Big/Long Creek Watershed TMDL Implementation Plan

August 31, 2014

Prepared by: Agricultural Watershed Institute and Northwater Consulting

Prepared For: Illinois Environmental Protection Agency
Bureau of Water – Watershed Management Section
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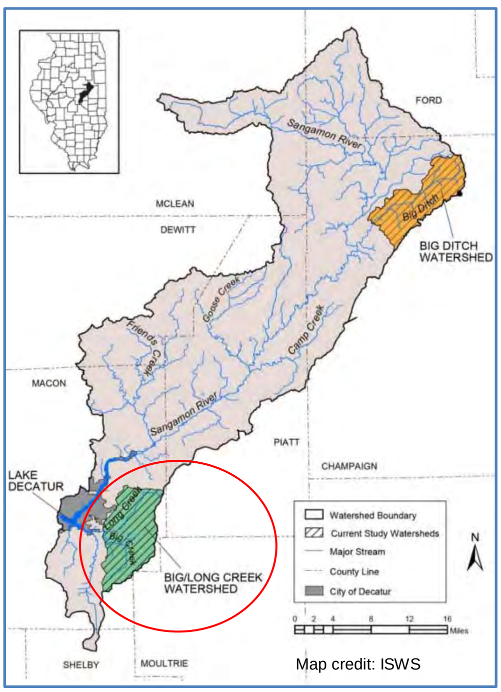

Map credit: ISWS

Funding for this project was provided, in part, by the U.S. Environmental Protection Agency and Illinois Environmental Protection Agency through Section 604b of the Clean Water Act. The findings and recommendations contained in this report are not necessarily those of the funding agencies.

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1.0 Causes & Sources of Watershed Impairments

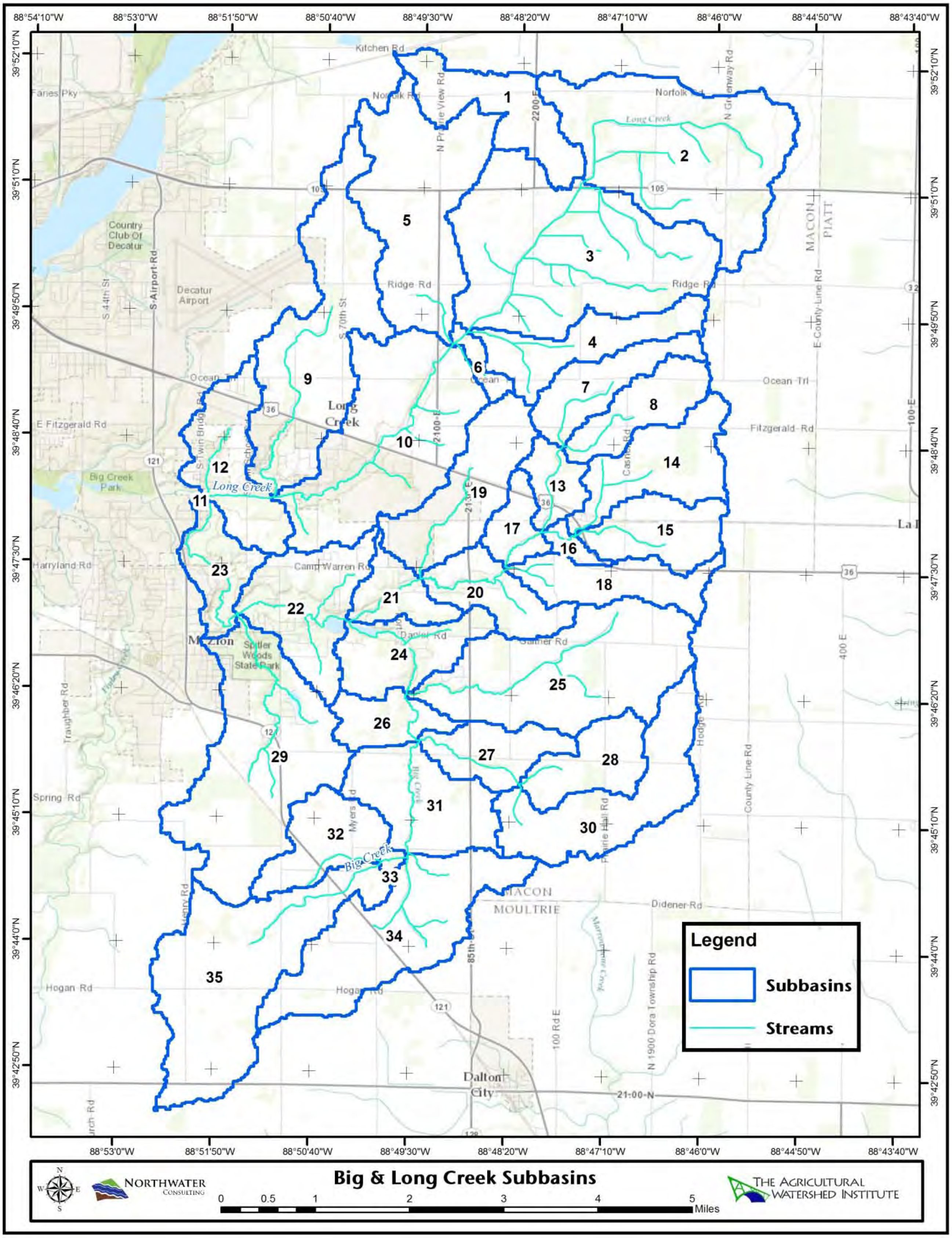
The Big/Long Creek watershed addressed in this Total Maximum Daily Load (TMDL) Implementation Plan is part of the Lake Decatur watershed, which in turn is part of the Upper Sangamon River watershed. The 8-digit Hydrologic Unit Code (HUC) of the Upper Sangamon River watershed is 07130006. The Big/Long Creek watershed includes the 12-digit HUC 071300060406 and most of HUC 071300060409 and is made up of 38 unique subbasins (Figure 1).

In the 2006 Illinois Environmental Protection Agency Section (IEPA) 303(d) list of impaired waters, Lake Decatur was listed as impaired for the designated uses of Aquatic Life and Public Water Supplies. Total Phosphorus and Total Suspended Solids (TSS) were among the potential causes listed for impairment of aquatic life. Nitrate-N was the only potential cause listed for impairment of the public water supply use. Lake Decatur TMDLs were subsequently developed for phosphorus and nitrate nitrogen and approved by the U.S. Environmental Protection Agency on September 6, 2007. The Sangamon River/Lake Decatur Watershed Final Approved TMDL report dated August 2007 stated: "Potential sources contributing to the listing of Lake Decatur include: agricultural runoff and permitted sewage treatment plants."

The analysis conducted to calculate the Total Phosphorus TMDL set a target of 0.05 mg-P/l, which is the water quality standard to protect aquatic life and aesthetic quality uses in Illinois lakes. The maximum phosphorus load to maintain compliance with that standard was calculated to be 31.4 kg-P/day in July and August, which was found to correspond to a reduction of approximately 74% in the existing phosphorus loads.

The target set for nitrate was 10 mg-N/l, which is the water quality standard for nitrate-N to protect public and food processing water supply uses in Illinois Lakes. To meet that standard, the calculated allowable nitrate load varies with flow conditions. The 2007 TMDL report concluded: "These allowable loads correspond to a reduction in nitrate loads up to 28% at higher flows or 613 cubic feet per second (cfs) and above and up to 13% for flows between 266 and 612 cfs. No reductions are needed during lower flow conditions (flows less than 266 cfs)."

Figure 1 - Big & Long Creek Watershed Subbasins



1.1 Problem Statement, Goals, & Objectives

This TMDL Implementation Plan for the Big/Long Creek watershed and the companion plan for the Big Ditch watershed in Champaign County are intended to improve water quality by reducing pollutant loads. The Big/Long Creek and Big Ditch watersheds account for approximately 5% and 4% of the Lake Decatur watershed area, respectively. Therefore, reducing nitrate and phosphorus loads from these watersheds alone will not achieve the Lake Decatur target loads. For purposes of TMDL implementation, the pollutant reduction targets proposed for Big/Long Creek watershed are the percentage reductions established in the 2007 TMDL report:

- 74% reduction in total phosphorus
- 28% reduction in nitrate-nitrogen

There is no TMDL for sediment reduction in Lake Decatur but, as discussed further below, this is a high priority goal of the City of Decatur. A sediment reduction target of 50% was chosen based on this local objective.

These plans for TMDL implementation in two Lake Decatur subwatersheds have been developed concurrently with the effort led by IEPA to develop an Illinois Statewide Nutrient Loss Reduction Strategy. While TMDLs address actions needed to meet water quality standards and designated uses in Illinois water bodies, the nutrient strategies being developed by Illinois and other states are intended to meet the national goal related to the issue of hypoxia in the Gulf of Mexico. The phosphorus and nitrate reduction goals in the draft Illinois Strategy dated 7, May 2014 are both 45%, with Phase 1 Milestones of 15% nitrate and 25% phosphorus reduction by the year 2025. The reduction targets in the draft Illinois Strategy are measured against the average annual loading from 1997 to 2011.

The 74% TMDL reduction target for phosphorus is much higher than the target for addressing hypoxia. Meeting the local TMDL target would represent a substantial contribution toward the statewide goal.

In terms of local stakeholder objectives, practices designed to reduce phosphorus in surface runoff from agricultural lands may also reduce erosion and sedimentation, which is an objective of the City of Decatur. Decatur is currently engaged in a multi-phase dredging project to restore lost reservoir capacity and enhance aesthetics and recreational use of Lake Decatur. The phase now underway at a contract cost of $89 million includes dredging the portion of Lake Decatur that receives flow from the Big/Long Creek watershed. Implementation of practices to reduce both nutrient and sediment loading from this watershed will help to protect the city’s investment in dredging.

The 28% TMDL reduction target for nitrate during high flow conditions is lower than the 45% statewide reduction goal based on addressing hypoxia. In this plan, we present strategies to meet the TMDL reduction target and consider additional actions to reach the statewide nitrate reduction goal.

The scope of work in the Financial Assistance Agreement for this project includes planning to reduce nutrient and suspended solids loads “through a combination of in-field, edge-of-field, and riparian corridor techniques, some of which are in the experimental stage or not yet widely used in Illinois”. Accordingly, this TMDL Implementation Plan includes provision for on-farm research and demonstration to assess the agricultural, environmental, and economic results of new practices and cropping systems.

While the planning horizon for meeting water quality targets may be 20-years or more, it is customary to assume, implicitly or explicitly, that the percentage of the agricultural landscape devoted to today's crops will not change enough to be a factor in watershed-level planning. However, in this plan, the possibility of significant land use change is explicitly included as part of an adaptive implementation approach in which assumptions about cropland conversion and water quality outcomes are tracked and the plan is adjusted over time as appropriate. The land use change that is envisioned is primarily the adoption of perennial herbaceous or woody crops sited and managed to produce food, feed, and fuel plus ecosystem services, notably including water quality enhancement and greenhouse gas reduction. The case to be made for projecting such a change is related in part to the prospect of growth in cellulosic biofuels (as called for in current federal energy policy) and consumer preference for grass-fed beef. The *Sustainable Decatur Plan* adopted by the Decatur City Council includes a Year 2020 objective of 10,000 acres of perennial energy crops planted for renewable energy and water quality. This acreage represents about 3% of the portion of the Lake Decatur watershed downstream of Monticello. If this local sustainability target is reached, it would create a significant market for bioenergy grasses grown in the Big/Long Creek watershed. Growth of the market for biomass beyond Year 2020 would support additional conversion of marginal cropland to perennial crops with water quality benefits.

2.0 Watershed Resource Inventory Summary of Key Findings

As part of this planning project, a Watershed Resource Inventory (WRI) was prepared for the Big/Long Creek watershed. The complete WRI is incorporated in this plan as Appendix A. In broad outline, the WRI confirmed that land in the watershed is well-suited to crop production and most of the land area is used for that purpose. A high percentage of the cropland is tile drained. There is only one small point source wastewater discharge. There is a small portion of the watershed with urban development and storm drainage; additional development may be expected over the next 20-years. There are no major livestock operations in the watershed but some small areas of pasture with cattle and horses.

Portions of the WRI that discuss the sources of pollutants addressed in this TMDL Watershed Implementation Plan and are of particular relevance to potential solutions are as follows:

- **Land Use/Cover:** A review of the land use data shows that major use of land is agricultural. Low-density urban development and rural grasslands are found along Big Creek and the lower reaches of Long Creek. According to the June, 2007 Big and Long Creek Watershed Resource Plan, 87.9% of the watershed is cropland, 5.9% is grassland and woodland, and 7.2% is urban or built up land. Of the 88% of the watershed in cropland, about 2/3 is in corn and 1/3 in soybean production in a given year. There are no major livestock facilities, only hobby livestock and horses with about 1% of the watershed in pasture. Due to the proximity to the City of Decatur and Village of Mt. Zion, urban development is expected to occur in the watershed.
- **Drainage:** Subsurface drainage is one source of nitrogen loss from this watershed. It is estimated that 70% or more of the farmland is drained in this manner. There are no maps available of tile outlet locations, but they may be embedded in NRCS farm plans and used for planning on a farm or

field basis or may be available through farm drainage contractors with permission of the landowner.

- **Riparian Corridors:** A survey of the watershed conducted in April, 2013 showed that buffer strips were being used near water bodies. A review of Google Earth imagery of the watershed conducted at that time showed the number of buffers along water bodies had declined in the past six years with approximately 110 acres remaining.
- **Municipal/Industrial Point Sources:** There is only one NPDES permitted site in this watershed; the Long Creek Township Water Treatment Plant's IEPA General NPDES permit: ILG640265. Information from the United States Environmental Protection Agency (USEPA) shows that the "Receiving Waters" are an "unnamed tributary (of Long Creek) to Lake Decatur". The permit has an effective date of 7/13/2012 and expiration date of 4/30/2017. Permit requirements are as follows: Flow must be reported; pH between 6.00 and 9.00 s.u.; TSS not to exceed a 30 day average of 15mg/l or a daily maximum of 30 mg/l; total residual chlorine not to exceed 0.05 mg/l.
- **Stormwater Management:** A relatively small part of Mt. Zion drains to Big Creek, including a portion of its storm sewers. The City of Decatur and the Village of Mt. Zion have Municipal Separate Storm Sewer System (MS4) permits. Long Creek is not an MS4 community. The Macon County Soil and Water Conservation District (SWCD) serves as technical staff in Macon County on MS4 permits and they issue land disturbance permits (LDPs). Building permits in Mt. Zion or Decatur require an LDP. In many cases a properly installed and maintained silt fence will satisfy the requirements. Land with greater slopes may require additional measures for which the SWCD provides technical assistance. Enforcement is done by the municipality in accordance with the LDP. The SWCD also manages the educational components of the MS4 program, which includes home shows, a contractors' workshop, and the website: www.maconcleanwater.com. For building permits in the county jurisdiction, the county has its own permit process and technical capability.
- **Soil Classification:** The predominant soils in this watershed are mollisols, which are prairie-derived soils with gentle slopes. Drummer-Milford silty clay loams and Flanagan silty clay are the highest percentage mollisols within this area. Both of these soils have little to no slope (0-2 %), a deep loess layer, low erodibility, a high shrink-swell potential and considered prime farmland if properly drained. Drummer-Milford soils are hydric, so poorly drained and subject to ponding during heavy rainfall. Flanagan soils are not hydric, but somewhat poorly drained and they are subject to high seasonal water tables. The balance of the soils in the watershed are found along or near the water bodies of Big and Long Creek and they tend to be alfisols, or forest derived soils. The higher percentage alfisols are Birkbeck silt loam, Russell silt loam, Senachwine clay loam and Xenia silt loam. The slopes of these soils vary from 2-35% and their susceptibility to erosion varies from moderate to high. These are drained soils and not hydric. At the confluence of the Big and Long Creeks, there are alluvial soils. These soils are in the floodplains and frequently flooded.
- **Soil Erosion:** According to the June 2007 Big and Long Creek Watershed Resource plan, erosion is occurring from three distinct areas: stream bank, cropland and urban sites under construction. The average annual erosion rates from cropland in this watershed range from 1-15 tons per acre. This report states that there are four types of erosion with roughly 50% from sheet and rill erosion, 36% from ephemeral erosion, 3% gully erosion and 11% stream bank erosion. The sheet and rill erosion is occurring throughout the entire watershed, while the other three types of erosion are occurring

within concentrated areas. These concentrated areas include urban sites under construction and lands with slopes greater than 5% adjacent to water bodies.

- **Wetlands:** The largest wetlands in this watershed are contained within Spitler Woods State Park and Ft. Daniel Conservation Area along Big Creek, which is owned by the Macon County Conservation District. In addition, there are several small wetlands along both Big Creek and the lower reaches of Long Creek. It was mentioned in the June, 2007 resource plan that there was concern that stormwater from the watershed may cause deterioration in the quality of these natural wetlands. In 1999 IEPA provided Section 319 grant funds to create a wetland through the Macon County SWCD Lake Decatur Watershed Program. One landowner installed a 1.5 acre shallow water wetland in the Big Creek Watershed. The site appears to be well maintained and functioning as a sediment and nutrient trap.
- **Existing Best Management Practices (BMPs):** A significant number of grass waterways, terrace systems, grade stabilization structures, filter strips and ponds exist throughout both Big Creek and Long Creek Sub-watersheds. The 2007 TMDL report noted that more are needed. Additional practices have been installed since that time through the Lake Decatur Watershed Program and financially supported by the City of Decatur or through Federal programs. There is a need for maintenance and upkeep of existing BMPs. There are some issues with erosion control BMPs associated with urban construction. During a watershed site tour in April 2013, it was observed that some BMPs were installed improperly and/or have not been adequately maintained. Another issue noted was the lack of tillage management. About 90% of the cropland in this watershed is chisel tilled, 2% is no-tilled, and the balance is mulch tilled or tilled with other tillage systems; no fields are being moldboard plowed. A portion of the ephemeral erosion occurring in the watershed is due to concentrated flow on tilled fields and therefore, a shift in tillage would result in a reduction of soil loss. Grassed waterways and vegetative filter strips are taxed at one sixth of the rate of productive farmland. The assessment for a farm is determined from current aerial photos of cropland and non-cropland. The tax assessor does not compile records of acreages of land determined to be in grassed waterways or vegetative field strips.
- **Septic Systems:** The Macon County Health Department regulates septic systems in the watershed and throughout the county. They investigate septic problems on a complaint basis and do not maintain a county wide septic failure rate. The majority of homes in the watershed are on septic systems and only a small part of the watershed is served by a sanitary sewer system connected to the Decatur municipal sewer system.
- **Water Quality Data:** IEPA does not list Big Creek (IL_EU-01) or Long Creek (IL_EUA-01) as being impaired for any of its five Designed Uses (Aquatic Life, Fish Consumption, Primary Contact, Secondary Contact, Aesthetic Quality). These creeks were not assessed in any of the most recent Integrated Water Quality Reports. The Illinois State Water Survey (ISWS) monitored flow and nitrate-N concentration at a station downstream of the Big Creek-Long Creek confluence from 1993 to 1998. Results are summarized in the WRI, Appendix A. Over that monitoring period, annual nitrate-N yield varied from 6 to 36 lb/acre/yr with a mean of 23 lb/acre/yr. The annual nitrate-N minimum concentration varied from 0.02 to 0.74 mg/L, the annual nitrate-N mean concentration varied from 2.06 to 8.63 mg/L and the annual nitrate-N maximum concentration varied from 9.18 to 16.07 mg/L. Sediment in Lake Decatur is a major concern to the City for both aesthetic/recreational reasons and due to loss of reservoir capacity. Since construction of the lake

in 1922, eight sedimentation surveys of Lake Decatur have been conducted by ISWS. The 2000-2001 sedimentation survey showed that the reservoir capacity of the Big/Long Creek Basin of Lake Decatur decreased from 2,754 ac-ft in 1922 to 1,512 ac-ft in 2001, a loss of 54.9 percent. Annual sedimentation rates for the basin are 9.9 ac-ft. Sediment in a lake causes loss of capacity, but it also carries with it phosphorus, a key nutrient for the growth of aquatic vegetation. The Big/Long Creek watershed has not been monitored for phosphorus.

3.0 Critical Areas

Critical areas selected for the Big/Long Creek watershed represent a selection of subbasins delineated by the ISWS as part of the SWAT modeling effort. Big and Long Creek was segmented into 35 unique subbasins. A summary of subbasin rankings are provided in Table 1.

The process for the establishment of critical areas included:

- Defining two primary watershed goal areas: 1) reduce nitrogen loads; 2) reduce phosphorus and sediment loads.
- Establishing a set of data driven indicators that represent each goal statement. For example, to reduce phosphorus and sediment loads, focus should be on those areas with the highest current phosphorus and sediment loads and greatest potential for load reductions. Here, indicators included: per acre modeled phosphorus and sediment loads, acres of existing BMPs, area of HEL agricultural soils, area of no-till and treatment area of field verified BMPs. For nitrogen, critical area criteria focused on a ranking of the optimal placement of BMPs identified through the SWAT model.
- A detailed GIS analysis of each indicator by subbasin.
- Normalization of indicator results by subbasin.
- A final score or ranking of subbasins for each goal

Subbasins with a ranking in the top 25% are considered critical, the next 25% are tier 2 critical, then tier 3, and the final 25% are considered tier 4. Work should focus first on those subbasins with the highest rankings (top 25%) and those where a sub basin is ranked high in both goal categories. Figures 2 and 3 show all critical subbasins.

Table 1 - Big & Long Creek Critical Subbasin Rankings

Subbasin	Subbasin Acres	Final Rank; Reduce Sediment & Phosphorus	Final Rank; Reduce Nitrogen
1	735	21	13
2	2,091	26	3
3	2,383	5	2
4	652	33	12
5	1,607	27	10
6	121	3	29
7	522	22	27
8	519	17	16
9	1,752	19	7
10	1,867	2	9
11	1	34	34
12	779	1	25
13	281	12	26
14	767	18	14
15	571	14	20
16	96	16	32
17	265	10	28
18	582	13	19
19	874	4	15
20	514	8	24
21	346	28	31
22	883	25	22
23	442	35	34
24	625	7	21
25	1,746	24	1
26	365	6	30
27	482	23	4
28	520	20	16
29	1,942	15	5
30	1,051	29	23
31	857	9	8
32	590	31	18
33	44	11	33
34	1,442	30	6
35	1,848	32	11

Figure 2 - Big & Long Creek Critical Areas for Nitrogen Reduction

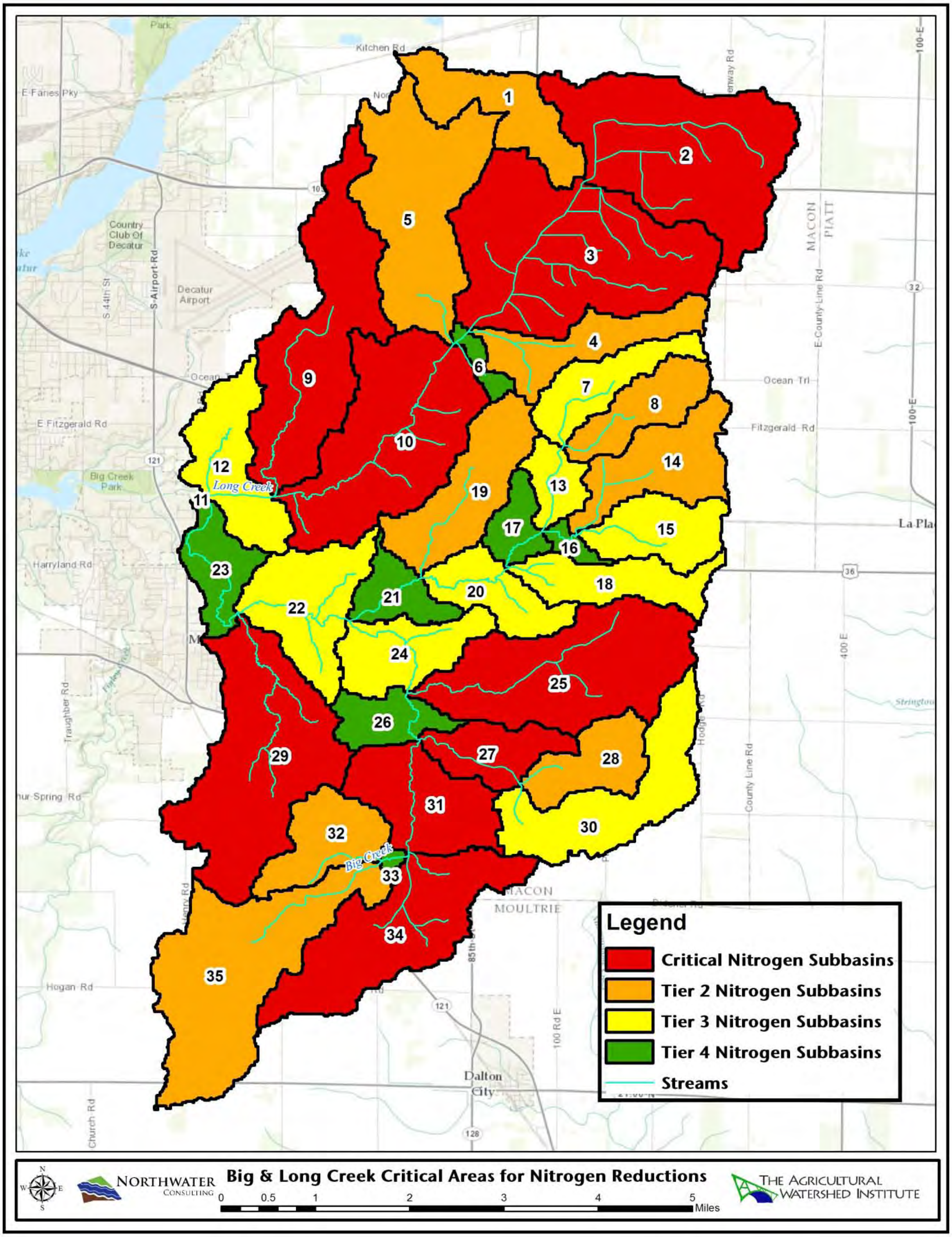
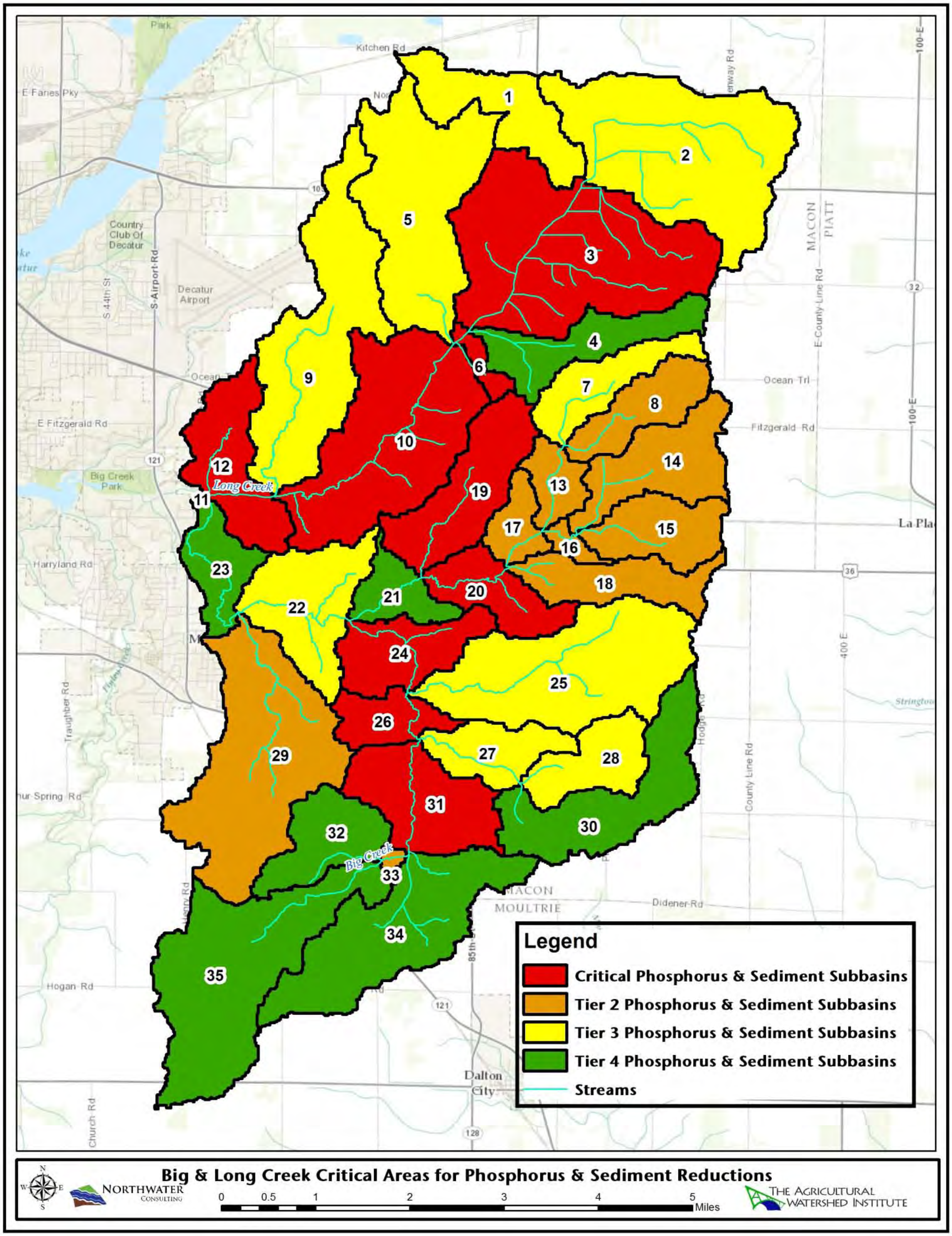


Figure 3 - Big & Long Creek Critical Areas for Phosphorus & Sediment Reduction



4.0 Nonpoint Source Management Measures & Load Reductions

4.1 Introduction & Methodology

SWAT generated hydrologic response units representing optimal areas for a suite of Best Management Practices (BMPs) were overlaid on aerial imagery and fields selected based on a visual interpretation of location suitability. Where applicable, structural BMPs such as grassed waterways were also identified; approximate drainage areas were then delineated for each site. In March of 2014 a watershed windshield survey was completed to gain an understanding of watershed conditions and features and to collect field specific data and verify BMP locations identified through aerial photo interpretation. Data collected in the field included:

- Tillage practices
- Cover types
- Project (BMP) locations and site suitability
- Sources of sediment and gully erosion

A spatially explicit and field specific GIS based pollution loading model was then developed for the Big Creek/Long Creek watershed. This supporting model simulates both surface runoff and tile flow using the curve number approach, local precipitation, the Universal Soil Loss Equation (USLE), and Event Mean Concentrations (EMCs) specific to land use and soil types in the watershed. In addition, information collected in the field was incorporated into the model such as tillage practices, the location of irrigated fields and existing conservation practices. The model was then calibrated to the existing SWAT model results by adjusting curve numbers and EMCs. Table 2 provides SWAT model outputs in annual per acre loading and calibrated totals for the supporting field based load model. It is important to note that the SWAT generated loads for phosphorus and sediment are not calibrated.

