silver Creek watershed was carried out at various times from 1972 to 2013 by the U.S. Geological Survey -Illinois Water Science Center (USGS-IWSC) and Illinois EPA (IEPA). Both agencies collected their data adjacent to the USGS gage 05594450 located on the main stem of Silver Creek near Route 40 east of Troy, Illinois (Figure A.51, 38 42" 59.1" N, 89 42' 59.3" W or 38.7167145, 89.829263). The drainage area for this monitoring site is 98,560 acres which covers 82% of the project area. Therefore, the data from this site provides a good overview of the overall status of water quality in the Upper Silver Creek watershed. In general, USGS-IWSC monitoring was conducted from the late 1970s unit 1997. After a gap of several years in monitoring, IEPA began monitoring at the same site from 2003 to 2005 and again from 2009 to 2011. Most of the same parameters were monitored by both agencies. Figure A.52 shows a timeline for when the various water quality parameters were measured at this location. In addition to the timeline shown in Figure A.52, daily mean discharge data for the USGS Gage 05594450 was obtained for the time period from 1966 to 2014 (Figure A.53).

A second data source is research conducted by a Southern Illinois University Master of Science student between 2008 and 2009 that was subsequently published in a peer-reviewed journal article in 2011.[188, 189] This data was gathered from 43 catchment areas within the Lower Kaskaskia River basin, including 16 catchment areas located within the Upper Silver Creek watershed.

A third data source is the data gathered by Illinois RiverWatch volunteers at two sites in the watershed between 1996 and 2014 (Table A.58). 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, % algal coverage, channelization, and the presence of macroinvertebrates.[190]

Table A.58. Location, date, and numbers of volunteers at RiverWatch sampling sites in the watershed.

Stream sampled	# times sampled	Years sampled	# volunteers who monitored there	RiverWatcher network group
Wendell Branch	9	1996-1997, 1999-2003, 2013-2014	18	
Knights Creek*	13	2000-2003, 2006-2014	>24	Triad High School

*not an official name in the GNIS

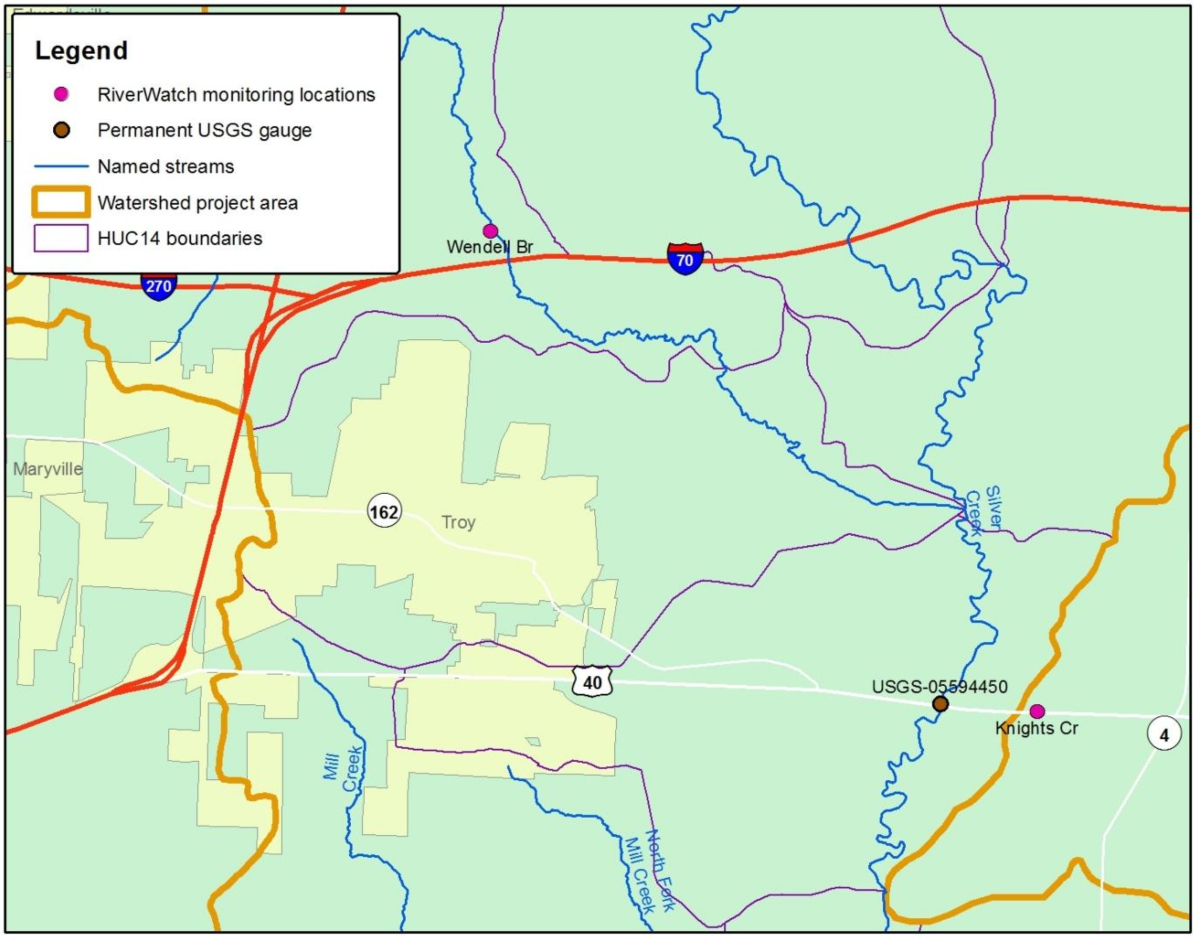


Figure A.51. Location of USGS gage 05594450 within HUC 07140204050604 in the watershed, and locations sampled by Illinois RiverWatch volunteers between 1996 and 2014.

Stream flow

The mean daily discharge measured at the USGS gage 05594450 starting in 1966 ranged from 0 to 7740 cfs, but half the discharge rates were 17 cfs or less, and 97% were less than 1000 cfs (Figure A.53). Most surface runoff, streambank erosion, and sediment transport occurs during extreme runoff events, due primarily to the large volume of water flowing through the river channel. The number of those events is inconsistent from year to year and difficult to predict, but since the year 1966, the highest peak streamflow each year has ranged from 546 to 10,600 cfs (Figure A.54). Not only are individual extreme runoff events variable and difficult to predict, but the annual mean discharge also varies widely from year to year due to annual variations in climate (Figure A.55).

RiverWatch volunteers measured an average stream discharge of 3.8 cfs and a peak discharge of 15.6 cfs at the Silver Creek site ("Knights Creek", 38.7162, -89.8181). At the Wendell Branch site (38.7578, -89.8181), the average was 4.5 cfs and the peak was recorded as 67.6 cfs.[191] Stream velocity was also recorded at these sites. At the Silver Creek site, the average velocity was 0.39 ft/s, and the peak velocity was 0.57 ft/s. at the Wendell Branch site, the average velocity was 0.40 ft/s, and the peak velocity was 10.3 ft/s.[192]

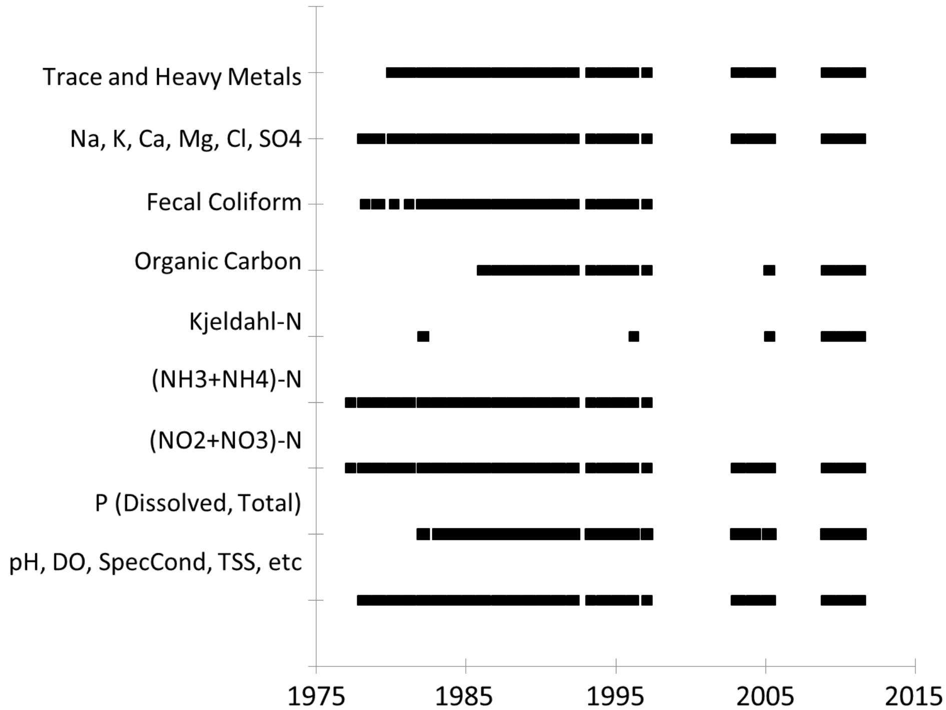


Figure A.52. Timeline showing when various water quality parameters were measured at the Silver Creek USGS gage 05594450.

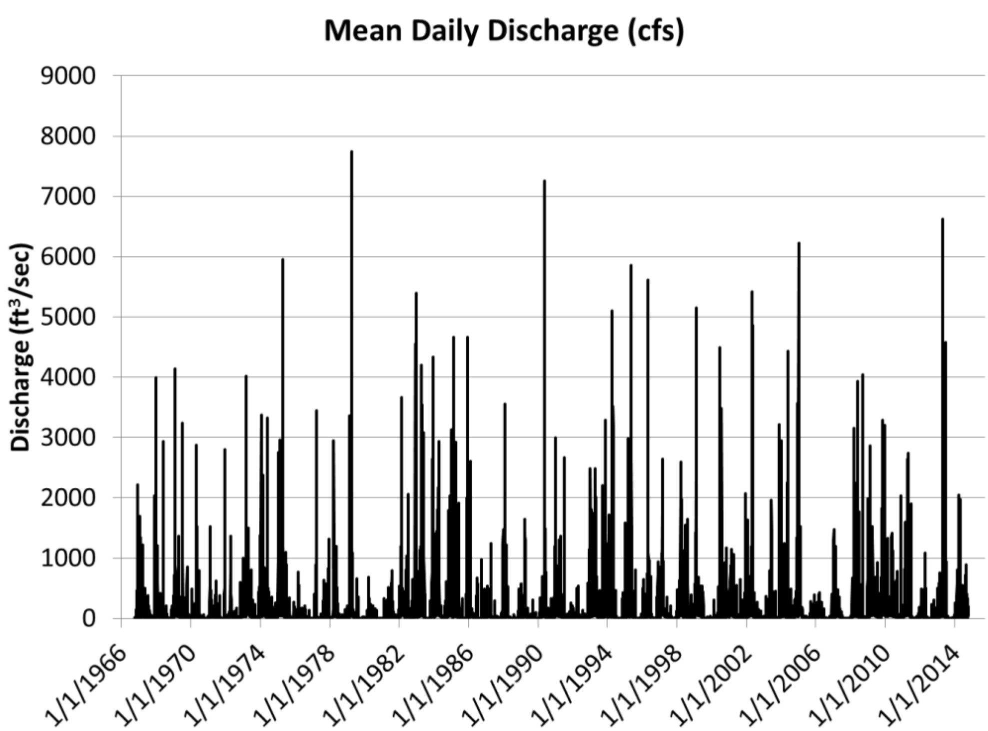


Figure A.53. Mean daily discharge measured at USGS gage 05594450 in the Upper Silver Creek watershed between 1966 and 2014.

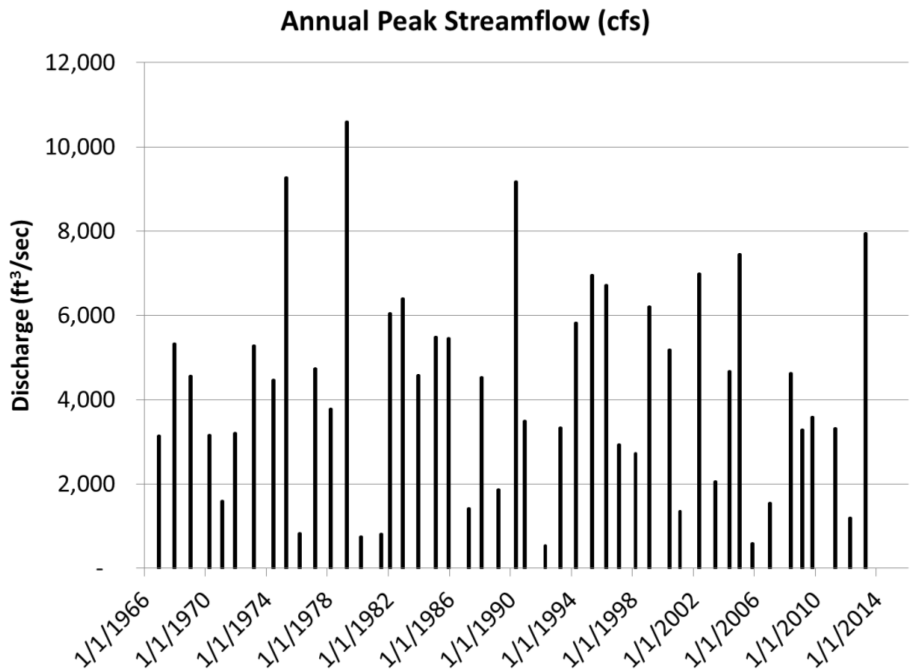


Figure A.54. Annual Peak streamflows measured at USGS gage 05594450 in the Upper Silver Creek watershed between 1966 and 2013.

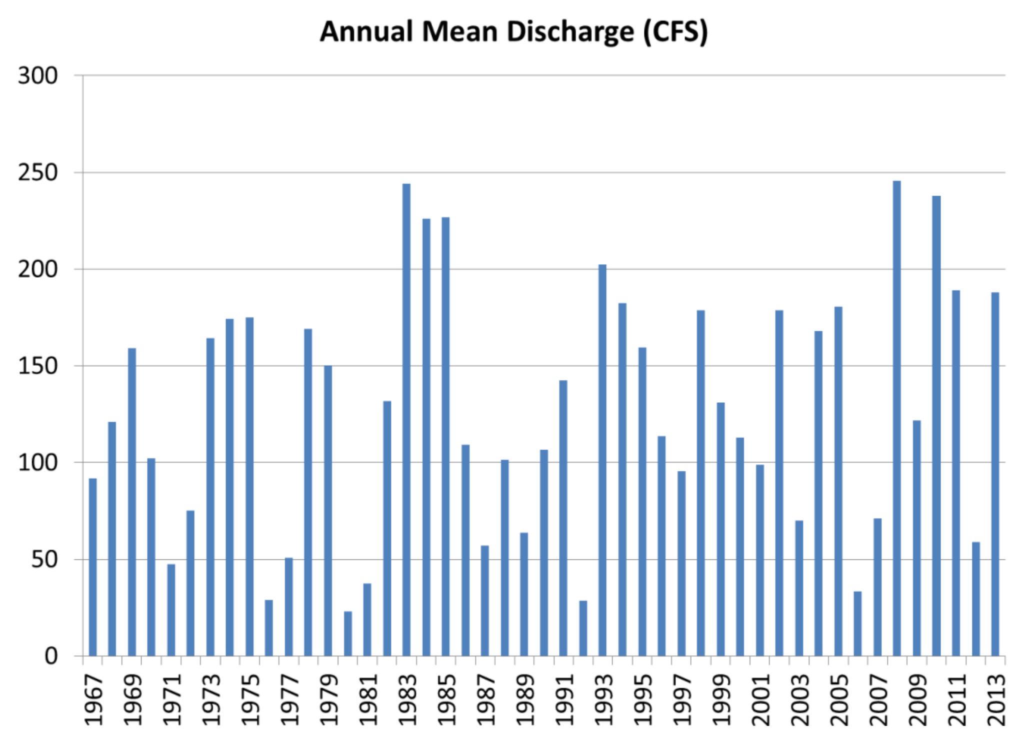


Figure A.55. Annual mean discharge for the Upper Silver Creek watershed measured at USGS gage 05594450 between 1967 to 2013.

Sediment loads

Total suspended solids (TSS) were measured in discrete samples collected from the Silver Creek at the USGS gage 05594450 from 1978 to 1991 by the USGS-IWSC and then by IEPA from 2003 to 2005 and 2009-2011. Both agencies collected 8 to 12 samples per year on monthly basis for a total of 220 samples. Total suspended solids (TSS) for individual events ranged from <5 mg/L to >2300 mg/L (Figure A.56-B). There was no clear relationship between TSS and discharge for the dates when samples were collected (Figure A.57), indicating that there are multiple factors affecting the suspended sediment concentration besides stream discharge. For instance, antecedent soil moisture due to rainfall and surface vegetative cover has major impacts on sediment losses from agricultural fields.

TSS values (Figure A.56-B)) were multiplied by the daily mean discharge for the corresponding date (Figure A.56-A), and also a unit adjustment factor, to determine the total suspended sediment load for those individual days (Figure A.56-C). It needs to be clearly noted that the sediment loads shown in Figure A.56-C represent a relatively few number of days throughout the period from 1978 to 2011. More specifically, there were 220 days with TSS data out of a time period that spanned 12,327 days. With that in mind, the results indicate that only a relatively small number of events result in large movements of sediments through the Silver Creek watershed. Stream discharge (Figure A.56-A), more than TSS, is the primary factor determining the amount of sediment transported. Of particular note is the extremely high sediment load of 8,794 ton/day measured on 4/12/1979 when the discharge rate was 7740 cfs. The second highest sediment load of 2,456 ton/day occurred seven weeks earlier on 2/23/1979 when the discharge was 2000 cfs. Examination of the hydrograph for Silver Creek (Figure A.53) for the period from 1966 to 2014 shows over 18 events where discharge exceeded 4,000 cfs, suggesting there were multiple times when large sediment loads were transported out of the Upper Silver Creek watershed , but without corresponding suspended sediment concentrations, it is impossible to calculate the exact suspended sediment load. The measured discharge and suspended sediment loads are consistent with the streambank assessment conducted for the project.

More recent suspended sediment loads for the Silver Creek watershed were reported in the 2011 Southern Illinois University-Carbondale study of land cover effects on water quality. [193] Average values ranging from 14.2 to 17.4 mg/L for baseflow, and from 163 to 227 mg/L for storm flow, were reported. These values are well below the peak values observed at the USGS gage site (Figure A.56) because the sampling methods used did not capture extreme storm events.

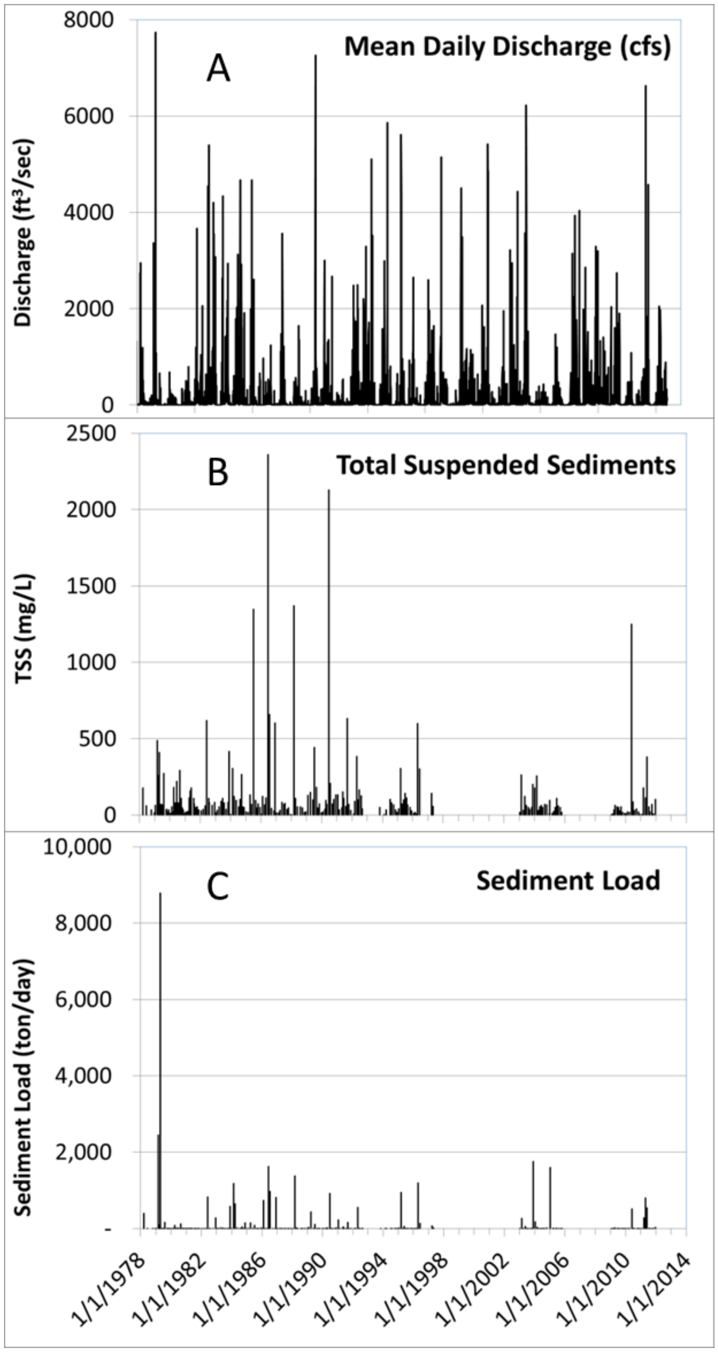


Figure A.56. (A) Mean daily discharge, (B) Total suspended sediments (TSS) in discrete water samples, and (C) suspended sediment load calculated from corresponding Discharge and TSS loads, for 223 individual days measured at USGS gage 05594450 between 1978 to 1996.

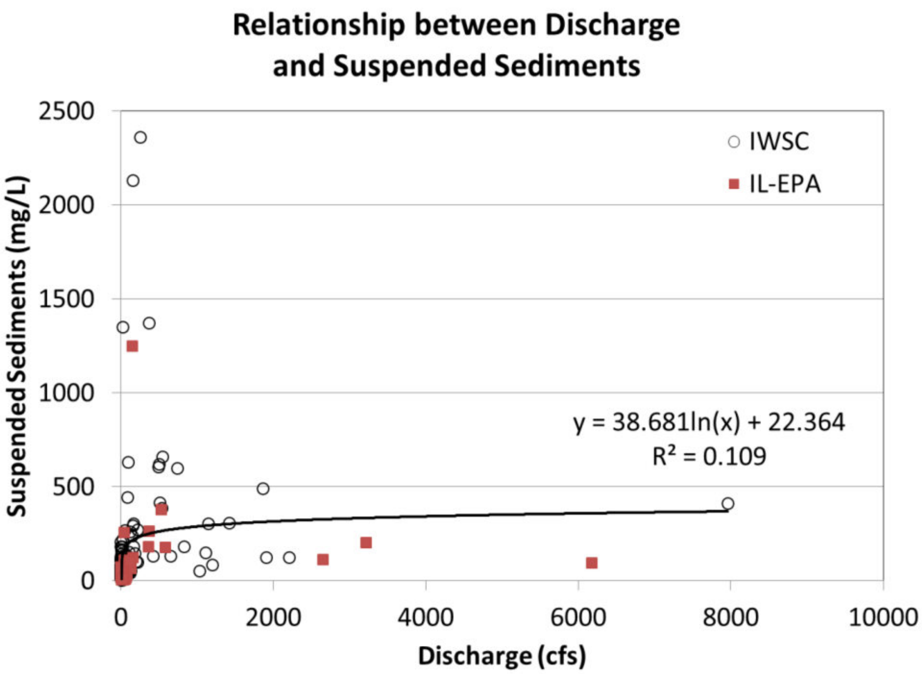
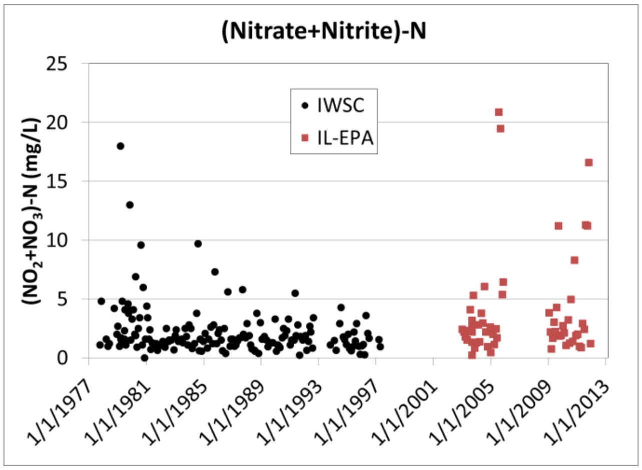


Figure A.57. Relationship between discharge and suspended sediments in discrete samples collected from Silver Creek at the USGS Gage 05594450 from 1978 to 2011 by the Illinois Water Survey and IEPA.

Nitrogen

Nitrate: More than 65% of the nitrate-nitrogen ((NO2+NO3)-N, referring to both nitrite and nitrate, among which nitrite concentrations are typically negligible compared to nitrate) concentrations measured at the USGS gage site from 1982 to 1997, were below 2 mg/L. During peak discharge periods, values reached concentrations as high as 20.9 mg/L (Figure A.58 and Table A.59). The average nitrate concentration for the Upper Silver Creek from 1977 to 2011 was 2.7 mg/L (Table A.59), which is less than the statewide average of 3.89 mg/L from 1980 to 1996 reported in a 1999 IEPA study.[194] More recently, base flow concentrations of NO_3-N were typically below 1 mg/L and storm flow concentrations were below 2 mg/L when measured at the subcatchment level in the in the Silver Creek watershed from January 2008 to August 2009 (Table A.60). The nitrate concentrations in the Silver Creek watershed tend to be lower than concentrations of 2 to 4 mg/L observed in the main channel of the Mississippi River between 1994 and 2004 near its confluence with the Kaskaskia River.[195] High levels of nitrate can indicate significant installation of tile drainage; these moderate levels may indicate that the watershed is not overly tiled. The presence of tile drains is difficult to measure.



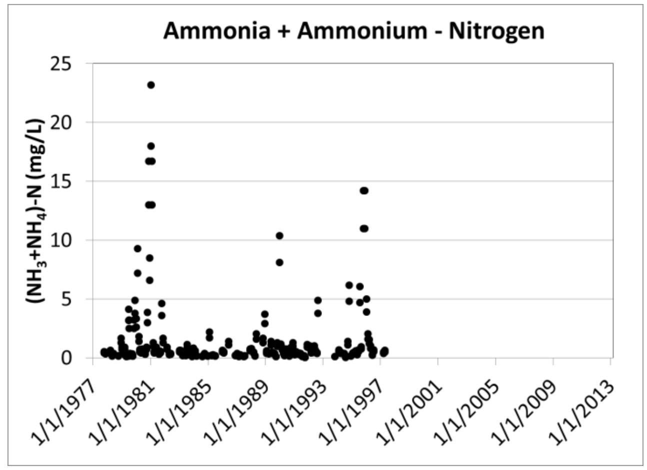


Figure A.58. Nitrate + nitrate nitrogen concentrations in Silver Creek water measured at USGS gage site 05594450 from 1982 to 1997.

Table A.59. 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 IEPA.

Characteristic	Units	n	Min	10th Pctl	25th Pctl	Median	75th Pctl	90th Pctl	Max	Mean
Nutrients										
(NH3+NH4)-N	mg/L	168	0.02	0.10	0.16	0.38	0.70	2.90	18.00	1.14
(NO2+NO3)-N	mg/L	225	0	0.80	1.13	1.70	2.80	5.29	20.90	2.70
Organic N	mg/L	2	0.95	0.95	0.95	1.03	1.10	1.10	1.10	1.03
Kjeldahl N	mg/L	32	0.43	0.49	0.57	0.89	1.13	1.53	1.87	0.91
Total N	mg/L	4	2.10	2.10	2.30	2.80	3.20	3.30	3.30	2.80
P, Dissolved	mg/L	157	0.07	0.15	0.23	0.38	0.79	1.9	5.3	0.73
P, Total	mg/L	157	0.14	0.31	0.46	0.64	1.3	2.2	5.4	1.0
Organic Carbon	mg/L	113	3.5	5.29	7.1	8.8	11.4	18.0	51.3	10.6
Fecal Coliforms	cfu/100mL	121	30	100	270	630	2100	5600	106000	3190

Table A.60. Statistical summary of standard water quality 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 IEPA.

Characteristic	Units	n	Min	10th Pctl	25th Pctl	Median	75th Pctl	90th Pctl	Max	Mean
Standard parameters										
Temperature (Water)	C	312	-0.14	0.6	6.5	13.5	21.5	24	29	13.5
pH		224	6.5	7	7.2	7.5	7.7	8	9	7.5
Specific Conductance	µS/cm	214	94	290	509	682	893	1270	2060	745
Chemical Oxygen Demand	mg/L	143	0	18	23	29	38	53	260	35
Dissolved Oxygen	mg/L	205	2	4.1	5.19	7.5	10.4	12.2	14.51	7.7
Alkalinity	mg/L	226	1	51	116	181	238	288	458	176
Total Dissolved Solids	mg/L	121	98	161	284	399	520	785	1460	432
Total Suspended Solids	mg/L	220	2	16	33	60	110	262	2360	132
Total Volatile Solids	mg/L	2	6	6	6	7	8	8	8	7
Suspended Sediment Concentration	mg/L	4	26	26	48	125.5	227	273	273	138
Suspended Sediment Concentration	tons/day	4	0.02	0.02	0.2	41.7	124	165	165	62
Fixes Suspended Sediments	mg/L	164	1	10	28	56	95	265	2120	128
Total Hardness (as CaCO3)	mg/L	120	66.4	110	180	270	345	410	490	264
Turbidity	NTU	169	1.9	4.2	9.4	22	60.1	180	1300	74
VSS	mg/L	217	0	4	6	10	18	32	240	17

Ammonium: Ammonium-nitrogen ((NH_3+NH_4)-N), which includes both ammonia (NH_3) and ammonium (NH_4) forms but is mostly the latter, was measured at the USGS gage 05594450. Between 1977 and 1997, ammonium-nitrogen ranged from 0.02 to 18 mg/L with a median value of 0.38 mg/L and an average of 1.14 mg/L (Figure A.58 and Table A.59). The average is slightly higher than the statewide average of 0.32 mg/L for Illinois from 1980 to 1996. A 2009 IEPA study identified the Upper Silver Creek watershed as one where ammonia-N tended to be elevated compared to the rest of the state.[196] There was no available ammonium data for the period after 1997 for the USGS Gage 05594450 site, but the 2011 SIU-Carbondale study reported ammonium concentrations in multiple subcatchment areas in the Upper Silver Creek watershed (Table A.60).[197] Their average values ranged from 0.24 mg/L for base flow in an agricultural catchment area to 0.43 mg/L for storm flow in an urban catchment area, so it's possible that ammonium levels in the Upper Silver Creek Watershed have declined since the period from 1977 to 1997.

Total / Kjeldahl / Organic N: On a few occasions during the period from 1977 to 2011, other forms of nitrogen were measured at the USGS gage, including organic N, Kjeldahl N, and Total N (Table A.59). Nitrogen in these forms consistently followed the trend of Total-N > Kjeldahl-N > organic-N. Kjeldahl N was measured in 32 samples by both the USGS-IWSC and IEPA, although the latter agency analyzed most of those samples. The amounts of nitrogen in these forms exceeded the concentrations reported for nitrate and ammonium. Without additional data for these forms of nitrogen, it is impossible to discern trends over time. However, when all the forms of nitrogen are considered together, nitrogen is not a significant problem in the watershed. Total N was listed as an impairment on the 2004 and 2006 303(d) list, but since then has not been considered an impairment.

Phosphorus

Both total and dissolved phosphorus were measured at USGS gage 05594450 from 1982 to 2011. Dissolved P is primarily orthophosphate (soluble reactive phosphorus) and is the form that is biologically active. Dissolved P tended to be high in the main stem of Silver Creek (Figure A.59) as well as in subcatchment waters during both base flow and storm flow (A.55). More than 99% of the orthophosphate concentrations measured at the USGS gage site from 1982 to 2011 and by the SIU-Carbondale study from 2008 to 2009 exceeded the Illinois statewide average for soluble phosphorus of 0.25 mg/L. In fact, that study reported that all of its measurements for orthophosphate during storm flow exceeded the statewide 95th percentile concentration of 1.07 mg/L.[198] Total phosphorus concentrations varied widely, as did dissolved P, but on average, total P values were 0.25 to 0.3 mg/L higher than the dissolved concentrations (Figure A.59). Nearby, on the main channel of the Mississippi River near its confluence with the Kaskaskia River, soluble reactive phosphorus concentrations from 1994 to 2004 were typically below 0.1 mg/L. Clearly, surface water in the Silver Creek watershed has a long history of excessive phosphorus and this is consistent with its inclusion on the 303(d) list of impaired waters.

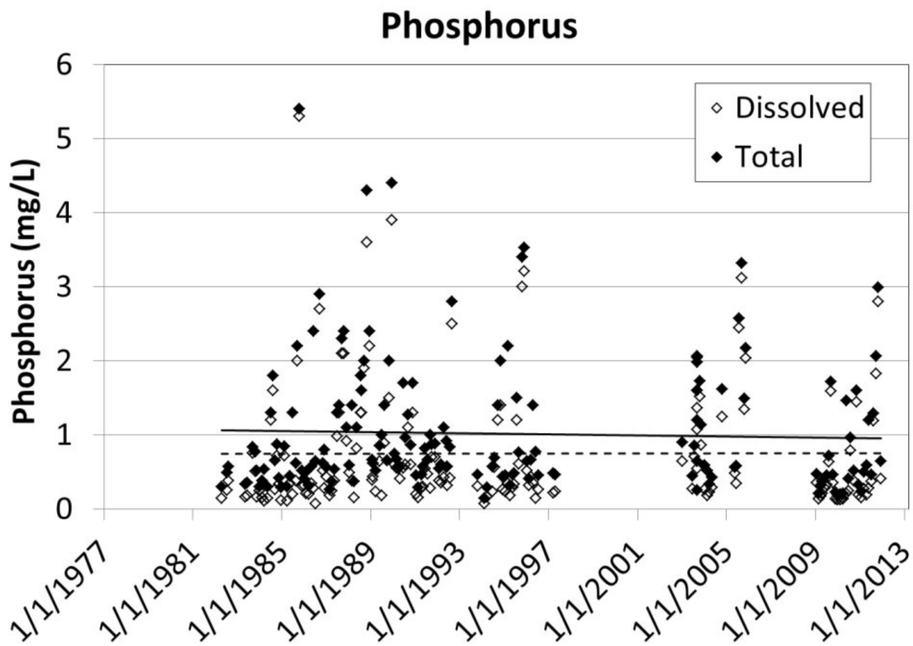


Figure A.59. Dissolved and Total phosphorus concentrations in water samples collected from Silver Creek adjacent to the USGS gage 05594450 by the IWSC and IEPA.

Table A.61. A comparison of water quality in various subcatchments of the Silver Creek Watershed. Water quality is categorized into Agricultural, Village, and Urban land uses. The number of subcatchments in each category is listed in parentheses. Data is from the SIU-Carbondale study published in 2011.[199]

Water quality parameter	Agriculture (21)	Village (12)	Urban (10)	p value*
	Base flow			
Turbidity (NTU)	19.5	12.2	10.8	<0.0001
TSS (mg/L)	17.4	14.2	14.3	0.0028
Fecal coliform (CFU)	736	944	1,594	0.1892
Escherichia coli (MPN)	497	471	571	0.0585
NH4–N (mg/L)	0.24	0.41	0.32	0.0020
NO3–N (mg/L)	0.47	0.48	0.66	0.0015
Ortho-P (mg/L)	0.48	0.76	1.88	<0.0001
	Storm flow			
Turbidity (NTU)	190	219	109	0.0002
TSS (mg/l)	163	227	168	0.2347
Fecal coliform (CFU)	1,900	1,630	1,683	0.7693
E. coli (MPN)	4,580	3,366	1,911	0.5815
NH_4–N (mg/L)	0.39	0.38	0.43	0.4801
NO_3–N (mg/L)	0.40	0.41	0.46	0.4028
Ortho-P (mg/L)	1.17	1.20	1.13	0.7029

*p values less than 0.05 indicate that the difference among the three land uses can be considered significantly different.

Biological indicators of water quality

Chemical Oxygen Demand (COD) was measured from 1977 to 1993 and there was no significant trend over time (Figure A.60). Most values were below 50 mg/L, but some values ranged from 50 to 125 mg/L (Table A.61). A single extremely high value of 260 mg/L was observed on a single day in 1986 that corresponded to a major hydrological event. COD is typically below 20 mg/L in unpolluted waters, so the values measured in Silver Creek indicate there is a significant organic carbon load in the stream for much of the time.

Dissolved oxygen (DO) was measured from 10/12/1978 to 12/15/2011 during three distinct periods. DO values less than 2 mg/L indicate hypoxic conditions, but no samples in the Silver Creek watershed had DO values below 2 mg/L (the minimum values was 2 mg/L). There was no significant trend over time, except for seasonal trends with DO values generally higher in the cooler winter months and lower during the hot summer months (Figure A.60). This is because warmer water can hold less DO. When shade trees are cut down next to streams, this has the same effect – the water becomes warmer and DO levels decrease. The median DO in the stream between 1972 and 2011 is 7.5 mg/L. It is unclear why DO was included on the list of impairments for the Silver Creek watershed, especially since the later IEPA measurement were never below 4 mg/L.

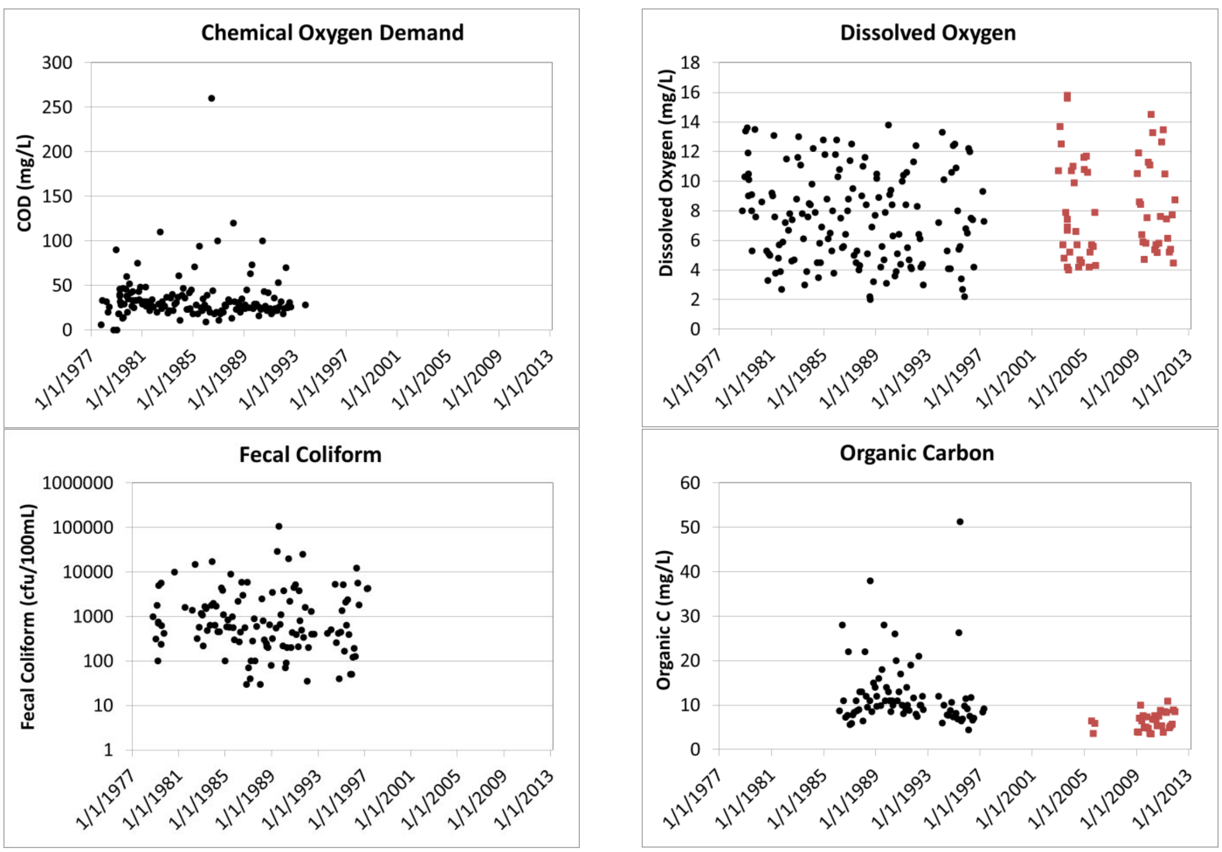


Figure A.60. Some water quality parameters relating to biological activity in water samples collected by the IWSC and IEPA at the Silver Creek USGS Gage 05594450 from 1977 to 2011.

Fecal coliforms were measured from 10/12/1978 to 4/22/1997 as the number of colony forming units per 100mL (cfu/100mL). Reported values ranged from 30 to 106,000 cfu/100mL. Before switching to other indicators of fecal contamination, the EPA used a threshold of 200 cfu/100mL to indicate unacceptable water quality for fishing and swimming. During the period from 1978 to 1997 when fecal coliforms were monitored, over 80% of the samples had concentrations above the minimum acceptable threshold (Figure A.60). Bacterial contamination have not been reported since 1997. Fecal coliforms were listed as an impairment on the 2004 303(d) list, but has not been re-listed since then.

Organic carbon is both an important indicator of biological activity as well as a substrate for microbial activity. Measurements by the USGS-IWSC from 1986 to 1997 varied widely but tended to be less than 15 mg/L (Figure A.60). Nearly all of the samples collected by IEPA from 2005 to 2011 were less than 10 mg/L. It is unclear whether the difference is due to actual changes in the organic carbon concentration in Silver Creek, or rather, due to the use of different laboratory methods. In general, the organic carbon values are typical of rivers in the Midwest.

Aquatic macroinvertebrate communities are also indicators of water quality. Macroinvertebrates are organisms without a backbone that are visible to the naked eye. Those that live in streams include the immature and adult stages of many flies, beetles, stoneflies, caddisflies, mayflies, dragonflies, aquatic worms, snails, and leeches. In the Intensive River Basin Survey of 2007 at the Silver Creek site, Illinois EPA found an MBI score of 33.9, indicating moderate impairment. Illinois RiverWatch volunteers conducted surveys of macroinvertebrates 22 times at two sites in the watershed between 1996 and 2014. The volunteer groups counted the number of individuals of different types of macroinvertebrate in the riffles of the stream sites, and calculated several metrics to describe the communities found. These are:

- **Taxa richness** – Taxa richness measures the abundance of a variety of different organisms as determined by the total number of taxa represented in a sample. Generally, taxa richness increases as water quality, habitat diversity, and habitat suitability increase. Low taxa richness generally indicates low water quality.
- **EPT taxa richness** – Ephemeroptera, Plecoptera, and Trichoptera (EPT) are the three most pollution-sensitive insect orders. The abundance of these orders in a population is an indicator of water quality. The lower the EPT taxa richness, the lower the number of EPT insects sampled, and the worse the water quality.
- **MBI** – Macroinvertebrate Biotic Index, a measure of water quality based on taxa richness, EPT taxa richness, and number of organisms sampled, as calculated through Illinois RiverWatch criteria.[200]
- **Dominance score (3 taxa)** – Percentage of the sample that is comprised of the 3 most abundant taxa identified. Calculated for 1993-2000 data only. This measure is useful because as habitat or water quality become more limited or impaired, more tolerant or opportunistic species replace sensitive or specialized species. As diversity declines, a few taxa will begin to dominate the population.
- **Biological score** – Percentile score of how that site ranked compared to a statewide selection of random samples for a range of habitat metrics. If the biological score is 78, that site ranked better than 78% of RiverWatch stream sites for macroinvertebrate community. Calculated as the weighted average of the percentile scores for MBI, EPT taxa richness, total taxa richness, percent dominance, and percent worms, where the first two are rated double. It has been normalized by the mean and standard deviation of the randomly selected sites. This score is commonly used by RiverWatch and follows IDNR guidelines. Calculated for 1993-2000 data only.

- **Habitat score** – Percentile score of how that site ranked compared to a statewide selection of random samples for a range of biological metrics. If the biological score is 85, that site ranked better than 85% of RiverWatch stream sites for habitat. The habitat score is based on several physical characteristics of the stream and its habitat, including surrounding land uses, channel disturbances, stream substrate, water odor, water color, and canopy cover. It has been normalized by the mean and standard deviation of the randomly selected sites. Calculated for 1993-2000 data only.

The metrics from the RiverWatch data indicate that the macroinvertebrate species richness and habitat, and associated water quality, at the three sites sampled is typically poor to fair (Table A.62). Taxa richness at the sites was typically poor, while EPT taxa richness ranged between very poor and fair over time. The dominance scores at Knights Creek and Wendell Branch showed that the 3 most abundant taxa comprised approximately 80% of the total macroinvertebrate populations, indicating poor diversity.

The average MBI scores indicated fair water quality, but those scores increased to high, “very poor” water quality ratings from time to time over the monitoring period. The biological scores showed the two sites have biological richness and diversity below the Illinois average of RiverWatch sites. The Knights Creek site was below the Illinois average for habitat scores, too, but the Wendell Branch site averaged the 85th percentile for Illinois in habitat.

Table A.61. Metrics based on macroinvertebrate populations sampled in the Upper Silver Creek watershed.

STREAM NAME	FIELD DATE	# ORGANISMS SAMPLED	TAXA RICHNESS	EPT TAXA RICHNESS	MBI	DOMINANCE SCORE	BIOLOGICAL SCORE	HABITAT SCORE
Knights Cr	2000-05-23	100	7	2	5.79	84.0%	45.3	4.1
Knights Cr	2001-05-29	96	14	2	6.18	67.7%	48.0	55.5
Knights Cr	2002-05-20	50	5	1	5.91	92.0%	23.1	67.5
Knights Cr	2003-05-15	76	10	1	7.68	75.0%	19.6	27.7
Knights Cr	2006-05-17	260	13	3	6.33			
Knights Cr	2007-05-16	0						
Knights Cr	2008-05-01	35	8	1	6.43			
Knights Cr	2009-05-12	167	9	3	6.03			
Knights Cr	2010-05-11	224	6	1	5.95			
Knights Cr	2011-05-04	159	10	3	6.38			
Knights Cr	2012-05-02	126	10	2	5.63			
Knights Cr	2013-05-06	82	5	0	6.23			
Knights Cr	2014-05-07	86	8	1	5.69			
Average		112.4	8.8	1.7	6.2	80%	34.0	38.7
Description of average			Poor/Fair	Very Poor/Poor	Fair water quality			
Range			5 to 14	0 - 3	5.63 - 7.68			
Description of range			Very Poor - Excellent	Very Poor - Fair	Fair - very poor water quality			
Wendell Br	1996-07-03	39	6	1	5.85	92.3%	23.5	55.5
Wendell Br	1997-06-30	74	12	3	6.32	63.5%	67.7	83.5
Wendell Br	1999-06-30	97.00	7	3	5.65	88.7%	56.4	67.5
Wendell Br	2000-06-11	146	5	2	5.91	97.9%	38.8	97.2
Wendell Br	2001-05-12	373	9	3	6.09	96.8%	35.2	97.2
Wendell Br	2002-06-04	75	8	2	5.99	80.0%	40.7	97.2
Wendell Br	2003-05-25	72	11	2	6.88	65.3%	27.6	97.2
Wendell Br	2013-07-11	14	3	0	6.14			
Wendell Br	2014-05-19	19	10	2	7.47			
Average		101.0	7.9	2.0	6.3	83%	41.4	85.0
Description of average			Poor	Poor	Fair water quality			
Range			3 to 12	0 - 3	5.85 - 7.47			
Description of range			Very Poor to Good	Very Poor - Fair	Fair - very poor water quality			

Earth and trace Metals

Water quality monitoring by the USGS-IWSC and IEPA at the USGS gage 05594450 included a large number of common earth metals (Table A.63) as well as trace and heavy metals (Table A.64). In most cases, both dissolved and total forms were reported. Earth metals are typically found in high concentrations throughout the environment because they are common ingredients in soils and plants. Trace and heavy metals are also relatively ubiquitous in the natural environment, but they tend not to be found in high concentrations. High concentrations of trace and heavy metals usually indicate some type of industrial contamination. This large Silver Creek dataset showed that these naturally occurring elements were all within normal ranges found in natural environments.

Manganese, which is listed as one of the impairments for Silver Creek, is a mineral that naturally occurs in rocks and soil. In trace amounts, it is essential to the health of plants and animals. It has similar properties to iron, and is used in compounds for uses including metal alloys, antiseptic creams, preservatives, batteries, fireworks, fertilizers, and animal feed. Manganese was listed as an impairment in 2010, 2012, and 2014. Measurements taken prior to 1997 are higher than those taken more recently, perhaps as a result of more accurate measurement procedures. The method detection level prior to 1997 was >1 µg/L, and for the 2009 to 2011 data it was 0.05 µg/L.

Sources of manganese include atmospheric deposition (particles in the air from industry and coal-burning power plants), groundwater as it flows through rocks and soils with high natural manganese, -discharges from industrial operations (including the production of metal alloys, antiseptic creams, preservatives, batteries, fireworks, fertilizers, and animal feed), and runoff from fertilizer on cropland. When water contains too much manganese, it leaves stains on everything with which it comes in contact, including pipelines, faucets, and fabrics. At concentrations exceeding 0.15 ppm, manganese imparts an undesirable taste to beverages and stains plumbing fixtures. The value recommended by the FAO is 0.1 ppm. The US EPA Secondary Maximum Contaminant Level (MCL), a recommended concentration set of drinking water for aesthetic reasons (ie to avoid staining to pipes) is 0.05mg/L (0.05 ppm).[201] The median manganese concentration in Silver Creek between 1977 and 2011 is 0.29 ppm (290 ug/L) dissolved manganese, while the maximum observed manganese was 3.2 ppm (3200 ug/L) dissolved manganese – well above the EPA and FAO recommended levels for drinking water (Figure A.61). However, surface water samples typically range from 1 to 200 µg/L.

Figure A.61. Manganese concentrations measured at the Troy USGS gauge from 1977 to 2013.

