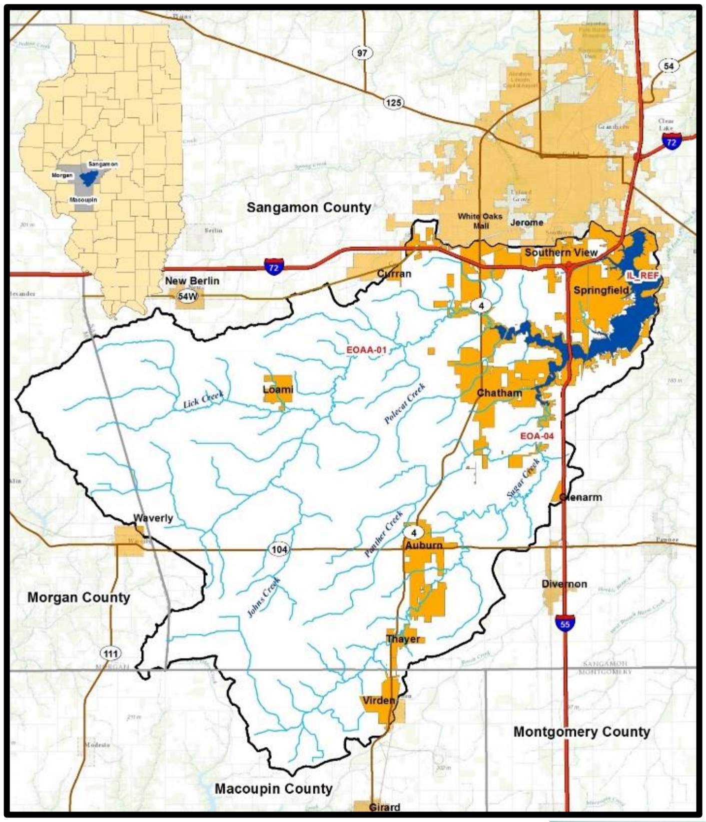
Lake Springfield

Watershed-based Management Plan

A Strategy to Enhance and Protect the Water Quality and Natural Resources of Lake Springfield and Its Watershed




Lake Springfield 1954 Drought

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Acknowledgements

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It was truly a team effort!

THANK YOU!

List of Acronyms

4Rs – Right Source, Right Rate, Right Time, Right Place
AFO – Animal Feeding Operation
BMP – Best Management Practice
CAFO – Confined Animal Feeding Operation
C-BMP – Illinois Council on Best Management Practices
CFO – Confined Feeding Operation
CFS - Cubic Feet per Second
CSO – Combined Sewer Overflow
CPESC – Certified Professional in Erosion and Sediment Control
CREP – Conservation Reserve Enhancement Program
CRP – Conservation Reserve Program
CWLP – City Water, Light and Power
DO – Dissolved Oxygen
EQIP - Environmental Quality Incentives Program
EPA – Environmental Protection Agency
GIS – Geographical Information System
HEL – Highly Erodible Land
HUC – Hydrologic Unit Code
IBI – Index of Biological Integrity
IDNR – Illinois Department of Natural Resources
IDOA – Illinois Department of Agriculture
IBC – Impaired Biotic Community
IEPA – Illinois Environmental Protection Agency
IGIG – Illinois Green Infrastructure Grant
IPCB – Illinois Pollution Control Board
ISWS – Illinois State Water Survey
KIC – Keep It for the Crop
LLCC – Lincoln Land Community College
LRS – Load Reduction Strategy
LSWMP – Lake Springfield Watershed-based Management Plan
LSWRPC – Lake Springfield Watershed Resource Planning Committee
MS4 – Municipal Separate Storm Sewer System
MIBI – Macroinvertebrate Index of Biological Integrity
MGD – Million Gallons per Day
MSL – Mean Sea Level
NFWF – National Fish and Wildlife Foundation

List of Acronyms (continued)

NPDES – National Pollutant Discharge Elimination System
NRCS - Natural Resources Conservation Service
NHD – National Hydrography Dataset
NMP – Nutrient Management Plan
NPS – Nonpoint Source Pollution
N – Nitrogen
NWI – National Wetlands Inventory
P – Phosphorus
QHEI – Qualitative Habitat Evaluation Index
SAFE – State Acres for Wildlife Enhancement
SCSWCD –Sangamon County Soil and Water Conservation District
SSCRPC - Springfield Sangamon County Regional Planning Commission
SWAMM – Spatial Watershed Assessment and Management Model
STEPL – Spreadsheet Tool for Estimating Pollution Loading
TSS – Total Suspended Solids
TMDL – Total Maximum Daily Load
TSI - Trophic State index
T & E – Threatened and Endangered Species
UIE – University of Illinois Extension
UIS – University of Illinois at Springfield
USACE – U.S. Army Corps of Engineers
USDA-ARS – United States Department of Agriculture-Agricultural Research Service
USLE – Universal Soil Loss Equation
RUSLE – Revised Universal Soil Loss Equation
USDA – U.S. Department of Agriculture
WWTP – Waste Water Treatment Plant
WQS – Water Quality Standards
WRP - Wetland Reserve Program
WASCOB – Water and Sediment Control Basin
WMP – Watershed Management Plan

The Methodology: How the Assessments and Plan Were Completed

To complete the 33 elements that make up the IEPA's 33-element checklist, the detailed watershed assessment used a data-driven approach. All known and available information were gathered to prepare the new 2017 Lake Springfield Watershed-based Management Plan (LSWMP), as well as to generate new data and results.

Methods comprised the latest technology such as Geographic Information Systems (GIS) and computer modeling to evaluate pollution causes and sources, along with conventional manual means such as direct observations of the watershed (through windshield surveys) and meetings with landowners/producers. Independent assessments were made of water quality data, local soils, hydrology (water movement and drainage patterns), land use, precipitation, geology, and biology.

A land-based pollution load model was developed to estimate annual and storm-event nitrogen, phosphorus, and sediment loads. The windshield survey and landowner consultations resulted in identifying of a series of site-specific projects, and a GIS mapping platform and aerial image interpretation were used to further identify and delineate project areas, evaluate their drainage characteristics, and analyze data used to identify critical or priority sub-watersheds.

These critical or priority sub-watersheds were identified through applying a series of weighted criteria related to the LSWMP's goals. In this way, the quality of each sub-watershed could be scored and ranked. For example, the goal to reduce nitrogen loading was supported by assessing the data on total nitrogen loads, acres of cropland, and number of nitrogen impairments; the key indicators of nitrogen issues. Each criterion was assigned a weight that was based on the quality of the data (for instance, whether the data source was a new sampling analysis or an older water quality analysis) and its relevance to the goal. The proportion of water quality samples in the watershed that exceed state standards was considered directly relevant.

Public input and participation is the foundation of this plan. The primary strategy for the 2017 LSWMP applied targeted watershed stakeholders, and local agency staff from the Soil and Water Conservation Districts, the Natural Resources Conservation Service (NRCS), Springfield City Water, Light and Power, county assessors' office, GIS Coordinator, and city governments. This approach verified that the information and concerns gathered at the meetings originally held to develop the 1990 Lake Springfield Watershed Plan and the plan revision process the Lake Springfield Watershed Resource Planning Committee (LSWRPC) started in 2012, remain relevant today. The still-active LSWRPC, formed in 1989, updated the stakeholder concerns and facilitated further public participation through a survey of the watershed mailed to approximately 700 landowners/producers, at various meetings held at a June 10, 2015 public meeting and media press releases requesting public input through this survey until October 15, 2015 to garner additional input.

EXECUTIVE SUMMARY

Lake Springfield (3,965 acres), owned by the City of Springfield and managed by City Water, Light and Power (CWLP), is the largest municipality-owned lake in Illinois. The Lake serves as the public water supply for approximately 165,000 customers, provides the cooling water source for Springfield's power plant condenser and is a major recreational area with over 600,000 visits annually.

Stewardship of this vital resource is the focus of this Lake Springfield Watershed-based Management Plan (LSWMP). The LSWMP identifies sources of nonpoint and point source pollutants in the watershed and outlines strategies to prevent them from reaching the Lake, thus improving water quality throughout the system.

1.1 Plan Purpose and Mission

With this comprehensive plan in place, the Sangamon County Soil and Water Conservation District (SCSWCD) and the Lake Springfield Watershed Resource Planning Committee (LSWRPC) can fulfill their **mission** of enhancing and protecting the water quality and natural resources of Lake Springfield and its watershed.

The stakeholder vision is to use this nine-element watershed-based plan as a guide to implementing strategies that will meet the goals, objectives and outcomes for improving, protecting and enhancing water quality and natural resources in this watershed, while also protecting public health and quality of life, now and into the future.

The **purpose** of the Lake Springfield Watershed-based Management Plan is to:

- Provide the framework for the protection and integrity of Lake Springfield, its tributaries and the natural resources in this watershed for today and for years to come.
- Address all types of point and nonpoint source pollution affecting the quality of the water entering Lake Springfield from its 265-square-mile watershed.
- Identify voluntary solutions for improving water quality and protecting the natural resources around Lake Springfield, in its stream system and throughout its watershed.
- Provide an in-depth analysis of the agricultural and urban dynamics affecting the water quality of Lake Springfield and its watershed caused by both point and nonpoint pollution sources.

With this plan complete, stakeholders will be in a position to request and obtain funding for the implementation and monitoring of land use-specific and watershed-wide Best Management Practices (BMPs) recommended in the LSWMP, the Illinois Environmental Protection Agency (IEPA) Stage 3 Total Maximum Daily Load Report (TMDL) for Lake Springfield and the Sugar Creek Watershed, and in the Illinois Nutrient Loss Reduction Strategy (NLRS) to accomplish the goals of improving the water quality of Lake Springfield and its watershed.

1.2 What is the Lake Springfield Watershed?

"We all live in a **watershed** — the area that drains to a common waterway, such as a stream, lake, estuary, wetland, aquifer or even the ocean — and our individual actions can directly affect it."[1] Watersheds supply drinking water, provide recreation and sustain life.

That definition is simple enough to understand, but a watershed is really quite complex. It is an interaction between many natural components (surface water, groundwater, climate, vegetation, wildlife) and humans that comprise our watersheds. The impact that human activities can have on these components affect the quality of their watershed and water resources. It is essential that everyone understand what they should do, or should not do, to protect and improve their watershed and to save their rivers, lakes and streams.

The Lake Springfield Watershed (LSW) includes all of the land that drains from the 169,161 acres (265 square miles) south and west of Springfield. The 2010 US Census Bureau estimates 74,300 people reside in this watershed.

This watershed covers portions of three counties in central Illinois and is predominately an agricultural watershed (74 percent), with 7 percent urban areas. Sangamon County represents 87 percent of those acres (148,245 acres) with 7 percent in northern Macoupin County (12,093 acres) and 6 percent (10,662 acres) located in eastern Morgan County. The watershed also includes 16,157 acres of the City of Springfield (City), making it the largest municipality in the watershed, covering approximately 9.5 percent of the entire watershed.

Lake Springfield, a man-made reservoir, was completed in 1935 to serve as the new public water supply for the City of Springfield (City). It has 57 miles of shoreline and 4,300 acres of marginal land surrounding the Lake, owned by the City. The Lake is 12 miles in length, averages one-half mile wide, and is two miles wide at its widest point. The City's electric generation and water filtration plants are located at the northwest end of the Lake.

Primary tributaries draining to Lake Springfield are Sugar Creek (IL_EOA_04) and Lick Creek (IL_EOAA_01), both flowing in a northeasterly direction to Lake Springfield (IL_REF). Water leaving Lake Springfield enters Sugar Creek which then flows north to the South Fork of the Sangamon River near Riverton, before entering the Illinois River. The Illinois River travels south almost 90 miles before entering the Mississippi River and ultimately the Gulf of Mexico.

The northern boundary of the LSW is Stevenson Drive along the eastern edge of Springfield and Route 54 west between Curran and New Berlin. The watershed extends south and west of Lake Springfield and includes the municipalities of Auburn, Chatham, Curran, Loami, Southern View, Thayer and Virden.

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[1]Retrieved from https://www.epa.gov/nps/watershed-approach

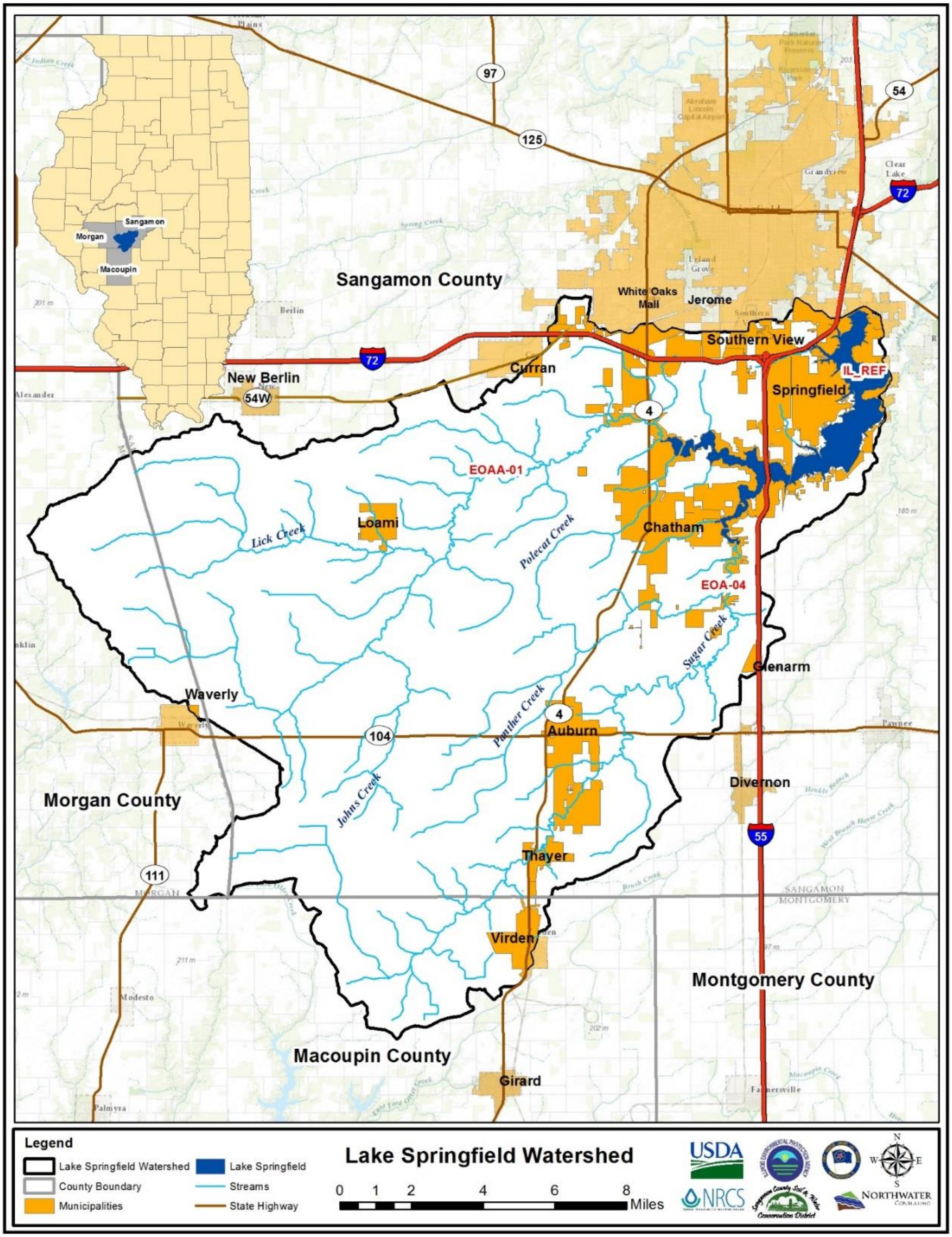

FIGURE 1 – LAKE SPRINGFIELD WATERSHED

Executive Summary

1.3 Challenges and Potential Obstacles for the Watershed

The watershed faces many challenges typical of agriculturally based communities, while also dealing with economic and lifestyle changes that put pressure on rural municipalities. The following conditions were identified during the planning process:

- Surface and subsurface water pollutants – nutrients and sediment.
- High total phosphorus, nitrate, aquatic algae and Total Suspended Solids (TSS) levels in Lake Springfield.
- Need for education and outreach to watershed stakeholders and the general public.
- Land use changes that challenge water quality.
- Lifestyle changes and expectations as all generations of people age.
- Need for stable funding sources for BMP implementation.

Nonpoint and point sources of pollution from crop production, livestock and pasture grazing, urban development, municipal point source discharges, private septic systems, and recreational use are a few of the sources of watershed impairments from human activities. These pollution sources cause the watershed impairments of nutrients (phosphorus and nitrogen), sediment, total suspended solids, aquatic algae, and alteration in stream-side and shoreline vegetation, which ultimately affect the water quality in Lake Springfield and its watershed's 201 miles of perennial streams.

Prior to settlement in this watershed, prairie grasses covered about 70 percent of the area consisting of nearly level to strongly sloping uplands. Sloping land near the streams was timbered. In the early 1800s, settlers cleared and farmed the timbered areas. By 1830, metal plows were available and the prairie grasses were plowed under to turn this highly fertile soil into agricultural cropland. Much of this nearly level land was very wet, and when underground tile drainage became available around 1875, the farmers were eager to artificially drain their land to facilitate its cultivation.

While agricultural production has been the prevailing industry in the LSW for over 200 years, the amount of cropland continues to dwindle, with just 74 percent still under cultivation, down from 88 percent in the early 1990s. Currently, there are approximately 407 active producers in the LSW who farm about 125,000 cropland acres. The size of a farm operation in the LSW ranges anywhere from 40 acres or less to 15,000 acres or more. A medium-sized farm operation may range between 1,500 and 2,500 acres. With almost all farmland having access to surfaced roads, homes and small subdivisions now dot the rural landscape, many on 5-acre or less land tracts with private water wells and septic systems.

Development of a system of railroads and highways, linking the countryside with the urban areas, spurred residential and commercial development throughout this watershed at a fairly rapid pace from the 1980s and into the early 2000s. A significant downturn in the economy over the past ten years has slowed this expansion. While most of the LSW's seven villages and cities continue to see limited growth, a couple of them have seen a considerable decline in population and business enterprises.

With diminishing business opportunities, many people in this watershed commute to larger communities such as Springfield for work, food, recreation and entertainment, which puts pressure on the rural municipalities to survive. In addition, a recent study of the millennial generation in this area show their preference to remain in the metropolitan areas and are not nearly as interested in commuting very far to work.

1.4 Plan Goals and Objectives

The following goals and objectives were established utilizing the latest watershed resource inventory information, LSW stakeholders' survey results, recent input from LSWRPC members and the general public on agricultural and urban resource concerns, combined with knowledge of Lake Springfield's 80-year history and previous watershed planning efforts:

1. Reduce surface water runoff from farm fields.
2. Identify and secure stable cost-share funding sources for BMP implementation.
3. Improve environmental education and outreach efforts to the public.
4. Reduce urban stormwater runoff.
5. Meet the 45% reduction goal for nutrients (phosphorus and nitrogen) as set in the NLRS.
6. Improve groundwater quality.
7. Meet IEPA's TMDL for phosphorus in Lake Springfield and Sugar Creek.
8. Meet IEPA's TMDL for total suspended solids (TSS) and aquatic algae in Lake Springfield.
9. Enhance the quality and quantity of wildlife habitat.
10. Promote prime farmland preservation and protection.
11. Support controlled urban development.
12. Restore and improve aquatic habitat.
13. Improve recreational opportunities.

These goals and objectives cannot be accomplished in a short period of time, but are attainable over the long term. This plan is intended to have an 18-year life, with a built-in plan for updates. Using an adaptive management approach allows for flexible decision-making which can be adjusted for uncertainties (i.e., weather, changing funding levels, etc.), and potential unknown outcomes from management actions.

With knowledge from past planning efforts, the ability to provide cost-share assistance to LSW producers for voluntarily implementing BMPs on their land will be imperative to the success of meeting the LSWMP's goals and objectives. Securing stable funding sources for BMP implementation (Goal #2) may hold the key to this success.

1.5 Recommendations

Now that the Lake Springfield Watershed-based Management Plan (LSWMP) has been completed, it is time to begin its implementation, with all of the watershed stakeholders doing their part to make it successful. The LSWMP will be our guide for many years to come, as was the original 1990 Lake Springfield Watershed Plan.

Actions recommended in the LSWMP include surveys and studies, outreach and education programs, monitoring, and BMP implementation. The plan identifies and prioritizes watershed and site-specific BMPs that can be implemented. Costs, watershed benefits and sources of funding are given.

The BMPs fall into three categories: watershed-wide BMPs, targeted location/land use BMPs and site-specific BMPs. BMPs should be evaluated by technical personnel for viability in the identified location. Pollution load reductions, implementation costs, funding availability, and critical areas will play key roles in BMP selection and timing of implementation.

- **Watershed-wide:**
  For consideration by any stakeholder anywhere within the LSW.
- **Targeted location/land use identified during windshield surveys**:
  These are location/land use-specific and require further site investigations and detailed project-specific planning.
- **Site-specific BMPs**:
  To be constructed in the next five years.

Implementation of BMPs outlined in the LSWMP for the Lake Springfield Watershed would help achieve the following goals:

1. Meet the 45% reduction goal for nitrogen and phosphorus, as outlined in Illinois' Nutrient Loss Reduction Strategy.
2. Meet IEPA's Total Maximum Daily Loads (TMDLs) and Load Reduction Strategy for phosphorus (P) in Lake Springfield (IL_REF) and Sugar Creek (IL_EOA-04).
3. Meet IEPA's TMDL for total suspended solids (TSS) and aquatic algae in Lake Springfield.
4. Become a success story by being removed from IEPA's 303(d) list for total phosphorus, total suspended solids, aquatic algae and dissolved oxygen in Lake Springfield and its watershed.

If all targeted BMPs are implemented throughout the watershed, a 47% reduction in nitrogen, a 51% reduction in phosphorus and a 56% reduction in sediment load can be achieved. Widespread adoption of field borders, filter strips and addressing conventional tillage, especially on HEL fields, are likely the most realistic practices that will achieve the greatest percent reductions to nutrient and sediment loads in this watershed.

A suite of practices is detailed that can be implemented at each of these scales. These include drainage water management, field borders, filter strips, shoreline stabilization, and livestock management protocols. There are innovative ideas at a variety of cost points, ranging from those that can reasonably be implemented by individual producers, to those that will take watershed-wide coordination with multiple stakeholders.

Additionally, an inventory of seven watershed studies and surveys that are needed to supplement the LSWMP include:

- Gully erosion
- Private septic systems and water wells
- Retention/detention basins (rural and urban)
- Streambank and channel bed study
- Subsurface drainage systems
- Tillage operations
- Urban expansion

1.6 Recommended BMPs

The LSWMP includes a list of BMPs for consideration by any stakeholder anywhere within the LSW. It also includes a list of recommended BMPs identified during windshield surveys. These are location/land use-specific and require further site investigations and detailed project-specific planning. There is also a list of site-specific projects to be constructed within the next five (5) years, further identified in Table 7.1, with funding requested in the SCSWCD's 2016 EPA grant application.

BMPs will be evaluated by technical personnel for viability in the identified location. Pollution load reductions, implementation costs, funding availability, and critical areas will play key roles in BMP selection and determining when they can be implemented. Landowners who implement BMPs on their farms do so on a completely voluntary basis.

The BMPs are listed below in three categories: watershed-wide BMPs, targeted location/land use BMPs and site-specific BMPs.

All of the BMPs currently on these three lists in the LSWMP will be considered for implementation based on the most up-to-date technical information provided in the NRCS Field Office Technical Guide (eFOTG), NRCS Conservation Practice Standard (CPS) Codes and the Illinois Urban Manual (IUM), as these BMPs receive funding for implementation.

Other BMPs currently listed in eFOTG and the IUM, along with new BMPs developed over time, can also be considered for funding and implementation, if they help meet the goals and objectives identified in this watershed plan.

- **Watershed-wide BMPs:**

1. Bioreactors (Denitrifying)—CPS 605
2. Bioswales (Grass Lined Channels)—IUM 840
3. Brush management—CPS 314
4. Commercial and residential/detention basins (Stormwater Runoff Control)—CPS 570
5. Conservation tillage, residue and tillage management, reduced till – CPS 345
6. Cover crops—CPS 340
7. Critical area planting—CPS 432
8. Diversion—CPS 362
9. Drainage water management—CPS 554
10. Field borders—CPS 386
11. Filter strips—CPS 393
12. Filter strips (urban)—IUM 835
13. Grade stabilization structures (concrete/aluminum toe wall, block chute, etc.)—CPS 410
14. Grade control structures (stream channel/streambank, riffles, J-hook, etc.) (Channel Bed Stabilization—CPS 584)
15. Grassed waterways—CPS 412
16. Green roofs
17. Livestock alternative watering systems—CPS 516, 614, 642
18. Livestock exclusion fence —(Fence) CPS 382
19. Livestock feed area waste management systems (waste storage, waste transfer, waste treatment)—CPS 313, 634, 629
20. Livestock pasture and prescribed grazing management—CPS 528
21. Livestock shelter structure (loafing sheds, feeding stations, etc.)—CPS 576
22. Livestock stream crossing (Stream Crossing)—CPS 578
23. Nutrient management —CPS 590
24. Permanent vegetative cover (Conservation Cover)—CPS 327, IUM 880
25. Ponds—CPS 378
26. Pond sealing or lining bentonite treatment—CPS 520,521A, 522
27. Porous/permeable pavement—IUM 890
28. Residential rain barrels and rain gardens—IUM 897
29. Residue and tillage management: no-till/strip-till/direct seeding—CPS 329
30. Residue and tillage management: reduced-till—CPS 345
31. Riparian forested buffers—CPS 391
32. Roofs and covers—CPS 367
33. Saturated buffers—CPS 604

34. Sediment basins – in-field, low flow/in-lake dams—CPS 350
35. Streambank/lake shoreline stabilization/stream corridor improvement—CPS 580
36. Streambank stabilization (structural)—IUM 940
37. Subsurface drain—CPS 606
38. Surface drain, main or lateral—CPS 608
39. Terraces—CPS 600
40. Tree and forest ecosystem preservation—IUM 984
41. Tree/shrub establishment—CPS 612
42. Tree and shrub planting (urban)—IUM 990A and B, 985
43. Water and Sediment Control Basins (WASCOBs)—CPS 638
44. Well decommissioning—CPS 351 and IUM 996
45. Wetlands – constructed—CPS 658, 659, 657
46. Wetlands – urban stormwater—IUM 997, 998, 999

- **Targeted BMPs – Location/Land Use-specific:**

1. Bioreactors
2. Cover crops
3. Detention/retention basins/ponds
4. Detention/retention at commercial/retail business sites
5. Drainage water management
6. Field borders
7. Filter strips
8. Riparian forest buffers
9. Grade stabilization structures, in-field
10. Grade control structures - channel bed stabilization – rock riffles
11. Grassed waterways
12. Livestock feed area waste systems (multiple BMPs may be included)
13. Nutrient management
14. Residue and tillage management—no-till/strip-till/direct seeding
15. Residue and tillage management – reduced-till
16. Residential rain barrels, rain gardens, detention basins, porous/permeable pavement
17. Permanent vegetative cover
18. Saturated buffers
19. Sediment basins/In-lake, low flow dams
20. Streambank/lake shoreline stabilization
21. Terraces
22. Water and Sediment Control Basins (WASCOBs)
23. Wetlands – constructed

- **Site-specific BMPs:**
    1. Cover crops
    2. Field borders/filter strips/riparian buffers[2]
    3. Grade stabilization structures
    4. Grassed waterways
    5. Lake shoreline stabilization
    6. Livestock exclusion system (fence)
    7. Nutrient management plans
    8. Water and sediment control basins/terrace systems
    9. Woodland improvement

- **Watershed Studies and Surveys, Needed to Supplement LSWMP**
    1. Gully erosion
    2. Private septic systems and water wells
    3. Retention/detention basins (rural and urban)
    4. Streambank and channel bed study
    5. Subsurface drainage systems
    6. Tillage operations
    7. Urban expansion

1.7 Education and Outreach

An active group of volunteer LSW stakeholders will be necessary for successful implementation of the LSWMP. Education and outreach efforts must intensify in order to provide these stakeholders with a greater knowledge of local water quality problems. These efforts include LSW meetings, newsletters and direct mailings, videos, public service announcements, press releases, surveys, and partnerships with other like-minded organizations.

1.8 Monitoring

Water quality monitoring will be a critically important component in the plan in order to:

- Evaluate the overall health of this watershed.
- Document watershed changes annually and long-term.
- Assess the effectiveness of implementation projects and their cumulative watershed-scale contribution towards achieving the goals and objectives in the LSWMP.

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[2] These BMPs are recommended for implementation and funding through the USDA Conservation Reserve Program

1.9 Future Plans for Sustaining the Watershed

Sustaining the Lake Springfield Watershed will require long-term commitments by the LSWRPC members and LSW stakeholders to ensure the LSWMP is successfully implemented. It must be reviewed annually, adjusted as necessary and updated when significant watershed changes occur, additional water quality issues arise, monitoring results determine a need for changes, and/or government regulations warrant the adoption of addendums. This is a living document that will serve as the comprehensive guidebook to follow now and for future LSW planning efforts.

Any addendums to the LSWMP will be carefully crafted and adopted by the LSWRPC members, with input from LSW stakeholders and the general public. They will be made available to the watershed stakeholders and general public through various media resources and outreach efforts.

Utilizing an adaptive management approach for decision making during the implementation of this plan will be extremely important. Adaptive management will include a structured decision-making process which will look at the "what, why and how" actions to be taken and be a move toward accountability and explicitness for the decisions made.

As the Scottish poet and lyricist Robert Burns once wrote: "The best laid plans of mice and men often go awry." No matter how carefully a project is planned, something may still go wrong with it. The implementation of the LSWMP will be no exception. However, using this structured decision-making approach will help keep implementation efforts on track:

1. Engage the pertinent stakeholders in the decision-making process.
2. Identify the problem(s) to be addressed.
3. Determine objectives and possible acceptable compromises needed.
4. Identify a range of decision alternatives which may be the next actions necessary to implement.
5. Discuss assumptions about these alternative actions.
6. Strategize about potential consequences of implementing each of the alternative actions.
7. Identify key uncertainties.
8. Evaluate risk tolerance for possible consequences of these decisions.
9. Assess future impacts of these decisions.
10. Account for legal guidelines and limitations.

Since 1990, the watershed stakeholders have always embraced their role "to do their part" to improve the water quality of Lake Springfield and its streams. The dedication and perseverance by all of these stakeholders will be the key to successful implementation of the LSWMP.

If you want to get involved, please join this volunteer effort to put this LSWMP into action. The LSWRPC will be the driving force and support for plan implementation and future planning efforts. Contact the Sangamon County Soil and Water Conservation District to find out how you can assist with the work going on in this watershed.

For more information, contact:
Sangamon County Soil and Water Conservation District
2623 Sunrise Drive – Suite 1
Springfield, IL 62703
(217) 241-6635 Extension 3
www.sangamoncountyswcd.com

1.10 Lake Springfield and its Watershed – 80 Years of History and Conservation Efforts

Since 1982, over $6 million has been spent in the LSW on conservation work. These water quality improvement efforts by the watershed stakeholders will continue well into the future and this watershed plan will be their guide.

To determine the viability of this water supply source over time, five sedimentation surveys have been conducted since 1948. These surveys have helped guide local efforts to protect the Lake.

In 1982, CWLP initiated its Lake Springfield Maintenance and Restoration Program (LSMRP).

In 1983, CWLP began providing cost-share funds to the SCSWCD for conservation aimed at reducing erosion and improving water quality in the LSW through the LSMRP and continues annually.

From 1987-1990, the City spent $7.8 million to dredge a portion of Lake Springfield.

In 1989, the LSWRPC initiated a watershed planning process to address the water quality issues in the Lake resulting from excess sediment, nutrients, and pesticides.

In 1990, the Lake Springfield Watershed Resource Plan (1990 Plan) was adopted.

In 1991, the City approved the ***Land Use Plan for Lake Springfield and Its Marginal Properties*** to define uses and management of the Lake and marginal lands***.*** It was updated in 1994, 2005, 2012, and 2014.

In 1995, an addendum to the 1990 Plan to address high levels of the herbicide atrazine in the Lake was approved. With great cooperation from LSW producers and local agricultural retailers, action items were successfully implemented.

Efforts for water quality improvement in the LSW have continued through a series of research studies and grants secured by the SCSWCD, CWLP and the LSWRPC partners:

- 1995 – IEPA 319 grant to demonstrate the need for and use of urban erosion control practices in a developing subdivision.
- 1997-2002 –"Assessment of Best Management Practices' Effectiveness on Water Quality and Agronomic Production in the Lake Springfield Watershed" began. Results determined that the BMPs most effective for improving surface water quality and

reducing movement of sediment, nutrients and pesticides from agricultural fields were filter strips along streams and no-till farming practices.

- 2003-2005 – An IEPA 319 grant to establish filter strips and riparian buffers throughout the LSW. Almost 600 acres of filter strips were established along 29 miles of unprotected stream corridors.
- 2008 – "Protecting Water Quality in Urban Centers in Illinois" IEPA 319 grant, the SCSWCD hosted an Urban Water Quality BMP tour for government leaders from Springfield and Sangamon County. The Sangamon County Board and the City of Springfield adopted sediment and erosion control ordinances in 2009 and 2012, respectively.
- 2013 – A Priority Lake and Watershed Improvement Project grant from IEPA was awarded to the City of Springfield to reduce sediment runoff and nutrient loading into Lake Springfield. Rip rap was installed on 2,756 feet of highly eroded Lake shoreline at the confluence of Lick and Sugar Creeks.
- 2013-2016 – A nitrogen management program/study in the LSW. Partners: the IL Council on Best Management Practices (CBMP), SCSWCD, CWLP, Lincoln Land Community College (LLCC), local agricultural retailers and LSW producers. Funded 50/50 by the National Fish and Wildlife Foundation (NFWF) and CWLP.
- 2014-2016 – Maximum Return to Nitrogen (MRTN) Rate established for the LSW. This was the first Illinois watershed to have its own MRTN recommendations. The nitrogen recommendation for soybean-corn rotation is 166 N units and 202 N units for planting corn after corn.
- 2015 – Two USGS water monitoring stations were installed on the two main tributaries (Sugar Creek and Lick Creek) of Lake Springfield, with financial support from IL Corn Growers Association. Real-time water monitoring for nonpoint pollutant sources is available 24/7.
- 2014-2016 – IEPA 319 Grant for watershed-based management plan (LSWMP) and for agricultural and urban BMPs throughout the LSW. Pollutant load reductions totaled 14,888 pounds of phosphorus, 24,210 pounds of nitrogen, and 20,119 tons of sediment over the lifespan of the BMPs.
- 2016-2017 – SCSWCD cover crop program in LSW. Thirty-five LSW producers planted 1,400 acres of cover crops in the fall of 2016.

Contents

Executive Summary

1.0 Introduction

1.0 INTRODUCTION

The 2017 Lake Springfield Watershed-based Management Plan (LSWMP) addresses the watershed impairments caused by point and nonpoint pollution sources of sediment and nutrients, primarily phosphorus, nitrogen and soil erosion, from both agricultural and urban land, which are affecting the water quality of Lake Springfield and the streams throughout its watershed.

Early reports and plans followed a similar structure as today's, focusing on identifying solutions to watershed and water quality problems. In each situation, planners and stakeholders identified watershed issues and made recommendations to alleviate quantifiable problems. Similar to today, many of the recommendations focused on a combination of education, land treatment, and structural practices. What is interesting about the planning history for this watershed is that, over the years, little has changed in terms of what stakeholders perceive as problems.

After beginning early land treatment projects, many of the watershed issues, such as soil erosion, sedimentation and nutrient (phosphorus and nitrogen) losses from cropland surface water runoff, runoff from farm field pesticides remain and many of the solutions are still very relevant. Regardless of the progress made to date in addressing watershed issues, these issues still do persist. This 2017 LSWMP identifies where and which solutions are needed, along with the water quality benefits achieved as a result.

This plan takes a look at the history of Lake Springfield (IL_REF) since its completion in 1935, documents historical planning and assessments of this watershed, and includes a chronological review of watershed planning efforts and accomplishments. It defines goals, objectives and strategies determined by the Lake Springfield Watershed Resource Planning Committee (LSWRPC) and Lake Springfield Watershed's (LSW) concerned citizens for implementation of agricultural and urban Best Management Practices (BMPs), which will protect and improve the water quality of Lake Springfield and its watershed streams, now and into the future. The LSWMP includes timelines and roles of responsibility, BMP cost estimates, potential funding sources for BMP implementation, pollutant load reductions for the BMPs and a water quality monitoring plan, in addition to outreach and education efforts and future planning.

The LSWMP also incorporates implementation of the BMPs recommended in the Illinois Environmental Protection Agency's 2016 Total Maximum Daily Load Stage 3 Report (TMDL) for Lake Springfield (IL_REF), the 34.28-mile Sugar Creek segment (IL_EOA_04), and the 2015 Illinois Nutrient Loss Reduction Strategy (NLRS). It also takes into consideration the 1990 Lake Springfield Watershed Resource Plan (1990 Plan) and renewed planning efforts of the Lake Springfield Watershed Resource Planning Committee (LSWRPC) from 2012 to 2014.

1.2 Lake Springfield

Lake Springfield (IL_REF) is a 3,965-acre, Y-shaped, man-made reservoir, with the Sugar Creek (IL_EOA_04) and Lick Creek (IL_EOAA_01) valleys making up the arms of the Y. The Lake is part of the Lower Sangamon River (HUC 0713000707) watershed. It measures approximately 12 miles in length, averages one-half mile wide and is two miles across at its widest point. It is owned and maintained by the City of Springfield (City). The City's electric generation and water filtration plants are located at the northwest end of the Lake. (Brill and Skelly, September, 2007).

Lake Springfield's primary functions are to:

1. Serve as the drinking water source for the City of Springfield, along with several nearby communities and rural customers.
2. Provide condenser cooling water for the municipal power plant complex.
3. Be a source of beauty and recreation for the citizens of the area.

Lake Springfield Identification and Location

County: Sangamon
Nearest Municipality: Springfield, IL
Latitude/Longitude: 39 42'43.0"/ -89 36' 13.0"
EPA Region: 5
EPA Major Basin Name:
Upper Mississippi Code: 07
EPA Minor Basin Name:
Illinois-Sangamon Code: 17
Major Tributaries: Lick Creek (EOAA_01), Sugar Creek (EOA_04), Polecat (EOAE), Panther Creek
Receiving Water Body: Sugar Creek
Ownership: City of Springfield's Office of Public Utilities, City Water, Light and Power (CWLP)

There are approximately 57 miles of shoreline and 4,300 acres of marginal land surrounding Lake Springfield and owned by the City of Springfield. 21.6 miles of shoreline are leased to private homeowners and lake clubs. The remaining shoreline is made up of natural area, public parks, and CWLP administrative property. Approximately 74,300 people reside in the watershed according to the 2016 Stage 3 TDML report.

Spaulding Dam, which impounds Sugar Creek near the power plant complex, is one of two dams that were constructed to form Lake Springfield. The top of the dam has an elevation of 570 feet above mean sea level (msl), which is ten feet above the spillway elevation of 560 feet. East Lake Drive crosses the top of the dam and is the northern boundary of the watershed. Making up the spillway are five manually-controlled, moveable drum gates at the west end of the dam, which are eight feet high and 45 feet long.

A narrow divide between Horse Creek (EOC_02) to the east and Sugar Creek (EOA_04) to the south required the building of an earthen "dividing dam" (saddle dam) just south of the Muni Opera location on East Lake Drive. This structure is 1,600 feet in length and 30 feet in height and was built to keep impounded water from overflowing into the Horse Creek drainage area.

Size of Lake Springfield

When Lake Springfield was completed in 1935, historical documents state that it covered 4,300 acres. As subsequent sedimentation studies and other documents were written, the size of the Lake was changed to 4,200 acres and subsequently to 4,040 acres. However, the 2016 Lake Springfield and Sugar Creek Watershed TMDL Report states that the Lake covers 4,200 acres.

Northwater Consulting compiled the watershed resource inventory for this watershed-based plan and utilized the latest Geographic Information System (GIS) technology available to determine that the Lake now encompasses 3,965 acres, which will be used in this document as the current size of the Lake Springfield.

The South Fork of the Sangamon River (EO_12) at its confluence with Horse Creek is also used as a supplemental water source when Lake Springfield is low. This dam impounds water in the channel and pumps located east of the dividing dam with a pipe passing through the dam for water transfer to the Lake. East Lake Drive runs across the dividing dam, creating a small section of the eastern boundary of the watershed.

Lake Springfield (IL_REF) is considered to be at full pool when the water surface reaches a pool elevation of 559.35 feet above msl. This is the mark at which water begins to flow over the spillway if no gates are lowered. Normal lake elevations are usually at some point less than full pool and are seasonably variable, depending on the amount of rain falling directly into the Lake and throughout its watershed. The amount of rainfall received throughout the year determines how full the Lake will stay. The lowest elevations are generally during the fall and early winter months after a long, hot summer. The highest lake levels occur after the springtime seasonal rains. During a hot, dry summer, Sugar and Lick Creeks often dry up into a series of disconnected pools and contribute little or no water to the Lake, when the demand for water remains high due to outdoor water use. In addition, evaporation increases during warmer weather, contributing to reduced lake levels in the late summer and autumn.

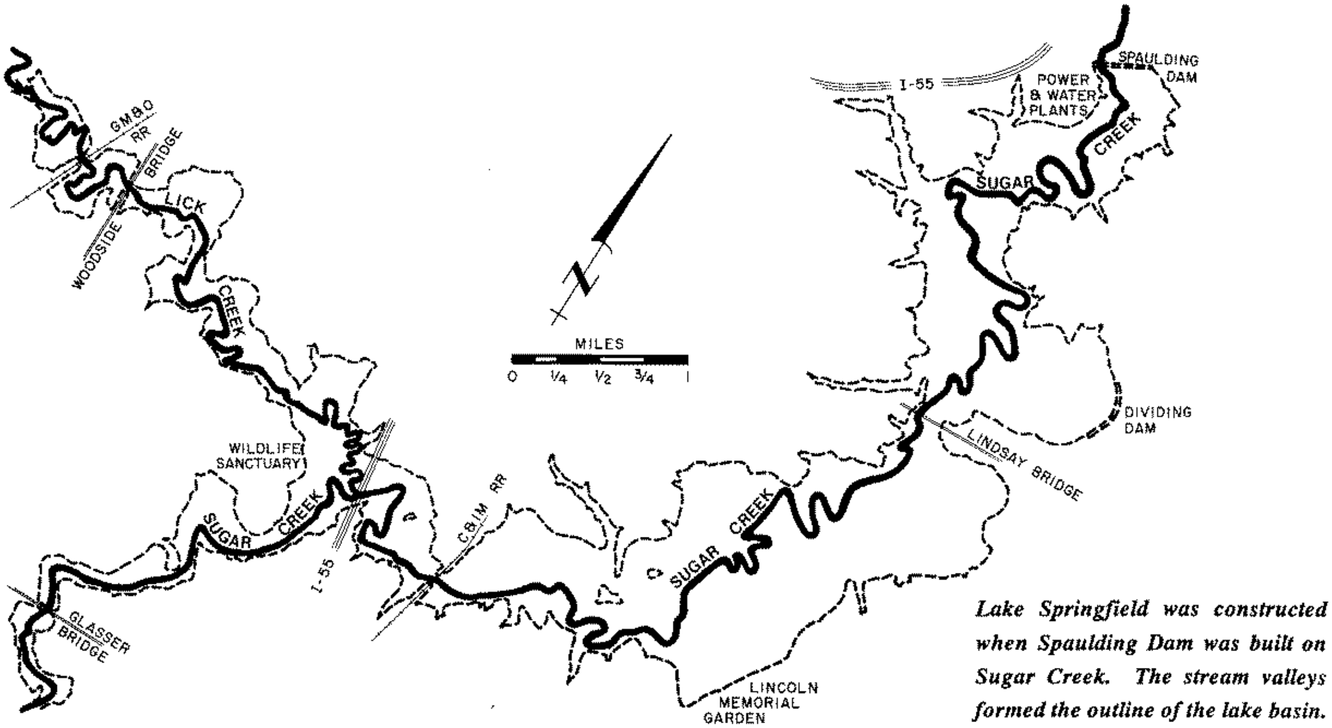


FIGURE 1.1.1 – MAP OF LAKE SPRINGFIELD

1935 Historical Lake Springfield Statistics
Surface Area: 4,300 acres
Shoreline Length: 57 miles
Maximum Depth: 35 feet at Spaulding Dam
Mean Depth: 14.4 feet (3.8 meters)
Storage Capacity: 19.5 billion gallons
Lake Type: Recreational, cooling and water supply impoundment
Watershed Area: 265 square miles (258.4 square miles, excluding Lake Springfield)
Spillway Elevation: 559.35 feet mean sea level (msl)

1.3 Lake Springfield Watershed

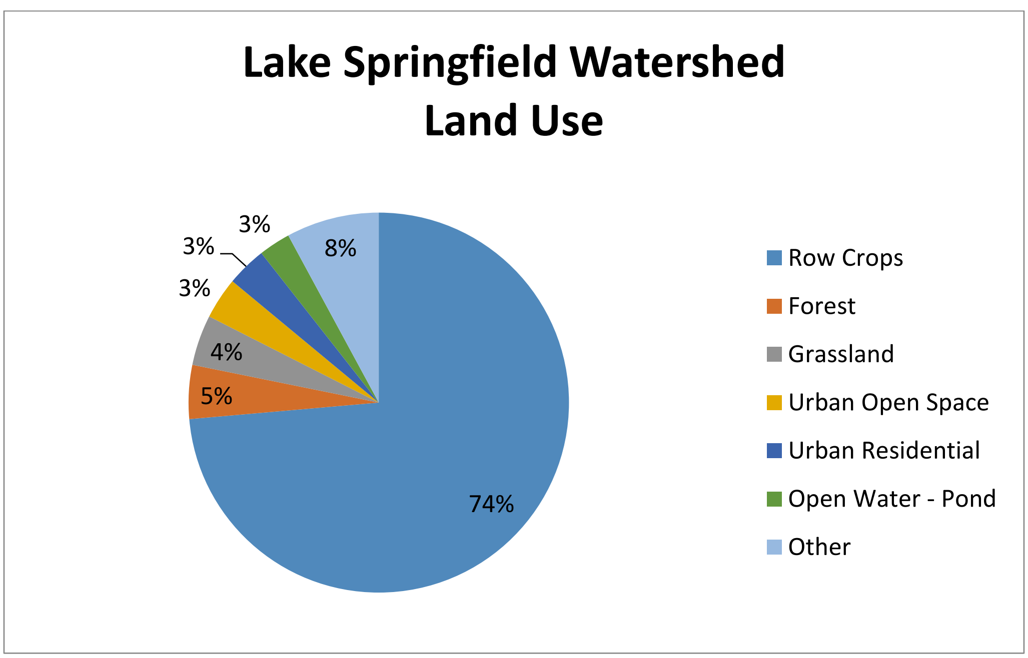
While everyone lives in a watershed, many people may not know in which one they live, or which direction it drains. All the land that drains from the 169,161 acres (265 square miles) into the stream system entering Lake Springfield is collectively referred to as the Lake's watershed. Most of the City of Springfield is not in the watershed. Rain falling in downtown Springfield drains north to the Sangamon River and has no impact on Lake Springfield's water level.

The northern boundary of the watershed is Stevenson Drive along the eastern side of Springfield and Route 54 west between Curran and New Berlin. The watershed extends south and west of Lake Springfield and includes a small portion of Springfield, and the municipalities of Auburn, Chatham, Curran, Loami, Southern View, Thayer and a portion of Virden. The majority of the LSW lies in southwestern Sangamon County, followed by 11,936 acres in northern Macoupin County and 10,568 acres in eastern Morgan County.

The entire watershed contains 124,522 acres (74%) of cropland, 7,744 acres (5%) of forest land, 5,992 acres (4%) of urban open space, 5,728 acres (3%) of urban residential land, 2,994 acres (2%) of pasture, and 2,719 acres of roads, with 72 percent of the land having 0 to 2 percent slopes.

There are approximately 1,227 farms in this watershed, with 693 in the Lick Creek watershed, 483 in the Sugar Creek watershed and 51 farms around Lake Springfield.

The largest urban development is in the northeastern extent of the watershed and consists of portions of the City of Springfield and the surrounding metropolitan area. The largest urban area in the LSW is the southern portion of the City covering 16,157 acres.



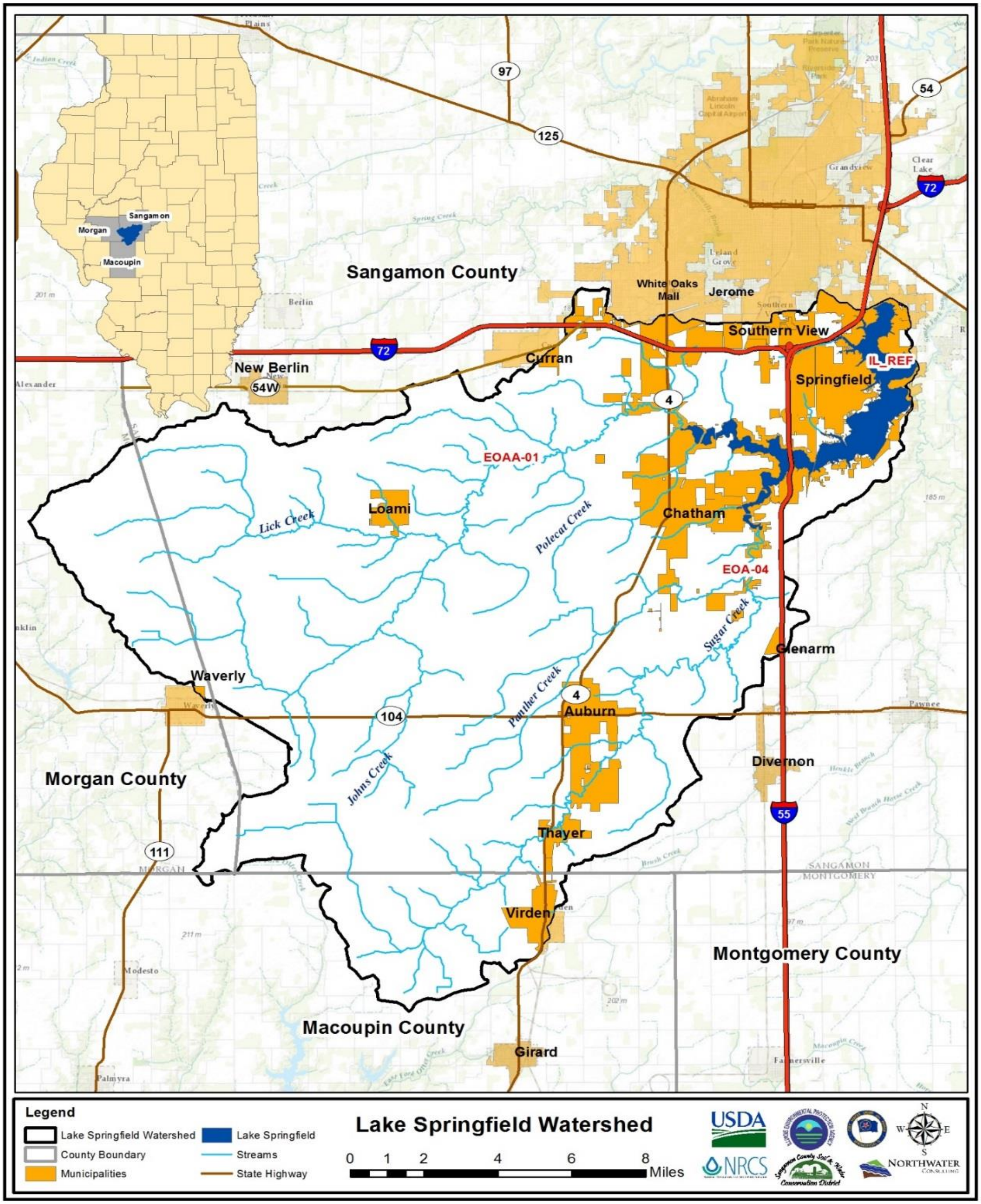
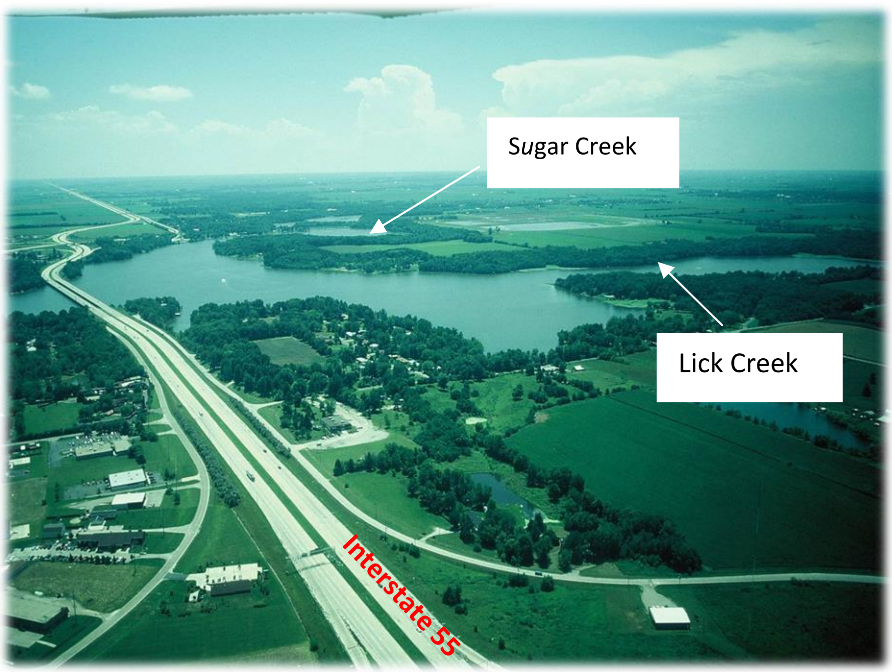


FIGURE 1.2.1 - LAKE SPRINGFIELD & WATERSHED STREAMS

Rain falling directly on the Lake's surface contributes only a minor fraction of the total amount of water in Lake Springfield. The stream system throughout this 265-square mile watershed flows from the south and west in a northeasterly direction to Lake Springfield and is the greatest source of water entering the Lake. Water from the major basins of Lick Creek and Sugar Creek, along with several smaller tributaries (Johns Creek, Little Panther Creek, Panther Creek, Polecat Creek, and the South Fork of Lick Creek), flow from the south and west into Lake Springfield. Tributary stream elevations vary from a high of 716 feet msl for Lick Creek at Waverly, IL to 559.35 feet msl at Spaulding Dam.

The Sugar Creek drainage area covers approximately 92 square miles of the watershed while the Lick Creek drainage area is about 139 square miles. These streams reach far south to the villages of Thayer and Virden, dipping down into northern Macoupin County and as far west as Waverly and portions of eastern Morgan County. The confluence, or point at which Sugar Creek (IL_EOA_04) and Lick Creek (IL_EOAA_01) flow together, is just west of the Interstate 55 (I-55) Bridge, which crosses Lake Springfield today.

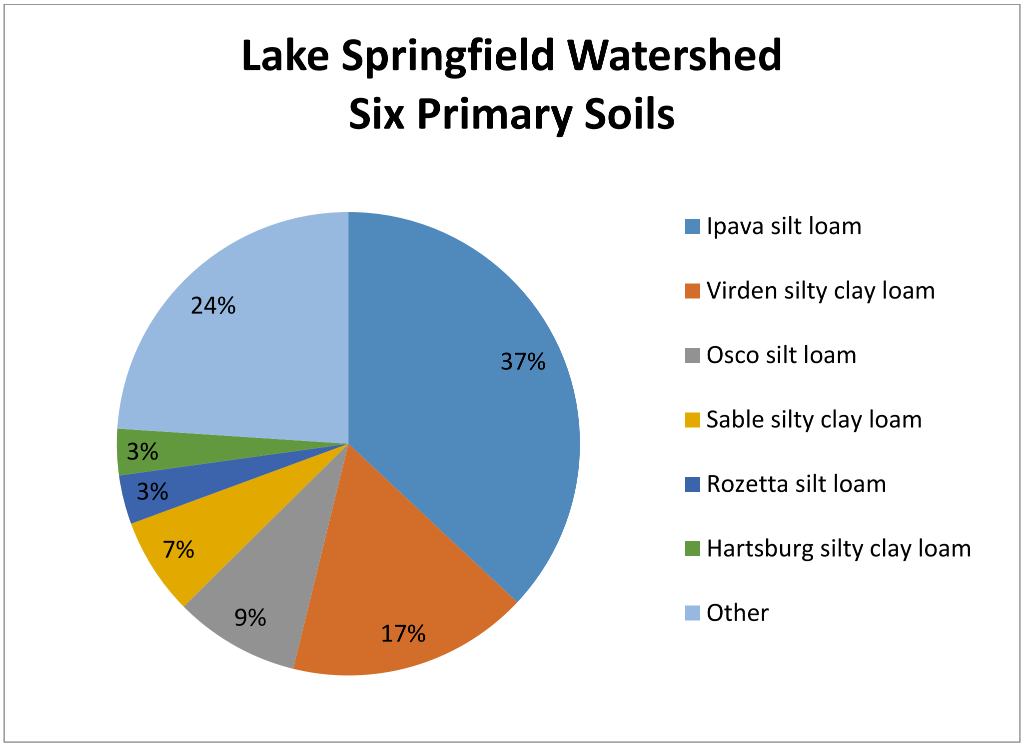


Lake Springfield - Confluence of Lick Creek and Sugar Creek at I-55 Bridge
(Looking South from Springfield)

The remaining 34 square miles of watershed drainage contributing runoff into the Lake are small ditches around the entire perimeter of the Lake and a few larger drainages which form the Hazel Dell area bays, Long Bay and Maple Grove Bay. The watershed area (169,161 acres) to lake surface area (3,965 acres) ratio is approximately 42:1.

1.4 Soils

The soils of the watershed are made from loess deposits that are up to eight feet thick, and are underlain by Illinois drift (Fitzpatrick et al., 1985). The average gross erosion rate was estimated to be as much as 3.96 tons per acre per year or a total of 601,000 tons per year for the LSW. (Lee and Stall, 1977).



1.5 Climate

The climate of the Springfield region is typically continental with warm summers and relatively cold winters. Annual rainfall totals approximately 36 inches, with thunderstorms occurring 50 days per year, on average.

TABLE 1.4.1- AVERAGE MONTHLY CLIMATE DATA—SPRINGFIELD, ILLINOIS

Month	Total Precipitation (in)	MAX Temperature (°F)	MIN Temperature (°F)
January	1.9	34.8	26.9
February	1.8	38.8	30.6
March	3.0	50.7	41.5
April	3.6	63.6	53.2
May	4.0	74.4	63.8
June	4.0	83.5	73.0
July	3.3	87.6	77.1
August	3.1	85.3	75.0
September	3.2	78.8	67.7
October	2.7	66.9	56.2
November	2.5	51.5	42.8
December	2.1	38.4	31.0
Total/Average	**35.3**	**62.8**	**53.2**

1.6 Lake Springfield Construction

Lake Springfield was built over a 3-year period from 1930 to 1933 in response to the needs of an ever-growing Springfield community. A $2.5 million bond issue was passed in 1930 and the City of Springfield purchased 8,500 acres of property, at a cost of $109 per acre, for its construction.

Of the 16 sites examined by engineers for the Lake, the optimal plan involved placing a dam on Sugar Creek, a tributary to the South Fork of the Sangamon River (IL_EO_12), impounding both the Sugar Creek tributary to the south and Lick Creek tributary to the west.

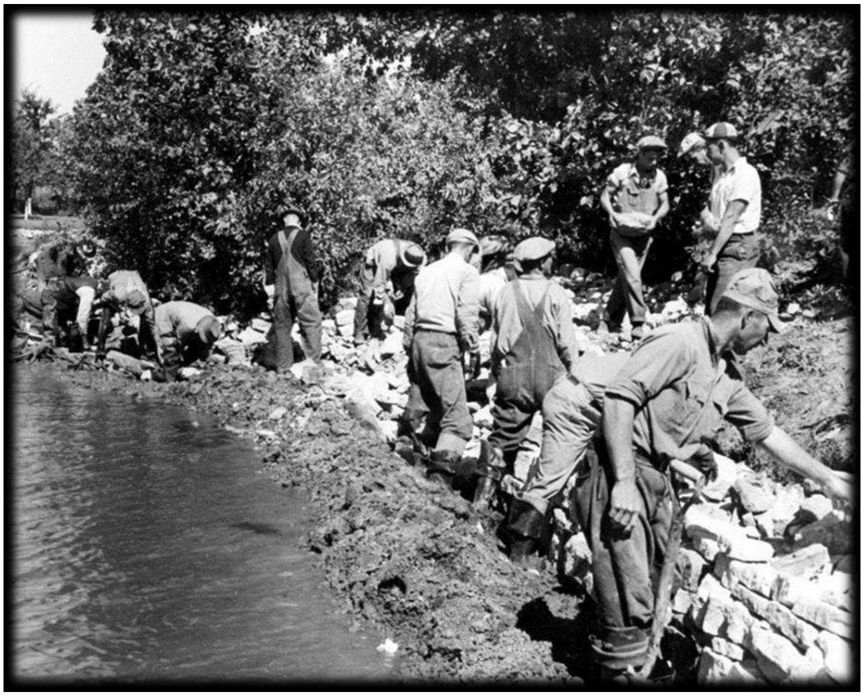
The stream channel of the pre-dam Sugar Creek (IL_EOA_04) was entrenched to a depth 10 feet below the valley floor, which was relatively flat and averaged about one-half mile wide. The original maximum depth of the Lake in the old stream channel at the dam was 35 feet, and the average depth on the valley bottom at the dam was 25 feet.

The Lake was constructed during the Great Depression and was followed by a drought during the Dust Bowl. Water did not flow over the spillway until May 2, 1935, eighteen months after the Lake's construction ended, marking the official completion date for Lake Springfield.

It took nearly 3,000 Civilian Conservation Corps workers three years; laboring six days a week for a 50 cent-an-hour wage, to help build bridges and roads, and dam construction, along with riprap placement, tree clearing and replanting.

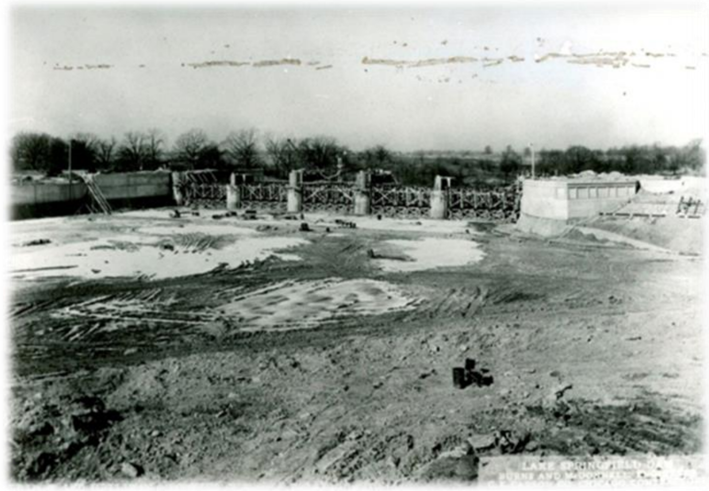
Spaulding Dam, named after Willis Spaulding, Springfield's first Commissioner of Public Property, is 1,900 feet in length and includes 1,600 feet of embankment and 300 feet of spillway, stretching in a northeast to southwest direction across the Sugar Creek valley.

When Lake Springfield (IL_REF) was completed in 1935, it encompassed 4,300 acres with a storage capacity of approximately 59,900 acre-feet or 20 billion gallons (Bogner, 1977). The Lake measured approximately 12 miles in length, averaged one-half mile wide and was two miles across at its widest point. The average depth of the entire Lake was 14.4 feet (Fitzpatrick, et al., 1985).



Civilian Corps Workers Riprap Lake Springfield Shoreline in 1933

Horse-Drawn Wagons Used in Lake Springfield's Construction



Lake Springfield Spaulding Dam Construction

Spaulding Dam under Construction

Water Flows over Spaulding Dam Spillway May 2, 1935

1.7 Natural and Cultural Resources

Forestland in the watershed is primarily deciduous trees along the banks of its main tributaries[3]. Most species of the trees dominating areas around Lake Springfield did not occur historically, but were planted, many along the shores and steep areas of the Lake, when it was being built back in the 1930s.

Lincoln Memorial Gardens includes more than 100 acres of land with many tree and plant species only native to the states of Illinois, Indiana, and Kentucky planted as a unique living memorial to President Abraham Lincoln.

In addition to the 12.89-acre **Wildlife Sanctuary** located on Woodland Trail, the City of Springfield set aside 340 acres of wooded hills and marshy lowlands known as the **Lick Creek Wildlife Preserve** at the western-most end of Lake Springfield.

A privately-owned 40-acre tract in the Lick Creek greenway is the only example of old growth Chinquapin Oak and Sugar Maple forest in Sangamon County. Some natural community researchers have suggested that these two tree species, when occurring together in a grove-like setting, may have been planted by American Indians or early settlers.

Camp Widjiwagan Girl Scout campground has some of the oldest Chinquapin Oaks in Sangamon County, with some aged over 300 years old. (FOSV, 2004)

Glenwood Woods is approximately 75 acres north of Glenwood Middle School, primarily owned by CWLP and includes the best example of old growth White Oaks at the Lake. The Nature Conservancy (TNC) would describe the white oak savanna of Illinois as one of the rarest natural communities in the state. "This is definitely a white oak savanna relic that's right on the south side of the Lake."

Nipper Wildlife Sanctuary, established in 1992, is a 120-acre site southwest of Springfield near Loami which includes 100 acres of restored prairie with over 150 different species of flowers and plants, 20 acres of floodplain forest, and 8 acres of wetlands.

[3] According to the Inventory of Sangamon County Natural Areas (Friends of the Sangamon Valley, June 2004) and Sangamon County Regional Plan 2009 (SSCRPC, 2009) draft plan.

1.8 Sub-watersheds

The LSW is divided into seven United States Geological Survey (USGS) 12-digit Hydrologic Unit Code (HUC) sub-watersheds as shown in **Figure 1.7.1**. **Lower Lick Creek–Polecat Creek sub-watershed (HUC 071300070708),** being the largest, covers 36,023 acres and is located in the northwestern part of the LSW.

Second largest in size is **South Fork Lick Creek–Johns Creek sub-watershed (HUC 071300070704),** with 31,203 acres, is located in the west central part of the LSW, and is sandwiched between the Upper Lick Creek sub-watershed to the north and the Upper Sugar Creek to the south.

The **Upper Sugar Creek sub-watershed (HUC 071300070701)** covers 22,819 acres, and is the most southern sub-watershed in Sangamon County. It includes the entire portion in northern Macoupin County, along with a very small area of eastern Morgan County, which are located in the LSW. It includes the headwaters of Sugar Creek, which flows in a northeasterly direction to Lake Springfield.

The **Upper Lick Creek sub-watershed (HUC 071300070705)** encompasses 21,782 acres and is just north of the South Fork Lick Creek—Johns Creek sub-watershed and south of the Lower Lick Creek–Polecat Creek sub-watershed. It includes about one-half of the eastern Morgan County acres in the LSW. It includes headwater streams of Lick Creek.

The **Lake Springfield sub-watershed (HUC 0713070707)** encompassing 21,470 acres, which includes the 3,965-acre Lake Springfield, is located in the northeastern part of the LSW and includes most of the village of Chatham, portions of the village of Southern View and the southern part of Springfield, south of Stevenson Drive. The confluence of Sugar Creek from the south and Lick Creek from the west is just west of the I-55 Bridge at Lake Springfield.

The **Lower Sugar Creek sub-watershed (HUC 0713070703)** has 21,422 acres and is on the eastern side of the LSW, north of the Upper Sugar Creek sub-watershed and south of the Lake Springfield sub-watershed, is dissected north to south by Sugar Creek, which flows directly into Lake Springfield.

The **Panther Creek sub-watershed (HUC 0713070702)** covers 15,072 acres and is the smallest sub-watershed. It is surrounded by all of the LSW sub-watersheds except for Upper Lick Creek. Panther Creek flows north through this sub-watershed into Sugar Creek at the upper tip of the sub-watershed boundary.

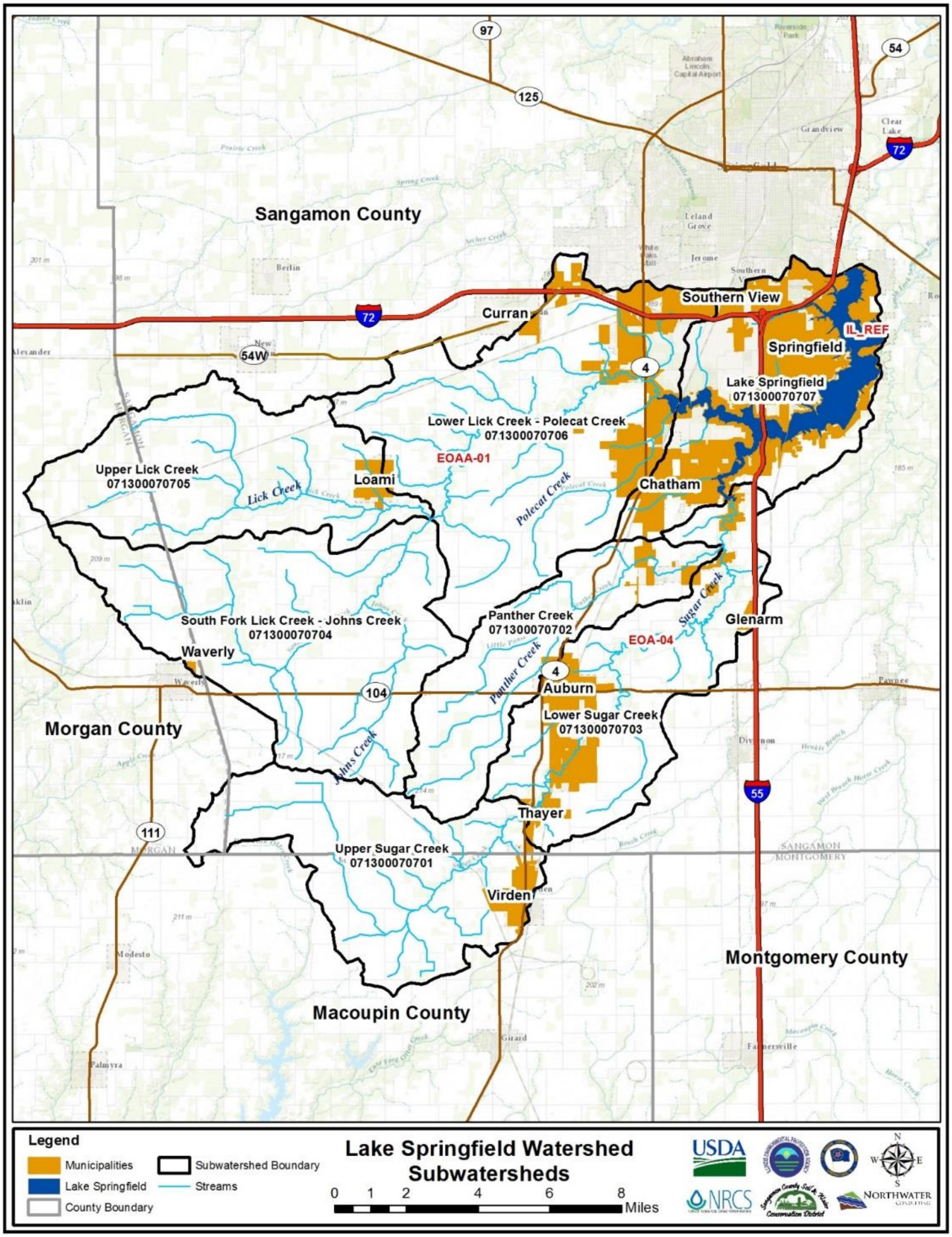


FIGURE 1.7.1 - SUB-WATERSHEDS WITH USGS HYDROLOGIC UNIT CODES (HUC)

1.9 Planning and Assessment Efforts

Lake Springfield has been the focus of conservation efforts by the CWLP since 1982. In 1990, following three years of dredging 3.2 million cubic yards of accumulated sediment from the upper reaches of Lake Springfield, the first LSWRPC was established and the first watershed-based resource plan was written.

It is important to recognize the historical planning and assessment efforts conducted within the watershed in order to inform current planning efforts, avoid duplication of efforts and to ensure a linkage with any future plans (Table 1.8.1). Several plans and reports have been completed for the watershed for the period 1990 to 2015, including local watershed and city/regional plans and numerous assessment reports**.** Key among these are the 2016 Lake Springfield and Sugar Creek Watershed Stage 3 TMDL document and CWLP's *"Land Use Plan for Lake Springfield and Its Marginal Properties",* adopted in 1991 and updated four times (1994, 2005, 2012 and 2014) to keep current sustainable guidelines for the development and preservation of lands surrounding Lake Springfield. (See also Section 1.10).

The existing TMDL provides an additional incentive to improve water quality degraded by nonpoint and point source pollutants in the watershed. The TMDL plan establishes numerical load reductions required to address stream and lake impairments. The LSWMP is directly tied to these targets. It establishes site-specific treatment practices required to reasonably achieve the needed load reductions within the watershed. The fact that a TMDL plan exists means the watershed is a higher priority for water quality improvement funds through state and federal government water quality programs.

Early reports and plans followed a similar structure as today's plan, focusing on identifying solutions to watershed and water quality problems. In each situation, planners and stakeholders identified watershed issues and made recommendations to alleviate quantifiable problems. Similar to today, many of the recommendations focused on a combination of education, land treatment and structural practices. What is interesting about the planning history for this watershed is that, over the years, little has changed in terms of what stakeholders perceive as problems.

Past planning efforts have identified many challenges facing Lake Springfield. These include:

- Soil erosion resulting in nutrient (phosphorus and nitrogen) losses from cropland surface
- Urban and farm runoff resulting in sedimentation of water bodies
- Runoff from farm fields that results in pesticide and nutrient loading to streams and lakes.

This 2017 LSWMP identifies where and which solutions are needed, along with the water quality benefits achieved as a result. After beginning early land treatment projects, many of the watershed issues, such as soil erosion, sedimentation and nutrient (phosphorus and nitrogen) losses from cropland surface water runoff, and runoff from farm field pesticides remain and many of the solutions are still very relevant. Regardless of the progress made to date in addressing watershed issues, these issues still do persist.

TABLE 1.8.1 - HISTORICAL PLANNING AND ASSESSMENT EFFORTS

Plan Name	Plan Year	Plan Purpose	Notes/Relevance
The Phase I Diagnostic/Feasibility Study report for Lake Springfield Restoration Plan	1987	To determine the Lake's long-term ability to function as the public water supply, as the cooling water source of electric generation facilities and as a recreational area for over 600,000 yearly recreational visits	Problem areas defined within the scope of this plan affecting degradation of Lake Springfield included: sedimentation, excessive aquatic vegetation, excess nutrients, shoreline erosion, rough forage fish populations increase, sport fish population decline, eroded soils carrying pesticide residuals and other agricultural chemicals into the Lake causing an advisory regarding consumption of some fish species.
Lake Springfield Watershed Resource Plan (1990)	1990	To maintain, enhance and improve the environmental conditions of Lake Springfield and the LSW	An NRCS-led process to address sedimentation and nutrient loading and identify resource concerns. Led to the formation of a planning committee that is still active today. The plan provides general watershed and lake characteristics and identifies resource concerns for both urban and agricultural areas. The plan outlines some strategies for addressing resource concerns, describes who is responsible and assigns a general timeline for action.
Lake Springfield Watershed Resource Plan Addendum	1995	To address the use of the corn herbicide atrazine, which cannot exceed 3 ppb in a public water supply's finished water	Five goals recommended: (1) develop model plans on 15 LSW farms; (2) use of alternate products to atrazine, pre-plant split applications of atrazine after April 1 nor more than 10 days prior to planting; (3) develop site-specific monitoring programs for atrazine movement; (4) encourage farmers of non-HEL to adopt half no-till system to reduce early season annual weeds and incorporate atrazine; and if no reasonable progress in goals 1-4, (5) petition IL Department of Agriculture (IDOA) to establish a regulation for restricted use of atrazine or other problem pesticides in the LSW, develop a surcharge for atrazine use, exempting farms with approved conservation plans. Last resort—ban atrazine use in LSW.

Plan Name	Plan Year	Plan Purpose	Notes/Relevance
Land Use Plan for Lake Springfield and Its Marginal Properties	1991 Revised in 1994, 2005, 2012 and 2014	To preserve the amenities of the Lake Springfield area by defining the uses and guiding the management of lake lands.	Three areas within the scope of this plan are: (1) water quality protection of Lake Springfield as the primary water supply for greater Springfield, (2) preservation of high quality sites for wildlife to prevent future degradation, and (3) responsible management of the Lake and its marginal lands as a residential community and a regional recreational area.
Lake Springfield Ecology and Management: A Leaseholder and Community Guide	1992	To provide historical information about Lake Springfield, lake ecology basics, and details of the lake's ecosystem and its ecosystem management.	An informational and educational guide for Lake Springfield leaseholders and the community on how they can help protect and preserve the integrity of Lake Springfield and its ecosystem on a daily basis.
Springfield Comprehensive Plan 2020	2000 with amendments up to 2007	To create a set of principles to guide growth	The plan provides direction on future land use in the City of Springfield. The plan specifically calls for the protection of Lake Springfield. "No industrial or commercial uses with the potential for pollutants, spills or heavy urban runoff should be located near Lake Springfield or its tributaries, and low density residential uses, served by all public utilities, should be encouraged in order to reduce runoff."
Springfield Strategy 2020	2000	Provide a vision for the future of Springfield	The strategy describes a general vision for Springfield in 2020. Although there is little in the plan specific to Lake Springfield and its watershed, the document does specifically mention enhancing natural resources and eliminating septic systems.
Sangamon County Regional Strategic Plan	2014	To create a compelling vision for the region's long-term growth and development - a vision that builds on significant assets and the opportunities the region offers for strengthening the region's economic vitality and overall quality of life.	Although there is very little in the strategic plan regarding Lake Springfield and its watershed, the document does highlight a general strategy to protect and enhance the region's lakes focusing on enhancing recreation and improving quality of life.

Plan Name	Plan Year	Plan Purpose	Notes/Relevance
Lake Springfield Watershed Total Maximum Daily Load (TMDL) Study **Stage 1 Report**	2014	To establish percentage load reductions for Boron and Phosphorus in Sugar Creek, sedimentation/siltation in Hoover Branch, and total phosphorus and total suspended solids for Lake Springfield	The Stage 1 report characterizes the watershed and tributaries and provides model recommendations for the TMDL to be developed in Stage 3. The Stage 3 report and TMDL is currently underway. The most important thing about a TMDL is that once in place, the assessed waterbody will receive priority for funding. A TMDL study is a mechanism to secure watershed improvement project funding.
Illinois Nutrient Loss Reduction Strategy	2015	To establish milestones for meeting the reductions in nitrogen and phosphorus necessary to eliminate the hypoxia zone in the Gulf of Mexico	The Lake Springfield Watershed is one of the "Keep It for the Crop" (KIC) priority watersheds selected, based on it being a public water supply and having a current watershed-based plan.

1.10 Watershed Successes

In 1995, an addendum to the original LSW Plan was adopted to address pesticide runoff. Atrazine was the preferred herbicide of use because it was the most effective weed control herbicide available for corn and the most economical. At that time, the LSW was approximately a 50/50 split on corn and soybean acres and the majority of farms were under 50/50 crop-share lease arrangements between landowners and their tenants.

The following action items adopted by LSW producers, with great cooperation from the local agricultural retailers, helped the City achieve compliance with IEPA's drinking water standards:

- Implementation of a two-pass atrazine application program.
- Reduction in rates of any single atrazine application.
- Incorporation of alternative herbicides for corn acres.
- Establishment of buffer strips.
- Adoption of no-till and/or minimum till farming practices.

As a result, the City's annual costs for removing atrazine with powdered activated carbon (PAC) from the raw water were reduced from $143,000 in 1994 to four consecutive years of $0 from 2004-2007. There were slight increases in atrazine concentrations from 2008 to 2011, primarily due to consecutive extremely wet years, a sizeable increase in corn-on-corn acreage, versus the traditional 50 percent corn/soybean rotation, and a significant increase in the cost of PAC. In 2012, there were zero dollars spent by CWLP to treat for atrazine. In 2013, this cost was $137,000 due to another extremely wet spring shortly after most of the herbicides had been applied to the corn fields.

1.11 Chronological Review of Planning Efforts and Accomplishments

The following chronological review of planning efforts and accomplishments provides an overview of what has transpired over the last 80 years, with respect to point and nonpoint source issues affecting the water quality in Lake Springfield and its watershed.

1935 – May 2, 1935, marked the final construction date of Lake Springfield, when water finally flowed over Spaulding Dam. The Lake was to serve as the public drinking water supply for the City of Springfield and several surrounding communities, as well as the source of condenser cooling water for the City's coal-fired power plant complex.

1948 – The first sedimentation survey of Lake Springfield was made from July through August 1948 in a cooperative study by the Illinois State Water Survey, USDA Soil Conservation Service and City of Springfield, City Water, Light and Power (CWLP). Three additional sedimentation surveys of Lake Springfield (1965, 1977, and 1984) were conducted by the Illinois State Water Survey. By 1948, the original storage capacity of the lake had been reduced to 19.6 billion gallons, a 4.36 percent total loss or 0.30 percent loss per year. The sedimentation accumulation in the reservoir represents an average rate of sediment production from the watershed amounting to 48.0 cubic feet or 1.03 tons per acre per year.

1965 – A reconnaissance survey of the Lake indicated a reduction in the rate of sedimentation from 1948 to 1965. An annual capacity loss of 0.17 percent per year was just over half that of the previous period from 1935 to 1948 and was attributed to the drought of the 1950s, which lowered the lake level as much as 12 feet, resulting in drying and compaction of the sediment. During this period, 98,368 tons of sediment (5,786 tons per year) had accumulated in the reservoir.

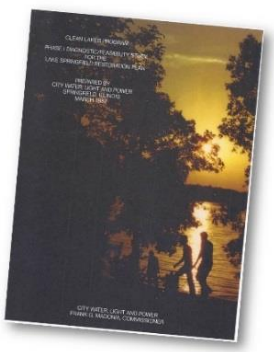
1977 - The 1977 sedimentation survey was conducted by the Illinois State Water Survey (ISWS) as part of a research grant from the Illinois Institute for Environmental Quality for the express purpose of evaluating nonpoint pollution sources of surface waters. Detailed analyses of watershed erosion rates were made using the Universal Soil Loss Equation (USLE). The results of this survey showed that sedimentation rates in the Lake had decreased slightly from 1965 to 1977, with the sedimentation rate being 0.29 percent per year, compared to a rate of 0.30 percent for the period 1934 to 1948. Total accumulated sediment from 1934 to 1977 was 7,561 acre-feet, with an average unit weight density of 39.0 pounds per cubic foot.

1982 - CWLP began its Lake Springfield Maintenance and Restoration Program (LSMRP):

- To remove sediment from the Lake.
- To provide shoreline stabilization.
- For watershed protection (to keep soil and excess nutrients from reaching the Lake).

1983 – CWLP began providing cost-share funds to the SCSWCD for conservation to reduce erosion and improve water quality in the LSW through their LSMRP. It began with the purchase of a no-till corn planter, and subsequently a no-till drill for watershed farmers to rent before investing in this expensive equipment for their farming operations. Within a few years, many farmers made the switch to no-till/minimum till equipment and this equipment-rental program was no longer needed. This cost-share program then evolved to establishment of conservation practices such as grass waterways, terraces, grade stabilization structures, dry dams, water and sediment control basins (WASCOBs) and ponds, along with stream bank stabilization, which continues to this day. Over $500,000 in assistance from CWLP has been made available to watershed producers for these conservation practices over the past 30 years and is administered by the SCSWCD under the same guidelines as the State of Illinois' Conservation Practices Program (CPP).

1984 – By 1984, 13 percent of the Lake's original capacity had filled in with 7,700 acre-feet (6.5 million tons of sediment) resulting in nearly one-half billion gallons of lost storage capacity, according to the ISWS' 1984 sedimentation survey. Lake Springfield had a reduced storage capacity of 52,200 acre-feet (17 billion gallons). On the average, Lake Springfield had lost 0.26 percent of its storage capacity annually from 1934 to 1984, which is well below the average of 0.47 per cent per year for large Illinois reservoirs



1987 – The Phase I Diagnostic/Feasibility Study report for Lake Springfield identified sedimentation, nutrients and shoreline erosion as major issues for the Lake and its watershed. The 3-phase lake restoration program initiated by CWLP to address these problems included:

- Establishment of a soil conservation grant program in the LSW (watershed conservation practices).
- Sediment removal from the Lake by hydraulic dredging.
- Shoreline stabilization around the Lake.

1986 – 2016 – Over 21 miles of the Lake's 57 miles of shoreline, and the islands, had been stabilized with riprap protection. Lake home owners spent over $7 million on steel seawalls and other methods of stabilization to protect 22 miles of their residential shorelines. City Water Light & Power (CWLP) maintains a database and has calculated a total of 57 miles (300,960 feet) of total lake shoreline, 43 miles (225,724 feet) of which are considered protected and 14 miles (75,240 feet) are considered natural.

1987 – 1990 - The City spent $7.8 million on a lake dredging project which:

- Removed 3.2 million cubic yards of sediment from the upper reaches of the Sugar Creek and Lick Creek arms of Lake Springfield, west of the I-55 Bridge.
- Re-established natural sedimentation basins of the Lake.
- Re-claimed approximately 652 million gallons of lost storage capacity.

1990 - The Lake Springfield Watershed Resource Planning Committee (LSWRPC) was formed to address the sedimentation of Lake Springfield as its primary resource concern, followed by nutrient concerns (phosphorus and nitrogen). There was little mention of pesticide use, only concerns about the persistence of those historically-used pesticides and their breakdown products (dieldrin, chloradane and heptachlor epoxide). This group's goal was to develop and apply a comprehensive resource management plan, involving both agricultural and urban communities, which would provide a framework for the protection and improvement of the water quality in Lake Springfield and its watershed. This plan has served as the guide for implementation of BMPs throughout the LSW.

1991 – ***Land Use Plan for Lake Springfield and Its Marginal Properties,*** approved by Springfield's City Council members in 1991, was revised in 1994, 2005 and again in 2012 and 2014 to keep current the defined uses and guidance for the management of Lake lands and its marginal lands. This plan provides for five land use categories: administrative, leased, parks and recreational, green space and wildlife preserves. Each category has a specific list of activities which are allowed. CWLP limits development around the Lake and dedicates unleased lands for public uses such as green spaces and natural areas. The guidelines developed in this plan are based on CWLP's priorities in order of importance:

1. Protection of the quality of the water.
2. Retention of the storage capacity of the lake.
3. Preservation of the aesthetics and the unique character of the lake and its environs.
4. Provision of residential and recreational opportunities.

1994 - There was a near violation of IEPA's drinking water requirement of an average running quarterly atrazine concentration of 3 ppb or less in the finished water supply of drinking water for the City of Springfield and its customers.

1995 – An addendum to the original LSW Plan was adopted to address pesticide runoff in the LSW. Atrazine was the preferred herbicide of use because it was the most effective weed control herbicide available for corn and the most economical. At that time, the LSW was approximately a 50/50 split on corn and soybean acres and the majority of farms were under 50/50 crop-share lease arrangements between landowners and their tenants. The following action items adopted by LSW producers, with great cooperation from the local agricultural retailers, helped the City achieve compliance with IEPA's drinking water standards by :

- Implementation of a two-pass atrazine application program.
- Reduction in rates of any single atrazine application.
- Incorporation of alternative herbicides for corn acres.
- Establishment of buffer strips.
- Adoption of no-till and/or minimum till farming practices

1995 – Through a Section 319 grant awarded to the SCSWCD, urban erosion control practices were established in a new subdivision (Piper Glen) in the LSW. The target audience for this demonstration project included real estate developers, land contractors, home builders, home owners and the general public. Urban erosion control products, such as erosion control blankets, silt fence, critical area/temporary seedings, etc., were installed to demonstrate proper installation, how these practices function, and the importance of having them in place on sites at all times prior to, during and after construction of new homes when developing new subdivisions.

1997 – A 5-year field-scale research study "Assessment of Best Management Practices' Effectiveness on Water Quality and Agronomic Production in the Lake Springfield Watershed" began in order to:

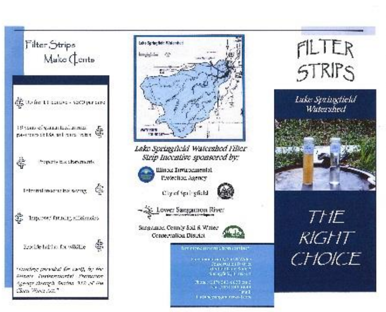
- conduct long-term research assessing BMPs on an entire watershed,
- document the effectiveness of specific BMPs for improving surface water quality and
- identify BMPs which significantly reduce movement of sediment, pesticides and nutrients from agricultural fields.

Partners in this study included: USDA Agricultural Research Service (USDA-ARS), Novartis Crop Protection, Inc. (now Syngenta), USDA Natural Resources Conservation Service (NRCS), IL State Water Survey, University of IL Extension (UIE), CWLP, LSWRPC and the SCSWCD. Results from this study identified vegetative buffer strips and no-till farming to be the most effective BMPs in reducing soil erosion, pesticide and nutrient movement through surface water runoff from agricultural fields.

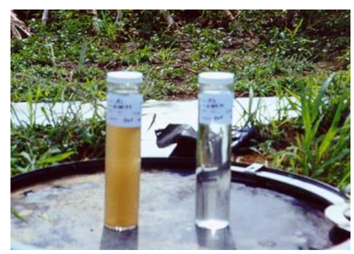
2000 – The USDA Conservation Reserve Enhancement Program (CREP) was approved for portions of 16 counties in Lower Sangamon River Basin, including all of Sangamon County and portions of Macoupin County in the LSW. This program provided significant financial incentives to landowners for taking cropland located in the 100-year floodplain, along with qualifying adjacent acres, out of production. In return, the landowners must establish conservation practices which will reduce soil erosion and surface water runoff (native grasses, shrubs, trees, etc.), while providing quality habitat for wildlife. These CREP contracts were for a minimum of 15 years. There were about 92 CREP contracts in the LSW, in addition to another 173 Conservation Reserve Program (CRP) contracts as of April 2014.

2000 – The SCSWCD formed The Sangamon Conservancy Trust (SCT), an IRS-approved 501(c)(3) not-for-profit charitable organization, whose goals mirror those of the SCSWCD to reduce soil erosion and improve water quality. The SCT

can apply for and administer grants, accept and hold conservation easements, implement BMPs not funded through current programs, fund special conservation education programs, promote land stewardship and farmland protection, and conserve soil, water and related resources. This Trust currently holds eleven permanent agricultural conservation easements on 4,030 acres. Two of those easements (635 acres) are in the LSW and are protected from residential, commercial and industrial development forever. One of these easements (113 acres) is immediately adjacent to Lake Springfield and was taken out of crop production by the landowner and planted to native grasses and trees. The other agricultural conservation easement (522 acres as of 2017) is in a prime development area of the LSW. These landowners are excellent stewards of their land and have established many conservation practices such as grade stabilization structures, grassed waterways, riparian buffers, and field borders on their farms.



2003 – With the 5-year BMP research study results in hand (see 1997 on previous page), the SCSWCD applied and received a Section 319 grant (40% match from City of Springfield) to establish vegetative filter strips throughout the LSW. A $200/acre incentive payment was awarded to landowners who established these filter strips through the USDA CRP program for a minimum of 15 years, instead of a normal 10-year CRP contract. Twenty-nine miles of unprotected stream corridors were protected under 75 CRP contracts, with landowners establishing about 600 acres of filter strips. Estimated total annual pollutant loadings were reduced by approximately 6,500 tons of sediment, 8,700 pounds of phosphorus and 18,000 pounds of nitrogen. Almost 200 acres of these filter strips were along Sugar Creek, with a reduction of approximately 1,934 tons of sediment, 2,688 pounds of phosphorus, and 5,316 pounds of nitrogen.



2004 - The most recent sedimentation survey of Lake Springfield was conducted by the CWLP, Land and Water Resources Department, (Daniel L. Brill, Thomas M. Skelly, September 2007) indicating a 7-percent decline in the erosion rate over the period 1984 to 2004. With a primary focus on erosion prevention through numerous federal, state and local cost-share programs, grants and research projects to demonstrate and effectively practice erosion control, LSW producers continue to incorporate BMPs into their farm operations which have been instrumental in reducing the erosion rate to the Lake.

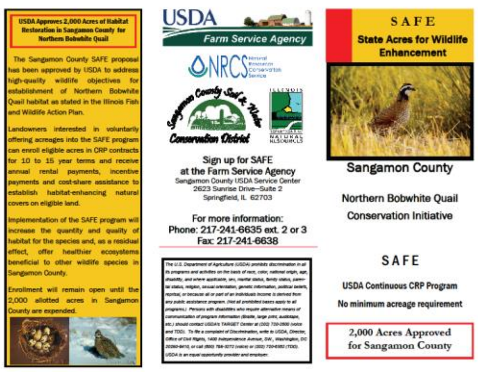
TABLE 1.10.1 - LAKE SPRINGFIELD SEDIMENTATION SURVEYS

Year	1934	1984	2004
Surface Area	4,234 acres	4,040 acres	4,044 acres
Maximum Depth	35 feet	29 feet	25 feet
Average Depth	14.4 feet	12.5 feet	13.4 feet

Year	1934	1984	2004
Volume/Feet	59,500 acre-feet	52,180 acre-feet	51,246 acre-feet
Volume/Gallons	19.5 billion gallons	17.5 billion gallons	16.7 billion gallons

2004 – 2007 - CWLP's annual costs for removing atrazine with powdered activated carbon (PAC) from the raw water were drastically reduced from $143,000 in 1994 to four consecutive years of zero dollars from 2004 to 2007. There were slight increases in atrazine concentrations from 2008 to 2011 primarily due to consecutive extremely wet years, a sizeable increase in continuous corn acreage, versus the traditional 50 percent corn/soybean rotation, and a significant increase in the cost of PAC. In 2012, there were zero dollars spent by CWLP to treat for atrazine.

2008 – USDA approved a special grant submitted by the SCSWCD entitled "Northern Bobwhite Conservation Quail Initiative" through the USDA State Acres for Wildlife Enhancement (SAFE).



This CRP program enabled Sangamon County landowners to establish wildlife habitat on 2,000 acres with grassland and forest practices (buffers, trees and grasses) to benefit quail and many other grassland species, some of them on the State-listed threatened species. The target area for this grant was the LSW, where three wildlife "sanctuaries" exist. SAFE is an additional tool for landowners to help protect Springfield's public water supply. There were about 20 SAFE contracts enrolled in this USDA program in the LSW as of April, 2014.

2008 –Through a "Protecting Water Quality in Urban Centers of Illinois" Section 319 grant, the SCSWCD hosted an Urban Water Quality Best Management Practices Tour on September 25, 2008 for key community leaders from Springfield and Sangamon County, representing the Mayor of Springfield, Sangamon County Board, City of Springfield Aldermen, Springfield-Sangamon County Regional Planning Commission (SSCRPC), Sangamon County Highway and Public Health Departments, Springfield Area Home Builders Association, CWLP and Public Works Department, along with federal and state agency personnel. A Certified Professional in Erosion and Sediment Control (CPESC) was the keynote speaker on this tour, discussing and demonstrating urban erosion control practices and the federal/state National Pollutant Discharge Elimination System (NPDES) rules and regulations for Municipal Separate Storm Sewer System 4 (MS4) communities such as Springfield and Sangamon County at each of the stops on the tour.

2008 - *The Sangamon County Sediment and Erosion Control Ordinance* was approved by the Sangamon County Board on December 9, 2008, and amended on March 20, 2009, and effective immediately to address comments received from the Springfield Area Home Builders Association. *https://www.municode.com/library/**il/sangamon_county***

2012 - On March 6, 2012, the City of Springfield amended *The 1988 City of Springfield Code of Ordinances*, by adding Chapter 154: Erosion Control Regulations. *https://www.municode.com/library/**il/springfield**/.../code_of_**ordinances***

2012 –The LSWRPC began work on a revision to its original 1990 LSW plan to reflect the most accurate watershed data, maps and land use changes now available through the use of GIS technology to identify existing and new agricultural and urban resource issues and to prepare a new comprehensive management plan involving both the agricultural and urban communities.

Over 60 people (farmers, fertilizer/chemical retailers, Lake home owners, college instructors, conservation land contractors, farm managers and federal, state and local government representatives) have been involved with this new planning effort. Twenty agricultural issues and 17 urban issues were identified by the LSWRPC, many of them the same as those identified in the 1990 LSW plan. Development and implementation of specific strategies to find solutions for the identified resource issues remains the task of the LSWRPC as it was back in 1990.

2013 –Springfield was awarded a Priority Lake and Watershed Improvement Project (PLWIP)

LAKE SPRINGFIELD SHORELINE STABILIZATION PROJECT

The City of Springfield has been awarded a $175,000 Priority Lake and Watershed Improvement Project grant by the Illinois Environmental Protection Agency to help reduce sediment run-off into Lake Springfield. The project will involve installation of approximately 2,500 tons of rip rap to stabilize 2,200 feet of previously unprotected, severely eroded shoreline. Work began the week of June 17 and will be completed by the end of July.

The installation, which uses a breakwater technique that has proven very successful in other Illinois reservoirs, will take place in the area of the confluence of Lick and Sugar Creeks, and will include a 500-foot section along the west side of the I-55 bridge and a 1,700-foot section along the Wildlife Sanctuary and Boy Scout Camp shoreline.

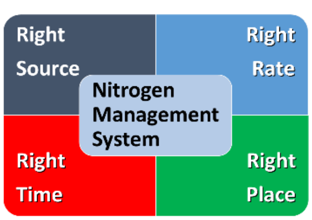
While the Lick and Sugar Creek basins comprise only 13% of the lake water storage capacity, this area traps over 50% of the incoming sediment. Stabilizing this section of shoreline not only will reduce sedimentation in the lake, it will slow phosphorous influx and provide an improved habitat for fish and other aquatic organisms.

The contractor selected for this project is CHAT, Ltd./Macoupin Boat Service from Good Hope, Illinois. In the past 19 years this company has placed over 180,000 tons of rip rap on 37 Midwestern Lakes. A special barge to install the rip rap.

June 27-July 3, 2013 | Illinois Times

grant from IEPA to help reduce sediment runoff and nutrient loading into the Lake. Riprap was installed on 2,756 feet of highly visible, highly eroded Lake Springfield shoreline at the confluence of Lick and Sugar Creeks, which traps over 50% of the incoming sediment to the Lake. This project reduced phosphorus loading by 453 pounds, nitrogen by 904 pounds and sediment load reduction by 453 tons per year.

2013 – A special 3-year nitrogen management program and study began through a partnership with the IL Council on Best Management Practices (C-BMP), City of Springfield, CWLP, SCSWCD,



Lincoln Land Community College (LLCC), local agriculture retailers and LSW producers to reduce the nitrate-N concentration in Lake Springfield. The goal of this project was to maintain the nitrate-N concentration in Lake Springfield at 50% below IEPA's drinking water standard of 10 ppm throughout the year. This study worked with local agriculture retailers and producers to identify nitrate-N levels in their crop fields and show them how to **m**inimize environmental impact, **o**ptimize harvest yield and **m**aximize input utilization (M.O.M.) through a multiple application approach to N management utilizing the 4Rs of nutrient management (Right source, Right rate, Right time and Right place) in order to minimize the risk of N loss prior to crop utilization.

Three years of cover crop establishment by LSW producers for nitrogen fixation, soil erosion control and other water quality benefits were also a big part of this project. Lincoln Land Community College has provided their farmland as an educational demonstration farm for several agricultural BMPs (bioreactor, cover crops, grade stabilization structure, sediment basin, and grassed waterways), along with a tile system with water quality monitoring equipment. Funding sources for this project were provided by the National Fish and Wildlife Foundation (NFWF) and CWLP.

2013 – A Lake Springfield Watershed BMP Implementation Section 319 grant proposal (3191415) was submitted and approved by IEPA for the implementation of agricultural and urban BMPs throughout the LSW and development of a new USEPA nine-element watershed-based plan. This project focused on implementation of recommendations from the 1990 LSW Resource Plan 2012 Revision and the 1987 Lake Springfield Diagnostic Feasibility Study to improve the water quality of Lake Springfield and its watershed by:

- Reducing nonpoint source pollution.
- Controlling soil erosion.
- Reducing nutrient and sediment loadings.

While the Sugar Creek (EOA_04) portion of the LSW has been on EPA's 303(d) list since 1994 for total phosphorus and is a primary target area, BMPs are being implemented throughout the entire watershed. NRCS technical staff assisted with inventory and evaluation, survey, and design of agricultural BMPs. The C-BMP and local agriculture retailers work with LSW producers to develop and implement nitrogen management systems utilizing the N-WATCH program and establishment of cover crops. Nutrient management plans and additional cover crops are important BMPs in this grant which address two of the sources of impairments (nitrate N and phosphorus).

2013 – An IL Green Infrastructure Grant (IGIG) grant proposal was submitted to IEPA for urban BMPs at the Ball-Chatham School District #5 Middle School complex. This school complex is immediately adjacent to Lake Springfield. BMPs to be installed were porous pavement parking lots, dissipaters, bio-swales, and shoreline stabilization with rock riprap. While this grant was not approved for funding, a request by the SCSWCD to move the stormwater dissipaters' portion of the IGIG grant to the 2013 EPA 319 grant (3191415) was approved by IEPA.

2014 – The final Lake Springfield and Sugar Creek Watershed TMDL Stage 1 Report for five impaired water body segments of the LSW, including Lake Springfield (IL_REF), 3 segments of Sugar Creek (EOA_01, EOA_04 and EOA_06) and the Hoover Branch (EOA segment north of Spaulding Dam, was released by IEPA in October 2014. Potential causes of impairment identified were total phosphorus, boron, TSS, and sedimentation/siltation. The first draft TMDL

Stage 1 Report was made public at an informational meeting held on March 27, 2014. Personnel from the City of Springfield, CWLP and SCSWCD have taken an active role in reviewing the information in this report for completeness and accuracy and provided their comments to IEPA. This group will continue to work closely with IEPA throughout the TMDL development process and implementation planning.

2014 – CWLP received the 2014 prestigious top honors award in the Source Water Protection–Large System Category from the Illinois Section of the American Water Works Association (ISAWWA) for developing and implementing exemplary source water protection programs for Lake Springfield and for watershed protection of the LSW.

2015 – Illinois Nutrient Loss Reduction Strategy was released in July, 2015. The purpose of this strategy is the implementation of BMPs which will reduce the N and P loadings in the water bodies which ultimately flow into the Mississippi River down to the hypoxia zone in the Gulf of Mexico. The hypoxia zone is the low-oxygen area where excessive nutrient pollution from human activities, coupled with other factors, has depleted the oxygen required to support most marine life in bottom and near-bottom water, creating a dead zone. The LSW was selected as one of the Keep It for the Crop (KIC) priority watersheds since Lake Springfield serves as a public water supply. Phase 1 milestones are 15% in nitrogen reductions and 25% reduction in phosphorus by 2025. Illinois' ultimate reduction strategy goals for N and P are 45%. Of the 33 states whose waters flow into the Mississippi River, Illinois is the largest contributor of N and P. (USGS Sparrow Model)

USGS SPARROW MODEL

Total Nitrogen				Total Phosphorus			
State	Percent of Total Flux	Cumulative Percent of Total Flux	Delivered Yield (kg km^{-2} yr^{-1})	State	Percent of Total Flux	Cumulative Percent of Total Flux	Delivered Yield (kg km^{-2} yr^{-1})
Illinois	16.8	16.8	1734.9	Illinois	12.9	12.9	117.4
Iowa	11.3	28.1	1167.2	Missouri	12.1	25.0	89.4
Indiana	10.1	38.2	1806.6	Iowa	9.8	34.8	89.2
Missouri	9.6	47.8	800.5	Arkansas	9.6	44.4	94.6
Arkansas	6.9	54.7	750.1	Kentucky	9.0	53.4	113.4

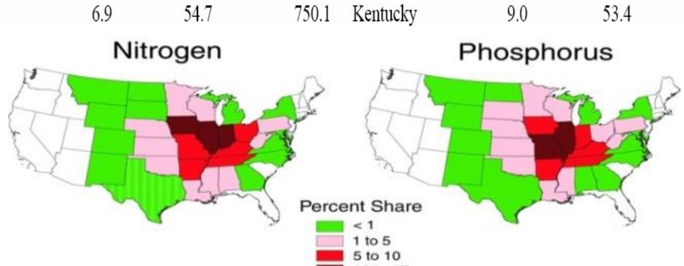


Figure 1.10.1 - USGS Sparrow Model for Nitrogen and Phosphorus

2015 – **Don't P on My Lawn** – An informational meeting for Lake Springfield homeowners was held to inform and educate them about the detrimental effects of using fertilizers containing phosphorus on their lawns around the Lake.

2016 – On March 1, 2016, the LSWRPC was awarded the 2016 Dick Hilton Watershed Stewardship Award by the Illinois Lake Management Association (ILMA) for their "significant contribution to stewardship of Illinois waters".

2016 – In July, 2016 the first draft of the Lake Springfield and Sugar Creek Watershed TMDL Stage 3 Report was sent to CWLP for review and comment, prior to its release for public comments (final report expected in 2017). This report included the BMP recommendations for phosphorus, TSS, and aquatic algae. BMPs recommended in this report for pollutant load reductions are being incorporated in this watershed-based plan.

2.0 Plan Purpose and Participation

2 PLAN PURPOSE AND PARTICIPATION

2.1 Plan Purpose

The purpose of this plan is provide the framework for the protection and integrity of Lake Springfield (IL_REF), its tributaries and the natural resources in this watershed for today and for years to come. This watershed-based plan addresses all types of point and nonpoint source pollution affecting the quality of the water entering Lake Springfield in an ongoing effort of its stakeholders to find voluntary solutions for improving water quality and protecting the natural resources. It also provides an in-depth analysis of the agriculture and urban dynamics affecting the water quality of Lake Springfield and its watershed caused by both point and nonpoint pollution.

2.2 Mission Statement

The mission of the Lake Springfield Watershed Resource Planning Committee (LSWRPC) is to enhance and protect the water quality and natural resources of Lake Springfield and its watershed. The LSWRPC consists of a group of stakeholders committed to fulfilling this mission by identifying both point and nonpoint source pollutants and seeking solutions for reducing their effect on the quality of water entering Lake Springfield and its tributaries.

Its vision is to look at all point and nonpoint sources impacting the LSW and to develop a watershed-based management plan for the LSW to serve as a guide for implementing strategies which meet the goals, objectives, and intended successful outcomes now and into the future.

2.3 Lake Springfield Watershed Resource Planning Initiative (1990)

The Sangamon County Soil and Water Conservation District (SCSWCD) initiated the first resource planning process for the Lake Springfield Watershed in 1990, with guidance from the Natural Resources Conservation Service of the US Department of Agriculture (NRCS). The City of Springfield had just completed a three-year, $7.8 million dredging project removing 3.2 million cubic yards (7,700 acre-feet) of sediment from the upper reaches of Lake Springfield, which represented a 13 percent loss of capacity since it was built in 1935. With the substantial sedimentation problem identified, the SCSWCD realized the importance of taking the lead role to come up with a plan that would address this problem and other resource concerns affecting the Lake, its feeder streams, and this watershed area.

Input and feedback from the public were imperative to the successful development of this watershed-based plan. Because these local watershed stakeholders were directly affected by the problems, they were the ones who needed to identify the resource problems, develop the strategies, and come up with solutions to the resource concerns.

Eighteen stakeholders from this area were invited to serve on the Lake Springfield Watershed Resource Planning Committee (LSWRPC). The objective of the LSWRPC was to maintain, enhance, and improve the environmental conditions of Lake Springfield and its watershed. The group's goal was to develop and apply a comprehensive resource management plan, involving both agricultural and urban communities, which would provide a framework for the protection and improvement of the water quality in Lake Springfield and its watershed. This plan has served as the guide for implementation of BMPs throughout the LSW for the past 27 years.

Their organizational meeting was held on September 19, 1990, at Lincoln Land Community College. The committee members, representing a variety of interests, resource concerns and different backgrounds, included farmers, conservation contractors, farm owners, Lake homeowner association members, a farm manager, the Mayor of Springfield, CWLP officials, a sportsman, a county board member, an educator, a Regional Planning Commission member and a radio broadcaster. Dick Lyons was elected to serve as the Chairman of this group and continues to serve in that capacity.

TABLE 2.3.2 – 1990 LAKE SPRINGFIELD WATERSHED RESOURCE PLANNING COMMITTEE

1990 Lake Springfield Watershed Resource Planning Committee	
Carl Anderson – Conservation Contractor	Lloyd Leheney –Lake Shore Improvement Association
Paul Briney – Farmowner, sportsman	Ossie Langfelder – Mayor of Springfield, IL
Bill Clark – County Board member, retired farmer	John Wilcox –Sangamon County SWCD Chairman
Don Skinner – Farmer, Lick Creek Steering Committee	Peggy Kaye Fish – Farm radio broadcaster
Randy Armstrong – Regional Planning Committee	Charles Tomlinson - Lake Shore Improvement Assoc.
Dr. John Harris – Farmer, Doctor	Dick Lyons –Lincoln Land Community College instructor
Ted Megginson – Farmer, Lick Creek Steering Committee	Dan Beccue – Farm manager
Patty Simpson – CPA, Sangamon County Farm Bureau	Lynn Frasco - CWLP
Tim Seifert – Watershed farmer	Tom Skelly - CWLP

The concerns identified by the LSWRPC in 1990, as shown in Table 2.3.2, addressed the sedimentation of Lake Springfield as its primary resource concern, followed by nutrient concerns (phosphorus and nitrogen). During this watershed planning effort, there was little mention of pesticide use, only concerns about the persistence of those historically-used pesticides and their breakdown products (dieldrin, chloradane and heptachlor epoxide).

TABLE 3.3.2 – 1990 LSWRPC MEETING RESOURCE CONCERNS IDENTIFIED

Resource Concerns	Identified Issues
Erosion	• From construction • Rip-rap • Lack of winter cover • More no-till • Plant trees
Sedimentation	• Soil loss – sediment accumulation • Sediment collection points • Water level • Silt trap
Water Quality	• Pesticides • Nitrogen and Phosphorous in lake • Wells • Water contamination of private homes (septic systems) • Prevent urban run-off (asphalt) • Underground water control
Urban Concerns	• Need for additional education for Lake residents/users about urban erosion and resource concerns • Control development around the Lake • Underground water control • Erosion from construction
Ag Concerns	• Soil loss • Lack of winter cover • Erosion control • Wildlife habitat • More no-till • Pesticides • Nitrogen and phosphorus • Plant trees • Timely application of fertilizers
Economics	• Budget to do adequate job • Where will funding come from
Communications	• Maintain dialogue between all concerned • Maintain database to track performance (water quality and siltation)
Wildlife Habitat	• Plant trees • Winter cover • Pesticides

Three sub-committees were formed to address these concerns:

- **Agriculture** – concentrated on cropland in the watershed
- **Sedimentation and water quality** – focused on the watershed floodplain and the Lake itself
- **Urban** – looked at direct tributaries feeding into the Lake and developed areas draining into Lake Springfield

Some of the suggested strategies required more detailed information to assess the environmental implications and costs/benefits. In order to assist the resource planning committee in evaluating these strategies, a technical advisory committee was appointed. Members of the committee helped formulate possible strategies for the resource planning committee to consider.

TABLE 2.3.4 – 1990 TECHNICAL ADVISORY COMMITTEE

1990 Technical Advisory Committee	
Mike Andreas, USDA Soil Conservation Service	Randy Armstrong, Regional Planning Committee
Roy Bailey, USDA Soil Conservation Service	Greg Good, IL EPA
Tom Skelly, CWLP	Tom Hornshaw, IL EPA
Debbie Scott, Department of Conservation	Dan Towery, USDA Soil Conservation Service
Rich Berning, City of Springfield	Bill White, Department of Conservation
Vince Smith, City of Springfield	Elmer Rankin, U of I County Extension Service
Ming Lee, IL State Water Survey	Mike Tierstrip, IL State Water Survey

2.4 Lake Springfield Watershed Resource Planning Initiative (2012)

In 2012, the LSWRPC began work on a revision to its original 1990 LSW plan to reflect the most accurate watershed data, maps and land use changes now available through the use of GIS technology to identify existing and new agricultural and urban resource issues and to prepare a new comprehensive management plan involving both the agricultural and urban communities.

This group had not met on a regular basis for about five years. There were 41 stakeholders in attendance at the initial meeting on January 26, 2012, which included representatives from CWLP, IL Environmental Protection Agency, USDA Natural Resources Conservation Service (NRCS), IL Department of Agriculture (IDOA), Sangamon County Board, Springfield Lake Shore Improvement Association (SLSIA), The Sangamon Conservancy Trust (SCT), Lincoln Land Community College (LLCC), farm management firms Agrivest, Inc., Farmers National Company, Myers-Rice Land Services, local agricultural retailers: BRANDT, Lincoln Land FS (now Prairieland FS), M & M Service, land contractors Fraase Excavating, 4N Lawn Care, LSW agribusiness Springfield Plastics, Inc., twelve (12) Lake Springfield Watershed producers/landowners, SC SWCD staff and project coordinator of the LSW BMP Research Project (1997–2002) and also the EPA 319 Grant Filter Strip Project Manager (2003–2005).

This meeting included an update on the LSW since 2006, a discussion of previous and new resource concerns in the watershed, information from IEPA on its present and future focus on watershed issues, information about federal, state and local conservation programs currently available for LSW producers, and a discussion on strategic planning for the future.

LSWRPC meeting minutes from nineteen (19) meetings held over the 5-year period from 2012 through 2016 are available by contacting the SCSWCD.

LAKE SPRINGFIELD WATERSHED PUBLIC MEETING - JUNE 10, 2015

TABLE 2.4.1 – 2015 LAKE SPRINGFIELD WATERSHED RESOURCE PLANNING COMMITTEE

2015 Lake Springfield Watershed Planning Committee	
Allen, Josh – Ag retailer, BRANDT	Kopp, Dennis – Agronomist/Dowson Farms
Bailey, Alan SCSWCD Chairman	Krueger, Jessica – Springfield Plastics
Baker, Steve – Springfield Plastics	Kuhlmann, Chad – Ag retailer, Prairieland FS
Breckenridge, Richard – IEPA	Leach, Roger – Farm manager, US Bank
Brill, Dan – City Water, Light and Power	Lionts, Larry – LSW producer/landowner
Briney, Paul – LSW landowner	Lyons, Dick – LSWRPC Chairman
Chard, Lynn – LSW landowner	Meckes, Ted – City Water, Light and Power
Copp, Steve – LSW producer/landowner	Megginson, John – LSW producer/landowner
Corrigan, Ed – Ag retailer, BRANDT	Megginson, Ted – LSW producer/landowner
Crumrine, Dan – Springfield Park District	Mendenhall, Barb – LSW producer
Curby, Karl – LSW producer/landowner	Moody, Ernie – Farm manager, Heartland Ag
Curby, Lee – LSW producer	Murphy, Peter – Lake Shore Improvement Assoc.
Curby, Michelle – LSW producer	Nicol, Michelle – City Water, Light and Power
Fleck, Larry – LSW landowner	Niemeyer, Garry – LSW producer/landowner
Frank, Steve – City Water, Light and Power	Peters, Tom – Farm manager, Farmers National Co.
Griffith, Tiffany – Farm manager, US Bank	Pyle, Hal – Natural Resources Conservation Service
Golden, Eric – Sangamon County SWCD	Seman, Shelly – Sangamon County SWCD
Hiler, Tom – Springfield Lake Shore Improvement Association	Thoma, Darrel – LSW producer/landowner
Holland, Teri – Springfield Lake Shore Improvement Association	Weitekamp, Larry – Farm manager, Agrivest, Inc.

While all participants are not listed, since the resumption of LSWRPC meetings in January, 2012, there have been over 40 additional meeting attendees, representing LSW producers/landowners, farm managers, agricultural retailers, agribusinesses, community college representatives, federal, state and local government agencies, and non-governmental organizations.

2.5 Lake Springfield Watershed Stakeholder Survey (2014-15)

As part of an IEPA 319 grant (3191415) which officially began on June 12, 2014, a survey of LSW stakeholders was completed and results tabulated.

In order to document the concerns of the watershed stakeholders, a survey was prepared and mailed to approximately 700 LSW households, provided at numerous meetings and tours, at the Springfield Lake Shore Improvement Association meeting, as well as through media press releases. The original date of June 9, 2015, was extended to October 15, 2015, for returning the surveys to the SCSWCD. Questions for this survey (**Appendix B**) were compiled using agricultural and urban resource concerns identified at 2012-2013 LSWRPC meetings and updated during the 2014-2015 meetings. In addition, the survey included five demographic questions about the participants and also a page was available for any additional comments or questions from the participants.

A public meeting was held on June 10, 2015, to discuss the survey results and to get additional input from the public. Forty (40) people attended this LSWRPC public meeting. They included farmers/landowners (16), farm managers (7), Springfield Lake Shore Improvement Association members (2), agricultural retailers (2), agribusiness owner (1), certified public accountant (1), CWLP representatives (3), US Fish and Wildlife Service representative (1), NRCS representative (1), SCSWCD staff (1) and watershed consultants (3). Several of these attendees actually represent more than one group of participants (i.e., ag retailer/SCSWCD Director/LSW landowner/farmer).

The results of 144 surveys completed by LSW stakeholders resulted in the following resource concerns to be addressed in this watershed plan:

1. ***Addressing the water quality of Lake Springfield and its watershed:***
   Sedimentation/soil loss
   Soil erosion
   Nutrients
   Pesticides
   Wildlife Habitat
   Land Use Change

2. ***Agricultural issues:***
   Fertilizer application/runoff
   Soil erosion (gully, rill, streambank, wind)
   Groundwater quality
   Highly erodible land (HEL) not being properly managed
   Pesticide application/runoff
   Sedimentation rates (streambank, timber, pasture
   Tillage practices
   Surface water runoff
   Land use change—urban development of agricultural cropland
   Tile—subsurface drainage management
   Diminishing wildlife habitat

Livestock feed operations/pasture management
Roadside maintenance

3. ***Urban Issues:***
Fertilizer application/runoff
Septic systems draining into Lake Springfield and its watershed streams
Trash and garbage in ditches – illicit dumping
Pesticide application/runoff
Land use change – development
Urban runoff
Golf courses around or flowing into Lake Springfield and watershed streams
Urban erosion (construction areas—residential and commercial
Stormwater runoff/management
Water quantity
Shoreline preservation/erosion—leaseholders' responsibilities
Invasive species in woodlands
Resident geese population—other wildlife problems
Urban residential and commercial development—Stormwater runoff
Rainwater and green infrastructure utilization

2.6 Goals and Objectives

Under the direction of the SCSWCD, with watershed resource inventory information and the LSW stakeholders' survey results in hand, the LSWRPC members set the final goals and objectives. As we move forward, key people from various federal, state and local agencies/organizations will provide guidance and their technical expertise during the implementation of this plan.

The following goals and objectives to be addressed in this watershed-based plan include:

1. Reduce surface water runoff from farm fields.
2. Identify and secure stable cost-share funding sources for implementation of BMPs.
3. Improve environmental education and outreach efforts to the public.
4. Reduce urban stormwater runoff.
5. Meet the 45% reduction goal for nutrients, as outlined in INLRS.
6. Improve groundwater quality.
7. Meet IEPA's TMDL for phosphorus in Lake Springfield (IL_REF) and Sugar Creek (EOA_04).
8. Meet IEPA's TMDL for TSS and aquatic algae.
9. Enhance the quality and quantity of wildlife habitat.
10. Promote prime farmland preservation and protection.
11. Support controlled urban development.
12. Restore and improve aquatic habitat.
13. Improve recreational opportunities.

