Big Ditch Watershed TMDL Implementation Plan

August 31, 2014

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Prepared by: Agricultural Watershed Institute, Northwater Consulting, and Champaign County Soil & Water Conservation District

Prepared For: Illinois Environmental Protection Agency

Bureau of Water – Watershed Management Section
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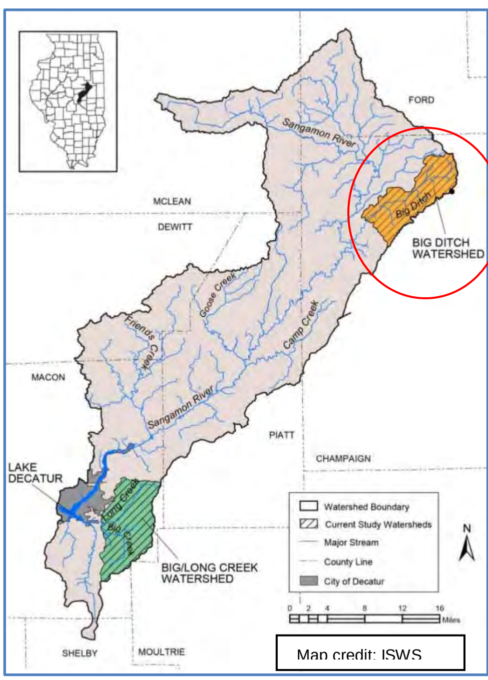

Funding for this project was provided, in part, by the U.S. Environmental Protection Agency and Illinois Environmental Protection Agency through Section 604b of the Clean Water Act. The findings and recommendations contained in this report are not necessarily those of the funding agencies.

Big Ditch Watershed
TMDL Implementation Plan

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1.0 Causes & Sources of Watershed Impairments

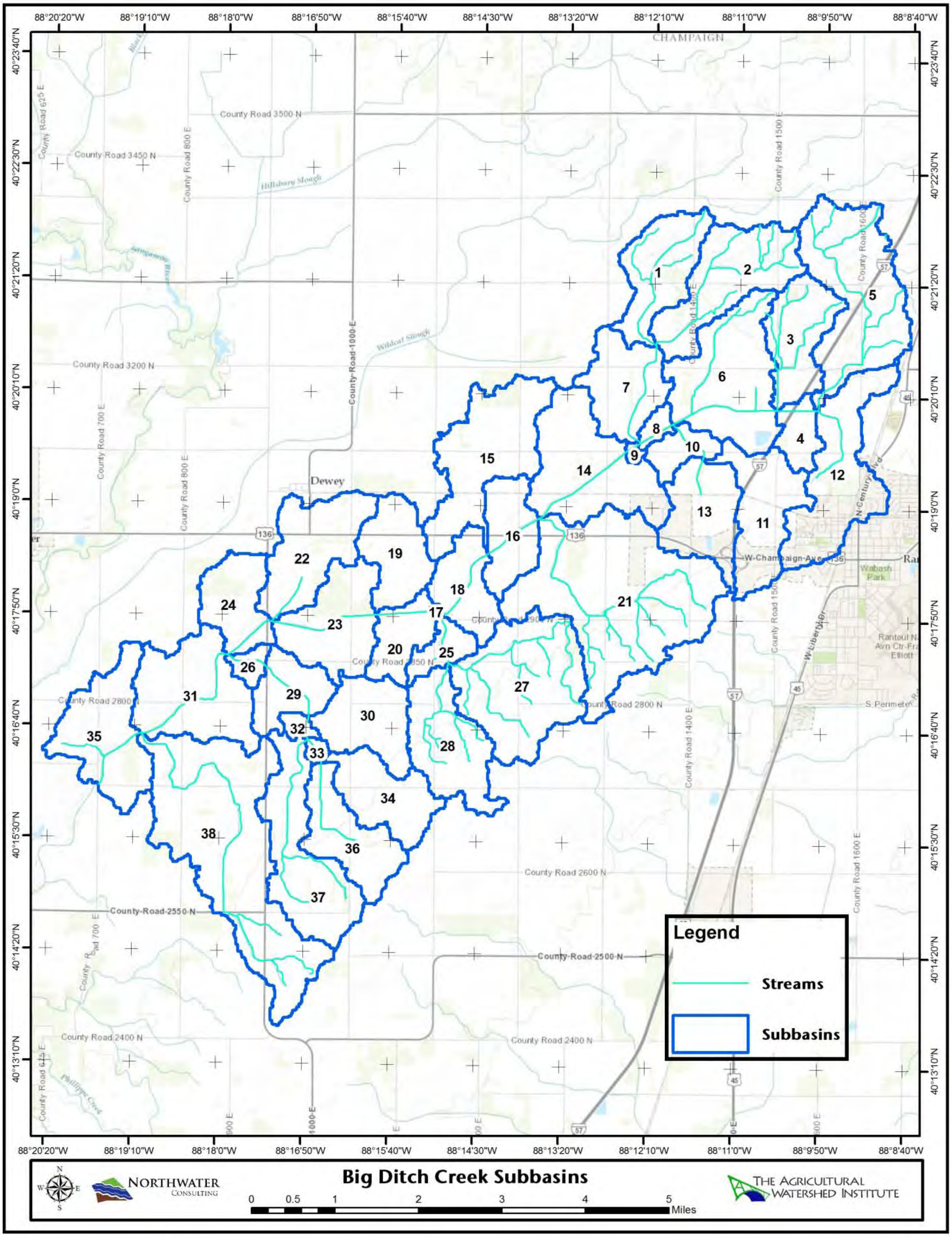
The Big Ditch watershed addressed in this Total Maximum Daily Load (TMDL) Implementation Plan is part of the Lake Decatur watershed, which in turn is part of the Upper Sangamon River watershed. The 8-digit Hydrologic Unit Code (HUC) of the Upper Sangamon River watershed is 07130006. The Big Ditch watershed includes the 12-digit HUC 071300060202 and 071300060203 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 Ditch Watershed and Subbasins



1.1 Problem Statement, Goals, & Objectives

This TMDL Implementation Plan for the Big Ditch watershed and the companion plan for the Big/Long Creek watershed in Macon 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 the Big Ditch watershed are the percentage reductions established in the 2007 TMDL report:

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

No sediment reductions were developed for the TMDL and therefore a 50% reduction in sediment was chosen. These plans for TMDL implementation in two Lake Decatur subwatersheds have been developed concurrently with the effort lead 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. Two basins near the upstream end of Lake Decatur were dredged during the past decade. The phase now beginning at a contract cost of $89 million will dredge downstream areas near the Lake Decatur dam. Implementation of practices to reduce both nutrient and sediment loading from the Big Ditch 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. If a level of nitrate reduction of 45% or more can be achieved by the management practices and cropping system changes presented in this plan, that would go beyond the TMDL reduction target and, in effect, demonstrate potential approaches that could be replicated widely to help 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 provisions for on-farm research and demonstration to assess the agricultural, environmental, and economic results of new practices and cropping systems.

While the implementation period for meeting TMDL water quality targets may be 20-years or more, it is customary to assume that the percentage of the agricultural landscape devoted to today's crops will not change enough to be a factor in watershed-level planning. In this plan, the possibility of significant landuse 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. Preliminary work has been done by and for the Village of Rantoul to explore the possibility of a biomass-fueled Combined Heat & Power facility. If implemented, such a project could create a significant local market for bioenergy grasses.

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 Ditch 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 is nearly all used for that purpose; much of the cropland is tile drained; there is only one small point source wastewater discharge and a small area that delivers urban stormwater to the watershed. There are no livestock operations in the watershed.

Portions of the WRI that identify 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 map shows that over 96% of land is used for agriculture. In 2013 about 66% of the farmland was in soybeans and 33% in corn. About 1% is used for other small grain crops such as winter wheat, and less than 1% is in pasture or hay production. Commercial and low-density urban development is found along the northeast edge of the watershed in the area of Rantoul. The land in this watershed is 95% cropland, 4% urban and commercial, and 1% grass and woodland.
- **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.
- **Riparian Corridors:** A survey of the watershed conducted in April, 2013 showed that buffer strips were being used near water bodies. A review of aerial imagery of the watershed conducted in April, 2013 showed the number of buffers along water bodies had held steady in the past six years. An estimated 460 acres of grass and/or forest buffer strips are still in existence.