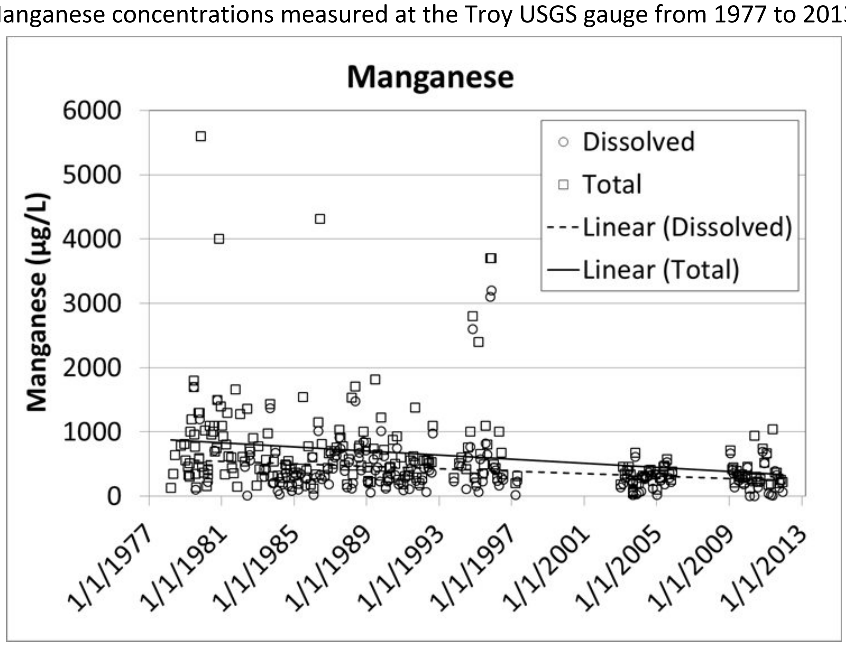


Table A.63. Statistical summary of earth metal concentrations monitored in Silver Creek adjacent to the USGS Gage 05594450 between 1977 and 2011 by the Illinois Water Science Center and IEPA.

Characteristic	Units	n	Min	10th Pctl	25th Pctl	Median	75th Pctl	90th Pctl	Max	Mean
Earth Metals										
Aluminum, Dissolved	µg/L	159	1.39	18	25	25	83	208	870	77
Aluminum, Total	µg/L	161	25	300	670	1500	2800	7500	54000	3511
Iron, Dissolved	µg/L	102	3.53	21	60	86.2	150	180	870	113
Iron, Total	µg/L	226	270	630	1070	1910	3400	8310	68000	4220
Mn, Dissolved	µg/L	169	2.59	78	190	290	511	740	3200	417
Mn, Total	µg/L	227	100	210	310	480	780	1280	5600	674
K, Dissolved	mg/L	169	0.63	3.5	4.5	6.1	8.5	12	27	7.1
K, Total	mg/L	198	1.6	4.2	5.2	7	10	12	26	7.9
Na, Dissolved	mg/L	169	2.5	10	22	38	60	130	226	51.4
Na, Total	mg/L	199	3.3	12	24	40	65.2	135	222	55.7
Calcium, Dissolved	mg/L	169	9.4	24	40.6	63	75.2	89	122	58.8
Calcium, Total	mg/L	199	12	30	47	66	79.2	95.2	123	64.1
Chloride, Dissolved	mg/L	169	6.2	16.1	26	43.1	89	220	281	72.1
Chloride, Total	mg/L	55	6.5	24.6	46.9	68.3	108	220	348	96.4
Fluoride, Dissolved	mg/L	2	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Fluoride, Total	mg/L	4	0.4	0.4	0.45	0.55	0.7	0.79	0.79	0.57
Oil+grea, Total	mg/L	98	0	0	0	1	2	7	80	3.7
Phenols, Total	µg/L	12	1.66	1.83	2	2.58	3.35	4.07	4.57	2.75
Sulfate, Dissolved	mg/L	171	12	39	64	99	133	165	335	102
Sulfate, Total	mg/L	54	9.76	19	37.1	50.5	72.6	101	138	57

Table A.64. 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 IEPA.

Characteristic	Units	n	Min	10th Pctl	25th Pctl	Median	75th Pctl	90th Pctl	Max	Mean
Trace and Heavy Metals										
Arsenic, Dissolved	µg/L	22	1.14	1.37	1.65	2.41	3.02	3.75	4.85	2.45
Arsenic, Total	µg/L	31	0.47	1.82	2.23	3	4.68	5.39	12	3.7
Barium, Dissolved	µg/L	166	2.5	50	62	80.5	97	120	149	80.9
Barium, Total	µg/L	199	50	50	93.6	100	120	200	900	123.5
Beryllium, Dissolved	µg/L	163	0.04	0.1	0.5	0.5	0.5	0.5	5	0.47
Beryllium, Total	µg/L	51	0.04	0.04	0.04	0.5	0.5	0.5	0.69	0.35
Boron, Dissolved	µg/L	148	19.2	40	56	80	130.5	230	460	114
Boron, Total	µg/L	185	0	47.8	60	100	160	290	510	132
Cadmium, Dissolved	µg/L	10	0.2	0.23	0.28	0.71	2.9	4	5	1.46
Cadmium, Total	µg/L	32	0	0	0	0.45	4.14	5	5	1.6
Chromium, Dissolved	µg/L	24	0.44	0.58	0.82	1.14	5	5	5	2.66
Chromium, Total	µg/L	81	0	0	1.6	6	11	20	100	10.1
Cobalt, Dissolved	µg/L	21	0.23	0.29	0.54	0.97	5	7.5	10	2.63
Cobalt, Total	µg/L	48	0.36	0.64	0.94	5	10	20	40	6.26
Copper, Dissolved	µg/L	31	0.94	2.3	3.23	5	7.2	11	13	5.57
Copper, Total	µg/L	85	0	0	5	5.2	10	30	80	10.6
Lead, Dissolved	µg/L	22	0.26	0.45	0.67	1.21	2.34	3.81	4.1	1.60
Lead, Total	µg/L	56	0	0	0	1.79	5.72	11.8	400	17.7
Manganese, Dissolved	ugL	169	2.59	78	190	290	511	740	3200	416.6
Manganese, Total	ugL	227	100	210	310	480	780	1280	5600	673.57
Nickel, Dissolved	µg/L	28	1.02	1.18	2	2.81	3.69	6.7	100	6.4
Nickel, Total	µg/L	45	0	0	0	3.43	6.9	9	100	6.8
Strontium, Dissolved	µg/L	167	20	66	110	170	207	229	290	159
Strontium, Total	µg/L	199	35	92	140	180	212	240	290	175
Vanadium, Dissolved	µg/L	40	0.37	1.53	2.71	5	7	10	14	5.3
Vanadium, Total	µg/L	74	0.68	4.4	8.3	10	20	50	130	19.3
Zinc, Dissolved	µg/L	44	0.86	2.16	4.7	6.75	26.2	110	240	30.4
Zinc, Total	µg/L	91	0	4.34	10	30	100	130	420	61.3

Water appearance

Water appearance documented by the Illinois RiverWatch volunteers at the two sites in the watershed between 1996 and 2014 was described as clear, dark brown, milky, or foamy (Table A.65). The Wendell Branch site (38.7578, -89.8181) had the greatest proportion of assessments with non-clear water appearance – 7 out of 9, or 88% of visits showed non-clear water such as milky or foamy. At the Silver Creek site near the USGS gauge (“Knights Creek”), the water appeared clear 8 out of 13 times (on 62% of visits). The volunteers also collected qualitative data on the worst weather in the last 24 and 48 hours. When the worst weather in the last 48 hours included rain, 57% of the water appearance descriptions were not “clear”. However, clear or overcast weather did not guarantee clear water; 4 out of 8 (50%) of the monitoring events with no rain in the last 48 hours had a milky appearance (both at the Wendell Branch site). The data show no clear trend of improvement or deterioration of water appearance over time.

Table A.65. Water appearance at the three RiverWatch monitoring sites, compared with worst weather in the last 48 hours at those sites, based on 23 monitoring events.[202]

	Frequency					
	Worst weather in last 48 hours					
Water appearance	CLEAR/SUNNY	OVERCAST	RAIN	SHOWERS	STORM	**Total**
CLEAR	1	3	1	4	1	**10**
DARK BROWN				1		**1**
FOAMY			1			**1**
MILKY	2	2	1	1	2	**8**
OTHER			1		1	**2**
Total	**3**	**5**	**4**	**6**	**4**	**22**

Turbidity

Of the 22 monitoring occasions where turbidity was reported by RiverWatch volunteers, 5 marked “clear”, 11 marked “slight”, 5 marked “medium”, and 1 marked “heavy”. The medium and heavy turbidity determinations all occurred within 48 hours of a rain event. The data show no clear trend of improvement or deterioration in turbidity over time.[203]

Agriculture and water quality

Grain agriculture requires the use of nitrogen and phosphorus fertilizers. This results in the annual addition of soluble nutrients to the watershed. A 2010 study published in the Journal of Environmental Quality reported that 75% of the nitrogen inputs into Madison County were a result of fertilizer applications, with another 9.3% from manure, 6.7% from the atmosphere, and 8.6% from human activities (sewage).[204] Similarly, a 2011 study in the Journal of Environmental Quality reported that 73% of phosphorus inputs into Madison County came from fertilizer, 21.2% from manure, and 5.6% from sewage.[205] The tillage practices associated with grain production result in annual disturbance of the soil surface making it more susceptible to sheet and rill erosion during precipitation events. The 2012 Illinois Department of Agriculture Soil Conservation Transect Survey reported that 75% of corn and 37% of soybeans in Madison County are produced using conventional tillage practices that result in significant soil disturbance.[206] These values are much higher than the state averages of 49.1% for corn and 21.5% for soybean. Inversely, the amount of no till crop production is 1% for corn and 7% for soybean, which is much lower than the state averages of 10.8% for corn and 38.6% for soybean. It is apparent that row crop agriculture in Madison County has the greatest impact on surface water quality.

Urbanization and water quality

The greatest detriment to water quality from urbanization is an increase in the amount of impervious surfaces such as asphalt. Impervious surfaces prevent the natural process of rain infiltration into the soil. Instead, rainfall is rapidly directed into stormwater sewer systems that deliver the water directly to streams. 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. The 2011 SIU-Carbondale study showed that during periods of base flow, both nitrate and orthophosphate concentrations in urban watersheds were higher than in agricultural subwatersheds of the Silver Creek watershed.[207] Sewer and septic systems in urban-dominated watersheds likely contribute significant amounts of nitrate and phosphate to stream base flows.

Private sewage systems

Given that so much of the Upper Silver Creek watershed is rural, many houses are a considerable distance from municipal sewer lines. Private sewage systems, commonly septic tanks, are the predominant type of sewage system throughout the watershed (Figure A.62). In the Madison County portion of the Upper Silver Creek watershed, there are approximately 3,579 private sewage systems, of which most are private individual systems, 120 are private central sewage systems shared between two or more households, and 110 are public sewage systems (with no data on numbers of households served). The private sewage systems are located throughout the watershed, with greater concentrations in subdivisions outside of municipal limits. Private sewage systems can release nutrients and bacteria to waterways if not properly maintained. USEPA reports that state agencies found that failing septic systems are the third most common source of groundwater contamination, and that approximately 10% of all septic systems nationally are failing.[208]

Private Sewage Systems

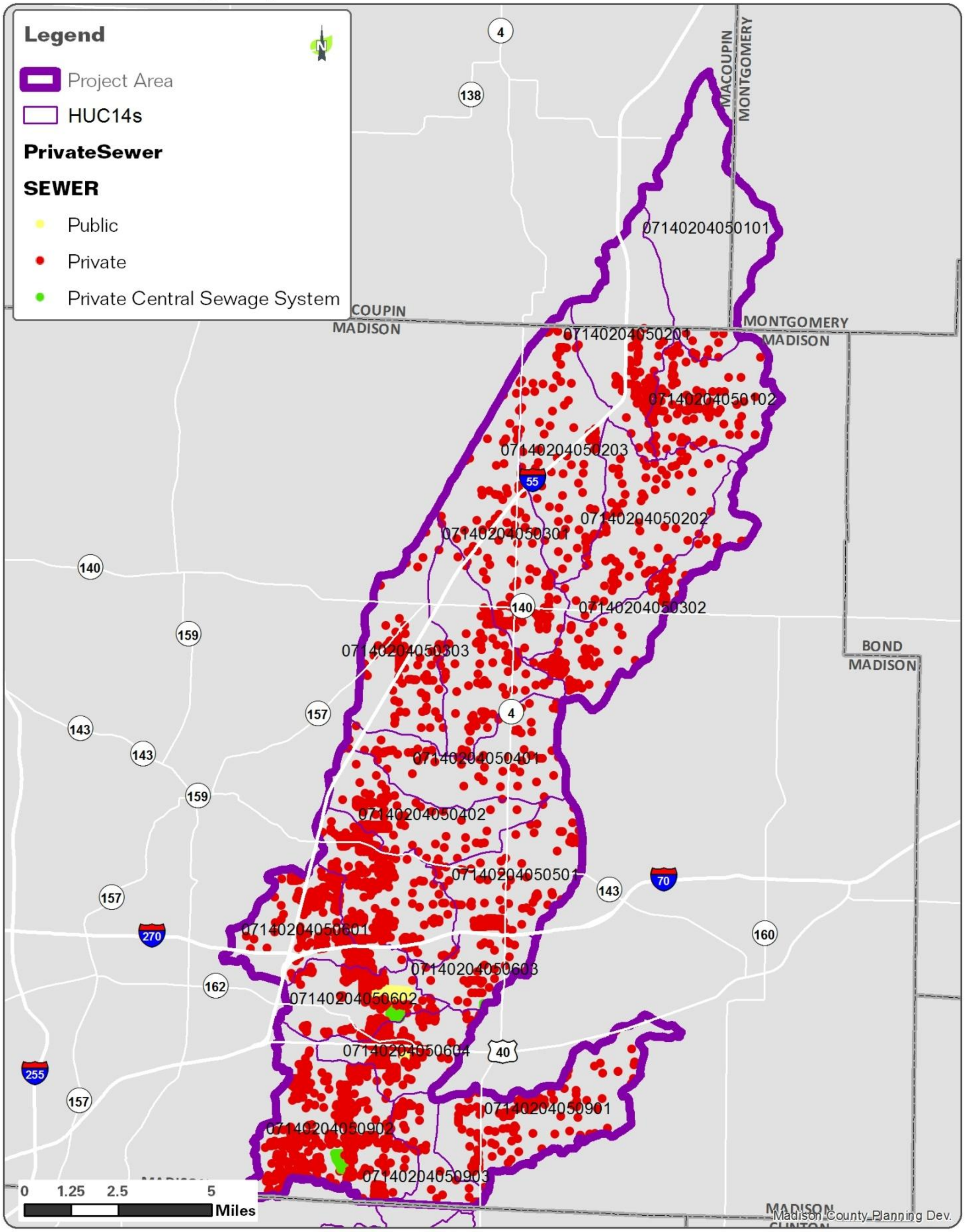


Figure A.62. Private sewage systems in Madison County. Data layer created in 2014 using permits and other information available to Madison County.[209]

NPDES permitted discharges

There are 10 facilities with National Pollution Discharge Elimination System (NPDES) permits to discharge into the Upper Silver Creek watershed (Table A.66). Six of them are water or sewage treatment plants. Several other facilities in the watershed have been issued NPDES permits in the past which have now expired. None of the facilities have exceeded the capacity for which they were designed. The permit limits can be downloaded from the Discharge Monitoring Report (DMR) Pollutant Loading Tool.[210]

Several pollutants are required to be monitored at these facilities, including residual chlorine, biological oxygen demand, fecal coliform, ammonia nitrogen, suspended solids, pH, dissolved oxygen, and total flow. Suspended solids monitored at the facilities are shown in Table A.67. Five out of the 10 permitted facilities monitored total suspended solids, and the average total of the total suspended solids from these five facilities was 55.77 lb/d. Translated into a yearly value, that's 10.18 t/year. As a proportion of total sediment load estimated by STEPL for the entire watershed, these NPDES permitted facilities contribute 0.017% of the watershed's sediment load (10.18 out of 60,230 t/year).

The Troy Sewage Treatment Plant (STP) was the only facility to track manganese, nitrogen, nitrate, and phosphorus discharge from 2007 to 2014, with some gaps (Table A.68). These pollutants are not subject to limits in the permit. On average, between 2012 and 2014, Troy STP discharged 104,355 lbs/year of nitrogen and 41,304 lbs/year of phosphorus. In 2013, a high loading year, the plant discharged more than twice as much nitrogen and phosphorus. As a proportion of total nitrogen load estimated by STEPL for the entire watershed, Troy STP contributed 9% of the watershed's nitrogen load (104,355 lbs/year out of 1,178,496 lbs/year) and 15% of the watershed's phosphorus load (41,304 lbs/year out of 264,952 lbs/year) .

Table A.66. NPDES permitted discharges to the Upper Silver Creek watershed.[211] WTP: Water Treatment Plant. STP: Sewage Treatment Plant. Data from U.S. EPA's Integrated Compliance Information System (ICIS) and Permit Compliance System (PCS) databases, which include NPDES data. The PCS/ICIS database provides information on companies which have been permitted to discharge waste water into rivers.[212]

HUC 12	Site name	Permit number	Permit expiry date	Residents served	Design Flow (MGD)	Average Daily Flow (MGD)
071402040501	City of Mount Olive	ILG870626	OCT-30-2016			
071402040502	Alhambra STP, Village of	ILG580004	JUN-30-2018	603		0.011
071402040502	Alhambra WTP	ILG640029	APR-30-2017		0.22	0.072
071402040502	Livingston STP	ILG580115	JUN-30-2018		0.66	0.14
071402040503	Hamel STP	ILG580011	JUN-30-2018		0.26	0.105
071402040506	B-Line Systems, INC.	ILP000151				
071402040506	Jarvis Township Road District	ILG870746	OCT-30-2016	917		
071402040506	Manors at Kensington Parque	IL0074993	AUG-31-2018		0.059	0.023
071402040506	Triad High School Dist 2 STP	ILG551025	JUN-30-2018		0.048	0.019
071402040506	Troy STP, City of	IL0031488	DEC-31-2016 & DEC-31-2015	6,086	3.902	1.35

Table A.67. Total Suspended Solids as averages from measurements from the PCS/ICIS.

HUC12	Name of facility	Permit #	Average total suspended solids discharge (lb/d)	Dates of data used
071402040501	City of Mount Olive	ILG870626		March 4, 2014 - January 31, 2015
071402040502	Alhambra STP, Village of	ILG580004	3.8	July 29, 2014 - January 31, 2015
071402040502	Alhambra WTP	ILG640029		
071402040502	Livingston STP	ILG580115	41.1	
071402040503	Hamel STP	ILG580011	10.4	Feb 14, 2014 - January 31, 2015
071402040506	B-Line Systems, INC.	ILP000151		March 28, 2013 - January 31, 2015
071402040506	Jarvis Township Road District	ILG870746		Feb 24, 2014 - January 31, 2015
071402040506	Manors at Kensington Parque	IL0074993	0.36	Sept 12, 2013 - January 31, 2015
071402040506	Triad High School Dist 2 STP	ILG551025	0.11	April 11, 2014 - January 31, 2015
071402040506	Troy STP, City of	IL0031488		Jan 1, 2011 - January 31, 2015
TOTAL			55.77	

Table A.68. Pollutant loads of nitrogen, nitrate, phosphorus, and zinc from Troy Sewage Treatment Plant from 2007 to October 2014.[213] Note that some pollutant measurements might overlap with other pollutant measurements. Consequently, the amounts of all the pollutants in this table should not be summed, as this would result in an overestimation of the total amount of pollution discharged. For other pollutants monitored, see the DMR.

Chemical Name	Total Discharged (lbs/year)								Average (lbs/year)
	2007	2008	2009	2010	2011	2012	2013	2014	
Manganese & manganese compounds	-	-	11.8	23.5	-	-	-	-	18
Nitrate compounds	-	-	-	-	-	54,389	251,536	42,369	116,098
Nitrogen	-	-	-	-	-	10,891	254,199	47,977	104,355
Phosphorus	-	-	-	-	-	102,602	12,428	8,882	41,304

Alhambra STP, Livingston STP, and Troy STP were assessed in the 2008 Clean Watershed Needs Survey. The survey identified no changes needed at the Livingston and Troy STPs, but $874,797 of needs at Alhambra STP (in 2008 dollars). Troy STP has advanced treatment methods for BOD Removal, Ammonia Organic Removal, and Nutrient Removal, while the other two STPs do not have any.[214] In the past five years, four of the ten facilities have had known pollutant exceedences.[215]

Outfalls

"Outfall" means a point source as defined by 40 CFR 122.2 at the point where a municipal separate storm sewer discharges to waters of the United States, according to the federal definition. 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.[216]

NPDES outfall locations are available to download from Illinois' Resource Management Mapping Service (RMMS). There are 13 within the watershed (Table A.69). (Madison County also created a georeferenced outfalls file covering the county some years ago, but it is not clear that the makers of this file used the federal definition of outfalls, and the file is not accompanied by metadata that could explain its attributes.)

Four of the outfalls are within municipal boundaries; three associated with Troy sewage and water treatment, and the Alhambra Water Treatment Plant (Figure A.63).

Table A.69. NPDES outfalls in the watershed. STP = Sewage Treatment Plant. WTP = Water Treatment Plant.[217]

HUC14	Facility name	NPID	Description
07140204050201	SUPER 8 MOTEL STP-STAUNTON	IL0066788	STP OUTFALL
07140204050201	LIVINGSTON STP	ILG580115	STP OUTFALL
07140204050302	ALHAMBRA WTP	IL0052299	
07140204050302	ALHAMBRA STP	ILG580004	STP OUTFALL
07140204050304	HAMEL STP	ILG580011	STP OUTFALL
07140204050502	MARINE STP	ILG580228	STP OUTFALL
07140204050502	HOPKINS PARK STP	ILG580217	STP OUTFALL
07140204050601	METRO-EAST AIRPARK STP	IL0075094	STP OUTFALL
07140204050603	TROY STP	IL0031488	EXCESS FLOW(OVER 3.902 MGD)
07140204050603	TROY WTP	IL0060062	TREATED IRON FILTER BACKWASH
07140204050603	MANORS AT KENSINGTON PARQUE	IL0074993	STP OUTFALL
07140204050603	TROY STP	IL0031488	STP OUTFALL
07140204050604	TRIAD COMMUNITY UNIT DIST #2	ILG551025	STP OUTFALL

NPDES outfalls

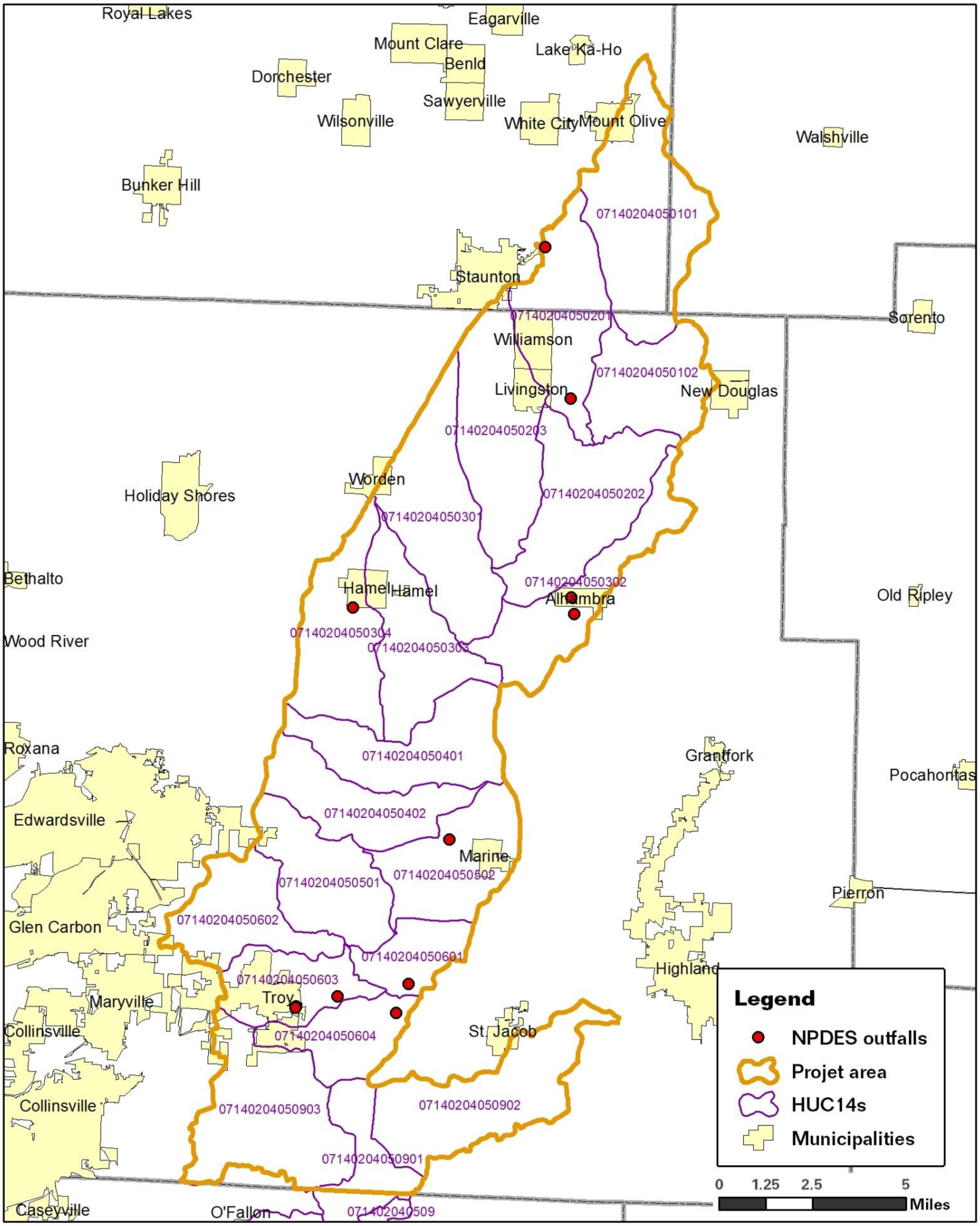


Figure A.63. NPDES outfall locations in the watershed. Only ten locations are visible because some locations are very close together and overlap when viewed with a small scale.

Pollutant loading analysis

Estimating pollutant loads by source

Nutrient (total nitrogen and total phosphorus) and sediment loads (sheet and rill erosion) for the Upper Silver Creek watershed were calculated using the Spreadsheet Tool for Estimating Pollutant Load (STEPL), a tool developed by the U.S. Environmental Protection Agency (EPA).[218] STEPL employs simple algorithms to calculate nitrogen, phosphorus, and sediment loads from different land uses.

Inputs required by the model include land uses, animal operations, precipitation, soil types and Universal Soil Loss Equation (USLE) parameters, septic systems, and direct discharges. Land use data was identified from the most recent National Land Cover Database (NLCD 2011). Animal (livestock) data was obtained from the USDA 2012 Agricultural Census database at the county level.[219] Runoff volumes were based on long-term precipitation records from the Southern Illinois University weather station at Belleville. The annual sediment load (sheet and rill erosion only) is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. USLE parameters were from the Madison County Soil Survey. Data related to septic systems was obtained from the U.S. Census Bureau and the USEPS. The remaining user input parameters were obtained from the online STEPL Input Data Server.[220]

Sediment loads due to streambank erosion were calculated using the NRCS Streambank Erosion Estimator (Direct Volume Method) with one additional factor added to distinguish between stable and actively eroding segments. The helicopter survey of Silver Creek streams classified lateral recession rates of eroding segments as slight, moderate, or severe, but it was impossible to examine the entire stream length of every tributary to confirm whether or not erosion was active. At any given time, not all stream segments are actively eroding. In an Iowa watershed of similar size and geomorphology to the Upper Silver Creek watershed, 40% of the assessed streambanks were actively eroding when assessed in 2010.[221] Therefore, it was assumed that for the Upper Silver Creek watershed, 40% of the total stream length was actively eroding and contributing sediments to the total suspended solids load. To determine the nitrogen and phosphorus load associated with streambank erosion, sediment loads were multiplied by the percent nitrogen or phosphorus in the sediments. Nitrogen and phosphorus concentrations were estimated by using the average organic matter content of the predominant soil types in the Upper Silver Creek watershed.[222] The scientifically accepted conversion factor for organic matter to total nutrient concentration is 5% for nitrogen and 0.5% for phosphorus.

Table A.70. Estimated current annual pollutant load by source at the watershed scale.

Sources	**N Load**		**P Load**		**Sediment Load**	
	(lb/yr)	(%)	(lb/yr)	(%)	(t/yr)	(%)
Cropland	927,787	78.7	231,153	87.2	19,442	32.3
Pastureland	103,687	8.8	8,588	3.2	818	1.4
Forest	3,859	0.3	1,909	0.7	57	0.1
Urban	87,519	7.4	13,813	5.2	2,041	3.4
Feedlots	10,737	0.9	2,147	0.8	-	-
Septic	9,774	0.8	3,828	1.4	-	-
Streambank	35,134	3.0	3,513	1.3	37,871	62.9
Total	**1,178,496**	**100.0**	**264,952**	**100.0**	**60,230**	**100.0**

The STEPL model calculated nutrient loads for each of the primary land uses as used in the NLCD (Table A.70). Cropland was by far the greatest source of nutrients and sediments in the Upper Silver Creek watershed. Cultivated cropland accounts for 58% of the total land surface in the watershed, but contributes 78.7% of the nitrogen load, 87% of the phosphorus load, and 32% of the sediment load. Hay and pastureland cover 14% of the land surface in the watershed, but contribute much smaller amounts of nutrients and sediments due to protection of the soil surface by a permanent vegetative cover. Forest also covers 14% of the watershed, but contributes less than 1% of the nutrient and sediment loads. Developed urban areas cover 12% of the watershed and contribute 7.4% of the nitrogen load, 5.2% of the phosphorus load, and 3.4% 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 the single largest contributor of sediments in the watershed based on the observations and calculations conducted for this report, which produced the estimate that 35% of the stream reaches in the Upper Silver Creek watershed exhibited moderate to severe streambank erosion.

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.71).

Table A.71. Annual pollutant loads by subwatershed, and area of cropland in acres.

HUC14	**Cropland** (acres)	**N Load** (lb/year)	**P Load** (lb/year)	**Sediment Load** (ton/year)
07140204050101	5,764	123,277	28,244	3,819
07140204050102	2,474	55,826	12,534	2,196
07140204050201	3,490	80,642	18,002	1,976
07140204050202	4,238	92,231	20,882	4,490
07140204050203	4,323	102,649	22,073	3,401
07140204050301	5,169	90,296	20,595	3,776
07140204050302	3,872	67,381	15,392	3,048
07140204050303	3,493	63,383	14,127	2,863
07140204050304	4,565	77,084	17,854	2,843
07140204050401	4,735	56,807	13,487	3,279
07140204050402	3,134	42,151	9,349	3,910
07140204050501	2,328	37,256	7,811	3,507
07140204050502	4,285	53,011	12,471	2,388
07140204050601	1,743	21,477	5,117	1,350
07140204050602	2,442	35,866	7,963	2,207
07140204050603	1,203	25,845	5,199	1,931
07140204050604	1,698	25,954	5,710	2,403
07140204050901	1,820	24,189	5,609	2,129
07140204050902	5,650	70,437	16,720	3,699
07140204050903	4,089	32,733	5,814	5,015
TOTAL	**70,516**	**1,178,496**	**264,952**	**60,230**

The relationship between nutrient loads and crop acreage is very strong, as is the relationship between sediment load and cropland. The correlation between total nutrient and sediment loads and all other land uses was weak or nonexistent, and are not shown in Table A.71. This does not indicate that other nutrient and sediment sources are unimportant, but rather that the amounts contributed by non-crop land sources are relatively small compared to cropland.

The HUC14 with the greatest nitrogen loading is 07140204050101, with 121,231 lb/year. The same HUC14 also has the most phosphorus loading (28,039 lb/year), and the most sediment loading (1,749 tons/year). It is important to note that 07140204050101 is also the largest subwatershed in the project area. Even when adjusted for area, it produces the most nitrogen per acre, with 12.6 lb/acre/year. The northernmost HUC14s generally produce more nitrogen per acre than the southern subwatersheds (Figure A.64).

The pattern is the same for phosphorus loading (Figure A.65), with HUC14 07140204050101 producing the most phosphorus in total and per acre, and the northernmost subwatersheds produce more phosphorus than the southern subwatersheds. The amount of phosphorus loading is much smaller than the nitrogen loading in terms of pounds.

Areas of high sediment loading are distributed somewhat evenly throughout the watershed, with the highest loading in HUC 07140204050304, and the lowest loading in 07140204050102 and the watersheds around Troy (Figure A.66).

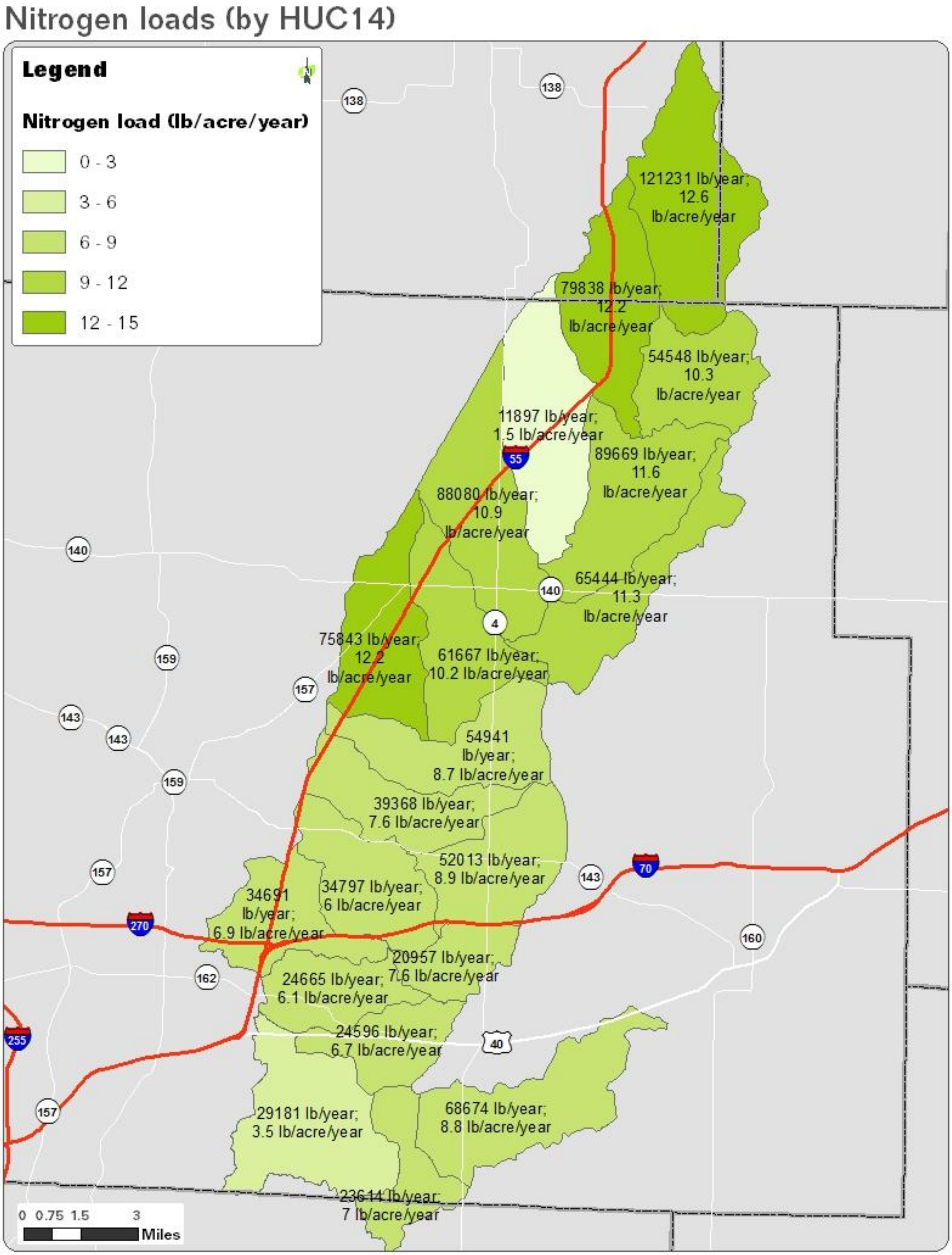


Figure A.64. Nitrogen loads to the HUC14s in the Upper Silver Creek watershed, as modeled using STEPL.

Phosphorus loads (by HUC14)

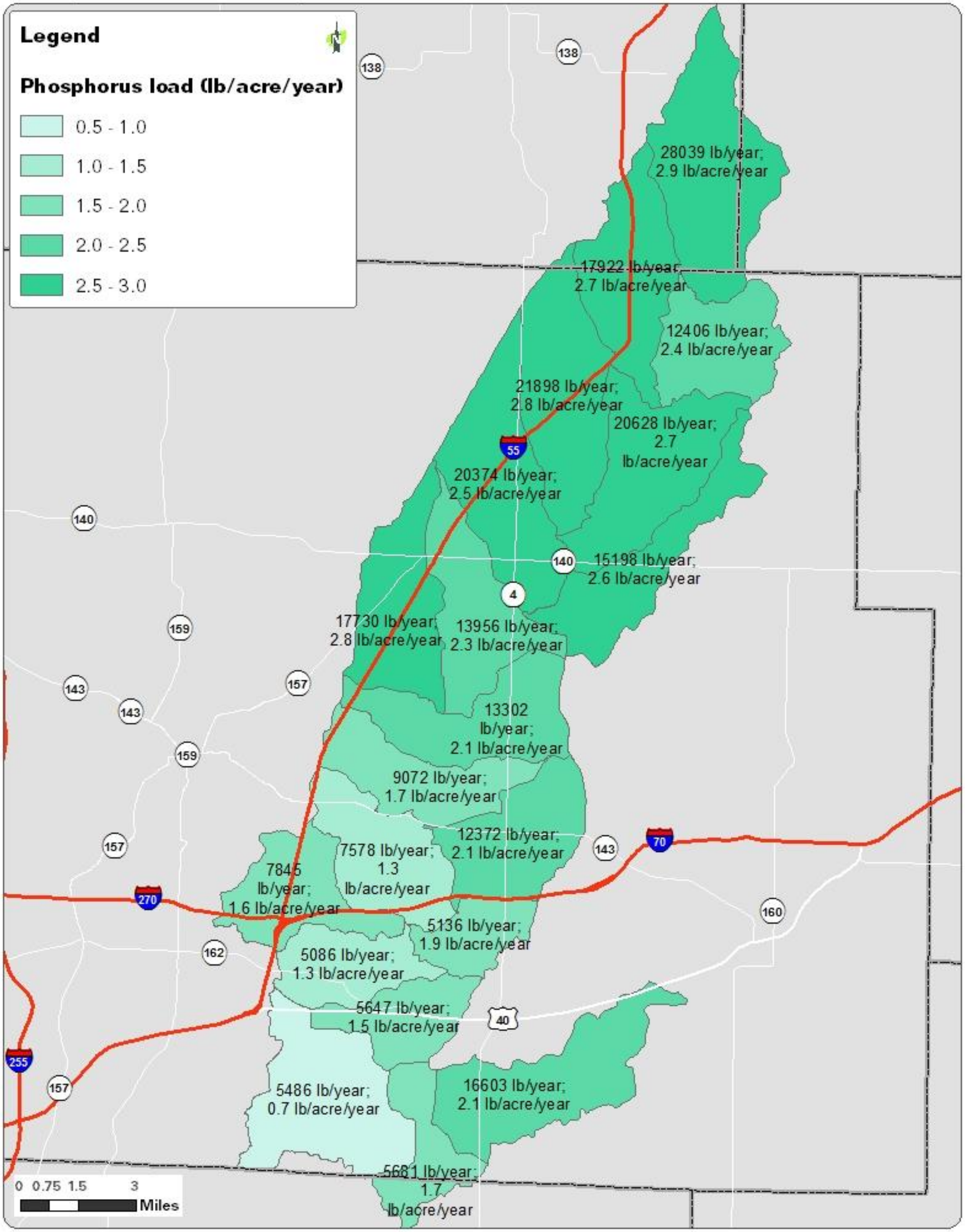


Figure A.65. Phosphorus loads to the HUC14s in the Upper Silver Creek watershed, as modeled using STEPL.

Sediment loads (by HUC14)

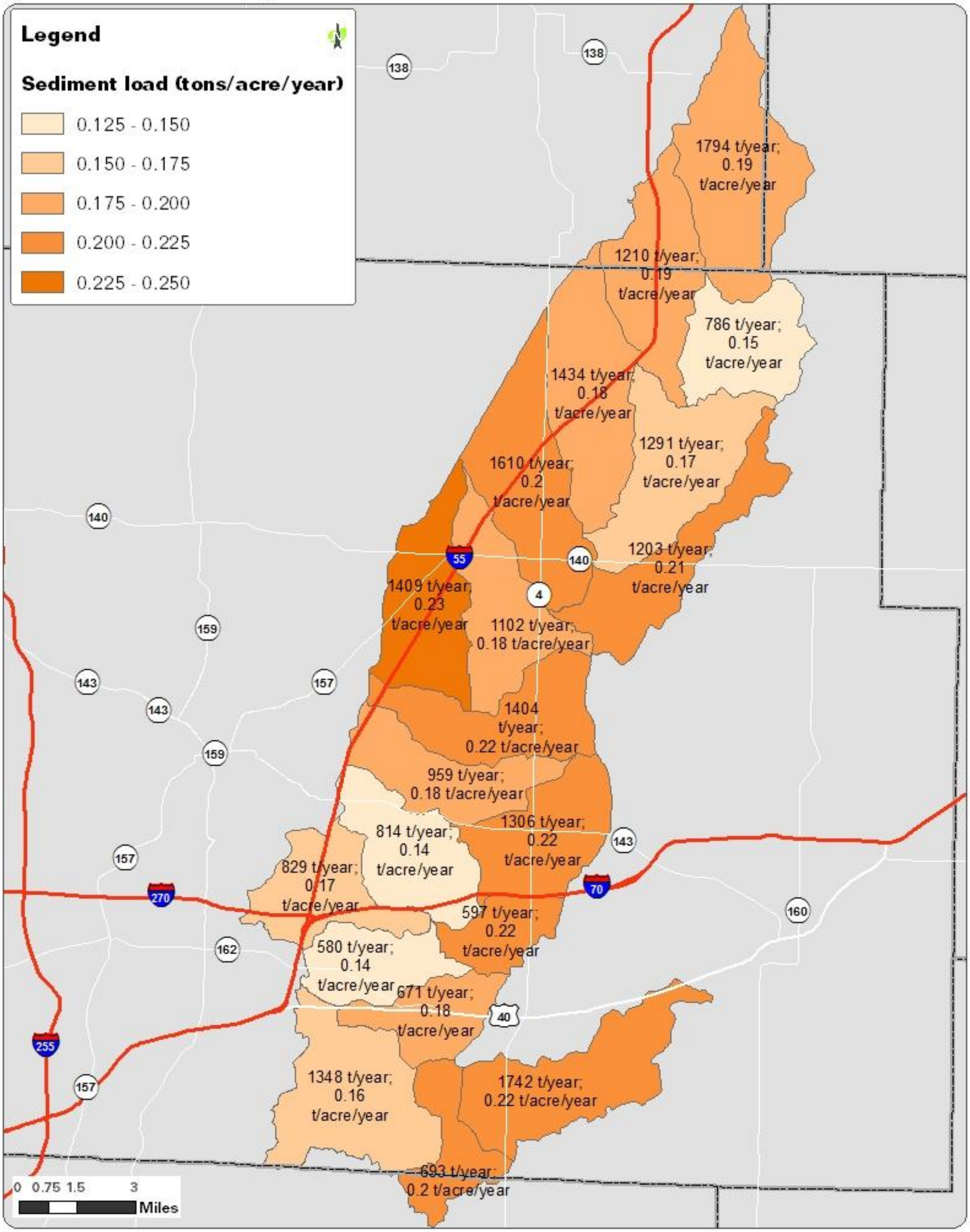


Figure A.66. Sediment loads to the HUC14s in the Upper Silver Creek watershed, as modeled using STEPL.

Data Tables

Hydrologic soil groups by HUC14

Table A.72. Area of hydrologic soil groups by HUC14.

HUC14	Area of Hydrologic Soil Group (acres)							Total area (acres)
	Unclassified*	A	B	B/D	C	C/D	D	
07140204050101	34		2072	114	1409	501	5483	9613
07140204050102	37	114	1623	406	1966	231	895	5273
07140204050201	245	293	1924	307	1109	446	2195	6518
07140204050202	47	321	2906	522	1909	315	1730	7750
07140204050203	79	416	2776	1359	1750	98	1278	7756
07140204050301	63	296	2824	2262	1453	195	959	8050
07140204050302	29	118	1493	663	1709	38	1747	5797
07140204050303	35	141	3011	1022	1512	117	225	6064
07140204050304	28	21	2861	1722	1073	236	284	6225
07140204050401	14		3124	1042	1479	175	457	6291
07140204050402	33		2645	386	1273	744	109	5188
07140204050501	51		4463		256	896	132	5799
07140204050502	13		1896	1141	1609	727	456	5843
07140204050601	17		1054	274	527	823	65	2758
07140204050602	28		4745		239			5012
07140204050603	70		3514		366	69	36	4055
07140204050604	26		2461		241	861	93	3681
07140204050901	8		1211		181	942	8	2350
07140204050902	15		2391	774	2049	1785	748	7762
07140204050903	63		7224		694	290	27	8298
Total	**935**	**1720**	**56217**	**11993**	**22803**	**9488**	**16926**	**120082**

Soil types with hydric category and hydrologic group

Table A.73. Soil types in the watershed with their hydric category and hydrologic group.

Hydrologic Soil Group	Map Symbol Code	Soil Type (SSURGO map unit name)	Hydric Soil?	Non-Hydric Soils area (acres)	Hydric Soils area (acres)	Total area (acres)
A	914D3	Atlas-Grantfork Silty clay loam 10-18% slope severely eroded	No	472		472
A	914C3	Atlas-Grantfork Silty clay loam 5-10% slope severely eroded	No	1248		1248
B	438B	Aviston silt loam 2-5% slopes	No	445		445
B	438C2	Aviston silt loam 5-10% slope eroded	No	159		159
B	3070A	Beaucoup silty clay loam 0-2% slope frequently flooded	Yes		1544	1544
B	1070L	Beaucoup silty clay loam undrained 0-2% slope occasionally flooded long duration	Yes		122	122
B	90A	Bethalto silt loam 0-2% slope	Some*	1418	71	1489
C/D	3334A	Birds silt loam 0-2% slope frequently flooded	Yes		5078	5078
C/D	5C2	Blair silt loam 5-10% slope eroded	No	4		4
C/D	515D3	Bunkum silty clay loam 10-18% severely eroded	No	663		663
C/D	515B3	Bunkum silty clay loam 2-5% severely eroded	No	514		514
C/D	515B3	Bunkum silty clay loam 2-5% slopes eroded	No	10		10
C/D	515C2	Bunkum silty clay loam 5-10% eroded	No	11		11
C/D	515C3	Bunkum silty clay loam 5-10% severely eroded	No	1974		1974
C/D	897D2	Bunkum-Atlas silt loams 10-18% slopes eroded	No	120		120
C/D	897C2	Bunkum-Atlas silt loams 5-10% slopes eroded	No	327		327
C/D	897C3	Bunkum-Atlas silt loams 5-10% slopes severely eroded	No	62		62
C/D	897D3	Bunkum-Atlas sitly clay loams 10-18% slope severely eroded	No	331		331
C/D	657A	Burksville silt loam 0-2% slope	Yes		394	394
D	657A	Burksville silt loam 0-2% slope	Yes		989	989
B	267B	Caseyville silt loam 0-2% slope	No	1825		1825
B		Caseyville silt loam 2-5% slope	No	1556		1556
B	3428A	Coffeen silt loam 0-2% slopes frequently flooded	No	495		495
D	880B2	Coulterville -Darmstadt silt loams 2-5% slope	No	1239		1239
D	878C3	Coulterville-Grantfork silty clay loam 5-10% slope severely eroded	No	932		932

D	112A	Cowden silt loam 0-2% slope	Yes		36	36
B	993A	Cowden-Piasa silt loam 0-2% slope	Yes		282	282
D	993A	Cowden-Piasa silt loam 0-2% slope	Yes		10119	10119
B	283B	Downsouth silt loam 2-5% slope	No	1055		1055
B	283C2	Downsouth silt loam 5-10% slope eroded	No	190		190
Unclassified	536	Dumps	No	227		227
B	384A	Edwardsville silt loam 0-2% slope	No	2461		2461
B	119D2	Elco silty clay loam 10-18% slope eroded	No	776		776
B	119D3	Elco silty clay loam 10-18% slope severely eroded	No	1081		1081
B	119C2	Elco silty clay loam 5-10% slope eroded	No	11		11
B	119C3	Elco silty clay loam 5-10% slope severely eroded	No	2317		2317
D	6B2	Fishhook silt loam 2-5% slope eroded	No	104		104
D	6C2	Fishhook silt loam 5-10% slope eroded	No	89		89
C	7432A	Geff silt loam 0-2% slope rarely flooded	No	43		43
B	127A	Harrison silt loam 0-2% slopes	No	8		8
B	127B	Harrison silt loam 2-5% slopes	No	45		45
B	46A	Herrick silt loam 0-2% slopes	No	3298		3298
B	790A	Herrick-Biddle Silt loam 0-2% slope	No	5		5
B	894A	Herrick-Biddle-Piasa silt loams 0-2% slope	No	7204		7204
B	8D3	Hickory clay loam 10-18% slope severely eroded	No	4		4
B	8D	Hickory silt loam 10-18% slope	No	23		23
B	8D2	Hickory silt loam 10-18% slope eroded	No	163		163
B	8d3	Hickory silt loam 10-18% slope severely eroded	No	391		391
B	8F	Hickory silt loam 18-35% slope	No	2976		2976
B	8F2	Hickory silt loam 18-35% slope eroded	No	100		100
B	8G	Hickory silt loam 35-60% slope	No	38		38
B	582B	Homen silt loam 2-5% slope	No	4053		4053
B	582C2	Homen silt loam 5-10% slope eroded	No	654		654
B	470B2	Keller silt loam 2-5% slopes eroded	No	79		79
B	3451A	Lawson silt loam 0-2% slope frequently flooded	No	1064		1064
C	517A	Marine silt loam 0-2% slope	No	5360		5360
B	517B	Marine silt loam 2-5% slope	No	4		4
C	517B	Marine silt loam 2-5% slope	No	5743		5743
B	385A	Mascoutah silty clay loam 0-2% slope	Yes		1457	1457
B	79F	Menfro silt loam 18-35% slope	No	2320		2320
B	79B	Menfro silt loam 2-5% slope	No	2573		2573
B	79C2	Menfro silt loam 5-10% slope eroded	No	538		538
B	79C3	Menfro silty clay loam 5-10% slope severely eroded	No	13		13
B	79D2	Menfro silty loam 10-18% slope eroded	No	1434		1434

B	79D3	Menfro silty loam 10-18% slope severely eroded	No	413		413
B		Menfro-Hickory silt loam 18-35% slope	No	485		485
B	2079D	Menfro-Orthents Urban land complex 8-15% slopes	No	6		6
Unclassified	M-W	Miscellaneous water	No	22		22
C	113A	Oconee silt loam 0-2% slope	No	37		37
C	113A	Oconee silt loam 0-5% slopes	No	237		237
C	113B	Oconee silt loam 2-5% slope	No	3209		3209
C	882A	Oconee-Coulterville-Darmstadt silt loams 0-2% slope	No	39		39
C	882B	Oconee-Coulterville-Darmstadt silt loams 2-5% slope	No	3036		3036
C	882B2	Oconee-Coulterville-Darmstadt silt loams 2-5% slope eroded	No	103		103
C		Oconeee silt loam 2-5% slopes	No	100		100
C	3415A	Orion silt loam 0-2% slopes frequently flooded	No	1979		1979
B	802D	Orthents loamy hilly	No	174		174
B	802B	Orthents loamy undulating	No	128		128
B	801D	Orthents silty hilly	No	237		237
B	801B	Orthents silty undulating	No	147		147
D	474A	Piasa silt loam 0-2% slope	Yes		691	691
D	31A	Pierron silt loam 0-2% slopes	Yes		1163	1163
D	703A	Pierron-Burksville silt loams 0-2% slope	Yes		862	862
B	583B	Pike silt loam 2-5% slope	No	1		1
B	7434B	Ridgway silt loam 2-5% slope rarely flooded	No	14		14
B	491D2	Ruma silt loam 10-18% slope eroded	No	338		338
B	491D3	Ruma silt loam 10-18% slope severely eroded	No	105		105
B	491B	Ruma silt loam 2-5% slope	No	704		704
B	491C2	Ruma silt loam 5-10% slopes eroded	No	583		583
B		Ruma-Hickory silt loams 18-35% slope	No	211		211
D	16A	Rushville silt loam 0-2% slopes	Yes			0
D	581B	Tamalco silt loam 2-5% slope	No	27		27
D	581B2	Tamalco silt loam 2-5% slope eroded	No	183		183
Unclassified	533	Urban land	No	26		26
B	250D	Velma silt loam 10-18% slopes	No	5		5
B/D	50A	Virden silt loam 0-2% slope	Yes		1903	1903
B/D	885A	Virden-Fosterburg silt loams 0-2% slope	Yes		10059	10059
B	3333A	Wakeland silt loam 0-2% slope frequently flooded	No	65		65
B/D	3333A	Wakeland silt loam 0-2% slope frequently flooded	No	30		30
C	3333A	Wakeland silt loam 0-2% slope frequently flooded	No	2879		2879
D	3333A	Wakeland silt loam 0-2% slope	No	157		157

		frequently flooded				
B	441B	Wakenda silt loam 2-5% slope	No	139		139
C	441B	Wakenda silt loam 2-5% slope	No	18		18
B	441C2	Wakenda silt loam 5-10% slope eroded	No	51		51
C	441C2	Wakenda silt loam 5-10% slope eroded	No	19		19
Unclassified	W	Water	No	661		661
D	165A	Weir silt loam 0-2% slope	Yes		302	302
B	3336A	Wilbur silt loam 0-2% slope frequently flooded	No	10		10
B	477D	Winfield silt loam 10-18% slope severely eroded	No	1129		1129
B	477B	Winfield silt loam 2-5% slope	No	3972		3972
B	477B3	Winfield silt loam 2-5% slope severely eroded	No	28		28
B	477C2	Winfield silt loam 5-10% slope eroded	No	951		951
B	477C3	Winfield silt loam 5-10% slope severely eroded	No	1815		1815
B	2477B	Winfield-Orthents Urban Land 2-8% slope	No	253		253
	Total			**84977**	**35072**	**120050**

Hydric soils by HUC14

Table A.74. Hydric and non-hydric soil areas by HUC14 subwatershed.