Representatives from the following agencies will be asked to provide detailed information to assess the environmental implications and cost/benefits of the strategies proposed for addressing the resource concerns identified by the LSWRPC. In addition, these agencies will assist in evaluating the strategies which need to be implemented in order to meet the goals and objectives as defined in this watershed-based plan.

- USDA Natural Resources Conservation Service (NRCS)
- US Fish and Wildlife Service (USFWS)
- Illinois Environmental Protection Agency (IEPA)
- Illinois Department of Agriculture (IDOA)
- Illinois Department of Natural Resources (IDNR)
- Illinois State Water Survey (ISWS)
- University of Illinois Extension (UIE)
- Springfield Sangamon County Regional Planning Committee (SSCRPC)
- City Water, Light and Power (CWLP)

Important items to consider in this watershed-based plan include:

1. The dynamics affecting the LSW, including a look at the evolution of agriculture and urban development of this watershed from 1935 to the present.
2. Resource concerns identified after reviewing all known point and nonpoint source pollutants in the LSW.
3. Established goals, objectives and strategies for determining realistic BMPs which can effectively improve the water quality of the Lake, its streams in this watershed over time.
4. Current Watershed Resource Inventory (WRI) data for the LSW.
5. Current resource data, along with a comparison of some historical data compiled from various studies and projects undertaken in the LSW since the Lake was built.
6. Make decisions for implementing the plan in order to:
   - set a realistic timeline for implementation of BMPs,
   - identify who will be responsible for implementation, and
   - determine possible funding sources to help offset the cost of establishing the BMPs.
7. A water quality monitoring plan which can help determine the level of success for meeting the plan's goals and objectives.
8. A course of action for evaluating the plan when revisions and future updates may be needed to keep this plan a living resource document.

Stakeholders will use this watershed-based plan as a guide for implementing strategies that will meet the goals, objectives and outcomes for improving, protecting and enhancing water quality and natural resources in the watershed, while protecting public health and quality of life of the people, now and well into the future.

3.0 Watershed Resource Inventory

3.0 Watershed Resource Inventory

3.1 Physical Description

3.1.1 Geographic Boundaries

The LSW, located in central Illinois, encompasses approximately 169,161 acres, with 146,656 acres (87%) in southwestern Sangamon County, 11,936 acres (7%) in northeastern Macoupin County and 10,568 acres (6%) in southeastern Morgan County, and is subdivided into seven 12-digit Hydrologic Unit Code (HUC) sub-watersheds.

The LSW includes over 26 percent of Sangamon County's 550,755 acres and comprises a 265-square-mile area, with the approximate northern boundary being Stevenson Drive in Springfield, Illinois and Route 54 to the west between Curran and New Berlin, draining south toward Lake Springfield (**Figure 3.1.1**). The southern tip of the LSW dips into northeastern Macoupin County, and is approximately 10 miles west of Interstate 55.

Lake Springfield (IL_REF) drains into the Lower Sangamon River (EO_12), which flows north and west to the Sangamon River (E_25), into the Illinois River at Beardstown (D-32, D-31, D-01), before flowing approximately 90 miles south near Marquette State Park where it enters the Mississippi River (J-05) at Grafton, which ultimately flows south, emptying into the Atlantic Ocean's Gulf of Mexico in the state of Louisiana.

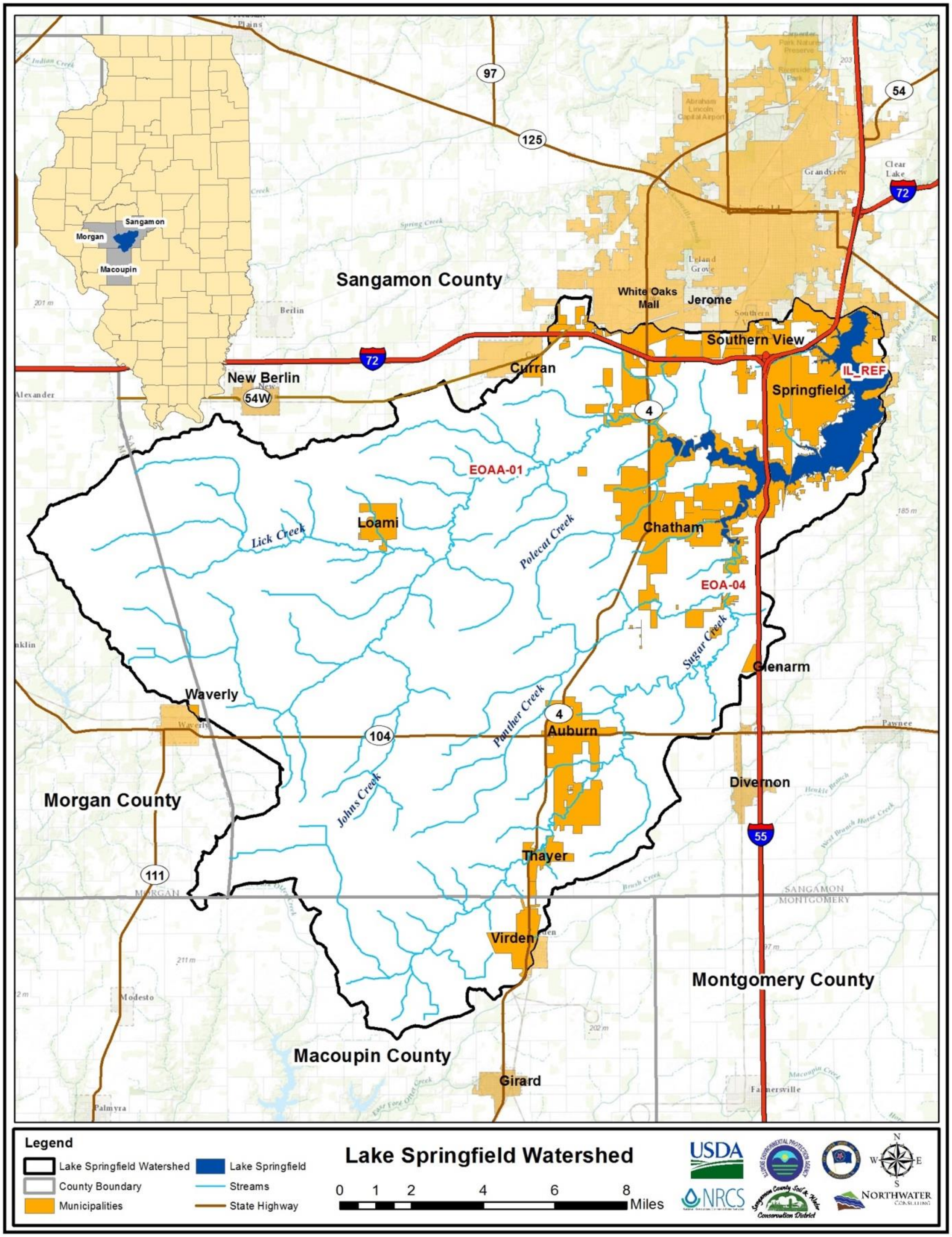


FIGURE 3.1.1 – LAKE SPRINGFIELD WATERSHED

3.1.2 Topography & Elevation

The topography of the watershed is similar to that of most of Central Illinois: relatively flat in the headwaters and uplands with increasing relief near the streams and major waterbodies. The slope also increases along stream corridors closer to the Lake.

The watershed is generally flat (0 to 2% slopes) with few steep slopes (27%) throughout the area. The elevation ranges from 540 to 716 feet above msl. The highest average sub-watershed slopes are found within **Lower Sugar Creek** and **Lower Lick Creek–Polecat Creek** sub-watersheds. The **Panther Creek** and **Upper Sugar Creek** sub-watersheds have the lowest average slope. The watershed as a whole has an average slope of 1.25% (0.72°) and a maximum percent slope of 27% (0.85°) as shown in **Table 3.1.1**.

TABLE 3.1.5 – ELEVATION BY SUB-WATERSHED

Sub-watershed Code	Sub-watershed	Maximum % Slope	Average % Slope	Average Slope (Degrees)
071300070701	Upper Sugar Creek	20	1.05	0.6
071300070702	Panther Creek	18	1.04	0.6
071300070703	Lower Sugar Creek	20	1.43	0.82
071300070704	South Fork Lick Creek—Johns Creek	14	1.11	0.64
071300070705	Upper Lick Creek	20	1.30	0.74
071300070706	Lower Lick Creek—Polecat Creek	27	1.49	0.85
071300070707	Lake Springfield	19	1.35	0.77
	Average	**20**	**1.25**	**0.72**

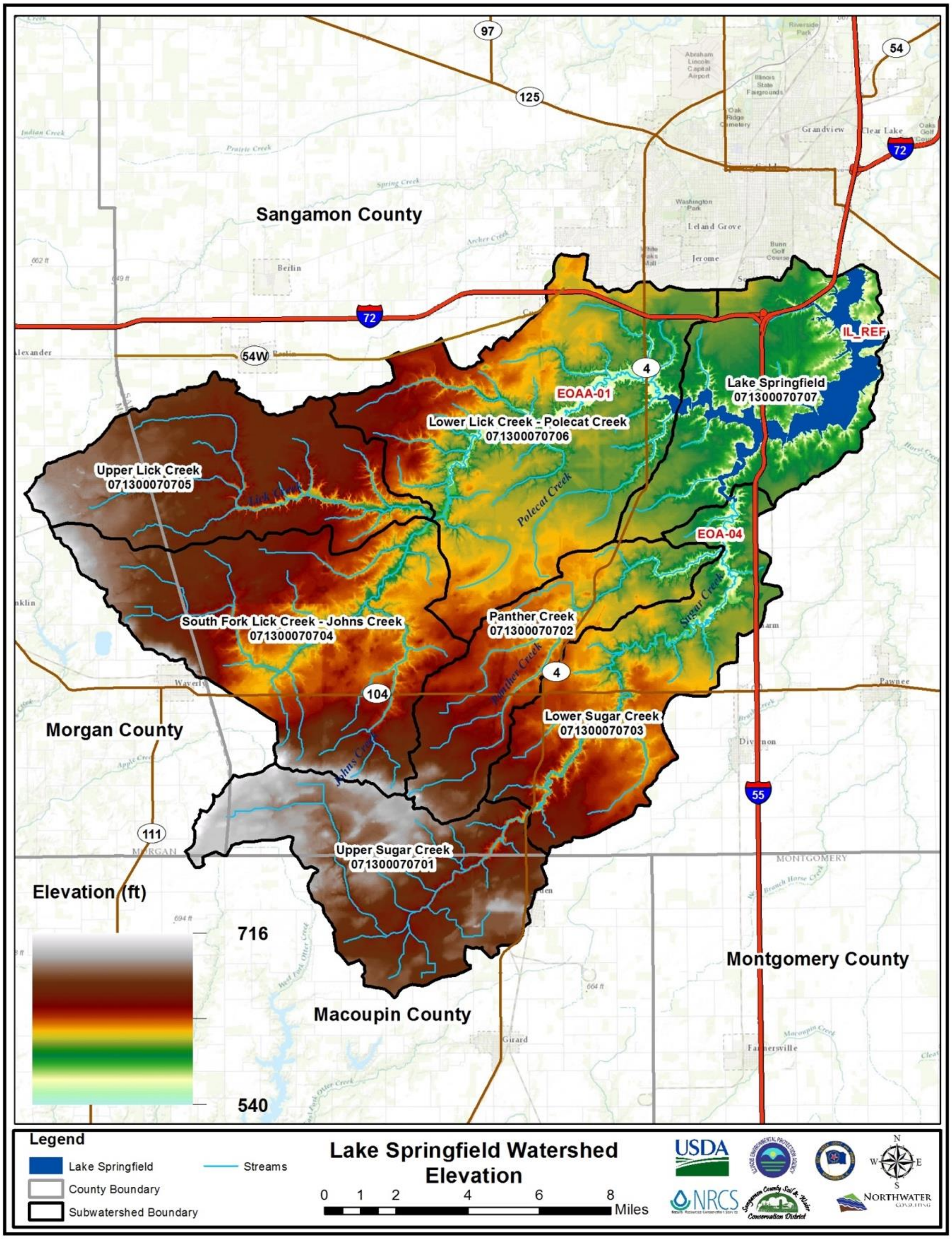


FIGURE 3.1.2 – LAKE SPRINGFIELD WATERSHED ELEVATION

3.1.3 Sub-watershed Boundaries

The LSW is defined by seven USGS 12-digit Hydrologic Unit Codes (HUCs 071300070701 – 071300070707).

TABLE 3.1.6 – SUB-WATERSHED AREA BY SQUARE MILES

Sub-watershed Code	Sub-watershed	Sub-watershed (acres)	Square Miles
071300070701	Upper Sugar Creek	22,189	35
071300070702	Panther Creek	15,072	24
071300070703	Lower Sugar Creek	21,422	34
071300070704	South Fork Lick Creek—Johns Creek	31,203	49
071300070705	Upper Lick Creek	21,782	34
071300070706	Lower Lick Creek—Polecat Creek	36,023	56
071300070707	Lake Springfield	21,470	34
	Total	**169,161**	**265**

Sugar Creek (IL_EOA_04) is located in four of the following 12-digit HUC sub-watersheds:

- Upper Sugar Creek (071300070701)
- Panther Creek (017300070702)
- Lower Sugar Creek (071300070703)
- Lake Springfield (071300070707)

The **Upper Sugar Creek** (HUC 071300070701) sub-watershed (22,819 acres) is the most southern sub-watershed in Sangamon County and includes the entire portion of northern Macoupin County, along with a small area of eastern Morgan County. It includes the headwaters of Sugar Creek which flows in a northeasterly direction to Lake Springfield. Most of the city of Virden and a small portion of Thayer are in this sub-watershed.

The **Panther Creek** (HUC 071300070702) sub-watershed (15,072 acres) is the smallest LSW sub-watershed and is surrounded by all of the LSW sub-watersheds except for Upper Lick Creek. Panther Creek flows north through this sub-watershed into Sugar Creek at the upper tip of the sub-watershed boundary. Small areas of Auburn and Chatham are located in this sub-watershed.

The **Lower Sugar Creek** (HUC 071300070703) sub-watershed (21,422 acres) on the eastern side of the LSW, is located north of the Upper Sugar Creek sub-watershed and south of the Lake Springfield sub-watershed; it is dissected north to south by Sugar Creek, which flows directly into Lake Springfield. It includes the village of Thayer, the city of Auburn, a small incorporated area of Chatham, and unincorporated Glenarm, which is on the very eastern edge of the watershed.

The **Lake Springfield** (HUC 071300070707) sub-watershed (21,470 acres), including the Lake, is located in the northeastern part of the LSW and includes most of the village of Chatham, portions of the village of Southern View, and the southern part of Springfield, south of Stevenson Drive. The confluence of Sugar Creek from the south and Lick Creek from the west is just west of the I-55 Bridge at Lake Springfield.

Lick Creek (IL_EOAA_01) flows through three 12-digit HUC sub-watersheds:

- South Fork Lick Creek—Johns Creek (071300070704)
- Upper Lick Creek (071300070705)
- Lower Lick Creek—Polecat Creek (071300070706)

The **South Fork Lick Creek–Johns Creek** (HUC 071300070704) sub-watershed (31,203 acres) is located in the west central part of the LSW, sandwiched between the Upper Lick Creek sub-watershed to the north and the Upper Sugar Creek to the south. It also includes a portion of eastern Morgan County and the headwater streams of Lick Creek to the west and Johns Creek to the south. The only municipality in this sub-watershed is a very small portion of the city of Waverly.

The **Upper Lick Creek** (HUC 071300070705) sub-watershed (21,782 acres) is north of the South Fork Lick Creek—Johns Creek sub-watershed and south of the Lower Lick Creek – Polecat Creek sub-watershed. It includes about half of the eastern Morgan County watershed area and the headwater streams of Lick Creek. The only municipality in this area is about three-fourths of the village of Loami.

Lower Lick Creek–Polecat Creek (HUC 071300070706) is the largest sub-watershed, covering 36,023 acres, is located in the northwestern part of the LSW and includes the village of Curran, a small portion of the village of Loami, and the southwestern side of Springfield and Southern View.

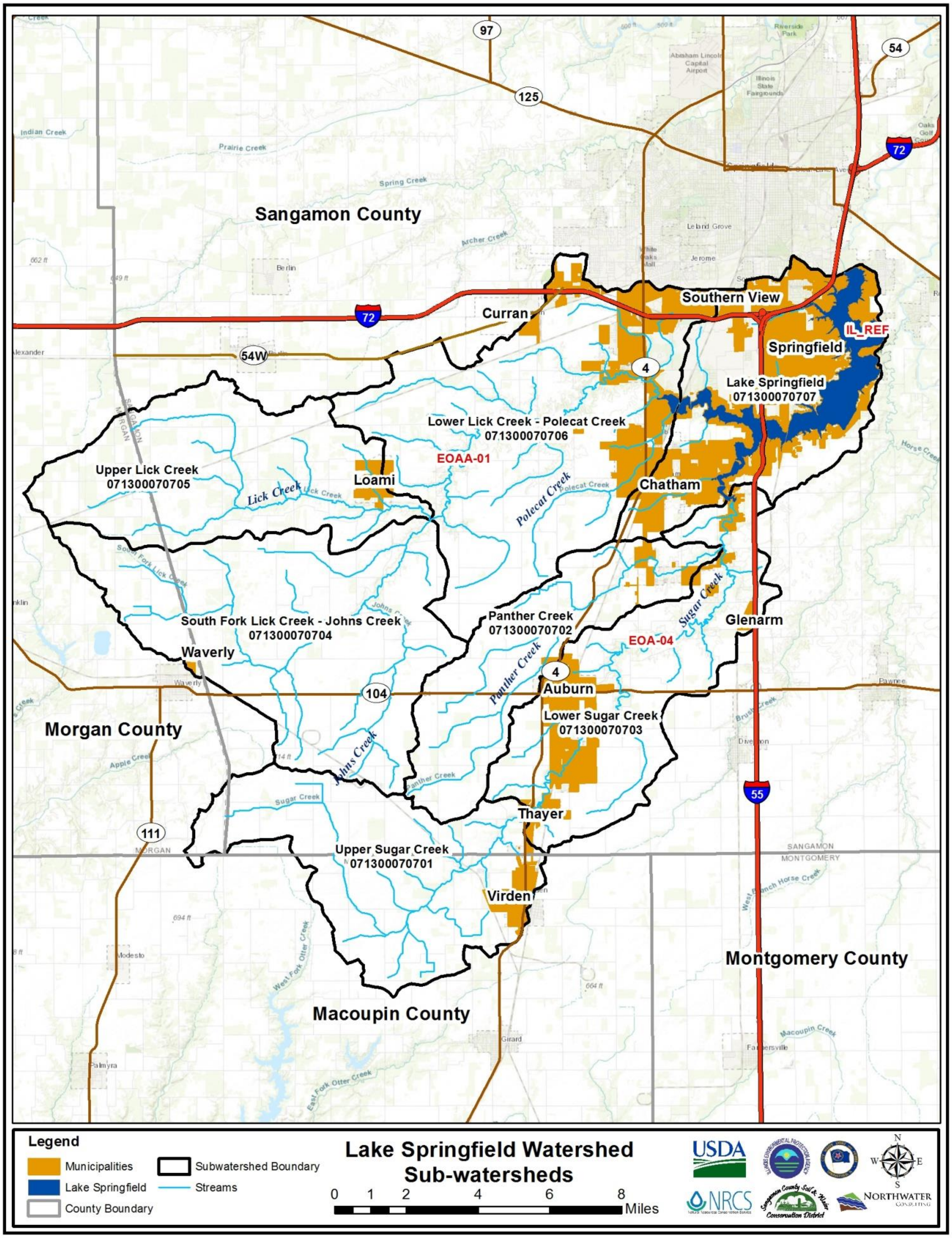


FIGURE 3.1.3 – LAKE SPRINGFIELD SUB-WATERSHEDS

3.1.4 Water Resources

Based on an analysis of current land use, the LSW contains 4,564 acres (2.7%) of open water, ponds or lakes and 1,062,975 feet, or 201 miles, of perennial streams. An analysis of stream-wetted width indicates there is a total of 449 acres, (0.3%) of open water perennial streams. The remainder of streams in the watershed, as classified in the United States Geological Survey's (USGS) National Hydrography Dataset (NHD), can be considered seasonal and, for the most part, represent subsurface flow. These seasonal, or subsurface drainages, total approximately 376,073 feet, or 71 miles, and are most prevalent in the headwaters.

Lake Springfield (IL_REF), a 3,965-acre impoundment which was built from 1931 to 1933, took 18 months (December 1935) to fill to capacity. It is approximately 12 miles in length and was formed by damming Sugar Creek (IL_EOA_04) and Lick Creek (IL_EOAA_01). Lick Creek and Sugar Creek are the two main tributaries which flow into the Lake from the south (Sugar Creek) in Macoupin County and west in Morgan County (Lick Creek) and through southern Sangamon County. Tributaries Little Panther and Panther Creeks flow into Sugar Creek, with Polecat Creek and a few smaller tributaries flowing directly into Lake Springfield.

Groundwater Hydrology

Groundwater in the Lake Springfield Watershed itself is very limited (Bergstrom et al., 1976). The possibility of finding groundwater beneath unconsolidated deposits is better if these deposits are greater than 300 feet deep. In Sangamon County, the deposits are rarely 100 feet deep and are less than 50 feet deep in most places. The closest sources of adequate sand and gravel deposits are found along the Sangamon River, in the Havana lowlands or in the Illinois River Valley. The Sangamon River Valley represents the major source of aquifer recharge in Sangamon County (Bergstrom et al., 1976).

The sand and gravel aquifers underlying the Lake Springfield Watershed generally produce less than 50,000 gallons per day, per square mile. As a result, one-sixth of the wells in the county are completed in the Pennsylvanian Bedrock (O'Hearn & Williams, 1982). These wells vary in depth from about thirty to 300 feet and receive their water from beds of sandstone a few feet thick or from fractured shale or limestone. They seldom produce yields greater than twenty gallons per minute (gpm) due to the thin layer of drift material. In addition, the water which originates below the lower portion of the Pennsylvanian rocks is too highly mineralized for most purposes.

The Illinois State Geological Survey (ISGS) has identified several locations with moderate groundwater potential in the watershed. These were defined as areas of generally discontinuous sand and gravel aquifers commonly less than fifteen feet thick with a moderate potential for groundwater development (Bergstrom, et al., 1976). All sites are small and already have at least one well on site.

Seepage from the Lake into aquifers or groundwater was considered to be negligible in the Yield Analysis of Lake Springfield (Makowski, et al., 1986), given the low hydrologic conductivity of the area. There is no groundwater entry into the Lake, as it is entirely surface fed. (Phase 1 Diagnostic/Feasibility Study, March, 1987).

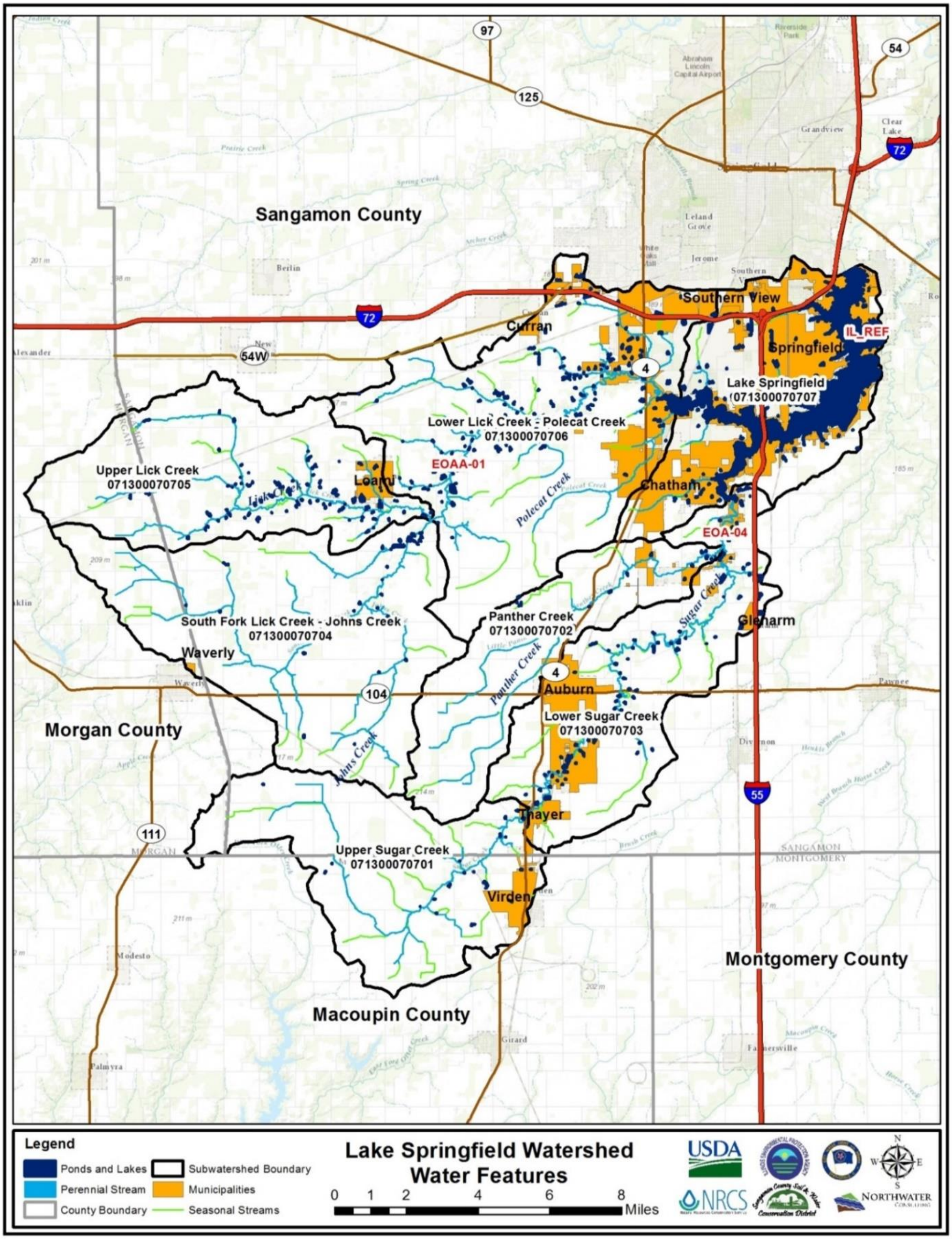


FIGURE 3.1.4 – LAKE SPRINGFIELD WATERSHED – WATER FEATURES

TABLE 3.1.3 – LAKE SPRINGFIELD WATERSHED STREAMS AND LAKES

Stream Name	AUID	Length (miles)	Notes
Lick Creek	IL_EOAA-01	27.55	Lick Creek flows generally east from the northwestern edge of the watershed before entering Lake Springfield west of the I-55 Bridge.
South Fork Lick Creek	IL_EOAAA	14.86	Beginning just east of Waverly, the South Fork of Lick Creek flows northeast before entering Lick Creek near Loami.
Johns Creek	IL_EOAAAA	6.95	Johns Creek flows south to north under Highway 104 before entering the South Fork of Lick Creek in the central part of the watershed.
Sugar Creek	IL_EOA-04	34.28	Originating in Macoupin County just south of Virden, Sugar Creek flows northeast along the southern edge of the watershed before entering Lake Springfield west of the I-55 Bridge.
Panther Creek	N/A	5.2	Panther Creek begins south and west of Auburn and flows northeast through the central part of the watershed before entering Sugar Creek at Chatham. Panther Creek is not assessed by the IEPA.
Polecat Creek	IL_EOAE	7.91	Polecat Creek begins south and east of Chatham and flows northeast through Chatham before entering Lake Springfield.
Lake Springfield	IL_REF	12	Lake Springfield is a 3,965-acre reservoir which is maintained at 560 feet mean sea level at Spaulding Dam.

Stream Segments Downstream of Lake Springfield			
Stream Name	AUID	Length (Miles)	Notes
Sugar Creek	IL_EOA-01, IL_EOA-06	6.2	After leaving Lake Springfield, Sugar Creek flows north before entering the South Fork of the Sangamon River (EO-01) near Riverton. The South Fork of the Sangamon then becomes the Sangamon River immediately north of the confluence with Sugar Creek.
Sangamon River	IL_E-26	12.05	The Sangamon River meanders north before turning west and flowing through the Carpenter Park Nature Preserve.
Sangamon River	IL_E-04, IL_E-24	38.89	The Sangamon River continues to flow west and then north through Petersburg before turning west toward the Illinois River at the Mason County line.
Sangamon River	IL_E-25	36.42	The Sangamon River then flows west and south before entering the Illinois River at Beardstown.
Illinois River	D-31, D-32, D-01	87.33	The Illinois River travels south almost 90 miles after its confluence with the Sangamon before entering the Mississippi River (J-05) near Pere Marquette State Park.

TABLE 3.1.4 – OPEN WATER, PONDS/LAKES AND PERENNIAL STREAMS BY SUB-WATERSHED

Sub-watershed Code	Sub-watershed	Stream AUID	Lake/ Ponds (acres)	% of Sub-watershed	Stream Length (feet)	Stream Miles	Stream Area (acres)	% of Sub-watershed
071300070701	Upper Sugar Creek	EOA_04	18	0.08%	109,749	21	40	0.2%
071300070702	Panther Creek	N/A	16	0.1%	117,652	22	45	0.3%
071300070703	Lower Sugar Creek	EOA_04	135	0.6%	137,388	26	91	0.4%
071300070704	South Fork Lick Creek—Johns Creek	EOAAA EOAAAA	31	0.1%	220,984	42	75	0.2%
071300070705	Upper Lick Creek	EOAA_01	92	0.4%	154,040	29	55	0.3%
071300070706	Lower Lick Creek—Polecat Creek	EOAA_O1 EOAE	306	0.9%	287,342	54	132	0.4%
071300070707	Lake Springfield	IL_REF	3,965	19%	35,821	7	12	0.06%
	Total		**4,564**	**2.7%**	**1,062,975**	**201**	**449**	**0.3%**

3.1.4.1 Surface/Groundwater Interaction

According to the IEPA, there is a very limited amount of aquifer material less than 50 feet below land surface throughout the Lake Springfield Watershed. There is a minimal amount within 20 feet below land surface located near the southern Sangamon/northern Macoupin Counties boundary, and a minimal amount 20 to 50 feet below land surface in an area west of the Lake, with the majority of aquifer material in the watershed area not being within 50 feet below land surface. There are no known karst areas in this watershed.

With increases in the development of land and water resources, it is important to look at the significant effect on the quantity and quality of surface and ground water. Surface water and groundwater are fundamentally interconnected and not only “feed” each other, but can contaminate each other. With the LSW being a major agricultural watershed, pesticide contamination of ground water and surface water can be dynamic, especially during periods of high runoff. The effects of urban runoff also play a significant role in the quality and quantity of surface water and ground water quality.

Numerous private wells dot the landscape in this watershed. While many of these wells may be abandoned, there is no accurate record of how many there are in this area. The number of abandoned wells may continue to increase as more rural residents tap into available community water supplies. Once a household hooks up to a public water supply, there must be a complete disconnect with the homeowners’ previous well to eliminate cross contamination of these two water systems. The South Sangamon Water Commission (SSWC), established in 2009, began serving customers in 2012. This is a public water supply which pumps water from wells drilled in the Sangamon River aquifer east of Rochester, southwest to the village of Chatham, and then pumped from its water tower west across the LSW to the Village of New Berlin.

Having access to a public water supply makes land along these water transmission lines very attractive to real estate developers. While Chatham is a rapidly developing urban area just a few miles south of Springfield, so are other municipalities in the watershed.

Auburn, Thayer and Virden in the LSW, along with several other municipalities outside the LSW, receive their water from the Otter Lake Water Commission, formed in 1967. Otter Lake and its water plant were built in 1969. It covers 765 acres, holds 16,065 acre-feet of water at full pool, has a 12,992-acre watershed in Macoupin County and is not located in the LSW. The Village of Loami is a wholesale water customer of Springfield’s CWLP.

In addition, Auburn, Loami, Thayer, and Virden have their own Wastewater Treatment Plants (WWTP). Contamination of groundwater and surface water runoff from these facilities from their effluent can be a significant water quality issue. Since these smaller facilities are not required by IEPA to sample the effluent they are pumping into the watershed streams, the extent of surface and groundwater contamination from these facilities is relatively unknown. Effluent is defined by USEPA as wastewater, treated or untreated, that flows out of a treatment plant, sewer, or industrial outfall and generally refers to wastes discharged into surface waters. With excess phosphorus being a source of impairment of Sugar Creek (IL_EOA_04) and Lake Springfield (IL_REF), these municipal discharge points may be the cause of this pollution and may be significant contributors to the water quality problems in these two EPA 303(d) listed waterbodies.

As Springfield's city limits and public utilities expand further south and west into the LSW, the number of water customers served by CWLP will increase significantly. This will also happen throughout the LSW as communities expand their utility service areas to accommodate more people and increase revenue. More households currently using a private well as their potable water supply will choose to connect to the public water supply. While many of these private wells may eventually be abandoned, they may not be properly decommissioned.

TABLE 3.1.5 – LAKE SPRINGFIELD WATERSHED – WATER WELLS BY SUB-WATERSHED

Sub-watershed Code	Sub-watershed	Number of Wells	% of Total Wells
071300070701	Upper Sugar Creek	19	3.3%
071300070702	Panther Creek	38	6.6%
071300070703	Lower Sugar Creek	126	21.9%
071300070704	South Fork Lick Creek—Johns Creek	16	2.8%
071300070705	Upper Lick Creek	57	9.9%
071300070706	Lower Lick Creek—Polecat Creek	180	31.3%
071300070707	Lake Springfield	139	24.2%
	Total	**575**	**100%**

3.1.4.2 Hydrogeology

Based on a review of the Illinois State Geologic Survey (ISGS) Wells and Borings database, there are likely a total of 575 private water wells within the Lake Springfield Watershed. According to the Illinois Environmental Protection Agency (IEPA) database, there are six Non-Community Water Supply (NCWS) wells, three in the **Lower Lick Creek–Polecat Creek** sub-watershed and three in the **Lake Springfield** sub-watershed.

No Community Water Supply (CWS) wells were found in the IEPA database for this watershed. While the SSWC's water wells are not physically located in this watershed, its water service transmission lines extend east from their water treatment plant on Buckhart Road (2 miles east of Rochester), southwest to Chatham's water tower, then northwest across the LSW through portions of the **Lake Springfield, Lower Sugar Creek, Panther Creek, Lower Lick Creek—Polecat Creek** and **Upper Lick Creek** sub-watersheds to New Berlin. Spatial statistics of water wells for each sub-watershed are shown in **Table 3.1.5**.

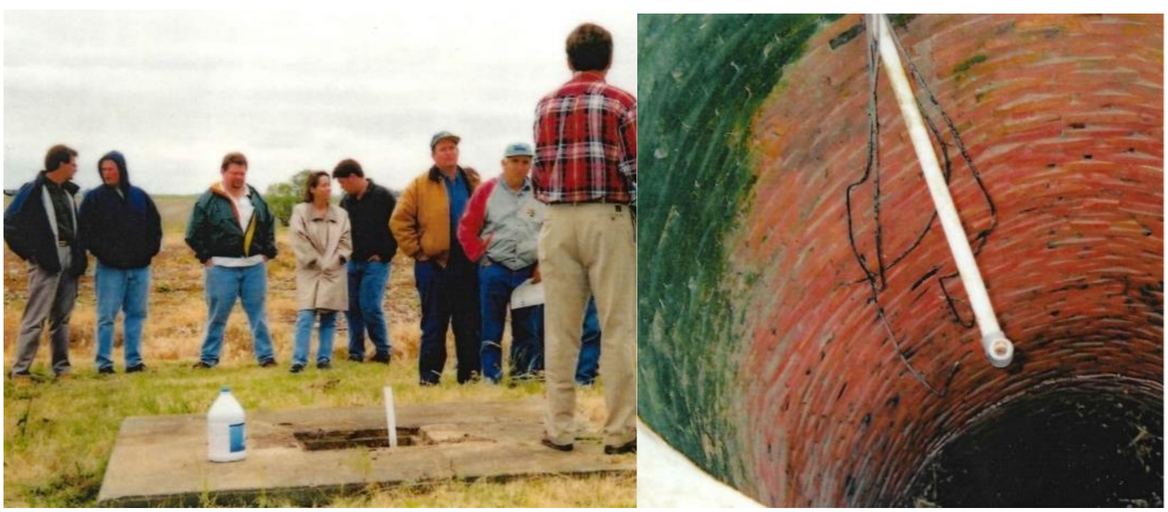
The **Lower Lick Creek—Polecat Creek** sub-watershed contains the highest percentage of water wells in the watershed (31%) and **South Fork Lick Creek—Johns Creek** contains the fewest wells

(3%). Based on state-level ISGS mapping, the watershed area does not include any major regional freshwater aquifers. Thus most of the water wells present in the basin yield water from discontinuous sand and gravel beds or production zones in the upper portions of the bedrock. Groundwater provides an important water supply in the study area. However, there are no major regional aquifers present in the watershed. The impermeable nature of the surficial geology acts to protect the limited groundwater resources from contamination. It is believed that groundwater plays a minor role in the health and function of the watershed system and is a small component of the water balance.

Caution should be taken in interpreting water well results, as most locations have not been field verified. It is unknown if a well is active or in use and locations have been determined in several different ways at different scales.

An inventory and study of existing private water wells, abandoned water wells, and how they were dug (hand dug or bored) and what materials were used to build them (bricks or concrete casings), age, size and depth definitely will be considered as part of future planning efforts for this watershed.

A well-decommissioning demonstration was held on a farm in the LSW in 2000, under the supervision and guidelines provided by the IL Department of Public Health and IL Department of Agriculture. However, no additional water well studies, inventories or demonstrations have been conducted in the LSW to date.



WATER WELL DECOMMISSIONING DEMONSTRATION PROJECT

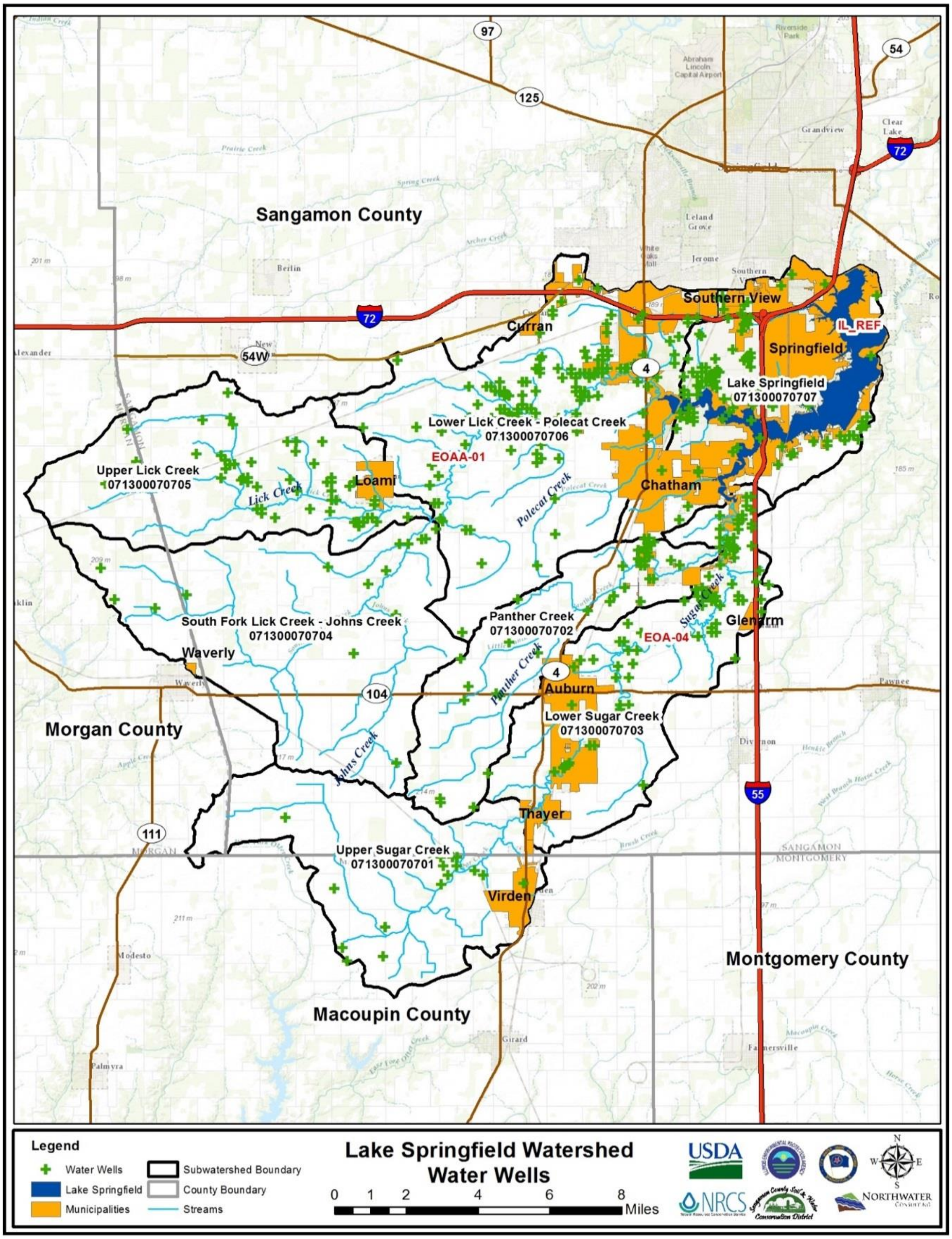


FIGURE 3.1.5 – LAKE SPRINGFIELD WATERSHED WATER WELLS

3.1.5 Floodplain

A review and analysis of the most recent Federal Emergency Management Agency's (FEMA) Digital Flood Insurance Rate Maps (DFIRM) indicates there are 11,413 acres of floodplain within the LSW, or approximately 7% of the total watershed area. Of the total floodplain area, only 51 acres are classified as being located in the 500-year floodplain. This small section lies in the Lower Sugar Creek sub-watershed, along Sugar Creek (See **Figure 3.1.6**). The remaining floodplain area is considered to be within the 100-year floodplain. The **Lake Springfield** sub-watershed has the largest percentage (20%) of floodplain acres (4,272 acres), followed by the **Lower Lick Creek–Polecat Creek** sub-watershed (2,620 acres) and **Lower Sugar Creek** sub-watershed (1,470 acres), covering 7% of the acres in their respective sub-watersheds.

TABLE 3.1.6 – FLOODPLAIN ACRES BY SUB-WATERSHED

Sub-watershed Code	Sub-watershed	Floodplain (acres)	% of Sub-watershed
071300070701	Upper Sugar Creek	497	2%
071300070702	Panther Creek	460	3%
071300070703	Lower Sugar Creek	1,470	7%
071300070704	South Fork Lick Creek—Johns Creek	1,140	4%
071300070705	Upper Lick Creek	953	4%
071300070706	Lower Lick Creek—Polecat Creek	2,620	7%
071300070707	Lake Springfield	4,272	20%
	Total	**11,413**	

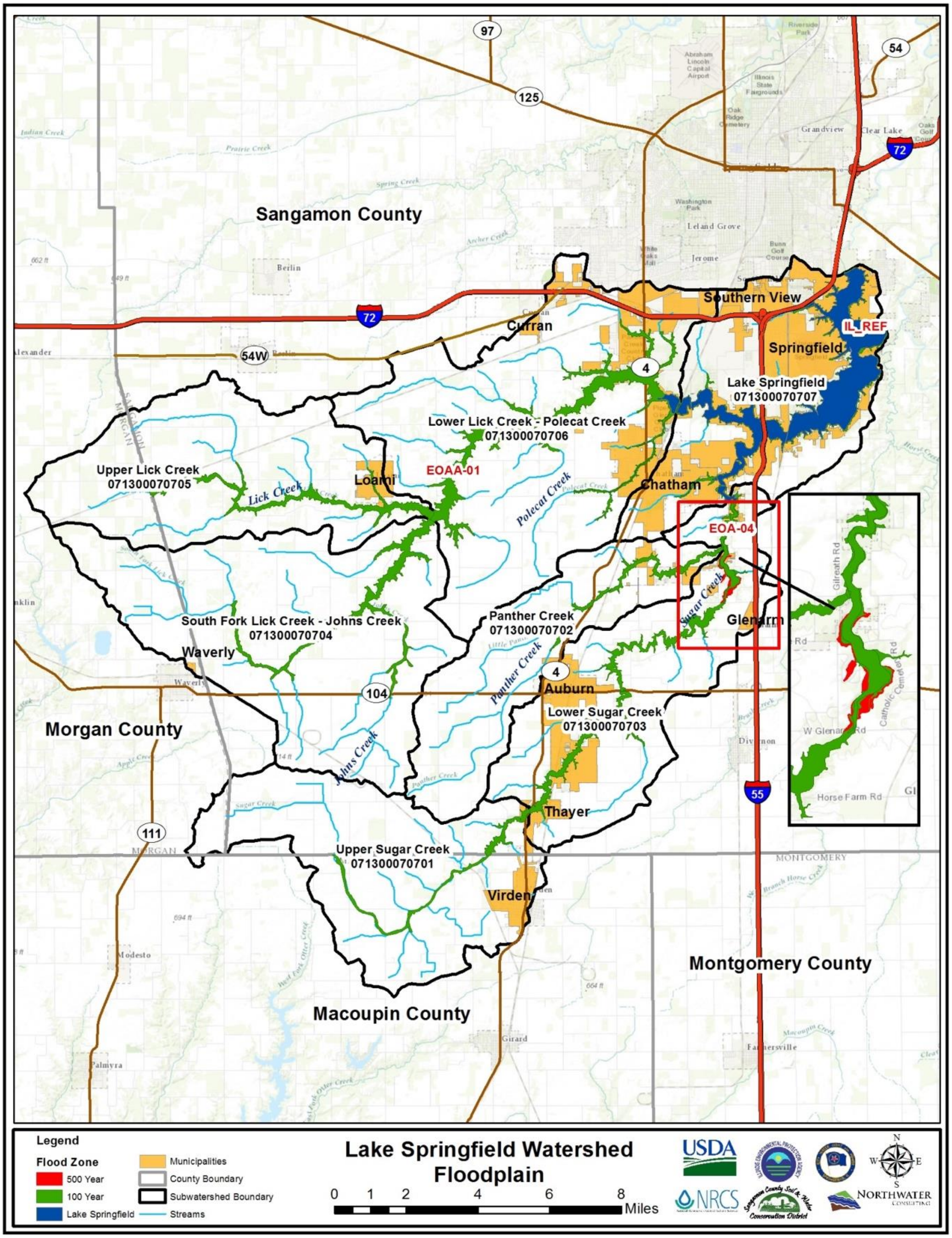


FIGURE 3.1.6 – LAKE SPRINGFIELD WATERSHED FLOODPLAIN

3.2 Geology and Climate

3.2.1 Geology

According to the March 1987 Clean Lakes Program Phase 1 Diagnostic/Feasibility Study for the Lake Springfield Restoration Plan, the Lake Springfield Watershed is located in the Springfield Plain of the Till Plains Section of the Central Lowland Physiographic Province (Bergstrom et al., 1976). The area is a relatively flat upland that contains many shallow valleys.

Unconsolidated, glacial, windblown and alluvial (river) deposits cover the area and vary in depth from less than one foot to about 300 feet. Below this, bedded sedimentary rocks—mainly limestone, dolomite, sandstone, and shale, are present to a depth of 5,000 to 6,000 feet. In the western portion of the watershed, the outcrops of uppermost sedimentary rocks, from the Pennsylvanian System, are present.

The surface materials in the watershed are mostly Peoria loess at the surface. The loess mantle averages about six feet in depth in the southern portion of Sangamon County and increases to fifteen feet in the northern portion. This predominantly silt material varies in depth from zero to four feet along the streams, up to fifteen feet in the upland. Below this is Roxana Silt which is either poorly drained, unoxidized (gleyed) or oxidized. This soil level can be up to six feet deep. A layer of Sangamon Soil up to ten feet thick is found below the Roxana Silt.

Herrin (No. 6) coal is present under much of the watershed and is found at depths of about 150 feet and greater. Limestone is exposed in a few places along creeks and gullies in the south and western portions of the watershed. Generally, the overburden is more that fifteen feet thick. Shale deposits are found under the Lake with less than fifty feet of overburden in places, but are not known to break the surface.

TABLE 3.2.1 – LAKE SPRINGFIELD WATERSHED SURFICAL GEOLOGY

Surficial Geology	Description*	Area (acres)	Percent of Watershed
Open Water	Lake Springfield	3,958	2.34%
Alluvium	Cahokia alluvium less than 6 m thick underlain by loamy and sandy till of the Glasford Formation	3,398	2.01%
	Cahokia alluvium less than 6 m thick, underlain by loamy and sandy till of the Glasford Formation with Pennsylvanian shales present below 6 to 15 meters depth	727	0.43%
	Cahokia alluvium less than 6 m thick, underlain by lacustrine silts and clays with Pennsylvanian shales present below 6 to 15 meters depth	13	0.01%
Loess	Peoria and Roxana loess less than 6 m thick, underlain by loamy and sandy till of the Glasford Formation	32,003	18.92%
	Peoria and Roxana loess less than 6 m thick, underlain by	5,936	3.51%

Surficial Geology	Description*	Area (acres)	Percent of Watershed
	loamy and sandy till of the Glasford Formation extending to at least 15 m depth but with continuous interbed of Wedron Formation sands and gravels between 6-15 m depth		
	Peoria and Roxana loess less than 6 m thick, underlain by loamy and sandy till of the Glasford Formation less than 6 m thick with Pennsylvanian shales present within 6 m depth	113,061	66.84%
	Peoria and Roxana loess less than 6 m thick, underlain by less than 6 m of loamy and sandy till of the Glasford Formation with Pennsylvanian sandstones present within 6 m depth	2,047	1.21%
	Peoria and Roxana loess less than 6 m thick, underlain by silty and clayey till of the Glasford Formation with interbeds of sand and gravel in top 6 m.	7,737	4.57%
	Peoria and Roxana loess less than 6 m thick, underlain by thin but continuous Pearl Formation glacial outwash deposits and loamy and sandy till of the Glasford Formation to at least 15 m depth	274	0.16%
* Adapted from Illinois State Geological Survey *Stack-Unit Mapping of Geologic Materials in Illinois to a Depth of 15 Meters*			

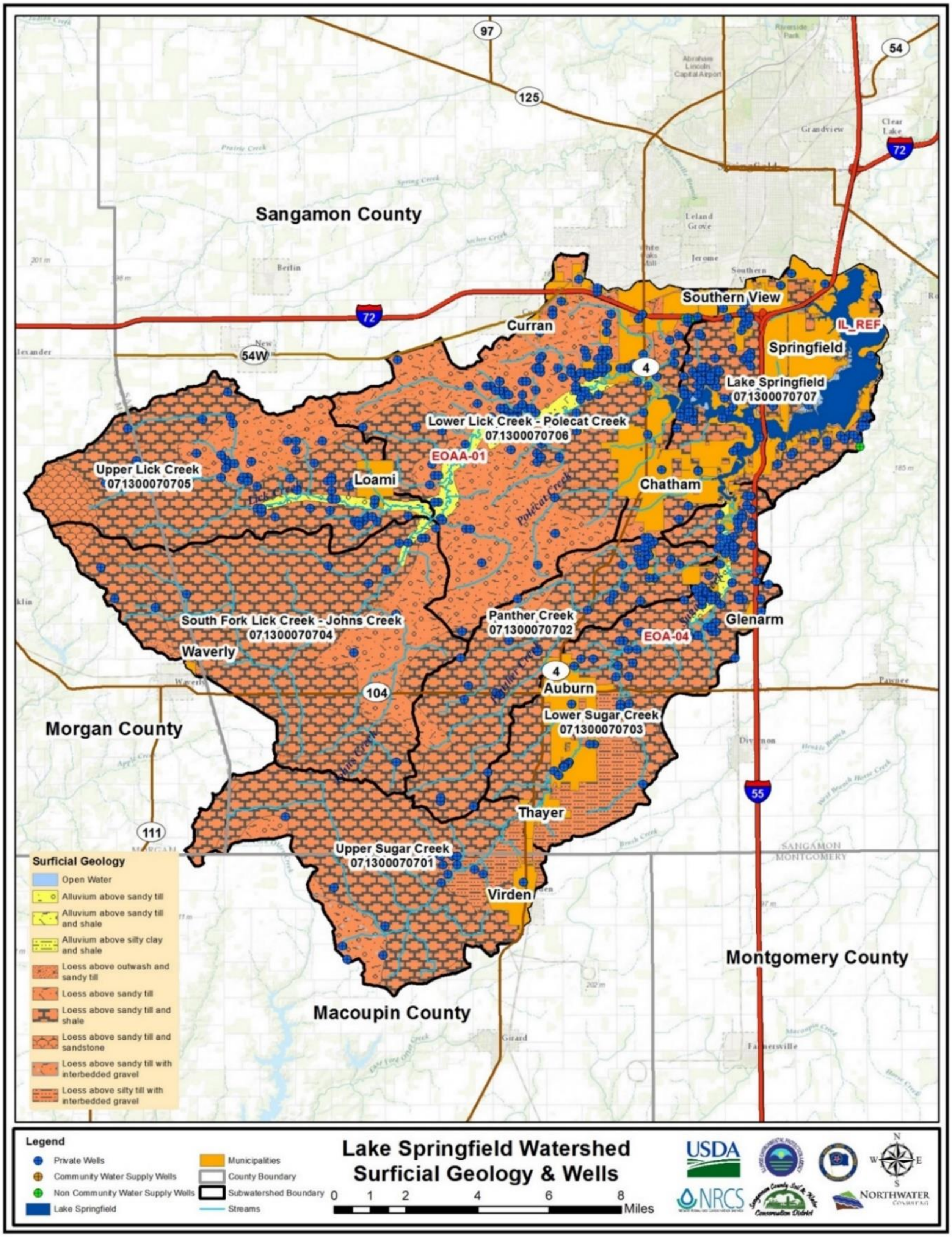


FIGURE 3.2.1 – SURFICIAL GEOLOGY AND WATER WELLS

3.2.2 Climate

Central Illinois has a temperate climate with hot summers and cold, snowy winters. Monthly precipitation data from Springfield, Illinois (station id. 93822) in Sangamon County were extracted from the National Climatic Data Center (NCDC) database for the years of 1901 through 2013. The data station in Springfield, Illinois was chosen to be representative of precipitation throughout the watershed. (2016 Lake Springfield and Sugar Creek Watershed TMDL).

TABLE 3.2.2 – AVERAGE MONTHLY CLIMATE DATA – SPRINGFIELD, ILLINOIS

Month	Total Precipitation (in)	MAX Temperature (°F)	MIN Temperature (°F)
January	1.9	34.8	26.9
February	1.8	38.8	30.6
March	3.0	50.7	41.5
April	3.6	63.6	53.2
May	4.0	74.4	63.8
June	4.0	83.5	73.0
July	3.3	87.6	77.1
August	3.1	85.3	75.0
September	3.2	78.8	67.7
October	2.7	66.9	56.2
November	2.5	51.5	42.8
December	2.1	38.4	31.0
Total/Average	**35.3**	**62.8**	**53.2**

In addition to the NCDC data, monthly precipitation data from three rain gauges within the watershed was available from a database created by Springfield City Water, Light and Power (CWLP). This dataset is from 1995 through 2013 and the rain gauges monitored by CWLP are distributed across the watershed at the Lake Springfield Filter Plant, along the Lick Creek and Sugar Creek tributaries upstream of the Lake, and provide a representation of average monthly precipitation totals for the watershed as a whole **(Table 3.2.3**).

Table 3.2.3 – Average Monthly Precipitation Data (Inches)[4]

Month	Filter Plant (in)	Lick Creek (in)	Sugar Creek (in)	Watershed Average (in)
January	2.0	0.8	0.4	1.1
February	1.8	2.1	.06	1.5
March	2.4	1.8	1.9	2.0
April	3.4	3.3	2.1	2.9
May	4.8	3.8	2.7	3.8
June	3.9	2.7	4.3	3.6
July	2.7	2.3	2.1	2.4
August	2.8	0.9	1.4	1.7
September	2.7	2.8	1.8	2.4
October	3.1	1.3	2.1	2.2
November	2.6	1.6	1.7	2.0
December	1.8	0.8	1.4	1.3
Total	34.1	24.2	22.4	26.9

Table 3.2.4 – All-Time Weather Records (1879 – 2016)[5]

Event	Value	Date
Record High Temperature	112 °	July 14, 1954
Record Low Temperature	-24 °	February 13, 1905
Record Precipitation (calendar day)	5.59“	August 12, 2016
Record Precipitation (24-hour period)	6.12”	December 2-3, 1982
Record Precipitation (1 month)	15.16“	September 1926
Record Snowfall (calendar day)	17.0”	March 24, 2013
Record Snowfall (24-hour period)	17.4”	March 24-25, 2013
Record Snowfall (1 month)	24.4”	February 1900
Record Snow Depth	16”	January 14-18, 1918 March 8, 1978 March 25, 2013

[4] From three CWLP LSW rain gauges

[5] Temperature and precipitation records began in 1879. Snowfall records began in 1881.

3.3 Soils

3.3.1 Soil Types

The Lake Springfield Watershed contains 41 unique soil series, ranging in slope from 0%-35%. The dominant soil series is **Ipava silt loam** (0-2% slopes) which makes up 37% (62,530 acres) of the entire watershed. **Virden silty clay loam** (0-2% slopes), **Osco silt loam** (2-5% slopes) make up a relatively high percentage at 17% (28,466 acres) and 9% (14,818 acres), respectively. With the addition of **Sable silty clay loam** 6.79% (11,475 acres), **Rosetta silt loam** 3.42% (5,787 acres) and **Hartsburg silty clay loam** 3.23% (5,466 acres), respectively, the top six soils in terms of area, cover 76.04% (128,542 acres) of the Lake Springfield Watershed.

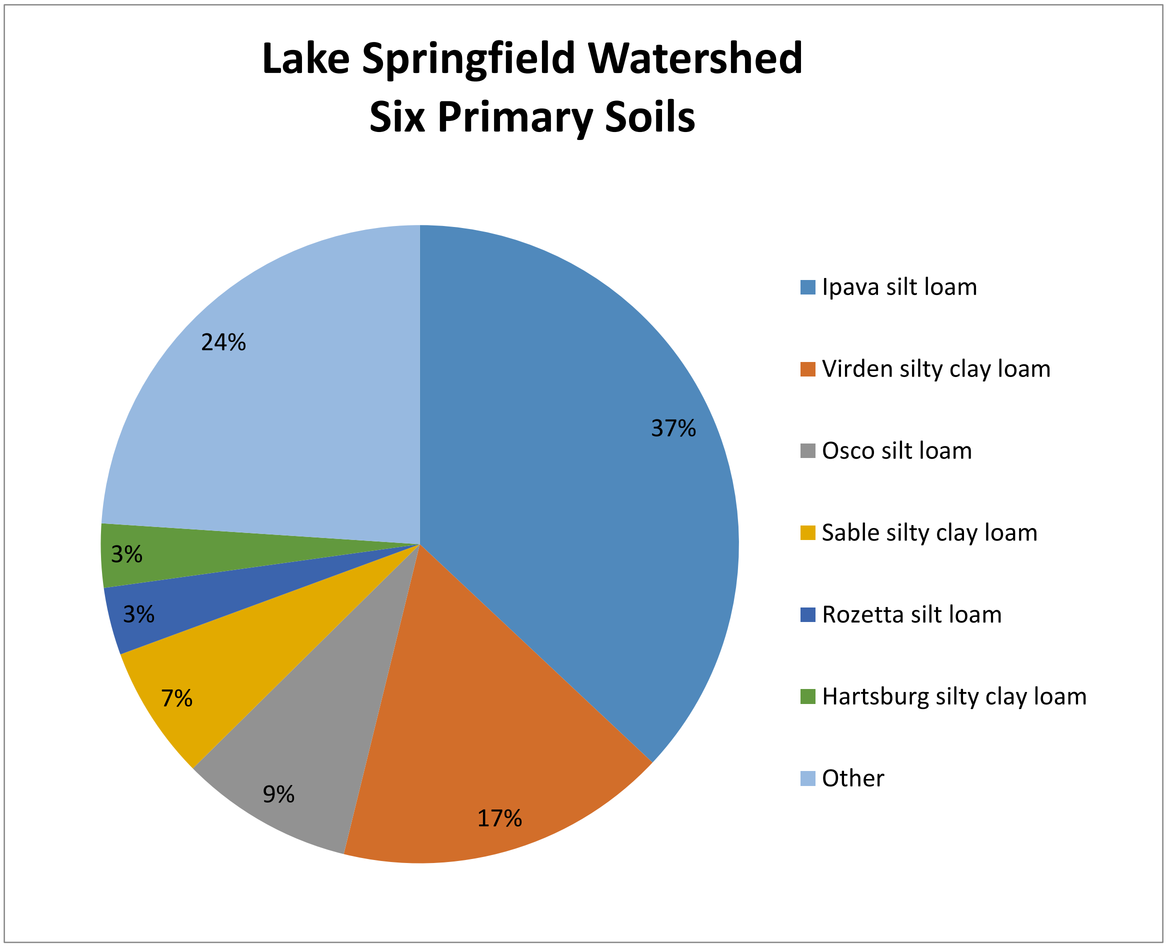


CHART 3.3.1 – LAKE SPRINGFIELD WATERSHED SIX PRIMARY SOILS

TABLE 3.3.1 – LAKE SPRINGFIELD WATERSHED SOILS

Soil Series	Soil Map Units	Slope Range	Acres	% of Watershed
Ipava silt loam	43A	0 to 2 percent slopes	62,530	36.99%
Virden silty clay loam	50A	0 to 2 percent slopes	28,466	16.84%
Osco silt loam	86B	2 to 5 percent slopes	14,818	8.77%
Sable silty clay loam	68A	0 to 2 percent slopes	11,475	6.79%
Rozetta silt loam	279B	2 to 5 percent slopes	5,787	3.42%
Hartsburg silty clay loam	244A	0 to 2 percent slopes	5,466	3.23%
Water	N/A	N/A	4,399	2.60%
Elco silt loam	119D	10 to 18 percent slopes	3,868	2.29%
Harrison silt loam	127C2	5 to 10 percent slopes, eroded	3,790	2.24%
Assumption silt loam	259C2	5 to 10 percent slopes, eroded	3,201	1.89%
Buckhart silt loam	705B	2 to 5 percent slopes	2,935	1.74%
Lawson silt loam	3451A	0 to 2 percent slopes, frequently flooded	2,429	1.44%
Fayette silt loam	280C2	5 to 10 percent slopes, eroded	2,413	1.43%
Sawmill silty clay loam	3107A	0 to 2 percent slopes, frequently flooded	2,280	1.35%
Keomah silt loam	17A	0 to 2 percent slopes	2,202	1.30%
Assumption silt loam	259D2	10 to 18 percent slopes, eroded	1,590	0.94%
Buckhart silt loam	705A	0 to 2 percent slopes	1,560	0.92%
Radford silt loam	3074A	0 to 2 percent slopes, frequently flooded	1,429	0.85%
Cowden silt loam	112A	0 to 2 percent slopes	1,283	0.76%

Soil Series	Soil Map Units	Slope Range	Acres	% of Watershed
Elco silty clay loam	119D3	10 to 18 percent slopes, severely eroded	969	0.57%
Clarksdale silt loam	257A	0 to 2 percent slopes	947	0.56%
Hickory silt loam	8F	18 to 35 percent slopes	691	0.41%
Assumption silt loam	259B	2 to 5 percent slopes	690	0.41%
Osco silt loam	86C2	5 to 10 percent slopes, eroded	634	0.38%
Edinburg silty clay loam	249A	0 to 2 percent slopes	528	0.31%
Denny silt loam	45A	0 to 2 percent slopes	463	0.27%
Elco silt loam	119C2	5 to 10 percent slopes, eroded	339	0.20%
Muscatune silt loam	51A	2 to 5 percent slopes	299	0.18%
Hickory silt loam	8D	10 to 18 percent slopes	248	0.15%
Hickory loam	8D2	10 to 18 percent slopes, eroded	228	0.13%
Urban land	N/A	N/A	194	0.11%
Spaulding silty clay loam	712A	0 to 2 percent slopes	153	0.09%
Elkhart silt loam	567C2	5 to 10 percent slopes, eroded	151	0.09%
Shiloh silty clay loam	138A	0 to 2 percent slopes	97	0.06%
Tice silty clay loam	3284A	0 to 2 percent slopes, frequently flooded	85	0.05%
Hickory clay loam	8D3	10 to 18 percent slopes, severely eroded	57	0.03%
Dumps	N/A	N/A	52	0.03%
Harrison silt loam	127B	2 to 5 percent slopes	51	0.03%
Navlys silt loam	630C2	5 to 10 percent slopes, eroded	48	0.03%

Soil Series	Soil Map Units	Slope Range	Acres	% of Watershed
Keller silt loam	470B	2 to 5 percent slopes	32	0.02%
Camden silt loam	134B	2 to 5 percent slopes	28	0.02%
Orthents	801C	Silty, rolling	21	0.01%
Drury silt loam	7075B	2 to 5 percent slopes, rarely flooded	19	0.01%
Proctor silt loam	7148A	0 to 2 percent slopes, rarely flooded	18	0.01%
Alvin fine sandy loam	131D2	10 to 18 percent slopes, eroded	11	0.01%
Camden silt loam	134C2	5 to 10 percent slopes, eroded	11	0.01%
Kendall silt loam	242A	0 to 2 percent slopes	10	0.01%
Fayette silt loam	280D3	10 to 18 percent slopes, severely eroded	10	0.01%
Clarksdale silt loam	257A	2 to 5 percent slopes	9	0.01%
Worthen silt loam	7037A	0 to 2 percent slopes, rarely flooded	8	0.005%
Elburn silt loam	198A	0 to 2 percent slopes	7	0.004%
Navlys silt loam	630D2	10 to 18 percent slopes, eroded	4	0.002%
Vesser silt loam	8396A	0 to 2 percent slopes, occasionally flooded	1	0.001%
Miscellaneous water	N/A	N/A	1	0.001%
Plano silt loam	199B	2 to 5 percent slopes	1	0.001%
Total			**169,035**	

Ipava silt loam (43A) soil, with 0 to 2% slopes, is somewhat poorly drained, with moderately slow permeability at a depth of 40 inches, moderately slow below 60 inches and depth to restrictive feature more than 80 inches. The available water capacity is about 12 inches to a depth of 60 inches. It has 4 to 5 percent organic matter content in the surface layer, with a high shrink-swell potential, and high potential for frost action. The apparent seasonal high water table is 1 to 2 feet below the surface, with medium surface runoff and low susceptibility to water and wind erosion. Ipava is considered prime farmland in all areas and is not classed as a hydric soil.

Virden silty clay loam (50A) soil, with 0 to 2% slopes, is poorly drained, with slowest permeability within a depth of 40 inches, moderately slow permeability below a depth of 60 inches and depth to restrictive feature at more than 80 inches. The available water capacity is about 11.1 inches to a depth of 60 inches. The organic matter content in the surface layer ranges from 3 to 6 percent, with a high shrink-swell potential and high potential for frost action. The apparent seasonal high water table is at the surface to 1 foot below the surface, with ponding at the surface to 0.5 foot above the surface. Surface runoff is negligible, with low susceptibility to water erosion and very low susceptibility to wind erosion. Virden silty clay loam is considered prime farmland where drained and is classed as a hydric soil.

Osco silt loam (86B) soil, with 2 to 5% slopes, eroded, is well drained, with slowest permeability within a depth of 40 inches, moderate permeability below a depth of 60 inches and depth to restrictive feature at more than 80 inches. The available water capacity is approximately 11.8 inches to a depth of 60 inches. The organic matter content in the surface layer is generally 3 to 4 percent with a moderate shrink-swell potential. The apparent seasonal high water table is 4 to 6 feet below the surface. It has a high potential for frost action. Surface runoff is low, with moderate susceptibility to water erosion and low susceptibility to wind erosion. Osco silt loam is considered prime farmland and is not classed as a hydric soil.

Sable silty clay loam (68A) soil, with 0 to 2% slopes, is poorly drained, with a moderate permeability within a depth of 40 and 60 inches. The available water capacity is about 11.9 inches to a depth of 60 inches. The apparent seasonal high water table is at the surface to 1 foot below the surface. The organic matter content in the surface layer is 5 to 6 percent, with a moderate shrink-swell potential and high potential for frost action. There is negligible surface runoff and low susceptibility to water erosion, with very low susceptibility to wind erosion. Sable silty clay loam soil is considered prime farmland where drained and is classed as a hydric soil.

Rozetta silt loam (279B) soil, with 2 to 5% slopes, is well drained with the slowest permeability at a depth of 40 inches, moderate below a depth of 60 inches and depth to restrictive feature at more than 80 inches. The available water capacity is about 12.3 inches to a depth of 60 inches. The organic matter content in the surface layer is 1 to 3 percent. The apparent seasonal high water table is 4 to 6 feet below the surface, with no potential for flooding, a moderate shrink-swell potential and a high potential for frost action. It is classed low for surface water runoff, moderate susceptibility to water erosion and low susceptibility to wind erosion. Rozetta silt loam is considered prime farmland in all areas and is not classed as a hydric soil.

Hartsburg silty clay loam (244A) soil with 0 to 2% slopes is poorly drained, with the slowest permeability within a depth of 40 inches, moderate below a depth of 60 inches and depth to restrictive at more than 80 inches. The available water capacity is about 12.6 inches to a depth of 60 inches. The organic matter content in the surface layer ranges from 3 to 5 percent. There is a moderate shrink-swell potential and a high potential for frost action. The apparent seasonal high water table is at the surface to 1 foot below the surface, with no potential for flooding. Surface runoff class is negligible, with low susceptibility for water erosion and very low susceptibility to wind erosion. Hartsburg silty clay loam is considered prime farmland where drained and is classed as a hydric soil.

TABLE 3.3.2 – CHARACTERISTICS OF TOP SIX LAKE SPRINGFIELD WATERSHED SOIL TYPES[6]

Soil Type	Soil Map Units	% Watershed Acres	Slope %	Extra Water Capacity (in)	Organic Matter %	Surface Water Runoff Potential	Hydric Soil
Ipava silt loam	43A	36.99	0 – 2	12.0– 60	4 – 5	Medium	No
Virden silty clay loam	50A	16.84	0 – 2	11.1– 60	3 – 6	Negligible	Yes
Osco silt loam	86B	8.77	2 – 5	11.8– 60	3 – 4	Low	No
Sable silty clay loam	68A	6.79	0 – 2	11.9– 60	5 – 6	Negligible	Yes
Rozetta silt loam	279B	3.42	2 – 5	12.3– 60	1 – 3	Low	No
Hartsburg silty clay loam	244A	3.23	0 – 2	12.6– 60	3 – 5	Negligible	Yes
Total		**76.04**					

Of the six primary soil types, five have low to very low susceptibility to water and wind erosion. **Rozetta silt loam** has moderate susceptibility to water erosion and low susceptibility to wind erosion. Although these soils have a low susceptibility to water erosion, they do represent the vast majority of the watershed. Despite having low rates of erosion, the cumulate soil loss can be significant. Furthermore, many of these flat, productive soils receive more tillage and contain much less residue than steeper, more highly erodible soils. Structural practices such as field borders or grassed waterways are also often absent on these flat soils and, therefore, very little of the eroded soil is prevented from leaving the field.

[6] The descriptions of the six primary soil classifications below were taken from the USDA-NRCS *Soil Survey of Sangamon County, Illinois*, certified in 2004

Four of these soils (64% of the watershed acres) have an apparent seasonal high water table of one (1) foot below the surface. **Osco silt loam** and **Rozetta silt loam** have an apparent seasonal high water table of 4 to 6 feet below the surface.

All of these top six soil types are considered to be prime farmland. **Hartsburg silty clay loam** and **Sable silty clay loam**, have this same designation only where drained.

As shown in **Table 3.3.3** below, the remaining 35 soil series cover 24% of the watershed (40,493 acres), 10,587 acres are 5% to 10% slopes that are classified as eroded. 1,036 acres on 10% to 18% slopes are classified as severely eroded. Of the 13,500 acres that have a 0% to 2% slope range, 6,223 acres are classified as frequently flooded.

TABLE 3.3.3 – OTHER SOIL SERIES IN THE LAKE SPRINGFIELD WATERSHED

Slope	# of Soil Series	Classification	Acres
0% -- 2%	17	None	7,277
0% -- 2%	4	Frequently Flooded	6,223
2% -- 5%	11	None	4,064
5% – 10%	8	Eroded	10,587
10% – 18%	2	None	4,116
10% -- 18%	4	Eroded	1,833
10% -- 18%	3	Severely Eroded	1,036
18% -- 35%	1	High Water Erosion Susceptibility	691

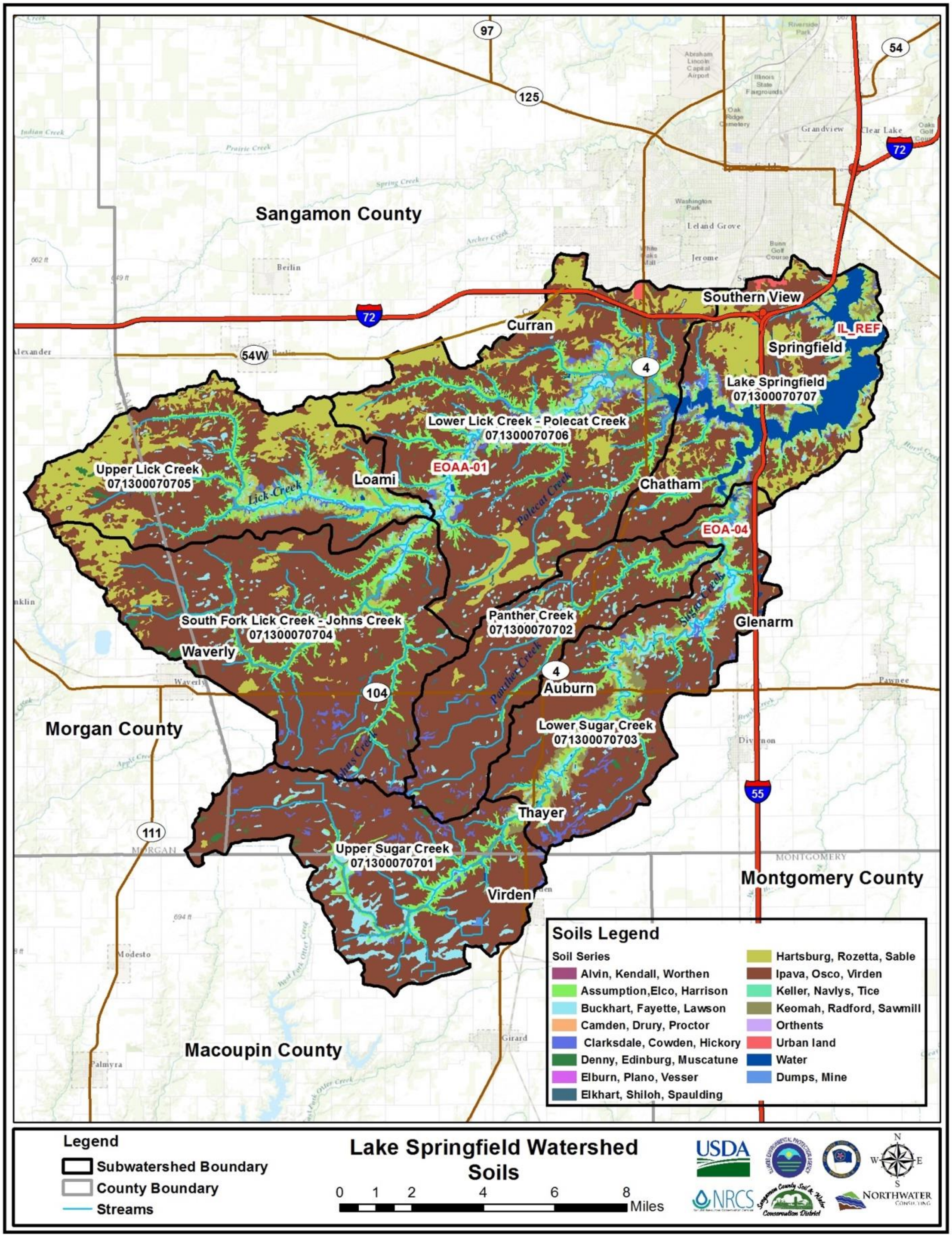


FIGURE 3.3.1 – LAKE SPRINGFIELD WATERSHED SOILS MAP

3.3.2 Hydrologic Soils Groups

The Natural Resources Conservation Service (NRCS) has classified soils into four hydrologic soil groups based on the infiltration capacity and runoff potential of the soil. The soil groups are identified as A, B, C, and D. Group A has the greatest infiltration capacity and least runoff potential, while group D has the least infiltration capacity and greatest runoff potential. **Table 3.3.4** provides a breakdown of hydrologic groupings by sub-watershed and **Figure 3.3.2** indicates the distribution of hydrologic soil groups within the watershed.

The watershed is dominated by Group C soils. This indicates a lower infiltration capacity and a greater runoff potential. **Upper Sugar Creek** and **Panther Creek** sub-watersheds have the highest percentage of Group C soils, 94% and 84%, respectively. **Upper Lick Creek** and **Lake Springfield** sub-watersheds have the highest percentage of Group B soils which are better at infiltration and less susceptible to runoff damage, 46% and 40%, respectively. The **South Fork Lick Creek—Johns Creek** is the only sub-watershed where Group A soils are present (11 acres). The large amount of unclassified soils within the **Lake Springfield** sub-watershed is a result of Lake Springfield.

Soils with high runoff potential have an influence on both flooding and the export of pollutants as a greater percentage of the precipitation that falls on these soils produces runoff.

3.3.3 Cropped C and D Soils

Table 3.3.5 shows that a relatively high percentage of hydrologic group C and D (high runoff potential) soils in the watershed are being cropped. Over 50% of all soils in the watershed are cropped C and D with the highest percentage occurring in the **Upper Sugar Creek** sub-watershed (83%). Of all the cropped area in the watershed, 76% of soils fall into group C and D with the highest percentage (96%) being in the **Upper Sugar Creek** sub-watershed. As a percentage of the group C and D soils in the watershed, 81%, or 94,332 acres, are being cropped. The highest percentage of cropped C and D soils occurs in the **South Fork Lick Creek—Johns Creek** sub-watershed at 92%, followed by **Panther Creek** (91%), **Upper Sugar Creek** (88%) and **Upper Lick Creek** (85%).

TABLE 3.3.4 – HYDROLOGIC SOILS GROUPINGS BY SUB-WATERSHED

Sub-watershed Code	Sub-watershed Name	Sub-watershed Acres	Group A Soils Acres/%		Group B Soils Acres/%		Group C Soils Acres/%		Group D Soils Acres/%		Unclassified Soils Acres/%	
071300070701	Upper Sugar Creek	22,189	0	0.00%	1,291	5.8%	20,845	94%	0	0.00%	26	0.12%
071300070702	Panther Creek	15,072	0	0.00%	2,338	16%	12,728	84%	0	0.00%	7	0.04%
071300070703	Lower Sugar Creek	21,422	0	0.00%	5,111	24%	16,182	76%	0	0.00%	127	0.59%
071300070704	South Fork Lick Creek—Johns Creek	31,203	11	0.04%	7,499	24%	23,666	76%	0	0.00%	13	0.04%
071300070705	Upper Lick Creek	21,782	0	0.00%	9,957	46%	11,716	54%	0	0.00%	75	0.34%
071300070706	Lower Lick Creek—Polecat Creek	36,023	0	0.00%	14,009	39%	21,636	60%	88	0.25%	252	0.70%
071300070707	Lake Springfield	21,470	0	0.00%	8,622	40%	8,829	41%	106	0.49%	3,901	18.17%
	Total	**169,161**	**11**	**0.01%**	**48,828**	**29%**	**115,602**	**68%**	**194**	**0.11%**	**4,400**	**2.60%**

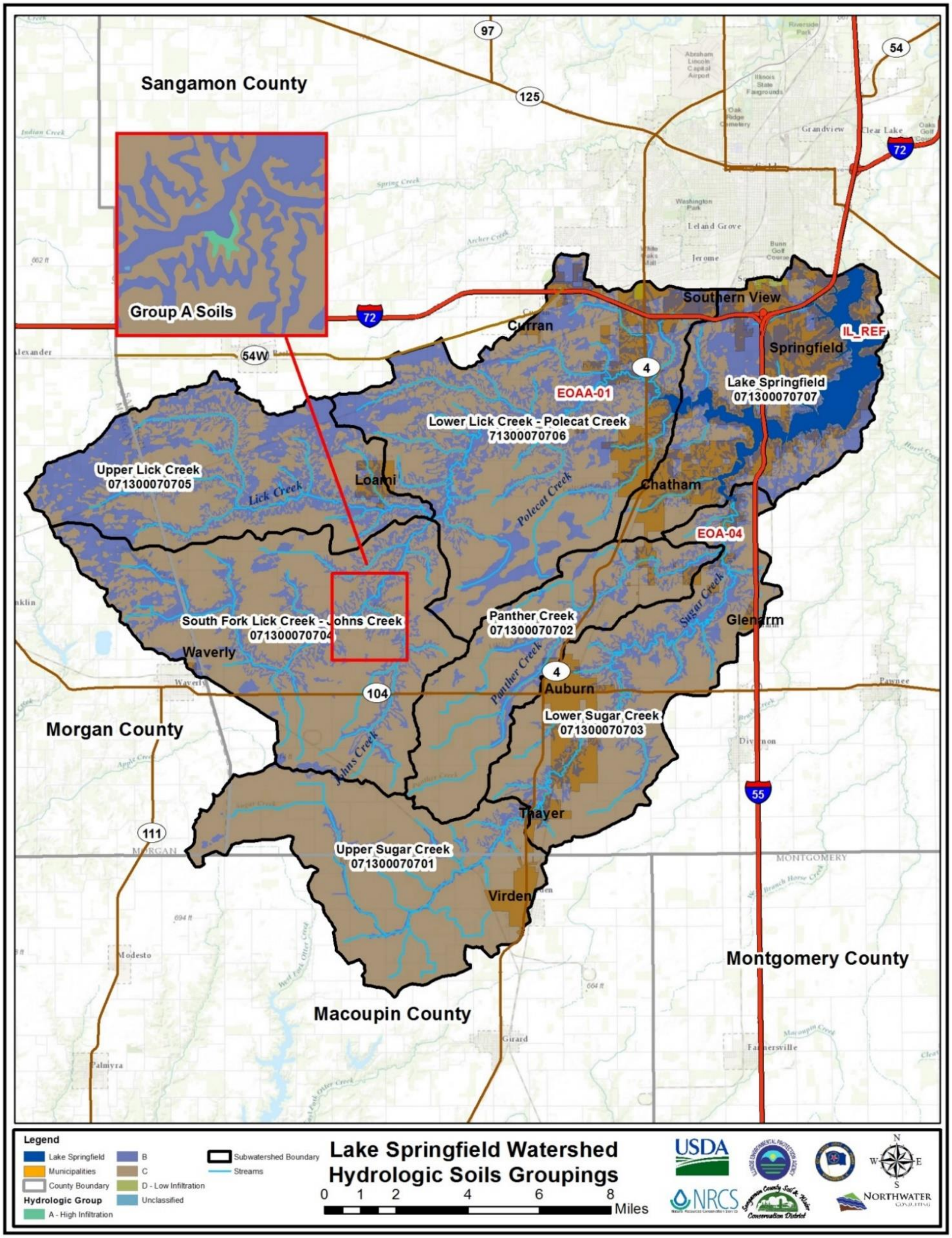


FIGURE 3.3.2 – HYDROLOGIC SOILS GROUPING

TABLE 3.3.5 – CROPPED HYDROLOGIC C AND D GROUP SOILS

Sub-watershed Code	Sub-watershed Name/Acres		Sub-watershed Crop Acres	C & D Group Soils Acres/Cropped Acres		Cropped C & D Soils % of Sub-watershed/ Crop Acres %		Cropped C & D Soils - % of all C & D Group Soils
071300070701	Upper Sugar Creek	22,189	19,130	20,845	18,339	83%	96%	88%
071300070702	Panther Creek	15,072	13,284	12,728	11,538	77%	87%	91%
071300070703	Lower Sugar Creek	21,422	14,988	16,182	12,600	59%	84%	78%
071300070704	South Fork Lick Creek –Johns Creek	31,203	27,762	23,666	21,741	70%	78%	92%
071300070705	Upper Lick Creek	21,782	17,806	11,716	9,940	46%	56%	85%
071300070706	Lower Lick Creek—Polecat Creek	36,023	24,957	21,724	16,415	46%	66%	76%
071300070707	Lake Springfield	21,470	6,595	8,935	3,759	18%	57%	42%
	Total	**169,161**	**124,522**	**115,796**	**94,332**	**56%**	**76%**	**81%**

3.3.4 Highly Erodible Soils

As defined by the NRCS, a highly erodible soil (HEL), or soil map unit, has a maximum potential for erosion that equals, or exceeds, eight times the tolerable erosion rate. The maximum erosion potential is calculated without consideration to crop management or conservation practices, which can markedly lower the actual erosion rate on a given field. Only eleven percent of the soils in the LSW are classified as highly erodible. Most of those HEL acres follow the main tributaries of Lick Creek and Sugar Creek throughout the watershed.

The Lake Springfield Watershed contains 18,296 acres of highly erodible soils or 11% of the total watershed area (**Table 3.3.6**). The greatest concentration of these soils is within the **Lower Lick Creek—Polecat Creek** and **Lake Springfiel**d sub-watersheds (14%).

TABLE 3.3.6 – HIGHLY ERODIBLE SOILS

Sub-watershed Code	Sub-watershed	Sub-watershed Acres	HEL Soils Acres/% HEL	
071300070701	Upper Sugar Creek	22,189	787	4%
071300070702	Panther Creek	15,072	867	6%
071300070703	Lower Sugar Creek	21,422	2,837	13%
071300070704	South Fork Lick Creek—Johns Creek	31,203	2,713	9%
071300070705	Upper Lick Creek	21,782	2,921	13%
071300070706	Lower Lick Creek—Polecat Creek	36,023	5,138	14%
071300070707	Lake Springfield	21,470	3,034	14%
	Total	**169,161**	**18,296**	**11%**

Table 3.3.7 lists both the average and maximum distance of HEL soils to a receiving waterbody by sub-watershed. In the LSW, HEL soils are, on average, 316 feet away from a stream or in the case of the **Lake Springfield** sub-watershed, the Lake itself. In the Lake Springfield sub-watershed, HEL soils are, on average, within only 186 feet of the Lake. In the **Lower Lick Creek-Polecat Creek** sub-watershed, HEL soils, on average, are a minimum 351 feet and a maximum 7,312 feet (1.4 miles) to a receiving stream. Watershed wide, the average maximum distance of HEL soils to a stream or Lake Springfield is 3,702 feet, or 0.7 miles.

TABLE 3.3.7 – HEL SOILS DISTANCE TO STREAMS/LAKE SPRINGFIELD

Sub-watershed Code	Sub-watershed Name	Sub-watershed Area (acres)	Average/Maximum Distance HEL Soils to Stream or Lake Springfield (feet)	
071300070701	Upper Sugar Creek	22,189	432	4,220
071300070702	Panther Creek	15,072	293	3,429
071300070703	Lower Sugar Creek	21,422	309	3,385
071300070704	South Fork Lick Creek—Johns Creek	31,203	371	3,755
071300070705	Upper Lick Creek	21,782	270	1,880
071300070706	Lower Lick Creek—Polecat Creek	36,023	351	7,312
071300070707	Lake Springfield	21,470	186	1,929
	Total/Average	**169,161**	**316**	**3,702**

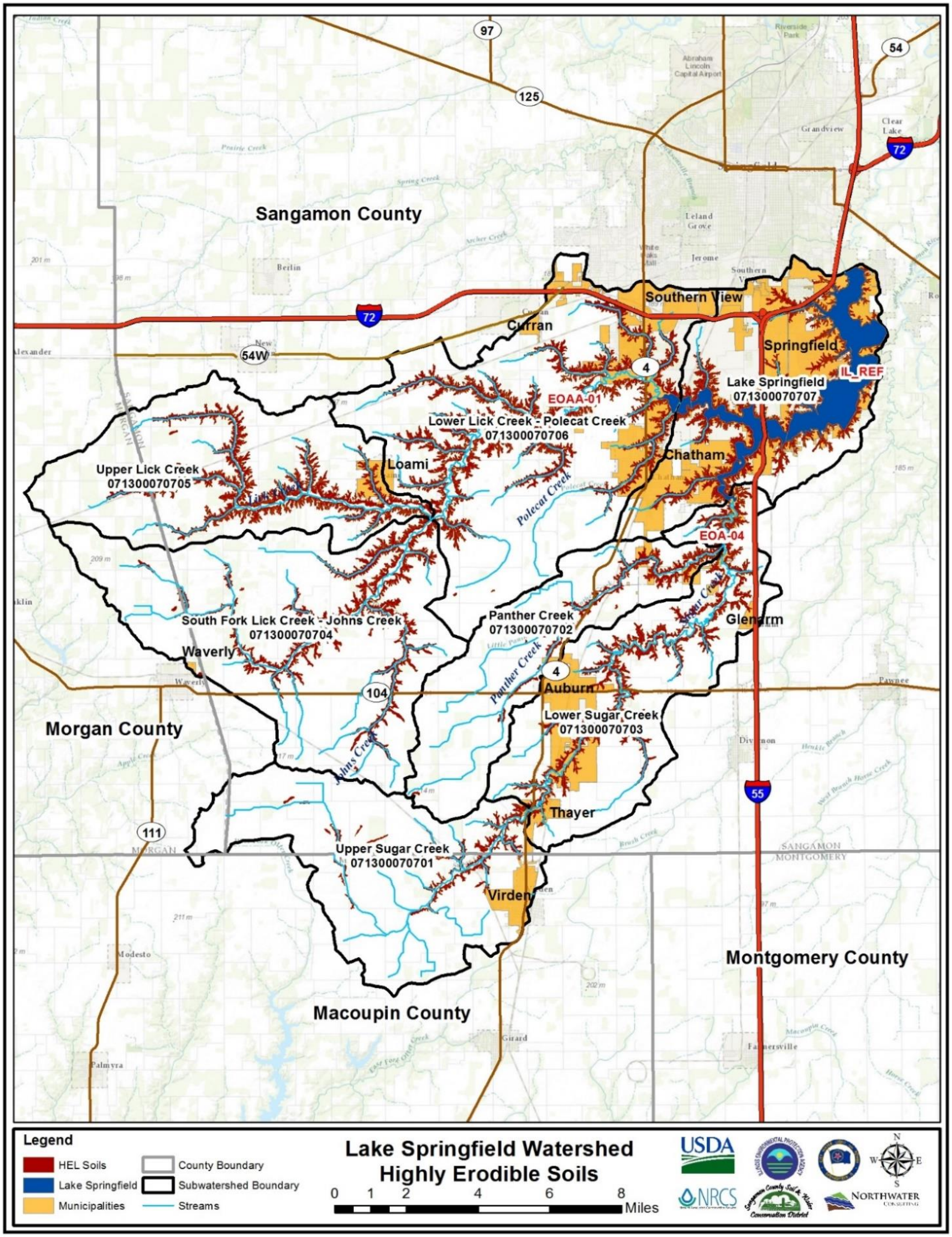


FIGURE 3.3.3 – HIGHLY ERODIBLE SOILS

3.3.5 Cropped Highly Erodible Soils

If a producer has a field identified as HEL and wishes to participate in a voluntary NRCS cost-share program, that producer is required to maintain a conservation system of practices that keeps erosion rates at a substantial reduction of soil loss. Fields that are determined Non-highly Erodible Land (NHEL) by NRCS are not required to maintain a conservation system to reduce erosion.

An analysis was performed on the HEL dataset generated for the watershed to determine any pattern between HEL designations and hydrologic soils groupings. Results indicate that the vast majority of HEL soils are also in the C hydrologic group; 75% or 13,758 acres. Twenty-four percent of all HEL soils are in the B hydrologic group.

The Lake Springfield watershed contains 6,952 acres of cropped HEL soils, or 4% of the entire watershed area. This translates into 38% of all HEL soils being cropped (6,952 acres out of 18,296 HEL acres). **Upper Lick Creek** and **South Fork Lick Creek—Johns Creek** sub-watersheds contain the highest overall quantity of cropped HEL soils as a percentage of sub-watershed area (6%). **South Fork Lick Creek—Johns Creek** and **Panther Creek** sub-watersheds contain the highest quantity of cropped HEL soils as a percentage of the cropped HEL soils at 65% and 56%, respectively.

TABLE 3.3.8 – CROPPED HIGHLY ERODIBLE SOILS BY SUB-WATERSHED

Sub-watershed Code	Sub-watershed	Sub-watershed Acres	HEL Soils by Sub-watershed Acres/%		Cropped HEL Soils by Sub-watershed Acres/%		% HEL Soils
071300070701	Upper Sugar Creek	22,189	787	4%	424	2%	54%
071300070702	Panther Creek	15,072	867	6%	482	3%	56%
071300070703	Lower Sugar Creek	21,422	2,837	13%	960	4%	34%
071300070704	South Fork Lick Creek—Johns Creek	31,203	2,713	9%	1,757	6%	65%
071300070705	Upper Lick Creek	21,782	2,921	13%	1,227	6%	42%
071300070706	Lower Lick Creek — Polecat Creek	36,023	5,138	14%	1,900	5%	37%
071300070707	Lake Springfield	21,470	3,034	14%	202	1%	7%
	Total	**169,161**	**18,296**	**11%**	**6,952**	**4%**	**38%**

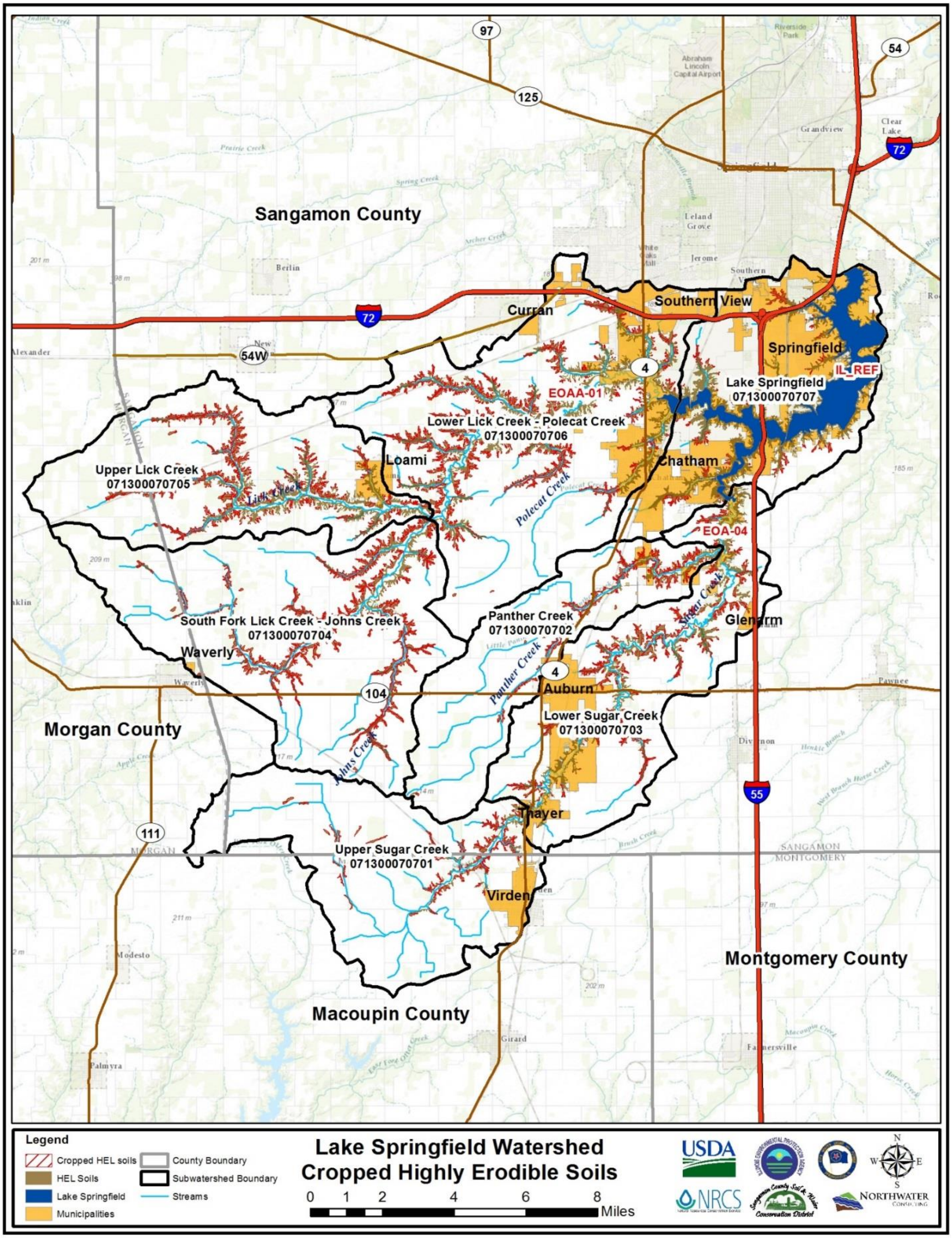


FIGURE 3.3.4 – CROPPED HIGHLY ERODIBLE SOILS

3.3.6 Hydric Soil Groups

Hydric soils are scattered throughout the watershed and are an indicator of former wetlands and potential areas for wetland development. As an indicator of the potential for wetland development, understanding where hydric soils are located can inform wetland restoration and creation activities.

The greatest concentration of hydric soils is found within the **Upper Sugar Creek** and **Panther Creek** sub-watersheds. The **Lower Lick Creek—Polecat Creek** sub-watershed has the highest total acreage of hydric soils. Hydric soils are typically wet and will flood if proper drainage, over land or through field tiles, is not available. There are 17 different hydric soils within the watershed totaling 52,732 acres, or 31%. **Table 3.3.9** provides a breakdown of area of hydric soils by sub-watershed and **Figure 3.3.5** indicates the location of hydric soils within the watershed. The **Lake Springfield** and **Lower Sugar Creek** sub-watersheds have the lowest overall percentage of hydric soils (20% and 23%, respectively) compared to a 31% average for the entire watershed.

TABLE 3.3.9 – HYDRIC SOILS BY SUB-WATERSHED

Sub-watershed Code	Sub-watershed	Sub-watershed (acres)	Hydric Soils Acres/%	
071300070701	Upper Sugar Creek	22,189	8,748	39%
071300070702	Panther Creek	15,072	5,897	39%
071300070703	Lower Sugar Creek	21,422	4,931	23%
071300070704	South Fork Lick Creek—Johns Creek	31,203	9,412	30%
071300070705	Upper Lick Creek	21,782	7,693	35%
071300070706	Lower Lick Creek—Polecat Creek	36,023	11,740	33%
071300070707	Lake Springfield	21,470	4,310	20%
	Total	**169,161**	**52,732**	**31%**

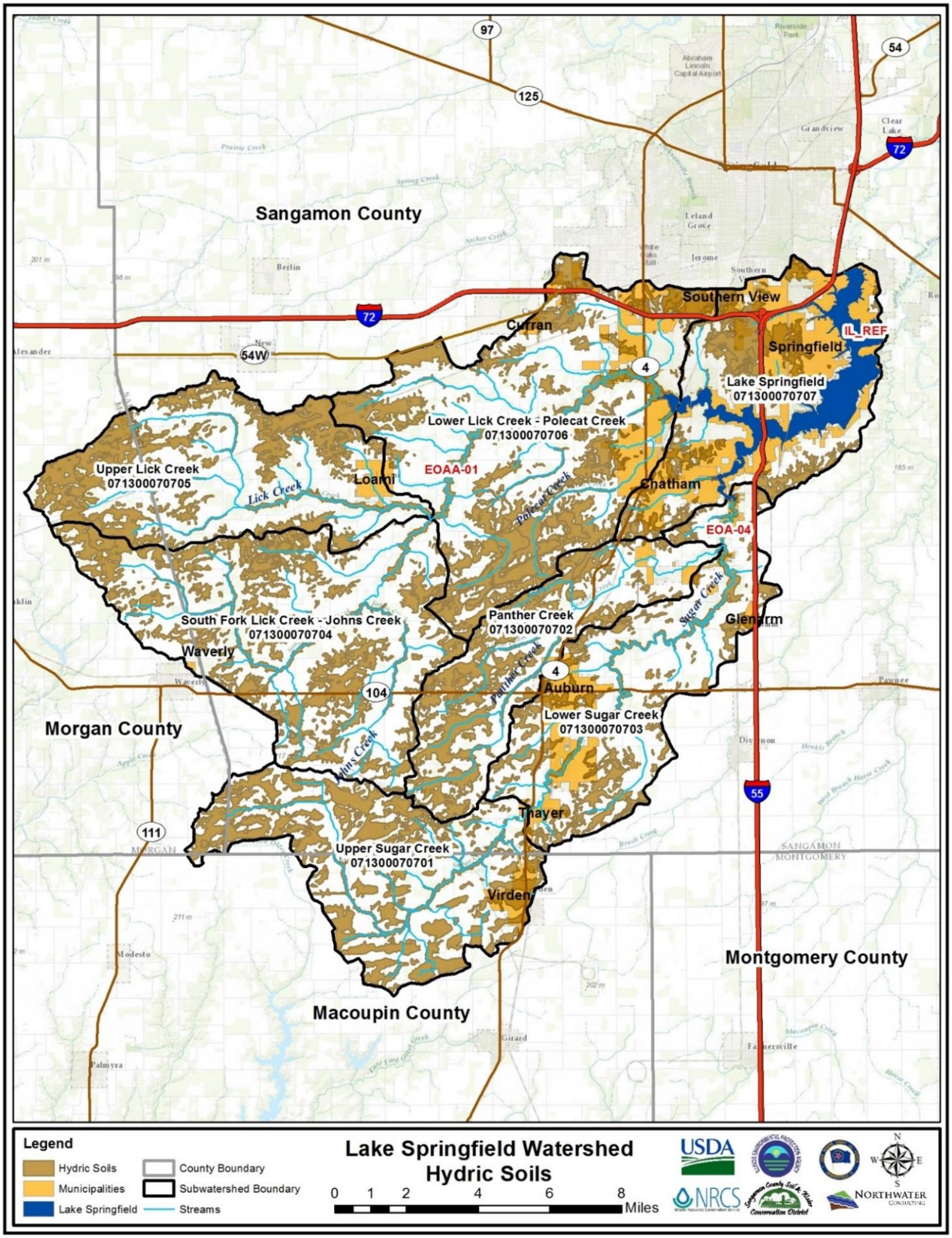


FIGURE 3.3.5 – LAKE SPRINGFIELD WATERSHED HYDRIC SOILS

3.3.7 Tiled Soils

The true extent of tile drainage within this watershed is unknown. To determine the approximate extent of those soils or fields that are tiled, it was assumed that all A & B slopes (0-5%), consisting of silty clay loams or silt loams are likely tiled. In the Lake Springfield Watershed, 94% (117,272 acres) of all cropped soils are thought to be tile drained. As noted in **Table 3.3.10** below, the highest percentage of tiled soils can be found within the **Upper Sugar Creek** sub-watershed (98%) and the **Panther Creek** sub-watershed (96%, although the percentage of tiled soils is high in each sub-watershed as a percentage of total cropped acreage. Tile-drained soils are a source of nitrogen loading in the watershed as high nitrogen concentrations have been observed at tile locations throughout the basin. The large extent of tile-drained cropland, combined with high nitrogen tile concentrations and greater delivery rates, have contributed to a relatively large percentage of the overall nitrogen load in the watershed.

In addition, a significant number of fields have been pattern tiled in the LSW over the past five to ten years. While this is a relatively expensive land improvement, landowners have been frustrated by the surface water damage to their crops from excessive spring rain events year after year and have chosen to invest in field tile.

Although the true extent of drainage tiles is unknown in the watershed, it is likely that the extent to which tiling is occurring has increased. The addition of new tile, as well as land use changes, can contribute to changes in a stream's hydrograph, as less water is absorbed and retained in the soil, leading to increases in rates of runoff. As runoff becomes more rapid, streams respond with more pronounced or extreme fluctuations in flow.

TABLE 3.3.10 – TILED SOILS BY SUB-WATERSHED

Sub-watershed Code	Sub-watershed	Sub-watershed (acres)	Sub-watershed Crop (acres)	Tiled Soils (acres)	% of Sub-watershed	% of Cropped Soils
071300070701	Upper Sugar Creek	22,189	19,130	18,652	84	98
071300070702	Panther Creek	15,072	13,284	12,806	85	96
071300070703	Lower Sugar Creek	21,422	14,988	13,992	65	93
071300070704	South Fork Lick Creek—Johns Creek	31,203	27,762	26,002	83	94
071300070705	Upper Lick Creek	21,782	17,806	16,558	76	93
071300070706	Lower Lick Creek—Polecat Creek	36,023	24,957	23,060	64	92
071300070707	Lake Springfield	21,470	6,595	6,202	29	94
	Total	**169,161**	**124,522**	**117,272**	**69**	**94**

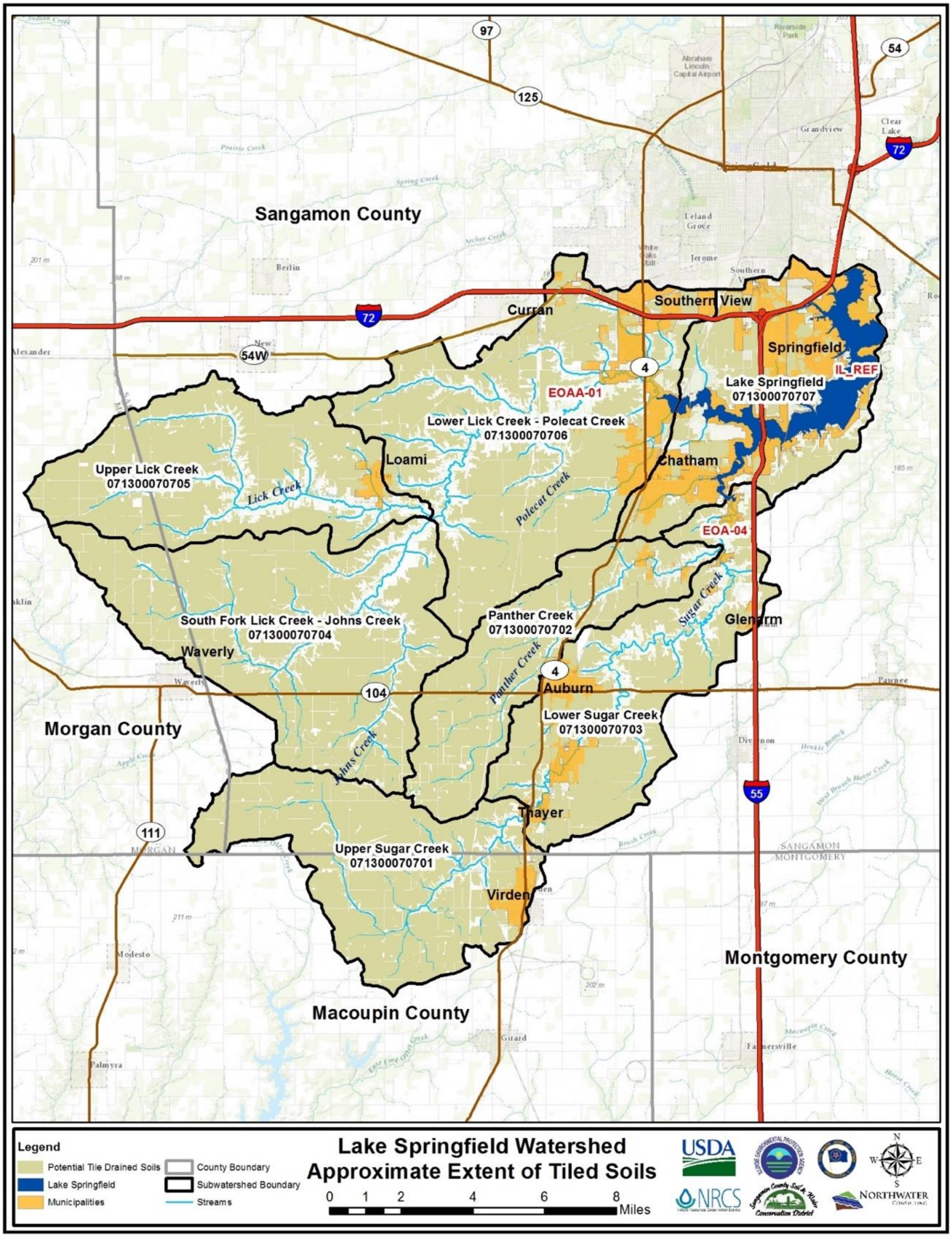


FIGURE 3.3.6 – POTENTIAL TILE-DRAINED SOILS

3.3.8 Soil Suitability for Septic Systems

Outside areas served by a Wastewater Treatment Plant (WWTP), residents within the Lake Springfield watershed use septic systems to manage and treat wastewater. Over 85% of the watershed (146,018 acres) is outside of a wastewater district (**Figure 3.3.7).** Only 14% of the watershed is within an area served by a WWTP.

TABLE 3.3.11 – WASTEWATER TREATMENT PLANT ACRES BY SUB-WATERSHED

Sub-watershed Code	Sub-watershed	Sub-watershed (acres)	Served by a Wastewater Treatment Plant (acres)	% of Sub-watershed	Communities Served
071300070801	Upper Sugar Creek	22,189	1,006	5	Thayer, Virden
071300070802	Panther Creek	15,072	63	0.4	Auburn
071300070803	Lower Sugar Creek	21,422	3,213	15	Springfield/Chatham, Thayer, Auburn, Virden
071300070804	South Fork Lick Creek—Johns Creek	31,203	0	0	N/A
071300070805	Upper Lick Creek	21,782	499	2	Loami
071300070806	Lower Lick Creek—Polecat Creek	36,023	5,533	15	Springfield/Chatham, Loami, Curran
071300070807	Lake Springfield	21,470	12,829	60	Springfield/Chatham, Southern View
	Total	**169,161**	**23,143**	**14**	

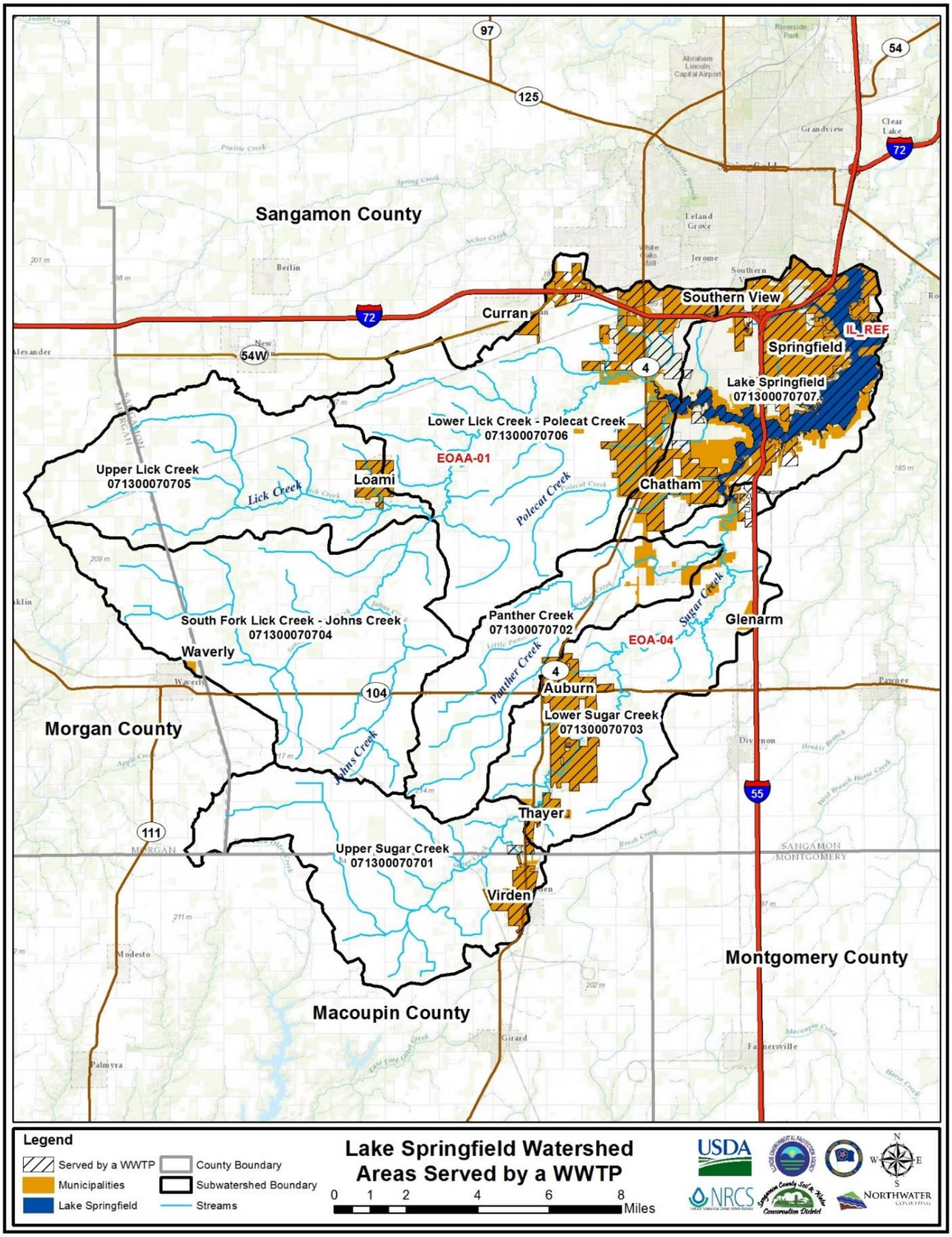


FIGURE 3.3.7 – AREAS SERVED BY WASTEWATER TREATMENT PLANTS

Not all soil types support septic systems; improperly constructed systems can lead to failure and allow leaching of wastewater into groundwater and surrounding waterways. An analysis of the USDA National Soils Dataset indicates that 83%, or 139,943 acres (**Table 3.3.12**) of soils within the watershed, are classified “very limited” with respect to septic suitability. The highest percentage falls within the **Upper Sugar Creek** sub-watershed (97%). This does not necessarily mean that all of these soils are unsuitable for septic but caution should be taken when establishing systems within most of the watershed. **Figure 3.3.8** illustrates the extent of limiting soils for septic fields along with the location of residential areas within the watershed.

Table 3.3.12 – Septic Limiting Soils Acreage by Sub-watershed

Sub-watershed Code	Sub-watershed	Sub-watershed (acres)	Septic Limiting Soils (acres)	% Septic Limiting Soils
071300070701	Upper Sugar Creek	22,189	21,511	97
071300070702	Panther Creek	15,072	13,541	90
071300070703	Lower Sugar Creek	21,422	17,615	82
071300070704	South Fork Lick Creek—Johns Creek	31,203	26,845	86
071300070705	Upper Lick Creek	21,782	17,885	82
071300070706	Lower Lick Creek—Polecat Creek	36,023	29,917	83
071300070707	Lake Springfield	21,470	12,629	59
	Total	**169,161**	**139,943**	**83**

In the Lake Springfield Watershed, it is estimated that of the 6,702 acres of high, medium and low density residential areas, 28%, or 1,854 acres, are likely served by septic systems rather than being connected to a WWTP (Table 3.3.13). Of the 1,854 acres on septic, 52%, or 965 acres, are located on soils classified as limiting or unsuitable for septic systems. All homes in the **South Fork Lick—Johns Creek** sub-watershed are on septic; **Panther Creek** sub-watershed contains the second highest percentage of residential area on septic (86% or 56 acres). Panther Creek and **Upper Sugar Creek** sub-watersheds contain the highest percentage of residential septic area on soils classified as limiting for septic fields. An estimate of the number of individual homes on septic, the number of potentially failing systems, and expected nutrient loading is presented in the following section. It is possible that those septic systems on limiting soils will have the greatest chance or potential to be failing.

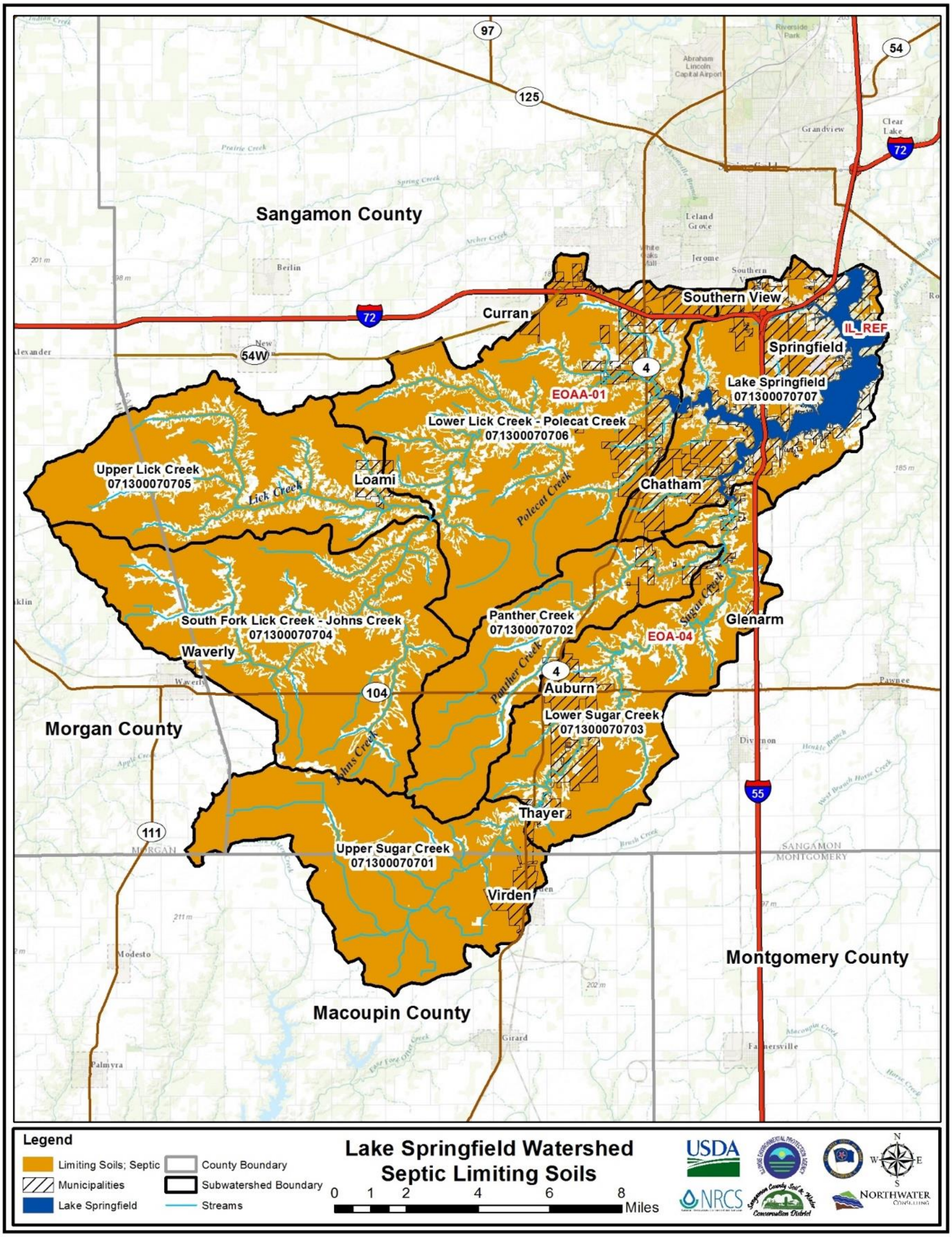


FIGURE 3.3.8 – SEPTIC LIMITING SOILS

TABLE 3.3.13 – RESIDENTIAL ACRES AND % ON SEPTIC SYSTEMS WITH LIMITING SOILS FOR SEPTIC FIELDS

Sub-watershed Code	Sub-watershed	Sub-watershed (acres)	Total Residential (acres)	Total Residential on Septic (acres)	% Residential Area	Residential on Septic & Limiting Soils (acres)	% Residential on Septic & Limiting Soils
071300070701	Upper Sugar Creek	22,189	499	105	21%	93	88%
071300070702	Panther Creek	15,072	65	56	86%	40	70%
071300070703	Lower Sugar Creek	21,422	932	295	32%	158	54%
071300070704	South Fork Lick Creek— Johns Creek	31,203	85	85	100%	55	64%
071300070705	Upper Lick Creek	21,782	234	129	55%	61	47%
071300070706	Lower Lick Creek— Polecat Creek	36,023	1,587	346	22%	189	55%
071300070707	Lake Springfield	21,470	3,299	838	25%	370	44%
	Total	**169,161**	**6,702**	**1,854**	**28%**	**965**	**52%**

Failing septic systems are typically an active source of pollutants. Faulty or leaking septic systems are sources of bacteria, nitrogen, and phosphorus. Typical national septic system failure rates are 10-20%. No failure rates are reported specifically for Illinois (USEPA 2002). However, reported failure rates vary widely depending on the local definition of failure (USEPA 2002).