Table 2 - Big & Long Creek Total Loading

Pollutant	Annual SWAT Load	Supporting Model; Calibrated Load	Total Watershed Load (lbs/yr)	Total Watershed Load (lbs/yr) from Surface Runoff	Total Watershed Load (lbs/yr) from Subsurface Flow
Nitrogen (lbs/ac/yr)	31.7	27	799,948	456,536	343,412
Phosphorus (lbs/ac/yr)	0.97	1.4	42,120	41,047	1,073
Sediment (tons/ac/yr)	0.28	0.53	15,694 (tons/yr)	15,694 (tons/yr)	0

The supporting field based model was then utilized to calculate load reductions resulting from the installation of recommended BMPs.

4.2 Best Management Practices & Expected Load Reductions

This section describes the BMPs recommended for the Big/Long Creek watershed, their applicable quantities and expected annual pollution load reductions. Many of the BMPs listed below are described further in the ISWS report "Decision Support Model for Generating Optimal Alternative Scenarios of Watershed Best Management Practices".

BMPs can be described as practices or procedures to prevent or reduce water pollution and address stakeholder concerns. BMPs typically include treatment requirements, operating procedures, and practices to control runoff and abate the discharge of pollutants. This section of the plan will describe both site-specific BMPs as well as those that can be applied to a field as a whole or basin-wide to achieve measurable load reductions in phosphorus, nitrogen, and sediment. A watershed wide field survey was conducted to evaluate potential project sites and document watershed features. Basin-wide and site- specific BMPs were identified first through an interpretation of aerial imagery and existing GIS layers and then verified through the field survey.

Recommended practices or BMPs focus on nonpoint source (NPS) pollution from both surface runoff and tile flow. Estimates of the expected pollution load reductions associated with recommended practices are included in this section. Load reductions are calculated using average potential pollutant reduction percentages based on existing literature and local expertise. Average potential pollutant reduction percentages can be found in Tables 3 and 4. These potential removal percentages were generated from work done by the Center for Watershed Protection, previous watershed plans for Mill Creek in Lake County and 9-Lakes in Lake and McHenry County, and professional judgment and an understanding of the specific BMP. In some cases, a range of potential pollutant reduction percentages are provided; a range is provided to account for differences in contributing area. It was assumed that a BMP is less efficient at reducing pollutant loading if it is required to treat a much larger areas and therefore, the larger the contributing area, the lower the percentage.

Table 3 – Average Potential Pollutant Reduction Percentages for Surface Runoff

Best Management Practice	Nitrogen Reduction Percentage Surface Runoff	Phosphorus Reduction Percentage Surface Runoff	Sediment Reduction Percentage Surface Runoff
Wetland	20%-40%	25%-45%	35%-70%
Pond	20%-40%	25%-50%	40%-70%
Field Border	40%	45%	55%
Cover Crop/Conservation Tillage	30%	30%	40%
Terrace/WASCB	30%	65%	70%
Saturated Buffer	5%	55%	60%
Filter Strip	50%	55%	65%
Grass Waterway	30%-55%	25%-45%	45%-70%
Nutrient Management Plan	0%	12%	0%
Two-Stage Ditch	10%	45%	30%

Best Management Practice	Nitrogen Reduction Percentage Surface Runoff	Phosphorus Reduction Percentage Surface Runoff	Sediment Reduction Percentage Surface Runoff
Drainage Water Management	0%	0%	0%
Grade Control Structure/Riffle*	2%	30%	40%
Denitrifying Bioreactor	0%	0%	0%
Perennial Crop Conversion	35%	45%	70%

Table 4 - Average Potential Pollutant Reduction Percentages for Subsurface Flow

Best Management Practice	Nitrogen Reduction Percentage Tile Flow	Phosphorus Reduction Percentage Tile Flow	Sediment Reduction Percentage Tile Flow
Wetland	25%-40%	0%	0%
Pond	5%	5%	0%
Field Border	10%	5%	0%
Cover Crop/Conservation Tillage	30%	10%	0%
Terrace/WASCB	0%	5%	0%
Saturated Buffer	50%	25%	0%
Filter Strip	5%	5%	0%
Grass Waterway	0%	0%	0%
Nutrient Management Plan	15%	40%	0%
Two-Stage Ditch	10%	2%	0%
Drainage Water Management	40%	10%	0%
Grade Control Structure/Riffle*	0%	0%	0%
Denitrifying Bioreactor	40%	5%	0%
Perennial Crop Conversion	90%	45%	0%

4.2.1 Site-Specific Best Management Practices

Site-Specific BMPs are those practices where a field visit has resulted in the identification of a specific project and project location with a unique drainage area. No further investigations are needed for these sites; recommended practices are feasible. Potential site-specific practices have been identified throughout the watershed and include:

- Cover Crops
- Constructed Wetland

- Grassed Waterways
- Water and Sediment Control Basins
- Rock Riffle and Grade Control Structure
- Detention Basin/Pond
- Perennial Crop Conversion
- Filter Strips
- Field Borders
- Bio Reactors
- Two-Stage Ditch
- Stream Bank Stabilization

If implemented, all recommended site-specific practices will result in total annual load reductions of 209,995 lbs nitrogen (7 lbs/ac), 14,047 lbs of phosphorus (0.47 lbs/ac) and 8,618 tons (0.3 tons/ac) of sediment. Implementing all site-specific practices will meet targets for sediment reduction but not for nitrogen and phosphorus. Table 5 provides a summary of total watershed loading and expected load reductions compared against load reduction targets. Table 6 summarizes total loading, load reductions and percent reductions by subbasin; Tier 1 critical subbasins are highlighted in red. When reviewing Table 6, it is important to note that the contributing areas of some BMPs do overlap with each other resulting in elevated load reductions; for example where total load reductions are near or are at 100%. In these cases, load reductions should be evaluated individually for each BMP. Locations with overlapping BMPs may offer a unique opportunity to achieve greater load reductions and should be considered first.

Table 5 - Site-Specific Load Reduction Summary & Reduction Targets

Total Nitrogen Load (lbs/yr)	799,948	**Total Phosphorus Load (lbs/yr)**	42,120	**Total Sediment Load (tons/yr)**	15,694
Nitrogen Load Reduction (lbs/yr)	209,995	**Phosphorus Load Reduction (lbs/yr)**	14,047	**Sediment Load Reduction (tons/yr)**	8,618
Nitrogen Reduction Target	28%	**Phosphorus Reduction Target**	74%	**Sediment Reduction Target**	50%
Nitrogen Reduction % Achieved	26%	**Phosphorus Reduction % Achieved**	33%	**Sediment Reduction % Achieved**	55%

Table 6 - Site-Specific Load Reductions by Subbasin

Subbasin Number	Subbasin N Load (lbs/yr)	Subbasin P Load (lbs/yr)	Subbasin Sediment Load (tons/yr)	BMP N Load Reduction (lbs/yr)	BMP P Load Reduction (lbs/yr)	BMP Sediment Load Reduction (tons/yr)	% Reduction N	% Reduction P	% Reduction Sediment
1	22,355	825	259	9,483	395	194	42%	48%	75%
2	**58,094**	**2,431**	**822**	**26,037**	**1,241**	**659**	**45%**	**51%**	**80%**
3	**73,979**	**4,399**	**1,796**	**22,024**	**1,541**	**947**	**30%**	**35%**	**53%**
4	19,068	735	240	1,243	21	26	7%	3%	11%
5	49,166	1,884	611	5,062	282	173	10%	15%	28%
6	**3,899**	**255**	**113**	**1,479**	**155**	**91**	**38%**	**61%**	**81%**
7	16,102	593	187	6,514	423	187	40%	71%	100%
8	15,635	619	207	6,984	218	120	45%	35%	58%
9	**43,618**	**2,294**	**811**	**9,618**	**737**	**465**	**22%**	**32%**	**57%**
10	**45,397**	**4,218**	**1,860**	**15,767**	**1,932**	**1,400**	**35%**	**46%**	**75%**
11	3.06	0.35	0.01	0	0	0	0%	0%	0%
12	**11,982**	**1,329**	**540**	**1,336**	**163**	**99**	**11%**	**12%**	**18%**
13	8,583	515	209	841	58	35	10%	11%	17%
14	20,907	899	311	7,428	436	227	36%	49%	73%
15	15,734	732	257	3,331	243	146	21%	33%	57%
16	2,355	185	81	1	0	0	0.03%	0%	0%
17	8,035	534	224	1,018	56	34	13%	11%	15%
18	17,190	762	269	2,861	184	121	17%	24%	45%
19	**25,800**	**1,694**	**709**	**12,137**	**880**	**548**	**47%**	**52%**	**77%**
20	**12,862**	**817**	**313**	**2,253**	**108**	**66**	**18%**	**13%**	**21%**
21	4,938	391	123	1,066	80	52	22%	20%	42%
22	10,202	887	274	1,232	85	58	12%	10%	21%
23	1,412	178	27	0	0	0	0%	0%	0%
24	**11,787**	**891**	**348**	**3,345**	**251**	**151**	**28%**	**28%**	**44%**
25	**51,633**	**2,664**	**1,016**	**16,081**	**1,444**	**917**	**31%**	**54%**	**90%**
26	**11,160**	**801**	**344**	**0**	**0**	**0**	**0%**	**0%**	**0%**
27	**13,394**	**830**	**330**	**3,997**	**273**	**161**	**30%**	**33%**	**49%**
28	15,851	636	214	2,657	182	112	17%	29%	52%
29	**47,766**	**2,629**	**993**	**16,175**	**918**	**564**	**34%**	**35%**	**57%**
30	20,152	848	320	2,927	276	177	15%	33%	55%
31	**25,079**	**1,400**	**549**	**12,161**	**735**	**435**	**48%**	**53%**	**79%**
32	17,952	686	221	2,252	152	84	13%	22%	38%
33	1,151	81	40	136	14	14	12%	18%	35%
34	**42,818**	**1,648**	**536**	**6,912**	**327**	**197**	**16%**	**20%**	**37%**
35	53,887	1,829	537	5,635	238	121	10%	13%	22%
Total	**799,948**	**42,120**	**15,694**	**209,995**	**14,047**	**8,618**	**26%**	**33%**	**55%**

Field Borders

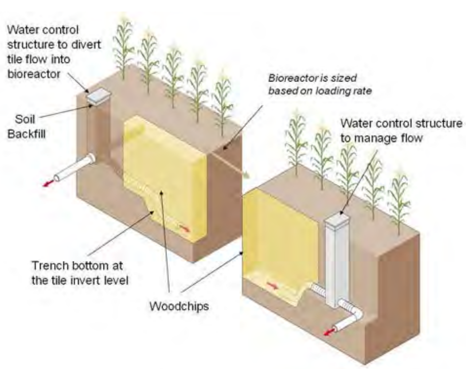
A field border is a type of conservation buffer consisting of a grassy border along one or more edges of a field. In addition to the soil and water protection provided by the perennial vegetation, field borders can be designed to provide other environmental and practical benefits. For example, field borders can straighten irregular field boundaries and provide space to turn and park tractors during field operations. Field borders can also harbor natural predators of crop pests and provide wildlife habitat.

Field Borders are recommended for 0.3 acres in the watershed and will treat 34 acres of drainage. Load reductions expected, if all sites are implemented are 272 lbs/year of nitrogen, 22 lbs/year of phosphorus, and 10 tons/yr of sediment. See Figure 4.

Perennial Grass Conversion

Conversion of cropland from annual row crops to perennial grasses can significantly reduce nutrient losses. Rather than considering new crops as a BMP, this type of cropland conversion and the potential nutrient loss reduction are discussed separately in Section 4.3. A few potential sites for perennial grass conversion are shown in Figure 4 and 16. If bioenergy or forage markets are developed for perennial grass crops, the converted acreage may be significantly larger than the examples shown in those figures.

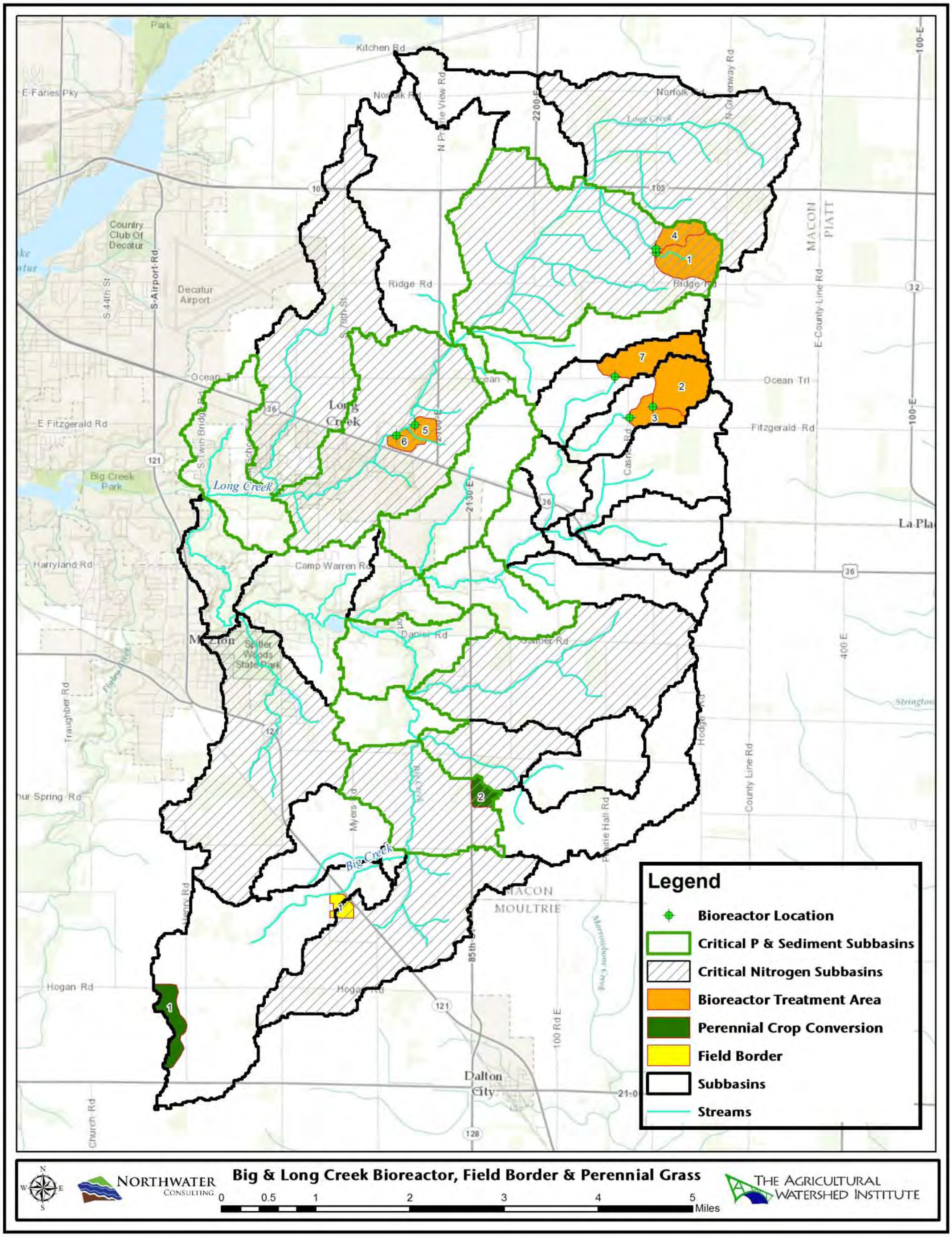
Denitrifying Bioreactor



A denitrifying 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 will treat approximately 50 acres. 31 site-specific bioreactors are recommended in Big/Long Creek; these bioreactors will treat 1,537 acres.

Load reductions expected, if all sites are implemented are 8,701 lbs/year of nitrogen, and 3.4 lbs/year of phosphorus. No reductions in sediment load are expected from this practice. See Figure 4.

Figure 4 – Potential Site-Specific Field Borders, Bioreactors & Perennial Crop Conversion



Cover Crops

A cover crop is a temporary vegetative cover that is grown to provide protection for the soil and improve soil conditions. Cover crops can be specifically applied to all no-till fields in the watershed. Cover crops on existing no-till fields are recommended on 813.6 acres. This number represents all no-till fields in the watershed, identified during an on-the-ground field survey. Load reductions expected, if all sites are implemented are 7,561 lbs/year of nitrogen, 200 lbs/year of phosphorus, and 68 tons/yr of sediment. See Figure 5.

Grassed Waterway

A grassed waterway is grassed strip in fields that acts as an outlet for water to control silt, filter nutrients and limit gully formation. 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 Big/Long Creek watershed, it was assumed that grassed waterways will reduce pollutant loads from gully erosion as well as a percentage from contributing drainage areas and therefore, high expected load reductions for nitrogen can be attributed to the stabilization of very large gullies, the size of contributing areas and the high overall per acre nitrogen loads found in the watershed.

Forty-seven (47) grassed waterways or 67 acres are recommended in Big/Long Creek; these waterways will treat 6,689 acres of drainage, using a ratio of drained (treated) area to waterway area of 100:1. This ratio was developed in consultation with NRCS taking into consideration that relatively flat topography in the watershed. Load reductions expected, if all sites are implemented are 60,763 lbs/year of nitrogen, 5,250 lbs/year of phosphorus, and 3,245 tons/yr of sediment. See Figure 6.

Detention Basin/Pond

A detention basin or a pond is a sediment or water impoundment made by constructing an earthen dam. Three (3) ponds treating 685 acres are recommended for the watershed. If implemented, these three ponds will result in annual load reductions of 3,476 lbs of nitrogen, 283 lbs of phosphorus, and 150 tons of sediment. See Figure 7.

Filter Strip

A filter strip is a narrow band of grass or other permanent vegetation used to reduce sediment, nutrients, pesticides, and other contaminants. Only those areas directly adjacent to an openly flowing ditch or stream were selected for the placement of filter strips. Twenty-one (21) individual filter strips or 6.6 acres are recommended for Big/Long Creek; these practices will treat 827 acres of drainage. If implemented, filter strips will reduce 9,443 lbs/year of nitrogen, 1,337 lbs/year of phosphorus, and 774 tons/year of sediment. See Figure 7.

Figure 5 – Potential Site-Specific Cover Crops

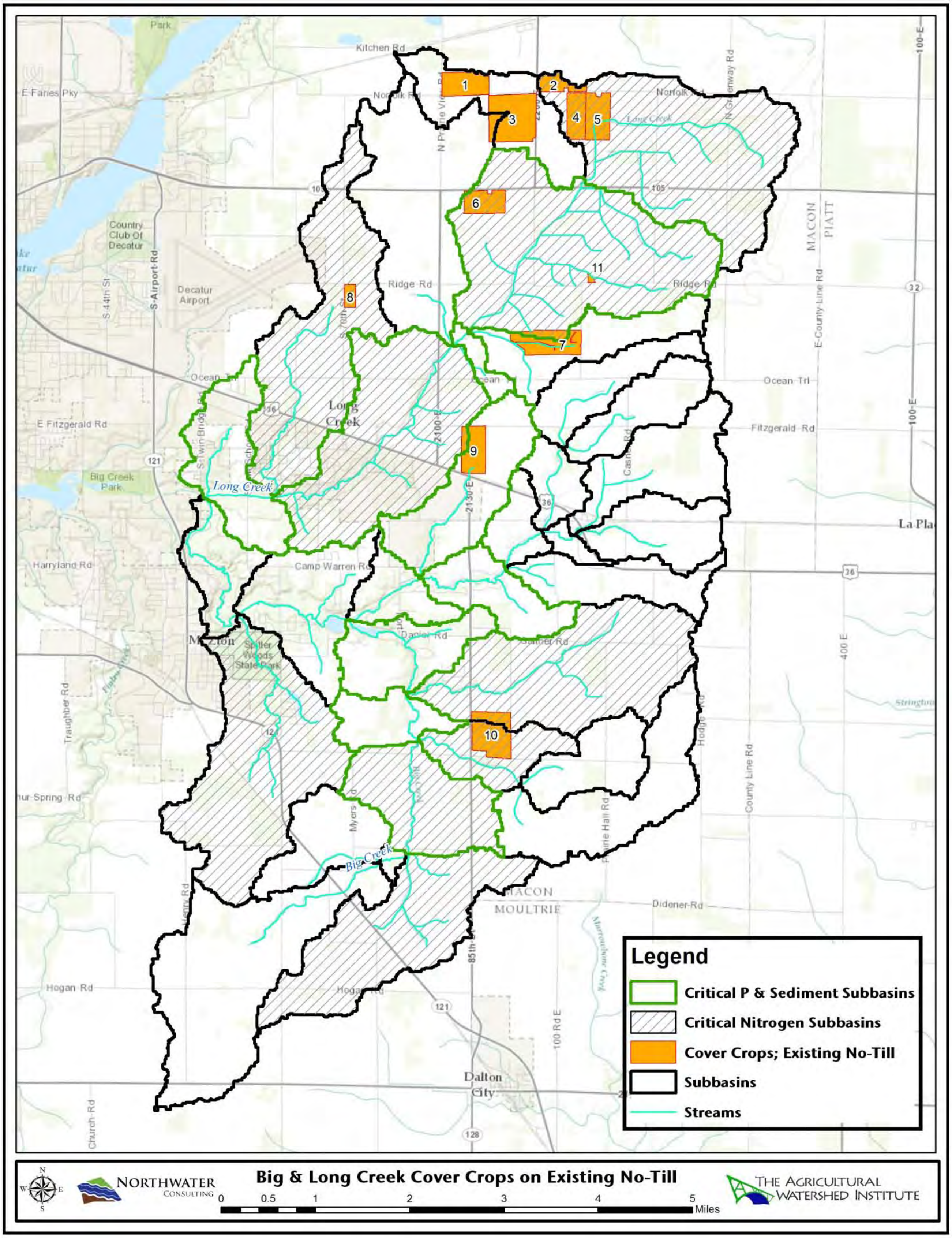


Figure 6 – Potential Site-Specific Grassed Waterways

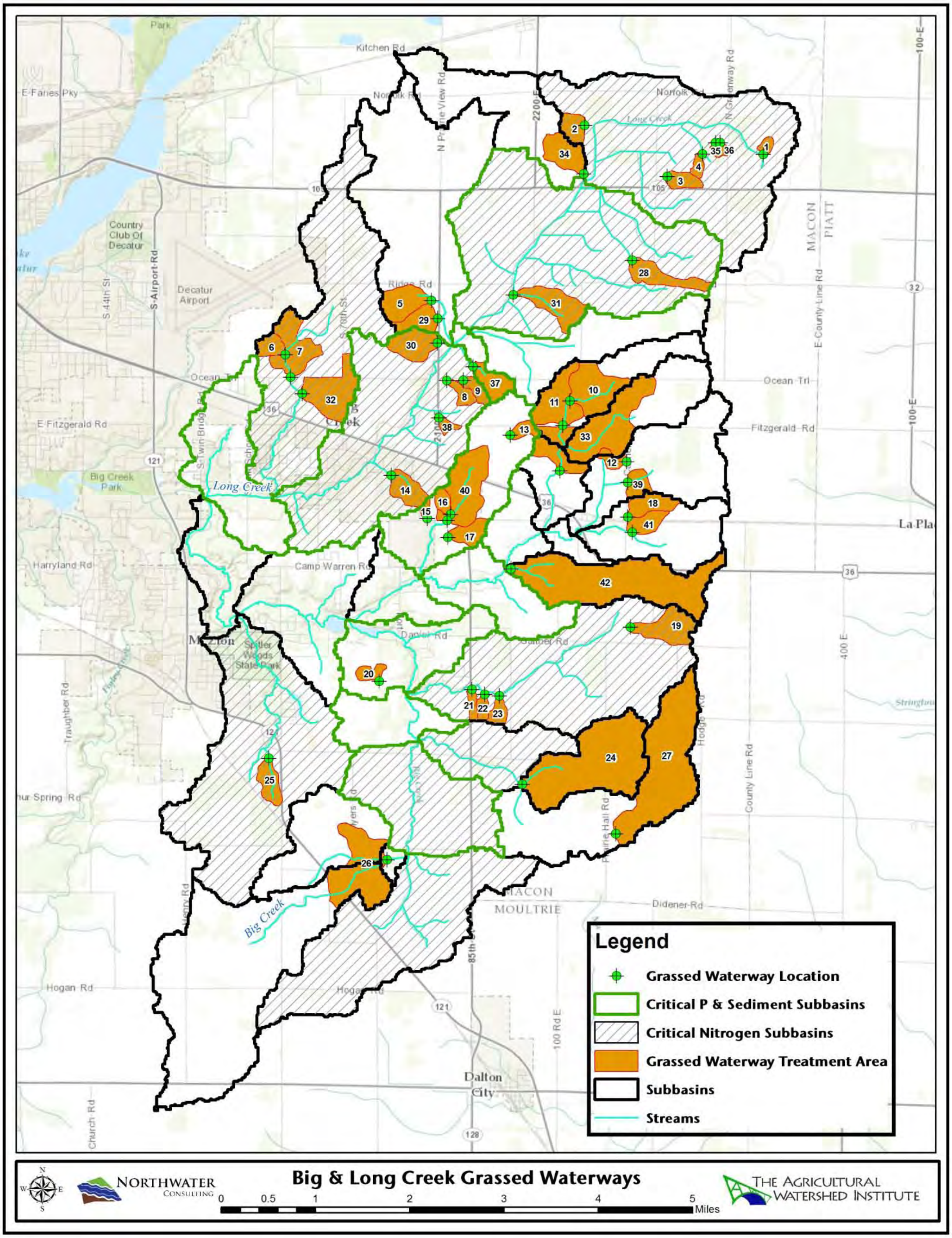
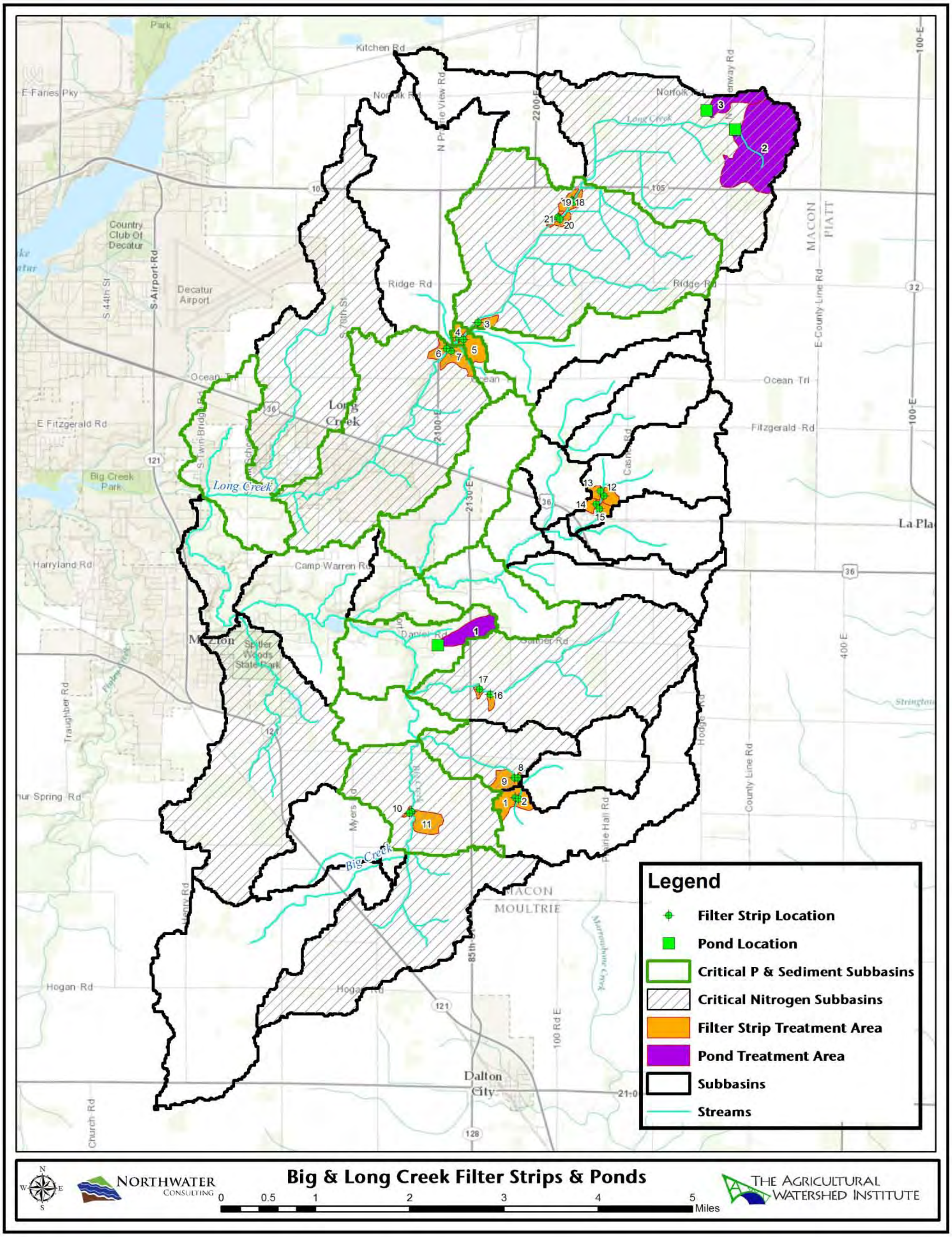


Figure 7 – Potential Site-Specific Ponds & Filter Strips



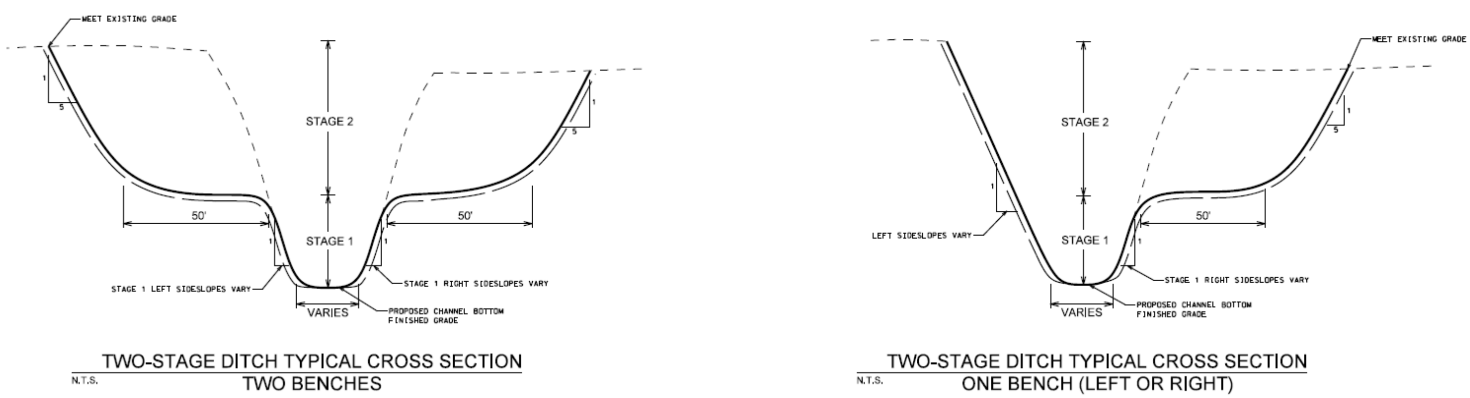
Constructed Wetland

A constructed wetland is a shallow water area 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. Seventy-eight (78) individual wetlands or 756 acres (based on a ratio of drainage area to wetland area of 15:1)are recommended in Big/Long Creek; these wetlands will treat 11,340 acres of drainage and result in annual load reductions of 112,850 lbs for nitrogen, 6,111 lbs of phosphorus, and 3,699 tons of sediment. See Figure 9. Wetland load reductions account for both surface runoff and tile flow.