HUC14	Area of Non-Hydric Soils (acres)	Area of Hydric Soils (acres)	Total area (acres)
07140204050101	4494	5119	9613
07140204050102	4112	1160	5273
07140204050201	3821	2697	6518
07140204050202	5186	2564	7750
07140204050203	5162	2594	7756
07140204050301	4555	3495	8050
07140204050302	3701	2095	5797
07140204050303	4076	1988	6064
07140204050304	4160	2065	6225
07140204050401	4336	1955	6291
07140204050402	4202	987	5188
07140204050501	4714	1085	5799
07140204050502	4592	1251	5843
07140204050601	1761	997	2758
07140204050602	4806	206	5012
07140204050603	3704	351	4055
07140204050604	2692	990	3681
07140204050901	1447	902	2350
07140204050902	5724	2038	7762
07140204050903	7732	566	8298
Total	84978	35104	120082

Highly erodible soils by HUC14

Table A.75. Area of highly erodible and non-highly erodible soils by HUC14.

HUC14	Highly erodible soils (acres)	Not highly erodible soils (acres)	Total area (acres)
07140204050101	2101	7512	9613
07140204050102	1768	3504	5273
07140204050201	1596	4921	6518
07140204050202	2186	5564	7750
07140204050203	1769	5987	7756
07140204050301	1656	6393	8050
07140204050302	1713	4083	5797
07140204050303	1667	4397	6064
07140204050304	1291	4934	6225
07140204050401	1201	5090	6291
07140204050402	1478	3711	5188
07140204050501	2671	3127	5799
07140204050502	1258	4585	5843
07140204050601	564	2195	2758
07140204050602	2161	2851	5012
07140204050603	1707	2347	4055
07140204050604	1377	2304	3681
07140204050901	477	1873	2350
07140204050902	1874	5888	7762
07140204050903	4314	3984	8298
Grand Total	34832	85250	120082

Land use/land cover by HUC14

Table A.76. Land use/land cover by HUC14 in the watershed. Note: Total watershed area is different from total identified in Watershed Boundaries section as a result of differences in projection of the layer files.

	HUC14	07140204050101	07140204050102	07140204050201	07140204050202	07140204050203	07140204050301	07140204050302	07140204050303	07140204050304	07140204050401
Barren Land	Area (Acres)	2	0	0	0	0	1	0	0	2	0
	Area (%)	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cultivated crop	Area (Acres)	5764	2474	3490	4238	4323	5169	3872	3493	4621	4735
	Area (%)	60.0	47.0	54.13	14.2	55.8	64.2	66.8	57.6	73.4	75.3
Deciduous forest	Area (Acres)	1778	1671	932.8	1955	574	914	515	863	136	536
	Area (%)	18.5	31.7	19.77	25.2	7.4	11.4	8.9	14.2	2.2	8.5
Developed, High Intensity	Area (Acres)	12	0	10.67	0	3	8	2	14	10	4
	Area (%)	0.1	0.0	0.082	0.0	0.0	0.1	0.0	0.2	0.2	0.1
Developed, Low Intensity	Area (Acres)	420	59	495.7	91	459	349	179	211	381	159
	Area (%)	4.4	1.1	4.389	1.2	5.9	4.3	3.1	3.5	6.1	2.5
Developed, Medium Intensity	Area (Acres)	49	12	102.7	6	43	48	43	92	77	21
	Area (%)	0.5	0.2	0.825	0.1	0.6	0.6	0.7	1.5	1.2	0.3
Developed, Open Space	Area (Acres)	417	276	509.1	283	428	385	374	275	361	331
	Area (%)	4.3	5.2	5.729	3.7	5.5	4.8	6.5	4.5	5.7	5.3
Emergent herbaceuous wetlands	Area (Acres)	0	0	0	0	0	0	0	0	2	2
	Area (%)	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Evergreen forest	Area (Acres)	0	0	0.445	0	0	3	3	0	0	0
	Area (%)	0.0	0.0	0.003	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hay/Pasture	Area (Acres)	1114	714	907.2	1097	1898	1084	783	1065	701	484
	Area (%)	11.6	13.5	14.04	14.2	24.5	13.5	13.5	17.6	11.1	7.7
Herbaceous	Area (Acres)	28	43	12.89	32	12	74	4	31	1	4
	Area (%)	0.3	0.8	0.304	0.4	0.1	0.9	0.1	0.5	0.0	0.1
Mixed forest	Area (Acres)	0	0	0	0	0	0	0	0	0	0
	Area (%)	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Open Water	Area (Acres)	23	20	55.8	40	10	13	20	15	5	8
	Area (%)	0.2	0.4	0.683	0.5	0.1	0.2	0.3	0.3	0.1	0.1
Shrub/Scrub	Area (Acres)	0	0	0	0	0	0	0	0	0	0
	Area (%)	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wood wetlands	Area (Acres)	0	1	0	7	0	0	0	3	0	5
	Area (%)	0.0	0.0	0.044	0.1	0.0	0.0	0.0	0.0	0.0	0.1
Total Area (Acres)		**9606**	**5269**	6517	**7748**	**7751**	**8049**	**5795**	**6063**	**6296**	**6290**

Table A.76 (continued). Land use/land cover by HUC14 in the watershed.

	HUC14	0714020405 0402	0714020405 0501	0714020405 0502	0714020405 0601	0714020405 0602	0714020405 0603	0714020405 0604	0714020405 0901	0714020405 0902	0714020405 0903	**Grand Total**
Barren Land	Area (Acres)	3	8	0	0	0	7	0	0	0	0	**23**
	Area (%)	0.1	0.1	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	
Cultivated crop	Area (Acres)	3134	2328	4285	1743	2442	1203	1698	1820	5650	4089	**70572**
	Area (%)	60.4	40.2	73.4	63.2	48.8	29.7	46.9	54.0	72.9	49.2	
Deciduous forest	Area (Acres)	647	1341	151	312	782	539	432	392	380	1617	**16470**
	Area (%)	12.5	23.1	2.6	11.3	15.6	13.3	12.0	11.6	4.9	19.4	
Developed, High Intensity	Area (Acres)	0	4	2	2	21	27	17	0	5	13	**155**
	Area (%)	0.0	0.1	0.0	0.1	0.4	0.7	0.5	0.0	0.1	0.2	
Developed, Low Intensity	Area (Acres)	120	245	490	79	423	992	441	81	146	330	**6148**
	Area (%)	2.3	4.2	8.4	2.9	8.4	24.4	12.2	2.4	1.9	4.0	
Developed, Medium Intensity	Area (Acres)	11	36	54	4	84	197	100	7	10	73	**1068**
	Area (%)	0.2	0.6	0.9	0.1	1.7	4.9	2.8	0.2	0.1	0.9	
Developed, Open Space	Area (Acres)	162	335	260	115	462	641	337	94	363	573	**6981**
	Area (%)	3.1	5.8	4.4	4.2	9.2	15.8	9.3	2.8	4.7	6.9	
Emergent herbaceuous wetlands	Area (Acres)	0	0	0	0	0	0	61	21	7	3	**95**
	Area (%)	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.6	0.1	0.0	
Evergreen forest	Area (Acres)	0	0	0	0	6	5	0	0	0	0	**18**
	Area (%)	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	
Hay/Pasture	Area (Acres)	1071	1397	580	203	761	395	295	446	955	1455	**17404**
	Area (%)	20.6	24.1	9.9	7.4	15.2	9.7	8.2	13.2	12.3	17.5	
Herbaceous	Area (Acres)	19	16	0	6	0	6	23	31	7	18	**368**
	Area (%)	0.4	0.3	0.0	0.2	0.0	0.2	0.6	0.9	0.1	0.2	
Mixed forest	Area (Acres)	0	0	0	0	0	0	0	0	0	0	**0**
	Area (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Open Water	Area (Acres)	18	34	12	17	27	23	52	16	11	46	**466**
	Area (%)	0.3	0.4		0.6	0.5	0.6	1.4	0.5	0.1	0.6	
Shrub/Scrub	Area (Acres)	0	0	0	0	0	0	0	0	0	0	**0**
	Area (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Wood wetlands	Area (Acres)	5	51	5	277	0	20	223	485	227	102	**1411**
	Area (%)	0.1	0.9	0.1	10.0	0.0	0.5	6.2	14.4	2.9	1.2	
Total Area (Acres)		**5189**	**5796**	**5838**	**2757**	**5007**	**4056**	**3679**	**3393**	**7759**	**8319**	**121179**

Future land use/land cover by HUC14

Table A.77. Existing and predicted future land use/land cover by HUC14. Predicted land use/land cover is based on zoning identified in the Comprehensive Plans of municipalities in the watershed for the 1.5 mile zone outside their current boundaries. Total watershed area is different from total identified in Watershed Boundaries section as a result of differences in projection of the layer files. Where current acres in a category are 0 and there is a projected increase, "[increase]" is noted (percentage change cannot be calculated using 0 as a starting point).

Land Use/Land Cover Description by HUC14	Land Use Code	Current Area (Acres)	Current Area (%)	Predicted Area (acres)	Predicted area (%)	Change (acres)	Percent Change
07140204050101		**9606.5**	**100%**	**9606.5**	**100%**	**0.0**	
Barren Land	31	1.6	0%	1.0	0%	-0.5	-34%
Cultivated crop	82	5763.6	60%	3786.6	39%	-1977.0	-34%
Deciduous forest	41	1778.4	19%	1234.3	13%	-544.1	-31%
Developed, High Intensity	24	11.6	0%	7.6	0%	-4.0	-34%
Developed, Low Intensity	22	419.9	4%	2340.8	24%	1920.9	457%
Developed, Medium Intensity	23	49.1	1%	1064.7	11%	1015.6	2067%
Developed, Open Space	21	417.0	4%	274.0	3%	-143.0	-34%
Emergent herbaceous wetlands	95	0.0	0%	0.0	0%	0.0	0%
Evergreen forest	42	0.0	0%	0.0	0%	0.0	0%
Hay/Pasture	81	1113.9	12%	830.7	9%	-283.2	-25%
Herbaceous	71	28.0	0%	18.4	0%	-9.6	-34%
Mixed forest	43	0.0	0%	0.0	0%	0.0	0%
Open Water	11	23.3	0%	31.8	0%	8.5	36%
Shrub/Scrub	52	0.0	0%	0.0	0%	0.0	0%
Wood wetlands	90	0.0	0%	16.5	0%	16.5	0%
07140204050102		**5269.4**	**100%**	**5269.4**	**100%**	**0.0**	
Barren Land	31	0.0	0%	0.0	0%	0.0	0%
Cultivated crop	82	2474.2	47%	1053.6	20%	-1420.6	-57%
Deciduous forest	41	1670.6	32%	771.9	15%	-898.7	-54%
Developed, High Intensity	24	0.0	0%	0.0	0%	0.0	0%
Developed, Low Intensity	22	58.7	1%	1921.0	36%	1862.3	3173%
Developed, Medium Intensity	23	12.0	0%	953.1	18%	941.1	7840%
Developed, Open Space	21	276.3	5%	117.7	2%	-158.7	-57%
Emergent herbaceous wetlands	95	0.0	0%	0.0	0%	0.0	0%
Evergreen forest	42	0.0	0%	0.0	0%	0.0	0%
Hay/Pasture	81	713.6	14%	394.6	7%	-319.0	-45%
Herbaceous	71	42.9	1%	18.3	0%	-24.6	-57%
Mixed forest	43	0.0	0%	0.0	0%	0.0	0%
Open Water	11	20.0	0%	23.6	0%	3.6	18%
Shrub/Scrub	52	0.0	0%	0.0	0%	0.0	0%
Wood wetlands	90	1.1	0%	15.6	0%	14.5	1304%
07140204050201		**6516.5**	**100%**	**6516.9**	**100%**	**0.4**	

Barren Land	31	0.0	0%	0.0	0%	0.0	0%
Cultivated crop	82	3489.7	54%	640.5	10%	-2849.1	-82%
Deciduous forest	41	932.8	14%	277.6	4%	-655.1	-70%
Developed, High Intensity	24	10.7	0%	2.0	0%	-8.7	-82%
Developed, Low Intensity	22	495.7	8%	3425.3	53%	2929.6	591%
Developed, Medium Intensity	23	102.7	2%	1686.0	26%	1583.3	1542%
Developed, Open Space	21	509.1	8%	93.4	1%	-415.6	-82%
Emergent herbaceous wetlands	95	0.0	0%	0.0	0%	0.0	0%
Evergreen forest	42	0.0	0%	0.0	0%	0.0	0%
Hay/Pasture	81	907.2	14%	326.1	5%	-581.1	-64%
Herbaceous	71	12.9	0%	2.4	0%	-10.5	-82%
Mixed forest	43	0.0	0%	0.0	0%	0.0	0%
Open Water	11	55.8	1%	36.8	1%	-19.0	-34%
Shrub/Scrub	52	0.0	0%	0.0	0%	0.0	0%
Wood wetlands	90	0.0	0%	26.6	0%	26.6	0%
07140204050202		**7748.0**	**100%**	**7748.0**	**100%**	**0.0**	
Barren Land	31	0.0	0%	0.0	0%	0.0	0%
Cultivated crop	82	4238.4	55%	2423.6	31%	-1814.8	-43%
Deciduous forest	41	1955.1	25%	1184.3	15%	-770.8	-39%
Developed, High Intensity	24	0.0	0%	0.0	0%	0.0	0%
Developed, Low Intensity	22	90.7	1%	2130.8	28%	2040.1	2249%
Developed, Medium Intensity	23	5.8	0%	1042.8	13%	1037.0	17942%
Developed, Open Space	21	282.5	4%	161.6	2%	-121.0	-43%
Emergent herbaceous wetlands	95	0.0	0%	0.0	0%	0.0	0%
Evergreen forest	42	0.4	0%	0.3	0%	-0.2	-43%
Hay/Pasture	81	1096.8	14%	726.7	9%	-370.1	-34%
Herbaceous	71	31.8	0%	18.2	0%	-13.6	-43%
Mixed forest	43	0.0	0%	0.0	0%	0.0	0%
Open Water	11	39.6	1%	39.2	1%	-0.4	-1%
Shrub/Scrub	52	0.0	0%	0.0	0%	0.0	0%
Wood wetlands	90	6.9	0%	20.5	0%	13.6	198%
07140204050203		**7750.7**	**100%**	**7750.7**	**100%**	**0.0**	
Barren Land	31	0.0	0%	0.0	0%	0.0	0%
Cultivated crop	82	4323.3	56%	1913.7	25%	-2409.6	-56%
Deciduous forest	41	574.4	7%	340.7	4%	-233.8	-41%
Developed, High Intensity	24	3.1	0%	1.4	0%	-1.7	-56%
Developed, Low Intensity	22	458.8	6%	2910.2	38%	2451.4	534%
Developed, Medium Intensity	23	42.7	1%	1372.5	18%	1329.8	3116%
Developed, Open Space	21	428.1	6%	189.5	2%	-238.6	-56%
Emergent herbaceous wetlands	95	0.0	0%	0.0	0%	0.0	0%
Evergreen forest	42	0.0	0%	0.0	0%	0.0	0%
Hay/Pasture	81	1898.2	24%	969.8	13%	-928.4	-49%
Herbaceous	71	11.6	0%	5.1	0%	-6.4	-56%

Mixed forest	43	0.0	0%	0.0	0%	0.0	0%
Open Water	11	10.4	0%	26.2	0%	15.8	151%
Shrub/Scrub	52	0.0	0%	0.0	0%	0.0	0%
Wood wetlands	90	0.0	0%	21.6	0%	21.6	0%
07140204050301		**8048.8**	**100%**	**8048.8**	**100%**	**0.0**	
Barren Land	31	1.3	0%	0.6	0%	-0.7	-56%
Cultivated crop	82	5169.4	64%	2291.9	28%	-2877.5	-56%
Deciduous forest	41	913.7	11%	494.7	6%	-419.0	-46%
Developed, High Intensity	24	8.2	0%	3.6	0%	-4.6	-56%
Developed, Low Intensity	22	349.2	4%	2962.5	37%	2613.3	748%
Developed, Medium Intensity	23	48.0	1%	1425.1	18%	1377.1	2868%
Developed, Open Space	21	384.6	5%	170.5	2%	-214.1	-56%
Emergent herbaceous wetlands	95	0.0	0%	0.0	0%	0.0	0%
Evergreen forest	42	3.3	0%	1.5	0%	-1.9	-56%
Hay/Pasture	81	1084.2	13%	615.1	8%	-469.1	-43%
Herbaceous	71	73.6	1%	32.6	0%	-41.0	-56%
Mixed forest	43	0.0	0%	0.0	0%	0.0	0%
Open Water	11	13.3	0%	28.3	0%	15.0	112%
Shrub/Scrub	52	0.0	0%	0.0	0%	0.0	0%
Wood wetlands	90	0.0	0%	22.4	0%	22.4	0%
07140204050302		**5795.1**	**100%**	**5795.1**	**100%**	**0.0**	
Barren Land	31	0.0	0%	0.0	0%	0.0	0%
Cultivated crop	82	3871.8	67%	1942.3	34%	-1929.5	-50%
Deciduous forest	41	514.8	9%	316.0	5%	-198.8	-39%
Developed, High Intensity	24	1.8	0%	0.9	0%	-0.9	-50%
Developed, Low Intensity	22	179.2	3%	1899.7	33%	1720.5	960%
Developed, Medium Intensity	23	43.1	1%	926.5	16%	883.4	2048%
Developed, Open Space	21	374.4	6%	187.8	3%	-186.6	-50%
Emergent herbaceous wetlands	95	0.0	0%	0.0	0%	0.0	0%
Evergreen forest	42	2.9	0%	1.4	0%	-1.4	-50%
Hay/Pasture	81	782.7	14%	479.3	8%	-303.4	-39%
Herbaceous	71	4.2	0%	2.1	0%	-2.1	-50%
Mixed forest	43	0.0	0%	0.0	0%	0.0	0%
Open Water	11	20.2	0%	24.6	0%	4.4	22%
Shrub/Scrub	52	0.0	0%	0.0	0%	0.0	0%
Wood wetlands	90	0.0	0%	14.4	0%	14.4	0%
07140204050303		**6063.0**	**100%**	**6063.0**	**100%**	**0.0**	
Barren Land	31	0.0	0%	0.0	0%	0.0	0%
Cultivated crop	82	3493.4	58%	1907.5	31%	-1585.9	-45%
Deciduous forest	41	863.4	14%	526.5	9%	-336.9	-39%
Developed, High Intensity	24	13.8	0%	7.5	0%	-6.3	-45%
Developed, Low Intensity	22	210.7	3%	1839.9	30%	1629.2	773%
Developed, Medium Intensity	23	92.0	2%	912.7	15%	820.6	892%

Developed, Open Space	21	275.4	5%	150.4	2%	-125.0	-45%
Emergent herbaceous wetlands	95	0.0	0%	0.0	0%	0.0	0%
Evergreen forest	42	0.0	0%	0.0	0%	0.0	0%
Hay/Pasture	81	1065.0	18%	664.1	11%	-400.9	-38%
Herbaceous	71	31.1	1%	17.0	0%	-14.1	-45%
Mixed forest	43	0.0	0%	0.0	0%	0.0	0%
Open Water	11	15.3	0%	22.1	0%	6.8	44%
Shrub/Scrub	52	0.0	0%	0.0	0%	0.0	0%
Wood wetlands	90	2.7	0%	15.2	0%	12.6	471%
07140204050304		**6296.0**	**100%**	**6296.0**	**100%**	**0.0**	
Barren Land	31	1.6	0%	0.7	0%	-0.8	-53%
Cultivated crop	82	4620.6	73%	2148.9	34%	-2471.7	-53%
Deciduous forest	41	136.4	2%	130.8	2%	-5.6	-4%
Developed, High Intensity	24	10.4	0%	4.8	0%	-5.5	-53%
Developed, Low Intensity	22	380.9	6%	2287.7	36%	1906.8	501%
Developed, Medium Intensity	23	76.7	1%	1091.0	17%	1014.2	1322%
Developed, Open Space	21	360.7	6%	167.7	3%	-192.9	-53%
Emergent herbaceous wetlands	95	1.8	0%	0.8	0%	-1.0	-53%
Evergreen forest	42	0.0	0%	0.0	0%	0.0	0%
Hay/Pasture	81	700.9	11%	427.0	7%	-273.9	-39%
Herbaceous	71	1.4	0%	0.6	0%	-0.7	-53%
Mixed forest	43	0.0	0%	0.0	0%	0.0	0%
Open Water	11	4.7	0%	19.0	0%	14.3	303%
Shrub/Scrub	52	0.0	0%	0.0	0%	0.0	0%
Wood wetlands	90	0.0	0%	16.8	0%	16.8	0%
07140204050401		**6289.8**	**100%**	**6289.8**	**100%**	**0.0**	
Barren Land	31	0.0	0%	0.0	0%	0.0	0%
Cultivated crop	82	4735.4	75%	4699.8	75%	-35.6	-1%
Deciduous forest	41	536.2	9%	533.1	8%	-3.1	-1%
Developed, High Intensity	24	4.4	0%	4.4	0%	0.0	-1%
Developed, Low Intensity	22	158.9	3%	187.4	3%	28.4	18%
Developed, Medium Intensity	23	20.9	0%	35.5	1%	14.7	70%
Developed, Open Space	21	330.8	5%	328.3	5%	-2.5	-1%
Emergent herbaceous wetlands	95	1.6	0%	1.5	0%	0.0	-1%
Evergreen forest	42	0.0	0%	0.0	0%	0.0	0%
Hay/Pasture	81	484.2	8%	481.9	8%	-2.2	0%
Herbaceous	71	3.8	0%	3.8	0%	0.0	-1%
Mixed forest	43	0.0	0%	0.0	0%	0.0	0%
Open Water	11	8.2	0%	8.4	0%	0.2	2%
Shrub/Scrub	52	0.0	0%	0.0	0%	0.0	0%
Wood wetlands	90	5.3	0%	5.5	0%	0.2	4%
07140204050402		**5188.9**	**100%**	**5188.9**	**100%**	**0.0**	
Barren Land	31	2.9	0%	1.9	0%	-1.0	-34%

Cultivated crop	82	3133.8	60%	2077.7	40%	-1056.1	-34%
Deciduous forest	41	647.3	12%	464.2	9%	-183.2	-28%
Developed, High Intensity	24	0.0	0%	0.0	0%	0.0	0%
Developed, Low Intensity	22	119.6	2%	1175.1	23%	1055.5	883%
Developed, Medium Intensity	23	10.7	0%	555.0	11%	544.3	5101%
Developed, Open Space	21	161.6	3%	107.1	2%	-54.5	-34%
Emergent herbaceous wetlands	95	0.0	0%	0.0	0%	0.0	0%
Evergreen forest	42	0.0	0%	0.0	0%	0.0	0%
Hay/Pasture	81	1071.0	21%	762.6	15%	-308.5	-29%
Herbaceous	71	19.3	0%	12.8	0%	-6.5	-34%
Mixed forest	43	0.0	0%	0.0	0%	0.0	0%
Open Water	11	17.8	0%	20.5	0%	2.8	15%
Shrub/Scrub	52	0.0	0%	0.0	0%	0.0	0%
Wood wetlands	90	4.9	0%	12.0	0%	7.1	145%
07140204050501		**5796.5**	**100%**	**5796.5**	**100%**	**0.0**	
Barren Land	31	8.4	0%	4.7	0%	-3.7	-44%
Cultivated crop	82	2328.1	40%	1296.7	22%	-1031.4	-44%
Deciduous forest	41	1340.9	23%	798.2	14%	-542.7	-40%
Developed, High Intensity	24	4.2	0%	2.4	0%	-1.9	-44%
Developed, Low Intensity	22	244.5	4%	1711.2	30%	1466.7	600%
Developed, Medium Intensity	23	36.5	1%	859.2	15%	822.7	2257%
Developed, Open Space	21	335.5	6%	186.8	3%	-148.6	-44%
Emergent herbaceous wetlands	95	0.0	0%	0.0	0%	0.0	0%
Evergreen forest	42	0.0	0%	0.0	0%	0.0	0%
Hay/Pasture	81	1397.2	24%	855.2	15%	-541.9	-39%
Herbaceous	71	16.2	0%	9.0	0%	-7.2	-44%
Mixed forest	43	0.0	0%	0.0	0%	0.0	0%
Open Water	11	34.0	1%	31.8	1%	-2.2	-7%
Shrub/Scrub	52	0.0	0%	0.0	0%	0.0	0%
Wood wetlands	90	50.9	1%	41.2	1%	-9.7	-19%
07140204050502		**5838.0**	**100%**	**5838.0**	**100%**	**0.0**	
Barren Land	31	0.0	0%	0.0	0%	0.0	0%
Cultivated crop	82	4284.8	73%	1300.0	22%	-2984.8	-70%
Deciduous forest	41	151.4	3%	127.3	2%	-24.1	-16%
Developed, High Intensity	24	1.6	0%	0.5	0%	-1.1	-70%
Developed, Low Intensity	22	489.7	8%	2642.9	45%	2153.1	440%
Developed, Medium Intensity	23	53.8	1%	1344.8	23%	1291.0	2400%
Developed, Open Space	21	259.6	4%	78.8	1%	-180.9	-70%
Emergent herbaceous wetlands	95	0.0	0%	0.0	0%	0.0	0%
Evergreen forest	42	0.0	0%	0.0	0%	0.0	0%
Hay/Pasture	81	579.8	10%	297.9	5%	-281.9	-49%
Herbaceous	71	0.0	0%	0.0	0%	0.0	0%
Mixed forest	43	0.0	0%	0.0	0%	0.0	0%

Open Water	11	12.2	0%	24.0	0%	11.8	97%
Shrub/Scrub	52	0.0	0%	0.0	0%	0.0	0%
Wood wetlands	90	5.1	0%	21.9	0%	16.8	328%
07140204050601		**2757.2**	**100%**	**2757.2**	**100%**	**0.0**	
Barren Land	31	0.0	0%	0.0	0%	0.0	0%
Cultivated crop	82	1742.8	63%	1661.4	60%	-81.4	-5%
Deciduous forest	41	312.1	11%	300.1	11%	-12.0	-4%
Developed, High Intensity	24	1.8	0%	8.1	0%	6.4	357%
Developed, Low Intensity	22	79.1	3%	139.8	5%	60.7	77%
Developed, Medium Intensity	23	3.8	0%	46.1	2%	42.3	1120%
Developed, Open Space	21	114.7	4%	117.1	4%	2.4	2%
Emergent herbaceous wetlands	95	0.0	0%	0.0	0%	0.0	0%
Evergreen forest	42	0.0	0%	0.0	0%	0.0	0%
Hay/Pasture	81	203.2	7%	197.6	7%	-5.6	-3%
Herbaceous	71	5.6	0%	5.3	0%	-0.3	-5%
Mixed forest	43	0.0	0%	0.0	0%	0.0	0%
Open Water	11	17.1	1%	17.0	1%	-0.2	-1%
Shrub/Scrub	52	0.0	0%	0.0	0%	0.0	0%
Wood wetlands	90	277.0	10%	264.7	10%	-12.3	-4%
07140204050602		**5007.3**	**100%**	**5007.3**	**100%**	**0.0**	
Barren Land	31	0.0	0%	0.0	0%	0.0	0%
Cultivated crop	82	2442.0	49%	102.0	2%	-2340.0	-96%
Deciduous forest	41	781.8	16%	128.6	3%	-653.2	-84%
Developed, High Intensity	24	20.9	0%	240.8	5%	219.9	1052%
Developed, Low Intensity	22	423.0	8%	2416.8	48%	1993.7	471%
Developed, Medium Intensity	23	83.6	2%	1586.9	32%	1503.3	1799%
Developed, Open Space	21	462.2	9%	307.2	6%	-155.0	-34%
Emergent herbaceous wetlands	95	0.0	0%	0.0	0%	0.0	0%
Evergreen forest	42	6.0	0%	0.3	0%	-5.8	-96%
Hay/Pasture	81	760.7	15%	175.7	4%	-585.0	-77%
Herbaceous	71	0.0	0%	0.0	0%	0.0	0%
Mixed forest	43	0.0	0%	0.0	0%	0.0	0%
Open Water	11	27.1	1%	25.1	1%	-2.0	-7%
Shrub/Scrub	52	0.0	0%	0.0	0%	0.0	0%
Wood wetlands	90	0.0	0%	24.0	0%	24.0	0%
07140204050603		**4056.3**	**100%**	**4056.3**	**100%**	**0.0**	
Barren Land	31	6.9	0%	2.9	0%	-4.0	-58%
Cultivated crop	82	1203.3	30%	505.6	12%	-697.7	-58%
Deciduous forest	41	539.1	13%	273.6	7%	-265.5	-49%
Developed, High Intensity	24	27.3	1%	129.1	3%	101.7	372%
Developed, Low Intensity	22	991.7	24%	1592.6	39%	600.9	61%
Developed, Medium Intensity	23	197.2	5%	858.9	21%	661.8	336%
Developed, Open Space	21	641.1	16%	410.5	10%	-230.6	-36%

Emergent herbaceous wetlands	95	0.0	0%	0.0	0%	0.0	0%
Evergreen forest	42	4.9	0%	2.1	0%	-2.8	-58%
Hay/Pasture	81	395.5	10%	236.7	6%	-158.7	-40%
Herbaceous	71	6.4	0%	2.7	0%	-3.7	-58%
Mixed forest	43	0.0	0%	0.0	0%	0.0	0%
Open Water	11	22.7	1%	21.3	1%	-1.4	-6%
Shrub/Scrub	52	0.0	0%	0.0	0%	0.0	0%
Wood wetlands	90	20.2	0%	20.3	0%	0.0	0%
07140204050604		**3679.1**	**100%**	**3679.1**	**100%**	**0.0**	
Barren Land	31	0.0	0%	0.0	0%	0.0	0%
Cultivated crop	82	1697.9	46%	847.6	23%	-850.3	-50%
Deciduous forest	41	432.4	12%	252.7	7%	-179.7	-42%
Developed, High Intensity	24	16.9	0%	100.6	3%	83.7	495%
Developed, Low Intensity	22	440.6	12%	1141.2	31%	700.6	159%
Developed, Medium Intensity	23	99.6	3%	657.7	18%	558.2	560%
Developed, Open Space	21	337.5	9%	279.0	8%	-58.4	-17%
Emergent herbaceous wetlands	95	61.1	2%	30.5	1%	-30.6	-50%
Evergreen forest	42	0.0	0%	0.0	0%	0.0	0%
Hay/Pasture	81	295.0	8%	202.5	6%	-92.5	-31%
Herbaceous	71	22.7	1%	11.3	0%	-11.4	-50%
Mixed forest	43	0.0	0%	0.0	0%	0.0	0%
Open Water	11	52.0	1%	35.2	1%	-16.8	-32%
Shrub/Scrub	52	0.0	0%	0.0	0%	0.0	0%
Wood wetlands	90	223.4	6%	120.7	3%	-102.7	-46%
07140204050901		**3392.7**	**100%**	**3392.7**	**100%**	**0.0**	
Barren Land	31	0.0	0%	0.0	0%	0.0	0%
Cultivated crop	82	1820.4	54%	1747.0	51%	-73.4	-4%
Deciduous forest	41	391.7	12%	378.6	11%	-13.1	-3%
Developed, High Intensity	24	0.0	0%	2.7	0%	2.7	0%
Developed, Low Intensity	22	81.1	2%	161.8	5%	80.6	99%
Developed, Medium Intensity	23	6.7	0%	48.3	1%	41.7	625%
Developed, Open Space	21	94.5	3%	90.7	3%	-3.8	-4%
Emergent herbaceous wetlands	95	20.7	1%	19.8	1%	-0.8	-4%
Evergreen forest	42	0.0	0%	0.0	0%	0.0	0%
Hay/Pasture	81	445.7	13%	431.8	13%	-13.9	-3%
Herbaceous	71	30.9	1%	29.7	1%	-1.2	-4%
Mixed forest	43	0.0	0%	0.0	0%	0.0	0%
Open Water	11	16.0	0%	16.0	0%	0.0	0%
Shrub/Scrub	52	0.0	0%	0.0	0%	0.0	0%
Wood wetlands	90	485.1	14%	466.2	14%	-18.9	-4%
07140204050902		**7759.4**	**100%**	**7759.4**	**100%**	**0.0**	
Barren Land	31	0.0	0%	0.0	0%	0.0	0%
Cultivated crop	82	5650.0	73%	3296.8	42%	-2353.1	-42%

Deciduous forest	41	380.4	5%	286.6	4%	-93.8	-25%
Developed, High Intensity	24	4.9	0%	67.5	1%	62.6	1280%
Developed, Low Intensity	22	146.1	2%	2067.3	27%	1921.3	1315%
Developed, Medium Intensity	23	10.0	0%	996.9	13%	986.9	9865%
Developed, Open Space	21	362.6	5%	211.6	3%	-151.0	-42%
Emergent herbaceous wetlands	95	6.7	0%	3.9	0%	-2.8	-42%
Evergreen forest	42	0.0	0%	0.0	0%	0.0	0%
Hay/Pasture	81	954.6	12%	653.9	8%	-300.6	-31%
Herbaceous	71	6.9	0%	4.0	0%	-2.9	-42%
Mixed forest	43	0.0	0%	0.0	0%	0.0	0%
Open Water	11	10.7	0%	22.4	0%	11.7	110%
Shrub/Scrub	52	0.0	0%	0.0	0%	0.0	0%
Wood wetlands	90	226.7	3%	148.5	2%	-78.3	-35%
07140204050903		**8319.4**	**100%**	**8319.4**	**100%**	**0.0**	
Barren Land	31	0.0	0%	0.0	0%	0.0	0%
Cultivated crop	82	4089.0	49%	2202.8	26%	-1886.2	-46%
Deciduous forest	41	1617.2	19%	948.0	11%	-669.3	-41%
Developed, High Intensity	24	13.1	0%	83.8	1%	70.7	539%
Developed, Low Intensity	22	329.9	4%	2531.5	30%	2201.6	667%
Developed, Medium Intensity	23	72.7	1%	1216.0	15%	1143.3	1573%
Developed, Open Space	21	573.3	7%	308.9	4%	-264.5	-46%
Emergent herbaceous wetlands	95	2.9	0%	1.6	0%	-1.3	-46%
Evergreen forest	42	0.0	0%	0.0	0%	0.0	0%
Hay/Pasture	81	1455.2	17%	899.1	11%	-556.1	-38%
Herbaceous	71	18.5	0%	9.9	0%	-8.5	-46%
Mixed forest	43	0.0	0%	0.0	0%	0.0	0%
Open Water	11	45.8	1%	43.9	1%	-1.9	-4%
Shrub/Scrub	52	0.0	0%	0.0	0%	0.0	0%
Wood wetlands	90	101.8	1%	74.0	1%	-27.8	-27%
Grand Total		**121178.6**		**121178.6**		**0.0**	

Stream reach data

Table A.78. NHD stream reaches in the Upper Silver Creek watershed, with length in feet and the HUC14(s) they fall within. Some reaches are present in more than one HUC14.

HUC14 & Reach Code	Length (ft)
07140204050101	**160158**
07140204000256	15794
07140204000257	5118
07140204000258	12520
07140204001279	262
07140204001280	3485
07140204001281	7694
07140204001282	24925
07140204001283	9507
07140204001284	7080
07140204001285	18347
07140204003144	3694
07140204003145	2208
07140204003146	1069
07140204003147	2001
07140204003148	3153
07140204003149	5421
07140204003150	3127
07140204003151	4649
07140204003152	1984
07140204003154	2697
07140204003155	2261
07140204003156	4409
07140204003157	5842
07140204003158	605
07140204003159	2987
07140204003160	846
07140204003163	2655
07140204003164	4043
07140204003165	565
07140204003167	1210
07140204050101 & 07140204050102	**11991**
07140204000255	11991
07140204050102	**95015**
07140204000253	837
07140204000254	955
07140204001273	9169
07140204001274	4908

07140204001275	7628
07140204001277	8742
07140204001278	8997
07140204001286	6177
07140204003170	3210
07140204003172	3867
07140204003174	2711
07140204003175	4912
07140204003176	2609
07140204003180	3755
07140204003181	3412
07140204003182	917
07140204003184	1104
07140204003185	1418
07140204003186	1816
07140204003187	2535
07140204003188	877
07140204003189	2395
07140204003190	2045
07140204003191	2228
07140204003194	3002
07140204003195	4789
07140204050102 & 07140204050202	**8052**
07140204000252	8052
07140204050201	**102610**
07140204001288	7332
07140204001290	12619
07140204001292	7739
07140204001293	14488
07140204001294	7413
07140204001295	4760
07140204001297	6081
07140204001298	5008
07140204001299	7159
07140204003161	3729
07140204003166	733
07140204003168	9327
07140204003169	2576
07140204003171	2172
07140204003177	1710
07140204003192	3529
07140204013630	1535
07140204013631	1890

07140204013635	185
07140204013636	110
07140204013637	189
07140204013638	1742
07140204013642	457
07140204013643	127
07140204050201 & 07140204050202	**7608**
07140204001287	7608
07140204050202	**161357**
07140204000243	3701
07140204000244	3564
07140204000245	6286
07140204000246	2251
07140204000247	5661
07140204000248	1169
07140204000249	4535
07140204000250	3696
07140204000251	140
07140204001263	5281
07140204001264	5622
07140204001265	7806
07140204001266	8885
07140204001267	6792
07140204001268	3672
07140204001270	3368
07140204001271	10940
07140204001272	13867
07140204001300	12187
07140204003196	678
07140204003200	3541
07140204003203	3689
07140204003204	3643
07140204003205	542
07140204003206	1838
07140204003207	2498
07140204003211	3648
07140204003213	2624
07140204003217	3903
07140204003218	1959
07140204003220	686
07140204003223	3259
07140204003224	2552
07140204003225	2580

07140204003229	1959
07140204003237	3135
07140204003244	3070
07140204003255	2478
07140204013691	1281
07140204013692	958
07140204013693	1413
07140204050202 & 07140204050301	**5752**
07140204000242	5752
07140204050203	**126861**
07140204001302	6450
07140204001303	9208
07140204001304	8088
07140204001305	13894
07140204001306	11855
07140204001307	9833
07140204001308	12616
07140204001309	20292
07140204003173	3301
07140204003178	1124
07140204003179	1490
07140204003183	2401
07140204003193	3567
07140204003197	2416
07140204003201	3000
07140204003202	1178
07140204003212	3878
07140204003221	3217
07140204003228	2044
07140204003242	4362
07140204003243	2647
07140204050203 & 07140204050301	**4144**
07140204001301	4144
07140204050301	**121298**
07140204000240	3026
07140204001311	20527
07140204001312	5255
07140204001313	6722
07140204001314	15057
07140204001315	6044
07140204003214	2777
07140204003222	2041
07140204003227	5323

07140204003230	1809
07140204003231	3519
07140204003233	647
07140204003235	3217
07140204003236	3004
07140204003247	2401
07140204003248	4332
07140204003253	8641
07140204003254	3219
07140204003261	4571
07140204003264	4055
07140204003265	1089
07140204003269	1037
07140204003270	1040
07140204003271	2024
07140204003273	970
07140204003274	1940
07140204003282	2959
07140204005944	702
07140204005998	1758
07140204005999	1592
07140204050301 & 07140204050302	**14708**
07140204000239	14708
07140204050302	**100297**
07140204001255	2017
07140204001256	11377
07140204001257	17929
07140204001258	11235
07140204001259	8378
07140204001260	6176
07140204001261	896
07140204001262	7345
07140204003238	2479
07140204003250	3877
07140204003260	2171
07140204003266	1501
07140204003267	1282
07140204003268	1754
07140204003272	4701
07140204003278	2876
07140204003279	1845
07140204003280	602
07140204003284	4096

07140204003291	2542
07140204003302	2139
07140204003316	3079
07140204050302 & 07140204050303	**7624**
07140204001254	7624
07140204050303	**125177**
07140204000235	3876
07140204000236	3557
07140204000237	3373
07140204000238	4652
07140204001253	5440
07140204001316	8001
07140204001317	8142
07140204001318	10744
07140204001319	663
07140204001320	5434
07140204001321	13182
07140204001322	7642
07140204003252	4146
07140204003258	2576
07140204003259	584
07140204003290	1844
07140204003292	1224
07140204003293	2326
07140204003294	1409
07140204003295	2491
07140204003300	742
07140204003301	3684
07140204003303	555
07140204003306	813
07140204003309	1406
07140204003323	4548
07140204003332	2339
07140204003337	4868
07140204003363	3101
07140204003375	4797
07140204003376	1480
07140204003386	2451
07140204003400	3087
07140204050303 & 07140204050304	**10402**
07140204000234	10402
07140204050303 & 07140204050304 & 07140204050401	**2934**

07140204000233	2934
07140204050304	**113190**
07140204001323	8007
07140204001324	4816
07140204001325	5110
07140204001326	2611
07140204001327	5822
07140204001328	13683
07140204001329	6389
07140204001330	5171
07140204003257	2440
07140204003276	1527
07140204003286	1192
07140204003287	1606
07140204003289	2802
07140204003299	3438
07140204003311	504
07140204003312	207
07140204003313	905
07140204003314	537
07140204003317	1497
07140204003319	2394
07140204003321	2271
07140204003322	575
07140204003324	280
07140204003325	679
07140204003330	1505
07140204003331	1036
07140204003333	2130
07140204003334	1392
07140204003335	497
07140204003338	719
07140204003340	1768
07140204003342	1222
07140204003343	1797
07140204003346	1358
07140204003347	844
07140204003348	2412
07140204003351	598
07140204003354	1107
07140204003355	2371
07140204003356	1313
07140204003360	972

07140204003361	178
07140204003365	612
07140204003369	1350
07140204003372	668
07140204003373	757
07140204003374	1941
07140204003377	2315
07140204003379	1885
07140204003380	1947
07140204003387	1679
07140204003394	2354
07140204050401	**130343**
07140204000231	4032
07140204000232	1715
07140204001246	4397
07140204001247	15829
07140204001248	4922
07140204001249	6390
07140204001250	542
07140204001251	9161
07140204001252	7145
07140204001332	4785
07140204001333	10694
07140204001334	6686
07140204001335	7523
07140204003336	2281
07140204003364	3337
07140204003396	3073
07140204003397	2188
07140204003401	1220
07140204003402	767
07140204003403	622
07140204003406	2028
07140204003408	2529
07140204003413	1357
07140204003415	2832
07140204003420	2038
07140204003425	1364
07140204003427	1388
07140204003430	1601
07140204003438	1930
07140204003440	3391
07140204003441	4957

07140204003444	1829
07140204003445	146
07140204003448	1402
07140204003452	1324
07140204003454	1851
07140204003458	1067
07140204050401 & 07140204050402	**4807**
07140204000230	3474
07140204003460	1333
07140204050402	**151616**
07140204000227	3249
07140204000228	9689
07140204000229	1677
07140204001245	14351
07140204001337	2905
07140204001338	4542
07140204001339	4110
07140204001340	11072
07140204001341	6815
07140204003429	950
07140204003432	2951
07140204003443	2688
07140204003447	1675
07140204003449	1295
07140204003450	2619
07140204003451	770
07140204003455	632
07140204003456	204
07140204003457	1796
07140204003459	1435
07140204003463	1254
07140204003464	1294
07140204003469	3335
07140204003471	311
07140204003472	2338
07140204003475	1396
07140204003477	2722
07140204003478	3629
07140204003479	1718
07140204003480	1662
07140204003483	763
07140204003484	3382
07140204003486	1155

07140204003487	2948
07140204003491	1640
07140204003492	1476
07140204003493	3358
07140204003494	2359
07140204003496	888
07140204003500	3175
07140204003504	1927
07140204003505	2273
07140204003508	483
07140204003510	559
07140204003511	146
07140204003512	1024
07140204003514	2580
07140204003524	1715
07140204003525	1263
07140204003526	2873
07140204003527	1349
07140204003529	3848
07140204003535	1805
07140204003536	896
07140204003540	1997
07140204003541	977
07140204003542	2137
07140204003543	628
07140204003545	507
07140204003549	668
07140204003550	1134
07140204003553	2440
07140204003559	2159
07140204050402 & 071402040502	**5212**
07140204003610	5212
07140204050402 & 07140204050501	**5368**
07140204000226	5368
07140204050402 & 07140204050502	**7679**
07140204001241	7679
07140204050501	**189208**
07140204000223	12394
07140204000224	5990
07140204000225	12587
07140204001243	9632
07140204001342	13717
07140204001343	1861

07140204001344	8309
07140204001345	4737
07140204003521	1020
07140204003522	5061
07140204003531	801
07140204003537	1533
07140204003546	2130
07140204003555	508
07140204003557	1278
07140204003558	219
07140204003560	855
07140204003563	5920
07140204003564	1525
07140204003565	1371
07140204003567	728
07140204003568	643
07140204003571	212
07140204003575	931
07140204003578	1980
07140204003579	605
07140204003582	1883
07140204003583	1417
07140204003584	1456
07140204003586	1856
07140204003589	4477
07140204003590	2683
07140204003594	2139
07140204003595	2061
07140204003603	2704
07140204003611	4635
07140204003612	1742
07140204003617	1491
07140204003618	472
07140204003624	2827
07140204003626	526
07140204003627	2183
07140204003632	2865
07140204003634	2014
07140204003652	4217
07140204003661	2286
07140204003663	602
07140204003666	2436
07140204003667	3671

07140204003668	2144
07140204003672	811
07140204003673	2853
07140204003674	2363
07140204003679	1748
07140204003680	254
07140204003682	748
07140204003683	750
07140204003685	1202
07140204003687	4564
07140204003688	3436
07140204003693	2107
07140204003695	3299
07140204003697	1163
07140204003706	1231
07140204003709	5011
07140204003715	1462
07140204003722	2833
07140204003727	2039
07140204050501 & 07140204050502 & 071402040601	**1383**
07140204000222	1383
07140204050502	**111007**
07140204001231	5479
07140204001232	6037
07140204001234	2810
07140204001235	10435
07140204001239	11345
07140204001240	2748
07140204001242	7351
07140204003498	5504
07140204003528	7420
07140204003530	3023
07140204003548	1466
07140204003556	2154
07140204003585	1443
07140204003598	1321
07140204003600	1357
07140204003601	2587
07140204003604	2409
07140204003615	2458
07140204003616	1595
07140204003621	1756

07140204003622	2736
07140204003625	1602
07140204003629	1611
07140204003630	1065
07140204003635	877
07140204003639	1295
07140204003640	2086
07140204003644	737
07140204003649	1123
07140204003654	2034
07140204003657	4691
07140204003658	1369
07140204003671	1591
07140204006002	7492
07140204050502 & 07140204050601	**9799**
07140204001230	4886
07140204003707	4913
07140204050601	**27752**
07140204001229	12465
07140204003070	855
07140204003690	172
07140204003691	755
07140204003739	6365
07140204003742	1102
07140204003743	1260
07140204003747	342
07140204003762	4436
07140204050601 & 07140204050603	**14489**
07140204000201	327
07140204000221	14162
07140204050601 & 07140204050604	**9795**
07140204003804	9795
07140204050602	**112167**
07140204000558	3971
07140204001347	7458
07140204001348	8254
07140204003638	2995
07140204003641	3331
07140204003642	1274
07140204003650	1546
07140204003651	7217
07140204003664	2063
07140204003669	840

07140204003670	2909
07140204003676	1293
07140204003677	3350
07140204003696	6323
07140204003698	816
07140204003699	4292
07140204003700	3798
07140204003705	2701
07140204003708	1529
07140204003717	2922
07140204003720	2885
07140204003721	1418
07140204003726	4918
07140204003729	2185
07140204003730	3367
07140204003731	3037
07140204003733	181
07140204003734	2356
07140204003735	997
07140204003736	1814
07140204003737	4222
07140204003741	5718
07140204003744	651
07140204003745	1526
07140204003755	6096
07140204003756	1914
07140204050602 & 07140204050603	**1362**
07140204003752	1362
07140204050603	**86263**
07140204000555	5816
07140204000556	4651
07140204001349	1593
07140204001350	15577
07140204001351	18673
07140204001352	6462
07140204003072	989
07140204003758	2280
07140204003759	1211
07140204003763	1618
07140204003765	1450
07140204003766	1997
07140204003775	3249
07140204003777	2556

07140204003778	3481
07140204003779	1535
07140204003781	1837
07140204003783	1087
07140204003784	1165
07140204003785	1299
07140204003791	609
07140204003795	3823
07140204003800	3305
07140204050604	**58055**
07140204000197	6040
07140204001357	19211
07140204001358	4176
07140204003801	4330
07140204003805	5705
07140204003813	1431
07140204003816	1539
07140204003817	2540
07140204003820	5574
07140204003823	1608
07140204003824	2050
07140204003831	1789
07140204003839	2062
07140204050604 & 07140204050901	**1063**
07140204000196	1063
07140204050901	**30531**
07140204000191	4378
07140204000192	3414
07140204001186	6695
07140204003840	106
07140204003858	3533
07140204003880	3511
07140204003929	2342
07140204003937	195
07140204003946	727
07140204003951	3774
07140204006006	1856
07140204050901 & 07140204050902	**17239**
07140204002277	12318
07140204006005	4921
07140204050901 & 07140204050903	**9749**
07140204000475	9749
07140204050902	**133552**

07140204000436	2122
07140204000437	15410
07140204000438	17185
07140204001187	8771
07140204001359	3705
07140204001360	21758
07140204001361	3673
07140204002247	8408
07140204003114	1609
07140204003115	908
07140204003798	2972
07140204003815	4909
07140204003827	2294
07140204003842	7690
07140204003844	1787
07140204003850	3431
07140204003852	1159
07140204003853	1958
07140204003854	2194
07140204003855	896
07140204003856	4418
07140204003857	1040
07140204003873	1280
07140204003875	4223
07140204003892	5359
07140204003896	1759
07140204003898	2216
07140204005945	418
07140204050903	**230141**
07140204000476	1532
07140204000478	14671
07140204000479	2699
07140204000480	5884
07140204001362	4167
07140204001363	10675
07140204001364	2923
07140204001365	9530
07140204001366	3870
07140204001367	7417
07140204001368	3355
07140204001369	4892
07140204001370	2193
07140204001371	4612

07140204001372	4525
07140204001373	5452
07140204001374	8734
07140204003819	1572
07140204003822	2358
07140204003828	533
07140204003829	103
07140204003830	2187
07140204003836	1746
07140204003837	3103
07140204003838	1940
07140204003841	1517
07140204003848	2100
07140204003849	1264
07140204003859	630
07140204003861	2892
07140204003862	1317
07140204003863	1330
07140204003864	1436
07140204003865	2381
07140204003866	2004
07140204003867	656
07140204003868	1298
07140204003870	2105
07140204003871	2211
07140204003872	2534
07140204003876	1306
07140204003883	1251
07140204003887	5097
07140204003891	2033
07140204003893	711
07140204003901	3785
07140204003903	3016
07140204003904	3122
07140204003906	215
07140204003907	1212
07140204003909	2548
07140204003910	1506
07140204003914	981
07140204003915	1145
07140204003918	697
07140204003919	1623
07140204003921	248

07140204003922	2019
07140204003923	1693
07140204003926	5043
07140204003927	1286
07140204003928	2129
07140204003930	2421
07140204003931	1331
07140204003932	2496
07140204003933	3214
07140204003934	1577
07140204003935	847
07140204003936	1941
07140204003938	3604
07140204003939	1523
07140204003940	1987
07140204003942	2129
07140204003943	91
07140204003944	3534
07140204003947	2308
07140204003948	749
07140204003949	7797
07140204003952	1999
07140204003953	3089
07140204003958	2925
07140204003961	5565
Grand Total	**2527758**

Streambank erosion by stream reach

Table A.79. Streambank erosion along stream reaches in the watershed.