Using a custom land use layer developed for the watershed and a boundary representing areas served by a WWTP, an estimate was made of the number of individual residential homes using septic systems. A corresponding nitrogen and phosphorus load was then estimated using the Spreadsheet Tool for Estimating Pollution Loading (STEPL). Areas identified as residential and not within an area served by a WWTP were assumed to be served by onsite septic systems at a rate of:

- 1 system per 1.2 acres for low density residential farms
- 1 system per 0.8 acres of medium density residential farms
- 1 system per 0.45 acres of high density residential farms
- 1 system for every 1.5 acres of low density urban residential area
- 1 system for every 0.6 acres of medium density urban residential area
- 1 system for every 0.4 acres of high density urban residential area

It was estimated that there is a total of 3,042 individual homes in the Lake Springfield Watershed on septic systems, and using a failure rate of 15%, 456 are potentially failing. The Lake Springfield sub-watershed contains the highest number of homes on septic as well as the highest number of potentially failing septic systems.

TABLE 3.3.14 – ESTIMATED (15% RATE) FAILING SEPTIC SYSTEMS BY SUB-WATERSHED

Sub-watershed Code	Sub-watershed	Sub-watershed Area (acres)	Estimated Number of Septic Systems	Estimated Number of Failing Septic Systems
71300070701	Upper Sugar Creek	22,189	221	33
71300070702	Panther Creek	15,072	101	15
71300070703	Lower Sugar Creek	21,422	643	96
71300070704	South Fork Lick Creek — Johns Creek	31,203	114	17
71300070705	Upper Lick Creek	21,782	166	25
71300070706	Lower Lick Creek — Polecat Creek	36,023	380	57
71300070707	Lake Springfield	21,470	1,417	213
	Total	**169,161**	**3,042**	**456**

Annual pollution loading from these potentially failing septic systems total 5,556 pounds per year of phosphorus and 14,186 pounds per year of nitrogen based on an average number of people per system of 2.43.

TABLE 3.3.15 – ESTIMATED ANNUAL POLLUTANT LOADS FROM FAILING SEPTIC SYSTEMS

Estimated Number of Septic Systems	Population per Septic System	Septic System Failure Rate (%)	Population on Failing Septic	Phosphorus Load (lbs/yr)	Nitrogen Load (lbs/yr)
3042	2.43	15	1,109	5,556	14,186

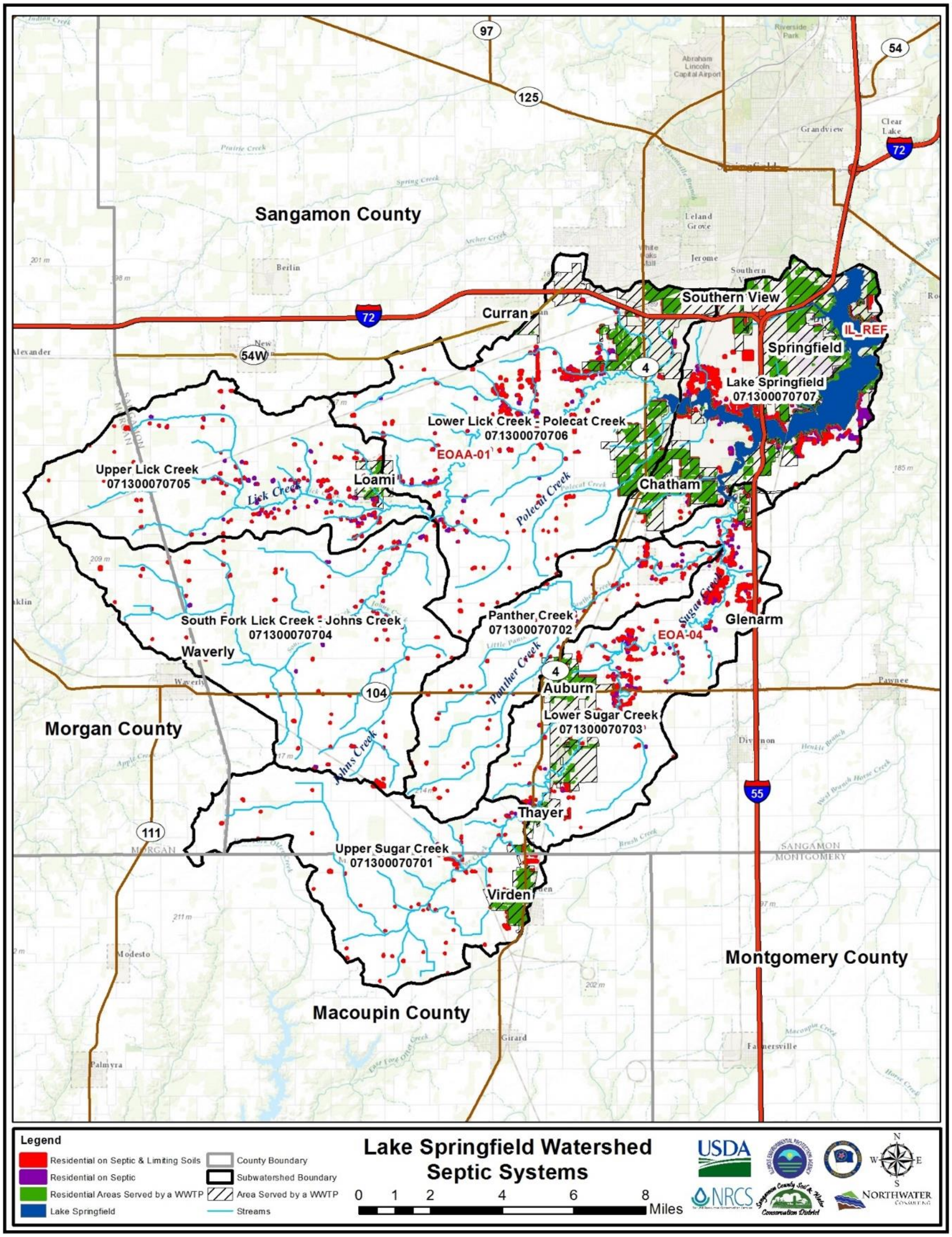


FIGURE 3.3.9 – POTENTIAL FAILING SEPTIC SYSTEMS

3.3.9 Gully Erosion

Gully erosion is the removal of soil along drainage lines by surface water runoff. Once started, gullies will continue to move by head-ward erosion or by slumping of the side walls unless steps are taken to stabilize the disturbance. Gully erosion occurs when water is channeled across unprotected land and washes away the soil along the drainage lines. Under natural conditions, run-off is moderated by vegetation which generally holds the soil together, protecting it from excessive run-off and direct rainfall. To repair gullies, the object is to divert and modify the flow of water by moving into and through the gully so that scouring is reduced, sediment accumulates and vegetation can establish. Stabilizing the gully head is important to prevent damaging water flow and head-ward erosion. In most cases, gullies can be prevented by good land management practices (Water Resources Solutions, 2014).

Gully erosion in the Lake Springfield watershed was evaluated during a watershed windshield survey and using GIS. For those gullies not visible from a road, GIS was used to estimate their location and extent. A line file representing gully length was created in GIS through an interpretation of aerial imagery; based on professional judgment, a conservative average width (1ft), depth (0.5ft) and number of years eroding (1 year) was applied to each gully. For those gullies observed during the watershed windshield survey, dimensions were measured in the field, recorded using GPS and transferred to GIS for analysis.

Total net erosion in tons/year and estimates of nitrogen and phosphorus loading were calculated using GIS and equations derived from IEPA's load reduction spreadsheet; a distance-based delivery ratio was applied to results to account for a gully's distance from a receiving waterbody.

The following equations were used:

Sediment (tons/yr) = Length (ft) * Height (ft) * Lateral Recession Rate (ft/yr) * Soil Weight Dry Density (tons/ft3)

Nitrogen (lbs/yr) = Sediment (tons/yr) * N concentration in soil (0.001 lbs/lb) * 2,000 (lbs/ton) * Corr. Factor

Phosphorus (lbs/yr) = Sediment (tons/yr) * P concentration in soil (0.0006 lbs/lb) X 2,000 (lbs/ton) * Corr. Factor

Delivery Ratio = Gully Distance from Stream ^-0.2069

A total of 40 gullies were observed and measured in the field and the remaining 1,183 gullies were estimated using GIS. Due to the inherent limitations in estimating gully erosion using aerial imagery as well as the inability to access all areas of the watershed during the windshield survey, caution should be taken when interpreting results.

There are an estimated 1,223 actively eroding gullies within the Lake Springfield Watershed delivering an estimated annual sediment load of 3,240 tons, an annual phosphorus load of 3,888 pounds and a nitrogen load of 6,480 pounds. Total gully length is estimated to be 520,843 feet, or 99 miles.

The highest quantities of delivered sediment and nutrients resulting from gully erosion is likely occurring from the **South Fork Lick Creek—Johns Creek** sub-watershed which is responsible for 31% of the overall sediment and nutrient load. The **Lake Springfield** sub-watershed contributes the lowest amount and percentage of loading from gully erosion.

TABLE 3.3.16 – GULLY EROSION AND NUTRIENT LOAD BY SUB-WATERSHED

Sub-watershed Code	Sub-watershed Name	Sub-watershed Area (acres)	Number of Gullies	Gully Length (feet)	Nitrogen Load (lbs/yr)	Phosphorus Load (lbs/yr)	Sediment Load (tons/yr)
71300070701	Upper Sugar Creek	22,189	184	69,643	814	488	407
71300070702	Panther Creek	15,072	94	44,580	484	291	242
71300070703	Lower Sugar Creek	21,422	84	36,921	711	426	355
71300070704	South Fork Lick Creek— Johns Creek	31,203	387	177,714	2,031	1,219	1,016
71300070705	Upper Lick Creek	21,782	141	49,707	694	417	347
71300070706	Lower Lick Creek—Polecat Creek	36,023	314	131,984	1,603	962	802
71300070707	Lake Springfield	21,470	19	10,294	143	86	71
	Total	**169,161**	**1,223**	**520,843**	**6,480**	**3,888**	**3,240**

A more in-depth study of gully erosion and tillage operations in the LSW are included in the LSWMP's future watershed planning efforts.

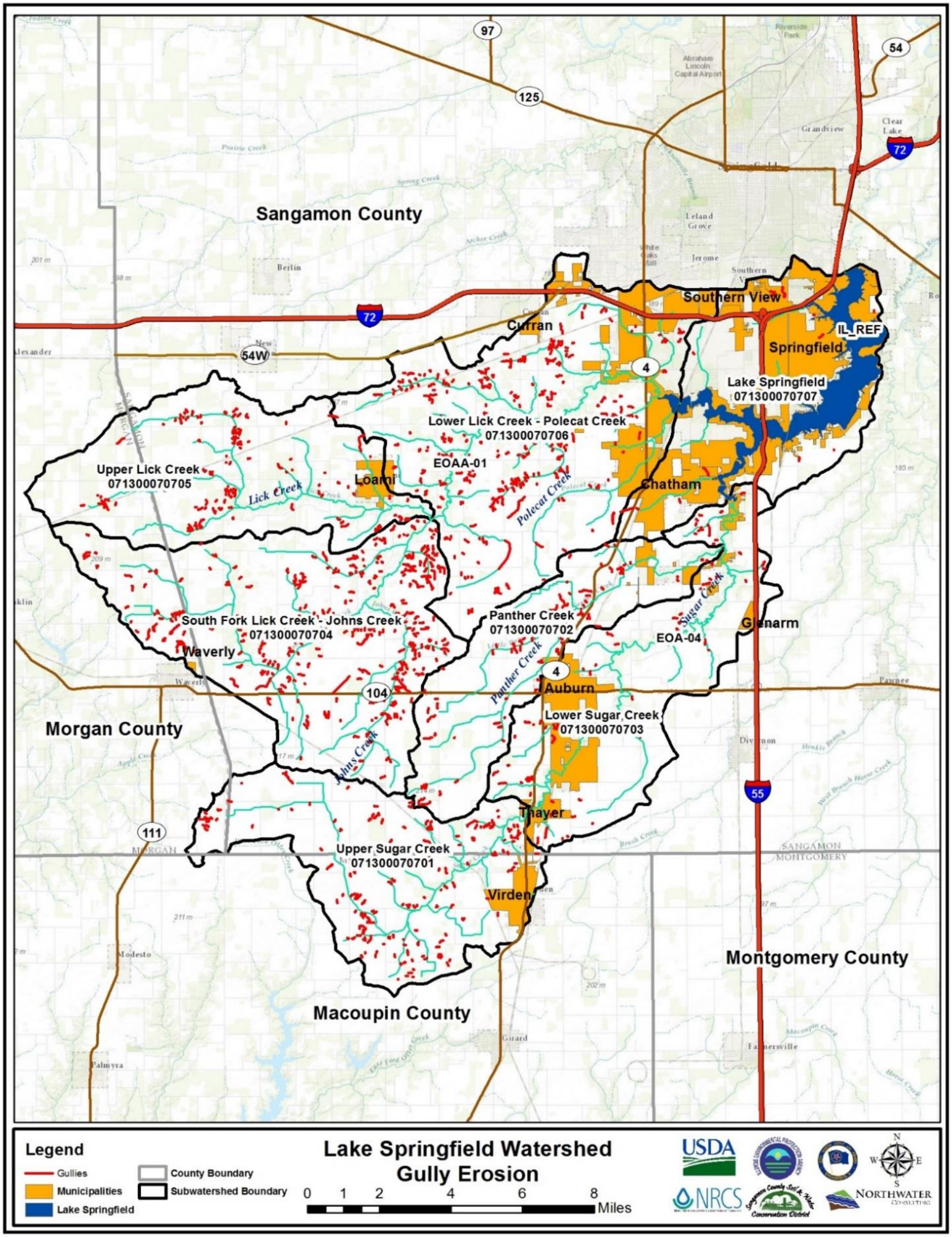


FIGURE 3.3.10 – GULLY EROSION IN THE LAKE SPRINGFIELD WATERSHED

3.3.10 Wetlands

The extent of wetlands in the Lake Springfield Watershed was determined through an analysis of the National Wetlands Inventory (NWI) dataset compared against recent aerial imagery. The NWI dataset was overlaid on aerial imagery and the boundaries of existing wetlands were delineated; those NWI derived wetland boundaries that did not appear to be wetlands anymore were coded as "degraded". Degraded or non-functioning/drained wetlands are located on existing crop ground and in urban/developed areas. These degraded wetland areas may provide the best opportunity for wetland creation and/or restoration as wetlands once existing in these areas.

There are an estimated 1,123 acres (0.66%) of wetlands in the Lake Springfield watershed. The greatest extent and percentage exists within the **Lower Lick Creek—Polecat Creek** sub-watershed which contains 576 acres or 1.6%. Of the 1,123 acres of wetlands, 102 acres (9%) are wetlands that have either been drained or degraded and are no longer functioning as wetlands. **Upper Sugar Creek** and **Panther Creek** sub-watersheds have the highest percentage of degraded or drained wetlands.

TABLE 3.3.17 – WETLAND ACRES BY SUB-WATERSHED

Sub-watershed Code	Sub-watershed	Sub-watershed (acres)	Wetland (acres)	% Sub-watershed	Degraded/ Drained Wetlands	% of Existing Wetlands	% Sub-watershed
71300070701	Upper Sugar Creek	22,189	80	0.36%	12	15.17%	0.05%
71300070702	Panther Creek	15,072	23	0.15%	4	16.33%	0.03%
71300070703	Lower Sugar Creek	21,422	175	0.82%	21	11.96%	0.10%
71300070704	South Fork Lick Creek— Johns Creek	31,203	88	0.28%	13	14.58%	0.04%
71300070705	Upper Lick Creek	21,782	141	0.65%	14	10.22%	0.07%
71300070706	Lower Lick Creek – Polecat Creek	36,023	576	1.60%	35	6.01%	0.10%
71300070707	Lake Springfield	21,470	40	0.18%	3	7.63%	0.01%
	Total	**169,161**	**1,123**	**0.66%**	**102**	**9.06%**	**0.06%**

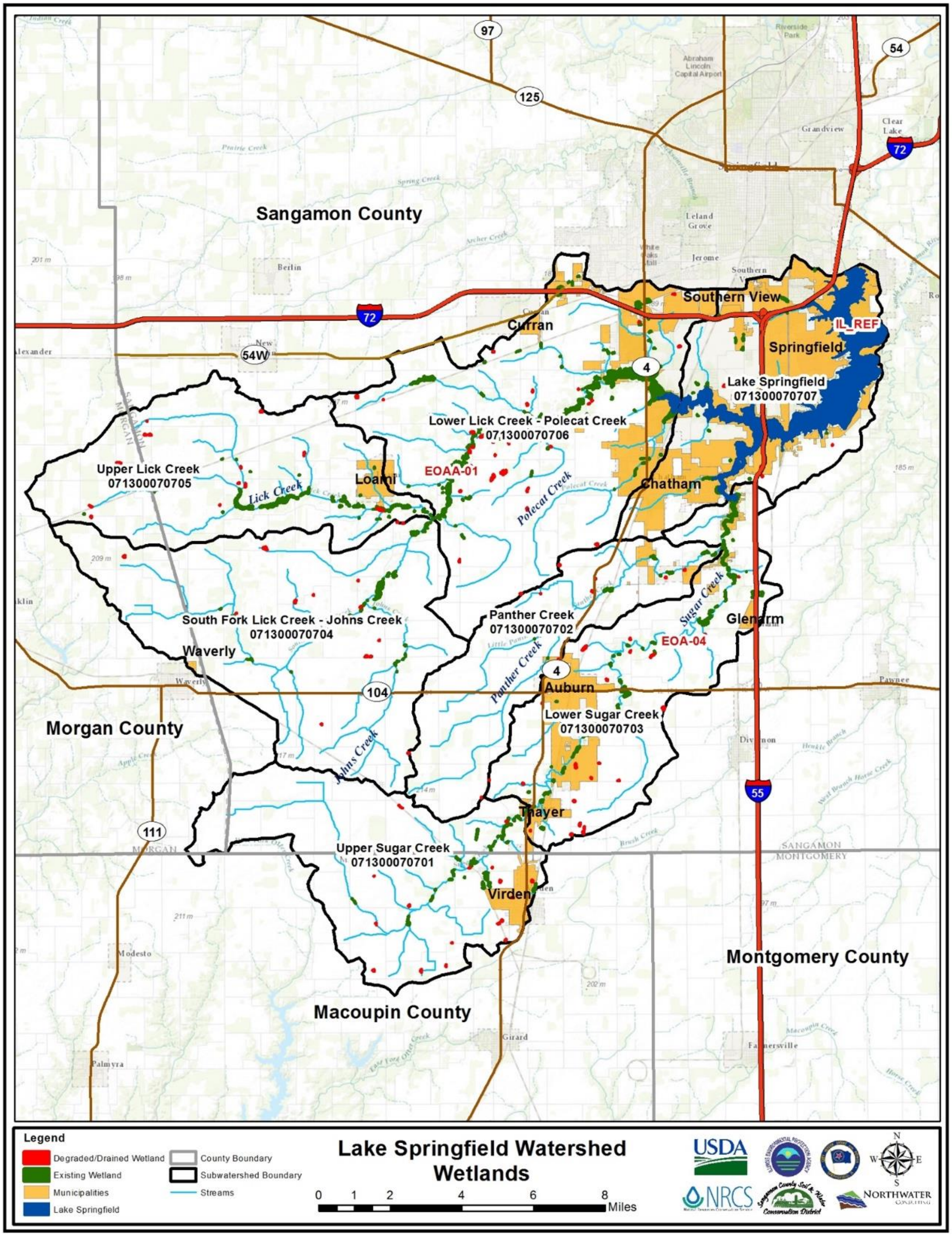


FIGURE 3.3.11 – EXISTING AND DEGRADED/DRAINED WETLANDS

3.4 Watershed Jurisdictions

While there are several federal, state, county, and local units of government that have specific jurisdictions and responsibilities for watershed protection and governance, there are also several special districts which are responsible for one specific service (i.e., school districts, road and bridge districts, public libraries, fire protection districts, etc.) for the well-being of all of the watershed residents living within their defined boundaries of these districts. (**Table 3.4.1**) Almost all of these units of government and special districts are supported with taxes (income, sales, motor fuel, property, special use taxes, etc.) for the services or products they provide. Property owners' tax bills from their respective county include a breakdown of the taxes being assessed by county and local governments and special districts in which they own property. Other taxes (state, county, local sales taxes, motor fuel taxes, etc.) are added to the price of products purchased or services rendered within a specific jurisdiction.

As watershed boundaries cross multiple jurisdictions, collaboration and coordination is required for outreach, funding and to satisfy requirements and priorities of varying agencies.

TABLE 3.4.1 – UNITS OF GOVERNMENT – WATERSHED JURISDICTIONS

<table>
<tr><th>Jurisdiction</th><th colspan="4">Description</th></tr>
<tr><td>Federal</td><td colspan="4">US Army Corps of Engineers (USACE)
US Department of Agriculture (USDA)
• USDA Natural Resources Conservation Service (NRCS)
• USDA Farm Service Agency (FSA)
US Department of Transportation (USDOT)
US Environmental Protection Agency (USEPA)
US Fish and Wildlife Service (USFWS)</td></tr>
<tr><td>State</td><td colspan="4">IL Department of Agriculture (IDOA)
IL Department of Natural Resources (IDNR)
IL Environmental Protection Agency (IEPA)
IL Nature Preserves Commission (INPC)</td></tr>
<tr><td>County</td><td colspan="4">County Board – Sangamon, Macoupin, Morgan
County Highway Department – Sangamon, Macoupin, Morgan
County Public Health Department, Sangamon, Macoupin, Morgan
Springfield Sangamon Regional Planning Commission
Morgan County Regional Planning Commission
West Central Development Council, Inc. (includes Macoupin County)</td></tr>
<tr><td>Township</td><td>Sangamon County
• Auburn
• Ball
• Capital
• Chatham
• Curran
• Divernon</td><td>Sangamon County
• Loami
• Maxwell
• New Berlin
• Talkington
• Woodside</td><td>Macoupin County
• Girard
• North Otter
• North Palmyra</td><td>Morgan County
• Alexander
• Franklin East
• Waverly</td></tr>
</table>

Jurisdiction	Description	
Local	**City** • Auburn • Springfield • Virden • Waverly	**Village** • Chatham • Curran • Loami • Southern View • Thayer
Special Districts	Airport Authorities - 1 Civic Center Authorities - 1 Drainage Districts - 0 Fire Protection Districts - 14 Library Districts - 6 Mass Transit Districts - 1 Multi-township Districts - 3	Park Districts - 3 Road Districts - 5 Road and Bridge Districts - 11 Sanitary Districts - 2 School Districts - 7 Soil and Water Conservation Districts - 3 Water Service Districts - 3

3.4.1 Federal and State Government Jurisdictions

At the federal level, the **US Army Corps of Engineers (USACE)** and **USEPA** are the key regulatory agencies for protection of all open waterbodies, wetlands and floodplains throughout the watershed.

Both of these agencies are responsible for enforcement of the Clean Water Act. The Federal Water Pollution Control Act of 1948 was the first major U.S. law to address water pollution. As amended in 1972, the law became commonly known as the Clean Water Act (CWA).

The 1972 CWA amendments:

- Established the basic structure for regulating pollutant discharges into the waters of the United States.
- Gave USEPA the authority to implement pollution control programs such as setting wastewater standards for industry.
- Maintained existing requirements to set water quality standards for all contaminants in surface waters.
- Made it unlawful for any person to discharge any pollutant from a point source into navigable waters, unless a permit was obtained under its provisions.
- Funded the construction of sewage treatment plants under the construction grants program.
- Recognized the need for planning to address the critical problems posed by nonpoint source pollution.

The USACE is responsible under Section 404 of the CWA for wetland regulation and buffer or wetland mitigation requirements when land development impacts wetlands. It also regulates land development affecting water resources such as rivers, streams, lakes, wetlands and floodplains when "Waters of the U.S." (WOTUS) are involved. That includes any wetland or river/stream that is hydrologically connected to navigable waters.

USDA Natural Resources Conservation Service (NRCS) is the primary federal agency that works with private landowners to help them conserve, maintain and improve their natural resources to implement conservation practices that clean the air, conserve and clean the water, prevent soil erosion and create and protect wildlife habitat. They are also responsible for providing technical assistance to the USDA Farm Service Agency for sodbuster, wetland and highly erodible land determinations and compliance issues.

US Fish and Wildlife Service (USFWS) and Illinois Department of Natural Resources (IDNR), along with Illinois Nature Preserves Commission (INPC) and Forest Preserve Districts, are responsible for protecting federal and state threatened and endangered species in the watershed which are often found on land that contains wetlands, lakes, ponds, and streams.

US Department of Transportation (USDOT) – USDOT's mission is to serve the United States by ensuring a fast, safe, efficient, accessible and convenient transportation system that meets our vital national interests and enhances the quality of life of the American people, today and into the future. Resources provided by USDOT include:

Highway - **Federal Highway Administration (FHWA)**

- Administers Federal-Aid Highway Program, which provides federal financial assistance to the States to construct and improve the National Highway System, urban and rural roads, and bridges.
- Provides funds for general improvements and development of safe highways and roads.

Aviation - **Federal Aviation Administration (FAA)**

- Operates a network of airport towers, air route traffic control centers, and flight service stations.
- Develops air traffic rules.
- Allocates the use of airspace.
- Provides for the security control of air traffic to meet national defense requirements.
- Constructs or installs visual and electronic aids to air navigation.
- Promotes aviation safety internationally.

Bicycles and Pedestrians - FHWA's Office of Safety

- Develops projects, programs and materials for use in reducing pedestrian and bicyclist fatalities.

Motorcycles – Federal Highway Administration (FHWA)

- Identifies effective motorcycle safety countermeasures.
- Promotes roadway maintenance and design practices that account for motorcycle-specific safety concerns
- Maintains a research program that supports an improved motorcycle riding environment on American highways.

Public Transit - **National Highway Traffic Safety Administration (NHTSA)**

- Sets and enforces safety performance standards for motor vehicles and equipment.
- Investigates safety defects in motor vehicles, sets and enforces fuel economy standards.
- Helps states and local communities reduce the threat of drunk drivers.
- Promotes the use of safety belts, child safety seats and air bags.
- Investigates odometer fraud.
- Establishes and enforces vehicle anti-theft regulations.
- Provides consumer information on motor vehicle safety topics.

Pipelines and HazMat - **Pipeline and Hazardous Materials Safety Administration (PHMSA)**

- Oversees the safety of more than 800,000 daily shipments of hazardous materials in the United States and 64 percent of the nation's energy that is transported by pipelines.
- Dedicated solely to safety by working toward the elimination of transportation-related deaths and injuries in hazardous materials and pipeline transportation.
- Promotes transportation solutions that enhance communities and protect the natural environment.

Railroads - **Federal Railroad Administration (FRA)**

- Promotes safe and environmentally-sound rail transportation.

- Ensures railroad safety throughout the nation.
- Employs safety inspectors to monitor railroad compliance with federally-mandated safety standards including track maintenance, inspection standards and operating practices.
- Conducts research and development tests to evaluate projects in support of its safety mission and to enhance the railroad system as a national transportation resource.
- Administers public education campaigns on highway-rail grade crossing safety and the danger of trespassing on rail property.

Research - Federal Highway Administration **(FHA)**

- Manages a comprehensive research, development, and technology program.

Trucking and Motor coaches - **Federal Transit Administration (FTA)**

- Ensures safety in motor carrier operations through strong enforcement of safety regulations, targeting high-risk carriers and commercial motor vehicle drivers.
- Improves safety information systems and commercial motor vehicle technologies; strengthening commercial motor vehicle equipment and operating standards
- Increases safety awareness.
- Helps plan, build, and operate transit systems with convenience, cost and accessibility in mind.
- Provides leadership and resources for safe and technologically advanced local transit systems
- Assists in the development of local and regional traffic reduction.

Illinois Environmental Protection Agency (IEPA) The Illinois General Assembly was the first state legislature in the nation to adopt a comprehensive Environmental Protection Act. It was signed into law by Governor Richard Ogilvie and became effective on July 1, 1970. As a part of that Act, the Illinois Environmental Protection Agency was created.

The mission of the IEPA is to safeguard environmental quality, consistent with the social and economic needs of the State, so as to protect health, welfare, property and the quality of life for its citizens. By partnering with businesses, local governments and citizens, Illinois EPA is dedicated to continued protection of the air we breathe and our water and land resources.

The CWA made it unlawful to discharge any pollutant from a point source into navigable waters, unless a permit was obtained. USEPA's National Pollutant Discharge Elimination System (NPDES) permit program controls discharges. The Illinois Environmental Protection Agency (IEPA) Bureau of Water is responsible for regulating wastewater and stormwater discharges to rivers, streams and lakes through the NPDES program. There are two phases to this program. Point sources are discrete conveyances, such as pipes or man-made ditches. Individual homes that are connected to a municipal system, use a septic system, or do not have a surface discharge do not need an NPDES permit; however, industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters.

The NPDES Phase 1 Stormwater Program applies to large and medium-sized Municipal Separate Storm Sewer Systems (MS4s), along with several industrial categories and construction sites where 5 acres or more of land is hydrologically disturbed. The NPDES stormwater program, enacted in 1990, regulates some stormwater discharges from three potential sources: municipal separate storm sewer systems (MS4s), construction activities, and industrial activities. Operators of these sources might be required to obtain an NPDES permit before they can discharge stormwater, which is designed to prevent stormwater runoff from washing harmful pollutants into local surface waters.

The NPDES Phase II program, which includes all municipalities with small, medium and large MS4s, additional industrial coverage and construction activities which hydrologically disturb more than one acre of land, are required to establish a series of BMPs and measure goals for each minimum control measure.

In addition, IEPA is responsible for regulating Animal Feeding Operations (AFOs) defined as agricultural operations where animals are kept and raised in confined situations. An AFO is a lot or facility (other than an aquatic animal production facility) where the following conditions are met:

- Animals have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period and;
- crops, vegetation, forage growth, or post-harvest residues are not sustained in the normal growing season over any portion of the lot or facility.

AFOs that meet the regulatory definition of a concentrated animal feeding operation (CAFO) are regulated under the NPDES permitting program. The NPDES program regulates the discharge of pollutants from point sources to waters of the U.S. CAFOs are point sources, as defined by the CWA Section 502(14) established in the CAFO regulation.

Illinois Department of Agriculture (IDOA) – This state agency registers pesticides; tests, certifies and licenses pesticide applicators; and investigates alleged cases of pesticide misuse. The Bureau of Environmental Programs also operates a statewide agricultural pesticide container-recycling program and operates a pesticide laboratory that tests groundwater, soil, and plant samples for pesticide residues and ensures accurate marketing and labeling of pesticides and enforces the proper storage, containment, and disposal of pesticides and fertilizers. IDOA also administers the Livestock Management Facilities Act that regulates the siting and construction of livestock production facilities across the state and includes requirements regarding facility setback distances, facility design and construction standards, waste management plans, and livestock manager certification. This agency works with other state agencies, planning commissions, and county governments to help reduce the extent to which farmland is affected by conversion or development. IDOA oversees the groundwater monitoring well network and IEPA's public water supply well pesticide-monitoring sub-network to determine the occurrence of pesticides in groundwater and whether there are significant, spatial or temporal trends in pesticide concentrations.

Units of local government with jurisdiction in the Lake Springfield Watershed and serving its residents include County Board of Supervisors or Commissioners representing Sangamon, Macoupin, and Morgan Counties, respectively, township supervisors, township road commissioners, local city and village elected officials, along with various special districts primarily supported by specific taxes for their services.

3.4.2 Local Jurisdictions

The Lake Springfield Watershed covers portions of three counties, includes two cities, five villages and one unincorporated community (**Table 3.4.2 and Table 3.4.3**). The majority of the watershed is within Sangamon County or 87%; Macoupin and Morgan County make up the remaining 13%. Cities or Villages cover 15% of the watershed, or 25,455 acres. The portion of the City of Springfield which is in the LSW covers 16,157 acres, making it the largest city in the watershed, or 9.5% of the entire watershed. Springfield is responsible for 63% of all the municipal land area in this watershed. Springfield falls under the home rule designation. Home rule powers are granted pursuant to Article VII, Section 6, of the Illinois Constitution. All counties with a chief executive officer elected by the people and any municipality with a population of more than 25,000 residents are automatically home rule units of government. When a county becomes a **home rule** unit, the county legislature inevitably runs into jurisdictional conflicts with municipalities within the county. The Illinois Constitution requires that when a home rule county and municipal ordinance conflict, "the municipal ordinance will prevail within its jurisdiction."

SPRINGFIELD'S WATER TREATMENT AND POWER PLANT COMPLEX

As the largest municipally-owned lake in Illinois, the City of Springfield owns and maintains Lake Springfield, along with its electric generation and water filtration plants located at the northwest end of the Lake. Of the 110 tracts of land (approximately 8,500 acres) purchased by the City, in the 1930s, at a cost of about $109 per acre for construction of the Lake, there are 4,300 acres of marginal land and 57 miles of shoreline owned by the City of Springfield and managed by City Water, Light and Power (CWLP).

Of the 4,300 acres of marginal land, there are 728 residential leases and 16 leases for clubs (Anchor Boat Club, Aqua Sports Club, Blue Ridge Club, DAV Club, Elks Club, Island Bay Yacht Club, Jesters Club, KC Lake Club, Lake Press Club, Firefighters/Postal Club, FOP Lake Lodge, Prop Club, Sangamon Surf Club, Springfield Motor Boat Club, Springfield Ski and Boat Club, TRN Club) and camps around the perimeter of the Lake. 21.6 miles of the 57 total shoreline miles, are part of the lake leases to private homeowners and Lake clubs. The remaining shoreline is made up of natural area, public parks and CWLP administrative property.

This impoundment was built over a 3-year period from 1930 to 1933 in response to the need for a reliable water supply for an ever-growing Springfield community. A $2.5 million bond issue was passed in 1930 for the construction of Lake Springfield as a new water supply. Of the 16 sites examined by engineers for the lake, the most cost-effective and feasible plan involved placing a dam on Sugar Creek, a tributary to the South Fork of the Sangamon River. Lick Creek is a second major tributary which joins Sugar Creek at a point just west of the Interstate 55 (I-55) bridge which crosses Lake Springfield today.

The Village of Chatham is the second largest municipality in the watershed followed by the cities of Auburn and Virden. It is important to note that only small areas of Waverly, Curran, and Southern View are contained within the watershed and a small section of Virden is located outside of the watershed.

Towns are municipalities that were created prior to the 1872 passing of the Cities and Villages Act, which set out standards and guidelines for incorporation. The largest remaining difference is that villages must have exactly six trustees, whereas cities may have six or more aldermen. The minimum size for incorporation as a city in Illinois is 2,500 people. All incorporated municipalities, regardless of type, are independent of each other, and cannot overlap. Villages can be created by referendum under the general state law or by special state charter.

TABLE 3.4.2 – COUNTY ACRES AND WATERSHED PERCENTAGE

County	Area (acres)	% of Watershed
Sangamon	146,656	87%
Macoupin	11,936	7%
Morgan	10,568	6%

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TABLE 3.4.3 – UNITS OF GOVERNMENT JURISDICTIONS/ACRES/% OF SUB-WATERSHED

Sub-watershed Code	Sub-watershed	Sub-watershed (acres)	Cities	Villages	Unincorporated	Area (acres)	% Sub-watershed
071300070701	Upper Sugar Creek	22,189	Virden	Thayer	N/A	1,022	5%
071300070702	Panther Creek	15,072	Auburn	Chatham	N/A	718	5%
071300070703	Lower Sugar Creek	21,422	Springfield Auburn Virden	Chatham Thayer	Glenarm	3,442	16%
071300070704	South Fork Lick Creek—Johns Creek	31,203	Waverly	N/A	N/A	19	0.1%
071300070705	Upper Lick Creek	21,782	N/A	Loami	N/A	544	2%
071300070706	Lower Lick Creek—Polecat Creek	36,023	Springfield	Chatham Curran Loami	N/A	5,672	16%
071300070707	Lake Springfield	21,470	Springfield	Chatham Southern View	N/A	14,039	65%
	Total	**169,161**				**25,455**	**15%**

3.4.3 Local Roles and Responsibilities

The **Sangamon County Board** holds all the powers of the County that are not assigned to elected officials. Overall, the Board is responsible for the financial management of all County funds, and exercises numerous regulatory powers, including zoning, public health, and building safety. Of the 29 Sangamon County Board districts, the LSW is represented by elected board members from nine of those in Districts #5, 6, 7, 13, 14, 15, 25, 26, and 29 and operates on the committee system. The County Board has 13 standing committees. All items concerning county government are discussed in depth by standing and special committees, and because not all issues require County Board approval, many items are resolved at the committee level. The County Administrator is the Chief Appointed Official for county government, is responsible for the day-to-day operation and administration of county government, and has direct supervision and oversight of more than 25 county departments. The County Administrator is responsible for the coordination and construction of the County's annual budget and the annual property tax levy, serves as the chief liaison between the County Board and county-wide elected officials, and also serves as the chief negotiator and strategist for the County Board on all budget, personnel, labor relations and economic development matters. The County Administrator also oversees major projects initiated by and for the County Board.

Macoupin County and Morgan County have comparable county board structures with similar roles and responsibilities. Macoupin County Board consists of 18 members (two from each District) and has 12 standing committees responsible for county government administration, services and oversight. The Morgan County Commissioners are a group of three (3) elected officials charged with administering their county government. Both of these county boards act as the executive of the local government, levy local taxes, administer county governmental services covering economic development, emergency management, Veterans' assistance, prisons, courts, public health oversight, property registration and assessment, building code enforcement, housing authority, animal control and public works such as road maintenance.

Springfield-Sangamon County Regional Planning Commission (SSCRPC) serves as the joint planning body for the City of Springfield and Sangamon County. Along with this on-going responsibility, the Planning Commission staff works with many other public and semi-public agencies throughout the area to promote orderly growth and redevelopment, conducting numerous research studies and planning projects each year. The Commission that oversees this work is made up of 17 members who include representatives from the Sangamon County Board, Springfield City Council, special units of government, and 6 appointed citizens from the city and county.

The Commission's Executive Director is appointed by the Executive Policy Board of the Commission and confirmed by the Sangamon County Board. Through the efforts of its professional staff, the Planning Commission provides overall planning services related to land use, housing, recreation, transportation, economics, and the environment, and conducts many special projects and programs.

The SSCRPC prepares area-wide planning documents and assists the county, cities, and villages, as well as special districts, with planning activities. For Springfield and Sangamon County, the planning staff reviews all proposed subdivisions, makes recommendations on all City and County zoning and variance requests, and serves as Floodplain Administrator.

The Commission also serves as the Metropolitan Planning Organization for the region, coordinating transportation planning efforts through the Springfield Area Transportation Study (SATS). SATS was initiated in 1964 as a cooperative effort by interested local, state and federal agencies to solve existing transportation problems and to provide a planned program to guide the future development of the urbanized area so that future transportation problems would be minimized.

The planning area covered by SATS is Springfield, Chatham and parts of Sangamon County, including the communities of Clear Lake, Curran, Grandview, Jerome, Leland Grove, Riverton, Rochester, Sherman, Southern View, Spaulding, and a small section of Williamsville. SATS works through a Policy Committee and a Technical Committee. Six jurisdictions are directly involved as voting members on both committees (SSCRPC, Sangamon County, City of Springfield, Village of Chatham, Springfield Mass Transit District and the IL Department of Transportation's Region 4, District 6). Springfield and Chatham are represented on the Policy Committee by virtue of their population.

The SSCRPC also acts as Census Coordinator and local A-95 review clearinghouse, processing and reviewing all Federally-funded applications for the County. The A-95 review clearinghouse refers to The Intergovernmental Cooperation Act of 1968 which enables the President and the Office of Management and Budget (OMB) the authority for establishing rules and regulations designed to affect a coordinated area and community development assistance policy. OMB Circular #A-95 requires all applications for federal monies from this Act to be reviewed by a state, regional or metropolitan clearinghouse.

The Planning Commission maintains existing base maps, Census tract maps, township and zoning maps and the road name map for the County. The Executive Director also oversees Sangamon County's Department of Zoning and Building Safety, and serves as the Plats Officer for Sangamon County, Springfield and some other municipalities. Divisions of land must be reviewed by the Plats Officer to ensure compliance with the State Plat Act and local zoning and subdivision regulations.

Morgan County Regional Planning Commission (MCRPC) was organized by the County Board in 1996 and the by-laws of the Commission established the following purposes for its service to:

- identify and evaluate mutual area-wide problems affecting the sound growth and development of the region;
- develop programs to fill service voids within the region;
- assist in the development of local and regional policies concerning the solution of intergovernmental problems;
- provide a forum for the exchange of knowledge that will strengthen and improve the intergovernmental concept of planning and development;
- conduct research and make available information on regional affairs and cooperation;
- assist in the development of local and regional resources, including the procurement and administration of state, federal, and foundation grants; and
- undertake any and all activities permitted by law in relation to the aforesaid purposes pursuant to the Commission's By-laws and the policies of the Board of Directors.

West Central Development Council, Inc. - Macoupin County and six other counties (Calhoun, Christian, Greene, Jersey, Montgomery, and Shelby) created the West Central Development Council, Inc. in 2009 for the purpose of comprehensive planning and development assistance and for the benefit of the citizens of the seven counties. This organization was formerly known as the West Central Illinois Valley Regional Planning Commission when created in 1974. However, no recent information about this group is available.

Sangamon County Public Health Department, under the supervision of the Sangamon County Board, is responsible for animal control services, rules and regulations, adult health and laboratory services, environmental health and building safety (food sanitation, food inspections, water testing, solid waste programs and building and safety), health education services and personal health programs and services such as communicable diseases, family case management, and WIC. The Special Supplemental Nutrition Program for Women, Infants and Children (WIC) is a federal assistance program of the Food and Nutrition Service (FNS) of the United States Department of Agriculture (USDA) for healthcare and nutrition of low-income pregnant women, breastfeeding women, and infants and children under the age of five. **Morgan County Health Department** is the official health agency of the community supported by tax monies from Morgan County and grants from the state and federal governments and is certified by the Illinois Department of Public Health. The **Macoupin County Public Health Department** is a local county government service supported through Federal, State and County taxes. The Department is governed by a Board of Health which is appointed by the Macoupin County Board. The roles and responsibilities of all three of these county health departments are basically the same.

Sangamon County Highway Department is responsible for construction and maintenance of the county highways and bridges in Sangamon County. The County Engineer is administrator of the County Highway Department. Its engineering department prepares road and bridge construction plans and maps in the county. In addition, it also provides information on road plans and right-of-way. The highway department also is responsible for the following services:

1) Right-of-way mowing and cleaning.
2) Drainage improvement and maintenance.
3) Inspection and repair of bridges.
4) Pavement repair, sweeping and snow removal.
5) Sign installation and repair.
6) Paint striping.
7) Establishment and posting of speed limits.

The Sangamon County Highway Department maintains 256 miles of county highways and 72 bridges in Sangamon County. There are 25 township road districts covering 1,053 miles of highways and 179 bridges under township jurisdiction. All or portions of 11 Sangamon County townships are in the LSW. Macoupin and Morgan County highway departments have similar responsibilities for construction and maintenance of their county highways and bridges.

Townships - Township government has served both the rural and urban residents of Illinois since 1848. There are 1,433 townships in Illinois which still function according to provisions of the Township Act of 1874, and amendments to the act. By statute, three services are to be provided by townships: a general assistance program to qualifying residents, property assessment, and maintenance of township roads and bridges. General assistance at the township level provides immediate help to the destitute, according to local standards and needs and with local dollars. In addition to mandated functions, many townships offer a variety of social services designed to improve life for their township residents, including senior citizen and youth programs, transportation, and cemetery maintenance. Property assessments provide income through tax levies for all local governments. Township government is the grassroots government of the people where citizens have a direct say in how this local unit of government is run.

Township road district commissioners are directly responsible for maintaining more than 53 percent of the state’s total road miles and nearly half of all bridges. These roads and bridges provide access for police and fire protection, school buses and rural postal service. Township roads must be maintained and kept open despite floods, snow, etc., especially in rural Illinois. The LSW encompasses all or portions of 16 townships, with ten of them located in Sangamon County, three in Macoupin County and three in Morgan County. Morgan County has never adopted a township form of government. The county has been divided into precincts and is governed by county commissioners. However, there is a congressional township map for Morgan County.

TABLE 3.4.4 – LAND AREA AND HOUSING UNITS BY TOWNSHIP/PRECINCT

Township/Precinct*	Land Area/ Square Mile	Urban %	Rural %	Housing Units
Sangamon County				
Auburn	35.8	83	17	2,513
Ball	29.9	79	21	2,403
Capital	54.1	100	0	56,090
Chatham	37.3	92	8	2,963
Curran	29.9	23	78	662
Divernon	27.2	11	89	667
Loami	21.1	0	100	449
Maxwell	21.0	0	100	72
New Berlin	31.1	0	100	634
Talkington	37.4	0	100	86
Woodside	14.4	97	3	5,668
Macoupin County				
Girard	18.1	0	100	1,102
North Otter	35.7	0	100	449
North Palmyra	36.1	0	100	388
Morgan County				
Alexander*	36.5	0	100	181
Franklin East*	49.6	.74	99.3	552
Waverly 1*	31.0	.37	99.6	445
Waverly 2*	4.0	.66	99.3	662
Waverly 3*	15.7	0	100	68

3.4.4 Special Districts

Special Districts differ from general-purpose governments such as counties and municipalities in that they provide a single service or group of services, according to the *Legislator's Guide to Local Governments in Illinois—Special Districts,* March 2003, Illinois Commission on Intergovernmental Cooperation. Other special districts established by Illinois legislative statutes governing and serving the citizens in the Lake Springfield Watershed include:

Drainage Districts construct, maintain and repair drains and levees, and engage in other drainage or levee work for agricultural, sanitary, or mining purposes. Districts are governed by a board of commissioners. They do not levy property taxes, however, they may collect assessments and they have bonding authority. There are no official drainage districts in the LSW.

Fire Protection Districts (FPD) are created to provide fire prevention, protection and control services for the people and property within its boundaries. They may also be called upon to assist the underwater recovery of drowning victims and may provide ambulance service. Districts are governed by boards of trustees and may levy property taxes and issue bonds. Fire Protection Districts in the LSW in Macoupin County are the Girard Fire Protection District, Scottville-Modesto Fire Protection District, and Virden Fire Protection District. The Morgan County portion of the LSW is served by the Franklin Fire Protection District. In Sangamon County, the following fire protection districts provide services throughout the LSW: Auburn, Chatham, Curran, Divernon, Island Grove, Springfield, Loami, New Berlin, Woodside, and Western.

Library Districts establish, support, and maintain public libraries for the general education of Illinois' citizens. Districts are governed by seven-member boards of trustees and may levy property taxes and issue bonds. In addition to Illinois' State Library and Lincoln Library in Springfield, other library districts serving residents in the LSW are: Grand Prairie of the West (Macoupin County), M-C River Valley Public Library District (Morgan County), Chatham Public Library District and West Sangamon Public Library District (Sangamon County).

Mass Transit Districts provide public transportation by acquiring, constructing, operating and maintaining mass transit lines or by subsidizing the service of mass transit. Districts are governed by boards of trustees and may levy a property tax and issue bonds. **Springfield Mass Transit District** serves the citizens of Springfield and the one local municipality, Southern View, in the LSW which is contiguous to Springfield.

Multi-township Assessment Districts are responsible for the assessment of real property in townships with less than 1,000 population and other townships electing to use these provisions. Districts are governed by boards of trustees and may levy a property tax, but they do not have bonding authority. There is one multi-township district in Macoupin County and two in the Sangamon County portion of the LSW.

Park Districts provide a wide range of recreational programs and facilities including: athletic fields, golf courses, playgrounds, skating rinks, swimming pools, tennis courts, trails and zoos. Districts are governed by boards of commissioners and may levy property taxes and issue bonds. The **Springfield Park District (SPD),** established in 1990, is supported by the City of Springfield and villages contiguous to Springfield which are in the LSW, and its facilities are open to all citizens who wish to visit or use the facilities governed by the SPD. The **SPD** is the public park authority serving the metropolitan area of Springfield is separate from the municipal government of the city of Springfield, covers approximately 2,500 acres of open space. The park district has taxing power over about 60 square miles of Sangamon County; and operates 40 facilities. The park district operates 3 bike trails, which includes the Interurban Trail, Sangamon Valley Trail, and Wabash Trail. SPD recreational facilities in the LSW include Edwin Watts Southwind Park (an Americans with Disabilities Act-compliant park), Paul A. Barker Park, Westchester Park, Centennial Park, Lincoln Greens Golf Course and Henson Robinson Zoo. In addition, the SPD oversees the Sangamon Valley Trail (with the Sangamon County Highway Department), the Wabash Trail, and the Interurban Trail.

While the **Springfield Park District** is the only officially designated park district in the LSW, most of the municipalities in this watershed provide many of these recreational facilities within their area and are listed below. In addition, there are three privately owned 18-hole golf courses open to the public, which also have restaurants and meeting facilities available to rent (Edgewood Golf Course near Auburn, Panther Creek Golf Course and Piper Glen Golf Course, south of Springfield on Route 4).

Knight's Action Park is a large privately owned amusement park, and features batting cages, go carts, arcade, Paratrooper, a giant Ferris wheel, a golf driving range, 18-hole miniature golf course, and Fortress of Fun for small children, in addition to seven water slides and a huge 20,000-square-foot wave pool with a lazy river throughout the water park.

There are four parks (*Pohlod Park, Union Park, Squad Park and Veterans Park*) in the City of Auburn which offer children's playground areas, a pavilion, and baseball diamonds with a concession stand. Auburn's parks are supported by county tax dollars received by the City of Auburn and held in a specific parks fund.

The *Chatham Public Parks and Recreation Commission* oversees their five public parks and recreational facilities. Chatham parks include Covered Bridge Park, Jaycee Park, South Park, Village Square, and West Park. Most of these parks offer sport facilities for baseball, football, soccer, tennis and volleyball. South Park also includes the Burke Amphitheater. These facilities are maintained from the Village of Chatham's general revenue funds.

Colburn Park in Loami, is located 10 miles west of Springfield. It includes a 10-acre lake noted for its excellent fishing opportunities, a large playground and picnic area.

The Village of Southern View has the *Southern View Community Park* with a playground area, community center and tennis courts available for the public.

Virden has three parks (*West Park, Mullens Fields and East Park*) for a variety of recreational activities, including a swimming pool, lighted tennis courts, baseball fields and soccer fields, which are supported and maintained by tax dollars received by the city.

Road Districts are responsible for the construction, repair, maintenance, financing and supervision of the rural roads and streets in approved subdivisions under their jurisdiction. The governing bodies vary depending on the type of district, but usually are comprised of township or county officials. Districts may levy several property taxes and issue bonds. Highway commissioners may acquire lands and other property for the construction, maintenance, alteration, or operation of any township or district road by exercising the power of eminent domain. In Sangamon County, these districts are referred to as Road and Bridge Districts. There are 11 of them in the Sangamon County area of the LSW (Auburn, Ball, Chatham, Curran, Divernon, Loami, Maxwell, New Berlin, Springfield, Talkington and Woodside). In Macoupin County, the area in the LSW is served by the Girard, North Otter, North Palmyra and Virden Road Districts. The LSW area in Morgan County is served by Morgan County Road Districts #8, #9 and #13.

TABLE 3.4.5 – ROAD & BRIDGE DISTRICT MILES AND BRIDGES MAINTAINED

County	Road District	Road Miles	# of Bridges
Sangamon	Auburn	47.6	10
	Ball	31.7	8
	Chatham	45.2	5
	Curran	28.2	9
	Divernon	41.6	11
	Loami	28.9	8
	Maxwell	24.8	4
	New Berlin	33.3	3
	Springfield	29.9	1
	Talkington	45.0	9
	Woodside	32.5	0
Macoupin	Girard	26.4	3
	North Otter	54.0	9
	North Palmyra	48.9	2
	Virden	22.2	5
Morgan	Road District #8	94.0	9
	Road District #9	117.0	8
	Road District #13	65.0	4

Sanitary Districts may be established for the protection of public health, abatement or reduction in water pollution, drainage control, protection from overflow, and the provision of sewage disposal. They are governed by boards of trustees and may levy several property taxes and issue bonds. The board of trustees of any district may provide for the collection and disposal of sewage and drainage of the district, and for the preservation of the water supplied to district inhabitants from contamination. For that reason, each district may establish, construct, maintain, and operate numerous facilities, including all the drains, channels, ditches, and pumping plants that might be required for the disposal of sewage and drainage. A sanitary district may acquire property and, if necessary, it may exercise the power of eminent domain. The board may also acquire, from an individual, corporation, or municipality, a drainage system sufficient for the needs of the district's inhabitants. Other powers include the authority to appoint a police force to prevent water pollution, and to build and maintain dams to regulate rivers or streams. The two sanitary districts serving the Lake Springfield Watershed are the Sangamon County Water Reclamation District (formerly Springfield Metro Sanitary District), and Virden Sanitary District. Sangamon County Water Reclamation District includes the communities of Chatham, Grandview, Jerome, Leland Grove, Rochester, Sherman and Southern View.

Special Service Areas Any district may acquire, construct, operate, and improve a waterworks system. It may also provide special services limited to construction, maintenance, and alteration of the district's drains, sewers, and other necessary adjuncts in any special service area. "Special Service Area" means a contiguous area within a district in which special governmental services are provided in addition to those services provided generally throughout the district.

On June 25, 2010, the City of Springfield issued $7.5 million in Special Service Area Ad Valorem Tax Bonds for the Legacy Pointe Area. The Legacy Pointe Town Center is approximately 277 acres in size and is located at the northwest corner of the I-72 intersection and the MacArthur Boulevard extension and highway interchange in Springfield, IL. Legacy Pointe Town Center is a mixed use development zoned as a Planned Unit Development (PUD-1) with a mix of general and specialty retail shops, restaurants, hotels, entertainment facilities, local commercial uses, office facilities, along with green space and a network of walking and bicycle trails throughout the development.

School Districts are corporate entities charged by law with governing a geographically defined school district. A unit school district in general includes and operates both primary schools (kindergarten through middle school or junior high) and high schools (grades 9–12) under the same district control. School districts are supported by taxes levied on property owners within their respective school district's boundaries.

The school board's primary responsibilities are to:

- Set the vision and goals for the district.
- Adopt policies that give the district direction to set priorities and achieve its goals.
- Hire and evaluate the superintendent.
- Adopt and oversee the annual budget.
- Manage the collective bargaining process for employees of the district.

There are seven public school districts (22 schools) which students attend that are located in the LSW, four of those in Sangamon County (Auburn–3 schools, Ball-Chatham–6 schools, New Berlin–3 schools and Springfield–2 schools), one in Macoupin County (Virden- 4 schools) and two in Morgan County (Franklin–3 schools and Waverly–2 schools). The majority of Illinois school boards consist of seven members who are residents within their school district's boundaries and are elected to serve terms of four years. Terms of members are staggered so there are three or four seats contested at each biennial election.

TABLE 3.5.6 – SCHOOL DISTRICT LAND COVERAGE

School District	Land Coverage (square miles)
Auburn School District #10	65.7
Chatham School District #5	94.5
Franklin School District #1 (Morgan County)	135.5
New Berlin School District #16	152.0
North Mac School District #34 (Virden)	148.7
Springfield School District #186	60.8
Waverly School District #6	5.1

In addition to the public schools, there are four private high schools, 16 private elementary schools, 11 private pre-kindergarten schools which are attended by children in the LSW. The Hope School Learning Center for special needs students is located in Springfield on 25.5 acres which are adjacent to the Lake.

Soil and Water Conservation Districts (SWCD) establish and implement comprehensive and coordinated erosion and sediment control programs to protect and conserve land, water, air and other resources. SWCDs are local units of government, partially funded annually by the Illinois State Legislature, and provided guidance and oversight by the IL Department of Agriculture's Bureau of Land and Water Resources. Each SWCD is independent of other SWCDs and are governed by five-member boards of directors, elected annually by owners and occupiers of the land within their county. The SWCDs are generally located in the same building as the USDA Farm Service Agency (FSA) and USDA Natural Resources Conservation Service (NRCS), sharing the same office area with NRCS. The three SWCDs representing the LSW are **Sangamon County SWCD** located in Springfield, IL, **Macoupin County SWCD** in Carlinville and **Morgan County SWCD** in Jacksonville.

Water Service Districts provide water services to any area not included in the corporate boundaries of a city, village, or incorporated town. They are governed by three-member boards of trustees and may levy property taxes and issue bonds. In addition to the usual powers of special districts, water service districts may sell water to individuals, municipalities, or public utilities operating water distribution systems either within or outside the district. Districts may contract with any city, village, or incorporated town lying adjacent to it or with a public utility to furnish water service for the district. The board may also contract for the installment, rental, or use of water service mains within the district. There are four water service districts in the LSW. **Springfield City Water, Light & Power (CWLP)** provides potable water to its watershed customers in Loami, Southern View and Springfield. The **Otter Lake Water Commission,** formed in 1967, is the public water supply for the towns and rural areas around Auburn, Divernon, Girard, Pawnee, Thayer, and Virden. Auburn, Thayer and Virden are located in the LSW. Curran receives water service from the **Curran-Gardner Water District**. The **South Sangamon Water Commission**, formed in 2009, began providing water service in 2012, to the Villages of Chatham, New Berlin and rural customers along their water transmission lines.

3.4.5 Other Partners

The Springfield Lake Shore Improvement Association (SLSIA) is a not-for-profit organization made up of the Lake Springfield lease holder residents. They collaborate with CWLP, City, County, and State organizations such as: EPA, DNR, U of I Extension, and various others to promote quality of life and leave a legacy of a healthy and prospering lake and community. They strive to gain knowledge to develop best management practices to preserve, protect, and conserve the Lake and its inhabitants. SLSIA's Watershed Resources Committee members serve on the Lake Springfield Watershed Resource Planning Committee and support the ongoing work of this group to improve the water quality of Lake Springfield. They also provide education and outreach to their organization's membership on what they need to be doing on their land which will protect and preserve the quality of the Lake and its marginal lands.

The objectives of the SLSIA are:

1) To promote the preservation and beautification of Lake Springfield and its marginal lands
2) To promote safety in the use and enjoyment of Lake Springfield
3) To represent the common interest of lease holders at Lake Springfield

Friends of the Sangamon Valley is a 501 (c)(3) land trust with a mission to preserve the natural heritage of the Sangamon River watershed by acquiring, restoring, and protecting ecologically significant lands. They now own 235 acres and help manage an additional 2,000 acres of natural areas. Their focus is hands-on stewardship. They believe in the strength and ability of community volunteers to provide the best care and management of our local natural resources. Their volunteers participate in strategic planning, endangered species monitoring, exotic species control, controlled burns, and other ecological management activities. They also provide opportunities for workshops, tours, and just getting outside to appreciate some of the overlooked gems in Central Illinois. www.fosv.org

The Sangamon Conservancy Trust (SCT) is a 501(c) (3) charitable land trust dedicated to land conservation and preservation forever. It was formed in 2000 to serve as the nonprofit arm of the Sangamon County SWCD and to mirror their goals and objectives:

- To reduce soil erosion and promote water quality.
- Implement BMPs not funded through current programs.
- Fund special conservation education programs.
- Promote land stewardship and farmland protection.
- Conserve soil, water and related resources.

As of January 2017, eleven (11) agricultural conservation easements, covering 4,030 acres of prime farmland, have been donated to the SCT, to permanently preserve those acres for agriculture use. Two of those easements (635 acres) are located in the Lake Springfield Watershed.

Colleges, Universities and Trade Schools. Everyone living in the LSW has educational opportunities within a reasonable proximity (~50 miles) of their home. Four-year colleges located in Springfield are University of Illinois at Springfield (UIS), Robert Morris University-Illinois and Benedictine University at Springfield. Lincoln College and Lincoln Christian University are north of the LSW in Lincoln. Blackburn College is south of the LSW in Carlinville, MacMurray College and Illinois College to the west in Jacksonville and Millikin University to the east in Decatur. Graduate degrees are also available.

Springfield is home of Southern Illinois University (SIU) School of Medicine, accredited in 1972, established to alleviate a chronic shortage of doctors in downstate Illinois. Numerous medical degrees and residency programs are available at SIU School of Medicine. Nursing degrees are available in Springfield through St. John's Hospital School of Nursing, Memorial Hospital School of Nursing, Benedictine University at Springfield, Robert Morris University-Illinois and at University of Illinois-Chicago-Springfield.

Two-year colleges in close proximity to LSW residents are Lincoln Land Community College (LLCC) in Springfield, with satellite campuses in Hillsboro/Litchfield and Taylorville, Richland Community College in Decatur and Lewis & Clark Community College in Godfrey, IL. In May 2016, LLCC received full approval for Agricultural Watershed Management Technician I and II certificates, to be available for enrollment in the Fall 2016 semester. http://www.llcc.edu/

Midwest Technical Institute (MTI) in Springfield provides numerous vocational degrees in the allied health and mechanical trade fields. MTI also has additional campuses in Chatham, Decatur, Jacksonville, Lincoln and Petersburg. Several of these degrees receive accreditation or college credits. https://midwesttech.edu/

The Capital Area Career Center (CACC), located within the LSW near the UIS and LLCC campuses, provides educational opportunities for junior and senior high school students from most of the schools in the LSW to learn a specific trade and/or vocational skills in the auto and industrial, business and communications, construction trades and health and human services fields. CACC programs also offer college credits and professional certification opportunities. http://www.capital.tec.il.us/

Utilities Auburn, Thayer and Virden receive their potable water from the Otter Lake Water Commission, while Chatham and New Berlin are served by the South Sangamon Water Commission. Loami and Southern View receive water from Springfield's City Water, Light and Power. The Village of Curran is served by the Curran-Gardner Water District. The majority of the LSW receives other electric and heating utilities from Ameren Illinois, Rural Electric Convenience Cooperative or Springfield City Water, Light and Power.

3.5 Demographics

3.5.1 Population Change and Growth Forecasts

According to the Stage 1 TMDL Report, 2014, approximately 74,300 people reside throughout the Lake Springfield Watershed. Between the 2000 and 2010 census timeframes, all of the predominantly rural townships saw significant decreases in population. Township population increases during this same timeframe ranged from 46.5% (Ball Township) to 15.9% (Chatham Township).

When reviewing population, population change and growth forecasts in the LSW, it is important to take into consideration several components which may have a significant effect on this area's population, such as age growth, workforce age, economic growth, personal wealth, job growth, business growth and high-technology business growth.

In the LSW, lack of employment opportunities is the biggest reason for rural population losses. In addition, many of the aging population want to be closer to medical facilities available in larger cities such as Springfield. Population growth in rural areas tend to be along interstates, home to large companies or contain popular tourism destinations. In the majority of this watershed, the Federal interstate highways (I-55 and I-72) are adjacent to Springfield. The only major highway intersecting the LSW north to south is State Route 4 through the municipalities of Chatham, Auburn, Thayer and Virden. State Route 104 intersects the LSW from east to west and through the City of Auburn.

While 90.5 percent of Springfield does not live in the LSW, it is an important hub of employment, economic opportunities and social amenities for many LSW residents. According to the Springfield Sangamon County Regional Planning Committee's (SSCRPC) Report *2015 Planning for Growth, Reviewing Economic Growth Trends in the Springfield-Sangamon County Economic Area*, "population growth is both a cause and a consequence of economic growth because the two are so inter-twined." In terms of long-term economic success, the Illinois Regional Economic Analysis Project's (IL-REAP) contention is that "attracting and retaining people to live, work, raise a family, and retire underlies the economic vitality of any region". The SSCRPC primarily used IL-REAP data to look at regional performance from 1970 to 2013.

TABLE 3.5.1 – SELECTED AGE CHARACTERISTICS IN LSW TOWNSHIPS

	Townships/Precincts	% Under 18 Years	% 65 Years +	Median Age
Sangamon County Sangamon County Census Analysis 2010	Auburn Township	28%	11%	35.7
	Ball Township	30%	9%	37.9
	Capital Township	23%	14%	38.1
	Chatham Township	26%	10%	35.7
	Cotton Hill Township	22%	12%	44.7
	Curran Township	20%	17%	47.9
	Divernon Township	24%	14%	42.4
	Loami Township	25%	13%	40.4
	Maxwell Township	30%	9%	37.8
	New Berlin Township	27%	13%	37.0
	Rochester Township	28%	13%	42.3
	Springfield Township	22%	14%	40.0
	Talkington Township	23%	15%	43.6
	Woodside Township	20%	17%	43.0
Macoupin County *Macoupin County statistics Homefacts.com	Girard Township*	23%	17%	42.0
	North Otter Township*	23%	17%	42.0
	North Palmyra Township*	23%	17%	42.0
	Virden*	23%	17%	42.0
Morgan County **Morgan County statistics US Census 2010	Alexander Precinct**	21%	17%	40.8
	Franklin East Precinct**	21%	17%	40.8
	Waverly No. 1 Precinct**	21%	17%	40.8
	Waverly No. 2 Precinct**	21%	17%	40.8
	Waverly No. 3 Precinct**	21%	17%	40.8

Table 3.5.2 was prepared for the seven municipalities in the LSW by using data from the *Demographics Information by City* available at www.city-data.com/city for the period 2000 to 2013. The Village of Chatham has seen a 40.7 percent increase in population and the City of Auburn showing an 11.7 percent positive population growth. The other five municipalities (Curran, Loami, Southern View, Thayer and Virden) have seen negative growth during this same timeframe, ranging from -7.7% to -1%.

TABLE 3.5.2 – POPULATION CHANGE BY MUNICIPALITY (2000 – 2010)

Municipality[7]	2000 Population	2010 Population	Change	% Change
City of Auburn	4,317	4,771	454	10.5
Village of Chatham	8,583	11,500	2,917	34.0
Village of Curran[8]	--------	212	N/A	N/A
Village of Loami	804	745	-59	-7.3
Village of Southern View	1,695	1,642	-53	-3.1
Village of Thayer	750	693	-57	-7.6
City of Virden	3,488	3,425	-63	-1.8
Total	**19,637**	**22,988**	**3,351**	**17.2**

The Springfield Area Transportation Study (SATS) is a long-term study of future water, sewage, recreation and other infrastructure spending, updated every five years, with oversight by the Springfield Sangamon County Regional Planning Commission (SSCRPC). The Metropolitan Planning Area (MPA) covered in this study does not cover the entire LSW, but does include all of the Chatham area, Curran and Southern View, and is significant to this LSW Plan. While the Village of Chatham is the largest village in the LSW, 9.5 percent of the City of Springfield also lies within the LSW's boundaries. Based on the 2040 Long Range Transportation Plan, it is predicted that Chatham will have nearly 19,000 people by 2040, a 63-percent increase from the 2010 Census figure of 11,500. The Village of Curran is projected to increase population by 50 percent and Southern View will be down by 10 percent over this timeframe.

Demographic information of the watershed municipalities provides a snapshot of who, where and how people live in this area. By comparing population figures, occupations, economic opportunities and household economic information, trends emerge which can be used to help predict future growth**. Table 3.5.3** provides demographic information for the seven villages/cities located in the LSW compiled from the website city-data.com. In addition, several documents prepared by the Springfield Sangamon County Regional Planning Commission were reviewed for the most recent demographic information for this area.

There is not much ethnic diversity in the LSW, with 95.3 percent of the people being white. The percentage of white non-Hispanic ethnicity population is 97.8%. The largest percentage of black people in

[7] Does not include City of Springfield's population within LSW boundaries.

[8] Not incorporated until 2005

the LSW is 2.5 percent in the Village of Southern View which is contiguous to Springfield. The greatest percentage of Hispanics is 3.7 percent in the Village of Chatham.

According to information provided by city-data.com, over the period 2000 to 2013, the median resident age ranged from 33.5 to 43.6, with an average of 38.5 years in municipalities in the LSW and 36.8 in the LSW townships in Sangamon County.

For persons 25 years and older, 89.6 percent have a high school or higher education, with the highest percentage being 97.6 percent in the Village of Chatham and the lowest in Virden at 84.3 percent. In Chatham, 44.3 percent have a Bachelor's degree or higher, with the remaining municipalities averaging 18.4 percent. Approximately 6.1 percent of the LSW residents have a graduate or professional degree. As of June 2014, the average unemployment rate in the LSW was 6.1 percent.

The SSCRPC's 2015 publication entitled, "The Millennials: What Local Leaders Should Know about America's Newest Generation," is an assessment and insight as to millennials' potential impact in Sangamon County. This newest generation of young Americans, known as Generation Y or the Millennials (ages 16-35), surpassed the previously largest group, the Baby Boomers (ages 52 to 70) in 2015. While 39 years (Generation X) is the median age of LSW residents, for farmers it is closer to the age of 60 (Baby Boomers). On average in this watershed, 25% of its residents are under 18 years of age (Millennials or Generation Y) and 12 percent are over 65 years old (Baby Boomers). Millennials desire more of an urban lifestyle than their parents and may be competing with Baby Boomers who are remaining in the workforce beyond normal retirement age.

TABLE 3.5.3 – DEMOGRAPHIC INFORMATION BY CITY/VILLAGE[9]

Demographic Information by City/Village	Auburn	Chatham	Curran	Loami	Southern View	Thayer	Virden
Population in 2013	4,814	12,077	213	749	1,655	692	3,458
Urban	92%	98%	82%	0%	100%	94%	98%
Rural	8%	2%	18%	100%	0%	6%	2%
Population change since 2000	+11.5%	+40.7%	N/A	-6.8%	-2.4%	-7.7%	-1%
Median Resident Age	37	37	43.6	33.5	38.9	42.7	36.5
Median Household Income							
In 2013	$ 57,662	$ 80,868	$ 55,317	$ 49,881	$ 45,435	$ 55,680	$ 38,296
In 2000	$ 43,250	$ 60,350	N/A	$ 46,691	$ 37,964	$ 42,031	$ 31,905
Median House/Condo Value							
In 2013	$105,280	$174,983	$130,900	$ 80,795	$ 88,995	$ 86,713	$ 71,543

9 Information Source: http://www.citydata.com/city

Demographic Information by City/Village	Auburn	Chatham	Curran	Loami	Southern View	Thayer	Virden
In 2000	$ 82,700	$169,600	N/A	$ 62,700	$ 68,200	$ 59,500	$ 64,800
Median Gross Rent	$ 671	$ 1,059	$ 609	$ 719	$ 820	$ 718	$ 686
Per Capita Income							
In 2013	$ 26,315	$ 33,161	$ 30,970	$ 20,742	$ 22,950	$ 29,154	$ 20,279
In 2010	$ 18,368	$ 23,167	N/A	$ 17,661	$ 18,633	$ 20,933	$ 16,541
Ethnic Diversity							
White	96%	92.0%	96.7%	94.1%	92.9%	98.1%	97.8%
Hispanic	1.6%	3.7%	.5%	2.3%	1.6%	0.9%	0.8%
Asian	0.3%	0.7%	2.4%	0.1%	1.0%	0.0%	0.6%
Two or more races	0.9%	0.7%	.5%	2.3%	1.4%	0.6%	0.6%
Black	0.5%	1.2%	------	1.2%	2.5%	0.4%	0.1%
American Indian	0.2%	0.03%	------	0.0%	0.4%	0.0%	0.06%
Native Hawaiian/Pacific Islander	0.08%	------	------	------	0.0%		
Other race	0.02%	1.4%	------	0.0%	0.2%	0.0%	0.06%
Foreign born residents	1.7%	1.8%		N/A	2.9%	4.9%	0.3%
Education - 25 years and over							
High School or higher	94.3%	97.6%	86.1%	88.1%	90.7%	86.7%	84.3%
Bachelor's degree or higher	21.9%	44.3%	1.7%	14.0%	17.9%	15.7%	9.4%
Graduate or professional degree	5.8%	17.0%	1.7%	3.1%	3.2%	6.5%	3.1%
Unemployed June 2014	6.2%	6.2%	6.2%	7.1%	3.7%	6.2%	6.9%
Population 15 years and over							
Never Married	25.3%	20.3%	19.8%	24.0%	32.8%	23.2%	29.5%
Now Married	57.0%	66.3%	49.1%	52.8%	39.1%	50.3%	45.5%
Separated	1.0%	1.2%	5.7%	2.4%	2.6%	1.4%	0.9%
Widowed	5.4%	3.2%	8.9%	3.9%	9.9%	3.2%	8.9%
Divorced	11.3%	9.1%	16.5%	16.9%	15.6%	11.8%	15.0%
Religious Affiliation	56.9%	56.9%	54.7%	56.9%	56.9%	56.9%	51.3%

Demographic Information by City/Village	Auburn	Chatham	Curran	Loami	Southern View	Thayer	Virden
Median real estate property taxes							
With mortgage	$1,876	$3,574	$1,714	$1,772	$1,482	$ 987	$1,537
Without/mortgage	$1,034	$2,792	$ 900	$1,013	$1,296	$1,143	$ 922
Employment by Industry - 2013							
Construction	10%	7%	-----	16%	8%	21%	19%
Transportation & Warehousing	----	----	3%	8%	12%	6%	12%
Other Services/not public admin.	6%	7%	14%	9%	15%	9%	8%
Retail Trade/Wholesale Trade	20%	8.5%	5.5%	8.5%	12%	12%	10%
Manufacturing	14%	----	7%	10%	9%	9.5%	12%
Public Administration	7%	23%	14%	12.5%	10%	10.5%	6%
Ag/forestry/fishing/hunting	1.7%	0.2%				0.50%	8%
Health care & Social assistance	33%	13%	20%	29%	14%	26%	33%
Finance & Insurance	----	8.5%	12%	7%	8%	11%	16%
Educational Services	7%	8.5%	-----	7%	9%	----	11%
Professional/Scientific/Tech Serv.	----	4.5%	-----	9%	9%	----	----
Accommodation and food services	-----	7%	13%	12%	10.5%	----	8%
Wholesale trade	-----	-----	-----	-----	-----	5%	----
Utilities	-----	-----	-----	-----	-----	4%	----
Installation, maintenance & repair	-----	-----	-----	-----	-----	----	18%
Most common occupations - 2013							
Sales and related occupations	12%	8.5%	-----	8.5%	11%	5.5%	8%
Management occupations	12%	11.5%	5%	-----	8%	7%	5%
Food preparation/serving-related	10%	-----	-----	12%	9%	-----	12%
Production jobs	9%	-----	7%	17%	10%	8%	-----
Office and administrative support	9%	14.5%	19.5%	29%	29%	25%	22.50%
Construction and extraction jobs	9%	6%	-----	12%	10%	19%	13%
Material moving jobs	7%	-----	10%	-----	-----	5%	7%

Demographic Information by City/Village	Auburn	Chatham	Curran	Loami	Southern View	Thayer	Virden
Education, training, library jobs	-----	7%	-----	9%	8%	-----	5%
Installation, maintenance & repair	-----	7%	6%	10%	0%	-----	18%
Personal care & service jobs	-----	9%	9%	5%	0%	-----	11%
Health diagnosing/practitioners	-----	12%	7.5%	5%	5%	10%	9%
Business & financial operations	-----	-----	14%	9%	6%	7%	12%
Art/design/ entertainment/sports/media	-----	-----	-----	-----	8%	-----	-----
Buildings & grounds/maintenance	-----	-----	-----	-----	-----	5%	-----
Transportation	-----	-----	-----	-----	-----	13%	10%
Health care support	-----	-----	-----	-----	-----	-----	5%
Class of Workers							
Federal government workers	4.7%	1.8%	N/A	0.4%	2.1%	3%	1.70%
State government workers	12.4%	22%	N/A	24.1%	22.3%	15.2%	12.80%
Local government workers	4.6%	5%	N/A	3.6%	4.7%	6%	4.30%
Self-employed							
Incorporated business	1.7%	2.4%	N/A	1.1	0.8%	4.3%	2.30%
Not incorporated	4.9%	6%	N/A	9.2	4.3%	3.8%	6.10%
Private company							
Employee	64.4%	50%	N/A	54.2	55.1%	56.1%	61.30%
Non-profit wage/salary workers	7.3%	11.6%	N/A	7.4	10.7%	11.7%	11.60%
Percentage Living in Poverty in 2013	9.6%	6%	29.1%	28.7%	13.8%	3.3%	14.2%
Cost of Living Index (100=USA Avg.)	85.3	87.4	86.7	86.7	86.5	85.5	83.8
City Library	Yes	Yes	No	No	No	No	Yes
Nursing home/rehab/assisted living	1	3	0	0	1	0	3
Public Water Service District							
Curran-Gardner Water District			Yes				
Otter Lake Water Commission	Yes					Yes	Yes

Demographic Information by City/Village	Auburn	Chatham	Curran	Loami	Southern View	Thayer	Virden
South Sangamon Water Comm.		Yes					
Springfield CWLP				Yes	Yes		
Air Quality Index – 2012 Avg.	78.2	78.2	78.2	78.2	74.9	78.2	78.2
Banks	2	5	0	1	3	0	3
Fire Protection District	Yes	Yes	Yes	Yes	Yes		Yes
Ambulance/Rescue Squad	Yes	Yes	0	0	0		Yes
Village/City Police Protection	Yes	Yes	0	Yes	Yes	0	Yes
Public Schools	PreK-12	PreK-12	0	4-6	K-5	0	PreK-12
Churches	9	12	0	3	3	1	8
Parks	4	5	1	1	1	0	3

TABLE 3.5.4 – DEMOGRAPHICS BY TOWNSHIP/PRECINCT

County	Townships/Precincts	Area (Miles Squared)	2010 Population	Urban%/ Rural %		White Non-Hispanic Ethnicity %
Sangamon	Auburn**	35.78	6,020	83%	17%	98.3%
	Ball**	29.94	4,573	79%	21%	96.7%
	Capital*	64.50	116,250	100%	0%	74.7%
	Chatham	37.26	6,019	92%	8%	96.7%
	Cotton Hill**	30.18	1,065	7%	93%	93.0%
	Curran	28.02	1,586	23%	77%	94.9%
	Divernon**	27.28	1,548	11%	89%	97.0%
	Loami	21.16	1,118	1%	99%	97.3%
	Maxwell	20.98	194	0%	100%	97.9%
	New Berlin**	31.22	1,262	1%	99%	98.3%
	Rochester**	33.63	4,486	70%	30%	97.8%
	Talkington**	37.51	263	0%	100%	97.7%
	Woodside	12.65	12,279	97%	3%	92.7%
Macoupin	Girard**	18.11	2,582	0%	100%	98.1%
	North Otter**	33.35	840	0%	100%	99.5%
	North Palmyra**	36.23	974	0%	100%	98.6%
	Virden**	18.00	3,689	95%	5%	98.5%
Morgan	Alexander**	36.49	383	0%	100%	100.0%
	Franklin East**	49.59	1,192	0%	100%	100.0%
	Waverly No. 1	31.04	984	.02%	99.9%	99.9%
	Waverly No. 2**	4.04	741	0%	100%	99.9%
	Waverly No. 3**	15.73	157	1%	99%	99.9%

*City of Springfield/Capital Township – Only a small portion is in the Lake Springfield Watershed (9.5%).
**While the entire township/precinct is not within the LSW, the data reflects the whole township.

TABLE 3.5.5 – POPULATION, HOUSING UNIT DENSITY BY TOWNSHIP[10]

County	Townships/Precincts	Housing Units	Average Per Square Mile Population/Housing Unit Density	
Sangamon	Auburn**	2,513	177.0	70.2
	Ball**	2,403	224.3	80.4
	Capital*	1,989	1988.6	952.6
	Chatham	2,963	187.4	79.6
	Cotton Hill**	389	30.2	13.0
	Curran	662	56.6	23.6
	Divernon**	677	95.4	24.9
	Loami	449	50.6	21.2
	Maxwell	72	9.2	3.4
	New Berlin**	634	48.9	20.3
	Rochester**	2,081	160.4	62.3
	Talkington**	86	5.0	2.3
	Woodside	5,668	905.6	448.4
Macoupin	Girard**	1,102	136.2	60.9
	North Otter**	449	22.9	12.6
	North Palmyra**	388	23.6	10.7
	Virden**	1,711	204.3	95.2
Morgan	Alexander**	181	10.5	5.0
	Franklin East**	552	24.1	11.2
	Waverly No. 1	445	31.7	14.4
	Waverly No. 2**	348	183.4	86.1
	Waverly No. 3**	68	10.0	4.3

*City of Springfield/Capital Township – only 9.5% of Springfield is in the Lake Springfield Watershed
**Entire township/precinct is not within LSW

[10] US Census Bureau, 2010 Census, Population and Housing Unit Counts

3.5.2 Income and Employment

The average median household income for 2013 is $50,379 for the municipalities of Auburn, Curran, Loami, Southern View, Thayer and Virden. However, that same statistic for the Village of Chatham is considerably higher at $80,868. In 2010, per capita income ranged from $16,541 to $20,933 for those same six municipalities, with Chatham at $23,161. Just three years later in 2013, the per capital income ranged from $20,279 to $30,970 for those municipalities, with Chatham being significantly higher at $33,161. The average unemployment rate throughout the LSW as of September, 2015 was approximately 4.7 percent and 5 percent for Sangamon County.

TABLE 3.5.6 – MAJOR EMPLOYERS IN LAKE SPRINGFIELD WATERSHED

City	Employer
Auburn	Auburn School District City of Auburn BRANDT Dickey-John Corporation Prairieland FS, Inc. Sievers Implement Company Springfield Plastics
Chatham	Ball-Chatham School District #5 Village of Chatham
Curran	Archer Daniels Midland (ADM) BRANDT Lincoln Land Concrete
Loami	N/A
Southern View	N/A
Thayer	N/A
Virden	Sloan Implement

While many of the LSW residents (urban and rural) are employed by the State of Illinois, or businesses located in Springfield and commute daily, there are also a significant number of local businesses which sustain the LSW communities with many of their basic daily needs. (i.e., grocery stores, gas stations, banks, pharmacies, etc.), as noted in **Table 3.5.7** below. Most of these municipalities have tax-supported police departments, fire protection districts (mostly volunteers), and school districts, or share these services with nearby communities. They also have at least one local bank, or branch banks from larger community banks, library services, a grocery store, at least one service station with a convenience store, a hardware store, a pharmacy, locally owned restaurants/bars (some fast-food chains), several denominational churches and a community park.

TABLE 3.5.7 – AREA BUSINESSES SERVING RESIDENTS IN LSW

Category	Auburn	Chatham	Curran	Loami	Southern View[11]	Thayer	Virden
Agri-business	5		1	2	N/A		33
Automotive	2	7		2	N/A		25
Financial Services	2	10	0		N/A		12
Fuel & Convenience	4	4		1	N/A		
Hobbies & Crafts	0	1			N/A		
Home Construction, Home Improvement Furnishings, & Appliances	3	5	1	8	N/A	1	33
Insurance Agencies	2	7		1	N/A		6
Medical / Dental / Optical	2	11		1	N/A		13
Nursing Homes/Assisted Living/Daycare	3	3			N/A		
Personal Beauty, Fitness, & Gymnastics	2	21			N/A		
Plumbing, Heating, & Electrical	0	5			N/A	1	
Printing/Design	0	1			N/A		6
Restaurants/Bars	2	30			N/A	3	9
Retail Businesses (Grocery)	9	19		4	N/A	4	25
Services	8	31		3	N/A	3	31
Utilities	2	3			N/A	1	

[11] Business listings for Southern View are included with all of Springfield's listings

3.6 Land Use/Land Cover

3.6.1 Lake Springfield Watershed

A custom, accurate and up-to-date land use GIS layer was generated for the Lake Springfield Watershed using the most recent aerial imagery and available base maps to verify land use classifications. Information collected during a watershed windshield survey was used for additional quality control. The resulting GIS shape file includes 36 individual land use categories. Row crops make up the highest land use percentage (74%) and acreage (124,522 acres). Forest, grassland and urban open space cover a relatively high percentage of land use, totaling 13% or 20,995 acres.

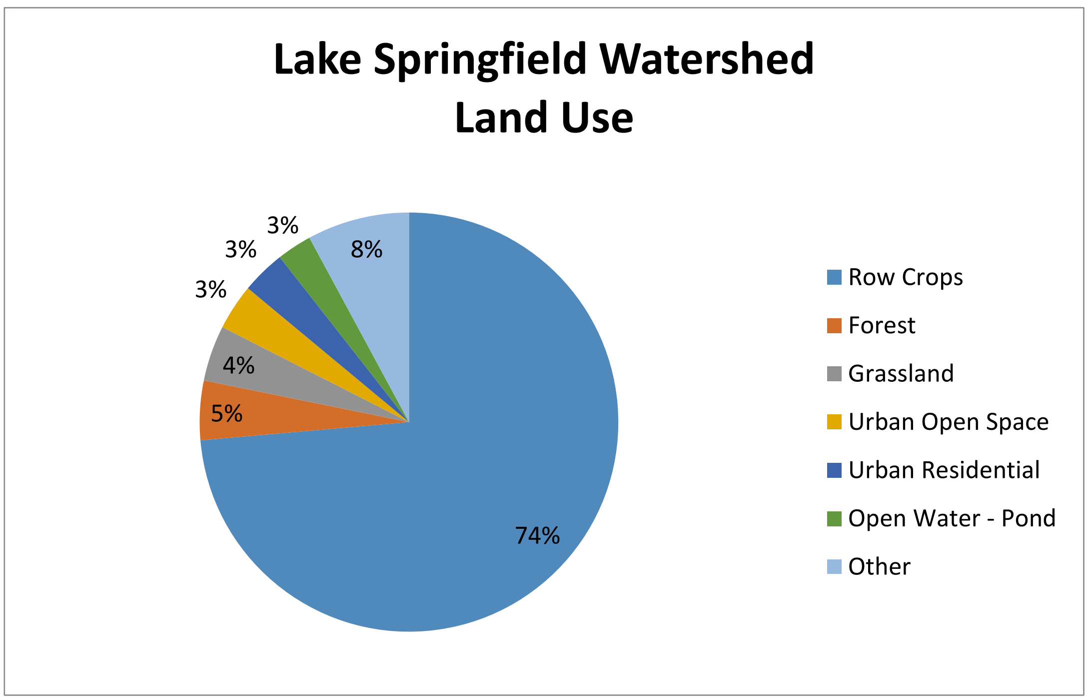


Chart 3.6.1 – Lake Springfield Watershed Land Use

TABLE 3.6.1 – LAKE SPRINGFIELD WATERSHED – LAND USE ACRES/% OF WATERSHED

Land Use Category	Acres	% of Watershed
Row Crops	124,522	74%
Forest	7,744	5%
Grassland	7,266	4%
Urban Open Space	5,992	4%
Urban Residential	5,728	3%
Open Water – Pond	4,561	3%
Pasture	2,994	2%
Roads	2,719	2%
Wetland	1,122	0.66%
Residential Farm	941	0.56%
Commercial/Retail	860	0.51%
Park	663	0.39%
Golf Course	577	0.34%
Farm Building	531	0.31%
Institutional	476	0.28%
Open Water – Stream	450	0.27%
Open Space Road	375	0.22%
Manufacturing and Industrial	320	0.19%
Railroad	302	0.18%
Wholesaling and Storage	214	0.13%
Utilities and Communication	166	0.10%
Sod Farm	137	0.08%
Cultural and Entertainment	90	0.05%
Feed Area	86	0.05%
Education	80	0.05%
Orchards and Nurseries	53	0.03%
Cemetery	51	0.03%
Grain Elevator	36	0.02%
Mobile Homes	36	0.02%
Confinement	27	0.02%
Marina/Resort	26	0.02%
Resource Extraction	23	0.01%
Junkyard	17	0.01%
Rail Yard	14	0.01%
Open Hog Lot	8	0.005%
Bus Terminal	4	0.003%
Total	**169,161**	**100%**

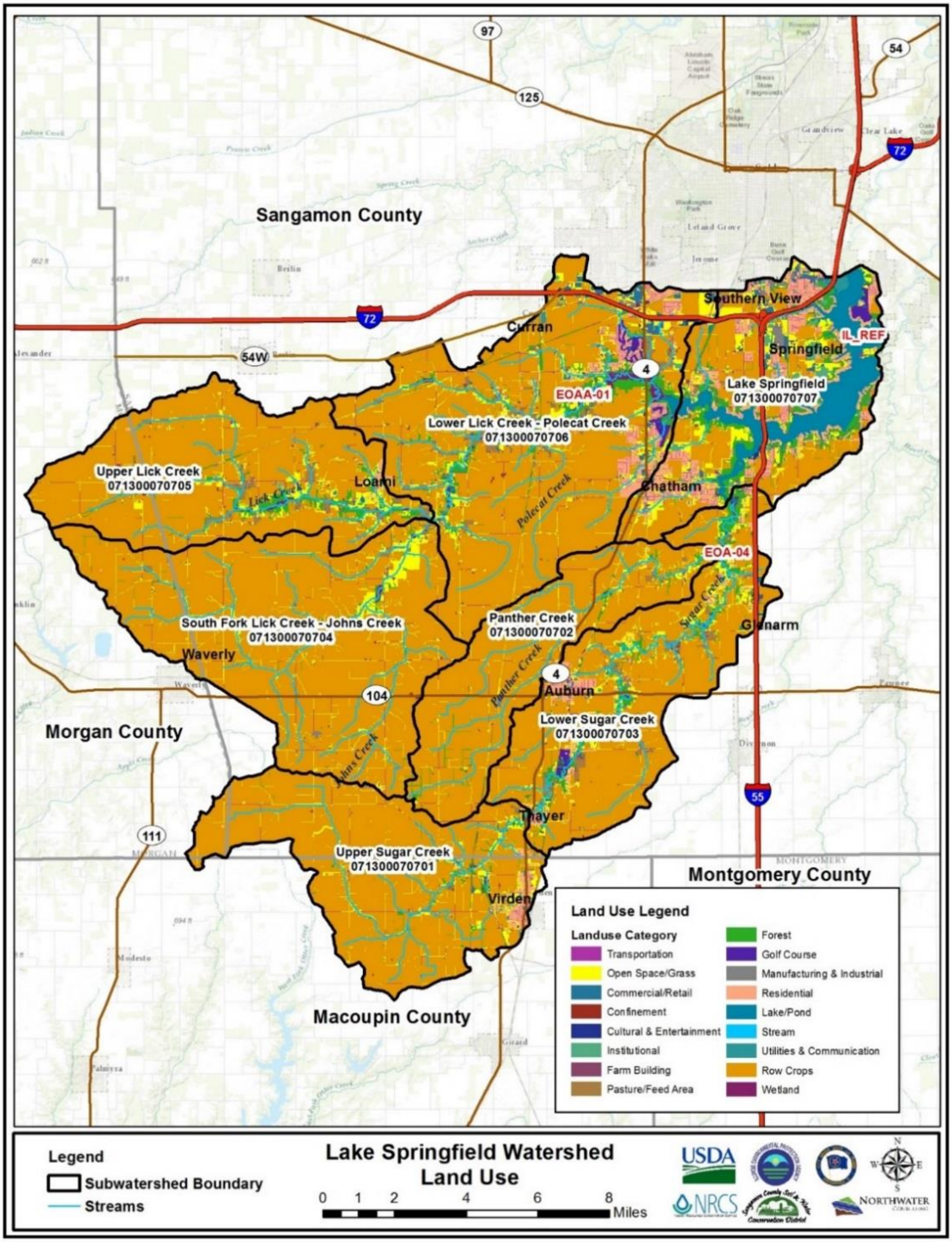


FIGURE 3.6.1 – LAKE SPRINGFIELD WATERSHED LAND USE

Row Crops dominate 74% of acreage in the LSW, with corn and soybeans being the primary agricultural products grown in this area. In the 1990s, there was a major shift from a corn/soybean rotation to multiple years of planting corn-after-corn, which means more fertilizer (nitrogen and phosphorus) and corn pesticide use. While this is still the case, the number of acres of soybeans have been increasing in recent years. As the economics and other issues associated with growing each of these crops are beginning to change, this trend towards more soybean acres may continue. Federal government programs will also play a key role as to which crop will have more acres in this watershed.

While return on investment on corn in most years has been better than with soybeans, since 2013, that has not been the case. According to University of Illinois agricultural economist Gary Schnitkey, "Since 2013, soybeans have been more profitable than corn." Other factors affecting commodity prices include a steady demand for biofuels, global factors concerning ethanol production and distribution, changes in demand for livestock feed, and global weather factors which affected crop production around the world, especially in countries competing with the United States for a greater share of those markets.

However, annual input costs for the coming year are paramount in the minds of producers when making annual planting decisions, along with potential problems which may be an issue in the coming year.

In the LSW, crop fields are being tiled to make them more accessible for planting earlier in the spring, which suggests corn will be the crop of choice for those fields. Soybeans are usually planted in late April, or early May, to make sure a late spring frost does not damage the vulnerable soybean crop.

While it had been a common practice for planting continuous corn, in 2016, there was a significant problem with Diplodia Ear Rot, primarily found in continuous-corn fields, which caused producers to consider a switch to soybeans on some of those fields the next year. Diplodia is a pathogen which overwinters on infested corn debris from the previous year. It occurs after flowering and corn ears are most vulnerable for three weeks after silking. Wet, warm weather during grain fill and upright ears with tight husks promote this disease.

DIPLODIA EAR ROT

Diplodia infestations result in reduced grain quality and reduced yield due to lightweight kernels, low test weight and infected kernels prone to breakage. According to an article published in September, 2016, by the College of ACES, University of Illinois Extension Educator Angie Peltier stated, “Some grain elevators will set a damage threshold above which they will not accept the grain. I have heard anywhere from above 15 to 50 percent damage, depending upon the end use and how quickly the grain will leave the elevator.” The price at which a farmer can market grain begins to decrease for every percentage point of damaged kernels above five percent.

Management of this disease includes planting corn hybrids resistant to this fungus, use of crop rotation (at least one year out of corn) and fall tillage to partially or completely bury the corn residue. Farmers who had diplodia-infested corn must now manage those corn fields differently than they may have intended.

The bottom line is that farmers face challenges of some sort every year, whether it be crop diseases, weather issues, falling crop prices, increased input prices, farm rent competition, and/or financial stability of their farm operations, all which can take their toll. Unfortunately, the profitability of each crop may not really be known until after the farmers have already had to sell their crops to pay bills, or need money available to purchase inputs (seed, fertilizer, chemicals) at discounted prices for next year’s crops. Those farmers whose working capital is being depleted more every year, or who are working with borrowed operating money, will continue to do what is necessary to make ends meet.

Forestland (7,444 acres) comprises 5% of the LSW and is primarily found along the banks of the main tributaries (Lick Creek and Sugar Creek) and around Lake Springfield. The **Lake Springfield** sub-watershed (HUC 0713000707) has the largest acreage of forestland (2,004 acres) and **South Fork Lick Creek-Johns Creek** sub-watershed (HUC 0713000704) the fewest acres (417 acres).

Forest and woodland land cover category is defined as land predominantly covered with trees and woody vegetation, and is an aggregate of these three classes: 1) Deciduous (trees that undergo seasonal change), closed canopy, 2) Deciduous, open canopy and 3) Coniferous (wooded areas dominated by pine and other coniferous trees) (IDNR 1996 Critical Trends Assessment Program, which monitors the biological condition of Illinois' forests, wetlands and grasslands). While there are no native pines in Sangamon County or this watershed, most of the pine trees seen in these areas were planted by individual landowners. Many of those trees were purchased from the Sangamon County SWCD which has sold thousands of pine trees to rural and urban landowners since 1975 (42 years). Many pine tree windbreaks dot the rural landscape around farmsteads in this watershed and throughout Sangamon County.

When land parcels were condemned for Lake Springfield in the 1920s and 1930s, a large section of the Lower Lick Creek bottomland was set aside by the City of Springfield as woodland to protect the Lake's water quality. The 340-acre watershed protection zone, known as the Lick Creek Wildlife Preserve, contains a notable grove of mixed sugar maples and chinquapin oaks. "Some natural community researchers have suggested that these two species, when occurring together in a grove-like setting, may have been planted by American Indians or early settlers." Camp Widjiwagan Girl Scout campground has some of the oldest chinquapin oaks, with some aged over 300 years old. (FOSV, 2004)

Glenwood Woods is about 150 acres near Lake Springfield is the best example of old growth white oaks on Lake Springfield. When the Lake was being built, many trees were planted along the shoreline of the Lake by the Civilian Conservation Corps workers to replace trees removed and also to stabilize the disturbed shoreline areas to reduce soil erosion.

Auburn Township's Irwin's Park in the **Panther Creek** sub-watershed includes 28 acres of picturesque timber meandering along both sides of Panther Creek that intersects Irwin's Park which was donated by the Irwin family to Auburn Township in 1991, and then deeded to the Irwin Park Association in 2008.

Twenty acres of the Nipper Wildlife Sanctuary's 120 acres, located 12 miles southwest of Springfield near Loami, are floodplain forest.

The Lincoln Memorial Garden in the **Lake Springfield** sub-watershed includes 100 acres of land, including the original 63 acres designed as a living memorial to President Abraham Lincoln by a renowned national landscape architect Jens Jensen in 1936. The Walnut Grove, along with groves of oaks, maples and hickory trees, all native to Illinois, Indiana and Kentucky were planted.

Grassland (7,266 acres) cover 4% of the total watershed acres, led by **Lower Lick Creek—Polecat Creek** sub-watershed (HUC 0713000706) the area with the most grassland at 1,820 acres and the fewest grasslands being in **Panther Creek** sub-watershed (HUC 0713000702) with 538 acres. Nipper Wildlife Sanctuary, in the Lower Lick Creek—Polecat Creek sub-watershed, includes over 90 acres of tall grass prairie which has been restored with over 150 different species of flowers and plants. Adjacent to Nipper, over 600 acres were enrolled in the Conservation Reserve Enhancement Program (CREP) and planted to prairie grasses. Twenty-nine acres of the Lincoln Memorial Garden, known as the Ostermeier Prairie Center, includes 20 acres of tall grass prairie.

Urban open space land use acres (5,992) comprise 4% of this watershed, with the most acres (1,382) in the **Lake Springfield** sub-watershed and the fewest acres (482) in the **Upper Lick Creek** sub-watershed (HUC 071300070705). Urban residential land covers 5,728 acres, or 3% of the watershed. The Lake Springfield sub-watershed leads the way with the most acres (3,202) in urban residential land and the fewest urban residential acres (16) in the **Panther Creek** sub-watershed. There are 728 residences around the shores of Lake Springfield.

Pasture comprises only 2% (2,994 acres) of the land use in the LSW. **Lower Sugar Creek** sub-watershed (HUC 071300070703) has the most pasture with 665 acres. **Upper Sugar Creek** sub-watershed (HUC 071300070701) has only 68 acres of pasture.

Transportation in this watershed includes 36 miles of federal interstate highways within this watershed which serve as major modes of transportation for businesses and the general public. Interstates are classified as controlled-access highways which provide an unhindered flow of traffic, with no traffic signals, intersections or property access. These interstate highways are 4 lanes, divided by a median, with a maximum 70 miles per hour (mph) and minimum 45 mph speed limit in Illinois. They are extensively used by LSW rural and urban residents to commute to cities such as Springfield for their jobs, medical services, educational opportunities, shopping, entertainment, etc. Businesses located in the LSW use these highways for receiving and delivering their goods and services. Farmers and agri-businesses use these highways for transporting their grain to local elevators and major grain hubs—Archer Daniels Midland (ADM), CHS and the Scoular Company throughout central Illinois. However, agricultural implements, non-motorized vehicles (bicycles), equestrians and pedestrians are prohibited from using Illinois' interstate highways.

Interstate 55 (I-55) is a major cross-country, north-south route (964.3 miles) dissecting several central states, including the entire state of Illinois, and eventually connecting the Gulf of Mexico in La Place, Louisiana to the Great Lakes at US Route 41 in Chicago. It runs south from Chicago, skirting several central Illinois cities (Bloomington/Normal, Lincoln, Springfield, etc.). I-55 interchanges connect with Interstate 72 to IL Route 4 at Springfield and Chatham, and IL Route 104 to Auburn.

Interstate 72 (I-72) is an east-west route, covering 182 miles in Illinois and runs parallel to the old Wabash Railroad (now the Norfolk Southern Railway) from Hannibal, MO east across Illinois to Champaign, IL. This interstate highway, commonly referred to as the Central Illinois Expressway, connects with I-55 at the southeastern edge of Springfield and intersects a small portion of the northern watershed boundary. It has interchanges which connect with IL Route 36/54 and IL Route 4 to Chatham, Auburn, Thayer and Virden and county highways to Curran, Loami and Waverly.

37 miles of State highways are in the LSW. Illinois Route 4, which includes portions of historic Old Route 66, runs in a southeasterly direction out of Springfield (Veterans' Parkway) through Chatham, Auburn, Thayer and Virden. Illinois Route 104 is an east-west 2-lane highway which extends across the southern third of the LSW in Sangamon and Morgan Counties, across the Illinois River, ending in downtown Quincy, IL.

There are 723 miles of county, township and municipal streets and roads in this watershed. They are overseen and maintained by local governmental officials and personnel with financial support from property tax funds levied by county, township road and bridge districts and municipalities. There are 36 miles of Interstate Highways and 37 miles of State Highways.

Railroads extend across 78 miles of the LSW. Six of the seven Class 1 railroads in the United States crisscross this watershed. The north-south railroads which run through the LSW include the **Canadian National Railway Company** (CN) and **Amtrak** (AMTK). CN is the largest transcontinental railway in Canada and the United States. With the purchase of Illinois Central (IC) and several smaller U.S. railways, CN now owns extensive miles of track from the Great Lakes to the Gulf of Mexico.

Amtrak (AMTK) is the only passenger rail service (*Texas Eagle*) running north to south through portions of the LSW. The Amtrak stations in Springfield and a flag stop in Carlinville (only on request if there are passengers to be picked up or dropped off) are the closest locations available for passengers to travel by train. This daily service connects riders from Chicago, IL to San Antonio, TX.

Amtrak's *Lincoln Service,* a higher-speed rail service, operates as part of the *Illinois Service* and is partially funded by the IL Department of Transportation. This service runs on Canadian National Railway/Union Pacific rail tracks from Chicago to St. Louis which are being upgraded to handle passenger train speeds up to a top speed of 110 mph to decrease travel times for this Chicago-St. Louis commute (11 station stops) by approximately one hour. Work began in 2010 to upgrade the tracks along this rail corridor. The primary purpose of the Chicago-St. Louis High Speed Rail (HSR) is to enhance the passenger transportation network along this corridor to result in a more balanced use of its components—highway (automobile and bus), air and rail travel. According to the American Association of State Highway and Transportation Officials, 2011, use of high-speed rail results in a 71 percent reduction of carbon dioxide emission by train, per passenger mile, as compared to automobiles. Potential environmental impacts of HSR were addressed through mitigation, incorporation of BMPS, minimization of existing vegetation removal, construction noise, vibration impacts, air pollution and erosion and sedimentation during construction. Illinois Farm Bureau (FHWA-IL Chicago-St. Louis High Speed Rail Project, Record of Decision, 2004) noted that the HSR posed little environmental impact to agricultural, except for added difficulty in negotiating gated crossings with large farm equipment.

The **BNSF Railway** (BNSF) and the **Union Pacific Railroad** (UP) share thousands of miles of rail track rights on three freight-hauling transcontinental routes that provide rail links between western and eastern U.S. The **Kansas City Southern Railway** (KCS) and **Norfolk Southern Railway** (NS) also share rail corridors for freight transmission through this watershed.

In total, there are 874 miles of transportation mode in the watershed. A comprehensive, well-maintained transportation system of roads and railway systems is essential to the viability of this watershed's residents and businesses for safe travel and ease of connection throughout the U.S.

Golf Courses in the LSW consist of four entities, public and private.

Edgewood Country Club and golf course, built in 1963, is a locally owned and operated facility located in Auburn Township in the Lower Sugar Creek Sub-watershed. Sugar Creek meanders through this golf course in a northeasterly direction.

Lincoln Greens Golf Course, opened to the public in 1957, is immediately adjacent to Lake Springfield on East Lake Shore Drive in the Lake Springfield Sub-watershed and is operated by the Springfield Park District.

Panther Creek Country Club and Golf Course, owned by its members, was built in 1992 and is located along Route 4 between Springfield and Chatham, in the Panther Creek subdivision in the Lick Creek-Polecat Creek sub-watershed.

Piper Glen Golf Course, opened in 1996, is located in the Piper Glen subdivision between Springfield and Chatham on IL Rt. 4 in the Lower Lick Creek-Polecat Creek sub-watershed. In March 2016, this facility, under foreclosure, was purchased by the only bidder, the Illinois National Bank. In 2017, Piper Glen was sold to a local investor group.

3.6.2 Upper Sugar Creek Land Use

Upper Sugar Creek sub-watershed **HUC 071300070701**, located at the southern end of the LSW, includes 9,453 acres in Sangamon County, all of the Macoupin County watershed acres (11,936 acres), about 800 acres in southeastern Morgan County. It is predominantly agriculture with 86 percent of the 19,130 acres being in row crops. Of the remaining 14 percent of the acres in this sub-watershed, 787 acres are highly erodible, primarily along the banks of Sugar Creek and has the lowest average slope (1.05%). The headwaters of Sugar Creek originate in this sub-watershed and there are 21 miles of streams. The concentration of forestland (542 acres) is generally along the banks of the streams. While only about 2% of the 11,413 floodplain acres in the LSW are in this sub-watershed, 8,748 acres (39%) are defined as hydric soils, which indicate that these areas are typically wet and flood-prone if proper drainage is not available. Upper Sugar Creek sub-watershed has the highest percentage (98%) of tiled soils. Urban open space and urban residential areas cover 5% of this sub-watershed primarily in the City of Virden and a very small portion of the Village of Thayer.

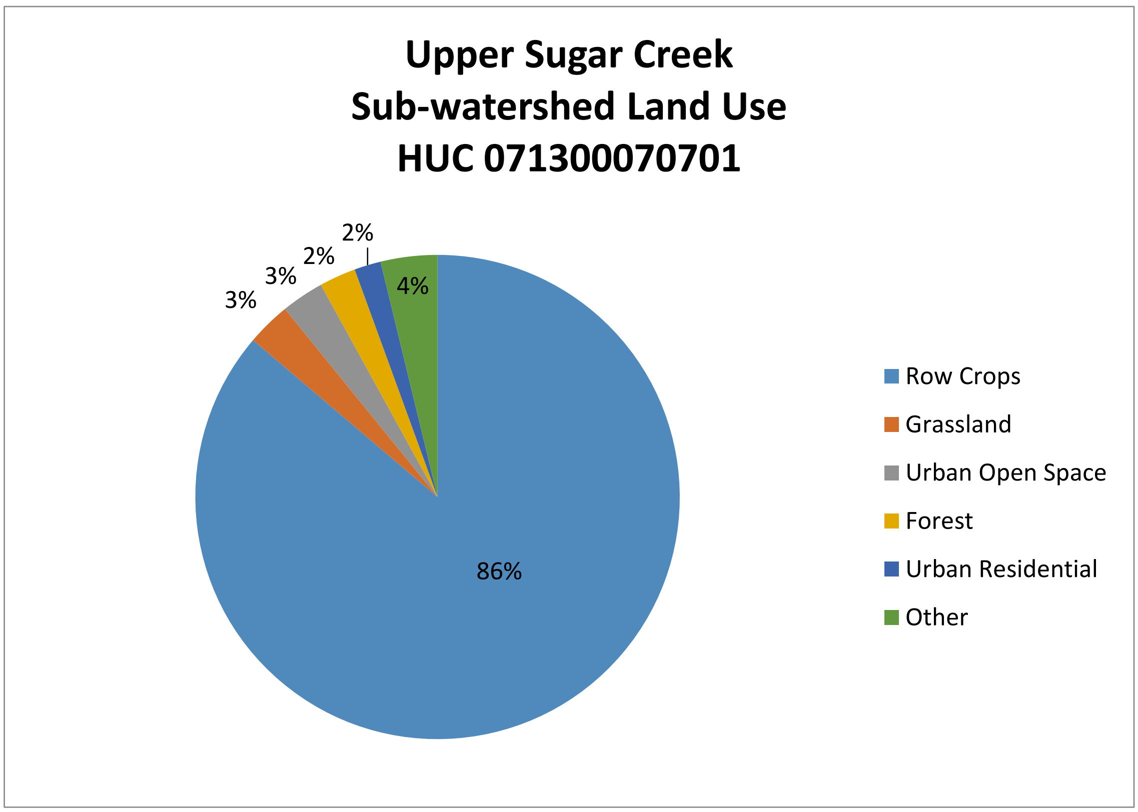


Chart 3.6.2 – UPPER SUGAR CREEK SUB-WATERSHED LAND USE

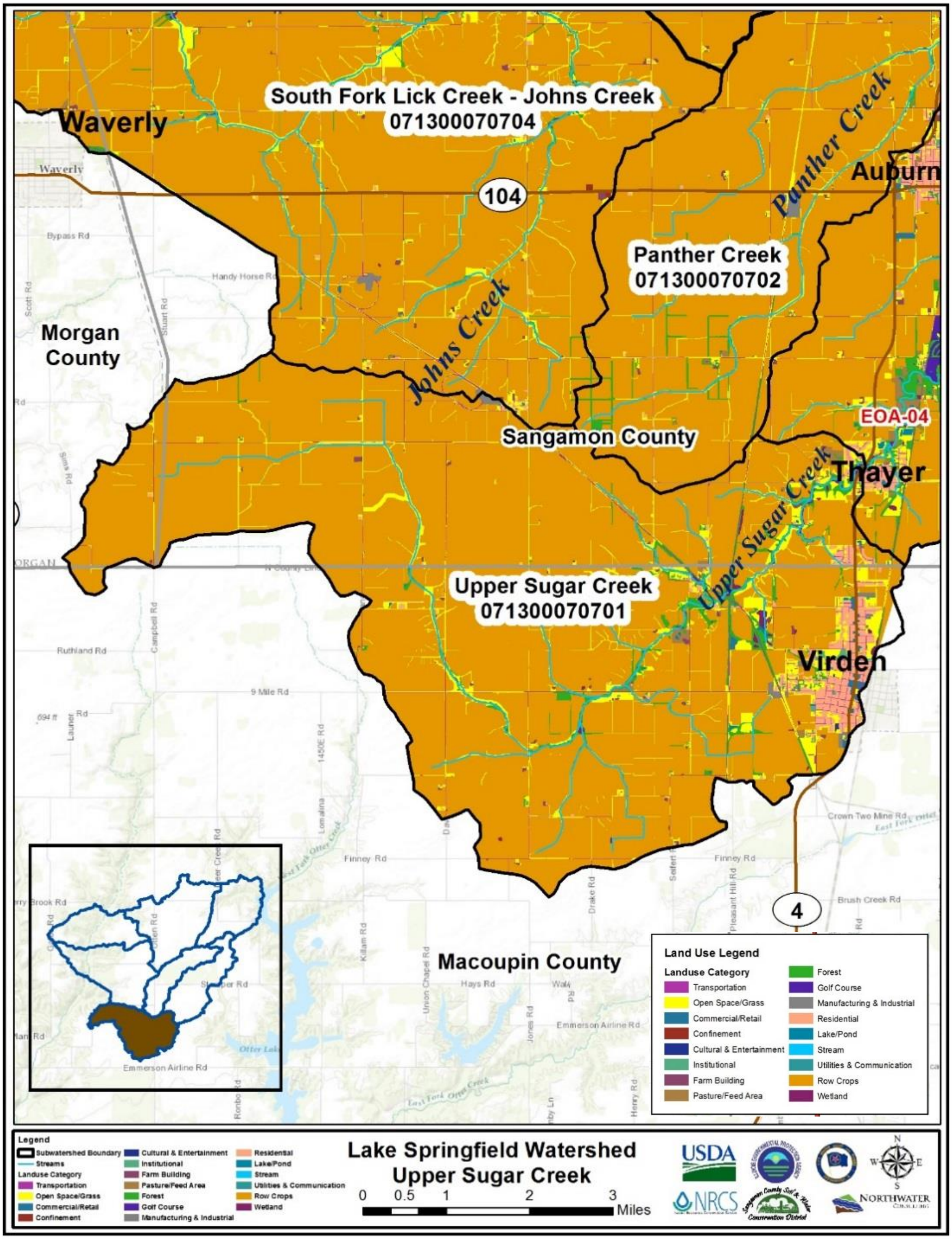


FIGURE 3.6.2 – UPPER SUGAR CREEK SUB-WATERSHED LAND USE

TABLE 3.6.2 – UPPER SUGAR CREEK SUB-WATERSHED LAND USE

Land Use Category	Total Acres	% of Sub-watershed
Row Crops	19,130	86%
Grassland	651	3%
Urban Open Space	632	3%
Forest	542	2%
Urban Residential	394	2%
Roads	223	1%
Residential Farm	100	0.45%
Wetland	80	0.36%
Pasture	68	0.30%
Park	61	0.28%
Manufacturing and Industrial	52	0.23%
Railroad	50	0.22%
Farm Building	47	0.21%
Open Water – Stream	40	0.18%
Commercial/Retail	38	0.17%
Cemetery	22	0.10%
Open Water – Pond	18	0.08%
Education	14	0.06%
Junkyard	6	0.03%
Mobile Homes	5	0.02%
Wholesaling and Storage	5	0.02%
Institutional	4	0.02%
Cultural and Entertainment	3	0.01%
Utilities and Communication	2	0.01%
Other	3	0.015
Total	**22,189**	**100%**

3.6.3 Panther Creek Land Use

The **Panther Creek** sub-watershed is the smallest (15,072 acres) of the seven LSW sub-watersheds with the second largest percentage (88%) of row crops (13,284 acres), 4% (538 acres) of grassland and 3% (413 acres) of forestland. Very small portions of the City of Auburn and Village of Chatham cover 350 acres (2.1%) of the urban open space and urban residential area in this sub-watershed. The average percent of slope is 1.04%, is one of the lowest in the LSW. There are 867 acres of HEL soils (6%); 39% of the soils are classified as hydric. It has 22 stream miles and 460 floodplain acres covering 2% of this sub-watershed.

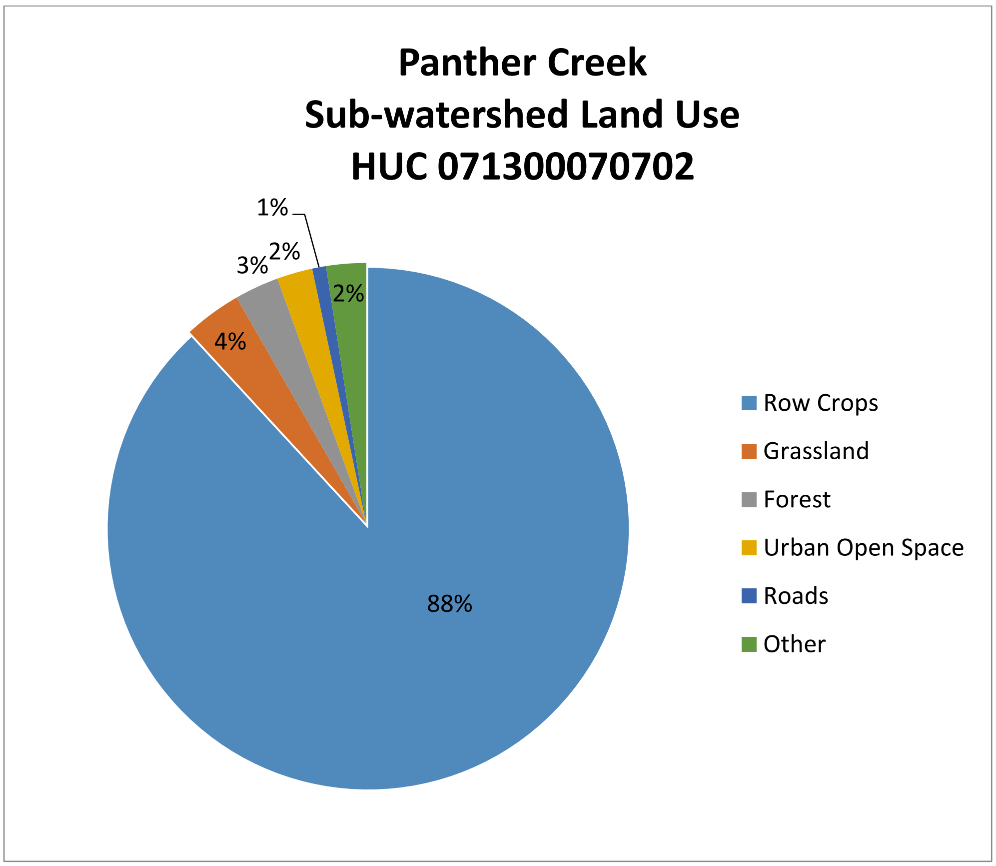


Chart 3.6.3 – PANTHER CREEK SUB-WATERSHED LAND USE

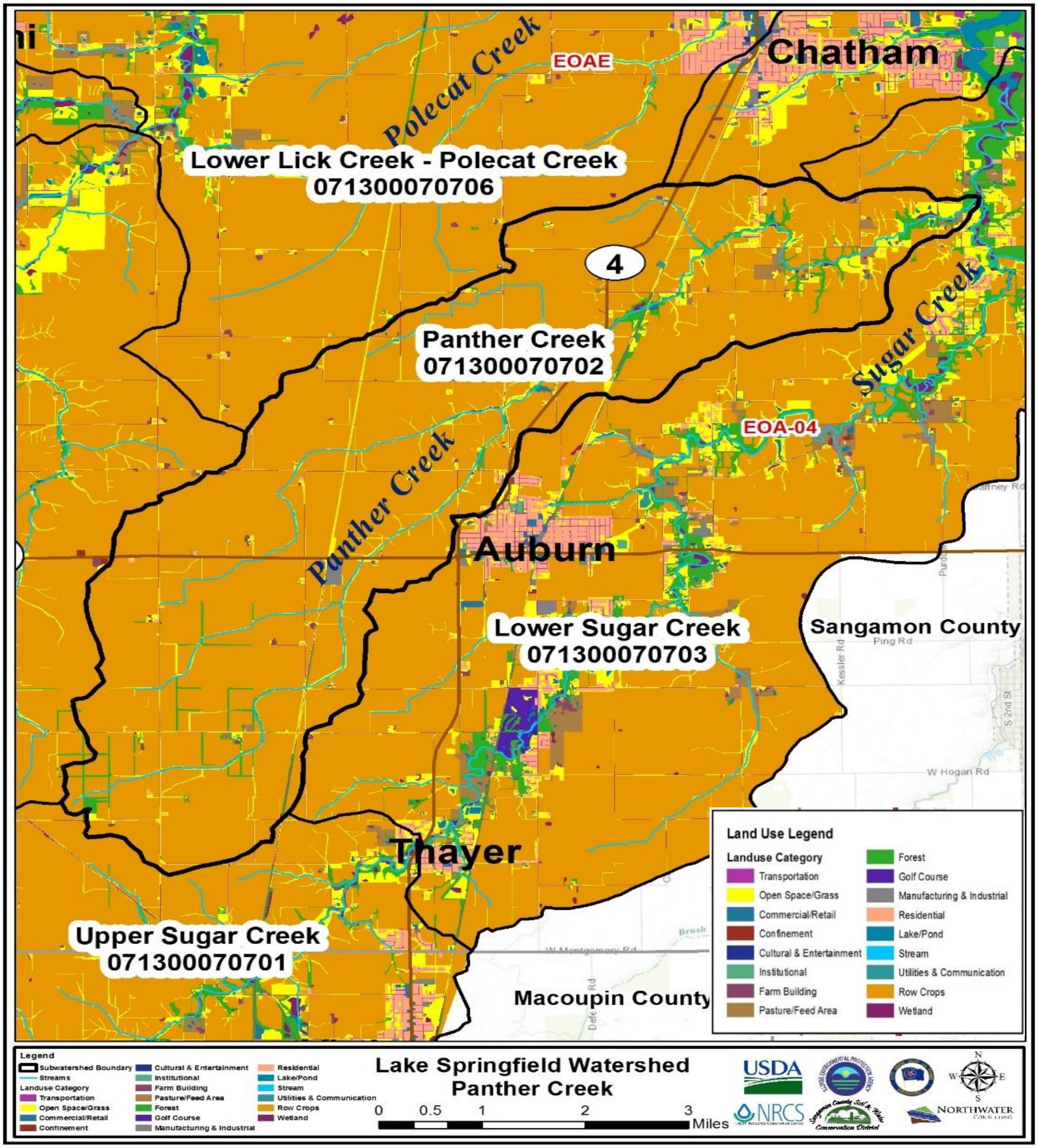


FIGURE 3.6.3 – PANTHER CREEK SUB-WATERSHED LAND USE

TABLE 3.6.3 – PANTHER CREEK SUB-WATERSHED LAND USE

Land Use Category	Total Acres	% of Sub-watershed
Row Crops	13,284	88%
Grassland	538	4%
Forest	413	3%
Urban Open Space	334	2%
Roads	129	0.86%
Pasture	103	0.68%
Residential Farm	49	0.33%
Open Water – Stream	45	0.30%
Farm Building	41	0.27%
Manufacturing and Industrial	32	0.21%
Wetland	23	0.15%
Railroad	20	0.14%
Sod Farm	17	0.11%
Urban Residential	16	0.11%
Open Water – Pond	16	0.11%
Utilities and Communication	3	0.02%
Commercial/Retail	2	0.01%
Open Space Road	2	0.01%
Wholesaling and Storage	1	0.01%
Park	1	0.01%
Feed Area	1	0.004%
Total	**15,072**	**100%**

3.6.4 Lower Sugar Creek Land Use

Seventy percent (14,988 acres) of the **Lower Sugar Creek** sub-watershed's 21,422 acres are in row crops, 1,458 acres (7%) of forestland, 1,780 acres (8%) of urban residential and urban open space in Auburn, Chatham, Glenarm and Thayer and a public golf course (115 acres) and 909 acres of grassland (4%) and 665 acres of pasture (3%). Thirteen percent (2,837 acres) of this sub-watershed are HEL soils. There are 26 stream miles, 1,470 floodplain acres (7%), and it has an average 1.43 slope percentage, one of the highest in the LSW.