- **Municipal/Industrial Point Sources:** There is only one NPDES permitted site in the watershed. It is the Conair Corporation's NPDES permit # IL0074136 which limits discharges to a pH between 6 and 9, limits TSS to a 30 day average of 15 mg/l and a daily maximum of 30 mg/l, and limits total residual chlorine discharges to a maximum daily level of .05 mg/l.
- **Stormwater Management:** This is mostly an agricultural watershed, but it does include commercial development and a small portion of the City of Rantoul along the northeast edge. During the 2013 survey, it was noted that most commercial development had retention basins, but it could not be verified for all properties.
- **Soil Classification:** Of the total 26,302 acres in this watershed soils with A, A/B, and B slopes comprise 19,175 acres, while C, C/D, and D slopes total 7,127 acres.
- **Existing Best Management Practices:** A significant number of grass waterways, grade stabilization structures, and filter strips exist throughout the Big Ditch subwatershed. In areas were filter strips have been removed, an adequate grass buffer is still being maintained. Ditch bank erosion is minimal and most likely because the Big Slough Drainage District has done an excellent job maintaining the ditch annually. However, there is a need for maintenance on a large number of the existing grass waterways.
- **Water Quality Data:** Illinois State Water Survey (ISWS) monitoring data on nitrate-N, sediment and siltation, and a subwatershed nutrient study are presented in the Big Ditch WRI, Appendix A.

3.0 Critical Areas

Critical areas selected for Big Ditch represent a selection of subbasins delineated by the ISWS as part of the SWAT modeling effort. Big Ditch was segmented into 38 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 subbasin is ranked high in both goal categories. Figures 2 and 3 show all critical subbasins.

Table 1 - Big Ditch Critical Subbasin Rankings

Subbasin	Subbasin Acres	Final Rank; Reduce Sediment & Phosphorus	Final Rank; Reduce Nitrogen
1	660	16	24
2	901	**3**	16
3	600	15	17
4	231	30	30
5	1,275	8	26
6	1,122	23	**3**
7	622	34	10
8	86	37	33
9	27	38	36
10	223	35	28
11	722	33	20
12	1,012	32	13
13	639	28	25
14	1,083	31	7
15	1,058	26	4
16	478	27	19
17	9	36	38
18	466	22	12
19	542	20	10
20	361	12	27
21	2,218	19	**1**
22	785	11	23
23	753	14	18
24	503	6	31
25	210	25	32
26	104	**2**	35
27	1,278	29	5
28	757	24	9
29	414	4	28
30	604	17	8
31	964	**1**	21
32	67	5	34
33	46	13	37
34	590	21	15
35	855	10	21
36	623	9	14
37	983	18	6
38	2,156	7	**2**

Figure 2 - Big Ditch Critical Areas for Nitrogen Reduction

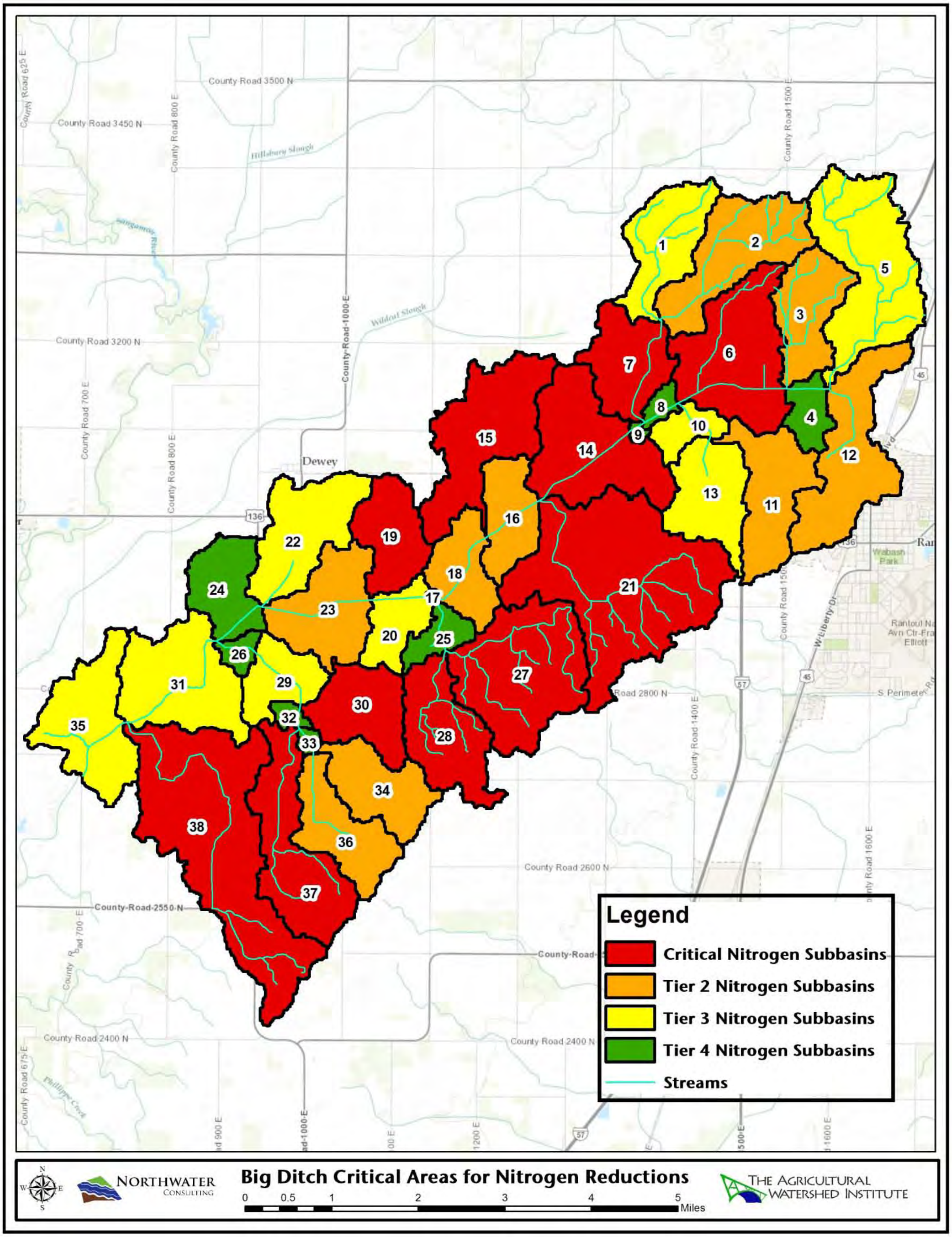
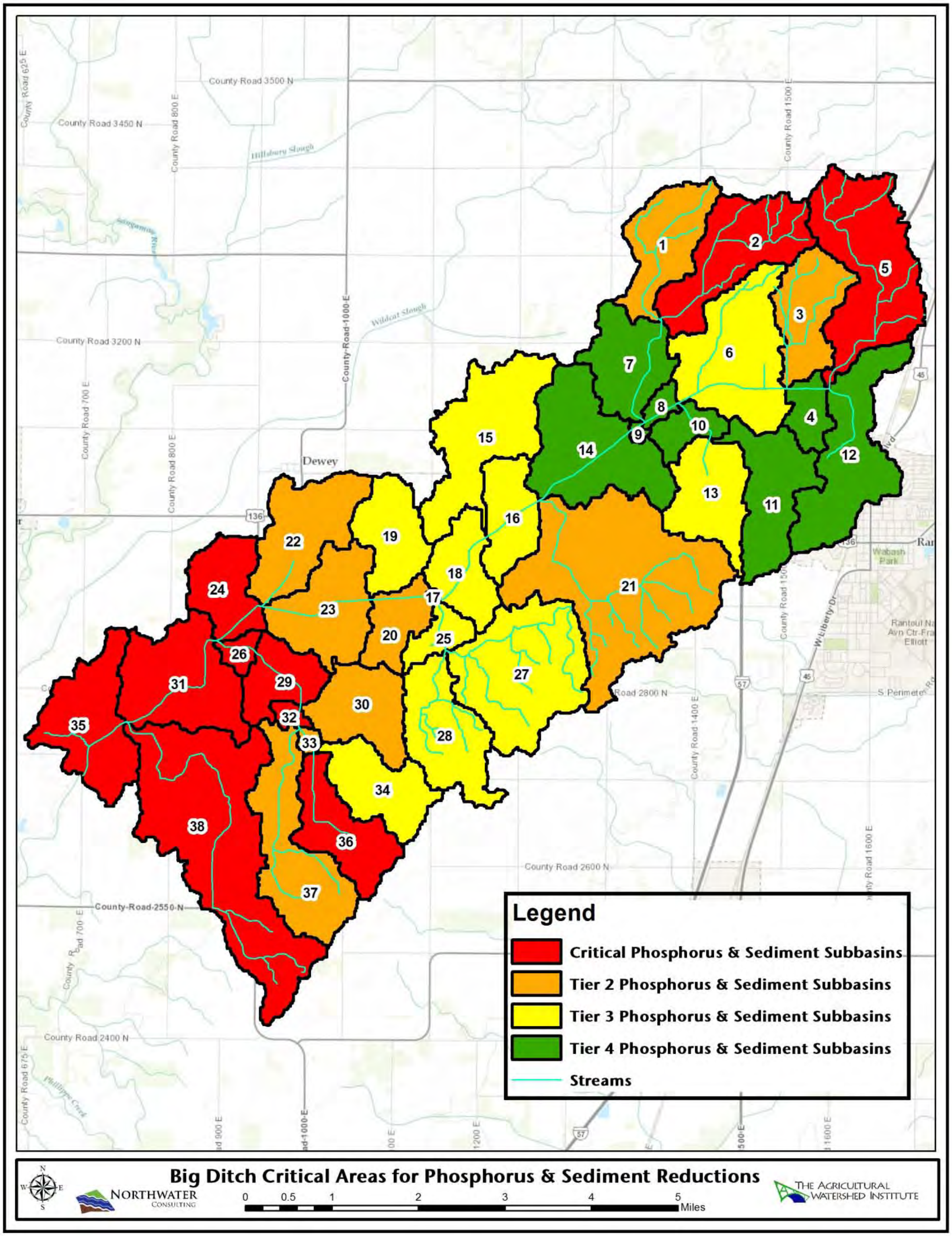