Stream or Tributary Name	Reach Code	Stream Length Assessed (ft)	None or Low Erosion (ft)	None or Low Erosion (%)	Moderate Erosion (ft)	Moderate Erosion (%)	High Erosion (ft)	High Erosion (%)
Silver Creek	07140204000256	15862.9	3557.0	22%	6982.5	44%	5323.4	34%
Silver Creek	07140204000257	5114.8	2370.3	46%	427.7	8%	2316.9	45%
Silver Creek	07140204000258	12582.0	8209.7	65%	2155.3	17%	2216.9	18%
	07140204001279	262.5	0.9	0%	206.8	79%	54.9	21%
	07140204001280	3484.3	448.1	13%	552.3	16%	2483.8	71%
	07140204001281	7693.6	4698.9	61%	2429.6	32%	565.1	7%
	07140204001282	24944.2	18272.1	73%	3771.9	15%	2900.2	12%
	07140204001283	9573.5	7332.6	77%	1704.2	18%	536.6	6%
	07140204001284	7063.6	5112.2	72%	1313.2	19%	638.2	9%
	07140204001285	18431.8	14436.3	78%	3132.3	17%	863.1	5%
	07140204003145	2211.3	1987.1	90%	224.2	10%		0%
	07140204003146	1059.7	778.9	74%	102.5	10%	178.3	17%
	07140204003148	3166.0	3044.1	96%		0%	121.9	4%
	07140204003149	5393.7	5203.2	96%	99.9	2%	90.6	2%
	07140204003150	3136.5	2949.2	94%	24.4	1%	162.9	5%
	07140204003151	4675.2	4602.2	98%		0%	73.0	2%
	07140204003152	1981.6	1887.5	95%		0%	94.1	5%
	07140204003156	4429.1	4186.5	95%		0%	242.6	5%
	07140204003158	600.4	491.2	82%		0%	109.2	18%
Silver Creek	07140204000255	12024.3	3616.0	30%	4130.4	34%	4277.9	36%
Silver Creek	07140204000253	830.1	190.9	23%	43.5	5%	595.7	72%
Silver Creek	07140204000254	958.0	260.8	27%	588.9	61%	108.4	11%
	07140204001273	9140.4	5591.5	61%	928.1	10%	2620.8	29%
	07140204001274	4865.5	686.9	14%	3366.4	69%	812.2	17%
	07140204001275	7585.3	5031.6	66%	199.1	3%	2354.5	31%
	07140204001277	8763.1	6738.2	77%	872.2	10%	1152.8	13%
	07140204001278	9042.0	8489.7	94%		0%	552.3	6%
	07140204001286	6200.8	6157.9	99%		0%	42.9	1%
	07140204003170	3205.4	3075.1	96%		0%	130.3	4%
	07140204003172	3868.1	3781.8	98%	86.3	2%		0%
	07140204003174	2713.3	2695.5	99%		0%	17.8	1%
	07140204003180	3756.6	3716.9	99%	39.7	1%		0%
	07140204003184	1108.9	263.4	24%	407.9	37%	437.6	39%
	07140204003185	1420.6	1320.9	93%	99.7	7%		0%
	07140204003186	1814.3	160.6	9%	353.0	19%	1300.7	72%
	07140204003187	2545.9	2423.7	95%	122.3	5%		0%
	07140204003188	876.0	530.7	61%	345.2	39%		0%
	07140204003190	2040.7	1314.8	64%	393.5	19%	332.4	16%
	07140204003191	2240.8	2161.5	96%		0%	79.3	4%
Silver Creek	07140204000252	8077.4	1849.6	23%	3285.9	41%	2942.0	36%
	07140204001288	7362.2	5086.5	69%	1613.0	22%	662.7	9%
	07140204001292	7762.5	6018.5	78%	1648.0	21%	96.0	1%

07140204001294	7437.7	4568.0	61%	2497.6	34%	372.1	5%
07140204001295	4780.2	2156.2	45%	1162.4	24%	1461.5	31%
07140204001299	7178.5	6054.6	84%	970.1	14%	153.8	2%
07140204003168	9376.6	8269.2	88%	1107.4	12%		0%
07140204003169	2585.3	2472.9	96%	112.4	4%		0%
07140204003171	2171.9	2036.1	94%	135.8	6%		0%
07140204003177	1702.8	1577.1	93%		0%	125.7	7%
07140204003192	3510.5	3217.3	92%	174.1	5%	119.1	3%
07140204001287	7631.2	2688.5	35%	3424.1	45%	1518.7	20%
07140204000243	3687.7	180.6	5%	229.5	6%	3277.6	89%
07140204000244	3569.6	218.6	6%	1074.9	30%	2276.0	64%
07140204000245	6318.9	1561.0	25%	4166.5	66%	591.4	9%
07140204000246	2250.7	389.2	17%	295.2	13%	1566.3	70%
07140204000247	5662.7	1444.7	26%	703.0	12%	3515.0	62%
07140204000248	1168.0	197.4	17%	309.7	27%	660.9	57%
07140204000249	4563.6	1954.3	43%	1702.8	37%	906.6	20%
07140204000250	3707.3	1076.4	29%	1263.6	34%	1367.4	37%
07140204000251	141.1	3.2	2%	137.9	98%		0%
07140204001263	5259.2	5067.6	96%		0%	191.6	4%
07140204001264	5580.7	5107.2	92%	286.5	5%	187.0	3%
07140204001265	7762.5	7642.5	98%	120.0	2%		0%
07140204001266	8864.8	8775.1	99%		0%	89.7	1%
07140204001267	6784.8	6667.2	98%		0%	117.6	2%
07140204001271	10912.1	10855.1	99%	57.0	1%		0%
07140204003217	3910.8	3747.4	96%		0%	163.4	4%
07140204003220	685.7	573.6	84%	112.1	16%		0%
07140204003224	2552.5	2367.4	93%		0%	185.1	7%
07140204003255	2483.6	2425.2	98%	58.4	2%		0%
07140204000242	5744.8	1243.6	22%	1747.4	30%	2753.7	48%
07140204001304	8113.5	4315.8	53%	1132.1	14%	2665.6	33%
07140204001305	13956.7	1330.8	10%	5866.1	42%	6759.8	48%
07140204001306	11932.4	11458.8	96%	473.6	4%		0%
07140204001307	9878.6	4498.5	46%	3469.1	35%	1911.1	19%
07140204001308	12670.6	12101.9	96%	321.2	3%	247.4	2%
07140204003173	3313.6	2117.4	64%	1196.2	36%		0%
07140204003179	1502.6	1251.0	83%		0%	251.6	17%
07140204003183	2421.3	1974.6	82%	446.6	18%		0%
07140204003193	3572.8	3289.2	92%	225.3	6%	58.3	2%
07140204003197	2408.1	1979.6	82%	235.3	10%	193.2	8%
07140204003212	3881.2	3478.9	90%		0%	402.3	10%
07140204001301	4156.8	3098.5	75%	75.5	2%	982.9	24%
07140204000240	3051.2	1016.2	33%	1813.1	59%	221.9	7%
07140204001311	20626.6	14441.4	70%	4533.4	22%	1651.8	8%
07140204001313	6732.3	1739.9	26%	3465.1	51%	1527.2	23%
07140204001314	15105.0	8464.5	56%	2787.6	18%	3852.9	26%
07140204001315	6086.0	5886.0	97%	199.9	3%		0%
07140204003235	3234.9	3020.6	93%	214.3	7%		0%
07140204003236	2998.7	311.2	10%	1347.6	45%	1339.9	45%
07140204003253	8681.1	1166.3	13%	3895.9	45%	3618.9	42%
07140204003261	4580.1	4396.8	96%	132.3	3%	50.9	1%

	07140204003264	4035.4	3819.3	95%	211.8	5%	4.4	0%
	07140204003269	1033.5	952.3	92%		0%	81.2	8%
	07140204003274	1925.9	1907.4	99%		0%	18.5	1%
	07140204003282	2952.8	2829.8	96%		0%	122.9	4%
	07140204005944	698.8	146.5	21%	361.3	52%	191.0	27%
	07140204005998	1752.0	49.0	3%	1017.0	58%	686.0	39%
	07140204005999	1591.2	468.4	29%	494.8	31%	628.0	39%
	07140204000239	14701.4	944.0	6%	3841.9	26%	9915.6	67%
	07140204001255	2007.9	317.1	16%	932.5	46%	758.3	38%
	07140204001256	11361.5	2596.5	23%	3871.5	34%	4893.6	43%
	07140204001257	17919.9	1189.1	7%	4413.7	25%	12317.2	69%
	07140204001258	11282.8	7341.2	65%	1568.6	14%	2373.0	21%
	07140204001260	6161.4	5995.9	97%	165.5	3%		0%
	07140204001261	892.4	727.9	82%		0%	164.5	18%
	07140204001262	7388.5	7194.8	97%		0%	193.7	3%
	07140204003238	2490.2	2272.5	91%		0%	217.7	9%
	07140204003250	3858.3	3579.0	93%		0%	279.3	7%
	07140204003260	2162.1	1498.9	69%	663.2	31%		0%
	07140204003268	1765.1	1655.9	94%	109.2	6%		0%
	07140204003278	2867.5	2721.5	95%		0%	145.9	5%
	07140204003284	4120.7	3987.8	97%	132.9	3%		0%
	07140204003291	2552.5	2420.7	95%		0%	131.8	5%
	07140204001254	7582.0	1597.1	21%	2815.1	37%	3169.8	42%
Silver Creek	07140204000235	3871.4	327.9	8%	232.9	6%	3310.6	86%
Silver Creek	07140204000236	3549.9	1130.6	32%	545.1	15%	1874.2	53%
Silver Creek	07140204000237	3359.6	607.7	18%	1480.1	44%	1271.7	38%
Silver Creek	07140204000238	4655.5	506.5	11%	1019.9	22%	3129.1	67%
	07140204001253	5410.1	4916.6	91%		0%	493.5	9%
	07140204001316	8021.7	8001.5	100%	20.2	0%		0%
	07140204001317	8182.4	8057.2	98%		0%	125.2	2%
	07140204001322	7650.9	7528.2	98%		0%	122.7	2%
	07140204003323	4553.8	4464.4	98%	89.4	2%		0%
	07140204003332	2322.8	2058.1	89%		0%	264.7	11%
	07140204003337	4858.9	4844.1	100%	14.8	0%		0%
	07140204003386	2447.5	2257.9	92%	189.6	8%		0%
	07140204003400	3061.0	2865.5	94%	195.5	6%		0%
Silver Creek	07140204000234	10433.1	3058.1	29%	4575.5	44%	2799.5	27%
Silver Creek	07140204000233	2959.3	1771.4	60%	1150.4	39%	37.5	1%
	07140204001323	8041.3	3813.3	47%	3112.3	39%	1115.7	14%
	07140204001324	4832.7	846.7	18%	1432.3	30%	2553.6	53%
	07140204001325	5128.0	4788.7	93%	317.2	6%	22.1	0%
	07140204001326	2618.1	950.5	36%	1255.8	48%	411.8	16%
	07140204001327	5843.2	1940.4	33%	2341.0	40%	1561.8	27%
	07140204001328	13743.4	9409.4	68%	3582.1	26%	751.9	5%
	07140204001329	6414.0	6338.8	99%		0%	75.3	1%
	07140204003257	2437.7	2379.8	98%	57.9	2%		0%
	07140204003276	1525.6	1349.0	88%		0%	176.6	12%
	07140204003289	2778.9	2596.6	93%		0%	182.2	7%
	07140204003314	531.5	263.7	50%	96.9	18%	170.9	32%
	07140204003319	2408.1	2230.4	93%		0%	177.7	7%

	07140204003334	1387.8	1173.0	85%	214.8	15%		0%
	07140204003374	1922.6	1793.4	93%	129.2	7%		0%
Silver Creek	07140204000231	4028.9	670.2	17%	944.2	23%	2414.5	60%
Silver Creek	07140204000232	1732.3	955.0	55%	435.3	25%	342.0	20%
	07140204001246	4396.3	336.3	8%	2243.6	51%	1816.4	41%
	07140204001247	15862.9	6302.1	40%	6064.8	38%	3496.0	22%
	07140204001248	4898.3	4311.8	88%	115.0	2%	471.5	10%
	07140204001332	4790.0	4678.7	98%	111.3	2%		0%
	07140204003336	2267.1	2168.6	96%		0%	98.4	4%
	07140204003364	3310.4	3221.3	97%	23.3	1%	65.8	2%
	07140204003406	2017.7	1974.4	98%	43.3	2%		0%
	07140204003444	1820.9	1746.1	96%	74.8	4%		0%
	07140204003454	1843.8	1700.6	92%	143.2	8%		0%
Silver Creek	07140204000230	3487.5	864.0	25%	1392.4	40%	1231.2	35%
	07140204003460	1328.7	1105.2	83%	223.5	17%		0%
Silver Creek	07140204000227	3244.8	805.3	25%	1123.5	35%	1315.9	41%
Silver Creek	07140204000228	9668.6	1476.7	15%	3123.7	32%	5068.2	52%
Silver Creek	07140204000229	1679.8	104.2	6%	535.0	32%	1040.6	62%
	07140204001245	14301.2	13992.7	98%	114.7	1%	193.8	1%
	07140204001337	2913.4	1086.1	37%	684.9	24%	1142.3	39%
	07140204001338	4517.7	4391.7	97%	126.0	3%		0%
	07140204001339	4117.5	89.0	2%	1056.5	26%	2971.9	72%
	07140204001340	11076.1	6641.7	60%	1332.0	12%	3102.5	28%
	07140204001341	6781.5	6699.4	99%		0%	82.1	1%
	07140204003429	948.2	850.2	90%		0%	98.0	10%
	07140204003447	1669.9	1600.5	96%	69.5	4%		0%
	07140204003475	1384.5	1252.7	90%		0%	131.8	10%
	07140204003484	3356.3	3289.4	98%		0%	66.9	2%
	07140204003496	892.4	706.5	79%		0%	185.9	21%
	07140204003505	2280.2	2088.4	92%		0%	191.8	8%
	07140204003510	554.5	439.5	79%		0%	114.9	21%
	07140204003511	144.4	0.0	0%		0%	144.35696	100%
	07140204003512	1030.2	803.2	78%		0%	227.0	22%
	07140204003525	1269.7	1234.6	97%		0%	35.1	3%
	07140204003536	899.0	725.0	81%		0%	174.0	19%
Silver Creek	07140204000226	5374.0	959.8	18%	1269.3	24%	3144.9	59%
Silver Creek	07140204000223	12398.3	4494.1	36%	4204.0	34%	3700.2	30%
Silver Creek	07140204000224	5990.8	1512.2	25%	384.1	6%	4094.5	68%
Silver Creek	07140204000225	12595.1	3558.0	28%	3204.2	25%	5832.9	46%
	07140204001243	9685.0	9579.9	99%	105.1	1%		0%
	07140204001342	13664.7	13534.5	99%		0%	130.2	1%
	07140204001343	1853.7	1643.2	89%		0%	210.5	11%
	07140204003583	1404.2	1339.1	95%		0%	65.1	5%
	07140204003611	4616.1	4360.2	94%		0%	255.9	6%
	07140204003617	1496.1	1427.0	95%	69.0	5%		0%
	07140204003624	2808.4	2739.0	98%		0%	69.4	2%
	07140204003632	2860.9	2735.6	96%	125.3	4%		0%
	07140204003672	813.6	636.4	78%	177.2	22%		0%
	07140204003683	751.3	503.0	67%		0%	248.3	33%
	07140204003687	4560.4	4328.0	95%		0%	232.4	5%

	07140204003722	2837.9	2753.2	97%	84.7	3%		0%
Silver Creek	07140204000222	1374.7	679.3	49%	695.4	51%		0%
	07140204001231	5452.8	607.9	11%	3410.3	63%	1434.6	26%
	07140204001232	6020.3	5946.0	99%	74.4	1%		0%
	07140204001234	2795.3	384.8	14%	2214.2	79%	196.3	7%
	07140204001235	10416.7	9979.1	96%	437.6	4%		0%
	07140204001240	2765.7	2540.5	92%	225.2	8%		0%
	07140204003498	5518.4	5345.2	97%		0%	173.2	3%
	07140204003528	7444.2	1789.5	24%	5285.5	71%	369.2	5%
	07140204003629	1601.0	1456.5	91%		0%	144.5	9%
	07140204003639	1302.5	466.7	36%	835.7	64%		0%
	07140204003640	2089.9	2008.2	96%	81.7	4%		0%
	07140204003644	738.2	1.5	0%	736.7	100%		0%
	07140204003657	4727.7	4543.8	96%	183.8	4%		0%
	07140204003671	1597.8	1379.7	86%	139.4	9%	78.6	5%
	07140204006002	7519.7	3154.6	42%	3116.0	41%	1249.1	17%
	07140204001230	4904.9	1051.0	21%	2749.8	56%	1104.0	23%
	07140204003707	4911.4	4548.8	93%	362.6	7%		0%
	07140204003762	4439.0	4326.9	97%	112.1	3%		0%
Silver Creek	07140204000201	331.4	205.5	62%		0%	125.8	38%
Silver Creek	07140204000221	14163.4	5293.1	37%	5510.6	39%	3359.7	24%
Wendell Branch	07140204000558	3963.3	1137.8	29%	2042.6	52%	782.8	20%
	07140204001348	8284.1	8268.9	100%		0%	15.2	0%
	07140204003641	3353.0	3210.6	96%	142.5	4%		0%
Wendell Branch	07140204003642	1269.7	645.9	51%	116.4	9%	507.4	40%
Wendell Branch	07140204003650	1548.6	741.4	48%	235.4	15%	571.7	37%
	07140204003651	7194.9	7040.8	98%	114.9	2%	39.2	1%
Wendell Branch	07140204003664	2060.4	439.9	21%	662.7	32%	957.8	46%
Wendell Branch	07140204003669	839.9	142.0	17%	247.2	29%	450.7	54%
Wendell Branch	07140204003676	1295.9	172.3	13%	202.9	16%	920.7	71%
	07140204003677	3356.3	3257.7	97%	98.6	3%		0%
Wendell Branch	07140204003696	6348.4	2830.9	45%	2928.6	46%	588.9	9%
	07140204003698	810.4	552.7	68%	251.2	31%	6.5	1%
	07140204003699	4261.8	4094.3	96%	152.5	4%	15.0	0%
	07140204003700	3812.3	3568.1	94%	244.3	6%		0%
	07140204003708	1528.9	735.1	48%	338.2	22%	455.6	30%
Wendell Branch	07140204003720	2897.0	1820.3	63%	808.5	28%	268.2	9%
	07140204003726	4895.0	4803.2	98%	91.8	2%		0%
	07140204003729	2191.6	2142.2	98%	49.4	2%		0%
	07140204003730	3349.7	3241.2	97%	108.5	3%		0%
	07140204003733	183.7	3.0	2%	180.7	98%		0%
	07140204003734	2355.6	2200.0	93%	38.4	2%	117.3	5%
Wendell Branch	07140204003737	4215.9	723.6	17%	2211.7	52%	1280.6	30%
Wendell Branch	07140204003741	5705.4	1926.5	34%	2982.6	52%	796.3	14%
	07140204003744	656.2	409.8	62%	139.5	21%	106.8	16%
Wendell Branch	07140204003745	1528.9	2.4	0%	877.7	57%	648.7	42%
	07140204003755	7040.7	5859.0	83%	792.7	11%	389.0	6%
Wendell Branch	07140204003752	1364.8	54.7	4%	851.5	62%	458.7	34%
Wendell Branch	07140204000555	5774.3	3251.3	56%	2141.8	37%	381.2	7%
Wendell Branch	07140204000556	4645.7	878.1	19%	3170.4	68%	597.1	13%

	07140204001349	1591.2	1239.0	78%	262.4	16%	89.9	6%
	07140204001350	15570.9	8012.2	51%	4273.0	27%	3285.6	21%
	07140204001351	18645.0	7600.7	41%	5878.8	32%	5165.5	28%
	07140204001352	6460.0	6388.9	99%		0%	71.1	1%
	07140204003758	2283.5	2258.9	99%		0%	24.6	1%
	07140204003759	1217.2	1163.6	96%	53.6	4%		0%
	07140204003766	2001.3	2000.3	100%	1.0	0%		0%
	07140204003791	610.2	525.4	86%		0%	84.9	14%
Silver Creek	07140204000197	6026.9	1222.5	20%	2104.5	35%	2700.0	45%
	07140204001357	19130.6	8179.3	43%	3385.5	18%	7565.8	40%
	07140204001358	4150.3	3959.4	95%	190.9	5%		0%
Silver Creek	07140204003804	9796.6	3762.4	38%	1287.0	13%	4747.2	48%
	07140204003816	1535.4	1436.1	94%		0%	99.3	6%
Silver Creek	07140204003820	5584.0	2901.3	52%	1011.1	18%	1671.6	30%
	07140204003823	1601.0	1525.4	95%	55.7	3%	20.0	1%
Silver Creek	07140204000196	1066.3	297.4	28%	171.2	16%	597.6	56%
Silver Creek	07140204000191	6975.1	3214.0	46%	1911.7	27%	1849.3	27%
Silver Creek	07140204000192	3402.2	4.9	0%	1389.1	41%	2008.2	59%
	07140204001186	6650.3	6300.9	95%		0%	349.3	5%
East Fork Silver Creek	07140204003840	11942.3	11836.3	99%	46.1	0%	59.8	1%
	07140204003880	3494.1	2957.2	85%	536.9	15%		0%
	07140204003929	2342.5	2180.5	93%	162.1	7%		0%
Silver Creek	07140204006006	1860.2	823.2	44%	418.0	22%	619.1	33%
Silver Creek	07140204002277	12372.0	1772.3	14%	9602.1	78%	997.6	8%
Silver Creek	07140204006005	4921.3	341.8	7%	3835.6	78%	743.9	15%
Mill Creek	07140204000475	9770.3	9177.6	94%	592.7	6%		0%
Lake Fork	07140204000436	2106.3	1259.2	60%	347.5	16%	499.6	24%
Lake Fork	07140204000437	15397.0	3937.1	26%	6596.3	43%	4863.5	32%
Lake Fork	07140204000438	17181.8	6339.8	37%	7117.9	41%	3724.1	22%
	07140204001361	3697.5	3308.1	89%	183.9	5%	205.4	6%
Lake Fork	07140204002247	8382.5	4640.7	55%	2469.7	29%	1272.2	15%
	07140204003798	2956.0	2849.7	96%	106.3	4%		0%
	07140204003892	5400.3	5255.9	97%	144.4	3%		0%
North Fork Mill Creek	07140204001362	4176.5	432.1	10%	1576.4	38%	2168.0	52%
	07140204001363	10652.9	5972.6	56%	3104.7	29%	1575.6	15%
North Fork Mill Creek	07140204001364	2939.6	366.8	12%	1309.0	45%	1263.8	43%
North Fork Mill Creek	07140204001365	9534.1	4736.1	50%	2129.4	22%	2668.7	28%
	07140204001370	2185.0	376.6	17%	324.6	15%	1483.8	68%
	07140204001371	4606.3	602.5	13%	2286.8	50%	1717.0	37%
	07140204001372	4553.8	4398.8	97%	155.0	3%		0%
	07140204001373	5439.6	3531.6	65%	326.5	6%	1581.6	29%
	07140204001374	8684.4	3231.3	37%	1855.7	21%	3597.4	41%
	07140204003838	1935.7	1925.9	99%	9.8	1%		0%
	07140204003861	2900.3	2855.5	98%	44.7	2%		0%
	07140204003867	659.4	561.0	85%	98.4	15%		0%
	07140204003868	1302.5	1259.6	97%		0%	42.9	3%
	07140204003870	2089.9	2009.4	96%	80.5	4%		0%

	07140204003909	2532.8	2434.7	96%	98.1	4%		0%
	07140204003921	249.3	70.4	28%		0%	179.0	72%
	07140204003927	1286.1	1149.6	89%		0%	136.5	11%
	07140204003930	2427.8	2348.2	97%		0%	79.6	3%
	07140204003935	853.0	779.0	91%		0%	74.0	9%
	07140204003936	1935.7	1835.4	95%		0%	100.3	5%
TOTAL		1456952.1	908914.2		283512.7		264525.2	
AVERAGE				65%		18%		17%

Channelization by stream reach

Table A.80. Degree of channelization along assessed stream reaches in the watershed.

Stream or Tributary Name	Reach Code	Stream Length Assessed (ft)	None or Low Channelization (ft)	(%)	Moderate Channelization (ft)	(%)	High Channelization (ft)	(%)
Silver Creek	07140204000191	4379.0	4379	100%		0%		0%
Silver Creek	07140204000192	3414.0	3414	100%		0%		0%
Silver Creek	07140204000196	1063.0	1063	100%		0%		0%
Silver Creek	07140204000197	5842.0	5842	100%		0%		0%
Silver Creek	07140204000201	327.0		0%	327	100%		0%
Silver Creek	07140204000221	14163.0	6362	45%	7801	55%		0%
Silver Creek	07140204000222	1383.0	1383	100%		0%		0%
Silver Creek	07140204000223	12394.0	12394	100%		0%		0%
Silver Creek	07140204000224	5990.0	3941	66%	2049	34%		0%
Silver Creek	07140204000225	12586.0	7580	60%	1791	14%	3215	26%
Silver Creek	07140204000226	5306.0	5306	100%		0%		0%
Silver Creek	07140204000227	3248.0	1569	48%		0%	1679	52%
Silver Creek	07140204000228	9689.0	9689	100%		0%		0%
Silver Creek	07140204000229	1677.0	1677	100%		0%		0%
Silver Creek	07140204000230	3473.0	1269	37%	2204	63%		0%
Silver Creek	07140204000231	4032.0	3708	92%		0%	324	8%
Silver Creek	07140204000232	1715.0		0%		0%	1715	100%
Silver Creek	07140204000233	2934.0		0%		0%	2934	100%
Silver Creek	07140204000234	10402.0	3132	30%	32	0%	7238	70%
Silver Creek	07140204000235	3876.0	3876	100%		0%		0%
Silver Creek	07140204000236	3556.0	3556	100%		0%		0%
Silver Creek	07140204000237	3373.0	1771	53%	1602	47%		0%
Silver Creek	07140204000238	4652.0		0%	4652	100%		0%
	07140204000239	14708.0	8988	61%	5720	39%		0%
	07140204000240	3027.0	165	5%		0%	2862	95%
	07140204000242	5752.0	4207	73%		0%	1545	27%
	07140204000243	3701.0	3701	100%		0%		0%
	07140204000244	3564.0	3048	86%		0%	516	14%
	07140204000245	6286.0	2462	39%	2729	43%	1095	17%
	07140204000246	2251.0	2251	100%		0%		0%
	07140204000247	5661.0	5661	100%		0%		0%
	07140204000248	1170.0	802	69%	368	31%		0%
	07140204000249	4534.0	924	20%	3610	80%		0%
	07140204000250	3695.0	2637	71%	1058	29%		0%
Silver Creek	07140204000252	7936.0	6065	76%	1871	24%		0%
Silver Creek	07140204000253	837.0	837	100%		0%		0%
Silver Creek	07140204000254	955.0	955	100%		0%		0%
Silver Creek	07140204000255	11990.0	11201	93%	789	7%		0%
Silver Creek	07140204000256	15794.0	10247	65%	4668	30%	879	6%
Silver Creek	07140204000257	5118.0	4799	94%		0%	319	6%
Silver Creek	07140204000258	8107.0	4984	61%		0%	3123	39%
Lake Fork	07140204000438	13411.0	8658	65%		0%	4753	35%
Wendell Branch	07140204000555	5815.0	745	13%		0%	5070	87%

Wendell Branch	07140204000556	4651.0	4651	100%		0%		0%
Wendell Branch	07140204000558	3970.0	2080	52%	1890	48%		0%
	07140204001230	4887.0	3888	80%		0%	999	20%
	07140204001231	5182.0	3644	70%		0%	1538	30%
	07140204001234	2810.0		0%		0%	2810	100%
	07140204001246	4397.0	4397	100%		0%		0%
	07140204001247	11176.0	6854	61%		0%	4322	39%
	07140204001254	7624.0	3465	45%	4159	55%		0%
	07140204001255	2017.0	1205	60%	812	40%		0%
	07140204001256	11378.0	10022	88%	907	8%	449	4%
	07140204001257	17928.0	11936	67%	3986	22%	2006	11%
	07140204001258	3855.0		0%	1661	43%	2194	57%
	07140204001273	4647.0	1238	27%	871	19%	2538	55%
	07140204001274	4742.0	137	3%	4605	97%		0%
	07140204001275	2711.0	2711	100%		0%		0%
	07140204001277	8742.0	6755	77%	1987	23%		0%
	07140204001278	8997.0	7633	85%	1364	15%		0%
	07140204001279	262.0	262	100%		0%		0%
	07140204001280	3485.0	3485	100%		0%		0%
	07140204001281	5250.0	4956	94%		0%	294	6%
	07140204001282	15814.0	13603	86%	2211	14%		0%
	07140204001283	8109.0	3757	46%		0%	4352	54%
	07140204001284	3423.0	3423	100%		0%		0%
	07140204001285	10996.0	3100	28%	855	8%	7041	64%
	07140204001287	7609.0	1075	14%	3634	48%	2900	38%
	07140204001288	7331.0	7232	99%		0%	99	1%
	07140204001292	7738.0		0%	3109	40%	4629	60%
	07140204001294	7414.0	3884	52%	651	9%	2879	39%
	07140204001295	4668.0	2722	58%	1946	42%		0%
	07140204001299	5766.0	4508	78%		0%	1258	22%
	07140204001301	4142.0	4142	100%		0%		0%
	07140204001304	8088.0	7537	93%	551	7%		0%
	07140204001305	13894.0	10771	78%	754	5%	2369	17%
	07140204001307	7307.0	2944	40%	3581	49%	782	11%
	07140204001311	8923.0	5823	65%		0%	3100	35%
	07140204001313	5785.0	4857	84%		0%	928	16%
	07140204001314	10719.0	8825	82%	1148	11%	746	7%
	07140204001323	8007.0	3943	49%	2769	35%	1295	16%
	07140204001324	4816.0		0%	4816	100%		0%
	07140204001326	2611.0	2020	77%	591	23%		0%
	07140204001327	5822.0	5325	91%		0%	497	9%
	07140204001328	8147.0	2743	34%	3918	48%	1486	18%
	07140204001337	2905.0	2905	100%		0%		0%
	07140204001339	4110.0	4110	100%		0%		0%
	07140204001340	7648.0	6486	85%	1162	15%		0%
	07140204001349	114.0	114	100%		0%		0%
	07140204001350	15577.0	13843	89%		0%	1734	11%
	07140204001351	16174.0	11306	70%	4868	30%		0%
	07140204001357	18123.0	13681	75%	1341	7%	3101	17%
North Fork Mill	07140204001362	4167.0	4167	100%		0%		0%

Creek								
	07140204001363	7461.0	6518	87%	417	6%	526	7%
North Fork Mill Creek	07140204001364	2923.0	2923	100%		0%		0%
North Fork Mill Creek	07140204001365	7537.0	7537	100%		0%		0%
	07140204001370	1978.0		0%	1978	100%		0%
	07140204001371	4612.0	4612	100%		0%		0%
	07140204001373	2674.0	2257	84%	417	16%		0%
	07140204001374	7376.0	3925	53%	1689	23%	1762	24%
Silver Creek	07140204002277	12320.0	1695	14%	7269	59%	3356	27%
	07140204003145	2208.0		0%	457	21%	1751	79%
	07140204003146	1017.0	1017	100%		0%		0%
	07140204003156	2158.0	1746	81%		0%	412	19%
	07140204003168	9327.0	7825	84%	1379	15%	123	1%
	07140204003173	3301.0		0%		0%	3301	100%
	07140204003184	1104.0		0%	1104	100%		0%
	07140204003186	1753.0	1596	91%	157	9%		0%
	07140204003190	2001.0		0%	2001	100%		0%
	07140204003236	2543.0	2543	100%		0%		0%
	07140204003253	8641.0	8641	100%		0%		0%
	07140204003511	146.0	146	100%		0%		0%
	07140204003528	7420.0	1743	23%		0%	5677	77%
	07140204003639	1109.0		0%		0%	1109	100%
Wendell Branch	07140204003642	1274.0	1274	100%		0%		0%
	07140204003644	737.0		0%	737	100%		0%
Wendell Branch	07140204003650	1546.0	1546	100%		0%		0%
Wendell Branch	07140204003664	2063.0	2063	100%		0%		0%
Wendell Branch	07140204003669	839.0	839	100%		0%		0%
Wendell Branch	07140204003676	1293.0	1293	100%		0%		0%
Wendell Branch	07140204003696	6324.0	4773	75%	1551	25%		0%
	07140204003698	814.0		0%	814	100%		0%
	07140204003708	1529.0	1529	100%		0%		0%
Wendell Branch	07140204003720	2885.0	2885	100%		0%		0%
	07140204003733	181.0	181	100%		0%		0%
Wendell Branch	07140204003737	4222.0	4222	100%		0%		0%
Wendell Branch	07140204003741	5719.0	5719	100%		0%		0%
Wendell Branch	07140204003745	1526.0	1526	100%		0%		0%
Wendell Branch	07140204003752	1362.0	1362	100%		0%		0%
	07140204003755	2607.0	2222	85%		0%	385	15%
Silver Creek	07140204003804	9796.0	4194	43%	5602	57%		0%
Silver Creek	07140204003820	5574.0	5574	100%		0%		0%
	07140204003838	231.0	231	100%		0%		0%
East Fork Silver Creek	07140204003840	106.0	106	100%		0%		0%
	07140204003861	161.0	161	100%		0%		0%
	07140204003867	656.0	656	100%		0%		0%
	07140204003909	1734.0	1019	59%	715	41%		0%
	07140204005944	702.0	702	100%		0%		0%
	07140204005998	1758.0		0%		0%	1758	100%

	07140204005999	1592.0		0%		0%	1592	100%
	07140204006002	7421.0	3876	52%		0%	3545	48%
Silver Creek	07140204006005	4921.0	4674	95%	247	5%		0%
Silver Creek	07140204006006	1851.0	1029	56%		0%	822	44%
TOTAL		759477.0	511793.0		127952.0		119732.0	
AVERAGE				68%		16%		15%

Riparian condition by stream reach

Table A.81. Riparian condition along assessed stream reaches in the watershed (total stream length assessed and average channelization conditions).

Stream or Tributary Name (GNIS name)	Reach Code	Stream Length Assessed (ft)	Good Condition (ft)	Good Condition (%)	Fair Condition (ft)	Fair Condition (%)	Poor Condition (ft)	Poor Condition (%)
Silver Creek	07140204000192	1144	1144	100%		0%		0%
Silver Creek	07140204000196	1063	559	53%	505	47%		0%
Silver Creek	07140204000197	6040	3544	59%	2497	41%		0%
Silver Creek	07140204000201	327		0%	327	100%		0%
Silver Creek	07140204000221	14162	11274	80%	2888	20%		0%
Silver Creek	07140204000222	1383	439	32%	944	68%		0%
Silver Creek	07140204000223	12394		0%	12394	100%		0%
Silver Creek	07140204000224	5990	5505	92%	485	8%		0%
Silver Creek	07140204000225	12586	4978	40%	7608	60%		0%
Silver Creek	07140204000226	5368	2452	46%	2916	54%		0%
Silver Creek	07140204000227	3249	2415	74%	834	26%		0%
Silver Creek	07140204000228	9689	654	7%	9035	93%		0%
Silver Creek	07140204000229	1677		0%	1677	100%		0%
Silver Creek	07140204000230	3475		0%	3475	100%		0%
Silver Creek	07140204000231	4032		0%	4032	100%		0%
Silver Creek	07140204000232	1715		0%	1715	100%		0%
Silver Creek	07140204000233	2934	2404	82%	530	18%		0%
Silver Creek	07140204000234	10402	4463	43%	5938	57%		0%
Silver Creek	07140204000235	3876		0%	3876	100%		0%
Silver Creek	07140204000236	3557		0%	3557	100%		0%
Silver Creek	07140204000237	3373		0%	3373	100%		0%
Silver Creek	07140204000238	4652		0%	4652	100%		0%
	07140204000239	14708	3120	21%	11589	79%		0%
	07140204000240	3026	1987	66%	1040	34%		0%
	07140204000242	5752	1616	28%	4136	72%		0%
	07140204000243	3701	2025	55%	1676	45%		0%
	07140204000244	3564	1982	56%	1583	44%		0%
	07140204000245	6286	4496	72%	1789	28%		0%
	07140204000246	2251	576	26%	1675	74%		0%
	07140204000247	5661	3924	69%	1737	31%		0%
	07140204000248	1169	279	24%	891	76%		0%
	07140204000249	4535	4535	100%		0%		0%
	07140204000250	3696	1551	42%	2145	58%		0%
	07140204000251	140	140	100%		0%		0%
Silver Creek	07140204000252	8052	7955	99%	97	1%		0%
Silver Creek	07140204000253	830	830	100%		0%		0%
Silver Creek	07140204000254	955	606	63%	350	37%		0%
Silver Creek	07140204000255	11990	5599	47%	6391	53%		0%
Silver Creek	07140204000256	15794	10428	66%	5366	34%		0%
Silver Creek	07140204000257	5118		0%	4642	91%	476	9%
Silver Creek	07140204000258	12521	5256	42%	7265	58%		0%
Lake Fork	07140204000438	13429	10040	75%		0%	3389	25%
Mill Creek	07140204000475	684	684	100%		0%		0%
Wendell Branch	07140204000555	4749	4215	89%	534	11%		0%
Wendell Branch	07140204000556	4651	3960	85%	691	15%		0%

Wendell Branch	07140204000558	3970	1716	43%	2131	54%	123	3%
	07140204001230	4887	1649	34%	3238	66%		0%
	07140204001231	5479	3125	57%	966	18%	1389	25%
	07140204001234	2810	658	23%		0%	2152	77%
	07140204001246	4396	1691	38%	2683	61%	22	0%
	07140204001247	14534	5213	36%	3998	28%	5323	37%
	07140204001254	7624	3803	50%	3821	50%		0%
	07140204001255	2008	2008	100%		0%		0%
	07140204001256	11377	5033	44%	1689	15%	4654	41%
	07140204001257	17928	9702	54%	7549	42%	676	4%
	07140204001258	3855	1581	41%		0%	2274	59%
	07140204001273	4837	1427	29%	3298	68%	112	2%
	07140204001274	4688	4378	93%	310	7%		0%
	07140204001275	2711		0%	2711	100%		0%
	07140204001278	5558	5558	100%		0%		0%
	07140204001279	262	188	72%		0%	74	28%
	07140204001280	3485	563	16%	2922	84%		0%
	07140204001281	5250	1770	34%	3186	61%	294	6%
	07140204001282	15814	6737	43%	8693	55%	384	2%
	07140204001283	8108	7156	88%		0%	952	12%
	07140204001284	3423	2152	63%	1271	37%		0%
	07140204001285	11032	6795	62%	4237	38%		0%
	07140204001287	5077	4011	79%		0%	1066	21%
	07140204001288	7331	3958	54%	3374	46%		0%
	07140204001292	7739	2690	35%		0%	5049	65%
	07140204001294	6954	1407	20%	5547	80%		0%
	07140204001295	4668	1273	27%	3395	73%		0%
	07140204001299	5798	4126	71%	353	6%	1319	23%
	07140204001301	934	934	100%		0%		0%
	07140204001304	3439	490	14%		0%	2949	86%
	07140204001305	13893	10364	75%	2365	17%	1163	8%
	07140204001307	7306	5148	70%	2159	30%		0%
	07140204001311	8874	8517	96%		0%	357	4%
	07140204001313	5787	2458	42%	3329	58%		0%
	07140204001314	10719	2977	28%	6586	61%	1156	11%
	07140204001323	8007	5802	72%	1155	14%	1049	13%
	07140204001324	4816	4816	100%		0%		0%
	07140204001326	2611	559	21%	404	15%	1648	63%
	07140204001327	5822	2232	38%	3590	62%		0%
	07140204001328	8255	4353	53%	3321	40%	581	7%
	07140204001337	2905	1360	47%	1545	53%		0%
	07140204001339	4110		0%	4110	100%		0%
	07140204001340	7649	4541	59%	2057	27%	1050	14%
	07140204001349	1593		0%	1593	100%		0%
	07140204001350	15501	5238	34%	9417	61%	846	5%
	07140204001351	16176	9822	61%	6354	39%		0%
	07140204001357	18025	8579	48%	9082	50%	364	2%
North Fork Mill Creek	07140204001362	4167	4167	100%		0%		0%
	07140204001363	7459	5360	72%	1534	21%	566	8%
North Fork Mill Creek	07140204001364	2923	2923	100%		0%		0%
North Fork Mill Creek	07140204001365	7536	6853	91%	684	9%		0%

	07140204001370	1993	490	25%	1503	75%		0%
	07140204001371	4613	1669	36%	2944	64%		0%
	07140204001373	2674	521	19%	2153	81%		0%
	07140204001374	7374	1950	26%	4542	62%	881	12%
Silver Creek	07140204002277	12318	9931	81%	1091	9%	1297	11%
	07140204003145	2208	1643	74%		0%	565	26%
	07140204003146	1060	1060	100%		0%		0%
	07140204003156	2158	1840	85%		0%	318	15%
	07140204003168	9327	3621	39%	5706	61%		0%
	07140204003173	3301	3301	100%		0%		0%
	07140204003184	1104	1104	100%		0%		0%
	07140204003186	1816	726	40%	1090	60%		0%
	07140204003190	2045	2029	99%	16	1%		0%
	07140204003236	2538	2538	100%		0%		0%
	07140204003253	8641	6323	73%	1386	16%	933	11%
	07140204003528	7420	497	7%	1390	19%	5533	75%
	07140204003639	1295		0%		0%	1295	100%
Wendell Branch	07140204003642	1274		0%	1274	100%		0%
	07140204003644	737		0%		0%	737	100%
Wendell Branch	07140204003650	1546		0%	1546	100%		0%
Wendell Branch	07140204003664	2063		0%	2063	100%		0%
Wendell Branch	07140204003669	840		0%	840	100%		0%
Wendell Branch	07140204003676	1293		0%	1293	100%		0%
Wendell Branch	07140204003696	6323	2101	33%	4222	67%		0%
	07140204003698	816		0%		0%	816	100%
	07140204003708	1529	1089	71%		0%	440	29%
Wendell Branch	07140204003720	2885	1387	48%	1498	52%		0%
Wendell Branch	07140204003737	4216	4216	100%		0%		0%
Wendell Branch	07140204003741	5718	3928	69%	1790	31%		0%
Wendell Branch	07140204003745	1526	1526	100%		0%		0%
Wendell Branch	07140204003752	1362	1362	100%		0%		0%
	07140204003755	2529	2282	90%		0%	248	10%
Silver Creek	07140204003804	9795	7773	79%	2022	21%		0%
Silver Creek	07140204003820	5574	256	5%	5318	95%		0%
	07140204003838	227	227	100%		0%		0%
	07140204003861	161		0%	161	100%		0%
	07140204003867	656		0%	656	100%		0%
	07140204003909	1867	829	44%	1037	56%		0%
	07140204005944	699	699	100%		0%		0%
	07140204005998	1758	406	23%	1352	77%		0%
	07140204005999	1591	1591	100%		0%		0%
	07140204006002	7491	1312	18%	2781	37%	3398	45%
Silver Creek	07140204006005	4921	621	13%	4299	87%		0%
Silver Creek	07140204006006	1856	690	37%	1166	63%		0%
TOTAL		739602.0	375036.2		306647.8		57918.0	
AVERAGE				49.9%		41.5%		8.5%

Streambed erosion by stream reach

Table A.82. Degree of streambed erosion along assessed stream reaches in the watershed.