Two-Stage Ditch

Two-stage ditches are drainage ditches that have been modified by adding benches that serve as floodplains within the overall channel. This form is more consistent with fluvial form and process, and therefore leads to greater channel stability. The benches can also function as wetlands during certain times of the year, reducing ditch nutrient loads. In Big/Long Creek, 34,903 ft of two-stage ditch is recommended for channelized sections of the watershed. If implemented, these two-stage ditches will treat 24 acre-ft of runoff and will result in annual load reductions of 163 lbs of nitrogen, 7.4 lbs of phosphorus, and 2.2 tons of sediment. See Figure 10.

Figure 8 - Two-Stage Ditch Cross Section



Note that the dimensions of the design shown in Figure 8 have been used to calculate load reductions and cost estimates for this plan. These dimensions provide the maximum benefits for improving water quality and flooding reductions and show an example cross-section with a generous bench width. More site-specific planning and design will be required based on landowner needs, hydrology and site constraints.

Figure 9 – Potential Site-Specific Constructed Wetlands

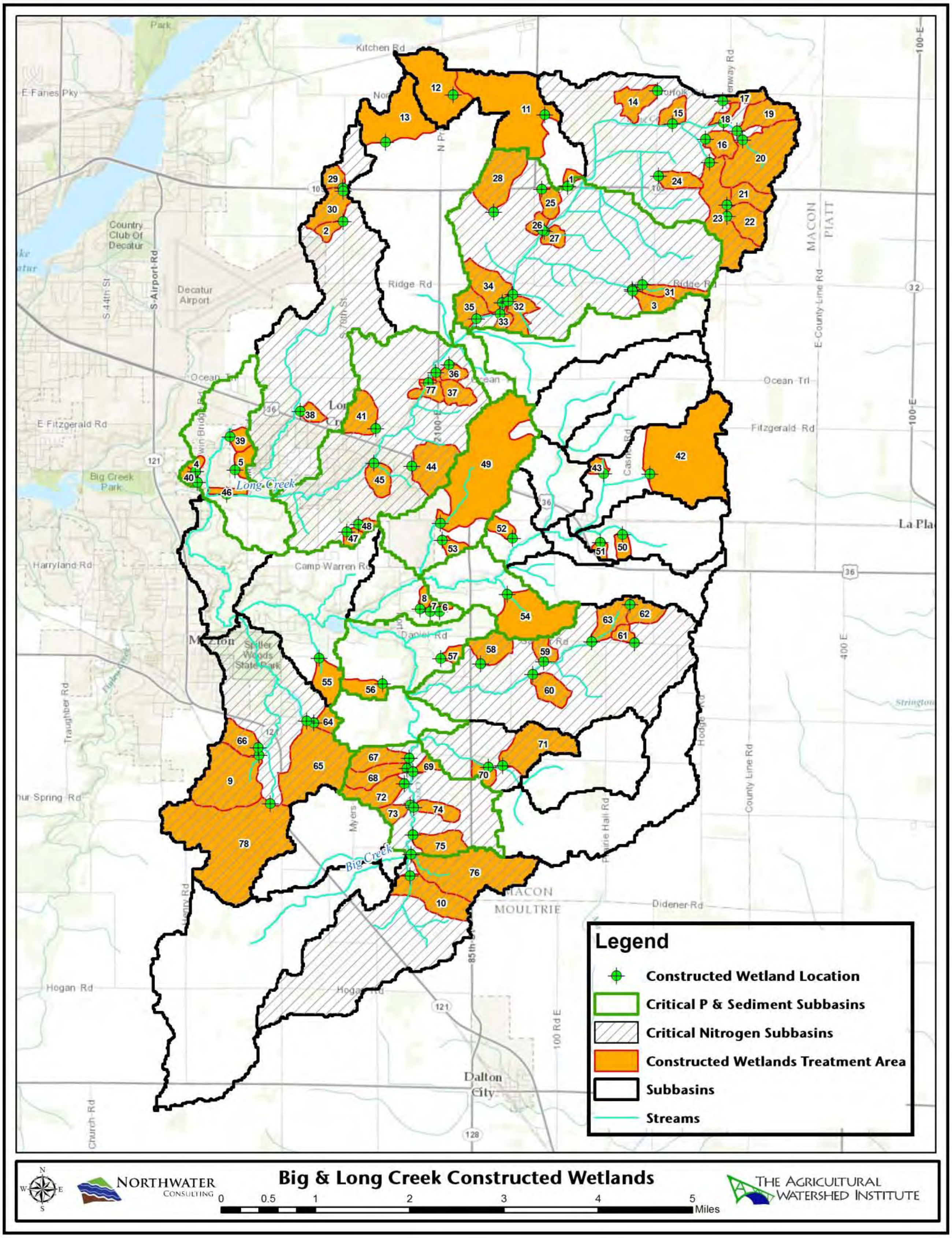
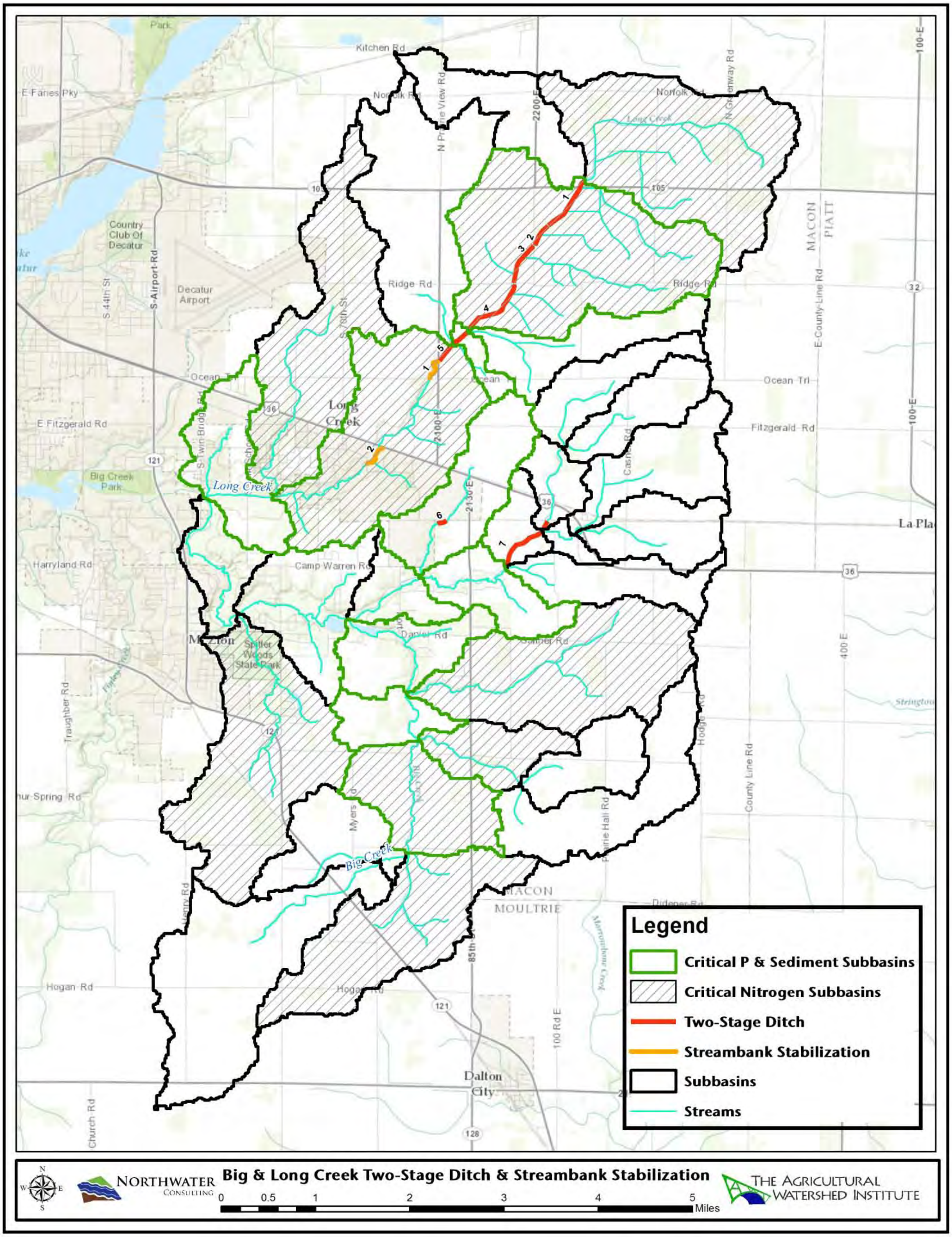


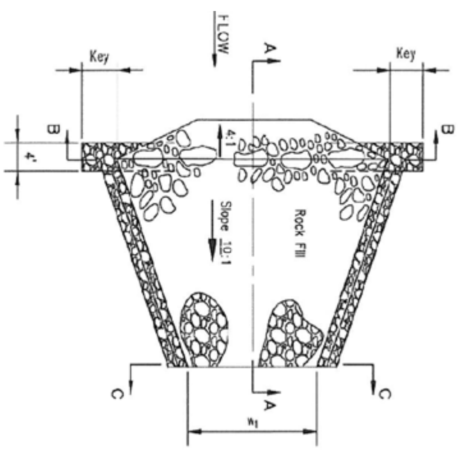
Figure 10 – Potential Site-Specific Two-Stage Ditch & Streambank Stabilization



Streambank Stabilization

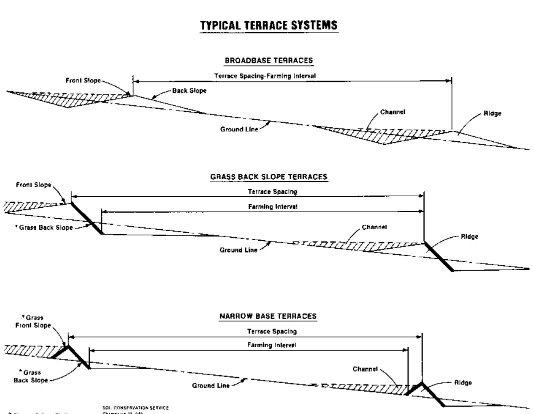
Streambank stabilization is the installation of designed structural measures to minimize or eliminate eroding streambanks. Typically, these structures include stone-toe protection of the placement of rock along banks and the installation of grade control measures such as rock riffles. In the Big/Long Creek watershed, streambank stabilization (stone-toe protection) is recommended for 2,776 feet of severely eroding streambanks. If implemented, streambank stabilization will result in annual load reductions of 797 lbs of nitrogen, 478 lbs of phosphorus, and 398 tons of sediment. See Figure 10.

Grade Control Structure/Rock Riffle



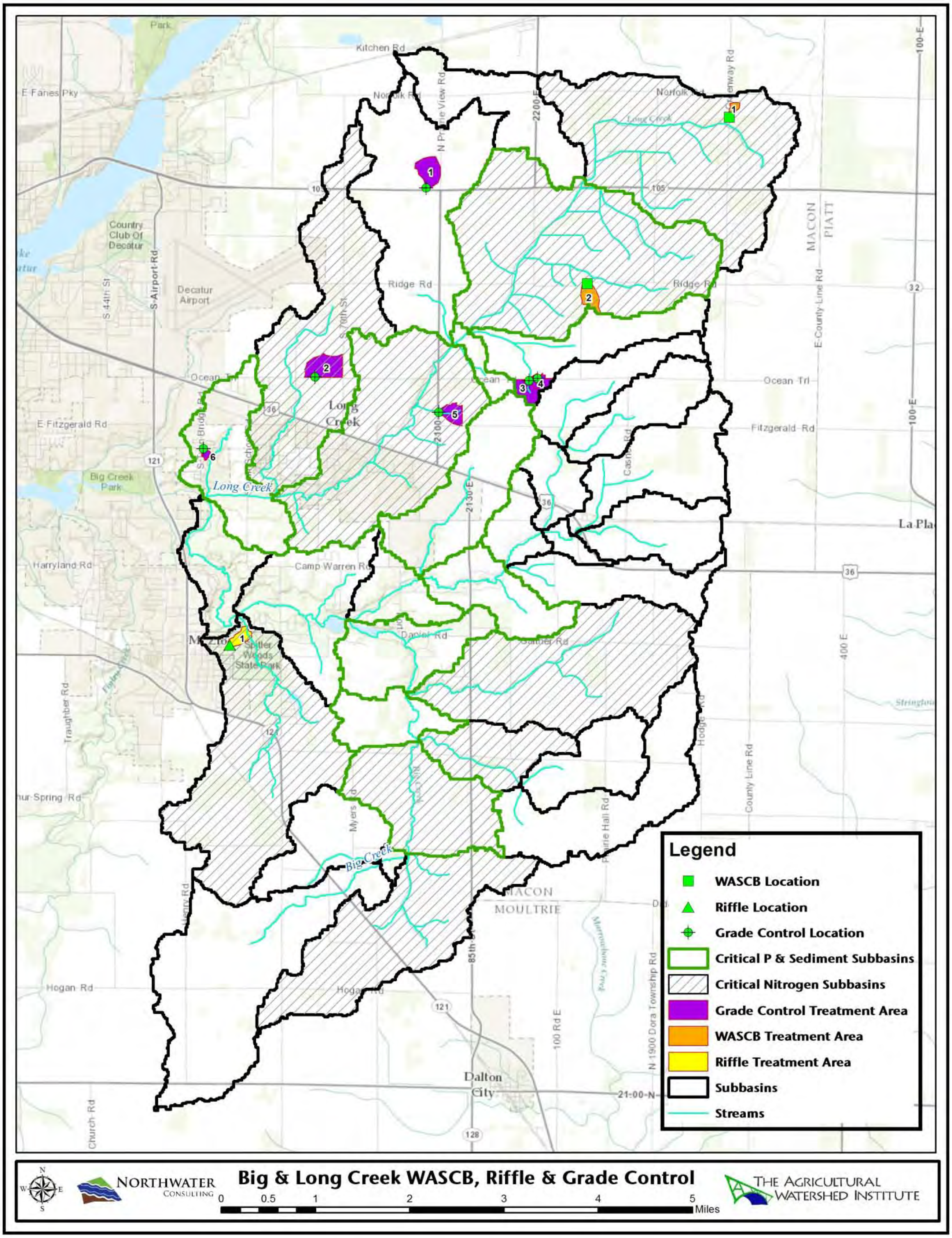
A grade control or rock riffle structure is constructed in a stream channel or gully to stabilize grade. One (1) riffle and six (6) grade control structures are recommended for Big/Long Creek. If implemented, these practices will treat 480 acres of drainage and will result in annual load reductions of 348 lbs of nitrogen, 136 lbs of phosphorus, and 178 tons of sediment (primarily from gully erosion). See Figure 11.

Water and Sediment Control Basins (WASCB)



WASCBs are earth embankments constructed across a slope to intercept runoff water and trap soil. In Big/Long Creek, nine (9) WASCBs at two sites are recommended to treat 87 acres of drainage. Load reductions expected, if WASCBs at this site are implemented total 473 lbs/year of nitrogen, 94 lbs/year of phosphorus, and 40.5 tons/yr of sediment. See Figure 11.

Figure 11 – Potential Site-Specific WASCBs, Grade Control/Riffles



4.2.2 Basin-Wide Best Management Practices

Basin-wide BMPs are those practices or management measures that can be applied throughout the watershed or to a field as a whole where exact locations may be unknown or where locations may not have been specifically verified through a site visit. In the case of Big/Long Creek, the majority of basin-wide practices were first screened using the SWAT model and verified in the field and by an interpretation of aerial imagery. As a result, many of the basin-wide practices were verified in the field however, a more detailed site investigation is still needed.

Basin-wide practices include cover crops, bio reactors, perennial crop conversion, saturated buffers, nutrient management, and drainage water management. Basin-wide BMP recommendations cover 63,862 acres in the watershed. It is important to note that many of these practices overlap with each other, such as cover crops and drainage water management and therefore, these BMPs result in coverage of over 100% of the basins' crop ground. Table 7 provides a summary of total watershed loading and expected load reductions compared against load reduction targets. Table 8 summarizes total loading, load reductions and percent reductions by subbasin; Tier 1 critical subbasins are highlighted in red. If all basin-wide practices are implemented, they will result in annual nitrogen reductions of 385,038 lbs (12.8 lbs/ac), annual phosphorus reductions of 31,125 lbs (1 lbs/ac), and annual sediment reductions of 8,328 tons (0.28 tons/ac). These basin-wide practices will exceed the nitrogen target, achieve the phosphorus target and exceed the sediment target.

Table 7 - Basin-Wide Load Reduction Summary & Reduction Targets

Total Nitrogen Load (lbs/yr)	799,948	**Total Phosphorus Load (lbs/yr)**	42,120	**Total Sediment Load (tons/yr)**	15,669
Nitrogen Load Reduction (lbs/yr)	385,038	**Phosphorus Load Reduction (lbs/yr)**	31,125	**Sediment Load Reduction (tons/yr)**	8,328
Nitrogen Reduction Target	28%	**Phosphorus Reduction Target**	74%	**Sediment Reduction Target**	50%
Reduction % Achieved	48%	**Reduction % Achieved**	74%	**Reduction % Achieved**	53%

Table 8 - Basin-Wide Load Reductions by Subbasin

Subbasin Number	Subbasin N Load (lbs/yr)	Subbasin P Load (lbs/yr)	Subbasin Sediment Load (tons/yr)	BMP N Load Reduction (lbs/yr)	BMP P Load Reduction (lbs/yr)	BMP Sediment Load Reduction (tons/yr)	% Reduction N	% Reduction P	% Reduction Sediment
1	22,355	825	259	10,009	551	120	45%	67%	46%
2	**58,094**	**2,431**	**822**	**32,059**	**1,916**	**474**	**55%**	**79%**	**58%**
3	**73,979**	**4,399**	**1,796**	**43,774**	**4,173**	**1,334**	**59%**	**95%**	**74%**
4	19,068	735	240	10,322	607	140	54%	83%	58%
5	49,166	1,884	611	22,002	1,281	265	45%	68%	43%
6	**3,899**	**255**	**113**	**2,189**	**200**	**61**	**56%**	**78%**	**54%**
7	16,102	593	187	8,228	407	78	51%	69%	42%
8	15,635	619	207	7,210	411	83	46%	66%	40%
9	**43,618**	**2,294**	**811**	**19,001**	**1,475**	**370**	**44%**	**64%**	**46%**
10	**45,397**	**4,218**	**1,860**	**19,102**	**3,198**	**1,010**	**42%**	**76%**	**54%**
11	3.06	0.35	0.01	0	0	0	0%	0%	0%
12	**11,982**	**1,329**	**540**	**2,206**	**763**	**206**	**18%**	**57%**	**38%**
13	8,583	515	209	3,648	423	122	43%	82%	58%
14	20,907	899	311	11,397	694	173	55%	77%	56%
15	15,734	732	257	7,089	494	115	45%	67%	45%
16	2,355	185	81	988	171	59	42%	92%	73%
17	8,035	534	224	3,785	534	181	47%	100%	81%
18	17,190	762	269	8,522	607	160	50%	80%	59%
19	**25,800**	**1,694**	**709**	**11,240**	**1,367**	**406**	**44%**	**81%**	**57%**
20	**12,862**	**817**	**313**	**5,049**	**460**	**95**	**39%**	**56%**	**30%**
21	4,938	391	123	1,494	196	52	30%	50%	42%
22	10,202	887	274	2,728	411	106	27%	46%	39%
23	1,412	178	27	59	22	4	4%	12%	13%
24	**11,787**	**891**	**348**	**3,649**	**491**	**121**	**31%**	**55%**	**35%**
25	**51,633**	**2,664**	**1,016**	**26,487**	**2,211**	**639**	**51%**	**83%**	**63%**
26	**11,160**	**801**	**344**	**4,418**	**682**	**217**	**40%**	**85%**	**63%**
27	**13,394**	**830**	**330**	**5,562**	**711**	**224**	**42%**	**86%**	**68%**
28	15,851	636	214	7,517	422	88	47%	66%	41%
29	**47,766**	**2,629**	**993**	**21,251**	**1,610**	**367**	**44%**	**61%**	**37%**
30	20,152	848	320	10,732	589	143	53%	69%	45%
31	**25,079**	**1,400**	**549**	**11,935**	**1,268**	**387**	**48%**	**91%**	**71%**
32	17,952	686	221	10,136	452	88	56%	66%	40%
33	1,151	81	40	629	72	27	55%	89%	67%
34	**42,818**	**1,648**	**536**	**21,706**	**1,119**	**227**	**51%**	**68%**	**42%**
35	53,887	1,829	537	28,914	1,132	187	54%	62%	35%
Total	**799,948**	**42,120**	**15,694**	**385,038**	**31,125**	**8,328**	**48%**	**74%**	**53%**

Drainage Water Management

Drainage water management (DWM) also known as controlled drainage is the practice of managing water table depths in such a way that nutrient transport from agricultural tile drains is reduced during the fallow season and plant water availability is maintained during the growing season. In Big/Long Creek, DWM can be applied to treat 12,028 acres or 241 systems. If fully implemented, these practices will reduce annual load of 69,831 lbs of nitrogen and 54.6 lbs of phosphorus. This practice will not result in any reductions in sediment load. See Figure 12.

Saturated Buffers

A saturated buffer is one of the new emerging BMPs in which drainage water is diverted as shallow groundwater flow through a riparian buffer for nitrate removal. A saturated buffer system can treat approximately 40 acres and consists of a control structure for diversion of drainage water from the outlet to a lateral distribution line that runs parallel to the buffer. Only areas draining directly adjacent to a stream or existing grass buffer were chosen for the placement of saturated buffers, and in Big/Long Creek, this represents a treatment area of 3,413 acres or 85 systems with an average buffer size of 0.5 acres. If fully implemented, these practices will result in annual load reductions of 27,391 lbs of nitrogen, 5,055 lbs of phosphorus, and 2,499 tons of sediment. See Figure 13.

Nutrient Management

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 each 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":

- 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.

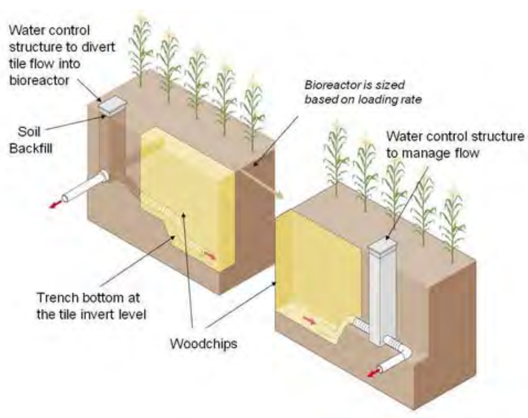
In Big/Long Creek, nutrient management can be applied to 23,672 acres and, if implemented on these acres, will reduce annual nitrogen loads by 51,561 lbs and annual phosphorus loads by 14,809 lbs. No reductions in sediment load are expected with this practice. See Figure 14.

Cover Crops/Tillage Management

The flat topography and productive crop land in the Big/Long Creek watershed reduces the feasibility of structural practices such as grassed waterways or sediment basins. Cover crops and modifications to current tillage practices offer realistic options for limiting soil and nutrient loss in such areas. For cover crops, the cost of seeds and planting may be at least partially offset by tangible and intangible benefits to the farm operation including reduction in nutrient loss and improvement of soil tilth. The willingness of producers to adopt cover crops and reduced tillage options is likely to depend in large part on how they see these practices fitting into their overall farming operation. Cover crop scenarios, including the economics and optimization of cereal rye, annual rye grass, and crimson clover, are described and analyzed in more detail in the ISWS report *Decision Support Model for Generating Optimal Alternative Scenarios of Watershed Best Management Practices.*

Before cover crops can be implemented on many fields, a shift in tillage management must occur. Basin-wide cover crops are recommended for all fields without no-till or those fields where a shift in tillage practices will have benefits. In Big/Long Creek, tillage management and cover crops are recommended on 21,634 acres or those farmed acres that are not currently practicing no-till or are currently in a USDA program and assumed to be implementing some type of nutrient management. If implemented, these practices will result in annual reductions of 214,195 lbs nitrogen, 10,514 lbs phosphorus, and 5,519 tons of sediment. These numbers reflect current conventional/reduced tillage practices and represent the combined reductions resulting from both a change in tillage (strip-till/no-till) and the application of cover crops. See Figure 15.

Denitrifying Bioreactor



A denitrifying 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 will treat approximately 50 acres. 46 basin-wide bioreactors can be applied in Big & Long Creek; these bioreactors will treat 2,289 acres.

Load reductions expected, if all sites are implemented are 13,285 lbs/year of nitrogen, and 5.2 lbs/year of phosphorus. No reductions in sediment load are expected from this practice. See Figure 16.