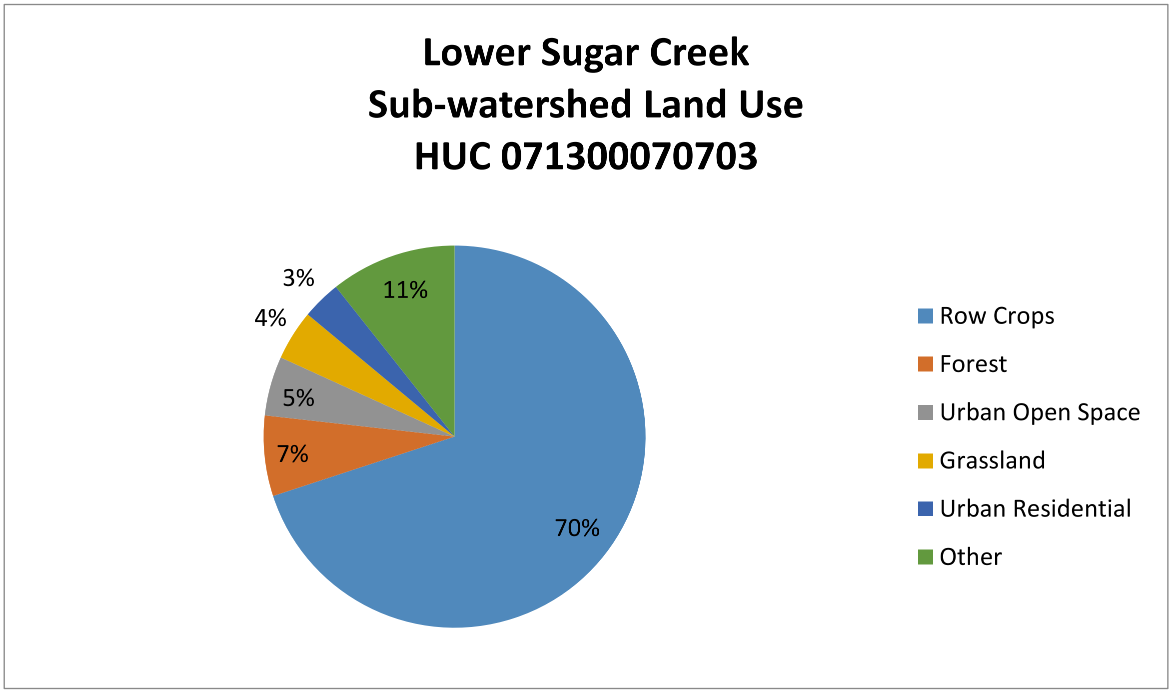


Chart 3.6.4 – LOWER SUGAR CREEK SUB-WATERSHED LAND USE

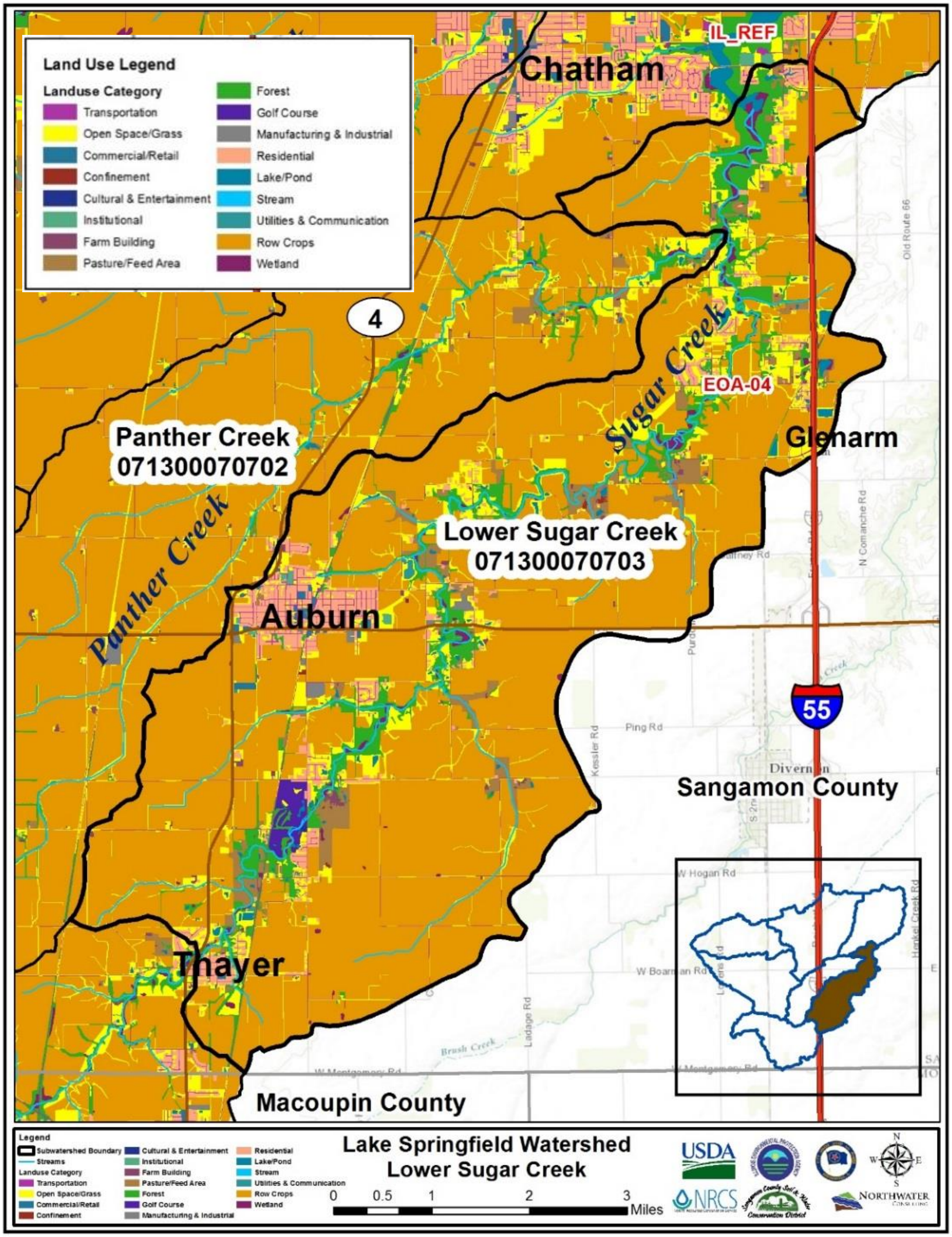


FIGURE 3.6.4 – LOWER SUGAR CREEK SUB-WATERSHED LAND USE

TABLE 3.6.4 – LOWER SUGAR CREEK SUB-WATERSHED LAND USE

Land Use Category	Total Acres	% of Sub-watershed
Row Crops	14,988	70%
Forest	1,458	7%
Urban Open Space	1,076	5%
Grassland	909	4%
Urban Residential	704	3%
Pasture	665	3%
Roads	377	2%
Residential Farm	210	0.98%
Wetland	175	0.82%
Open Water – Pond	133	0.62%
Golf Course	115	0.54%
Sod Farm	102	0.48%
Open Water – Stream	91	0.43%
Farm Building	77	0.36%
Open Space Road	73	0.34%
Commercial/Retail	48	0.22%
Manufacturing and Industrial	35	0.16%
Railroad	31	0.15%
Park	26	0.12%
Cemetery	18	0.08%
Mobile Homes	17	0.08%
Utilities and Communication	15	0.07%
Grain Elevator	14	0.07%
Feed Area	14	0.06%
Wholesaling and Storage	11	0.05%
Junkyard	10	0.05%
Institutional	10	0.05%
Other	19	0.09%
Total	**21,422**	**100%**

3.6.5 South Fork Lick Creek—Johns Creek Land Use

The South Fork Lick Creek—Johns Creek sub-watershed is the second largest sub-watershed (31,203 acres) in the watershed and has the largest percentage (89%) of those (27,762 acres) in row crops, mostly under conventional tillage. The average percentage of slope is 1.11, has 42 stream miles, 1,140 floodplain acres (4%) and 2,713 HEL acres (9%). Thirty percent of its soils (9,412 acres) are classified as hydric. The only urban area is a portion of the City of Waverly.

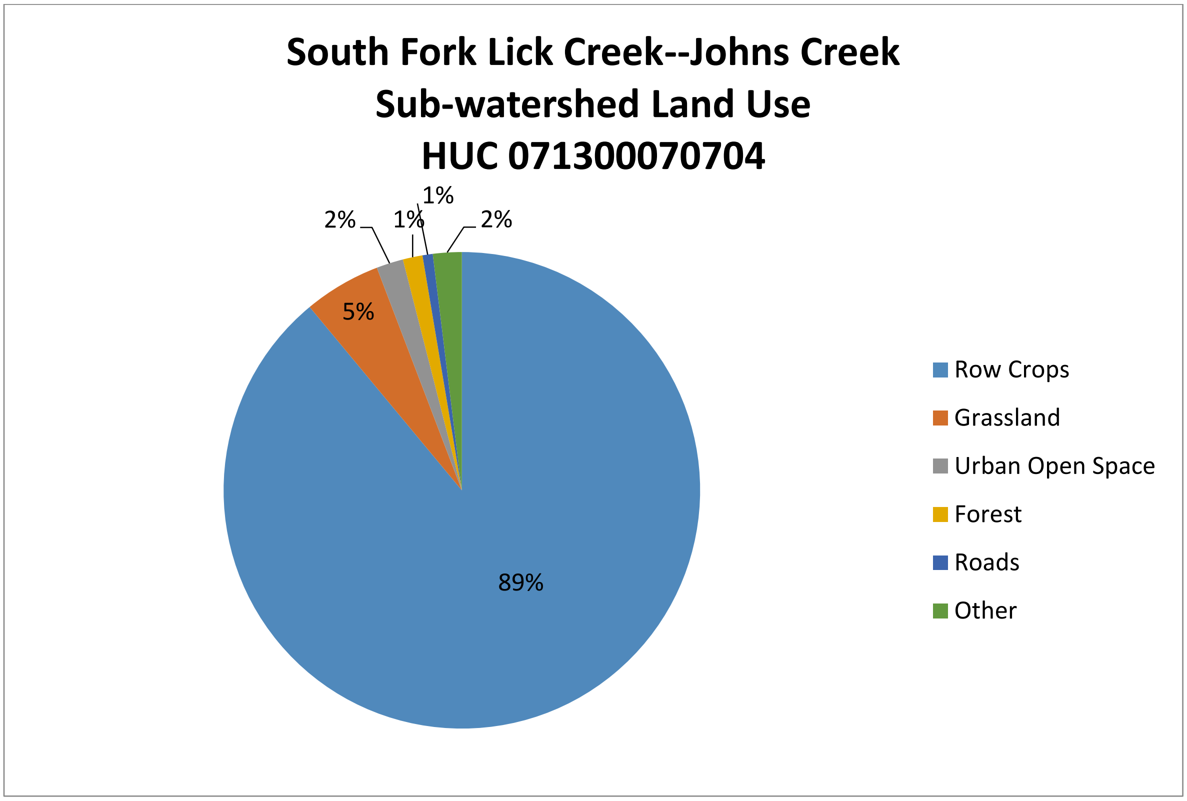


Chart 3.6.5 – SOUTH FORK LICK CREEK – JOHNS CREEK SUB-WATERSHED LAND USE

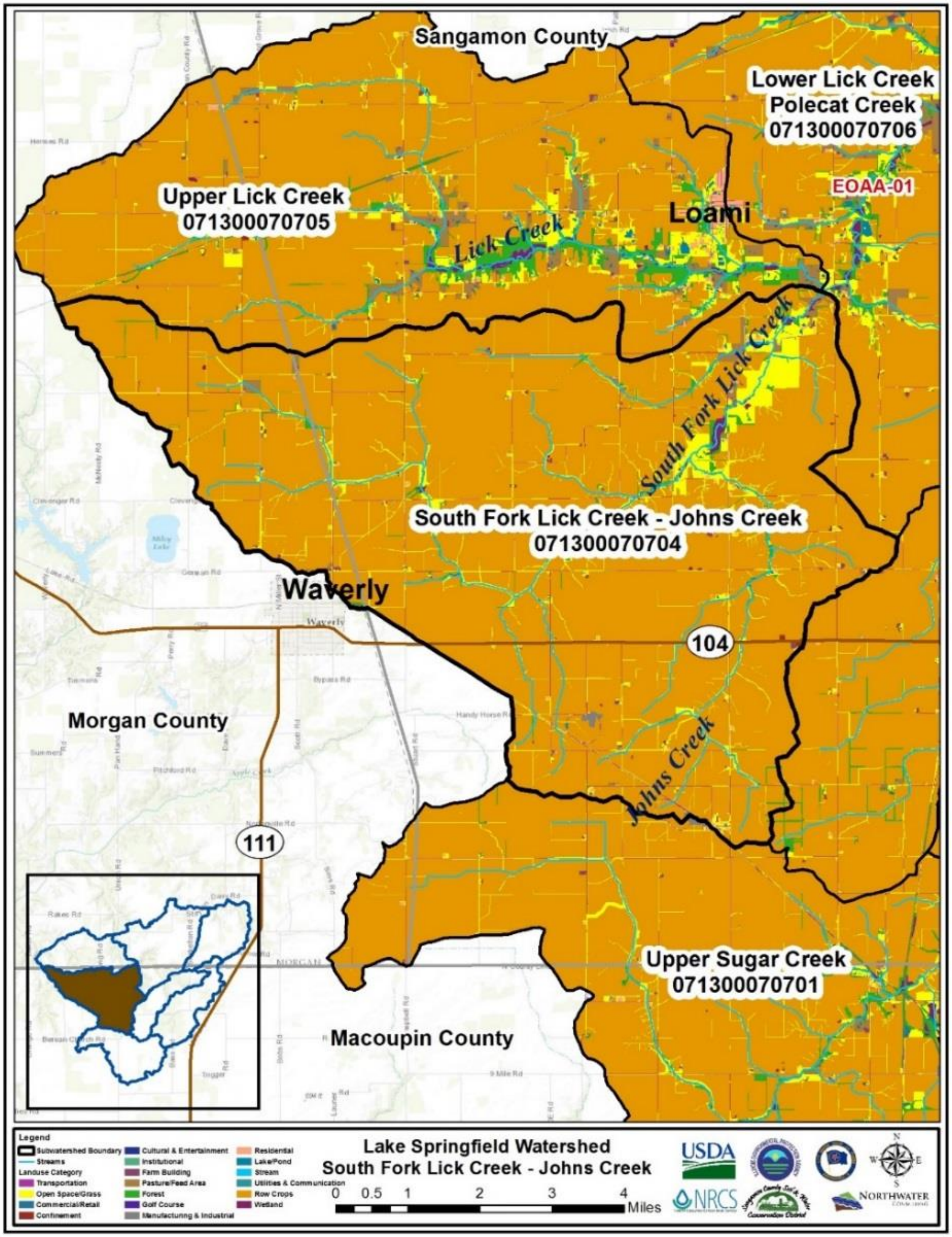


FIGURE 3.6.5 – SOUTH FORK LICK CREEK—JOHNS CREEK SUB-WATERSHED LAND USE

TABLE 3.6.5 – SOUTH FORK LICK CREEK – JOHNS CREEK SUB-WATERSHED LAND USE

Land Use Category	Total Acres	Percent of Sub-watershed
Row Crops	27,762	89%
Grassland	1,629	5.22%
Urban Open Space	570	1.83%
Forest	417	1.34%
Roads	217	0.69%
Pasture	179	0.57%
Wetland	88	0.28%
Residential Farm	85	0.27%
Open Water - Stream	75	0.24%
Farm Building	67	0.21%
Railroad	37	0.12%
Open Water - Pond	31	0.10%
Manufacturing and Industrial	25	0.08%
Confinement	8	0.03%
Feed Area	6	0.02%
Park	6	0.02%
Cemetery	1	0.00%
Utilities and Communication	0	0.00%
Junkyard	0	0.00%
Total	**31,203**	**100%**

3.6.6 Upper Lick Creek Land Use

Eighty-two percent (17,806 acres) of the **Upper Lick Creek** sub-watershed's acres (21,782) are planted to row crops, 5% (987 acres) in forest and 978 acres (4%) of grassland. The average slope percentage is 1.3, has 29 stream miles, 953 floodplain acres (4%), 2,921 HEL acres (13%) and 7,693 acres (35%) are classified as hydric soils. Two percent (599 acres) urban open space and urban residential area includes most of the Village of Loami.

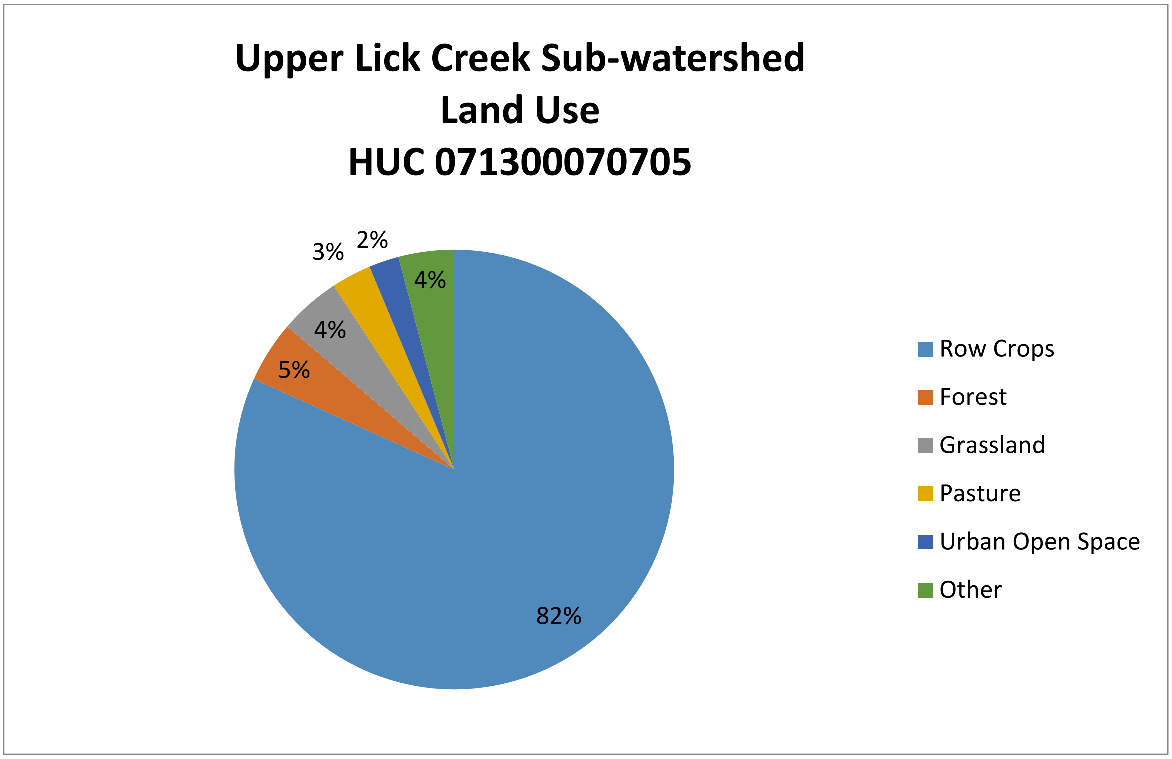


Chart 3.6.6 – UPPER LICK CREEK SUB-WATERSHED LAND USE

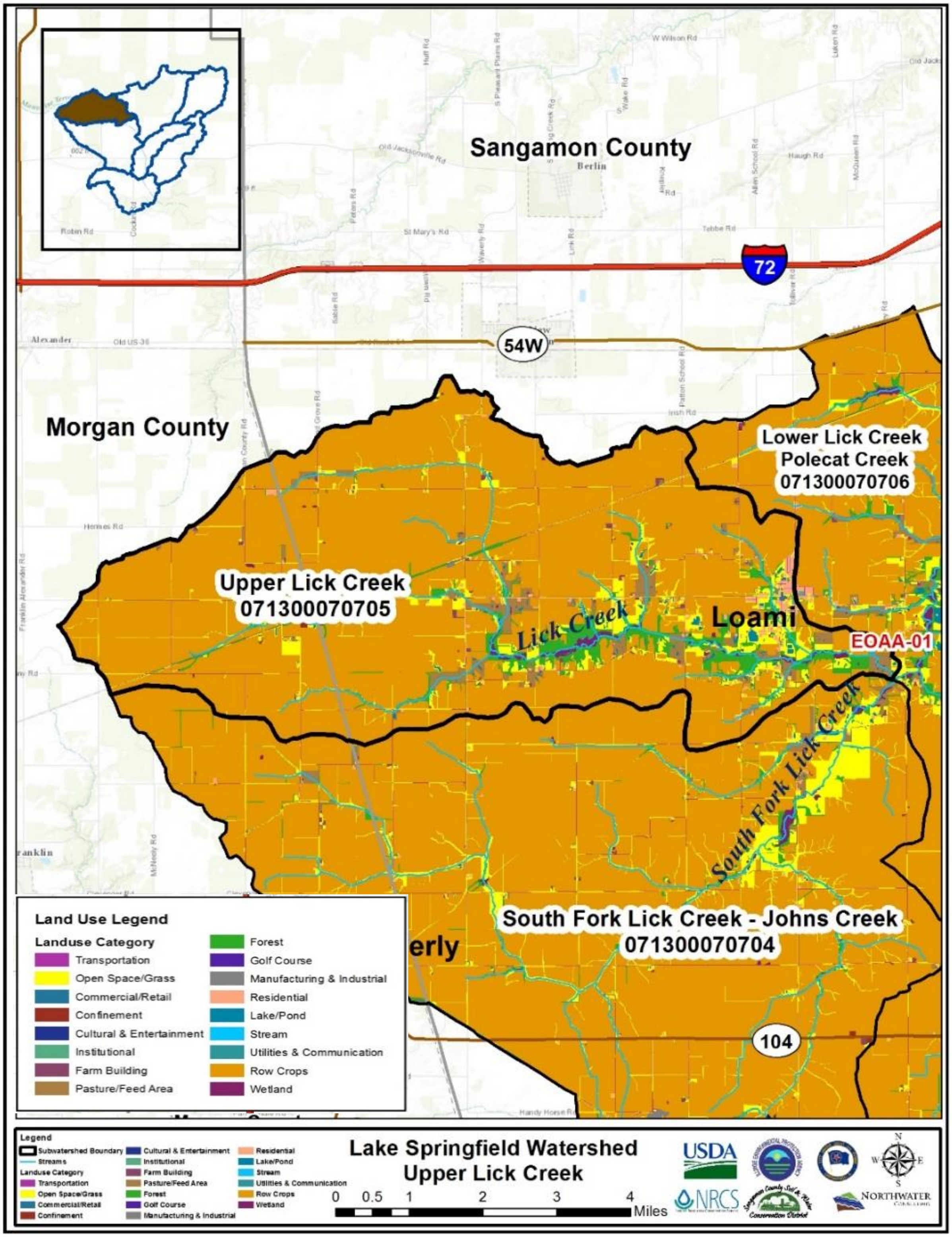


FIGURE 3.6.6 – UPPER LICK CREEK SUB-WATERSHED LAND USE

TABLE 3.6.6 – UPPER LICK CREEK SUB-WATERSHED LAND USE

Land Use Category	Total Acres	% of Sub-watershed
Row Crops	17,806	82%
Forest	987	5%
Grassland	978	4%
Pasture	639	3%
Urban Open Space	482	2%
Roads	164	1%
Wetland	141	1%
Residential Farm	117	1%
Urban Residential	107	0%
Open Water – Pond	92	0%
Farm Building	76	0%
Open Water – Stream	55	0%
Feed Area	32	0%
Railroad	25	0%
Sod Farm	17	0%
Park	14	0%
Mobile Homes	10	0%
Manufacturing and Industrial	8	0%
Open Hog Lot	8	0%
Cemetery	8	0%
Confinement	8	0%
Commercial/Retail	5	0%
Institutional	3	0%
Orchards and Nurseries	1	0%
Utilities and Communication	1	0%
Total	**21,782**	**100%**

3.6.7 Lower Lick Creek—Polecat Creek Sub-Watershed Land Use

The **Lower Lick Creek—Polecat Creek sub-watershed** is the largest in the LSW, covering 36,023 acres. Sixty-nine percent (24,957) of these acres are planted to row crops, 8% (2,821 acres) of urban open space and urban residential is the Village of Curran, parts of Springfield, Southern View and Chatham, along Lick Creek and Polecat Creek. Thirty-three percent (11,740 acres) of the soils are classified as hydric. Fourteen percent (5,138 acres) are HEL soils, and 7% (2,620 acres) are in the 100-year floodplain. The forested land includes 1,924 acres (5%). A band of timber follows Lick Creek from its origination in western Sangamon County, flowing eastward. A 340-acre riparian zone was designated as the *Lick Creek Wildlife Preserve* by CWLP in 1991.

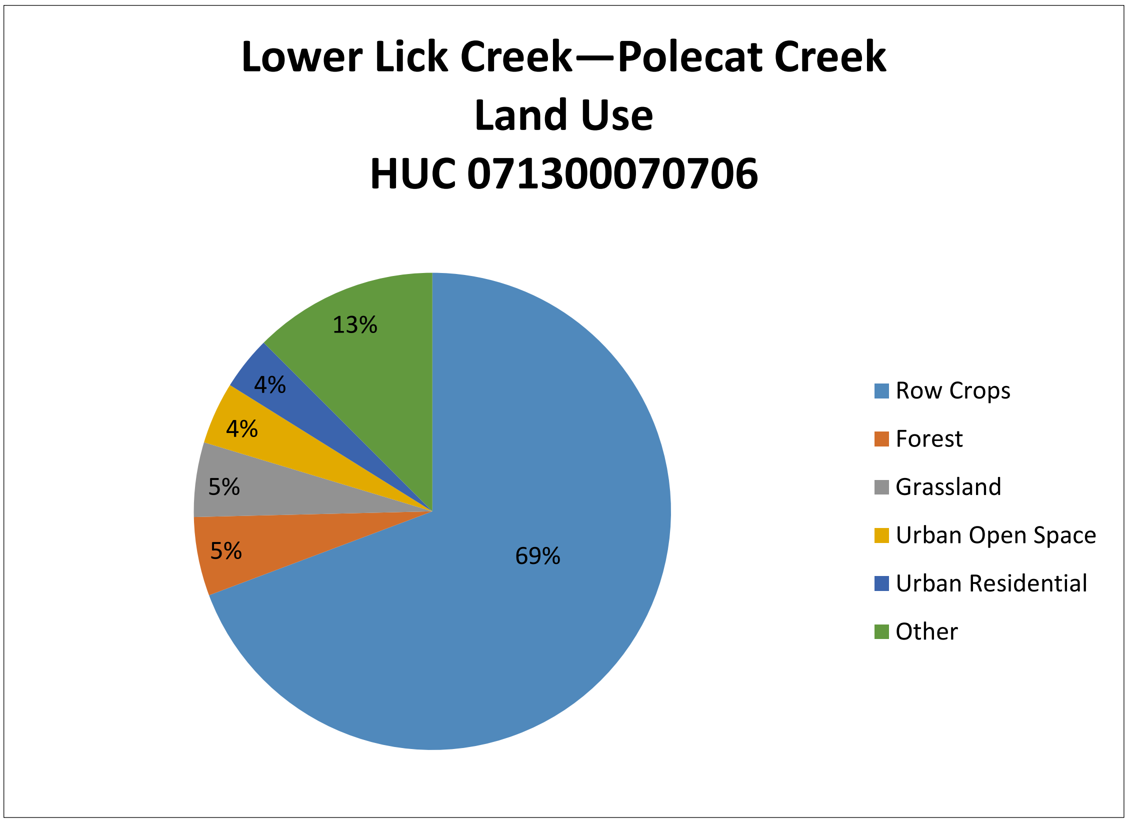


Chart 3.6.7 – LOWER LICK CREEK POLECAT CREEK SUB-WATERSHED LAND USE

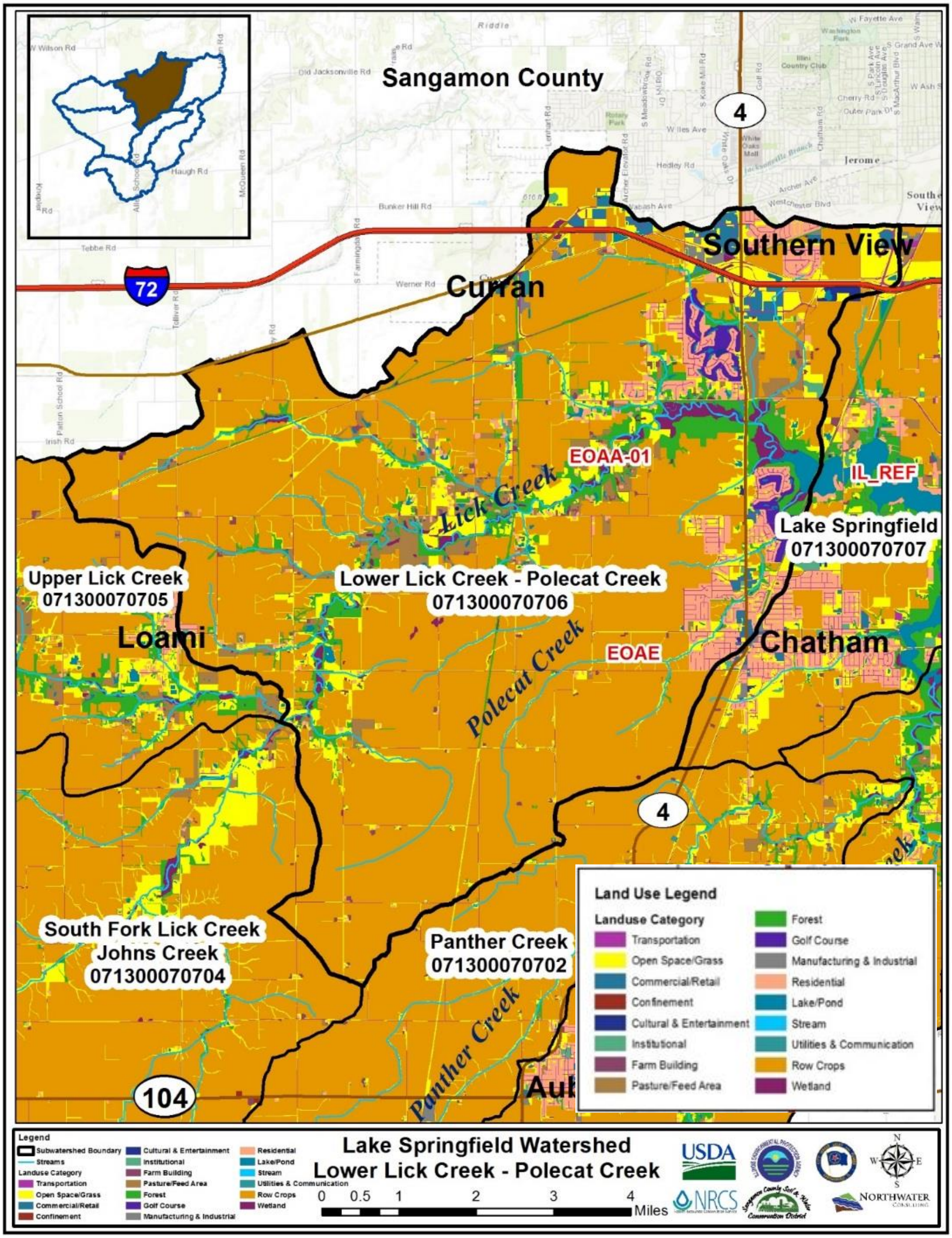


FIGURE 3.6.7 – LOWER LICK CREEK—POLECAT CREEK SUB-WATERSHED LAND USE

TABLE 3.6.7 – LOWER LICK CREEK—POLECAT CREEK SUB-WATERSHED LAND USE

Land Use Category	Total Acres	% of Sub-watershed
Row Crops	24,957	69%
Forest	1,924	5%
Grassland	1,820	5%
Urban Open Space	1,516	4%
Urban Residential	1,305	4%
Pasture	1,169	3%
Roads	664	2%
Wetland	576	2%
Commercial/Retail	374	1%
Open Water – Pond	306	0.85%
Golf Course	305	0.85%
Residential Farm	285	0.79%
Farm Building	162	0.45%
Open Water – Stream	132	0.37%
Open Space Road	116	0.32%
Railroad	77	0.21%
Cultural and Entertainment	54	0.15%
Institutional	54	0.15%
Wholesaling and Storage	45	0.12%
Park	37	0.10%
Manufacturing and Industrial	31	0.08%
Feed Area	28	0.08%
Resource Extraction	23	0.06%
Orchards and Nurseries	22	0.06%
Grain Elevator	21	0.06%
Utilities and Communication	16	0.05%
Confinement	3	0.01%
Cemetery	2	0.00%
Rail Yard	0	0.00%
Total	**36,023**	**100%**

3.6.8 Lake Springfield Sub-Watershed

Lake Springfield sub-watershed is the most unique of the seven sub-watersheds, covering 21,470 acres. Only 6,595 (31%) acres are planted to row crops. Lake Springfield covers 3,955 acres (18%) of this area and 2,004 acres (9%) are forestland. When Lake Springfield was being built, thousands of deciduous trees were planted to replace those which were cleared. 4,584 acres (21%) of the land is urban residential and urban open space. There are 728 residences, along with 16 clubs and camps in 21.6 miles of the Lake's shoreline. While all of these homes are privately owned, they are on land leased from the City of Springfield. These leases remain with the land even when the homes change hands. Specific guidelines for use of the City's land is outlined in its ***"Land Use Plan for Lake Springfield and Its Marginal Properties"***, adopted in 1991 and updated in 1994, 2005, 2012 and 2014. These directives were established for the logical development and preservation of lands surrounding Lake Springfield currently and simultaneously serve to avoid water quality deterioration. This sub-watershed includes most of the Village of Chatham, a portion of Southern View and southern part of Springfield, which is south of Stevenson Drive.

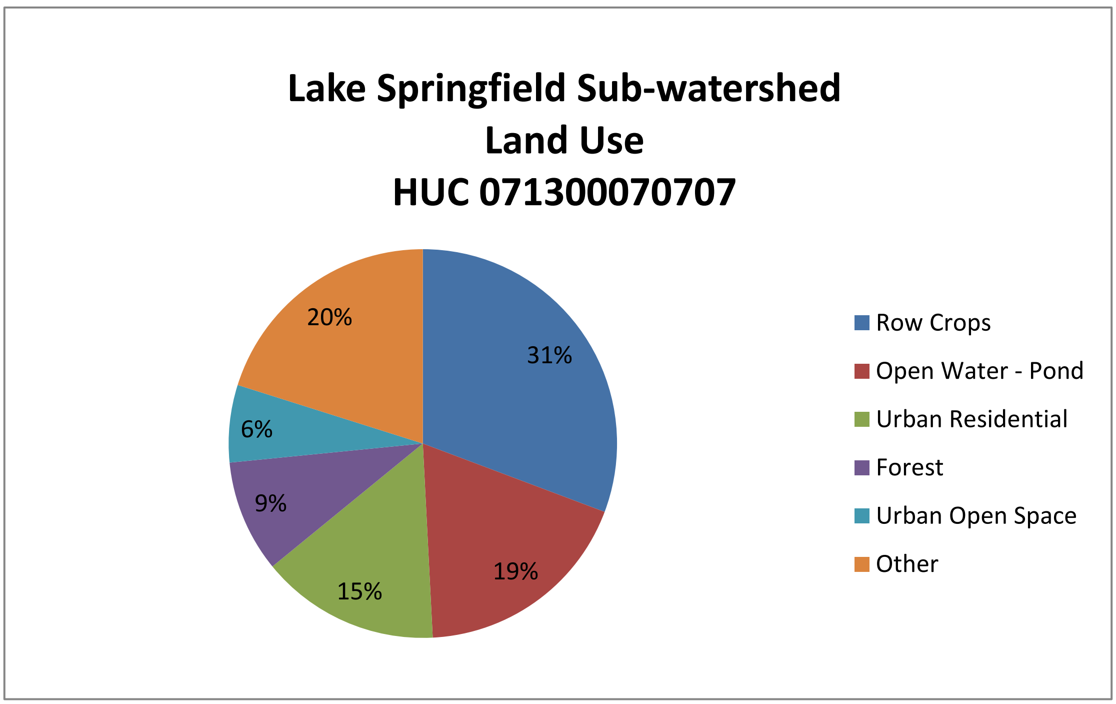


Chart 3.6.8 – LAKE SPRINGFIELD SUB-WATERSHED LAND USE

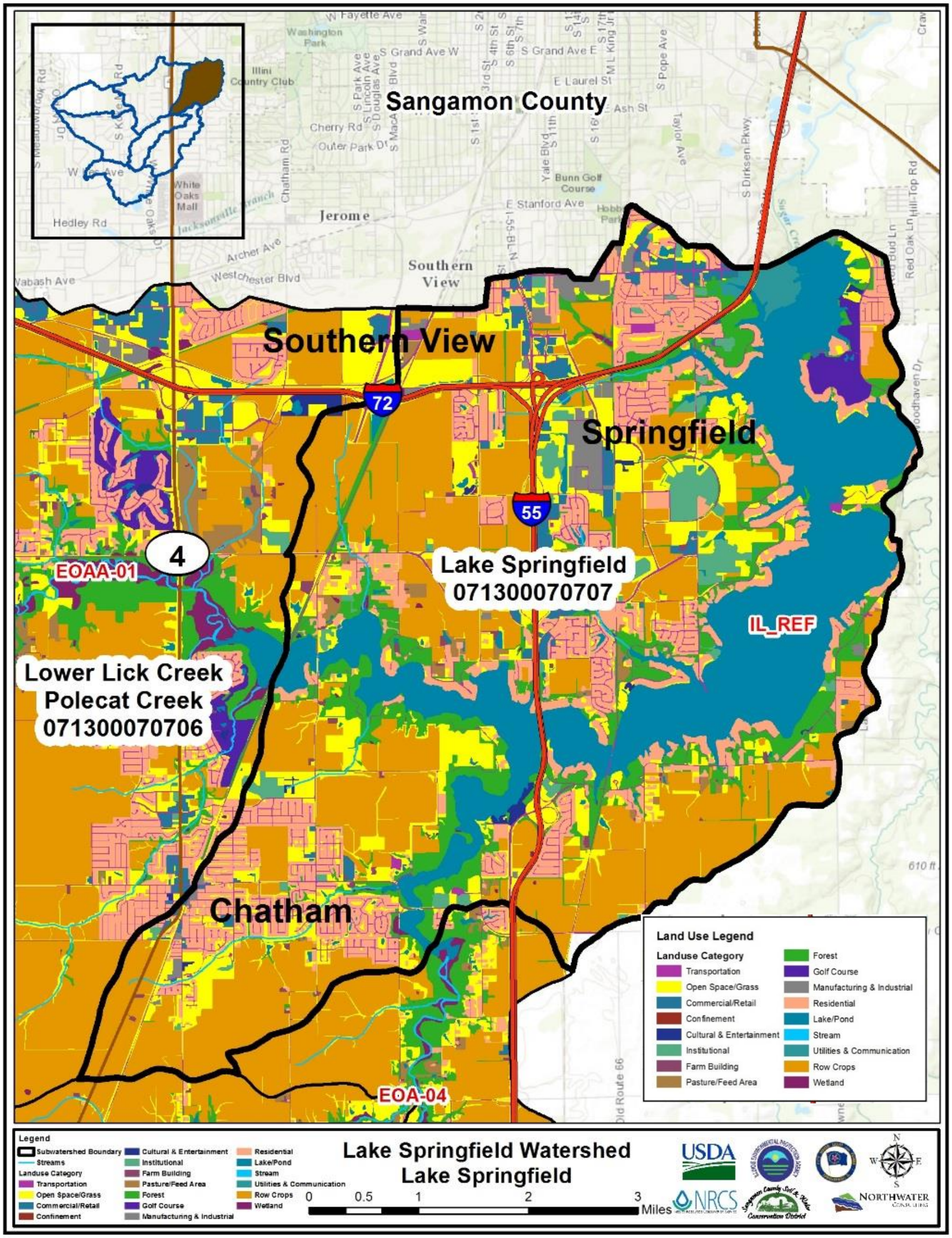


FIGURE 3.6.8 – LAKE SPRINGFIELD SUB-WATERSHED LAND USE

TABLE 3.6.8 – LAKE SPRINGFIELD SUB-WATERSHED LAND USE

Land Use Category	Total Acres	% of Sub-watershed
Row Crops	6,595	31%
Open Water – Pond	3,965	18%
Urban Residential	3,202	15%
Forest	2,004	9%
Urban Open Space	1,382	6%
Roads	946	4%
Grassland	741	3%
Park	518	2%
Institutional	405	2%
Commercial/Retail	393	2%
Open Space Road	182	0.85%
Golf Course	158	0.73%
Wholesaling and Storage	152	0.71%
Manufacturing and Industrial	138	0.64%
Utilities and Communication	127	0.59%
Pasture	122	0.57%
Residential Farm	95	0.44%
Farm Building	61	0.29%
Railroad	60	0.28%
Education	59	0.27%
Wetland	40	0.19%
Cultural and Entertainment	31	0.15%
Orchards and Nurseries	30	0.14%
Marina/Resort	26	0.12%
Rail Yard	13	0.06%
Open Water – Stream	12	0.06%
Feed Area	6	0.03%
Bus Terminal	4	0.02%
Mobile Homes	3	0.01%
Total	**21,470**	**100%**

3.6.9 Land Use and Distance to Lake Springfield

A proximity analysis (Table 3.6.9) was performed to determine the average distance of each land use category to Lake Springfield. On average, marinas, bus terminals and institutional land uses are situated closest to Lake Springfield. Row crops are almost twice the average distance away from Lake Springfield. All fields combined are, on average, 44,156 feet, or 8.4 miles away from the lake. The closest crop field in the watershed is 195 feet from the Lake and the farthest away is 94,533 feet (18 miles) away.

TABLE 3.6.9 – LAND USE AVERAGE DISTANCE TO LAKE SPRINGFIELD

Land Use Category	Acres	Average Distance (ft)	Average Distance (miles)
Marina/Resort	26	0	0
Bus Terminal	4	492	.1
Institutional	476	9,522	1.8
Open Space Road	375	9,544	1.8
Golf Course	577	10,627	2.0
Rail Yard	14	11,747	2.2
Roads	2,719	13,689	2.6
Cultural and Entertainment	90	13,871	2.6
Park	663	15,927	3.0
Wholesaling and Storage	214	18,224	3.5
Resource Extraction	23	20,023	3.8
Orchards and Nurseries	53	20,921	4.0
Commercial/Retail	860	20,948	4.0
Education	80	21,304	4.0
Urban Residential	5,728	22,426	4.2
Grain Elevator	36	22,542	4.3
Utilities and Communication	166	24,897	4.7
Open Water – Lake Springfield	3,965	N/A	N/A
Open Water – Pond	596	27,717	5.3
Railroad	302	30,662	5.8
Urban Open Space	5,992	31,117	5.9
Forest	7,744	33,312	6.3
Wetland	1,122	33,794	6.4
Manufacturing and Industrial	320	35,280	6.7
Residential Farm	941	36,370	6.9
Pasture	2,944	36,771	7.0
Open Water – Stream	450	37,987	7.2
Grassland	7,266	38,660	7.3
Farm Building	531	39,064	7.4
Feed Area	86	39,629	7.5
Mobile Homes	36	40,278	7.6

Land Use Category	Acres	Average Distance (ft)	Average Distance (miles)
Row Crops	124,522	44,156	8.4
Cemetery	51	46,246	8.2
Confinement	27	46,497	8.8
Sod Farm	137	47,007	8.9
Open Hog Lot	8	48,727	9.2
Junkyard	17	57,059	10.8
Total	**169,161**	**27,973**	**5.3**

3.6.10 Wildlife, Habitat, Protected Areas, Threatened & Endangered Species

The Lake Springfield Watershed is home to many species of animals and plants, a few of which are protected under the Endangered Species Act, and can be seen in designated wildlife areas or various other locations throughout the watershed where habitat suitable for their sustainability is available.

According to Michael Chandler, IDNR District Wildlife Habitat Biologist, the soils in Sangamon County support habitat for a variety of wildlife, including pheasant, quail, mourning dove, turkey, white-tailed deer, squirrel, rabbit, songbirds, fox, raccoon, mink, and muskrat. Snipe, heron, and other shore birds inhabit the bottomland areas. The streams and lakes support smallmouth bass, catfish, carp, and sunfish. Many farm ponds are stocked with largemouth bass, catfish and bluegill. These ponds provide habitat for migratory ducks in spring and fall, as well as habitat for giant Canada geese.

Protected Areas

The 12.89-acre **Lake Springfield Wildlife Sanctuary**, owned and operated by Springfield City Water, Light and Power, is the home to numerous wildlife species, including a very large deer population. It is located on the southwest side of the Lake, along Woodland Trail. The park area of the Wildlife Sanctuary has a small amount of playground equipment and a softball diamond. There are one pavilion and four additional uncovered picnic areas, each accommodating 75 people. A dock near the pavilion allows easy access to the park from the lake. The park has a small permanent restroom facility.

Lick Creek Wildlife Preserve covers 340 acres owned and operated by CWLP. It is located at the western-most end of Lake Springfield in the Lower Lick Creek—Polecat Creek sub-watershed, comprises eye-catching wooded hills and marshy lowlands. There are hiking trails throughout the Preserve, which is home to a variety of native flora and fauna. This area was set aside as a wildlife preserve in 1991 by CWLP. When land parcels were condemned for Lake Springfield in the 1920s and 1930s, to build Lake Springfield, a large section of the lower Lick Creek bottomland was set aside as woodland to protect the lake's water quality. This area contains a notable grove of mixed sugar maples and chinkapin oaks. One chinkapin, located in Camp Widjiwagan, has been dated at more than 300 years of age.

Nipper Wildlife Sanctuary is a 120-acre wildlife sanctuary and educational center located about two miles southeast of Loami, Illinois, along Lick Creek in the Lower Lick Creek—Polecat Creek sub-watershed in the LSW. Farmers Frank and Gladys Nipper donated the land and money, through establishment of the sanctuary land trust to be used to replant this area back to pre-settlement times of tall grasses and prairie plants once common in this area. At the time of settlement, Sangamon County was approximately 70 percent tallgrass prairie. In 1999, approximately 150 species of flowers and plants were replanted in this former farmland to entice prairie insect and birdlife to the sanctuary. In addition, a series of five wetlands have been established at Nipper. Over the past several years, grassland birds, such as meadowlarks and dickcissels, have become a common sight and the state-endangered short-eared owl has been seen here.

Abraham Lincoln Memorial Garden (LMG) is a self-governing, 100-acre woodland and prairie garden owned by the City of Springfield and managed by the Abraham Lincoln Memorial Garden Foundation, founded in 1952. The Garden is made up of two major units, the original 63-acre Jensen section bordering Lake Springfield, and the newer 29-acre Ostermeier Prairie Center section which contains approximately 20 acres of Illinois tallgrass prairie. There are also 19 acres of additional buffer properties. In 1934, when the City of Springfield was acquiring land to build Lake Springfield, Harriett Knudson asked the city to set aside approximately 0.6 miles of future shoreline as a garden to memorialize Abraham Lincoln. The city agreed and leased the Jensen section, which was cultivated farmland with approximately 12 trees, to the Springfield Civic Garden Club, in perpetuity. Landscape architect Jens Jensen designed the garden to reflect an idealized vision of the Midwestern woods and prairies, which included 28 species of canopy trees, 14 species of intermediate-sized trees, 23 varieties of shrubs, and 11 varieties of wildflowers, all native to Illinois, Indiana, and Kentucky, Lincoln's three native states. LMG was dedicated in 1939. In 1965, the LMG constructed a Nature Center within the Jensen Unit. In 1992, the Jensen Unit was added to the U.S. National Register of Historic Places as an example of Jensen's mature landscape design.

LMG maintains approximately five miles of footpaths. Plantings within the Jensen Unit include white oak (the Illinois state tree), sugar maple, dogwood, and redbud trees. Ostermeier Prairie Center includes prairie grasses such as big bluestem, and some fire-resistant tree specimens such as bur oak. The garden is populated with many native species, including red fox, raccoons, opossums, squirrels, coyotes, rabbits, chipmunks, deer, and turtles. It is an extremely popular site for birders because it attracts both resident and migratory birds.

The **Sangamon Valley Trail** (SVT) is a 5.5-mile rail trail on the west side of Sangamon County skirting Springfield and extending from Centennial Park, on Springfield's southwest side, to Stuart Park on the city's northwest side. It was opened to the public on July 26, 2011, and is operated by the Springfield Park District. The current SVT is a segment of a 38-mile right-of-way that has been set aside for rail trail use. The entire right-of-way connects Girard, to the south in Macoupin County, and north to Athens in Menard County. The right-of-way spans the western half of Sangamon County in a north-south direction through the center of the Lake Springfield Watershed. The right-of-way occupies an abandoned segment of the St. Louis, Peoria and North Western Railway, later consolidated into the Chicago and North Western Railroad, now owned by IDNR (75.51 acres). Future expansion plans include extending the trail north to Athens and south to Girard. In April, 2016, final plans for the approximately 6-mile extension were submitted to the Illinois Department of Transportation to extend the existing 5.5-mile section northwest from Stuart Park to Irwin Bridge Road, about a mile south of the Menard County line. Extending the SVT southwest through the Lake Springfield Watershed to Girard will be dependent on receiving federal grant funds similar to those received to complete this most recent trail segment.

The **SVT** will be part of the 60-mile Western Alternative Route of the Route 66 Trail. The SVT will offer a more rural off-road trail experience, west of the Route 66 main trail, and along the west edge of Springfield. The existing main trail on-street through Springfield and the county's other communities will remain, as an important connection to Springfield historic sites and attractions, the original Route 66 highway, and the Interurban Trail. There will be 28 SVT miles in Sangamon County. The Western Alternate Route is 64 miles long and includes the counties of Sangamon, Macoupin, Montgomery, and Madison. Communities on the Western Route include Auburn, Virden, Girard, Nilwood, Carlinville, Gillespie, Benld, and Staunton. The Western Alternate Route, from Chatham to Staunton, is along the 1926 Route 66 highway alignment. Township, county, and municipal roads are used. When segments of the Sangamon Valley Trail south of Springfield are developed, the future Western Alternate will move from an on-road alignment onto the SVT.

The **Interurban Trail** is a 8.3-mile rail trail in Sangamon County, Illinois, built and managed by the Illinois Department of Transportation (IDOT). It occupies an abandoned Illinois Terminal Railroad interurban corridor stretching from the south side of Springfield, through the Lake Springfield sub-watershed, to the center of Chatham, ending at Walnut Street. It parallels a Class I railroad mainline throughout its entire length currently operated by the Union Pacific Railroad which carries *Lincoln Service* passenger train service. The trail passes underneath Interstate 72 south of Springfield near the MacArthur extension. It crosses the southwestern arm of Lake Springfield on a refurbished railroad bridge, where Lick Creek enters the Lake. The trail is very scenic even with its close proximity to the active railroad line. Most of the trail passes through areas that are open farmland or scattered housing. It links with the eastern end of the Wabash Trail located at the intersection of Wabash Avenue and Park Avenue and provides additional access to Springfield's southwest side.

The 430-mile **Route 66 Trail** is aligned on existing off-road bicycle trails wherever possible connecting Chicago to St. Louis along the historic Route 66 corridor. The trail becomes a part of local and regional trail systems to extend and connect the Route 66 Trail to other locations and resources. Off-road trails give the Route 66 Trail an element of variety and additional safety. Sixty-four miles on eleven off-road bicycle trails comprise fifteen percent of the Route 66 Trail. These off-road trails are located throughout the Route 66 corridor and in eight of the eleven Route 66 Trail counties. Seven are rail-trails, developed on former railroad and includes six miles of the Interurban Trail in Sangamon County, from Springfield to Chatham. It is the intention to define the Route 66 Trail alignment using existing, planned and potential future off-road trails that are close (within several miles) to the original Route 66 road route. The Southern Region section of the Route 66 Trail extends from Springfield on the north to the St. Louis Metro East area on the south, starting at the Sangamon County line, north of Springfield and Williamsville, and ending at the Old Chain of Rocks Bridge on the Mississippi River at Granite City. There are 118 miles of main trail and 60 miles of western alternate route trail in the southern region. In Sangamon County, 50 miles of the trail combines county, township, state, and municipal roads. It also includes the Interurban Trail between Springfield and Chatham. The Route 66 Trail and Western Alternate Route meander through the following Sangamon County townships beginning near Springfield: Woodside, Curran, Ball, Chatham, Auburn, and Virden and Girard townships in Macoupin County.

The **Wabash Trail** is a 3.0-mile rail trail in Sangamon County, Illinois, built by the Illinois Department of Transportation (IDOT) and occupies an abandoned Wabash Railroad right-of-way on the southwest side of Springfield, Illinois. It stretches eastward from Robbins Road to just short of MacArthur Boulevard, linking with the northern end of the Interurban Trail. Upkeep and policing of this trail are managed by the Springfield Park District.

Fisheries

Lake Springfield is a highly ranked fishing lake in Illinois according to the IL Department of Natural Resources and contains the following fish species:

Black Crappie	Muskellunge	Saugeye
Bluegill	Northern Pike	Smallmouth Bass
Bullhead	Rainbow Trout	Walleye
Channel Catfish	Hybrid Striped Bass	White Bass
Carp	Largemouth Bass	White Crappie
Flathead Catfish	Longear sunfish	Yellow Perch
Green Sunfish	Redear Sunfish	

Since 1984, nearly 45 species and several hybrid fish have been collected in Lake Springfield. Of these, approximately 15 are considered sport fish species: channel catfish, crappie, bluegill, largemouth bass, flathead catfish, carp, striped bass, white bass, yellow bass, black bullhead, yellow bullhead, walleye, and redear sunfish. The Division of Fisheries entered into a formal Cooperative Management Agreement in 1984 with the City of Springfield to manage the sport fishery.

Lake Springfield has a power plant on the Lake that keeps the lower end of the Lake open to fishing year round. Lake Springfield has four concrete boat ramps for easy access. There are two posted public fishing areas: at the Dividing Dam and the Sunset View Fishing Area (on East Lake Drive just south of the zoo turnoff). In addition, there is a fishing pier between East and West Tom Madonia Parks, which is also designed for persons with disabilities.

Lake Springfield is the most heavily fished impoundment located entirely in the county. Approximately 25,000 fishing trips are made to the Lake each year (Illinois Department of Conservation, 1991). Approximately 150 fishing tournaments are scheduled at the Lake from mid-June through October each year.

Sport Fish Consumption Advisory

Over time, heavy metals and pesticides that erode or leach into open bodies of water can accumulate inside the tissues of the fish occupying those waters. Each year, the Illinois Department of Natural Resources (IDNR) surveys the fish populations in many bodies of water across the state to determine the degree to which different fish might be contaminated by hazardous chemicals or heavy metals. In particular, they watch for the presence of methyl mercury and four known carcinogens (chlordane, dieldrin, heptachlor epoxide, and PCB), which have been shown to exist in elevated levels in some fish populations statewide. Under the Fish Contaminant Monitoring Program, sport fish are collected by IDNR are then tested by IEPA. When high levels of any of these substances are detected in a waterway's fish population, the Illinois Department of Public Health (IDPH) issues a Sport Fish Consumption Advisory, based on IEPA's test results. The advisory alerts consumers to the level of contamination that has been detected and provides maximum recommended consumption rates for the contaminated fish.

In the past, a number of different sport fish from Lake Springfield have been included in IDPH's Sport Fish Consumption Advisory. However, a steady decline in chemical contamination levels in the Lake as a whole gradually reduced both the number of fish included in the Advisory and the severity of the risk posed by their consumption. Currently, there is no specific consumption advisory in effect for any fish caught in Lake Springfield. However, Lake Springfield falls under a general state-wide methyl mercury advisory aimed at children and women of child-bearing years. These individuals tend to be more at risk for the effects of the heavy metal, which can be found in varying levels in many predator fish. Because even a small amount of methyl mercury has the potential to cause developmental and other significant damage to a fetus or child, the State of Illinois recommends that children under age 15 and women who are or may become pregnant eat no more than one meal per week of predator fish from any source. Persons not in these two groups can safely eat as many meals as they wish of predator fish caught in Lake Springfield. Predator fish include all species of black bass (largemouth, smallmouth, and spotted), striped bass, white bass, hybrid striped bass, walleye, sauger, saugeye, flathead catfish, muskellunge, and northern pike.

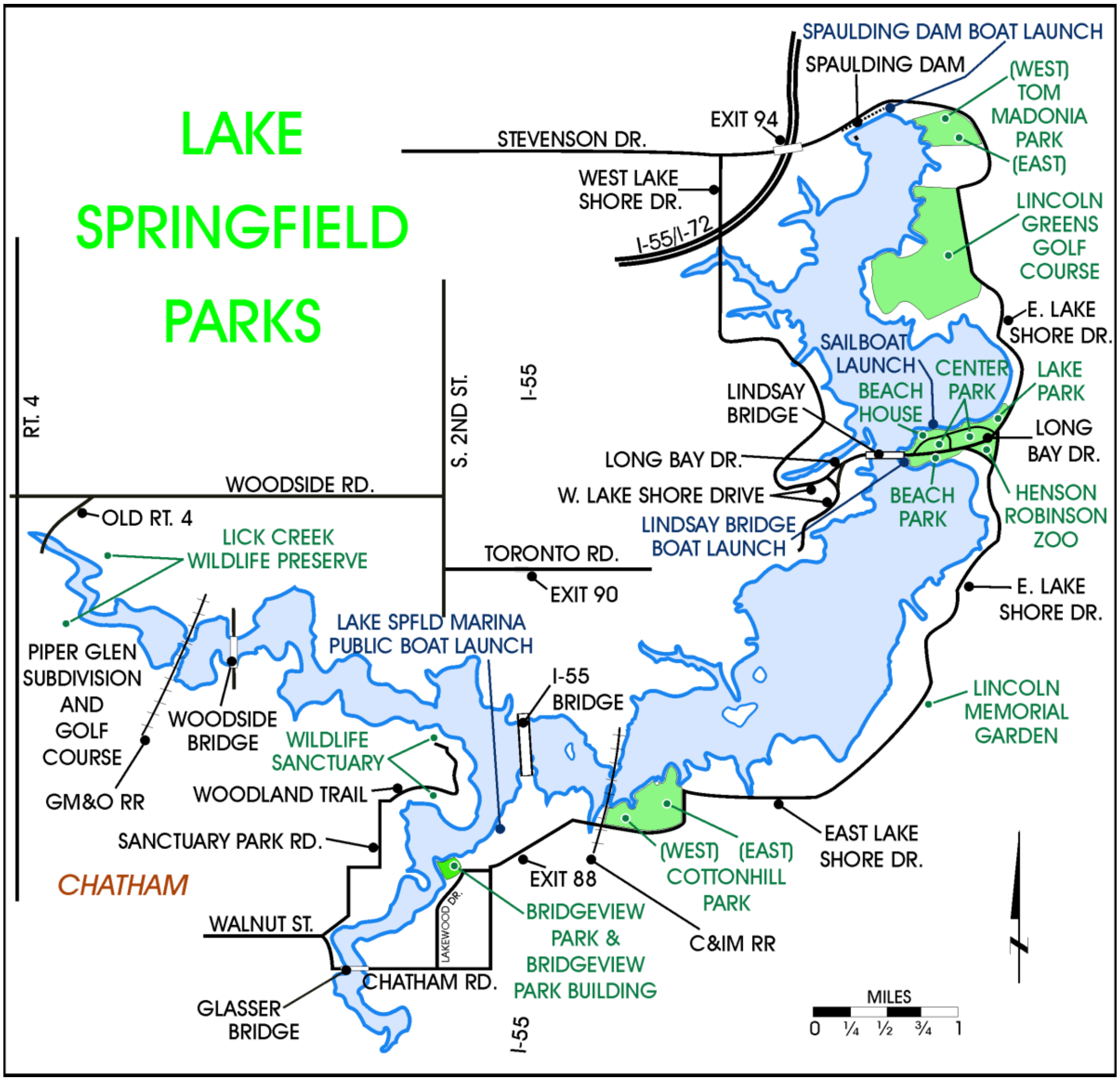


FIGURE 3.6.9 – LAKE SPRINGFIELD PARKS AND RECREATIONAL AREAS

Recreational Areas

There are eight public parks available offering opportunities for numerous outdoor activities such as picnicking, boating, fishing, hiking, camping (designated areas), volleyball, horseshoes, nature observation, cross country skiing, ice skating (designated areas in specified months). The Lake Springfield Land Use Plan, City Code and/or lease documents provide specific guidelines and restrictions for all uses of the land owned by the City of Springfield.

The **Henson Robinson Zoo** - In 1967, a tract of land was donated to the Springfield Park District by the City of Springfield to fulfill Henson C. Robinson's dream for a local zoo. Construction of this private nonprofit zoo began in 1968 and was officially opened in 1970 on the eastern shore of Lake Springfield. The zoo is now home to animals native to Australia, Africa, Asia and North and South America. Over 90 species of native and exotic animals are housed here among naturalistic exhibits. The zoo participates in scientific research studies and conservation efforts in addition to providing a fun and educational environment for people of all ages. Henson Robinson Zoo is accredited by the Association of Zoos and Aquariums (AZA) for achieving rigorous, professional standards for animal care, education, wildlife conservation and science and is among 200 of America's accredited zoos who have joined in building North America's largest wildlife conservation movement.

Threatened and Endangered Species

An **Endangered** species is any species that is in danger of extinction throughout all or a significant portion of its range. A **Threatened** species is one that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Each species is either "listed as threatened" (LT) or "listed as endangered" (LE).

In 2010, the Franklin's Ground Squirrel (*Poliocitellus franklini*) was documented along a segment of the SVT, located in the Lower Lick Creek—Polecat Creek sub-watershed, near Centennial Park. This species was placed on the State of Illinois' endangered species list in 2004. The 2005 Illinois Wildlife Action Plan, prepared by the IL Department of Natural Resources, lists Franklin's Ground Squirrel as a "species in greatest need of conservation", with an objective to delist it from the state-threatened listing by 2025. Loss and fragmentation of tallgrass prairie habitat for this species, due to intensive agricultural practices, is thought to be the reason for the decline in population of the Franklin's Ground Squirrel. It was suggested that these squirrels probably favor abandoned rail routes because track embankments drain well and provide the habitat they prefer, which includes a mixture of grassy and woody vegetation, referred to as savanna-like habitat.

The Illinois Endangered Species Protection Board (IESPB) is responsible for reviewing and revising the threatened and endangered species lists in Illinois, as warranted and no less often than every five years. The most recent list on their website at http://www.dnr.state.il.us/espb/index.htm was effective May 19, 2015. However, the most current Threatened and Endangered Species list is documented in the Illinois Natural Heritage Database prepared by Illinois' Division of Natural Heritage which is updated on a daily basis. https://dnr.state.il.us/conservation/naturalheritage/inhd.htm

In reviewing the latest lists for Sangamon, Macoupin and Morgan counties, several of these same species' locations have been documented over the years in more than one of these counties. The **Franklin's Ground Squirrel** and the **Indiana Bat** have been spotted in Macoupin and Sangamon counties. The **Loggerhead Shrike** and the **Short-eared Owl** have been documented in Morgan and Sangamon Counties. All three LSW counties have documented sightings of the **Bunchflower** and the **Ornate Box Turtle**. On August 9, 2007, the **Bald Eagle** was removed from the federal list of threatened and endangered species and Illinois' list in 2009. It had been on the list since 1967.

TABLE 3.6.10 – ILLINOIS' THREATENED AND ENDANGERED SPECIES LIST [12]

County	Scientific Name	Common Name	Type	Threatened - LT Endangered - LE	Year Listed
Morgan	*Pseudacris illinoensis*	Illinois Chorus Frog	Amphibian	LT	2014
Sangamon	*Necturus maculosus*	Mudpuppy	Amphibian	LT	2014
Sangamon	*Tyto alba*	Barn Owl	Bird	LT	2016
Sangamon	*Nycticorax nycticorax*	Black-crowned Night-Heron	Bird	LE	2007
Sangamon	*Ixobrychus exilis*	Least Bittern	Bird	LT	1985
Morgan	*Lanius ludovicianus*	Loggerhead Shrike	Bird	LE	1997
Sangamon	*Lanius ludovicianus*	Loggerhead Shrike	Bird	LE	1994
Sangamon	*Circus cyaneus*	Northern Harrier	Bird	LE	2007
Morgan	*Asio flammeus*	Short-eared Owl	Bird	LE	2013
Sangamon	*Asio flammeus*	Short-eared Owl	Bird	LE	2016
Morgan	*Bartramia longicauda*	Upland Sandpiper	Bird	LE	1989
Morgan	*Fundulus dispar*	Starhead Topminnow	Fish	LT	1927
Morgan	*Hesperia ottoe*	Ottoe Skipper	Insect	LE	1998
Morgan	*Speyeria idalia*	Regal Fritillary	Insect	LT	2012
Sangamon	*Poliocitellus franklinii*	Franklin's Ground Squirrel	Mammal	LT	2015
Macoupin	*Poliocitellus franklinii*	Franklin's Ground Squirrel	Mammal	LT	2009
Macoupin	*Myotis sodalis*	Indiana Bat	Mammal	LE	2015
Morgan	*Myotis sodalis*	Indiana Bat	Mammal	LE	2015
Sangamon	*Myotis sodalis*	Indiana Bat	Mammal	LE	1970
Morgan	*Fusconaia ebena*	Ebonyshell	Mussel	LE	2002
Morgan	*Astragalus distortus*	Bent Milk Vetch	Plant	LE	2012
Morgan	*Buchnera americana*	Blue Hearts	Plant	LT	2016

[12] EFFECTIVE AS OF OCTOBER 6, 2016.

County	Scientific Name	Common Name	Type	Threatened - LT Endangered - LE	Year Listed
Macoupin	*Melanthium virginicum*	Bunchflower	Plant	LT	2012
Morgan	*Melanthium virginicum*	Bunchflower	Plant	LT	1993
Sangamon	*Melanthium virginicum*	Bunchflower	Plant	LT	1955
Morgan	*Boltonia decurrens*	Decurrent False Aster	Plant	LT	2013
Macoupin	*Sisyrinchium atlanticum*	Eastern Blue-eyed Grass	Plant	LE	1997
Sangamon	*Stellaria pubera*	Great Chickweed	Plant	LE	2016
Macoupin	*Trillium viride*	Green Trillium	Plant	LE	2000
Morgan	*Schoenoplectus hallii*	Hall's Bullrush	Plant	LT	1993
Sangamon	*Plantago cordata*	Heart-leaved Plantain	Plant	LE	2007
Macoupin	*Astragalus crassicarpus var. trich*	Large Ground Plum	Plant	LE	2013
Morgan	*Agalinis skinneriana*	Pale False Foxglove	Plant	LT	2003
Morgan	*Polygala incarnata*	Pink Milkwort	Plant	LE	1994
Sangamon	*Tradescantia bracteata*	Prairie Spiderwort	Plant	LE	2016
Macoupin	*Silene regia*	Royal Catchfly	Plant	LE	2002
Sangamon	*Silene regia*	Royal Catchfly	Plant	LE	2016
Sangamon	*Clonophis kirtlandi*	Kirtland's Snake	Reptile	LT	2015
Morgan	*Heterodon nasicus*	Plains Hog-nosed Snake	Reptile	LT	2015
Morgan	*Tropidoclonion lineatum*	Lined Snake	Reptile	LT	1983
Macoupin	*Terrapene ornata*	Ornate Box Turtle	Reptile	LT	2016
Morgan	*Terrapene ornata*	Ornate Box Turtle	Reptile	LT	2016
Sangamon	*Terrapene ornata*	Ornate Box Turtle	Reptile	LT	1978
Sangamon	*Apalone mutica*	Smooth Softshell	Reptile	LE	2010

The USFWS is responsible for administering the Federal Endangered Species Act. To fulfill its responsibilities, they do the following:

1. Identify and assess declining species that may need Endangered Species Act protection and take steps to conserve those species.
2. Take steps to list candidate species as endangered or threatened and designate critical habitat. They also remove species from the Threatened and Endangered Species List ("delist") when they no longer need Endangered Species Act protection.

TABLE 3.6.11 – FEDERAL THREATENED AND ENDANGERED SPECIES LIST

County	Scientific Name	Common Name	Type	Threatened - LT Endangered - LE
Macoupin	*Myotis sodalis*	Indiana Bat	Mammal	LE
Morgan	*Myotis sodalis*	Indiana Bat	Mammal	LE
Sangamon	*Myotis sodalis*	Indiana Bat	Mammal	LE
Macoupin	*Myotis Septentrionalis*	Northern Long-eared Bat	Mammal	LT
Morgan	*Myotis Septentrionalis*	Northern Long-eared Bat	Mammal	LT
Sangamon	*Myotis Septentrionalis*	Northern Long-eared Bat	Mammal	LT
Morgan	*Boltonia decurrens*	Decurrent False Aster	Plant	LT
Macoupin	*Platanthera leucophaea*	Eastern Prairie Fringed Orchid	Plant	LT
Morgan	*Platanthera leucophaea*	Eastern Prairie Fringed Orchid	Plant	LT
Sangamon	*Platanthera leucophaea*	Eastern Prairie Fringed Orchid	Plant	LT

3.6.11 Nuisance and Invasive Species

While the area around Lake Springfield and in this sub-watershed is very beautiful, it does have some problematic areas. Lake Springfield is a haven for migratory birds such as Canada Geese. Many of these geese seem to be using the Lake and retention ponds in the Springfield area subdivisions for more long-term residency. While they are fed daily by some area residents, they are considered a nuisance by many others who have to deal with excessive geese feces, damage to lawns, flower beds, etc. In addition, these geese do considerable crop damage to fields in these areas, especially near retention ponds where they hatch their young each spring and use the spring-planted crops as a food source for their young goslings.

Excessive white-tail deer population is another nuisance issue in the Lake Springfield sub-watershed area, especially around the Lake and near the Wildlife Sanctuary. They are a hazard to drivers on the roads and use crops for feed, doing significant damage to crop fields in this sub-watershed.

3.6.12 Future Trends

3.6.12.1 Agricultural Land Ownership

According to the Illinois 2014 Tenure, Ownership and Transition of Agricultural Land (TOTAL) survey, 90 percent of the agricultural land acres are expected to change hands within the next five years. If this information is indicative for the Lake Springfield Watershed, a substantial number of cropland acres will see significant ownership change during this timeframe.

With the average age of farmers now being close to 60, many will be looking at retirement in the near future and turning their farm operations over to their younger adult children interested in farming, renting out their farms to other farmers looking to expand their farm operations or selling their farmland to support their final years in retirement. It is quite possible that the approximately 400 active farmers in this watershed will continue to decrease and the farm fields they operate will be absorbed by several of the larger farm operations. If commodity prices don't rebound so that farmers, who are highly leveraged with operating, equipment and land loans, can make an acceptable rate of return ($40/acre), some farmers may be forced to liquidate their assets and quit farming. As a farmer and/or his spouse begin to have health issues, they may need to make other living arrangements, which may require downsizing and moving from the farm and closer to medical and assisted living facilities. These scenarios and many others will impact changes throughout the LSW farming community.

In 2014, there were 127,808 landlord entities who rented out agricultural land[13] Of the total 16.2 million acres that are rented out in Illinois, 13.5 million acres are owned by non-operator landlords, with 94% of the total agricultural land being cropland.

The average age of the non-operator principal landlord is 66.2 years compared to 57.8 years for farm operators in the 2012 Census of Agriculture. Of those principal landlords, 52.6 percent have never farmed. TOTAL is a comprehensive study of all land, including non-operator landlords of agriculture land, is part of the census of agriculture program compiled by the USDA National Agricultural Statistics Service (NASS), in collaboration with USDA's Economic Research Service (ERS). www.agcensus.usda/gov/Publications/TOTAL/.

Many of the farms in the LSW are owned by second and third generations of families who may be absentee landlords, with no direct connection on decisions made about their farms. According to the 2012 Census of Agriculture, the average size farm in the LSW's three counties is approximately 425 acres, with approximately 3,002 operators engaged in farming. The trend towards farm cash rent versus crop share leases will continue, as long as landowners prefer not to be involved in the direct management of the farm.

With large crop price fluctuations and high crop production input costs, farmers will be looking for more flexible or variable cash rent agreements. 2014 cash rents were steady overall for the Region 7 area. Most of the leases were share rent, share with supplemental cash and cash rent. Rents for the "excellent productivity" category trended from $350 to $450 per acre, with the good productivity category in the $200 to $300 area per acre. Cash rents tend to drive the rate of return in relation to

13 2014 Tenure, Ownership and Transition of Agricultural Land (TOTAL) Survey in Illinois

land values. In 2014, with farm income being lower, crop share lease income was noticeably reduced as compared to cash rent. Many times, farmers are reluctant to ask the landowner for a lower cash rent price in fear of losing the opportunity to farm the land that they were relying on to help cover their investments in the latest high-tech equipment which has hit the scenes in recent years. There is a great deal of competitiveness for cash rent farmland in the LSW, particularly because of "mega" farmers who have the financial stability to outbid other farmers for many of the largest tracts of land.

Land Value

Based on information in the "2015 Illinois Farmland Values and Lease Trends," published by the Illinois Society of Professional Farm Managers and Rural Appraisers (ISPFMRA), 48 percent of farmland was sold in 2014 to settle estates, 17 percent was sold based on receiving a good price, 8 percent involved the need for cash and 5 percent were from forced liquidations. Of the knowledgeable individuals surveyed on the farmland market, 66 percent expect farmland prices to average decreases over the next five years. Positive factors and their potential impacts on farmland prices over the next three years include non-farm investor demand, Chinese (Far East) demand, inflation pressures and instability around the world. Factors with the most negative impacts include commodity prices, input prices, net farm income and interest rates. These respondents believed more factors will have negative impacts than positive impacts on farmland prices.

According to ISPFMRA's "2012 Illinois Farmland Values and Lease Trends," yearly increases in land prices have averaged 6.7 percent across all of Illinois between 1970 and 2011, with yearly increases averaging 12 percent from 2005 to 2011.

Productivity

ISPFMRA Region 7 – West Central area covers 10 counties, three of them within the LSW (Sangamon, Macoupin and Morgan). According to the ISPFMRA Region 7 committee members, 2014 values for farmland classified as "excellent productivity" farmland ranged from $12,000 to $14,000 per acre, "good productivity" land from $7,000 to $9,000 per acre, "average productivity" farmland bringing $5,000 to $7,000 per acre, followed by "fair productivity" and "recreational" land in the $3,000 to $4,000 per acre range. Most of the farmland in the LSW would fall into the excellent to good productivity land categories, which were steady to down five percent in total value per acre in 2013. However, these land values have sky-rocketed over the past five years.

TABLE 3.6.12 – 2014 LAND TRACTS SOLD IN SANGAMON, MACOUPIN AND MORGAN COUNTIES

2014 Land Tract Sales	Sangamon		Macoupin		Morgan	
	Acres	Price	Acres	Price	Acres	Price
Excellent Productivity	1,041	$13,694	400	$14,038	337	$13,482
Good Productivity	276	$10,507	482	$9,053	489	$9,723
Average Productivity	______	______	90	$10,300	______	______
Fair Productivity	______	______	133	$4,998	______	______

Excellent productivity tracts are generally described as flat, black and square, with productivity indexes of 133 and above, and are in great demand in this area. This land is well maintained, located in a desirable community with excellent access to transportation and markets, Most of the buyers have been operating farmers and investors with close ties to aggressive operating farmers. Of the six predominate soil types in the LSW, five of them (67.3% of the land acres) are considered prime farmland and would meet the criteria for “excellent productivity” farmland.

Good productivity tracts have lessor productive soils, with productivity indexes in the 117 to 132 range, located in desirable communities with good transportation and market access. This land may have unusual shapes, varying topography, lack of road frontage, ditches or ponds, cut by roads or railroads or other public utilities. If potential flooding is an element of hazard, the land discount is higher.

Average productivity tracts have average to good soils with a significant amount of those soils with productivity indexes of 100 to 116 and are located in a community with adequate services available, fair transportation and market access. This land value varies based on percentage of tillable and non-tillable and production hazards similar to those listed under “good productivity” of the tract. These soils may show evidence of erosion, fertility loss, improper drainage or noxious weed infestations. Pasture or recreational land use of non-tillable acres contributes to the sales price. Higher prices generally are those nearer to metropolitan areas and at the higher end of the productivity range.

Fair productivity tracts have below average-to-fair soils with a significant amount of these soils with productivity indexes below 100, located in a fair community, with fair-to-poor transportation and market access, adverse topography with serious hazards from flooding, erosion, etc.

Recreational tracts are normally high in non-tillable acres with soils that may be subject to erosion and/or flooding. These tracts are typically purchased by non-resident owners for hunting, fishing and other recreational uses.

Transitional tracts are those that are well located and have good potential for development within a few years. These tracts may be used for commercial or residential uses.

In 2010, values for excellent and good land value categories were up 3 to 7 percent. Eight out of 10 counties in this region had farmland sales in excess of $7,000 per acre. Morgan and Sangamon Counties had sales exceeding $8,000 per acre, with the majority of the buyers being local farmers.

Commercial and Residential Development

With a considerable amount of agricultural land in the LSW being located south and west of Springfield and contiguous to the seven LSW municipalities, there will continue to be transitional land available in the LSW for development. Over the past five years, however, commercial and residential development has been stagnant due to the overall economic downturn at the federal, state and local levels. Investors may be reluctant to purchase this land at this time, but will in due time as the economy turns around and especially if interest rates remain low.

It is common for developers to purchase a tract of farmland for future development and continue to keep it in agricultural production, re-zoning only those portions which are being developed for commercial, residential, or a combination of both, uses. This keeps the undeveloped portion of the property taxed at the agricultural rate, which is significantly less than the real estate taxes on commercial and residential property. There are also sales of this type of land based on a square foot-price rather than a per-acre price, especially if utilities and roads are already in existence and based on its location.

Lower commodity prices recently have diminished from the traditional 3.5 to 4.0 percent competitive return on farmland investments to the current 2.0 to 2.5 percent range, which investors still find acceptable and see as an extremely safe-haven investment. As long as the return on investment continues at this acceptable level by investors, excellent, good and transitional farmland tracts will remain in demand in the LSW.

Land Use

With 74 percent of the LSW being in crop production, corn and soybean production will continue to dominate the LSW as the primary land use in the LSW. However, farmers will be expected to adopt changes in their farming operations which will reduce nutrient losses from their fields by 45 percent for nitrogen and phosphorus. These changes will include the implementation of structural BMPs (grassed waterways, water and sediment control basins, grade control structures, etc.) and watershed-wide BMPs (cover crops, split application of nitrogen, nutrient management plan implementation, reduced-tillage or no-tillage, etc.) and edge-of-field BMPs (filter strips, field borders, bioreactors, saturated buffers, constructed wetlands, etc.) on their farms to meet these goals.

Population

As noted in the Springfield Sangamon County Regional Planning Commission's 2010 Census Analysis, using US Census Bureau and American Community Survey (ACS) data, most townships in the LSW experienced population decreases from 2000 to 2010, except for Auburn Township (5.2%) and Ball Township (46.5%). The largest decreases in population during this period occurred in the rural areas, with a greater decrease in areas more distant from a larger urban area. Another contributing factor to population decreases is the fact that the townships that don't have a strong incorporated area don't attract residents, as seen in the Talkington Township statistics, showing a 28.1 percent decrease in population over this 10-year period.

Employment

With changes in the agriculture to larger equipment and a significant decline in the number of smaller family farms, fewer people in these rural areas are necessary to sustain their industry. In 2010, only 1.2 percent were employed in the agriculture, forestry, fishing and hunting, and mining industry category. The largest employment statistic (25%) is found in the education, health care and social assistance industry category. Most of these industries are located in or within close proximity of Springfield and Chatham. Most of the townships seeing population declines are in rural areas, primarily in the western portion of Sangamon County. The Lake Springfield Watershed is a large agricultural community dependent on a large urban community to help sustain it.

Grain Handling

Most of the grain grown in the LSW is transported either by rail, river barges or semi-trailer trucks to food, livestock feed and ethanol processing centers throughout the United States. Many of the local country elevators in the LSW have either merged with other elevators to survive or have been bought out by larger ones (i.e., The Scoular Company and CHS, Inc., near Waverly in Talkington Township and Archer Daniels Midland (ADM) in Curran Township, just west of Springfield).

In March 2010, The Scoular Company of Omaha, Nebraska, and Johnson Grain, LLC of Waverly, Illinois, formed a new venture to own and operate grain handling assets in central Illinois, which included Johnson's three grain-handling facilities in Palmyra and Waverly, Illinois. All three facilities were incorporated into Scoular's North American marketing network. The Scoular Company (www.scoular.com) is a 124-year-old employee-owned company with nearly $5 billion in annual sales. Its 100+ independent business units provide diverse supply chain solutions for end-users and suppliers of grain, feed ingredients and food ingredients around the world. It has 120 strategically located offices and grain-handling facilities in North America, South America and Asia with 1200+ employees engaged in the business of buying, selling, storing, handling and processing grain and ingredients, along with managing transportation and logistics worldwide.

The 105-year old Farmers Elevator Company, with grain storage facilities at Lowder and Auburn, was purchased by CHS, Inc. in August 2010. It owns two ethanol plants in Rochelle and Annawan, Illinois, and is one of the largest exporters of distillers dried grains with solubles (DDGS), an ethanol byproduct used for animal feed, with access to many global markets. CHS Inc. (www.chsinc.com) is a leading global agribusiness owned by farmers, ranchers and cooperatives across the United States. It supplies energy, crop nutrients, grain marketing services, animal feed, food and food ingredients, along with business solutions including insurance, financial and risk management services. The company operates petroleum refineries/pipelines and manufactures, markets and distributes Cenex® brand refined fuels, lubricants, propane and renewable energy products.

Local farmers and other country elevators from the surrounding area can benefit financially by delivering their grain to these top-notch grain terminals operated by these two global marketing companies in this watershed.

3.6.13 Agricultural Land Use and Quality by Sub-categories, Acreage and Percent of Watershed Row Crop Production

Row Crops

Row crops are the dominant land use as a percentage of area in each of the sub-watersheds. Comparing land use statistics by sub-watershed, **South Fork Lick Creek—Johns Creek** and **Panther Creek** contain the greatest overall percentage of row crops at 89% and 88%, respectively. **Lake Springfield** sub-watershed contains the least percentage of row crops at 31%, but has the largest percentage of urban residential area (15%) and 18% is open water, primarily Lake Springfield. While corn has been the predominant crop for many years in this watershed, soybeans have been gaining ground in recent years.

Pasture

There is a total of 2,944 acres (2%) of pasture within the Lake Springfield Watershed. **Lower Lick Creek—Polecat Creek** sub-watershed contains the greatest acreage of pasture and the same percentage as **Lower Sugar Creek** and **Upper Lick Creek** sub-watershed, or 3%. **Upper Sugar Creek** sub-watershed contains the least amount and percentage of pasture (68 acres or 0.3%).

TABLE 3.6.13 – PASTURE ACRES BY SUB-WATERSHED

Sub-watershed Code	Sub-watershed	Sub-watershed (acres)	Pasture Acres	% of Sub-watershed
071300070701	Upper Sugar Creek	22,189	68	0.3%
071300070702	Panther Creek	15,072	103	1%
071300070703	Lower Sugar Creek	21,422	665	3%
071300070704	South Fork Lick Creek--Johns Creek	31,203	179	1%
071300070705	Upper Lick Creek	21,782	639	3%
071300070706	Lower Lick Creek--Polecat Creek	36,023	1,155	3%
071300070707	Lake Springfield	21,470	136	1%
	Total	**169,161**	**2,944**	**2%**

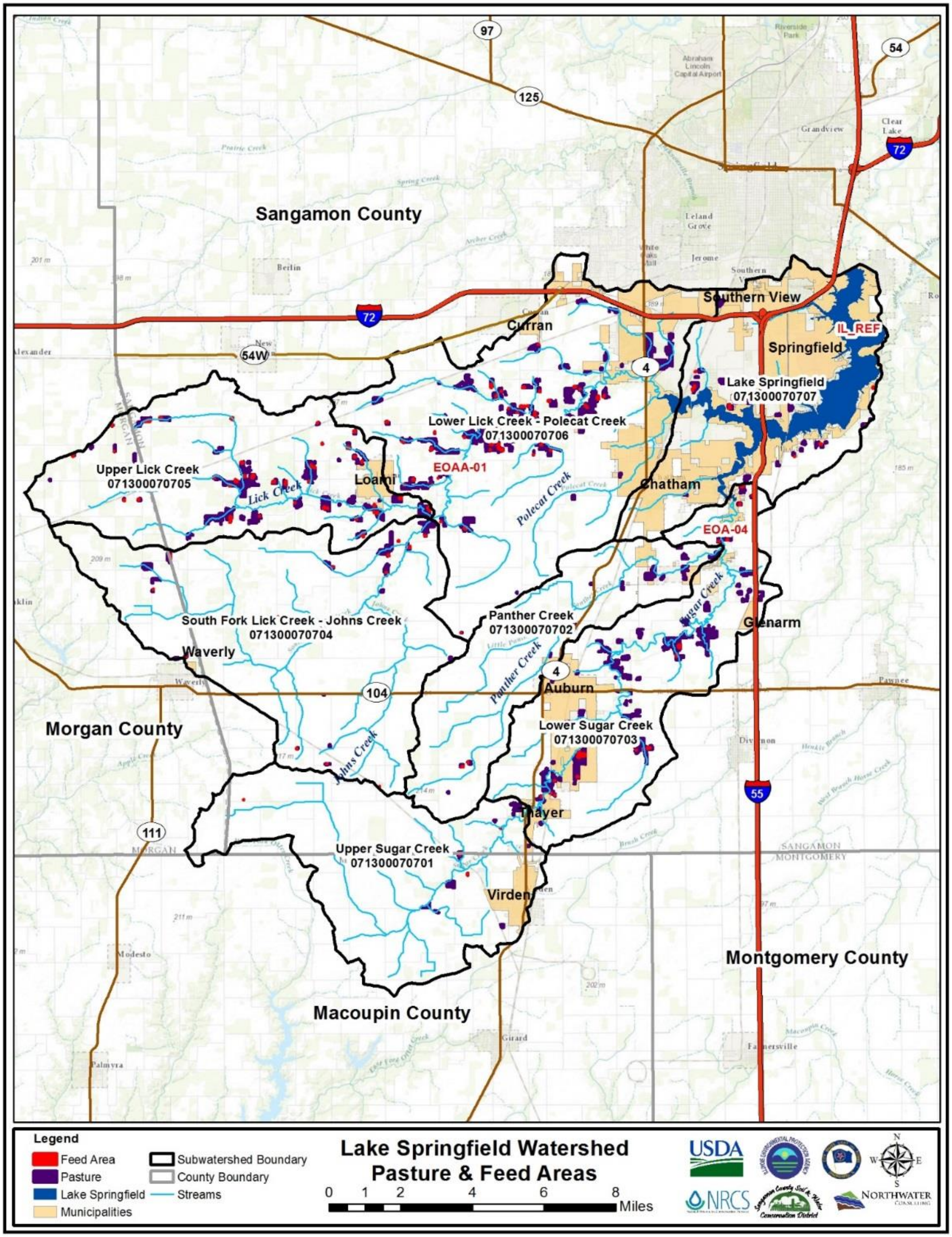


FIGURE 3.6.10 – PASTURE AND FEED AREAS

Pasture Quality

Pasture quality was coded as good, moderately overgrazed, and overgrazed based on a visual inspection completed during the watershed windshield survey and an interpretation of recent aerial imagery. Pasture coded as good represents high quality pasture with minimal grazing pressure. Overgrazed pasture is of poor quality with evidence of erosion and moderately overgrazed represents moderate pasture quality with minimal evidence of erosion. Sixty-five percent (65%) of the pasture in the watershed can be considered moderately overgrazed, 10% overgrazed and 25%, with 735 acres, in good condition. **South Fork Lick Creek—Johns Creek** sub-watershed contains the highest percentage of overgrazed pasture and **Panther Creek** sub-watershed contains the greatest percentage of pasture in "good" condition. While most of the pasture in this watershed is grazed by cattle, with some having access to adjacent streams, there are also a few horse farms.

TABLE 3.6.14 – PASTURE QUALITY BY SUB-WATERSHED

Sub-watershed Code	Sub-watershed	Pasture (acres)	Overgrazed (acres)	% of Acres	Moderately Overgrazed (acres)	% Acres	Good Condition (acres)	% Acres
071300070701	Upper Sugar Creek	68	4	5%	61	91%	3	4%
071300070702	Panther Creek	103	2	2%	40	39%	61	60%
071300070703	Lower Sugar Creek	665	90	14%	388	58%	187	28%
071300070704	South Fork Lick Creek—Johns Creek	179	52	29%	104	58%	23	13%
071300070705	Upper Lick Creek	639	64	10%	464	73%	111	17%
071300070706	Lower Lick Creek—Polecat Creek	1,169	74	6%	821	70%	261	22%
071300070707	Lake Springfield	122	2	2%	44	36%	90	74%
	Total	**2,944**	**287**	**10%**	**1,922**	**65%**	**735**	**25%**

Livestock Feed Areas

Livestock feed areas are small concentrated feeding areas for cattle, horses and other livestock, in or adjacent to a pasture. There is a total of 86 acres covering 149 small concentrated feeding areas within the Lake Springfield Watershed. Most beef cattle are raised on pasture and not in confinement facilities. The highest percentage is found within the **Upper Lick Creek** sub-watershed.

TABLE 3.6.15 – LIVESTOCK FEED AREAS BY SUB-WATERSHED

Sub-watershed Code	Sub-watershed Name	Sub-watershed Area (acres)	Feed Area (acres)	% of Sub-watershed
071300070701	Upper Sugar Creek	22,189	1	0.005%
071300070702	Panther Creek	15,072	1	0.004%
071300070703	Lower Sugar Creek	21,422	14	0.06%
071300070704	South Fork Lick Creek — Johns Creek	31,203	6	0.02%
071300070705	Upper Lick Creek	21,782	32	0.15%
071300070706	Lower Lick Creek — Polecat Creek	36,023	28	0.08%
071300070707	Lake Springfield	21,470	6	0.03%
	Total	**169,161**	**86**	**0.05%**

While there isn't a large amount of livestock production in this watershed, there are at least two confinement animal feed operations (CAFOs), both raising hogs. EPA's CAFO definitions are listed in **Table 3.6.16**. Each of these livestock operations are required to:

- have a general National Pollutant Discharge Elimination System (NPDES) permit for discharge and surface water runoff of pollutants;
- develop and implement a nutrient management plan for manure and wastewaster handling;
- be supervised by a certified livestock manager; and
- submit an annual report to the IEPA.

One family-owned hog facility is just west of Auburn (**Lower Sugar Creek** sub-watershed) and has been in operation for many years. There is one large dairy cattle farm with a milking facility in the **Lower Sugar Creek** sub-watershed.

In the southwestern part of the watershed near Waverly in Morgan County (**Upper Lick Creek** sub-watershed), a family expanded with a new 3,600-head hog feeder-to-finish barn on September 26, 2014. Every generation of their family has raised hogs (farrow-to-finish until 1998) and this expansion was to provide their fifth-generation children the opportunity to be involved in their farm. In addition, this family also raises cattle and farms 1,200 acres of crops (Prairie Farmer, Nov. 2014).

TABLE 3.6.16 – EPA'S CONCENTRATED ANIMAL FEED OPERATIONS REGULATORY DEFINITIONS

Animal Sector	Size Thresholds (number of animals)		
	Large CAFOs	Medium CAFOs	Small CAFOs
Cattle or cow/calf pairs	1,000 or more	300 - 999	less than 300
Mature dairy cattle	700 or more	200 - 699	less than 200
Veal calves	1,000 or more	300 - 999	less than 300
Swine (weighing over 55 pounds)	2,500 or more	750 - 2,499	less than 750
Swine (weighing less than 55 pounds)	10,000 or more	3,000 - 9,999	less than 3,000
Horses	500 or more	150 - 499	less than 150
Sheep or lambs	10,000 or more	3,000 - 9,999	less than 3,000
Turkeys	55,000 or more	16,500 - 54,999	less than 16,500
Laying hens or broilers (liquid manure handling systems)	30,000 or more	9,000 - 29,999	less than 9,000
Chickens other than laying hens (other than a liquid manure handling systems)	125,000 or more	37,500 - 124,999	less than 37,500
Laying hens (other than a liquid manure handling systems)	82,000 or more	25,000 - 81,999	less than 25,000
Ducks (other than a liquid manure handling systems)	30,000 or more	10,000 - 29,999	less than 10,000
Ducks (liquid manure handling systems)	5,000 or more	1,500 - 4,999	less than 1,500

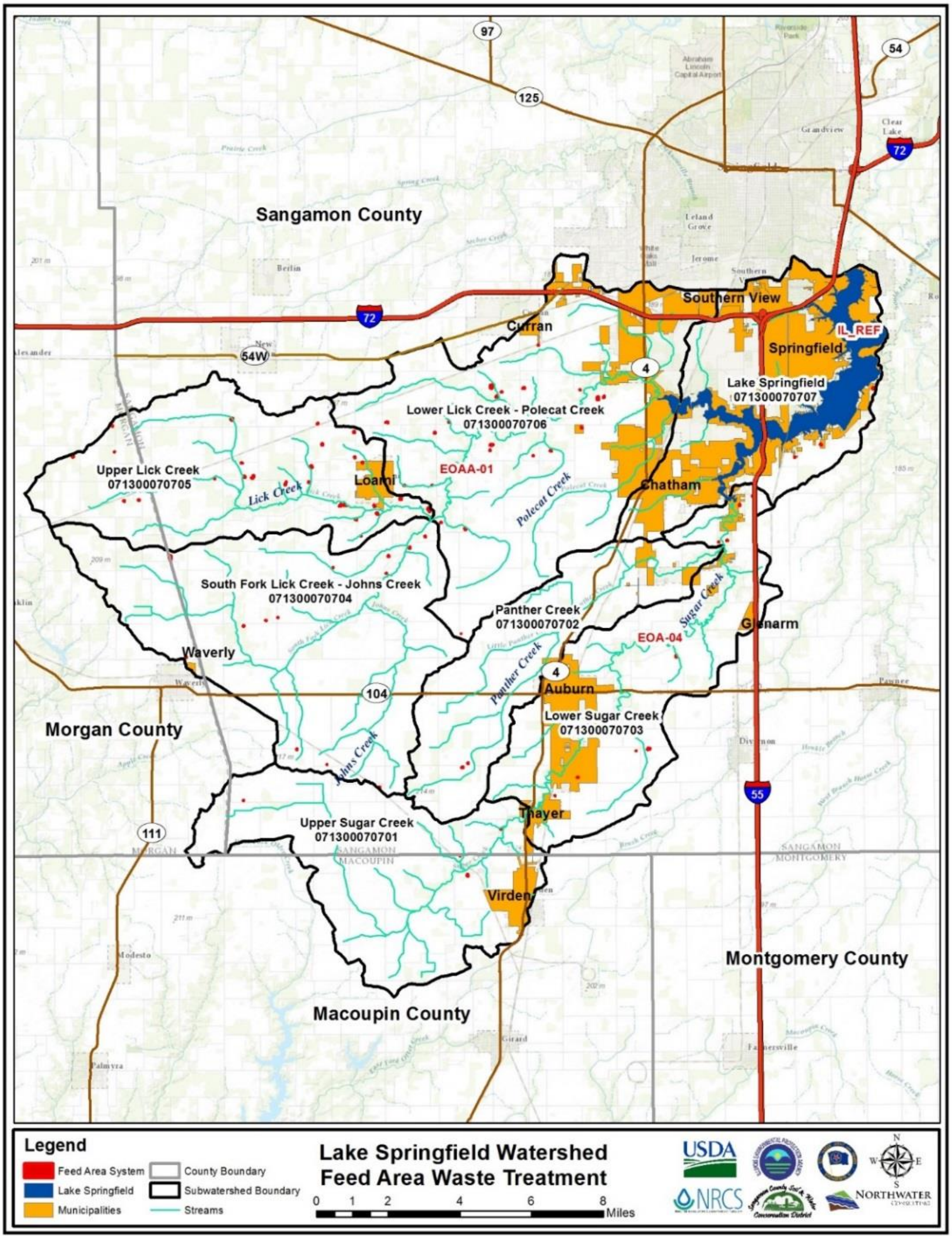


FIGURE 3.6.11 – LIVESTOCK FEED AREAS IN LAKE SPRINGFIELD WATERSHED

3.6.14 Tillage

Tillage practices in the Lake Springfield Watershed were determined based on a watershed-wide windshield survey in the spring of 2015. Each field visible from the road was coded as either no-till, spring-till, or conventional tillage. Those fields observed to be in cover crops, wheat, alfalfa or hay were also coded as such. Those fields not visible from the road were coded as conventional tillage. Very few fields, approximately 10%, were not visible from the road.

Conventional tillage is most prevalent in the watershed, accounting for 74% (92,714 acres) of all cropland, to the greatest extent in the **Upper Sugar Creek** sub-watershed (87%), followed by 80% in both the **South Fork Lick Creek—Johns Creek** and **Upper Lick Creek** sub-watersheds. Spring tillage accounts for 13%, or 16,526 acres, and no-till is being practiced on 12%, or 14,447 acres, in the watershed, primarily in the **Lick Creek—Polecat Creek** (21%) and **Lower Sugar Creek** (19%) sub-watersheds.

The number of times a field is tilled and the amount of the previous crop's residue remaining on the field determines whether it is classified as conventionally tilled. Many of the newer pieces of tillage equipment available today are considered one-pass tillage implements and bury the majority of the crop residue with just one pass across the field. After using those implements just one time, most of those fields would be classified as conventionally-tilled.

The 16,526 acres of spring tillage are those acres which received no tillage after harvest, but were either conventionally tilled, or reduced-tilled (less tillage than conventional tillage), in early spring prior to planting, usually to incorporate herbicides and/or spring-applied fertilizer, or to help increase soil temperatures. These fields may have had fall anhydrous fertilizer applied, but received no additional tillage until spring.

No-till acres are left untouched after harvest and the spring crop is planted directly into the previous crop's residue. Those no-till fields to be planted to corn may have been strip-tilled or had anhydrous applied in the fall, but will receive no further soil disturbance before planting.

While cover crops were only documented on 276 acres or 0.2% of the watershed's cropland during this windshield survey, there has been a significant increase in the use of cover crops over the past four years. One watershed farmer in the **Lower Sugar Creek** sub-watershed has planted over 1,000 acres cover crops for each of the past four years. Through the LSW's NFWF and EPA 319 grants, 46 producers planted a minimum of 40 acres of cover crops and received cost-share assistance for cover crop seed and spring cover crop termination expenses. Many of these producers actually planted additional cover crop acres without receiving financial assistance.

TABLE 3.6.17 – TILLAGE PRACTICES BY SUB-WATERSHED

Sub-watershed Code	Sub-watershed	Crop Area (acres)	Conventional Tillage (acres)	%	Spring Tillage (acres)	%	No-Till (acres)	%	Cover Crops (acres)	Hay, Alfalfa, Wheat (acres)
071300070701	Upper Sugar Creek	19,130	16,625	87%	1,235	6%	1,183	6%	9	0
071300070702	Panther Creek	13,284	9,587	72%	996	8%	2,542	19%	159	0
071300070703	Lower Sugar Creek	14,989	10,746	72%	2,060	14%	2,076	14%	0	52
071300070704	South Fork Lick Creek—Johns Creek	27,762	22,183	80%	4,192	15%	1,255	5%	83	36
071300070705	Upper Lick Creek	17,806	14,329	80%	2,376	13%	908	5%	25	133
071300070706	Lower Lick Creek—Polecat Creek	24,957	14,598	58%	4,982	20%	5,276	21%	0	62
071300070707	Lake Springfield	6,439	4,647	70%	684	11%	1,207	19%	0	21
	Total	**124,522**	**92,714**	**74%**	**16,526**	**13%**	**14,447**	**12%**	**276**	**304**

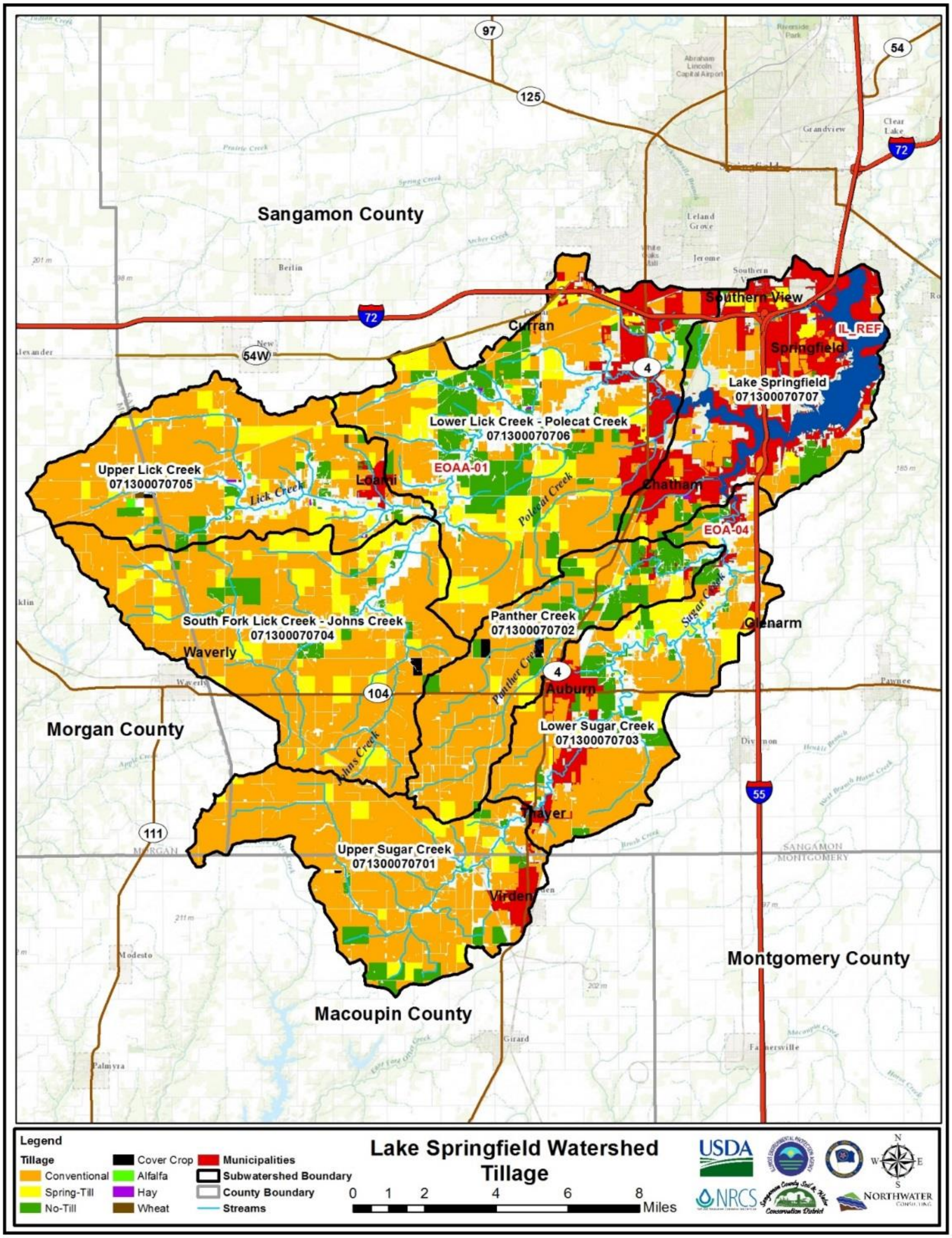


FIGURE 3.6.12 –TILLAGE PRACTICES IN LAKE SPRINGFIELD WATERSHED

HEL – Conventional/Spring-tilled HEL

As shown in Table 3.6.18, 55% of all cropped HEL soils within the watershed are conventionally tilled and 19% are considered spring till. **Upper Sugar Creek** (46%) and **South Fork Lick Creek–Johns Creek** (43%) contain the highest percentage of conventionally-tilled HEL soils. Priority should be given to addressing tillage in these sub-watersheds. **South Fork Lick Creek–Johns Creek** (12%) and **Lower Lick Creek–Polecat Creek** (9%) contain the highest percentage of spring-tilled HEL soils as shown in **Table 3.6.19**.

Conventional and spring-tilled soils are responsible for a large percentage of the overall sediment and nutrient loads from cropland within the watershed. Furthermore, a relatively large percentage of the total nutrient and sediment load is originating from conventional and spring-tilled soils that are also considered to be HEL. Addressing both conventional and spring tillage on highly erodible land (HEL) will result in significant reductions in sediment and nutrient loads to Lake Springfield.

As part of the implementation of this watershed-based plan, completing a comprehensive tillage practices study in the near future will provide a better understanding of the dynamics of these practices with respect to sediment and nutrients entering Lake Springfield and its streams. The results will also assist in making BMP implementation decisions for this land.

TABLE 3.6.18 – CONVENTIONAL TILLAGE ON HEL SOILS BY SUB-WATERSHED

Sub-watershed Code	Sub-watershed	HEL Soils (acres)	Sub-watershed Crop Area (acres)	Cropped HEL Soils (acres)	Conventional Tillage (acres)	Conventional HEL Soils (acres)	% of Crop Area	% of HEL Soils	% of Cropped HEL Soils	% of Conventional Fields
071300070701	Upper Sugar Creek	787	19,130	424	16,625	360	2%	46%	85%	2%
071300070702	Panther Creek	867	13,284	482	9,587	187	1%	22%	39%	2%
071300070703	Lower Sugar Creek	2,837	14,988	960	10,746	487	3%	17%	51%	5%
071300070704	South Fork Lick Creek—Johns Creek	2,713	27,762	1,757	22,183	1,165	4%	43%	66%	5%
071300070705	Upper Lick Creek	2,921	17,806	1,227	14,329	840	5%	29%	68%	6%
071300070706	Lower Lick Creek—Polecat Creek	5,138	24,957	1,900	14,598	698	3%	14%	37%	5%
071300070707	Lake Springfield	3,034	6,595	202	4,647	112	2%	4%	55%	2%
	Total	**18,296**	**124,522**	**6,952**	**92,714**	**3,849**	**3%**	**21%**	**55%**	**4%**

TABLE 3.6.19 – SPRING-TILLED HEL SOILS BY SUB-WATERSHED

Sub-watershed Code	Sub-watershed	HEL Soils (acres)	Crop Area (acres)	Cropped HEL Soils (acres)	Spring Tillage (acres)	Spring Tilled HEL Soils (acres)	% of Crop Area	% of HEL Soils	% of Cropped HEL Soils	% Spring Tilled Fields
071300070701	Upper Sugar Creek	787	19,130	424	1,235	43	0%	5%	10%	3%
071300070702	Panther Creek	867	13,284	482	996	60	0%	7%	12%	6%
071300070703	Lower Sugar Creek	2,837	14,988	960	2,060	144	1%	5%	15%	7%
071300070704	South Fork Lick Creek—Johns Creek	2,713	27,762	1,757	4,192	331	1%	12%	19%	8%
071300070705	Upper Lick Creek	2,921	17,806	1,227	2,376	194	1%	7%	16%	8%
071300070706	Lower Lick Creek—Polecat Creek	5,138	24,957	1,900	4,982	469	2%	9%	25%	9%
071300070707	Lake Springfield	3,034	6,595	202	684	56	1%	2%	28%	8%
	Total	**18,296**	**124,522**	**6,952**	**16,526**	**1,297**	**1%**	**7%**	**19%**	**8%**

3.6.15 Existing Best Management Practices and Conservation Programs

Much work to address sediment and nutrient loading to the Lake has already occurred in the watershed. Since 1983, over $6 million has been spent on water quality improvement in the LSW through federal, state and local conservation programs such as PL-566, WLTP, WQIP, CRP, EQIP, CREP, CPP and IEPA Section 319 which have funded numerous projects throughout the watershed.

More than 80 projects have been funded through the **IEPA's Section 319** program, including planning, education, erosion control (grade control, streambank stabilization and basins), filter strips, riparian buffers, grassed waterways, wetland restoration, retention and urban BMPs and staffing. Annual load reductions from Section 319 funded practices in the watershed total 15,286 pounds of nitrogen, 7,750 pounds of phosphorus and 5,598 tons of sediment.

From 2003 to 2005, there were 75 **USDA-funded filter strip contracts**, which established 599 acres of filter strips along 29 miles of unprotected corridors in the LSW. In addition, landowners received a $200 per acre incentive payment for these filter strips through IEPA 319 grant (#3190315). CWLP has provided the 40 percent required matching funds for the IEPA 319 grants and 50 percent matching funds with NFWF for the 3-year LSW special project grant focusing on nitrate reduction and efficiency and cover crops.

From 1999 to 2012, the **Illinois Department of Agriculture (IDOA)** provided 65% cost-share assistance on $111,811 of projects through its Conservation Practices Program (CPP) administered by the Sangamon County SWCD. An urban streambank stabilization project, as well as 16 grassed waterways (many with tile), four terraces, one grade stabilization structure and one water and sediment control basin (WASCOB) were established in this watershed. Cost-share funds and operational funds to soil and water conservation districts have been dramatically reduced over the past several years due to Illinois' budget shortfalls.

In 2010, the 1,000-foot streambank stabilization project funded by IDOA/CWLP resulted in annual reductions of 104 pounds of nitrogen 52 pounds of phosphorus and 52 tons of sediment.

Since 1983, **CWLP** has provided over $559,000 in cost-share assistance through their **Lake Springfield Maintenance and Restoration Program** (LSMRP) for purchasing conservation-friendly equipment (no-till planter and no-till drill) for LSW producers to rent for a nominal fee and establishing structural BMPs throughout the watershed, following State CPP program guidelines. Over the past 15 years (1999-2014), $277,603 of those funds were spent on BMPs, including 14 waterways (7 of them with tile), 12 ponds, 4 block chutes, one WASCOB project and one urban streambank stabilization project.

While **producers/landowners** received significant cost-share assistance (65% to 80%), for implementing these BMPs, they have done their part to implement and maintain these practices and covered the remaining project costs, in most cases up to 35% of the cost. Many times, the land taken out of production for the BMP is highly productive.

The 3-year **Special Nitrate Project** (2013-2016) included the establishment of cover crops in the Lake Springfield watershed. In the first year, over 500 acres of cover crops were planted by 12 producers. Eleven (11) producers planted over 1,400 acres of cover crops the second year. In the final year, 23 producers planted over 3,000 cover crop acres. Each year, the producers were only paid for planting 40 acres of cover crops through this grant. However, many of them planted more than the required number of acres and covered this additional $30+ per-acre expense. Through this grant, an 18-foot vertical tillage implement, complete with a cover crop seeding attachment ($53,000), was purchased to give producers an opportunity to rent and to switch from conventional tillage to reduced tillage on some of their fields. Fourteen (14) of these cover crop participants had Nutrient Management Plans (NMPs) prepared on approximately 1,740 acres. These plans were cost-shared through the Sangamon County SWCD's IEPA 319 grant.

In the spring of 1994, there was an extremely high spike of the corn herbicide atrazine in the raw water of Lake Springfield. At that time, atrazine was the most effective and least expensive herbicide being used by farmers for weed control in their corn fields. Heavy spring rains right after the atrazine had been applied had caused excessive surface water runoff of sediment, nutrients and herbicides (atrazine) from corn fields into the streams which feed the Lake.

The City of Springfield was near a violation of the IEPA's 3 parts per billion (ppb) of atrazine water quality standard requirement in Lake Springfield, which is used as a public water supply. While treatment of the raw water with excessive amounts of Powdered Activated Carbon (PAC) kept the City's water supply in compliance with this water quality standard, it came at a very high price. The expense of PAC to the City to remove atrazine was in excess of $140,000 a year for water treatment.

In an effort to reduce the amount of atrazine entering the streams and the Lake, the LSWRPC brought representatives from all of the local agricultural retailers with customers in the LSW together to come up with a solution to this problem. This group formed a coalition to find a solution to this problem. The BMP Action Plan prepared by these individuals and implemented by the LSW producers was extremely successful. This plan focused on the following:

- Implementing a two-pass atrazine application program
- Reducing rates for any single application
- Incorporation of alternative chemicals
- Establishing buffers strips
- Using no-till farming methods

A five-year effort (1997-2002), **"Assessment of Best Management Practices' (BMPs) Effectiveness on Water Quality and Agronomic Production in the Lake Springfield Watershed"** (BMP Project), included water sample collection and analysis to determine the concentrations of phosphorus, nitrates and sediment, in addition to six specific pesticides. This project was built upon the partnerships of eight federal, state, local agencies and private entities, with one representative from each of the partners contributing an expertise to the project's goals and objectives while serving as Technical Advisory Committee (TAC) members (**Table 3.6.20**).

Table 3.6.20 - BMP Project Partners and Technical Advisory Committee Members

Partners	Member
Sangamon County Soil and Water Conservation District	John Greene
Lake Springfield Watershed Resource Planning Committee	Richard (Dick) Lyons
USDA Agricultural Research Service	Dr. Jerry Hatfield
Novartis (Syngenta) Crop Protection, Inc.	Dr. Dennis Tierney
USDA Natural Resources Conservation Service	Hal Pyle
Illinois State Water Survey	Laura Keefer
University of Illinois Extension	Dr. George Czapar
City of Springfield—City Water, Light and Power	Tom Skelly

Thirteen ISCO automatic water samplers were strategically placed in streams throughout the watershed to collect water samples weekly for analysis by a certified laboratory (USDA Agricultural Research Service in Ames, IA) and to provide stream flow data during major spring and fall rain events. Grab samples from three whole field and edge-of-field sites were also analyzed by a local certified lab. Automatic rain-tipping buckets recorded measurable rainfall at each of these sites. In addition, a volunteer rain checker network (1 every 4 square miles) recorded daily rainfall amounts.

Edge-of-field research sites were established throughout the watershed to study specific BMPs and their effectiveness in reducing soil erosion and surface water runoff.

Water samples were also collected at various sites in the watershed and within Lake Springfield by City Water, Light and Power (CWLP), analyzing the levels of regulated pesticides to determine what additional water treatment was needed to remain in compliance with the Maximum Contaminant Levels (MCLs) of the 1991 Safe Drinking Water Act regulating public water supplies.

A Geographical Information System (GIS) and information database of the entire watershed was created to assist in the evaluation of data from this study.

This project provided educational information and progress reports throughout the duration of the project to farmers, landowners and the general public through various media sources, printed materials, informal meetings, etc.

Water sampling data were reviewed annually by the Technical Advisory Committee to determine vulnerable areas in the watershed and to provide guidance about the selection of BMPs, or combination of BMPs, which could be most effective improving the quality of the surface water runoff from those areas.

The results of this study and analysis of the five years of water sampling data by the Technical Advisory Committee determined that the most effective BMP for reducing off-site impacts of surface water runoff from the agricultural fields was the establishment filter strips planted to cool season grasses, warm season grasses, a combination of both, or to trees as a riparian buffer strip. In addition to being effective for improving water quality, each provides different sources of habitat for attracting and sustaining wildlife.

This study also determined that a voluntary reduction in atrazine use would also improve Lake Springfield's water quality. With the availability of several new herbicides for effective weed control in corn and as economical as atrazine, producers now had other viable herbicide options to use. In addition, utilizing split applications of atrazine reduces the amount available to adhere to the soil when most susceptible to high intensity spring rains.

Lake Springfield Watershed Filter Strip Grant (2003 – 2005). Taking the results from the 5-year BMP study of the LSW into consideration, IEPA awarded the Sangamon County SWCD a Section 319 grant to establish filter strips on environmentally-sensitive cropland along stream corridors in the LSW. This grant resulted in 75 landowner contracts which enrolled 599 acres of filter strips along 29 miles of unprotected LSW streams through the USDA Conservation Reserve Program. In addition to the $200 per acre incentive payment to landowners from the 319 grant, USDA will make $1.2 million in annual direct CRP payments to these producers for establishing and maintaining these filter strips over the 15-year contract period.

Lake Springfield Watershed Special Project Grant (2013 – 2016) "Focus on Stewardship" ended on December 31, 2016. The purpose of this project was to partner with Springfield City Water, Light and Power to help ensure they could deliver drinking water (finished product) at an average of 5 parts per million (ppm) below the USEPA drinking water standard of 10 ppm for nitrate-N without the need for nitrate removal technology.

The National Fish and Wildlife Foundation (NFWF) and Springfield City Water, Light and Power (CWLP) provided funding for this 3-year project. Additional partners were IL Council on Best Management Practices (CBMP), Lincoln Land Community College (LLCC) and Sangamon County Soil and Water Conservation District (SCSWCD) local agriculture retailers and LSW producers and landowners.

To accomplish this objective, the Illinois Council on Best Management Practices (CBMP), coordinated the program with local agricultural retailers and project partners to achieve a sustained reduction in nitrate-N loading from agricultural nonpoint pollution sources through promotion and adoption of nitrogen management systems on farm fields within the Lake Springfield Watershed.

Also included in the project was LSW stream sampling at 26 sites, with 13 of them being the same locations sampled during the 5-year BMP research study previously mentioned. In addition, CWLP provided sampling results from its Lick Creek and Sugar Creek stations, the intake at the water treatment plant and also provided the finished water results. Water samples were analyzed by a local certified laboratory (Prairie Analytical) for Nitrate-N concentrations.