Reach Code	Stream Length Assessed (ft)	Low Streambed Erosion (ft)	(%)	Moderate Streambed Erosion (ft)	(%)	High Streambed Erosion (ft)	(%)
07140204000223	250	250	100%		0%		0%
07140204000226	200	200	100%		0%		0%
07140204000233	50	50	100%		0%		0%
07140204000237	150	150	100%		0%		0%
07140204000240	200	200	100%		0%		0%
07140204000245	200		0%	200	100%		0%
07140204000250	200	200	100%		0%		0%
07140204000252	100	100	100%		0%		0%
07140204000255	250	250	100%		0%		0%
07140204000258	300	100	33%	200	67%		0%
07140204000436	100		0%		0%	100	100%
07140204000437	450		0%	100	22%	350	78%
07140204000438	400	50	13%	200	50%	150	38%
07140204000475	200	200	100%		0%		0%
07140204000476	100		0%		0%	100	100%
07140204000478	400	100	25%	300	75%		0%
07140204000479	300		0%		0%	300	100%
07140204000555	300	300	100%		0%		0%
07140204000556	100		0%	100	100%		0%
07140204000558	200		0%	200	100%		0%
07140204001231	200		0%		0%	200	100%
07140204001234	50		0%	50	100%		0%
07140204001246	50	50	100%		0%		0%
07140204001247	350		0%	350	100%		0%
07140204001254	500	500	100%		0%		0%
07140204001256	200	100	50%	100	50%		0%
07140204001257	375	225	60%	150	40%		0%
07140204001258	50	50	100%		0%		0%
07140204001273	50	50	100%		0%		0%
07140204001277	100	100	100%		0%		0%
07140204001282	250	100	40%	150	60%		0%
07140204001283	50		0%	50	100%		0%
07140204001285	150	150	100%		0%		0%
07140204001287	100	100	100%		0%		0%
07140204001288	250	250	100%		0%		0%
07140204001292	100		0%	100	100%		0%
07140204001294	50	50	100%		0%		0%
07140204001299	200	100	50%	100	50%		0%
07140204001302	150	150	100%		0%		0%
07140204001305	400	400	100%		0%		0%
07140204001307	200	200	100%		0%		0%
07140204001311	250	250	100%		0%		0%

07140204001313	200	200	100%		0%		0%
07140204001314	300	300	100%		0%		0%
07140204001323	200	50	25%		0%	150	75%
07140204001324	300		0%	300	100%		0%
07140204001326	50		0%	50	100%		0%
07140204001327	100	100	100%		0%		0%
07140204001328	300	150	50%		0%	150	50%
07140204001340	450	450	100%		0%		0%
07140204001350	600	200	33%	400	67%		0%
07140204001351	650		0%	650	100%		0%
07140204001357	150	50	33%		0%	100	67%
07140204001362	400		0%		0%	400	100%
07140204001363	150		0%	150	100%		0%
07140204001365	75		0%	75	100%		0%
07140204001370	300		0%		0%	300	100%
07140204001373	150	150	100%		0%		0%
07140204001374	400		0%	200	50%	200	50%
07140204002277	200	200	100%		0%		0%
07140204003145	50	50	100%		0%		0%
07140204003156	250		0%		0%	250	100%
07140204003168	150	150	100%		0%		0%
07140204003186	200		0%	200	100%		0%
07140204003190	50		0%	50	100%		0%
07140204003236	100	100	100%		0%		0%
07140204003253	200	200	100%		0%		0%
07140204003528	250		0%		0%	250	100%
07140204003657	100		0%	100	100%		0%
07140204003696	150		0%	150	100%		0%
07140204003720	100	100	100%		0%		0%
07140204003741	150		0%	150	100%		0%
07140204003804	150	150	100%		0%		0%
07140204003838	250		0%		0%	250	100%
07140204003861	100	100	100%		0%		0%
07140204003933	300		0%		0%	300	100%
07140204005998	200	200	100%		0%		0%
07140204006002	125		0%	125	100%		0%
07140204006006	300	300	100%		0%		0%
TOTAL	16675	8175		4950		3550	
AVERAGE			53%		30%		17%

Detention/retention basin site visit data

Table A.83. Detention and retention basin site visit data. "Naturalized" indicates native trees and vegetation around the basin. Inlets counted do not include black pipes from roof gutters.

Coordinates & road name	Type	Approx. size (ac)	# inlets	# outlets	Type of outlets	Trash rack present?	Maintenance/design problems	Potential improvements recommended	Condition
38.787996 -89.886048	Retention	0.59	2	1	Overflow channel (vegetated) flowing to a field	No	Algae present Sediment Scouring of outlet channel	Dredging Use overflow pipe rather than outlet channel, or a rock overflow Native vegetation instead of turf	POOR
Staunton Rd	Wet bottom								
	Not naturalized								
	Turf slopes								
38.894895 -89.841558	Retention	0.44	2	1	Overflow pipe (under road)	No	Sediment filled in the sides (grass growing) Algae present Bank erosion Murky milky water Trash present	Dredging Bank stabilization (more riprap) Longer outlet pipe reaching further into basin Native vegetation instead of turf	AVERAGE
Cimarron Dr	Wet bottom								
	Not naturalized								
	Turf slopes								
38.885043 -89.741828	Retention	4.78	>2	1	Pipe (overflow)	No	Small amount of algae Bank erosion on W side (Unclear where overflow water goes - hazard?)	Bank stabilization on W side Native vegetation instead of turf	GOOD
Landolt Dr	Wet bottom								
	Not naturalized								
	Turf slopes								
38.765788 -89.813362	Detention	1.35	1	1	Channel? Not visible.	Not seen	Algae present Trash Presence of invasives - multiflora rose Willow may take over the area	Maintenance plan for removal of invasives and controlling spread of willow as desired	GOOD
Virginia Dr	Dry bottom								
	Naturalized								
	Trees/grasses on slopes								
38.731492 -89.834977	Retention	1.12	1	1	Swale (overflow)	No	Algae present	Continue riprap stabilization on steeper S slope	GOOD
Schmalz Rd	Wet bottom								
	Not naturalized								

	50:50 turf & riprap slopes								
38.723060 -89.856693 Oakshire Dr	Detention Dry bottom Naturalized Turf slopes	0.51	2	1	Pipe	No	Invasive species - very dense phragmites Very dense cattails Trash present Outlet pipe leads towards power station - potentially unsafe	Mow basin more often (Dale Grapperhaus) Remove/treat invasive phragmites and plant native grasses/trees	POOR
38.727221 -89.873027 Theresa Dr	Retention Wet bottom Not naturalized Turf slopes	2.06	1	1	Natural overflow	No	(Treated for algae - water blue Old railroad ties stabilizing S bank are getting older and starting to disintegrate	Replace railroad ties with stabilizing feature before banks cave in	GOOD
38.706187 -89.866577 Country Ln	Retention Wet bottom Not naturalized Turf slopes	0.88	1	2	Culverts in the dam wall	No	(Treated for algae - water blue) Road floods (according to neighbor) - blocked under-road pipe from field to basin Sediment	Dredging Unclog culvert under road Replace trees on dam wall with rock/material that won't degrade its structural integrity	AVERAGE
38.706796 -89.897205 Antler Dr	Retention Wet bottom Not naturalized Turf slopes	1.85	2	2	Pipe to creek and overflow grassed swale	No	(Treated for algae - water blue) Sediment Submerged inlet pipe Road narrowing uphill from the basin as it collapses	Bank stabilization on S end Replace inlet pipe with one above water level	AVERAGE
38.745551 -89.920539 Whitworth Dr	Retention Wet bottom Not naturalized Riprap slopes	0.52	3	1	3-pipe outlet (very large pipes)	Yes - screens on 2 of the 3 pipes	None	None	GOOD

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COMMUNITY FLOOD SURVEY REPORT
2014

UPPER SILVER CREEK WATERSHED
MADISON COUNTY, ILLINOIS

Table of Contents

List of Tables

List of Figures

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EXECUTIVE SUMMARY

This report summarizes the findings of the Madison County Community Flood Survey, which was distributed to homeowners and business owners in the Upper Silver Creek Watershed to gather information about the location, extent, impacts, and causes of flooding in the watershed.

A total of 477 surveys were completed from within the study area out of 2,000 mailed out, giving a response rate of 24%. Some of these were collected via an online survey.

A watershed is an area that drains to a defined point. Watersheds are defined at a variety of scales for different purposes. For management and analysis purposes, the Upper Silver Creek Watershed is defined by smaller hydrologic units between up-stream and down-stream points. Each unit has a unique 14-digit hydrologic unit code (HUC), and these units are informally called HUC14 subwatersheds. Thirty percent (30%) of survey respondents were within the HUC14 subwatershed that contains Troy, 07140204050603. All HUC14 subwatersheds had at least 2 respondents.

Key Findings

- **PREVALENCE:** Over a quarter of respondents (26%) experienced flooding in the last 10 years.

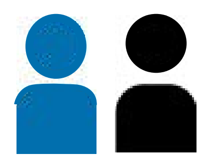
- **FREQUENCY:** 55% of respondents with flooding experienced flooding at least once per year in the last 10 years. On average, respondents with flooding experience 2.7 floods per year.

AVERAGE

2.7

FLOODS *PER YEAR*

- **EXTENT OF DAMAGE:** Of those who had been flooded in the last 10 years:
    - 45% said that the flooding had damaged their primary home or business;
    - 43% had damage to fences, auxiliary buildings, and other structures; and
    - 46% had damage to yards and landscaping.



1/2 of Neighbors Flooded Too

- **NEIGHBORS:** Half of all survey respondents were aware of flooding on one or more of their neighbors' properties. Of the survey respondents who had been flooded, half said that their neighbors had also been flooded.

- **TOP FOUR CAUSES OF FLOODING**:
    1. Heavy rainstorms
    2. Water draining from a neighboring property
    3. Flooding from a nearby river, stream, lake, ditch, or pond
    4. Blocked or unmaintained pipe, culvert, or ditch

- **REPORTING:** Over half of respondents who had flooding did not report it to anyone. Those that did report it were most likely to contact their city or village (18%) or their township (13%).

DIDN'T REPORT FLOODING

- **EFFECTS FROM FLOODING**: Stress was the most commonly reported impact from flooding. Others included loss of access to property, including loss of access to major entry/exit routes to their homes; lost business income; crop damage; and repair and replacement costs of goods and structures.

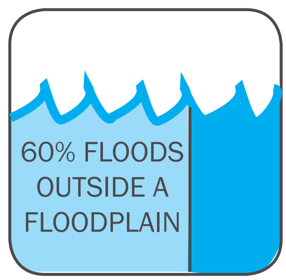
- **MONETARY LOSS:** Two-thirds who reported a monetary loss said their monetary loss over 10 years was less than $5,000. Another 24% said that the loss was between $5,000 and $20,000. Two respondents (4% of those who answered) said their losses were between $100,000 and $500,000.

  Respondents reported a total of at least $330,016 in costs due to flooding over the last 10 years. Each respondent who reported a cost paid at least $6,471 over 10 years. The average cost paid was $18,579 over 10 years. It is estimated that about $42,902,080 was lost due to flooding over the last 10 years in the Upper Silver Creek Watershed.

$43 Mill

LOST DUE TO FLOODS *IN LAST 10 YEARS*

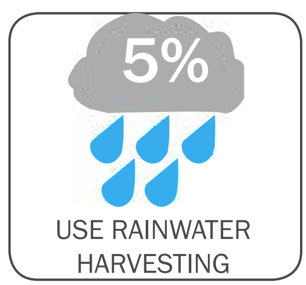
- **RELATIONSHIP TO FLOODPLAINS:** Floodplains designated by the Federal Emergency Management Agency (FEMA) constitute close to 11% of the total acreage in the Upper Silver Creek Watershed within Madison County, and 13% of the survey responses came from parcels wholly or partly within a FEMA-designated floodplain. However, 10% of survey respondents did not know that they lived or owned property in a FEMA-designated floodplain.



- **FLOODING OUTSIDE OF THE FLOODPLAIN**: Flooding does not always occur in floodplains in the watershed. Respondents reported that approximately 146 events per year occur outside of FEMA-designated floodplains in the watershed. Within floodplains, approximately 88 flood events per year were reported.

- **FLOOD INSURANCE:** Fourteen percent (14%) of respondents have flood insurance.

- **FLOOD INSURANCE CLAIMS:** Eight percent (8%) of people who have flood insurance (5 respondents) have made one or more claims. Of those respondents who have flood insurance, 54 (82%) have it on structures that are not in a floodplain.



- **DOWNSPOUTS:** Ninety percent (90%) of respondents said their downspouts flow out onto their lawn or other ground surface. Five prercent (5%) of respondents said their downspouts were connected to cisterns, rain barrels, or other rainwater harvesting storage, and the remaining 5% said they were connected to storm sewers.

- **ACTIONS TAKEN TO PREVENT FLOODING:** 138 respondents made one or more improvements to try to prevent or reduce flooding on their properties.

- **CROPLAND FLOODING:** Six percent (6%) of all survey respondents own cropland that has flooded. Two-thirds of these respondents said that the cropland had flooded 6-10 times in the last 10 years.

- **VALUING WATER MANAGEMENT:** Respondents to the survey place high value on clean drinking water, prevention of flood damage, water-based recreation, and healthy ecosystems (in that order).

- **FLOODING "HOTSPOTS":** Three (3) HUC14 subwatersheds, 07140204050401, 07140204050304, and 07140204050101, were reported "hotspots" for flooding in the Upper Silver Creek Watershed. These hotspots were determined based on a simple ranking/prioritization tool that considers percentage of respondents reporting flooding, frequency of flooding, occurrences of neighbors' flooding, and monetary loss due to flooding. However, these HUC14s also had a low number of respondents (6, 17, and 2, respectively).

INTRODUCTION

This section provides a brief overview of the survey and its purpose.

Overview

Several areas in Madison County regularly experience flooding. Some of this flooding occurs in floodplains designated by the Federal Emergency Management Agency (FEMA), which cover almost 15 percent of the county's area (approximately 110 square miles) and contain at least 4,128 structures with a total value of more than $213 million.[1] A great deal of flooding also occurs outside of floodplains. During heavy storms, inadequate drainage or stormwater infrastructure, coupled with large expanses of impervious surfaces, can cause flooding almost anywhere. Although structures in designated floodplains have been identified, and their owners made aware of their flood risk through the National Flood Insurance Program (NFIP), there is no data or notification system for structures outside of floodplains in Madison County.

Madison County promotes flood-safe development practices and the protection of existing development from flood risk. To determine how to best allocate resources and address flood problems, the locations, causes, and extents of flooding need to be identified. Map-based data and other data gathered by government agencies and organizations are useful to identify flood problems. However, a survey of homeowners and businesses is the most direct way to reveal the location, cause, and extent of flood problems they face.

The economic, social, and environmental consequences of flooding can be substantial to people and communities. Chronically wet houses and land result in higher insurance rates and deductibles, and industry experts estimate that wet basements decrease property values by 10-25 percent.[2] Almost 40 percent (40%) of small businesses never reopen their doors following a flooding disaster.[3] In the streams, rivers, lakes, and ponds that collect floodwater, erosion becomes a significant problem and water quality declines as sediment and other pollutants enter the water supply.

The Illinois Department of Natural Resources (IDNR) is currently conducting a survey on urban flooding, as directed by the Urban Flooding Awareness Act. Urban flooding is defined in the Act as "the inundation of property in a built environment, particularly in more densely populated areas, caused by rainfall overwhelming the capacity of drainage systems, such as storm sewers. "Urban flooding" does not include flooding in undeveloped or agricultural areas." Using this definition, the Madison County Community Flood Survey has collected data on urban flooding as well as non-urban flooding. The State of Illinois will use the results of the Urban Flood Survey to develop strategies for minimizing flood damage and increase the availability, affordability, and effectiveness of flood insurance.

Survey Area - Upper Silver Creek Watershed

The Upper Silver Creek watershed is located 20 miles northeast of St. Louis, Missouri in southwestern Illinois. The majority of the watershed is in Madison County, and small portions fall within Macoupin and Montgomery counties. Silver Creek flows south from the project area to join the Kaskaskia River, which ultimately drains into the Mississippi River.

The majority of the watershed's population lives in unincorporated areas. Portions of thirteen (13) municipalities are also in the watershed, including Troy, Mount Olive, Marine, and Livingston.

Silver Creek has been identified as an impaired water by the Illinois Environmental Protection Agency (IEPA) because of pollution from animal feeding operations, municipal point source discharges, urban runoff, and crop production. In addition, the watershed experiences flooding inside and outside of its designated 100-year floodplains, causing damage to property and threatening life safety.

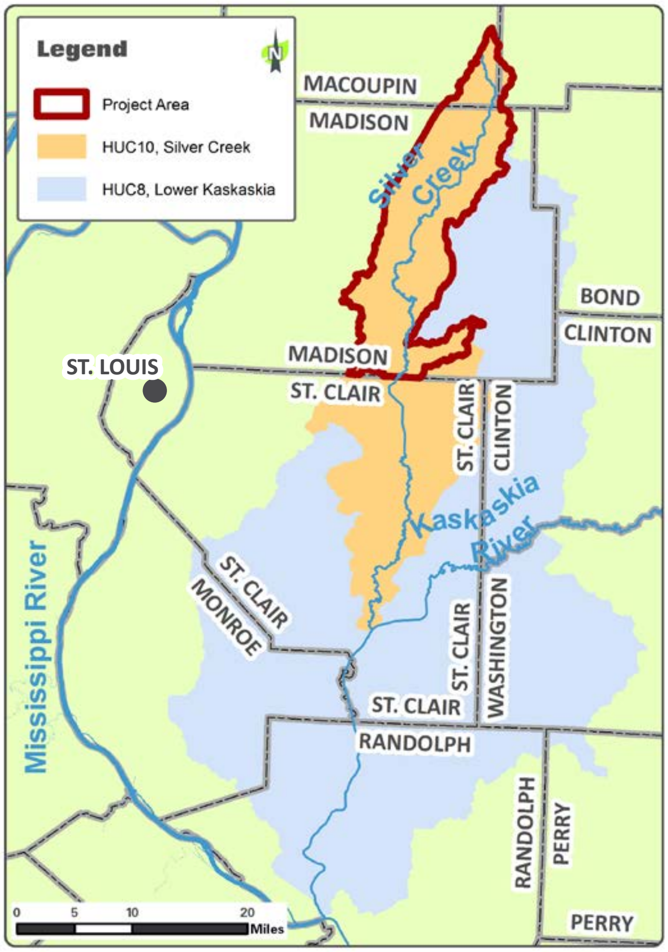


FIGURE 1. UPPER SILVER CREEK PROJECT AREA

The Madison County Community Flood Survey ("the Survey") was conducted in the summer and fall of 2014 to get a better understanding of flooding issues in the Upper Silver Creek project area. The findings of the Survey will be incorporated in the Upper Silver Creek Watershed Plan. When completed, the Plan will provide recommendations for improving water quality and flooding.

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METHODOLOGY

This section discusses survey design, the survey area, how the results were mapped, and limitations of the data.

Survey Area

The survey was mailed to recipients in the Upper Silver Creek watershed, which encompasses 120,091 acres. This watershed extends from Mount Olive in Macoupin County in the north to the Madison-St. Clair County boundary line in the south, and from Troy in the west to Marine in the east. The survey was also available online for community members in the watershed. Some survey respondents provided addresses outside the watershed. These responses were not considered in the results of this report.

Subwatersheds

A watershed is an area that drains to a defined point. Watersheds are defined at a variety of scales for different purposes. For management and analysis purposes, the Upper Silver Creek Watershed is defined by smaller hydrologic units between up-stream and down-stream points. Each unit has a unique 14-digit hydrologic unit code (HUC), and these units are informally called HUC14 subwatersheds or “HUC14s”.

The watershed plan project area and survey distribution area is composed of 20 HUC14 subwatersheds (See map on next page). The HUC14s were delineated using methods employed by United States Geological Survey (USGS) to define watersheds in the Watershed Boundary Dataset (WBD), a component of the National Hydrography Dataset (NHD), a nationwide database of waterways and waterbodies. The HUC14s range from 2,758 to 9,613 acres in size.

Survey Design

The Madison County Community Flood Survey consisted of sixteen (16) questions covering a variety of flooding topics, including frequency of flooding, causes of flooding, the extent and costs of flood damage, flood insurance coverage, and personal values about water quality. A full copy of the survey is available in the Appendix.

Questions were created using best practices to maximize survey response, such as:

- **Powerful purpose:** The survey stated that Madison County is trying to identify and solve flooding problems to make it safer to invest and live in Madison County.

- **Simple to return:** The survey was made as easy to return as possible, with a stamped, self-addressed envelope enclosed. For those wishing to take the survey online, a QR code directed phone users directly to the survey on the website.

- **Privacy assurance:** Survey respondents feel more comfortable providing information when they know how it will be used and that it will be kept private. The first question included a disclaimer that addresses will be kept confidential.

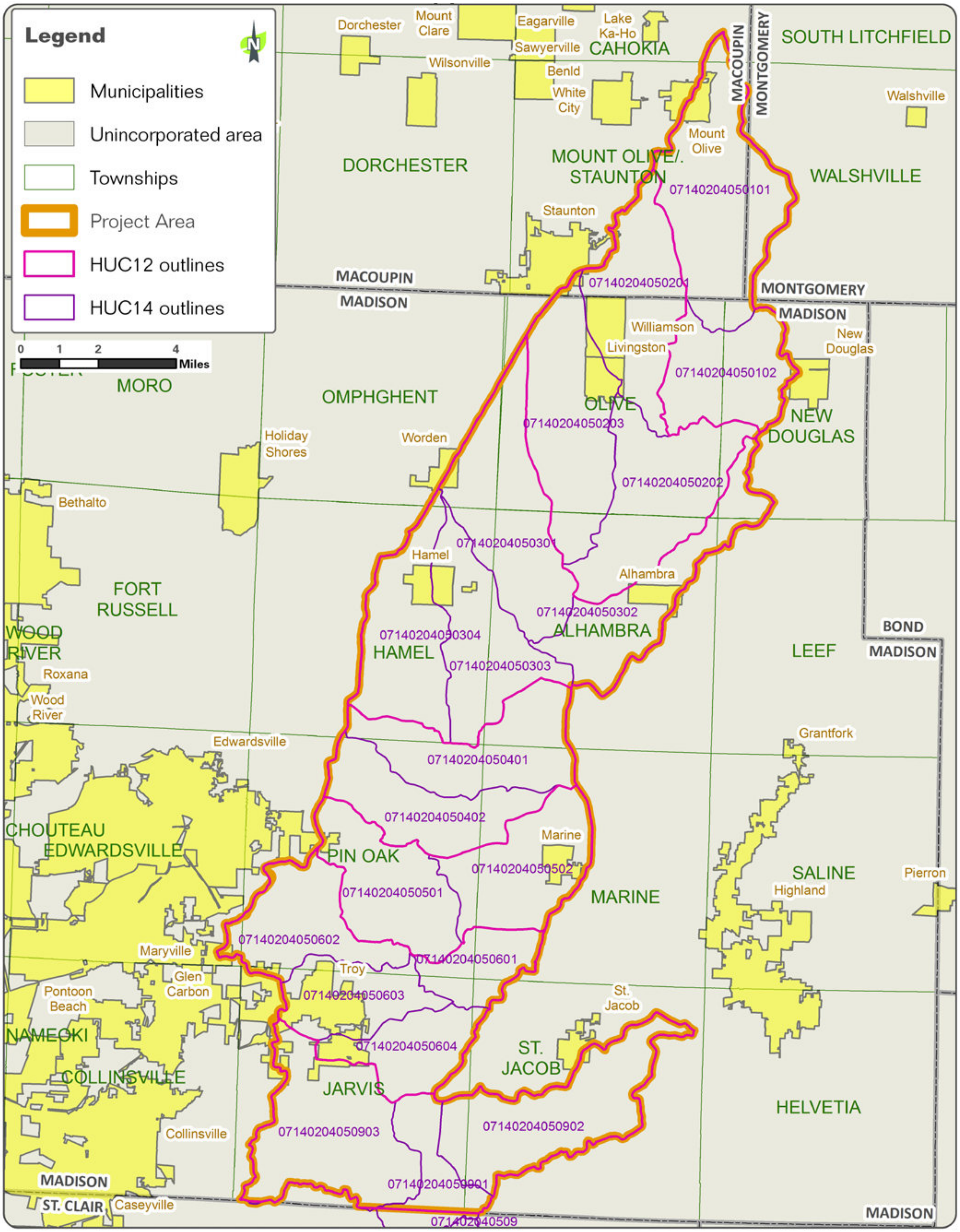

FIGURE 2. UPPER SILVER CREEK WATERSHED PROJECT AREA WITH HUC14 LOCATIONS AND LOCAL JURISDICTIONS.

Survey Distribution and Outreach

Two thousand (2,000) surveys were mailed to randomly selected addresses in the Upper Silver Creek Watershed. Most addresses were in Madison County and a few were in Macoupin County. The randomized list of addresses was created by assigning a number to each parcel in the watershed, and then generating 2,000 random addresses within the range to correspond to the parcels. Duplicate addresses and names were omitted, as were P.O. Box addresses and addresses outside the watershed. These filters resulted in a mailing list of residents, businesses, and property owners currently living or working in the watershed. Madison County printed and mailed the surveys, received the returned responses, and entered the response data.

The survey was also available on the web via SurveyMonkey.com. The mailed survey contained a link to the online survey so recipients could fill it out online instead of by hand. The survey link was also sent to email addresses of interested people and organizations. Some of the recipients of the emailed link may have forwarded it to others.

The survey was publicized at individual and group stakeholder meetings, public open houses, and other meetings for the Upper Silver Creek Watershed Plan. Two weeks after the survey was mailed, reminder postcards were distributed to the same list of mailing addresses to maximize the response rate (and promote the concurrent Open House events for the Watershed Plan). The reminder postcard is available in the Appendix.

Survey Results Mapping

For those respondents who provided an address, the parcel number associated with that address was identified so that the responses could be mapped. Parcel numbers were found using data files from Madison County and the County Assessor's online database.

The response data was grouped and mapped by HUC14 subwatershed. Further geographic breakdown of the response data, such as by Census block, was not possible while maintaining the privacy of respondents' locations.

Data Limitations

It is likely that people who have experienced flooding and received the survey were more likely to reply to the survey than those who have not experienced flooding. Those who received the survey and have never been flooded were more likely not to respond. Of those who did complete the survey, some may not have owned the property for all of the previous 10 years, meaning their estimates are underestimates of frequency and cost. Poor handwriting may also have led to data entry errors. For example, there were at least 35 typos/misinterpretations among responses in the “address” field.

Urban areas were geographically overrepresented in this survey because of the randomized parcel selection process; the ratio of the number of urban to rural parcels is greater than the ratio of the area of urban to rural parcels. This effect is compounded by the fact that a single property owner in a rural area often owns several parcels, and duplicate names were removed in the address selection process causing fewer rural parcels were on the list. Essentially, a geographically representative sample, or one that gave greater weight to answers from rural parcels based on their larger size, would have looked very different.

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SURVEY RESULTS

This section provides the compiled results of the survey. Additional survey response information is available in the Appendix.

Response Rate

A total of 501 unique surveys were completed and returned. Of the total respondents, 477 were properties within the Upper Silver Creek Watershed survey area, and 24 were outside the survey area. The results discussed here are only from the 477 within the study area.

The number of responses exceeded the initial goal of 400 surveys. With this sample size, the survey results are accurate within +/-5% at the 95% confidence level. The response rate of surveys within the watershed is 24%.

Most surveys were returned in hard copy by mail, six (6) were returned at open house events, and other responses were entered online. The online survey gathered responses from 38 people who had not been sent a mailed survey. One hundred thirty-six (136) mailed surveys were returned to the County as a result of invalid addresses.

Survey responses were received from throughout the watershed. Over half of the survey responses came from the Troy area (zip code 62294). At least two (2) responses were received from within each HUC14. A median of 14 responses were received from each HUC14. In HUC14 subwatersheds with only a few respondents, the sample size cannot support strong conclusions. Furthermore, respondents who said they had been flooded in the last 10 years represent an even smaller subset of the population. The number of respondents in each subwatershed replying that they had been flooded ranged between one (1) (four HUC14 subwatersheds) and 34 (HUC 07140204050603).

TABLE 1. ZIP CODE OF SURVEY RESPONDENTS WITHIN WATERSHED PLAN PROJECT AREA

ZIP CODE	RESPONDENTS IN WATERSHED	
Troy (62294)	**257**	**53.9%**
Edwardsville (62025)	**64**	**13.4%**
St. Jacob (62281)	**43**	**9.0%**
Marine (62061)	**33**	**6.9%**
Alhambra (62001)	**32**	**6.7%**
Hamel (62046)	**10**	**2.1%**
Staunton (62088)	**10**	**2.1%**
Worden (62097)	**10**	**2.1%**
New Douglas (62074)	**8**	**1.7%**
Highland (62249)	**6**	**1.3%**
Glen Carbon (62034)	**4**	**0.8%**
TOTAL	**477**	**100%**

Most of the responses (470) were able to be mapped by identifying parcel information from the address given. All of these mappable responses came from the Madison County portion of the watershed.

HUC 07140204050603 (Troy/NW St. Jacob) had the highest concentration of surveys returned with 151, or 30% of all survey responses. The next highest, with 69 responses and 14% of surveys returned is HUC 07140204050604 (E Troy/W St. Jacob), followed by HUC 07140204050903 (Southern Troy Area) with 59 responses, or 12% of all survey responses.

The total land area of the parcels from which surveys were returned is 2,841 acres (2.4% of the overall Watershed Plan Project Area). Parcel sizes ranged between 0.03 and 174 acres, with an average of six (6) acres.

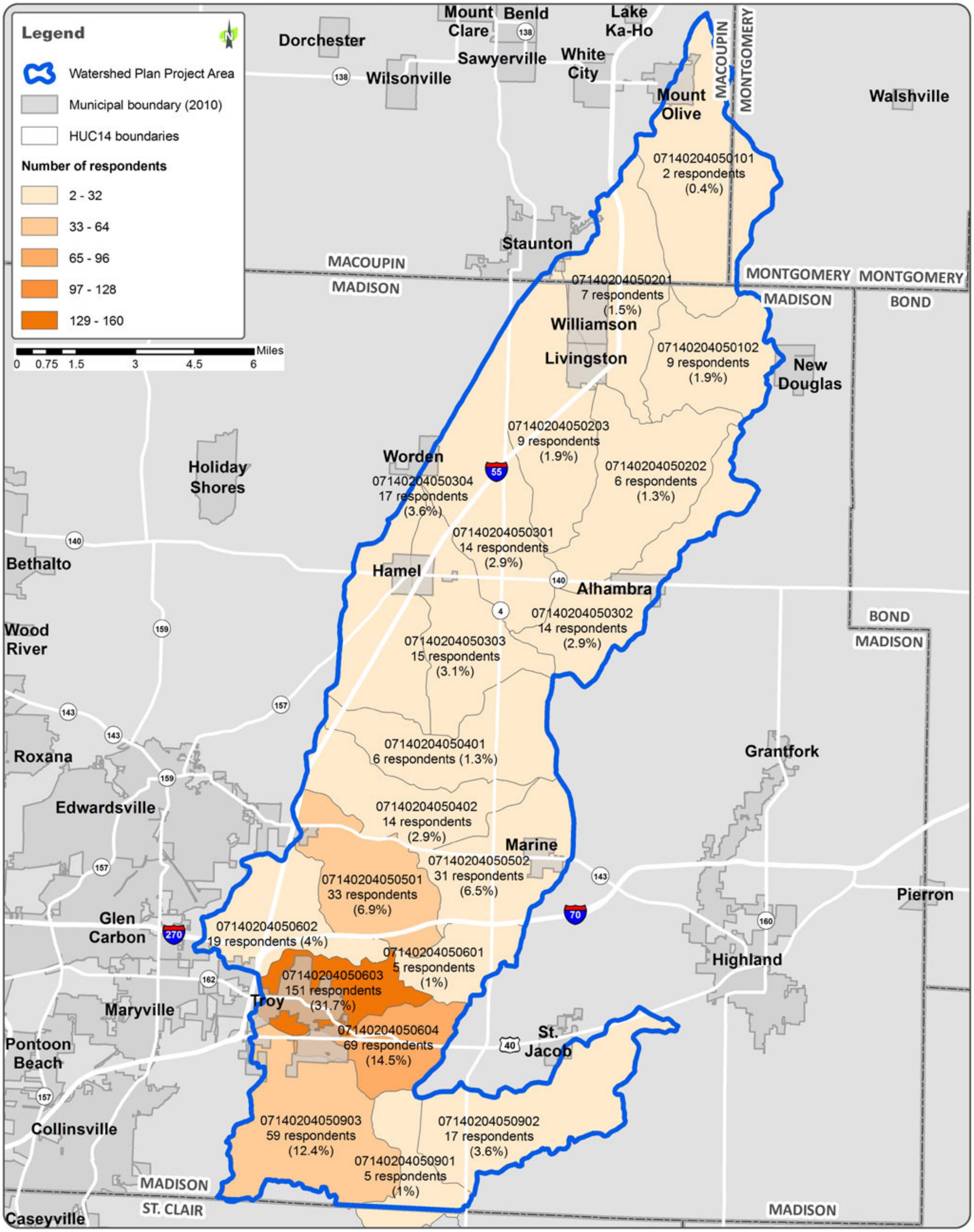


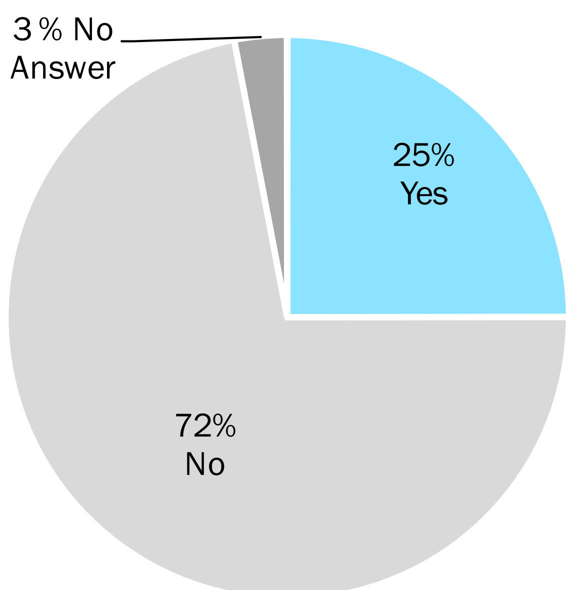
FIGURE 3. SURVEY RESPONSE RATE BY HUC 14

Note: Several respondents' properties were within two HUC14s and were counted in both.

Prevalence

Over a quarter of respondents (26%) replied that they had experienced flooding in the last 10 years.

FIGURE 4. PERCENT OF RESPONDENTS WITH FLOODING IN THE LAST 10 YEARS



HUC 07140204050603 (Troy/NW St. Jacob) had the largest number of respondents with flooding in the last 10 years, with 34 responses. HUCs 07140204050601 (S Marine/NW St. Jacob), 07140204050202 (NE Alhambra/SW New Douglas), and 07140204050101 (Mt. Olive) had the highest percentages of respondents who experienced flooding events in the last 10 years. The lowest percentage of respondents that had been flooded was for the subwatershed containing Williamson (HUC 07140204050201).

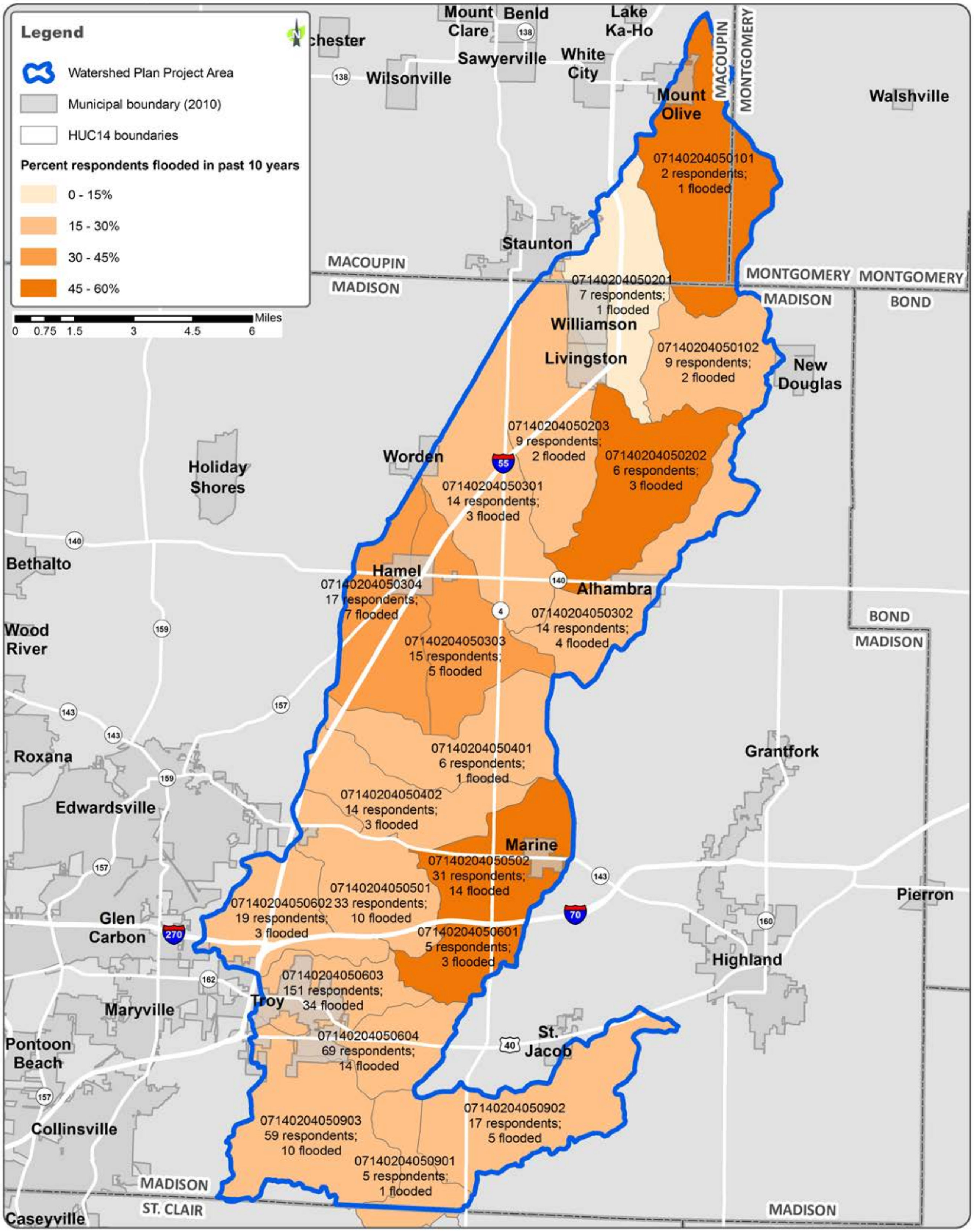


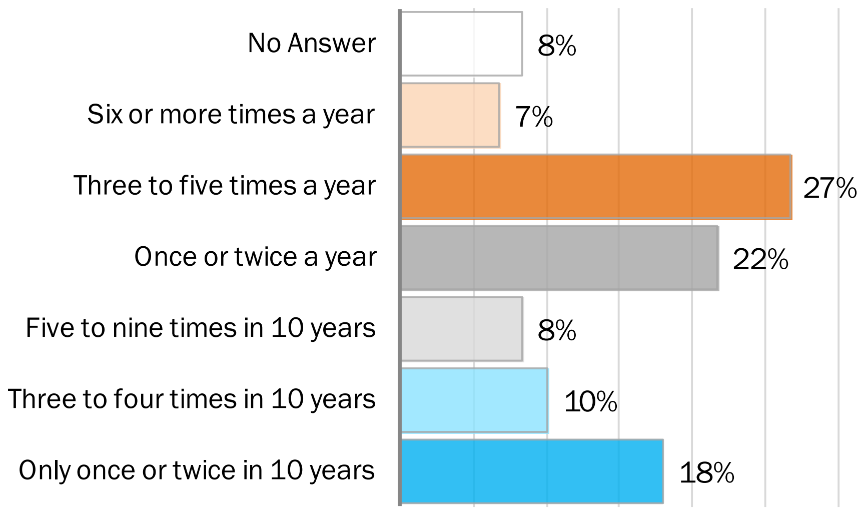
FIGURE 5. PERCENT OF RESPONDENTS FLOODED BY HUC14

Note: Several respondents' properties were within two HUC14s and were counted in both.

Frequency

Of the respondents who had experienced flooding in the last 10 years, 55% experienced flooding at least once per year in the last 10 years. The two most popular responses regarding flooding frequency were three to five times per year (27%), and once or twice per year (22%).

FIGURE 6. FREQUENCY OF RESPONDENTS' FLOODING OVER 10 YEARS



Respondents reported a total of 238 flood events per year in the watershed. When spread over 10 years, it totals around 2,375 flood events. Multiple respondents may have reported the same flood events, and, therefore, they may appear twice or more in the results.

TABLE 2. FREQUENCY OF FLOODING

FLOODING FRQUENCY	RESPONSES		AVG. TIMES PER YEAR	AVG. FREQUENCY x RESPONSES
1-2 Times in 10 Years	22	18%	0.15	3.3
3-4 Times in 10 Years	12	10%	0.35	4.2
5-9 Times in 10 Years	10	8%	0.7	7.0
1-2 Times Per Year	26	22%	1.5	39.0
3-5 Times Per Year	32	27%	4.0	128.0
6 or More Times Per Year	8	7%	7.0	56.0
No Answer	10	8%	–	–
TOTAL	120		2.7 (AVG)	

Based on a weighted average of responses per HUC14, the areas with the highest reported frequency of flooding are HUC 07140204050401 (South of Alhambra) and HUC14 07140204050901 (south of Troy at the Madison and St. Clair Counties' border), each with an average of seven (7) flood events per year. On average, respondents with flooding experience 2.7 floods per year across the watershed.

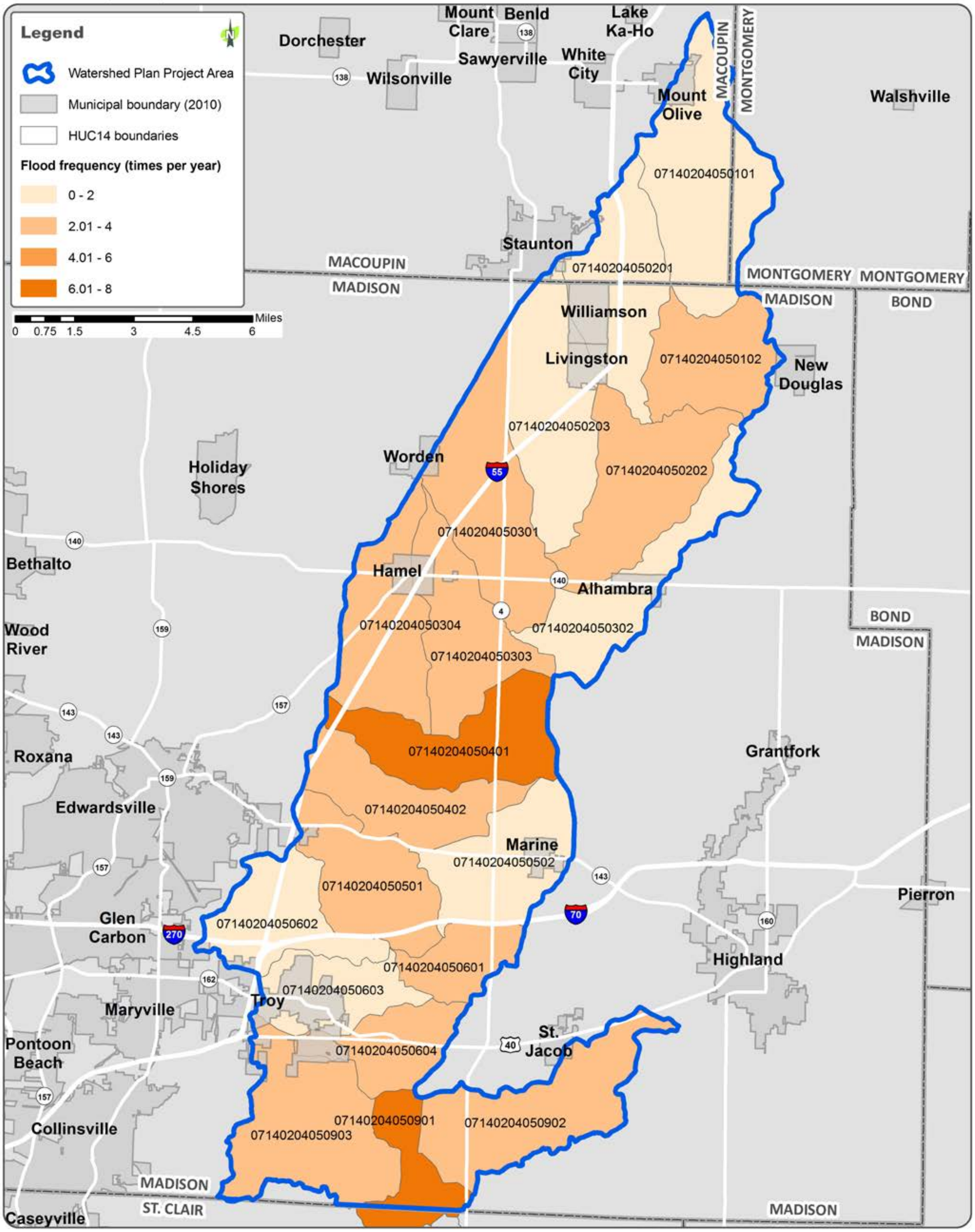


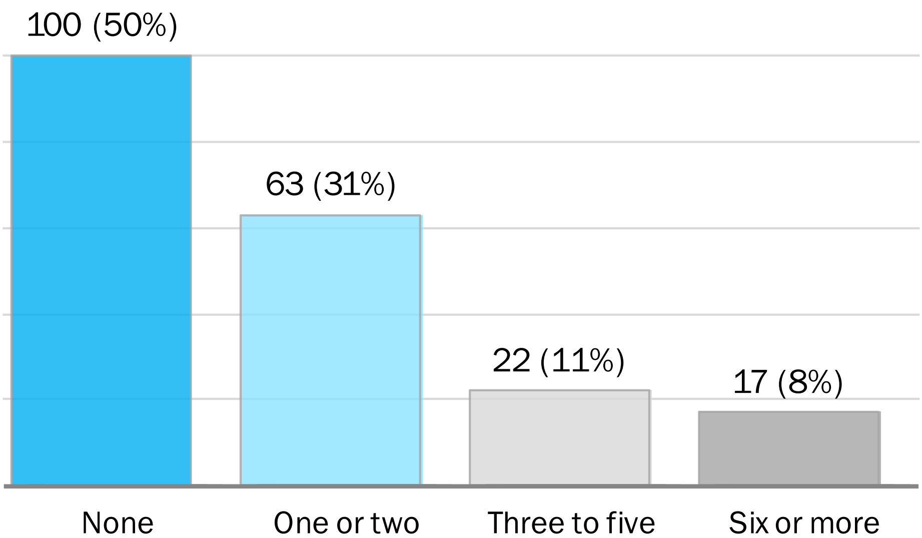
FIGURE 7. FREQUENCY OF FLOODING BY HUC14

Note: Several respondents' properties were within two HUC14s and were counted in both.

Neighbors with Flooding

Half of respondents were not aware of any flooding on neighboring properties. Nearly one-third of respondents were aware of flooding on one to two neighboring properties. Of the respondents who had been flooded, half said that their neighbors had also been flooded.

FIGURE 8. RESPONDENTS' NEIGHBORS THAT ALSO HAD FLOODING IN THE LAST 10 YEARS



Note: Although only 120 respondents reported flooding on their own properties, 205 people responded to this question about their neighbors, which is about 43% of all survey respondents.

On average, 53% of respondents per HUC14 who had flooding in the last 10 years also reported flooding on neighboring properties. This amounts to an average of 1.5 neighboring properties with flooding per respondent with flooding.

All respondents with flooding in HUCs 07140204050401 (center of the watershed) and 07140204050101 (Mt. Olive) also had neighbors with flooding. HUC 07140204050401 also had the highest weighted average of flooded neighboring properties, with an average of seven (7) neighboring properties with flooding per respondent. HUCs 07140204050901 (Madison-St. Clair County border), 07140204050202 (Alhambra/New Douglas), 07140204050203 (Livingston), and 07140204050304 (Hamel/Worden) had an average of two (2) or more neighboring properties with flooding per respondent.

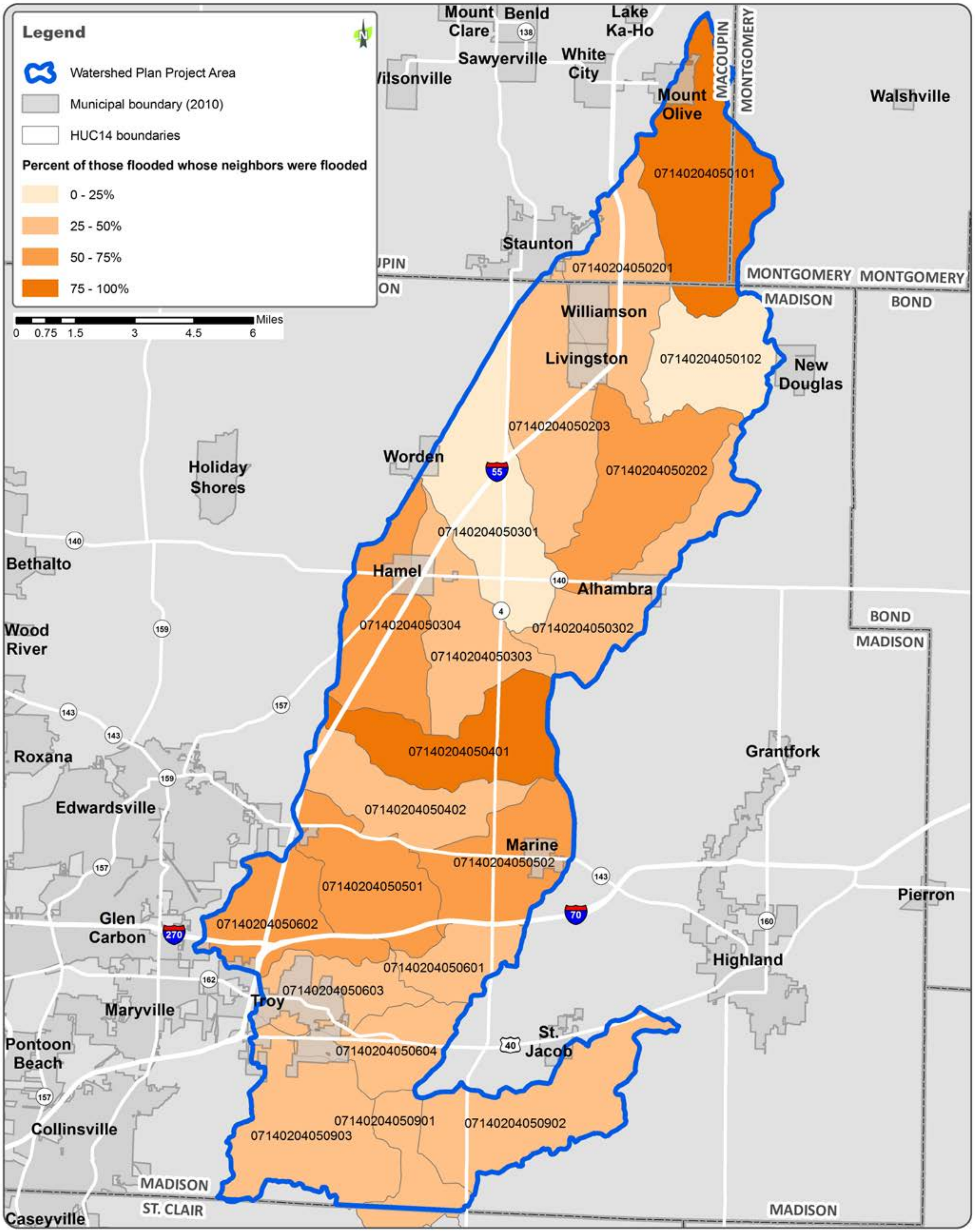


FIGURE 9. RESPONDENTS WITH AT LEAST ONE NEIGHBOR WITH FLOODING BY HUC14

Note: Several respondents' properties were within two HUC14s and were counted in both. Map shows the weighted average of respondents who had been flooded and who said that at least one of their neighbors had been flooded in the last 10 years, as a weighted average, by HUC14

Extent of Flood Damage

Of those who had been flooded in the last 10 years, 45% said that the flooding had damaged their primary home or business; 43% had damage to fences, auxiliary buildings, and other structures; 46% had damage to yards and landscaping; and 70% had little to no yard damage.