Figure 12 – Potential Basin-Wide Drainage Water management

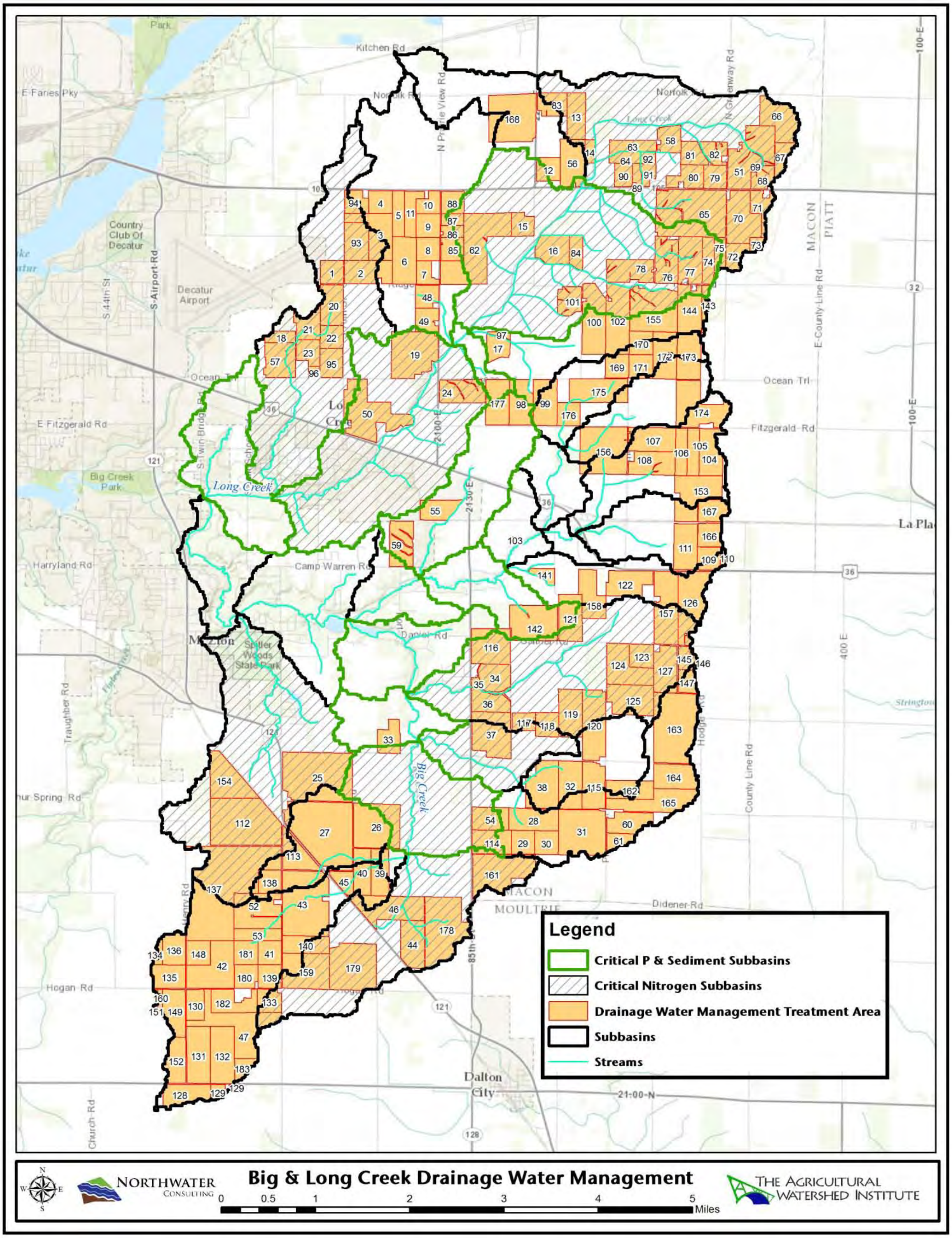


Figure 13 – Potential Basin-Wide Saturated Buffers

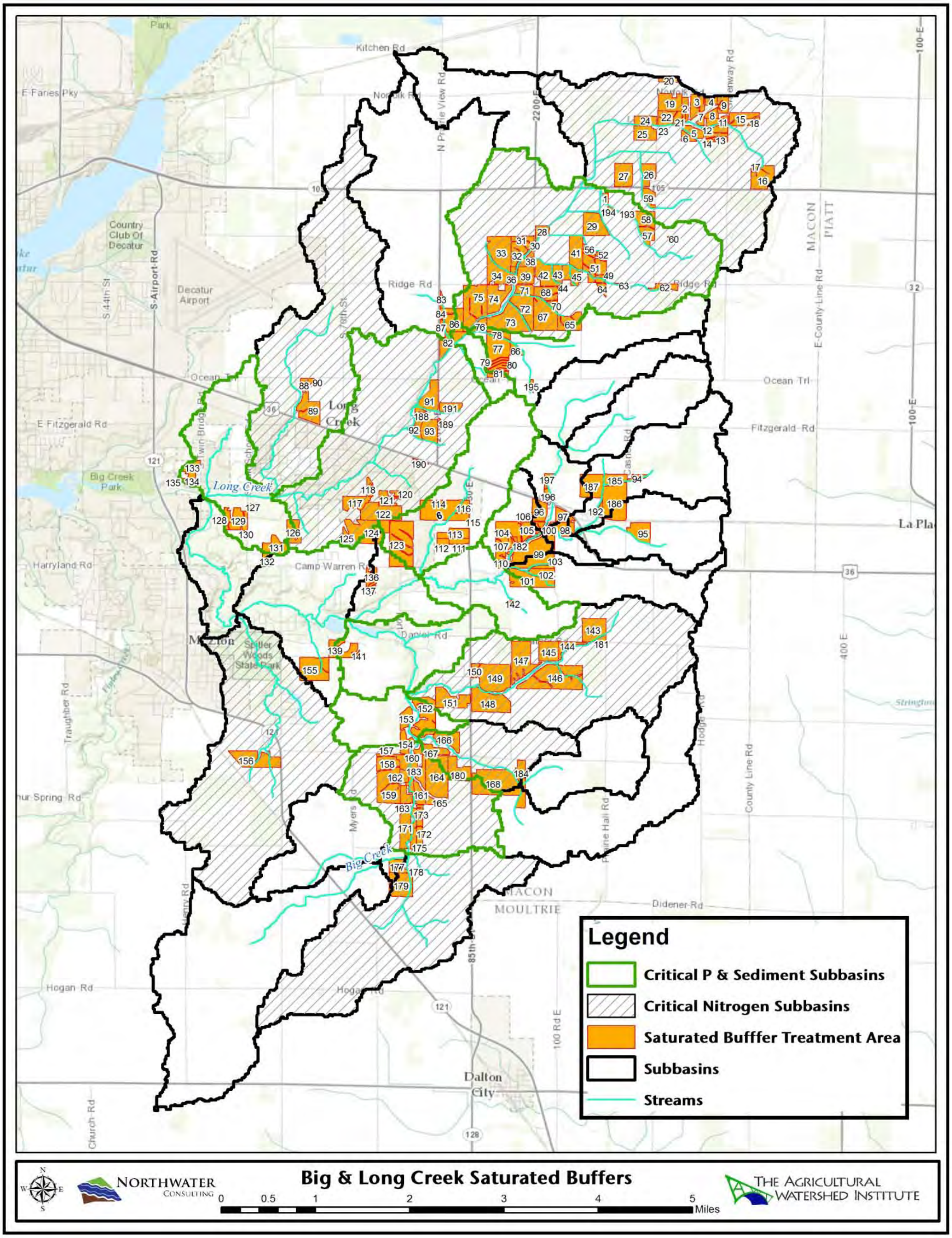


Figure 14 – Potential Basin-Wide Nutrient Management

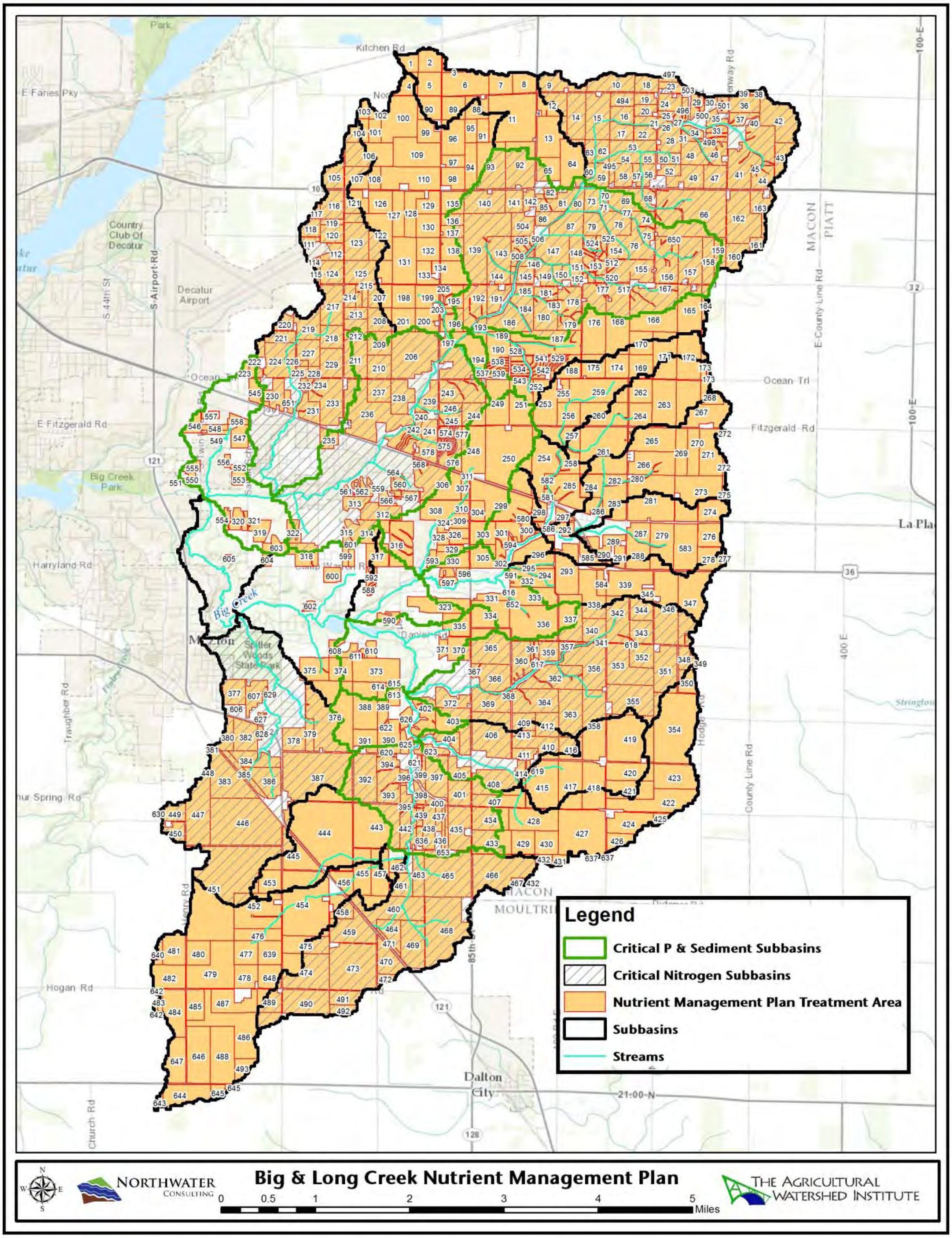


Figure 15 – Potential Basin-Wide Cover Crops/Tillage Management

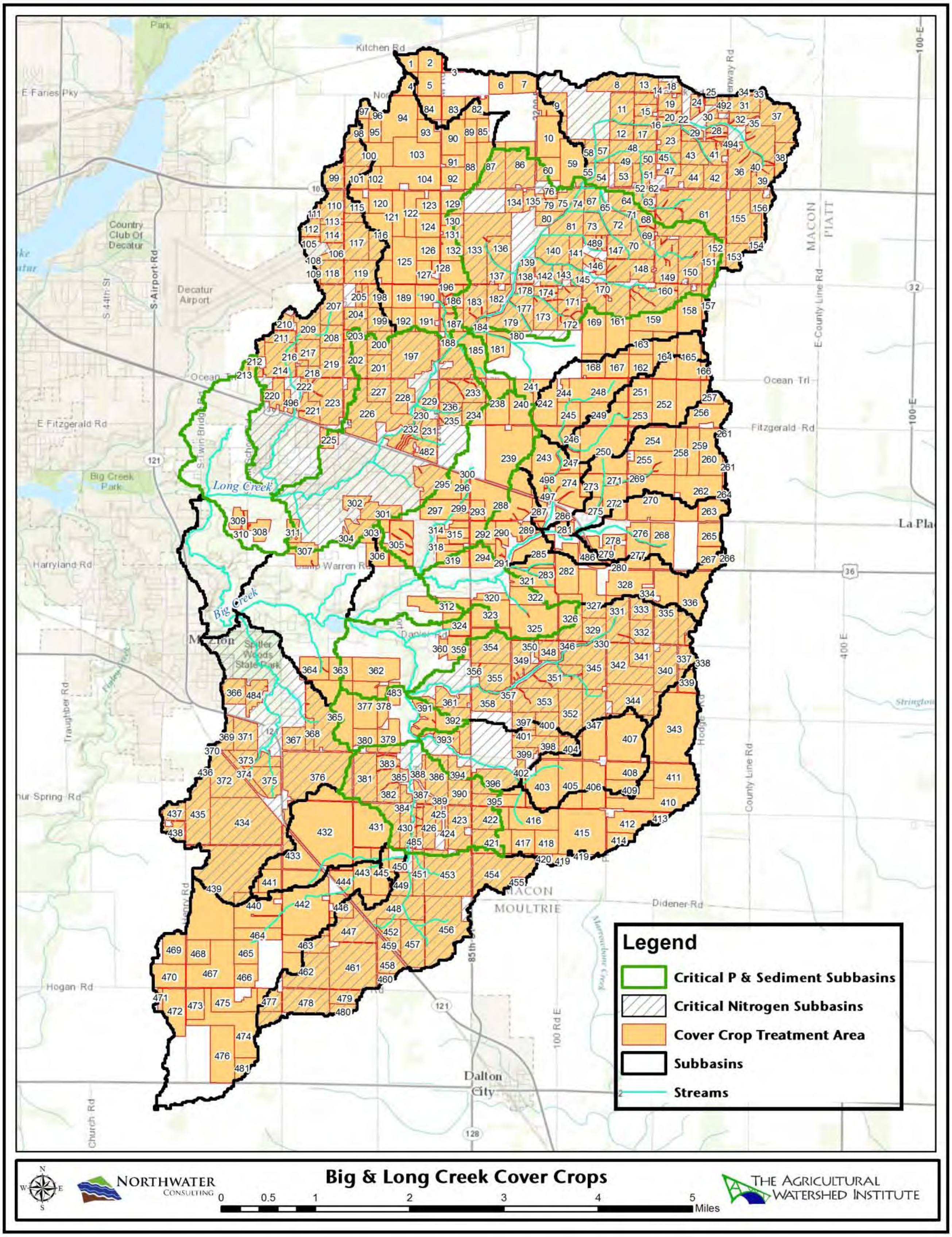
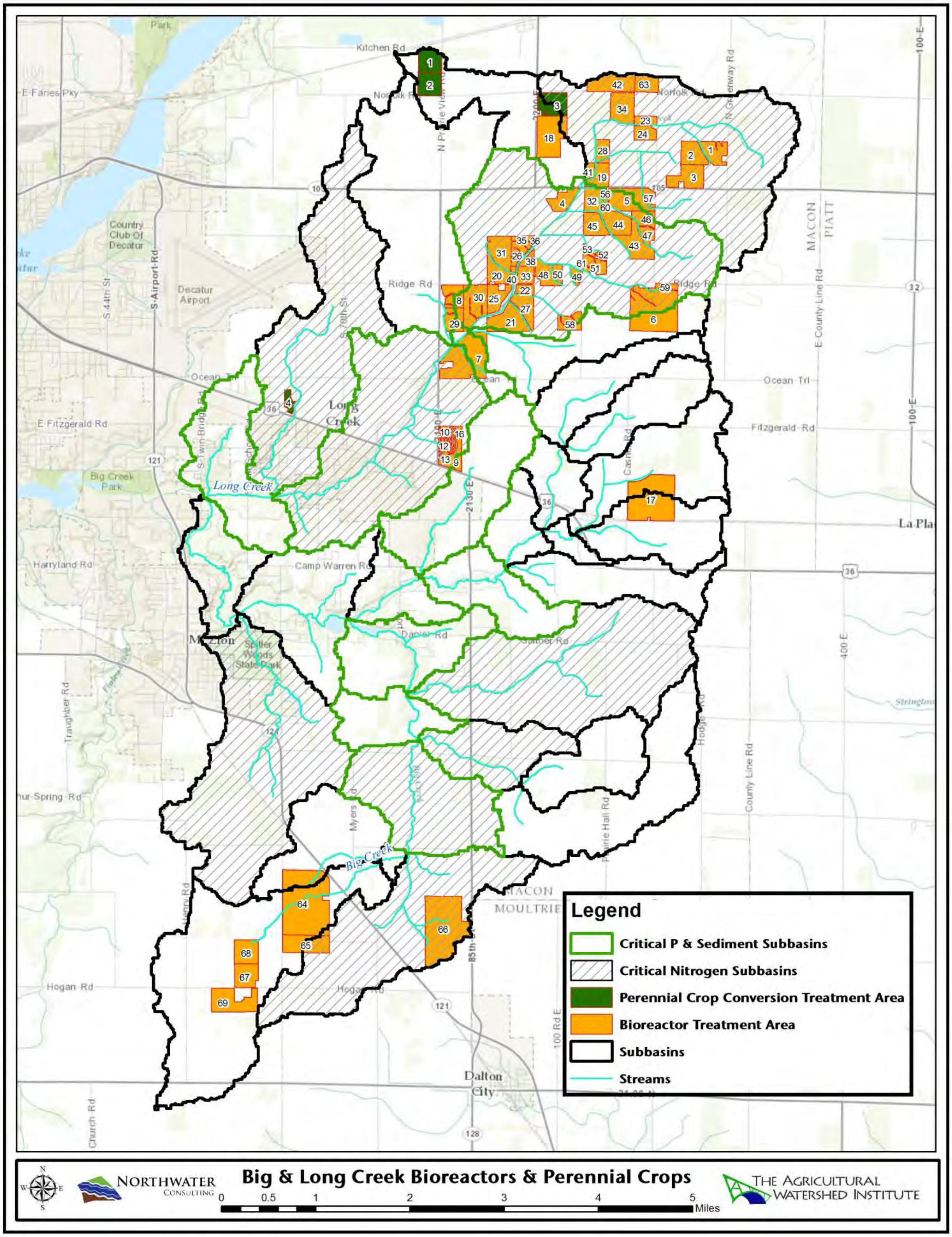


Figure 16 – Potential Basin-Wide Bioreactors & Perennial Crop Conversion



Perennial Grass Conversion

Conversion of cropland from annual row crops to perennial grasses can significantly reduce nutrient losses. Rather than considering new crops as a BMP, this type of cropland conversion and the potential nutrient loss reduction are discussed separately in Section 4.3. A few potential sites for perennial grass conversion are shown in Figures 4 and 16. If bioenergy or forage markets are developed for perennial grass crops, the converted acreage may be significantly larger than the examples shown in those figures.

Saturated Buffers OR Denitrifying Bioreactors

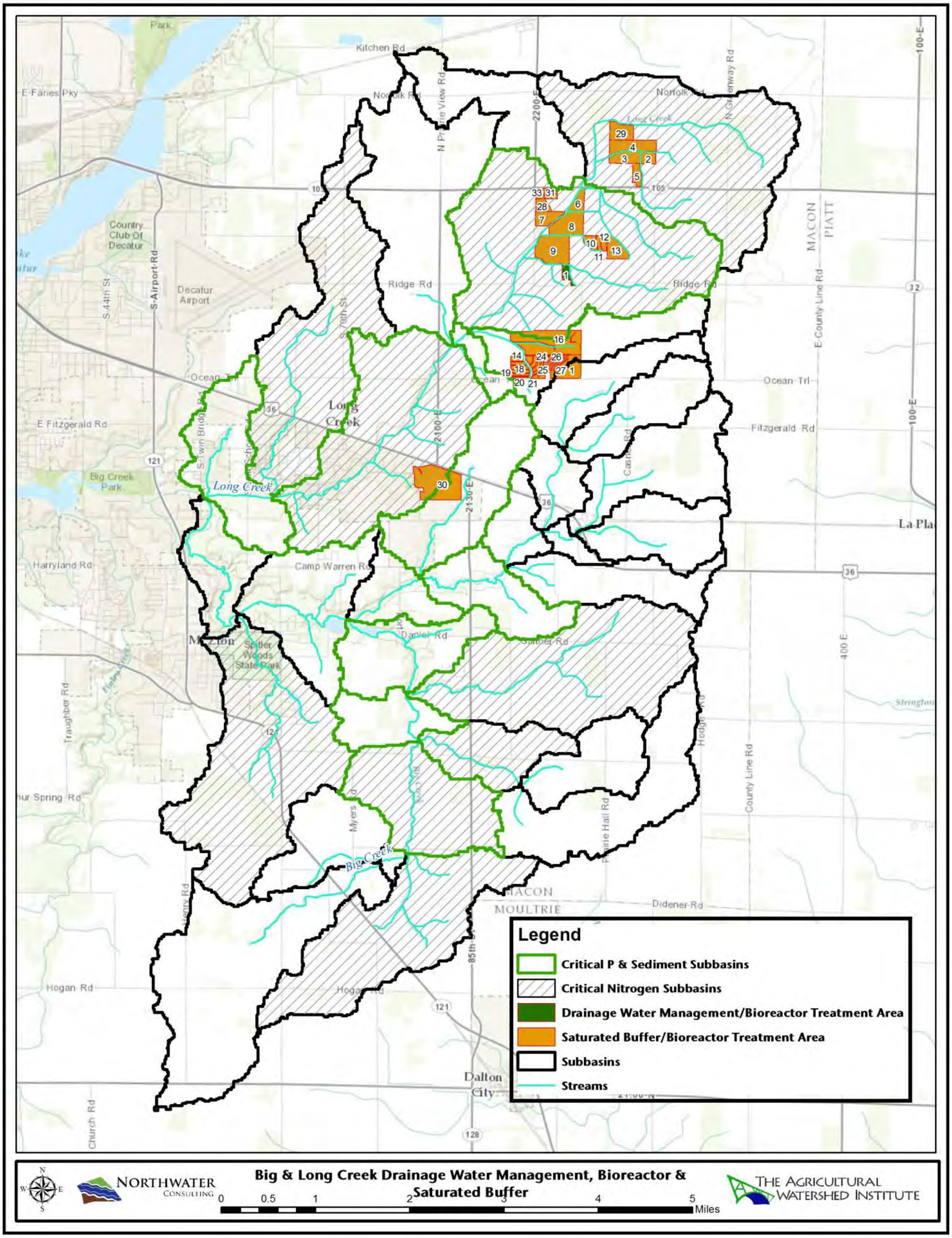
Numerous basin-wide sites in the watershed are likely appropriate for saturated buffers, denitrifying bioreactors, or both. In these cases, a detailed site assessment and negotiation with the landowner is needed prior to the selection of the most appropriate BMP or combination thereof. Both saturated buffers and bioreactors are recommended for 680 acres or 17 saturated buffer systems and 14 bioreactors. If implemented, these practices will result in annual load reductions of 6,072 lbs nitrogen, 589 lbs of phosphorus, and 252 tons sediment. It is important to note that only installing bioreactors will not result in any reductions in sediment and only a minimal reduction in phosphorus. See Figure 17.

Denitrifying Bioreactor OR Drainage Water Management

A denitrifying bioreactor is a structure containing a carbon source, installed to reduce the concentration of nitrate nitrogen in subsurface agricultural drainage flow via enhanced denitrification. Drainage water management (DWM) also known as controlled drainage is the practice of managing water table depths in such a way that nutrient transport from agricultural tile drains is reduced during the fallow season and plant water availability is maintained during the growing season.

One basin-wide site in the watershed are likely appropriate for both DWM and denitrifying bioreactors. In this case, a detailed site assessment and negotiation with the landowner is needed prior to the selection of the most appropriate BMP or combination thereof. Both DWM and bioreactors are recommended for 9 acres or 1 system. If implemented, these practices will result in annual load reductions of 52 lbs nitrogen and 0.04 lbs phosphorus. No reductions in sediment load will be realized through the installation of these practices. See Figure 17.

Figure 17 – Potential Basin-Wide Saturated Buffer/Bioreactor & Drainage Water Management/Bioreactor



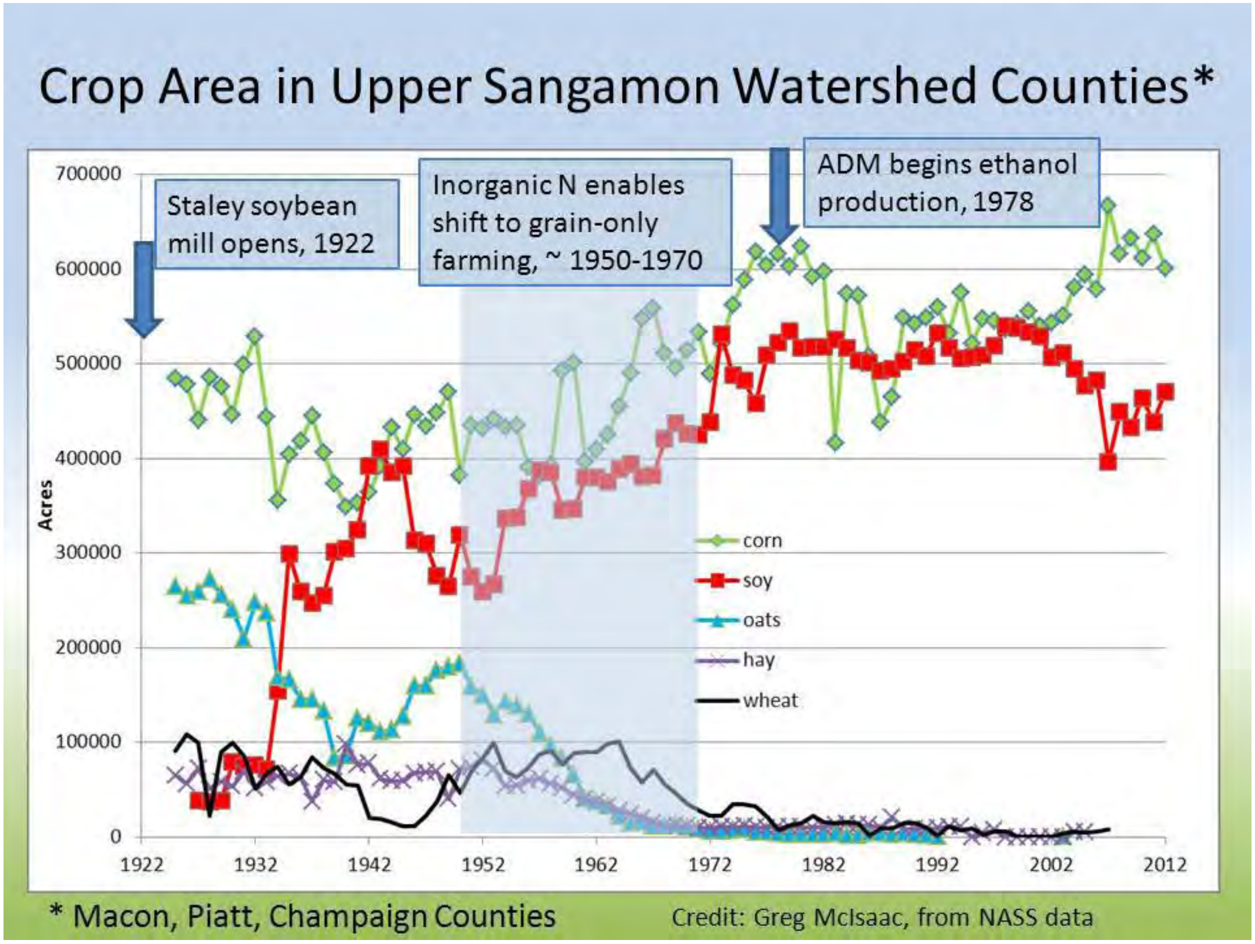
4.3 Cropping System Changes & Expected Load Reduction

In addition to the BMPs discussed in the previous section, nutrient and sediment loads may be reduced through conversion of land in agricultural production from annual row crops to perennial biomass crops, including grasses or legumes grown for forage or bioenergy/bioproduct feedstock. Converting land from annual row crops to perennial crops has been shown to dramatically reduce runoff, erosion and nutrient losses. The amount of reduction depends upon factors such as slope, slope length, soil characteristics and the practices used. On sloping land, the largest reductions in sediment and phosphorus loss are likely to occur where soil and phosphorus losses from row crops are large. Thus, converting highly erodible land (HEL) from row crop production to perennial crops is likely to provide greater reductions in sediment and phosphorus loss than converting non-HEL acres. Furthermore, recent research in Iowa has shown that strategically converting 10% of row cropped areas to perennials reduced edge-of-field sediment loss by 96% and phosphorus losses in surface runoff by 90%. This research was conducted on slopes ranging from 6 to 10.5%. Smaller reductions are expected on milder slopes, which are more common in the Big/Long Creek watershed. But the mechanism of reducing sediment and phosphorus delivery by reducing the amount and speed of runoff is expected to provide nutrient and sediment retention at milder slopes. The amount retained will depend on the specific characteristics of the fields and could be measured or estimated as described below. Estimates of statewide nitrate-N reductions from two land use conversion scenarios were included in the Science Assessment to Support an Illinois Nutrient Reduction Strategy.

For TMDL planning purposes, a target of 10% of farmland acres converted from annual crops to perennial crops is proposed. In order for a shift of that magnitude from annual to perennial crops to occur, markets for perennial crops will need to increase very significantly and, almost certainly, policies to incentivize the ecosystem services associated with perennial crops will need to be in place. Market and policy considerations are discussed in subsequent sections of this plan.

As historical context, for a 10% land use change target, Figure 18 illustrates changes in crop area since the 1920s in the three counties that include most of the Lake Decatur watershed; Macon, Piatt and Champaign. In the 1920s, Central Illinois farms produced corn, small grains, and livestock. Through the 1930s and 1940s, soybean acreage increased and small grains began to decline but hay acres held steady at around 7-8% of total crop acres. The period from 1950 to 1970 saw a major shift in Midwestern agriculture as the availability of inexpensive inorganic nitrogen fertilizer helped to bring about a transition from mixed grain-livestock operations to grain-only farming in prime row crop areas such as Central Illinois. During that period, hay acres dropped to less than 1% of total crop acres and that remains the case today. The acreage shown in Figure 18 does not include pasture, which if added to hayed acreage, could bring the total acres that were in perennial forage before 1960 to more than 10% of farmland.

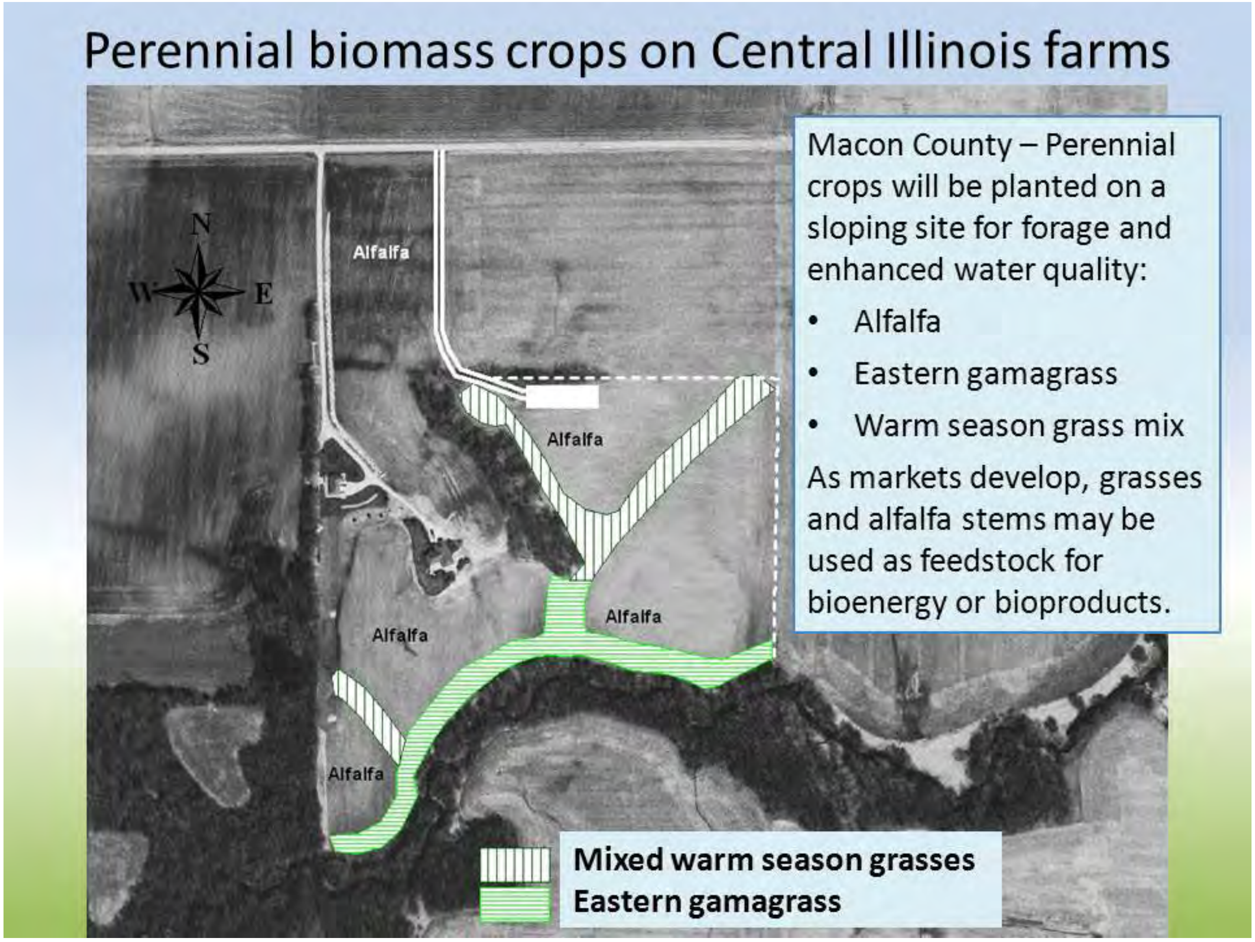
Figure 18 – Historical Crop Acreage in Upper Sangamon Watershed Counties



Projections of land use conversion that may be driven by ramping up production of cellulosic biofuels or a shift to more grass-fed beef are highly dependent on the assumptions built into the scenarios, including policy and economic assumptions. Regional economic studies of bioenergy scenarios generally conclude that corn stover will be the main cellulosic biomass feedstock produced in intensive corn-soybean growing areas. However, such analyses typically do not place a value on the ecosystem services including clean water, fish and wildlife habitat, and soil carbon sequestration associated with perennial biomass crops. The shift from fossil fuels to renewables and policies to promote climate change mitigation and adaptation may be drivers of agricultural land use change over the next 20-years comparable in scale to the change that occurred between 1950 and 1970.

As discussed further in the following sections, the Upper Sangamon/Lake Decatur watershed is beginning to function as an experimental watershed, sometimes called a “landlab”, for on-farm research and demonstrations of coproduction of harvestable biomass and ecosystem services. An example of a demonstration site planted on a farm in the Lake Decatur watershed in the spring of 2014 is shown in Figure 19.

Figure 19 – Example of Perennial Forage and Bioenergy Crops to Enhance Water Quality



Statewide estimates of nitrate-N and phosphorus reductions were included in the Science Assessment report for two land use change scenarios:

- Putting cropland that was converted to row crops from pasture/hay from 1987 through 2007 into perennial crops and
- Converting 10% of tile-drained land to perennials.

In both of these scenarios, the reduction in nitrate-N and phosphorus losses for land converted from annual crops to perennial crops was estimated to be 90% for the actual converted acres.

Alfalfa and cool season forage crops can generally be harvested or grazed in the year they are first planted and produce a stand that persists for a number of years. The establishment period for warm season grasses is typically two or three years. Once well established, perennial biomass crops generally do not require spring field operations for tillage, planting, or pest management. Some perennial crops can tolerate periods of saturated soils or ponding. The reduced need for drainage to ensure trafficability for farm equipment and an unsaturated root zone makes it feasible to grow wetness-tolerant perennial crops in poorly drained areas that are marginal for corn and soybean production. It may also be feasible to modify drainage systems to saturate the soil with tile flow containing nitrate, thus creating in effect a harvestable saturated buffer or harvestable seasonal wetland. In some circumstances, land converted to perennial crops may also serve to reduce nutrient and sediment losses from land draining across the converted acres.

In flat and low lying areas that periodically experience saturation and/or ponding, converting row crops to perennial crops that tolerate saturated conditions may provide substantial reductions in nitrate loss, if these areas can be managed to function like a wetland during wet periods. Further nutrient removal could occur if and when the perennial crop was harvested. Converting 5% of a watershed to wetlands treating tile drainage water has been show to remove about 40% of the nitrate on average.

Constructing a wetland to receive tile water generally requires considerable earthmoving. An alternative approach would be to install drainage water control structures and additional tile to redirect drainage waters to a portion of a field where saturation tolerant perennial crops were being grown. The saturated conditions in the soil would remove nitrate nitrogen through denitrification. In some years, the perennial crop may benefit from having access to additional water and nutrients. This is essentially extending the saturated buffer concept to subirrigate the low lying portion of a field.

At this time, our estimates of the nutrient reduction potential of these scenarios for strategically located perennial crops and drainage system modifications are based expert judgment and the similarity of the practices to practices for which there is a research based consensus on expected nutrient loss reductions. In each of these scenarios, perennial crops can not only reduce nutrient losses from the actual converted acres but can also reduce losses from acres that drain across the land converted to perennials. We propose that the following nutrient reduction estimates be used until more information is available about these practices.