Figure 3 - Big Ditch Critical Areas for Phosphorus & Sediment Reduction



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 Ditch 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 landuse 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 exiting 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 based on a very limited set of water quality data, especially for high flow events that generate much of the sediment and phosphorus load and therefore the supporting model calibrated values are significantly higher than the SWAT output.

Table 2 - Big Ditch 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)	31.6	27	699,009	399,670	299,339
Phosphorus (lbs/ac/yr)	0.54	1.6	40,813	39,878	935
Sediment (tons/ac/yr)	0.11	0.63	16,310 (tons/yr)	16,310 (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 will describe the Best Management Practices (BMPs) recommended for the Big Ditch 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	15%-40%	20%-45%	25%-70%
Pond	40%	50%	70%
Field Border	40%	45%	55%
Cover Crop/Conservation Tillage	30%	30%	40%
Terrace/WASCB	30%	65%	70%
Restrictor/Blind Inlet	5%	50%	70%
Saturated Buffer	5%	55%	60%
Filter Strip	50%	55%	65%
Grass Waterway	40%-55%	45%	70%
Nutrient Management Plan	0%	37%	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	20%-40%	0%	0%
Pond	5%	5%	0%
Field Border	10%	5%	0%
Cover Crop/Conservation Tillage	30%	10%	0%
Terrace/WASCB	0%	5%	0%
Restrictor/Blind Inlet	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

- Filter Strips
- Field Borders
- Blind Inlets
- Bio Reactors
- Two-Stage Ditch

If implemented, all recommended site-specific practices will result in total annual load reductions of 247,400 lbs nitrogen (9.5 lbs/ac), 16,927 lbs (0.65 lbs/ac)of phosphorus and 9,732 tons (0.4 tons/ac)of sediment. If implemented, these site-specific practices will exceed the nitrogen and sediment target but will not meet the phosphorus reduction target. 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)	699,009	**Total Phosphorus Load (lbs/yr)**	40,813	**Total Sediment Load (tons/yr)**	16,310
Nitrogen Load Reduction (lbs/yr)	247,400	**Phosphorus Load Reduction (lbs/yr)**	16,927	**Sediment Load Reduction (tons/yr)**	9,732
Nitrogen Reduction Target	28%	**Phosphorus Reduction Target**	74%	**Sediment Reduction Target**	50%
Reduction % Achieved	35%	**Reduction % Achieved**	41%	**Reduction % Achieved**	57%

Table 6 - Site-Specific Load Reduction Summary & Reduction Targets

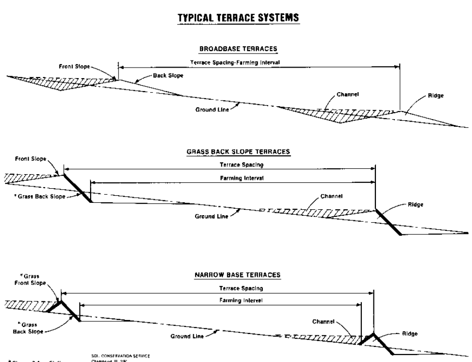
Subbasin Number	Subbasin Nitrogen (lbs/yr)	Subbasin P Load (lbs/yr)	Subbasin Sediment Load (tons/yr)	BMP N Load Reduction (lbs/yr)	BMP P Load Reduction (lbs/yr)	BMP Sediment Load Reduction (tons/yr)	% Reduction N	% Reduction P	% Reduction Sediment
1	20,371	923	318	3,816	189	105	19%	20%	33%
2	29,086	1,620	637	8,124	599	319	28%	37%	50%
3	18,152	1,100	451	1,775	17	4	10%	2%	1%
4	6,149	341	126	68	2	0	1%	1%	0%
5	37,435	2,590	1,077	8,529	833	458	23%	32%	43%
6	32,335	1,786	671	13,137	739	401	41%	41%	60%
7	16,236	806	303	4,241	268	127	26%	33%	42%
8	1,694	69	21	752	28	12	44%	40%	55%
9	608	33	12	44	1	0	7%	4%	2%
10	5,322	293	111	598	67	33	11%	23%	30%
11	15,435	959	335	2,863	219	136	19%	23%	41%
12	19,204	1,168	432	6,767	412	249	35%	35%	58%
13	12,761	793	256	3,180	5	134	25%	1%	52%
14	26,431	1,422	507	224	7	1	1%	1%	0%
15	27,256	1,170	376	4,244	219	98	16%	19%	26%
16	12,083	773	306	37	13	0	0%	2%	0%
17	105	8	3	5	2	0	4%	20%	0%
18	12,196	834	343	442	24	12	4%	3%	4%
19	14,575	720	254	2,272	180	56	16%	25%	22%
20	9,973	698	302	4,826	597	302	48%	86%	100%
21	55,954	3,509	1,428	24,806	1,849	1,018	44%	53%	71%
22	22,301	1,177	449	4,156	359	185	19%	31%	41%
23	22,089	1,186	465	7,665	588	294	35%	50%	63%
24	15,095	798	308	2,555	160	89	17%	20%	29%
25	5,175	341	139	956	70	45	18%	21%	32%
26	3,127	216	100	653	87	51	21%	41%	51%
27	32,800	1,596	562	12,049	536	272	37%	34%	48%
28	19,524	937	343	15,342	734	343	79%	78%	100%
29	12,245	915	404	3,064	419	285	25%	46%	71%
30	16,769	1,064	488	9,061	655	477	54%	62%	98%
31	29,530	2,012	913	17,285	1,518	913	59%	75%	100%
32	2,381	330	205	354	102	91	15%	31%	44%
33	1,241	120	57	232	25	16	19%	21%	28%
34	15,448	826	368	11,366	649	368	74%	79%	100%
35	24,342	1,408	717	18,332	1,143	717	75%	81%	100%
36	17,234	1,379	616	6,890	590	381	40%	43%	62%
37	24,972	1,416	552	13,654	780	463	55%	55%	84%
38	61,373	3,478	1,354	33,036	2,241	1,276	54%	64%	94%
Total	**699,009**	**40,813**	**16,310**	**247,400**	**16,927**	**9,732**	**35%**	**41%**	**57%**

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 7.4 acres in the watershed and will treat 929 acres of drainage. Load reductions expected, if all sites are implemented are 6,667 lbs/year of nitrogen, 643 lbs/year of phosphorus, and 223.4 tons/yr of sediment. See Figure 4.

Water and Sediment Control Basins (WASCB)

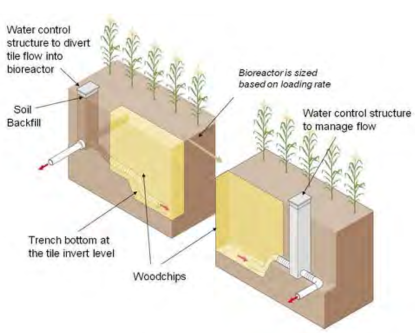


WASCBs are earth embankments constructed across a slope to intercept runoff water and trap soil. In Big Ditch, three (3) WASCBs at one site are recommended to treat 16 acres of drainage. Load reductions expected, if WASCBs at this site are implemented total 109 lbs/year of nitrogen, 40 lbs/year of phosphorus, and 20.8 tons/yr of sediment. See Figure 4.

Blind Inlet

A blind inlet is defined as an excavated earthen box with perforated collector tubing placed in the bottom and filled to the surface with rock or gravel. The rock is the inlet for surface water. One (1) blind inlet system comprising of two (2) blind inlets is recommended for Big Ditch to treat 79 acres. Load reductions expected, if two blind inlets are implemented at this site total 81 lbs/year of nitrogen, 127 lbs/year of phosphorus, and 88 tons/yr of sediment. See Figure 4.