A 3-year cover crops program was also an important component of this project. Forty-six producers participated in this program by seeding a minimum of 40 acres of cover crops on their farms and received a financial incentive to cover a portion of the cover crop seeding and termination expenses. Most of them planted many additional cover crop acres without receiving funds to do so. In addition, 14 of these participants also had nutrient management plans (NMPs) written on their fields (1,908 acres).

Informational meetings, bus tours, field days, machine shed-type meetings, along with education and outreach opportunities, were promoted through written invitations, press releases to media outlets, by email, websites, newsletters, etc. Meeting topics were selected to provide the most current information about nitrogen management, nutrient reductions, cover crops, soil health and effective water quality improvement BMPs. Resource notebooks were prepared for most of these events, so attendees had information to review at a later time about each presentation. Lake Springfield Watershed-specific plat books were also printed and distributed to LSW landowners and producer could verify which of their farm fields were located in this watershed.

In 2015, two USGS water monitoring stations were installed on each of the two main tributaries (Lick Creek and Sugar Creek) flowing into Lake Springfield to record extensive stream water data. Coupled with other historical water sampling data, this water monitoring effort provides sufficient data to interpret when making decisions for implementing site-specific and watershed-wide BMPs which will improve the water quality of Lake Springfield.

Lake Springfield Watershed BMP Implementation and Watershed-based Plan Grant – In 2014, the Sangamon County SWCD received an EPA 319 grant to implement a considerable list of structural, in-field and edge-of-field BMPs and to write a new USEPA nine-element watershed-based plan, which includes a comprehensive watershed resource inventory, to replace the original watershed plan adopted in 1990.

TABLE 3.6.21 – FUNDS SPENT IN LAKE SPRINGFIELD WATERSHED FOR WATER QUALITY IMPROVEMENT

Watershed Programs/Grants[14]	Funding Entity	Years	Funding Amount
LSW Maintenance & Restoration Program (LSWMRP)	CWLP	1983 - 2015	$ 559,000
Water & Land Treatment Program (WLTP)	USDA	1990 - 1994	$ 293,222
Public Law 83-566 (PL-566)	USDA	1990 - 1997	$ 1,461,411
Water Quality Improvement Program (WQIP)	USDA	1996	$ 114,000
5-year Effectiveness of BMPs Research Study	C-FAR	1997 - 2002	$ 105,000
5-year Effectiveness of BMPs Research Study	CWLP	1997 - 2002	$ 12,500
5-year Effectiveness of BMPs Research Study	ICGA	1997 - 2002	$ 10,000
5-year Effectiveness of BMPs Research Study (C-2000)	IDOA	1997 - 2002	$ 25,150
5-year Effectiveness of BMPs Research Study	Monsanto	1997 - 2002	$ 10,000
5-year Effectiveness of BMPs Research Study	Novartis	1997 - 2002	$ 630,000
5-year Effectiveness of BMPs Research Study	SCB	1997 - 2002	$ 36,250
Conservation Practices Program (CPP)	IDOA	1999 - 2012	$ 111,811
EPA 319 Grant #3190315 (Filter Strips)	IEPA/CWLP	2003 - 2006	$ 341,088
Conservation Reserve Program (CRP) - Filter Strips	USDA	2003 - 2006	$ 1,200,000
Technical Services – 3-year Nitrate Study	CBMP	2013 - 2016	$ 69,000
LSW Special Project – 3-year Nitrate Study	NFWF/CWLP	2013 - 2016	$ 537,360
EPA 319 Grant #3191415 (BMPs & Watershed Plan)	IEPA/CWLP	2014 - 2017	$ 553,142
Total			**$ 6,025,168**

[14] Does not include other federal conservation cost-share program funds (EQIP, CSP, CRP/CREP/SAFE)

3.7 Watershed Drainage System

3.7.1 Channelization

Recent aerial imagery was evaluated to determine the extent of stream channelization in the Lake Springfield Watershed. Out of a total of 1,062,975 feet, or 201 miles of perennial streams, 26%, or 53 miles, can be considered channelized. The **Panther Creek** and **South Fork Lick Creek—Johns Creek** sub-watersheds contain the highest percentage of channelized stream length or 54% and 42%, respectively. The **Lower Sugar Creek** sub-watershed contains the lowest overall percentage.

Channelization increases the slope and velocity of the altered stream, which increases its capacity to erode streambanks, stream channels and transport sediment. Channelization typically creates straight channels of uniform depth and slope, eliminating or reducing meanders and the natural pool and riffle areas. Meanders provide a natural release for the stream's energy. A channelized stream may erode streambanks and bottoms in an alternating manner in an attempt to re-establish a sinuous course by lengthening the stream and reducing its slope, unlike meanders, pools and riffles which serve as an effective means of reducing the erosive energy of a stream. Channelization reduces habitat diversity by creating a basically uniform stream water depth, velocity, and bottom type and by reducing stream sinuosity and length. Channelization reduces the total quantity of aquatic habitat area. The hydraulic connection between a stream and its adjacent floodplain and wetland area is also reduced through channelization.

Channelization of the streams in this watershed has been done over time by individual landowners, primarily occurring through agricultural production. There are no known levees in this watershed and limited stream restoration work has been done.

A streambank stabilization and restoration project (SSRP) was completed in 2010 on Sugar Creek (EOA_04) in the Piper Glen subdivision with 75 percent from SSRP funds from the IL Department of Agriculture (IDOA), 15 percent from CWLP's Lake Springfield Maintenance and Restoration Program (LSMRP) cost-share program and ten percent from the landowner.

TABLE 3.7.1 – STREAM LENGTH/CHANNELIZED STREAMS BY SUB-WATERSHED

Sub-watershed Code	Sub-watershed	Stream AUID	Stream Length (ft)	Total Stream Miles	Channelized Stream (ft)	Channelized Streams (Miles)	% of Total Stream Length
071300070701	Upper Sugar Creek	EOA_04	109,749	21	30,047	6	27%
071300070702	Panther Creek	N/A	117,652	22	63,403	12	54%
071300070703	Lower Sugar Creek	EOA_04	137,388	26	7,053	1	5%
071300070704	South Fork Lick Creek—Johns Creek	EOAAA EOAAAA	220,984	42	91,911	17	42%
071300070705	Upper Lick Creek	EOAA_01	154,040	29	41,064	8	27%
071300070706	Lower Lick Creek— Polecat Creek	EOAA_01 EOAE	287,342	54	42,667	8	15%
071300070707	Lake Springfield	IL_REF	35,821	7	4,863	1	14%
	Total		**1,062,975**	**201**	**281,007**	**53**	**26%**

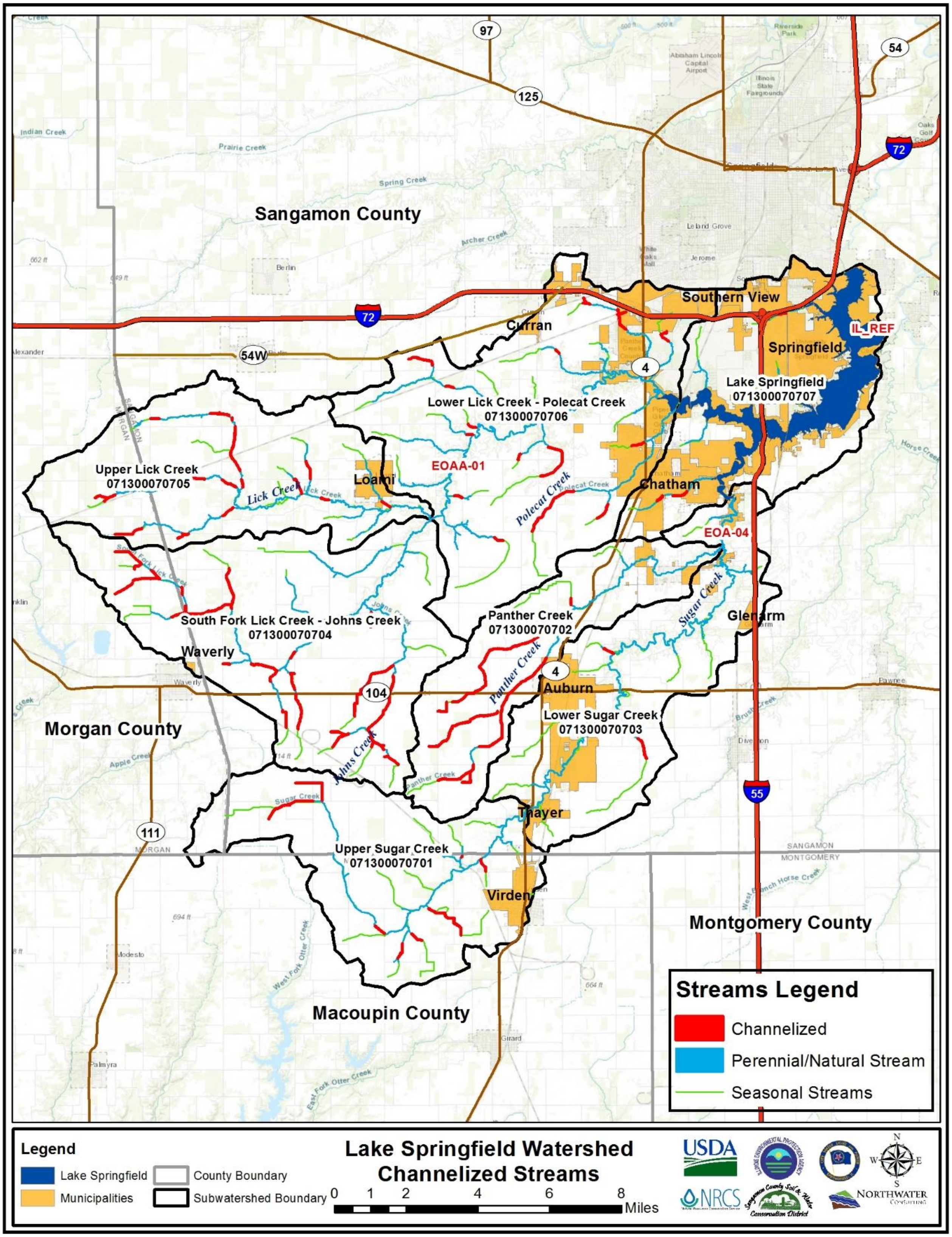


FIGURE 3.7.1 – CHANNELIZED STREAMS – LAKE SPRINGFIELD WATERSHED

3.7.2 Streambank Erosion

Streambank erosion is a naturally occurring process, and refers to the removal of soil and other material, such as rock and vegetation, from the streambank. The rate at which it occurs is often increased by anthropogenic or human activities such as urbanization and agriculture.

Streambank erosion within the watershed was estimated following the NRCS Rapid Assessment, Point Method (RAP-M). Observations of eroding bank height and annual lateral recession rate were made at each bridge crossing within the watershed and recorded using GPS. Using GIS, data was then appended to a modified (cleaned) National Hydrography Dataset (NHD) streams file and used to calculate bank length; all results were extrapolated either upstream or downstream to those stream reaches not visible during the field assessment. Finally, annual sediment, nitrogen and phosphorus loads were calculated for both left and right banks.

Annual sediment loading to Lake Springfield from eroding streambanks **(Table 3.7.2)** is estimated at a conservative 6,789 tons, which represents approximately 5% of the total watershed sediment load.

An analysis of streambank erosion rates and nutrient loading by sub-watershed **(Table 3.7.3)** indicates that the **Lower Sugar Creek** sub-watershed delivers the greatest quantity of sediment and nutrients from streambank erosion (33% of the entire watershed load originating from streambank erosion). The **Lake Springfield** sub-watershed has the highest average lateral recession rate and the lowest sediment and nutrient load; this is due to a combination of low overall stream length and high bank erosion rates within the sub-watershed.

Although some stream segments were observed to be exhibiting severe streambank erosion, watershed-wide observations indicate that streambank erosion may not represent a significant contribution to the overall sediment load to Lake Springfield. Further investigation is needed to gain an accurate estimate of eroding stream miles and more extensive stream information, especially for those stream reaches on private property or not immediately visible from a road.

TABLE 3.7.2 - STREAMBANK EROSION RATES AND LOADINGS

Bank	Length (ft)	Sediment Load (tons/year	Phosphorus Load (lbs/yr)	Nitrogen Load (lbs/yr)	Average Eroding Bank Height (ft)	Average Lateral Recession Rate (ft/yr)
Left	929,882	3,375	4,050	6,751	1.5	0.04
Right	929,882	3,414	4,096	6,827	1.6	0.05
Total	352 miles	6,789	8,146	13,578	1.55	0.045

TABLE 3.7.3 - STREAMBANK EROSION RATES AND NUTRIENT LOADINGS BY SUB-WATERSHED

Sub-watershed Code	Sub-watershed	Stream Miles*	Sediment Load (tons)	Phosphorus Load (lbs/yr)	Nitrogen Load (pounds/yr)	Average Eroding Bank Height (ft)	Average Lateral Recession Rate (ft/yr)
071300070701	Upper Sugar Creek	21	1,002	1,203	2,004	1.80	0.07
071300070702	Panther Creek	22	449	539	898	1.60	0.03
071300070703	Lower Sugar Creek	26	2,241	2,689	4,481	2.00	0.06
071300070704	South Fork Lick Creek—Johns Creek	42	610	732	1,220	1.32	0.03
071300070705	Upper Lick Creek	29	460	552	921	1.18	0.03
071300070706	Lower Lick Creek—Polecat Creek	54	1,889	2,267	3,779	1.59	0.05
071300070707	Lake Springfield	7	138	165	275	1.17	0.08
	Total	**201**	**6,789**	**8,146**	**13,578**	**1.52**	**0.05**

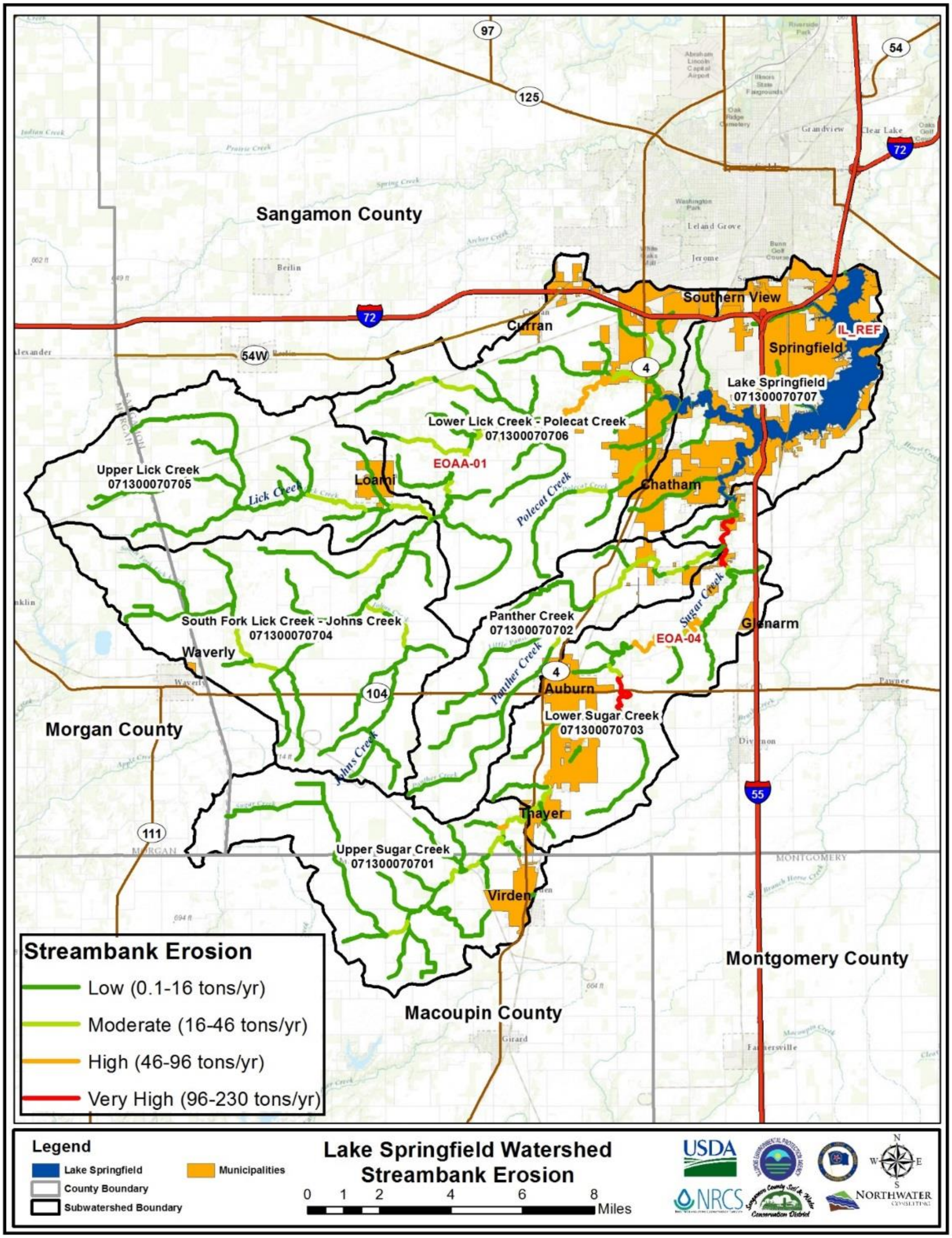


FIGURE 3.7.2 – STREAMBANK EROSION MAP

3.7.3 Riparian Buffers/Stream Buffers

A riparian buffer is a vegetated area next to water resources that protects water resources from nonpoint source pollution and provides bank stabilization and aquatic and wildlife habitat. According to NRCS, riparian buffers are one of the most important practices to control nonpoint pollution and improve water quality. These buffers are the grasses, grass-like forbs, shrubs, trees or other vegetation growing along streams. They absorb excess nutrients such as nitrogen and phosphorus from farm and livestock operations. Plants protect the streambanks from erosion by providing a protective barrier against the water. The plants' and trees' trunks, branches, stems and leaves intercept the water currents that can weaken and wash away bank material. In addition to protecting water and soil, riparian buffers provide important habitat for aquatic and upland wildlife and also fish habitat.

RIPARIAN BUFFER IN LAKE SPRINGFIELD WATERSHED

Using a custom land use layer, an evaluation of existing stream buffers was performed to determine the extent to which 201 miles of perennial streams in the Lake Springfield Watershed are adequately buffered or contain at least a minimal riparian zone area. Any stream not buffered by at least 35 feet of forest, grassland, wetland, minimally-grazed pasture, low density urban or residential open space on either side of the wetted channel, was considered to be inadequate. Results do not necessarily consider buffer quality, only that a buffer or riparian zone exists.

Results indicate that the majority of perennial streams within the Lake Springfield Watershed are not adequately buffered. Just over 50% (545,550 feet or 103 miles) do not contain an adequate stream buffer or riparian zone. This is most prevalent in the **Upper Lick Creek** and **Panther Creek** sub-watersheds. Sixty-seven percent (67%) of all perennial streams in Panther Creek sub-watershed and 74% in Upper Lick Creek sub-watershed can be considered inadequate. In Panther Creek sub-watershed, it is largely the result of livestock access to streams, whereas in the Upper Lick Creek sub-watershed, the lack of riparian zones is the result of very flat topography, intensive row crop agriculture and stream channelization. **Lower Sugar Creek** sub-watershed contains the greatest percentage of adequate riparian zones due to the large, expansive blocks of bottomland, floodplain and forest.

In looking at riparian zone areas or acres, the results, although significantly lower in terms of total percentages, follow a very similar pattern. **Panther Creek** sub-watershed, **Upper Lick Creek** sub-watershed and **Lower Lick Creek–Polecat Creek** sub-watershed contain the greatest percentage area of inadequate riparian zone, or 11%, 19% and 12%, respectively. **Lower Sugar Creek** sub-watershed and **Lake Springfield** sub-watershed contain the lowest overall percentage at 7% each. Significant opportunities exist to expand stream buffers and riparian zones in the Lake Springfield Watershed. At a minimum, 2,160 acres and 103 miles of stream buffers could potentially be implemented in the watershed.

Vegetative filter strips are land areas of either planted or indigenous vegetation, situated between a potential pollutant-source area and a surface-water body that receives runoff. The term “buffer strip” is sometimes used interchangeably with filter strip, but filter strip is the preferred usage.

Through efforts of the Lake Springfield Watershed Resource Planning Committee and the Sangamon County Soil and Water Conservation District in 1996, State legislators introduced House Bill 3447 to approve The State of Illinois Vegetative Filter Strip Assessment Law, Public Act 89-606, to reduce property tax assessments on qualifying cropland converted to vegetative filter strips. The Vegetative Filter Strip Assessment Law provides for a reduction in the assessed value of cropland certified as meeting the requirements of the law to 1/6 of its value. This law became effective on January 1, 1997, and was recently approved for another 10-year period. Establishment of vegetative filter strips are a proven conservation practice which can aid in reducing soil erosion, improve water quality, and provide significant habitat for grassland wildlife.

VEGETATIVE FILTER STRIP IN LAKE SPRINGFIELD WATERSHED

The vegetative filter strip legislation set the following criteria for land eligible to be certified as a vegetative filter strip. These criteria include:

1. Any cropland surrounding a surface or ground water conduit is eligible (lakes, streams, rivers, ponds).
2. The minimum and maximum width of the vegetative filter strip eligible for the assessment reduction is determined by the slope of the land on which the vegetative strip is located.

The vegetative filter strip must be part of a conservation plan and must provide for a uniform ground cover; have a heavy fibrous root system; and tolerate pesticides used in farm fields.

Under EPA 319 grant #3190315, administered by the Sangamon County SWCD from 2003 to 2005, twenty-nine (29) miles of unprotected stream corridors in the LSW were buffered with 599 acres of vegetative filter strips or riparian buffers through 15-year USDA CRP contracts with 75 watershed landowners. CWLP provided the 40% required matching funds for this grant. Landowners who established filter strips under this grant received a one-time, $200-per-acre incentive payment for taking their cropland out of production and seeding it to grasses and/or shrubs to filter surface water runoff from these farm fields into adjacent streams whose water ultimately flows into Lake Springfield.

TABLE 3.7.4 - RIPARIAN ZONE AREAS/ACRES

Sub-watershed	Sub-watershed (acres)	Total Area 35 ft Riparian Zone (acres)	Total Area Inadequate 35 ft Riparian Zone (acres)	% of 35 ft Riparian Zone	Length of Stream (miles)	Length (miles) Inadequate Riparian Zone (35ft)	% of Total Stream Length (miles)
Upper Sugar Creek	22,189	216	15	7%	21	9	44%
Panther Creek	15,072	235	26	11%	22	15	67%
Lower Sugar Creek	21,422	311	21	7%	26	7	25%
South Fork Lick Creek—Johns Creek	31,203	430	42	10%	42	23	54%
Upper Lick Creek	21,782	303	57	19%	29	22	74%
Lower Lick Creek—Polecat Creek	36,023	593	70	12%	54	26	48%
Lake Springfield	21,470	71	5	7%	7	2	29%
Total	**169,161**	**2,160**	**235**	**11%**	**201**	**103**	**51%**

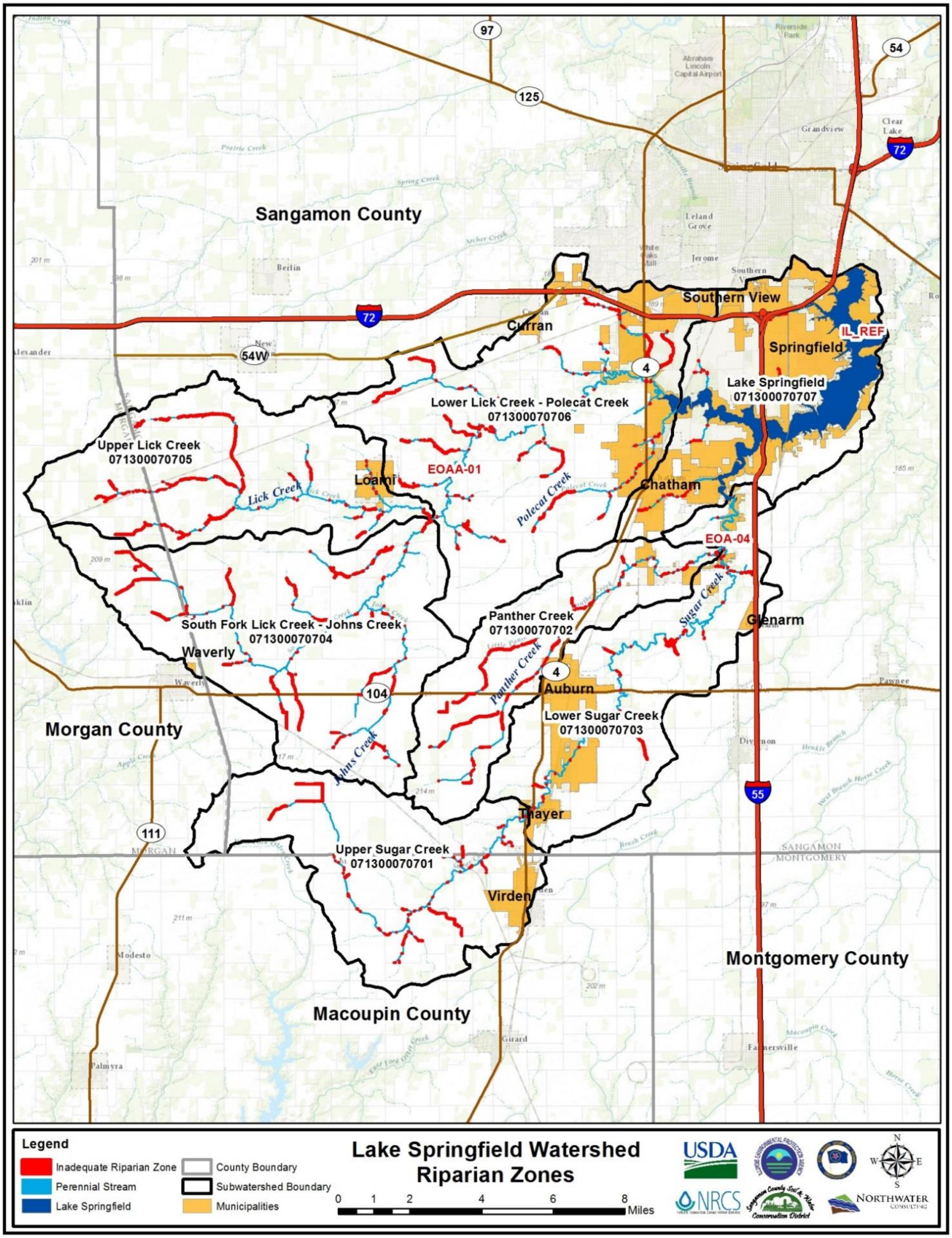


FIGURE 3.7.3 – LAKE SPRINGFIELD WATERSHED RIPARIAN ZONES

3.7.4 Debris Blockages

An extensive survey of all the streambanks in the LSW was not completed during this recent watershed resource inventory due to insufficient funds. Therefore, it is not possible to report on the extent or existence of any issues being caused by debris blockages. However, when streambank inspections were made at all of the bridge sites in the LSW, visual reviews were made, looking as far upstream and downstream as possible, for any debris blockages or problem areas and were noted. Completion of a comprehensive streambank survey will be designated a priority in future watershed planning efforts.

3.7.5 Lake Shoreline Erosion and Sediment Loading

A lake shoreline erosion assessment was completed on Lake Springfield in October 2014 by Northwater Consulting and CWLP. Annual erosion rate and bank height were recorded using GPS. The data was then processed in GIS to determine bank length. Banks were classified as either armored or eroding. No distinction was made between the types of armoring. However, CWLP maintains data on the type of armoring, which is presented in **Table 3.7.5.** For all eroding banks, annual lateral recession rate (feet/year) and eroding bank (feet) were calculated. This information was combined with bank length to determine annual sediment and nutrient delivery. Results from the assessment indicate that there are 46 miles (243,464 feet) of armored shoreline and 9 miles (46,871 feet) of exposed or eroding shoreline within Lake Springfield. City Water Light & Power (CWLP) maintains a database and has calculated a total of 57 miles (300,960 feet) of total lake shoreline, 43 miles (225,724 feet) of which are considered protected and 14 miles (75,240 feet) are considered natural shoreline areas that haven't been physically altered through human intervention. These differences in length estimates can be accounted for by sampling techniques. CWLP used a combination of parcel data and extended the lake boundary up several tributaries and detached coves based on a defined elevation limit.

The most recent shoreline erosion survey excluded two large detached coves and did not extend the lake boundary upstream into any tributary. However, it would be beneficial to broaden this GPS survey to include the same area CWLP previously surveyed (two large detached coves and Lake's boundary upstream into the tributaries based on a defined elevation limit), and then prioritize areas needing stabilization, determine the type of erosion control that would be most effective and provide cost estimates for this work. Since the 1987 Feasibility Study, CWLP has made Lake shoreline stabilization a top priority under its Lake Springfield Maintenance and Restoration Program and continues to this day to complete shoreline stabilization projects as funding allows. One of the problems with getting this work done is having sufficient funds available to pay for the minimum amount of riprap work the contractor will agree to complete.

TABLE 3.7.5 – DELINEATED LAKE SHORELINE SEGMENTS INFORMATION

Segment ID	Length (ft)	Lateral Recession Rate (ft/yr)	Bank Height (ft)	Sediment Load (tons/yr)	Phosphorus Load (lbs/yr)	Nitrogen Load (lbs/yr)	Bank Condition
1	4,004	0.01	2	3.00	3.45	6.91	Eroding
2	653	0	0	0	0	0	Armored
3	15,493	0	0	0	0	0	Armored
4	7,509	0	0	0	0	0	Armored
5	10,648	0.05	2	39.93	45.92	91.84	Eroding
6	14,218	0	0	0	0	0	Armored
7	77,617	0	0	0	0	0	Armored
9	90,650	0	0	0	0	0	Armored
10	1,647	0	0	0	0	0	Armored
11	443	0.5	4	33.26	38.25	76.50	Eroding
12	15,194	0.01	2	11.40	13.10	26.21	Eroding
13	414	0.7	9	97.88	112.56	225.13	Eroding
14	265	0	0	0	0	0	Armored
15	343	0.08	4	4.12	4.74	9.47	Eroding
16	377	0	0	0	0	0	Armored
17	273	0.6	6	36.79	42.31	84.61	Eroding
18	404	0	0	0	0	0	Armored
19	571	0.8	8	136.97	157.51	315.02	Eroding
20	117	0	0	0	0	0	Armored
21	2,133	0.08	2	12.80	14.72	29.44	Eroding
22	1,129	0	0	0	0	0	Armored
23	732	0.7	8	153.77	176.83	353.66	Eroding
24	365	0	0	0	0	0	Armored
25	398	0.7	7	73.06	84.01	168.03	Eroding

Segment ID	Length (ft)	Lateral Recession Rate (ft/yr)	Bank Height (ft)	Sediment Load (tons/yr)	Phosphorus Load (lbs/yr)	Nitrogen Load (lbs/yr)	Bank Condition
26	884	0	0	0	0	0	Armored
27	485	0.5	4	36.37	41.82	83.65	Eroding
28	166	0	0	0	0	0	Armored
29	262	0.8	12	94.30	108.44	216.89	Eroding
30	405	0	0	0	0	0	Armored
31	539	0.1	4	8.08	9.29	18.59	Eroding
32	1,119	0	0	0	0	0	Armored
33	156	0.2	4	4.68	5.39	10.77	Eroding
34	122	0	0	0	0	0	Armored
35	406	0.09	2	2.74	3.15	6.31	Eroding
36	1,084	0	0	0	0	0	Armored
37	721	0.35	5	47.35	54.45	108.89	Eroding
38	3,414	0	0	0	0	0	Armored
39	5,335	0.1	3	60.02	69.03	138.05	Eroding
41	3,638	0.1	3	40.79	46.91	93.82	Eroding
43	10,803	0	0	0	0	0	Armored
44	54	0.5	5	5.09	5.85	11.71	Eroding
45	4,871	0	0	0	0	0	Armored
46	36	0.6	5	4.08	4.69	9.38	Eroding
47	10,152	0	0	0	0	0	Armored
48	85	0.6	3	5.71	6.57	13.13	Eroding
Total	**290,334**						

Results obtained during the 2014 survey estimate annual sediment loading from shoreline erosion to be 912 tons/year. Eroding shorelines contribute 1,049 pounds/year of phosphorus and 2,098 pounds/year of nitrogen. See **Table 3.7.6** and **Figure 3.7.4**.

TABLE 3.7.6 - 2014 LAKE SHORELINE EROSION SURVEY ESTIMATED LOADINGS

Bank Type	Length (ft)	Sediment Load (tons/yr)	Phosphorus Load (lbs/yr)	Nitrogen Load (lbs/yr)	Average Eroding Bank Height (ft)	Average Lateral Recession Rate (ft/yr)
Eroding	46,871	912	1,049	2,098	4.7	0.37
Armored/ Protected	243,464	N/A	N/A	N/A	N/A	N/A

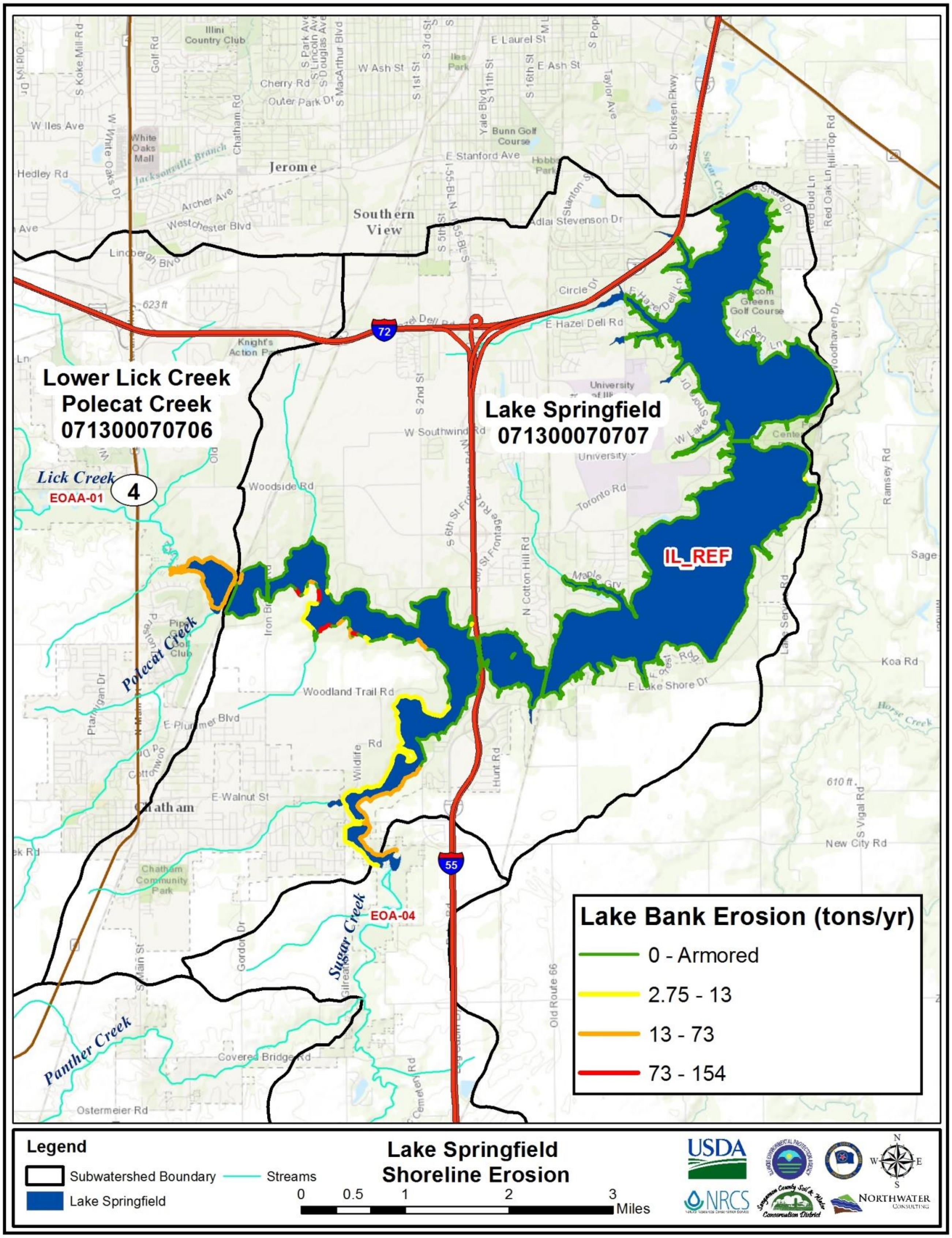


FIGURE 3.7.4 - LAKE SPRINGFIELD SHORELINE EROSION

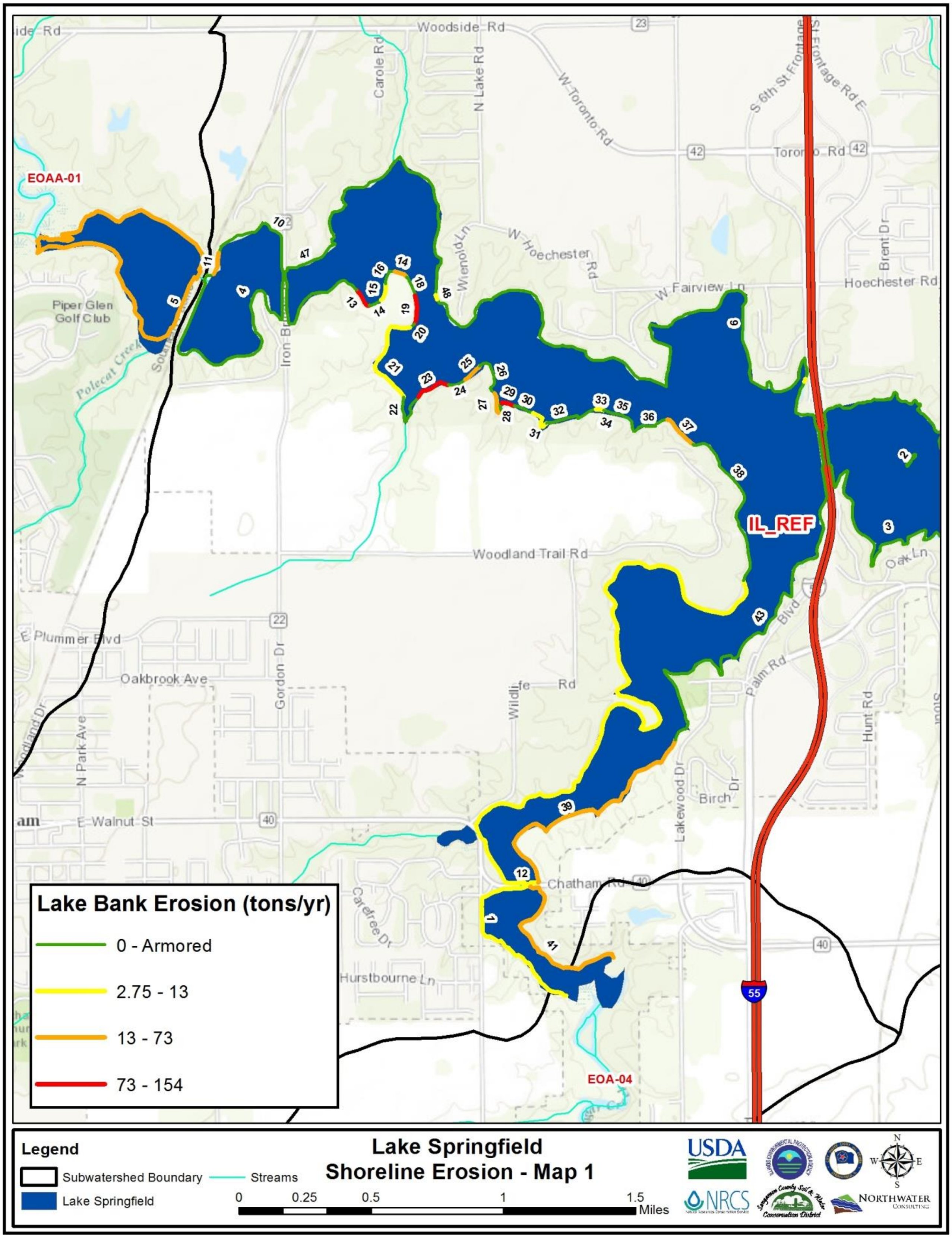


FIGURE 3.7.5 – LAKE SPRINGFIELD SUPPLEMENTAL SHORELINE EROSION – MAP 1 (SEE TABLE 3.7.5)

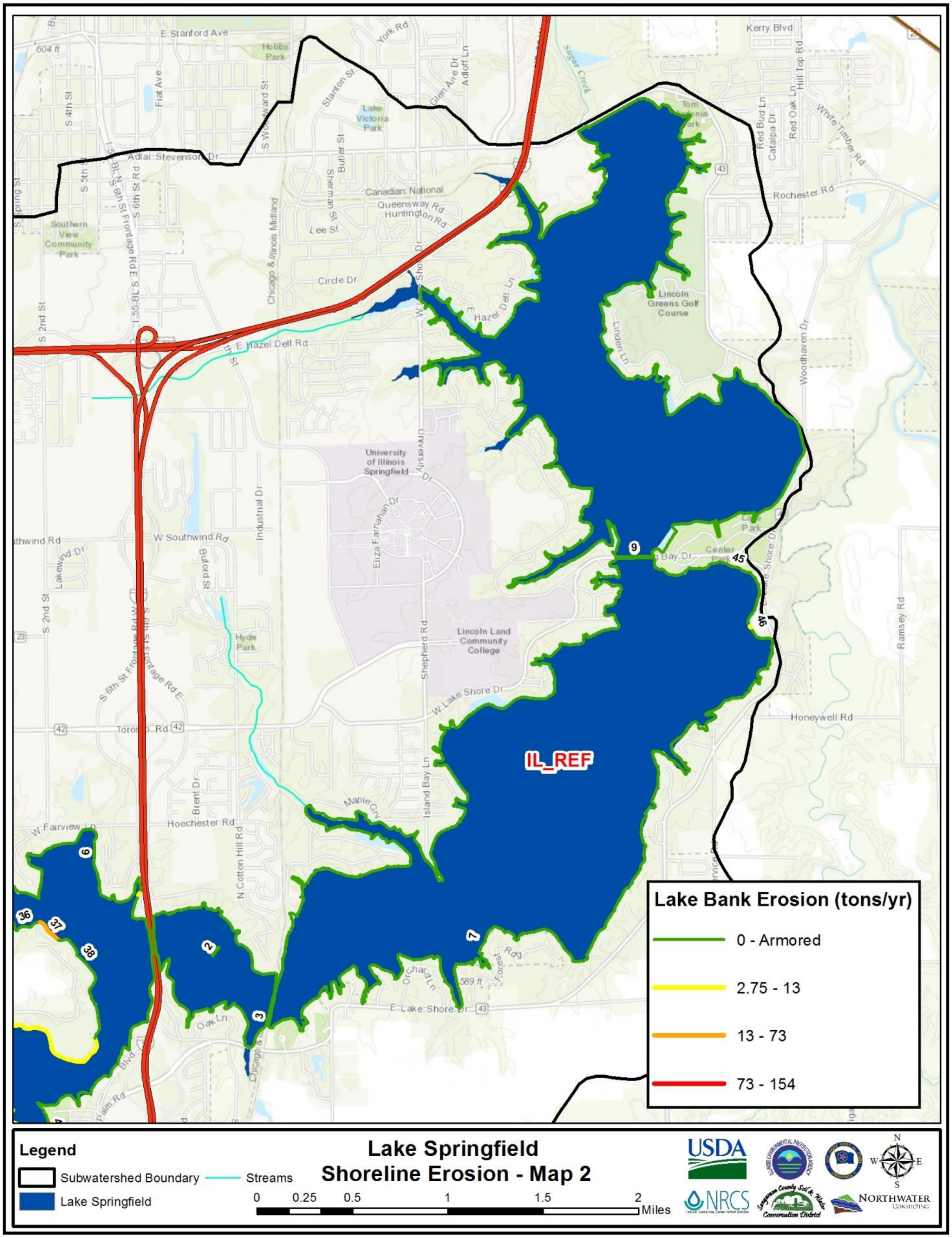
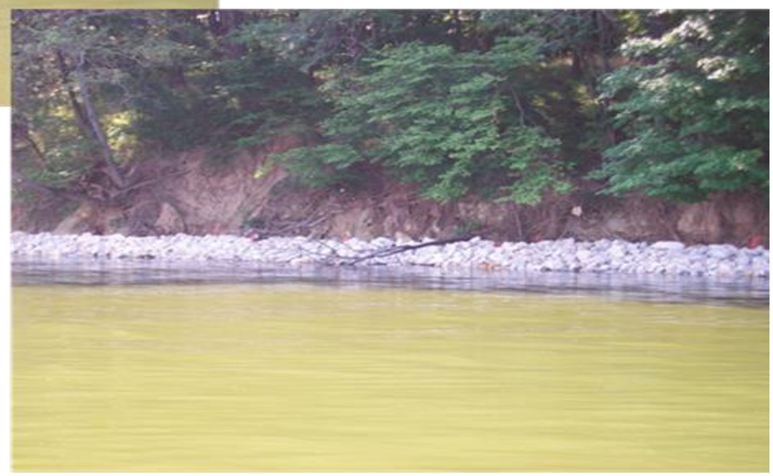


FIGURE 3.7.6 – LAKE SPRINGFIELD SUPPLEMENTAL SHORELINE EROSION – MAP 2 (SEE TABLE 3.7.5)



3.7.6 Lake Springfield Shoreline Stabilization

CWLP maintains a database of the extent and type of shoreline stabilization installed around Lake Springfield. This database is updated annually by CWLP personnel. In 2014, CWLP estimated protected shoreline at 225,720 feet or 43 miles out of a total of 300,960 feet, or 57 miles of shoreline. An estimated 21 miles of shoreline are public property and 22 shoreline miles are considered private property. This would indicate that 75% of Lake Springfield is protected using some form of armoring. **Table 3.7.7** provides a breakdown of the type of armoring present, the condition of the armoring and the percentage of erosion around the Lake as of March, 2016, with information provided by CWLP. Rip-rap or rock stabilized shoreline is the primary type of armoring used.

TABLE 3.7.7 – LAKE SHORELINE STABILIZATION ARMORING MATERIALS/CONDITION/EROSION

Type	Riprap	Natural	Steel	Concrete	Wood	Block	Gabion	Vinyl	Fiberglass
Length (feet)	161,406	75,240	58,302	1,856	645	692	2,171	438	210
Length (miles)	30.56	14.25	11.04	0.35	0.12	0.13	0.41	0.08	0.04
% of material used	53.63%	25.00%	19.37%	0.01%	<0.01%	<0.01%	0.01%	<0.01%	<0.01%
Materials Condition	**Riprap**	**Natural**	**Steel**	**Concrete**	**Wood**	**Block**	**Gabion**	**Vinyl**	**Fiberglass**
Condition - Good	60%	25%	95%	95%	20%	90%	90%	100%	100%
Condition - Fair	25%	15%	------	------	40%	------	------	------	------
Condition - Poor	15%	60%	5%	5%	40%	10%	10%	------	------
Shoreline Erosion	**Riprap**	**Natural**	**Steel**	**Concrete**	**Wood**	**Block**	**Gabion**	**Vinyl**	**Fiberglass**
Erosion - High	25%	25%	------	------	40%	5%	------	------	------
Erosion - Medium	25%	25%	5%	5%	40%	5%	5%	------	------
Erosion - Low	50%	50%	95%	95%	20%	90%	95%	100%	100%

3.7.7 Watershed Retention/Detention

Retention refers to maintaining a pool of water throughout the year and holding stormwater runoff following storms. Detention refers to holding water for a short period of time; the pond temporarily holds water before it enters the stream. Both the retention and detention of stormwater runoff from residential and other developed areas can help to reduce pollution loading.

An evaluation of the extent of retention was conducted for residential and other developed areas within the Lake Springfield Watershed. Using GIS, all residential and developed areas draining to a retention or open water basin or pond were coded as either retained or not retained. (Area treated—drainage area) An analysis was completed to determine the total residential and developed land area in the watershed with some form of retention in place. Retention structures are only included in the analysis if they were observed to have water at the time the aerial imagery used was generated; it is possible that temporarily wet retention basins are also captured in this analysis.

As depicted in **Table 3.7.8**, only 4% of the entire Lake Springfield Watershed drains to, or is filtered through, a retention basin. Of the 6,705 residential acres in the watershed, only 17%, or 1,112 acres, has some form of retention in place. **Lower Lick Creek—Polecat Creek** sub-watershed has the highest percentage of retained residential area (25%) and **Upper Sugar**

Creek and **Panther Creek** sub-watersheds have the lowest at 2% and 3%, respectively. It is important to note that the **Lake Springfield** sub-watershed contains the highest overall percentage of residential acres (15%). The percentage of residential acres with retention (15%) in the **Lake Springfield** sub-watershed is below the watershed average of 17%.

TABLE 3.7.8 – RESIDENTIAL RETAINED ACRES

Sub-watershed Code	Sub-watershed	Sub-watershed (acres)	Residential (acres)	% of Sub-watershed	Residential Retention (acres)	% Retention
071300070701	Upper Sugar Creek	22,189	499	2%	11	2%
071300070702	Panther Creek	15,072	65	0.4%	2	3%
071300070703	Lower Sugar Creek	21,422	932	4%	138	15%
071300070704	South Fork Lick Creek—Johns Creek	31,203	85	0.3%	9	10%
071300070705	Upper Lick Creek	21,782	234	1%	52	22%
071300070706	Lower Lick Creek—Polecat Creek	36,023	1,590	4%	390	25%
071300070707	Lake Springfield	21,470	3,299	15%	509	15%
	Total	**169,161**	**6,705**	**4%**	**1,112**	**17%**

As noted in **Table 3.7.9** below, there are 2,817 acres of developed non-residential acres in the watershed, such as schools, retail or manufacturing and only 14%, or 404 acres, have some form of retention in place. Again, **Lower Lick Creek—Polecat Creek** sub-watershed contains the highest percentage of retained acres, or 24%. **South Fork Lick Creek—Johns Creek** and **Panther Creek** sub-watersheds contain the least amount of retention for developed non-residential acres, or 0% and 3%, respectively. It is important to note that the **Lake Springfield** sub-watershed contains the highest overall percentage of developed non-residential acres. The percentage of retained acres is below the watershed average.

TABLE 3.7.9 – OTHER DEVELOPED NON-RESIDENTIAL RETAINED ACRES

Sub-watershed Code	Sub-watershed	Sub-watershed Area (acres)	Acres Developed Non-Residential	Percent Sub-watershed	Acres with Retention	Percent with Retention
071300070701	Upper Sugar Creek	22,189	164	1%	12	7%
071300070702	Panther Creek	15,072	80	1%	3	3%

Sub-watershed Code	Sub-watershed	Sub-watershed Area (acres)	Acres Developed Non-Residential	Percent Sub-watershed	Acres with Retention	Percent with Retention
071300070703	Lower Sugar Creek	21,422	221	1%	23	11%
071300070704	South Fork Lick Creek—Johns Creek	31,203	92	0.3%	0	0%
071300070705	Upper Lick Creek	21,782	93	0.4%	11	12%
071300070706	Lower Lick Creek—Polecat Creek	36,023	756	2%	182	24%
071300070707	Lake Springfield	21,470	1,410	7%	173	12%
	Total	**169,161**	**2,817**	**2%**	**404**	**14%**

While commercial retention/detention areas (developed non-residential) have not been significantly addressed in this plan, a more extensive study of retention/detention throughout the entire watershed will be included in future planning efforts.

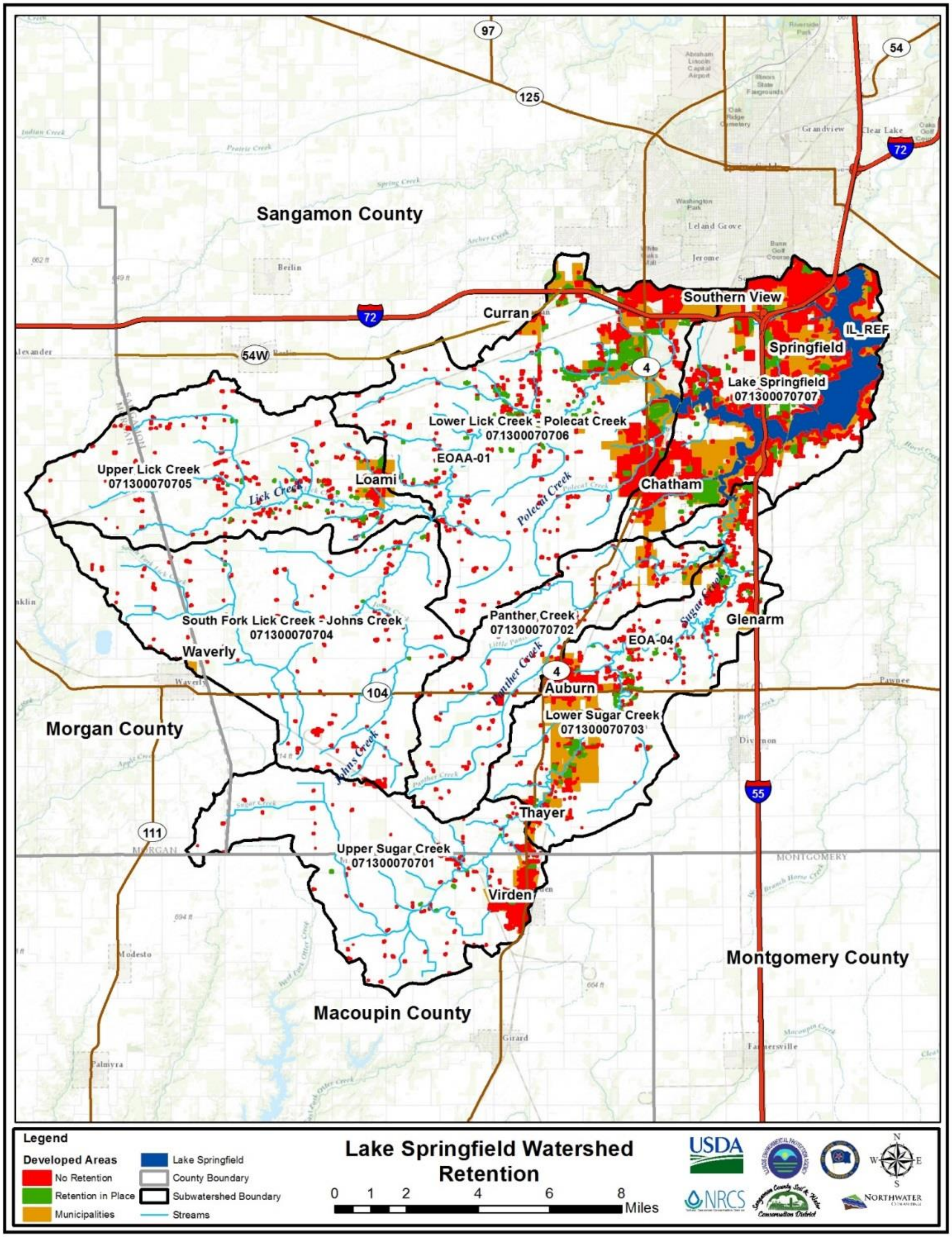


Figure 3.7.7- Retention Areas in Lake Springfield Watershed

3.8 Water Quality Assessment

3.8.1 Water Monitoring

IEPA has been monitoring Illinois surface water since 1970 for environmental conditions and to evaluate the effectiveness of water pollution control programs as required by state and federal regulations. Monitoring and assessing environmental conditions provides vital information for achieving natural resource goals and ensuring that Illinois' waters are safe for human consumption and recreation, while supporting other beneficial uses, such as healthy aquatic life, aesthetic enjoyment, and various agricultural and industrial uses.

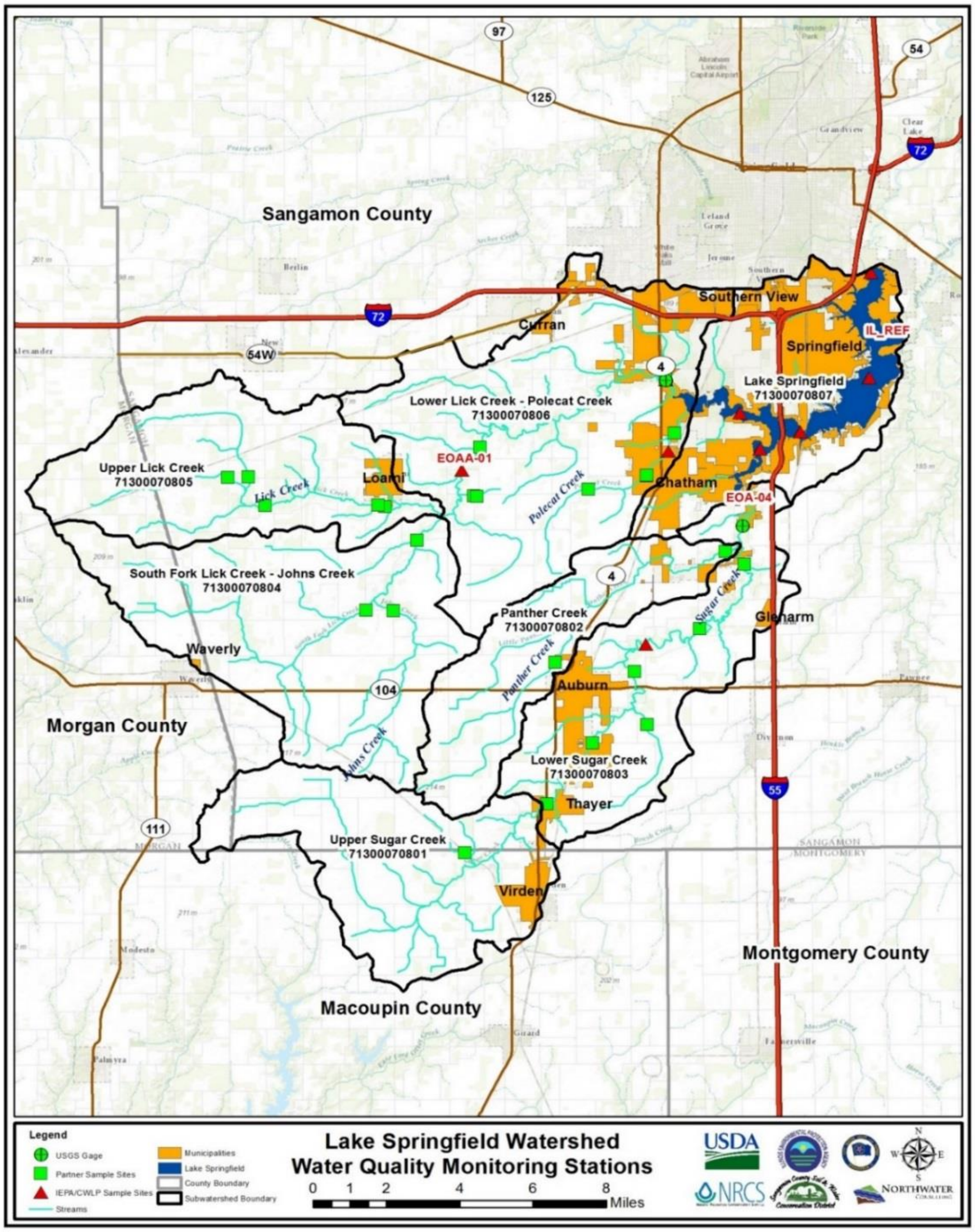


FIGURE 3.8.1— WATER QUALITY MONITORING STATIONS

In 1992, IEPA created its first list of impaired waters to fulfill the requirements set forth in Section 303(d) of the federal Clean Water Act and the Water Quality Planning and Management regulation at 40 CFR Part 130. The 2016 Water Quality Integrated Report is based on guidance from the USEPA to satisfy the requirements of Sections 305(b), 303(d) and 314 of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500) and subsequent amendments (hereafter, collectively called the "Clean Water Act" or "CWA") in a combined report. The Integrated Report was divided into two volumes in 2014 and has continued through 2016: Volume I surface water quality and Volume II groundwater quality. It is updated on a biennial basis, with guidance from USEPA, and includes assessments of waters impaired by point and nonpoint sources. These lists identify each waterbody by segment ID, Hydrologic Unit Code (HUC), size by acres for lakes or miles for streams, designated uses, potential causes and potential sources of pollution. This report also provides information about the Total Maximum Daily Load (TMDL) program/process in Illinois. Sugar Creek (IL_ EOA-04), Lick Creek (IL_ EOAA-01), and Lake Springfield (IL_REF) have been assessed for water quality impairments. Monitoring station locations are shown in **Figure 3.8.1**.

According to the IL State Water Survey Report *WATER QUALITY EVALUATIONS FOR LAKE SPRINGFIELD AND PROPOSED HUNTER LAKE AND PROPOSED LICK CREEK RESERVOIR*, December, 1997, several studies have reported on water, sediment, and nutrient budgets for Lake Springfield. One of the earliest studies was a sedimentation investigation of Lake Springfield by Fitzpatrick, Bogner, and Bhowmik (1985). Fitzpatrick and Keefer (1988) reported results of a two-year field monitoring study (May 15, 1985 - May 14, 1987) to assess the hydrologic, sediment, and nutrient budgets of the Lake Springfield watershed. Fitzpatrick and Knapp (1991) performed drought yield analyses of Lake Springfield and Hunter Lake. These investigators developed and presented current (1990) stage-capacity relationships for both lakes, considering a 1987-1990 dredging of the upper portion of Lake Springfield, and future (2025 and 2040) stage-capacity relations considering projected future sedimentation. The USEPA Clean Lakes Program Phase I and Phase II reports for Lake Springfield by CWLP (1987; 1992a) documented the historical background for Lake Springfield, and monitored data on hydrology and water quality.

From 1997 to 2002, a watershed-wide research study included continuous water sampling from 13 sites located on LSW streams to depict surface runoff and stream flow. Grab samples were taken from edge-of-field and whole field sites, along with subsurface water samples at tile outlets. All of these sites also had automated tipping rain buckets collecting data. Water samples were analyzed by the USDA Agricultural Research Service's National Soil Tilth Laboratory in Ames, IA for atrazine, alachlor, metribuzin, metolachlor, acetochlor and simazine, in addition to nitrates and ortho-phosphates, Total Suspended Solids (TSS) samples were analyzed by the local firm Crawford, Murphy & Tilly, using USEPA-approved methods.

3.8.2 Impaired Water Bodies - Designated Use Support Status

According to IEPA's 2014 Integrated Water Quality Report, two streams, Sugar Creek (IL_EOA_04) and Lick Creek (IL_EOAA_01), are not fully supporting for their designated use of Aquatic Life, as outlined in **Table 3.8.2** below. The cause of impairment for Sugar Creek is Total Phosphorus, with its primary source of impairment being crop production. For Lick Creek, alteration in stream-side or littoral vegetative covers are the cause of impairment, with loss of riparian habitat being its source of impairment. On the 2014 303(d) list, Lick Creek has been identified by IEPA for Aquatic Algae due to alteration in stream-side or littoral vegetative covers.

In Appendix A-2 of IEPA's 2016 303(d) List, Sugar Creek's cause of impairment is Dissolved Oxygen and Total Phosphorus and Lick Creek is listed for Dissolved Oxygen.

According to the Stage 1 TMDL Report, 2014, to make 303(d) listing determinations for Aquatic Life uses, Illinois EPA collects biological data and if these data suggest that impairment to aquatic life exists, a comparison of available water quality data with water quality standards will then occur. For Public and Food Processing Water Supply waters, Illinois EPA compares available data with water quality standards to make impairment determinations.

TABLE 3.8.2 – IMPAIRED STREAMS IN LAKE SPRINGFIELD WATERSHED

Water Body Name	Lick Creek (IL_EOAA-01)	Sugar Creek (IL_EOA-04)
Use Support Level	Not fully supporting	Not fully supporting
Designated Use	Aquatic life	Aquatic life
Cause of Impairment	Alteration in stream-side or littoral vegetative covers	Phosphorus (Total)
Source of Impairment	Loss of riparian habitat	Crop production (crop land and dry land)

The following information on the two major tributaries in the LSW (Sugar Creek and Lick Creek) was provided by IDNR Stream Specialist Randy Sauer regarding fishes collected by IDNR Fisheries staff (using electric seine) as part of 2003 and 2008 Sangamon River basin surveys: "The species richness (only 10-13 fish species collected per sample) and IBI scores (from 19 to 24) both indicate very deplorable conditions in these streams. Streams of this size often yield 20 or more species, and IBI scores can range from 0 to 60, putting both streams in the "Poor" category.

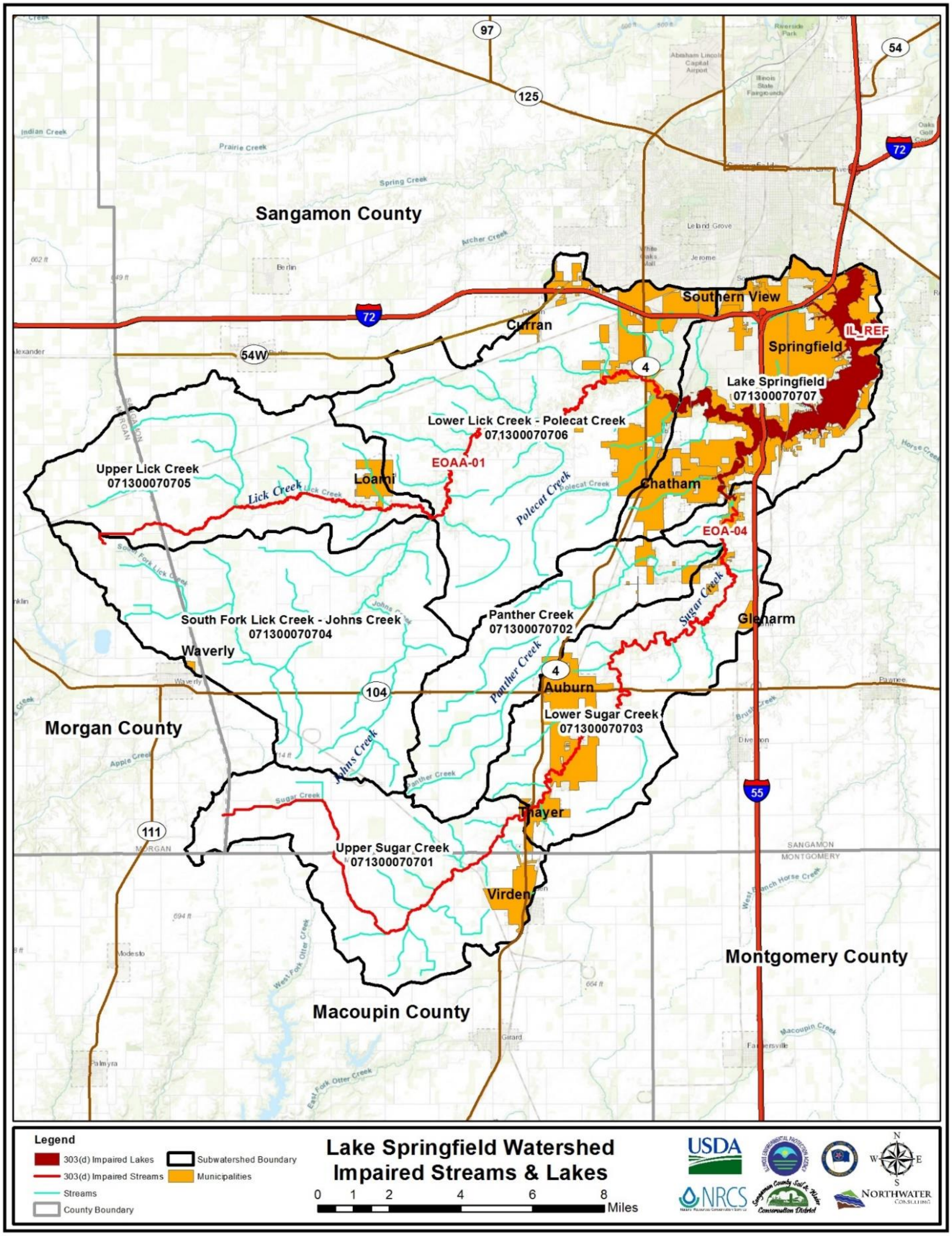


FIGURE 3.8.2 – EPA 303(D) LIST IMPAIRED STREAMS & LAKES

Sugar Creek and Lick Creek display similar habitat conditions (none of them good). They both have fairly low gradient, incised (down cut) channels featuring bottom substrates dominated by mud, clay and woody debris. Flow appears limited as evidenced by accumulations of duckweed on the surface. Lick Creek in particular had discontinuous (pooled) flow at the time of our fish survey. Habitat diversity was quite low with deep, sluggish pools and little in the way of shallow riffle areas.

Another factor possibly contributing to these streams' limited fish community may be habitat fragmentation. Both streams flow eventually into Lake Springfield. As such, they are cut off from possible sources of colonization by most stream fish species present in downstream waters (i.e., South Fork and Sangamon Rivers). So, even if water quality and habitat conditions were to improve in these streams, they may not likely attain the same biotic quality as similar streams directly connected to their receiving streams.

The Biological Stream Characterization (BSC) has been replaced by a Biological Stream Rating (BSR) system which utilizes macroinvertebrate and (if available) mussel data, in addition to the fish data which were used exclusively in BSC. According to a 2008 BSR report (which utilized 2003 Sangamon data), Sugar Creek and Lick Creek each received a "C" rating for Diversity and a "D" rating for Biotic Integrity.

"Trends in the Lower Sangamon River Basin Fish Community, 1981 to 2008," prepared by Doug Carney from the IDNR Division of Fisheries was published on June 30, 2010, and includes sampling of a Sugar Creek (EOA-04) site near Auburn, which is a South Fork Sangamon River tributary. Fish community, macroinvertebrate, habitat and water quality were sampled at 17 locations throughout the Lower Sangamon River Basin in 2008. This was the fourth Lower Sangamon Basin survey since 1981.

The revised version of the Index of Biotic Integrity (IBI) was used to assess stream quality base on fish sample data. IBI scores may range from 0-60 with higher scores indicating higher stream quality, using five biological integrity classes: IBI score of 56-60 = moderately high, 46-55 = moderate, 31-45 = moderately low, 16-30 = low and 0-15 = very low. Carney noted, "Outside urban areas, row crop agriculture dominates the watershed and contributes to water quality limitations for fishes primarily through excessive sedimentation". The IBI score for this Sugar Creek site in the LSW was 24, indicating moderately low stream quality, but was a +4 change from 2003 to 2008.

TABLE 3.8.3 – FISH COLLECTED FROM SUGAR CREEK AND LICK CREEK BY IDNR (AUGUST 2013)

Species	Sugar Creek 7/14/2003 EOA-04	Sugar Creek 8/25/2008 EOA-04	Lick Creek 7/14/2003 EOAA-01
Gizzard shad			1
Golden shiner	9	75	
Creek chub	9	3	
Hornyhead chub		1	
Red shiner	60	11	15
Bluntnose minnow	4	5	
White sucker	1	5	2
Channel catfish			2
Yellow bullhead	1	3	1
Tadpole madtom	15	1	
Pirate perch	1	23	22
Largemouth bass	1	2	3
Green sunfish	69	55	31
Bluegill x green SF hybrid	1		2
Bluegill	3	20	4
Redear sunfish		1	
Freshwater drum			7
Total fish	174	205	90
Species	11	13	10
Index of Biotic Integrity (IBI)	20	24	19

Habitat was evaluated by IEPA at each site using the Quantitative Habitat Evaluation Index (QHEI) (Rankin 1989), which ranks the condition of substrate, instream cover, channel morphology, riparian and streambank condition, pool and riffle quality and stream gradient. Composite QHEI scores range from 0 to 100, with higher scores indicating better habitat quality. The QHEI for the Sugar Creek site was 52.5 for this 2008 study.

IEPA habitat data collected on August 27, 2013, at two LSW sites Sugar Creek (EOA-04) and Lick Creek (EOAA-01) indicate QHEI scores of 50 and 34.5, respectively. No bank erosion was noted at either site, with predominate bankside vegetation being trees. The Sugar Creek site indicates a 2.5 decrease in QHEI score from the 2008 study.

Lake Springfield

As noted in the Stage 1 TMDL Report, 2014 for Lake Springfield, the IEPA 2014 303(d) list identifies Lake Springfield (IL_REF) as being impaired for Total Phosphorus, Total Suspended Solids (TSS) and Aquatic Algae and Sugar Creek for Total Phosphorus. In Appendix A-2 of IEPA's 2016 303 (d) List, Lake Springfield is listed for Total Phosphorus, Total Suspended Solids and Dissolved Oxygen.

The numeric water quality standard for lakes and reservoirs under the General Use water quality standard for Total Phosphorus is 0.05 milligrams per liter (mg/L). There is no numeric standard set for Total Phosphorus for public and food processing water supplies. Total Phosphorus is also listed by Illinois EPA as a cause for impairment in Sugar Creek. However, no numeric water quality standard has been set by IEPA for Total Phosphorus in streams. Illinois EPA has established water quality guidelines, which are target guidelines, for parameters that do not have numerical water quality criteria. With the use of the Illinois Nutrient Loss Reduction Strategy's established targets as water quality goals, Illinois EPA is using a statewide approach to a nutrient reduction goal of 45% for phosphorus to develop a Load Reduction Strategy (LRS) for that impairment.

TABLE 3.8.4 – KNOWN POTENTIAL CAUSES AND SOURCES OF WATERSHED IMPAIRMENTS IN LAKE SPRINGFIELD

Causes of Watershed Impairments	Sources of Watershed Impairments
• **Alteration in stream-side or littoral vegetative covers** • **Aquatic Algae** • **Nutrients: (phosphorus and nitrogen)** • **Other flow regime alterations** • **Sediment** • **Total Suspended Solids**	• Crop production • Golf Courses • Habitat modification • Highway/Road/Bridge Runoff • Littoral/shore Area Modifications (Non-riverine) • Livestock • Loss of riparian habitat • Loss of wetlands • Municipal Point Source Discharges • On-site treatment systems (septic systems) • Other Recreational Pollution Sources • Pasture Grazing • Runoff from forest/grassland/parkland • Shoreline erosion • Site clearance (land development) • Stream channelization • Streambank erosion • Urban runoff

3.8.3 Causes & Sources of Watershed Impairments

As described in the Stage 1 TMDL Report, 2014, potential sources of phosphorus, total suspended solids and excessive algae to Lake Springfield include: crop production, golf courses, runoff from forestland, grassland and parkland, littoral/shore area modifications, and other recreational pollution sources. Potential sources listed for Sugar Creek include: municipal point source discharges and crop production.

Although not listed by IEPA as a cause of impairment, historical water quality data collected throughout the watershed indicates that total nitrogen is also a major concern and is addressed in this section. Potential sources of total nitrogen to Lake Springfield and its tributaries include: crop production, livestock/pasture and urban/residential runoff.

Modeled results presented in Section 3.8.3 indicate that the primary sources of phosphorus and total suspended solids are crop production, streambank erosion and urban/residential runoff, with the highest total load originating from crop production. Failing septic systems are also a potential source of phosphorus. Approximately seven (7%) percent of the LSW consists of developed or urbanized land, with the majority of businesses, residences and other structures in the Springfield area served by the Sangamon County Water Reclamation District (formerly Springfield Metro Sanitary District), with the remainder of the watershed being rural.

Auburn, Loami and Thayer have their own municipal sewer systems. With approximately 85 percent of the rural areas in the LSW not being served by a municipal sanitary district, those private residents most likely have their own septic system (and private water well), which may or may not be functioning properly and could be contributing to the high phosphorus levels in this watershed.

Municipal point source discharges are also likely a source of phosphorus in the watershed, primarily within Sugar Creek. However, very little data is available to support this statement. Permit limits for phosphorus do not exist for municipal point source discharges in the watershed. Therefore, data on concentrations or loads are not reported. Only one permitted discharge in the watershed reports data on phosphorus loading.

The primary sources of nitrogen are crop production, pasture/livestock and urban residential runoff; the greatest total nitrogen load can be attributed to crop production, with slightly less than fifty percent (50%) of this originating from tile flow.

South Fork Lick Creek (IL_ EOAAA), Johns Creek (IL_ EOAAAA), and Polecat Creek (IL_ EOAE) have not been assessed by IEPA.

TABLE 3.8.4 - 2006-2016 LAKE SPRINGFIELD WATERSHED IMPAIRMENTS ON THE 303(D) LIST

Waterbody Segment/HUC Name	Size	Year Listed	Designated Use (not supporting)	Cause of Impairment
IL_REF 0713000707 Lake Springfield	**3,965 Acres**	2006	Aesthetic Quality	Total Phosphorus, Total Suspended Solids & Aquatic Algae
		2008	Aesthetic Quality	Total Suspended Solids
		2010	Aesthetic Quality	Total Suspended Solids & Total Phosphorus
		2012	Aesthetic Quality	Total Suspended Solids & Total Phosphorus
		2014	Aesthetic Quality	Total Suspended Solids, Total Phosphorus & Aquatic Algae
		2016	Aquatic Life	Dissolved Oxygen & Total Suspended Solids Dissolved Oxygen
		2016	Aesthetic Quality	
		2016	Aquatic Life	Total Phosphorus
IL_EOA-04 0713000707 Sugar Creek	**34.28 miles**	2006	Aquatic Life	Total Phosphorus
		2008	Aquatic Life	Total Phosphorus
		2010	Aquatic Life – Low	Dissolved Oxygen
		2012	Aquatic Life-Medium	Total Phosphorus
		2014	Aquatic Life – Medium	Total Phosphorus
		2016	Aquatic Life – Medium	Dissolved Oxygen & Total Phosphorus
IL_EOAA-01 0713000707 Lick Creek	**27.55 miles**	2006	Aquatic Life	Alteration in stream-side or littoral vegetative covers
		2014	Aquatic Life	
		2016	Aquatic Life - Medium	Dissolved oxygen

3.8.5 - 2014 Assessment Status of 303(d) Listed Water Bodies in Lake Springfield Watershed

Assessment Status of Sugar Creek (IL_ EOA-04)			
Designated Use	Use ID	Assessed in 2014 Integrated Report	Use Attainment
Aquatic Life	**582**	**Yes**	**Not Supporting**
Fish Consumption	583	No	N/A
Primary Contact	585	No	N/A
Secondary Contact	586	No	N/A
Aesthetic Quality	590	No	N/A
Assessment Status of Lick Creek (IL_ EOAA-01)			
Designated Use	**Use ID**	**Assessed in 2014 Integrated Report**	**Use Attainment**
Aquatic Life	**582**	**Yes**	**Not Supporting**
Fish Consumption	583	No	N/A
Primary Contact	585	No	N/A
Secondary Contact	586	No	N/A
Aesthetic Quality	590	No	N/A
Assessment Status of Lake Springfield (IL_REF)			
Designated Use	**Use ID**	**Assessed in 2014 Integrated Report**	**Use Attainment**
Aquatic Life	582	Yes	Fully Supporting
Fish Consumption	583	Yes	Fully Supporting
Public and Food Processing Water Supplies	584	Yes	Fully Supporting
Primary Contact	585	No	N/A
Secondary Contact	586	No	N/A
Aesthetic Quality	**590**	**Yes**	**Not Supporting**

TABLE 3.8.6 - 2016 303(D) LIST IMPAIRED DESIGNATED USE AND CAUSES FOR LAKE SPRINGFIELD WATERSHED

Waterbody	Assessment Unit ID	Size	Impaired Designated Use	Causes of Impairment(s)	Sources of Impairment(s)
Sugar Creek	IL_ EOA-04	34.28 miles	Aquatic Life	Phosphorus (Total)	Municipal Point Source Discharges, Crop Production (Crop Land or Dry Land)
Lick Creek	IL_ EOAA-01	27.55 miles	Aquatic Life	Alteration in stream-side or littoral vegetative covers	Loss of Riparian Habitat
Lake Springfield	IL_REF	3,965 acres	Aesthetic Quality	Total Suspended Solids (TSS), Phosphorus (Total), Aquatic Algae	Golf Courses, Littoral/shore Area Modifications (Non-riverine), Other Recreational Pollution Sources, Runoff from Forest/Grassland/Parkland

3.9 Detailed Analysis of Pollution Sources

The following section provides sources descriptions identified at the significant subcategory level, along with estimates to the extent they are present in the watershed.

3.9.1 Phosphorus & Nitrogen

Modeling of NPS pollution in the watershed indicates that phosphorus and nitrogen loadings from crop production are the primary source of nutrients to Lake Springfield (See Section 4.6). Crop production is responsible for 94% of the total nitrogen and 87% of the total phosphorus load. Urban residential, other developed areas and runoff from pasture operations are secondary sources of nitrogen loads in the watershed. Urban areas contribute nutrients primarily as a function of greater rates of runoff and less infiltration; the application of lawn fertilizers will also contribute to nutrient loading from urban areas which cover 5,728 acres in the watershed; rural residential areas cover 941 acres. Pasture operations deliver 0.8% (17,561 lbs./year) of the total watershed nitrogen load and urban residential areas deliver 0.7%, or 15,422 lbs./year.

Other significant sources of phosphorus include eroding gullies at 1.8% of the total annual phosphorus load, or 3,889 pounds/year, streambank erosion at 3.8%, or 8,146 lbs./year, failing septic systems at 2.6%, or 5,555 pounds/year and urban residential areas at 1%, or 2,410 lbs./year.

The entire watershed contains 124,522 acres (74%) of cropland, 5,728 acres (3%) of urban residential and 2,994 acres (2%) of pasture. There are an estimated 1,223 eroding gullies, 66 miles of severely eroding streambanks and an estimated 456 failing septic systems.

Although noted in the Stage 1 TMDL Report, 2014 and within the 2012 and 2014 303(d) list, golf courses and runoff from forest, grassland and park land do not appear to be a significant source of the total nitrogen or phosphorus load to the Lake. There are 577 acres (0.34%) of golf courses, 21,665 acres (13%) of forest, grassland and park land. Loading from these three sources combined only account for 1% of the total nitrogen and 1.5% of the total phosphorus load. Despite the fact that golf courses are a minimum contributor to the overall nutrient load, they do have moderately high per-acre rates and should be considered as potential areas for the installation of BMPs. Due to the relatively large land area of a golf course, opportunities may exist that are not available elsewhere, such as large retention/detention areas or wetlands for both runoff from within the course and runoff from external areas. Opportunities also exist for stream buffers within courses with major tributary drainages.

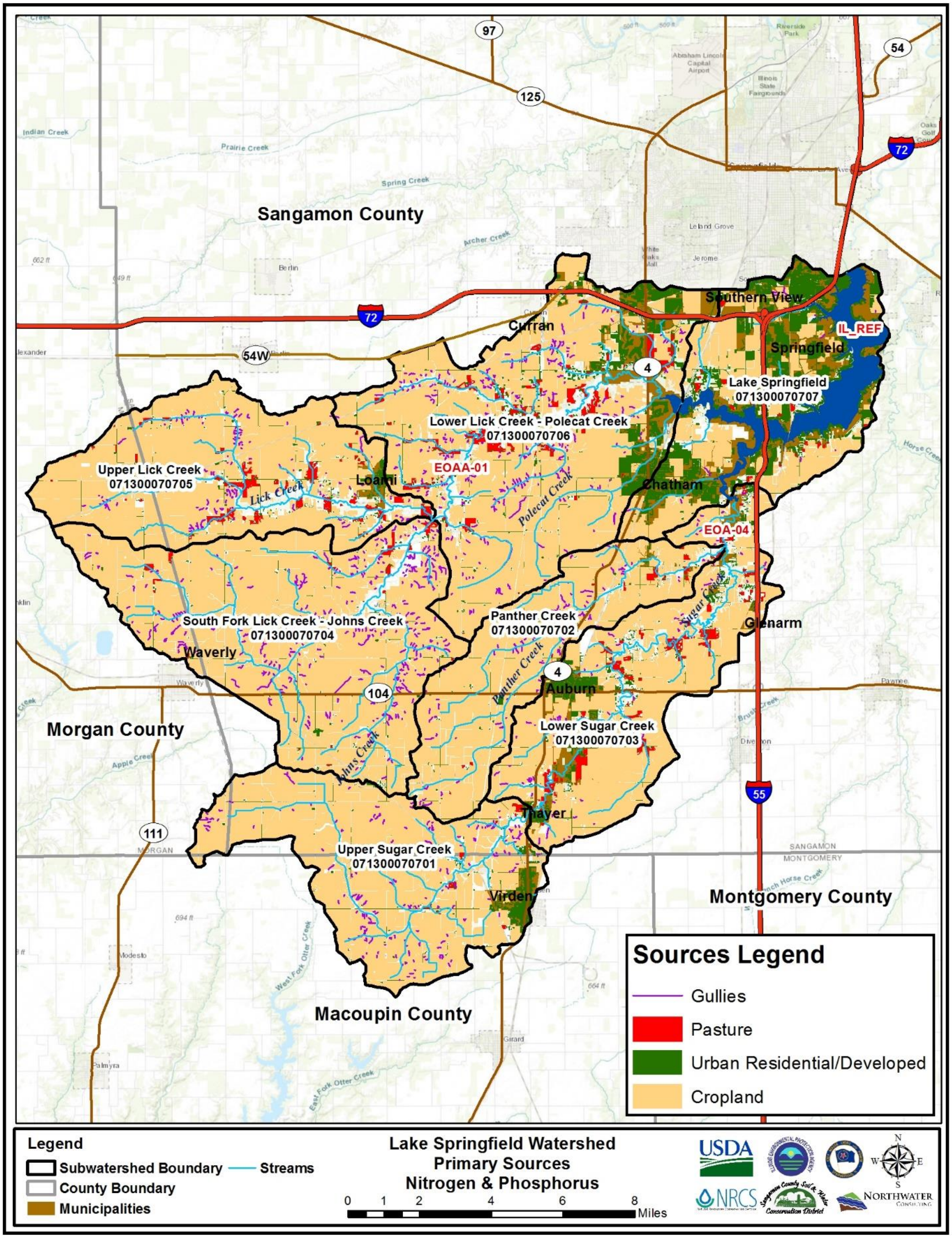


FIGURE 3.9.1 – PRIMARY NITROGEN AND PHOSPHOROUS SOURCES

3.9.2 Total Suspended Solids (TSS)

Suspended and bedded sediments (SABS) are defined by EPA as particulate organic and inorganic matter that suspend in or are carried by the water, and/or accumulate in a loose, unconsolidated form on the bottom of natural water bodies. This includes the frequently used terms of clean sediment, suspended sediment, total suspended solids, bedload, turbidity, or in common terms, dirt, soils or eroded materials.

Sources of TSS identified in the Stage 1 TMDL Report, 2014 for Lake Springfield are:

- Sediment from crop production
- Streambank erosion
- Littoral/shore area modifications (lake bank erosion)
- Golf courses
- Other recreational sources
- Runoff from forest, grassland and park land

Sediment loading from crop production is one of the primary sources of TSS to Lake Springfield. (Stage 1 TMDL Report, 2014). Crop production, including gully erosion, is responsible for 94% (158,693 tons/year) of the total sediment load delivered to the Lake. A more detailed analysis of cropland in the watershed indicates that a relatively large sediment contribution is occurring from a small overall percentage of cropped HEL soils; the 6,952 acres of cropped HEL soils, alone, contribute 35% (54,789 tons/year) of the total cropland sediment load. Just fewer than 6% of all cropped soils in the watershed are responsible for 35% of the sediment delivered from cropland, or 33% of the entire watershed sediment load. A secondary source of TSS is streambank erosion which accounts for 4%, or 6,789 tons per year.

Although noted in the Stage 1 TMDL Report, 2014 and within the 2012 and 2014 303(d) list, golf courses, littoral/shore area modifications, other recreational pollution sources and runoff from forest, grassland and park land do not appear to be a significant source of the total TSS load to the Lake. Combined, golf courses, other recreational pollution sources and runoff from forest, grassland and park land account for less than 0.2% of the total sediment load. Littoral/shore area modifications or lake bank erosion is responsible for 912 tons of delivered sediment per year, or 0.5% of the total annual watershed sediment load. Much of the Lake’s shoreline is stabilized or eroding at very low rates and, therefore, is not considered a significant source of TSS. However, a very small section of lake shoreline is responsible for the vast majority of all eroding banks within the lake and will be addressed as a critical area in need of attention in the near future. If these critical bank segments can be stabilized, they will eliminate almost the entire shoreline sediment and nutrient load from within the Lake.

3.9.3 Aquatic Algae

Although Aquatic Algae is not a pollutant, it has been listed as a cause of impairment in Lake Springfield. No numeric water quality standard has been set by EPA for Aquatic Algae. Excess algae is often linked to high nutrient levels and its presence depletes oxygen levels in lakes leading to eutrophication (Stage 1 TMDL Report, 2014). Substantial nutrient loads associated with crop production, urban and developed-area runoff, streambank, gully and other forms of erosion are likely the leading sources of Aquatic Algae growth. Based on nutrient concentration information provided by CWLP, Lake Springfield is considered hypereutrophic, or excessively productive. Simply stated, the Lake has more nutrients than it needs. Reducing nutrient inputs to the Lake will likely reduce algae growth and help to mitigate this particular impairment.

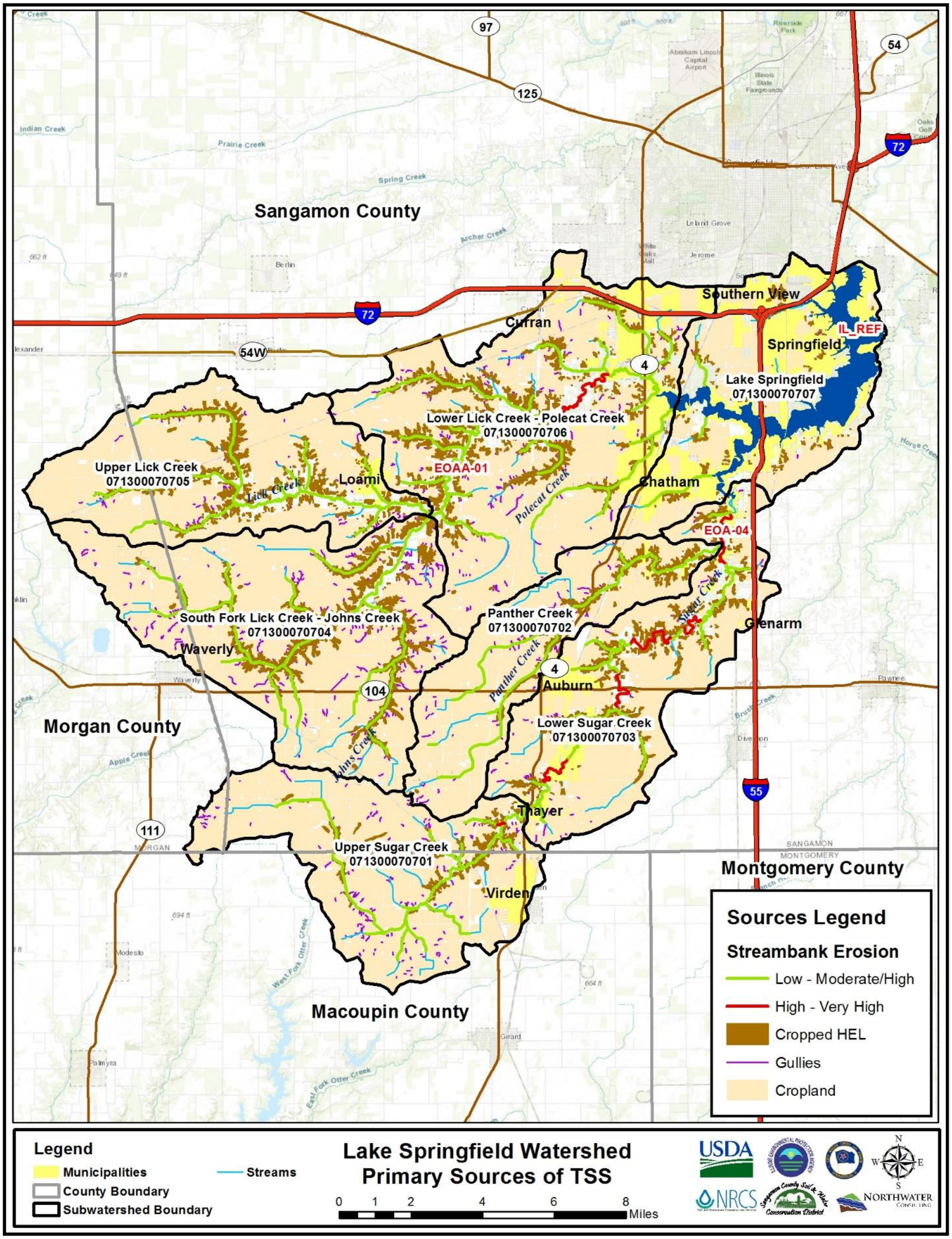


FIGURE 3.9.2 – PRIMARY SOURCES OF TOTAL SUSPENDED SOLIDS

3.9.4 Other Potential Sources

In addition to the primary sources of sediment, nutrient and aquatic algae impairments, other potential sources should be considered. Although concentrated livestock feed areas contribute low total sediment and nutrient loads to Lake Springfield, they are very high in terms of per-acre loading. The 94 acres of open, concentrated livestock feed areas throughout the watershed produce the greatest per-acre loading of phosphorus, the second greatest per-acre loading of nitrogen and the second greatest per-acre load of sediment.

According to 2010 Census information by township, there are approximately 5,341 housing units in the rural areas of the LSW townships. These houses are most likely on private septic systems. Despite this being an uncertain number, it is safe to assume that many of these septic systems may be failing and are a likely source of lake nitrogen and phosphorus loads. The top four soil types (69%) in this watershed are considered very limited for depth to saturated zone and restricted permeability for septic tank absorption fields. (Table 22 - Sanitary Facilities, *Soil Survey of Sangamon County, Illinois*) Urban residential areas are an additional source of phosphorus. Potentially failing septic systems contribute 0.6% of the total nitrogen load, or 14,186 pounds/year. Urban residential areas are responsible for 2,410 pounds/year of phosphorus, or 1.1% of the total annual load.

An in-depth survey and documentation of the number and GPS location of septic systems and private water wells in the LSW will be a priority on the critical areas list in this watershed, and will also include BMP recommendations which will reduce the phosphorus and nitrogen loadings from these septic systems. There is also a possibility that these failing septic systems could be causing contamination of some private water wells.

The nine (9) municipal point source discharges are also thought to be a source of phosphorus in the watershed. As previously noted, permit limits for phosphorus are unavailable for municipal point source discharges in the watershed and, therefore, data on concentrations or loads is nonexistent. Reported phosphorus levels from other communities in Illinois without specific permit limits for the nutrient indicate that very high phosphorus concentrations can be discharged in situations where permit limits do not exist. Given this information, the concentration and loading of phosphorus from permitted dischargers in the watershed will be considered a critical area to explore for BMP implementation.

In accordance with Sections 305(b) and 303(d) of the federal Clean Water Act, the Illinois Environmental Protection Agency (IEPA) must report to the U.S. Environmental Protection Agency on the quality of Illinois surface water (e.g., lakes, streams, Lake Michigan, wetlands) and groundwater resources (Section 305(b)) and provide a list of those waters where their designated uses are deemed ‘impaired’ (Section 303(d)). There are seven designated uses in Illinois; however, only six of those uses apply within the LSW. These are Aquatic Life, Fish Consumption, Public and Food Processing Water Supplies, Primary Contact, Secondary Contact and Aesthetic Quality.

3.10 Total Maximum Daily Load (TMDL)

The Clean Water Act also requires that a Total Maximum Daily Load (TMDL) be developed for each pollutant of an impaired water body. The *Lake Springfield Watershed TMDL Stage 1 Report* was completed in October 2014. The July 2016 Stage 3 TMDL Report, released for public comment on March 7, 2017, included TMDLs for Total Phosphorus and Total Suspended Solids in Lake Springfield and Sugar Creek Watershed and made recommendations for BMPs which will be used in the LSWMP to help meet the goals set in this plan, the TMDL goals and the IL Nutrient Loss Strategy goals.

The IEPA regulates wastewater and stormwater discharges to streams and lakes through the National Pollutant Discharge Elimination System (NPDES) program. An NPDES permit is required for the discharge of: 1) treated municipal effluent; 2) treated industrial effluent; and 3) stormwater from municipal separate storm sewer systems (MS4s) and construction sites.

Under Phase I of the NPDES Stormwater program, operators were required to obtain permit coverage for construction activity that resulted in a total land disturbance of 5 acres or more or less than 5 acres if they were part of a "larger common plan of development or sale" with a planned land disturbance of 5 acres or greater. Phase II reduced that project size to 1 acre or more.

Phase I of the NPDES Stormwater program began in 1990 and required medium and large municipal separate storm sewer systems (MS4s) to obtain NPDES coverage. The expanded Phase II program began in March 2003 and required small MS4s in urbanized areas to obtain NPDES permits and implement six (6) minimum control measures. An urbanized area, as delineated by the Bureau of Census, is defined as a central place or places and the adjacent densely settled surrounding area that together have a residential population of at least 50,000 people and an overall population density of at least 500 people per square mile.

Table 3.10.1 – Active NPDES Permitted Facilities

Facility ID	Facility Name	Impaired Segment
IL0022403	Auburn STP	Sugar Creek EOA-04
IL0023426	Virden North STP	Sugar Creek EOA-04
IL0024767	Springfield CWLP	Lake Springfield
IL0050253	Lake Springfield Baptist Camp	Lake Springfield
ILG580260	Thayer STP	Sugar Creek EOA-04
ILG580275	Loami STP	Lick Creek EOAA-01

Most of the municipalities in the LSW have waste water treatment facilities regulated under the NPDES permits and/or MS4 permits. The majority of the rural LSW and portions of the Lake Springfield area have private septic systems, many of which have been deemed as "failing systems" and are installed in limiting soils which are unsuitable for septic systems.

TABLE 3.10.2 – MUNICIPAL SEPARATE STORMWATER SEWER (MS4) PERMITS

Municipality	MS4 Permit #	Permit Name	Drainage Area (Square miles)
Springfield	ILR400453	Springfield, City of	61.4*
Chatham	ILR400624	Chatham, Village of	5.0
Southern View	ILR400246	Southern View Village	0.5

*Not all of the drainage area is in the LSW.

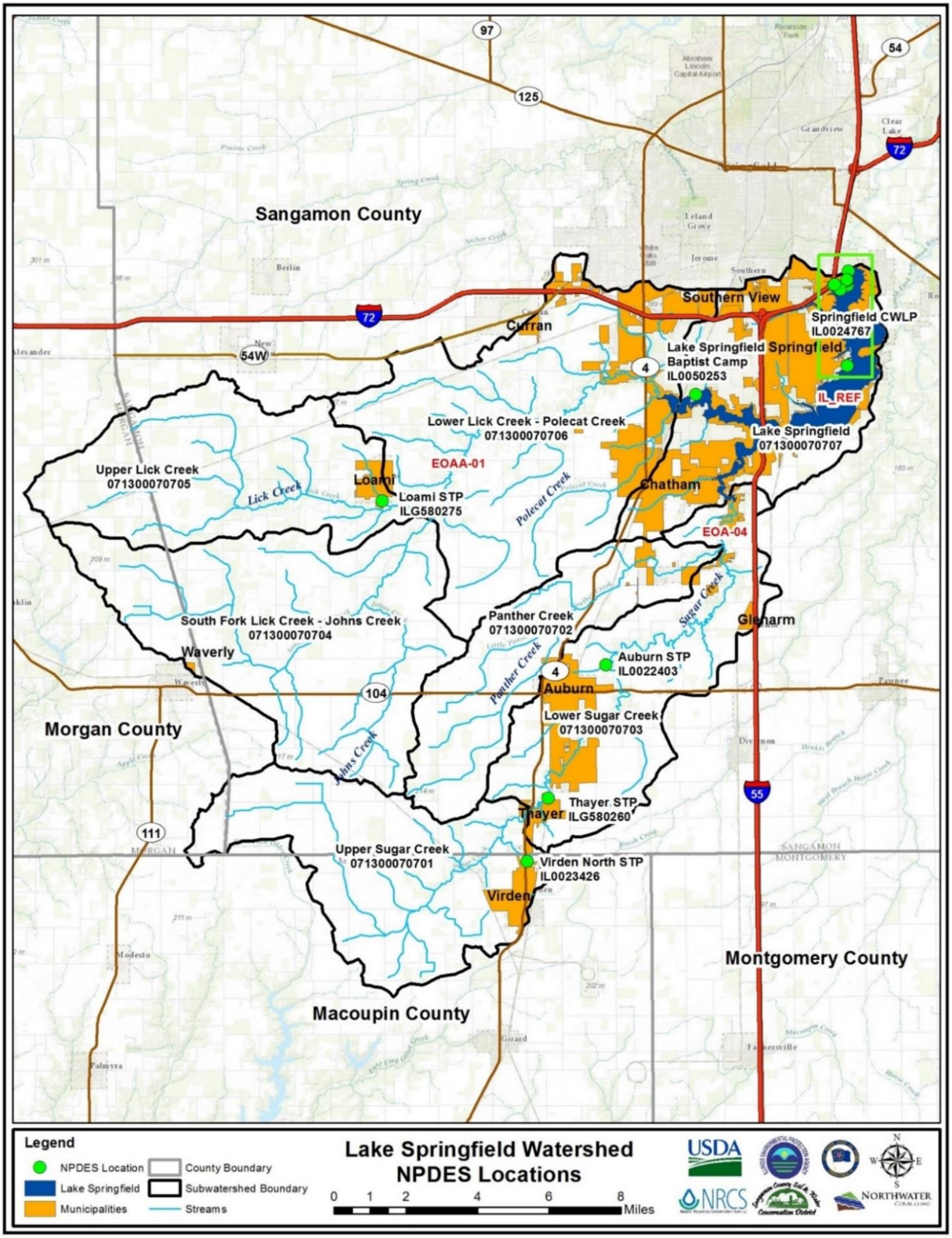


Figure 3.10.1 – NPDES Permit Locations

3.11 Existing Annual Pollutant Loads Estimates

This section provides an overview of nutrient and sediment loading from all sources within the watershed: surface runoff and tile flow, gully erosion, streambank erosion, lake bank erosion, failing septic systems and permitted point source discharges. Loadings from surface runoff and tile flow, gully erosion, lake bank and streambank erosion and failing septic systems were modeled and are described in the following **Tables: 3.11.1, 3.11.2 and 3.11.3**. Loadings from permitted point source discharges in the watershed were obtained from the permitted facilities' most recent full year of Discharge Monitoring Report (DMR) data. It is important to note that no permitted facility in the watershed reports values for total nitrogen and only one facility (Lake Springfield Baptist Church) reports data for phosphorus.

The number of private septic systems in this watershed is not known, nor the number of these systems that are failing. A survey to obtain and document both private septic systems and private water well information will be one of the objectives in this watershed management plan.

With Sugar Creek and Lake Springfield both being on EPA's 303(d) list for total phosphorus, BMPs which can significantly reduce phosphorus loadings in these water bodies will be targeted as a critical area for implementation. Two of the major drawbacks in implementing streambank stabilization BMPs are the cost of these practices and the accessibility to the site with equipment necessary to do this restoration and stabilization work.

3.11.1 – Annual Nitrogen Loading By Sub-watershed

Sub-watershed Code	Sub-watershed	Total Annual Nitrogen Load (Pounds per year) Surface Runoff & Tile Flow	Gully Erosion	Streambank Erosion	Lake Bank Erosion	Failing Septic Systems	Permitted Point Sources	Grand Total
071300070701	Upper Sugar Creek	354,100	814	2,004	0	1,031	N/A	357,949
071300070702	Panther Creek	250,214	484	898	0	471	N/A	252,067
071300070703	Lower Sugar Creek	265,485	711	4,481	0	2,998	N/A	273,675
071300070704	South Fork Lick Creek—Johns Creek	533,582	2,031	1,220	0	532	N/A	537,365
071300070705	Upper Lick Creek	323,466	694	921	0	774	N/A	325,855
071300070706	Lower Lick Creek—Polecat Creek	426,038	1,603	3,779	0	1,772	N/A	433,192
071300070707	Lake Springfield	128,941	143	275	2,098	6,608	N/A	138,065
	Total	**2,281,826**	**6,480**	**13,578**	**2,098**	**14,186**	**N/A**	**2,318,168**

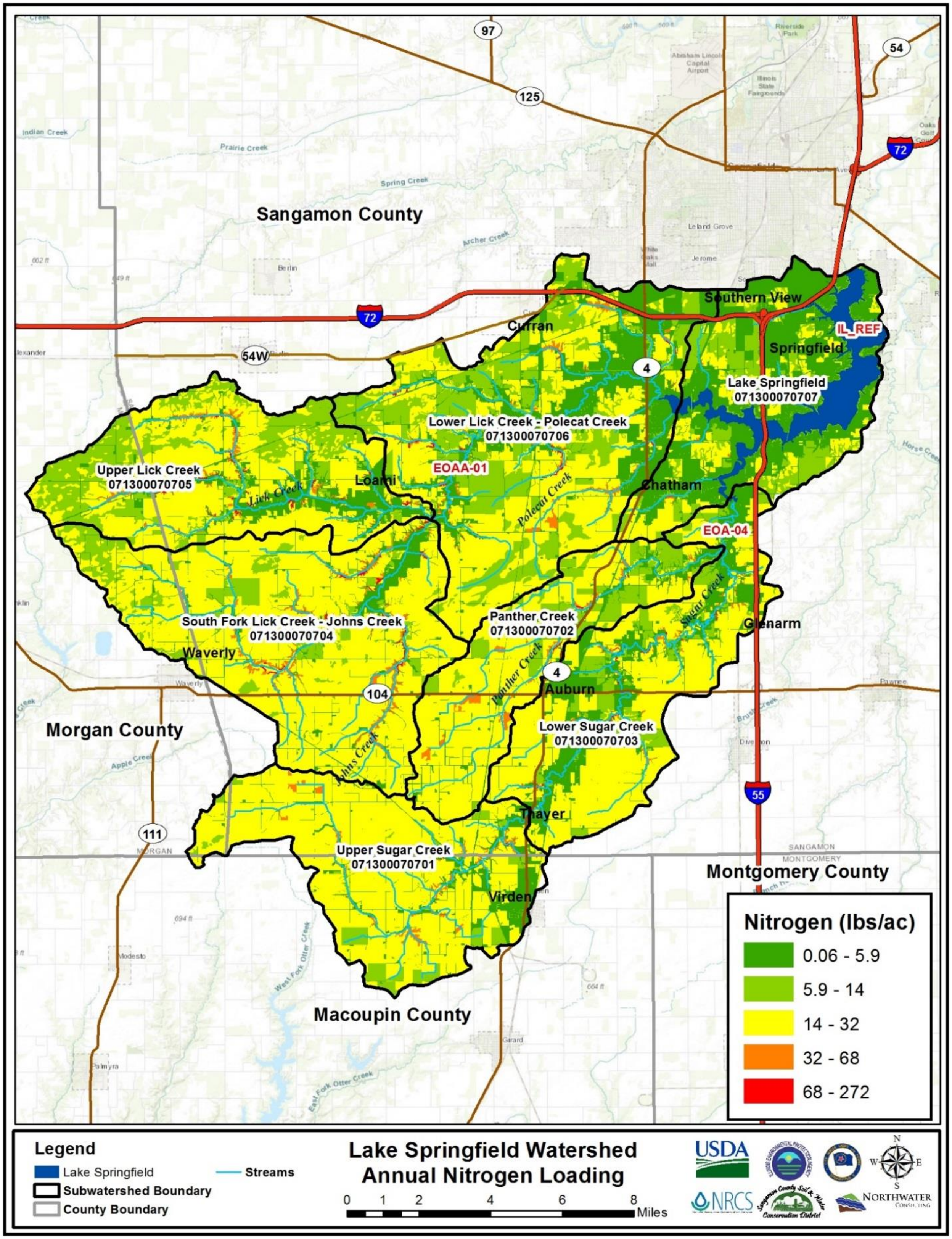


FIGURE 3.11.1 –ANNUAL NITROGEN LOADING BY SUB-WATERSHED

TABLE 3.11.2 – PHOSPOROUS LOADINGS BY SUB-WATERSHED

Sub-watershed Code	Sub-watershed	Total Annual Phosphorus Load (Pounds per year)						Grand Total
		Surface Runoff Tile Flow	Gully Erosion	Streambank Erosion	Lake Bank Erosion	Failing Septic Systems	Permitted Point Sources	
071300070701	Upper Sugar Creek	26,290	488	1,203	0	404	N/A	28,385
071300070702	Panther Creek	19,743	291	539	0	184	N/A	20,757
071300070703	Lower Sugar Creek	21,478	426	2,689	0	1,174	N/A	25,767
071300070704	South Fork Lick Creek—Johns Creek	48,074	1,219	732	0	208	N/A	50,233
071300070705	Upper Lick Creek	30,624	417	552	0	303	N/A	31,896
071300070706	Lower Lick Creek—Polecat Creek	37,290	962	2,267	0	694	N/A	41,213
071300070707	Lake Springfield	11,264	86	165	1,049	2,588	18.3	15,170
	Total	**194,763**	**3,889**	**8,146**	**1,049**	**5,555**	**18.3**	**213,402**

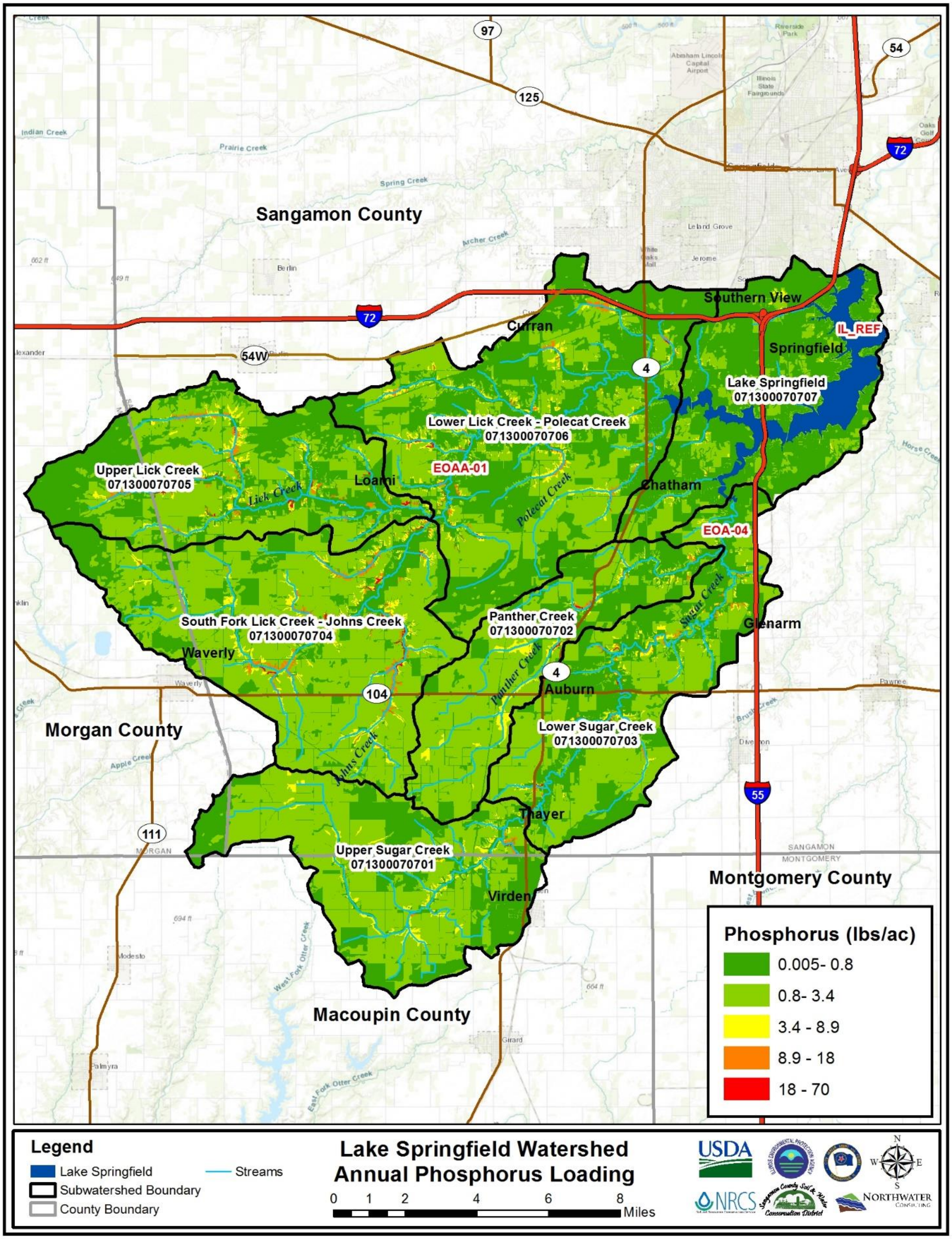


FIGURE 3.11.2 –ANNUAL PHOSPHORUS LOADING BY SUB -WATERSHED

TABLE 3.11.3 – ANNUAL SEDIMENT LOADINGS BY SUB-WATERSHED

Sub-watershed Code	Sub-watershed	Total Annual Sediment Load (Tons per year)						Grand Total
		Surface Runoff	Gully Erosion	Streambank Erosion	Lake Bank Erosion	Failing Septic Systems	Permitted Point Sources	
071300070701	Upper Sugar Creek	19,862	814	1,002	0	N/A	1	21,679
071300070702	Panther Creek	14,779	484	449	0	N/A	0	15,712
071300070703	Lower Sugar Creek	16,545	711	2,241	0	N/A	7	19,503
071300070704	South Fork Lick Creek—Johns Creek	40,876	2,031	610	0	N/A	0	43,517
071300070705	Upper Lick Creek	26,912	694	460	0	N/A	0.5	28,067
071300070706	Lower Lick Creek—Polecat Creek	29,213	1,603	1,889	0	N/A	0	32,705
071300070707	Lake Springfield	5,704	143	138	912	N/A	60	6,957
	Total	**153,892**	**3,240**	**6,789**	**912**	**N/A**	**68**	**164,901**

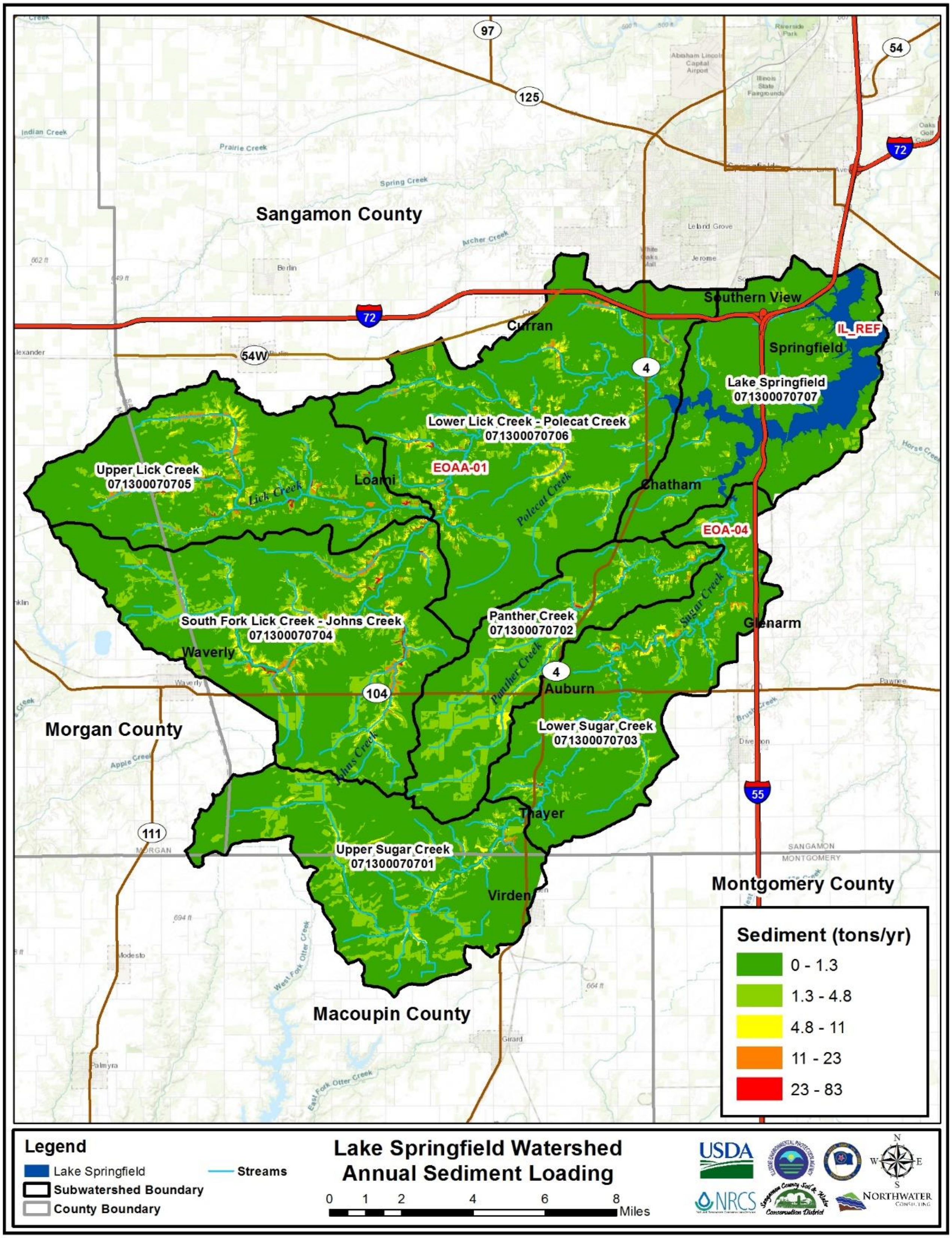


FIGURE 3.11.3 – ANNUAL SEDIMENT LOADING BY SUB-WATERSHED

3.12 Annual Pollutant Load Reduction Target Estimates by Source

Lake Springfield Watershed Modeled Pollution Loading

The Lake Springfield Watershed nonpoint source pollution loading model (SWAMM) incorporates land use data, soils and precipitation to calculate annual runoff using the Curve Number approach; literature-based Event Mean Concentrations (EMCs) and the Universal Soil Loss Equation (USLE) are incorporated to calculate loading. The model integrates rainfall from three separate weather stations, uses a distance-based delivery ratio, estimates loading contributions from tile flow and accounts for or gives credit to existing BMPs and detention. The Lake Springfield Watershed SWAMM was calibrated using existing water quality data. Calibrated model values are within acceptable ranges. The model does not directly account for streambank or gully erosion (See Section 3.3.1 for estimates of gully and streambank erosion).

Appendix C includes the complete SWAMM methodology.

Total annual nonpoint-source loading varies by pollutant. Total annual loading in the Lake Springfield Watershed is 2,281,826 pounds for nitrogen, 194,762 pounds for phosphorus and 153,892 tons for sediment. This corresponds to per-acre rates of 13.5 pounds for nitrogen, 1.15 pounds for phosphorus and 0.92 tons for sediment. The highest annual per-acre load of nitrogen is originating from the **South Fork Lick Creek—Johns Creek** and **Upper Sugar Creek** sub-watersheds; total load is highest in the **South Fork Lick Creek—Johns Creek** and **Lower Lick Creek** sub-watersheds.

The highest per-acre annual phosphorus load is found in the **South Fork Lick Creek—Johns Creek** and **Upper Lick Creek** sub-watersheds. Total phosphorus loading is highest in the **South Fork Lick Creek—Johns Creek** and **Lower Lick Creek** sub-watersheds. The highest annual per-acre sediment load can be attributed to **Upper Lick Creek** and the **South Fork Lick Creek—Johns Creek** sub-watersheds. Total annual sediment load is highest from the **South Fork Lick Creek—Johns Creek** and **Lower Lick Creek** sub-watersheds.