1) **Contour strips and toe-slope buffers:** We estimate that strategically locating perennial crops as contour buffer strips or toe slope buffers on 10% of HEL land could reduce sediment and phosphorus losses by 50%. This is the approach being studied in Iowa in the STRIPS project (Science-based Trials of Row crops Integrated with Prairie Strips) where reductions of 90% have been measured on steeper slopes. We expect less reduction on the milder slopes in the Big/Long Creek watershed. There are 1,892 acres of cropped HEL land in Big/Long Creek watershed, as shown in Figure 20. Average annual phosphorus loss is 5.32 lbs/ac and sediment loss is 2.64 tons/ac from this HEL land, based on modeled results. Using 50% reduction from 1,892 treated acres, estimated load reductions from conversion of 189 acres of row crops to perennial biomass crops in contour strips or toe slope buffers are 5,032 lbs/yr of phosphorus and 2,497 tons/yr of sediment.
2) **Harvested seasonal wetlands:** Converting row crops to tile fed wetlands planted to saturation tolerant perennial crops on 5% of acres may reduce nitrate losses from the tile drained area by 40%. This is a potential alternative to constructed wetlands, which could treat 11,340 acres in Big/Long Creek watershed. We assume that designing the wetland to allow harvesting of perennial crops may reduce the residence time of the water in the wetland and thus reduce the nitrate removal percentage, but uptake of nitrate by the vegetation and removal in harvesting would provide some nitrate removal that does not occur in constructed wetlands that are not harvested. Consequently the 40% reduction is approximately equal to the expected reduction from constructed wetlands. Using 40% reduction from 11,340 treated acres with an average annual

nitrate-N loss of 27 lbs/ac, estimated load reduction from conversion of 567 acres of row crops to harvestable seasonal wetlands is 122,472 lbs/yr of nitrogen.

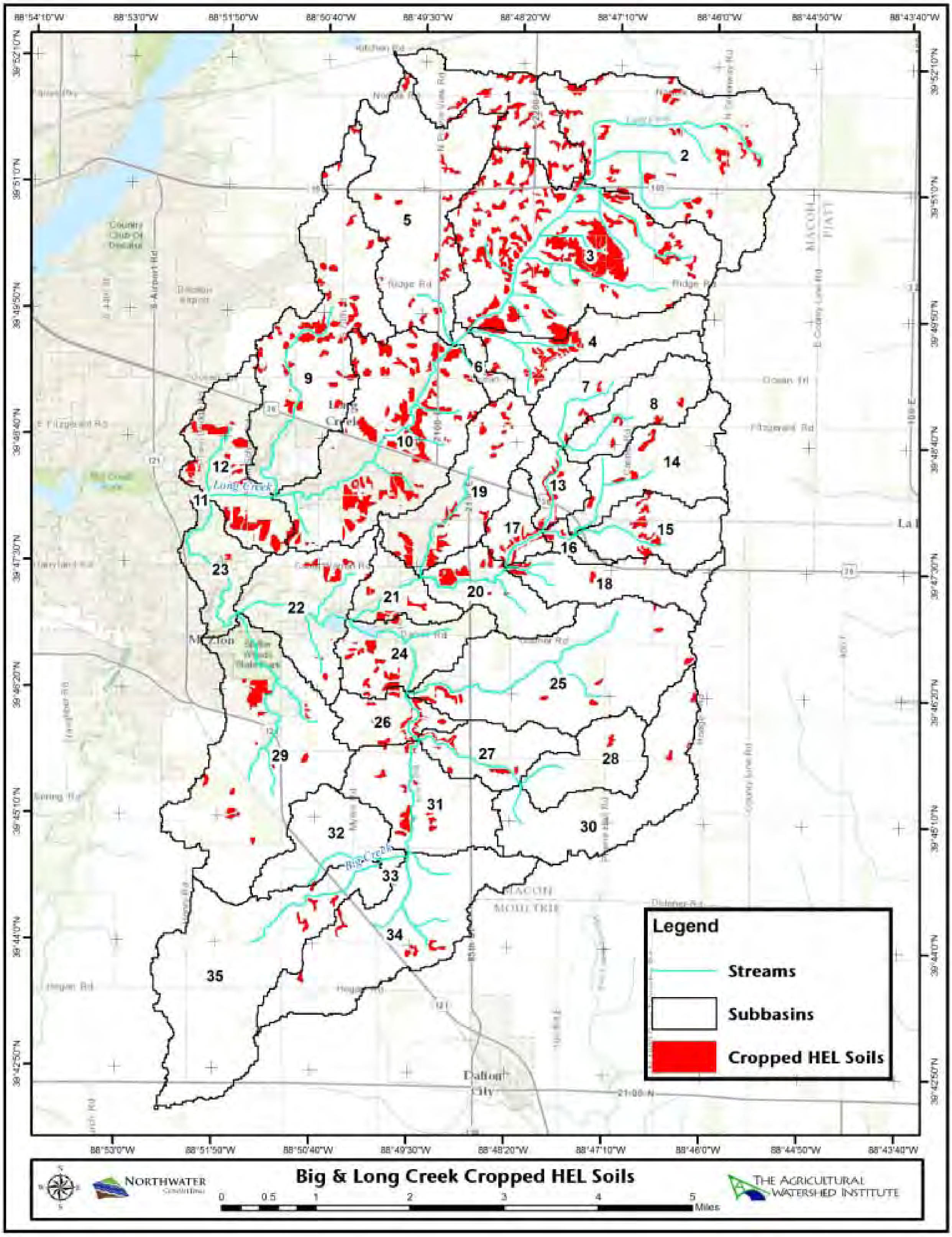
3) **Harvested saturated buffers or hillslopes:** Redirecting tile water to saturate/subirrigate the lower 5% of a field where perennial crops are grown may reduce nitrate loss from the tile drained area by 20%. We assumed this practice would be half as effective as a constructed wetland because it would involve less saturation and less residence time. In effect, this would extend the saturated buffer concept beyond buffers into cropped acres on slopes or at the toe of slope. Drainage control structures and the buried "water gate" technology could be used to maintain saturated soil conditions conducive to denitrification and plant uptake of nitrate for much of the spring. Where drainage tile layouts are suitable, such systems could be installed in the same contour or toe-slope buffers described in the first scenario for phosphorus load reduction. In that case, this scenario would not represent any additional converted acres. No estimate of N load reduction was made for this scenario.

These strategically located conversions to perennial crops total 756 acres and treat surface runoff or subsurface tile flow from a total of 13,232 acres. These nutrient loss reduction estimates will be updated as more information about their performance in the peer reviewed scientific literature becomes available. Depending on the availability of funds for monitoring and research, estimates may be refined based on application of models such as RUSLEII and SWAT, or monitoring of similar fields with and without these practices. Measuring sediment and nutrient losses from fields would provide valuable information about the effectiveness of strategic location of perennial crops at a cost of approximately $60,000 per year for monitoring three or four fields.

If future ramp-up of perennial bioenergy does result in 10% overall land conversion from row crops to perennial bioenergy crops, additional conversion will take place on land other than the treatment areas described in the above scenarios. Other crop acreage in Big/Long Creek watershed is 15,839 acres with average annual losses of 32.31 lbs/ac of nitrogen, 1.38 lbs/ac of phosphorus and 0.50 tons/ac of sediment. Assuming 10% conversion of this land to perennial crops and 90% load reduction for each parameter, this would result in 1,584 acres converted to perennials and annual load reductions of 46,063 lbs of nitrogen, 1,964 lbs of phosphorus, and 713 tons of sediment.

Figure 20 shows the extent of HEL ground in the watershed. Soils shown include both cropped HEL and cropped Predominantly HEL (PHEL) soils. PHEL are soils that can be either HEL or non HEL depending on site specifics. Ten Illinois counties were given special approval in 1997 to allow planning on soils for a conservation planning Alternative Cropping System (ACS). These soils when HEL, could be planned for up to two times the tolerable soil loss and meet the ACS. Two to four times the tolerable soil loss could be used for planning with an ACS if approved by the State Conservationist. Slope lengths can vary widely within a specific soil type and therefore special provision was made to allow PHEL soil map units to use minimal tillage after soybeans, and still meet the ACS level of treatment.

Figure 20 – Cropped Highly Erodible Land (HEL) in Big/Long Creek Watershed



5.0 Costs & Technical Assistance

Assumptions and estimates used in developing planning-stage BMP costs are as follows:

- Wetlands average cost per acre estimated at $10,500/acre with a 20:1 ratio of wetland to treated area. This ratio is for a tile-fed wetland only. If surface water flows through the wetland a smaller ratio should be used. This average cost is based on actual projects in McLean County.

- Grassed Waterways average cost per/acre is estimated to be $3,250/acre, including seeding and fertilizing. This cost is based upon area contractor prices and the NRCS unit price. The primary purpose is to prevent ephemeral gulley erosion and also to trap sediment from adjacent crop fields.

- Stream Bank Stabilization is estimated to cost $40/ft based on assuming approximately 0.75/tons per lineal foot of stream bank and/or weir, at approximately $53/ton placed.

- Saturated Buffers are estimated to cost approximately $4,000 per installation, including 1000' of 4" plastic drain tile, control structure, and design. This cost is based on area contractor prices and cost reported by the Agricultural Drainage Management Coalition (ADMC). The analysis of cost and load reductions assumed such a saturated buffer would treat an area of 40 acres.

- Wood Chip 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/cubic yard NRCS cost estimate, is based on input from a local drainage contractor who has installed several bioreactors. 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.

- Field Border/Filter Strip minimum width is 30' at an estimated establishment cost of about $500/acre, including seed bed preparation, seed, nurse crop, and all required fertilizers. The NRCS cost share basis appears to be fairly accurate for this practice. The ratio of treated area to filter strip area is assumed to be ratio 125:1. If a native and/or pollinator seed mix is used, the establishment costs could be about $660/acre.

- Nutrient Management Plan cost is estimated to be $16.65 an acre, based on the NRCS cost share doc.

- Drainage Water Management was estimated to cost $161.60 per acre for installation to retrofit an existing tile system, using the estimate presented in the ISWS Decision Support Model report. Costs for including DWM in a drainage system would be expected to be at least 15% lower than for retrofit.

- Cover Crops were estimated to cost $70/acre for a two variety mixture, subject to significant variability based on seed varieties and establishment practices.

BMP costs estimates and load reductions are presented in Table 9 for site-specific BMPs and Table 10 for basin-wide BMPs. Estimated load reductions are presented in Table 11 for conversion of row crops to perennial crops. No cost estimates were developed for conversion of row crops to perennial crops.

Table 9 - Site-Specific BMP Cost Estimates & Load Reductions

Best Management Practice	BMP Drainage/ Treatment Area (Acres)	Total Cost	Nitrogen Load Reduction (lbs/yr)	Phosphorus Load Reduction (lbs/yr)	Sediment Load Reduction (tons/yr)	Cost/lb Nitrogen Reduction	Cost/lb Phosphorus Reduction	Cost/ton Sediment Reduction
Edge of Field BMP								
Constructed Wetland	11,340	$7,938,294	112,850	6,111	3,699	$70	$1,299	$2,146
Grassed Waterway	6,689	$217,394	60,763	5,250	3,245	$3.58	$41	$67
WASCB	87	$22,500	473	94	40	$48	$239	$556
Rock Riffle	N/A	$8,000	195	121	83	$41	$66	$96
Pond	685	$105,000	3,476	283	150	$30	$371	$670
Grade Control Structure	378	$60,000	152.92	15	95	$392	$3,986	$633
Filter Strip	827	$3,307	9,443	1,337	774	$0.35	$2.47	$4.27
Field Border	34	$137	272	22	10	$0.50	$6.23	$14
Bioreactor	1,537	$230,566	8,701	3.40	0	$27	$67,837	N/A
Two-Stage Ditch	17,451	$2,428,538	163	7.41	2.23	$14,874	$327,614	$1,087,258
Streambank Stabilization	N/A	$124,920	797	478	398	$157	$261	$314
In Field BMP								
Cover Crop	813.58	$56,951	7,561	200	68	$7.53	$284.26	$836
Total	**39,842**	**$11,195,608**	**204,846**	**13,922**	**8,565**	**$55 (avg)**	**$804 (avg)**	**$1,307 (avg)**

Table 10 – Basin-Wide BMP Cost Estimates & Load Reductions

Best Management Practice	BMP Drainage/ Treatment Area (Acres)	Total Cost	Nitrogen Load Reduction (lbs/yr)	Phosphorus Load Reduction (lbs/yr)	Sediment Load Reduction (tons/yr)	Cost/lb Nitrogen Reduction	Cost/lb Phosphorus Reduction	Cost/ton sediment Reduction
Edge of Field BMP								
Saturated Buffer	3,413	$341,273	27,392	5,055	2,499	$12	$68	$137
Saturated Buffer/ Bioreactor	680	$102,069	6,072	589	252	$17	$173	$405
Drainage Water Management	12,028	$1,958,205	69,831	54.56	0	$28	$35,894	N/A
Drainage Water Management/ Bioreactor	9.00	$1,464.48	52	0.04	0	$28	$35,969	N/A
Bioreactor	2,289	$343,416	13,285	5.19	0	$26	$66,178	N/A
In Field BMP								
Cover Crop	21,634	$1,514,382	214,195	10,514	5,519	$7.07	$144	$274
Nutrient Management Plan	23,672	$394,132	51,561	14,809	0	$7.64	$27	N/A
Total	**63,726**	**$4,654,941**	**382,387**	**31,026**	**8,370**	**$12 (avg)**	**$150 (avg)**	**$563 (avg)**

Table 11 – Perennial Crop Conversion Load Reductions

Perennial Crop Scenario	Area Converted to Perennials (Acres)	Treated Area (Acres)	Nitrogen Load Reduction (lbs/yr)	Phosphorus Load Reduction (lbs/yr)	Sediment Load Reduction (tons/yr)
Contour strips & buffers	189	1,892	Not estimated	5,032	2,497
Harvested seasonal wetlands	567	11,340	122,472	Not estimated	Not estimated
Other converted areas	1,584	1,584	46,063	1,964	713
Total	**2,340**	**14,816**	**168,535**	**6,996**	**3,210**

6.0 Information & Education

The Macon County SWCD provides education to all landowners and producers in Macon County with the goal being to increase adoption of conservation practices across the landscape. Particular outreach is targeted to the Lake Decatur Watershed, which includes the Big/Long Creek watershed, and at least 12 education events are hosted each year with that particular land base in mind. In recent years, nutrient management and reduced tillage have been the main subjects of targeted education to producers, and will continue to be in the next decade. As new technologies and practices come onboard to address these subjects, the Macon County SWCD will keep producers informed on all the "tools in the toolbox" to achieve conservation objectives. With 87% of the Lake Decatur watershed in row crop agriculture, the majority of education events are targeted to crop producers. But education is still provided to the suburban and urban communities, particularly with regards to what they can do to limit erosion and enhance water quality on their own properties. This type of education includes providing information on storm water management, erosion and sediment control on construction sites, and creating wildlife habitat.

The Macon County SWCD partners with Illinois Department of Agriculture (IDOA) and USDA Natural Resources Conservation Service (NRCS) to promote and put in place nutrient management plans, reduced tillage, and many other soil and nutrient saving practices. Drainage districts can play a large role in improving water quality in the watershed. Drainage districts may have the capability and resources to implement two stage ditches, water management control structures, and bioreactors. Macon County SWCD works with additional partners on specific projects including, for example, the American Farmland Trust (AFT) to promote cover crops.

Farmers and landowners in the area will also have access to cost share programs for BMPs that reduce nutrient losses. A few of the current cost share programs are:

- IDOA Partners for Conservation Fund Program
- IEPA Section 319 Program
- USDA
    - Conservation Reserve Program (CRP)
    - Conservation Reserve Enhancement Program (CREP)
    - Environmental Quality Incentives Program (EQIP)
    - Conservation Stewardship Program (CSP)
    - Regional Conservation Partnership Program

The Heart of the Sangamon Watershed Ecosystem Partnership brings together numerous agencies and stakeholders to share ideas and pursue opportunities to enhance water and soil resources in the Macon County and Piatt County portion of the Lake Decatur watershed. Members of this Partnership include the Macon County SWCD, NRCS, AWI, City of Decatur, University of Illinois Extension, Macon County Conservation District, the Farm Bureaus of Macon and Piatt Counties, Decatur Audubon Society, and Millikin University.

AWI provides information, education, and outreach related to new practices such as bioreactors and saturated buffers and perennial crops managed to provide ecosystem services, especially improved water quality. AWI, in collaboration with University of Illinois, has small plots of bioenergy grasses on the grounds of the Farm Progress Show in Decatur. When the Show is held in Decatur in odd-numbered years, AWI, Energy Biosciences Institute, Illinois Biomass Working Group, and additional sponsors organize an Energy Grass Education Area featuring the plots and educational displays. AWI and partners hold additional education and outreach events related to perennial crops and water quality and speak on this topic at workshops and conferences sponsored by other organizations, including the biennial Illinois Water conference at University of Illinois. A perennial biomass workshop and tour of the AWI—Caterpillar "Prairie for Bioenergy" plots in Decatur was held in 2013 and 2014 and is expected to be an annual event to promote perennial biomass crops for forage, bioenergy, clean water, and wildlife habitat.

A noteworthy partner for education and outreach about perennial crops is Dr. Sarah Taylor Lovell of University of Illinois. Dr. Lovell is the Project Director on a five-year USDA Agriculture and Food Research Initiative (AFRI) grant awarded in 2013 for a project titled "Multifunctional Perennial Cropping Systems (MPCs) for introducing local food and biomass production for small farmers in the Upper Sangamon River Watershed". Dr. Gregory McIsaac, who works part time for AWI, is a co-P.I. on the project. The project description states, in part:

> *Multifunctional Perennial Cropping Systems (MPCs) offer an opportunity to integrate multiple ecosystem services into the landscape, yet farmers lack tools to design, plan, and implement these systems to optimize the benefits. Our overall goal is to develop the information and tools to facilitate the transition to MPCs on "opportunity lands" of farms (lands marginal for conventional crops). These systems will be designed to provide alternative food and biomass products that would improve prosperity for small and medium-sized farms, while also providing ecosystem services such as wildlife habitat, biodiversity, and water quality.*

7.0 Implementation Schedule

The Macon County SWCD has learned over the years working in watersheds that time is needed to educate and implement new practices. During the first five years (2015-2020), it will be the goal to promote in-field nutrient reduction BMPs and to demonstrate innovative practices and cropping systems and assess their economic and environmental outcomes in order to find the needed measures to begin moving land owners and operators in the direction to improve soil health and water quality. This will entail a great deal of educational materials, cost share programs, on-farm research and demonstrations, and related effort throughout the next 20+ years.

In addition to promoting the nutrient management "4Rs", cover crops, and strip and no-till, this initial 5-year period will place an emphasis on efforts to demonstrate and assess innovative strategies to promote adoption of cost-effective nutrient reduction strategies. Once new practices and cropping systems are proven to be successful in the watershed, widespread adoption can happen rapidly. Finding and addressing the factors that cause producers to hold back on implementation of a practice can expedite change over to improved soil health and water quality.

New practices that will be demonstrated include bioreactors, drainage water management, and saturated buffers. Bioreactors, in particular, are cost-effective for reducing nitrate losses through drainage tiles but they are seen as a "hard sell" to agricultural producers and landowners because they confer no discernable benefit on the farm operation. Macon County SWCD is currently working with AWI and the wastewater agencies of Decatur and Chicago on a proposal for the new USDA Regional Conservation Partnership Program (RCPP) to demonstrate technologies such as bioreactors and saturated buffers that could be used in water quality trading and/or the "environmental utility" concept.

To our knowledge, it is not customary, and it may be unprecedented, to include conversion of row crop acreage to perennial crops as a strategy to achieve water quality objectives in TMDL implementation plans. Given the general desirability of increasing renewable energy and specific federal policies for cellulosic biofuels, including an appropriate role for bioenergy from dedicated energy crops, AWI suggests that it is desirable for watershed plans to begin looking more closely at prospects for water quality benefits associated with perennial crops grown for bioenergy, animal feed, and other uses. Over the next five years, AWI will continue to work with local watershed partners; multi-state networks including Green Land Blue Waters (GLBW) and the Midwest Conservation Biomass Alliance (MCBA); and public, private and nonprofit sector stakeholders with an interest in ecosystem services from perennial bioenergy crops.

AWI and partners will also continue to pursue governmental and foundation grants for on-farm research and demonstration projects, including policy experimentation to promote adoption of perennial crops grown for multiple benefits. From our work to date on perennial and cover crops, it appears likely that potential changes to current USDA policies (notably crop insurance and also some Farm Bill conservation and energy programs) could dramatically increase willingness to plant alternative crops and manage these crops to optimize water quality and wildlife benefits. Coproduction of energy biomass and ecosystem services is a topic of great interest to the U.S. Department of Energy (DOE). AWI recently collaborated with scientists from Argonne National Laboratory and University of Illinois to prepare and submit comments in response to DOE's Request for Information on Landscape Design for Sustainable Bioenergy Systems. AWI is an active participant in the GLBW Watershed Initiative, which is now getting underway, and the GLBW Perennial Biomass Initiative, which is still in the formation stage. These GLBW initiatives are intended to be 5 to 20-year efforts to promote transformational change on the landscape toward multifunctional agriculture systems with much more continuous living cover on working lands and much better environmental outcomes.

As noted, a major focus of this Big/Long Creek Watershed TMDL Implementation Plan is to demonstrate and achieve wide adoption of effective practices and cropping systems, including concepts that are either new or not yet widely adopted. Macon County SWCD and AWI will collaboratively pursue intensive efforts regarding high priority practices and cropping systems over the next five growing seasons and will conduct a reassessment of the plan in the year 2020 for purposes of adaptive implementation.

The schedule for implementation of practices and cropping systems to be emphasized during this initial period is:

- **Cover crops, tillage management, and nutrient management:** Promoting these management changes will be a high priority for Macon County SWCD and partners throughout the next five years. The Lake Decatur Watershed Program holds at least twelve education events per year for the watershed, including Big/Long Creeks. The SWCD plans to focus on how landowners and operators can make management changes on their whole field to reduce nutrients and sediment from leaving their fields. Sharing the economic benefits of all three practices is a high priority as well.

- **Waterways, WASCOBs, Terraces, Ponds, and other in-field practices:** Promoting these traditional in-field practices will continue to be a high priority for the Macon County SWCD. Cost share for the implementation of these types of practices are included in the SWCD's two current Section 319 grants, and will continue to be a focus in future grant applications.
- **Bioreactors, drainage water management, and saturated buffers:** Over the next five years, the willingness of local landowners and producers to adopt these practices will be assessed. Willingness to adopt, and documenting the environmental and economic performance of these practices, will be a part of a current RCPP proposal the Macon County SWCD is submitting. Information gathered will help overcome barriers to adoption that may become clear.
- **Perennial Crops:** AWI's ongoing Local Bioenergy Initiative will continue and, as funding permits, expand over the next five years in conjunction with GLBW's regional watershed and biomass programs. This initiative will be pursued in collaboration with Macon County SWCD, University of Illinois researchers, and other partners including companies in the field to end use supply chain for biomass energy. Its broad components are:
    - Stakeholder engagement; outreach and technical/financial assistance to early adopters of perennial biomass crops.
    - Development of markets for perennial biomass, business enterprises related to the biomass supply chain and end uses, and ecosystem service payments to ensure the economic viability of biomass crops.
    - Development and demonstration of landscape design concepts to optimize co-production of harvestable biomass and ecosystem services.

The reassessment of this TMDL Implementation Plan in 2020 will be intended to determine the extent to which implementation of practices and cropping systems has been successful and what changes are needed or desired to achieve the plan's water quality objectives over a 20-year implementation period.

8.0 Implementation Milestones & Responsible Parties

Implementation is already under way and will continue by both Macon County SWCD and AWI. Both are working hard on education to growers. During implementation of this plan, Macon County SWCD will be the lead organization for implementation of well-established BMPs, including cover crops, the 4Rs of nutrient management, and strip till or no-till systems. The Macon County SWCD will work with landowners and producers to push forward new agriculture ideas that promote good soil health and water quality. The USDA and the Macon County SWCD will continue to support the county with Technical Assistance for the installation of BMPs and farming techniques that will support the reduction of nutrient and sediment loss.

The Macon County SWCD, working with landowners, producers, NRCS, and technical service providers, will be the responsible parties to achieve the following measurable milestones by the Year 2020 plan review:

- 50% of annual crop acres in the watershed are following the 4Rs of nutrient management, including in-season nitrogen application and reduced fall application.
- 75% of waterways needed are implemented.
- 25% of annual row crop acres have adopted cover crops to reduce soil and nutrient losses between harvest and planting.
- Continue to provide technical assistance that will assist in the implementation of all practices noted in Table 9.

The Macon County SWCD and AWI will jointly be the responsible parties to achieve these measurable milestones by 2020:

- Bioreactors or saturated buffers will be installed to treat tile systems draining 2,000 acres.
- Drainage water management structures will be installed on tile systems draining 3,000 acres.

AWI will be the lead organization to demonstrate and promote perennial crops for production of harvested biomass and ecosystem services in collaboration with Macon County SWCD, cooperating farmers and landowners, University of Illinois, and biomass supply chain businesses. Biomass markets are essential and ecosystem service payments are likely necessary to form the economic basis for wide adoption of perennial biomass crops. Targets for perennial biomass crops and markets are included in the *Sustainable Decatur* plan adopted by the Decatur City Council. Measurable milestones for perennial crops to be achieved by the Year 2020 plan review are:

- Develop one or more biomass energy projects in the Decatur area that create a market for at least 10,000 acres of perennial biomass crops, producing in the range of 30,000 to 80,000 tons/year depending on the species grown and other factors.
- Obtain funding, recruit cooperating producers, and conduct at least two on-farm research or demonstration projects for the STRIPS, harvested seasonal wetland, and/or harvested saturated buffer or hillside concepts described in Section 4.3, including assessment of pollutant load reduction.
- Assist Dr. Sarah Taylor Lovell to map “opportunity lands” suitable for conversion from annual crops to perennial crops and develop about 16 site plans for perennial cropping systems, as part of the 5-year USDA-funded project “Multifunctional Perennial Cropping Systems (MPCs) for introducing local food and biomass production for small farmers in the Upper Sangamon River Watershed”.
- Prepare a report on the agroecology and economics of perennial crops grown for forage or energy plus environmental benefits in Central Illinois, including an assessment of policies and programs for ecosystem service payments.
- Provide technical assistance and, as funding permits, financial incentives to producers to establish perennial crops sited and managed to enhance water quality.

9.0 Water Quality Monitoring Strategy

The purpose of the monitoring strategy for the Big/Long Creek watershed is to utilize existing monitoring data and continue to monitor the condition and health of the watershed in a consistent and on-going manner. The strategy allows for evaluation of the overall health of the watershed and its changes through time. Another key purpose is to assess the effectiveness of plan implementation projects, and their cumulative watershed-scale contribution towards achieving the goals and objectives of the plan. While programmatic monitoring tracks progress through achievement of actions, this section outlines a strategy to directly monitor the effectiveness of the actions.

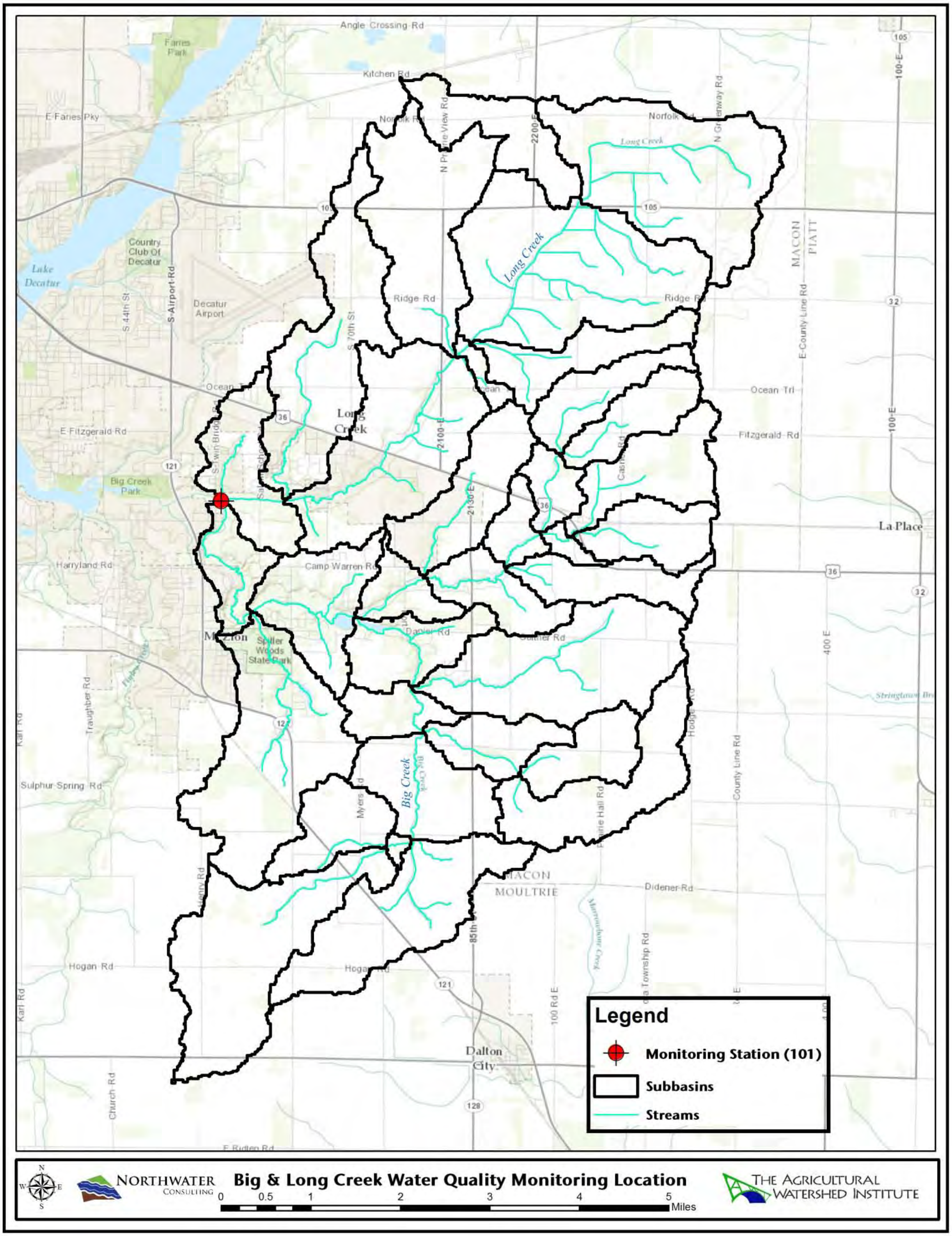
Monitoring environmental criteria as outlined in this strategy is an effective way to measure progress toward meeting water quality objectives. One potential problem with in-stream indicators is the issue of isolating dependent variables. There are likely many variables influencing the monitoring results, so making conclusions with regard to one specific constituent should be done with caution. It should be noted however that the indicators are excellent for assessing overall changes in a watershed's condition.

One ISWS monitoring station existed from 1993 to 1998 on Long Creek (Station 101) at Twin Bridge Road (Figure 21 close to the watershed outlet, just downstream of the Long Creek—Big Creek confluence. Given the historical data currently available, it is recommended that this site be reactivated and streamflow and nutrient monitoring resume under direction of ISWS. The proposed monitoring categories and associated recommendations are summarized in Table 12. Monitoring activities should be coordinated with the ISWS and additional resources should be sought such as the RiverWatch program through the National Great Rivers Research and Education Center (NGRREC). Physical and biological data should be collected at the monitoring site to augment existing water quality information. Due to the uncertainty in securing resources for edge-of-field monitoring to measure the effectiveness of BMPs, it is recommended that a more detailed monitoring plan be developed alongside future implementation actions, if funding permits.