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. 35 site-specific bioreactors are recommended in Big Ditch; these bioreactors will treat 1,759 acres.

Load reductions expected, if all sites are implemented are 8,797 lbs/year of nitrogen, and 3.4 lbs/year of phosphorus. No reductions in sediment load are expected from this practice. See Figure 5.

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 2,248 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 18,373 lbs/year of nitrogen, 518 lbs/year of phosphorus, and 159.1 tons/yr of sediment. See Figure 6.

Grassed Waterway

A grassed waterway is a grassed strip in fields that acts as an outlet for water to control silt, filter nutrients and limit gully formation. 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 Ditch 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.

Twenty-two (22) grassed waterways or 30 acres are recommended in Big Ditch; these waterways will treat 3,023 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 26,685 lbs/year of nitrogen, 2,391 lbs/year of phosphorus, and 1,489.6 tons/yr of sediment. See Figure 7.

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. Sixty-nine (69) individual wetlands or 1,106 acres (based on a ratio of drainage area to wetland area of 15:1) are recommended in Big Ditch; these wetlands will treat 16,596 acres of drainage and result in annual load reductions of 78,876 lbs for nitrogen, 9,735 lbs of phosphorus, and 5,883 tons of sediment. See Figure 8. Wetland load reductions account for both surface runoff and tile flow.