TABLE 3.12.1 – TOTAL ANNUAL RUNOFF AND NONPOINT SOURCE POLLUTANT LOADING

Sub-watershed Code	Sub-watershed	Annual Runoff (Acre-ft.)	Total Annual N Load (lbs./yr.)	Per Acre	Total Annual P Load (lbs./yr.)	Per Acre	Total Annual Sediment Load (tons/year)	Per Acre
071300070701	Upper Sugar Creek	23,188	354,100	16.01	26,290	1.19	19,862	0.86
071300070702	Panther Creek	14,930	250,214	16.60	19,743	1.31	14,779	0.99
071300070703	Lower Sugar Creek	20,544	265,485	12.43	21,478	1.01	16,545	0.81
071300070704	South Fork Lick Creek—Johns Creek	30,656	533,582	17.11	48,074	1.54	40,876	1.33
071300070705	Upper Lick Creek	19,657	323,466	14.87	30,624	1.41	26,912	1.37
071300070706	Lower Lick Creek—Polecat Creek	32,392	426,038	11.84	37,290	1.04	29,213	0.90
071300070707	Lake Springfield	26,629	128,941	6.02	11,264	0.53	5,704	0.21
	Total	**167,995**	**2,281,826**	**13.51**	**194,762**	**1.15**	**153,892**	**0.92**

Annual sub-watershed sediment and nutrient loading as a percentage of the total Lake Springfield load is presented in **Table 3.12.2**. Results indicate that **South Fork Lick Creek—Johns Creek** is responsible for the highest percentage of the total annual nitrogen, phosphorus, and sediment load or 23%, 25% and 27%, respectively. The **Lake Springfield** sub-watershed accounts for the lowest overall percentage in each constituent category.

TABLE 3.12.2 – TOTAL ANNUAL NITROGEN, PHOSPHOROUS AND SEDIMENT LOADING

Sub-watershed Code	Sub-watershed	Total Annual N Load (lbs/yr)	% of Total Annual Watershed Load	Total Annual P Load (lbs/yr)	% of Total Annual Watershed Load	Total Annual Sediment Load (tons/yr)	% of Total Annual Watershed Load
071300070701	Upper Sugar Creek	354,100	16%	26,290	13%	19,862	13%
071300070702	Panther Creek	250,214	11%	19,743	10%	14,779	10%
071300070703	Lower Sugar Creek	265,485	12%	21,478	11%	16,545	11%
071300070704	South Fork Lick Creek—Johns Creek	533,582	23%	48,074	25%	40,876	27%
071300070705	Upper Lick Creek	323,466	14%	30,624	16%	26,912	17%
071300070706	Lower Lick Creek—Polecat Creek	426,038	19%	37,290	19%	29,213	19%
071300070707	Lake Springfield	128,941	6%	11,264	6%	5,704	4%
	Total	**2,281,826**	**100%**	**194,762**	**100%**	**153,892**	**100%**

An analysis of loading by land use in the watershed indicates that cropland accounts for the greatest total annual load of nitrogen, phosphorus and sediment. The top three values are highlighted in red in each column in **Table 3.12.3**. Cropland also accounts for the greatest annual runoff followed by roads and open water – ponds.

Following row crops, pasture and urban residential areas account for the second and third highest total annual nitrogen load; row crops, feed areas and open hog lots account for the highest per- acre loadings. Urban residential areas and roads also account for the second and third highest total annual phosphorus and sediment loads. Open hog lots, feed areas and confinements account for the highest per-acre phosphorus loads and row crops, open hog lots and marina/resorts account for the highest per-acre sediment loads.

For all pollutants, row crops account for the highest percentage of the total annual sediment and nutrient load; 95% for nitrogen, 93% for phosphorus and 99% of the total annual sediment load.

TABLE 3.12.3 – ANNUAL LOADINGS BY LAND USE CATEGORY

Land Use Category	Annual Runoff (acre-ft)	Nitrogen (lbs/yr)	Per Acre	Phosphorus (lbs/yr)	Per Acre	Sediment (tons/yr)	Per Acre
Row Crops	**123,005**	**2,177,953**	**17.53**	**181,152**	1.46	**152,213**	**1.22**
Pasture	2,049	**17,561**	5.96	1,716	0.58	194	0.07
Urban Residential	5,669	**15,422**	2.69	**2,410**	0.42	**377**	0.07
Roads	**6,187**	15,164	5.58	**2,242**	0.82	**420**	0.15
Open Water - Pond	**12,838**	11,926	2.61	795	0.17	24	0.01
Urban Open Space	3,627	8,511	1.42	2,043	0.34	84	0.01
Forest	3,165	7,463	0.96	800	0.10	147	0.02

Land Use Category	Annual Runoff (acre-ft)	Nitrogen (lbs/yr)	Per Acre	Phosphorus (lbs/yr)	Per Acre	Sediment (tons/yr)	Per Acre
Open Water - Stream	1,275	4,331	9.62	381	0.85	5	0.01
Commercial/Retail	1,352	2,925	3.40	417	0.49	77	0.09
Grassland	2,884	2,813	0.39	522	0.07	53	0.01
Farm Building	471	2,511	4.73	154	0.29	30	0.06
Wetland	1,035	2,417	2.15	69	0.06	9	0.01
Residential Farm	702	1,782	1.89	252	0.27	35	0.04
Golf Course	331	1,559	2.70	303	0.53	15	0.03
Institutional	586	1,420	2.99	177	0.37	34	0.07
Feed Area	104	1,028	11.89	178	2.05	11	0.13
Open Space Road	318	1,016	2.71	198	0.53	10	0.03
Manufacturing & Industrial	516	991	3.09	130	0.41	35	0.11
Park	352	934	1.41	224	0.34	5	0.01
Sod Farm	123	732	5.36	81	0.60	17	0.12
Utilities & Communication	221	690	4.17	111	0.67	21	0.13
Railroad	349	607	2.01	103	0.34	30	0.10
Wholesaling & Storage	330	593	2.77	91	0.42	19	0.09
Education	114	271	3.37	38	0.47	5	0.07
Grain Elevator	45	228	6.38	14	0.39	3	0.10
Confinement	32	168	6.14	42	**1.52**	2	0.06
Marina/Resort	37	164	6.37	22	0.86	5	**0.21**
Cultural & Entertainment	113	153	1.69	22	0.24	4	0.05
Open Hog Lot	8	146	**18.77**	26	**3.35**	2	**0.24**
Cemetery	31	113	2.23	17	0.33	1	0.02
Mobile Homes	36	83	2.32	10	0.28	2	0.04
Orchards and Nurseries	22	56	1.07	9	0.17	1	0.02
Resource Extraction	25	28	1.21	5	0.21	1	0.03
Junkyard	15	27	1.61	3	0.19	1	0.07
Rail Yard	19	24	1.79	3	0.23	1	0.07
Bus Terminal	8	17	3.92	2	0.58	0.44	0.10

3.12.4 – Total Annual Pollutant Loadings by Land Use Category

Land Use Category	Nitrogen (lbs/yr)	% of Total Annual Watershed Loading	Phosphorus (lbs/yr)	% of Total Annual Watershed Loading	Sediment (tons/yr)	% of Total Annual Watershed Loading
Row Crops	2,177,953	95%	181,152	93%	152,213	99%
Pasture	17,561	1%	1,716	1%	194	0.13%
Urban Residential	15,422	1%	2,410	1%	377	0.24%

Land Use Category	Nitrogen (lbs/yr)	% of Total Annual Watershed Loading	Phosphorus (lbs/yr)	% of Total Annual Watershed Loading	Sediment (tons/yr)	% of Total Annual Watershed Loading
Roads	15,164	1%	2,242	1%	420	0.27%
Open Water - Pond	11,926	1%	795	0.4%	24	0.02%
Urban Open Space	8,511	0.37%	2,043	1%	84	0.05%
Forest	7,463	0.33%	800	0.41%	147	0.10%
Open Water - Stream	4,331	0.19%	381	0.20%	5	0.003%
Commercial/Retail	2,925	0.13%	417	0.21%	77	0.05%
Grassland	2,813	0.12%	522	0.27%	53	0.03%
Farm Building	2,511	0.11%	154	0.08%	30	0.02%
Wetland	2,417	0.11%	69	0.04%	9	0.01%
Residential Farm	1,782	0.08%	252	0.13%	35	0.02%
Golf Course	1,559	0.07%	303	0.16%	15	0.01%
Institutional	1,420	0.06%	177	0.09%	34	0.02%
Feed Area	1,028	0.05%	178	0.09%	11	0.01%
Open Space Road	1,016	0.04%	198	0.10%	10	0.01%
Manufacturing & Industrial	991	0.04%	130	0.07%	35	0.02%
Park	934	0.04%	224	0.12%	5	0.003%
Sod Farm	732	0.03%	81	0.04%	17	0.01%
Utilities & Communication	690	0.03%	111	0.06%	21	0.01%
Railroad	607	0.03%	103	0.05%	30	0.02%
Wholesaling & Storage	593	0.03%	91	0.05%	19	0.01%
Education	271	0.01%	38	0.02%	5	0.003%
Grain Elevator	228	0.01%	14	0.01%	3	0.002%
Confinement	168	0.01%	42	0.02%	2	0.001%
Marina/Resort	164	0.01%	22	0.01%	5	0.003%
Cultural & Entertainment	153	0.01%	22	0.01%	4	0.003%
Open Hog Lot	146	0.01%	26	0.01%	2	0.001%
Cemetery	113	0.005%	17	0.01%	1	0.001%
Mobile Homes	83	0.004%	10	0.01%	2	0.001%
Orchards and Nurseries	56	0.002%	9	0.005%	1	0.001%
Resource Extraction	28	0.001%	5	0.002%	1	0.000%
Junkyard	27	0.001%	3	0.002%	1	0.001%
Rail Yard	24	0.001%	3	0.002%	1	0.001%
Bus Terminal	17	0.001%	2	0.001%	0.44	0.000%

An analysis of model results for tile load contributions versus surface runoff loading indicates that a relatively high percentage of the overall nitrogen load is originating from tile flow. Forty-seven percent (47%) of the total watershed nitrogen load, or 1,076,848 pounds per year, is delivered to Lake Springfield through tile flow, as noted in **Table 3.12.5**. Only 4% of the total annual load, or 7,487 pounds per year of phosphorus, reaches Lake Springfield via tile flow. Tile nitrogen loading is highest in the **Upper Sugar**

Creek sub-watershed where 53% of the total annual nitrogen load can be attributed to tile flow. Tile phosphorus loading as a percentage of the overall sub-watershed load is also the highest in the **Upper Sugar Creek** sub-watershed where 5% of the total annual load is delivered to Lake Springfield. With over 1 million pounds of nitrogen per year (47%) being delivered to Lake Springfield through tile flow, the remaining 53 percent (53%) of these annual loads may be coming from surface water runoff which warrant the implementation of BMPs (grassed waterways, WASCOBs, terraces, filter strips, etc.) to keep nutrient-laden sediment from leaving agricultural fields.

TABLE 3.12.5 – TOTAL ANNUAL TILE NITROGEN AND TILE PHOSPHOROUS LOADINGS

Sub-watershed Code	Sub-watershed	Total Tile Nitrogen Load (lbs/yr)	% of Total Annual Load	Total Tile Phosphorus Load (lbs/yr)	% of Total Annual Load
071300070701	Upper Sugar Creek	186,472	53%	1,295	5%
071300070702	Panther Creek	121,106	48%	842	4%
071300070703	Lower Sugar Creek	132,668	50%	921	4%
071300070704	South Fork Lick Creek—Johns Creek	244,806	46%	1,700	4%
071300070705	Upper Lick Creek	145,053	45%	1,007	3%
071300070706	Lower Lick Creek—Polecat Creek	195,614	46%	1,367	4%
071300070707	Lake Springfield	51,129	40%	355	3%
	Total	**1,076,848**	**47%**	**7,487**	**4%**

3.13 Important Concepts

3.13.1 Total Suspended Solids

Total suspended solids (TSS) are particles that are larger than 2 microns found in the water column. Anything smaller than 2 microns (average filter size) is considered a dissolved solid. Most suspended solids are made up of inorganic materials such as silt and sediment, which can easily become suspended due to runoff, erosion and resuspension from seasonal water flow. Suspended solids are often due to natural causes. Natural solids such as bacteria and algae can also contribute to the total solids concentration. These solids include anything drifting or floating in the water, from sediment, silt and sand to plankton and algae. As algae, plants and animals decay, the decomposition process allows small organic particles to break away and enter the water column as suspended solids and contributes to the TSS concentration.

Total suspended solids are a significant factor in observing water clarity. The more solids present in the water causes less clarity of the water. When suspended solids exceed expected concentrations, they can negatively impact a body of water. Excess over background amounts are often attributed to human influence, whether directly or indirectly. Pollution may contribute to either organic or inorganic suspended solids, depending on the source. Algae, sediment and pollution will affect water quality in different ways depending on the quantity present.

Some suspended solids can settle out into sediment at the bottom of a body of water over a period of time. Heavier particles, such as gravel and sand, often settle out when they enter an area of low or no water flow. The remaining suspended solid particles that do not settle out are called colloidal solids and are either too small or too light to settle to the bottom.

Those solids that do settle to the bottom are known as bedded sediments, or bedload. These sediments can vary from larger sand and gravel to fine silt and clay, depending on the flow rate of water. Sometimes these sediments can move downstream even without rejoining the suspended solids concentration. When those solids are moved along the bottom of a body of water by a strong flow, it is called bedload transport.

Any potentially harmful substance that is added to the environment by humans, whether directly or indirectly, is considered pollution. If these pollutants are larger than 2 microns, they will contribute to the total suspended solids concentration. Some of the more common suspended solid pollutants are pathogens, wastewater effluent, sewage, airborne particulates, and road particles (e.g., asphalt and tire flecks).

Nutrients like nitrate and phosphorus are often considered pollutants. Since they are dissolved substances, they do not contribute directly to the suspended solids concentration. However, they are indirect contributors which fuel algal blooms and affect TSS and turbidity. Nitrate and phosphorus can cause eutrophication (excessive plant and algae growth) which, in turn, causes low dissolved oxygen levels due to plant respiration and microbial decomposition.

Weather, particularly heavy rainfall, also affects water flow which, in turn, affects turbidity. Rainfall can increase stream volume and, thus, stream flow, which can re-suspend settled sediments and erode streambanks.

Rain can also directly increase the level of total suspended solids through runoff. As water flows over a surface, it can pick up particles and deposit them in a body of water. Runoff can also wash away topsoil, and contribute to riverbank erosion. If the flow rate increases enough, it can re-suspend bottom sediments, further raising TSS concentrations.

3.13.2 Sediment: Runoff and Erosion

Sediment is comprised of any solid material that can be transported by water, wind or ice. It is usually defined as the soil particles (including silt, clay and sand) that are deposited on the bottom of a body of water. These particles are usually classified by size from smallest (clay) to largest (coarse sand), with silt falling somewhere in between.

In areas of high flow, even rocks can be considered sediment as they are deposited in water. However, not all sediment is suspended. The amount and size of suspended sediment is dependent on water flow. The faster the flow, the larger the particle that can be suspended. Higher flow rates can also support a higher concentration of suspended solids. Particles larger than 0.5 mm usually settle out as water flow decreases. Most of the suspended sediment that remains (colloidal solids) consists of fine sand, silt, and clay.

The majority of suspended sediment present in water bodies comes from runoff and erosion. If the land surrounding a body of water has only sparse vegetation, the topsoil can easily be washed away into the water. Highly vegetated areas will absorb most of the runoff, keeping the body of water clearer.

Runoff causes erosion, washing soil and other particulates into a body of water.

In addition to collecting suspended particles from runoff, rivers and streams can slowly erode soft riverbanks due to the constant water flow. An increase in river volume and flow (due to rain or other causes) can increase the rate of erosion. On the other side of the spectrum, bedrock-based streams may not have much sediment available to suspend. The local geology will determine natural turbidity levels based on normal flow rates, soil type, land structure and vegetation. If the surrounding land is altered by agriculture, construction or other soil-disturbing use, it can accelerate erosion and runoff, increasing turbidity. Erosion is also an issue in areas of modern farming, where the removal of native vegetation for the cultivation and harvesting of a single type of crop has left the soil unsupported. Many of these regions are near rivers and drainages. Loss of soil due to erosion removes useful farmland, adds to sediment loads, and can help transport fertilizers into the river system, which leads to eutrophication.

Human activities can accelerate the rate at which nutrients enter ecosystems. Runoff from agriculture and development, pollution from septic systems and sewers, sewage sludge spreading, and other human-related activities increase the flow of both inorganic nutrients and organic substances into ecosystems. Elevated levels of atmospheric compounds of nitrogen can increase nitrogen availability. Phosphorus is often regarded as the main culprit in cases of eutrophication in lakes subjected to "point source" pollution from sewage pipes. The concentration of algae and the trophic state of lakes correspond well to phosphorus levels in water.

Surface runoff can cause soil erosion. There are four main types of soil erosion by water: splash erosion, sheet erosion, rill erosion and gully erosion. Splash erosion is the result of mechanical collision of raindrops with the soil surface: soil particles which are dislodged by the impact then move with the surface runoff. Sheet erosion is the overland transport of sediment by runoff without a well-defined channel. Soil surface roughness may cause runoff to become concentrated, forming narrower flow paths known as rills. If runoff continues to cut and enlarge rills, they may eventually grow to become gullies. Gully erosion can transport large amounts of eroded material in a short time period.

Reduced crop productivity usually results where soil erosion is present in the crop field. Larger particles settle over short transport distances, whereas small particles can be carried over long distances suspended in the water column. Erosion of silty soils that contain smaller particles generates turbidity and diminishes light transmission, which disrupts aquatic ecosystems.

Erosion causes loss of the fertile top soil and reduces its fertility and quality of the agricultural produce. Modern industrial farming is another major cause of erosion. In some areas in the American Corn Belt, more than 50 percent of the original topsoil has been carried away within the last 100 years.

3.13.3 Land Use

Land use is a major factor in increased turbidity and total suspended solids concentrations. Construction, logging, mining and other disturbed sites have an increased level of exposed soil and decreased vegetation. Agricultural areas are also considered disturbed areas after they are tilled. Land development, whether it is agricultural or construction, disturbs and loosens soil, increasing the opportunities for runoff and erosion. The loosened soils caused by these sites can then be carried away by wind and rain to a nearby body of water, which leads to an increase in runoff rates, causing erosion and increased turbidity in local streams and lakes. Bedded sediments can be deposited on the bottom of a lake, river or stream, damaging the habitat of the animals and plants that live on or in the bottom layers of the water body. Erosion due to land use is considered a non-point source of turbidity. The use of silt fences and sedimentation basins at construction sites can prevent soils from reaching nearby water sources.

Most agricultural pollution is due to unintentional runoff, and not a specific discharge. However, it can be detrimental to water quality as these pollutants are untreated. Animal wastes can increase pathogen concentrations in the water, while the fertilizer can contribute to eutrophication and excessive algal growth.

Sediment and pollutant-filled runoff can also occur in urban areas. When it rains, soil, tire particles, debris and other solids can get washed into a water system. This often occurs at a high flow rate due to the amount of impervious surface areas (e.g., roads and parking lots). Water cannot penetrate these surfaces, so sediment cannot settle out. This stormwater runoff flows right over the pavement, carrying the suspended solids with it. Even in areas with storm drains, these drains usually lead directly to a local water source without filtration. To minimize the pollution and turbidity caused by urban runoff, stormwater retention ponds can be constructed. These basins allow suspended particles to settle before water drains downstream.

3.13.4 Resuspension

Even carp and other bottom-feeding fish can contribute to increased turbidity levels. As they remove vegetation, sediment can become re-suspended in the water. Sediment at the bottom of a body of water can be stirred up by shifting water flow, bottom-feeding fish, and human activities such as dredging. Dredging projects to remove built-up sediment in navigation channels are a major source of re-suspended sediments in the surrounding water. Dredging can cause high turbidity levels as it disturbs large amounts of settled sediment in a relatively short period of time. These stirred-up particles are mostly silt and sand and can alter habitats, smother fish eggs and suffocate bottom-dwelling organisms when they re-settle.

4.0 Watershed-based Plan Implementation

4.0 Watershed-based Plan Implementation

4.1 Problem Statement

Lake Springfield and its major tributaries, Sugar Creek and Lick Creek, are impaired for water quality.

Lake Springfield (IL_REF) is currently a 3,965-acre reservoir completed in 1935 to serve as the public drinking water supply for the City of Springfield and several surrounding communities serving approximately 165,000 retail and wholesale customers (150-square-mile service area). The Lake also provides condenser cooling water for the City's power plant complex, has a significant residential area (728 lake leases) and is a major recreational area with over 600,000 visits annually.

This 2017 LSWMP identifies potential Best Management Practices to address water quality issues in the watershed, along with benefits to be gained and estimated costs to achieve results. Regardless of progress made, many of the challenges, such as soil erosion, sedimentation and nutrient (phosphorus and nitrogen) losses from cropland surface water runoff, and farm field pesticides remain. At the same time, many of the solutions are still relevant. The following section identifies major trends and factors that will influence our efforts.

4.1.1 Nonpoint Source Pollutants

The major contributing nonpoint source pollutants affecting the water quality of Lake Springfield are sediment, nutrients (phosphorus and nitrogen) and herbicides entering from this major agricultural watershed which spans 265 square miles of highly productive soils that are intensively cropped each year.

The Lake has been on IEPA's 303(d) list for the past 20 years. The current causes of impairment listed by IEPA, which pose a threat to this drinking water source, include Phosphorus (Total), Total Suspended Solids (TSS) and Aquatic Algae. In addition, historical water quality data collected during studies from 1997 to 2002 and 2013 to 2016 indicate that total nitrogen (N) is also a significant cause of impairment for this public water supply, although it is not listed as such by IEPA.

While Lake Springfield has one of the lowest capacity loss rates for large reservoirs in Illinois at 0.26 percent per year, 137,000 tons per year of sediment has eroded from the LSW, of which an average 130,000 tons of sediment has settled in Lake Springfield each year since it was constructed (Fitzpatrick et al., 1985). By concentrating on erosion prevention through numerous cost-share programs and research projects to demonstrate and effectively practice erosion control, the erosion rate has declined by 7 percent over a 20-year period, based on the most recent sedimentation survey (Brill and Skelly, 2007).

In addition to agricultural crop production affecting the water quality and quantity of Lake Springfield, other sources of impairment include golf courses, runoff from forest, grassland and parkland, shoreline erosion, construction erosion, urban runoff, septic systems, municipal discharges and land use changes.

Its main feeder streams Sugar Creek (IL_EOA_04) (34.28 miles) and Lick Creek (IL_EOAA_01) (27.55 miles) drain approximately 153,000 acres of this 169,161-acre watershed, with the remaining watershed drainage area coming from direct tributaries to the Lake and a few small areas around the Lake. Sugar Creek has been, and is still, on the 2016 EPA 303 (d) list for Phosphorus (Total), with crop production and municipal point source discharges identified as causes of impairment. The cause of impairment for Lick

Creek is alteration in stream-side or littoral vegetative covers, with loss of riparian habitat being its primary source of impairment.

About 74 percent (124,522 acres) of the watershed is currently in agricultural crop production on land that has 0 to 2% slopes, with most of it being conventionally tilled (74%). A majority of this cropland is classified as non-highly erodible (NHEL) and no NRCS-approved conservation plans are required to participate in the USDA farm programs. To be classified as highly erodible (HEL), the field must have "C" slopes (greater than 5% slopes) on one-third of its acres. Because of the relatively flat topography (<2% slopes) in the LSW, less than seven (7) percent of this watershed's cropland is HEL.

Because of conventional tillage, excessive sedimentation from cropland surface water runoff, both HEL and NHEL, is a major contributor to contamination of the LSW's streams and the Lake.

4.1.2 Trends in Agriculture

There have been several major changes in agricultural production over the past 80 years since Lake Springfield was built. Since the 1990s, the emergence of cash rent-per-farm leases has had a significant impact on the farming community. With cash rent leases, the producer has control of the farm for that year, pays for all of the crop production expenses, and receives all of the income from the entire harvested crop, along with the USDA program payments available for that farm. Many producers who had been farming the same farm for years missed the opportunity with this shift to cash rent leases. A few "mega" farm operations emerged in the LSW as a result.

In the original 1990 LSW Resource Plan, it stated that there were 815 farms in this watershed. In 2013, SCSWCD's Resource Conservationist, using the most current GIS land use data layers, determined that there were 1,227 farms in the LSW, 693 of those farms in the Lick Creek watershed, 483 farms in the Sugar Creek watershed and 51 farms around Lake Springfield.

It is estimated that there are about 125,000 acres of cropland in the LSW. While it is very difficult to obtain information on how many operators are farming these acres each year, it is estimated that many of the medium size LSW farm operations range between 1,500 and 2,500 acres. However, there are individual farm owner/operators who farm anywhere from 40 acres and a few of the large entities farm in excess of 10,000 acres. In addition, several of these farm owner/operators have established multiple legal entities sometimes to fulfill the USDA requirements for payment limitations, for estate planning purposes or for other unknown reason.

While many of the LSW farms have remained family-owned for several generations, the current owners' only direct tie to the farm may be its ownership. Many of these farm owners, classified as absentee landowners, may have hired a farm management firm to oversee their farms and/or may have changed from the traditional 50/50 crop share lease agreements to farm cash rental agreements or a hybrid agreement such as a variable cash rental agreement. When that is the case, the operators for these farms could change annually, based on which cash rent bidder offers the highest cash rent for the farm that year, or best meets any other requirements set by the landowner. Cash rents in the LSW are significantly higher now, ranging more in the $300 to $375 per acre range. While some of these costs have been reduced a little in the past two years, so have the prices the producer receives for corn and soybeans.

Unless something specific related to implementing conservation practices is written into the farm lease, rate of return for the operator takes the lead and conservation may take the back seat. Some of the primary issues facing production agriculture today include the following:

1. There is little direct landowners' involvement in the day-to-day management of their farms.
2. Producers need to farm every acre possible to cover the cash rent payments, equipment and crop production expenses. New technological developments available for farm equipment, such as GPS positioning systems and auto steer technology have revolutionized farming in recent years. If farmers can afford this technology, they can pretty much farm 24 hours a day, weather permitting. In order to pay for this new technology, farmers, in some cases, need more acres to farm to help cover these costs.
3. New corn and soybean hybrids have become available over the last 10+ years that are modified with traits resistant to above and below-ground pests and diseases. These engineered traits drove up costs for these seeds significantly, putting additional strain on the farmers' bottom line. In 2000, seed corn prices were in the $100 per bag range (plants approximately 2.25 acres) and seed beans were around $30 a bag. The cost for planting an acre of corn was about $35 per acre and $30 per acre for beans. In 2016, seed corn with the "triple-stacked" traits was over $300 per bag and treated soybeans were in the $75 per bag range, quadrupling the seed corn costs and increasing seed beans cost by 2.5 times more than 16 years ago. While "early pay" and volume discounts may help reduce seed input costs, many farmers have to borrow money to cover these purchases.
4. Government payments (based on soil rental rates) for establishing conservation practices are not high enough to compete with cash rents per acre. There has been a significant rise in farmland prices, putting more pressure on the rate of return on investment from farming. Prime farmland in the 1990s was selling in the $3,000 per acre range and now is closer to the $12,000 per acre range. According to Gary Schnitkey from the University of Illinois Department of Agricultural and Consumer Economics, for an eight-year period (2006-2014) several of the following non-land costs have seen major increases:
    a. Seed – 164% increase from $55/acre in 2006 to $119/acre in 2014.
    b. Machinery depreciation – 230% increase from $20/acre to $66/acre.
    c. Crop insurance – 145% increase from $11/acre to $27/acre.
    d. Grain drying – 109% increase from $8/per acre to $23/acre.
    e. Fertilizer – 98% increase from $82/acre to $163/acre.
    f. Cash rent – 95% increase from $150/acre to $294/acre.
5. At the same time, crop prices have declined, and foreign competition has increased, putting pressure on farmers to put all available cropland to use. Coupled with widely fluctuating grain prices and high crop production expenses, the cost to implement conservation practices and the lack of adequate cost-share funding to help offset those costs significantly limits the producers' ability to address the resource concerns on their farms.

For the 2012 and 2013 crop years, the corn price was around the $7.00 per bushel range and soybeans were in the $13.00 per bushel range. For the 2014 and 2015 crop years, corn prices declined to the $3.50 to $4.00 per bushel range and soybeans around $9.00 to $10.00 per bushel and have remained in that same range in 2016. Corn and soybean yields were very good again in the LSW and 2017 projected crop prices are expected to remain in this similar range, which is putting a significant strain on farmers' working capital and equity.

A recent radio report from the Wall Street Journal stated that "The United States is no longer the breadbasket of the world".

- Brazil now leads the world in soybean exports.
- Brazil is a close second behind the U.S. for corn exportation.
- Russia is the leading country for wheat exports.
- One-third of the U.S. corn is used for ethanol production.
- Brazil continues to increase the number of acres of available agricultural land and still has much more land that can be put into agricultural production.
- Growing seasons in South American countries allow for year-round crop production.

6. A major shift since the 1990s from a corn/soybean rotation to multiple years of planting corn-on-corn means more fertilizer (nitrogen and phosphorus) and corn pesticide use. This is similar for chemical and fertilizer purchases. Most farmers have applied a significant amount of their nitrogen (anhydrous ammonia), phosphorus, potash fertilizer shortly after harvest on fields they know they will be farming the next year. Fertilized fields being left exposed to winter storms create the potential for nutrient runoff into waterways.
7. While utilizing more precision planting technologies, implementing the 4Rs of Nutrient Stewardship (split fertilizer applications, nitrogen inhibitor), 2.5 acre GPS grid soil sampling, variable rate technology (VRT) for fertilizer applications, and seeding cover crops are very good for water quality improvement, they all come with additional costs to the producer which may not always result in crop yield increases which will offset those extra costs. The question remains as to how long these extra costs will be sustainable to the producer.
8. Landowners continue to pattern-tile their poorly draining cropland in the LSW. While a well-drained field assures the farmer planting corn on a quicker-drying tiled field in the spring will have less long-term ponding following heavy rain events, more nitrogen and phosphorus may leave the field through those tile lines, especially if the fertilizer was already applied the previous fall, or the crop is in its infancy and cannot utilize the amount of fertilizer readily available for the crop.
9. Grain marketing has become a real challenge for farmers. Weather, global crop production, speculators, value of the US dollar and price of oil are some of the factors that can affect grain prices on a daily basis. Unlike most businesses, farmers cannot price their grain like businesses which can set the price of the items they are selling to include enough markup to guarantee them a profit. Farmers are at the mercy of the market. They have to determine their break-even price, factoring all incurred expenses, and then try to find the right time to market that grain for a profit.
10. The 2014 Farm Bill eliminated direct payments for corn acres and instituted a new program which shifts payments based on 10-year crop farm yield averages and average county rate-based prices. Agricultural Risk Coverage (ARC) or Price Loss Coverage (PLC) replaced direct farm payments to

provide a safety net similar to crop insurance. Producers cannot count on this income when creating budgets and preparing financial statements for the financial lending institutions. Lenders may require more certainty by demanding additional collateral as security for farm loans. For highly leveraged farmers without a considerable amount of equity, this situation may force them to quit farming.

11. With the development of Roundup Ready seed corn and seed beans, herbicide costs have decreased. However, some invasive weeds such as mare's tail, water hemp and palmer amaranth are becoming resistant to the Roundup herbicide and can significantly affect crop yields, if not controlled.

4.1.3 Urban Issues

While urban issues may not be affecting the water quality as significantly as agricultural issues, they still need to be addressed. Approximately seven (7) percent of the land in the LSW is classified as urban, with a large portion of it being in the Lake Springfield sub-watershed and around the Lake. The urban communities must be educated as to how and why their day-to-day activities are affecting the water quality throughout this watershed. With continued involvement in the LSW planning process by members of the SLSIA, Lake Springfield residents are helping spread the message of water quality improvement by all the people in this watershed. However, this education and outreach effort needs to be more widespread.

4.1.4 Messaging

Positive and accurate messages about what has been done and is currently being done to improve water quality in this watershed are not reaching enough of the general public. Recent fear-mongering newspaper articles (i.e., Illinois Times "Too Much Phosphorus in Lake Springfield"), and opinions expressed in "letters-to-the-editor" in local newspapers and through other media outlets do not always include accurate information and have a tendency to accentuate the negative issues, even when the authors may also be privy to the positive side (successes) of the story.

4.2 Key Inputs

Goals and objectives for this watershed-based management plan were determined by the following:

1. Results from the LSW stakeholders' 2015 survey and public input meeting on June 10, 2015.
2. Input from those who attended LSWRPC meetings held since January 2012, when a revitalization of this committee began.
3. Historical review of the LSW since the adoption of the 1990 LSW Plan.
4. Review and dissemination of the watershed resource inventory information compiled by Northwater Consulting.
5. BMP implementation recommendations from Northwater Consulting and NRCS based on nutrient load reductions, site-specific inventory and evaluations by NRCS and SWCD staff, cost estimates, and available cost-share funding sources.
6. BMP implementation recommendations for phosphorus and nitrogen from Illinois' Nutrient Loss Reduction Strategy, in which the Lake Springfield Watershed is one of seven KIC priority watersheds designated in the NLRS.

7. IEPA's 2016 TMDL Stage 3 Report for Lake Springfield and Sugar Creek Watershed (See APPENDIX D) as defined in Section 9 Implementation Plan for BMPs to address nonpoint source pollution affecting the aesthetic quality and aquatic life designated uses in the following impaired waterbodies:
    a. Lake Springfield - total suspended solids, total phosphorus (and aquatic algae).
    b. Sugar Creek Impaired Segment IL_EOA_04 – total phosphorus.
8. While the Lick Creek tributary (EOAA_01) is not part of the 2016 Stage 3 TMDL Report, it is now listed on IEPA's 2016 303 (d) list for aquatic life designated use caused by dissolved oxygen, along with Sugar Creek (IL_EOA_04) and Lake Springfield (IL_REF). Any BMP implementation and outreach and education activities will be included in this LSWMP for the Lick Creek (IL_EOAA_01) watershed area as well.

4.3 Goals and Objectives

This plan identifies more than 45 watershed-wide BMPs that can be implemented to help meet water quality and natural resource goals set forth in Table 4.3.1. The LSWRPC supports the implementation of these BMPs to protect and improve the water quality throughout the watershed (see Section 4.6.1). Ultimate goals to be reached through implementation of BMPs outlined in the LSWMP for the Lake Springfield Watershed are:

5. Meet the 45% reduction goal for nitrogen and phosphorus, as outlined in Illinois' Nutrient Loss Reduction Strategy.
6. Meet IEPA's Total Maximum Daily Loads (TMDLs) and Load Reduction Strategy for Phosphorus (P) in Lake Springfield (IL_REF) and Sugar Creek (IL_EOA-04).
7. Meet IEPA's TMDL for total suspended solids (TSS) and aquatic algae in Lake Springfield.
8. Become a success story by being removed from IEPA's 303(d) list for total phosphorus, total suspended solids, aquatic algae and dissolved oxygen in Lake Springfield and its watershed.

Objectives necessary to accomplish these goals:

1. Reduce surface water runoff from farm fields.
2. Identify and secure stable cost-share funding sources for implementation of Best Management Practices (BMPs).
3. Improve environmental education and outreach efforts to the public.
4. Reduce urban stormwater runoff.
5. Improve groundwater quality.
6. Enhance the quality and quantity of wildlife habitat.
7. Promote prime farmland preservation and protection.
8. Support controlled urban development.
9. Restore and improve aquatic habitat.
10. Improve recreational opportunities.

TABLE 4.3.1—PLAN GOALS

#1 - Reduce surface water runoff from farm fields				
Priority	**Critical Areas**	**Criteria for Selection**	**BMP Priorities**	
High	Farm fields adjacent to streams and Lake All highly erodible fields All conventional-tilled fields Concentrated flow areas High volume surface water runoff areas Gully erosion areas	# of Conventional-tilled fields High % cropped HEL soils High per-acre sediment loads into Lake Springfield	No-till/strip-till Filter strips Field borders Cover crops	Detention/retention basins WASCOBs/terraces Grassed waterways
# 2- Reduce nutrient (phosphorus and nitrogen) runoff				
Priority	**Critical Areas**	**Criteria for Selection**	**BMP Priorities**	
High	Continuous corn fields Conventionally-tilled fields Failing septic systems (rural and urban) High volume surface runoff areas Infiltration limiting soils Livestock waste areas Municipal wastewater discharges Streambank and shoreline erosion Tile-drained land Urban and rural stormwater runoff	# of conventional-tilled fields High % cropped HEL soils # of private septic systems High % of infiltration limiting soils Lack of affluent analysis from waste treatment facilities Poor pasture management Lack of livestock exclusion systems High nutrient levels in stream and Lake water samples	Cover crops Field borders Filter strips Grassed waterways Livestock exclusion systems Livestock waste management	Pasture management systems No-till/strip-till/mulch-till Nutrient management plans WASCOBs Wetlands
#3 – Meet IL Nutrient Loss Reduction Strategy (NLRS) 45% nutrient reduction goals **#4 – Meet TMDL water quality standards for phosphorus, total suspended solids and algae**				
High	Continuous corn fields Conventional-tilled cropland	High nutrient levels in stream sampling	Bioreactors Drain Water Management	Nutrient management Saturated buffers

	HEL cropland near streams Livestock areas near streams Gully erosion areas Tile-drained land Municipal wastewater discharges Livestock waste areas	# of failing septic systems Conventional-tilled fields	Detention/retention basins Cover Crops Livestock waste management Livestock exclusion systems	Shoreline stabilization Streambank stabilization Wetlands
#5 – Reduce urban stormwater runoff				
Priority	**Critical Areas**	**Criteria for Selection**	**BMP Priorities**	
Medium	Urban commercial/residential areas High volume surface runoff areas Failing septic systems Shoreline erosion Impervious pavements Lawn fertilizer applications Urban construction areas	Urban development near Lake Potential urban sprawl	Detention/retention basins Rain barrels/rain gardens Urban filter strips Urban stream stabilization	Urban wetlands Woodland management

4.4 Use Impairments of Water Resources

Designated uses for Lake Springfield and the Sugar Creek Watershed are the General Use and Public Food Processing Water Supplies Use. The Illinois Pollution Control Board defines the General Use classification as standards that "will protect the State's water for aquatic life, wildlife, agricultural use, secondary contact use and most industrial uses and ensure the aesthetic quality of the State's aquatic environment." The Public and Food Processing Water Supplies is defined by the IPCB as standards that are cumulative with the general use standards of Subpart B and must be met in all waters designated in Part 303 at any point at which water is withdrawn for treatment and distribution as a potable supply or for food processing. (July, 2016 Stage 3 TMDL Report).

IEPA designated use impairments include:

Lake Springfield (IL_REF) – Aesthetic Quality

Sugar Creek (IL_EOA_04) – Aquatic Life

Lick Creek (IL_EOAA_01) – Aesthetic Quality

4.5 Cause and Sources of Impairments/Identified Critical Areas

Lake Springfield (IL_REF), Sugar Creek (IL_EOA_04) and Lick Creek (IL_EOAA_01) have been identified as medium priorities in Appendix A-1 Illinois' 2016 EPA 303(d) List and Prioritization.

For the 3,965-acre Lake Springfield (IL_REF), one of the causes of impairment is **Total Suspended Solids** (TSS) for the **Aesthetic Quality** designated use. While not generally health-related, the aesthetic quality of drinking water, including taste, odor, color, turbidity, salinity, hardness, softness and temperature, can be easily detected by consumers and have significant effects on perceptions of water quality and acceptability.

Another cause of impairment for the **Aquatic Life** designated use is **Oxygen (Dissolved)** which is an essential factor for sustaining aquatic life. Humans need air to breathe and aquatic organisms need dissolved oxygen to respire. It is necessary for the survival of fish, invertebrates, bacteria, and underwater plants. It is also needed for the decomposition of organic matter. Sources of impairment include crop production, golf courses, runoff from forest/grassland/parkland, littoral/shore area modifications and other recreational pollution sources.

The causes of impairment for the **Aquatic Life** designated use in the 34.28-milesegment of Sugar Creek (IL_EOA-04) are **Phosphorus (total)** and **Oxygen (Dissolved)**, with two known sources of impairments being crop production and municipal point source discharges.

The 27.55-mile segment of Lick Creek's (IL_EOAA_01) cause of impairment is **Oxygen (Dissolved)** for the **Aquatic Life** designated use. Alteration in stream-side or littoral vegetative covers (loss of riparian habitat) is the potential source of impairment.

4.6 Best Management Practices to Achieve Water Quality and Natural Resource Objectives

Watershed-wide Best Management Practices

Below are the BMPs which will most effectively achieve the water quality and natural resource objectives in the LSW now and well into the future. The LSWRPC supports the implementation of these BMPs to protect and improve the water quality throughout the watershed. The list is not all-inclusive; additional BMPs found in the NRCS Field Office Technical Guide and Illinois Urban Manual are also appropriate and recommended after a site investigation and on a site-by-site basis. In addition, the LSWRPC supports the investigation and application of new and retrofitted BMPs to accomplish water quality protection in the most effective and efficient manner possible. In some cases, more extensive studies will need to be completed and analyzed before establishing a few of these practices.

This LSWMP strongly encourages that BMPs implemented in this watershed meet the most current NRCS technical standards and specifications, whether surveyed and designed by NRCS technical staff, NRCS-approved Technical Service Providers (TSP) or Professional Engineers (PE). The Illinois Urban Manual can also serve as the guide for implementation of urban BMPs.

An overview of these watershed-wide BMPs follows in **Table 4.6.1**. A detailed guide is found in Section 4.7.

The BMPs listed, with corresponding NRCS Conservation Practice Standard (CPS) Codes and Illinois Urban Manual (IUM) Practice Standard Codes for potential implementation include:

47. Bioreactors (Denitrifying)—CPS 605
48. Bioswales (Grass Lined Channels)—IUM 840
49. Brush management—CPS 314
50. Commercial and residential/detention basins (Stormwater Runoff Control)—CPS 570
51. Conservation tillage, residue and tillage management, reduced till – CPS 345
52. Cover crops—CPS 340
53. Critical area planting—CPS 342
54. Diversion—CPS 362
55. Drainage water management—CPS 554
56. Field borders—CPS 386
57. Filter strips—CPS 393
58. Filter strips (urban)—IUM 835
59. Grade stabilization structures (concrete/aluminum toe wall, block chute, etc.)—CPS 410
60. Grade control structures (stream channel/streambank, riffles, J-hook, etc.) (Channel Bed Stabilization—CPS 584)
61. Grassed waterways—CPS 412
62. Green roofs
63. Livestock alternative watering systems—CPS 516, 614, 642
64. Livestock exclusion fence —(Fence) CPS 382

65. Livestock feed area waste management systems (waste storage, waste transfer, waste treatment)—CPS 313, 634, 629
66. Livestock pasture and prescribed grazing management—CPS 528
67. Livestock shelter structure (loafing sheds, feeding stations, etc.)—CPS 576
68. Livestock stream crossing (Stream Crossing)—CPS 578
69. Nutrient management —CPS 590
70. Permanent vegetative cover (Conservation Cover)—CPS 327/IUM 880
71. Ponds—CPS 378
72. Pond sealing or lining bentonite treatment—CPS 520,521 A, 522
73. Porous/permeable pavement—IUM 890
74. Residential rain barrels and rain gardens—IUM 897
75. Residue and tillage management: no-till/strip-till/direct seeding—CPS 329
76. Residue and tillage management: reduced-till—CPS 345
77. Riparian forested buffers—CPS 391
78. Roofs and covers—CPS 367
79. Saturated buffers—CPS 604
80. Sediment basins – in-field, low flow/in-lake dams—CPS 350
81. Streambank/lake shoreline stabilization/stream corridor improvement—CPS 580
82. Streambank stabilization (structural)—IUM 940
83. Subsurface drain—CPS 606
84. Surface drain, main or lateral—CPS 608
85. Terraces—CPS 600
86. Tree and forest ecosystem preservation—IUM 984
87. Tree/shrub establishment—CPS 612
88. Tree and shrub planting (urban)—IUM 990A and B
89. Water and Sediment Control Basins (WASCOBs)—CPS 638
90. Well decommissioning—CPS 351 and IUM 996
91. Wetlands – constructed—CPS 658, 659, 657
92. Wetlands – urban stormwater—IUM 997, 998, 999

Additionally, an inventory of seven watershed studies and surveys that are needed to supplement the LSWMP include:

- Gully erosion
- Private septic systems and water wells
- Retention/detention basins (rural and urban)
- Streambank and channel bed study
- Subsurface drainage systems
- Tillage operations
- Urban expansion

TABLE 4.6.1 – WATERSHED-WIDE BEST MANAGEMENT PRACTICES

Best Management Practice NRCS Conservation Practice Standard (CPS) Code Illinois Urban Manual Practice Standard (IUM)	Description	Watershed Benefit
1. Bioreactors (Denitrifying) —CPS 605	A bioreactor is an edge-of-field treatment process which allows the producer to reduce the amount of nitrogen leaving the field from a tile line, improving water quality of the receiving stream. It consists of a buried pit filled with a carbon source, commonly wood chips, through which tile water is diverted. The carbon provides material which serves as a food source for microorganisms.	In the low-oxygen environment, the microbes use the nitrate to metabolize the carbon, converting the nitrate to harmless atmospheric nitrogen (N2) gas.
2. Bioswales (Grass Lined Channels) —IUM 840	A bioswale is a stormwater runoff delivery system that provides an alternative to storm sewers which can absorb low flows or carry runoff from heavy rains to storm sewer inlets or directly to surface waters.	Improves water quality by infiltrating the first flush of stormwater runoff and filtering water from large storm flows.
3. Brush management —CPS 314	The management or removal of woody (non-herbaceous or succulent) plants, including those that are invasive and noxious.	Create the desired plant community consistent with the ecological site. Maintain, modify or enhance fish and wildlife habitat. Improve forage accessibility, quality and quantity for livestock and wildlife. Manage fuel loads to achieve desired conditions.

Best Management Practice NRCS Conservation Practice Standard (CPS) Code Illinois Urban Manual Practice Standard (IUM)	Description	Watershed Benefit
4. Commercial and residential/detention basins (Stormwater Runoff Control)—CPS 570	Detention basins have an orifice level with the bottom of the basin so that all of the water eventually drains out and it remains dry between storms. They are a cost-effective way to provide temporary stormwater runoff storage.	Help alleviate local flooding by reducing peak rate of runoff into storm sewers and streams. Provide water quality benefits, reduce erosion, alleviate local flooding, can provide wildlife habitat.
5. Conservation tillage, residue and tillage management, reduced till —CPS 345	Manage the amount, orientation and distribution of crop and other plant residue on the soil surface year-round while limiting soil-disturbing activities used to grow and harvest crops in systems where the field surface is tilled prior to planting.	Reduce sheet, rill and wind erosion and sedimentation of surface waters, reduce particulate emissions, improve soil health and improve organic matter content, reduce energy use.
6. Cover crops—CPS 340	Cover crops are close-growing crops that can adequately protect the soil during the months following harvest through early spring (mid-October through early April) when soil is most vulnerable to soil erosion. For livestock producers, planting palatable cover crop species can also provide a supplemental forage for feeding their animals, while still providing protection for the soil.	Improve soil health, increase nutrient recycling, keep ground covered during critical erosion periods, protect water quality, reduce winter annual weed competition, reduce pests, and reduce compaction and erosion.
7. Critical area planting —CPS 342	The establishment of permanent vegetation on sites that have, or are expected to have, high erosion rates, and on sites that have physical,	Stabilize stream banks and shorelines, stabilize areas of high erosion, due to water or wind, and rehabilitate degraded sites.

Best Management Practice NRCS Conservation Practice Standard (CPS) Code Illinois Urban Manual Practice Standard (IUM)	Description	Watershed Benefit
	chemical or biological conditions that prevent the establishment of vegetation with normal practices.	
8. Diversion—CPS 362	A water diversion is a channel generally constructed across the slope with a supporting ridge on the lower side.	Reduce erosion and runoff, reduce damage from upland runoff, break up concentrations of water on long slopes, undulating land surfaces and land too flat or irregular for terracing.
9. Drainage water management —CPS 554	The process of managing the drainage volume and water table elevation by regulating the flow from a surface or subsurface agricultural drainage system.	Reduce nutrient, pathogen and pesticide loading into downstream receiving waters, improve health of plants, and reduce oxidation of soil organic matter.
10. Field borders —CPS 386	A strip of permanent vegetation established at the edge or around the perimeter of a field, sometimes consisting of timber or native plants.	Reduce erosion, protect soil and water quality, manage pests, provide habitat and increase carbon storage, improve air quality.
11. Filter strips—CPS 393	A band of grass or other permanent herbaceous vegetation used to absorb sediment, nutrients, pesticides, and other sediment-adsorbed contaminants.	Reduce suspended solids and associated contaminants, reduce dissolved contaminant loadings, and reduce suspended solids and contaminants in irrigation tailwater.
12. Filter strips (urban)—IUM 835	A created or preserved area of vegetation designed to remove sediment and other pollutants and to enhance the infiltration of surface water runoff.	Reduce runoff quantities from impervious surfaces by infiltrating it into the ground.
13. Grade stabilization structures (concrete/aluminum toe wall, block chute, etc.)—CPS 410	An earthen, wooden, concrete, aluminum or other type of structure built across a drainage way that prevents gully erosion.	Often used at the outlet of a grassed waterway to stabilize the waterway outlet, prevent gully erosion.

Best Management Practice NRCS Conservation Practice Standard (CPS) Code Illinois Urban Manual Practice Standard (IUM)	Description	Watershed Benefit
14. Grade control structures (stream channel/streambank, riffles, J-hook, etc.) (Channel Bed Stabilization—CPS 584)	A grade stabilization structure is used to control the grade in natural or constructed channels. A rock riffle is a channel bed stabilization structure placed in a shallow section of a stream or river with rapid current and a surface broken by various sizes of rock.	Constructed to stabilize grade, reduce erosion, prevent upstream head cutting and improve water quality.
15. Grassed waterways —CPS 412	A grassed strip in fields that acts as an outlet for water to control silt, filter nutrients and limit gully formation.	Reduce erosion in a concentrated flow area, such as in a gully or in ephemeral gullies, and reduce sediment and nutrients delivered to receiving waters.
16. Green roofs	A roof of a building that is partially or completely covered with vegetation and a growing medium, planted over a waterproofing membrane. It may also include additional layers, such as a root barrier and drainage and irrigation systems.	Improve water quality by reducing runoff, conserve energy, mitigate the urban heat island, increase longevity of roof, reduce noise and air pollution, sequester carbon, increase habitat, provide space for urban agriculture.
17. Livestock alternative watering systems —CPS 516, 614, 642	Watering systems for grazing livestock on pasture or in a barn can include several alternatives such as moveable hard plastic, aluminum or concrete water tanks, wells, automatic waterers with buried pipelines, pond-fed, etc.	Keeping livestock from surface water can improve water quality and groundwater protection.
18. Livestock exclusion fence —(Fence) CPS 382	A system of permanent fencing installed to exclude livestock from streams and critical areas not intended for grazing to improve water quality.	Improve water quality, reduce soil erosion of streambanks, limit amount of manure entering the water body.

Best Management Practice NRCS Conservation Practice Standard (CPS) Code Illinois Urban Manual Practice Standard (IUM)	Description	Watershed Benefit
19. Livestock feed area waste management systems (waste storage, waste transfer, waste treatment) —CPS 313, 634, 629	A livestock feed area waste system includes three individual practices working in series: settling basin to capture solids, rock spreader and vegetated swale for initial waste treatment, treatment wetland to capture and treat remaining waste.	Improve water quality by limiting amount of manure entering adjacent water bodies.
20. Livestock pasture and prescribed grazing management—CPS 528	The controlled harvest of vegetation with grazing animals managed with the intent to achieve a specific objective.	Improve water infiltration, protect streambanks from erosion, and manage for deposition of fecal material away from water bodies.
21. Livestock shelter structure (loafing sheds, feeding stations, etc.)—CPS 576	A permanent or portable structure with less than four walls and/or a roof to provide for improved utilization of pastureland and rangeland and to shelter livestock from negative environmental factors, and is not to be construed to be a building.	Protect surface waters from nutrient and pathogen loading. Protect wooded areas from accelerated erosion and nutrient deposition.
22. Livestock stream crossing (Stream Crossing) —CPS 578	A livestock stream crossing provides a hard, stable area where livestock and/or equipment can cross a stream without damaging the streambed or banks	Provide livestock access, keeps water cleaner, improved cattle health.
23. Nutrient management —CPS 590	Managing the amount (rate), source, placement (method of application) and timing of plant nutrients and soil amendments.	Reduces input costs and protects water quality by preventing over-application of commercial fertilizers and animal manure.
24. Permanent vegetative cover (Conservation Cover)	A small area or field can be converted from agricultural use to native grasses or timber.	Reduce soil erosion and sedimentation, improve air, soil and water quality, enhance habitat, and manage plant pests.

Best Management Practice NRCS Conservation Practice Standard (CPS) Code Illinois Urban Manual Practice Standard (IUM)	Description	Watershed Benefit
—CPS 327/IUM 880		
25. Ponds—CPS 378	A water impoundment created by constructing an embankment or by excavating a pit or dugout. Ponds are classified as embankment ponds if the depth of water impounded against the embankment at the auxiliary spillway elevation is three feet or more.	Provide water for livestock, fish and wildlife, recreation, fire control, maintain or improve water quality.
26. Pond sealing or lining bentonite treatment —CPS 520,521 A, 522	To reduce seepage losses from ponds or waste treatment impoundments for water conservation and environmental protection.	Reduce seepage rates and impede migration of contaminants.
27. Porous/permeable pavement —IUM 890	Paving that allows stormwater to seep into the ground as it falls rather than running off into storm drains and waterways	Limit runoff at the source, reduce downstream erosion, and improve water quality by filtrating pollutants.
28. Residential rain barrels and rain gardens—IUM 897	**Rain barrels** hold rainwater from residential roof runoff. They work in conjunction with gutter systems to capture rain and store it for future outdoor use. **Rain gardens** are shallow depressional areas (4 to 8” deep) strategically located and landscaped with vegetation that allows rainwater runoff from impervious urban areas (roofs, driveways, walkways, parking lots, compacted lawn areas) to be absorbed.	Intercept runoff from impervious surfaces, conserve water for future use.

Best Management Practice NRCS Conservation Practice Standard (CPS) Code Illinois Urban Manual Practice Standard (IUM)	Description	Watershed Benefit
29. Residue and tillage management: no-till/strip-till/direct seeding—CPS 329	Managing the amount, orientation and distribution of crop and other plant residue on the soil surface year round, limiting soil-disturbing activities to those necessary to place nutrients, condition residue and plant crops.	Increases the amount of water that infiltrates into the soil and increases organic matter retention and cycling of nutrients.
30. Residue and tillage management: reduced-till—CPS 345	Managing the amount, orientation and distribution of crop and other plant residue on the soil surface year round, limiting soil-disturbing activities to those necessary to place nutrients, condition residue and plant crops	Reduce sheet and rill erosion, reduce wind erosion, improve soil quality, increase plant-available moisture, and reduce energy use.
31. Riparian forested buffers—CPS 391	An area predominantly trees and/or shrubs located adjacent to and up-gradient from watercourses or water bodies.	Maintain water temperatures to improve aquatic habitat, reduce amounts of sediment, organic material, nutrients and pesticides in surface runoff and ground water flow.
32. Roofs and covers—CPS 367	A rigid, semi-rigid or flexible manufactured membrane, composite material, or roof structure placed over a waste management facility, agri-chemical handling facility or an on-farm secondary containment facility.	Protect clean water from dilution in waste water and protect nearby surface water quality, capture biogas emissions.

Best Management Practice NRCS Conservation Practice Standard (CPS) Code Illinois Urban Manual Practice Standard (IUM)	Description	Watershed Benefit
33. Saturated buffers—CPS 604	A saturated buffer is a conservation drainage practice which removes nitrates from subsurface drainage water at low cost without affecting farm field drainage. Instead of water flowing through the tile straight to an outflow point, water is directed to a lateral tile which runs parallel to a ditch. A vegetative buffer zone (minimum 30-foot vegetative strip) is created at the edge of the field above this lateral tile, which takes up the water and nutrients in the water, before it leaves the field.	Reduce nitrate loading to surface water from subsurface drain outlets. Enhance saturated soil conditions in waterways and wetlands.
34. Sediment basins – in-field, low flow/in-lake dams—CPS 350	A basin constructed with an engineered outlet, formed by an embankment or excavation or a combination of the two, with a purpose to capture and detain sediment-laden runoff or other debris for a sufficient length of time to allow it to settle out in the basin.	Intercept runoff from disturbed areas. Minimize the number of entry points for runoff entry into the basin.
35. Streambank/lake shoreline stabilization/stream corridor improvement—CPS 580	Treatment(s) used to stabilize and protect banks of streams or constructed channels, in addition to shorelines of lakes, reservoirs or estuaries.	Prevent loss of land due to erosion, maintain the flow capacity of streams and channels, reduce downstream or offsite effects of sedimentation, improve habitat.
36. Streambank stabilization (structural)—IUM 940	Streambank stabilization of eroding streambanks by using designed structural measures is for the protection of these areas from erosive forces of flowing water.	Prevent loss of land due to erosion, maintain the flow capacity of streams and channels, reduce downstream or offsite effects of sedimentation, improve habitat.

Best Management Practice NRCS Conservation Practice Standard (CPS) Code Illinois Urban Manual Practice Standard (IUM)	Description	Watershed Benefit
37. Subsurface drain —CPS 606	A subsurface drain is a conduit installed beneath the ground surface to collect and/or convey excess water as part of a resource management system.	Remove or distribute excessive soil water, remove salts or other contaminants from the soil profile.
38. Surface drain, main or lateral —CPS 608	An open drainage ditch for moving the excess water collected by a field ditch or subsurface drain to a safe outlet.	Convey excess surface or shallow subsurface water to a safe outlet, provide flood prevention.
39. Terraces—CPS 600	A terrace is an earth embankment, or a combination ridge and channel, constructed across the field slope.	Reduce erosion by reducing slope length, retain runoff or moisture conservation.
40. Tree and forest ecosystem preservation—IUM 984	The preservation of contiguous stands of trees from damage during construction operations for the purpose of preserving contiguous forested areas and stands of trees that have present and future value.	Erosion protection, wildlife habitat, landscape aesthetics.
41. Tree/shrub establishment—CPS 612	Establishing woody plants by planting seedlings or cuttings, direct seeding or natural regeneration.	Provide habitat, control erosion, treat waste, store carbon, reduce energy use and promote renewable energy, restore diversity, enhance aesthetics.
42. Tree and shrub planting (urban) —IUM 990A and B	Planting of selected trees and shrubs for the purpose of conserving soil, providing shade, aesthetics.	Protect soil from erosion, beautification, provide windbreaks, reduce noise levels, provide habitat.
43. Water and Sediment Control Basins (WASCOBs)—CPS 638	An embankment and/or channel constructed across a slope to intercept runoff water and/or control water runoff to control formation of rill and gully erosion by breaking	Reduce watercourse and gully erosion, trap sediment and reduce and manage onsite and downstream runoff.

Best Management Practice NRCS Conservation Practice Standard (CPS) Code Illinois Urban Manual Practice Standard (IUM)	Description	Watershed Benefit
	longer slopes into smaller segments.	
44. Well decommissioning —CPS 351 and IUM 996	The sealing and permanent closure of a water well, boring or monitoring well.	Prevent entry of contaminated surface water into the well and migration of contaminants into the unsaturated or saturated zone. Prevent the comingling of chemically or physically different ground waters between separate water-bearing zones.
45. Wetlands – constructed —CPS 658, 659, 657	A constructed wetland is a shallow maximum 2-foot water depth area (except in those instances where deep water areas are included as a special design) constructed by creating an earth embankment or excavation.	Remove nutrients, pesticides and bacteria from surface waters, collect sediment from runoff water, reduce soil erosion, and recharge groundwater supplies.
46. Wetlands – urban stormwater —IUM 997, 998, 999	A constructed system of shallow pools that creates growing conditions suitable for emergent and riparian wetland plants explicitly designed to lessen the impacts of stormwater quality and quantity in urban areas.	Maximize pollutant removal, provide temporary storage of urban stormwater runoff.

Targeted Best Management Practices, Expected Load Reductions and Costs

In addition to those recommended watershed-wide BMPs described in Section 4.6.1, an analysis of land use was completed to identify target areas for BMPs that can be applied throughout the watershed in critical areas. Although these BMP recommendations are location/land use-specific, they have not necessarily been field verified. Some of these practices include: residential rain barrels, rain gardens, permeable pavement and detention, commercial and institutional detention, nutrient management, no-till, and waste management for concentrated feed areas.

Table 4.6.2 summarizes expected annual load reductions if all of the Targeted BMPs presented in this section were installed, as well as the percent reduction compared to the total annual watershed nutrient and sediment load. If all BMPs are implemented throughout the watershed, a 47% reduction in nitrogen, a 51% reduction in phosphorus and a 56% reduction in sediment load can be achieved. Widespread adoption of field borders, filter strips and addressing conventional tillage, especially on HEL ground, are likely the most realistic practices that will achieve the greatest percent reductions to nutrient and sediment loads in this watershed.

The most efficient and effective implementation of this plan is to implement target BMPs where they do most good in the reduction of sediment, phosphorus and nitrogen. The LSWMP encourages landowners to install the BMPs listed in the watershed-wide section of the plan.

The entire list of targeted BMPs follows:

24. Bioreactors
25. Cover crops
26. Detention/retention basins/ponds
27. Detention/retention at commercial/retail business sites
28. Drainage water management
29. Field borders
30. Filter strips
31. Riparian forest buffers
32. Grade stabilization structures, in-field
33. Grade control structures - channel bed stabilization – rock riffles
34. Grassed waterways
35. Livestock feed area waste systems (multiple BMPs may be included)
36. Nutrient management
37. Residue and tillage management—no-till/strip-till/direct seeding
38. Residue and tillage management – reduced-till
39. Residential rain barrels, rain gardens, detention basins, porous/permeable pavement
40. Permanent vegetative cover
41. Saturated buffers
42. Sediment basins/In-lake, low-flow dams
43. Streambank/lake shoreline stabilization
44. Terraces
45. Water and Sediment Control Basins (WASCOBs)
46. Wetlands – constructed

The total estimated cost for implementing all watershed project recommendations is approximately $143,457,865. Fifty-seven percent (57%) of the total cost can be attributed to installing rain barrels or some form of retention/detention on all recommended residential areas lacking stormwater retention/detention BMPs and 19% can be attributed to recommended commercial retention/detention BMPs within the watershed; 76% of the entire cost estimate presented is captured by residential and commercial retention/detention.

Total cost represents the actual cost, including engineering and design and maintenance in some cases. Actual costs do not necessarily represent costs based on program incentive payments which, often times, only cover a percentage of the actual cost. Cost assumptions presented below are based on average costs through the Sangamon County SWCD, the NRCS, other Illinois counties and professional judgment. No costs have been estimated for septic systems due to the uncertainty in the total number of systems requiring maintenance; major septic system repairs can easily exceed $10,000. A breakdown of cost estimates for BMPs is presented in **Table 4.6.3**, using the following assumptions:

1. **Bioreactors** cost an estimated $50.00 per cubic yard to install, including labor and materials. This figure, which is somewhat higher than the $43.96 per cubic yard NRCS cost estimate, is based on input from a local drainage contractor in McLean County. Based on a surface area of 20' x 50' and a 4' depth, the cost is estimated to be about $7,500 for a system sized to treat 50 acres.
2. **Commercial Detention/Retention Basins (Ponds)**[15]
3. **Cover crops** costs are based on Sangamon County SWCD rates and are assumed to cost $66.67 per acre, on average.
4. **Drainage Water Management** was estimated to cost $161.60 per acre for installation to retrofit an existing tile system, using the estimates obtained from the Agricultural Watershed Institute in Macon County.
5. **Grass/Shrub/Tree Plantings** based on NRCS cost-share rates which include land preparation, materials and seeding.
6. **Filter strips** and **field borders** costs are calculated at $700 per acre. Costs are generated using NRCS cost-share rates and include land preparation, materials and seeding. Estimates do not include any annual rental payments or land acquisition costs.
7. **Grassed waterways** assume a cost of $3,704 per acre and are based on Sangamon County SWCD average cost rates for earth work and seeding. However, most of these grassed waterways will also require installation of tile which, based on tile size, could increase the project cost.
8. **Lake shoreline and streambank stabilization** is estimated to cost $40 per foot, based on assuming approximately 0.75 tons per lineal foot of stream bank and/or weir, at approximately $53 per ton placed. Streambank stabilization estimates also assume 1 rock riffle per 1,000 feet at $8,000 each.
9. **Livestock feed area waste system** costs are based on professional judgment at a cost of $30,000 per facility.

[15] Cost estimates for some of these BMPs will be prepared when they are selected for implementation.

10. **No-till** costs are based on Sangamon County SWCD rates and are assumed to cost $33.33 per acre, on average.
11. **Nutrient management plan development** costs are estimated to be $16.00 an acre, based on the Sangamon County SWCD rates.
12. **Pasture management** includes a combination of costs for multiple practices. **Livestock exclusion fencing** is based on professional judgment and NRCS rates at a cost of $3.00 per foot. **Livestock stream crossings** are based on professional judgment and NRCS rates at a cost of $8,000 per crossing. **Livestock alternative water systems** are based on professional judgment and NRCS rates at an average cost of $15,000/system. **Water diversions** use the same cost noted for WASCOBS, or $2,000/structure. Wetlands use the same cost previously calculated at $10,500/ac. Riparian buffers use the same cost noted for filter strips, or $700.00 per acre. Retention/detention basins use professional judgment and are estimated at $30,000 each.
13. **Permanent vegetative cover** based on NRCS cost-share rates which include land preparation, materials and seeding.
14. **Residential rain barrels, rain gardens and urban retention/detention systems** are estimated at four times the treatment area, or four per acre. Each acre assumes eight 60-gallon rain barrels and four rain gardens or retention/detention systems. Assumed costs are $80 for rain barrels and $4,000 for each rain garden or retention/detention system which is based on a 20-square-foot basin using SWCD average costs of $10.00 per square-foot.
15. **Retention/detention basins or ponds** costs are based on site conditions and professional judgment/experience, and are estimated at $50,000 each, including engineering and design costs.
16. **Rock riffles** and **stream grade control structures** costs are based on professional judgment and field experience, and total $8,000 per individual structure, including engineering and design.
17. **Saturated buffers** are estimated to cost approximately $4,000 per installation; including plastic drain tile, control structure, and design. This cost is based on McLean County, Illinois area contractor prices and cost reported by the Agricultural Drainage Management Coalition (ADMC). The analysis assumes such a saturated buffer would treat an area of 40 acres.
18. **Water and sediment control basin** costs are based on Sangamon County rates and are estimated at $2,000 per basin including earth work, tile and risers.
19. **Wetlands creation** and/or restoration assume a cost of $10,500 per acre. This estimate is based on actual costs from McLean County, Illinois.

Analyses of total costs and per-unit load reductions by BMP indicate that permanent vegetative cover establishment, no-till and filter strips are the most cost-effective practices for reducing nitrogen, phosphorus and sediment loading; all of which are well below the average cost per pound. With respect to nitrogen reductions, saturated buffers, wetlands, grassed waterways, cover crops and nutrient management are also very cost effective. Grassed waterways, WASCOBS, shoreline stabilization, no-till and nutrient management are relatively cost-effective practices for reducing phosphorus. Lake shoreline stabilization, grassed waterways, and WASCOBS are additionally cost=effective practices for reducing sediment.

Costs for installing these BMPs are high and funding availability will play a major role as to when, where and how many of these BMPs can be implemented. This is a prime example of how important the use of an adaptive management approach will be for implementation of these BMPs in a timely manner to reach the TMDLs set for the LSW and for reaching the NLRS goals and milestones.

TABLE 4.6.2 – TARGETED BMP LOAD REDUCTION SUMMARY

BMP	Total N Reduction	% N Total Load	Total P Reduction	% P Total Load	Total Sediment Reduction	% Sediment Total Load
Bioreactor	3,922	0.2%	3	0.002%	0	0%
Commercial Detention/Retention	2,679	0.1%	416	0.2%	109	0.1%
Cover Crops	51,283	2%	2,980	1%	2,660	2%
Detention/Retention Basins/Ponds	7,501	0.3%	1,191	1%	1,090	1%
Drainage Water Management	3,851	0.2%	7	0.003%	0	0%
Field Borders	85,897	4%	11,397	5%	9,435	6%
Filter Strips	54,298	2%	9,279	4%	9,651	6%
Grade Stabilization Structure**	**	**	**	**	**	**
Grassed Waterways	3,667	0.2%	999	0.5%	982	1%
Grass/Shrub/Tree Planting***	0	0	0	0	0	0
Lake Shoreline Stabilization	1,677	0.1%	839	0.4%	729	0.4%
Livestock Alternate Water System*	*	*	*	*	*	*
Livestock Exclusion Fencing*	*	*	*	*	*	*
Livestock Feed Area Waste *	512	0.02%	99	0.05%	7	0.004%
Livestock Pasture Management*	2,586	0.1%	282	0.1%	41	0.02%
No Till/Strip-Till (Cropped Non HEL)	536,819	23%	36,404	17%	37,841	23%
No-Till/Strip-Till (Cropped HEL)	62,322	3%	13,324	6%	20,297	12%
Nutrient Management	160,987	7%	12,800	6%	0	0%
Permanent Vegetative Cover***	0	0	0	0	0	0
Porous Pavement***	0	0	0	0	0	0
Residential Rain Barrel/Rain Garden	7,569	0.3%	1.203	1%	230	0.1%
Rock Riffles/Grade Control Structures	468	0.02%	358	0.2%	330	0.2%
Saturated Buffers	50,841	2%	2,884	1%	2,680	2%
Septic Systems	14,186	1%	5,555	3%	0	0%
Streambank Stabilization	7,689	0.3%	4,613	2%	3,844	2%
Stream Crossings*	*	*	*	*	*	*
WASCOBS	1,864	0.1%	921	0.4%	916	1%
Water Diversions*	*	*	*	*	*	*
Wetlands	22,284	1%	1,630	1%	1,650	1%
Total	1,082,902	47%	107,184	51%	92,492	56%

*These BMPs are sometimes components of livestock waste management systems and/or livestock pasture management systems listed above in **Table 4.6.2.** The pollutant load reductions are reflected under those two BMPs. **Grade Stabilization Structure – The pollutant load reduction calculation for this BMP is normally done under the grassed waterway design. ***Pollutant load reductions have not been determined for these BMPs.

TABLE 4.6.3 –COST ESTIMATES FOR ALL TARGETED BMPS

BMP	Quantities	Unit	Unit Cost	Total Cost	Cost/lb. Nitrogen Reduction	Cost/lb. Phosphorus Reduction	Cost/ton Sediment Reduction
Bioreactor	19	#	$7,500	$142,500	$36.33	$41,912	N/A
Commercial Detention/Retention	1,647	acres	$16,640	$27,406,080	$10,230	$65,880	$251,431.93
Cover Crops	14,052	acres	$66.67	$936,847	$18.27	$314	$352.20
Drainage Water Management	942	acres	$161.60	$152,227	$39.53	$21,747	N/A
Field Borders	5,761	acres	$700	$4,032,700	$46.95	$354	$427.42
Filter Strips	324	acres	$700	$226,800	***$4.18***	***$24.44***	***$23.50***
Grade Stabilization Structures	17	#	$8,000	$136,000	$290.60	$380	$412.12
Grass/Shrub/Tree Planting	81	acres	$700	$56,700	***$1.86***	***$10.71***	***$9.73***
Grassed Waterway	44	acres	$3,704	$162,976	$44.44	$163	$165.96
Lake Shoreline Stabilization	4,630	Ft	$40	$185,200	$110.44	$221	$254.05
Livestock Waste Area System*	95	#	$30,000	$2,850,000	$5,566.41	$28,788	$407,142.86
No-Till (Non-HEL)	103,936	acres	$33.33	$3,464,187	***$6.45***	$95.16	$91.55
No-Till (HEL)	5,147	acres	$33.33	$171,550	***$2.75***	***$12.88***	***$8.45***
Nutrient Management	123,611	acres	$16	$1,977,776	$12.29	$155	N/A
Pasture Management	17	#	$62,447	$1,061,591	$410.51	$3,765	$25,892.45
Residential Rain Barrels/Gardens	4,921	acres	$16,640	$81,885,440	$10,818.53	$68,068	$356,023.65
Porous Pavement							
Retention/Detention/Pond	17	#	$50,000	$850,000	$113.32	$714	$779.82
Permanent Vegetative Cover	265	acres	$700	$185,500	$39.23	$305	$301.63

BMP	Quantities	Unit	Unit Cost	Total Cost	Cost/lb. Nitrogen Reduction	Cost/lb. Phosphorus Reduction	Cost/ton Sediment Reduction
Rock Riffles (174 riffles)[16]							
Saturated Buffer	216	#	$4,000	$864,000	$16.99	$300	$322.39
Septic Systems	456	#	N/A	N/A	N/A	N/A	N/A
Streambank Stabilization	347,393	Ft	$44	$15,285,292	$1,987.94	$3,313.53	$3,976.40
Streambed Control Structures*							
WASCOBS	98	#	$2,000	$196,000	$105.15	$213	$213.97
Water Diversions*							
Wetlands	117	acres	$10,500	$1,228,500	$55.13	$754	$744.55
Total	**613,806**			**143,457,865**	**$1,361.69**	**$10,795**	**$55,188.14**

[16] Cost estimates for some of these BMPs will be prepared when they are selected for implementation.

Bioreactors (Denitrifying)—CPS 605

Bioreactors should be prioritized by total annual load reductions for nitrogen. Implementing bioreactors at 3 out of 12 recommended locations (14 systems) with the greatest expected load reductions will treat 695 acres, and capture 70% of the total nitrogen and 71% of the total phosphorus reduction realized from implementing all recommended bioreactors.

Concentrating bioreactors within the **Lower Sugar Creek** sub-watershed (605 treatment acres) and **Upper Sugar Creek** sub-watershed (282 treatment acres) will achieve the majority of expected load reductions.

Bioreactors were identified by direct observation during a watershed windshield survey and by an interpretation of aerial imagery.

Twenty-seven (27) bioreactors at 12 locations can be applied in the Lake Springfield Watershed; these bioreactors will treat 1,224 acres. Saturated buffers can also be considered at each site.

Load reductions expected, if all bioreactors are implemented total:

- 3,922 pounds/year nitrogen from tile discharge/runoff.
- 3.4 pounds/year phosphorus from tile discharge/runoff.

Critical areas which would benefit from a bioreactor are:

- Tile drained land.
- Continuous corn fields.
- Conventionally tilled fields.
- Infiltration limiting soils.

Cover Crops—CPS 340

Cover crops should be promoted throughout the watershed with a focus on existing no-till fields. Based on expected nutrient and sediment load reductions, 135 out of 540 fields could be prioritized. Implementing cover crops at these 135 locations will treat 9,322 acres, and capture 67% of the total nitrogen 57% of the total phosphorus and 49% of the total sediment reduction realized from implementing all recommended cover crops.

Concentrating cover crops within the **Lower Lick Creek—Polecat Creek** (5,276 acres), **Lower Sugar Creek** (2,076 acres) and **Panther Creek** (2,541 acres) sub-watersheds will achieve the majority of expected load reductions.

Cover crops are recommended for 540 fields where no-till is currently being practiced or have subsurface drainage systems and were identified by direct observation during a watershed windshield survey.

If implemented, cover crops can be applied to a total of 14,052 acres. Load reductions expected, if all cover crops are implemented, total:

- 51,283 pounds/year nitrogen from surface and tile discharge/runoff.
- 2,980 pounds/year phosphorus from surface and tile discharge/runoff.
- 2,660 tons/year sediment from surface runoff.

Critical areas which would benefit from cover crops to reduce surface runoff soil erosion and tile discharge/ runoff are:

- Continuous corn fields.
- Conventionally tilled fields.
- Highly erodible land.
- Tile-drained land.
- Livestock feed waste areas.

Detention/Retention Basin/Ponds (Stormwater Runoff Control) —CPS 570

Detention/Retention Basins/Ponds should be prioritized by total annual load reductions for nitrogen, phosphorus and sediment. Constructing 8 out of 17 recommended basins/ponds with the greatest expected load reductions will treat 2,451 acres, and capture 90% of the total nitrogen, 90% of the total phosphorus and 91% of the total sediment reduction realized from implementing all basis/ponds.

Concentrating detention/retention/ponds within the **Lower Sugar Creek** sub-watershed (943 treatment acres) and **Lower Lick Creek—Polecat Creek** sub-watershed (1,149 treatment acres) will achieve the majority of expected load reductions.

Optimal locations observed by direct observation during a watershed windshield survey are recommended for both urban and agricultural areas. In the Lake Springfield Watershed, a total of 17 basins are recommended at 16 sites. At 5 sites, multiple wetlands are also feasible and at 3 sites, water diversions are also recommended. Recommended detention/retention basins/ponds will treat 2,710 acres.

Load reductions expected, if all basins/ponds are implemented, total:

- 149 pounds/year nitrogen from gully erosion.
- 90 pounds/year phosphorus from gully erosion.
- 74.7 tons/year of sediment from gully erosion.
- 7,352 pounds/year nitrogen from surface and tile discharge/runoff.
- 1,101 pounds/year phosphorus from surface and tile discharge/runoff.
- 1,015 tons/year sediment from surface runoff.

Critical areas benefitting from detention/retention basins/ponds in agricultural areas include:

- Concentrated flow areas.
- Gully erosion sites.
- High volume surface runoff areas.

Detention/Retention Basins at commercial/retail business sites (Stormwater Runoff Control)—CPS 570

A combination of detention and retention basins and porous/permeable pavement are recommended for commercial, manufacturing and industrial, institutional, cultural and entertainment, manufacturing and industrial, utilities, resorts and wholesale, and storage areas; all very high, high and medium-density categories that do not currently have detention or retention in place were analyzed. Implementation of some type of retention or detention is the recommended BMP for these areas. However, other BMPs, such as permeable pavement and/or bioswales, can be considered.

In the Lake Springfield Watershed, retention for non-residential areas is recommended on 1,647 acres. Load reductions expected, if all areas are treated, total:

- 2,679 pounds/year nitrogen from surface runoff.
- 416 pounds/year phosphorus from surface runoff.
- 109 tons/year sediment from surface runoff.

Sites should be prioritized by total annual load reductions for nitrogen and phosphorus and by proximity to a stream or lake. Treating 980 out of 1,647 recommended acres with the greatest expected load reductions will capture 66% of the total nitrogen, 66% of the total phosphorus and 67% of the total sediment reduction realized from treating all acreage.

Whether a detention/retention/infiltration basin is installed at identified locations will be determined by the technical staff and the landowner, based on specific criteria found in the area to be treated and available space for the BMP.

Concentrating detention and retention basins in these commercial/retail business areas within the **Lake Springfield** sub-watershed (946 treatment acres) and **Lower Lick Creek —Polecat Creek** sub-watershed (423 treatment acres) will achieve the majority of expected load reductions. **(Figure 4.6.3)**

Critical areas which would benefit from installation of detention/retention basins to address the nonpoint source pollution from surface water runoff include:

- Concentrated flow areas.
- Construction erosion areas.
- Gully erosion sites.
- High volume surface runoff area.
- Impervious pavement.
- Urban and rural stormwater runoff/commercial and residential.

Drainage Water Management – CPS 554

Drainage Water management should be prioritized by total annual load reductions for nitrogen.

One large area, using 19 systems to treat 50-acre sections, for a total of 950 acres, has been identified for this drainage water management BMP. Sites were identified by direct observation during a watershed windshield survey and by an interpretation of aerial imagery.

Consideration should be given to incrementally applying DWM at this location within the **Upper Sugar Creek** sub-watershed.

In the Lake Springfield Watershed, DWM can be applied to treat 12,028 acres. Wetlands may also be applicable at these locations.

Load reductions expected, if all DWM systems are implemented, total:

- 3,851 pounds/year nitrogen from tile discharge/runoff.
- 7 pounds/year phosphorus from tile discharge/runoff.

Critical areas for drain water management BMPs include:

- Tile-drained land.

Field Borders —CPS 386

Field borders should be prioritized by total annual load reductions for nutrients and sediment. Implementing field borders on 118 fields that are within the top 25% for nitrogen load reductions will treat 18,730 acres (59%) and capture 61% of the total nitrogen, 61% of the total phosphorus and 62% of the total sediment reduction realized from implementing all recommended field borders. Sites were identified by direct observation during a watershed windshield survey and by an interpretation of aerial imagery.

Concentrating Field Borders within the **South Fork Lick Creek–Johns Creek** (1,109 acres) and **Lower Lick Creek–Polecat Creek** (1,253 acres) sub-watersheds will achieve the majority of expected load reductions.

Field borders of native prairie grasses are recommended for 12 individual fields totaling 104 acres, or 60,500 feet. Load reductions expected, if all field borders are implemented, total:

- 1,861 pounds/year nitrogen from surface and tile discharge runoff.
- 233 pounds/year phosphorus from surface and tile discharge runoff.
- 218 tons/year sediment from surface runoff.

Field borders are recommended to treat 31,942 acres, or 447 individual fields in the watershed. Using a buffer width of 50 feet, placed along one half of a field’s perimeter, translates into a total of 5,761 acres of grassed field borders.

Load reductions expected, if all field borders are implemented, total:

- 85,897 pounds/year nitrogen from surface and tile discharge/runoff.
- 11,397 pounds/year of phosphorus from surface and tile discharge/runoff.
- 9,435 tons/year of sediment from surface runoff.

Critical areas which would benefit from field borders to reduce surface and tile discharge runoff include:

- Areas experiencing gully erosion.
- Concentrated flow areas.
- Continuous corn fields.
- Conventionally tilled fields.
- Highly erodible land.
- Livestock feed waste areas.
- Tile-drained land.

Filter Strips — CPS 393/Riparian Forest Buffers—CPS 391

Filter strips should be prioritized by total annual load reductions for nitrogen. Implementing 40 out of 157 recommended filter strips with the greatest expected load reductions will treat 4,528 acres and capture 55% of the total nitrogen, 55% of the total phosphorus and 54% of the total sediment reduction realized from implementing all recommended filter strips.

Concentrating filter strips within the **South Fork Lick Creek–Johns Creek** sub-watershed (2,034 treatment acres) and **Panther Creek** sub-watershed (2,038 treatment acres) will achieve the majority of expected load reductions.

Only those areas directly adjacent to an openly flowing ditch or stream were selected for the placement of filter strips. Sites were identified by direct observation during a watershed windshield survey and by an interpretation of aerial imagery. Filter strip widths range from 30-60 feet, depending on the site. One hundred and fifty-seven (157) individual filter strips, 440,200 linear feet or 324 acres are recommended for the Lake Springfield Watershed. Riparian forest buffers may also be an option at some of these locations.

If implemented, these sites will treat 8,148 acres. Load reductions expected, if all filter strips are implemented, total:

- 54,298 pounds/year nitrogen from surface and tile discharge/runoff
- 9,279 pounds/year phosphorus from surface and tile discharge/runoff
- 9,651 tons/year sediment from surface runoff

Critical areas in greatest need of filter strips and riparian forest buffer BMPs include:

- Areas experiencing gully erosion
- Areas with urban and rural stormwater runoff/commercial and residential
- Conventionally tilled fields
- Concentrated flow areas
- Highly erodible land

- Lake shoreline erosion
- Livestock feed waste areas
- Municipal wastewater discharge areas
- Streambank erosion
- Tile-drained land

Grade Stabilization Structures, in-field—CPS 410

Grade stabilization structures, in-field are used to control the grade in natural or constructed channels. They can be an earthen, concrete, aluminum or other structure built across a drainageway to prevent gully erosion. A dam or embankment built across a gully or grass waterway drops water to a lower elevation while protecting the soil from gully erosion or scouring. Structures are typically either a drop spillway or a small dam and basin with a pipe outlet. Many times this BMP is used in conjunction with the implementation of grassed waterways where there is considerable fall in elevation in the area. If the structure has water holding capacity, it can also provide a water source for wildlife.

Grade Control Structures – Channel Bed Stabilization—Rock Riffles—CPS 584

Grade control structures, such as rock riffles in the stream channels and along streambanks, should be prioritized based on sediment reduction. However, given that each recommended site is unstable, all 17 structures at 4 sites should be considered. Grade control structures were identified by direct observation during a watershed windshield survey.

Concentrating grade control structures within the **Lower Sugar Creek** sub-watershed (486 treatment acres) and **Lake Springfield** sub-watershed (329 treatment acres) will achieve the majority of expected load reductions. **(Figure 4.6.7)**

Seventeen (17) individual grade control structures or rock riffles are recommended at four (4) sites throughout the watershed. If implemented, these sites will treat 975 acres. Load reductions expected, if all systems are implemented, total:

- 287 pounds/year nitrogen from gully erosion
- 172 pounds/year phosphorus from gully erosion
- 144 tons/year of sediment from gully erosion
- 181 pounds/year nitrogen from surface runoff
- 186 pounds/year phosphorus from surface runoff
- 186 tons/year sediment from surface runoff

Critical areas in need of grade control structures, rock riffles or other identified stream channel BMPs include:

- Areas experiencing gully erosion
- Areas experiencing streambank erosion.

Grassed Waterways –CPS 412

Recommendations include both new waterways and the maintenance of existing; a width of 30 feet was assumed for maintenance and a width of 60 feet for new waterways. The locations of grassed waterways were determined by direct observation during a watershed windshield survey and by an interpretation of aerial imagery.

Grassed waterways should be prioritized by total annual load reductions. Constructing 7 out of 19 recommended grassed waterways with the greatest expected load reductions will treat 2,790 acres and capture 74% of the total nitrogen, 76% of the total phosphorus and 75% of the total sediment reduction realized from implementing all recommended waterways.

Concentrating grassed waterways within the **South Fork Lick Creek–Johns Creek** sub-watershed (1,001 treatment acres) and **Lower Lick Creek–Polecat Creek** sub-watershed (1,737 treatment acres) will address the greatest acreage and achieve the majority of expected load reductions.

Nineteen (19) grassed waterways, 38,450 feet or 44 acres are recommended in the watershed; 9 out of 19 waterways only require maintenance. If implemented, these waterways will treat 3,715 acres. Load reductions expected, if all sites are implemented, total:

- 683 pounds/year nitrogen from gully erosion
- 410 pounds/year phosphorus from gully erosion
- 342 tons/year of sediment from gully erosion
- 2,948 pounds/year nitrogen from surface runoff
- 589 pounds/year phosphorus from surface runoff
- 640 tons/year sediment from surface runoff

Critical areas which would benefit from grassed waterways include:

- Areas experiencing gully erosion
- Concentrated flow areas
- Conventionally tilled fields
- Continuous corn fields
- High volume surface runoff areas
- Tile-drained land

Livestock Feed Area Waste Systems—CPS 313, 634, 629

Given that livestock feed areas are responsible for some of the highest per-acre loading for nutrients and sediment loads, all 95 feed areas should be considered. Focus should be on those feed areas within close proximity to a stream or lake. An integrated system can be constructed to manage livestock waste from small, concentrated feed areas.

A small number of feed areas were identified during a watershed windshield; the remainder or majority were identified by interpreting aerial imagery. Concentrating livestock waste management systems within the **Upper Lick Creek** (19 acres) and **Lower Lick Creek—Polecat Creek** (17 acres) sub-watersheds will achieve the majority of expected load reductions.

A feed area waste system is recommended for a total of 95 feed areas or 49 acres in the watershed. Load reductions expected, if all feed areas are treated total:

- 512 pounds/year nitrogen from surface runoff.
- 99 pounds/year phosphorus from surface runoff.

- 6.7 tons/year sediment from surface runoff.

Critical areas benefitting from livestock feed area waste system BMPs include livestock waste areas.

Nutrient Management—CPS 590

Nutrient management should be promoted throughout the watershed. Based on expected nutrient load reductions, 223 out of 2,049 fields could be prioritized. Implementing nutrient management plans at these 223 locations will treat 28,173 acres, and capture 24% of the total nitrogen and 17% of the total phosphorus reductions realized from implementing nutrient management on all recommended acres. Concentrating nutrient management planning within the **Lower Lick Creek-Polecat Creek** sub-watershed (24,897 acres) and **Upper Lick Creek** sub-watershed (17,745 acres) will achieve the majority of expected load reductions.

In Lake Springfield, nutrient management can be applied to 123,611 acres of cropland. Load reductions expected, if all acres are treated, total:

- 160,987 pounds/year nitrogen from tile discharge/runoff
- 23,800 pounds/year phosphorus from surface and tile discharge/runoff

Critical areas benefitting from nutrient management planning include:

- Conventionally tilled fields
- Continuous corn fields
- Livestock feed waste areas
- Highly erodible land
- High volume surface runoff areas
- Tile-drained land

Residue and Tillage Management--No-till/Strip-till/Direct Seeding—CPS 329

NRCS Conservation Practice Standard Code 329 defines no-till, strip-till and direct seeding as managing the amount, orientation and distribution of crop and other plant residue on the soil surface year round, limiting soil-disturbing activities to those necessary to place nutrients, condition residue and plant crops.

No-till farming should be promoted throughout the watershed on all conventionally tilled fields, focusing on those cropped HEL soils. If no-till is targeted to the 5,147 acres of HEL soils that are either being conventionally tilled or spring-tilled, total annual load reductions can be reduced by 62,322 lbs. for nitrogen, 13,324 lbs. for phosphorus and 20,297 tons for sediment. This represents 10% of the total expected no-till reduction for nitrogen, 27% for phosphorus and 35% for sediment for only treating 5% of all eligible or recommended no-till acreage. **(Figure 4.6.11)**

A switch from conventional tillage to no-till is often a prerequisite for the establishment of cover crops and, therefore, is recommended for all fields in the watershed where conventional tillage is occurring, or 109,083 acres.

Load reductions expected, if all fields with conventional tillage are converted to no-till, total:

- 599,141 pounds/year nitrogen from surface and tile discharge/runoff

- 49,728 pounds/year phosphorus from surface and tile discharge/runoff
- 58,138 tons/year sediment from surface runoff

If these fields are converted to reduced-till instead of no-till, the above load reductions would be cut by approximately 50 percent.

Critical areas which would benefit from no-till/strip-till/direct seeding implementation include:

- Conventionally tilled fields
- High volume surface runoff areas
- Infiltration limiting soils
- Tile-drained land

Concentrating no-till on cropped HEL soils to the **South Fork Lick Creek–Johns Creek**, **Lower Lick Creek – Polecat Creek** and **Upper Lick Creek** sub-watersheds is recommended. 1,496 acres are possible in **South Fork Lick Creek–Johns Creek** sub-watershed and will result in annual load reductions of 19,431 lbs. of nitrogen, 4,149 lbs. of phosphorus and 6,310 tons of sediment; 1,033 acres are possible in the **Upper Lick Creek** sub-watershed and will result in annual load reductions of 14,756 lbs. of nitrogen, 3,209 lbs. of phosphorus and 4,939 tons of sediment; 1,167 acres are possible in **Lower Lick Creek–Polecat Creek** sub-watershed and will result in annual load reductions of 13,096 lbs. of nitrogen, 2,786 lbs. of phosphorus and 4,231 tons of sediment. **(Figure 4.6.12)**

Residue and Tillage Management—Reduced-till—CPS 345

While the recommended residue and tillage management for this watershed is no-till/strip-till/direct seeding, the next most acceptable alternative for reducing tillage would be mulch-till. NRCS CPS Code 345, Residue and Tillage Management, Reduced Till, defines this practice as managing the amount, orientation and distribution of crop and other plant residue on the soil surface year round while limiting the soil-disturbing activities used to grow and harvest crops in systems where the field surface is tilled prior to planting. With 74% of the LSW cropland currently being conventionally tilled, switching to reduced-till may be the most acceptable tillage alternative by LSW producers.

Residential Rain Barrels, Rain Gardens, Detention Basins & Porous/Permeable Pavement —IUM 897

A combination of rain barrels, rain gardens, detention and porous pavement are recommended, primarily in urban residential areas of the watershed; all high- and medium-density residential areas that do not currently have detention/retention basins in place were analyzed.

Residential rain barrels, rain gardens, detention and/or retention basins and porous/permeable pavement should be prioritized by total annual load reductions for nitrogen and phosphorus and by proximity to a stream or lake. Treating 1,795 out of 4,921 recommended acres with the greatest expected load reductions will capture 43% of the total nitrogen, 45% of the total phosphorus and 45% of the total sediment reduction realized from treating all acreage.



In the Lake Springfield Watershed, a combination of rain barrels, rain gardens, permeable pavement and retention/detention basins are recommended for 4,921 acres of high and medium density residential areas.

Concentrating these BMPs within the **Lake Springfield** sub-watershed (2,176 treatment acres) and **Lower Lick Creek—Polecat Creek** sub-watershed (1,095 treatment acres) will achieve the majority of expected load reductions.

Load reductions expected, if all areas are treated total:

- 7,569 pounds/year nitrogen from surface runoff.
- 1,203 pounds/year phosphorus from surface runoff.
- 230 tons/year sediment from surface runoff.

Rain barrels, rain gardens, bioswales, and permeable pavement BMPs are suited for controlling surface water runoff in:

- Concentrated flow areas.
- Construction erosion areas.
- High volume surface water runoff areas.
- Highly erodible land.
- Impervious pavements.
- Urban and rural stormwater runoff/commercial and residential.

Permanent Vegetative Cover —CPS 327/IUM 880

Sites were identified by direct observation during a watershed windshield survey and by an interpretation of aerial imagery. Field conversions to native grasses or tree plantings are recommended for 48 individual fields totaling 265 acres. Load reductions expected, if all fields are converted, total:

- 27 pounds/year nitrogen from gully erosion.
- 16 pounds/year phosphorus from gully erosion.
- 13.4 tons/year of sediment from gully erosion.
- 4,701 pounds/year nitrogen from surface and tile discharge/runoff.
- 593 pounds/year phosphorus from surface and tile discharge/runoff.
- 602 tons/year sediment from surface runoff.

Critical areas which would benefit from permanent vegetative cover include:

- Areas experiencing gully erosion.
- Concentrated flow areas.
- Highly erodible land.
- Shoreline erosion areas.
- Tile-drained land.

Saturated Buffers —CPS 604

Saturated buffers should be prioritized by total annual nitrogen reductions. Implementing saturated buffers at 14 out of 55 recommended sites with the greatest expected load reductions will treat 5,718 acres, and capture 69% of the total nitrogen reduction realized from implementing all recommended saturated buffers. (**Figure 4.6.14**) These sites will treat very large drainage areas and will likely require the installation of complementary stream buffers and multiple saturated buffer systems.

Concentrating saturated buffers within the **Upper Sugar Creek** (3,454 treatment acres) and **South Fork Lick Creek—Johns Creek** sub-watersheds (3,112 treatment acres) will achieve the majority of expected load reductions.

Only areas draining directly to a stream or existing grass buffer were chosen for the placement of saturated buffers. Pollutant removal efficiency is higher where saturated buffers are installed. Bioreactors may also be appropriate in conjunction with, or in the place of, 9 out of the 55 sites recommended.

A total of 216 saturated buffer systems (approximately 19 sites) are recommended for the Lake Springfield Watershed. This represents a treatment area of 8,997 acres, based on approximately 40 acres per system. Load reductions expected, if all sites are implemented, total:

- 50,841 pounds/year nitrogen from surface and tile discharge/runoff.
- 2,884 pounds/year phosphorus from surface and tile discharge/runoff.
- 2,680 tons/year sediment from surface runoff.

Saturated buffers and/or bioreactors are best suited for the following critical areas:

- Continuous corn fields.
- Tile-drained land.

Sediment Basins/In-lake, low flow dams—CPS 350

Two in-lake/low flow dams are recommended for Lake Springfield. Based on an understanding of watershed dynamics and sediment regime, it is believed such a BMP is a feasible practice to reduce sediment and nutrients entering the main body of the Lake and could allow lake sediment and nutrient management to be more cost-effective in the long term. One structure is recommended at the inlet of Lick Creek (800 feet long) and one near the inlet of Sugar Creek (850 feet in length).

Sediment trapping is dependent on the ratio of inflow to storage capacity. Given the large drainage area associated with each tributary, with a maximum 20-percent sediment trapping efficiency assumed.

Two general cost options for two in-lake/low flow dams are presented below. The cost comparisons are based on figures developed for Otter Lake and Lake Carlinville.

1. An embankment dam installed on the lake bed.
2. Installation of a steel sheet pile wall, with a low-flow section notched lower to provide the low-flow weir.
3. Excavation or dredging of a sediment basin behind the dams.

Table 4.6.4- Cost Estimate for Embankment Dams

Item	Unit	Quantity	Unit Cost	Lick Creek Total	Sugar Creek Total
Construction	Feet	800	$1,000	$800,000	
Construction	Feet	850	$1,000		$850,000
Dredging of Sediment Basin				$1,500,000	$1,500,000
Engineering & Permitting (15%)				$345,000	$252,500
Contingencies (10%)				$230,000	$235,000
			Total	**$2,875,000**	**$2,837,500**

Table 4.6.5 - Cost Estimate for Sheet Pile Walls

Item	Unit	Quantity	Unit Cost	Lick Creek Total	Sugar Creek Total
Construction	Feet	800	$900	$720,000	
Construction	Feet	850	$900		$765,000
Dredging of Sediment Basin				$1,500,000	$1,500,000
Engineering & Permitting (15%)				$333,000	$339,750
Contingencies (10%)				$222,000	$226,500

Total	**$2,775,000**	**$2,831,250**

The high end total cost (embankment dam) for both structures is estimated at $5,712,500.

A sediment trapping efficiency of 20%, a nitrogen removal efficiency of 20% and a phosphorus removal efficiency of 10% was used to estimate expected annual load reductions. Both structures will treat a total of 141,852 acres, or 84% of the watershed. The total impounded area behind the dams is estimated to be 212 acres.

If constructed, both structures combined are likely to reduce total annual lake nitrogen loadings by 6% (141,852 lbs.), phosphorus loading by 9% (19,030 lbs.) and sediment loads by 18% (30,503 tons). See **Table 4.6.6** below. Using cost estimates provided in **Tables 4.6.4 and 4.6.5,** the low flow/in-lake dams can achieve nitrogen reductions equivalent to $14/lb., phosphorus reductions of $300/lb. and sediment reduction of $187/ton.

TABLE 4.6.6 – LOW FLOW/IN-LAKE DAM EXPECTED POLLUTION LOAD REDUCTIONS

Location	Dam length (ft)	Drainage/ Treatment Area	Inundated Area behind Dam (acres)	Nitrogen Load Reduction (pounds/yr)	Phosphorus Load Reduction (pounds/yr)	Sediment Load Reduction (tons/yr)
Lick Creek Inlet	800	83,088	128	239,701	11,539	19,325
Sugar Creek Inlet	850	58,764	84	176,738	7,491	11,178
Total	**1,650**	**141,852**	**212**	**416,439**	**19,030**	**30,503**

Streambank/Lake Shoreline Stabilization—CPS 580

Priority should be given to 66 miles (347,393 feet) of severely eroding streambanks in the watershed; those that account for more than 50% of the overall sediment and nutrient load or those that are eroding at 50 tons/year or greater. **4.6.15** shows those priority stream segments eroding at a rate greater than 50 tons/year.

A more detailed streambank erosion and streambed assessment is recommended for all streams within the watershed. Such an assessment will result in significantly more accurate estimates of streambank erosion and aid in the identification of additional in-stream BMPs. Given the logistical constraints in obtaining property access from numerous landowners, one option may be to conduct the assessment using a boat to evaluate segments between public access points, when, or if, navigable. A second option could be to investigate the possibility of conducting an aerial survey. Although an aerial assessment requires less time, the cost may be prohibitive and is often difficult to reasonably determine eroding bank heights and lateral recession rates.

Streambank stabilization could be targeted first to the **Lower Sugar Creek** sub-watershed which accounts for 49% of the total sediment load originating from the 66 miles of severely eroding stream banks. Stabilizing 25 miles (131,117 feet) of eroding streambank in this sub-watershed will result in annual load reductions of:

- 1,882 tons of sediment.
- 2,259 pounds of phosphorus.
- 3,765 pounds of nitrogen.

Approximately 347,393 feet of stone-toe protection is required at these locations. It is likely that stream channel or bank grade control or rock riffle structures may also be required. Assuming a conservative estimate of one rock riffle for every 1,000 feet of stream, this could result in 174 rock riffle structures.

If implemented, these practices will result in annual load reductions of:

- 3,844 tons of sediment.
- 4,613 pounds of phosphorus.
- 7,689 pounds of nitrogen.

Critical areas that would benefit from installation of streambank stabilization BMPs would be:

- Areas with eroding streambank.

Water and Sediment Control Basins (WASCOBs)—CPS 638/Terraces —CPS 600

Given the relatively small number of recommended WASCOBs and/or terrace systems in the watershed, all 98 should be installed. However, implementing the two WASCOB/terrace systems with the greatest total load reductions will accomplish 43% of the total expected sediment and phosphorus reductions.

WASCOBs/terrace system recommendations were identified by direct observation during a watershed windshield survey. Ninety-eight (98) WASCOB/terrace systems are recommended at 19 sites throughout the watershed (**Figure 4.6.16**). If implemented, these systems will treat 388 acres and 19 eroding gullies.

Wetlands—Constructed—CPS 658, 659, 657

Locations of constructed wetlands were determined by identifying historical wetlands that have either been degraded or drained and by delineating wet areas and existing hydric soils.

Constructed wetlands should be prioritized by total annual load reductions for nitrogen. Constructing 33 out of 121 recommended wetlands (**Figure 4.6.17**) with the greatest expected load reductions will treat 2,576 acres, and capture 66% of the total nitrogen, 64% of the total phosphorus and 62% of the total sediment reduction realized from implementing all recommended wetlands.

Concentrating wetlands within the **Lower Sugar Creek** (772 treatment acres) and **Lower Lick Creek—Polecat Creek** (1,001 treatment acres) sub-watersheds will address the greatest acreage and achieve the majority of expected load reductions.

One hundred twenty-one (121) individual wetlands or 117 acres are recommended in the Lake Springfield Watershed; these wetlands will treat 3,923 acres of drainage. Load reductions expected, if all sites are implemented total:

- 22,284 pounds/year nitrogen from surface and tile discharge/runoff.
- 1,630 pounds/year phosphorus from surface runoff.650 tons/year sediment from surface runoff.

Critical areas where constructed wetlands would be very beneficial are:

- Concentrated flow areas.
- Failing septic systems.
- Groundwater recharge areas.
- Highly erodible land.
- Livestock feed area waste areas.
- Municipal wastewater discharges.
- Wastewater treatment facilities.
- Tile-drained land.
- Urban and rural stormwater runoff/commercial and residential.

Specific information on individual BMPs and their associated load reductions are available by contacting Jeff Boeckler at Northwater Consulting – jeff@northwaterco.com.