Table 12 - Summary of Monitoring Categories & Recommendations

Monitoring Category	Summary of Recommendations
Streamflow	Measure streamflow during every sampling event.
Ambient water quality	Develop and execute regular monitoring for water quality.
Physical and biologic assessment	Develop and execute annual monitoring for fish, macroinvertebrates, habitat and channel morphology.
BMP effectiveness	Monitoring BMP effectiveness of specific practices or clusters of practices. Develop a detailed monitoring plan in combination with implementation activities.
Monitoring Partnerships	Coordinate with the ISWS. Explore/Implement a volunteer monitoring program in the basin through RiverWatch.
Storm event runoff monitoring	Conduct additional monitoring during storm events.

Figure 21 - Big & Long Creek Monitoring Station



9.1 Water Quality Monitoring

Monthly and spring storm-event water quality monitoring should be considered for at least one station in the watershed (Figure 20). Efforts should focus initially on collecting additional storm event data followed by a regular sampling program.

Table 13 includes the minimum parameters that should be considered for monitoring. Quantitative benchmarks that indicate impairment conditions are also illustrated in this table. 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, suspended sediment concentration, total nitrogen and nitrate-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.

Table 13 - Baseline Water Quality Analysis Parameters

Analyte	Benchmark Indicators
Total Phosphorus	Less than 0.05 mg/l (IEPA standards)
Nitrate-nitrogen	Less than 10 mg/L
Total Suspended Solids (TSS)	Less than 115 mg/l
Turbidity	Less than 20 NTU
Flow	--

9.2 Stream Bioassessment

Aquatic stream bioassessment monitoring should be considered annually or at the maximum of 3 to 5 year increments. One station is recommended in the watershed, in conjunction with water quality station criteria defined prior. Table 14 shows the typical stream bioassessment techniques that can be applied to the monitoring program.

Table 14 - Stream Bioassessment Metrics

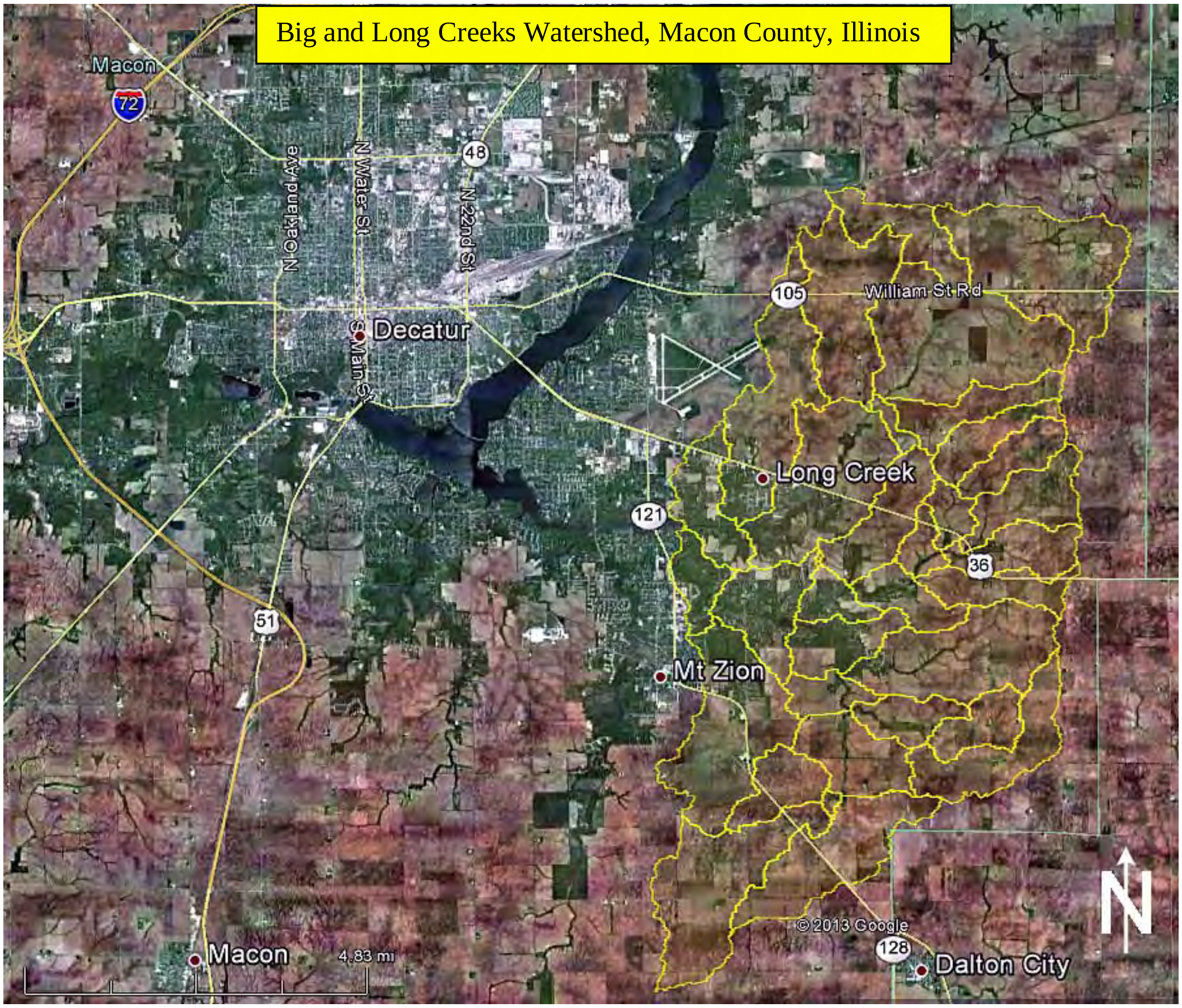
Monitoring	Definition	Benchmark Indicators
Fish Index of Biologic Integrity (IBI)	Index based on presence and populations of non-native and native fish species and their tolerance to degraded stream conditions.	**Exceptional** (50-60) **Very Good** (49-42) **Good** (41-34) **Fair** (33-27) **Poor** (26-17) **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** (4.6-8.9) **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)

Monitoring	Definition	Benchmark Indicators
Stream Condition Index (SCI)	Index that incorporates macroinvertebrate community, habitat and water quality components to grade the quality of a stream.	**Exceptional** (>70) **Good** (49.4-69.8) **Fair** (24.6-49.2) **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 bankfull Bed material Cross-sectional area Water slope

Appendix A

Big & Long Creek Watershed Resource Inventory

Big and Long Creeks
Watershed Resource Inventory



THE AGRICULTURAL WATERSHED INSTITUTE

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Executive Summary

This report contains a watershed resource inventory (WRI) for the Big & Long Creeks watershed, Hydrologic Unit Codes 071300060406 and a portion of 071300060409, a tributary of Lake Decatur. This WRI includes the natural, human, and man-made resources in the Big & Long Creeks watershed. The inventory attempts to identify current nutrient loadings and potential sources of those loadings in the Big & Long Creeks watershed. Existing GIS data, water quality data, and other relevant information were used in compiling this report.

This watershed resource inventory was prepared by the Agricultural Watershed Institute for submittal to the Illinois Environmental Protection Agency as part of the Lake Decatur Watershed TMDL Implementation Planning project.

Overview

The Lake Decatur Total Maximum Daily Load (TMDL) was approved by USEPA in September 2007.[1] The Sangamon River is impaired for primary contact recreational use by fecal coliform. Lake Decatur is impaired for aquatic life use, fish consumption, public and food processing water supplies, and aesthetic quality by phosphorus, nitrate nitrogen, aquatic algae, total suspended solids (TSS) and siltation & sedimentation.

A TMDL consists of waste load allocations for point sources, load allocations for non-point sources, and a margin of safety. The TMDL loading capacity is defined as the maximum pollutant load that a water body can receive and still maintain compliance with water quality standards.

For Lake Decatur the phosphorus loading capacity was determined to be 859 kg/month with a 95 kg/month margin of safety. To allow for seasonal variation, the total load for the July-August period is not to exceed 1908 kg. These allowable loads correspond to about a 75% reduction in the existing load.

For Lake Decatur, the nitrate loading capacity ranges from 245 kg/d of nitrate at 10 cfs flow to 49,000 kg/d of nitrate at 2000 cfs flow rate. A reduction of 13 to 28% of nitrate loading is required to meet the TMDL target which is dependent on flow rate with the greatest percentage reduction needed at the highest flow rate. No reduction is needed in low flow conditions below 265 cfs.

The goal of this project is to estimate the loadings for nutrients and sediment from the Big & Long Creek Sub-watershed into Lake Decatur, determine which BMP's could be applied in different areas of this sub-watershed, and how much reduction we expect those BMP's to achieve.

This report addresses the need for a comprehensive resource inventory of the Big Creek and Long Creek watershed, Hydrologic Unit Codes 071300060406 and a portion of 071300060409, a tributary of Lake Decatur. The Big Creek and Long Creek watershed is located in central Illinois in Macon County (Figure 1). This watershed drains 29,568 acres or about 46.2 square miles to Lake Decatur. The majority of the land is in cropland and drains about 5% of the Lake Decatur watershed.

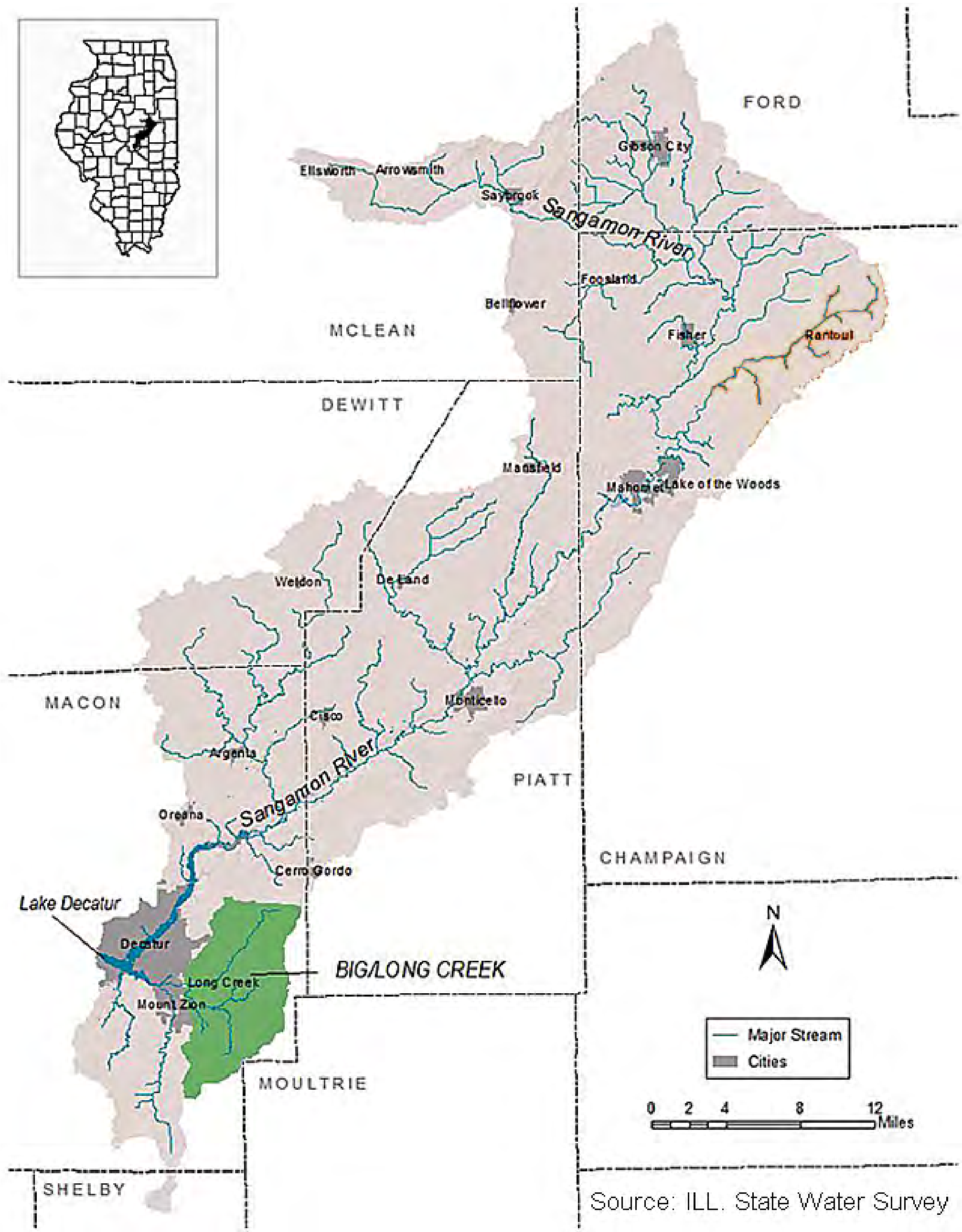


Fig. 1

Geology and Topography

This watershed lies within the Bloomington Ridged Plain, a product of the Wisconsinan glaciation. On this layer was deposited the Peoria Silt, or windblown loess, which blankets the uplands.

The Big Creek watershed generally drains from south and north to west before entering Lake Decatur. The greatest change in elevation is along the drainage ways of the watershed and the Tuprin and Cerro Gordo Moraines. The moraines form the east and southeast boundaries of this watershed. The areas of greatest elevation change will be the focus for BMP's addressing erosion and sedimentation issues.

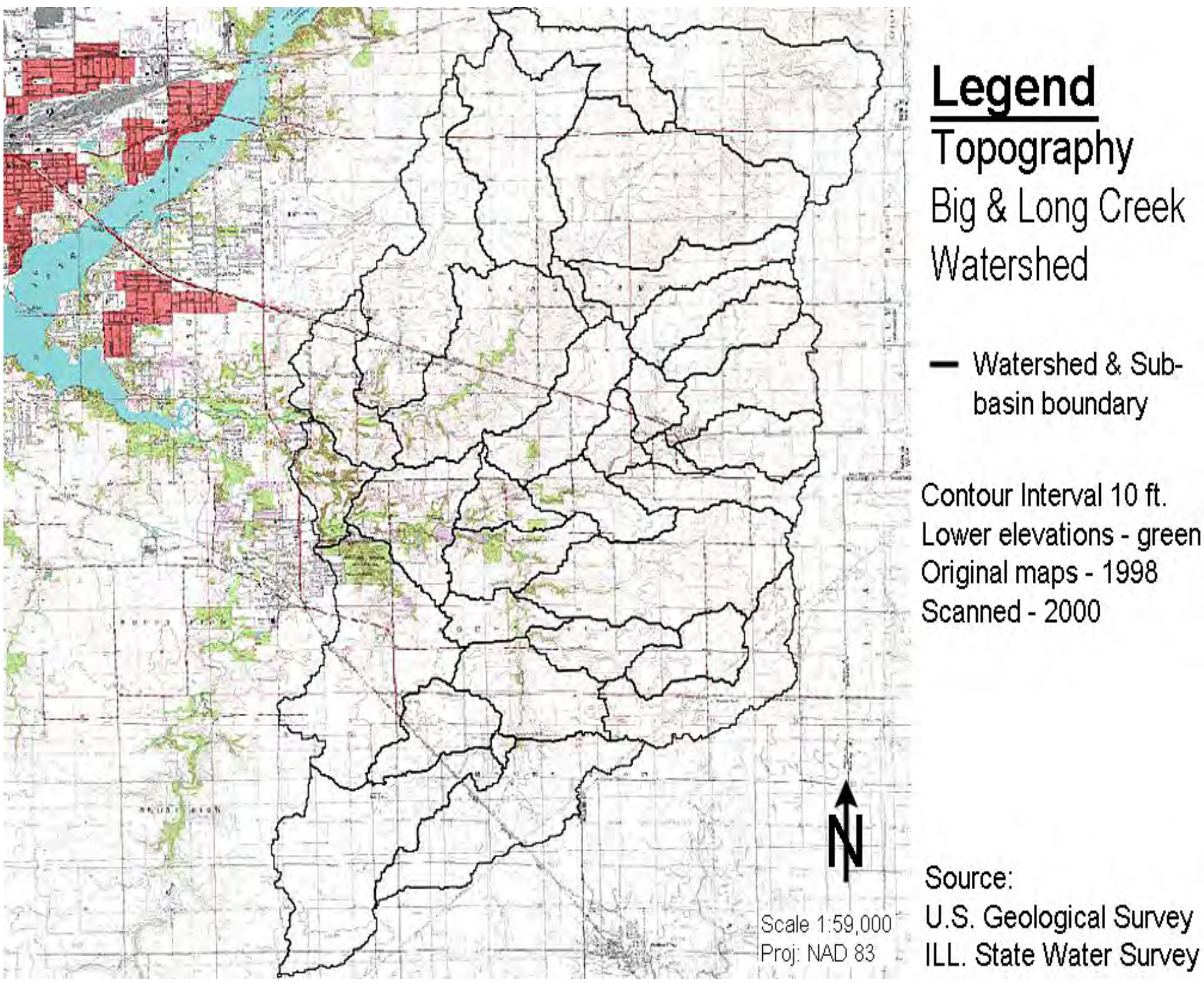


Fig. 2- Topography Map

Soil Classification

The predominant soils in this watershed are mollisols, which are prairie-derived soils with gentle slopes. Drummer-Milford silty clay loams and Flanagan silty clay are the highest percentage mollisols within this area. Both of these soils have little to no slope (0-2 %), a deep loess layer, low erodibility, a high shrink-swell potential and considered prime farmland if properly drained. Drummer-Milford soils are hydric, so poorly drained and subject to ponding during heavy rainfall. Flanagan soils are not hydric, but somewhat poorly drained and they are subject to high seasonal water tables.

The balance of the soils in the watershed are found along or near the water bodies of the Big and Long Creeks and they tend to be alfisols, or forest derived soils. The higher percentage alfisols are Birkbeck silt loam, Russell silt loam, Senachwine clay loam and Xenia silt loam. The slopes of these soils vary from 2-35% and their susceptibility to erosion varies from moderate to high. These are drained soils and not hydric.

At the confluence of the Big and Long Creeks, there are alluvial soils. These soils are in the floodplains and frequently flooded.[2]

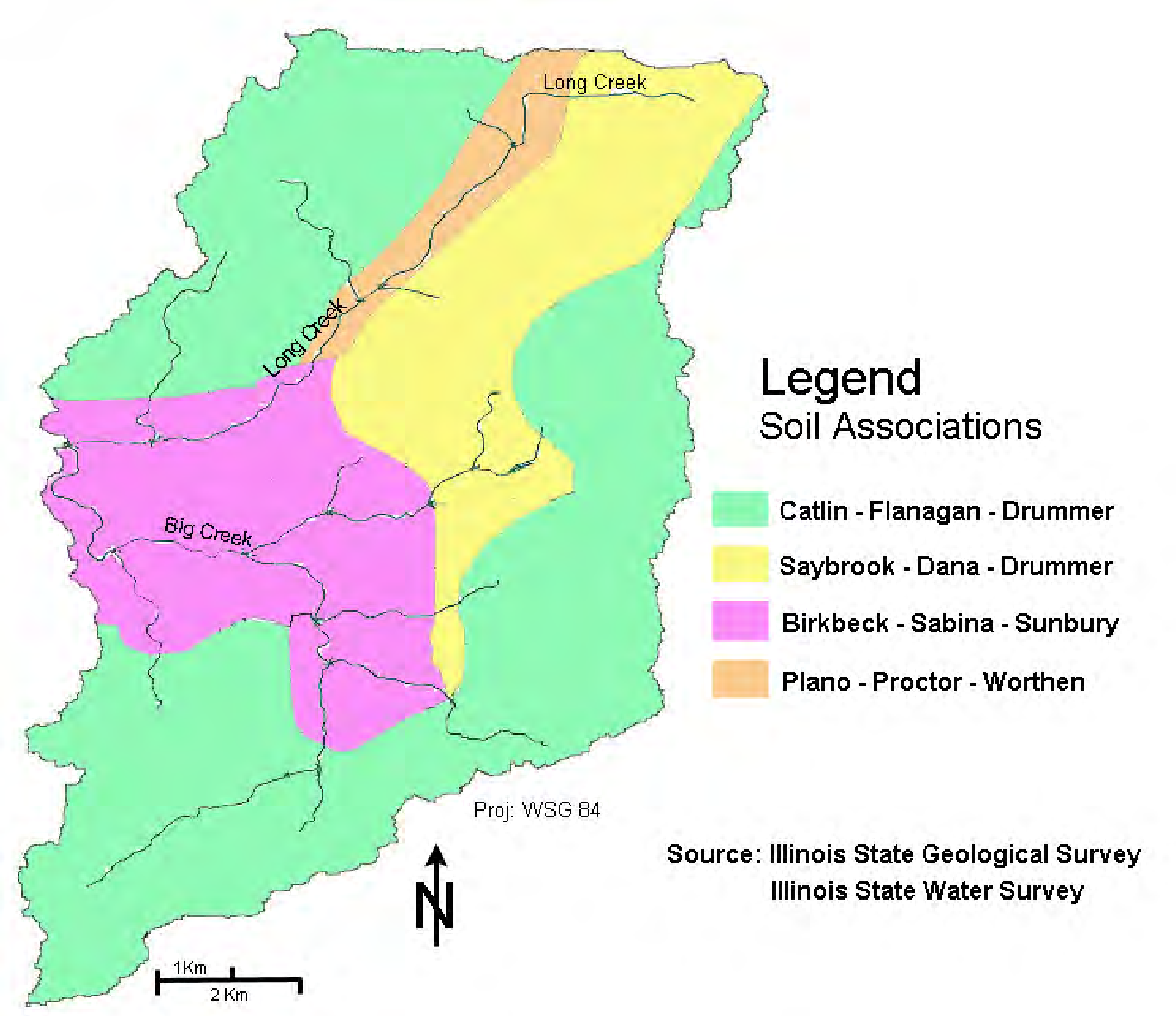


Fig. 3- Soil Associations map

The most up-to-date soils mapping provided by the USDA Natural Resources Conservation Service (NRCS) was used to summarize the extent of soil types, hydric soils, soil erodibility, and hydrologic soil groups within the Big Creek watershed (Table A).

Table A. Soil series including hydric status, hydrologic soil group, erodible status, acres, &percent of watershed.

Table A

Soil Unit	**SOILS:**	**Hydric Rating**	**Hydrologic Soil Group**	**Highly Erodible**	**% Slope Range**	**Area[acres]**	**%WaterArea**
56B 56C2	**Dana**	Non-Hydric	B	N Y	2 to 5 5 to 10	1125.4	3.7
67A	**Harpster**	Hydric	B	N	0 to 2	510.1	1.7
132A	**Starks**	Non-Hydric	B	N	0 to 2	22.6	0.1
134B 7134B	**Camden**	Non-Hydric	B	Potential	2 to 5	51.9	0.2
136A	**Brooklyn**	Hydric	C/D	N	0 to 2	50.9	0.2
148B 148C2	**Proctor**	Non-Hydric	B	y	2 to 5 5 to 10	97.2	0.3
152A 722A	**Drummer**	Hydric	B	N	0 to 2	10940.9	35.9
153A	**Pella**	Hydric	B	N	0 to 2	361.8	1.2
154A	**Flanagan**	Non-Hydric	B	N	0 to 2	9494.5	31.1
171B	**Catlin**	Non-Hydric	B	Potential	2 to 5	655.7	2.2
198A	**Elburn**	Non-Hydric	B	N	0 to 2	1228.8	4.0
199B	**Plano**	Non-Hydric	B	Potential	2 to 5	349.6	1.1
206A	**Thorp**	Hydric	C/D	N	0 to 2	6.5	0.0
233B	**Birkbeck**	Non-Hydric	B	Potential	2 to 5	651.3	2.1
234A	**Sunbury**	Non-Hydric	B	N	0 to 2	310.1	1.0
236A	**Sabina**	Non-Hydric	B	N	0 to 2	741.7	2.4
291B	**Xenia**	Non-Hydric	B	Potential	2 to 5	667.7	2.2
322C2	**Russell**	Non-Hydric	B	Y	5 to 10	204.3	0.7
330A	**Peotone**	Hydric	C	N	0 to 2	156.6	0.5
348B	**Wingate**	Non-Hydric	B	Potential	2 to 5	80.7	0.3
481A	**Raub**	Non-Hydric	B	N	0 to 2	302.0	1.0
533	**Urban Land**		N/A	D		0.7	0.0
618C2 618D2 618D3 618F 618G	**Senachwine**	Non-Hydric	B	Y	5 to 10 10 to 18 10 to 18 18 to 35 35 to 60	926.1	3.0
622B2 622C2	**Wyanet**	Non-Hydric	B	Y	2 to 5 5 to 10	429.2	1.4
679B	**Blackberry**	Non-Hydric	B	N	2 to 5	66.0	0.2
865	**Pits, Gravel**	N/A				4.6	0.0
3077A	**Huntsville**	Non-Hydric	B	N	0 to 2	7.3	0.0
3107A	**Sawmill**	Hydric	D	N	0 to 2	215.7	0.7
3333A	**Wakeland**	Hydric	C	N	0 to 2	34.2	0.1
3451A	**Lawson**	Hydric	B	N	0 to 2	631.9	2.1
7802B 802B 802D	**Orthents**	Non-Hydric	C	Potential	NA	111.0	0.4
Water		WTR				52.5	0.06
Totals						30489.5	100

Hydric Soils

Wetland or "Hydric Soils" form over poorly drained clay material associated with wet prairies, marshes, and other wetlands and from accumulated organic matter from decomposing surface vegetation. Hydric soils are important because they indicate the presence of existing wetlands or drained wetlands where restoration may be possible.[3]

The National Wetlands Inventory in 1987 provided only county level data and none on the watershed level. Estimates of wetlands past and present are provided in the IL Natural History Special Publication 15, but only at the county level as percentages.[4]

Soil Erosion

Soil erosion is the process whereby soil is removed from its original location by flowing water, wave action, wind, and other factors. Sedimentation is the process that deposits eroded soils on other ground surfaces or in bodies of water such as streams and lakes. Soil erosion and sedimentation reduces water quality by increasing total suspended solids (TSS) in the water column and by carrying attached pollutants such as phosphorus, nitrogen, and hydrocarbons. When soils settle in streams and lakes they often blanket rock, cobble, and sandy substrates needed by fish and aquatic macro invertebrates for habitat, food, and reproduction.

According to the June 2007 Big and Long Creek Watershed Resource plan, erosion is occurring from three distinct areas: stream bank, cropland and urban sites under construction. The average annual erosion rates from cropland in this watershed range from 1-15 tons per acre. This report states that there are four types of erosion with roughly 50% from sheet and rill erosion, 36% from ephemeral erosion, 3% gully erosion and 11% stream bank erosion. The sheet and rill erosion is coming from the entire watershed, while the other three types of erosion are coming from concentrated areas. These concentrated areas are urban sites under construction and lands with slopes greater than 5% along the water bodies.[5]

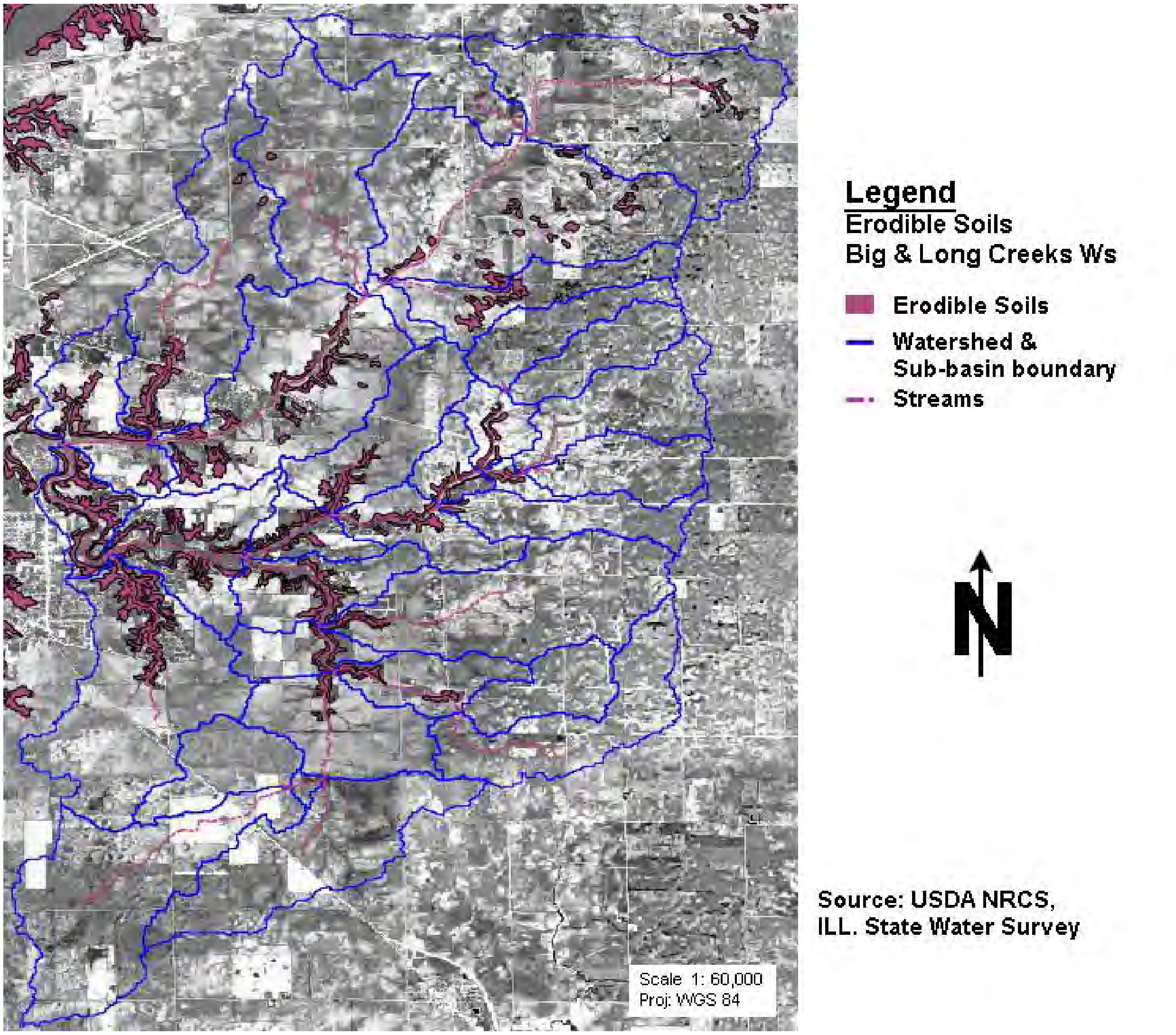


Fig. 4- Erodible Soils map

Table A includes a list of the soil types in the watershed with a column indicating soil susceptibility to erosion based on a selection of particular attributes such as soil type and the percent slope on which a soil is located.

Hydrologic Soil Groups

Soils also exhibit different infiltration capabilities and have been classified to fit what are known as "Hydrologic Soil Groups" (HSGs). HSGs are based on a soil's infiltration and transmission (permeability) rates and are used by engineers to estimate runoff potential. Knowing how a soil will hold water ultimately affects the type and location of recommended infiltration Management Measures such as wetland restorations and detention basins. More importantly however is the link between hydrologic soil groups and groundwater recharge areas.