Figure 4 – Potential Site-Specific WASCBs, Field Borders & Blind Inlets

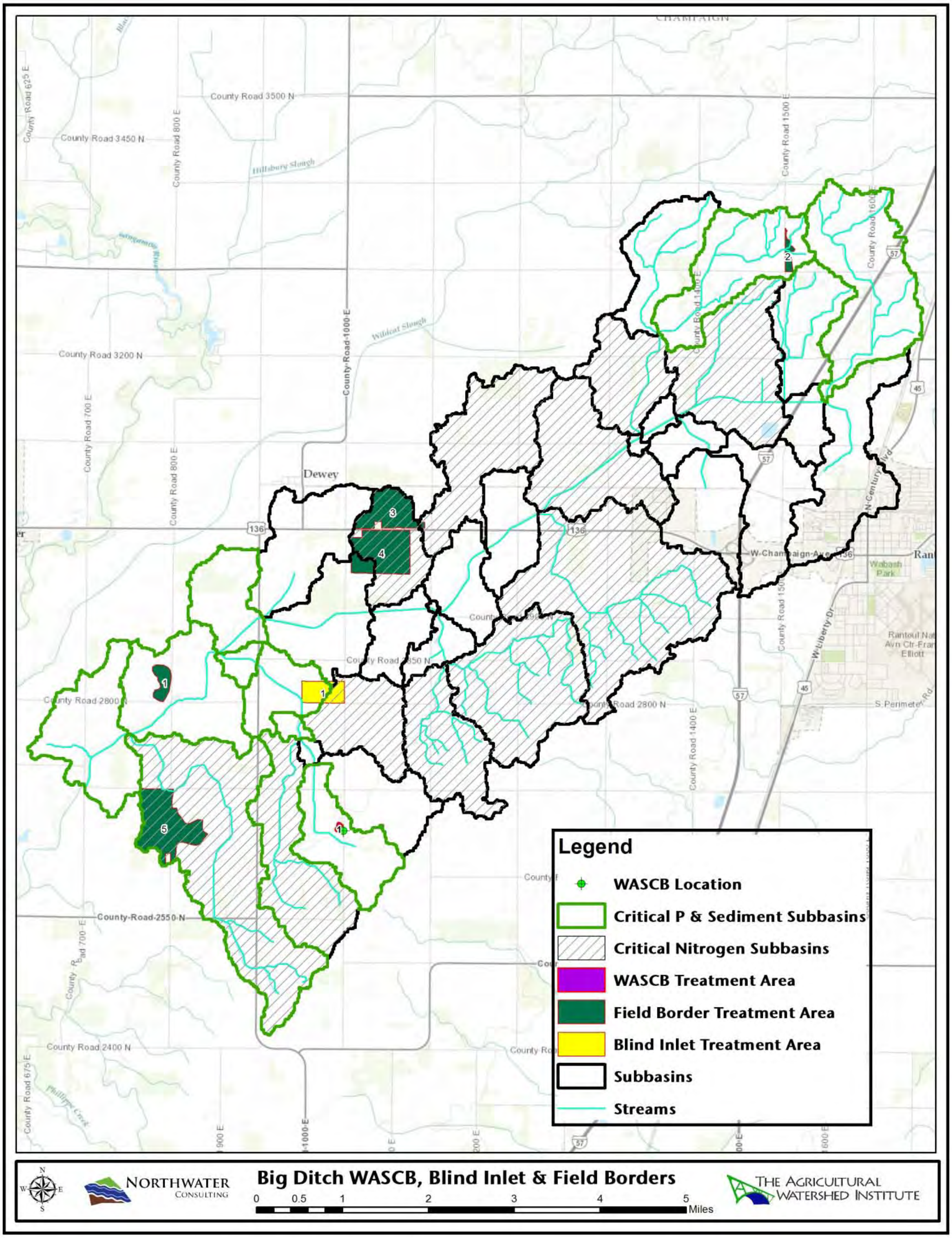


Figure 5 – Potential Site-Specific Bioreactor

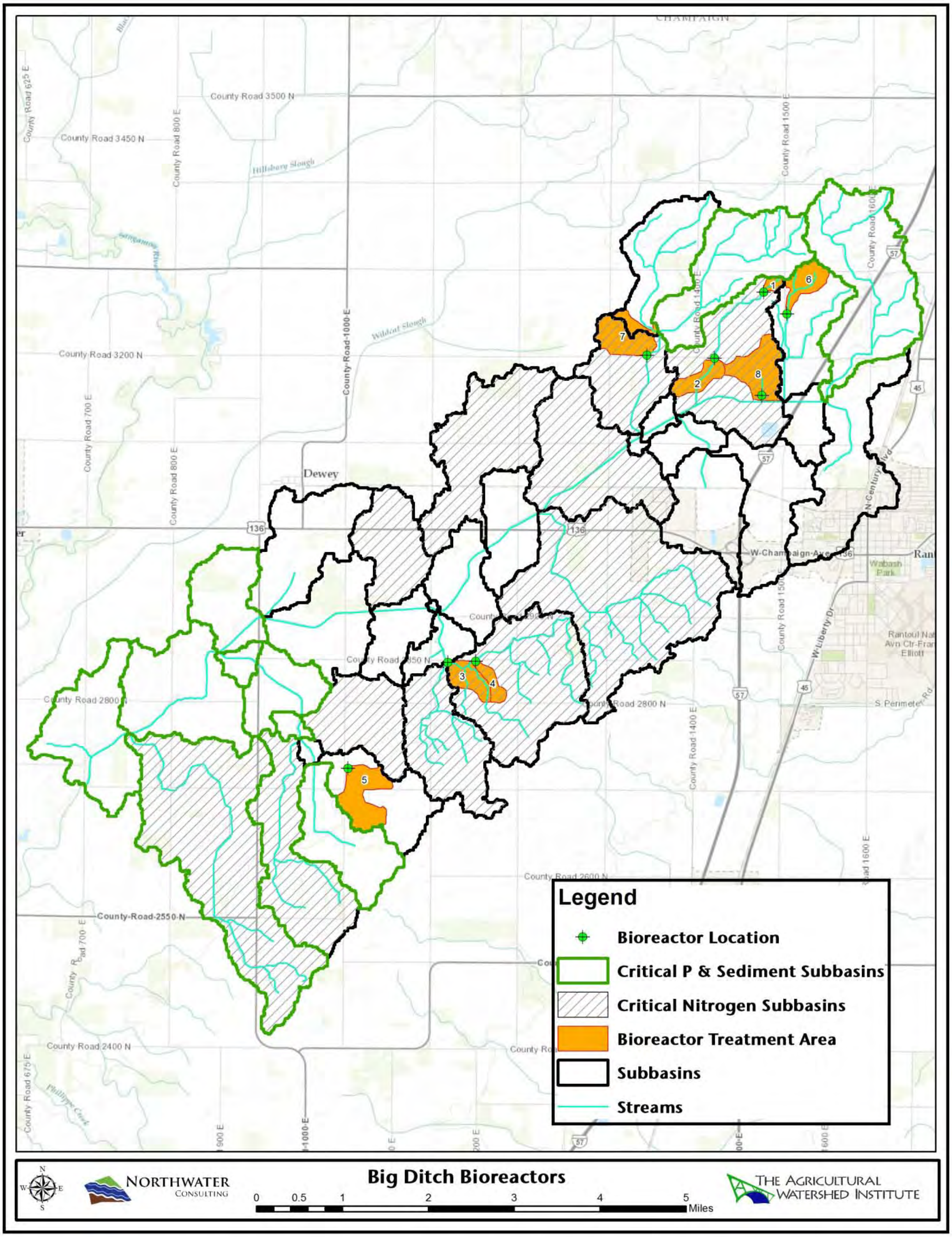


Figure 6 – Potential Site-Specific Cover Crops

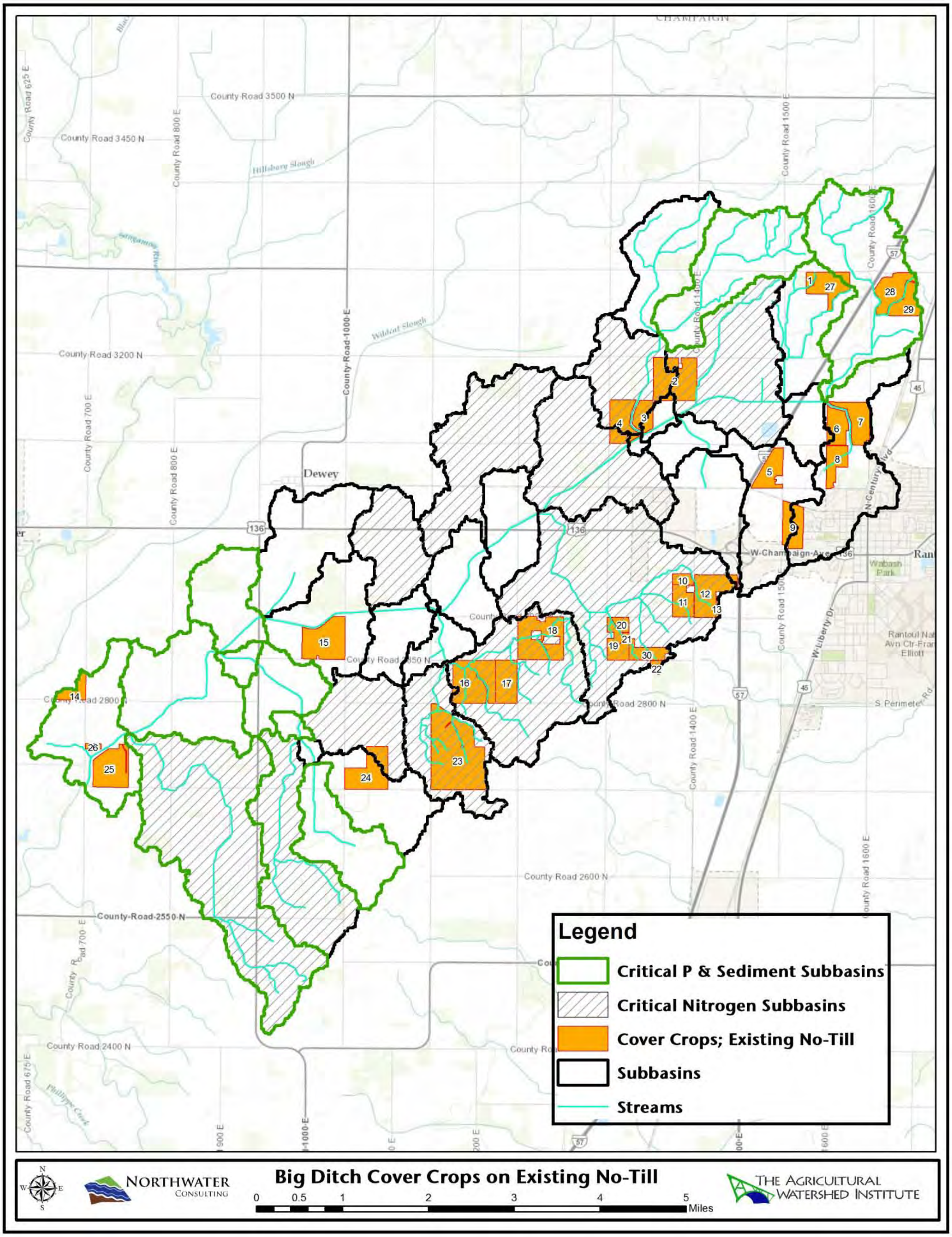


Figure 7 – Potential Site-Specific Grassed Waterway

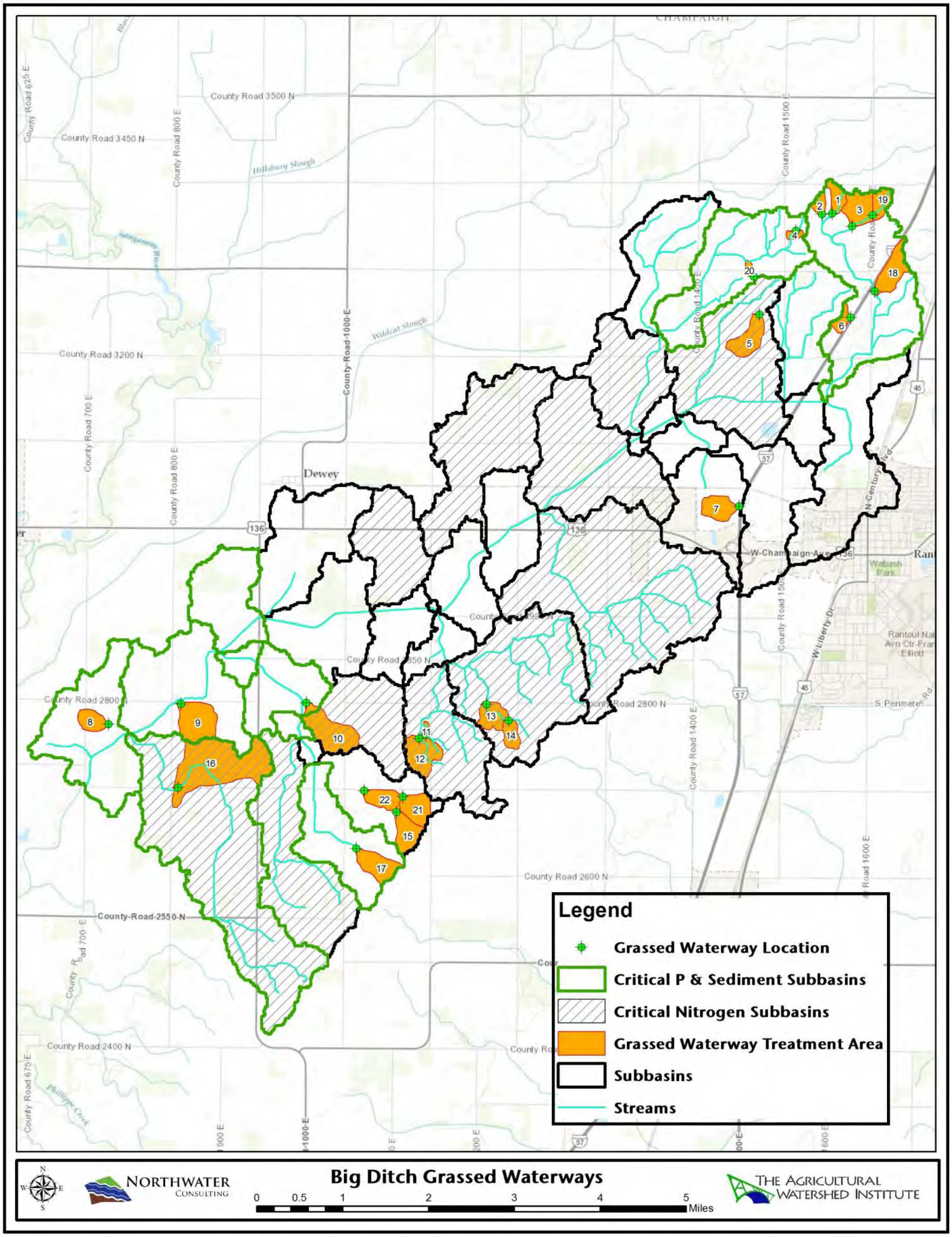
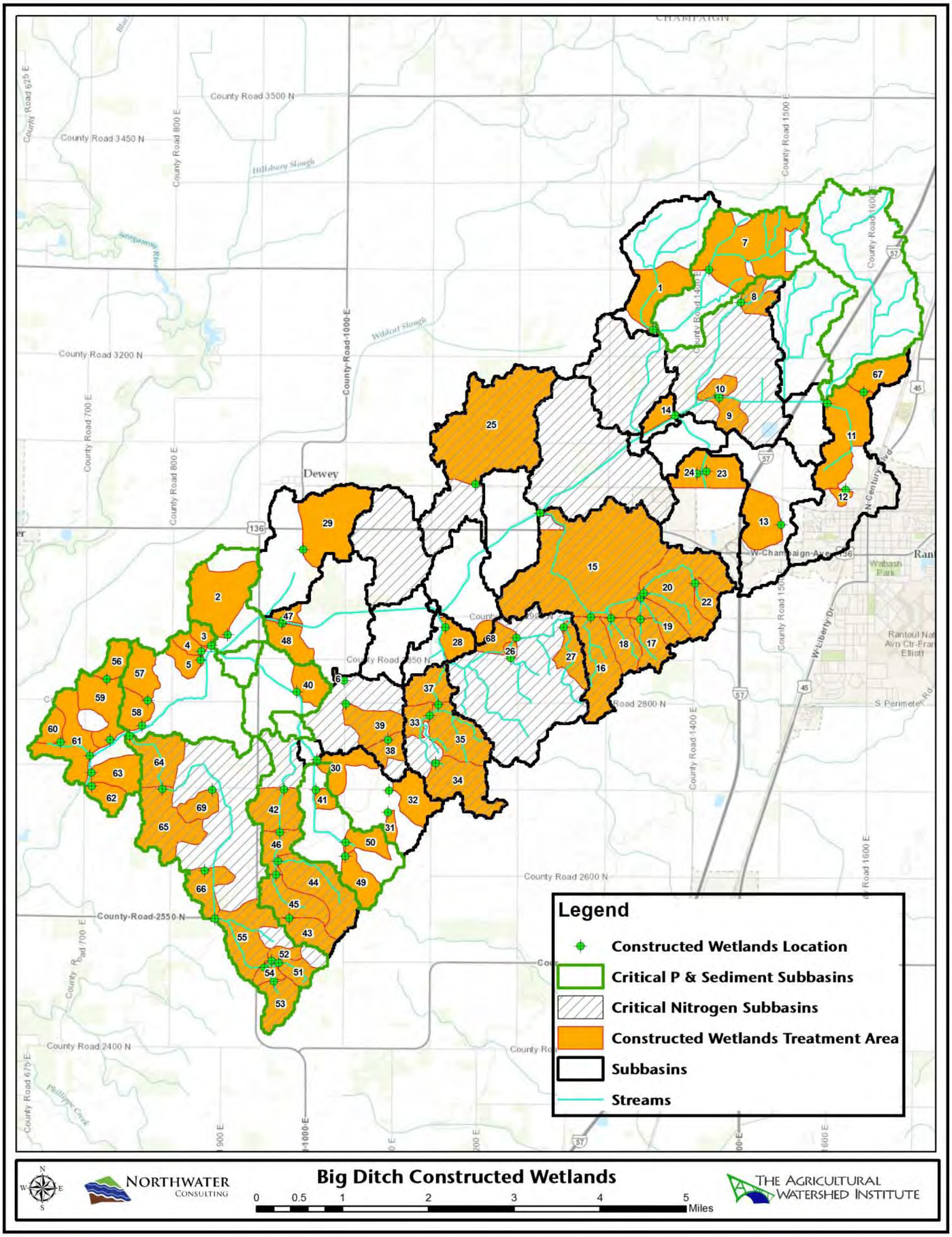