Maps of Potential BMP Sites:

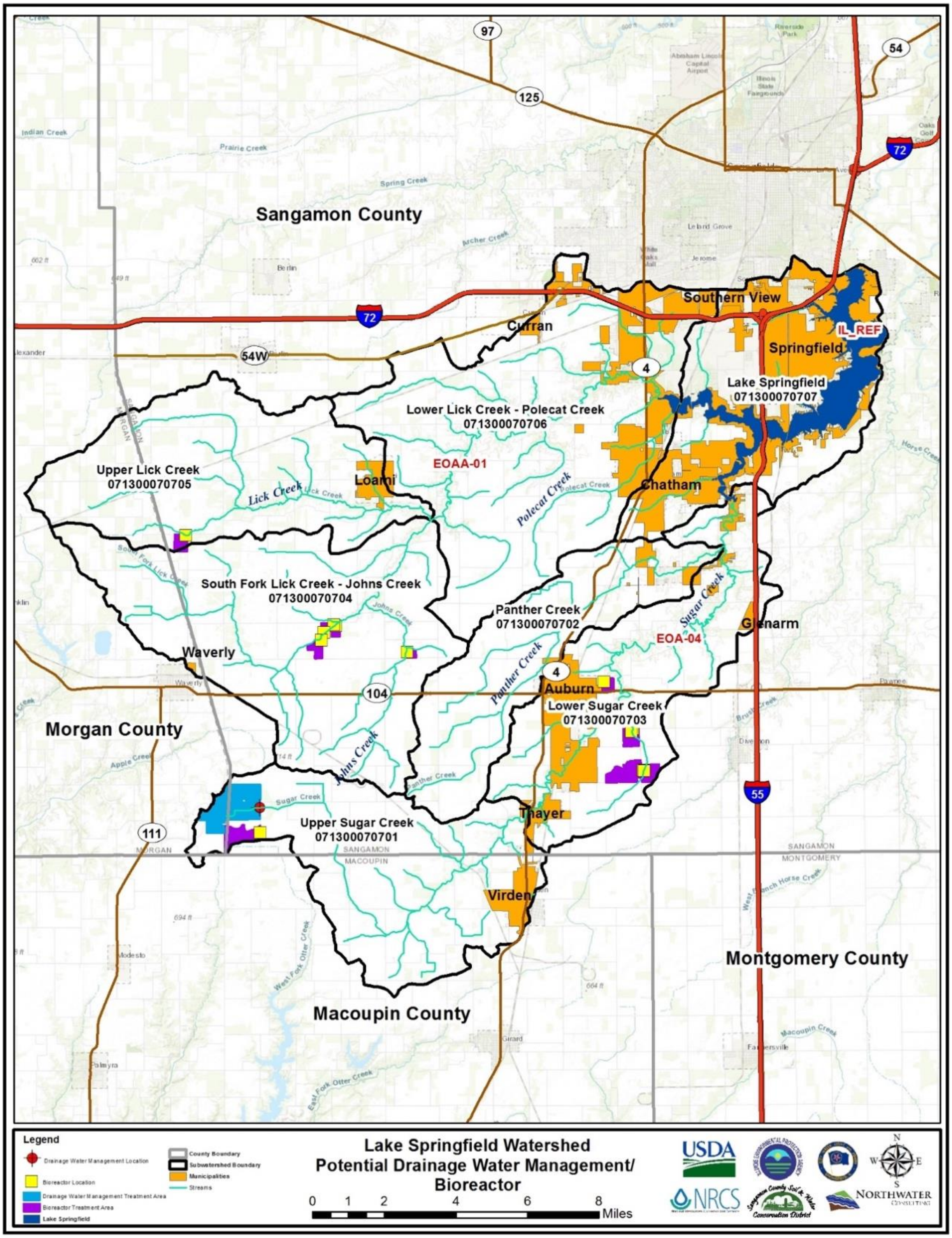


FIGURE 4.6.1—POTENTIAL BIOREACTOR/DRAINAGE WATER MANAGEMENT SITES

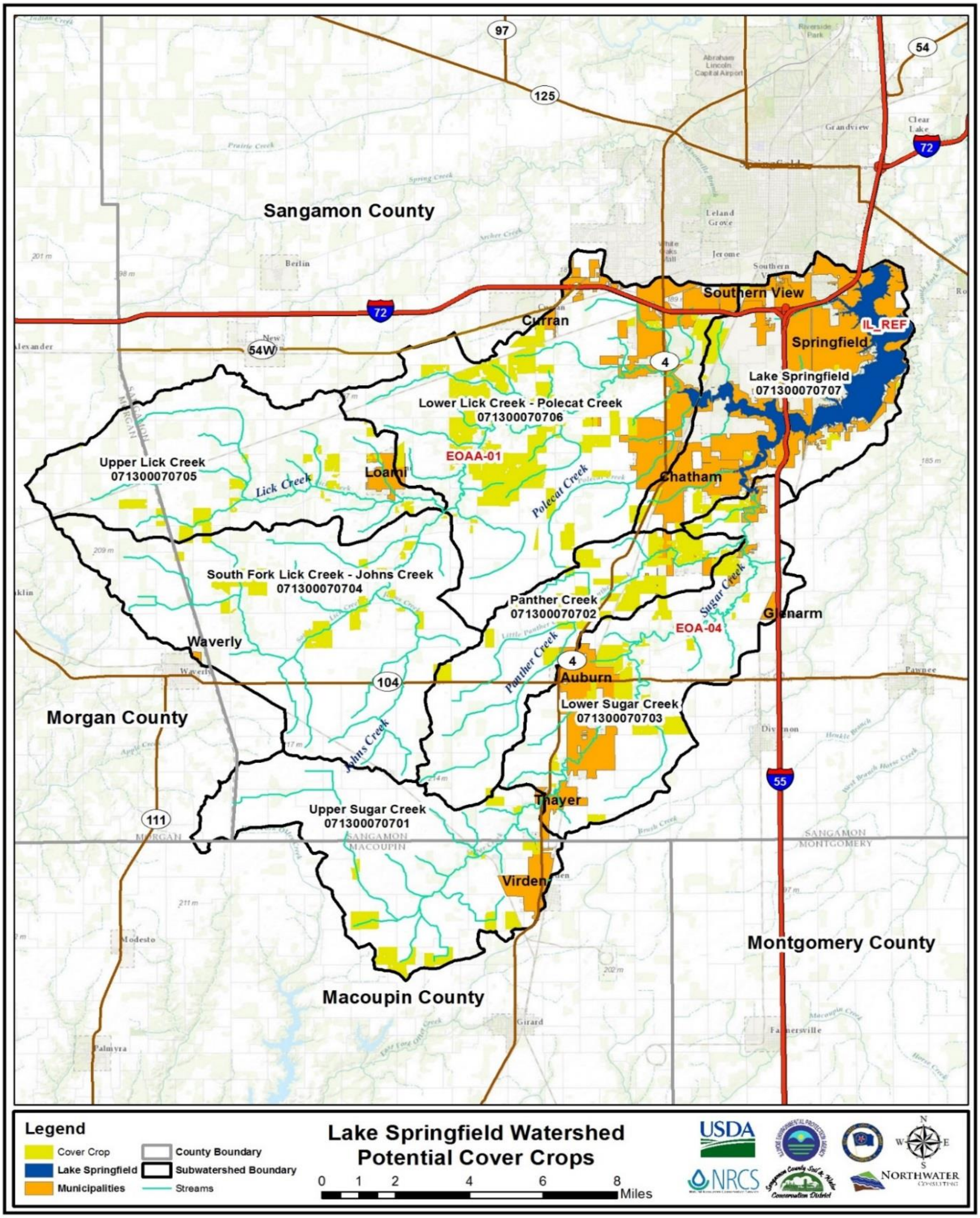


FIGURE 4.6.2—POTENTIAL COVER CROP SITES

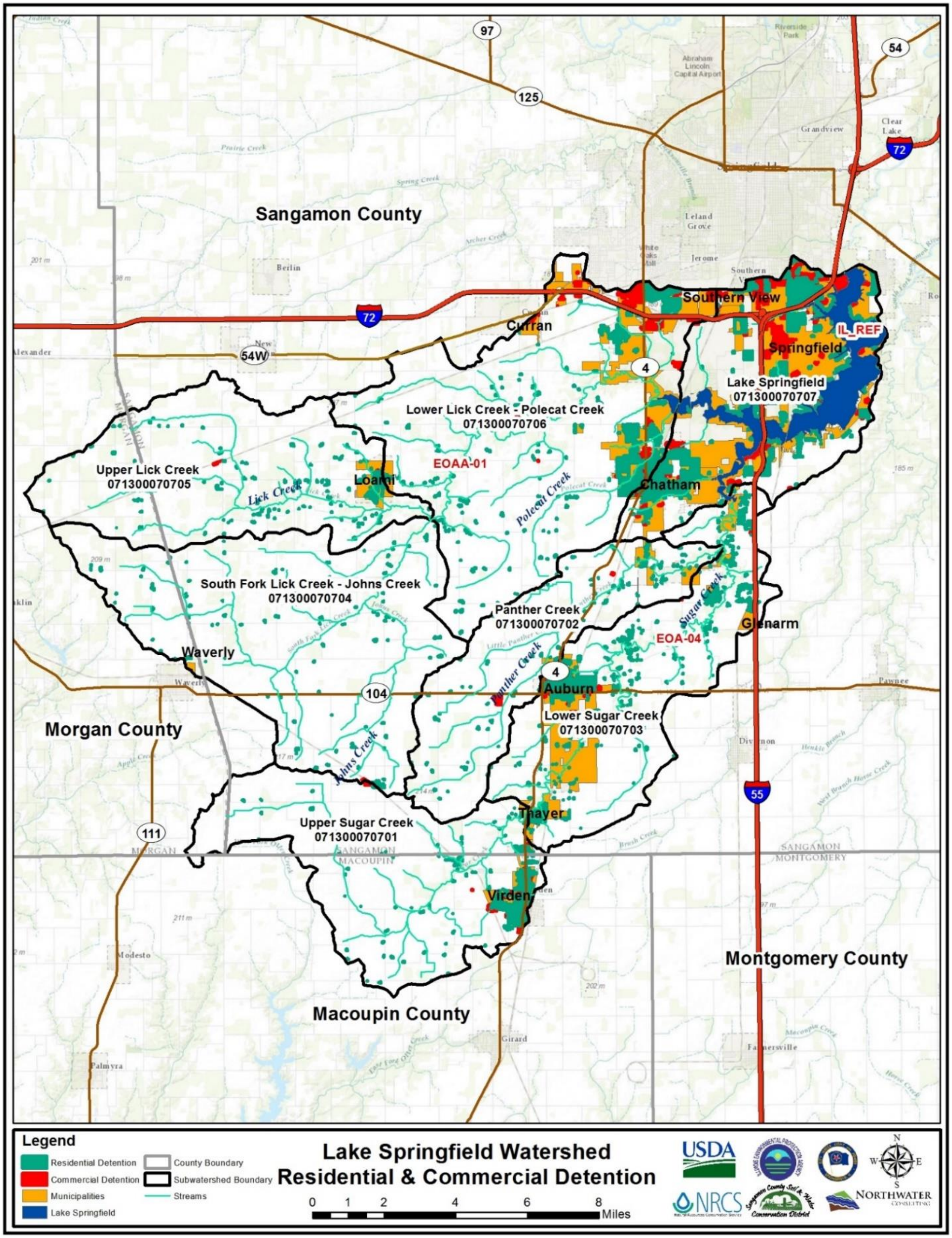


FIGURE 4.6.3—POTENTIAL RESIDENTIAL & COMMERCIAL DETENTION/RETENTION SITES

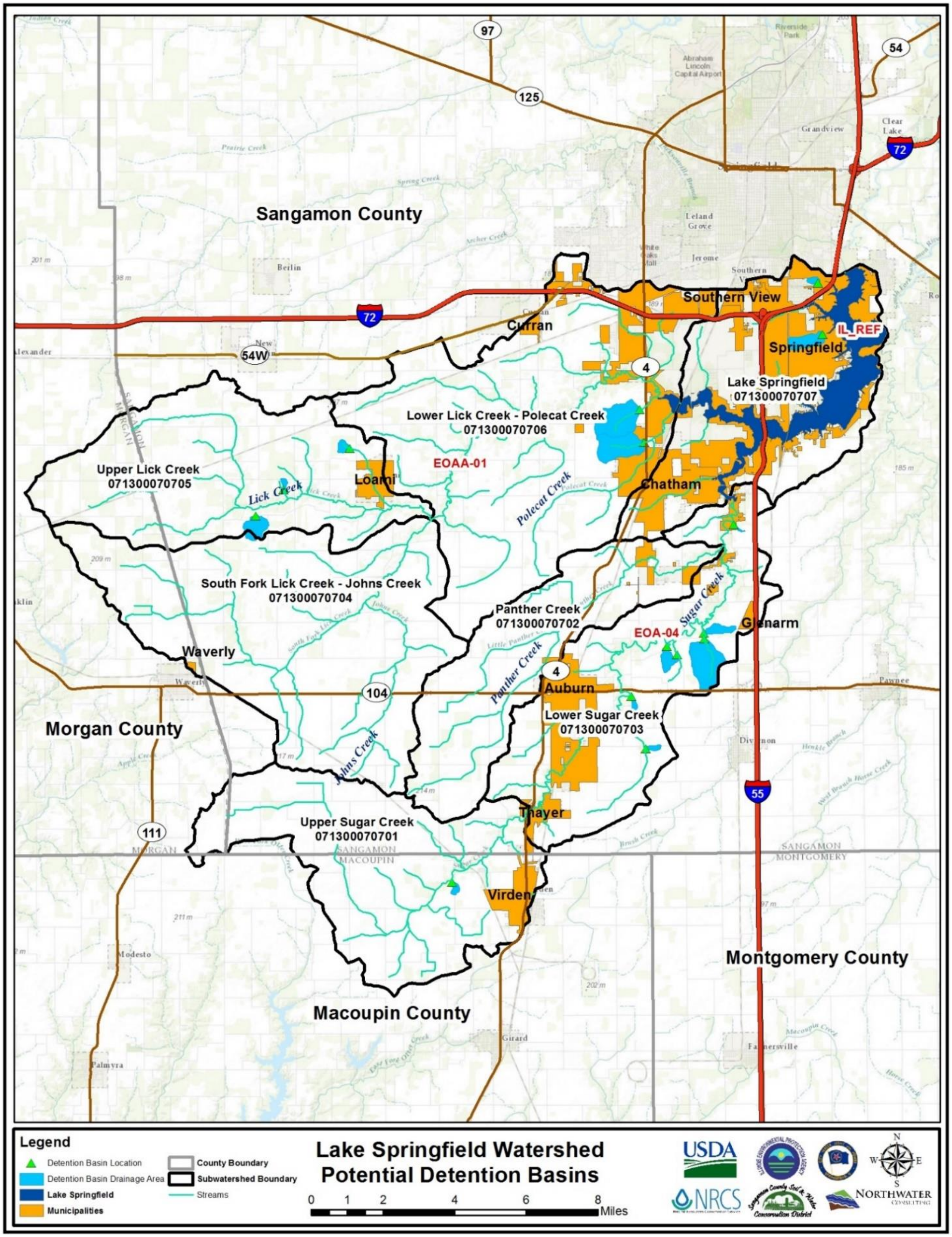


FIGURE 4.6.4—POTENTIAL DETENTION/RETENTION BASIN SITES

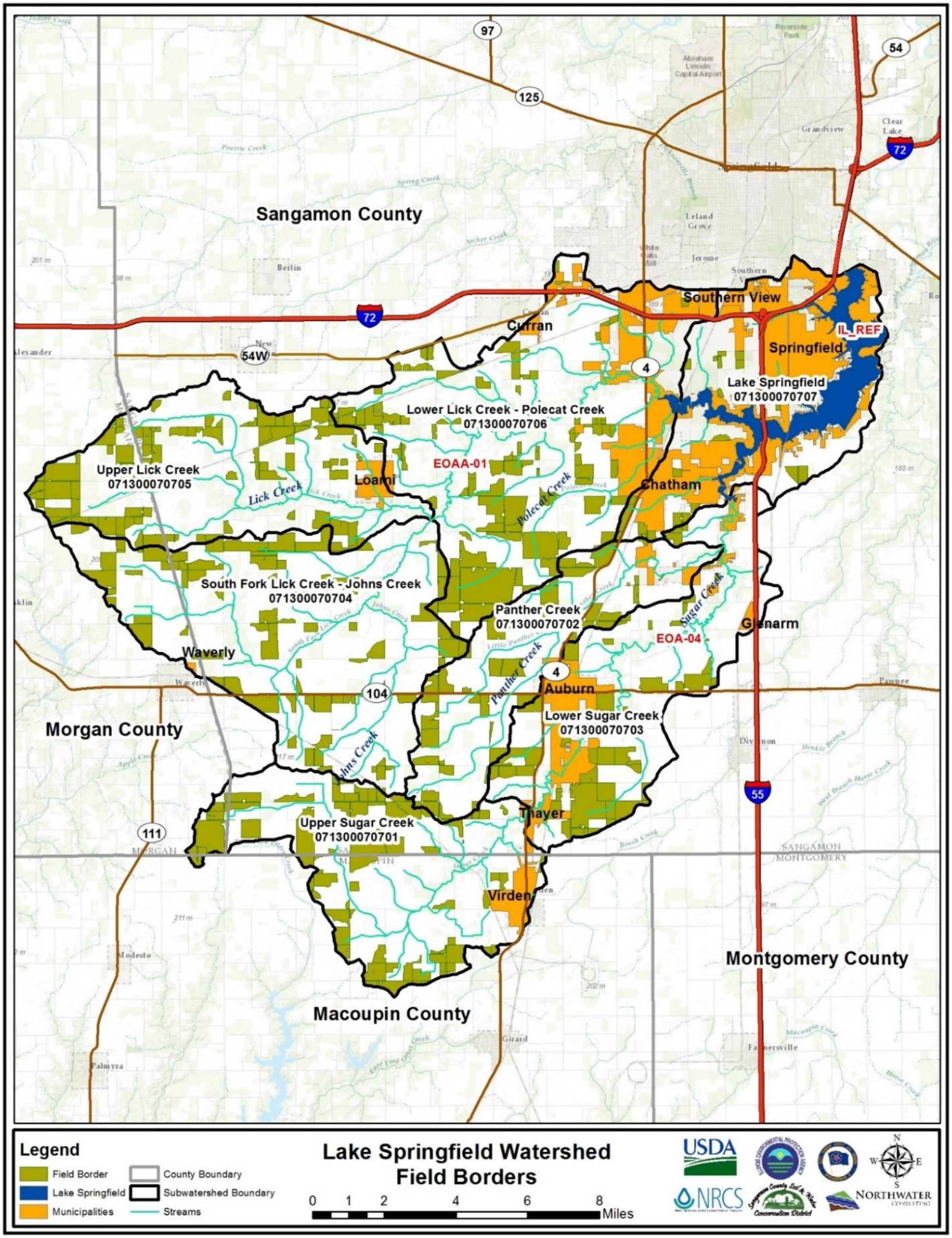


FIGURE 4.6.5—POTENTIAL FIELD BORDERS SITES

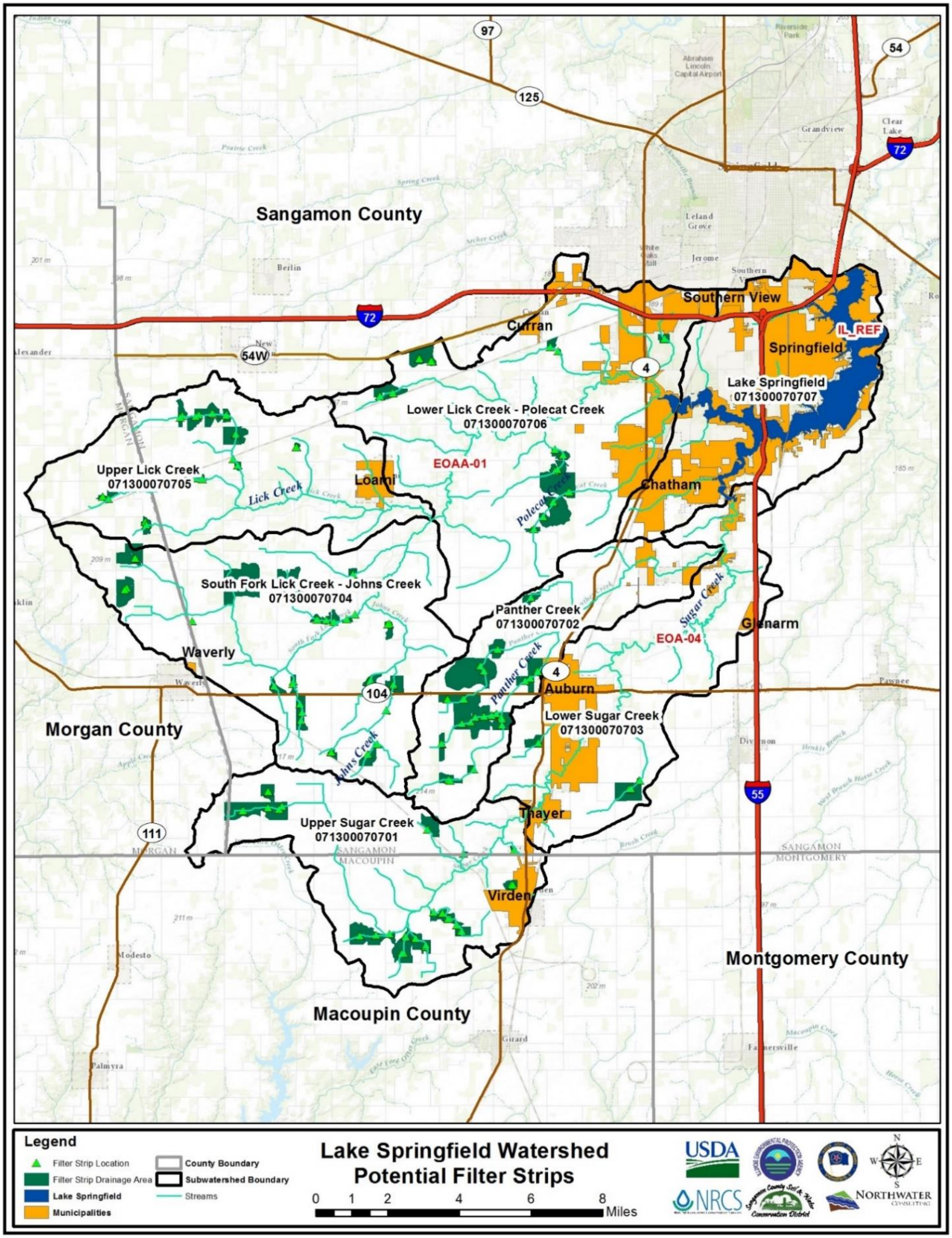


FIGURE 4.6.6 – POTENTIAL FILTER STRIP LOCATIONS

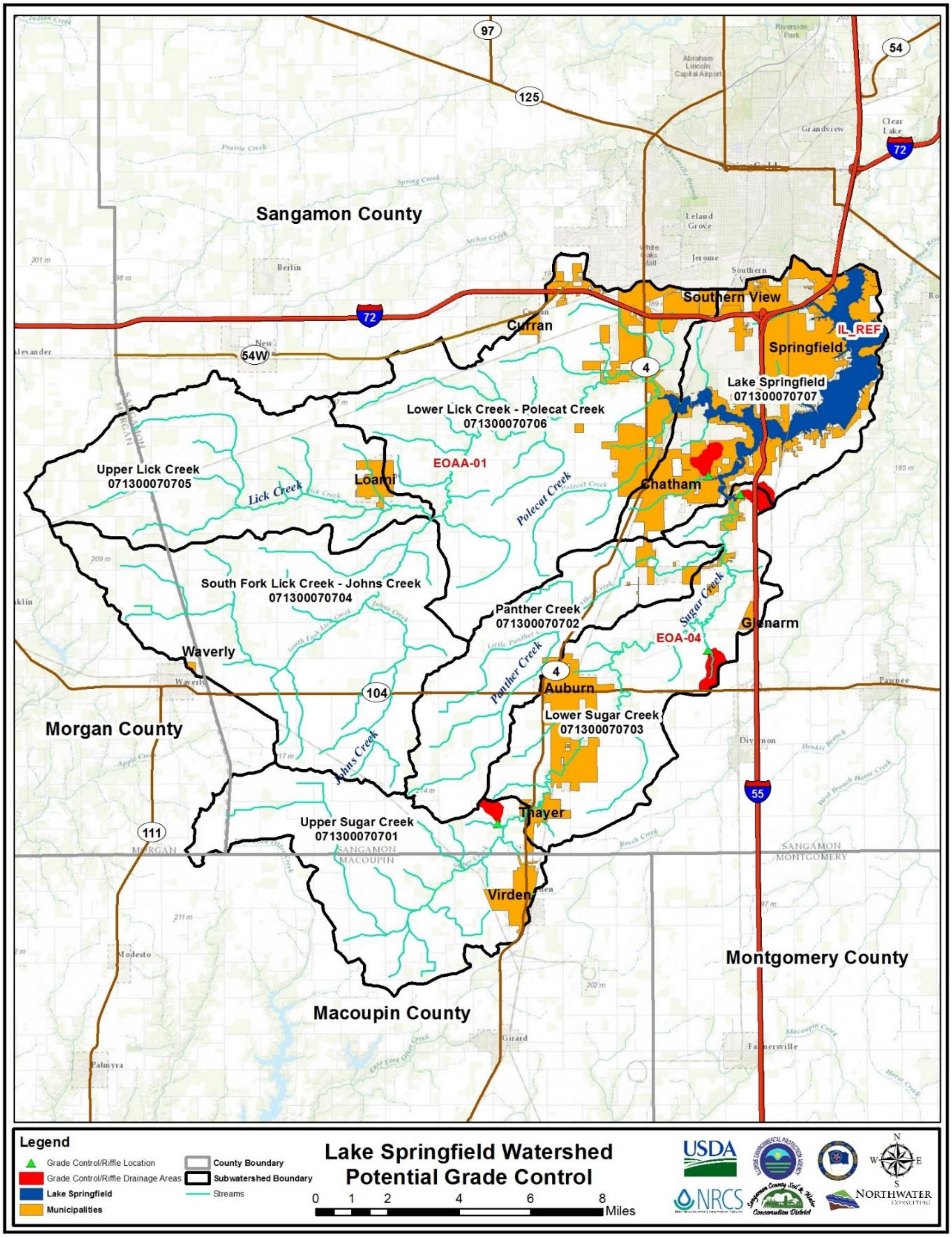


FIGURE 4.6.7 – POTENTIAL STREAM GRADE CONTROL STRUCTURES/ROCK RIFFLE SITES

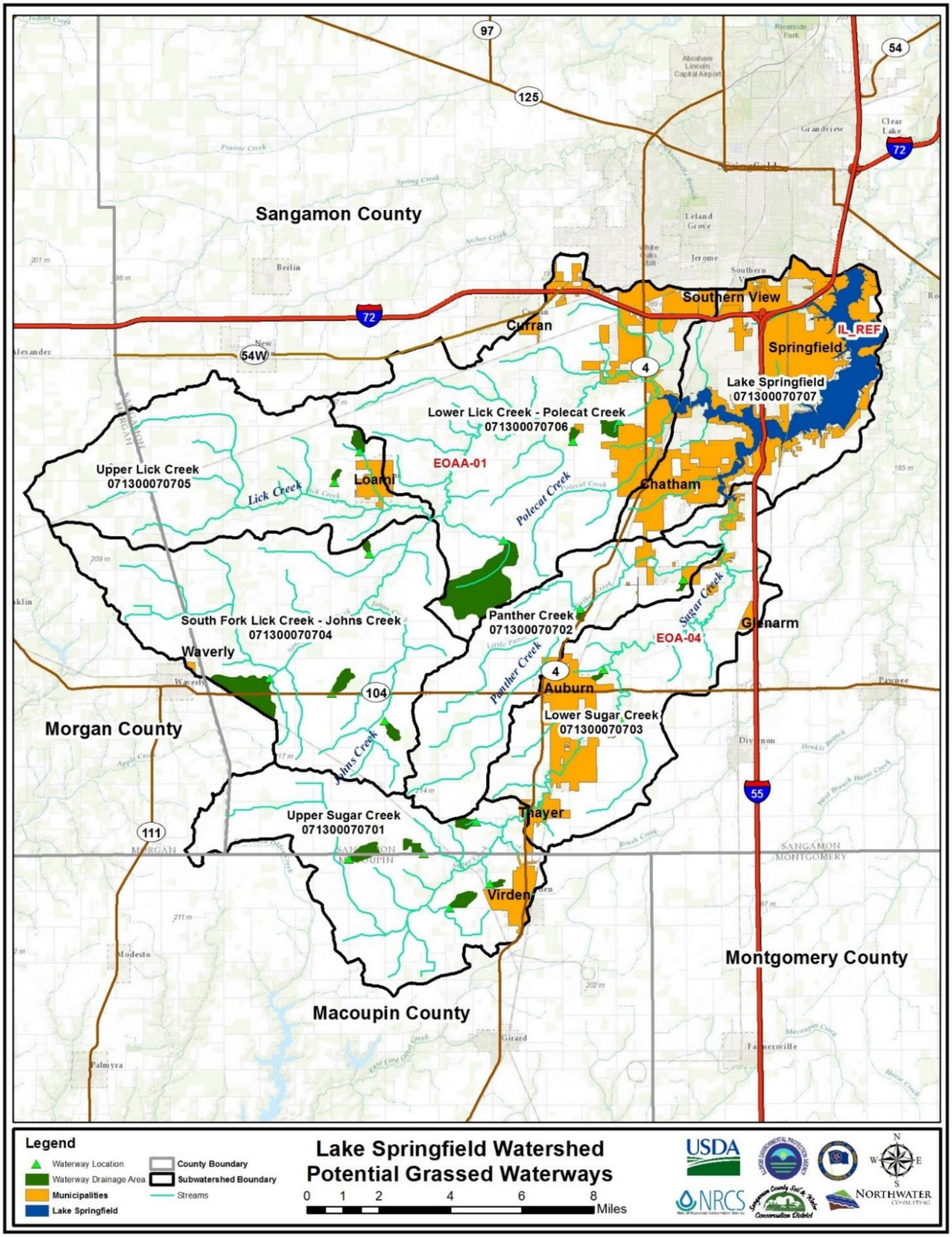


FIGURE 4.6.8 – POTENTIAL GRASSED WATERWAY SITES

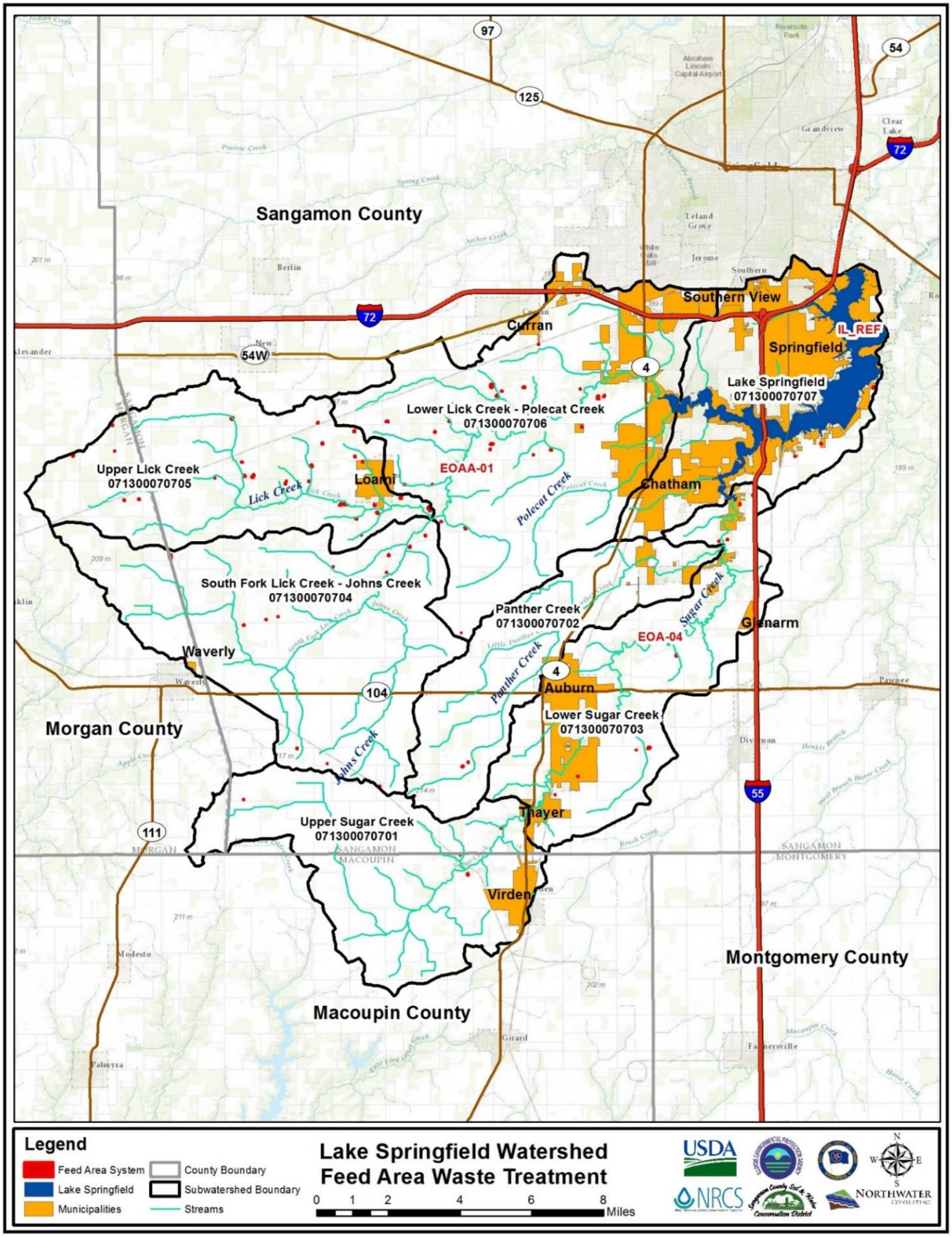


FIGURE 4.6.9 – POTENTIAL FEED AREA WASTE TREATMENT LOCATIONS

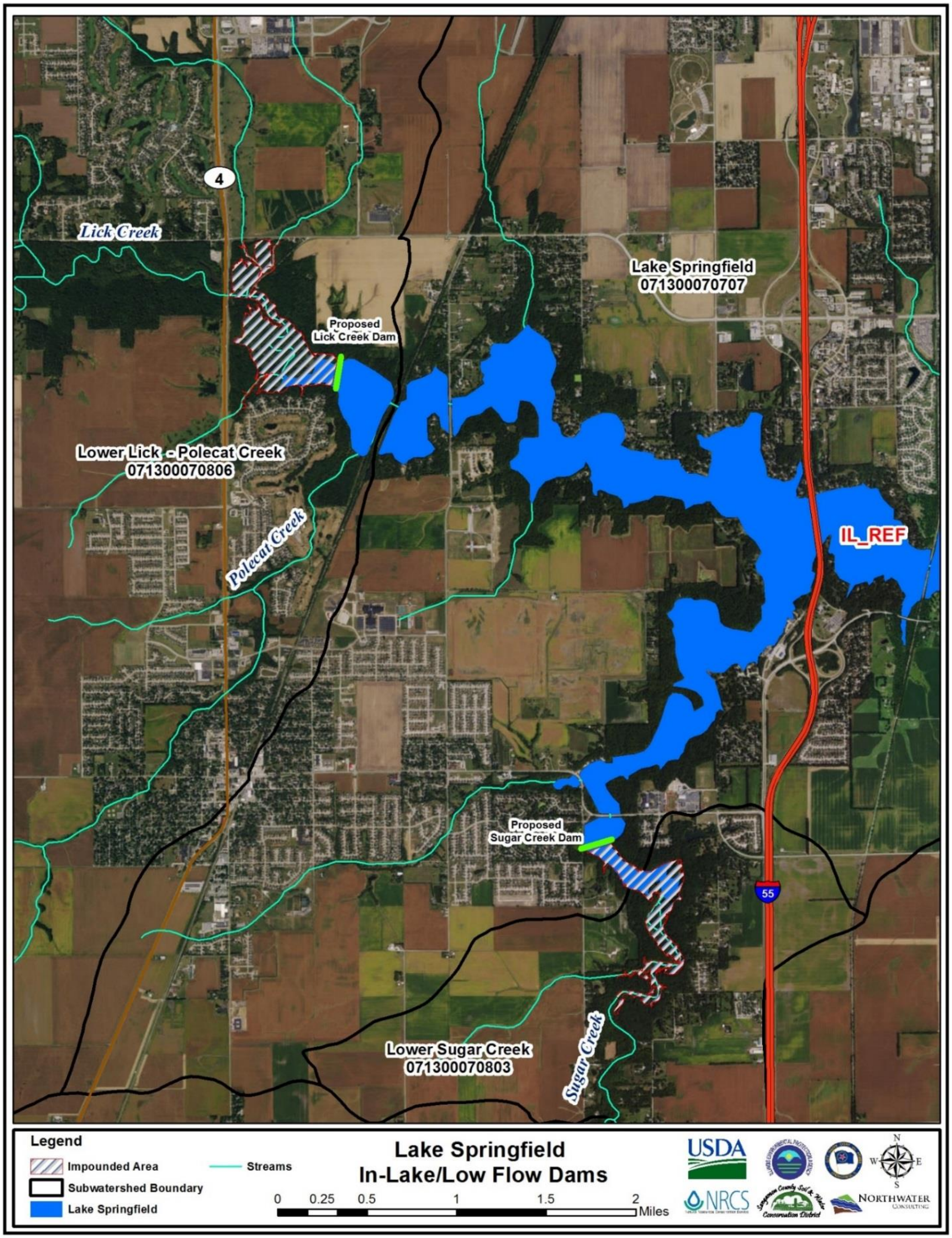


FIGURE 4.6.10—POTENTIAL IN-LAKE/LOW FLOW DAMS

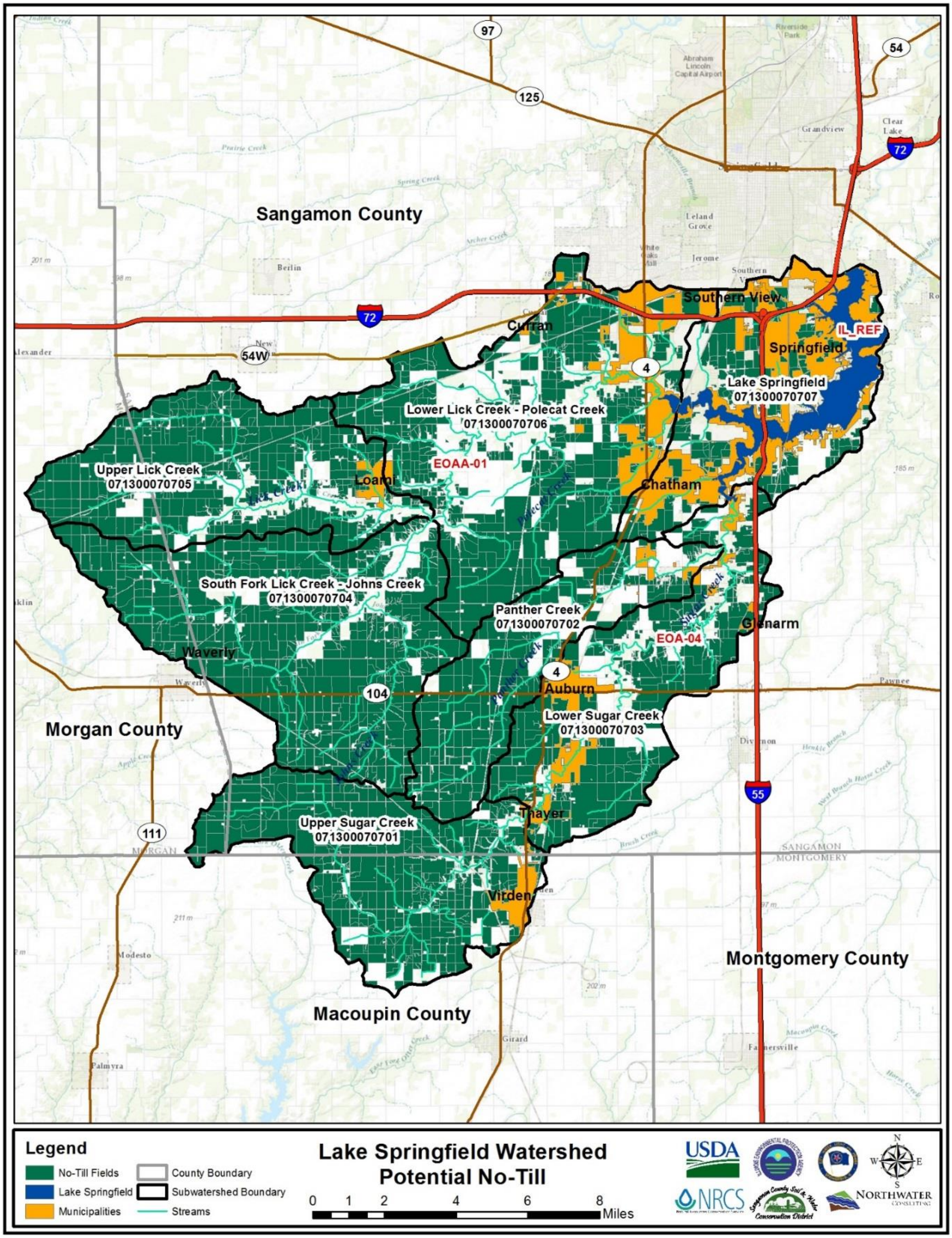


FIGURE 4.6.11 – POTENTIAL NO-TILL FIELD SITES

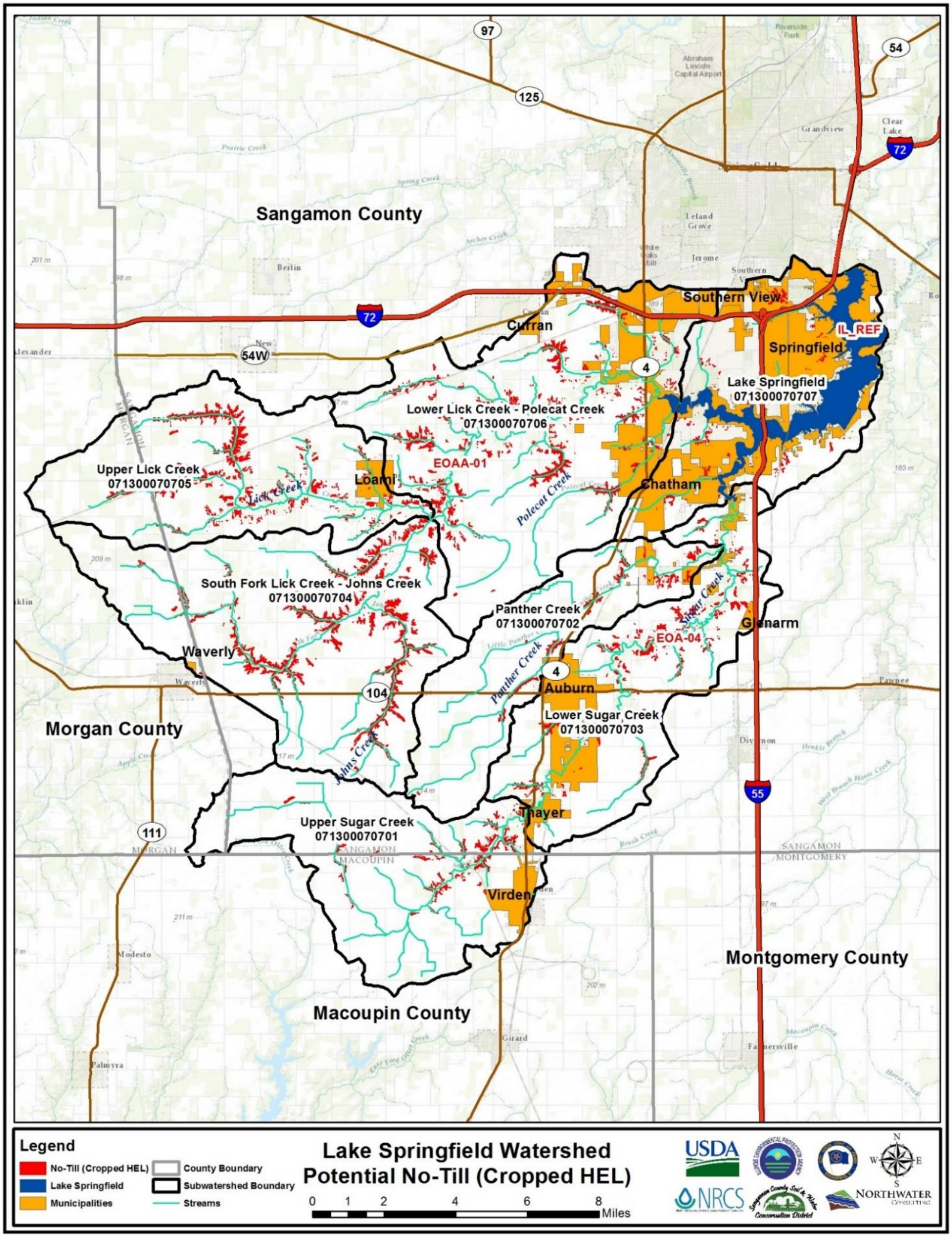


FIGURE 4.6.12 – POTENTIAL NO-TILL (CROPPED HEL) SITES

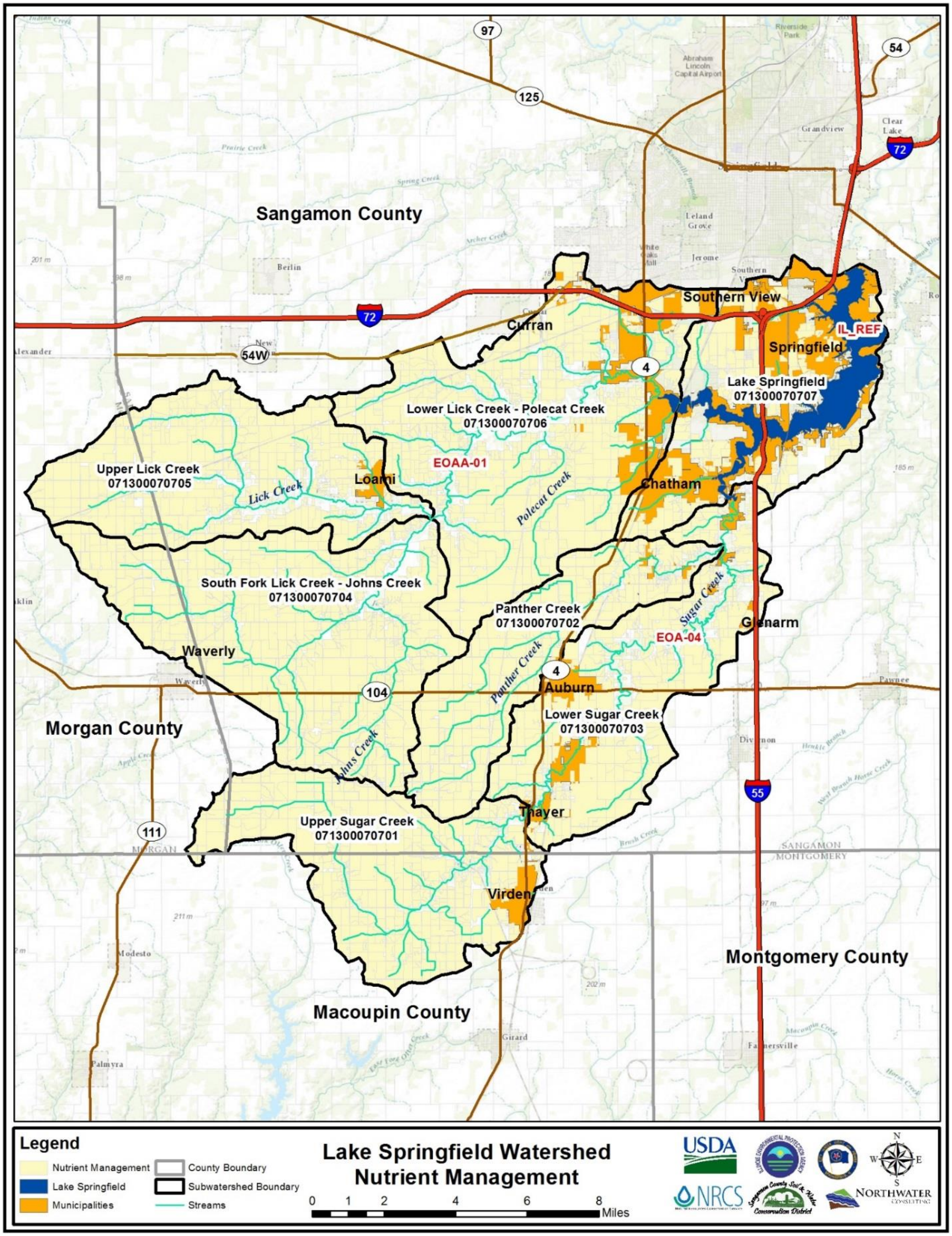


FIGURE 4.6.13 – POTENTIAL NUTRIENT MANAGEMENT PLAN FIELD SITES

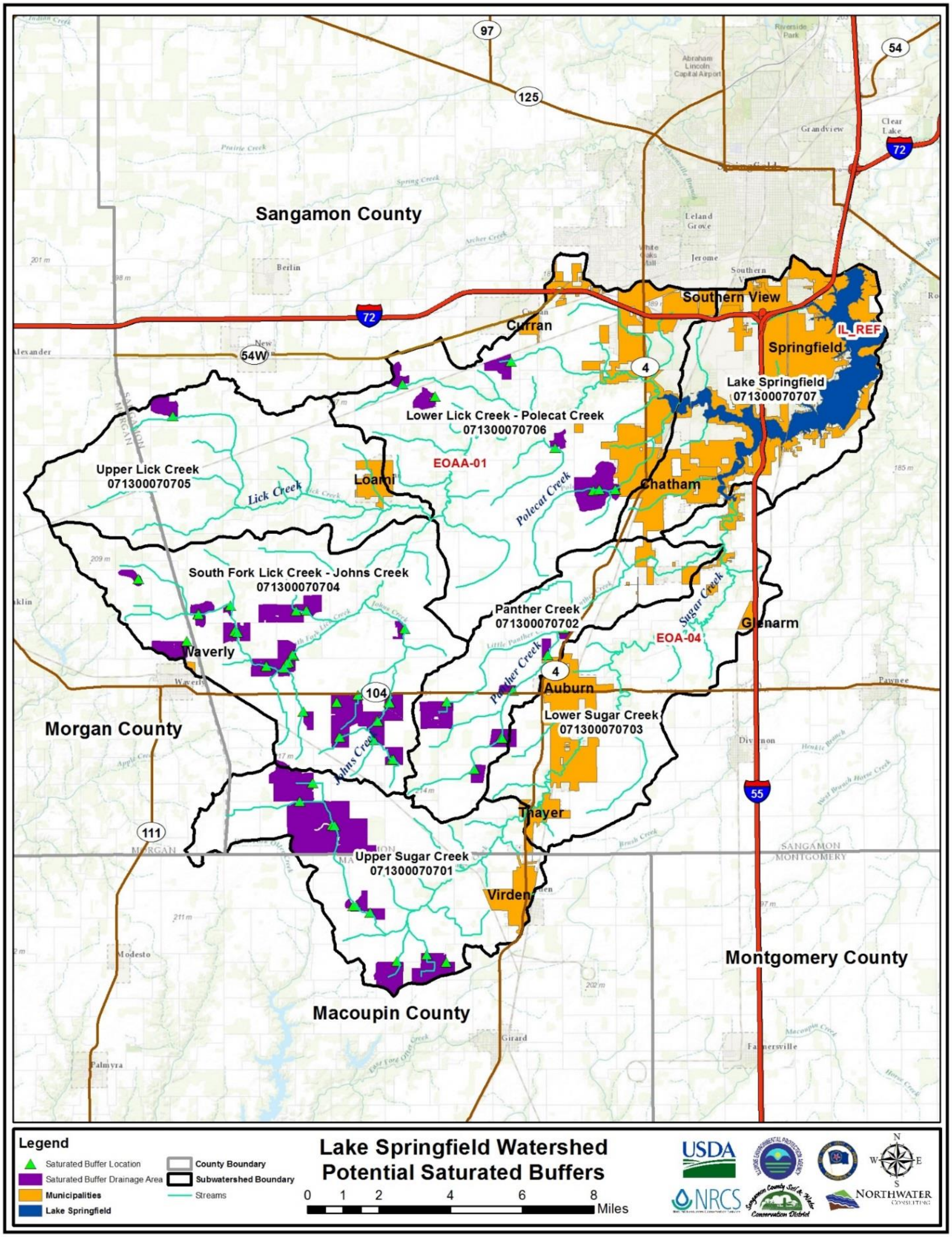


FIGURE 4.6.14 – POTENTIAL SATURATED BUFFER SITES

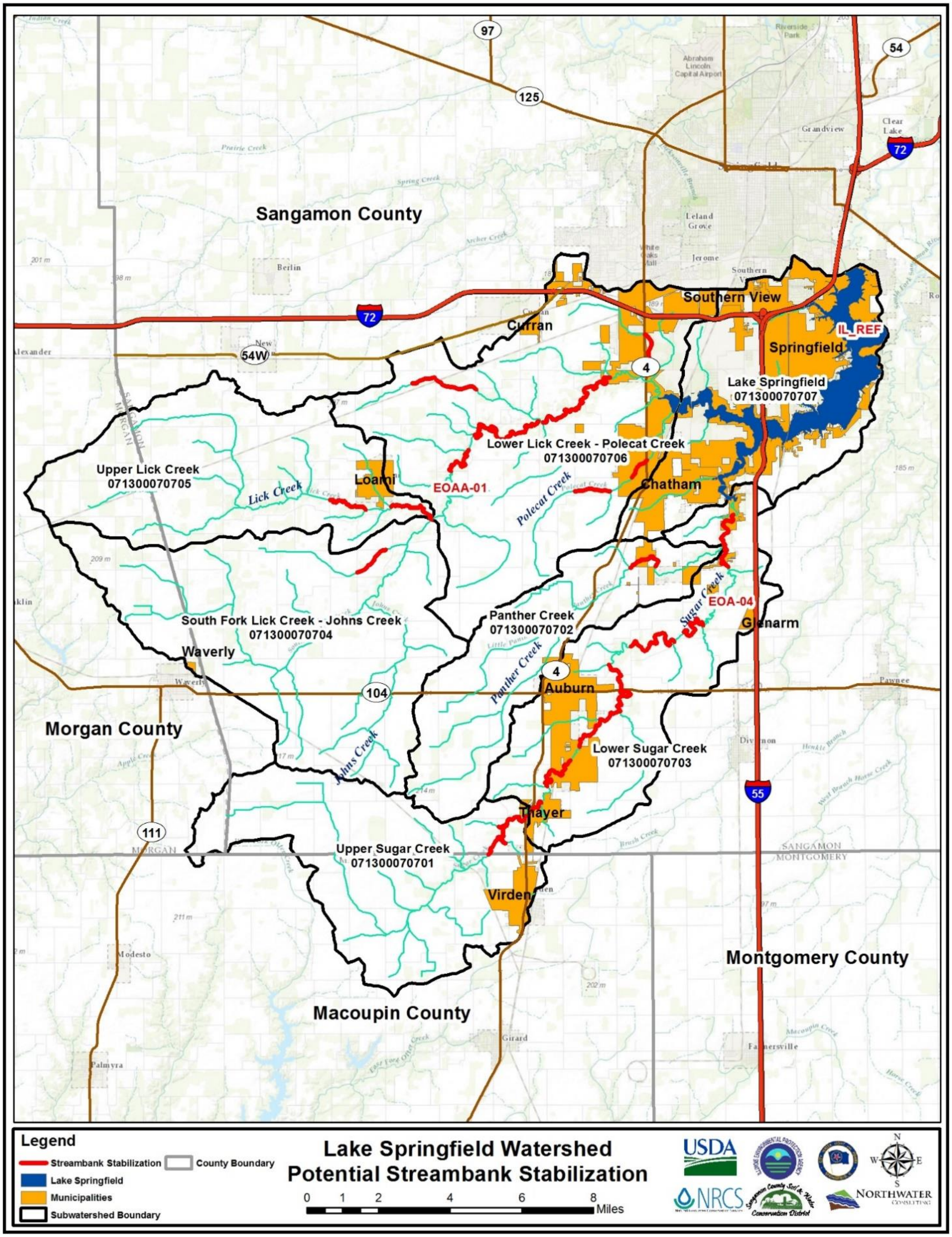


FIGURE 4.6.15 – POTENTIAL STREAMBANK STABILIZATION AREAS

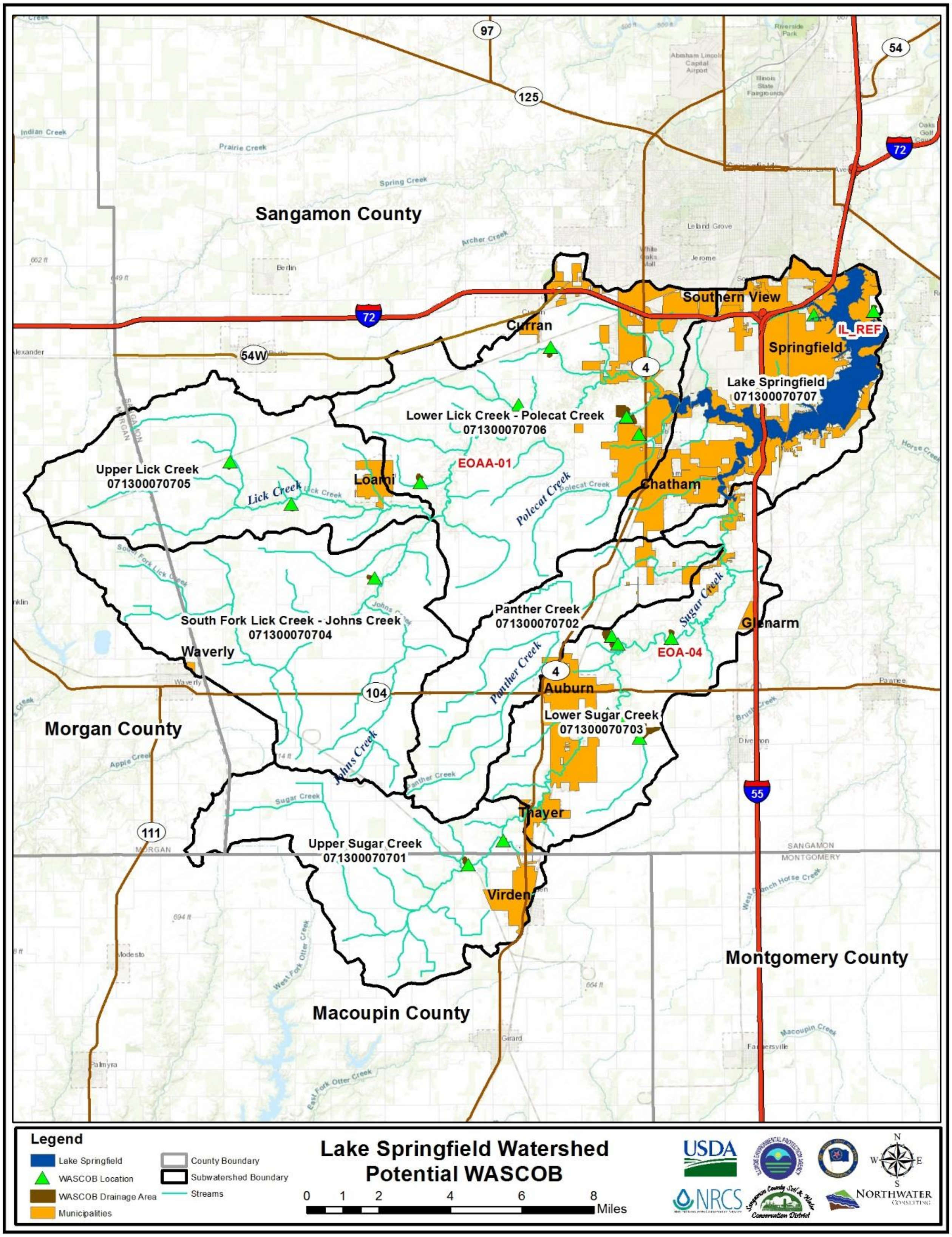


FIGURE 4.6.16 – POTENTIAL WASCOB SITES

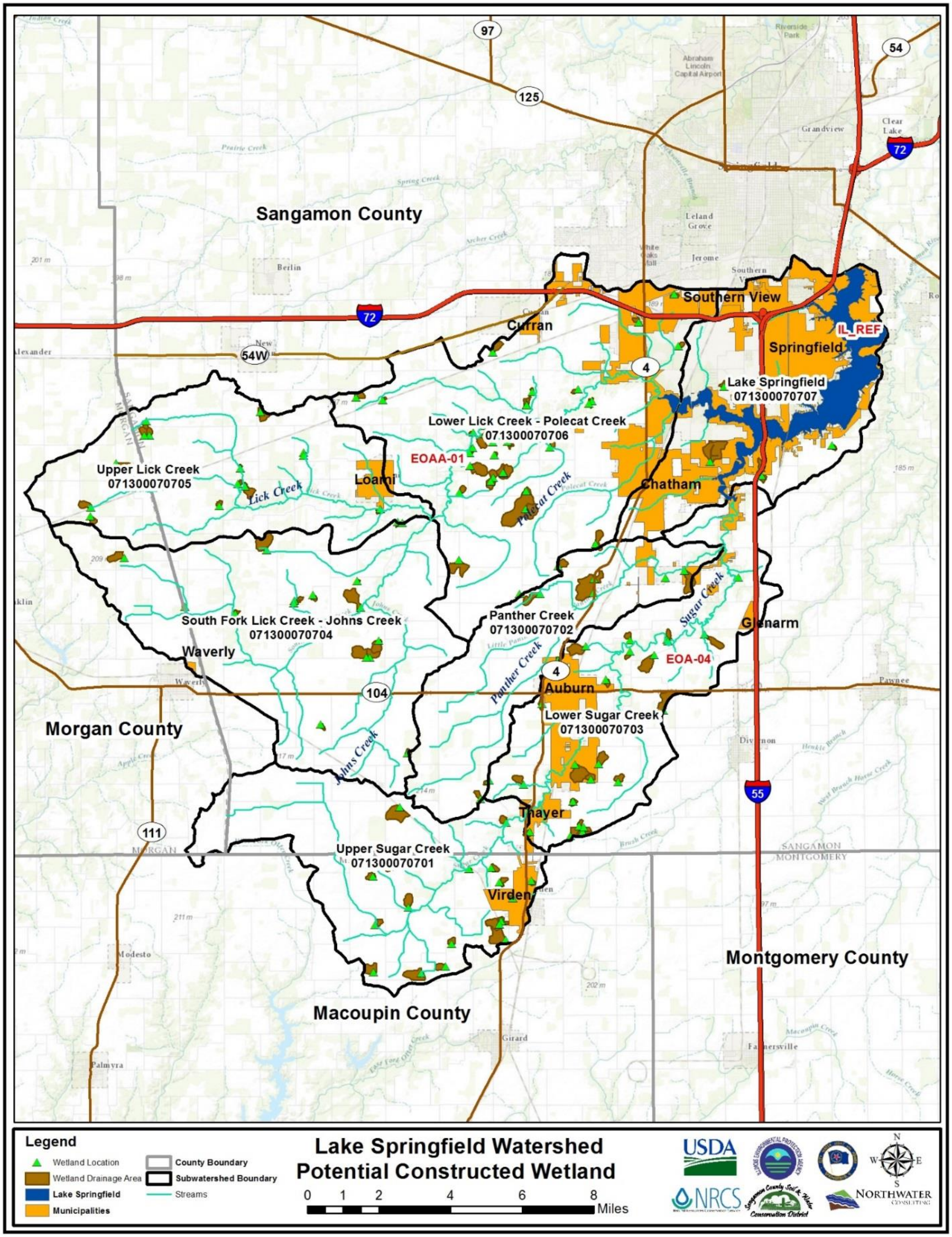


FIGURE 4.6.17 – POTENTIAL CONSTRUCTED WETLAND SITES

Critical Sub-watersheds BMPs and Plan Goals

Critical areas are those within the geographic boundaries of this watershed where BMP implementation activities need to be prioritized with the intent of achieving the greatest benefit to water quality. Meeting the 45-percent nitrogen and phosphorus reduction NLRS goals and the TMDLs for total phosphorus, total suspended solids, aquatic algae and dissolved oxygen will not happen immediately. However, by utilizing the adaptive management (phased approach) for BMP implementation, which is accepted by USEPA, it will make it possible to reach the NLRS goals and the goals of this plan.

With this watershed being divided into seven 12-digit HUCs, it seemed like the logical way to prioritize critical areas. Tier 1 is the most critical area where implementation efforts should be focused to result in the greatest benefit to water quality. Critical areas fall into two categories:

1. Critical HUC 12-digit sub-watersheds, Tier 1, Tier 2 and Tier 3. Tier 4 sub-watersheds are considered moderate priority overall and are considered important specifically for nitrogen reductions. The remaining Tier 5 sub-watersheds are also considered moderate priority.
2. Urban critical areas represented by the City of Springfield and Village of Chatham Municipal Boundary.

Table 4.6.7 lists critical areas by sub-watershed and the criteria utilized in making this designation.

However, where resources are limited, BMPs which will best treat those Lake and stream causes of impairment (total phosphorus, aquatic algae, total suspended solids, dissolved oxygen and alteration of stream-side or littoral vegetative covers) and their associated sources of impairment to streams (crop production, loss of riparian habitat, municipal point source discharges) and to Lake Springfield (agriculture, forest/grassland/parkland runoff, other recreational pollution sources, golf courses and internal nutrient recycling, deemed critical to the entire watershed, will receive priority consideration.

Critical areas which need to reduce nonpoint source pollution (sediment, phosphorus and nitrogen) which may be critical to Lake Springfield and/or the entire watershed include the following in alpha order:

- Concentrated flow areas – urban and rural areas.
- Construction erosion areas – areas being developed.
- Continuous corn fields.
- Conventionally tilled fields.
- Eroding lake shoreline areas.
- Eroding streambank areas
- Failing septic systems.
- Groundwater recharge areas.
- Gully erosion areas.
- High volume surface runoff areas.
- Highly erodible land.
- Impervious pavement areas.
- Infiltration limiting soils.
- Livestock waste areas.

- Municipal wastewater discharges.
- Tile-drained land.
- Urban and rural stormwater runoff/commercial and residential land use areas.

Based on the critical sub-watershed and critical areas and BMP priorities determined by a thorough review of the most recent watershed resource inventory information compiled for this watershed plan and discussions with LSWRPC members, the following **Table 4.6.7** lists BMP recommendations by critical sub-watersheds. While the number of BMPs to be established and a timeframe for implementation are included in this table, actual BMP implementation will vary based on cost-share funding sources, landowner participation, weather-related issues and more on critical areas than by specific sub-watershed locations. Many of the landowners/producers in the LSW farm in several of these sub-watersheds and will need to work with the agencies providing technical assistance and cost-share funding to help them prioritize their specific BMP implementation schedule.

Sub-watersheds listed in Tiers 1, 2 and 3 as Critical, High-priority areas will be recommended for BMP implementation in the first 1 to 5 years of the LSWMP's implementation schedule. Available cost-share funding will be prioritized for BMP projects based on all of the following:

- Critical areas and plan goals as defined in **Table 4.6.7 Plan Goals** within those sub-watersheds.
- Nutrient and/or sediment load reductions for the BMP.
- NRCS/SWCD inventory and evaluation of the project.
- Number and type of resource concerns being addressed.
- Project site location, size and viability.
- Landowners' willingness to implement the BMPs.
- Timeframe, potential weather factors impacting BMP implementation.
- Funding sources availability.

The same criteria above applies to those sub-watersheds listed in Tiers 4 and 5 and Urban Critical Areas as Moderate Priority areas of **Table 4.6.7 HUC 12 Prioritized Critical Sub-watersheds/BMP Priorities.** These projects will be recommended for BMP implementation within 6 to 10+ years, unless special funding is secured to expedite BMP implementation in those areas, or circumstances change over time to warrant a re-evaluation and decision by the LSWRPC to move one or more of these sub-watersheds to Critical, High-Priority areas.

Additional factors that may be considered when evaluating all BMP implementation projects are:

- Special watershed studies results. (Tillage operations, gully erosion, streambank/streambed, septic systems/water wells, subsurface drainage, detention/retention.)
- LSW water monitoring results.
- IEPA 303(d) list changes for Lake Springfield and its tributaries.
- New or renewed water quality or other environmental issues and concerns.
- Availability of new BMPs shown to be effective for nutrient loss and sedimentation.
- Opportunities for special water quality research studies, demonstration and educational sites, etc.

Criteria for Loading Reductions Progress and Achievability

A series of recommended location/land use-specific BMPs have been identified using a combination of field observations and GIS analysis. This section describes the types of BMPs, their estimated quantities and expected load reductions. **Table 4.6.8 (Surface Runoff) and Table 4.6.9 (Sub-surface Flow)** include pollutant removal efficiencies by BMP used to calculate expected load reductions. Schedule is based on several factors, including BMP priority and funding availability.

TABLE 4.6.7 - HUC 12 PRIORITIZED CRITICAL SUB-WATERSHEDS/BMP PRIORITIES

Critical Area Sub-watershed/ City/Village	Area (acres)	Tier	Criteria for Selection	BMP Priorities	
Panther Creek **HUC 071300070702**	**15,072**	Tier 1 – Critical High Priority Implementation 1 – 5 Years	Close proximity for pollutants to be delivered to Lake Springfield High overall percentage of cropped HEL soils Future potential for urban sprawl and development Stream sampling suggests high phosphorus concentrations Lack of previous conservation efforts A priority area for the Lake Springfield Planning Committee's Agricultural sub-committee	No-till/Strip-till on conventionally-tilled cropped HEL Filter strips Field borders Detention basin/pond Cover crops WASCOBS/terrace	
South Fork Lick Creek – Johns Creek **HUC 071300070704**	**31,203**	Tier 2 – Critical High Priority Implementation 1 – 5 Years	Highest total and nitrogen, phosphorus and sediment loads Highest per-acre nitrogen and phosphorus load 2nd highest per-acre sediment load Substantial BMP opportunities Stream and tile sampling suggests high nitrogen concentrations High number of eroding gullies High percentage of conventional tillage High percentage conventionally tilled HEL soils	Grassed waterways WASCOBS Saturated buffers Nutrient management CRP filter strips No-till/Strip-till Cover crops Field borders	
Lower Lick Creek – Polecat Creek **HUC 071300070706**	**32,392**	Tier 3 – Critical High Priority Implementation 1 – 5 Years	Second highest total sediment and phosphorus load Stream and tile sampling suggests high nitrogen concentrations High percentage of cropped HEL soils Future potential for urban sprawl and development High potential for landowner participation Close proximity to Lake Springfield	No-till/Strip-till Cover crops Grassed waterways Nutrient management Cover crops Field borders	WASCOBS/terrace Detention/pond Pasture/feed area management Wetlands CREP crop conversion

Critical Area Sub-watershed/ City/Village	Area (acres)	Tier	Criteria for Selection	BMP Priorities
Upper Sugar Creek **HUC 071300070701** **Upper Lick Creek** **HUC 071300070705**	22,189 21,782 **43,971**	Tier 4 – Moderate Priority Implementation 6 – 10 Years+	High per-acre nitrogen, phosphorus and sediment loads High percentage of conventionally tilled HEL soils Stream and tile sampling suggests high nitrogen concentrations Substantial BMP opportunities	Nutrient management Bioreactor Drainage water management Saturated buffers No-till Cover crops Pasture/feed area management Filter strips
Lower Sugar Creek **HUC 071300070703** **Lake Springfield** **HUC 071300070707**	21,422 21,470 **47,172**	Tier 5 – Moderate Priority Implementation 6 -10 years+	High streambank erosion rates Stream sampling indicates high phosphorus and sediment concentrations High urban area density High failing septic systems potential	Streambank stabilization Lake shoreline stabilization Grade control structures Wetlands Detention/pond Septic system inspections
City of Springfield & Village of Chatham	**20,306**	Urban Critical Area – Moderate Priority Implementation 6 – 10 years+	Represent the largest percentage of urban areas within the watershed Close proximity to Lake High rates of runoff High percentage impervious areas Lack of existing detention Focus of Lake Springfield Watershed Planning Committee Urban Sub-committee members Substantial opportunity for urban BMPs	Urban detention/retention Education and outreach Rain barrels and rain gardens Septic system inspections Porous/permeable pavement

TABLE 4.6.8 – AVERAGE POLLUTANT REMOVAL EFFICIENCY PERCENTAGES: SURFACE RUNOFF

Best Management Practice	Nitrogen Reduction	Phosphorus Reduction	Sediment Reduction
Bioreactor	0%	0%	0%
Cover Crop/No-Till	30%	30%	40%
Drainage Water Management	0%	0%	0%
Field Borders	35-40%	40-45%	45-55%
Filter Strip	30-50%	35-55%	40-65%
Grade Stabilization Structure*	*	*	*
Grassed Waterway*	10-15%	15-25%	20-35%
Livestock Feed Area Waste System	65%	70%	75%
Livestock Pasture Management	40-45%	45-50%	55-60%
Nutrient Management Plan	0%	12%	0%
Permanent Vegetative Cover (CREP/SAFE)	75%	75%	75%
Retention Practices/Retention Basin	35-50%	40-55%	45-70%
Saturated Buffer	5-50%	5-55%	5-65%
Stream Grade Control Structure/ Rock Riffle*	2-5%	15-30%	20-40%
Terrace/WASCOB	25%	60%	65%
Wetland	25%-50%	30-55%	35-70%

*treats 100% of sediment from gully erosion – Grade stabilization structures are generally installed with grassed waterways and the percent of removal efficiencies would be included with the grassed waterway BMP.

TABLE 4.6.9 – AVERAGE POLLUTANT REMOVAL EFFICIENCY PERCENTAGES: SUB-SURFACE FLOW

Best Management Practice	Nitrogen Reduction Percentage	Phosphorus Reduction Percentage	Sediment Reduction Percentage
Bioreactor	40%	5%	0%
Cover Crop/No-Till	30%	10%	0%
Drainage Water Management	40%	10%	0%
Field Borders	5-10%	5%	0%
Filter Strip/Riparian Buffers	5%	5%	0%
Grade Control Structure/Rock Riffle	0%	0%	0%
Grass Waterway	0%	0%	0%
Livestock Feed Area Waste Systems	0%	0%	0%
Livestock Pasture Management	0%	0%	0%
Nutrient Management Plan	15%	40%	0%
Permanent Vegetative Cover	90%	45%	0%
Retention/Detention Basin	5%	5%	0%
Saturated Buffer	50%	25%	0%
Terrace/WASCOB	0%	0%	0%
Wetland	30-40%	0%	0%

Site-specific BMPs

Site-specific BMPs to be established within the first 1 to 5 years of the LSWMP are shown in **Table 4.7.1**. Projects were prioritized by cost effectiveness and landowner willingness to immediately implement the BMPs. Of the 13 land use site-specific BMP projects, five are in the **Lower Sugar Creek** sub-watershed, three in the **Lake Springfield** sub-watershed, three in the **Upper Lick Creek** sub-watershed, one in the **Lower Lick Creek—Polecat Creek** sub-watershed, one in the **South Fork Lick Creek-Johns Creek** sub-watershed. The LSWRPC will add to the site-specific BMP list as they are identified, field verified and available for implementation.

TABLE 4.7.1 – SITE-SPECIFIC BMPS

Site-specific BMPS	Number of Sites	Total Units	Estimated Costs
Grade Stabilization Structures	4	4 structures	40,000
Grassed Waterways (acres)	8	17 acres	64,000
Livestock Exclusion System	1	4,787 feet	10,000
Shoreline Stabilization	1	1,500 feet	108,000
Water and Sediment Control Basin/Terrace	1	1 system	16,000
Woodland Improvement	1	70 acres	18,760
			$256,760
Edge-of-Field BMPs			
Filter Strips/Riparian Buffers	8	16 acres	$11,200
Field Borders	6	12 acres	8,400
			$19,600
Watershed-wide BMPs			
Conservation Tillage	50	4,000 acres	N/A
Cover Crops	500	5,000 acres	150,000
Nutrient Management Plans	40	2,000 acres	80,000
			230,000
Total			**$506,360**

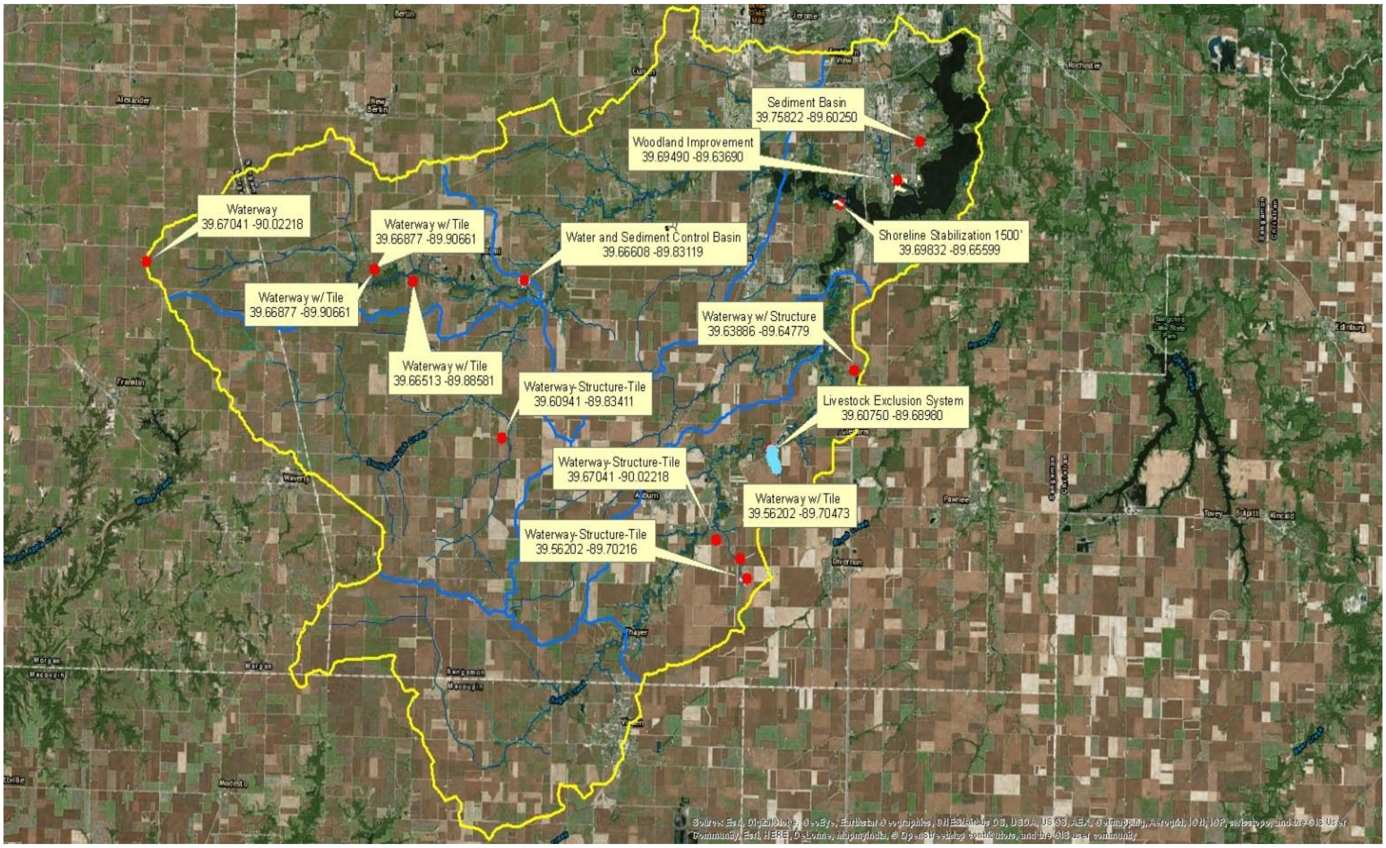


FIGURE 4.7.0-1 – SITE-SPECIFIC BMP LOCATIONS MAP

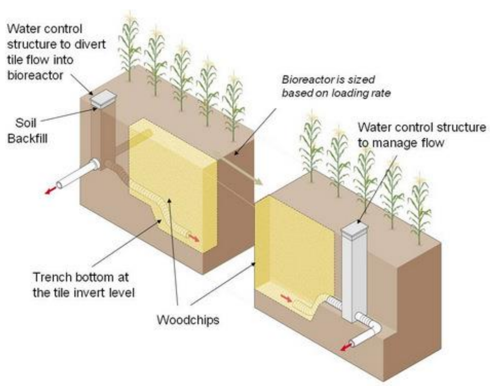
TABLE 4.7.2– SITE-SPECIFIC BMP LOCATIONS

Sub-watershed Code	Sub-watershed	Best Management Practice	Latitude	Longitude
071300070703	Lower Sugar Creek	Grassed Waterway/Tile	39.56202	-89.70473
071300070703	Lower Sugar Creek	Grassed Waterway/Tile Grade Stabilization Structure	39.67041	-90.02218
071300070703	Lower Sugar Creek	Grassed Waterway/Tile Grade Stabilization Structure	39.56202	-89.70216
071300070703	Lower Sugar Creek	Livestock Exclusion System	39.60750	-89.68980
071300070703	Lower Sugar Creek	Grassed Waterway/Tile Grade Stabilization Structure	39.63886	-89.64779
071300070704	South Fork Lick Creek—Johns Creek	Grassed Waterway/Tile Grade Stabilization Structure	39.60941	-89.83411
071300070705	Upper Lick Creek	Grassed waterway	39.67041	-90.02218
071300070705	Upper Lick Creek	Grassed Waterway/Tile Grade Stabilization Structure	39.66877	-89.90661
071300070705	Upper Lick Creek	Grassed Waterway/Tile	39.66513	-89.88581
071300070706	Lower Lick Creek—Polecat Creek	Water & Sediment Control Basin/Grassed Waterway	39.66608	-89.83119
071300070707	Lake Springfield	Sediment Basin	39.75822	-89.60250
071300070707	Lake Springfield	Shoreline Stabilization	39.69832	-89.65599
071300070707	Lake Springfield	Woodland Improvement	39.69490	-89.63690

Watershed-wide Best Management Plan Practices Details and Plans

Bioreactors (Denitrifying)—CPS 605

A bioreactor is an edge-of-field treatment process which allows the producer to reduce the amount of nitrogen leaving the field from a tile line, improving water quality of the receiving stream. It consists of a buried pit filled with a carbon source, commonly wood chips, through which tile water is diverted. The carbon provides material which serves as a food source for microorganisms. In the low oxygen environment, the microbes use the nitrate to metabolize the carbon, converting the nitrate to harmless atmospheric nitrogen (N_2) gas.



A bioreactor is a structure containing a carbon source, installed to reduce the concentration of nitrate nitrogen in subsurface agricultural drainage flow via enhanced denitrification. One bioreactor system can treat approximately 50 acres.

Bioreactors have no adverse effects on crop production and do not restrict drainage. They provide an organic last line of defense against subsurface nitrates, removing 35 to 50 percent of nitrates from water flowing through them and are relatively inexpensive to install and maintain.

BIOREACTOR SYSTEM AT LINCOLN LAND COMMUNITY COLLEGE

Many bioreactors are constructed as part of a drain water management system which can include installation of drain water management structures and field tile in a grassed waterway.

Bioswales (Grass Lined Channels)—IUM 840

A bioswale is a stormwater runoff delivery system that provides an alternative to storm sewers which can absorb low flows or carry runoff from heavy rains to storm sewer inlets or directly to surface waters. It improves water quality by infiltrating the first flush of stormwater runoff and filtering water from large storm flows.

When possible, enhance and utilize the existing natural drainage swales by planting native plants and thicker and heavier grasses to filter out contaminants. Subgrade drains and amended soils may be needed to facilitate infiltration. When designing or maintaining bioswales, it is important to also consider the following:

- Variability of costs based on size, plant material and site considerations. Bioswales are less expensive when used in place of underground piping.
- For infiltration and reduced maintenance, use deep-rooted native plants.
- Soil infiltration rates should be greater than one-half inch per hour.
- A parabolic or trapezoidal shape with side slopes no steeper than 3:1 is recommended.
- Soil compaction during installation should be avoided.
- Bioswales should be sized to deliver at least a 10-year storm (4.3 inches in 24 hours).

Brush Management—CPS 314

NRCS Conservation Practice Standard Code 314, Brush Management, defines brush management as the management or removal of woody (non-herbaceous or succulent) plants, including those that are invasive and noxious for the following purposes:

- Create the desired plant community consistent with the ecological site.
- Restore or release desired vegetative cover to protect soils, control erosion, reduce sediment, improve water quality or enhance stream flow.
- Maintain, modify or enhance fish and wildlife habitat.
- Improve forage accessibility, quality and quantity for livestock and wildlife.
- Manage fuel loads to achieve desired conditions.

This practice applies on all lands, except cropland, where the removal, reduction, or manipulation of woody plants (non-herbaceous or succulent) is desired. It does not apply to removal of woody vegetation by prescribed fire (use Prescribed Burning NRCS CPS Code 338) or removal of woody vegetation to facilitate a land use change (use Land Clearing NRCS CPS Code 460).

General criteria applicable to all purposes include:

- Designed to achieve the desired plant community based on species composition, structure, density and canopy (or foliar) cover or height.
- Applied in a manner to achieve desired control of the target woody species and protection of desired species by mechanical, chemical, burning or biological methods, either alone or in combination. NRCS will not develop biological or chemical treatment recommendations, except for biological control utilizing grazing animals, but may provide clients with acceptable biological and/or chemical control references.
- Use NRCS CPS Code 666, Forest Stand Improvement, when intent is to manage trees for silvicultural purposes.

Additional criteria, considerations, plans and specifications and operation and maintenance information are available in NRCS CPS Code 314, Brush Management.

Commercial and Residential Detention Basins (Stormwater Runoff Control) —CPS 570

Detention basins are appropriate for urban commercial and industrial sites, but are not designed to infiltrate stormwater at the site. Commercial detention basins (ponds) are cost-effective and primarily used to:

- Manage stormwater and pollutant runoff from commercial buildings and adjacent parking lots.
- Provide for temporary stormwater runoff storage
- Help alleviate local flooding by reducing peak rate of surface water runoff into storm sewers and streams.
- Provide water quality benefits.

- Reduce streambank erosion downstream.
- Provide wildlife habitat when area around detention basin is landscaped.

Detention ponds are generally less effective at removing pollutants because they release all captured runoff over time and do not allow for the permanent ponding of water. However, they are suited for placement at all sites, including large sites, where a substantial volume of runoff needs to be contained. Frequently, detention basins are used at sites where other stormwater BMPs do not apply or are not effective.

The primary difference between a detention and a retention basin is whether or not it has a permanent pool of water – like a "traditional" pond. The water level is established by the low flow orifice. Most of the time the orifice is part of a metal or concrete structure called a riser. A **detention basin**, or dry basin, has an orifice level with the bottom of the basin so that all of the water eventually drains out and it remains dry between storms – hence, a dry basin**.** A **retention basin** has a riser with an orifice at a higher point so that it retains a permanent pool of water.

Retention (Wet Ponds/Basins)
Retention ponds, known as wet ponds, continually have a pool of water in them called dead storage. A retention basin is used to manage stormwater runoff to prevent flooding and downstream erosion, and improve water quality in an adjacent river, stream, lake or bay. Sometimes called a wet pond or wet detention basin or stormwater management pond, it is an artificial lake with vegetation around the perimeter, and includes a permanent pool of water in its design. Stormwater is typically channeled to a retention basin through a system of street and/or parking lot storm drains, and a network of drain channels or underground pipes. The basins are designed to allow relatively large flows of water to enter, but discharges to receiving waters are limited by outlet structures that function only during very large storm events.

Retention ponds are often landscaped with a variety of grasses, shrubs and/or wetland plants to provide bank stability and aesthetic benefits. Vegetation also provides water quality benefits by removing soluble nutrients through uptake. In some areas, the ponds can attract nuisance types of wildlife like ducks or Canada geese, particularly where there is minimal landscaping and grasses are mowed. This reduces the ability of foxes, coyotes and other predators to approach their prey unseen. Such predators tend to hide in the cattails and other tall, thick grass surrounding natural water features.

Usually a retention pond is constructed because of a high groundwater table where groundwater is near the surface of the earth. The bottom of the pond is excavated below the water table elevation to establish a permanent pool. The outlet of the pond is placed at or above the desired pool elevation. The volume of the permanent pool is set by a desired residence time to allow microbes and vegetation in the water to consume nutrients and to allow suspended pollutants to settle. In general, retention ponds require more area than a detention pond due to constraints in the allowable depth of water to maintain the vegetation on the pond. The level of water in the pond is maintained by setting the outlet structure above the pond bottom at the groundwater elevation.

Sediment in the runoff settles down in the calm waters of the **retention pond**, and chemicals, such as lawn fertilizers, are consumed by naturally occurring aquatic vegetation. As a result of natural processes, cleaner water slowly drains from the **retention ponds** into the rivers.

RETENTION POND IN LAKE SPRINGFIELD WATERSHED

Detention (Dry Basins/Ponds)
A detention basin is a sediment or water impoundment made by constructing an earthen dam to manage stormwater runoff, to prevent flooding and downstream erosion following heavy rain events. Detention basins do not have dead storage and dry out between storms (EPA 2001). A detention basin, sometimes called a "dry pond," which temporarily stores water after a storm, eventually empties out at a controlled rate to a downstream water body.

Detention ponds help control the rate of flow by using a control device that maintains the pre-development rate of flow. The volume of the detention pond is calculated by comparing the pre- and post- development runoff volumes. The difference is the detention volume. Usually, the control device is placed at the entrance to the outlet pipe to control the rate of flow to the pre-development rate. The pond is intended to drain the stormwater within a period of time to make the volume available for the next storm event. The outlet pipe (or control device) is placed at the bottom elevation of the detention volume to allow the pond to drain dry.

Infiltration Basin (Recharge Basin)
An infiltration basin is known as a recharge basin (sump) and is used to:

- Manage stormwater runoff.
- Prevent flooding and downstream erosion.
- Improve water quality in an adjacent water body.

An infiltration basin is a shallow artificial pond designed to direct stormwater to groundwater through permeable soils into the groundwater aquifer. They do not release water, except by infiltration, evaporation or emergency overflow during flood conditions. Infiltration basins have been less effective in areas with:

- High groundwater levels close to the infiltrating surface.
- Compacted soils.
- High levels of sediment in stormwater.
- High clay soil content.

Conservation Tillage, Residue and Tillage Management, Reduced Till – CPS 345

According to NRCS Conservation Practice Standard (CPS) 345, conservation tillage is managing the amount, orientation and distribution of crop and other plant residue on the soil surface year-round, while limiting soil-disturbing activities used to grow and harvest crops in systems where the field surface is tilled prior to planting.
The purposes of conservation tillage (reduced till) on all cropland are to:

- Reduce sheet, rill and wind erosion and excessive sediment in surface waters (soil erosion).
- Reduce tillage-induced particulate emissions (air quality impact).
- Improve soil health and maintain or increase organic matter content (soil quality degradation).
- Reduce energy use (inefficient energy use).

General criteria applicable to all reduced-till purposes include:

- Mulch tillage or conservation tillage where the entire soil surface may be disturbed by one or more of these tillage operations:
  - Chisel plowing.
  - Field cultivating.
  - Tandem disking.
  - Vertical tillage.
- Uniformly distribute residues over the entire field.
- Do not burn residues.
- The crop interval Soil Tillage Intensity Rating (STIR) value rating shall be no greater than 80 for year-to-year soil disturbance field operations and no primary inversion tillage implements (e.g. moldboard plow) shall be used.

Additional considerations are included in the NRCS Standard Practice Code 345 for each of the purposes listed above.

General considerations include:

- Removal of crop residue (baling or grazing) can have a negative impact on resources and should not be performed without full evaluation of impacts on soil, water, animal, plant and air resources.
- Reduced till may be practiced continuously throughout the crop sequence, or may be managed as part of a residue management system such as no-till.
- Selection of high residue-producing crops in the rotation, use of cover crops and adjustment of plant populations and row spacing can produce adequate amounts of crop residue necessary for the proper functioning of this practice.
- For organic crop production, ensure residue and tillage management activities are consistent with USDA Agricultural Marketing Service National Organic Program regulations.

Plans and specifications should be prepared for each site and purpose and recorded in an approved implementation requirements document:

- Purpose for applying the practice.
- Planned crops.
- Amount of residue produced by each crop.
- All field operations or activities that affect:
    - Residue orientation.
    - Surface disturbance.
    - Field operations and amount of residue (pounds/acre or percent surface cover) required to accomplish the purpose, and time of year it must be present.
    - Planned STIR value, Soil Condition Index (SCI) value and erosion rate.
    - Benchmark and planned energy consumptions.

Operation and maintenance plans include:

- Evaluate/measure the crop residue cover and orientation for each crop to ensure the planned amounts are being achieved.
- Adjust management as needed to either:
    - Plan a new residue amount or orientation.
    - Adjust planting, tillage or harvesting equipment.
- Areas of heavy residue accumulation can be spread prior to planting to avoid interference with planter operation.

Cover Crops—CPS 340

Cover crops are close-growing crops that can adequately protect the soil during the months following harvest through early spring (mid-October through early April) when soil is most vulnerable to soil erosion. For livestock producers, planting palatable cover crop species can also provide supplemental forage for feeding their animals, while still providing protection for the soil. Cover crops should be seeded and terminated in accordance with Illinois' NRCS standards and guidelines.

Cover crop purposes:

- Add organic matter to the soil.
- Build soil tilth, improving soil health.
- Improve soil microbiology.
- Increase nutrient recycling.
- Increase soil porosity and infiltration.
- Keep ground covered during critical erosion periods.
- Protect water quality.
- Reduce winter annual weed competition.
- Reduce pests, breaking pest cycles.
- Minimize and reduce soil compaction.
- Reduce soil and wind erosion.

Cover crops can be applied over a relatively broad area in the watershed, where no-till is occurring, or on tile-drained fields to sequester the nutrients from fall to early spring and reduce the amount of nutrients leaving the field through the tile lines which ultimately enter the LSW streams. Cereal rye is the most common cover crop seeded in this watershed. It can be aerial seeded, drilled, spread with fertilizer with a dry fertilizer or air flow applicator. It is one of the least expensive cover crops, quick germination and emergence and provides full coverage until it is terminated in the spring.

LSW COVER CROP PROGRAM PARTICIPANT

CEREAL RYE COVER CROP

Another popular cover crop option is seeding daikon radish with a nurse crop of oats. While this cover crop mixture may be more expensive to establish, radishes and oats are normally aerially seeded into the standing crop in the late summer/early fall months prior to harvest, giving them a longer growing period and then terminate when the first killing frost hits. One disadvantage to radishes is the offensive smell they emit when dying. Radishes may not be a good option for fields near a residential area.

Critical Area Planting—CPS 342

According to NRCS CPS Code 342, critical area planting is the establishment of permanent vegetation on sites that have, or are expected to have, high erosion rates, and on sites that have physical, chemical or biological conditions that prevent the establishment of vegetation with normal practices. Critical area plantings can be used to:

- Stabilize stream and channel banks and shorelines.
- Stabilize areas with existing or expected high soil erosion rates by water or wind.
- Rehabilitate and revegetate degraded sites that cannot be stabilized using normal stabilization techniques.

Highly disturbed areas needing critical area plantings include:

- Eroded banks of natural stream channels.
- Banks along newly constructed channels.
- Lake shorelines.
- Locations degraded by natural events or human activities.
- Urban construction sites.
- Road construction sites.
- Conservation practice construction sites.
- Areas affected before or after natural disasters (floods, tornadoes, wildfires, etc.)

Areas to be planted need to meet NRCS criteria designated for:

- Site preparation.
- Species selection.
- Establishment of vegetation.
- Additional criteria to stabilize stream and channel banks and shorelines.
- Site protection and access control for grazing animals.

Other considerations for critical area plantings include:

- Use of native species when appropriate for the site.
- Selection of a diverse mixture of legumes and forbs to support pollinator habitat and other wildlife.
- Consider species diversity.
- Avoid species that may harbor pests.
- Limit management activities (mowing, spraying) in a manner and at times that cause the least disruption to wildlife.
- Address the following elements in the preparation and management of the critical area:
    - Site preparation

- Topsoil requirements
- Seedbed/planting area preparation
- Methods and time of seeding/planting
- Selection of species, seed/plant source/seed analysis
- Seeding rate/plant spacing
- Mulching
- Supplemental water needed for establishment
- Protection of plantings.

Diversion—CPS 362

A water diversion is a channel generally constructed across the slope with a supporting ridge on the lower side. As noted in NRCS Conservation Practice Standard Code 362 for Diversion, several purposes for establishing diversions are:

- Break up concentrations of water on long slopes, on undulating land surfaces, and on land that is generally considered too flat or irregular for terracing.
- Divert water away from farmsteads, agricultural waste systems, and other improvements.
- Collect or direct water for storage, water-spreading or water-harvesting systems.
- Protect terrace systems by diverting water from the top terrace where topography, land use, or land ownership prevents terracing the land above.
- Intercept surface and shallow subsurface flow.
- Reduce runoff damages from upland runoff.
- Reduce erosion and runoff on urban or developing areas and at construction or mining sites.
- Divert water away from active gullies or critically eroding areas.
- Supplement water management on conservation cropping or strip-cropping systems.

Capacity. Diversions as temporary measures, with an expected life span of less than 2 years, shall have a minimum capacity for the peak discharge from the 2-year frequency, 24-hour duration storm. Diversions that protect agricultural land shall have a minimum capacity for the peak discharge from a 10-year frequency, 24-hour duration storm.

Diversions designed to protect areas such as urban areas, buildings, roads, and animal waste management systems shall have a minimum capacity for the peak discharge from a storm frequency consistent with the hazard involved but not less than a 25-year frequency, 24-hour duration storm. Freeboard shall be not less than 0.3 ft. Design depth is the channel storm flow depth plus freeboard.

Location. The outlet conditions, topography, land use, cultural operations, cultural resources, and soil type shall determine the location of the diversion.

Protection against sedimentation. Diversions normally should not be used below high sediment producing areas. When they are, a practice or combination of practices needed to prevent damaging accumulations of sediment in the channel shall be installed. This may include practices such as land treatment erosion control practices, cultural or tillage practices, vegetated filter strip, or structural measures. Install practices in conjunction with or before the diversion construction. If movement of sediment into the channel is a problem, the design shall include extra capacity for sediment or periodic removal as outlined in the operation and maintenance plan.

Outlets. Each diversion must have a safe and stable outlet with adequate capacity. The outlet may be a grassed waterway, a lined waterway, a vegetated or paved area, a grade stabilization structure, an underground outlet, a stable watercourse, a sediment basin, or a combination of these practices. The outlet must convey runoff to a point where outflow will not cause damage. Vegetative outlets shall be installed and established before diversion construction to insure establishment of vegetative cover in the outlet channel.

The release rate of an underground outlet, when combined with storage, shall be such that the design storm runoff will not overtop the diversion ridge.

To prevent the diversion from overtopping, the designed outflow capacity of the outlet(s) must be achieved at, or below, the design depth of the diversion at their junction.

Vegetative Establishment. Diversions shall be vegetated according to NRCS Conservation Practice Standard Critical Area Planting (342). Species selected shall be suited to the site conditions and intended uses. Selected species will have the capacity to achieve adequate density, height, and vigor within an appropriate time frame to stabilize the diversion.

Establish vegetation as soon as conditions permit. Use mulch anchoring, nurse crop, rock, straw or hay bale dikes, fabric checks, filter fences, or runoff diversion to protect the vegetation until it is established. Planting of a close growing crop, e.g. small grains or millet, on the contributing watershed prior to construction of the diversion, can significantly reduce the flow through the diversion during establishment.

Lining. If the soils or climatic conditions preclude the use of vegetation for erosion protection, non-vegetative linings, such as concrete, gravel, rock riprap, cellular block, or other approved manufactured lining systems, may be used. Liners shall be designed in accordance with NRCS Conservation Practice Standard Lined Waterway or Outlet (468).

Considerations

A diversion in a cultivated field should be aligned and spaced from other structures or practices to permit use of modern farming equipment. The side slope lengths should be sized to fit equipment widths when cropped. At non-cropland sites, consider planting native vegetation in areas disturbed due to construction.

Drainage Water Management—CPS 554

Drainage water management (DWM), also known as controlled drainage, is the practice of managing water table depths with a water level control structure in such a way that nutrient transport from agricultural tile drains is reduced during the fallow season (fall to spring) and nutrient-laden plant water is maintained and available for the crop during the growing season. DWMs can be modified for a field with existing tile system, incorporated with a new tile system, or a major component within a saturated buffer system.

According to NRCS CPS Code 554, Drainage Water is the process of managing the drainage volume and water table elevation by regulating the flow from a surface or subsurface agricultural drainage system for the purpose of:

- Reducing nutrient, pathogen and pesticide loading from drainage systems into downstream receiving waters.
- Improving productivity, health and vigor of plants.
- Reducing oxidation of organic matter in soils.

DWM applies where a high natural water table exists or has existed and the topography is relatively smooth, uniform and flat to very gently sloping.

Drainage water management (DWM) is the practice of using a water level control structure in the main, submain (or sometimes lateral) drain to raise the drainage outlet to various depths. This allows farmers to have more control over drainage. The outlet or control structure shown in the figure above is:

- Raised after harvest until early spring to limit drainage outflow and reduce the delivery of nitrate to ditches and streams during the off-season. (Figure 1)
- Lowered so the drain can flow freely before field operations such as planting or harvest. (Figure 2)
- Raised again after planting and spring field operations to create a potential to store water that could be used by the crop in midsummer. (Figure 3)

Published studies have found reductions in annual nitrate load in drain flow ranging from about 15% to 75%, depending on location, climate, soil type, and cropping practice. Nitrate load is reduced by about the same percentage as drain flow is reduced, since most studies have found little change in the nitrate concentration in the drain flow.

DWM manages the timing and amount of water discharged from agricultural drainage systems. The process is based on the premise that identical drainage intensity is not required at all times during the year. Water quality benefits are possible by minimizing unnecessary tile drainage and reducing nitrate amounts that leave farm fields. DWM systems can also retain water needed for late season crop production. DWM systems work best on very flat ground—a fact that eliminates farms with steep or sloped ground.

To have a functional DWM system, a properly prepared and implemented DWM Plan must include the following items:

- Farm and field identification.
- Field maps with field boundaries marked.
- Landowner goals and objectives.
- Maps—tile system, soils, topographic.
- Management schedule.
- Water control structure placement strategy.

A detailed operation and maintenance (O & M) plan for the farm landowner/operator to follow is imperative for its success over the lifetime of this BMP.

NEWLY INSTALLED DRAIN WATER MANAGEMENT STRUCTURE

Field Borders—CPS 386

As noted in NRCS CPS Code 386, a field border is a strip of permanent vegetation established at the edge or around the perimeter of a field to accomplish one or more of the following:

- Reduce erosion from wind and water
- Protect soil and water quality
- Manage pest populations
- Provide wildlife food and cover and pollinator habitat
- Increase carbon storage
- Improve air quality

Field borders established around the perimeter of fields can support or connect other buffer practices within and between fields. This practice may also apply to recreation land or other land uses where agronomic crops, including forages, are grown.

In addition to the soil and water protection provided by the perennial vegetation, field borders can be designed to provide other environmental and practical benefits. Field borders can straighten irregular field boundaries. However, field borders cannot be used to turn equipment around and park tractors during field operations. Field borders can also harbor natural predators of crop pests and provide wildlife habitat. Potential field border sites include all cropped fields or portions of a field draining to, and within 30 feet of, a road ditch.

In some cases, a portion of a field with a timber border can potentially be converted from agricultural use into native prairie grasses. In the Lake Springfield Watershed, fields bordered by timber may be eligible for a CP33 field border and may be appropriate as a field border. This practice is to provide habitat buffers for upland birds, such as the ring-necked pheasant and northern bobwhite quail. Field borders should generally be located around the entire perimeter of the field but, at a minimum, along edges where runoff enters or leaves the field. The minimum average width is 30 feet and normally does not exceed a maximum of 120 feet.

Field borders should be planted to a diversified mix usually including a mix of three grasses and three broadleaf species.

FIELD BORDERS

- Planting field borders around the entire field, not just on the field edges where water enters or leaves the field, maximizes multiple resource protection.
- Establishing a narrow strip of stiff-stemmed upright grass at the crop/field border interface can increase soil particle trapping efficiency of the field border.

- Native plants are best suited for wildlife and pollinator habitat enhancement and provide other ecological benefits where adapted to site conditions and when consistent with producer objectives.
- Native plants that provide diverse pollen and nectar sources encourage local pollinator populations.
- Use field borders as corridors to connect existing or planned habitat blocks.
- Prescribed burning, strip disking, or selective herbicide applications are management tools that can be used to maintain suitable habitat for specifically desired wildlife species.
- Overseed the field border with legumes for increased plant diversity, soil quality, pollinators, and wildlife benefits.
- Waterbars or berms may be needed to break up or redirect concentrated water flow within the borders.
- In selecting plant species to establish in the field border, among other items, consider the plant's tolerance to:
    - sediment deposition and chemicals planned for application.
    - drought in arid areas or where evapotranspiration can potentially exceed precipitation during the field border's active growing period(s.)
    - equipment traffic.
- Design border widths to match the required field application setback widths for easier management (i.e., land-use and management changes occur in the same location).
- Establish plant species that will have the desired visual effects and that will not interfere with field operations or field border maintenance.
- Consider the amount of shading that the field border or portions of the field border may experience and select species for those locations accordingly.
- The use of native perennial plant species as opposed to annual species provides a longer period of resource protection.
- Consider installing a contour buffer system, no-till practice or other conservation practices on adjacent upland areas to reduce surface runoff and excessive sedimentation of field borders.
- Field borders require careful management and maintenance for performance and longevity.

The following operations and maintenance activities will be planned and applied as needed:

- Repair storm damage.
- Remove sediment from above or within the field border when accumulated sediment either alters the function of the field border or threatens the degradation of the planted species' survival.

Filter Strips—CPS 393

A filter strip is a band of grass or other permanent herbaceous vegetation used to absorb sediment, nutrients, pesticides, and other sediment-adsorbed contaminants. According to NRCS Conservation Practice Code 393, criteria evaluated for filter strip width and length include the field slope percentage and length, filter strip slope percent, erosion rate, amount and particle size distribution of sediment of cropland adjacent to the stream, density and height of filter strip vegetation and runoff volume associated with erosion-producing events. The filter strip vegetation can be a single species or mixture of grasses, legumes and/or other forbs adapted to the soil, climate and farm chemicals used in adjacent cropland.

As described by the CPS 393 standard, the purpose of a filter strip is to:

- Reduce suspended solids and associated contaminants in runoff.
- Reduce dissolved contaminant loadings in runoff.
- Reduce suspended solids and associated contaminants in irrigation tailwater.

Filter strips are established where environmentally sensitive areas need to be protected from sediment, other suspended solids and dissolved contaminants in runoff.

FILTER STRIP IN LAKE SPRINGFIELD WATERSHED

Filter strips are strips of grass, trees, or shrubs that filter or clean runoff and remove contaminants before they reach water bodies or water sources, such as wells.

- Grass, trees and shrubs provide cover for small birds and animals
- Ground cover reduces soil erosion
- The vegetative strip moves row crop operations farther from a stream.
- Vegetation prevents contaminants from entering water bodies, protecting water quality.

Filter Strips (urban)—IUM 835

In the Illinois Urban Manual, the NRCS PCS Code 835 Filter Strip is defined as a created or preserved area of vegetation designed to remove sediment and other pollutants and to enhance the infiltration of surface water runoff. Another purpose is to reduce runoff quantities from impervious surfaces by infiltrating it into the ground. Urban filter strips should be established in urban land areas where surface water runoff is discharged as overland sheet flow in the following typical locations:

- Adjacent to roadways, parking lots, and other impervious surfaces to filter and convey runoff before it is discharged to swales, storm sewers or surface water bodies.
- Lawns where roof downspouts are discharged to disperse and infiltrate runoff.
- Adjacent to wetlands, streams, ponds or lakes, or conservation practices to provide the runoff mitigation benefits described above and to serve as a wildlife habitat buffer.
- On construction sites and land undergoing development to filter sediment from overland sheet flow.

Criteria applicable to all purposes include:

- Maximum drainage area to the filter strip is 5 acres.
- Vegetative filter strips with slopes of 15 percent or less.
- Minimum length (dimension parallel to flow path) of the filter strip is determined by the drainage area being treated and the width of the filter strip. Its length needs to be at least one-half the unit area length.
- Width (dimension perpendicular to flow path) of the filter strip determines the required length of the filter strip. The wider the filter strip, the shorter the required filter strip length. The width should be as near the same width as the impervious area being treated.
- Some applications (e.g., roof downspouts) may require a level spreader to prevent a concentrated flow path through the filter strip.
- Maximum flow velocity through the filter strip shall be calculated for the 10-year frequency, 24-hour duration storm event and shall not exceed the maximum permissible velocities as described in NRCS PCS 840 Grassed Lined Channel.
- Vegetation shall follow the NRCS PCS Code 880 Permanent Vegetation and be protected with an erosion control blanket (Erosion Blanket Code 830) or mulched according to PCS Code 875 Mulching, or vegetated with sod (PCS Code 925 Sodding).
- Filter strip vegetation should be fully established before the contributing impervious surface is created and its runoff directed onto the filter strip.

Other considerations, plans and specifications and operation and maintenance are included in IUM NRCS PCS Code 835 Filter Strip.

Grade Stabilization Structures (earthen, concrete/aluminum toe wall, block chute, etc.)—CPS 410

An in-field grade stabilization structure is an earthen, wooden, concrete, aluminum or other type of structure built across a drainageway that prevents gully erosion:

- Grade control stabilization structures are often used at the outlet of a grassed waterway to stabilize the waterway outlet, preventing gully erosion.

- Grassed, non-eroding waterways made possible with a grade stabilization structure provide better water quality, can be easily crossed with equipment, and look better than non-stabilized gullies.
- If designed to store water, a grade stabilization structure may provide a water source and habitat for wildlife.

As noted in the NRCS Practice Code 410, a grade stabilization structure is used to control the grade in natural or constructed channels. It is constructed to stabilize grade, reduce erosion, prevent upstream head cutting and improve water quality. In this watershed, grade control structures are recommended at locations where slopes are very steep, gully erosion is considered very severe, and areas where WASCOBs, terraces or grassed waterways are just not feasible. Grade control structures were identified by direct observation during a watershed windshield survey.

Grade Control Structures (stream channel/streambank, riffles, J-hook, etc.) (Channel Bed Stabilization—CPS 584)

Grade control structures in stream channels and along streambanks provide the following benefits:

- Stabilizes the banks and bed of a channel by reducing stream slope and flow velocity.
- Controls erosion.
- Prevents gully head cut formation and channel bed erosion by lowering water in a controlled manner.
- Enhances environmental quality and reduces pollution hazards.
- Manages channel flow line for non-erosion benefits, including fish passage, water table control and reduced turbidity.

- May provide water source and habitat for wildlife.
- Protects existing structures that can be at risk from bed degradation.

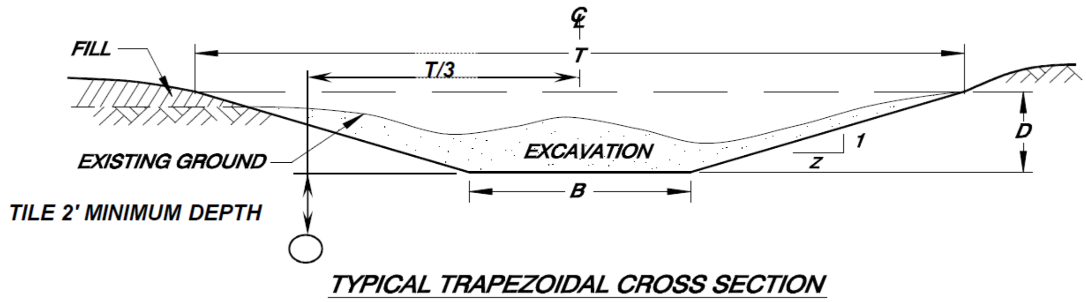
A rock riffle is a channel bed stabilization structure placed in a shallow section of a stream or river with rapid current and a surface broken by various sizes of rock. Rock riffles are instrumental in the formation of meanders, with deeper pools forming alternately. All trees, stumps, roots, brush, weeds, and other objectionable materials are removed from the riffle work area. Disturbance to the existing banks and trees needs to be minimized. Trees with a solid foundation, which do not restrict access for installation of treatment methods, should remain intact. Angular to sub-round in shape rock riprap is placed to the depths, dimensions and finish elevations as designed and may require some hand placement to provide a neat, uniform surface.

Rock riffles are part of a category of BMPs known as aquatic habitat structures, or in-stream improvement structures. Other aquatic habitat structures include weirs, dikes, random rocks, bank covers, substrate reinstatement, fish passage structures and off-channel ponds and coves. A riffle is a shallow section of a stream or river with rapid current and a surface broken by gravel, rubble or boulders. Riffles are instrumental in the formation of meanders, with deeper pools forming alternately.

Grassed waterways—CPS 412

A grassed waterway is a grassed strip in fields that acts as an outlet for water to control silt, filter nutrients and limit gully formation. Most grassed waterways also include a tile component to deliver the water to a suitable outlet. The primary function of a grassed waterway is to reduce erosion in a concentrated flow area, such as in a gully or in ephemeral gullies, and reduce sediment and nutrients delivered to receiving waters. Vegetation also reduces runoff and filters some of the sediment and nutrients delivered to the waterway; however, filtration is a secondary function of a grassed waterway. In the Lake Springfield Watershed, it is assumed that grassed waterways will reduce pollutant loads from gully erosion, as well as a small percentage from contributing drainage areas.

Grassed waterways are constructed graded channels that are seeded to grass or other suitable vegetation. The vegetation slows the water and the grassed waterway conveys the water to a stable outlet at a non-erosive velocity. Grass or permanent vegetation established in waterways protects the soil from concentrated flows. Grassed waterways significantly reduce gully erosion and may also be used to convey runoff from terraces, diversions, or other sources of water concentrations to a stable outlet.



GRASSED WATERWAY DURING CONCENTRATED FLOW EVENT

GRASSED WATERWAY IN LAKE SPRINGFIELD WATERSHED

Grassed waterways are shaped to establish a natural drainageway that prevent gullies from forming by safely conveying water flows off the field.

- Grass cover protects the drainageway from gully erosion.
- Vegetation may act as a filter, absorbing some of the chemicals and nutrients in runoff water.

- Vegetation provides cover for small birds and animals.

Green roofs

A green roof or living roof is a roof of a building that is partially or completely covered with vegetation and a growing medium, planted over a waterproofing membrane. It may also include additional layers such as a root barrier and drainage and irrigation systems. With land being replaced with impervious surfaces due to population growth and urbanization, the recovery of green space is becoming increasingly critical to maintain environmental quality.
Installing green roofs can:

- Reduce the negative impact of development.
- Provide numerous environmental, economic, and social benefits.
- Improve stormwater management by:
  - Reducing runoff.
  - Improving water quality.
  - Conserving energy.
  - Mitigating the urban heat island.
  - Increasing longevity of roofing membranes.
  - Reducing noise and air pollution.
  - Sequestering carbon.
  - Increasing urban biodiversity by providing habitat for wildlife.
  - Providing space for urban agriculture.
  - Providing a more aesthetically pleasing and healthy environment to work.
  - Improving return on investment compared to traditional roofs.

The mitigation of stormwater runoff is considered by many to be the primary benefit because of the prevalence of impervious surfaces in urban areas. Rapid runoff from roof surfaces can:

- Exacerbate flooding.
- Increase erosion.
- May result in raw sewage that is discharged directly into rivers.

The larger amount of runoff also results in a greater quantity of water that must be treated before it is potable. Benefits of green roofs:

- Has the ability to absorb stormwater and release it slowly over a period of several hours.
- Retain 60 to 100% of the stormwater they receive.
- Have a longer lifespan than standard roofs because:
  - They are protected from ultraviolet radiation and extreme temperature fluctuations that cause roof membranes to deteriorate.
  - Vegetation helps cool the membrane and the building during the summer as the plants and growing substrate act as an insulation layer and shade for the roof.
- Address the issues of environmental stewardship through construction and maintenance of green roofs.

- Provide business opportunities for roofing contractors, plant producers, landscape designers and contractors, and other green industry members.

Livestock Alternative Watering Systems—CPS 516, 614, 642

Ponds and streams can provide water for cattle in pasture systems, but it is desirable to fence cattle away from such surface water when possible, allowing only a small access to the water. A good alternative is to provide an appropriate pumping system to deliver the water from the pond or stream to a pasture tank.

Watering systems for grazing livestock on pasture or in a barn can include several alternatives, such as moveable hard plastic, aluminum or concrete water tanks, wells, automatic waterers with buried pipelines, pond-fed, etc.

Several considerations for development of a good pasture watering system for the producer are:

- Water quality and quantity
- Supply equipment
- Groundwater protection
- Human and animal safety

Water requirements for beef animals vary from about 9 gallons of water per 1000 lbs. bodyweight per day in winter to nearly 30 gallons per 1000 lbs. bodyweight per day on hot summer days. For management-intensive grazing applications, the total water supply must be adequate for the herd but may have much more constant demand on the flow rate than in non-intensive grazing applications where the entire herd goes to water at once. If the water tank is placed within 500-800 feet of the paddock, cattle will visit the tank one at a time or a few at a time, creating less demand for access to the water tank.

Supply Equipment

Tank Sizing: Use water tanks that only hold 20-50 gallons. Ample valve sizing and proper sized water pipe combine to keep the tank water level near full as cattle are drinking, reducing the risk of cattle tipping the tank over. If a direct-connect solar pumping system is used, a large tank that holds the water supply for a day or more will be required.

Tank valves: Select tank valves based on the maximum flow rate needed at the tank. Full–flow floats can deliver up to 20 gallons per minute with the proper pipe and system design. A bottom-inlet float device on the tank controls the water level but is generally out of reach of the cattle. While more expensive, they can support more cattle drinking at the same time.

To prevent potential groundwater contamination from livestock watering equipment, any tank or waterer supplied by well water or a water district pipeline should be fitted with a vacuum-break or backflow prevention device to prevent tank water entering the water supply in the event of a line pressure loss.

Energy-free or electrically heated permanent waterers should be sized for one watering space (1 cup or 2 lineal feet of tank) per 25 head. For details on pasture tanks and freeze-proof waterers, review information in Midwest Plan Service MWPS-14, Private Water Systems Handbook.

Siphons: When a pond or other static water source is not too distant from the pasture being developed, it is sometimes preferable to keep the cattle away from the pond by routing pond water to a tank through a siphon. A siphon is a gravity-fed water delivery system that can deliver water from a pond over (instead of through) the pond bank and down to a water tank at some elevation lower than the pond water surface. If using a floating inlet or gravel screen inlet in the pond, any screen on the inlet will add to the total pressure drop and reduce the flow rate to the tank.

Ram Pumps: Where there is a spring-fed stream with adequate flow and gravity head, install a ram pump that will water cattle uphill from the stream. No other power source is needed. A ram pump will deliver only a fraction of the water that goes through the pump.

Solar-Powered Pumps: Use a solar-powered pumping station for pasture operations with a water source available but no electric utility power nearby. Solar systems are usually set up with a large tank, with up to five day's supply of water, so that cattle will have water during cloudy periods when solar pumping is reduced.

Wind-Powered Pumps: During the May-September grazing period, wind energy in Illinois is much less reliable than solar energy. Economic and operational studies show that solar is a better buy than wind for pasture pumping. However, a hybrid wind/solar system may be economical in some situations and may work well with an extended grazing season.

Nose Pumps (cattle-operated): For lifting water up to about 20 feet and for fairly short distances, the nose pump will work well. The animals pump water a stroke at a time via a piston/valve arrangement by pushing the plunger back during drinking. Only one animal can access it at a time, so it won't be too practical for larger herds. Each nose pump will serve about 25 head.

Shallow-well Pumps: The simplest type of pump for use on a well is a shallow-well suction pump. A restriction on such a pump is the maximum suction lift (depth to water plus friction head in the suction line) allowable. A good foot valve is necessary to avoid loss of prime when the pump shuts off.

Setting up the System

If you can gravity-flow the water, linear low-density polyethylene (LLDPE) pipe is sufficient. For pressurized systems, use a rolled high-density polyethylene (HDPE) with a minimum of 150 PSI rated pressure. A pressure-flow chart will help select the minimum size needed.

Provide water to every paddock, if possible. Using a lane to get cattle to water can provide the same water tank for several paddocks. Economic analyses of grazing systems indicate that the money spent to provide water to several locations or to each paddock pays back rapidly. Distance to water should ideally be no more than about 800 feet from any point in the paddock.

Keep water systems portable and flexible at first. Lay the pipe on top of the ground in case you want to make changes to paddock layout or the water system. Install a main trunk line underground and have risers with quick-disconnects for the tank or tanks when you are certain the system is configured the way you want it.

Other Considerations

Black pipe on top of the ground will heat water somewhat. Heated water is not a problem in summer, because cattle best use water at near rumen temperature. Keep the pipe under the fence so the taller forage will provide shading and minimize solar heating.

Place mobile, temporary tanks under an electric fence to keep cattle pressure off the equipment and reduce tank upsets. Locate the tanks in different spots each time the paddock is used to help reduce the forage kill and mud problems around the tank. Gravel the area around all permanent tanks to provide all-weather access. Use a combination of geotextile covered with gravel to form a stable base around permanent water tanks.

Livestock Exclusion Fence—(Fence) CPS 382

Livestock exclusion fencing is a system of permanent fencing installed to exclude livestock from streams and critical areas not intended for grazing to improve water quality. The fencing is one integral part of a pasture management system which may also include stream crossings, watering facilities, rotational grazing, loafing sheds, and feeding stations, along with other possible livestock BMPs which will:

- Keep the water in the stream clean.
- Reduce soil erosion of the stream banks.
- Limit the amount of manure entering the water body.
- Limit the amount of damage to the stream bed and banks from equipment crossings.
- Keep the water cooler and cleaner when trees and grass grow along the stream banks.
- Maintain healthy pastures to limit overgrazing and potential soil erosion problems.
- Maintain a healthy livestock herd.

According to NRCS PCS Code 382 Fence, this practice facilitates the accomplishment of conservation objectives by proving a means to control movement of animals and people, including vehicles, where management of animal or human movement is needed.

General criteria applicable to all purposes for livestock exclusion fencing include:

- Fencing materials and type and design of fence installed must be of a high quality and durability.
    - May be permanent, portable or temporary.
    - Meet management objectives and site challenges.
- Ingress/egress features (gates and cattle guards) to facilitate management requirements.

- Fence life expectancy should meet management objectives.
- All federal, state and local laws and regulations must be met.
- Landowner/user is responsible for determining legal boundaries for proper fence location.
- Minimum life expectancy of 20 years is required for permanent fences.
- Height, size, spacing and type of materials must provide desired control, life expectancy and management of animals and people of concern.
- Fence design, location and installation meet appropriate local wildlife and land management needs and requirements.
- Fence posts of “native wood” (osage orange, black locust, red cedar, redwood) do not require treatment.
- Notching of treated wood posts to retain wires or braces is prohibited. Cutting off excess treated wood posts is discouraged.
- Barbed wire fence must not be used to contain sheet and goats.
- Fences must be installed a minimum 25 horizontal feet from any perennial stream, pond, lake or actively eroding streambank.

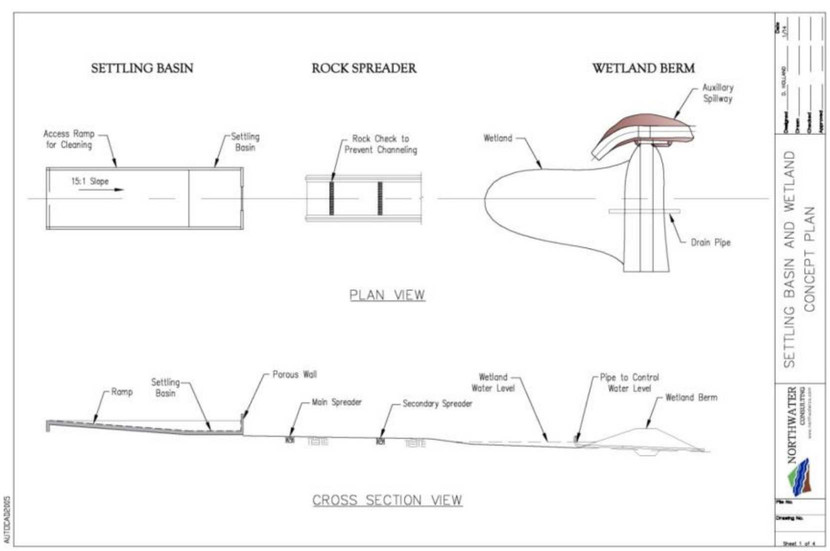
Other considerations, plans and specifications and operation and maintenance for livestock exclusion fencing are available from the NRCS PCS Code 382 Fence and NRCS PCS publication.

Livestock Feed Area Waste Management Systems (waste storage, waste transfer, waste treatment)—CPS 313, 634, 629

A livestock feed area waste system includes three individual practices working in series:

- A settling basin to capture solids.
- A rock spreader and vegetated swale for initial waste treatment.
- A treatment wetland to capture and treat the remaining waste.

A conceptual design is presented below.



Waste Storage Facility—CPS 313

A waste storage facility is defined in NRCS CPS Code 313 as an agricultural waste storage impoundment or containment made by constructing an embankment, excavating a pit or dugout, or by fabricating a structure to store manure, agricultural by-products, wastewater and contaminated runoff to provide the agricultural operation management flexibility for waste utilization.

When regular storage is needed for wastes generated by agricultural production or processing and where soils, geology and topography are suitable for construction of the facility. For reception pits, refer to NRCS CPS Code 634 Waste Transfer.

For liquid waste storage facilities implemented with an embankment, this practice applies only to low-hazard structures. Refer to NRCS National Engineering Manual (NEM), Part 520.23. This practice does not apply to the storage of human waste or routine animal mortality.

General criteria applicable to all waste storage facilities include:

- Plan, design and construct the facility to meet all federal, state and local laws and regulations.
- Locate and design the facility outside the 100-year floodplain.
- Base the minimum storage period on the timing required for environmentally-safe waste utilization, considering climate, crops, soil, equipment and local, state and federal regulations.
- Design storage volume based on operational, emergency and freeboard volume.
- Exclude non-polluted runoff from the structure to the fullest extent practical, except where including the runoff is advantageous to the operation of the agricultural waste management system.
- Design inlet to resist corrosion, plugging, freeze damage and ultraviolet deterioration.
- Provide components for removing waste, such as gates, pipes, docks, wet wells, pumping platforms, retaining walls or ramps, incorporating features to protect against erosion, tampering and accidental release of stored waste.
- Make provision for periodic removal of accumulated solids.
- The maximum operating level for liquid storage structures is the level that provides the operational volume.
- Place a staff gauge or other permanent marker in the liquid storage facility to clearly indicate the following elevations:
  - Maximum operating level (top of the operational volume).
  - Emergency level (top of the design storage volume).
- Include appropriate safety features to minimize the hazards of the facility. Refer to American Society of Agricultural and Biological Engineers Standard EP470, Manure Storage Safety for guidance.
- Use NRCS CPS Code 367, Roofs and Covers for design of waste storage facility covers or roofs.
- Use criteria from NRCS CPS Code 367 for treated wood and fasteners.

Additional criteria, considerations, plans and specifications and operation and maintenance plan requirements are included in NRCS CPS Code 313, Waste Storage Facility.

Livestock Waste Transfer—CPS 634

Waste transfer is a system using structures, conduits or equipment to convey by-products (wastes) from agricultural operations to points of usage for the purpose of transferring agricultural material associated with production, processing and/or harvesting through a hopper or reception pit, a pump, a conduit and/or hauling equipment to:

- A storage/treatment facility.
- A loading area.
- Agricultural land for final utilization as a resource.

The transfer component is part of a planned waste management or comprehensive nutrient management system, which includes hauling nutrients from one geographical area with excess nutrients to an area that can utilize the nutrients in an acceptable manner.

General criteria applicable to all purposes include:

- All structures and work area around pumps must be designed to withstand anticipated static and dynamic loading.
- Reception pits must be sized to contain a minimum of one full day's production.
- Openings to structures to receive material from alley scrape collection must be a minimum of nine square feet, with one dimension no smaller than four feet.
- Curbs must be of sufficient height to ensure all materials flow into the structure and are adequately anchored.
- Pipelines must be designed in accordance with sound engineering principles considering waste material properties, management operations, exposure, etc., with the minimum pipeline capacity from collection to storage/treatment facilities being the maximum peak flow anticipated.
- Minimum pipeline capacity from storage/treatment facilities to utilization areas must ensure those facilities can be emptied within the time limits stated in the nutrient utilization management plan.
- All pipes must be designed to convey the required flow without plugging, based on the type of material and total solids content. Design velocities must be between three to six feet per second to minimize settling of solids.
- Cleanout access must be provided for gravity pipelines at a maximum interval of 150 feet, unless an alternative design is approved by the design engineer.
- A minimum head is required in a gravity flow pipe system, depending upon the consistency of the material.
- Gravity discharge pipes used for emptying a storage/treatment facility must have a minimum of two gates or valves, one of which shall be manually operated.
- Pipelines must be installed with appropriate connection devices to prevent contamination of private or public water supply distribution systems and ground water.
- Concrete-lined ditches must be designed in accordance with NRCS CPS Code 468, Lined Waterway or Outlet, with a minimum 1.5 feet per second design velocity.

- Pumps installed for transfer must meet NRCS CPS Code 533, Pumping Plant requirements and based on pump manufacturer's recommendations.
- A filtration or screening device, settling tank, settling basin or settling channel used to separate a portion of solids from the manure or liquid waste stream must be designed in accordance with NRCS CPS Code 632 Solid/Liquid Waste Separation Facility.
- The system design must consider the safety of humans and animals during construction and operation.
  - Open structures must be provided with covers or barriers (gates, fences, etc.).
  - Ventilation and warning signs must be provided for transfer systems to warn of the danger of entry and to reduce the risk of explosion, poisoning or asphyxiation.
  - Pipelines from enclosed buildings must be provided with a water-sealed trap and vent or similar devices to control gas entry into buildings.
  - Barriers must be placed on push-off ramps to prevent tractors or other equipment from slipping into waste collection, storage or treatment facilities.
- Products from diseased animals shall be handled in accordance with the state veterinarian's recommendations.
- Equipment leaving the farm must be sanitized as appropriate to prevent the spread of disease.

Additional criteria, considerations, plans and specifications and an O & M Plan information are included in NRCS CPS Code 634, Waste Transfer.

Livestock Waste Utilization—CPS 633

NRCS CPS Code 633, Waste Utilization definition is using agricultural waste, such as manure and wastewater or other organic residues, on land in an environmentally acceptable manner while maintaining or improving soil, air, water and plant resources for the following purposes to:

- Minimize water quality impacts.
- Provide optimum levels of nutrients for crops, forage, fiber production and forest products.
- Improve or maintain soil structure.
- Provide feedstock for livestock.
- Provide a source of energy.

General criteria applicable to all purposes include:

- Must strictly adhere to all federal, state and local laws, rules and regulations governing waste management, pollution abatement, health and safety, secure all required permits or approvals and be responsible for operating and maintaining any components in accordance with applicable laws and regulations.
- Must follow the waste management plan, document the amount of waste to be transferred and record the person(s) responsible for the environmentally acceptable use of the waste. Waste utilization records must be kept a minimum of five years.
- Wastes will not be applied to frozen or snow-covered soil over five percent slope, unless provisions are made to control runoff and pollution.

- Application to cropland requires that cropland meet soil loss tolerances, and not applied to cropland with slopes over 15 percent.
- Waste may be surface applied to pasture land, hay land or meadow crops without incorporation or injection on slopes up to 20 percent, if the land meets soil loss tolerances and applied when runoff is unlikely.
- No application shall occur within 200 feet of wells, sinkholes or surface waters.
- Liquid manures shall not be applied to soils within less than 10 inches of at least moderately permeable soil over fractured bedrock, sand or gravel.
- No application shall occur on organic soils with a seasonal water table within one foot of the surface.
- Only the injection or immediate incorporation application method can be used on floodplains with a 10-year flood frequency.
- No waste can be spread in an established waterway or any area where there may be a concentrated water flow.
- Soil and plant tissue testing will be conducted according to guidelines in the NRCS CPS Code 590, Nutrient Management.

For additional criteria, information, considerations, plans and specifications and operation and maintenance requirements, refer to NRCS CPS Code 633, Waste Utilization. Appendices A, B and C, respectively, include information on the Illinois Phosphorus Assessment Procedure, Recommended Management Practices to Reduce Nitrogen and Phosphorus Losses and Procedure to Calculate the Bray P1 or Equivalent Soil Buildup.

Livestock Pasture and Prescribed Grazing Management—CPS 528

As noted in NRCS CPS Code 528, Prescribed Grazing is the controlled harvest of vegetation with grazing animals managed with the intent to achieve a specific objective. This practice applies to all lands where grazing and/or browsing animals are managed and will manipulate the intensity, frequency, duration and season of grazing to:

- Improve water infiltration.
- Protect streambanks from erosion.
- Manage for deposition of fecal material away from water bodies.
- Improve or maintain the:
    - Surface and/or subsurface water quality and quantity.
    - Desired species composition and vigor of plant communities.
    - Riparian and watershed function.
    - Quantity and quality of forage for grazing and browsing animals' health and productivity.
    - Quantity and quality of food and/or cover available for wildlife.

Pastures are kept in good condition by controlling weeds, fertilizing and, most importantly, managing livestock. Implementing pasture management and grazing principles will increase forage yield and quality, provide a healthier place for livestock and improve farm aesthetics.

Planned prescribed grazing systems use forage plantings and grazing rotations to maximize production and reduce sediment and nutrient runoff, taking into consideration food, water, and herd size.

- Improves vegetative cover, reducing erosion and improving water quality.
- Increases harvest efficiency and helps ensure adequate forage throughout grazing season.
- Increases forage quality and production which helps increase feed efficiency and can improve profits.
- Rotating also evenly distributes manure nutrient resources.

Pasture planting is used to plant grass and legumes that reduce soil erosion and improve production.

- Heavy grass cover slows water flow, reducing soil erosion.
- Good pastures protect water quality by filtering runoff water and increasing infiltration.
- Lush pastures offer wildlife cover and habitat.
- As plants recycle and roots die, organic matter in the soil is improved.

Criteria applicable to all purposes include:

- Removal of herbage in accordance with:
    - Site production limitations.
    - Rate of plant growth
    - Physiological needs of forage plants
    - Nutritional needs of the animals
- Adequate quantity and quality of drinking water supplied at all times during animals' pasture occupancy.
- Adjust intensity, frequency, timing and duration of grazing and/or browsing to meet the desired objectives for the plant communities and associated resources, including the grazing and/or browsing animals.
- Manage kind of animal, and animal numbers, grazing distribution, length of grazing and/or browsing periods and timing of use to provide grazed plants sufficient recovery time to meet planned objectives.
- Provide deferment or rest from grazing or browsing to ensure the success of prescribed fire, brush management, seeding or other conservation practices which cause stress or damage to key plants.
- Manage grazing and/or browsing animals to maintain adequate vegetative cover on sensitive areas (i.e., riparian, wetland, habitats of concern).
- Manage livestock movements based on rate of plant growth, available forage and allowable utilization target.
- Develop contingency plans to deal with expected episodic disturbance events (e.g., insect infestation, drought, wildfire, etc.)

Considerations, plans and specifications and operation and maintenance information are included in NRCS CPS Code 528, Prescribed Grazing.

LIVESTOCK PASTURE

Once a site has been identified, a planned prescribed grazing system can be designed to:

- Control runoff.
- Minimize erosion.
- Improve grazing productivity.

This system can include diversions to route contributing drainage (clean water) around the pasture, alternative water systems, stream fencing, stream crossings, rotational grazing and treatment wetlands.

Livestock Shelter Structure (loafing sheds, feeding stations, etc.)—CPS 576

NRCS CPS Code 576 defines a livestock shelter structure as a permanent or portable structure with less than four walls and/or a roof to provide for improved utilization of pastureland and rangeland and to shelter livestock from negative environmental factors, and is not to be construed to be a building. The purpose of this practice is to:

- Provide protection for livestock from excessive heat, wind, cold or snow.
- Protect surface waters from nutrient and pathogen loading.
- Protect wooded areas from accelerated erosion and excessive nutrient deposition by providing alternative livestock shelter/shade locations.
- Improve distribution of grazing livestock to enhance wildlife habitat, reduce overused areas, or correct other resource concerns resulting from improper livestock distribution.

This practice provides protection to sensitive areas and must be used in conjunction with exclusion of animals from the sensitive area, utilizing NRCS CPS Code 382, Fence.