Out of the 54 respondents who said their primary home or business had been damaged by floods, 72% said the flooding reached the basement, and 26% said it reached the first floor or habitable space.

FIGURE 10. EXTENT OF FLOODING DAMAGE IN THE LAST 10 YEARS
Note: Respondents could select more than one answer to this question

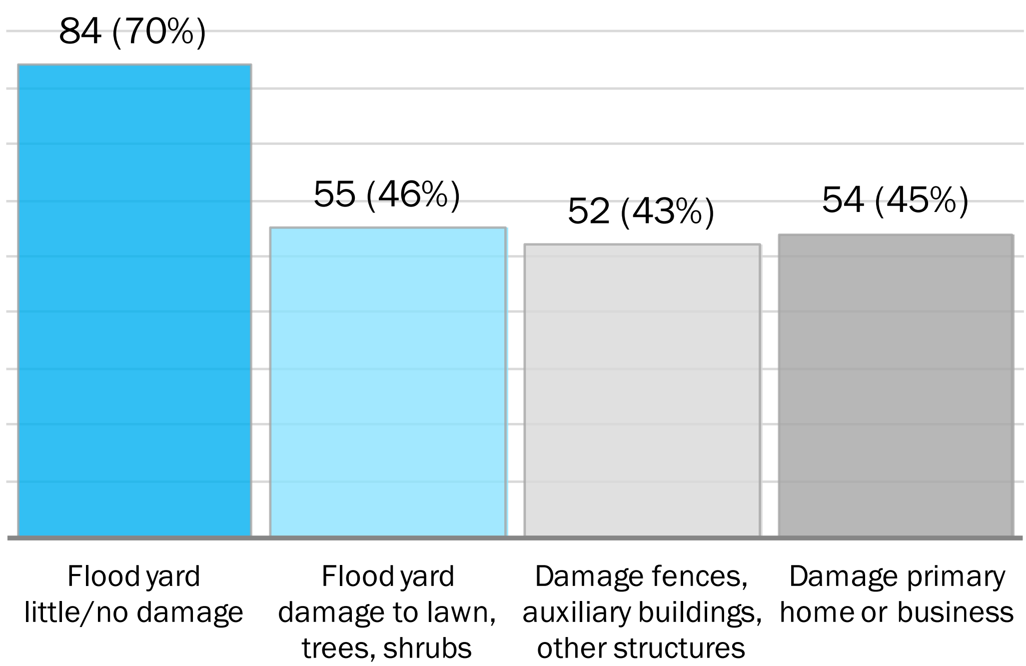
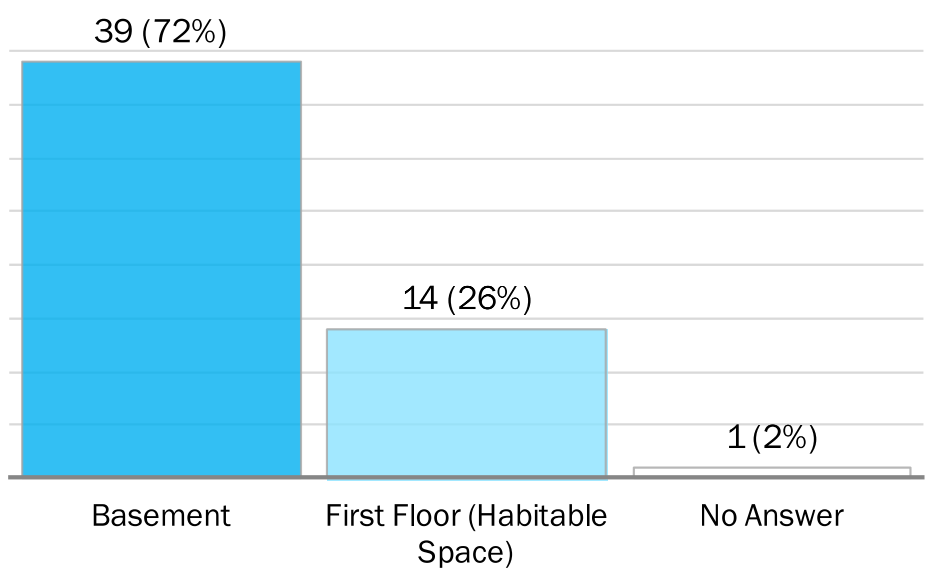


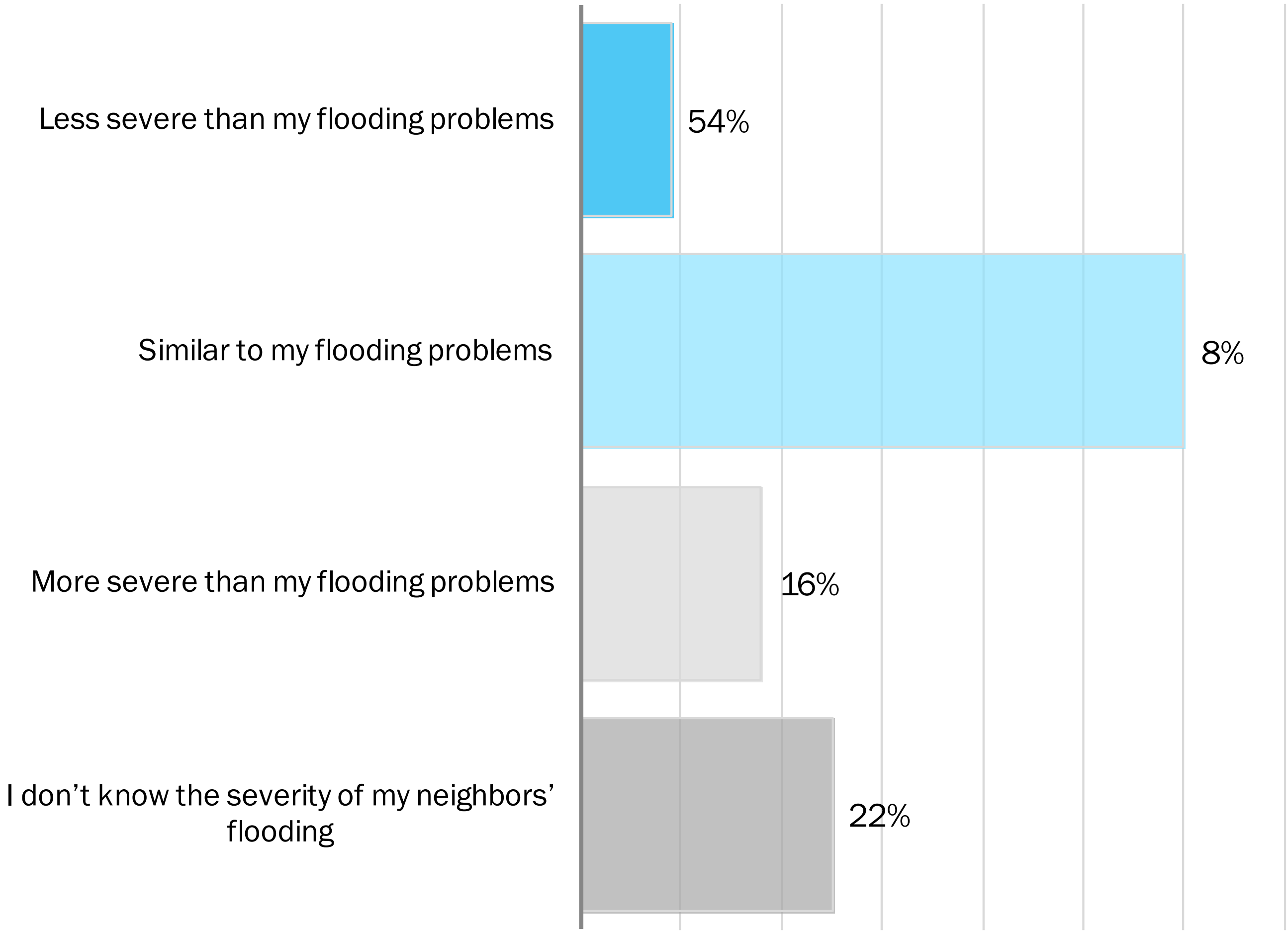
FIGURE 11. LOCATION OF DAMAGE TO PRIMARY HOME OR BUSINESS
Note: Respondents could select more than one answer to this question



Severity of Neighbors' Flood Damage

Half of the respondents who had been flooded said that their neighbors had also been flooded. Of these, 54% said that the extent of their neighbors' flooding was similar to their own. Another 16% said their neighbors' flooding was more severe than their own, while 8% said it was less severe. This indicates that the flood damage reported by respondents about their own property may be representative or an understatement of the wider effects of flooding on their communities.

FIGURE 12. EXTENT OF NEIGHBORS' FLOODING DAMAGE IN THE LAST 10 YEARS



Causes of Flooding

All respondents who had been flooded said that heavy rainstorms were a cause of their flooding. Other causes with responses were water draining from a neighboring property (48%); flooding from a nearby river, stream, lake, ditch, or pond (37%); and a blocked or unmaintained pipe, culvert, or ditch (34%). For this question, respondents could choose more than one answer, so these responses were not mutually exclusive.

TABLE 3. CAUSES OF RESPONDENTS' FLOODING

CAUSE	RESPONSES	
Heavy Rainstorm	120	100%
Water Draining from Neighboring Property	57	48%
Flooding from Nearby River, Stream, Lake, Ditch, or Pond	41	37%
Pipe, Culvert, or Ditch that was Blocked/Needs Maintenance	33	34%
Lack of Drainage Facilities to Drain Water From Property	30	28%
Log-Jam or Other Obstruction in Nearby Watercourse/Waterbody	26	25%
Sewer Backup	7	22%
I Don't Know	4	6%
Other (see Appendix)	44	3%

Forty-four (44) respondents listed other causes of flooding. Some common responses include malfunctioning sump pumps (including no backup power available to run the pump during a power outage), crawl space or basement present in high water table areas, improper drainage/grading design of subdivision, and blocked or improperly sized culverts. The full list is provided in the Appendix.

Overflow from a river, stream, ditch, or pond was reported as a cause of flooding by all respondents in HUCs 07140204050101 (Mt. Olive/Walshville) and 07140204050202 (Alhambra/New Douglas), and two-thirds of respondents with flooding in HUC 07140204050601 (Marine/St. Jacob).

Neighboring properties contributed floodwater to all respondents' properties within HUCs 07140204050101 (Mt. Olive), 07140204050201 (Williamson/Staunton), and 07140204050203 (Livingston), and to more than two-thirds of respondents in HUCs 07140204050604 (Troy/St. Jacob), 07140204050202 (Alhambra/New Douglas), and 07140204050402 (between Edwardsville and Marine).

Blocked or unmaintained pipes, culverts, or ditches contributed to flooding in more than one-quarter of respondents with flooding in HUCs 07140204050203 (greater Livingston) and 07140204050601 (Marine/St. Jacob). See Appendix for full breakdown.

Reporting

Over half of respondents who were flooded did not report their flooding to anyone. Respondents that did report it were most likely to contact their city/village (18%) or their township (13%).

TABLE 4. HOW RESPONDENTS REPORTED FLOODING

REPORTED FLOODING TO:	RESPONSES	
I did not report my flooding to anyone	81	53%
My city/village	27	18%
My township	20	13%
My insurance company	13	9%
Madison County	7	5%
Crop insurance company*	1	<1%
Developer*	1	<1%
Former mayor*	1	<1%
Homeowners insurance*	1	<1%
Public hearing on neighbor's development project*	1	<1%

** Written in under "Other"*

Impacts and Effects from Flooding

The most commonly reported impact from flooding was stress. Loss of access to the property was the next most common impact, with respondents commenting under "Other" that floods had restricted access on their own land (e.g., their driveway flooded) or blocked an entrance road to their subdivision. Several responses noted costs associated with repairing flood damage or replacing lost items (a combined 17%). Respondents identified other specific effects including increases in homeowners' insurance rates, the presence of mosquitoes in floodwater, and delays and difficulties with yard maintenance.

TABLE 5. EFFECTS FLOODING HAD ON RESPONDENTS

EFFECT FROM FLOODING	RESPONSES	
It caused stress	60	24%
No significant effect	47	19%
Partial loss of access to property	37	15%
Time off work to clean up	30	12%
Monetary loss due to repair of flood damage	29	11%
Monetary loss due to lost valuables or equipment	15	6%
Lost business income	7	3%
Affected/damaged crops	5	2%
It affected the physical health of someone in your household or business	4	2%
Damaged fencing*	3	1%
Debris cleanup*	2	1%
Washing/cleaning structures/materials*	2	1%
Affected livestock*	1	<1%
Affected farmland*	1	<1%
Concern about power outage knocking out sump pump*	1	<1%
Unknown damage behind walls*	1	<1%
Damaged farmland*	1	<1%
Mosquito infestation*	1	<1%
Danger to children and small animals*	1	<1%
Delayed lawn maintenance*	1	<1%
Increase in homeowners insurance*	1	<1%
Landscaping not done to avoid future flood damage*	1	<1%
Logjams*	1	<1%
Soft ground difficult to mow*	1	<1%
Potential decrease in home value*	1	<1%

** Written in under "Other"*

Costs from Flooding

Of those who said they had been flooded and provided their monetary loss due to flooding (within a range), 67% said that the loss was less than $5,000 over the last 10 years. Another 24% said that the loss was between $5,000 and $20,000. Two respondents (4% of those who answered) said their loss was between $100,000 and $500,000.

FIGURE 13. COSTS ASSOCIATED WITH RESPONDENTS' FLOODING OVER THE LAST 10 YEARS

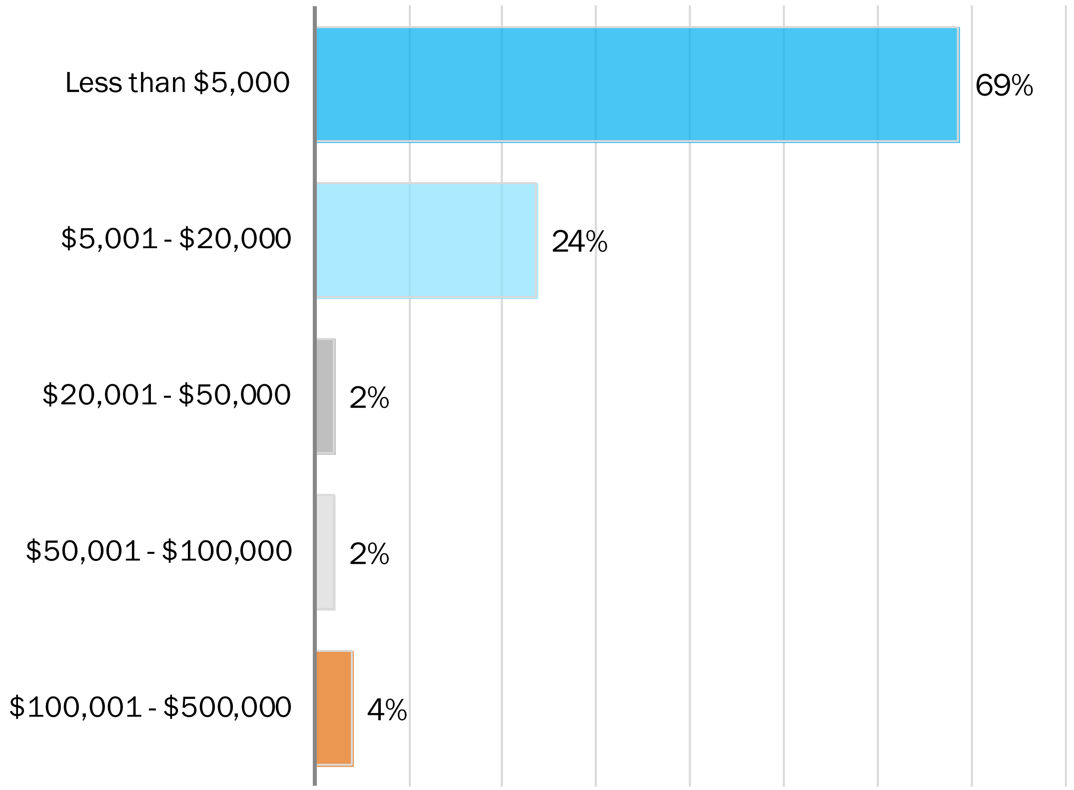


TABLE 6. COSTS ASSOCIATED WITH RESPONDENTS' FLOODING OVER THE LAST 10 YEARS

COST OVER 10 YEARS	RESPONSES*		LOWEST COST IN CATEGORY	LOWEST COST x RESPONSES	AVG. COST IN CATEGORY	AVG. COST x RESPONSES
Less than $5,000	35	69%	$0	$0	$2,500	$87,500
$5,001 - $20,000	12	24%	$5,001	$60,012	12,501	$150,006
$20,001 - $50,000	1	2%	$20,001	$20,001	$35,001	$35,001
$50,001 - $100,000	1	2%	$50,001	$50,001	$75,001	$75,001
$100,001 - $500,000	2	4%	$100,001	$200,002	$300,001	$600,001
I don't know	32	–	–	–	–	–
I prefer not answering	6	–	–	–	–	–
No Answer	388	–	–	–	–	–
TOTAL	**477**		**LOW ESTIMATE:**	**$330,016**	**HIGH ESTIMATE:**	**$947,508**

** Percent = percentage of respondents who answered with a cost*

The lowest estimate of the total costs reported by respondents is $330,016 over the last 10 years. Divided by the 51 respondents who reported a cost in this question, each respondent paid an average of $6,471 over 10 years. Using the average of the amounts reported, the total spent by respondents is $947,508, with an average of $18,579 spent by each respondent over the last 10 years.

Using the lower estimate of costs, and extrapolating to the population of 61,994 in the watershed (estimated in the Watershed Resource Inventory of the ongoing Upper Silver Creek Watershed Plan), i.e., multiplied by 130 [61,994/477], an estimated $42,902,080 of monetary loss has occurred due to flooding over the last 10 years in the Upper Silver Creek watershed.

The greatest average monetary damage occurred in the two central HUC14s in the watershed, between Hamel, Edwardsville, and Marine (HUCs 07140204050304 and 07140204050401).

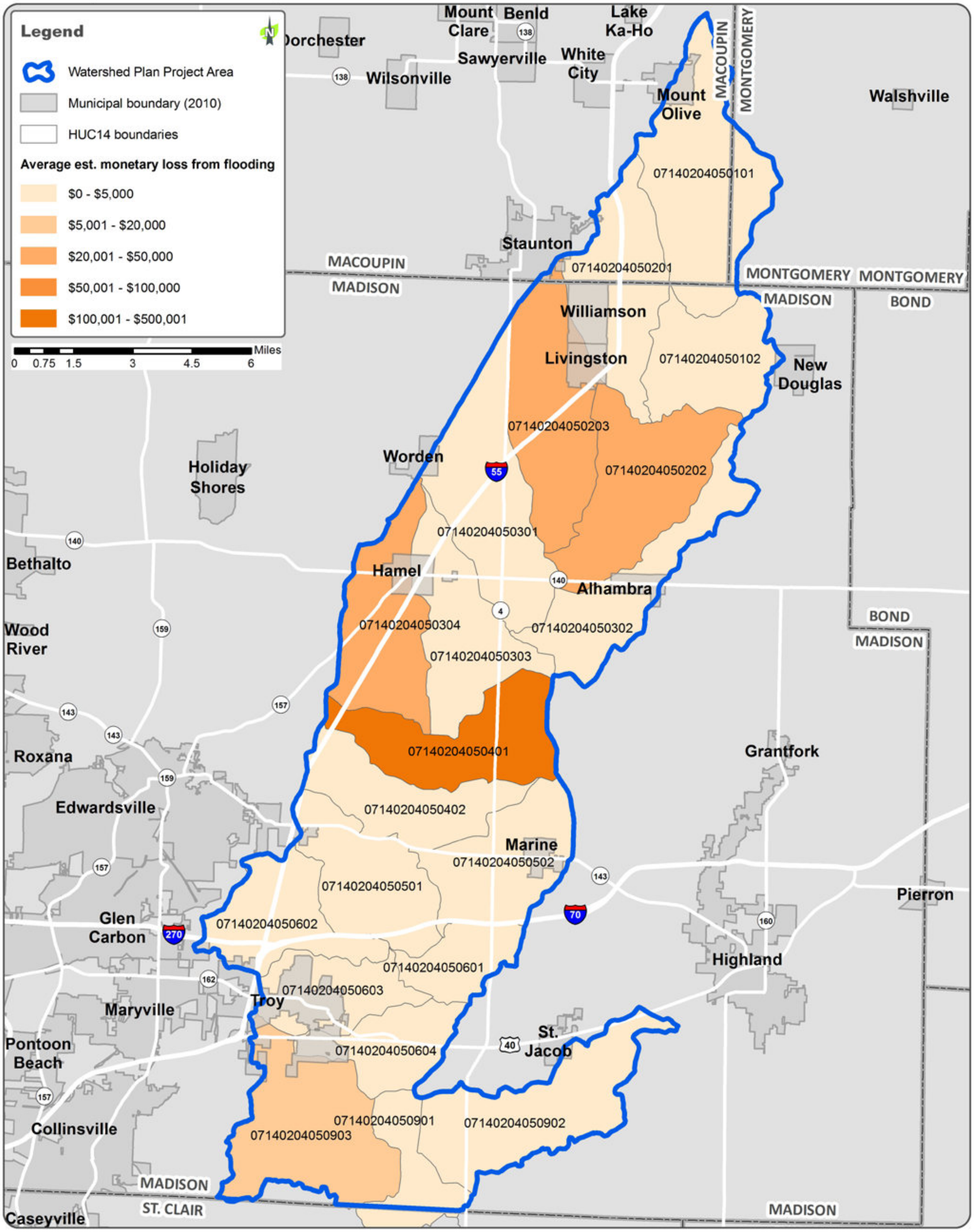


FIGURE 14. MONETARY LOSS FROM FLOODING BY HUC14 (USING LOW ESTIMATE)

Note: Several respondents' properties were within two HUC14s and were counted in both.

Correlation with Floodplains

FEMA-designated floodplains cover close to 11% of the total acreage in the Upper Silver Creek Watershed within Madison County. A similar proportion of surveys, 13%, came from parcels wholly or partly within these floodplains. However, only 3% of survey respondents (13 people) responded that they lived in a FEMA-designated floodplain. Forty (40) respondents, or 10% of those who answered the survey question, unknowingly own property that is wholly or partly in a floodplain.

FIGURE 15. RESPONDENTS' PROPERTY WITHIN OR OUTSIDE A FLOODPLAIN

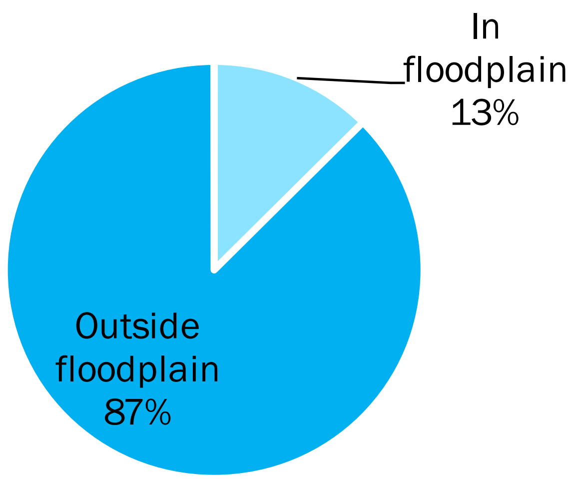
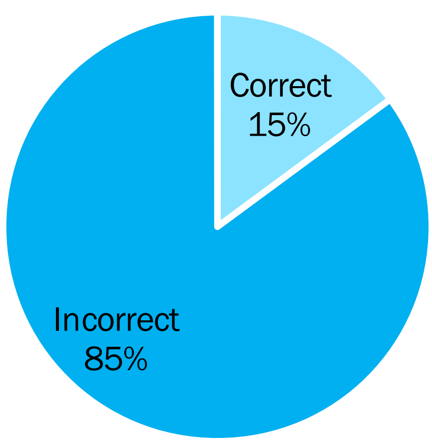


FIGURE 16. RESPONDENTS WHO CORRECTLY KNEW THEIR PROPERTY IS IN A FLOODPLAIN

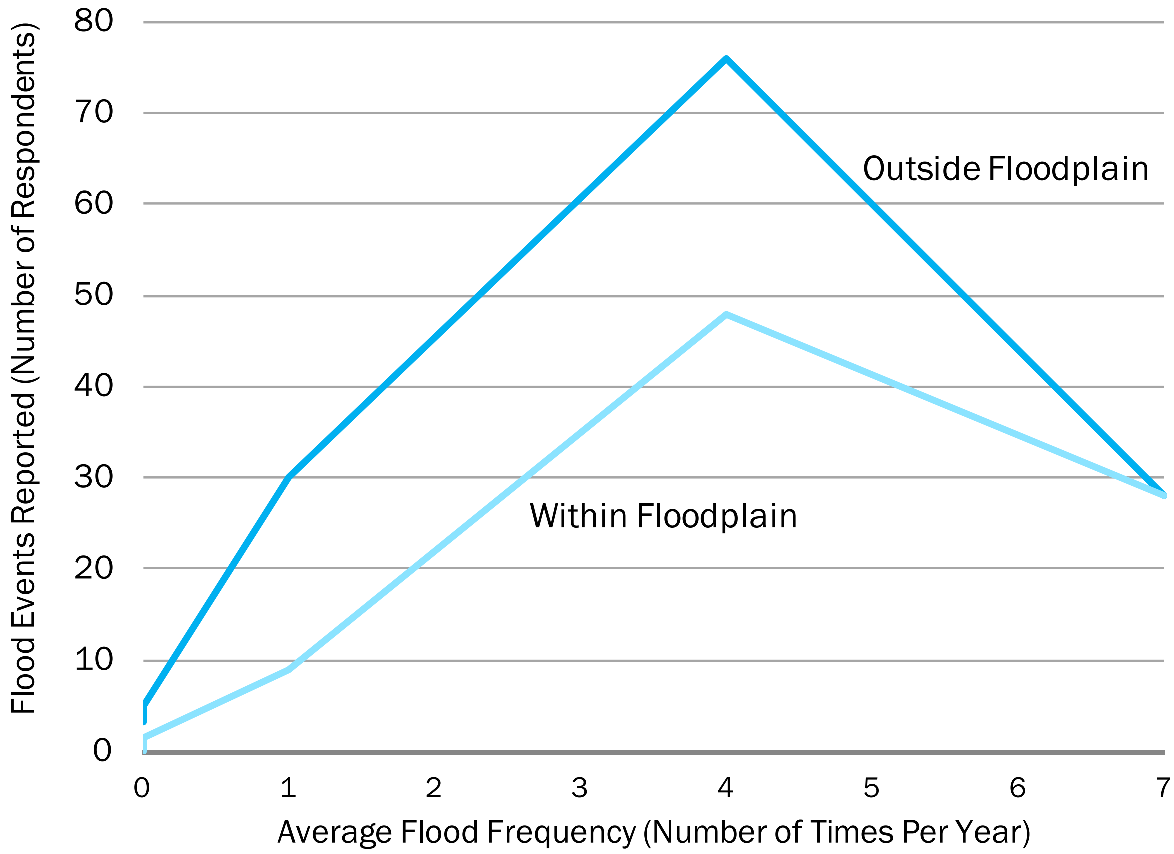


Respondents reported a total of approximately 146 events per year taking place outside of FEMA-designated floodplains over the last 10 years. Within floodplains, approximately 88 parcels per year were flooded.

TABLE 7. FLOOD FREQUENCY BY PROPERTY LOCATION

		PARCELS IN FLOODPLAIN		PARCELS OUTSIDE FLOODPLAIN	
FLOOD FREQUENCY	AVG. TIMES PER YEAR	NUMBER	NUMBER OF TIMES FLOODED PER YEAR	NUMBER	NUMBER OF TIMES FLOODED PER YEAR
1-2 Times in 10 Years	0.15	0	0.0	22	3.3
3-4 Times in 10 Years	0.35	1	0.35	11	3.85
5-9 Times in 10 Years	0.7	2	1.4	7	4.9
1-2 Times Per Year	1.5	6	9.0	20	30
3-5 Times Per Year	4.0	12	48.0	19	76
6 or More Times Per Year	7.0	4	28.0	4	28
TOTAL	2.7	59	86.75	83	146.05

FIGURE 17. FLOOD FREQUENCY BY PROPERTY LOCATION WITHIN OR OUTSIDE OF A FLOODPLAIN



Flood Insurance Coverage

Madison County, Macoupin County, Montgomery County, and five (5) communities in the watershed are enrolled in the National Flood Insurance Program (NFIP), allowing floodplain residents to purchase flood insurance for their properties. The average flood insurance premium paid by Madison County residents is $732 per year.[4] Nationwide, approximately 20% of NFIP claims are for properties located outside floodplains, some of which are from flooding caused by local drainage problems.[5]

Fourteen percent (14%) of respondents (66 people) said that they have flood insurance. Of these respondents, 11% made a claim in the watershed in the last 10 years.

Fifty-four (54), or 82%, of the survey respondents have flood insurance on structures that are not in a floodplain.

FIGURE 18. RESPONDENTS' FLOOD INSURANCE COVERAGE

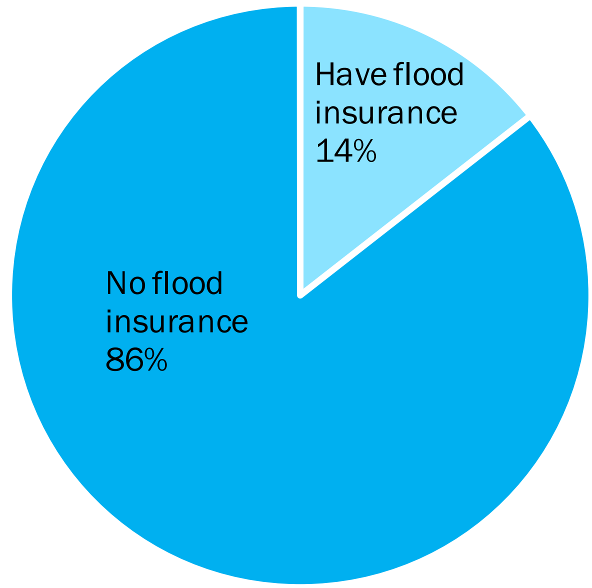
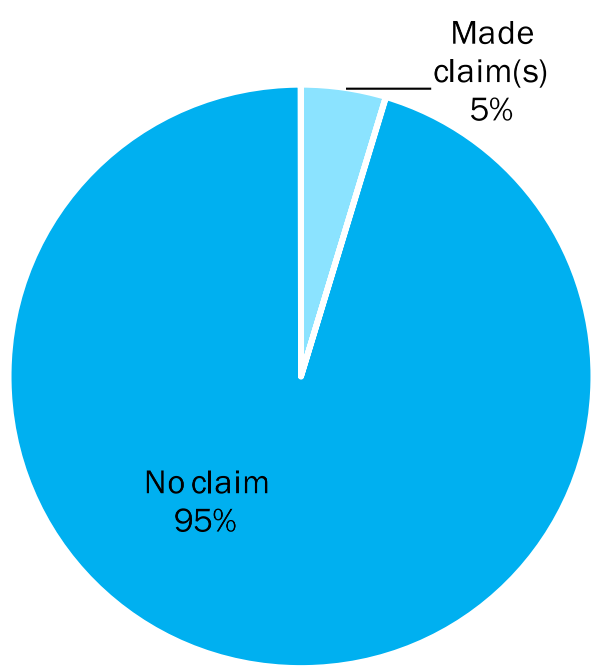


FIGURE 19. RESPONDENTS' FLOOD INSURANCE CLAIMS



Notes on Figures 18 and 19: Those who responded that they did not have flood insurance and then left the claims question blank are assumed not to have made a claim. (4 respondents).

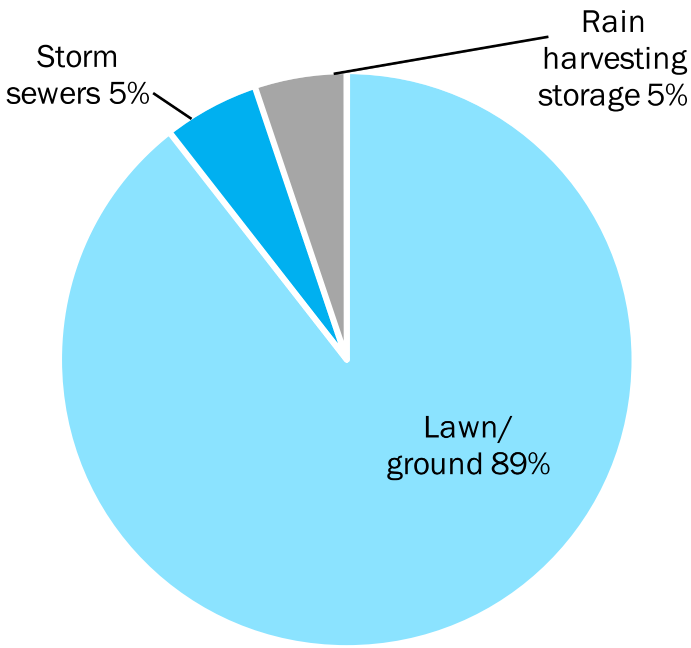
Two (2) respondents said they did not have flood insurance but did make a claim. These respondents may be confused about the claim made; it may have been to their home insurance company instead of a flood insurance company.

Downspout Connections

When downspouts are connected directly to a sanitary sewer system or private sewer system, heavy rainfall can lead to sewer backups into the building. When downspouts open out onto a lawn or other ground surface, the imperviousness and slope of the surface determines where and how fast the water flows. If there is inadequate infiltration, floodwaters can accumulate quickly around a building. A direct connection between downspouts and a storm sewer system quickly transports the water away from the building and into a detention pond or local waterway. Rainwater harvesting methods such as rain barrels or cisterns collect runoff from the roof, preventing it from contributing to flooding around the building or downstream. This is the optimal downspout connection scenario, as it does not allow stormwater to accumulate by the structure or downstream. Rainwater harvesting also allows for reuse of the water in, for example, gardening.

The majority of respondents (90%) who knew where their downspouts connected/terminated said that they flowed out onto their lawn or other ground surface. Smaller proportions of respondents, just over 5% each, said their downspouts were connected to cisterns, rain barrels, or other rainwater harvesting storage, or to storm sewers. The survey did not ask if downspouts were connected to a sanitary or private sewer system.

FIGURE 20. WHERE RESPONDENTS' DOWNSPOUTS CONNECT



Measures to Prevent Future Flooding

138 respondents, or 29%, said they had made one or more improvements in an attempt to prevent future flooding/flood damage. Several respondents (12%) said they installed or enlarged swales or ditches as a flood mitigation improvement. Eight percent (8%) said they planted native vegetation or buffer strips, or took another conservation measure. Creating or enlarging ponds, detention, or retention basins was the next most popular option, at five percent (5%) of respondents. Respondents were given the option to write in other improvements they had made, and several noted that they had installed sump pumps, extended their downspouts, and installed drain tiles and lines. See Appendix for full list of “Other” responses to improvements.

TABLE 8. TOP ACTIONS TAKEN BY RESPONDENTS TO PREVENT FUTURE FLOODING

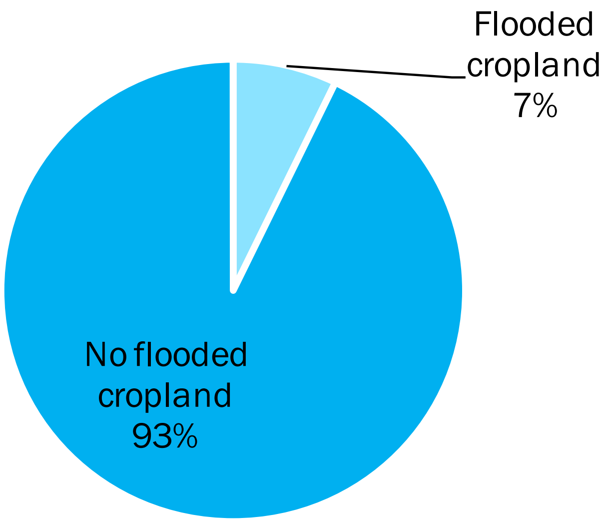
ACTION TAKEN	RESPONSES	
Installed or enlarged swales or ditches	57	12%
Planted native vegetation, buffer strips, or other conservation measures	38	8%
Created or enlarged a pond, detention, or retention basin	23	5%
Installed sump pump*	9	2%
Extended downspouts*	8	2%
Installed drain(s)/drain tile/lines*	8	2%
Installed permeable paving	7	2%
Elevated/graded land*	7	2%
Dug new waterway/ditch*	4	1%
Installed French drain*	4	1%
No flood problem	4	1%
Installed a rain garden	3	<1%
Installed levee/retaining wall*	3	<1%

** Written in under “Other”*

Cropland

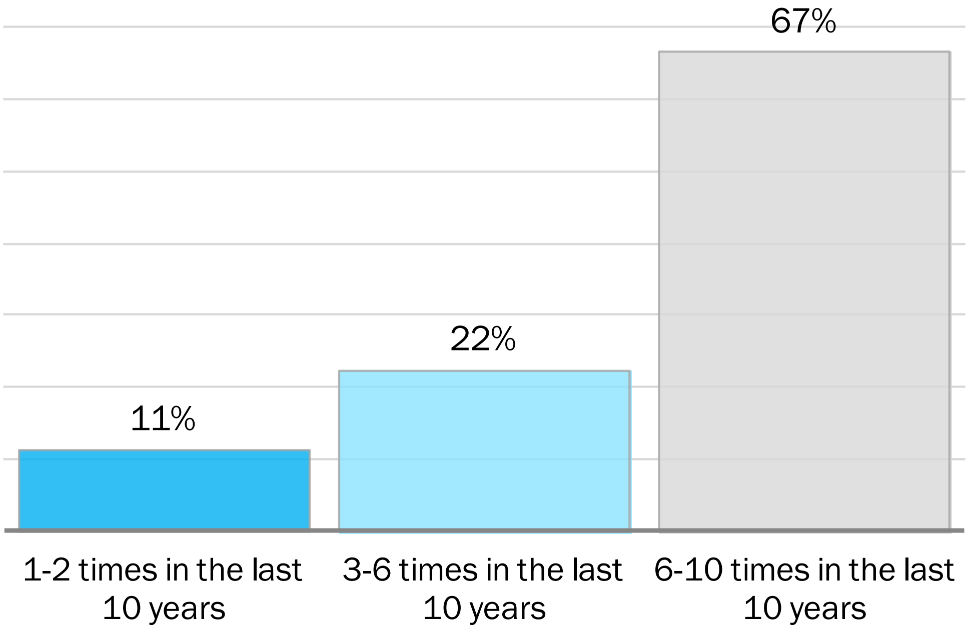
Twenty-seven (27) respondents said they own cropland that has flooded, which is 6% of all survey respondents.

FIGURE 21. FLOODING STATUS OF RESPONDENTS WHO OWN CROPLAND



Two-thirds of respondents whose cropland had flooded said that the cropland had flooded 6-10 times in the last 10 years.

FIGURE 22. FREQUENCY OF FLOODED CROPLAND

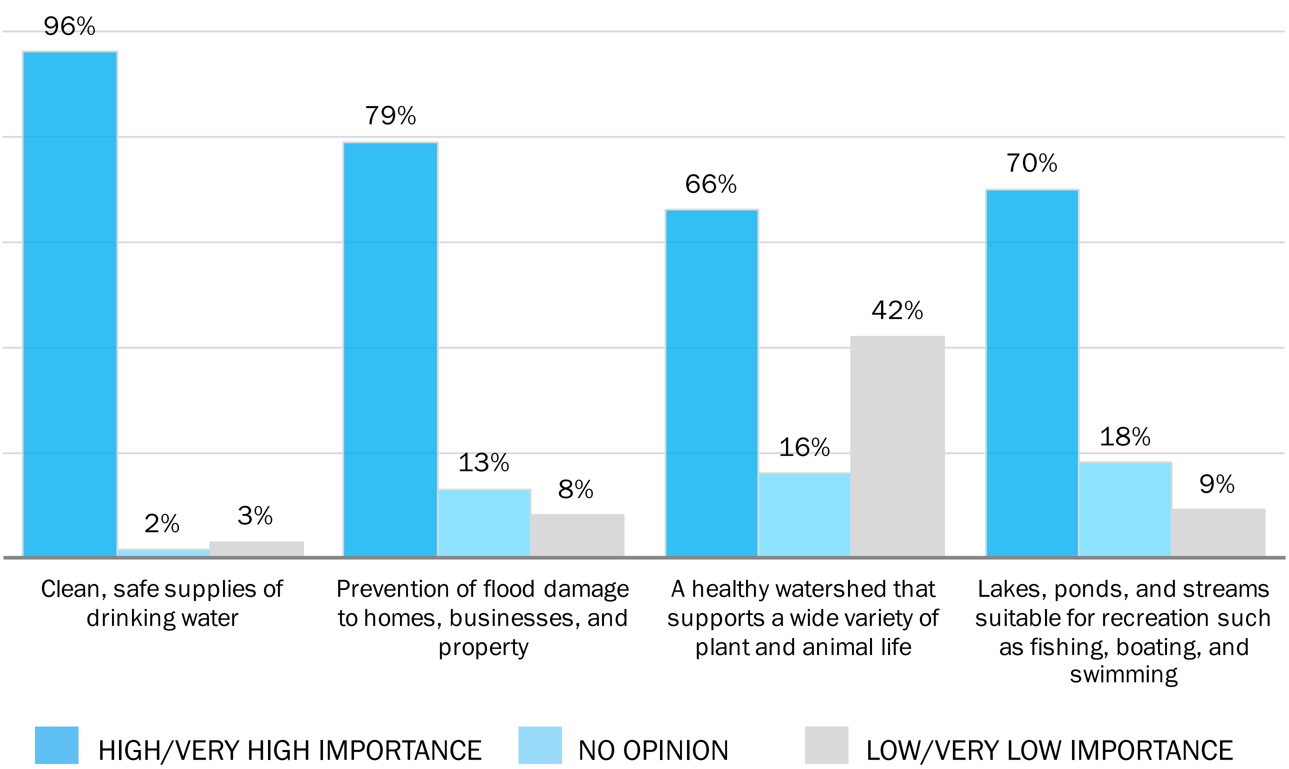


Values of Water Management

Most respondents replied to the question about their values on water-related issues, whether or not they had experienced flooding. The question asked how important four (4) issues were to respondents, and gave an importance scale with five (5) options – very low importance to very high importance.

The highest importance was placed on "clean, safe supplies of drinking water", followed by "prevention of flood damage to homes, businesses, and property"; then "lakes, ponds and streams suitable for recreation such as fishing, boating, and swimming"; and "a healthy watershed that supports a variety of plant and animal life."

FIGURE 23. IMPORTANCE OF WATER MANAGEMENT VALUES TO SURVEY RESPONDENTS



Flooding "Hotspots"

HUC14s in the Upper Silver Creek Watershed were ranked as "hotspots" for flooding. The ranking was determined by assessing four (4) attributes: 1) percentage of respondents who said they had been flooded, 2) flood frequency, 3) percentage who said that neighbors had been flooded, and 4) monetary loss as a result of flooding.

The top three (3) flooding hotspots based on the survey results are HUCs 07140204050401, 07140204050304, and 07140204050101. However, these subwatersheds also had a small number of respondents (6, 17, and 2, respectively) and fewer respondents who said they had been flooded (1, 7, and 1, respectively).

TABLE 9. RANKING OF HUC14 FLOODING "HOTSPOTS"

HUC14	RESPONDENTS FLOODED	AVG. TIMES FLOODED PER YEAR	WITH FLOODED NEIGHBORS	ESTIMATED MONETARY LOSS	RANKING
07140204050401	17%	7	100%	$300,001	1
07140204050304	41%	3	60%	$101,667	2
07140204050101	50%	1	100%	–	3
07140204050202	50%	2	67%	$38,750	4
07140204050601	60%	3	50%	$2,500	5
07140204050901	20%	7	50%	–	6
07140204050502	45%	1	64%	$2,500	7
07140204050501	30%	2	64%	$5,000	8
07140204050303	33%	3	50%	$2,500	9
07140204050203	22%	1	50%	$38,750	10
07140204050302	29%	1	50%	$7,500	10
07140204050603	23%	2	50%	$5,834	10
07140204050602	16%	2	67%	$2,500	11
07140204050102	22%	4	25%	$2,500	11
07140204050301	21%	2	25%	$2,500	11
07140204050402	21%	3	33%	$2,500	11
07140204050604	20%	3	46%	$5,000	11
07140204050903	17%	3	35%	$15,625	11
07140204050902	29%	3	38%	–	11
07140204050201	14%	2	33%	–	12

HIGHEST IN CATEGORY   SECOND HIGHEST   THIRD HIGHEST   LOWEST IN CATEGORY

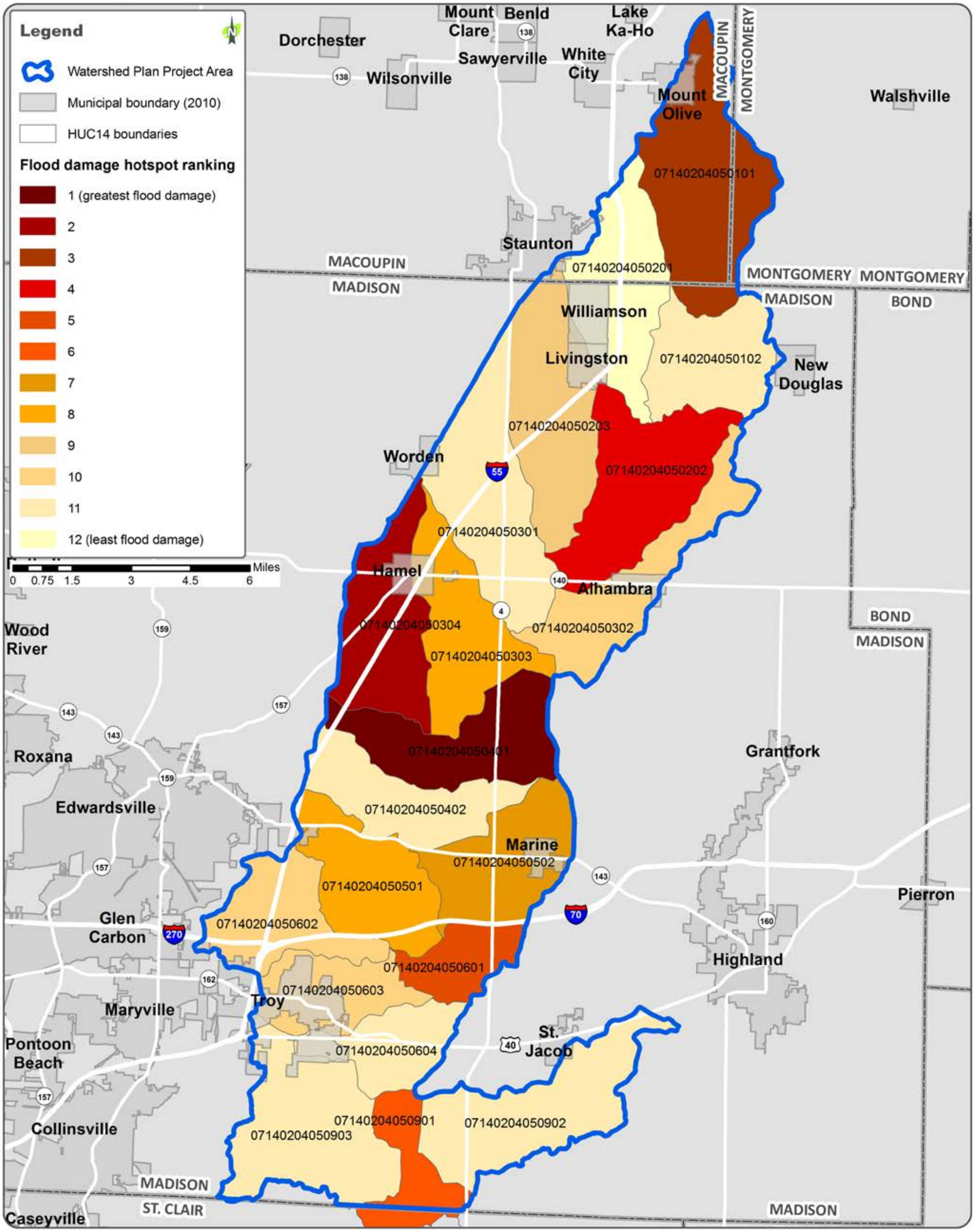


FIGURE 24. FLOODING "HOTSPOTS" BY HUC14

Note: Several respondents' properties were within two HUC14s and were counted in both.