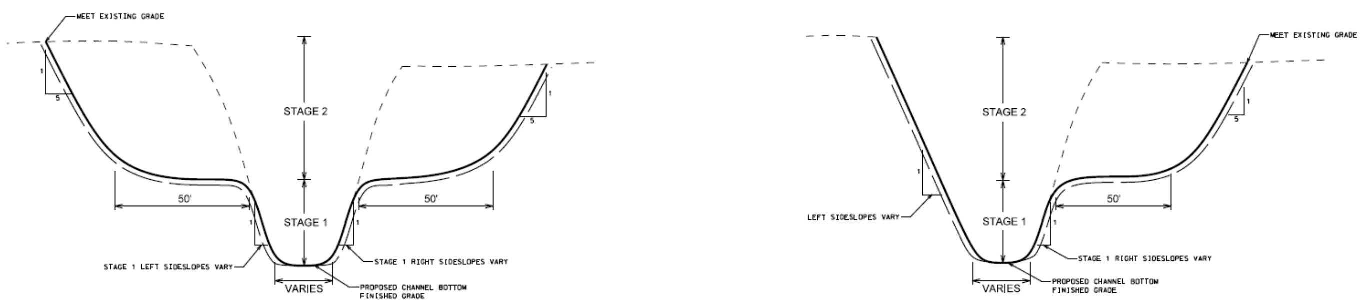
Figure 8 – Potential Site-Specific Constructed Wetland



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.

Figure 9 - Two-Stage Ditch Cross Section



TWO-STAGE DITCH TYPICAL CROSS SECTION
N.T.S. TWO BENCHES

TWO-STAGE DITCH TYPICAL CROSS SECTION
N.T.S. ONE BENCH (LEFT OR RIGHT)

In Big Ditch, 187,988 ft of two-stage ditch is recommended for channelized sections of the watershed. If implemented, these two-stage ditches will treat 129.5 acre-ft of runoff and will result in annual load reductions of 879 lbs of nitrogen, 40 lbs of phosphorus, and 12 tons of sediment. See Figure 10.

Note that the dimensions of the design shown in Figure 9 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.

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. Forty-seven (47) individual filter strips or 24 acres are recommended for Big Ditch; these practices will treat 2,993 acres of drainage. If implemented, filter strips will reduce 27,868 lbs/year of nitrogen, 3,430 lbs/year of phosphorus, and 1,856 tons/year of sediment. See Figure 11.