General criteria applicable to all purposes and structure types include:

- Equip portable structures with runners or wheels or other means to facilitate transport, providing lateral support to vertical and horizontal structural members to prevent twisting and/or buckling.
- Locate the structure to avoid adverse effects to cultural resources and endangered, threatened and candidate species and their habitat.
- Select appropriate upland locations:
    - Away from riparian areas and concentrated flow areas to avoid water quality impairment.
    - A minimum of 100 feet from any surface water bodies.
    - 150 feet from up-gradient well.
    - 300 feet from a down-gradient well.
    - No surface water flow through the structure.
- Provide erosion protection from roof runoff.
- Construct with durable materials commensurate with a minimum structure life of 10 years.
- Design the structure to facilitate the distribution of manure across grazing lands in accordance with nutrient management plan.
- Incorporate NRCS CPS Code 528, Prescribed Grazing as part of the resource management plan.

For additional criteria, considerations, plans and specifications and O & M Plan information for this practice, refer to NRCS CPS Code 576, Livestock Shelter Structure.

Livestock stream crossing (Stream Crossing)—CPS 578

A livestock stream crossing provides a hard, stable area where livestock and/or equipment can cross a stream without damaging the streambed or banks.

Benefits of a Fenced Stream Crossing:

- Provide livestock access to all your pastures.
- Crop and graze fields that are difficult to access.
- Keeps farm water cleaner by keeping cattle out of the stream.
- You decide where the cattle cross the stream.
- Improve cattle health by keeping them out of the mud.

LIVESTOCK EXCLUSION STREAM CROSSING--NO ACCESS/ACCESS COMPARISON

Some of the costs to consider are:

- Grading the stream banks and bottom.
- Gravel and filter fabric.
- Hog panels, stone or other material to be placed in the streambed.
- Fencing to lead the livestock to the crossing.

The NRCS PCS Code 578 defines a stream crossing as a stabilized area or structure constructed across a stream to provide a travel way for people, livestock, equipment or vehicles, with the following purposes:

- Improve water quality by reducing sediment, nutrient, organic and inorganic loading of the stream.
- Reduce streambank and streambed erosion.
- Provide crossing for access to another land unit.

Criteria applicable for all purposes include:

- Location in stable streambed area or where grade control can provide a stable condition, avoiding wetland areas and shady riparian areas to discourage cattle loafing time in stream.
- Access roads with measures installed to minimize erosion and sediment of the roadside ditch, road surface and/or cut slopes. Refer to NRCS CPS 560 Access Road.
- Provide an adequate travel-way width for the intended use, generally no less than 10 feet wide for a multi-use stream crossing, measured from the upstream end to the downstream end, not including side slopes.
- Side slope cuts and fills must be stable for the soil involved, no steeper than 2 horizontal to 1 vertical.
- Stream approaches must:
    - Blend with existing site conditions.
    - Not be steeper than 4 horizontal to 1 vertical.
    - Be underlain with suitable material to withstand repeated, long-term use.

  - Have a minimum width equal to the width of the crossing surface, with surface runoff diverted around the approaches to prevent erosion.
- Rock must withstand exposure to air, water, freezing and thawing and sufficiently large and dense so it cannot be immobilized by design flood flows.
- Permanent fencing of areas adjacent to the stream crossing to manage livestock access to the crossing.
  Refer to NRCS CPS 382 Fence.
- Use breakaway wire, swinging floodgates, hanging electrified chain, etc. to allow passage of floodwater debris during high flows.
- Plant vegetation as soon as practical after construction using NRCS CPS 342 Critical Area Planting if natural regeneration is unlikely.

Additional criteria, specifications, operation and maintenance information is included in the NRCS CPS Code 578 Stream Crossing document.

A livestock stream crossing provides a hard, stable area where livestock and/or equipment can cross a stream without damaging the streambed or banks.
Benefits of a Fenced Stream Crossing:

- Provide livestock access to all your pastures.
- Crop and graze fields that are difficult to access.
- Keeps farm water cleaner by keeping cattle out of the stream.
- You decide where the cattle cross the stream.
- Improve cattle health by keeping them out of the mud.

Some of the costs to consider are:

- Grading the stream banks and bottom.
- Gravel and filter fabric.
- Hog panels, stone or other material to be placed in the streambed.
- Fencing to lead the livestock to the crossing.

Nutrient management —CPS 590

Nutrient management is the practice of using nutrients essential for plant growth, such as nitrogen and phosphorus fertilizers in proper quantities and at appropriate times for optimal economic and environmental benefits. Nutrient management is a non-structural practice that can be applied throughout the study area; it is well suited to the flat topography and productive nature of soils in the watershed although, if a field is being farmed, nutrient management should be practiced regardless of these factors. The nutrient management system now being promoted by the Illinois Council on Best Management Practices (IL CBMP) utilizes the approach commonly called the “4Rs of Nutrient Stewardship”:

- Right Source: Matches fertilizer type to crop needs.
- Right Rate: Matches amount of fertilizer to crop needs.
- Right Time: Makes nutrients available when crops need them.
- Right Place: Keeps nutrients where crops can use them.

NRCS CPS Code 590, Nutrient Management is defined as managing the amount (rate), source, placement (method of application) and timing of plant nutrients and soil amendments for the following purposes to:

- Budget, supply and conserve nutrients for plant production.
- Minimize agricultural nonpoint source pollution of surface and groundwater resources.
- Properly utilize manure or organic by-products as a plant nutrient source.
- Protect air quality by reducing odors, nitrogen emissions (ammonia, oxides of nitrogen), and the formation of atmospheric particulates.
- Maintain or improve the physical, chemical and biological condition of soil.

Changes made in 2014 to the national NRCS CPS Code 590, Nutrient Management, include the following:

- Landowners must manage ephemeral, gully, sheet, rill and wind erosion to protect soil and water quality.
- On organic operations, the nutrient sources and management must be consistent with the USDA's National Organic Program (NOP) and certification agency.
- When irrigation water is applied on a field that has nutrient sources, an Irrigation Water Management Plan (IWM) will be developed following the current NRCS Washington practice standards.
- Sampling depths now MUST follow land grant university guidance with a minimum sampling depth of 12 inches when not defined otherwise for a particular crop by the land grant university.
- Planned nutrient application rates for nitrogen, phosphorus and potassium must not exceed appropriate land grant university crop production guidelines based on realistic yield goals. Additional guidance applies to use of manures or organic by-products as nutrients.
- A nitrogen and phosphorus risk assessment will be done on all sites. The goal is for applied nutrients to stay on the field. The index determines the risk level of nutrients leaving the field.

Nutrient management plans (NMPs) prepared for this watershed must adhere to all of these new standards, where applicable.

Nutrient management is applying the correct amount and form of plant nutrients for optimum yield with minimal impacts on water quality.

- Sound nutrient management reduces input costs and protects water quality by preventing over-application of commercial fertilizers and animal manure.
- Correct manure and sludge application on all fields can improve soil tilth and organic matter.

A Nutrient Management Plan includes the following information:

Section 1. Cover Page

a. Name of owner/operator.
b. Farm location, mailing address, operator and phone number.
c. TSP Name, address and phone.
d. Total acres of the plan.

e. Signature blocks for all required signatures.

Section 2. Background and Site Information

a. General Description of Operation.
b. Description of concerns related to water quality, soil erosion (wind & water) or other local concerns.
c. Field names and/or codes including acres.
d. List of crops grown on the parcel with acreage for each crop.
e. Conservation plan map.
f. Soil map and appropriate soil descriptions.

Section 3a. Land Treatment

a. GIS map(s) documenting fields and conservation practices including:
   1. Aerial maps and soil maps of land application area.
   2. Fields delineated to show setbacks, buffers, conservation practices planned, etc.
   3. Identification of sensitive areas, such as sinkholes, streams, wells, water sources, etc.
   4. Other site information features, such as property boundaries or occupied dwellings, etc.

Section 3b. Land Treatment Conservation Practices

b. Land treatment conservation practices planned or applied including:
   1. Practice narrative, Operations & Maintenance (O & M) , design specifications, job sheets, etc.
   2. Recommended conservation practices on adjacent fields.
   3. Any additional resource concerns addressed for erosion, water quality and air quality.
   4. If required, air quality impact mitigation.

Section 4. Nutrient Management, Practice Standard 590

4.1 Field Information.
4.2 Nitrogen and Phosphorus Risk Analyses Result.
4.3 Soil test data.
4.4 Planned crops and fertilizer recommendations.
4.5 Planned nutrient applications.
4.6 Field nutrient balance.
4.7 Fertilizer material annual summary.
4.8 Plan nutrient balance.
4.9 Nitrogen management.
4.10 NMP record keeping:
- Soil test results.
- Variable Rate Technology (VRT) recommendations and as-applied maps.
- Crop information and yields records.
- Conservation practice records.

Section 5. References & Job Sheets

NRCS Conservation Practice Standards

Code 340 Cover Crops

Code 590 Nutrient Management

Permanent Vegetative Cover (Conservation Cover)—CPS 327/IUM 880

In some cases, a small area or field can potentially be converted from agricultural use to native grasses or timber.

The purpose of establishing Conservation Cover, according to NRCS CPS Code 327, may accomplish one or more of the following:

- Reduce soil erosion and sedimentation.
- Improve water quality.
- Improve air quality.
- Enhance wildlife habitat and pollinator habitat.
- Improve soil quality.
- Manage plant pests.

Working closely with NRCS technical staff to address the following general criteria applicable for all purposes to establish conservation cover:

- Selection of proper species, adapted to soil, ecological sites and climatic conditions.
- Seeding rates and dates, using only certified seed.
- Planting dates, methods and care for an acceptable rate of survival.
- Site preparation adequate to eliminate weed establishment.
- Timing and use of equipment appropriate for site and soil conditions.
- Application of nutrients following NRCS Field Office Technical Guide (FOTG).
- Establishment procedures and management actions to ensure an adequate stand.

Additional criteria to be taken into consideration for this BMP are defined in NRCS 327 standard Conservation Cover for the accomplishment of the six purposes listed above.

Ponds—CPS 378

Ponds are water impoundments created by constructing an embankment or by excavating a pit or dugout. Ponds are classified as embankment ponds if the depth of water impounded against the embankment at the auxiliary spillway elevation is three feet or more.

According to NRCS CPS Code 378, Ponds, the purpose of ponds are:

- To provide water for:
  - Livestock.
  - Fish and wildlife.
  - Recreation.
  - Fire control.
  - Development of renewable energy systems, etc.
- To maintain or improve water quality.

General criteria applicable to all ponds include:

- All federal, state and local requirements shall be addressed in the design.
- A protective vegetative cover must be established on all exposed areas of embankments, spillways and borrow areas according to NRCS Code 342 Critical Area Planting standards.
- Runoff from the design storm can be safely passed through a:
    - Natural or constructed auxiliary spillway.
    - Combination of principal and auxiliary spillway.
    - Principal spillway.
- Drainage area above the pond must be protected against erosion to the extent that sedimentation will not shorten the planned, effective life of the pond.
- Reservoir area will permit storage of water at a depth and volume that will ensure a dependable supply, considering beneficial use, sedimentation, season of use, and seepage losses.
- If surface water runoff is the primary water source for the pond, the soils shall be impervious enough to prevent excessive seepage losses, or be of a type that sealing is practicable.

Considerations for ponds include:

- The visual pond design in areas of high public visibility and those associated with recreation must be:
    - Appropriate for the location.
    - The shape and form of the pond, excavated material and plantings should relate visually to their surroundings and function.
- Existence of cultural resources in the project area and the pond's potential negative impact on them.
- Minimize the impacts to existing fish and wildlife habitat.
- Fishpond Management NRCS Practice Standard Code 399 should be considered for pond stocking.
- Vegetation by stockpiling topsoil for placement on disturbed areas can facilitate revegetation.
- Water quantity components of the water budget include:
    - Effects on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation and ground water recharge.
    - Variability of effects caused by seasonal or climatic changes.
    - Effects on downstream flows and impacts to the environment:
        - Wetlands.
        - Aquifers.
        - Social and economic impacts to downstream uses and users.
    - Potential for multiple purposes.
- Water quality effects include:
    - Erosion and movement of sediment, pathogens and soluble and sediment-attached substances carried by runoff.
    - Visual quality of onsite and downstream water resources.

  - Short-term and construction-related effects on the quality of downstream water courses.
  - Water level control on temperatures of downstream water to prevent undesired effects on aquatic and wildlife communities.
  - Wetlands and water-related wildlife habitats.
  - Soil water level control on salinity of soils, soil water or downstream water.
  - Water levels on soil nutrient processes, such as plant nitrogen use or denitrification.
  - Potential for earth moving to uncover or redistribute toxic materials, such as saline soils.

Plans and specifications, along with an operation and maintenance plan, should be developed according with NRCS Practice Code 378 and reviewed with the landowner or person responsible for operation and maintenance of the pond.

Pond Sealing or Lining Bentonite Treatment—CPS 520,521A, 522

To reduce seepage losses from ponds or waste treatment impoundments for water conservation and environmental protection, it is sometimes necessary to install a liner consisting of a compacted soil-bentonite mixture. Bentonite is a kind of absorbent clay formed by the breakdown of volcanic ash, used especially as a filler. This NRCS Practice Standard Code 521C applies where:

- Soils are suitable for treatment with bentonite.
- Ponds or waste storage impoundments require treatment to reduce seepage rates and to impede the migration of contaminants to within acceptable limits.

General criteria applicable to all purposes include:

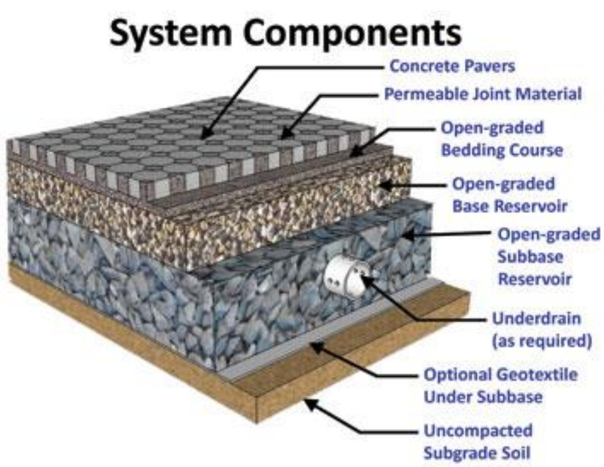
- Bentonite-treated soil liners must comply with all federal, state and local laws, rules and regulations.
- Bentonite liners shall be filter-compatible with the sub-grade on which they are compacted to prevent loss of the liner soil into larger openings in the sub-grade material, with criteria on filter compatibility provided in the National Engineering Handbook, Part 633, Chapter 26.
- Bentonite liners for ponds must be designed to reduce seepage to rates that will allow the pond to function suitably, as intended.
- Other criteria for pond sealing or lining bentonite treatment are outlined in NRCS Practice Code 521C.
- Considerations include:
  - Using a flexible geomembrane or geosynthetic clay liner for pond sites that have water depths greater than 24 feet.
  - Alternatives to bentonite-treated soil liners should be considered for poor foundation conditions.
- Plans and specifications for these liners for ponds and waste impoundments must be in keeping with this practice standard and shall describe the requirements for applying the practice to achieve its intended purpose and include the following:

- Drawings.
- Specifications.
- Material requirements.
- Quantities.
- Construction requirements.
- Equipment requirements.
- Other documents, as necessary, to describe the work to be done.

- The following maintenance activities and operations for this practice include:
  - Excluding animals and equipment from the treated area.
  - Repairing damage to the liner occurring from erosion:
    - During the initial filling
    - Wave action after the impoundment fills.
    - Caused by agitation, pumping operations and activities involved in removal of solids and sludge.
  - Removal of trees and large shrubs whose roots may damage the liner.
  - Repair of disturbed or eroded areas to restore the liner to its original thickness and condition.

Porous/Permeable Pavement—IUM 890

Porous/Permeable Pavement is a method of paving that allows stormwater to seep into the ground as it falls, rather than running off into storm drains and waterways.



Permeable pavements:

- Function similarly to sand filters.
- Filter the water by forcing it to pass through different aggregate sizes and some sort of filter fabric.
- Infiltrate precipitation down into the storage basin where it is slowly released into the surrounding soil.

Pervious, permeable, and porous pavers (the three Ps) often are used interchangeably by professionals without regard to their unique characteristics. They are, however, not the same.

There is an obvious and distinct difference between pervious, permeable, and porous pavers. Each possesses certain physical and aesthetic qualities that need to be considered prior to project design and installation. Careful consideration of site characteristics and project objectives will enable the owner to minimize stormwater runoff and maximize the water quality benefits that these products provide.

The goal in using these types of pavers for stormwater control is to:

- Limit runoff at the source.
- Reduce downstream erosion.
- Improve water quality by filtering pollutants in the substrata layers.

In the case of both pervious and porous pavers, this is partially achieved within the paver before water enters the layers below. With permeable pavers, water is circumvented around the paver, and the filtering process begins between the pavers in the void space filled with select aggregates. All three types require a similar compacted stone aggregate layering process beneath the surface to accept the stormwater and create a “reservoir” prior to the water percolating into the sub-grade or being piped away. This stormwater conveyance process is referenced by some paver manufacturers as the “paver system.”

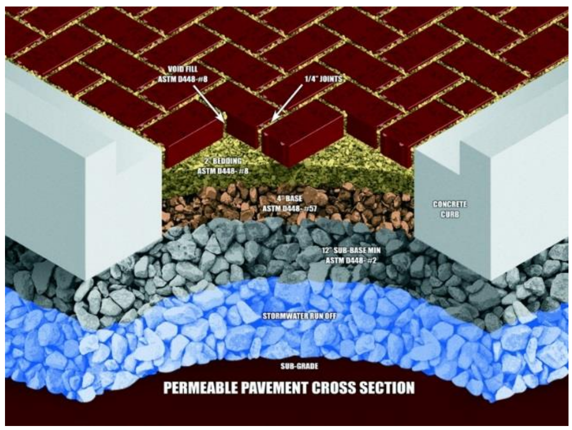


Image courtesy of Pine Hall Brick Company, Inc.

While most rainfall events deliver less than 25 mm (1 inch), rainfall intensity always must be considered. Less than 25 mm over 15 minutes could cause more issues than 76 mm (3 inches) over 8 hours. Therefore, variances for stormwater runoff management primarily are for high-frequency, low-occurrence events. During a large storm event, the water table below any of these pavers can rise, preventing precipitation from absorbing into the ground. Paver system modifications generally are considered when determining the infiltration capacity of the sub-grade native soil and the depth of base rock for stormwater storage. Bioswales, rain gardens, and underdrain systems also are often considered during the design stages.

Residential Rain Barrels and Rain Gardens—IUM 897

Rain Barrels

Rain barrels are various types of barrels used as cisterns to hold rainwater from residential roof runoff. They work in conjunction with a building's gutter system to capture rain that falls on the roof and stores the water for future outdoor use. A mere 1/10th of an inch of rain falling on 1,000 square feet of rooftop can fill a 50-gallon barrel. That's 50 *free* gallons to use to water your flowers, shrubs and other outdoor plants. It is estimated that a 55-gallon rain barrel can save about 1,300 gallons of water during the summer. Outdoor uses for collected rainwater include washing vehicles or watering flowers and lawns. Rainwater is a favorable source of water for plants because it doesn’t contain chlorine or salts.

Rain Gardens

Rain gardens are designed, shallow depressional areas (4 to 8 inches deep) that are strategically located and landscaped with native perennial flowers and vegetation that allow rainwater runoff from impervious urban areas (roofs, driveways, walkways, parking lots, compacted lawn areas) to be absorbed. They are an example of the low-impact development approach to stormwater management that retains and infiltrates rainfall on site. Native plants:

- Are easy to maintain once established (no fertilization required).
- Adapt to Illinois temperatures.
- Resist local pests and disease.
- Reduce stormwater runoff.
- Build soil structure.
- Infiltrate rainfall.

Rain gardens should be:

- Located in an area to intercept runoff from impervious surfaces.
- Placed where good soils with adequate percolation rates exist. (minimum .5 inches per hour percolation rate)
- Kept away from building foundations, utilities and septic systems.
- Five to ten percent of the size of the impervious surface generating the runoff. (Measure square footage of the impervious area, then multiply by 7 percent (0.07).
- A blended soil (20%), sand (50%) and compost (30%) mixture to enhance infiltration.
- The same depth throughout the rain garden to increase the opportunity for infiltration.
- Planted with a selection of native plants based on site considerations for light, moisture and soil
    - Vary plant structure, height and flower color for seasonal appeal and butterfly habitat.
    - Use young plants, or plugs, clumping individual species in groups of 3 to 5 plants to provide bolder color.
- Surrounded by a mowed grass border, if possible.
- Mulched with a 2" shredded wood layer and watered regularly throughout the first season until plants are well established.

Residue and tillage management: no-till/strip-till/direct seeding—CPS 329

Residue and Tillage Management--No-Till/Strip-Till/Direct Seed, according to NRCS CPS 329 Code definition is managing the amount, orientation and distribution of crop and other plant residue on the soil surface year-round, limiting soil-disturbing activities to those necessary to place nutrients, condition residue and plant crops.

No-till farming (also called zero tillage or direct drilling) is a way of growing crops or pasture from year to year without disturbing the soil through tillage. No-till is an agricultural technique which increases the amount of water that infiltrates into the soil and increases organic matter retention and cycling of nutrients in the soil. In many agricultural regions, it can reduce or eliminate soil erosion. It increases the amount and variety of life in and on the soil, including disease-causing organisms and disease suppression organisms. The most powerful benefit of no-tillage is improvement in soil biological fertility, making soils more resilient.

NO-TILL FARMING – CORN

NO-TILL FARMING – SOYBEANS

According to NRCS, no-till is not just about leaving residue on the soil surface. It is also about stopping the disturbance of the soil structure. Any tillage, regardless of its depth, will undo all of the benefits of any previous no-till farming if it fractures the consolidated soil and breaks the macro-pores. This includes losing any improvements in soil quality gained by previous investments in no-till.

No-till is not:

- Using a rotary harrow
- Using a row crop cultivator
- Using a vertical tillage tool
- Incorporating manure with disk covers
- Tilling ground every other year or once every four years

NRCS-approved implements are:

- No-till and strip-till planters
- Certain drills and air seeders
- Strip-type fertilizer and manure injectors and applicators
- In-row chisels
- Similar implements that only disturb strips and slots (zone-till)

All other implements are considered to be full-width or capable of full disturbance and, therefore, not compatible. NRCS can evaluate your farm field operations by utilizing the Soil Tillage Intensity Rating (STIR) value on all field operations performed during the crop interval between harvest of the previous crop and harvest or termination of the current crop. The STIR value for the entire year cannot exceed 30.

No-till is most important for erosion protection on steeper slopes. During heavy spring rains, no-till fields have relatively minor erosion compared to tilled fields, including those fields with high residue levels. Where vertical tillage tools were used, there is more sheet and rill erosion and relatively severe ephemeral erosion compared to no-till fields. No-till alone is often not enough to eliminate erosion on steeper slopes, but that a combination of practices, such as no-till, contour farming, contour buffer strips, terraces, grassed waterways, and field borders, need to be established to truly slow down the erosion process, including cover crops as a practice that can help protect against erosion during the winter and through early spring.

LAKE SPRINGFIELD WATERSHED NO-TILL FIELDS BORDERED BY CP-33 SAFE ACRES

Residue and tillage management: reduced-till—CPS 345

The definition for reduced-till, as provided in the NRCS Conservation Practice Standard Code 345, is managing the amount, orientation and distribution of crop and other plant residue on the soil surface year-round, while limiting the soil-disturbing activities used to grow and harvest crops in systems where the field surface is tilled prior to planting.

The benefits for using reduced-till are:

- Reduce sheet and rill erosion.
- Reduce wind erosion and particulate matter (PM) less than 10 micrometers in diameter.
- Maintain or improve soil quality.
- Increase plant-available moisture.
- Reduce energy use.

Reduced-till applies to all cropland where a majority of the soil surface is disturbed by using the following full-width tillage equipment, just at different soil depths:

- Vertical tillage
- Chiseling
- Disking

No-till/strip-till/direct seeding and mulch-till are considered conservation tillage methods, which create a suitable soil environment for growing a crop and that conserves soil, water and energy resources mainly through the reduction in the intensity of tillage and retention of plant residues.

Conventional tillage, which disturbs the entire soil surface, along with beneficial microbes and organisms, buries the majority of the crop residue and destroys the soil structure with every tillage pass, negating the conservation tillage benefits listed above.

> A comprehensive study and survey of LSW producers about their whole-field tillage operations, the effects on soil health, crop yields and economics will be part of future planning efforts in this watershed.

Riparian Forested Buffers—CPS 391

A riparian forest buffer is defined in NRCS CPS Code 391 as an area of predominantly trees and/or shrubs located adjacent to and up-gradient from watercourses or water bodies for the purpose of:

- Creating shade to lower or maintain water temperatures to improve habitat for aquatic organisms.
- Creating or improve riparian habitat and provide a source of detritus and large woody debris.
- Reducing excess amounts of sediment, organic material, nutrients and pesticides in surface runoff and reduce excess nutrients and other chemicals in shallow ground water flow.
- Reducing pesticide drift entering the water body.
- Restoring riparian plant communities.
- Increasing carbon storage in plant biomass and soils.

Riparian forest buffers are established on areas adjacent to permanent or intermittent streams, lakes, ponds and wetlands, but not to stabilize streambanks or shorelines.

General criteria applicable to all purposes include:

- Positioning the riparian forest buffer appropriately and designed to achieve sufficient width, length vertical structure/density and connectivity to accomplish the intended purpose(s).
- Dominant vegetation will consist of existing, naturally regenerated, or seeded/planted trees and shrubs suited to the soil and hydrology of the site and intended purpose(s).
- Vegetation will extend a minimum width to achieve the purpose(s), measuring at and perpendicular to the normal waterline, bank-full elevation, or the top of the bank as determined locally.
- Overland flow through the riparian area will be maintained as sheet flow.
- For regenerated or planted sites, excessive sheet-rill and concentrated-flow erosion will be controlled.
- Excessive sheet-rill and concentrated-flow erosion will be controlled in areas immediately adjacent and up-gradient of the buffer site.
- Tree and shrub species used will be native and non-invasive. Plantings and seedings will only be with viable, high-quality and adapted plant materials.

- Tree and shrub species that have multiple values, such as those suited for timber, nuts, fruit, florals, browse, nesting and aesthetics, will be favored.
- Periodic removal of some forest products, such as high-value trees, medicinal herbs, nuts and fruits is permitted, provided the intended purpose is not compromised by the loss of vegetation or harvesting disturbance.
- Site preparation and planting will be done at a time and manner to ensure survival and growth of selected species.
- Livestock needs to be controlled or excluded. Refer to NRCS CPS Code 528, Prescribed Grazing and Code 472, Access Control.
- Harmful plant and animal pests must be controlled or eliminated. Refer to Code 595, Pest Management.

Additional criteria, considerations, plans and specifications and operation and maintenance instructions are included in NRCS CPS Code 391 Riparian Forest Buffer.

Roofs and Covers—CPS 367

NRCS CPS Code 367 defines Roofs and Covers as a rigid, semi-rigid or flexible manufactured membrane, composite material, or roof structure placed over a waste management facility, agri-chemical handling facility or an on-farm secondary containment facility to:

- Protect clean water from dilution in waste water in an existing or planned animal waste handling or storage area.
- Improve waste management and utilization to protect nearby surface water quality.
- Capture biogas emissions from an existing or planned animal waste storage facility to reduce the net effect of greenhouse gas emissions, improve air quality and reduce odor as a result of:
  - Biological treatment with composite cover material.
  - Combustion by flare.
  - Combustion by engine generator for energy production.
- Protect clean water by excluding it from a chemically contaminated area.

General criteria applicable to all purposes:

- Select the type, thickness and material properties of the roof or cover and any supporting members after accounting for all loads and stresses due to operational, environmental and climatic conditions.
- Include all anticipated loads in the facility's structural design components that serve as part of the foundation or support for a roof or cover.
- For structural design criteria of the foundations associated with these practices, refer to NRCS CPS Code 313 Waste Storage Facility, or Code 309 Agrichemical Handling Facility.
- Provide suitable access for normal operation and maintenance of an enclosed facility, as a result of a roof or cover.
- Provide ridge or end vent openings of at least 2 inches per 10-foot width of the building to prevent buildup of moisture and gases in the attic area.
- Provide exhaust fans or natural (adequate openings) ventilation for enclosed buildings to maintain a safe working environment when human entry is intended.

- Provide safety features, including fences and warning signs, as appropriate to prevent undue hazards from biogases and drowning.
- Design covers and grating over openings so that livestock and/or humans cannot accidentally displace them and fall into the facility.
- Include provisions in the design to prevent the unintentional conveyance of biogas to any facilities connected to the installed roof or cover.

Saturated Buffers—CPS 604

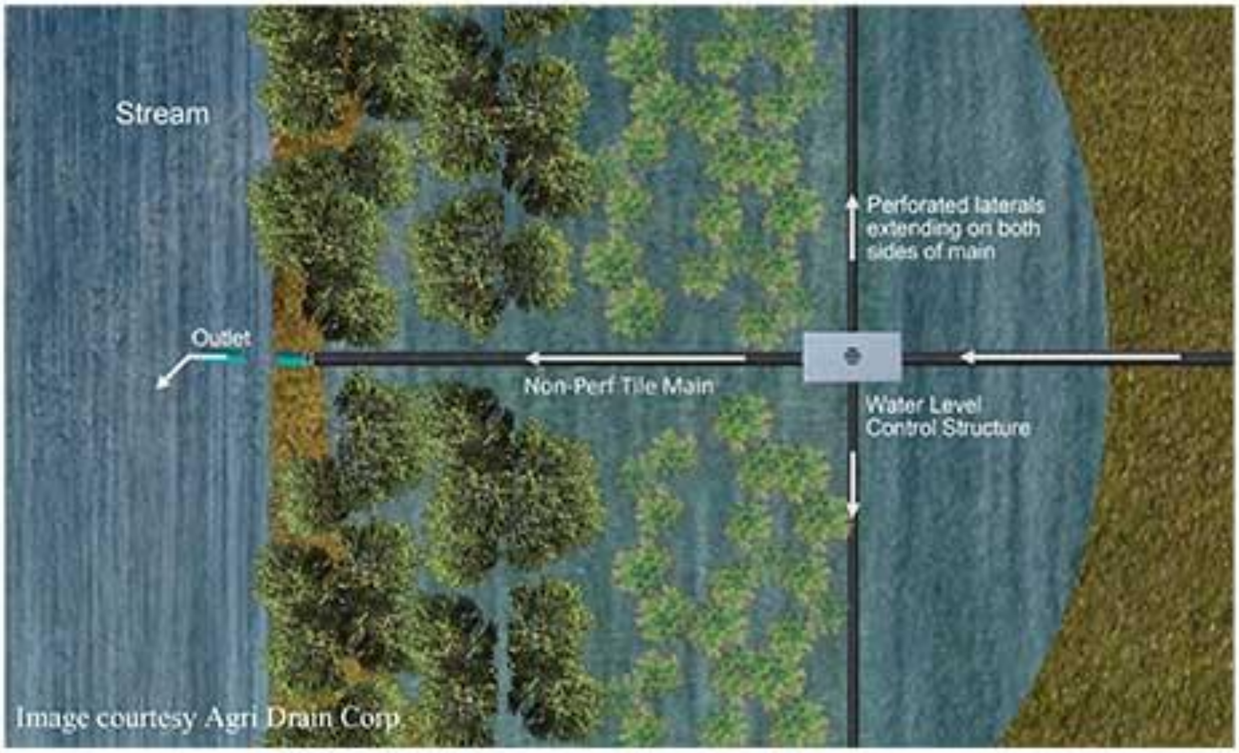
The NRCS CPS Code 604, Saturated Buffer has been available since May 2016.

A saturated buffer is a conservation drainage practice which removes nitrates from subsurface drainage water at low cost without affecting farm field drainage. Instead of water flowing through the tile straight to an outflow point, water is directed to a lateral tile which runs parallel to a ditch. A vegetative buffer zone (minimum 30-foot vegetative strip) is created at the edge of the field above this lateral tile, which takes up the water and nutrients in the water, before it leaves your field. This BMP will achieve one or more of the following purposes:

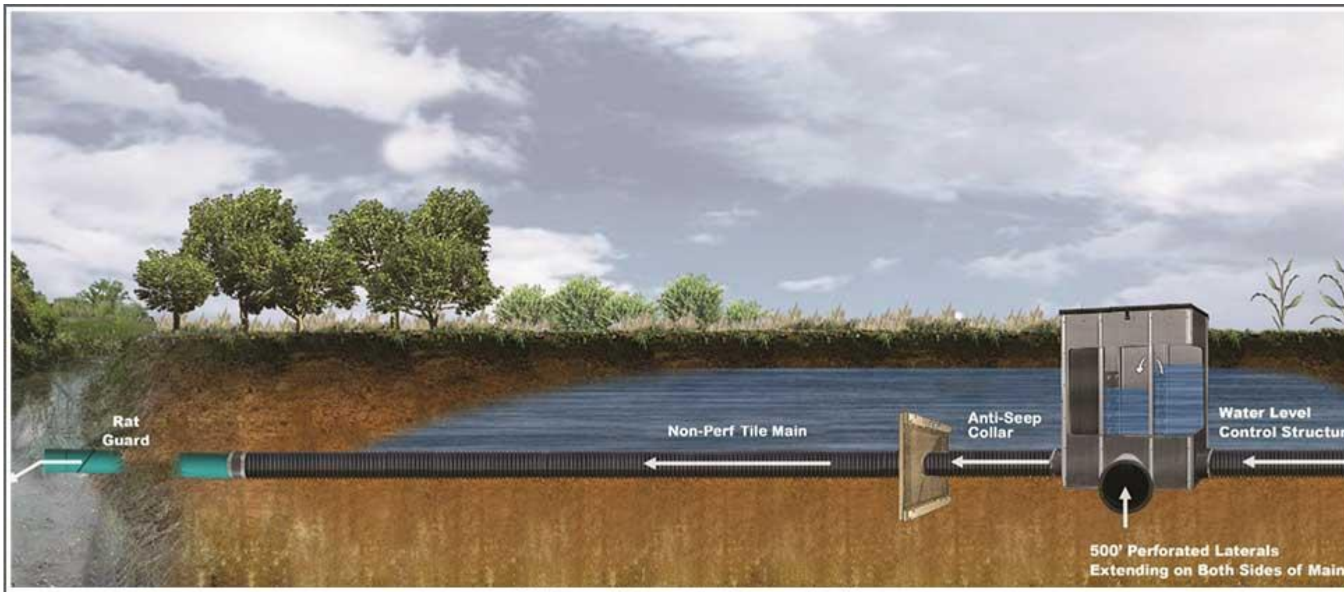
- To reduce nitrate loading to surface water from subsurface drain outlets.
- To enhance or restore saturated soil conditions in rivers or river banks, lakeside fringe, slope or depression wetland landscape classes.

A saturated buffer system has a control structure that diverts the flow from the outlet to a perforated lateral distribution line. The lateral distribution line runs parallel to the buffer and saturation occurs as the water is diverted to this line. As this saturation, or lateral water movement through the buffer, occurs, the vegetation naturally removes the nutrients in the water.

A saturated buffer is one of the new emerging BMPs in which drainage water from subsurface drain outlets is diverted into a perforated distribution pipe used to spread drainage system discharge to a vegetated area to increase soil saturation, primarily for nitrate removal. A saturated buffer system can treat approximately 40 acres and consists of a buffer strip and water control structure to a lateral distribution line which runs under the buffer strip.



An Aerial View of a Theoretical Saturated Buffer



A Side View of A Theoretical Saturated Buffer

SATURATED BUFFER IN LAKE SPRINGFIELD WATERSHED

Sediment Basins – in-field, low flow/in-lake dams—CPS 350

NRCS CPS Code 350 Sediment Basin's definition is a basin constructed with an engineered outlet, formed by an embankment or excavation or a combination of the two, with a purpose to capture and detain sediment-laden runoff or other debris for a sufficient length of time to allow it to settle out in the basin. All sediment basins must comply with all applicable federal, state and local laws and regulations.

Sediment basins are an effective BMP for establishment on:

- Urban land.
- Construction sites.
- Agricultural land.
- Other disturbed lands.

Sediment basins are the last line of defense for capturing sediment when erosion has already occurred. Choose locations for these basins which:

- Intercept as much runoff as possible from the disturbed area.
- Minimize the number of entry points for runoff entry into the basin.
- Reduce interference with construction or farming practices.
- Are not located in perennial streams.

Sediment basin construction must include the following considerations:

- Sediment, detention and temporary flood storage capacities.
- Use of sediment forebays to reduce turbulence and provide a settling area for larger sediment particles from runoff.
- Accessibility to the basin for mechanical sediment removal.
- Dewatering between storm events.
- Site conditions.
- Safety concerns.
- Local laws.
- Visually blending in with the surrounding urban or suburban area topography.

An operation and maintenance plan for sedimentation basins should include the following:

- Essential periodic inspections and maintenance of basin components after significant runoff events.
    - Embankment.
    - Principal and auxiliary spillways.
    - Dewatering device.
- Prompt repair or replacement of damaged components.
- Punctual removal of sediment when reaching pre-determined storage elevations.
- Periodic mowing of vegetation to control trees, brush and invasive species.
- Continuing inspection of safety components and immediate repair, if necessary.

If a sediment basin will also serve a dual purpose as a "wildlife pond", it will be important to plant native species to provide habitat diversity and food for the wildlife. When scheduling maintenance activities, wildlife use of the basin needs consideration, as wildlife life cycles may be disrupted, and pollinators may be negatively impacted.

Sediment trapping in Lake Springfield is dependent on the ratio of inflow to storage capacity. Given the large drainage area associated with each tributary, a maximum 20% sediment trapping efficiency is assumed.

A two- to four-foot in-lake low flow dam is likely possible. However, an engineering study is necessary to gather more accurate estimates of storage volume, areas of inundation and to develop plans and more precise cost estimates. This would likely require topographic and bathymetric surveying, geotechnical sampling, hydraulic modeling, and outlining permitting requirements and strategies.

Additional considerations:

- An in-lake/low-flow dam will require that the up-gradient areas be dredged on 10 to 15-year cycles, in order to maintain the storage capacity necessary for sediment-trapping efficiency. This will require ingress and egress access for sediment removal. There will also need to be a plan for disposing of dredged sediment.
- A 15 to 30-acre area upstream of the proposed dams should be considered for 6 to 8 feet of excavation. This sediment basin would provide an added storage benefit and produce a sediment trap that can be a primary focus for dredging and maintenance. An

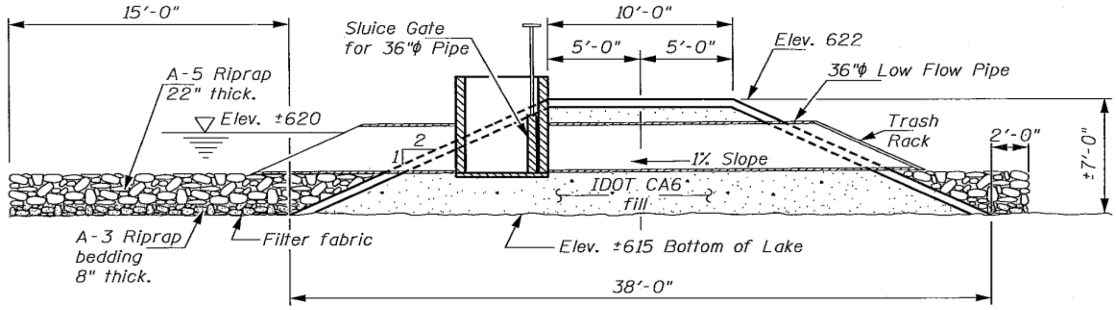
excavated area would provide additional storage capacity and improve sediment-trapping efficiency.

- Flood easements or property purchases may be required.

Two cross-section drawings developed by Hurst-Rosche Engineers for Otter Lake in Macoupin County are provided below.

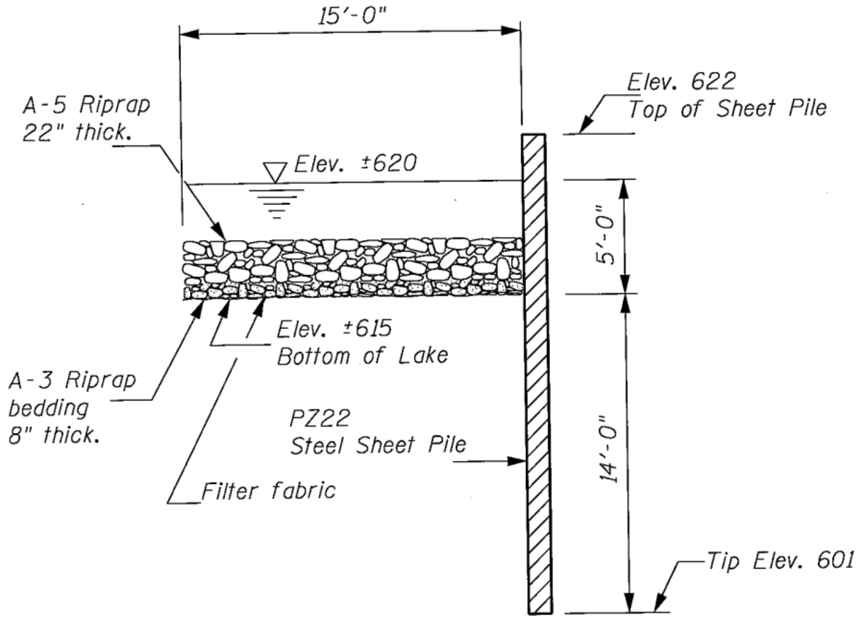
The Otter Lake Low Flow In-lake Dam

Example Details of an Embankment Dam (Above) & Driven Sheet Pile Dam (Below)



SECTION THRU PROPOSED DAM

AT LOW FLOW PIPE



SECTION THRU SHEET PILE DAM

Streambank/lake shoreline stabilization/stream corridor improvement—CPS 580

Once a comprehensive study of the streambanks and stream channels in the LSW is completed, the information will be evaluated and areas needing stabilization will be prioritized for implementation of BMP practices utilizing the NRCS Standard Code 580, Streambank and Shoreline Protection primarily in rural areas, along with NRCS Standard Code 940 Structural Streambank Stabilization from the Illinois Urban Manual for urban areas. Additional criteria for streambanks, shorelines and stream corridor improvement and all applicable local, state and federal laws and regulations will be followed. Until this study is complete, the LSWRPC supports the implementation of these BMPs on a site-by-site basis, dependent upon the BMP's ability to reduce sediment, nitrogen and phosphorus from leaving the project site.

NRCS' definition of streambank and shoreline protection is treatment(s) used to stabilize and protect banks of streams or constructed channels, in addition to shorelines of lakes, reservoirs or estuaries. The purposes of these treatments are to:

- Prevent the loss of land, damage to and protection of:
    - Land uses.
    - Facilities adjacent to the streambanks and constructed channels.
    - Historical, archaeological and traditional cultural properties.
- Maintain the flow capacity of streams and channels.
- Reduce the offsite or downstream effects of sediment resulting from bank erosion.
- Improve or enhance the stream corridor for fish and wildlife habitat, aesthetics and recreation.

All purposes general criteria applicable for this BMP are:

- Avoid adverse effects to endangered or threatened species and their habitats, whenever possible.
- Avoid adverse effects to archaeological, historic, structural and traditional cultural properties, whenever possible.
- Conduct assessment of unstable streambank or shoreline sites in sufficient detail to identify causes contributing to the instability:
    - Livestock access.
    - Watershed alterations resulting in modifications of discharge or sediment production.
    - In-channel modifications (i.e.) gravel mining.
    - Head cutting.
    - Water level fluctuations.
    - Boat-generated wave action.
- Apply proposed protective treatments compatible with improvements being planned or installed by others.
- Ensure that protective treatments are compatible with:
    - Bank or shoreline materials.
    - Water chemistry.
    - Channel or lake hydraulics.

    - Slope characteristics above and below the water line.
- Adequately anchor, terminate and stabilize end sections:
    - To existing treatments.
    - In stable areas.
    - To prevent flanking of the treatment.
- Result in stable slopes.
    - Design limitations of banks or shoreline materials and type of measure installed determine steepest permissible slopes.
- Designs provide protection of installed treatments from overbank flows resulting from upslope runoff and flood return flows.
- Internal drainage for bank seepage will be provided as needed, using geotextiles or properly designed filter bedding.
- Design treatments for anticipated ice and wave action, along with fluctuating water levels.
- Establish erosion control BMPs around all disturbed areas and protective treatments as soon as practical after construction.
- Prepare and follow a vegetative management plan in accordance with NRCS Critical Area Planting Code 342.

The following items are provided in the NRCS CPS Code 580 Streambank and Shoreline Protection:

- Additional criteria for streambanks, shorelines and stream corridor improvement.
- Considerations:
    - Changes to watershed hydrology and sedimentation over the design life of the treatments.
    - Utilization of debris removed from the channel or streambank in the treatment design.
    - Minimize visual impacts and maintain or complement existing landscape, avoiding excessive disturbance and compaction of the site during installation.
    - Utilize vegetative species that are native and/or compatible with local ecosystems.
    - Select plants that provide habitat for desirable wildlife and pollinators.
    - Install treatments that promote beneficial sediment deposition and filtering of sediment, sediment-attached and dissolved substances.
    - Include treatments in the design which provide aquatic habitat, lower or moderate water temperature and improve water quality.
    - Stabilize side channel inlets and outlets of tributary streams from erosion.
    - Select the type of toe stabilization which will protect aquatic habitat.
    - Maximize adjacent wetland functions in the design to minimize adverse effects to existing wetland functions and values.
    - Consider livestock exclusion and grazing BMPs during vegetative treatment establishment.

  - Establish buffer strips and/or diversions at the top of the bank or shoreline protection zone to improve their function to filter out sediments, nutrients and pollutants from runoff and provide additional wildlife habitat.
  - Conserve and stabilize archeological, historic, structural and traditional cultural properties, when applicable.
  - Consider potential safety hazards to boaters, swimmers, or people using the shoreline and streambank when designing treatments for the area.
  - Establish treatments that are self-sustaining or require minimum maintenance.
- Plans and specifications which are prepared for specific field sites based on this NRCS standard practice must include:
  - BMPs to achieve its intended purpose.
  - Treatments to minimize erosion and sediment production during construction.
  - Provisions necessary to comply with conditions of:
    - Any environmental agreements.
    - Biological opinions.
    - Terms of applicable permits.
- Operation and maintenance plan:
  - To insure proper function of the established BMPs
  - Periodic inspections
  - Prompt repair or replacement of damaged components or erosion.

GRADE CONTROL STRUCTURES - ROCK RIFFLES

Stream channel stabilization BMP practices such as rock riffles are supported in this LSWMP for implementation. The streambank/stream channel stabilization study will also include assessment and documentation of locations where these BMPs should be implemented.

While erosion and the transport and deposition of sediments is usually a very slow natural process along shorelines, plants, animals, human activities and natural disturbances can accelerate this erosion process. Eroded soils are, by volume, the greatest pollutant of lakes and streams in the United States.

Lake shoreline stabilization BMPs should be selected based on the following dynamics affecting the shoreline:

- Severity of wave action.
- Ice expansion shoreward.
- Degree and duration of water level fluctuation.
- Steepness of the shoreline.
- Soil/substrate conditions.
- Severity of existing erosion.
- Adjacent land uses and related aesthetic considerations.
- Maintenance needs.

LAKE SPRINGFIELD SHORELINE STABILIZATION USING ROCK RIP RAP

BMPs which can limit shoreline degradation and improve the water quality of lakes include:

- Placement of rocks and rock rip rap and other structural barriers (various types of lake retaining walls) to reduce erosive impact from wave action.
    - Grade shoreline no steeper than 3:1 slope prior to riprap installation.
    - Install heavyweight (4 or 6 ounce) filter fabric, avoiding seams, when possible. Secure to ground or shoreline with steel staples throughout the entire sheet of fabric.
    - Use a clean mix of rip rap 6 to 12 inches in diameter. The steeper the shoreline and/or faster the water may require larger size rip rap.
    - Lake retaining walls should be built in accordance with all governmental rules and regulations.

- Plant vegetative plantings in near-shore land areas to reduce erosion and absorb nutrient runoff.
  - Remove existing non-native, undesirable vegetation.
  - Re-grade bank to create a stable slope.
  - Install temporary soil stabilization measures (e.g., erosion control blanket, cover crops) until the new vegetation becomes fully established.
  - Plant native plant species which can become self-sustaining and will reproduce under shoreline conditions.
  - Perform annual or biennial controlled burns (or mowing) to control non-native plants and prevent invasion by undesirable woody plants.
- Establishing riparian tree/shrub plantings (willow post method) in more isolated locations where direct shoreline access and visibility is not necessary exhibits great shoreline stability.
  - Plant riparian cuttings (buttonbush, redosier dogwood, sandbar willow, etc.) with extensive fibrous root systems that grow towards the water.
  - Plant during dormant state (early spring or late fall) into pilot holes on random centers 4 to 5 feet apart in the shoreline, using a seeded cover crop while cuttings are becoming established.
- Install and stake biodegradable fiber rolls (sausage-like cylinders of compacted fiber wrapped with a fiber mesh), along with aquatic emergent vegetation, in the shallow water zone next to the shoreline to dissipate wave energy and trap eroded sediments.
- Install A-Jacks structures (two identical pieces of pre-cast concrete forming a 6-legged structure) placed in a linear fashion into a shallow trench excavated at the toe of eroding slopes to provide immediate erosion protection, which creates a living system of erosion control.
  - Fill void spaces with an erosion control product and cover with soil.
  - Plant native species of shrubs, grasses and wildflowers in the backfilled areas.
- Re-grading shoreline land areas to more gradual slopes to reduce velocity runoff and consequential erosion.
- Construct sediment basins near the Lake's inlet to allow excessive amounts of sediment to settle out of water before entering the Lake.
- Establish shoreline wetlands to enrich aquatic life diversity and remove pollutants from surface water runoff.

The primary BMP used around the public portion of shoreline around Lake Springfield has been the placement of rock riprap. In privately owned areas of the Lake, various types of lake retaining walls (concrete, rock, steel, etc.) armor the shoreline.

Streambank Stabilization (structural)—IUM 940

Streambank stabilization of eroding streambanks by using designed structural measures is for the protection of these areas from erosive forces of flowing water, as noted in IUM NRCS PCS Code 940. Sections of streambanks that are subject to erosion due to excessive erosion from construction activities are appropriate where flow velocities exceed five feet per second or where vegetative streambank protection is inappropriate.

A development plan and design, prepared by an engineer experienced in this field, should be based on specific site conditions according to the following principles:

- Make protective measures compatible with other channel modifications planned or being carried out in other channel reaches.
- Use the minimum design velocity of the peak discharge of the 10-year storm.
- Ensure the channel bottom is stable or stabilized by structural means before installing any permanent bank protection.
- Ensure streambank protection extends between stabilized or controlled points along the stream.
- Do not change channel alignment without a complete evaluation of the anticipated effect on the rest of the stream channel, especially downstream.
- Maintain and improve habitat for fish and wildlife.
- Meet all state law and all permit requirements of local, state and federal agencies.

Types of structural material for stabilizing streambanks include:

- Rip rap – most commonly used. Rip rap is rock or other material used to armor shorelines, streambeds, bridge abutments, pilings and other shoreline structures against scour and water or ice erosion. Refer to IUM construction specification 61 Loose Rock Rip rap.
- Gabions are rectangular, rock-filled wire baskets that are pervious, semi-flexible building blocks that can be used to armor the bed and/or banks of channels, or can act as deflectors to divert flow away from eroding channel sections. Refer to IUM construction specification 64 Wire Mesh Gabions.
- Reinforced concrete may be used to armor eroding sections of the streambank by constructing retaining walls or bulkheads. It can also be used as a channel lining for stream stabilization.
- Grid pavers are modular concrete units with interspersed void areas that can be used to armor the streambank while maintaining porosity and allowing the establishment of vegetation.
- Revetment is structural support or armoring to protect an embankment from erosion by using a combination of riprap or gabions (stacked or placed as a mattress).

Subsurface Drain—CPS 606

As defined in NRCS PCS Code 606 Subsurface Drain, a subsurface drain is a conduit installed beneath the ground surface to collect and/or convey excess water as part of a resource management system to achieve one or more of the following purposes:

- Remove or distribute excessive soil water.
- Remove salts or other contaminants from the soil profile.

Installation of a subsurface drainage system can mitigate the following adverse conditions caused by excessive soil moisture and can distribute excess water through a subsurface water utilization or treatment area:

- Poor health, vigor and productivity of plants.
- Poor field trafficability.
- Wet soil conditions around farmsteads structures and roadways.

Considerations when planning, designing and installing this practice should include the following items:

- Protection of shallow drains, auxiliary structures and outlets from damage due to freezing and thawing.
- Proper surface drainage to reduce the required intensity of the subsurface drainage system.
- Designs that incorporate drainage water management practices to reduce nutrient loading of receiving waters.
- Drainage laterals oriented along elevation contours to improve the effectiveness of drainage water management structures.
- The effects of drainage systems on runoff volume, seepage and the availability of soil water needed for plant growth.
- Identification of soil profile hydraulic characteristics, soil texture layering, water table depth, etc., confirmed with soil survey information and site investigation.
- Effects of drainage systems on the hydrology of adjacent lands.
- Subsoiling or ripping of soils with contrasting texture layers to improve internal drainage.
- Installations in dry soil profile to minimize problems of trench stability, conduit alignment and soil movement into the drain.
- Effects to surface water quality.
- Use of temporary flow blocking devices to reduce risk of drain water contamination from surface applications of manure.

Numerous criteria to be included in the design of a subsurface drainage system, as noted in NRCS CPS Code 606, include:

- Design capacity.
- Size of the subsurface drains.
- Internal hydraulic pressure.
- Horizontal alignment.
- Location, depth and spacing, based on the site conditions including:

  - Soil.
  - Topography.
  - Groundwater conditions.
  - Crops.
  - Land use.
  - Outlets.
  - Saline or sodic conditions.
  - Proximity to wetlands.
- Minimum velocity and grade, based on site conditions and a velocity of not less than 0.5 feet per second, if a sedimentation hazard does not exist. A velocity of not less than 1.4 feet per second shall be used to establish the minimum grades if a sedimentation hazard exists.
- Maximum velocity based on protective measures which will not exceed manufacturer's recommended limits.
- Thrust control following pipe manufacturer's recommendations where the following conditions exist:
  - Axial forces that tend to move the pipe down steep slopes.
  - Thrust forces from abrupt changes in pipeline grade or horizontal alignment, which exceed soil-bearing strength.
  - Reductions in pipe size.
- Outlets adequate for the quantity and quality of water to be discharged.
- Protection from biological and mineral clogging, when applicable.
- Protection from root clogging, when drains are in close proximity to perennial vegetation.
- Water quality. Protection from septic systems and animal waste being directly introduced into the subsurface drainage system.
- Materials of acceptable quality.
- Foundations must be stabilized and protected from settlement.
- Filters and filter material used around conduits, as needed, to prevent movement of the surrounding soil material into the conduit.
- Envelopes and envelope material used around subsurface drains if needed for proper conduit bedding or to improve flow characteristics into the conduit.
- Placement and bedding to be applied to both excavation trenching and plow-type installations.
- Auxiliary structures and protection with the capacity of any structure installed in the drain line no less than that of the line or lines feeding into or through them.

Refer to the NRCS CPS Code 606 Subsurface Drain for plans and specifications and the O & M Plan instructions.

Surface Drain, Main or Lateral—CPS 608

NRCS CPS Code 608 Surface Drain, Main or Lateral and NRCS CPS 582 Open Channel are defined as an open drainage ditches for moving the excess water collected by a field ditch or subsurface drain to a safe outlet for the following purposes:

- To convey excess surface or shallow subsurface water from a field ditch to a safe outlet.
- To convey excess subsurface water from a subsurface drain to a safe outlet.
- To provide discharge capacity required for flood prevention, drainage, other authorized water management purposes or any combination of these purposes.

General criteria applicable to all purposes include:
- Completion of a wetland determination, if wetlands are present.
- Location and design of mains and laterals to serve as integral parts of a surface or subsurface drainage system that meets the conservation and land use needs.
- Size of the ditch capacity which will provide for the removal of excess water, based on climatic and soil conditions and the needs of the crops.
- Determine hydraulic grade line for drainage ditch design from control points.
- Design the drainage ditch deep enough to allow for normal siltation.
- Design the ditch cross section to meet combined requirements of capacity, limiting velocity, depth, side slopes, bottom width, along with allowances for initial sedimentation, all below the design hydraulic grade line.
- Ensure stability of the ditch bottom and side slopes. Base the maximum permissible design velocity on site conditions.
- Locate adjacent berms at a safe distance from the drain and shape berm-side slopes as required to:
    - Provide access for maintenance equipment; eliminate the need for moving spoil banks in the future.
    - Provide for work areas and facilitate spoil bank spreading; prevent excavated material from washing or rolling back into ditches
    - Lessen sloughing of ditch banks caused by heavy loads near the edge of the ditch banks.
- Protect drainage mains and laterals against erosion where surface water or shallow ditches enter deeper ditches.
- Establish vegetation according to NRCS CPS Code 342 Critical Area Planting.

Other considerations include:
- Use of low-flow or two-stage channel design (NRCS CPS Code 582 Open Channel).
    - Leads to greater channel stability.
    - Function as wetlands during certain times of the year, reducing ditch nutrient loads.
    - Restores some of the beneficial natural processes within the ditch environment while providing the drainage capacity necessary for production.
    - Must not be constructed along ditches with established trees.
    - Low flow channel and vegetation below the bench elevation will not be disturbed.
    - Water quality impacts will be evaluated and measures taken to overcome any impacts determined.
    - Total bench width will be between 2 and 4 times the existing low channel flow (bank) width, with an even split preferred. One-sided construction only if needed

    to avoid protected or inhibitory areas (trees, wetlands and/or cultural resources).
  - Bench height determined by regional curve method to size low flow channel to carry between 0.5 and 1-year, 24-hour storms, or by approximating elevation of natural bench formations.
  - Outside bank slopes will be 2:1 or flatter, using erosion control blanket if conditions are not suitable for rapid vegetative establishment.
  - Existing drainage tile outlets must be repaired and outlet onto the newly created bench, if possible and with riprap or other erosion protection placed at outlets to protect bench.
  - NRCS CPS 342 Critical Area Planting will be followed for establishing vegetation.
  - An O & M plan will be developed for each channel system.
- Impacts of sedimentation downstream.
- Possible damages above or below the point of discharge that might involve legal actions or other offsite impacts.
- Potential impacts on wetlands.
- Impacts on cultural resources.
- Use of riparian buffers, filter strips and fencing.
- Potential water quality effects of soluble pollutants and sediment-attached pollutants.
- Impacts to wildlife.
- Impacts of invasive species movement and establishment through the drainage network.

Refer to NRCS CPS Code 608, Surface Drain, Main or Lateral, NRCS CPS Code 382 Open Channel for plans and specifications and preparation of a site-specific O & M plan.

While the LSWMP does not encourage new drainage ditches, it is a BMP that may be necessary for implementation on a case-by-case basis, in connection with other BMPs which are effective at reducing the amount of nitrogen and phosphorus from entering the LSW streams.

Terraces—CPS 600

According to NRCS Conservation Practice Code 600, a terrace is an earth embankment, or a combination ridge and channel, constructed across the field slope to:

- Reduce erosion by reducing slope length.
- Retain runoff for moisture conservation.

Terraces are used when:

- Soil erosion caused by water and excessive slope length is a problem.
- Excess runoff is a problem.
- There is a need to conserve water.
- The soils and topography are such that terraces can be constructed and reasonably farmed.
- A suitable outlet can be provided.

Terraces can be grass-backed, narrow or wide. Most terraces have field tile installed with an adequate drainage outlet.

General criteria applicable to all purposes for this terrace BMP include:

- Terrace spacing to achieve the intended purpose(s).
- Alignment to accommodate farm machinery and farming operations.
- Terrace capacity to control runoff from a 10-year frequency, 24-hour storm without overtopping. Other specific terrace designs to meet the purpose of the terrace are included in the NRCS Standard Code 600.
- Terrace cross section proportioned to:
    - Fit the land slope.
    - Crops grown.
    - Accommodate the farm machinery and farming operations used.
    - Ridge height should be added, if necessary, to provide for:
        - Settlement.
        - Channel sediment deposits.
        - Ridge erosion.
        - Effect of normal tillage operations.
        - Safety.
- Terrace end closures.
    - Open ends for level terraces.
    - Partial end closures.
    - Complete end closures.
- Stable channel grade to prevent crop damage or delay in farming activities from prolonged ponding.
- Level terrace length where the volume of water stored in level terraces is proportional to the length.
- Adequate outlets to convey runoff water to a point where it will not cause damage.
- Vegetation to stabilize the area using NRCS Practice Standard 342 Critical Area Planting.
- Install subsurface drainage to stabilize soils and improve terrace function, following NRCS Practice Standard 606 Subsurface Drain for design and installation criteria.

Additional criteria applicable to retaining runoff for moisture control, other considerations for successful terrace systems, plans and specifications and preparation of an operation and maintenance plan for the operator are included in Terrace NRCS Conservation Practice Standard Code 600.

Tree and Forest Ecosystem Preservation—IUM 984

With only five percent of this watershed being classified as forest, along with the prevalence of considerable urban sprawl in this watershed, preservation of this natural resource is extremely important. While the forested areas around Lake Springfield are protected under the rules and regulations outlined in the "Lake Springfield and Its Marginal Properties" Land Use Plan, efforts to preserve the tree and forest ecosystem using this practice standard will provide guidelines for accomplishing this task throughout the LSW.

The Tree and Forest Ecosystem Preservation IUM Practice Standard Code 984 defines this practice as the preservation of contiguous stands of trees from damage during construction operations for the purpose of preserving contiguous forested areas and stands of trees that have present and future value for:

- Erosion protection.
- Wildlife habitat.
- Landscape aesthetics.
- Other economic and environmental benefits.

This practice applies on development sites containing stands of trees and should take into consideration the following features:

- Rare and endangered/threatened species.
- Historical or archaeological significance.
- Quantity and quality of forested area in the county or local governmental area.
- Frailty of resources without existing trees.
- Potential for soil erosion without existing trees.
- Loss of aesthetic quality of the site and existence of critical areas (floodplains, steep slopes and wetlands.
- Unique flora and fauna.
- Health and condition of individual trees and the forest ecosystem.
- Loss of habitat and flora and fauna species diversity.
- Groups of trees to be saved on the erosion control plan.
- A mitigation plan for damaged trees prepared in consultation by a professional forester or certified arborist to include construction plans and contract documents.

Criteria applicable for all purposes include:

- Protecting from one foot outside the perimeter of the leaf canopy of the stand of trees to be protected.
- Installing required protection measures prior to commencement of any site development activity and remain in place and in working, functional order until all site development activities have ceased or the surrounding area has been stabilized.
- Permitting no construction activities within the CFEZ.
- Keeping all roadways, parking areas and storage areas located outside the CFEZ.
- Installing of construction fencing (fluorescent safety netting), wooden snow fence or approved equivalent with a minimum 40-inch height around the CFEZ of all forested areas to be preserved, prior to pruning.

Additional criteria, other considerations, plans and specifications and an operation and maintenance plan are included in the IUM Tree and Forest Ecosystem Practice Standard Code 984.

Tree/Shrub Establishment—CPS 612

According to NRCS Conservation Practice Standard Code 612, Tree/Shrub Establishment is establishing woody plants by planting seedlings or cuttings, direct seeding or natural regeneration for the following purposes:

- Forest products such as timber, pulpwood, etc.
- Wildlife habitat.
- Long-term erosion control and water quality improvement.
- Treating waste.
- Storing carbon in biomass.
- Reduce energy use.
- Develop renewable energy systems.
- Improving or restoring natural diversity.
- Enhancing aesthetics.
- Storing carbon in biomass.
- Reduce energy use.
- Develop renewable energy systems.
- Improving or restoring natural diversity.
- Enhancing aesthetics.

Trees and shrubs can be established on any appropriately prepared site where woody plants can be grown. Other specialized NRCS practice standards for woody plant establishment include:

- Riparian forest buffer (Code 391).
- Alley cropping (Code 311).
- Windbreak/shelterbelt establishment (380).
- Critical area planting (342).
- Hedgerow planting (422).

General criteria applicable to all purposes:

- Planting species adapted to site conditions and suitable for planned purpose(s).
- No planting of noxious weeds on the Federal or state noxious weeds list.
- Planting or seeding rates adequate to accomplish the planned purpose for the site.
- Planting dates, care, handling and planting of seed, cuttings or seedlings to ensure an acceptable survival rate.
- Exclusive use of viable, high-quality and adapted planting stock or seed.
- Appropriately prepared sites following NRCS Standard Code 490 Tree/Shrub Site Preparation.
- Adequate seed sources or advanced reproduction needs to be present or provided for when using natural regeneration to establish a stand.
- Planting technique and timing selection which are appropriate for the site and soil conditions.
- Acceptability and timing of coppice regeneration based on species, age and diameter.

- Protection of planting from plant and animal pests and fire following NRCS Standard Code 595 Integrated Pest Management.
- Evaluation of site to determine if mulching, supplemental water or other cultural treatments (e.g., tree protection devices, shade cards, brush mats) will be needed to assure adequate survival and growth.

Additional criteria, considerations, plans and specifications and an operation and maintenance plan are included in the Tree/Shrub Establishment NRCS Standard Code 612.

Tree and Shrub Planting (urban)—IUM 985, 990A and 990B

The Tree and Shrub Planting Practice Standard Code 985 from the Illinois Urban Manual is for the planting of selected trees and shrubs for the purpose of establishing trees and/or shrubs to:

- Conserve soil.
- Beautify.
- Screen unsightly views.
- Provide shade.
- Attract wildlife.

While this practice identifies its use specifically for urban environments, it is also very adaptable for rural residential or commercial locations for:

- Protecting the soil from erosion.
- Planting ornamental plants which are desirable for landscaping and beautification.
- Planting woody plants to block undesirable views.
- Planting woody plants for windbreaks.
- Reducing noise levels.
- Providing wildlife food and habitat.

Criteria applicable for all purposes include:

- Selecting of tree and shrub species that are:
    - Suited to the soil and site conditions.
    - Adapted to the plant hardiness zone.
- Keeping roots of bare root stock moist at all times prior to planting.
- Planting trees and shrubs at proper spacing to provide enough space for full crown development.
- Ensuring all bare root, container grown and balled and burlapped planting stock meet the minimum root system spread criteria described in IL Urban Manual's (IUM) Practice Code 707 Digging, Transporting, Planting and Establishment of Trees, Shrubs and Vines.
- Planting stock while they are dormant and planting dates and procedures conform to those established by the 707 Practice Code.
- Mulching of all planting stock spread uniformly graded and have the ability to completely block sunlight from reaching the soil's surface, according to Practice Standard Code 895 Mulching and meet minimum requirements for mulching materials as listed in IUM Practice Codes 592, 800. 801, 802 and 803.

Other considerations, plans and specifications and an operation and maintenance plan are outlined in the Urban Tree Planting Practice Code 985, 990A and 990B.

Water and Sediment Control Basins (WASCOBs)—CPS 638

A water and sediment control basin (WASCOB) is an embankment and/or channel constructed across a slope to intercept runoff water and/or control water runoff to control formation of rill and gully erosion by breaking longer slopes into smaller segments. WASCOBs are often constructed to mitigate gully erosion where concentrated flow is occurring and where drainage areas are relatively small. Terraces, similar to a WASCOB in design, are placed in areas where concentrated flow paths are less defined, such as long, wide-sloping fields. These practices are both popular with landowners in the watershed and applicable in many situations.

NRCS CPS Code 638 describes a WASCOB as an earth embankment or a combination ridge and channel constructed across the slope of minor watercourses to form a sediment trap and water detention basin with a stable outlet. Most of the WASCOBs in this watershed are comprised of a tile inlet upstream of the berm (ridge) with the tile run to a suitable outlet. The purpose of a WASCOB is to reduce watercourse and gully erosion, to trap sediment and/or to reduce and manage onsite and downstream runoff. This BMP usually applies to sites where the topography is generally irregular; gully erosion is a problem; sheet and rill erosion are controlled by other conservation practices; runoff and sediment damages land and works of improvements; and adequate outlets can be provided.

A WASCOB is a short earthen dam built across a drainageway where a terrace is impractical, usually part of a terrace system.

- Basins improve water quality by trapping sediment on uplands and preventing it from reaching water bodies.
- Structures reduce gully erosion by controlling water flow within a drainage area.
- Grass cover may provide habitat for wildlife.

WATER AND SEDIMENT CONTROL BASINS (WASCOBS)

This practice may be applied as part of a resource management system for one or more of the following purposes:

- To reduce watercourse and gully erosion.
- To trap sediment.
- To reduce and manage onsite and downstream runoff.

This standard should not be used in place of terraces. Where the ridge and/or channel extends beyond the detention basin or level embankment, use NRCS CPS Code 600, Terrace or NRCS CPS Code 362, Diversion, as appropriate.

General criteria applicable to all purposes include:

- Install WASCOBs as part of a conservation system that adequately addresses resource concerns both above and below the basin. Where land ownership or physical conditions preclude treatment of the upper portion of a slope, a WASCOB may be used to separate this area from, and permit treatment of, the lower slope.
- Locate WASCOBs to control erosion in drainageways. Basins may be installed singly or in series as part of a system. Adjust the location to fit the topography, maximize storage and accommodate farm equipment and farming operations.
- Minimum top widths for embankments are shown below. Construct embankments at least 5% greater than design height to allow for settlement. Measured from natural ground at the centerline of the embankment, the maximum settled height of the embankment must be 15 feet or less.

Minimum Top Width of Embankments

Fill Height (feet)	Top Width (feet)
0 – 5	3
5 - 10	6
10 –15	8

- Design embankment slopes should be no steeper than 2 horizontal to 1 vertical. The sum of the horizontal components of the upstream and downstream slopes of the embankment must be 5 or greater. Design all slopes to be farmed no steeper than those on which farm equipment can be operated safely. Portions of basin ridges designed to impound more than a 3-foot depth of water must include foundation cutoff and if conditions warrant, seepage control. Refer to NRCS CPS Code 378 Pond, for criteria for foundation cutoff and seepage control.
- As a minimum, design WASCOBs with sufficient capacity to control the runoff from a 10-year frequency, 24-hour duration storm using a combination of flood storage and discharge through the outlet. Where basins are used for flood control or to protect other works of improvement, if warranted, use larger design storms appropriate to the risk.

- In addition to the above storage, WASCOBs must have the capacity to store at least the anticipated 10-year sediment accumulation, or periodic sediment removal is required in the Operation and Maintenance Plan to maintain the required capacity.
- A WASCOB must have an adequate outlet. The outlet must convey runoff water to a point where it will not cause damage. Outlets can be underground outlets, pipe drop structures, soil infiltration, stabilized channels or a combination of outlet types.
- If the basin is cropped, design the outlet so that the flow release time does not exceed the inundation tolerance of the planned crops. If sediment retention is a primary design goal, adjust the release rate according to sediment particle size so that sediment is retained in the basin. Refer to NRCS CPS Code 620, Underground Outlet, for design criteria for underground outlets.
- Outlets can include auxiliary spillways above the primary storage to handle large storm flows. If an auxiliary spillway is used, add freeboard to the design height of the embankment to provide for the safe operation of the spillway. The freeboard shall be at least 0.5 ft. above the design flow depth through the auxiliary spillway. Auxiliary spillways must not contribute runoff to lower WASCOBs unless they are designed to handle the runoff. Refer to Conservation Practice Standard (378), Pond for criteria to design auxiliary spillways.
- Where necessary to restore or maintain productivity, spread topsoil over areas disturbed by construction. Topsoil can be salvaged and stockpiled from the site of the WASCOB prior to construction.
- After construction, revegetate disturbed areas that will not be cropped as soon as possible. In non-cropland settings other erosion protection, such as gravel or organic mulches, can also be used.

NRCS CPS Code 342, Critical Area Planting provides criteria on seed selection, seedbed preparation, fertilizing and seeding, considerations, plans and specifications and O & M plan requirements.

Well Decommissioning—CPS 351 and IUM 996

NRCS CPS Code 996 in the IL Urban Manual defines well decommissioning as the sealing and permanent closure of a water well, boring or monitoring well for the purpose of:

- Preventing entry of contaminated surface water into the well and migration of contaminants into the unsaturated or saturated zone.
- Preventing entry of vermin, debris or other foreign substances into the well or well bore hole.
- Eliminating the physical hazard of an open hole to people, animals and vehicles.
- Preventing the commingling of chemically or physically different ground waters between separate water bearing zones.

Well decommissioning applies to sealing and permanent closure of a water well, boring or monitoring well that is no longer in use, or is in a state of disrepair that it has the potential for transmitting contaminants into an aquifer or threatens public health or safety. It does not apply to wells that:

- Were used for waste disposal.
- If evidence of contamination in the well exists.
- Contains contaminant levels that exceed state or federal water quality standards.

Treatment of contamination is required before a well is decommissioned.

Well decommissioning is regulated by the Illinois Water Well Construction Code, Section 920, 120-Abandonded Wells and Section 920-130-Permit Requirements and current local health department ordinances, with state/local codes having primacy over this NRCS CPS Code 996.

To the extent practicable, an abandoned well should be decommissioned in a manner that restores the original hydrogeological conditions of the well site and does not preclude the use of the site from future land management practices.

Wetlands – constructed—CPS 658, 659, 657

According to NRCS Conservation Practice Standard Code 656, a constructed wetland is a shallow, maximum 2-foot water depth area (except in those instances where deep water areas are included as a special design) constructed by creating an earth embankment or excavation. Constructed wetland practices can include a water control structure and are designed to mimic natural wetland hydrology.

Constructed wetlands are treatment systems that use natural processes involving wetland vegetation, soils, and their associated microbial assemblages to improve water quality. Natural wetlands perform many functions that are beneficial to both humans and wildlife. One of their most important functions is water filtration. As water flows through a wetland, it slows down and many of the suspended solids become trapped by vegetation and settle out. Other pollutants are transformed to less soluble forms taken up by plants or become inactive. Wetland plants also foster the necessary conditions for microorganisms to live there. Through a series of complex processes, these microorganisms also transform and remove pollutants from the water.

Nutrients, such as nitrogen and phosphorous, are deposited into wetlands from stormwater runoff, from areas where fertilizers or manure have been applied and from leaking septic fields. These excess nutrients are often absorbed by wetland soils and taken up by plants and microorganisms.

Wetlands are some of the most biologically diverse and productive natural ecosystems in the world. While not all constructed wetlands replicate natural ones, it makes sense to construct wetlands that improve water quality and support wildlife habitat. Constructed wetlands can also be a cost-effective and technically feasible approach to treating wastewater. Wetlands are often less expensive to build than traditional wastewater treatment options, have low operating and maintenance expenses and can handle fluctuating water levels. Additionally, they are aesthetically pleasing and can reduce or eliminate odors associated with wastewater. Wetland plants and associated microorganisms treat wastewater as it flows through a constructed wetland system.

Constructed wetlands are generally built on uplands and outside floodplains or floodways in order to avoid damage to natural wetlands and other aquatic resources. Wetlands are frequently constructed by excavating, backfilling, grading, diking and installing water control structures to establish desired hydraulic flow patterns. If the site has highly permeable soils, an impervious, compacted clay liner is usually installed and the original soil placed over the liner. Wetland vegetation is then planted or allowed to establish naturally. (www.nepis.epa.gov)

WETLANDS IN LAKE SPRINGFIELD WATERSHED

A wetland is a marsh-type area with saturated soils and water-loving plants. Wetlands provide wildlife habitat and serve as natural filters of agricultural runoff.

- Wetlands can provide natural pollution control. They remove nutrients, pesticides, and bacteria from surface waters and can act as efficient, low-cost sewage and animal waste treatment practices.
- Wetlands filter and collect sediment from runoff water.
- Because wetlands slow overland flow and store runoff water, they reduce both soil erosion and flooding downstream.
- Many wetlands release water slowly into the ground, which recharges groundwater supplies.

Wetlands – urban stormwater—IUM 997, 998, 999

An urban stormwater wetland, as defined NRCS CPS Code 800 in the IUM, is a constructed system of shallow pools that create growing conditions suitable for emergent and riparian wetland plants explicitly designed to lessen the impacts of stormwater quality and quantity in urban areas, with the following purposes to:

- Maximize pollutant removal.
- Create wetland habitat through the creation of a matrix which collectively provides temporary storage of urban stormwater runoff:
    - Water.
    - Sediment.
    - Plants.
    - Detritus (waste or debris of any kind):
        - Gravel, sand, silt, or other material produced by erosion.

        - Organic matter produced by the decomposition of organisms.
- Removes multiple pollutants from it through a series of complementary physical, chemical and biological pathways.

This practice applies to watersheds in urban or urbanizing landscapes where stormwater quality and quantity control is needed to meet the diverse management objectives of developers and local governing units.

Criteria applicable to all purposes include:

- Capture and effectively treat stormwater runoff produced by 90 percent of storms in the urban watershed area.
- Pre-treat the stormwater runoff before it reaches the wetlands with pre-treatment structures such as pre-settling basins and forebays.
- Create a diversity of depth zones within the wetland to meet unique growing requirements of emergent wetland plants.
- Establish a diverse and dense wetland plant community in the shortest possible time.
- Create a functional pondscape within and around the wetland that:
    - Augments pollutant removal.
    - Creates better wildlife habitat.
    - Promotes a more natural appearance.
- Reduce the future maintenance burden of the stormwater wetland through preventative management to protect its long-term function.
- Provide habitat elements that promote greater wildlife and waterfowl use within the wetland and buffer, but avoid undesirable habitat outcomes.
- Serve as an attractive, yet safe, community amenity for adjacent residents.
- Reduce or avoid any undesirable secondary environmental impacts produced by the construction or operation of the stormwater wetland.

Other considerations include:

- Avoid conflicts with natural wetlands whenever possible.
- Use design techniques to enhance pollutant removal performance of stormwater wetland systems.
- Establish the plant community by transplanting stock native to the region and/or by utilizing mulch/topsoil from a nearby donor wetland planned nearby.
- Plan habitat diversity to meet the feeding, breeding/nesting and cover requirements for a wide range of aquatic, avian and terrestrial species.
- Secure all required permits from local, state and federal agencies issuing permits for stormwater wetlands prior to construction.

Plans and specifications, and a comprehensive operation and maintenance (O & M) plan, covers both initial establishment and future development of the wetland, requiring active management of the hydrology and vegetation, as it grows in biomass, diversity and spatial coverage, with a strong emphasis on the first three years. Maintenance activities must be fully vested with a responsible party through an enforceable maintenance covenant, which includes a projected schedule for inspections and forebay sediment cleanouts, and provide evidence that dedicated funding will be available to perform this function. This O & M plan includes specific inspection criteria, sediment cleanout, mowing functions for the stormwater wetland. Refer to NRCS CPS Code 800 for more detailed information on Urban Stormwater Wetlands.

5.0 Public Outreach and Education

5.0 Public Outreach and Education

In order to improve the water quality of Lake Springfield and its tributaries, stakeholders and the general public must be informed about this new watershed-based plan and engaged in implementing its recommended BMPs. A strategic outreach and education campaign, using a variety of communications approaches and working with multiple partners, must be developed. Public informational meetings led by qualified presenters; personal meetings with landowners, producers, and farm managers; and continued support from LSWRPC members will be key to creating and executing this plan.

This effort also will also apply to meeting the goals of the 2015 Illinois Nutrient Loss Reduction Strategy (NLRS) and the 2016 Total Maximum Daily Load Stage 3 Report for Lake Springfield and the Sugar Creek Watershed.

5.1 Outreach and Education Goals

This education and outreach campaign must address the following:

1) What are the water quality issues in Lake Springfield and its tributaries?
2) How were these issues determined and by whom?
3) What actions will be necessary to resolve these issues?
4) Who will be responsible for resolving these issues?
5) What is a realistic timeframe for resolving these water quality issues?
6) What is the strategy for improving water quality in this watershed?
7) What has been done over the past 25 years to improve water quality?
8) What have the successes and failures been over the past 25 years in this watershed?
9) How will the amount of cost-share money needed to implement the BMPs be secured within a reasonable timeframe?
10) How will progress be measured, monitored and by whom, as the new Lake Springfield Watershed-based Management Plan is implemented?
11) How will this plan be updated to keep it a living, ever-growing document? How often?

5.2 Outreach and Education Strategies

Sangamon County SWCD executives and staff, along with LSWRPC members, will lead outreach, information and education activities including:

- Direct mailings to approximately 700 LSW stakeholders (urban and rural).
- One-on-one meetings with landowners/producers/farm managers/agribusiness owners.
- Annual LSW informational meetings with continuing education units available.
- LSW bus tours.
- Field days/special project meetings (i.e., cover crops, soil health, BMP implementation demos, etc.).
- Sub-watershed meetings (some farmer-hosted machine shed-type meetings).

- Meetings with stakeholders in areas targeted as critical areas for BMP implementation (i.e., conventional tillage, HEL cropland, streambank erosion, gully erosion, failing septic systems, municipal wastewater discharges, livestock waste areas, etc.).
- Women farmland owners meetings.
- LSW newsletters and www.sangamoncountyswcd.com website.
- Media productions/videos/promotions/press release/ TV and radio interviews/public service announcements.
- US congressional, State legislative members, county and city government officials' updates/invitations to LSW events.
- LSWRPC meetings/outreach by members to the general public (urban and rural).
- Springfield Lake Shore Improvement Association (SLSIA) meetings/LSW updates/Urban issues meetings.
- Education and outreach in the schools about protecting and improving water quality through the Agricultural Education Partnership classroom program activities.
- Lincoln Land Community College demonstration farm/agricultural laboratory events/Ag Watershed Management course work/presentations.
- Land contractors, tiling contractors, septic system and water well contractors and road commissioners meetings (BMP implementation, right-of-way maintenance, USDA AD-1026 wetland determination requirements, septic system and water well regulations and installation requirements).
- Area builders and realtors association meetings (urban development, construction regulations, land use and enforcement, NPDES permit and plan requirements, private septic systems and water wells).
- LSW villages and cities meetings (land use planning, ordinances, construction regulations and enforcement).

Advertising and promotion of all events will be accomplished through the use of multiple media sources:

- Individual LSW producer/landowner mailings, emails, websites, social media sources.
- LSWRPC members, agribusinesses, governmental agencies, non-governmental organizations.
- Local agricultural fertilizer and chemical retailers.
- Seed dealers.
- Event and special news postings at SWCD offices.
- Sangamon County SWCD website and at various meetings
- CBMP website and e-newsletters.
- Sangamon County Farm Bureau website and e-newsletters.
- Local newspapers (10 South County Publications and State Journal-Register).
- FarmWeek and Agri-News, Illinois Farmer Today and other agriculture newspapers.
- Producer-to-producer invitations in person, by phone calls, texts, emails, mailings, etc.
- Facebook and other social media postings.

5.3 Project Partners

The following project partners have committed to help meet this plan's goals and objectives, to successfully organize and facilitate meetings in the LSW, and to provide other beneficial services to stakeholders in the watershed. Other partners willing to commit to these efforts and support the plan implementation will be encouraged to participate.

Illinois Corn Growers Association (ICGA) will:

a. Provide education and technical assistance to producers from Cover Crop Specialists on all aspects of the use of cover crops in their farming operation (i.e., environmental benefits, seed selection, planting and terminating cover crops, etc.), through its Cover Crop Technical Assistance and Cost-share Program.
b. Provide analysis of water samples taken by producers/landowners on their farms from streams, tile outlets, ponds, etc., to document nitrate levels in those samples through its Water Testing Program available in all three LSW counties at the SWCD and/or Farm Bureau offices or at special meetings and field days.
c. Provide funding for the two USGS water monitoring superstations in order to obtain real-time water quality data measuring nutrient, sediment and dissolved oxygen levels in Lick and Sugar Creeks near their entrance point to Lake Springfield.

National Corn Growers Association's Soil Health Partnership (SHP) and the SCSWCD, along with other partners, will:

a. Coordinate up to four field days at two SHP cooperators' farms in the LSW.
b. Arrange for keynote speakers and farmers to discuss topics on soil health, cover crops, nutrient management.
c. Provide the latest research results from N-Rate studies, cover crops, and nutrient research.
d. Provide financial resources to offset costs for advertising and other LSW event expenses.

American Farmland Trust (AFT) will work with the SCSWCD to facilitate a series of outreach and education meetings/tours called "conservation learning circles", for LSW women farmland owners to:

a. Promote sound farming practices (suites of BMPs, reduced tillage, efficient nutrient management and cover crops).
b. Protect our soil, and increase the soil's ability to provide nutrients to growing crops and hold nutrients applied in place, rather than leaching into our water bodies.
c. Promote farmland protection and preservation, keeping farmers on the land.

Lincoln Land Community College (LLCC) will continue to be our "go to" LSW demonstration/tour site to showcase BMPs that have been implemented on its farmland and throughout the LSW. In addition, a new Workforce Program, "Agricultural Watershed Management," has been added to LLCC's course work and is available for enrollment this fall for students of all ages. LLCC's farmland, adjacent to the college, will serve as its programmatic laboratory and location for outdoor practicums.

IL Fertilizer and Chemical Association (IFCA), in partnership with the Illinois Nutrient Research and Education Council (NREC), will continue to:

a. Implement on-farm 4Rs of Nutrient Stewardship programs, which were initiated in the LSW in 2013.
b. Provide in-kind financial support to implement the N-WATCH Soil Testing Program on 20 sites and 10 On-Farm Nitrogen Rate Trials.
c. Identify participating ag retailers/crop advisors/farmers for both programs.
d. Do N-WATCH tracking and soil sampling 4-5 times at each site during the crop year, covering all associated sample shipping fees and lab fee payments.
e. Receive and process results and prepare N-WATCH reports for participants and the SWCD based on lab results.
f. Oversee implementation of 10 On-Farm Nitrogen Rate Trials in the LSW, utilizing U of I Department of Crop Science protocols for the trials to ensure accurate mapping and implementation of the trials.
g. Gather harvest yield results and share with participating farmer/ag retailer.
h. Coordinate and share findings with Dr. Emerson Nafziger (U of I Crop Sciences) to evaluate and assess findings, and prepare reports on findings from both programs.

IL Council on Best Management Practices (CBMP) will provide in-kind support through digital and e-newsletter promotion of LSW program efforts, events planned and important water quality information not only to the LSW producers/landowners/stakeholders, but also reaching a large audience of people outside the LSW who are also interested in improving water quality and learning about what has been and is being done in the LSW.

Nipper Wildlife Sanctuary will provide its site, facility and staff for tours, special meetings and serve as an educational BMP site for wetlands, prairie restorations and wildlife habitat establishment, and possibly a water sampling site for nutrients in its five wetlands.

5.4 Next Steps

One of the first outreach activities will be a direct marketing campaign to approximately 700 LSW landowners/producers to highlight details about the recommended BMPs, provide information on cost-share assistance available for implementation and to encourage signup for the watershed-wide BMPs:

- Use of cover crops
- Creation of nutrient management plans
- Implementation of structural BMPs
- Practice of conservation tillage
- Use of an 18-foot Great Plains Turbo-Maxx Vertical Tillage implement with Gandy Cover Crop Seeder and Great Plains 10-foot No-till Drill.

Sample contracts for participation will be included in the mailing and available on the SCSWCD website and in the SCSWCD Annual Report.

Bus tours will be organized, highlighting the demonstration farm at LLCC and visits to key BMP sites throughout the LSW. These bus tours will be targeted to LSW producers/landowners and will include resource notebooks prepared with a map of the LSW, information about each of the tour stops, other pertinent water quality information. The final tour stop will include a meal and featured speakers on topics determined by the LSWRPC and SCSWCD. We will seek sponsors to cover the meal costs and other expenses.

Holding sub-watershed meetings each year will be one of the keys to success in getting producers to sign up for BMP implementation in this watershed, especially for cover crops, nutrient management plans and conservation tillage. The hosts will be asked to provide the meeting location (i.e., their on-farm machine shed, town hall, community building) and to invite LSW farmers, landlords, farm managers, preferably within the sub-watershed where they live. Invitations to agency people, other than the meeting speakers, will be limited. Opportunities will be available to provide water sample testing for nitrates at these meetings.

There will be newsletter direct mailings to LSW stakeholders highlighting the on-going work being done in the LSW, accomplishments, invitations to upcoming events, etc. We will continue to maintain an accurate mailing list for the LSW and build upon our current LSW email and phone list, giving us quicker, less expensive delivery of LSW information and outreach opportunities. Utilizing websites for posting watershed information and outreach opportunities will also broaden our outreach, information and education capabilities.

6.0 Water Quality Monitoring Plan

6.0 Water Quality Monitoring Plan

The goals and objectives of this water quality monitoring plan for the LSW include the following:

- To monitor the condition and health of the watershed in a consistent and on-going manner.
    - Utilize existing water monitoring data from IEPA and partner stations.
    - Continue to gather water sampling data from these same locations as long as possible.
    - Ensure consistency in the reporting of monitoring results.
    - Evaluate trends and changes over time.
- To assess the effectiveness of the BMP implementation projects at reducing the pollutants (Phosphorus, Total Suspended Solids and Nitrogen) entering the streams and Lake.
- To determine watershed BMP projects' cumulative watershed-scale contribution towards achieving the goals and objectives of the plan.
- To track the programmatic progress through achievement of actions in the watershed:
    - Success of specific BMPs
    - Success of stakeholders' actions and participation in water quality efforts.
- To develop a strategy for directly monitoring the effectiveness of these actions.
- To monitor environmental criteria in an effective way to measure progress toward meeting water quality objectives.
    - Use data from the in-stream biological indicators to assess overall changes in the watershed's condition, being careful to not making conclusions based on one specific indicator over another.
    - Build and maintain a long-term database of LSW in-stream biological data results.
- To develop a LSWMP data management program to be housed and maintained by one designated entity (e.g., CWLP, SCSWCD) for maintaining water quality data.
    - In-lake sampling--raw water and finished water results database.
    - Watershed stream sampling database.
    - Physical and biological stream database
    - Special watershed study databases. (Additional databases may be added over time, as needed.)
        - Streambank and streambed
        - Shoreline
        - Gully erosion
        - Septic systems and private wells
        - Conventional tillage
        - Detention/retention basins/ponds
        - Watershed-wide transect survey (tillage, erosion, BMPs)
    - Use SWAMM model to assist in recommending and documenting BMP implementation needs and locations.

6.1 Water Monitoring Efforts

CWLP has conducted regular monitoring at 10 existing IEPA stations (**Table 6.1.1**) within the LSW, in addition to sampling both raw and finished water from the water treatment plant. During the LSW Special Project grant (a joint partnership between CWLP, SCSWCD, CBMP and LLCC) from 2014 to 2016, 23 additional sample sites were monitored. Initially, CBMP and SCSWCD identified and mapped 16 water quality sampling sites along tributaries of Lake Springfield that were monitored for nitrate nitrogen, with phosphorus occasionally added as an additional parameter. At the recommendation of Illinois EPA, seven additional sites were added for a total of 23. A sample technician collected water samples according to accepted protocols, with stage level measurements and streamflow at six of the sampling sites.

In-stream water sampling through the SCSWCD joint partnership began on January 13, 2014, and continued twice a week until August 2014, except when low, or no-flow, conditions triggered a reduction in sampling frequency to once per week or two following a significant rain. Sampling concluded in November 2014 due to winter conditions. A second season of monitoring began in February 2015 with the spring thaw, continued through the end of 2015 with warm, wet fall weather, allowing for an extended sampling period. Sampling also continued through 2016. Samples were analyzed by Prairie Analytical of Springfield for nitrate nitrogen with results being tracked and compared to CWLP ambient monitoring results from locations within Lake Springfield. A consultant was hired to perform survey work at each of the six sites where stage discharge measurements were collected.

In the summer of 2015, two USGS stream gages were installed within the watershed, one on Sugar Creek and one on Lick Creek. These USGS stations collect regular stream flow, temperature, specific conductance, pH, Dissolved Oxygen, nitrate + nitrite, phosphate and turbidity data.

Other historical water quality information includes a 1997-2002 study on atrazine, Ortho-Phosphate, sediment (TSS) and nitrogen at numerous bridges and edge-of-field locations, in addition to a 2012 nitrate monitoring study performed by a student at the University of Illinois, Springfield. Many of those same bridge sites were those monitored during the LSW Special Project period.

TABLE 6.1.1 – EXISTING MONITORING SITES & STATION DESCRIPTIONS

Station ID	Station Description	Waterbody	Notes
EOA_04	2.5 miles NE of Auburn	Sugar Creek	Existing IEPA monitoring site
EOA_98	5 miles N of Divernon	Sugar Creek	Existing IEPA monitoring site
EOAA_01	1.75 miles E of Loami	Lick Creek	Existing IEPA monitoring site

EOAA_04	Old Bridge at Chatham Rd, 0.5 miles SW of Woodside Rd, 2.7 miles N of Chatham	Lick Creek	Existing IEPA monitoring site
EOAE_04	At Plummer Blvd, 0.2 miles E of Main St in Chatham	Polecat Creek	Existing IEPA monitoring site
REF_1	Near Dam Over Old Channel	Lake Springfield	Existing IEPA monitoring site
REF_2	15,000 ft SW of REF-1	Lake Springfield	Existing IEPA monitoring site
REF_3	1,700 ft W ICRR Bridge	Lake Springfield	Existing IEPA monitoring site
REF_5	Lick Creek arm	Lake Springfield	Existing IEPA monitoring site
REF_6	Sugar Creek	Lake Springfield	Existing IEPA monitoring site
Various	All Partner Sites – Locations N/A	Various	Location information unavailable[17]
USGS Gage 1	Sugar Creek at 9781 Old Indian Trail	Sugar Creek	USGS gage station
USGS Gage 2	Old Chatham Rd. Bridge, 625 feet E of the Route 4 crossing	Lick Creek	USGS gage station

[17] These locations were sampled from 2014 through 2016 under the Lake Springfield Watershed Special Project grant funded through the National Fish and Wildlife Foundation and CWLP and results were not revealed publicly.

6.2 Monitoring Recommendations

Given the historical data currently available, it is recommended that all 2016 monitoring continue for a minimum of two years at the existing sites listed above, ideally under direction from the IEPA and partners such as CWLP and the SCSWCD. Subsequent monitoring will occur periodically at established IEPA sample sites and results should be provided to watershed partners for inclusion into a comprehensive database.

Physical and biological data should be collected at seven (7) monitoring sites (See Stream Bio-assessment Section) to augment water quality information since limited biological data exists. Due to the uncertainty in securing resources for edge-of-field monitoring to measure the effectiveness of BMPs, it is recommended that additional sites be considered and a more detailed monitoring plan be developed alongside future implementation actions, if funding permits. Stream gages should remain in place and stage discharge measurements should continue indefinitely at each of the 6 partner sites to establish a more complete record of stream flows. An attempt should be made to capture a higher frequency of large runoff events to gain a better understanding of the loading associated with extreme rainfall.

Table 6.2.1 includes the minimum parameters that should be considered for monitoring. Quantitative benchmarks that indicate impairment conditions are also illustrated in this table. Total phosphorus and Total Suspended Sediment (TSS), as well as other analytes such as Dissolved Oxygen, temperature and pH, should be added to the list of parameters sampled at each of the 23 partner sites.

TABLE 6.2.1 – BASELINE WATER QUALITY ANALYSIS PARAMETERS

Analyte	Benchmark Indicators
Total Phosphorus	Less than 0.05 mg/l
Total Nitrogen	Less than 10 mg/L
Total Suspended Sediment (TSS)	Less than 750 mg/l
Turbidity	Less than 20 NTU
Dissolved Oxygen	No less than 6.0 mg/l (IEPA standards)
Temperature	Less than 90° F (IEPA standards)
pH	Between 6.5 – 9.0 (IEPA standards)
Flow	--

The establishment of baseline conditions is important in order to evaluate trends and changes in water quality over time through implementation. Parameters, such as total phosphorus, total suspended sediment, and total nitrogen, should be analyzed considering flow volumes, in order to make relative comparisons year to year, as concentrations of pollutants vary with flow volumes. The water quality monitoring results may also be used to calibrate the nonpoint source pollution load model and make revised annual loading estimates throughout implementation. With installation of each of the BMPs, estimates of pollutant load reduction numbers can be calculated. However, quantifying those numbers will require long-term monitoring to track the success of these watershed-based plan BMPs.

The proposed monitoring categories and associated recommendations are summarized in **Table 6.2.2**. Monitoring activities should be coordinated with the IEPA and project partners, including the SCSWCD and CWLP.

TABLE 6.2.2 – SUMMARY OF MONITORING CATEGORIES & RECOMMENDATIONS

Monitoring Category	Summary of Recommendations
Data Management	Develop a standardized database of monitoring results and house in one central location managed by one individual/organization
Stream flow	Measure stream flow during every sampling event, if conditions permit. Maintain USGS gage stations and continue stage discharge measurements at the 6 partner sites
Ambient water quality	Utilize IEPA, CWLP and local partners to execute regular monitoring for water quality for a minimum of two years (until 2018). Continue to track results from IEPA sampling efforts.
Physical and biologic assessment	Develop and execute monitoring for fish, macroinvertebrates, habitat and channel morphology at each partner location, if applicable and if budget permits.
BMP effectiveness	Monitoring BMP effectiveness of specific practices or clusters of practices. Develop a detailed monitoring plan in combination with implementation activities on both urban and agricultural ground.
Monitoring Partnerships	Coordinate with the IEPA, CWLP and other project partners. Explore/Implement a volunteer monitoring program through River Watch or another local volunteer network.
Storm event runoff monitoring	Conduct additional monitoring during large storm events. Existing monitoring data lacks very high-flow events.

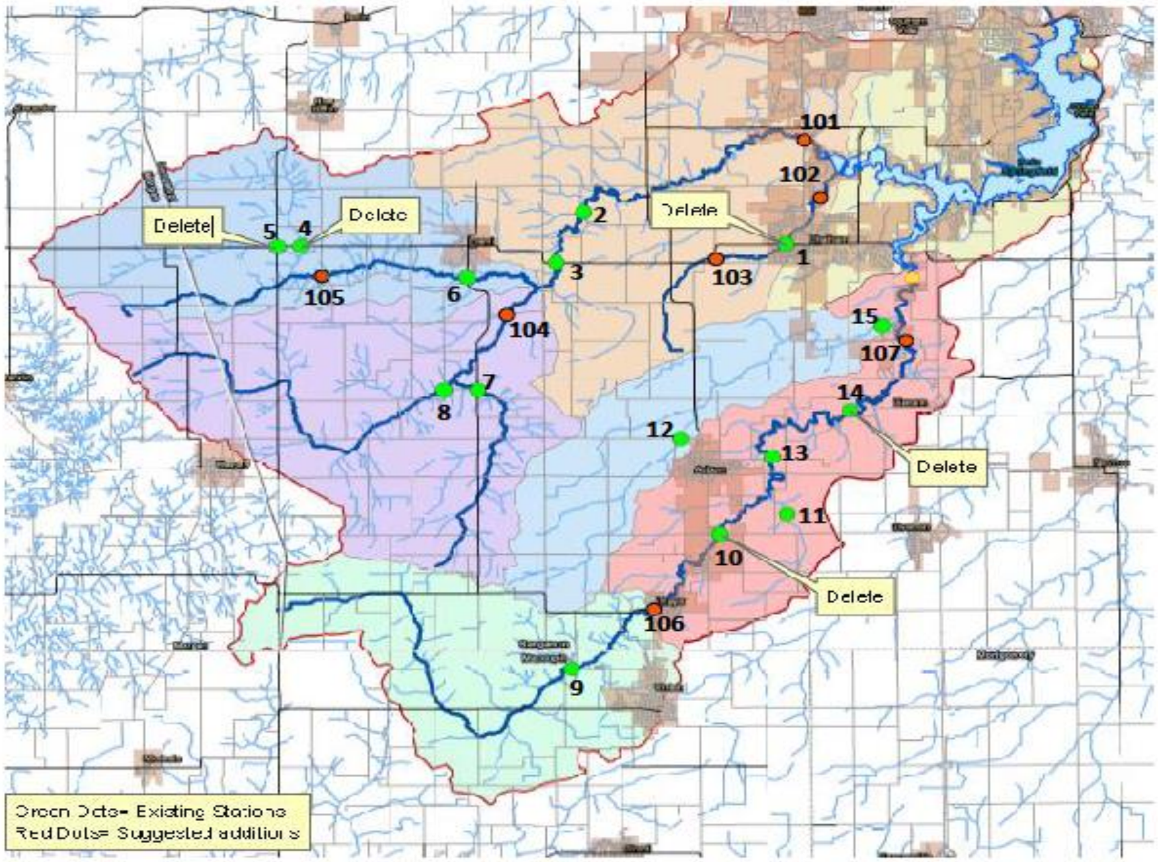


FIGURE 6.2.1 – MONITORING LOCATIONS

6.3 Data Management

A formal program should be developed to house all available monitoring data in one location. Currently, effective data analysis is limited by data sets housed in separate locations. Each organization responsible for maintaining and collecting data does so independently of each other. As a result, it is difficult to access all monitoring data in one central location. Furthermore, each data set is organized in a different format, requiring substantial time and effort to synthesize. Specific data management recommendations include:

1. Establish one responsible entity for housing and managing all water quality data (current and historical). All data should be housed and managed at the Sangamon County SWCD office and administered by one individual.
2. Develop an Excel or Access database of all current and historical water quality data organized using a unique station ID number, based off IEPA monitoring site IDs; each sample event should be recorded in the database by date, time, and by water quality parameter and should include a brief description to distinguish between types of monitoring sites (i.e., tile versus stream). Any other information relevant to an individual sample site or event should be recorded in the database, such as individual or partner organization conducting the sampling, active/inactive status, site observations or special notes. If collected or available, stream flow data should be recorded alongside each entry in the database.
3. Maintain a working GIS point file of each sampling location. The GIS file should contain station IDs that are identical to those in the database, as well as active/inactive status and latitude and longitude coordinates. New data should be submitted to the responsible entity and integrated into the working database on a regular basis. Database quality control should occur quarterly.
4. New data should be submitted to the responsible entity and integrated into the working database on a regular basis. Database quality control should occur quarterly.

6.4 Stream Bio-Assessment

At a minimum, aquatic biotic monitoring should be conducted once every 3 to 5 years. Seven locations at existing partner monitoring sites are recommended for aquatic stream monitoring; one on Lower Lick Creek, Upper Lick Creek, South Fork Lick Creek – Johns Creek, Polecat Creek, Panther Creek, Upper Sugar Creek and one on Lower Sugar Creek. **Table 6.4.1** shows the typical stream bio-assessment techniques that can be applied to the monitoring program.

TABLE 6.4.1 – STREAM BIO-ASSESSMENT MEASURES

Monitoring	Definition	Benchmark Indicators
Fish Index of Biologic Integrity (IBI)	Index based on presence and populations of non-native and native fish species and their tolerance to degraded stream conditions.	Exceptional (50-60) Very Good (49-42) Good (41-34) Fair (33-27) Poor (26-17) Very Poor (<17)
Macroinvertebrate Biotic Index (MBI) or Macroinvertebrate Index of Biologic Integrity (MIBI)	Index indicative of stream quality based on the macro-invertebrate species and populations.	Excellent (< 5.0) Good (5.0 – 5.9) Fair (6.0-7.5) Poor (7.4-8.9) Very Poor (> 8.9)
Qualitative Habitat Evaluation Index (QHEI)	Index indicative of habitat quality that incorporates substrate, in-stream cover, channel morphology, riparian zone, bank erosion and riffle/pool condition.	Excellent (>70) Good (55-69) Fair (43-54) Poor (30-42) Very Poor (<17-29)
Stream Condition Index (SCI)	Index that incorporates macroinvertebrate community, habitat and water quality components to grade the quality of a stream.	Exceptional (>70) Good (49.4-69.9) Fair (24.6-49.3) Poor (0-24.5)
Mussels	Live and dead mussels collected and species and populations indicative of stream condition.	Qualitative based on species diversity, population and live and dead specimens
Channel Morphology	Establish fixed cross-section and longitudinal profile of channel along a 1,500-foot-long fixed reach. Monitor regularly to assess changes in channel.	Entrenchment ratio Width/depth ratio bank full Bed material Cross-sectional area Water slope

7.0 BMP Objectives, Responsible Parties, Technical Assistance and Funding Sources

7.0 BMP Objectives, Responsible Parties, Technical Assistance and Funding Sources

7.1 Implementation Schedule/Interim and Measurable Milestones

The implementation milestones and objectives presented in this section are intended to be achievable and realistic over an 18-year period and follow the site-specific, basin-wide, and supplemental practices described in Section 4.6. Although alone, these implementation milestones do not entirely meet water quality targets, they will result in substantial improvements to water quality and the future attainment of water quality standards in the watershed.

Implementation milestones and goals are intended to be measured by adoption of BMPs, as documented through USDA conservation program contracts (CRP, EQIP, etc.), EPA 319-funded cost-share measures, Springfield CWLP and SWCD initiated projects. The goals are meant to be both measurable and realistic, given that much of the farm field construction work must be accomplished seasonally to avoid growing crops and agricultural planting and harvest activities. Direct outreach and communication, one-on-one with landowners/producers, will be necessary for successful implementation of BMPs and will be components of every effort to secure the adoption of the BMPs listed below. This communication and outreach will also help to ensure practices are maintained over time.

The aggressive BMP implementation schedule presented in **Table 7.1.1** spans the 18 years remaining to reach the NLRS goals of 45% nutrient reduction for nitrogen and phosphorus. It also includes BMPs recommended for implementation in the 2016 Stage 3 TMDL Report for Lake Springfield and the Sugar Creek Watershed. Each practice described is to be accompanied by a written commitment by the producer, contingent on funding. Successful education and outreach, up to this point, has resulted in landowners willing to implement a substantial number of specific practices. BMPs listed in the most recent EPA 319 grant application submitted on August 1, 2016, will be implemented within the terms of this grant (2 years). The SCSWCD and LSWRPC will seek additional funding sources available through federal, state, county and local grants, non-governmental organizations and partnerships to implement all of the BMPs in this LSWMP, under an adaptive management approach.

All of the studies recommended as part of the LSWMP for BMP implementation will be considered high and immediate priorities of the LSWRPC, with a goal to complete them within the first five years of this plan's implementation. Securing funding sources and stakeholders/volunteers providing in-kind services will be necessary for completion of these studies.

Having current information available from these studies will be imperative to move forward with BMP implementation in a timely manner to address the nonpoint source pollutant issues facing this watershed for meeting the goals and objectives in this LSWMP, the NLRS and the 2016 Stage 3 TMDL Report.

Table 7.1.1 – Implementation Objectives, Responsible Parties and Technical Assistance

BMP/Objective	Responsible Party	Primary Technical Assistance/Funding Source
Targeted Basin Wide Best Management Practices		
BMP: Bioreactors **Objective:** Install 27 bioreactors at 12 locations-treat 1,224 acres.	Landowner/SWCD/NRCS	***Technical Assistance***: SWCD/NRCS ***Funding Source***: USDA FSA/NRCS/Private funds/EQIP
BMP: Cover Crops **Objective***:* Install 14,052 cover crop acres on 540 fields	Landowner/SWCD/NRCS	***Technical Assistance***: SWCD/NRCS ***Funding Source***: Federal and State grants/Private funds/EQIP
BMP: Detention/Retention Basins/Ponds/Sediment Basins-Commercial and Residential **Objective:** Install 17 Detention/Retention basins/Ponds-treats 1,647 non-residential acres 17 basins in ag/urban residential areas-treats 2,710 acres	Landowners/SWCD/NRCS	**Technical Assistance:** NRCS/SWCD /Consultants **Funding Source:** Federal and State grants/ Private funds
BMP: Filter strips **Objective:** Install 157 filter strips, 440,200 feet or 324 acres-treats 8,148 acres	Landowner/SWCD/NRCS	**Technical Assistance:** SWCD /NRCS /FSA /Consultants **Funding Source**: Federal and State grants

BMP/Objective	Responsible Party	Primary Technical Assistance/Funding Source
Targeted Basin Wide Best Management Practices (continued)		
BMP: Grade Stabilization Structures/Rock Riffles **Objective**: Install 17 individual grade control structures or rock riffles at 4 sites-treat 975 acres	Landowners SWCD/NRCS/IDOA	**Technical Assistance:** SWCD/NRCS/IDOA **Funding Source:** Federal and State grants/Private funds
BMP: No-Till/Strip-till/Direct Seeding **Objective**: Convert 109,083 acres to No-till/Strip-till	Landowner/SWCD/NRCS	***Technical Assistance:*** SWCD/NRCS/Consultants ***Funding Source***: Federal and State grants/Private funds/EQIP
BMP: Rain Barrels/Rain Gardens/Porous Pavement **Objective:** Install 400 rain barrels, four rain gardens and two porous pavements – treating 4,921 acres	Landowners/City	**Technical Assistance:** SWCD/IEPA. **Funding Source:** Federal and State grants/Private funds
BMP: Saturated Buffer/Drainage Water Management **Objective:** Install 216 systems/19 sites- treat 12,028 acres	Landowners/NRCS	**Technical Assistance:** NRCS/Consultants **Funding Source:** EQIP/City/ Federal and State grants/Private funds
BMP: Wetland Creation **Objective:** Create up to 121 wetlands – 117 acres	Landowner/SWCD/NRCS	**Technical Assistance**: SWCD/NRCS/Consultants **Funding Source**: Federal and State grants/Private funds

BMP/Objective	Responsible Party	Primary Technical Assistance/Funding Source
Targeted Site-Specific Best Management Practices		
BMP: Grassed Waterway **Objective**: Install 19 grassed waterways, 38,450 feet or 44 acres treating 3,715 acres	Farmer/Landowner/SWCD/NRCS	**Technical Assistance**: SWCD/NRCS/Consultants **Funding Source**: Federal and State grants/Private funds/EQIP/City funds
BMP: Field Borders **Objective:** Install 447 50 ft.-wide field borders-5,761 acres-treats 31,942 acres	Farmer/Landowner/SWCD	***Technical Assistance***: SWCD/NRCS/IDNR/IDOA ***Funding Source***: Federal and State grants/Private funds/IDOA/City funds
BMP: Grade Control/Riffle **Objective:** Install **4** grade control/rock riffle structures	Farmer/Landowner/IDOA/SWCD/NRCS	**Technical Assistance**: SWCD/NRCS/Consultant
BMP: Livestock Feed Area BMPs **Objective:** Install 17 pasture operations treating 523 acres – Install 95 livestock feed areas or 49 acres	Farmer/Landowner/NRCS	**Technical Assistance**: SWCD/NRCS/Consultant **Funding Source**: Federal and State grants/Private funds/EQIP/City funds

BMP/Objective	Responsible Party	Primary Technical Assistance/Funding Source
Targeted Site-Specific Best Management Practices (continued)		
BMP: Nutrient Management Plans **Objective:** Write/implement 223 NMPs - 123,611 acres	Farmer/Landowner/SWCD/NRCS	***Technical Assistance***: SWCD/NRCS/Consultant ***Funding Source***: Federal and State grants/Private funds/ EQIP/CRP/City funds
BMP: Permanent Vegetative Covers **Objective:** 265 acres on 48 fields	Farmer/Landowner/SWCD/ NRCS	**Technical Assistance**: SWCD/NRCS/Consultant/IDNR **Funding Source**: USDA-FSA/Private funds/ CRP/EQIP/ Quail Forever/ USFWS
BMP: Shoreline Stabilization **Objective:** Stabilize 4,630 feet of shoreline	City of Springfield CWLP	**Technical Assistance**: Consultant **Funding Source**: Federal and State grants/City funds
BMP: Terraces/Water and Sediment Control Basins (WASCOBs) **Objective:** Install 98 WASCOBs/Terraces - 19 sites	Farmer/Landowner/SWCD/NRCS	***Technical Assistance***: SWCD/NRCS/Consultant ***Funding Source:*** Federal and State grants/Private funds/EQIP/City funds

BMP/Objective	Responsible Party	Primary Technical Assistance/Funding Source
Supplemental Management Measures		
BMP: Streambank Survey **Objective:** Conduct comprehensive streambank/stream channel study	IDOA/SWCD/ NRCS	**Technical Assistance**: SWCD/NRCS/Consultant **Funding Source**: Federal and State grants
BMP: Gully Survey **Objective:** Conduct gully erosion study	IDOA/SWCD/ NRCS	**Technical Assistance**: SWCD/NRCS/Consultant **Funding Source**: Federal and State grants
BMP: Retention/Detention Basin/In-lake Dam Study **Objective:** Conduct retention/detention/in-lake dam study	City of Springfield CWLP	**Technical Assistance**: Consultant **Funding Source**: Federal and State grants/City funds
BMP: Septic System and Water Well Study/Inspections **Objective:** Conduct study	IDOA/SWCD/ NRCS	**Technical Assistance**: SWCD/ Consultant **Funding Source**: Federal and State grants
BMP: Tillage Operations Study **Objective:** Conduct study	IDOA/SWCD/ NRCS	**Technical Assistance**: SWCD/NRCS/Consultant **Funding Source**: Federal and State grants/IDOA funds
BMP: Subsurface Drainage Systems Study **Objective:** Conduct study	IDOA/SWCD/ NRCS	**Technical Assistance**: SWCD/NRCS/Consultant **Funding Source**: Federal and State grants//IDOA funds
BMP: Urban Expansion Study **Objective: Conduct study**	IDOA/SWCD/ CWLP	**Technical Assistance**: SWCD/ Consultant **Funding Source**: Federal and State grants

BMP/Objective	**Responsible Party**	Primary Technical Assistance/Funding Source
Education and Outreach		
BMP: Education and Outreach **Objective:** Stakeholder engagement	LSWRPC/SWCD/NRCS	**Technical Assistance:** SWCD/NRCS/ **Funding Source:** Federal and State grants/Private funds

Table 7.1.2 – Implementation Milestones & Timeframes

Timeframe	Milestone
Years 1 - 5 **2017 -2021**	Prepare Operation & Maintenance Plans for each BMP to be established and continue one-on-one communication with interested producers. Installation of 5 WASCOB systems. Install 1 agricultural and 1 urban constructed wetland. Install 1 bioreactor. Plant 5,000 acres of cover crops each year. Convert conventional tillage to no-till or strip-till on 20 fields each year (100 fields). Install 2 sediment basins or ponds. Install 5,000 feet of shoreline stabilization. Install 8 acres of grassed waterways. Install 8 acres of filter strips. Establish field borders on at least 20 fields. Install 2 pasture management systems with watering and fencing components. Install 2 livestock feed area waste systems. Install grade stabilization structures at 4 sites. Implement 70 acres of woodland management. Prepare Nutrient Management Plans on 2,000 acres each year. Conduct comprehensive streambank/stream channel study. Conduct a retention/detention basin and in-lake dam study. Conduct septic systems and private wells study. Conduct tillage operations study. Conduct subsurface drainage systems study. Conduct a gully erosion study. Conduct landowner outreach through newsletters, meetings, correspondence. Monitor effectiveness of BMPs being installed and already implemented. Fund a watershed coordinator position and related expenses. Provide funds for water quality monitoring of watershed streams and the Lake. Fund outreach and educational activities (meeting room rental, mailings, speaker fees, printed educational materials, etc.). Purchase no-till/reduced-till equipment to promote a movement away from excess tillage.

Timeframe	Milestone
Years 6 - 11 **2022 - 2027**	Prepare Operation & Maintenance Plans for each BMP to be established and continue one-on-one communication with interested producers. Installation of 5 WASCOB systems. Install 1 agricultural and 1 urban constructed wetland. Install 1 bioreactor. Plant 5,000 acres of cover crops each year. Convert conventional tillage to no-till or strip-till on 20 fields each year (100 fields). Install 2 sediment basins or ponds.

Timeframe	Milestone
	Install 5,000 feet of shoreline stabilization. Install 8 acres of grassed waterways. Install 8 acres of filter strips. Establish field borders on at least 20 fields. Install 2 pasture management systems with watering and fencing components. Install 2 livestock feed area waste systems. Install grade stabilization structures at 4 sites. Implement 70 acres of woodland management. Prepare Nutrient Management Plans on 2,000 acres each year. Conduct comprehensive streambank/stream channel study. Conduct a retention/detention basin and in-lake dam study. Conduct septic systems and private wells study. Conduct tillage operations study. Conduct subsurface drainage systems study. Conduct a gully erosion study. Conduct landowner outreach through newsletters, meetings, correspondence. Monitor effectiveness of BMPs being installed and already implemented. Update 2017 Lake Springfield Watershed-based Management Plan. Fund a watershed coordinator position and related expenses. Provide funds for water quality monitoring of watershed streams and the Lake. Fund outreach and educational activities (meeting room rental, mailings, speaker fees, printed educational materials, etc.). Purchase no-till/reduced-till equipment to promote a movement away from excess tillage.

Timeframe	Milestone
Years 12 - 18 **2028 - 2035**	Conduct additional one-on-one outreach with producers Prepare O & M Plans for BMPs and maintain direct communication with producers Install 5 additional WASCOBs Install or upgrade 2 terraces Plant 5,000 acres of cover crops each year (25,000 acres) Convert conventional tillage to no-till or strip-till on 40 HEL fields each year (400 fields) Install 3 new sediment basins/ponds Install 5 acres of grassed waterways Install 5 acres of filter strips Install 3 ag and 3 urban constructed wetlands Install 2,000 feet of streambank stabilization Install 2,000 feet of lake shoreline riprap each year Install 200 rain barrels in LSW villages/cities Install 2 rain gardens in LSW villages/cities Install 2 porous pavements in LSW villages/cities Install 6 urban retention/detention basins in LSW villages/cities Convert 10 acres of cropped HEL soils to native grasses Monitor effectiveness of BMPs being installed and already implemented. Fund a watershed coordinator position and related expenses. Provide funds for water quality monitoring of watershed streams and the Lake. Fund outreach and educational activities (meeting room rental, mailings, speaker fees, printed educational materials, etc.). Purchase no-till/reduced-till equipment to promote a movement away from excess tillage.

8.0 Plan Logistics

8.0 Plan Logistics

8.1 Timeline for Watershed Plan Updates

The SCSWCD and LSWRPC will be the lead entities for keeping this watershed plan a living, working document, and making sure it is reviewed annually. While the LSWMP has been prepared to cover at least 18 years, an update to this plan within the next nine (9) to ten (10) years will be necessary to meet US EPA's requirement to be eligible for Section 319 funding. Items to be taken into consideration in this plan update include:

- Additional concerns affecting the water quality in the LSW.
- Significant changes in the watershed's health due to increased development.
- Changes in agronomic practices affecting water quality.
- A need to update or expand the plan to include newly developed BMPs.
- Special study results or to incorporate other pertinent information affecting the LSW's water quality.

The LSW stakeholders will be encouraged to:

- Remain engaged in BMP implementation on their property.
- Assist with securing funding for implementing numerous aspects outlined in this plan.
- Help with the establishment of new, or renewal of, partnerships.
- Participate in education and outreach activities in the watershed.
- Assist in meeting the goals and objectives of this watershed plan.
- Be leaders in engaging the rural and urban communities in open dialogue about the LSW.

Any recommended changes or updates to this watershed plan will be:

- Thoroughly vetted, reviewed and discussed at LSWRPC meetings and/or special public meetings.
- Posted on the SCSWCD website for public comment for a 30-day period.
- Adopted by a majority of the LSWRPC members in attendance at a special LSWRPC meeting designated following the end of the public comment period.
- Watershed plan updates will be posted on the SCSWCD website and copies available at the SCSWCD office or by email, upon request.
- Plan updates will be sent to IEPA, Bureau of Water, Watershed Management Section.

Contact information for this watershed plan:

Sangamon County Soil and Water Conservation District
2623 Sunrise Drive – Suite 1
Springfield, IL 62703-7302
(217) 241-6635 ext. 3
www.sangamoncountyswcd.com

Appendices available for review with the 2017 Lake Springfield Watershed-based Management Plan include:

APPENDIX A – 1990 Lake Springfield Watershed Plan
1995 Addendum to the 1990 LSW Plan
APPENDIX B – 2015 Lake Springfield Watershed Survey Results with Demographics of Participants
APPENDIX C – Spatial Watershed Assessment & Management Tool (SWAAM)
APPENDIX D – IEPA Final TMDL Report for Lake Springfield and the Sugar Creek Watershed
www.epa.illinois.gov/.../tmdls/reports/lake-springfield/draft-stage-3-final-report.pdf
APPENDIX E – Summary Table of BMPs – Contact Northwater Consulting
jeff@northwaterco.com