NEXT STEPS

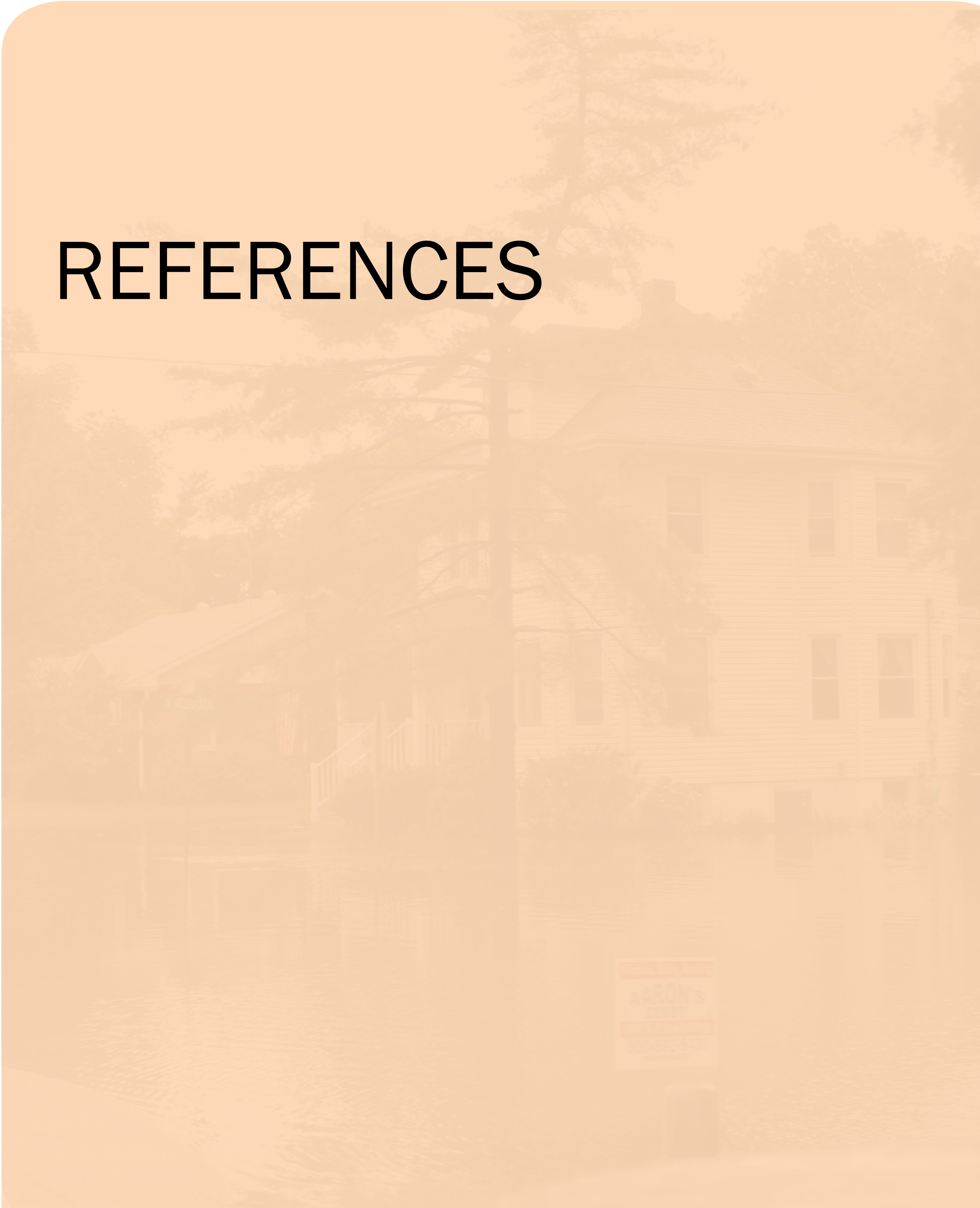
Next Steps

The findings of this survey will be incorporated into the Upper Silver Creek Watershed Plan. Some data about the location and extent of flooding in the watershed has already been gathered from interviews with stakeholders including mayors, township highway road commissioners, property owners, and landowners. The results of this survey will be considered alongside this data as the Technical Committee for the Watershed Plan considers recommendations for mitigating water quality and flooding issues.

More community flood surveys may be undertaken in other watersheds in Madison County and the region as further watershed planning takes place. Having more extensive knowledge about flooding problems in multiple areas will help county and municipal governments prioritize flood mitigation and protection projects across their entire jurisdictions.

Further research into flooding issues and their solutions may include gathering data from private insurers about flood insurance claims. Insurance data would allow for the calculation of the distribution of flood insurance and the costs of flooding through verified policies and claims, rather than best estimates.

REFERENCES



[1] Madison County Planning and Development Department and Madison County Emergency Management Department, Madison County Hazard Mitigation Plan, June 2006, http://www.state.il.us/iema/planning/Documents/Plan_MadisonCounty.pdf

[2] Center for Neighborhood Technology, The Prevalence and Cost of Urban Flooding, May 14, 2013, http://www.cnt.org/resources/the-prevalence-and-cost-of-urban-flooding/

[3] FEMA, as cited in Center for Neighborhood Technology, The Prevalence and Cost of Urban Flooding, May 14, 2013, http://www.cnt.org/resources/the-prevalence-and-cost-of-urban-flooding/

[4] FEMA, Policy Statistics by state as of 9/30/2013, http://bsa.nfipstat.fema.gov/reports/1011.htm

[5] FEMA, National Flood Insurance Program Community Rating System Coordinator's Manual, FIA-15/2013, OMB No. 1660-0022, expires: September 30, 2013, http://www.fema.gov/media-library-data/20130726-1557-20490-9922/crs_manual_508_ok_5_10_13_bookmarked.pdf

Photo Credit: Village of Marine

APPENDIX

The Appendix includes:

- Causes of flooding written in by respondents under “Other”
- Improvements Made to Prevent Future Flooding written in by respondents under “Other”
- Detailed table outlining the Top 3 Causes of Flooding by HUC14
- A copy of the Madison County Community Flood Survey, as mailed
- Postcard survey reminder sent to area residents, businesses, and property owners

Other Causes of Flooding

Causes written in by respondents under “Other”, by response keyword (corresponds to Table 3 on Page 22):

TABLE 10. OTHER CAUSES OF FLOODING

OTHER CAUSE	RESPONSES
Inadequate drainage infrastructure	4
Poor drainage design/grading	4
Sump pump failure	4
Neighboring property	3
Heavy rain	2
Removal of vegetation	2
Dam built downstream	1
Drainage tile on farm fields	1
Ephemeral/historic waterways filling up	1
Power failure at pumping station	1
Rising water table, rising creek	1
Lack of drainage infrastructure maintenance	1
Levees built downstream	1
Logjams	1
Damage to drainage pipes	1
Drainage tile on farm fields	1
New subdivision	1
Bad window well drainage	1
High water table	1
Power outage causing sump pump failure	1

Other Actions Taken to Prevent Flooding

Improvements written in by respondents under “Other”, by response keyword (corresponds to Table 6 on page 32):

TABLE 11. OTHER ACTIONS TAKEN TO PREVENT FLOODING

OTHER ACTIONS	RESPONSES	
Installed sump pump	9	2%
Extended downspouts	8	2%
Installed drain(s)/drain tile/lines	8	2%
Elevated/graded land	7	2%
Dug waterway/ditch	4	1%
Installed French drain	4	1%
No flood problem	4	1%
Installed levee/retaining wall	3	1%
Built dam(s)	2	<1%
Connected downspout(s) to storm sewer	2	<1%
Planted tree(s)	2	<1%
Cleared obstruction(s)	1	<1%
Drain tiled basement	1	<1%
Dug deeper into stream	1	<1%
Seeded waterway/ditch	1	<1%
Installed deck/porch	1	<1%
Installed gutters and downspouts	1	<1%
Installed rain barrel	1	<1%
Installed small cofferdams	1	<1%
Laid sandbags, logs, and plywood as barriers	1	<1%
Laid straw bales	1	<1%
Maintain ditches	1	<1%
Rerouted drainage to drain	1	<1%

Top 3 Flooding Causes in the Watershed by HUC14

All respondents with flooding said heavy rainfall was one of the causes. The next most popular responses – from a neighboring property, a watercourse or waterbody, and a pipe, culvert, or ditch issue – are assessed by subwatershed.

TABLE 12. TOP 3 CAUSES OF FLOODING IN THE WATERSHED (EXCEPT HEAVY RAIN) BY HUC 14

HUC14	NEIGHBORING PROPERTY	WATERCOURSE OR WATERBODY	PIPE, CULVERT, OR DITCH PROBLEMS
07140204050603	53%	5%	6%
07140204050604	71%	5%	8%
07140204050903	30%	7%	5%
07140204050501	40%	10%	7%
07140204050502	43%	19%	24%
07140204050602	33%	–	–
07140204050304	29%	13%	13%
07140204050902	60%	21%	13%
07140204050303	20%	25%	–
07140204050302	50%	17%	–
07140204050301	33%	17%	17%
07140204050402	67%	17%	17%
07140204050102	50%	13%	–
07140204050203	100%	13%	29%
07140204050201	100%	–	–
07140204050202	67%	100%	20%
07140204050401	–	–	–
07140204050601	33%	67%	25%
07140204050901	–	25%	–
07140204050101	100%	100%	–

Madison County Community Flood Survey- Cover

Madison County Community Flooding Survey

Homes, Businesses, and Property Owners

Thank you in advance for taking the time to fill out this survey regarding the impact of floods on homes, businesses, and property in Madison County. This voluntary survey is an important part of the Upper Silver Creek Watershed Plan. Your response is greatly appreciated and will help in determining strategies and recommendations for addressing flooding problems in the Silver Creek Watershed. Flooding has tremendous costs including damage to homes, businesses, and infrastructure.

This survey is part of a larger planning effort for the Upper Silver Creek Watershed. The watershed plan is an opportunity to identify strategies to improve water quality and reduce the impacts of flooding in the watershed. The Upper Silver Creek watershed is one of ten watersheds in Madison County and the watershed plan is an important component of Madison County's Stormwater Plan. By documenting existing conditions and developing recommendations and strategies for best practices to improve water quality and reduce flooding, the plan will be a roadmap for communities, agencies, and landowners for future improvements. Strategies for mitigating flooding will help reduce costs for homeowners, businesses, and taxpayers. Multiple partners are involved with this effort including Madison County, HeartLands Conservancy, Madison County Soil and Water Conservation District, and the Great Rivers Research and Education Center.

Please complete and return this survey by
September 12, 2014.

Your time and input is greatly appreciated!
If you have questions about the survey or the Upper Silver Creek Watershed Plan visit:

www.HeartLandsConservancy.org/UpperSilverCreek

or contact:
Janet Buchanan at HeartLands Conservancy,
(618) 566-4451 ext. 25
janet.buchanan@heartlandsconservancy.org

You can complete this survey in three ways:

1. Fill out and return the survey via the enclosed return envelope.
2. Fill out and return at one of two open houses for the Upper Silver Creek Watershed Plan:
   Tuesday, August 19th at Troy City Hall, 6pm - 9pm
   Wednesday, August 20th at Hamel Community Center, 6pm - 9pm
3. Fill out the survey on-line at:
   www.surveymonkey.com/s/UpperSilverCreek

MADISON COUNTY PLANNING & DEVELOPMENT
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MADISON COUNTY ILLINOIS

HEARTLANDS CONSERVANCY

Turn Page to Start Survey

Madison County Community Flood Survey- Page 1

Start Survey

1. Please provide your address: (Note: Addresses will be kept confidential, unless you request follow-up information below. By giving your address, it allows the planning team to identify areas of flooding.)

Address: ______________________ City: ____________ Zip: __________

☐ Check here if you would like to be put on our mailing list to receive updates and more information. Provide your name, phone, and e-mail below:

Name: ______________________ Phone: ______________________

E-mail: ____

2. Has your home, business, or property at this address been flooded in the last 10 years?

☐ Yes

☐ No *(If you or your neighbors have not experienced flooding, skip to Question #10)*

If yes, how often has your home, business, or property been flooded over the last 10 years? *(Choose one)*

☐ Only once or twice in 10 years.

☐ Three to four times in 10 years.

☐ Five to nine times in 10 years.

☐ Once or twice a year.

☐ Three to five times a year.

☐ Six or more times a year.

3. If flooding does occur at your home, business, or property, does it: *(Select all that apply)*

A. Flood your yard, with little or no damage? ☐ Yes ☐ No

B. Flood your yard, with damage to lawn, trees, and shrubs? ☐ Yes ☐ No

C. Damage fences, auxiliary buildings (sheds, etc) or other structures? ☐ Yes ☐ No

D. Damage the primary home or business? ☐ Yes ☐ No

If flooding damages your primary home or business, how far does the floodwater penetrate into your home or business?

i. Basement ☐ Yes ☐ No

ii. First floor (habitable space) ☐ Yes ☐ No

4. What was the cause of the flooding that affected your home, business, or property? *(Select all that apply)*

☐ Heavy rainstorm.

☐ Water draining from neighboring property.

☐ Flooding from nearby river, stream, lake, ditch, or pond.

☐ Log-jam or other obstruction in nearby river, stream, lake, ditch, or pond.

☐ Pipe, culvert, or ditch that was blocked or needs maintenance.

☐ Lack of drainage facilities (swales, ditches, storm sewers, etc.) to drain water from your property.

☐ Sewer backup.

☐ I don't know.

☐ Other (please explain): ______________________________

Madison County Community Flood Survey- Page 2

5. Have any of your nearby neighbors experienced flooding at their home, business, or property in the last 10 years. *(Choose one)*

- ☐ Yes. One or two neighboring properties.
- ☐ Yes. Three to five neighbors neighboring properties.
- ☐ Yes. Six or more neighbors neighboring properties.
- ☐ No. I don't know of any neighbors who have experienced flooding on their home or property.

6. If you answered yes above that your nearby neighbors experienced flooding at their home, business, or property; what was the severity of their flooding? *(Choose one)*

- ☐ Less severe than my flooding problems.
- ☐ Similar to my flooding problems.
- ☐ More severe than my flooding problems.
- ☐ I don't know the severity of my neighbors' flooding.

7. Did you report your flooding to anyone? *(Select all that apply)*

- ☐ My city/village.
- ☐ My township.
- ☐ The Madison County Stormwater Hotline (618-296-7788).
- ☐ My insurance company.
- ☐ I did not report my flooding to anyone.
- ☐ Other (please explain): ____________________

8. If you have had flooding in the past at your home, business, or property, how have you been affected? *(Select all that apply)*

- ☐ Monetary loss due to repair of flood damage.
- ☐ Monetary loss due to lost valuables or equipment.
- ☐ It caused stress.
- ☐ Time off work to clean up.
- ☐ Partial loss of access to property.
- ☐ It affected the physical health of someone in your household or business.
- ☐ Lost business income.
- ☐ No significant affect.
- ☐ Other (please explain): ____________________

9. If you suffered a monetary loss due to flooding over the last 10 years (such as damage to structures or buildings, lost valuables or equipment, lost wages or income, etc.) what was the estimate of your cumulative dollar expenses over the last 10 years due to flooding?

- ☐ Less than $5,000
- ☐ $5,001 - $20,000
- ☐ $20,001 - $50,000
- ☐ $50,001 - $100,000
- ☐ $100,001 - $500,000
- ☐ Over $500,000
- ☐ I don't know.
- ☐ I prefer not answering.

Madison County Community Flood Survey- Page 3

10. Is your home, business, or property covered by a flood insurance policy?
(Note: Flood insurance is typically not included in a standard home insurance policy).

☐ Yes ☐ No

11. Have you ever made a flood insurance claim?

☐ Yes ☐ No

12. Is your home, business, or property in a FEMA-designated floodplain?

☐ Yes ☐ No

13. Where do your roof downspouts connect to? *(Choose one)*

☐ They connect to the storm sewers.
☐ They flow out onto my lawn or other ground surface.
☐ They are connected to cisterns, rain barrels, or other rain harvesting storage.
☐ I don't know.

14. Have you made any improvements to your property to help reduce stormwater or flood impacts?
(Select all that apply)

☐ Installed a rain garden.
☐ Created or enlarged a pond, detention or retention basin.
☐ Installed or enlarged swales and ditches.
☐ Installed permeable paving.
☐ Planted native vegetation, buffer strips, or other conservation measures.
☐ Other (please explain): ______________________________

15. Do you own cropland that has flooded? (If you have multiple fields that flood, answer based on the field with the most frequent flooding) If **yes**, How many times out of the last 10 years has it flooded?

☐ 1-2 times.
☐ 3-6 times.
☐ 6-10 times.
☐ I don't have cropland that has flooded.

16. How important are the following water issues to you?

	Very Low Importance	*Low Importance*	*No Opinion*	*High Importance*	*Very High Importance*
A. Clean, safe supplies of drinking water:	☐	☐	☐	☐	☐
B. Prevention of flood damage to homes, businesses, and property:	☐	☐	☐	☐	☐
C. Lakes, ponds, and streams suitable for recreation such as fishing, boating, and swimming:	☐	☐	☐	☐	☐
D. A healthy watershed that supports a wide variety of plant and animal life:	☐	☐	☐	☐	☐

Please complete and return this survey by: **September 12, 2014.**

Thank you for completing this survey!
Your time and input is greatly appreciated. Survey responses will be used to help shape the recommendations for the Upper Silver Creek Watershed Plan.

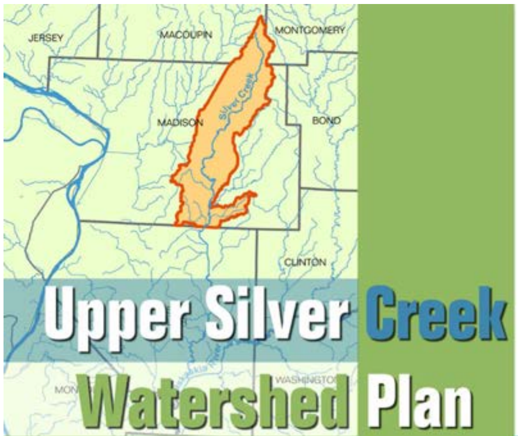
Return this survey via the enclosed envelope or mail to:

Upper Silver Creek Survey - Madison County Planning and Development
157 North Main Street, Suite 254

For updates and progress on the Upper Silver Creek Watershed Plan, please visit:

www.HeartLandsConservancy.org/UpperSilverCreek

Madison County Community Flood Survey Postcard



For more information about the survey and the Upper Silver Creek Watershed Plan visit:

www.HeartLandsConservancy.org/UpperSilverCreek

Reminder to Take the Madison County Community Flooding Survey

Please take a moment to fill out the survey regarding flooding impacts to homes, businesses, and property in Madison County. This voluntary survey is an important part of the Upper Silver Creek Watershed Plan. Your response is greatly appreciated.

The survey will be open until:
September 12, 2014

You can complete the survey on-line!

To complete the survey on-line, go to:

www.surveymonkey.com/UpperSilverCreek

Madison County Planning and Development
157 North Main Street, Suite 254
Edwardsville, IL 62025

Madison County Community Flooding Survey

Homes, Businesses, and Property Owners

Take the Community Flooding Survey on-line at:

www.surveymonkey.com/UpperSilverCreek

by September 12, 2014

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ILLINOIS

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Investing In The Nature Of Southwestern Illinois

APPENDIX C – THE LANDOWNER/FARMER SURVEY

The Landowner/Farmer Survey was sent out to over 1,000 landowners in the watershed who own parcels of at least 5 acres in size. HeartLands Conservancy and Madison County collaborated to send out this survey in summer 2015. The aim of the survey was to create awareness among landowners about the types of grants that are available to them to implement the BMPs recommended in this Watershed Plan. This will help in creating a seamless transition between the planning and implementation processes, and will keep momentum going after the Plan is complete.

The mailing included information about the Watershed Plan, types of grants available for the implementation of various types of Best Management Practices (BMPs), and types of BMPs eligible for grants. The survey questions ask what types of issues landowners have found on their land and in the creeks. Contact information is provided so that interested landowners will know who to talk to about applying for the grant most appropriate for them.

This Appendix includes a copy of the survey, and the survey results as displayed in a SurveyMonkey report.

Upper Silver Creek Watershed Plan

MADISON COUNTY PLANNING & DEVELOPMENT — PLAN | GROW | SUSTAIN

HEARTLANDS CONSERVANCY

Landowner/Farmer Survey: Land Management Practices and Funding

Dear Landowner/Farmer,

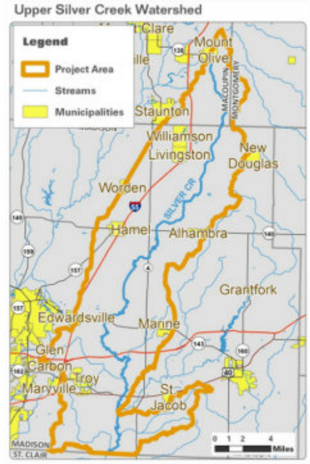
As an owner and steward of some of southwestern Illinois' finest land, you already know the importance of clean water and a thriving agricultural economy to our region. You're probably also aware of issues with flooding, poor water quality, topsoil loss, and streambank erosion. Fortunately, there are efforts underway to address these issues in a thorough, effective manner – a Watershed Plan. And we'd love you to be a part of it.

Please take this opportunity to read about the Upper Silver Creek Watershed Plan underway in this area, funding sources for implementing Best Management Practices, and the types of practices eligible. Then take our quick survey to let us know what your issues are and what you would like to do!

Please return the survey by July 10th.

Upper Silver Creek Watershed Plan

Upper Silver Creek Watershed



The Upper Silver Creek Watershed Plan is an opportunity to address water quality and flooding problems in a strategic way in eastern Madison County. The upper Silver Creek watershed is the area that drains to Silver Creek above the Madison-St. Clair county border, including Troy, Hamel, Livingston, and Marine.

Within this area, water quality issues have been identified in the streams, and flooding has been reported both inside and outside of floodplains. (You may have received the Madison County Community Flood Survey last summer, which found widespread flooding experienced by 26% of respondents in the last 10 years). Funded by Madison County and Illinois EPA, the Watershed Plan is gathering information and feedback from the public in order to identify the locations where we can implement the most effective solutions.

Grants Available

Several grants are available to farmers and landowners in the upper Silver Creek watershed to pay for land conservation, restoration, and management practices.

A **319 grant** from Illinois EPA can help with construction costs of practices that protect soil and water quality. HeartLands Conservancy and the Madison County Soil and Water Conservation District (SWCD) are planning to apply for the grant this year, making funds available next year, if there is enough interest from landowners.

Field floods near Marine, 2014

Over the past 12 years, HeartLands has helped distribute $2.7 million to landowners in Clinton County through the 319 grant program.

Other grant programs include the **Conservation Reserve Program** (CRP), the **Conservation Reserve Enhancement Program** (CREP), the **Environmental Quality Incentives Program** (EQIP), the **Streambank Stabilization and Restoration Program** (SSRP), and the **Agricultural Conservation Easement Program** (ACEP), which includes Agricultural Land Easements and Wetland Reserve Easements. Each program has a different focus and distributes funds in a different way. A cost share (monetary contribution from the landowner) is almost always needed; amounts and proportions vary depending on the grant and the type of project. Some projects in Madison County have been 95% paid for by a grant.

Best Management Practices (BMPs)

Several Best Management Practices (BMPs) may be eligible for funding and cost sharing, including the following:

BMP	Description & Benefits
Terraces/ Contour Farming	Earthen embankments around a hillside that stop water flow and store or guide water safely off a field. Terraces reduce soil erosion and increase the ability to farm slopes.
Riparian Buffer	Vegetated zone immediately adjacent to a stream. The vegetation and well-structured soil can remove sediment, nutrients, and bacteria from runoff, stabilize streambanks, provide wildlife habitat, and encourage recreation.
Grassed Waterway	Vegetated channels with grass to drain water from areas of concentrated flow (eg gullies). The vegetation slows down the water and the channel conveys it to a stable outlet at a non-erosive velocity. Grass waterways trap sediment entering them via field surface runoff.
Filter Strip	Vegetated surfaces designed to treat sheet flow from adjacent surfaces. Filter strips slow runoff velocity, filter out sediment and other pollutants, and provide some infiltration into underlying soils.
Cover crops	Plants seeded into agricultural fields for the protection and enrichment of soil. Cover crops reduce soil erosion and limit the amount of nitrate-N leaching from the soil.
Water and Sediment Control Basin (WASCOB)	Earth embankment or combination ridge-and-channel built perpendicular to (across) a small watercourse or area of concentrated flow within a field. Runoff is slowed so that less topsoil is lost, sediments are trapped, and the watercourse is prevented from becoming a gully.
Wetlands/Wetland restoration	Areas that are typically wet and support vegetation adapted to live in wet environments. Wetland plants, soils, and microbes cleanse the water entering the wetland, recharge groundwater, store stormwater, reduce high water flows, and provide food and habitat for wildlife.
Pond	Small body of still water formed naturally or by hollowing or embanking. Ponds can trap floodwater, filter pollutants from water, allow water to infiltrate the soil, and provide fish and wildlife habitat.
Streambank and channel restoration	Stabilization of eroding streambanks, streambeds, and channels. This work involves improvements to a stream channel using artificial pool-riffle complexes, streambank stabilization using a combination of native vegetation and hard armoring with rock if needed, and adjacent riparian area improvements to vegetation. These practices together improve water quality by reducing sediment transport, increasing oxygen, and improving habitat. Stream restoration can reduce sediment, phosphorus, and nitrogen by as much as 90%.

Start Survey

1. Please provide your address: (Note: Addresses will be kept confidential.)

Name: ______________________________ Phone: ______________

Address: ______________________________ City: __________ Zip: ________

E-mail: ____

2. Which of these issues have you noticed on your land/cropland? *Check all that apply.*

- ☐ Soil erosion
- ☐ Loss of topsoil / thin topsoil
- ☐ Gullies getting deeper
- ☐ Ponds / detention basins filling up with sediment
- ☐ Cropland floods
- ☐ Other issues (please state):______________________________________
  ____

3. Have you noticed any of these issues in creeks and streams on or adjacent to your land?

A. Logjams ☐ Yes ☐ No
B. Unstable streambanks ☐ Yes ☐ No
C. Muddy water ☐ Yes ☐ No
D. Streams getting deeper ☐ Yes ☐ No
E. Overtopping/stream flooding out of its banks ☐ Yes ☐ No
F. Other issues (please state):____

____

4. Which of the following is present on your land? *Check all that apply.*

☐ Forested area
☐ Wetlands (farmable or not) / marsh / swamp / bog
☐ Steep slopes
☐ Highly erodible soil
☐ Floodplain

5. Which of the following programs are you participating in? And which program(s) might you be interested in participating in?

Program	**Currently Participating?**		**Interested in Participating?**	
Conservation Reserve Program (CRP)	YES	NO	YES	NO
Conservation Reserve Enhancement Program (CREP)	YES	NO	YES	NO
Environmental Quality Incentives Program (EQIP)	YES	NO	YES	NO
Agricultural Conservation Easement Program (ACEP)	YES	NO	YES	NO
Streambank Stabilization & Restoration Program (SSRP)	YES	NO	YES	NO
EPA 319 Grant	YES	NO	YES	NO

Other / Comment: ____

____

6. If you are aware of any or all of the programs above, what concerns prevented you from applying / participating?? *Check all that apply.*

☐ I didn't want to take cropland out of production
☐ My costs would be too high
☐ The project/BMP wouldn't have a big enough impact
☐ The problems on my land aren't that severe
☐ Too much time and paperwork to enroll
☐ Other (please explain): ____

____

____

Continue survey on next page.

7. What type(s) of projects might you be interested in implementing on your land? *Check all that apply.*

   - ☐ Terraces/contour farming
   - ☐ Riparian buffer
   - ☐ Grassed waterways
   - ☐ Filter strips
   - ☐ Cover crops
   - ☐ Water and sediment control basin
   - ☐ Wetland/wetlands restoration
   - ☐ Pond
   - ☐ Sreambank/stream channel restoration
   - ☐ Other (please explain): ____

   ____

8. Are there any other issues on your land you may need assistance with? ____________________

   ____

   ____

9. Would you like us to follow up with you about this survey and funding available for BMP projects? **YES** **NO**

10. If YES, what's the best way to contact you? (e.g. phone, email) ____________________________

11. Questions/comments: ____

    ____

    ____

Thank you for completing this survey!

Return this survey in the enclosed envelope by July 10th to:

Upper Silver Creek Landowner Survey, attn: Janet Buchanan
HeartLands Conservancy
406 E. Main St.
Mascoutah, IL 62258

Contact Us

After completing this survey, if you are interested in receiving more information about the programs and funding available for conservation activities on your land, please contact Janet Buchanan at the address above, or by phone at 618-566-4451 ext. 25,
or by email at janet.buchanan@heartlandsconservancy.org.

For updates and progress on the Upper Silver Creek Watershed Plan, please visit: www.HeartLandsConservancy.org/UpperSilverCreek.

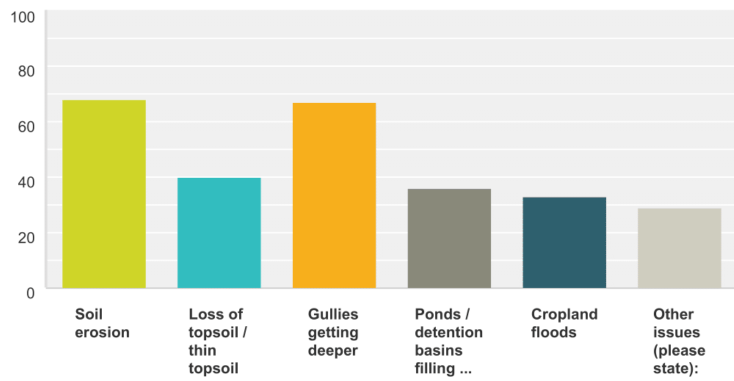
Q1 Please provide your name, address, and contact information. (Note: This information will be kept confidential.)

Answered: 124 Skipped: 1

Answer Choices	Responses	
Name	100.00%	124
Company	0.00%	0
Address	99.19%	123
Address 2	0.00%	0
City/Town	0.00%	0
State/Province	0.00%	0
ZIP/Postal Code	0.00%	0
Country	0.00%	0
Email Address	62.10%	77
Phone Number	85.48%	106

Q2 Which of these issues have you noticed on your land / cropland?

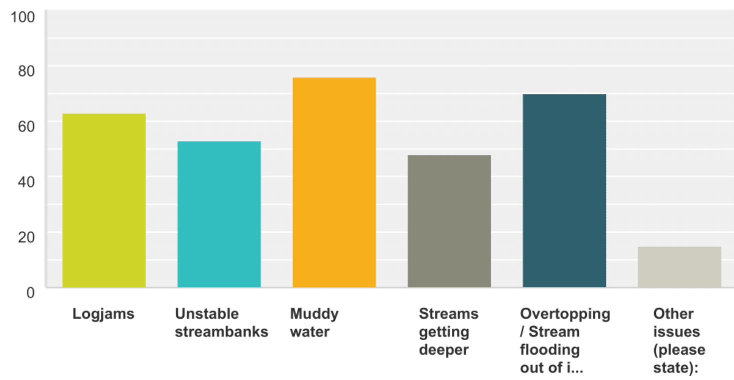
Answered: 103 Skipped: 22



Answer Choices	Responses	
Soil erosion	66.02%	68
Loss of topsoil / thin topsoil	38.83%	40
Gullies getting deeper	65.05%	67
Ponds / detention basins filling up with sediment	34.95%	36
Cropland floods	32.04%	33
Other issues (please state):	28.16%	29
Total Respondents: 103		

Q3 Which of these issues have you noticed in the creeks and streams on or adjacent to your land?

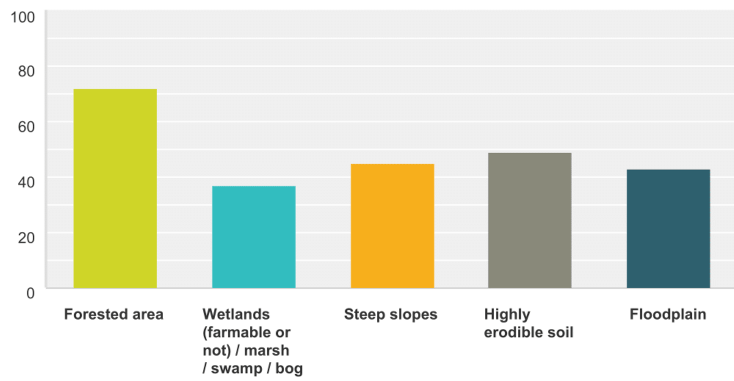
Answered: 98 Skipped: 27



Answer Choices	Responses	
Logjams	64.29%	63
Unstable streambanks	54.08%	53
Muddy water	77.55%	76
Streams getting deeper	48.98%	48
Overtopping / Stream flooding out of its banks	71.43%	70
Other issues (please state):	15.31%	15
Total Respondents: 98		

Q4 Which of the following is present on your land?

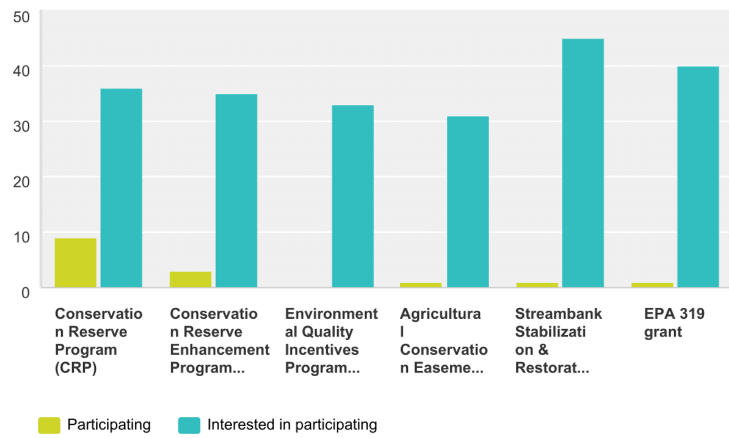
Answered: 96 Skipped: 29



Answer Choices	Responses	
Forested area	75.00%	72
Wetlands (farmable or not) / marsh / swamp / bog	38.54%	37
Steep slopes	46.88%	45
Highly erodible soil	51.04%	49
Floodplain	44.79%	43
Total Respondents: 96		

Q5 Which of the following programs are you participating in? And which program(s) might you be interested in participating in?

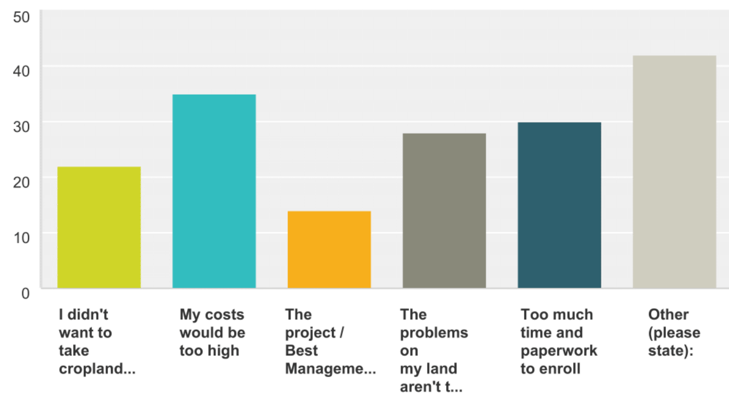
Answered: 68 Skipped: 57



	Participating	Interested in participating	Total Respondents
Conservation Reserve Program (CRP)	20.45% 9	81.82% 36	44
Conservation Reserve Enhancement Program (CREP)	7.89% 3	92.11% 35	38
Environmental Quality Incentives Program (EQIP)	0.00% 0	100.00% 33	33
Agricultural Conservation Easement Program (ACEP)	3.13% 1	96.88% 31	32
Streambank Stabilization & Restoration Program (SSRP)	2.17% 1	97.83% 45	46
EPA 319 grant	2.44% 1	97.56% 40	41

Q6 If you are aware of any or all of the programs above, what concerns prevented you from applying / participating?

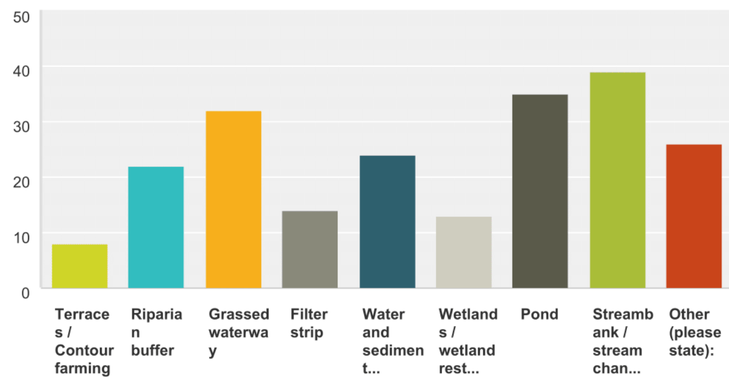
Answered: 95 Skipped: 30



Answer Choices	Responses	
I didn't want to take cropland out of production	23.16%	22
My costs would be too high	36.84%	35
The project / Best Management Practice wouldn't have a big enough impact	14.74%	14
The problems on my land aren't that severe	29.47%	28
Too much time and paperwork to enroll	31.58%	30
Other (please state):	44.21%	42
Total Respondents: 95		

Q7 What type(s) of projects might you be interested in implementing on your land?

Answered: 88 Skipped: 37



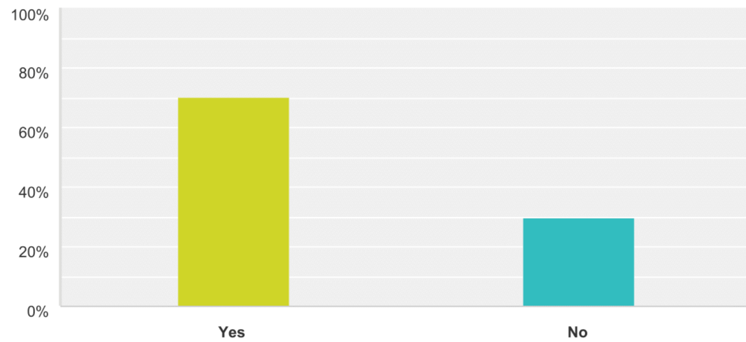
Answer Choices	Responses	
Terraces / Contour farming	9.09%	8
Riparian buffer	25.00%	22
Grassed waterway	36.36%	32
Filter strip	15.91%	14
Water and sediment control basin (WASCOB)	27.27%	24
Wetlands / wetland restoration	14.77%	13
Pond	39.77%	35
Streambank / stream channel restoration	44.32%	39
Other (please state):	29.55%	26
Total Respondents: 88		

Q8 Are there any other issues on your land you may need assistance with?

Answered: 25 Skipped: 100

Q9 Would you like us to follow up with you about this survey and funding available for BMP projects?

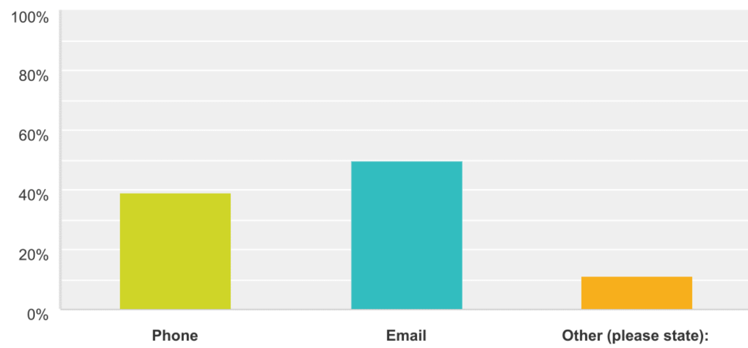
Answered: 111 Skipped: 14



Answer Choices	Responses	
Yes	70.27%	78
No	29.73%	33
Total		111

Q10 If YES, what's the best way to contact you?

Answered: 82 Skipped: 43



Answer Choices	Responses	
Phone	39.02%	32
Email	50.00%	41
Other (please state):	10.98%	9
Total		82

Q11 Questions / Comments:

Answered: 16 Skipped: 109

APPENDIX D – CRITICAL AREAS

This appendix includes descriptions of the source data used to delineate Critical Areas, and maps of each Critical Area. Maps of Best Management Practices 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's Agricultural Conservation Planning Framework (ACPF) tools.

Wetland restoration ranking values

Wetland restoration ranking values and wetland importance values were created for the watershed by the Missouri Resource Assessment Partnership (MoRAP). Several layers of data, especially topography, soil type, and land cover, were used to create maps of existing wetlands which it is highly important to protect, and areas which were formerly wetlands which it would be highly beneficial to restore.

Agricultural Conservation Planning Framework (ACPF)

The ACPF is a set of GIS-based tools developed by the U.S. Department of Agriculture's Agricultural Research Service (USDA-ARS) that can substantially enhance watershed planning capabilities on agricultural land. The ACPF is currently available for Minnesota, Iowa, and Illinois, and uses new high-resolution data sources, such as soils, land use, crop rotations, and elevation (from LiDAR). The tools determine slope, flow accumulation, and other factors by HUC12, allowing analysis at watershed and field scales. Among the outputs of the tools are possible beneficial locations for different types of practices placed in fields, at field edges, and in riparian zones. No recommendations are made. The aim is to create a planning resource to use in watershed planning and consultation with landowners.

The BMPs recommended by the model include grassed waterways, contour buffer strips, drainage water management, appropriate riparian vegetation, and nutrient management wetlands. Many of the tools within the ACPF have parameters that can be adjusted by the user to change their output. For example, the user can define the width of contour buffer strips generated and the minimum distance between buffer strips. Table D.1 shows the user-defined or modifiable values used for this assessment.

Table D.1. Values entered into ACPF tools to generate BMP locations for user-defined or modifiable parameters.

ACPF BMP	Values used for user-defined or modifiable parameters
Grassed waterways	Drainage threshold: >6 acres Limited to Runoff Risk categories Critical, Very High, or High
Contour buffer strips	Buffer strip width: 15 feet Minimum distance between buffer strips: 90 feet (default) Limited to Runoff Risk categories Critical, Very High, or High
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 (25 meters away from roads)
WASCOBs	Embankment height: 1.5 meters (default) Limited to Runoff Risk categories Critical, Very High, or High Road file used to avoid roads (25 meters away from roads)
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 Madison County Soil and Water Conservation District and NRCS staff to explore BMP options with farmers interested in implementing a soil conservation or waterway protection project. The ACPF results were also useful in setting the numeric targets for this watershed plan.

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

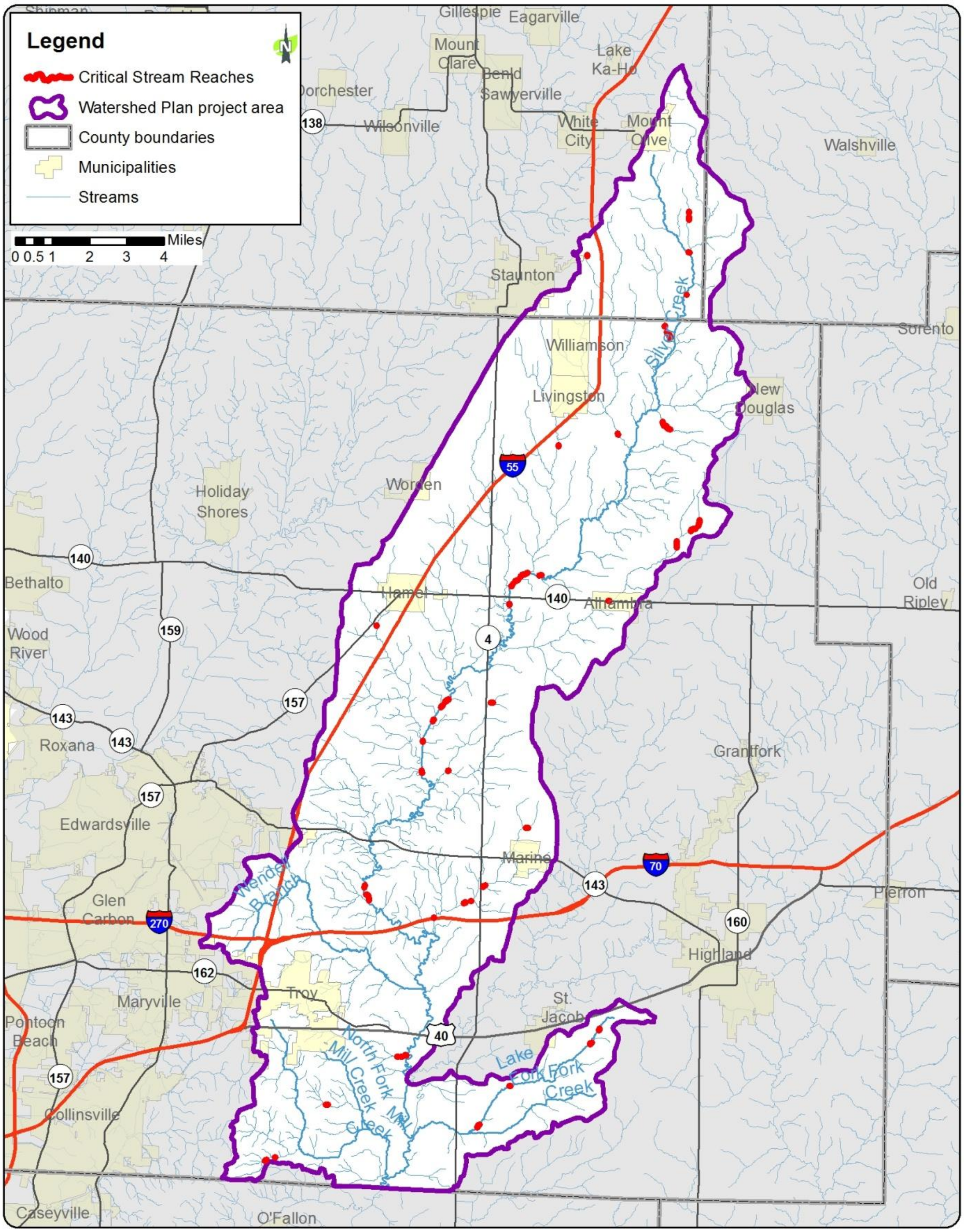
The following table (Table D.2) and maps show the ACPF results for several Best Management Practices.