Figure 10 – Potential Site Specific Two-Stage Ditch

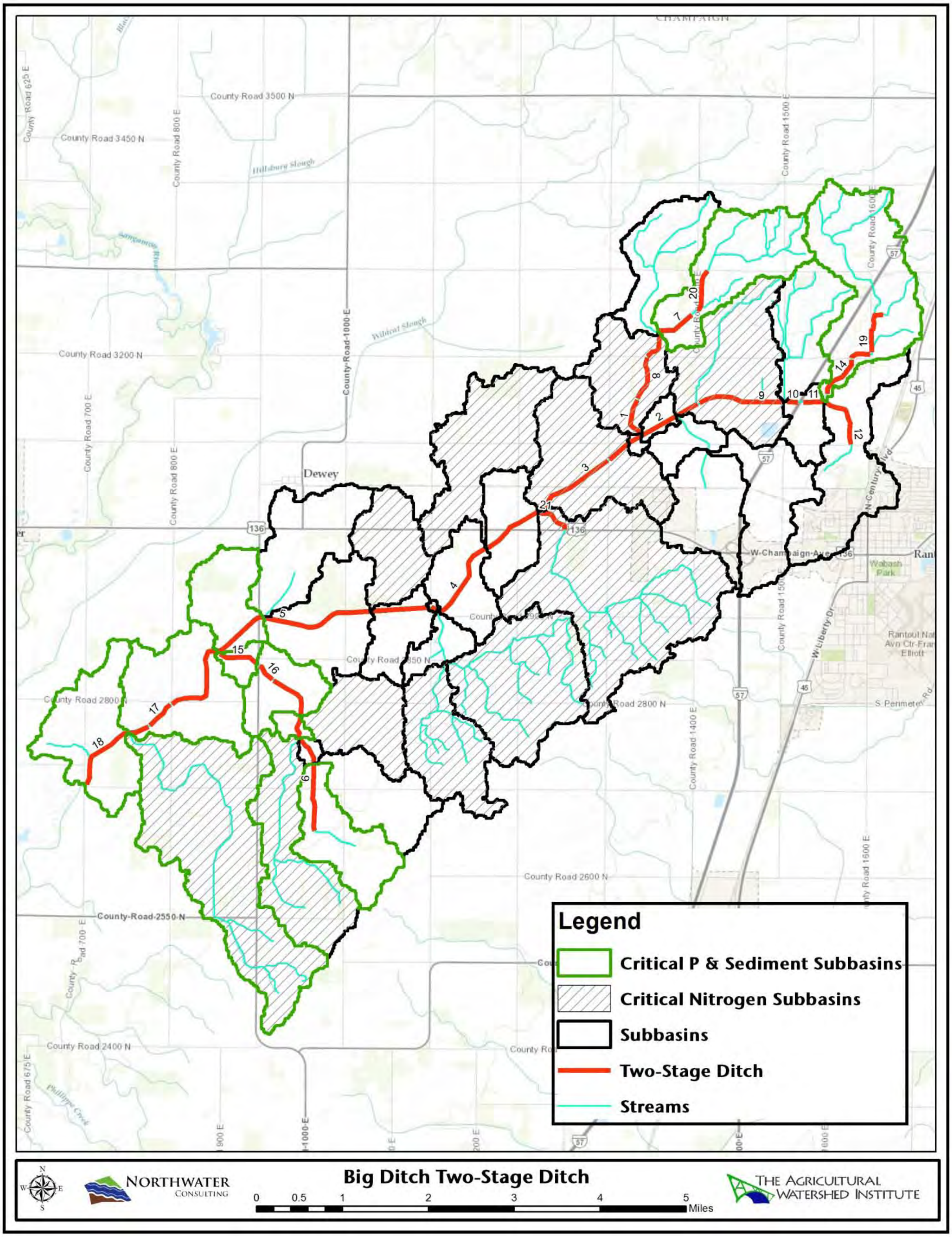
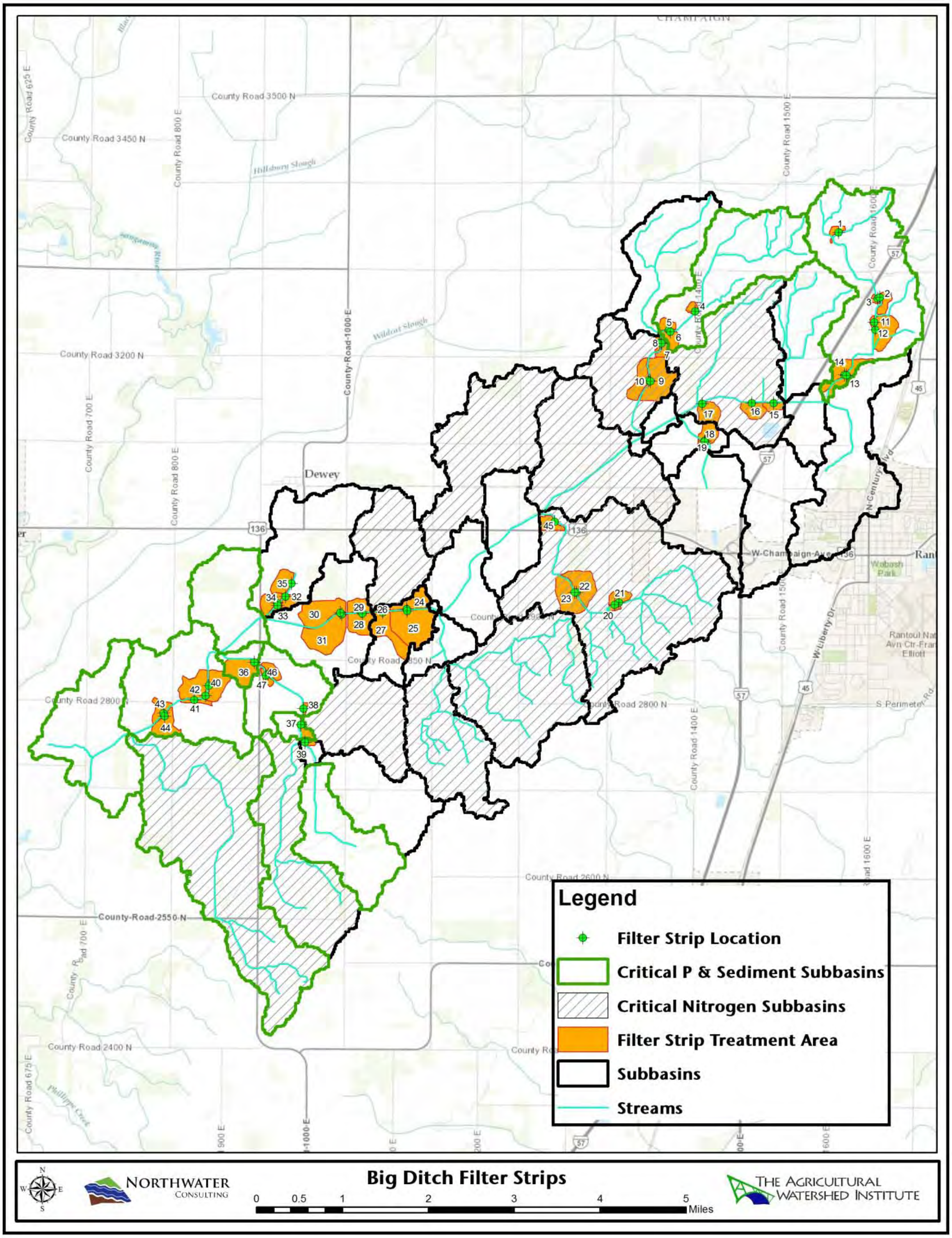


Figure 11 – Potential Site-Specific Filter Strips



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 Ditch, 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, blind inlets, saturated buffers, nutrient management, and drainage water management. Basin-wide BMP recommendations cover 67,060 acres in each 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 372,578 lbs (14.3 lbs/ac), annual phosphorus reductions of 35,072 lbs (1.35 lbs/ac), and annual sediment reductions of 10,351 tons (0.4 tons/ac). These basin-wide practices will exceed the nitrogen target, exceed the phosphorus target and exceed the sediment target.

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

Total Nitrogen Load (lbs/yr)	699,009	**Total Phosphorus Load (lbs/yr)**	40,813	**Total Sediment Load (tons/yr)**	16,310
Nitrogen Load Reduction (lbs/yr)	372,578	**Phosphorus Load Reduction (lbs/yr)**	35,072	**Sediment Load Reduction (tons/yr)**	10,351
Nitrogen Reduction Target	28%	**Phosphorus Reduction Target**	74%	**Sediment Reduction Target**	50%
Reduction % Achieved	53%	**Reduction % Achieved**	86%	**Reduction % Achieved**	63%

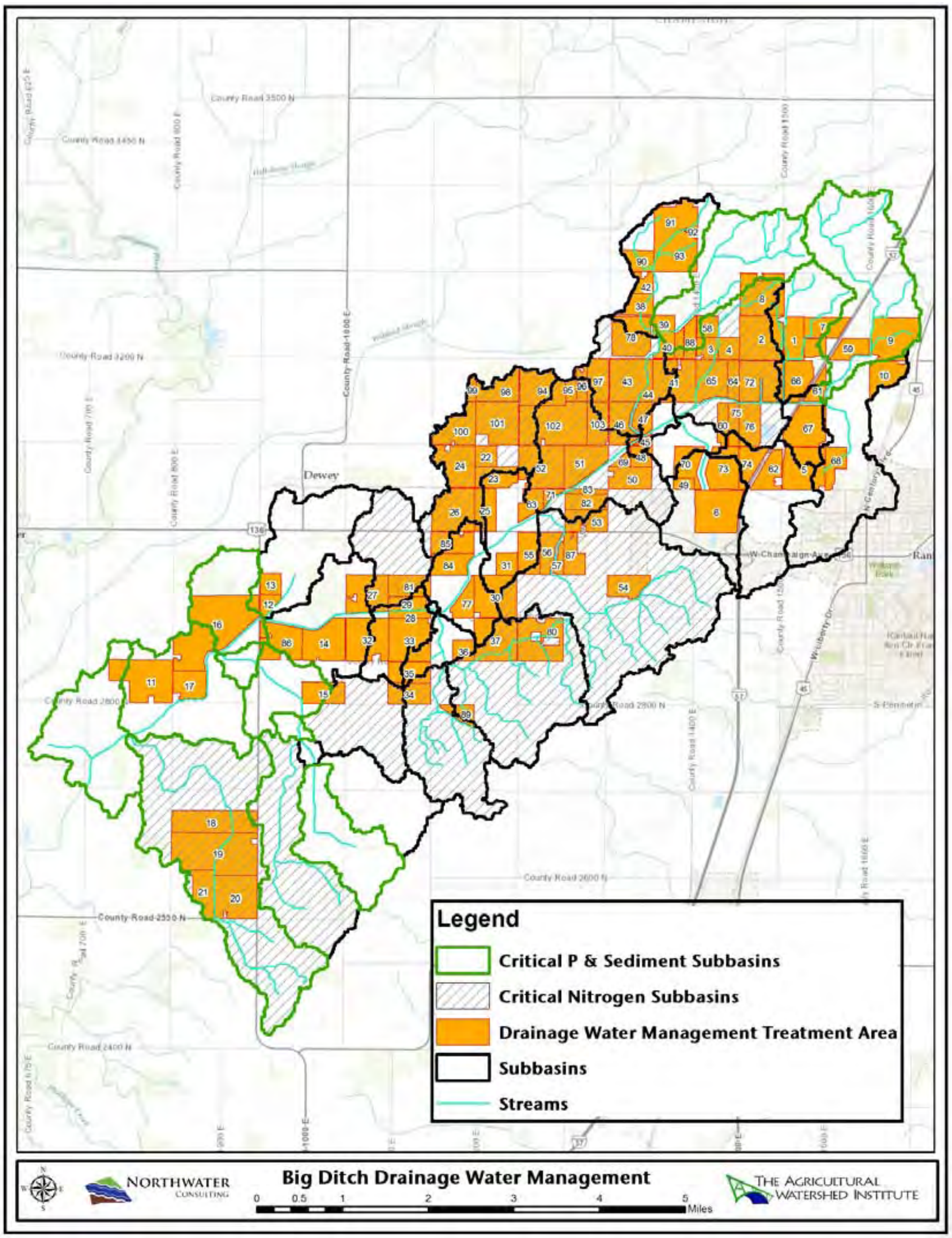
Table 8 - Basin-Wide Load Reductions by Subbasin