HSG's are classified into four primary categories; A, B, C, and D, and three dual classes, A/D, B/D, and C/D. The HSG categories and their corresponding soil texture, drainage description, runoff potential, infiltration rate, and transmission rate are shown in Table B. Table A includes a list of the soil types in the watershed with a column indicating the soil's hydrologic group.

Poorly drained areas (Hydrologic Groups C, C/D and D) account for 576 acres of the watershed. Excessively and moderately drained (Hydrologic Group A, A/D, B, and B/D) areas make up an additional 29,914 acres of the watershed.

Table B. Hydrologic Soil Groups and their corresponding attributes.

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

Land Use/Cover

A review of that land use map shows the major use of land is agricultural. Low-density urban development and rural grasslands are found along Big Creek and the lower reaches of Long Creek. The June 2007 Big and Long Creek Watershed Resource plan states the need for more conservation practices to be installed, which includes water and sediment control basins, grade stabilization structures, increase the use of mulch and no-tillage practices, buffer strips, stream bank stabilization and utilize BMP's to manage urban run-off.

According to this same report, "87.9% of the watershed is cropland, 5.9% is grassland and woodland, (and) 7.2% is urban or built up land."

Of the 88% of the watershed in cropland, about 2/3 is in corn and 1/3 in soybean production in a given year. About 90% of this ground is chisel tilled, 2% is no-tilled, and the balance mulch tilled or other tillage systems. None is moldboard plowed.

There are no major livestock facilities, only hobby livestock and horses with about 1% of the watershed in pasture.

Due to the proximity to the City of Decatur and Village of Mt. Zion, urban sprawl is expected to gradually reduce the farm land, and while under development at least, is likely to increase sedimentation and reduce water quality.[6]

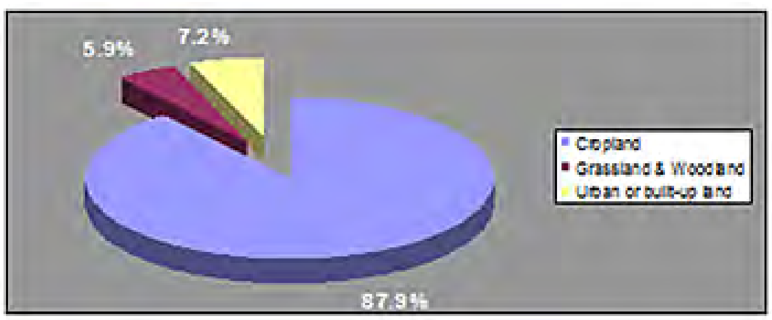


Fig. 5- Percentages of Land Use

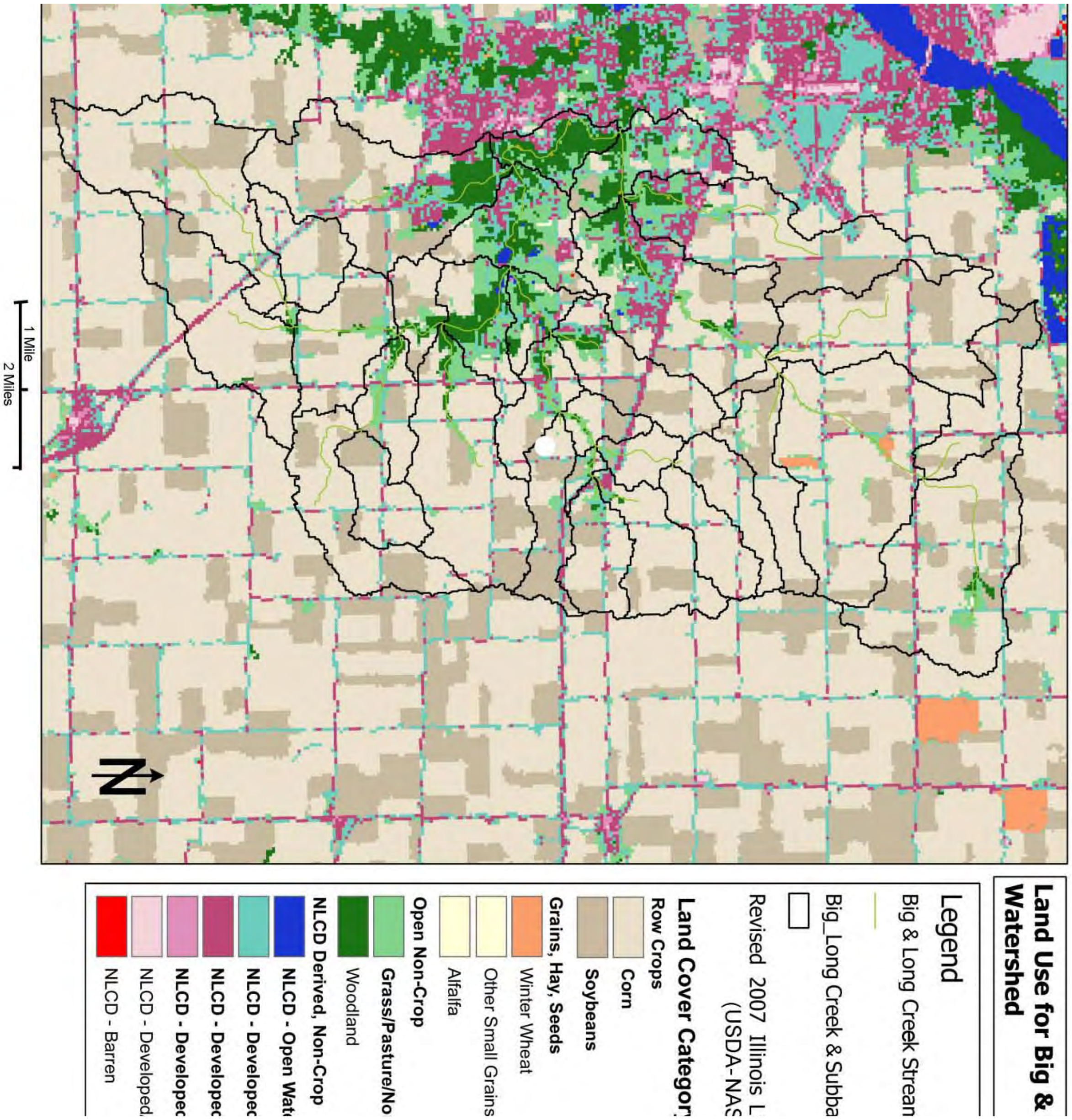


Fig. 6- Land Use map

Floodplains

The base flood elevation (BFE) is the elevation that the base flood would reach every one hundred years. This area is the 100-year floodplain and has the potential of flooding to the BFE once every one hundred years or a 1% probability of flooding each year. However, this does not mean that this magnitude of flooding cannot occur more often. Within the floodplain are the floodway and the flood fringe. The floodway includes the stream channel and overbank area. Beyond the floodway is the flood fringe that makes up the rest of the floodplain. Fill material or structures put in the floodplain can alter the base flood elevation and raise it to a higher level because the fill or structures displace the flood storage area.

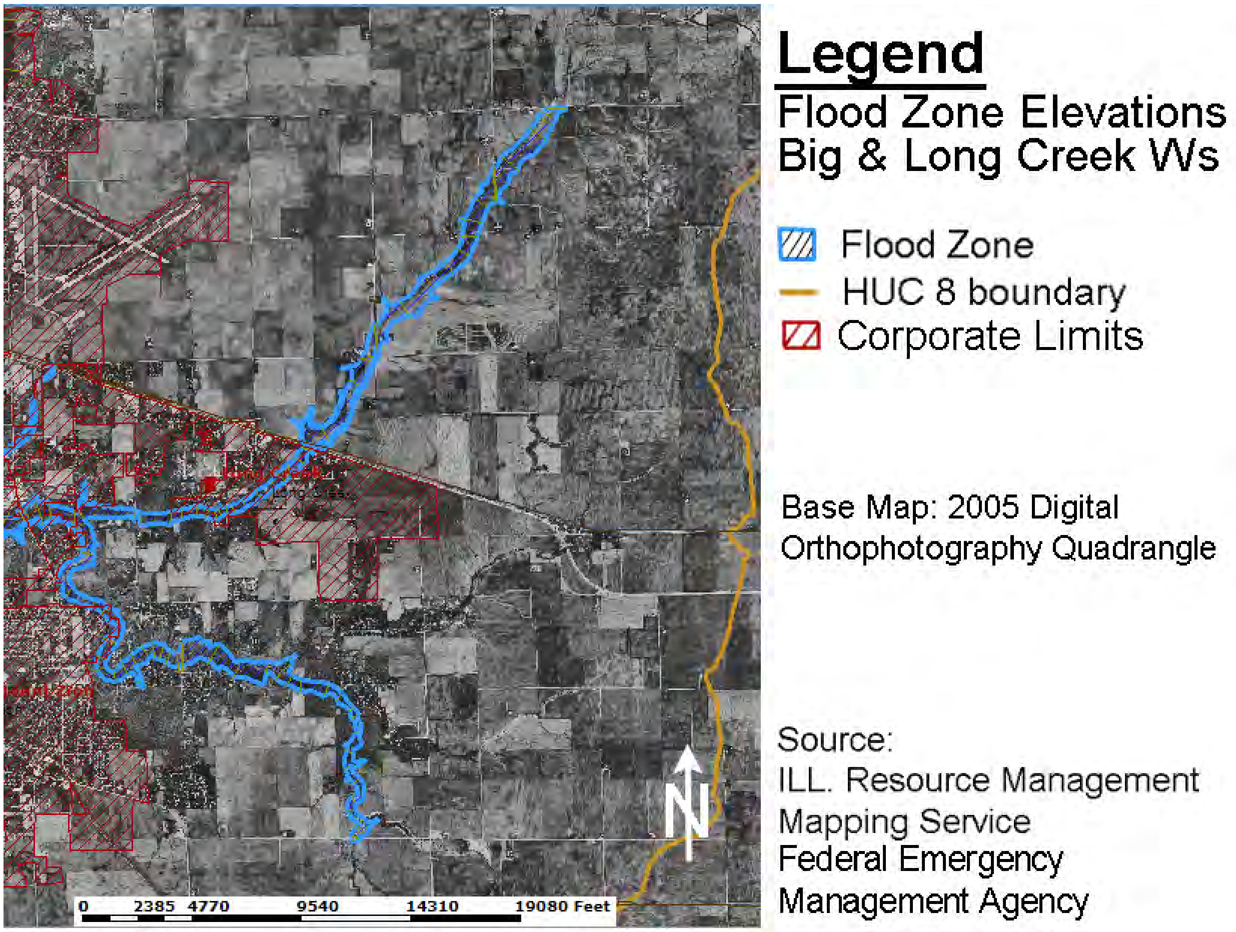


Fig. 7- Floodplain Map

The Lower Part of the Upper Sangamon River Watershed Resource Plan[7] advised that the following practices be implemented to reduce the likelihood of flooding and the erosion that comes with flooding.

- Deter all construction or filling in of the FEMA 100-year mapped floodplain. Encourage the update of the current FEMA maps.

- Discourage the placement of detention basins in the floodplain.
- The placement of a detention basin in a flood fringe area should require compensatory storage for 1.5 times the volume below the base flood elevation occupied by the detention basin. A flood fringe area is the area above the floodway. The floodway is the channel and overbank area.
- No reduction in existing floodway surface area.
- Deter on-stream detention.

- Preserve the floodplain as open space or natural areas planted with native species when possible. Use existing programs such as Conservation Enhancement Reserve Program to achieve protection.

The following photos document floodplain issues in this watershed:

Fig. 8- Retention basin in the floodplain on Big Creek near Ft. Daniel Road

Fig.9- pole building built on the fringe of the Long Creek floodplain near Long Creek Road

Fig. 10-Filling in part of the Long Creek floodplain fringe with earth and construction debris

Fig. 11- View of the floodplain in the agricultural portion of this watershed

Wetlands

The largest wetlands in this watershed are contained within Spitler Woods State Park and Ft. Daniel Conservation Area along Big Creek. In addition, there are several small wetlands along both Big Creek and the lower reaches of Long Creek. It was mentioned in the June 2007 Resource plan that there was concern that stormwater from the watershed may cause deterioration in the quality of these natural wetlands.

In 1999 IEPA provided 319 funds to create a wetland through the Lake Decatur Watershed Program of the Macon County Soil and Water Conservation District. The landowner, Dr. David Fletcher installed a 1.5 acre shallow water wetland in the Big Creek Watershed. As viewed through the Google earth imagery dated 4/10/12, the site has been well maintained. Since no monitoring of the project was required or conducted, precise benefits cannot be quantified, but it appears to function well as a sediment and nutrient trap for its immediate watershed.[8]

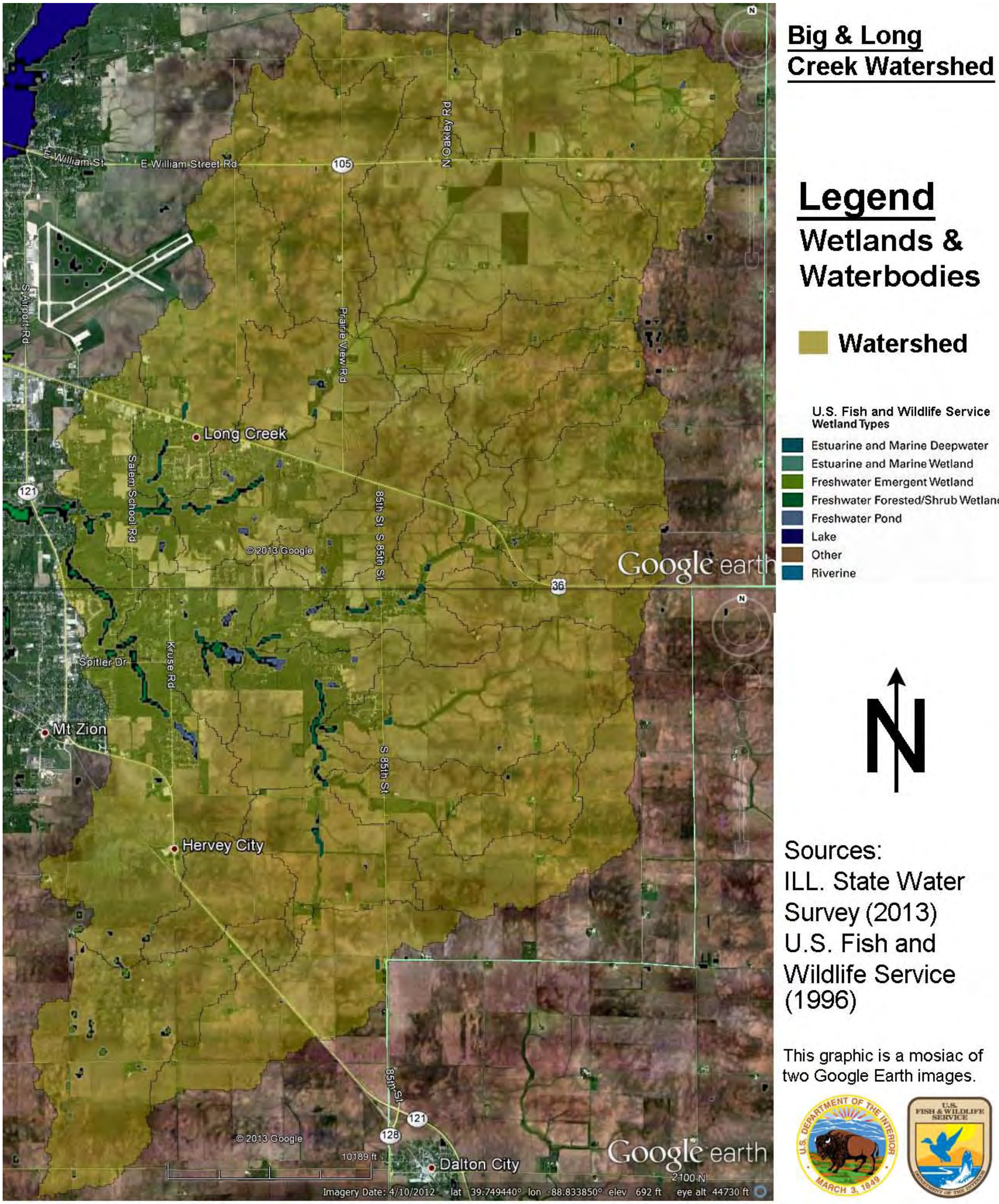


Fig. 12- Map of Wetland areas

Riparian Corridors

The Big and Long Creek Watershed Resource Plan states that there is a need for more filter and buffer strips next to bodies of water and drainage ways. The plan estimates that this watershed needs 378 acres of buffer strips to reduce the amount of sediment entering these water bodies. The numbers in this plan were generated using NRCS transect methods.[9]

A survey of the watershed conducted in April 2013 showed that buffer strips were being used near water bodies. A review of Google Earth imagery of the watershed conducted in April 2013 showed the number of buffers along water bodies had declined in the past six years with approximately 110 acres remaining.

Groundwater Issues

Elevated levels of arsenic have been detected in the Glasford Aquifer, which lies under this watershed and is considered to be a semi-confined aquifer. "There is considerable spatial variability in the arsenic concentrations in … aquifers: wells less than a mile apart frequently have significantly different arsenic concentrations."[10]

According to the Long Creek Township Public Water Supply the maximum contaminant level for arsenic is 10 ppb, and the highest monitored level in 2012 was 1.7 ppb. Water monitoring showed no violations, and disinfection byproducts were the only issue of concern with the highest detection level of total trihalomethanes at of 68 ppb with an MCL of 80 ppb. A well site survey identified quarrying as a potential route for contaminants to the aquifer. [11]

The village wells are provided with a 200 foot minimum setback under the Illinois Groundwater Protection Act, meaning that certain potential sources of contamination (such as large fuel tanks) and routes of contamination (such as abandoned wells or gravel pits) are forbidden within this 200 foot radius circle around the well. In 1998, the Village by local ordinance extended this setback for wells # 1 & 2 to 1000 feet.[12]

The Village of Mt. Zion obtains drinking water from the City of Decatur.

A search of the Illinois State Water Survey, Illinois State Geological Survey, Illinois Dept. of Agriculture, Illinois EPA and local media outlets did not reveal any other groundwater issues in this area. [13]

Irrigation

In surveying this watershed, we were unable to find any visible irrigation systems.

Drainage

Subsurface drainage is cited as one source of nitrogen loss from this watershed. It is estimated that 70 percent or more of the farmland is drained in this manner.[14] This watershed area includes all or part of HUC's: 071300060409 and 071300060406, which drain the area above the Twin Bridge Road crossing of Long Creek.

Fig. 13- Subsurface drainage outlet on a tributary of Big Creek

There are no maps available of tile outlet locations, but they may be embedded in NRCS farm plans and used for planning on a farm or field basis or may be available through farm drainage contractors with permission of the landowner.

Priority Watershed

The Upper Sangamon River/Lake Decatur Watershed (HUC: 07013000601, 0701000602, 0713000604) has been identified by the Illinois Environmental Protection Agency as one of six priority watersheds to reduce nutrient loss within the state.

Wildlife

There have been no wildlife surveys or censuses in this sub-watershed, but there has been one completed within the larger Upper Sangamon watershed of which this watershed is a part. The landscape with this watershed is highly agricultural with only narrow riparian areas for wildlife habitat or the public lands (Spitler Woods State Park and Ft. Daniel

Conservation Area). This has led to very fragmented habitat sites that are not conducive to the long-term sustainability of birds and mammals.

The wildlife assessment performed within the larger Upper Sangamon watershed states the following about aquatic life, birds, mammals and amphibians. As previously mentioned in the "Biological Indicators", the aquatic resources are rated "Fair". "Most …upland sites in the basin are small and have little potential to be enlarged sufficiently to create interior habitat for forest or grassland birds." "The preservation of upland and floodplain forests would enhance the suitability of the …habitat for a variety of forest dwelling species…" "Prairie restorations, coupled with the preservation of native prairie remnants and other types of grassland habitats, would provide habitat…"[15]

Socio-Economic/Human Resources

This watershed is located in Macon County, next to the City of Decatur. Within the watershed, farming is the largest business. However, the largest numbers of the residents work outside the watershed in neighboring Decatur. All of the Village of Long Creek and a very small part of the Village of Mt. Zion are within the watershed.

United States Census Bureau data for Macon County shows that the median household income for the period, 2007-2011, was $45,987. This is below the state's median household income for the same period of $56,576. This same census data show that the percent of people below the poverty level is 15.05, whereas the state average is 13.1%. The population density is estimated to be 103.23 persons per square mile. [16] [17]

The high school graduation rate is higher within Macon County than the state average, but the percentage of people with a bachelor's degree or higher is lower than the state average. With the largest employers being in Decatur and most of the jobs being factory or service industry jobs, there is not a need for a bachelor's degree or higher.

The Macon County Conservation District (MCCD) owns a number of nature areas within the county and one of those sites is located in this watershed. MCCD's Ft. Daniel Conservation Area contains 200 acres of oak-hickory forests, a sugar maple grove, open grasslands, and floodplain forests.

Spitler Woods State Park is also located within the watershed. It contains 202.5 acres and eastern two-thirds of the state park is noted for its old-growth forest grove of white oak and hickory.

The map below shows the location of these two public lands.

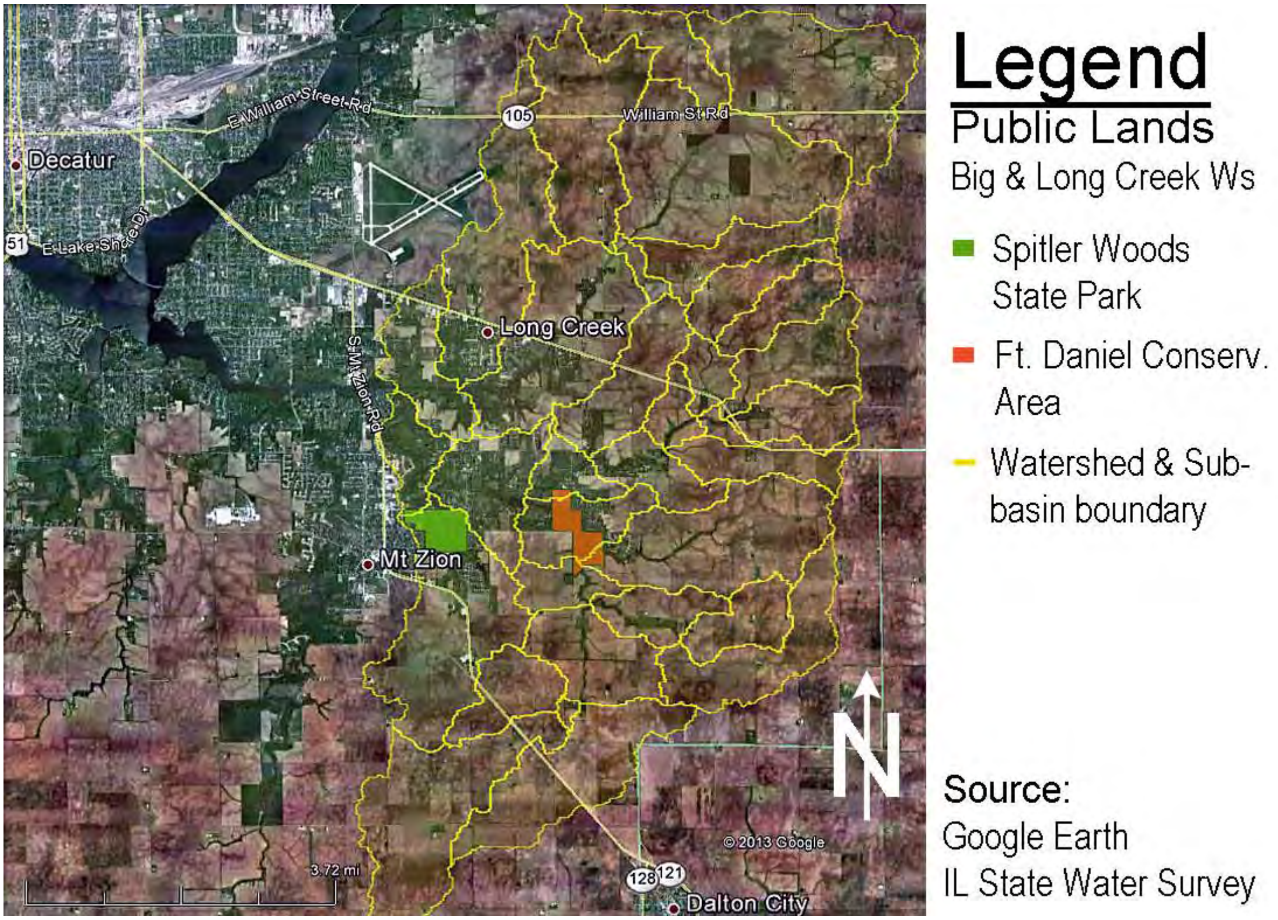


Fig. 14- Map of public lands

There are four drainage districts in the watershed, two are active and two are inactive. The active districts are Union Drainage District #1 of Oakley & Long Creek Townships and Union Drainage District #2 of Oakley & Long Creek Townships. The inactive districts are Casner Mutual Drainage District (near Casner) and Union Drainage District #3 of Oakley Township.

Municipal/Industrial Point Sources

There is only one NPDES permitted site in this watershed. It is the Long Creek Township Water Treatment Plant's IEPA General NPDES permit: ILG640265. Information from the USEPA shows that the "Receiving Waters" are an "unnamed tributary (of Long Creek) to Lake Decatur". [18]

The Illinois EPA shows that the Long Creek Township Water Treatment Plant's permit has an effective date of 7/13/2012 and expires on 4/30/2017.[19]

No other point sources were discovered in this watershed.

Stormwater Management

NPDES Phase II Stormwater Permit Program

The IEPA Bureau of Water regulates wastewater and stormwater discharges to streams and lakes by setting effluent limits, and monitoring/reporting on results. The Bureau oversees the National Pollutant Discharge Elimination System (NPDES) program. The NPDES program was initiated under the federal Clean Water Act to reduce pollutants to the nation's waters. This program requires permits for discharge of: 1) treated municipal effluent; 2) treated industrial effluent; and 3) stormwater from municipal separate storm sewer systems (MS4's) and construction sites.

The IEPA's NPDES Phase I Stormwater Program began in 1990 and applies only to large and medium-sized municipal separate storm sewer systems (MS4's), several industrial categories, and construction sites disturbing 5 acres of land or more. The NPDES Phase II program began in 2003 and differs from Phase I by including additional MS4 categories, additional industrial coverage, and construction sites disturbing greater than 1 acre of land. More detailed descriptions can be viewed on the Illinois EPA's web site.

Under NPDES Phase II, all municipalities with small, medium, and large MS4's are required to complete a series of Best Management Practices (BMPs) including; 1) Develop a stormwater management program comprised of BMPs and measurable goals for at least 6 control measures such as public education and pollution prevention; 2) Submit a completed Notice of Intent (NOI) to share Phase II requirement with other municipalities; and 3) Submit an annual report to IEPA reporting on the status of the implemented programs.

The Phase II Program also covers all construction sites over 1 acre in size. For these sites the developer or owner must comply with all requirements such as completing and submitting a NOI before construction occurs, developing a Stormwater Pollution Prevention Plan (SWPPP) that shows how the site will be protected to control erosion and sedimentation, completing final stabilization of the site, and filing a Notice of Termination (NOT) after the construction site is stabilized.

The Big and Long Creek Watershed Resource Plan mentions the need to better manage stormwater runoff in residential areas with improved detention basin design. The plan states that "…all municipalities or counties in the watershed to change their ordinances to reflect a more restricted release rate for the watershed." In addition, "incorporate a broader scale of detention basin design concepts to meet the primary benefits for stormwater and pollution management and as many secondary benefits as possible such as recreation, aesthetics, and habitat." "Require detention on all new development for commercial and industrial sites and residential dwellings of more than one residence per two-acre lot." [20]

A relatively small part of Mt. Zion drains into Big Creek, but some of its storm sewers do. Long Creek is not an MS4 community. The Macon County Soil and Water Conservation

District (SWCD) serves as technical staff in Macon County on MS4 permits and they issue land disturbance permits (LDPs). According to SWCD specialist Megan Baskerville[21] building permits in Mt. Zion, Decatur, and Forsyth require an LDP. The SWCD charges $25 for a spoil pile, $50 for under one acre or $500 for an LDP encompassing greater than one acre of disturbed land. In many cases properly installed and maintained silt fence will satisfy the requirements. Land with greater slopes may require additional measures for which the SWCD will provide technical assistance. Enforcement is done by the municipality in accordance with the LDP. The SWCD also does the educational components of the MS4 program, which includes home shows, a contractors' workshop, and the website: www.maconcleanwater.com For building permits in the county jurisdiction, the county has its own permit process and technical capability.

Hydrologic Modifications

There have been numerous hydrologic modifications to this watershed. A review of aerial photos shows that Long Creek has been channelized and straightened in the upper reaches of its watershed. This same review shows that Big Creek has several impounded lakes on its tributaries.

In addition, on the lower reaches of both creeks there are housing developments, which have installed detention basins.

Designated Uses

The Big Creek and Long Creek on their own are considered to have the designated use of General Use. These creeks drain directly into Lake Decatur, the public water supply of the City of Decatur, which has a designated use of Public and Food Processing Water Supplies Use. Lake Decatur is classified as impaired for aquatic life use, fish consumption, public and food processing water supplies, and aesthetic quality by phosphorus, nitrate-nitrogen, aquatic algae, total suspended solids, and siltation/sedimentation.[22] Big and Long Creeks watershed has been monitored for nitrates in the stream water and results have shown levels above the nitrate-nitrogen MCL of 10 mg/l.[23] Sedimentation has been documented as a problem in these streams with sediment yields of 0.56 T/A/yr. into the Long and Big Creek Basin of Lake Decatur.[24] For more information on water quality, see the Water Quality Data section below.

Biological Indicators

Neither Big nor Long Creeks have been evaluated for biological indicators. An IDNR "Upper Sangamon River Area Assessment – Living Resources", 1999, stated that the Sangamon River is rated "Fair" for aquatic resources. Its problems included siltation, impoundments, dredging, and pollution for industrial, agricultural and domestic sources.[25]

Water Quality Assessment

The IEPA does not list Big Creek (IL_EU-01) or Long Creek (IL_EUA-01) as being impaired for any of its five Designed Uses (Aquatic Life, Fish Consumption, Primary Contact, Secondary Contact, Aesthetic Quality) because they were not assessed in any of the most recent *Integrated Water Quality Reports*.