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

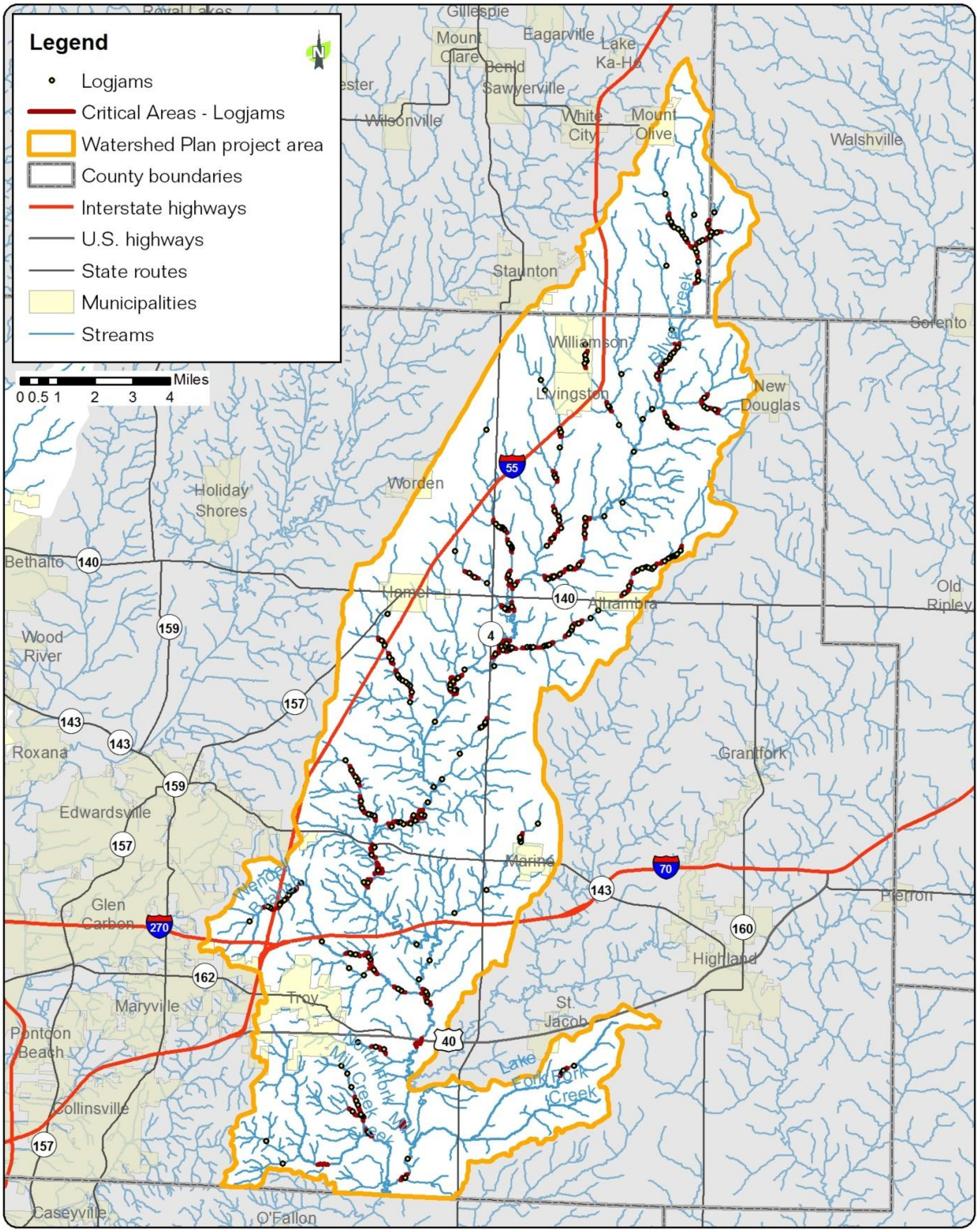
ACPF results	HUC12							TOTAL
	071402040501	**071402040502**	**071402040503**	**071402040504**	**071402040505**	**071402040506**	**071402040509**	
# nutrient removal wetlands	1	1	-	12	-	14	1	**29**
Nutrient removal wetlands area (wetland & buffers) (sq meters)	62,121	47,053		548,855		726,761	36,388	**1,421,178**
Wetland area only (sq meters)	21,111	27,180		191,518		368,616	8,619	**617,044**
Area draining to nutrient removal wetlands (sq meters)	3,250,539	1,530,909		17,546,796		39,285,873	706,257	**62,320,374**
# drainage management polygons	220	316	428	79	75	11	49	**1,178**
Area drainage management fields (sq meters)	25,202,075	32,021,560	45,922,435	8,551,558	6,820,055	676,125	4,911,316	**124,105,124**
# contour buffer strips	20	105	253	191	229	254	520	**1,572**
Total area contour buffer strips (sq meters)	12,607	84,279	202,805	162,395	189,581	203,402	456,756	**1,311,825**
Grass waterways total length (m)	91,174	118,996	179,475	49,898	73,264	79,129	130,866	**722,802**
# WASCOBs	57	159	57	70	106	138	404	**1,291**
Area WASCOB basins when filled (sq meters)	146,701	360,544	515,014	785,373	362,883	502,109	894,617	**3,567,241**
Riparian area: # Critical Zone segments (CZ)	22	25	51	2	26	12	25	**163**
Riparian area: # Multi Species Buffer (MSB)	22	24	44	14	16	13	23	**156**
Riparian area: # Stiff Stemmed Grasses (SSG)	56	80	97	36	35	33	66	**403**
Riparian area: # Deep Rooted Vegetation (DRV)	229	435	464	33	215	195	311	**1,882**
Riparian area: # Stream Bank Stabilization (SBS)	207	378	394	77	182	155	285	**1,678**

Critical Areas Maps

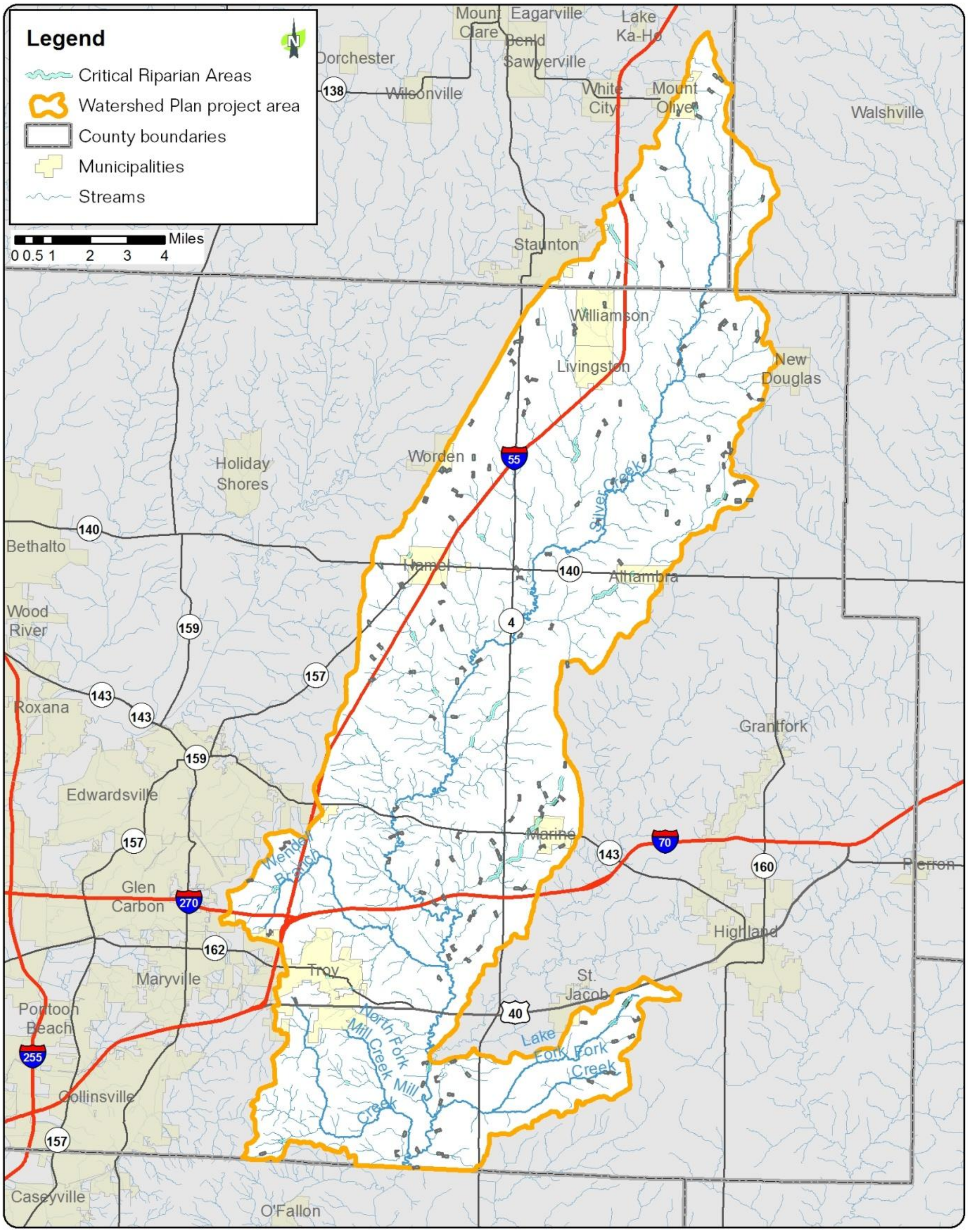
Critical Areas: Stream reaches



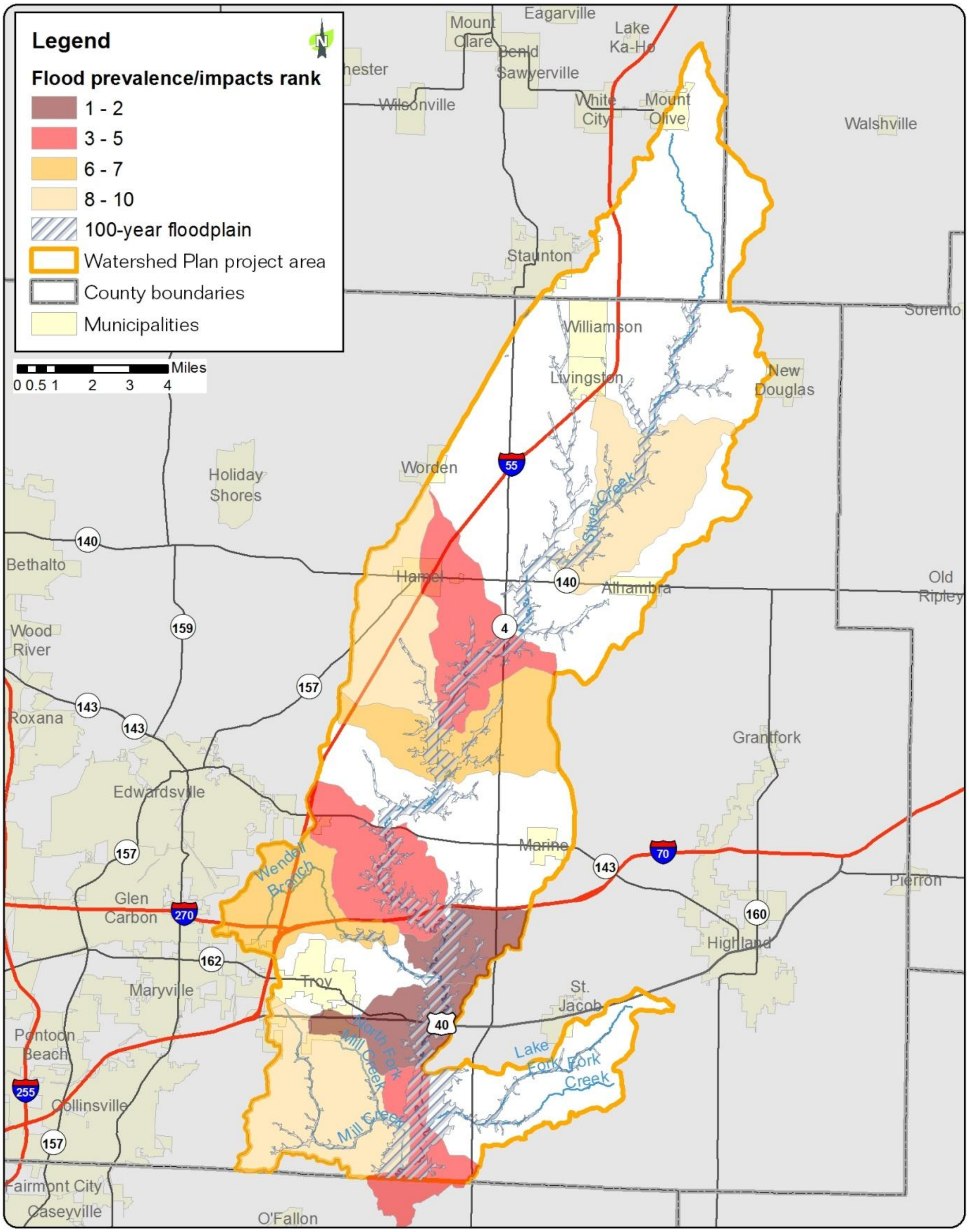
Critical Areas: Logjams



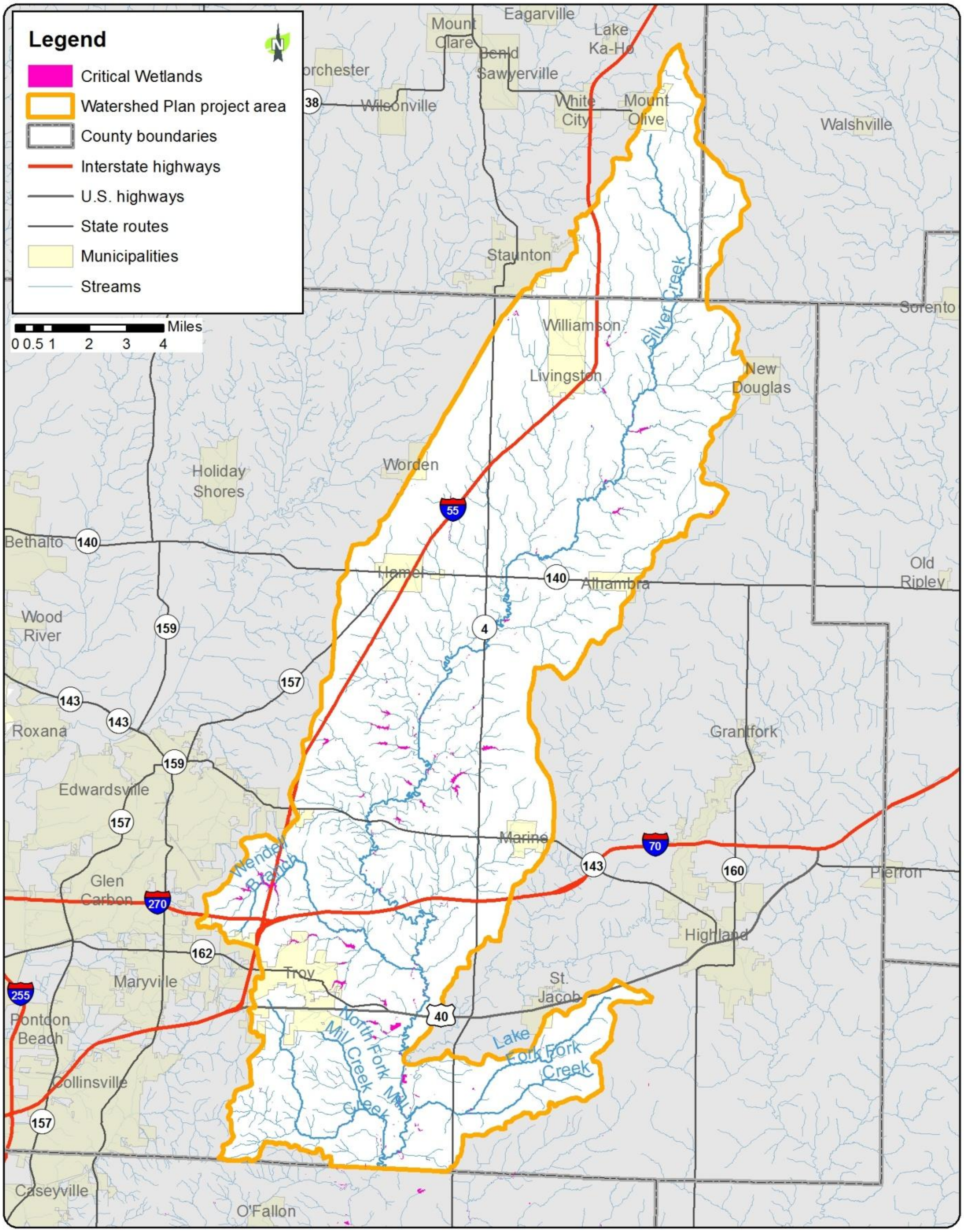
Critical Areas: Riparian areas



Critical Areas: Flooding

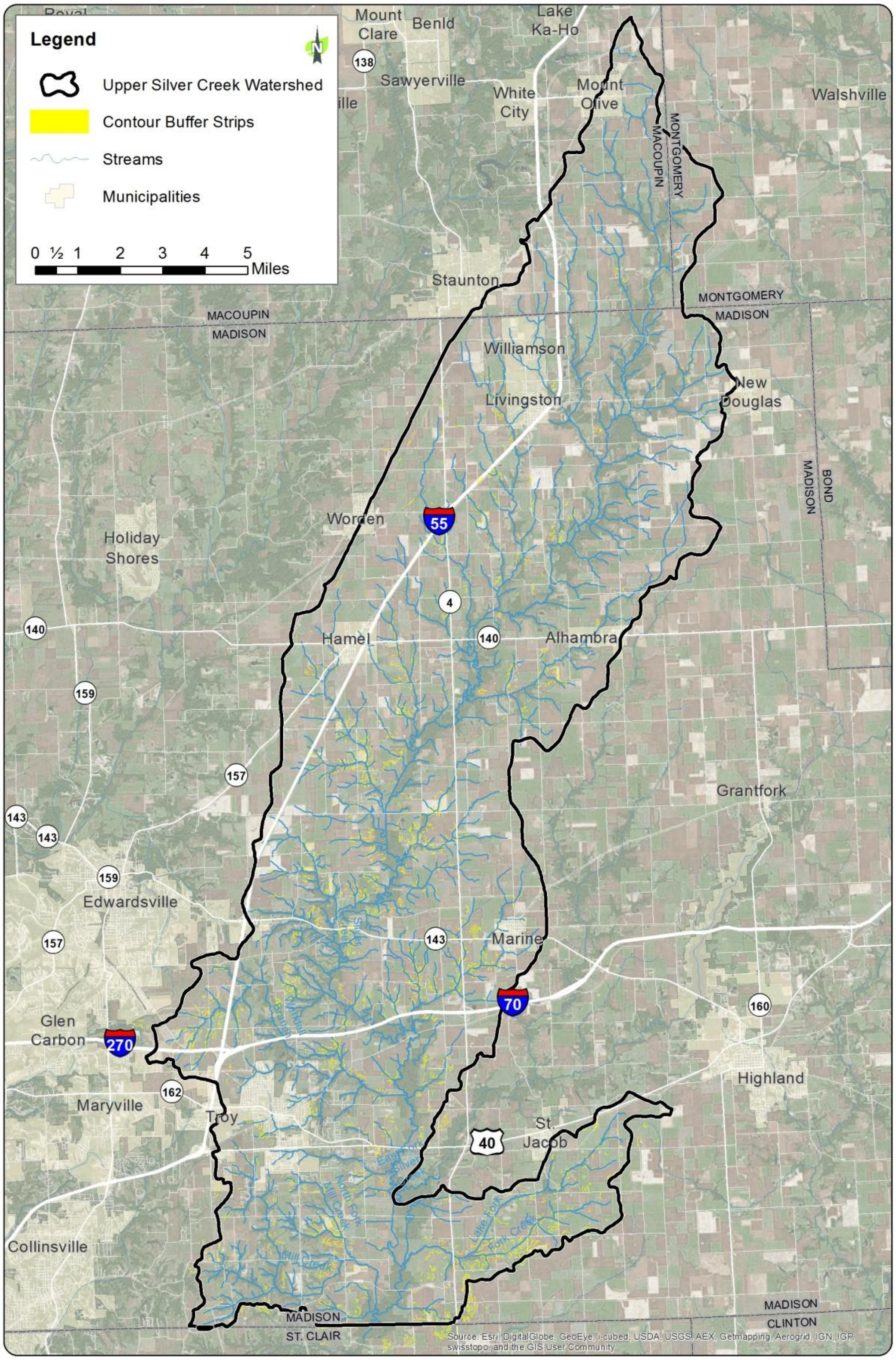


Critical Areas: Wetlands

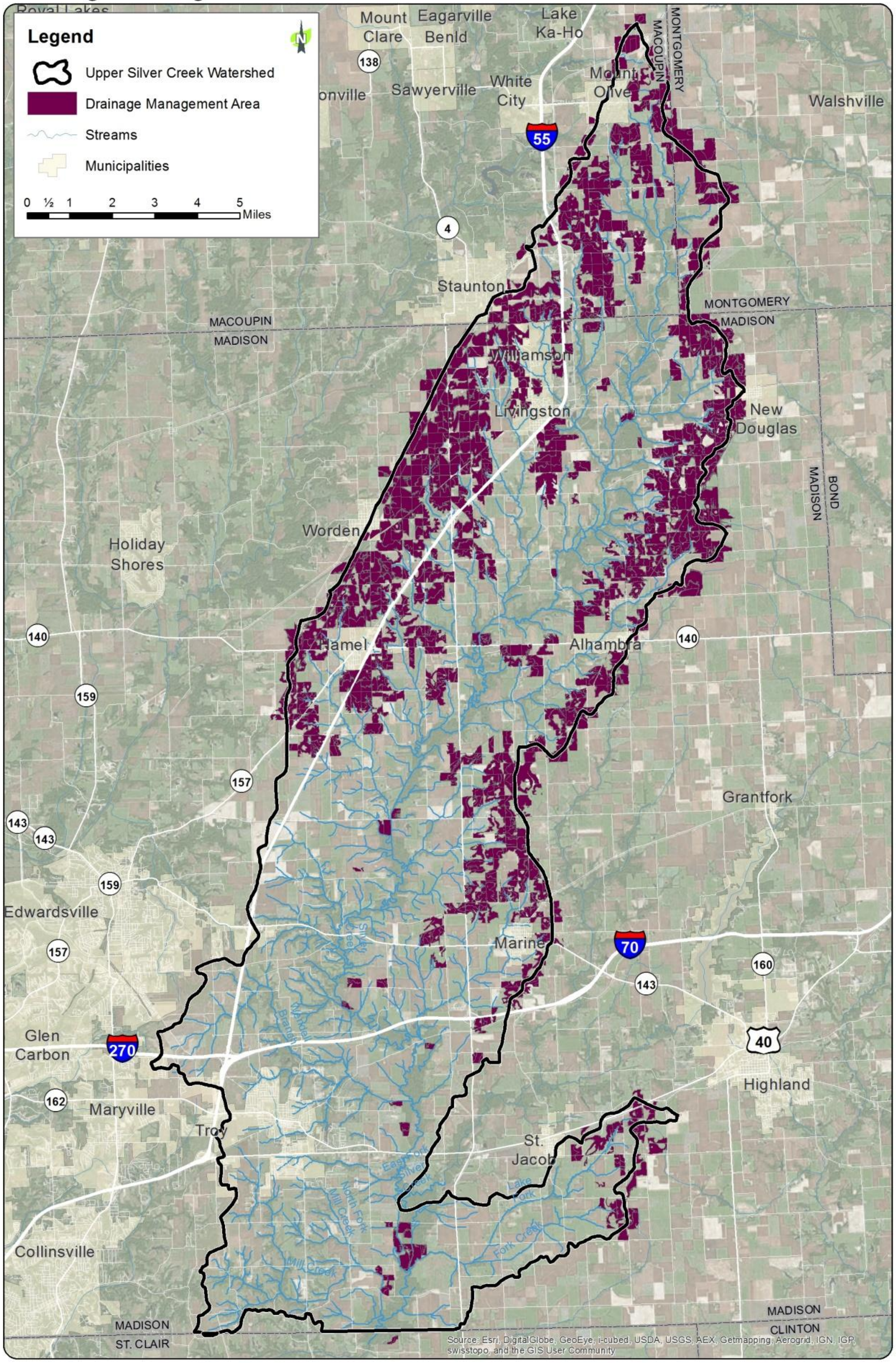


Agriculture Conservation Planning Framework (ACPF) output maps – BMPs

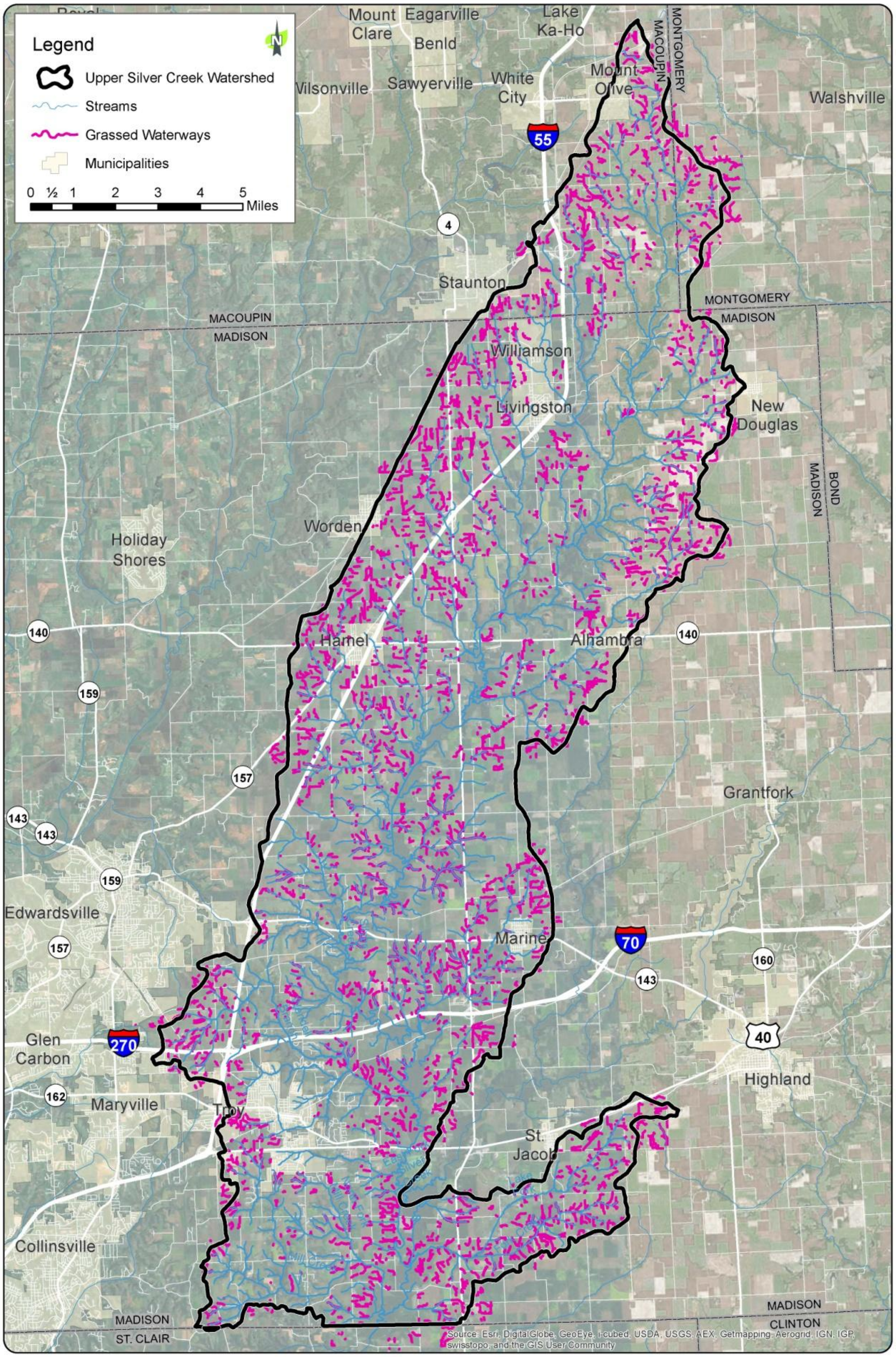
Contour Buffer Strips



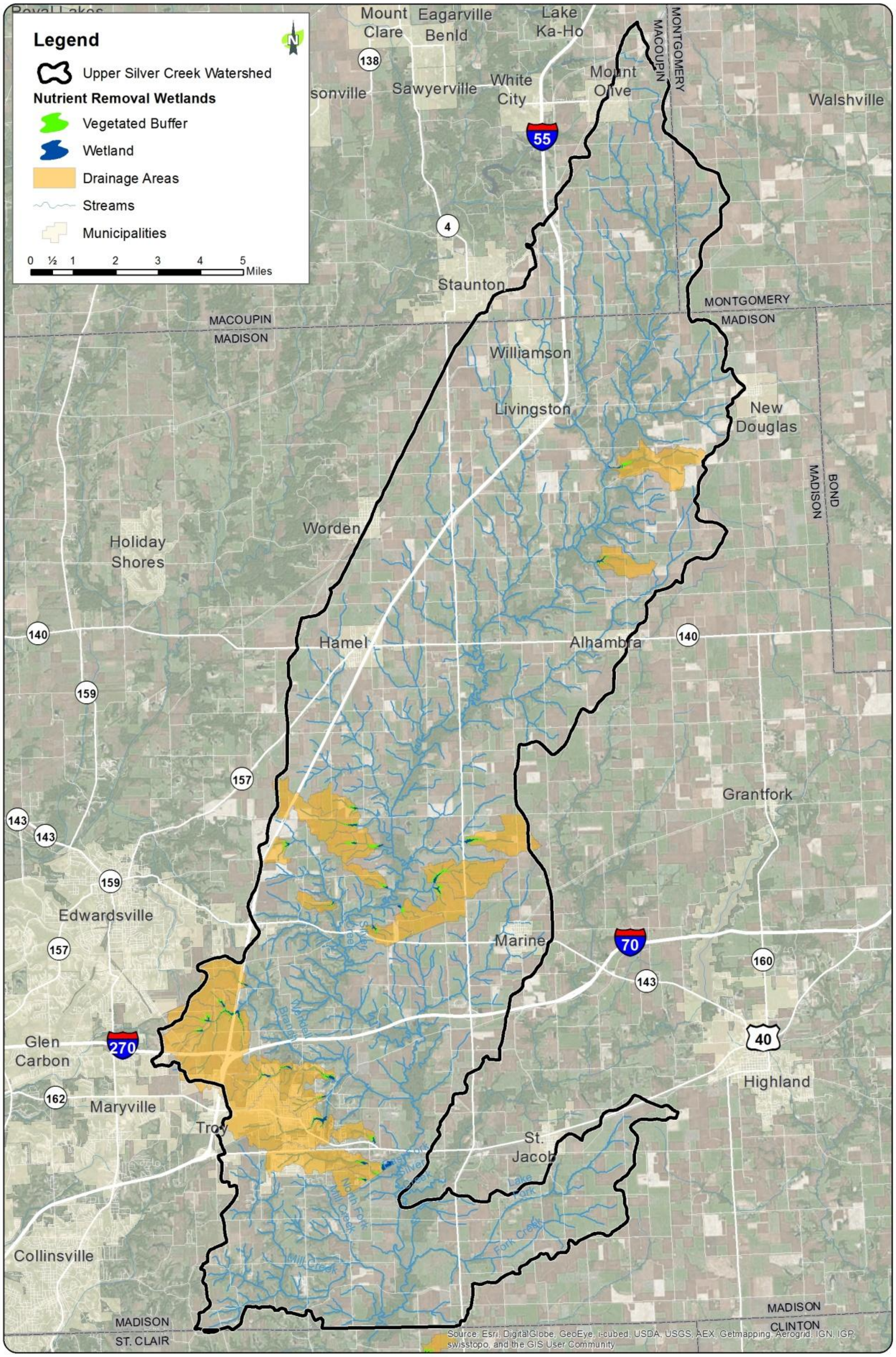
Drainage Management



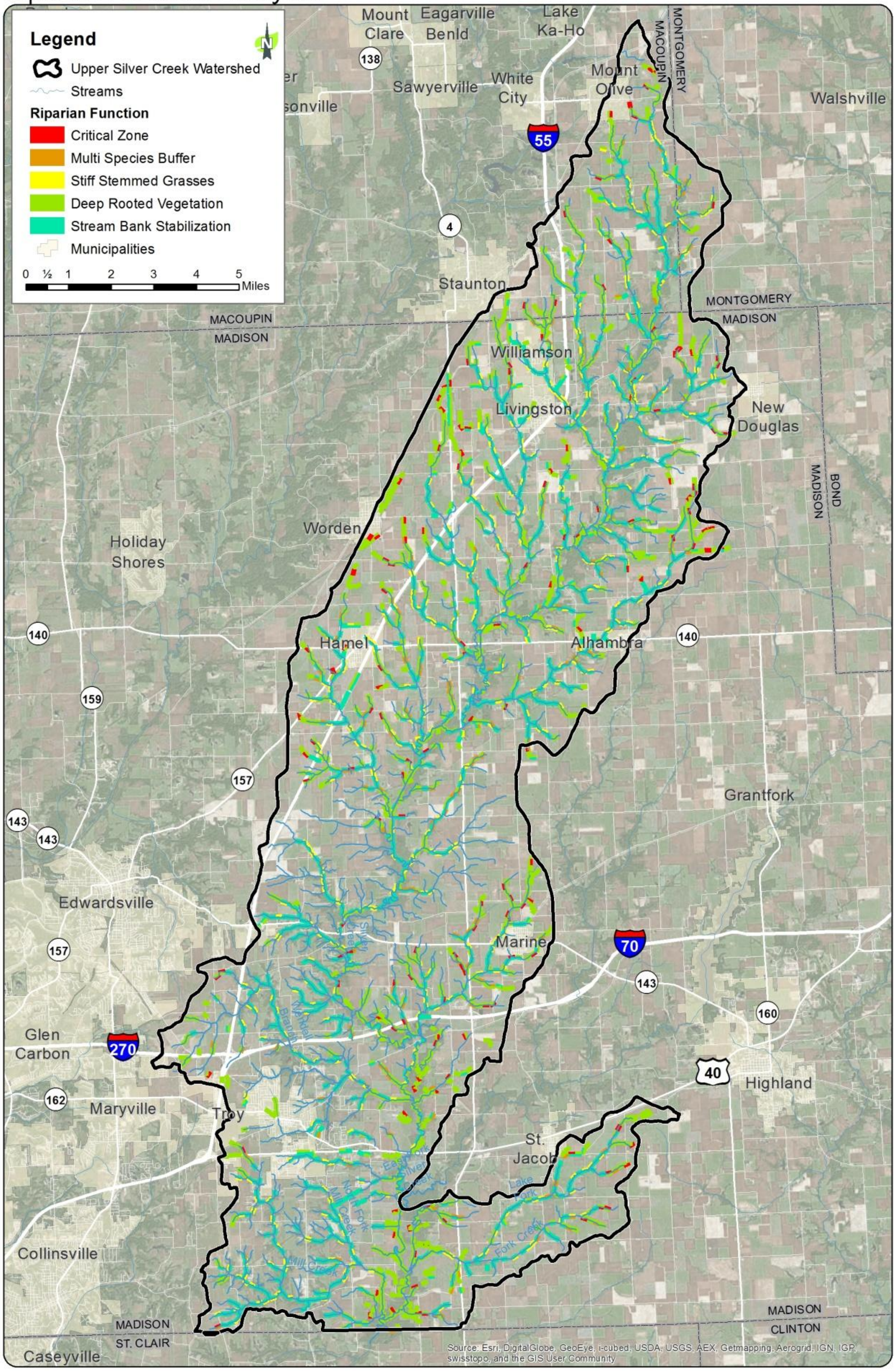
Grassed Waterways



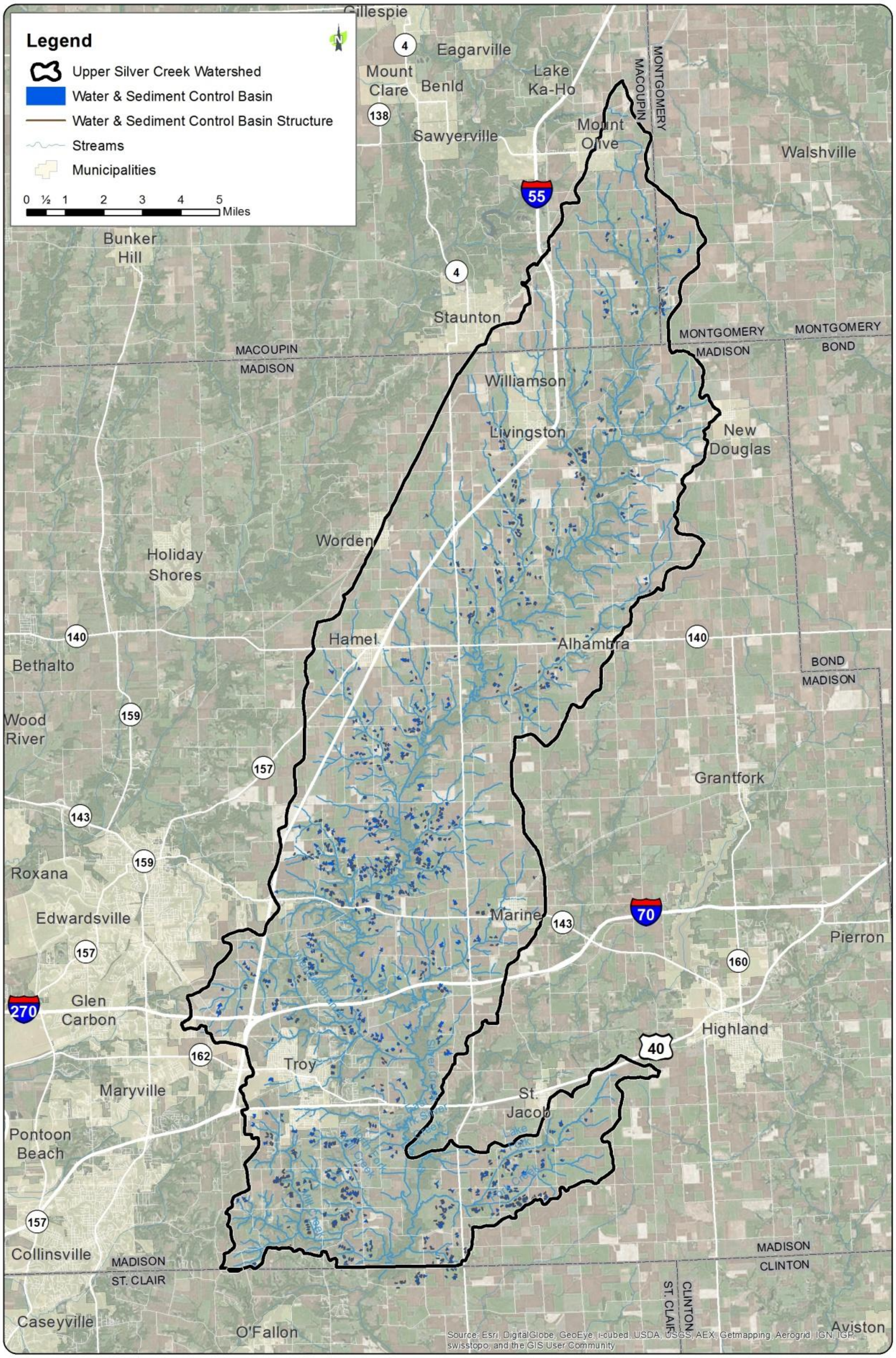
Nutrient Removal Wetlands



Riparian Function Analysis



Water & Sediment Control Basins (WASCOBs)



APPENDIX G - FUNDING SOURCES

The following funding sources are available for watershed management efforts. All the sources listed here are linked to one or more of the issues identified in and practices recommended for this watershed.

State/federal government

Illinois Environmental Protection Agency (Illinois EPA)

The **Section 319(h) Nonpoint Source Pollution Control Financial Assistance Program** implements Illnois' 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 NPS pollution in Illinois waters that have impaired water quality are given priority. The Upper Silver Creek watershed is one of Illinois EPA'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 projects. 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.

Illinois Department of Agriculture (IDOA)

The **Streambank Stabilization and Restoration Program (SSRP)** is designed to demonstrate effective streambank stabilization at demonstration sites using inexpensive vegetative and bio-engineering techniques. Program funds may be used for labor, equipment, and materials. Recipients of the cost-share and project funding must maintain the streambank stabilization project for at least 10 years. This program is not currently funded, but funding may be reinstated in future.

The **Conservation Practice Program (CPP)** is implemented by the Soil and Water Conservation Districts (SWCDs) in Illinois. Cost-share funds are available through the SWCDs for various conservation practices including Filter Strips, Grassed Waterways, No-Till, and Terraces. A CPP-Special Project cost share program funds practices that meet local natural resource priorities but are not on the state-wide list of practices, such as stream crossings, rain gardens, and heavy area livestock use area protection. Applications received are prioritized based on tons of soil saved, acres benefited, cost per acre of practice, and cost per ton of soil saved. This program is not currently funded, but funding may be reinstated in future.

The **Sustainable Agriculture Grant Program** funds research, education, and on-farm demonstration projects that address one or more purposes related to sustainable farming. These purposes include minimizing environmental degradation, clarifying the connections between specific agricultural practices and types of pollution, testing approaches to on-farm research, and identifying critical research and education needs related to sustainable agriculture.

Illinois Department of Natural Resources (IDNR)

The **Urban Flood Control Program** has been implemented for many years under the authority of the Flood Control Act of 1945. IDNR's Office of Water Resources (OWR) has typically applied the program to out-of-bank riverine flooding, and to the development and construction of projects that provide an outlet for stormwater systems.

Illinois Emergency Management Agency

The **Flood Mitigation Assistance (FMA) program** is a cost-share program (75% federal, 25% local match) through which communities can receive grants for the development of a comprehensive flood mitigation plan and the implementation of flood mitigation projects. Communities must be members of the National Flood Insurance Program (NFIP). (See Table G.1.)

The **Pre-Disaster Mitigation (PDM) program** makes grants available to state and local governments to implement cotst-effective hazard mitigation activities that complement a comprehensive mitigation program. Funding is awarded for the development of an all-hazards mitigation plan or for a cost-effective hazard mitigation project. (See Table G.1.)

The **Hazard Mitigation Grant (HMG) program** makes grants available to state and local governments as well as eligible private, non-profit organizations to implement cost-effective, long-term mitigation measures following a major disaster declaration. A project does not have to be in a declared county to be eligible; every community that is vulnerable to natural hazards should consider applying. (See Table G.1.)

The **Severe Repetitive Loss program** provides funding to reduce or eliminate the long-term risk of flood damage to severe repetitive loss structures insured under the NFIP. These structures are residential properties insured under the NFIP that have had two or more large claims (see FEMA website for details). (See Table G.1.)

Illinois Department of Commerce and Economic Opportunity (DCEO)

The **Illinois Community Development Assistance Program** administers funds through the Federal Community Development Block Grants: Small Cities program. The Community Development Assistance Program is designed to help communities meet their greatest economic and community development needs, with a focus on communities with low- to moderate-income populations. The public infrastructure component of the program is used to mitigate conditions that are detrimental to public health and welfare, primarily in residential areas. These projects can include the design and construction of storm sewers. (See Table G.1.)

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

Table G.1. Sources of funding, program outputs, and participation requirements for various types of flood hazard mitigation identified in the IDNR Urban Flooding Awareness Act draft report (adapted from Table 6.1 in that report).

	IDNR/OWR UFC	IEMA FMA	IEMA PDM	IEMA HMGP	Direct Legislative Action	DCEO CDAP Pl and Emergency Pl	DCEO CDP Pl + Design	IEPA Revolving Loan
Types of Projects/Outcomes								
Storm Sewer Improvements		x	x	x	x	x	x	x
Combined Sewer Improvements					x	x	x	x
Conveyance Improvements	x	x	x	x	x			
Levees	x				x			
Detention Basins	x	x	x	x	x			
Projects on Private Property		x	x	x				
Individual Basement Mitigation								
Repetitive Loss Structure Buyouts		x	x	x				
Planning Reports	x	x	x	x	x			
Program Outputs								
Project Specific Planning Documents	x				x		x	
Construction Documents	x				x	x	x	
Construction Funding	x	x	x	x	x	x	x	
Construction Engineering	x				x	x	x	
Local Participation Requirements								
Operation and Maintenance	x	x	x	x	x	x	x	x
Utility Relocations	x							
Land Rights Acquisition	x							
NFIP Participation	x	x	x	x		x	x	
Emphasis on Low to Moderate Income						x	x	
Pre-approved Planning		Mitigation Pl	Mitigation Pl	Mitigation Pl		x		x
Program Funding								
Federal Disaster Declaration Required				x				
Local Cost Share		25%	25%	25%		25%	25%	Low interest loan
B/C Ratio	≥ 1.0	≥ 1.0	≥ 1.0	≥ 1.0	None	None	None	None
Funding Limits						$450,000 or $200,000 for Emergency	$450,000 max with $150,000 Design Included	

Acronyms used in Table G.1:

IDNR/OWR – Illinois Department of Natural Resources, Office of Water Resources
IEMA – Illinois Emergency Management Agency
FMA – Flood Mitigation Assistance program
PDM – Pre-Disaster Mitigation program
HMG – Hazard Mitigation Grant program
DCEO – Department of Commerce and Economic Opportunity
CDAP Pl and Emergency Pl – Community Development Assistance Program – Planning and Emergency Planning
CDP Pl + Design - Community Development Assistance Program – Planning and Design
IEPA – Illinois Environmental Protection Agency
NFIP – National Flood Insurance Program
B/C ratio – Benefit/Cost ratio
Mitigation Pl – Mitigation Plan

U.S. Department of Housing and Urban Development (HUD)

The **National Disaster Resilience Competition**, announced in June 2014, invited communities that have experienced natural disasters to compete for funds to help them rebuild and increase their resilience to future disasters. The competition supports innovative resilience projects at the local level while encouraging communities to adopt policy changes and activities that plan for the impacts of extreme weather and climate change. All states with counties that experienced a Presidentially Declared Major Disaster in 2011, 2012 or 2013, which includes Illinois, were eligible to apply. This competition may be renewed in future years.

U.S. Environmental Protection Agency

The **USEPA Source Reduction Assistance grant program** supports pollution prevention projects that will provide an overall benefit to the environment by preventing pollutants at the source (i.e., not treatment or cleanup programs). Applicants must demonstrate new or innovative techniques for education or training that promote pollution prevention and source reduction efforts. State and local governments and non-profits are eligible to receive funds or cooperative agreements.

The **Environmental Education Grants Program** supports environmental education projects that promote environmental awareness and stewardship and help provide people with the skills to take responsible actions to protect the environment. Grants are issued to organizations including local education agencies, state schools, colleges, and nonprofit organizations.

The **Environmental Justice Small Grants Program** supports communities working on solutions to local environmental and public health issues through collaborative partnerships. One focus of successful applications is community-based preparedness and resilience efforts, particularly for climate resiliency.

The **Urban Waters Small Grants Program** improves coordination among federal agencies and collaborates with community-led revitalization efforts to improve the Nation's water systems. Fund 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.

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 **Conservation Reserve Program (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: the Agricultural Conservation Easement Program (ACEP), the Environmental Quality Incentives Program (EQIP), the Conservation Stewardship Program (CSP), or the Healthy Forests Reserve Program (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 (U.S. FWS) 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 & 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 under. 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 Foundation** – The Walton Foundation supports projects including freshwater projects that sustain healthy communities in the Mississippi River Basin.
- **Illinois American Water's 2015 Environmental Grant Program** – Illinois American Water distributed over $15,000 for watershed projects around the state last year, including three in or near Madison County. Individual grants may be up to $10,000.

Other

In-Lieu Fee Mitigation Program

In-lieu fee mitigation is a type of mitigation banking that can be used to compensate for unavoidable impacts to wetlands while directing funds to sites with high ecological value. A permittee pays a fee to a third party instead of conducting project-specific mitigation or buying credits from a wetland mitigation bank. The fee represents the estimated cost of replacing the wetland functions lost or degraded as a result of the permittee's project. The in-lieu fee mitigation program gathers several such fees and uses them to finance an extensive mitigation project. HeartLands Conservancy is in the final stages of becoming an Approved Program Sponsor within the American Bottoms and Lower Kaskaskia River watersheds. Once approved, project implementation should begin in 2016. Mitigation sites will include both wetlands and streams, so fees will go towards both wetland and stream restoration.

APPENDIX H – PROGRESS REPORT CARDS

PM = Progress made; A = Achieved

Goal 1: Improve Surface Water Quality

Existing Conditions

264,952 lbs/year of phosphorus, 60,230 tons/year of sediment, and 1,178,496 lbs/yr of nitrogen enter the upper Silver Creek watershed every year, based on the STEPL model.
Silver Creek has seen low Dissolved Oxygen (DO) levels between 1972 and 2011, with a minimum of 2 mg/L (mean 7.7 mg/L).
High concentrations of dissolved manganese have been found in Silver Creek between 1972 and 2011 (mean 417 µg/L, median 290 µg/L, and maximum 3200 µg/L).
Fecal coliform levels in Silver Creek have spiked several times between 1972 and 2011 (with most spikes in the 70's and 80's); the median level was 630 cfu/100ml.
Over 3,000 private sewage systems are present in the watershed. Given 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

25% or 66,238 lbs/year reduction in phosphorus loading by 2025, based on the Illinois Nutrient Loss Reduction Strategy.
20% or 12,046 tons/year reduction in sediment loading by 2025, based on estimated impacts of proposed BMPs.
15% or 176,774 lbs/year reduction in phosphorus loading by 2025, 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.
No manganese samples higher than the general use water quality standard of 1,000 µg/L, and a general reduction in mean manganese concentrations.
68% or 430 cfu/100 ml reduction in fecal coliform, to reach a geometric mean of 200 cfu/100 ml in a minimum of 5 samples taken over a period of ≤30 days; based on 35 Ill. Adm. Code 302.
Removal of Silver Creek and Troy Creek from the Illinois EPA 303(d) list.
Programmatic changes regarding wastewater treatment, private sewer, and conservation easements.

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	108	216	324	... acres contour buffer strips (100% of locations identified by the ACPF) (cumulative)	SWCD, NRCS, farmers, contractors	
	8,798	17,595	26,393	... acres cover crops (30% of total agricultural land area) (cumulative)		
	60	119	179	... acres grassed waterways (100% of locations identified by the ACPF) (cumulative)		
	33	67	100	... acres ponds (cumulative)		

	10,264	20,528	30,792	... acres reduced tillage (conservation tillage/no-till) (35% of total agricultural land area) (cumulative)		
	19,131	38,263	57,394	... feet of poor condition riparian areas ecologically restored, including 100% Critical Riparian Areas (cumulative)		
	33,333	66,667	100,000	... feet terraces (cumulative)		
	7	13	20	... acres waste storage structures/waste management systems (cumulative)		
	294	587	881	... acres Water and Sediment Control basins (100% of locations identified by the ACPF) (cumulative)		
	240	481	721	... 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)		
	31	63	94	... acres detention basin retrofits (native vegetation buffers, etc.) (100% of the 67 basins identified in the watershed, with average size of 1.4 acres) (cumulative)		
	22	45	67	... detention basins maintained (dredging, mowing, burning, invasives, etc.) (100% of the 67 basins identified in the watershed, with average size of 1.4 acres) (cumulative)		
	50	100	150	... 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)		
	56	112	168	... properties use single property flood reduction strategies (168 is 3 times the number of Flood Survey responses that said floods damaged their primary home/business; 1.6% of all households in the watershed) (cumulative)		
	38,720	77,440	116,160	... feet streambank & channel restoration (22 miles, or 5% of all streams), including 100% Critical Stream Areas (cumulative)	NRCS, SWCD, contractors	
	3,300	6,600	9,900	... feet logjam removal sites (5% of the Critical Logjam Areas)		
Removal of Silver Creek and Troy 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, nitrogen, fecal coliform, and manganese (see Monitoring	NGRREC (water quality monitoring	

				Plan). Measured increases in in-stream dissolved oxygen (see Monitoring Plan).	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	8	13	… 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	

GRADE	

Notes

Goal 2: Reduce Flooding and Mitigate Flood Damage

Existing Conditions

26% of Flood Survey respondents experienced flooding in the last 10 years, reporting a total of >$330,016 in costs over that time

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 acres dry detention basins installed

100 acres wet detention basins installed

Retrofits & maintenance on existing detention basins

Critical Flooding Areas prioritized

100% Critical Wetlands Areas restored

Stream flow reduced peak discharge during storm events

Programmatic changes regarding flood damage prevention ordinances, riparian buffer ordinances, and stormwater infrastructure funding

Measurement Indicator	**Milestone**				**Data source**	**Achieved?**
	Short-term (1-10 years)	Medium-term (10-20 years)	Long-term (20+ years)			
Number and extent of Management Measures (BMPs) implemented	19,131	38,263	57,394	... feet of poor condition riparian areas ecologically restored, including 100% Critical Riparian Areas (cumulative)	SWCD, NRCS, farmers, contractors	
	240	481	721	... 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	Madison County adopts 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, eg a Stormwater Utility. Dollar amount of revenue streams.	PM	PM	A	Madison County adopts a mechanism for dedicated funding for stormwater infrastructure All municipalities engaged to inform about stormwater infrastructure funding options	Counties, municipalities	

GRADE	

Notes

Goal 3: Promote Environmentally Sensitive Development Practices

Existing Conditions

Current 3% impervious cover; 2.8% annual increase in impervious cover (2006-2011); current 6,981 acres developed open space (2011 NLCD) or 1,289 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	
	31	63	94	... acres detention basin retrofits (native vegetation buffers, etc.) (94 acres is 100% of the 67 basins identified in the watershed, with average size of 1.4 acres) (cumulative)	Counties, municipalities, SWCD	
	31	63	94	… acres detention basin maintenance (dredging, mowing, burning, invasives, etc.) (100% of the 67 basins identified in the watershed, with average size of 1.4 acres) (cumulative)	Counties, municipalities, SWCD	
	50	100	150	... 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	2.8% or less annual increase in impervious cover in the overall watershed (held to the predicted annual increase based on 2006-2011)	NLCD Percent Developed Impervious Surface dataset	
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	
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, eg 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	Madison County adopts 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 (eg 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	

GRADE	

Notes

Notes, continued

Goal 4: Support Healthy Fish and Wildlife Habitat

Existing Conditions

57,918 feet of riparian areas are currently in poor condition, per the aerial assessment results. Of this, 183,036 feet are Critical Riparian Areas. 37.5 miles Critical Logjam Areas have been identified.

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 Logjam Areas assessed

5% Critical Logjam areas have logjams removed

100% Critical Wetlands Areas restored

Macrointertebrate & 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	19,131	38,263	57,394	... feet of poor condition riparian areas ecologically restored, including 100% Critical Riparian Areas (cumulative)	NRCS, SWCD, contractors	
	240	481	721	… acres wetlands restored, enhanced, or created (100% of Critical Wetland Areas) (cumulative)		
	3,300	6,600	9,900	… feet logjam removal sites (5% of the Critical Logjam Areas)		
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	

GRADE	

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 Upper Silver Creek Watershed-Based Plan as a “guidance document”.	PM	PM	A	All watershed partners adopt and/or support (via a resolution) the Upper 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	Madison County adopts 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, eg 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		

GRADE	

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)			
Number of 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 county residents who know which watershed they live in (survey).	25%	50%	75%	… of survey respondents (or all education session participants) in Madison County who can correctly identify which watershed they live in on an annual basis.		
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	

GRADE	

Notes