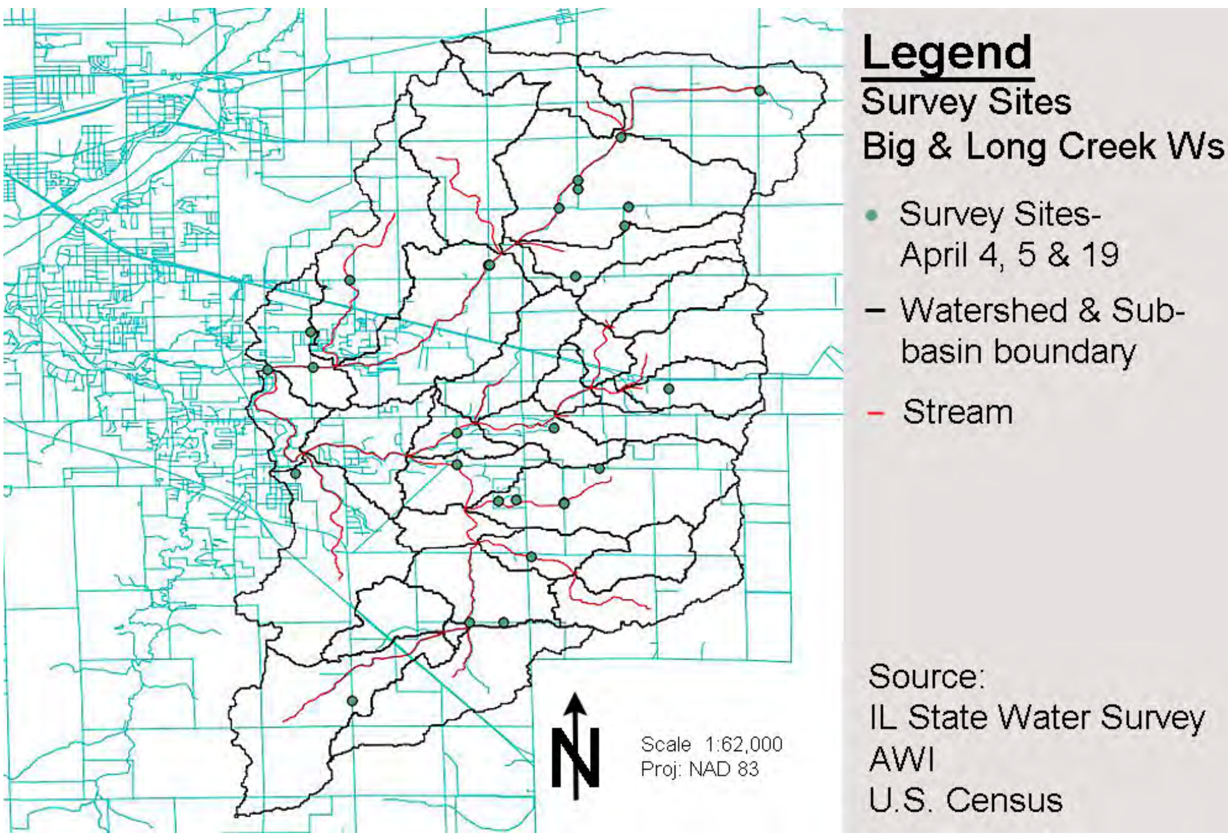


Fig. 15 – April Watershed Survey sites--Big Creek, Long Creek, & Tributaries

Big Creek is about 12.9 miles long, Long Creek is about 9.6 miles long, and their tributaries add about 8.7 miles. The total stream and tributary length is about 31.2 miles.[26]

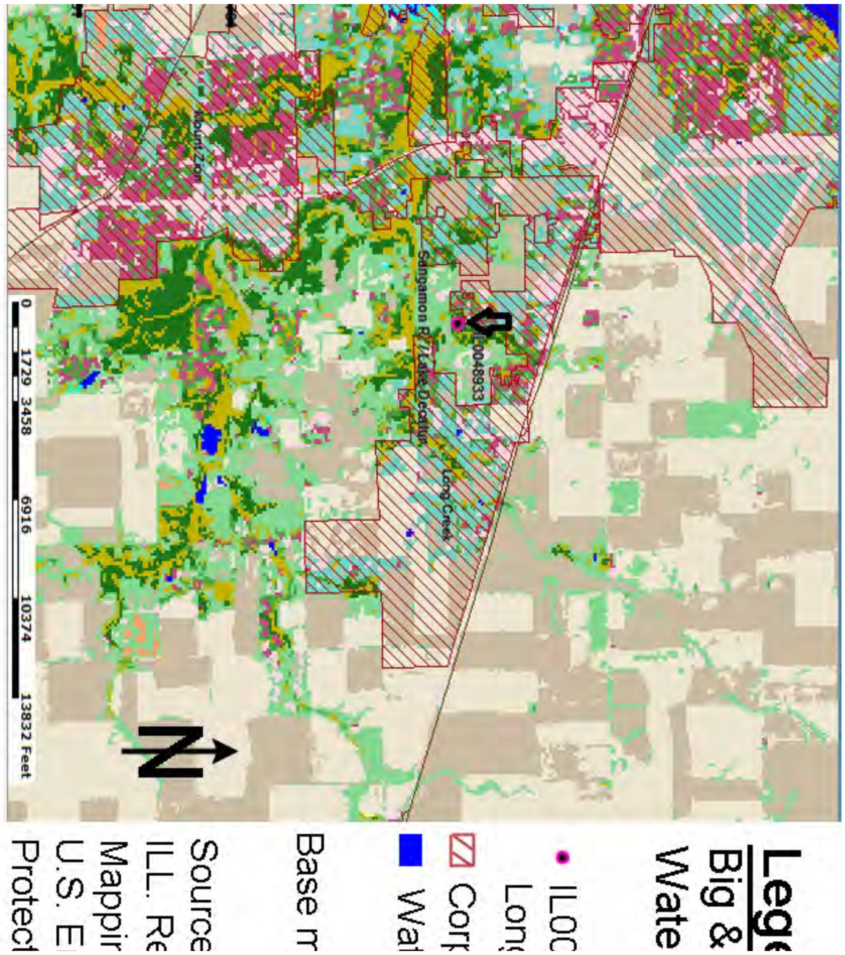


Fig. 16- Map of NPDES sites and corporate limits

Septic Systems

The Macon County Health Department regulates septic systems in this watershed and throughout the county. They investigate septic problems on a complaint basis and do not maintain a county wide septic failure rate. The great majority of homes in this watershed are on septic systems. The small part of the watershed that is served by a sanitary sewer system is connected to the Decatur municipal sewer system. Kathy Wade of the Macon County Health Department stated that septic system installations are filed by address, not by watershed boundaries; to research septic systems, we would need to provide addresses of homes in question.[27]

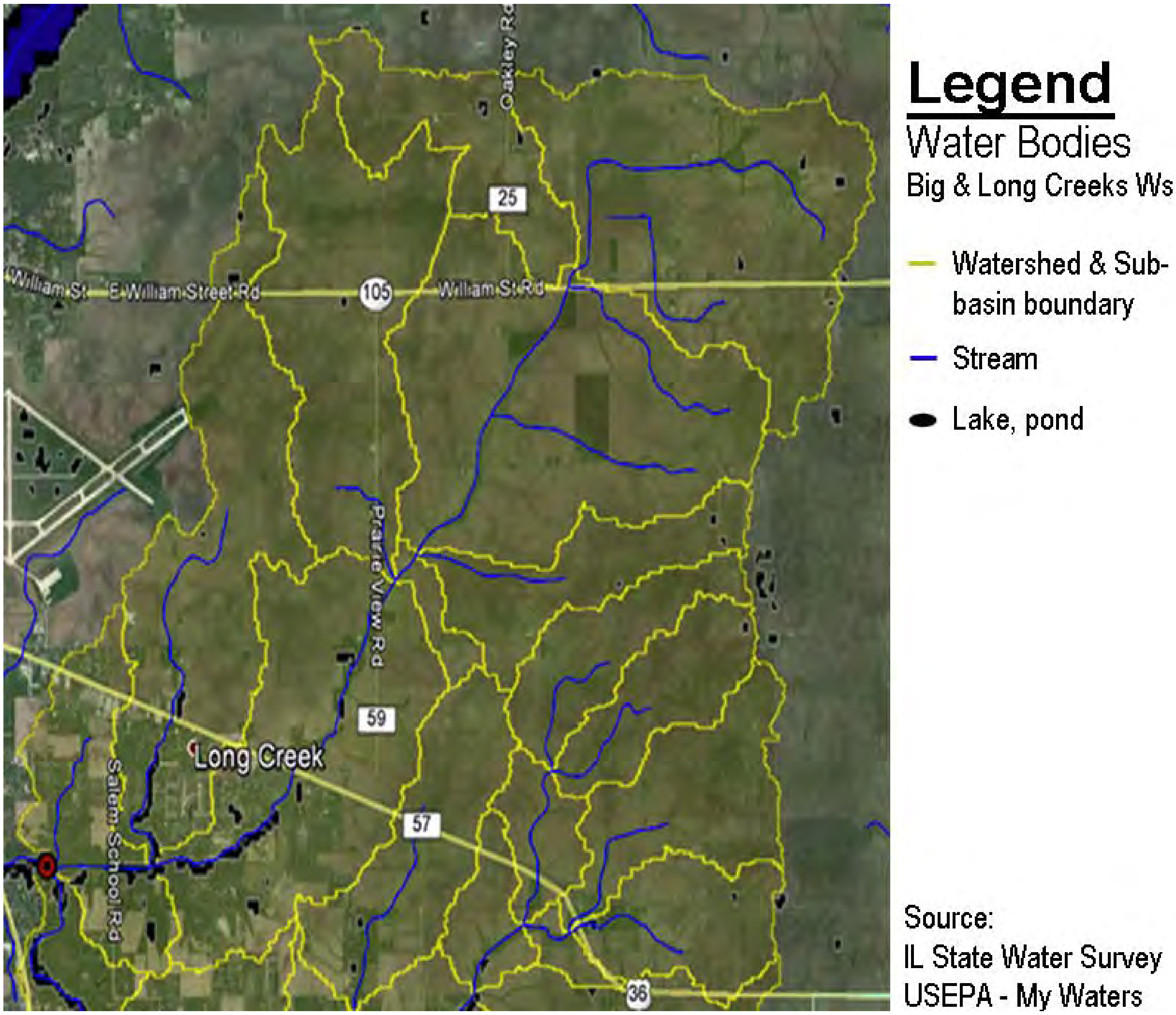


Fig. 17a- Map of Water Bodies North Part of Sub-Watershed

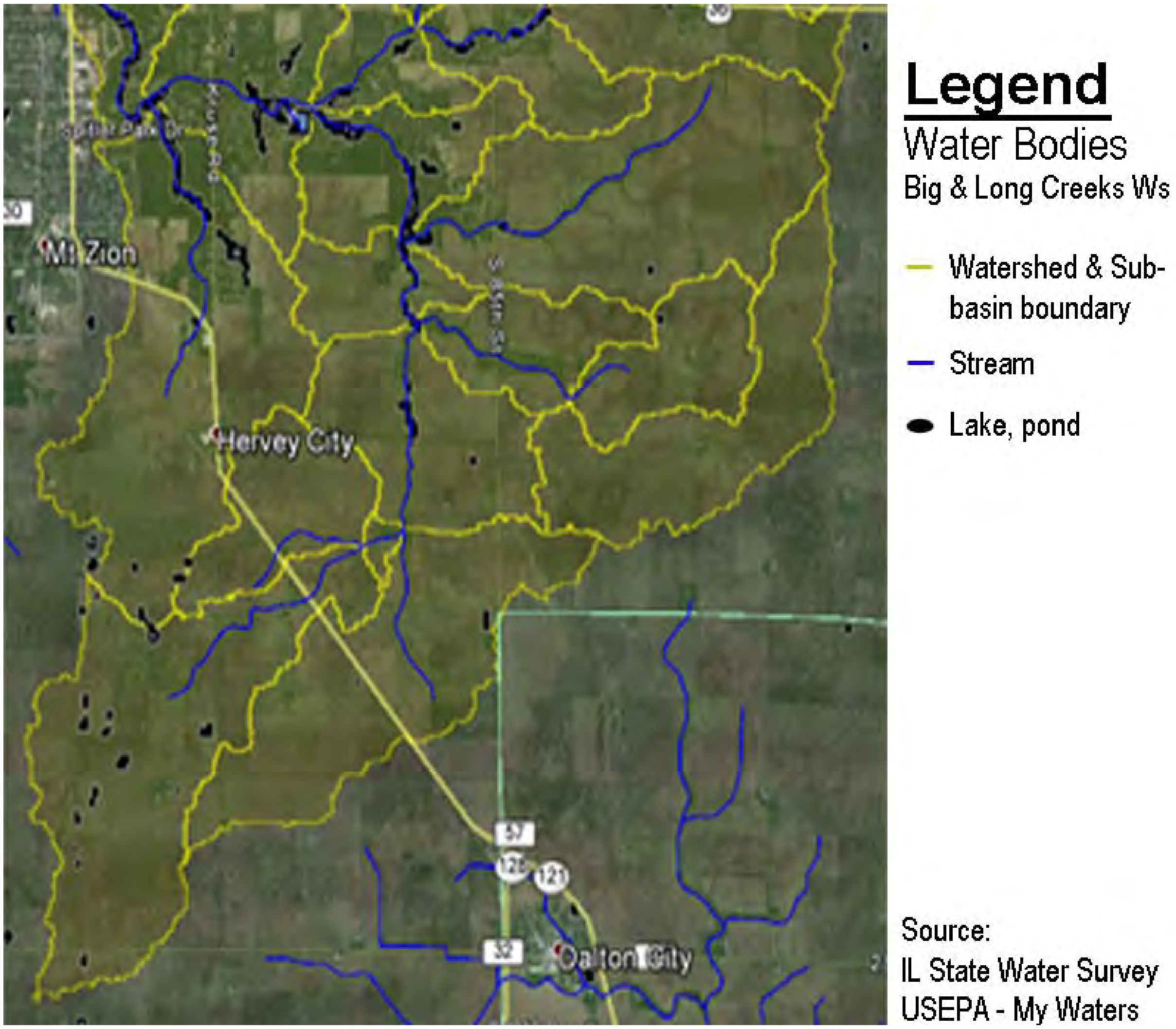


Fig. 17b- Map of Water Bodies South Part of Sub-Watershed

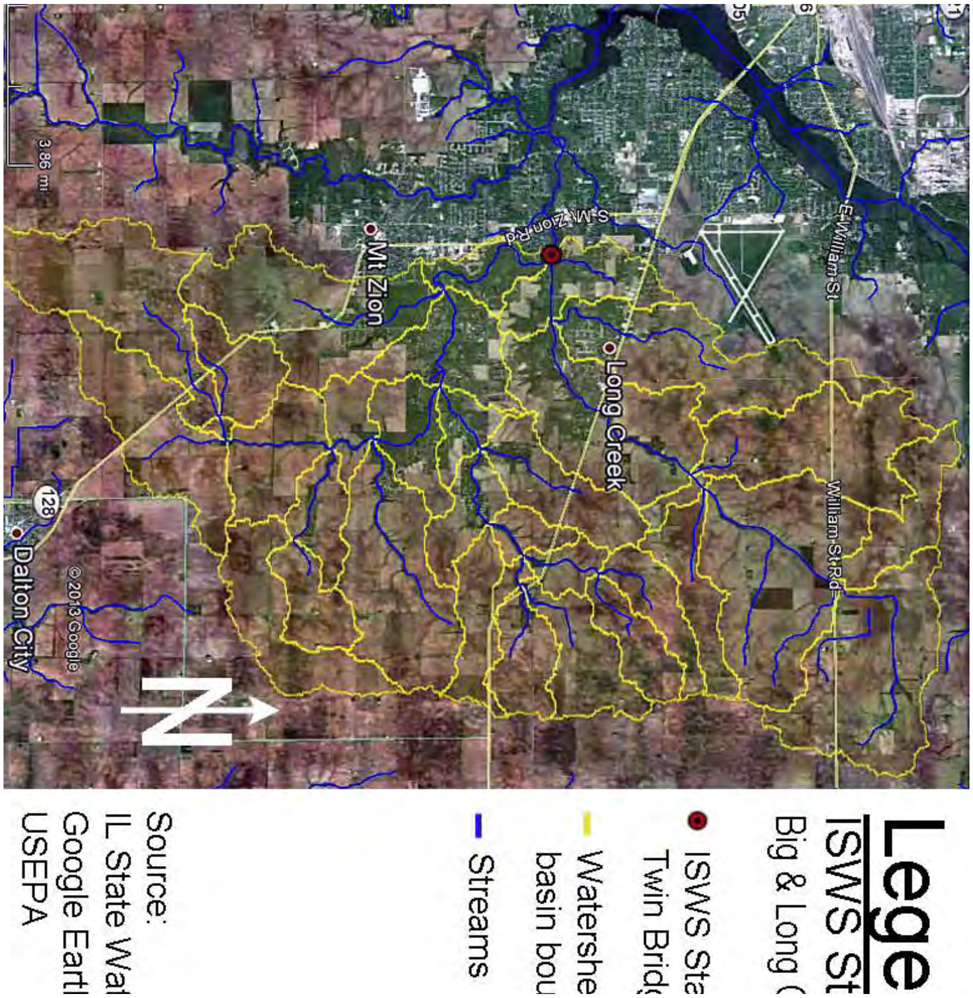


Fig. 18- Sampling station site map

Water Quality Data – Nitrogen

This watershed had weekly nitrate monitoring from 1993 to 2008. The following table shows that the flow-weighted nitrate-N concentration over this period varied from 7.1 mg/L to 10.3 mg/L. Flow-weighted concentrations are useful for detecting changes over time. For this same period of time, the annual nitrate-N yield varied from 6 to 36 lbs/acre/year.

Table 1 Summary of Rainfall, Runoff, Flow-Weighted Nitrate-N Concentration, and Nitrate-N Yield for the Long Creek at Twin Bridge Road (101) for WY1993–2008

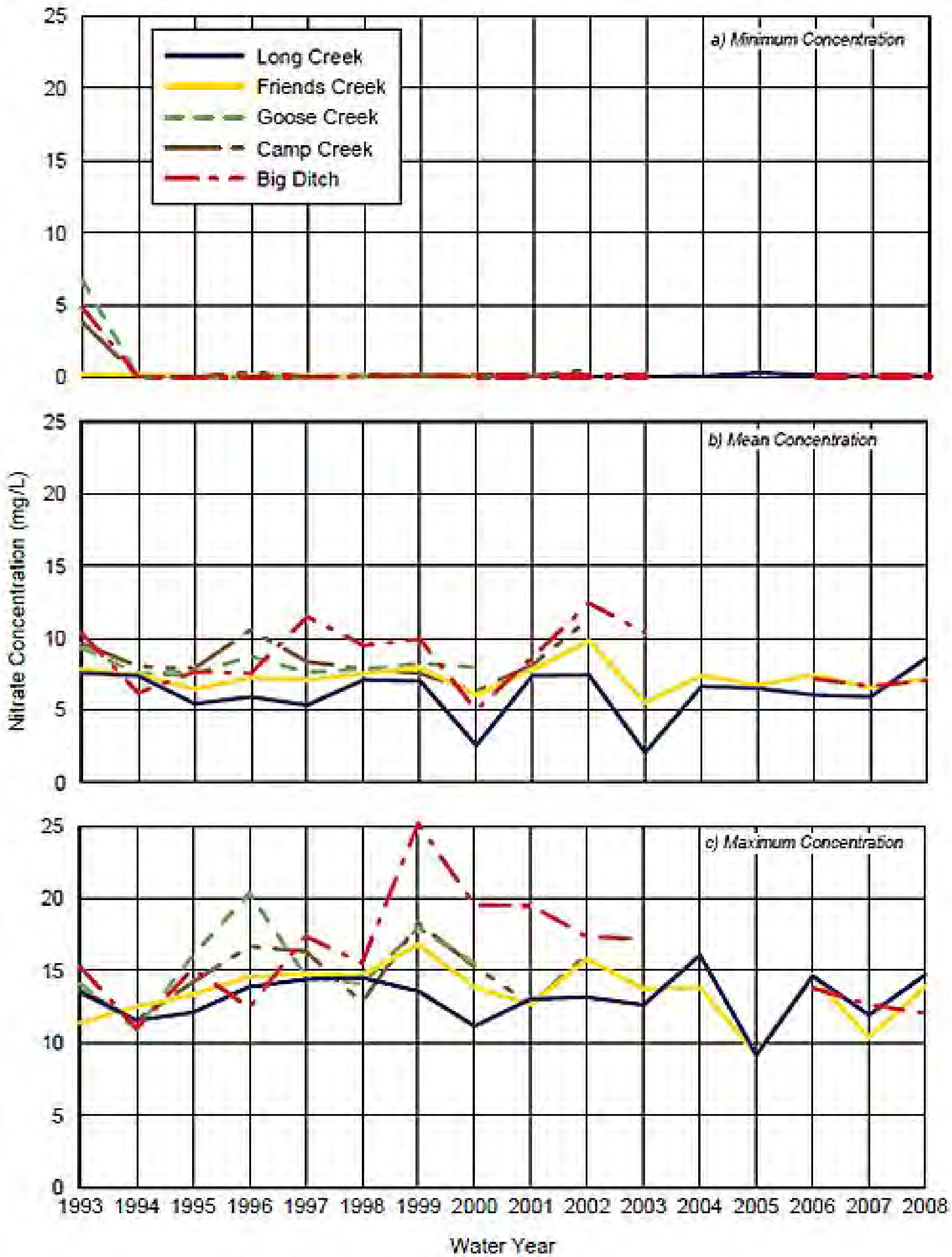
Water year (Oct-Sept)	*Total annual rainfall (inches)*	*Annual mean streamflow (1000 x cfs)*	*Annual runoff (inches)*	*Flow-Weighted nitrate-N concentration (mg/L)*	*Annual nitrate-N yield (lb/acre/yr)*
1993*	52.4	3	*3.3	*7.7	*6
1994	34.4	17	16.3	7.1	26
1995	36.3	8	6.6	9.1	14
1996	39.1	14	11.3	9.1	14
1997	30.2	5	3.7	8.8	7
1998	38.9	21	17.0	10.2	39
1999	34.5	20	16.1	10.3	37
2000	29.5	5	4.2	4.6	4
2001	38.0	17	13.1	9.8	29
2002	46.9	23	18.8	8.8	36
2003	33.6	3	2.6	6.2	4
2004	37.9	13	10.9	10.0	25
2005	42.2	21	17.1	7.4	28
2006	36.5	11	8.9	8.9	18
2007	31.9	12	9.8	8.1	19
2008	60.0	29	23.6	10.0	50
15-year mean (1993-2008)	38.9	14	12.0	8.5	23

Notes: *Data only for May–September 1993.
Source: Hydrologic and Nutrient Monitoring of the Lake Decatur Watershed: Final Report 1993–2008, L. Keefer etal.

Table 3. Summary of Rainfall, runoff and nitrate-n concentrations and yield for Long Creek at Twin Bridge Road

Over this period, the annual nitrate-N minimum concentration varied from 0.02 to 0.74 mg/L, the annual nitrate-N mean concentration varied 2.06 to 8.63 mg/L and the annual nitrate-N maximum concentration varied from 9.18 to 16.07 mg/L. "All the mean nitrate-N concentrations were below the maximum contaminant level (MCL) of 10 mg/L for the entire monitoring period."[28] All the nitrate-N sample concentrations for this site (ISWS station #101) can be found in Appendix E of "Hydrologic and Nutrient Monitoring of the Lake Decatur Watershed: Final Report 1993-2008" on pages A-120 to A-138.

The following graph shows the annual nitrate-N concentration data, please note that Long Creek is the dark blue line.



Annual nitrate-N concentrations in the tributary stations:
a) minimum, b) mean, and c) maximum
Source: Hydrologic and Nutrient Monitoring of the Lake Decatur Watershed: Final Report 1993–2008, L. Keefer etal.

Fig. 19

Other data from “Hydrologic and Nutrient Monitoring of the Lake Decatur Watershed: Final Report 1993-2008” shows an annual runoff of 12 inches of water per year. This is a contributing factor to the sediment and siltation problem of the nearby Lake Decatur, which is the drinking water source for the City of Decatur.

Water Quality Data – Sediment and Siltation

Sediment is “a recognized long-term problem to be controlled so that Lake Decatur can provide an adequate water supply to the City of Decatur. The ISWS has conducted eight sedimentation surveys in Lake Decatur (1931 1932, 1936, 1946, 1956, 1966, 1983, 2000, and 2001). Analysis of the lake sedimentation surveys from 1922 until 1983 showed that total lake storage capacity dropped from 27,900 to 18,800 acre-feet (ac-ft), a loss of one-third of the original capacity in 61 years. The annual capacity loss rate for Lake Decatur averaged 149 ac-ft. The total sediment delivered to the lake between 1922 and 1983 was 21.4 tons per acre of watershed. The 1922–1983 annual rate of sediment delivered to the lake is 0.35 tons per acre (per year), and 77 percent of that sediment is trapped (deposited) in the lake for an annual accumulation rate of 0.27 tons per acre (per year).”[29]

Sedimentation surveys conducted in 2000 and 2001 showed that “the capacity of the Big/Long Creek Basin [of Lake Decatur] decreased from 2,754 ac-ft. in 1922 to 1,512 ac-ft in 2001, a loss of 54.9 percent. Annual sedimentation rates for the basin were 9.9 ac-ft.”[30] Sediment in a lake causes loss of capacity, but it also carries with it phosphorus, a key nutrient for the growth of aquatic vegetation.

Water Quality Data--Phosphorus

The following graph from the “Sangamon River/Lake Decatur Watershed Total Maximum Daily Load Stage One Report”, October 2006, shows that the sediment and siltation in Lake Decatur caused the lake water to exceed the total phosphorus MCL of 0.05 mg/L.[31]

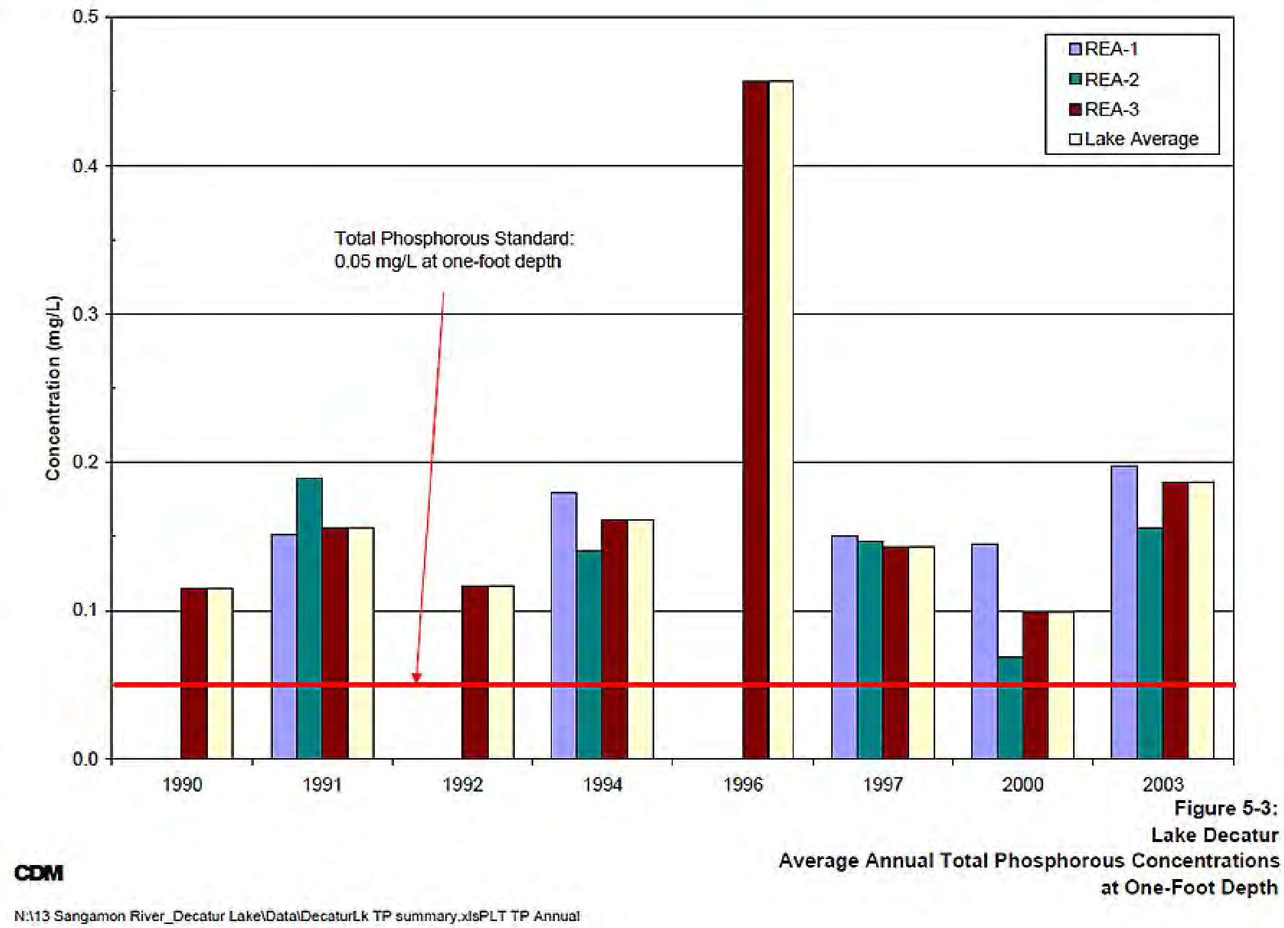


Fig. 20

Existing Best Management Practices (BMPs)

Observations of existing BMPs in this watershed were made during a rainy period in April 2013 by Tim McMahon, a certified professional in erosion and sediment control (CPESC).

A significant number of grass waterways, terrace systems, grade stabilization structures, filter strips and ponds exist throughout both Big Creek & Long Creek Sub-watersheds (see figures 21-23). The 2007 TMDL report noted that more are needed. Additional practices have been installed since that point in time, through the Lake Decatur Watershed Program financially supported by the City of Decatur or through Federal programs. There is a need for maintenance and upkeep of existing BMPs. The lack of maintenance is creating erosive conditions in conjunction with the existing BMP (see figure 24).

There were issues with erosion control BMPs associated with urban construction. In the sites that were visited, it was observed that some BMPs were installed improperly and/or have not been properly maintained. (See figures 25-27).

Another issue noted was the lack of tillage management. About 90% of the cropland in this watershed is chisel tilled, 2% is no-tilled, and the balance is mulch tilled or tilled with other tillage systems. None is moldboard plowed. Some of the ephemeral erosion was due to areas of concentrated flows having been tilled. If these areas had been left untilled, the possibility of erosion occurring in these areas would have been reduced.

Josh Tanner, Supervisor of Assessments for Macon County, stated that grassed waterways and vegetative filter strips are taxed at one sixth of the rate of productive farmland. The assessment for a farm is determined from current aerial photos of cropland and non-cropland. The tax assessor is not required to, and does not, keep or compile any separate records of acreages of land determined to be in grassed waterways or vegetative field strips.[32]

Melanie Hall of the Macon County Farm Service Agency and Rob Lawson of the Natural Resources Conservation Service confirmed that neither FSA nor NRCS keep records for any of the following programs based on watershed boundaries: Wetlands Reserve Program (WRP), Grasslands Reserve Program (GRP), Wildlife Habitat Incentives Program (WHIP), Environmental Quality Incentives Program (EQIP), Conservation Reserve Enhancement Program (CREP), & Conservation Reserve Program (CRP). [33]

Fig. 21- Filter Strip along both sides of a Big Creek tributary

Fig. 22- Grassed waterway with a Drop Notch structure at the end

Fig. 23- A Block Chute structure at the end of a grassed waterway

Fig. 24- Note water flowing along the edge of the grassed waterway. The orange arrow points out the path of concentrated flow <u>across</u> the waterway to the neighboring field. This waterway needs to be reshaped.

Fig. 25- Note improper maintenance of a silt fence, which has been allowed to fall down and is now covered by eroded soil.

Fig. 26- Silt fence that is no longer protecting a storm drain inlet that feeds directly to Big Creek.

Fig. 27- Silt fence that has been installed and not maintained adjacent to road ditch. No BMPs installed on downstream slope on perimeter of lot.

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