Subbasin Number	Subbasin Nitrogen (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	20,371	923	318	14,607	875	202	72%	95%	64%
2	29,086	1,620	637	17,247	1,581	465	59%	98%	73%
3	18,152	1,100	451	10,125	912	262	56%	83%	58%
4	6,149	341	126	3,898	233	55	63%	68%	43%
5	37,435	2,590	1,077	19,621	2,453	813	52%	95%	75%
6	32,335	1,786	671	18,556	1,308	329	57%	73%	49%
7	16,236	806	303	9,577	750	233	59%	93%	77%
8	1,694	69	21	946	75	19	56%	108%	93%
9	608	33	12	436	37	12	72%	115%	98%
10	5,322	293	111	2,972	266	73	56%	91%	66%
11	15,435	959	335	6,227	598	146	40%	62%	44%
12	19,204	1,168	432	7,772	851	254	40%	73%	59%
13	12,761	793	256	6,660	536	138	52%	68%	54%
14	26,431	1,422	507	16,028	1,113	289	61%	78%	57%
15	27,256	1,170	376	14,858	806	163	55%	69%	44%
16	12,083	773	306	7,049	660	190	58%	85%	62%
17	105	8	3	60	9	3	57%	109%	97%
18	12,196	834	343	7,748	839	266	64%	101%	78%
19	14,575	720	254	6,205	475	102	43%	66%	40%
20	9,973	698	302	5,648	529	150	57%	76%	50%
21	55,954	3,509	1,428	25,345	3,065	955	45%	87%	67%
22	22,301	1,177	449	9,841	867	225	44%	74%	50%
23	22,089	1,186	465	13,249	1,080	319	60%	91%	69%
24	15,095	798	308	8,914	579	146	59%	73%	47%
25	5,175	341	139	2,864	308	97	55%	90%	70%
26	3,127	216	100	2,104	248	95	67%	115%	95%
27	32,800	1,596	562	16,246	1,353	341	50%	85%	61%
28	19,524	937	343	8,436	804	198	43%	86%	58%
29	12,245	915	404	7,392	867	290	60%	95%	72%
30	16,769	1,064	488	8,272	983	368	49%	92%	75%
31	29,530	2,012	913	17,856	1,824	586	60%	91%	64%
32	2,381	330	205	1,576	400	205	66%	121%	100%
33	1,241	120	57	849	141	55	68%	118%	97%
34	15,448	826	368	6,689	629	161	43%	76%	44%
35	24,342	1,408	717	12,920	1,473	477	53%	105%	67%
36	17,234	1,379	616	9,927	1,510	545	58%	109%	88%
37	24,972	1,416	552	13,755	1,399	428	55%	99%	78%
38	61,373	3,478	1,354	30,101	2,637	696	49%	76%	51%
Total	699,009	40,813	16,310	372,578	35,072	10,351	53%	86%	63%

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 Ditch, DWM can be applied to treat 8,962 acres or 179 systems. If fully implemented, these practices will reduce annual load of 45,402 lbs of nitrogen and 37.5 lbs of phosphorus. This practice will not result in any reductions in sediment load. See Figure 12.

Figure 12 – Potential Basin-Wide Drainage Water Management



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 Ditch, this represents a treatment area of 5,820 acres or 146 systems with an average buffer size of 0.5 acres. If fully implemented, these practices will result in annual load reductions of 44,924 lbs of nitrogen, 6,340 lbs of phosphorus, and 3,002 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 Ditch, nutrient management can be applied to 23,242 acres and if implemented on these acres, will reduce annual nitrogen loads by an estimated 44,901 lbs and annual phosphorus loads by an estimated 14,774 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 both watersheds reduces the feasibility of structural practices such as grassed waterways or sediment basins. Modifications to current tillage practices offer a realistic option for further limiting soil and nutrient loss. Before cover crops can be implemented on these fields, a shift in tillage management often 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 Ditch, tillage management and cover crops are recommended on 20,896 acres or those farmed acres that are not currently practicing no-till or are currently in a United States Department of Agriculture (USDA) program and assumed to be implementing some type of nutrient management. If implemented, these practices will result in estimated annual reductions of 188,073 lbs nitrogen, 11,182 lbs phosphorus, and 6,177 tons of sediment. These numbers reflect current conventional/reduced tillage practices and represent the combined reductions resulting from both a change in tillage (to 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. 96 basin-wide bioreactors can be applied in Big Ditch; these bioreactors will treat 4,819 acres. Load reductions expected, if all sites are implemented are 24,051 lbs/year of nitrogen, and 9.4 lbs/year of phosphorus. No reductions in sediment load are expected from this practice. See Figure 16.

Figure 13 – Potential Basin-Wide Saturated Buffers

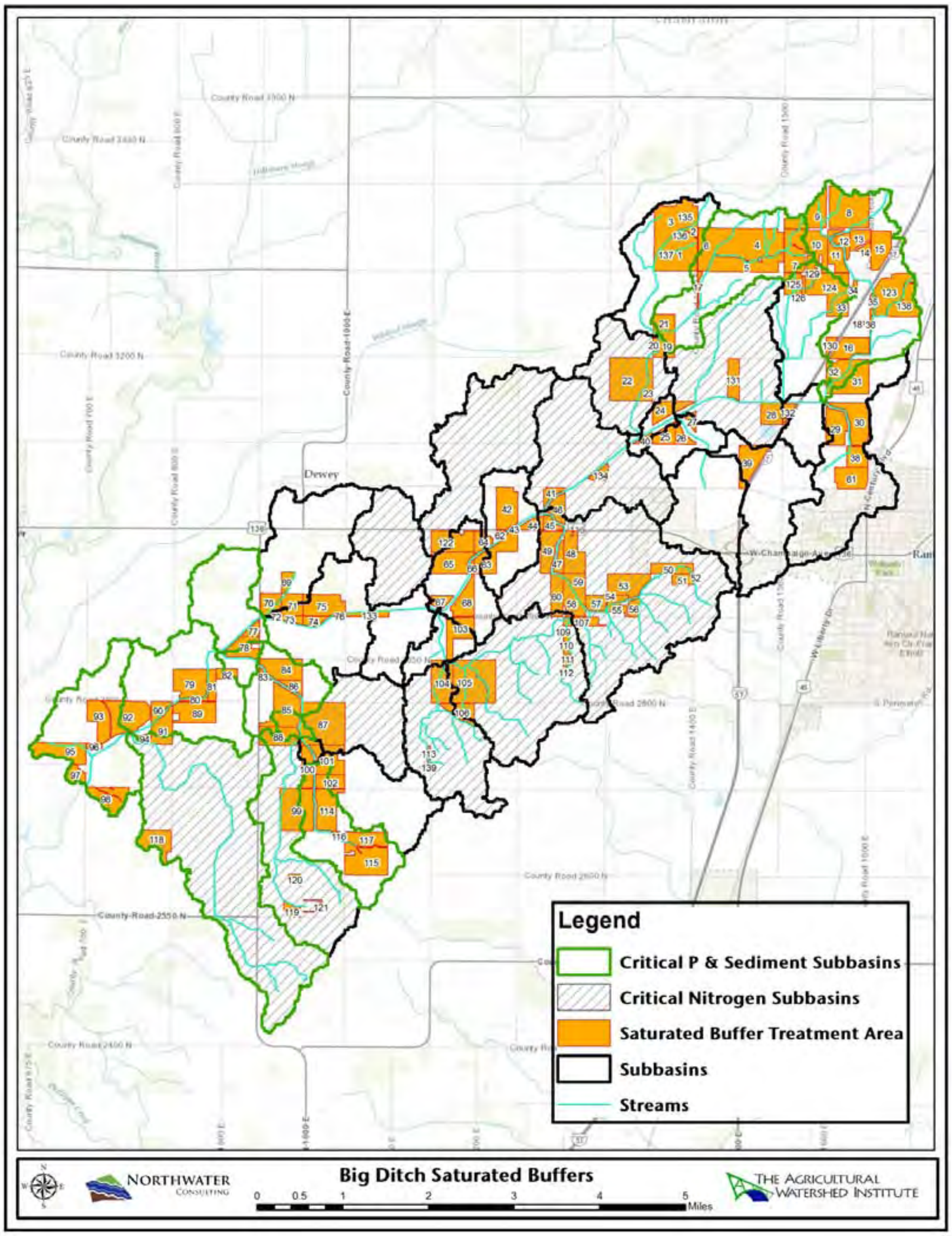


Figure 14 –Potential Basin-Wide Nutrient Management

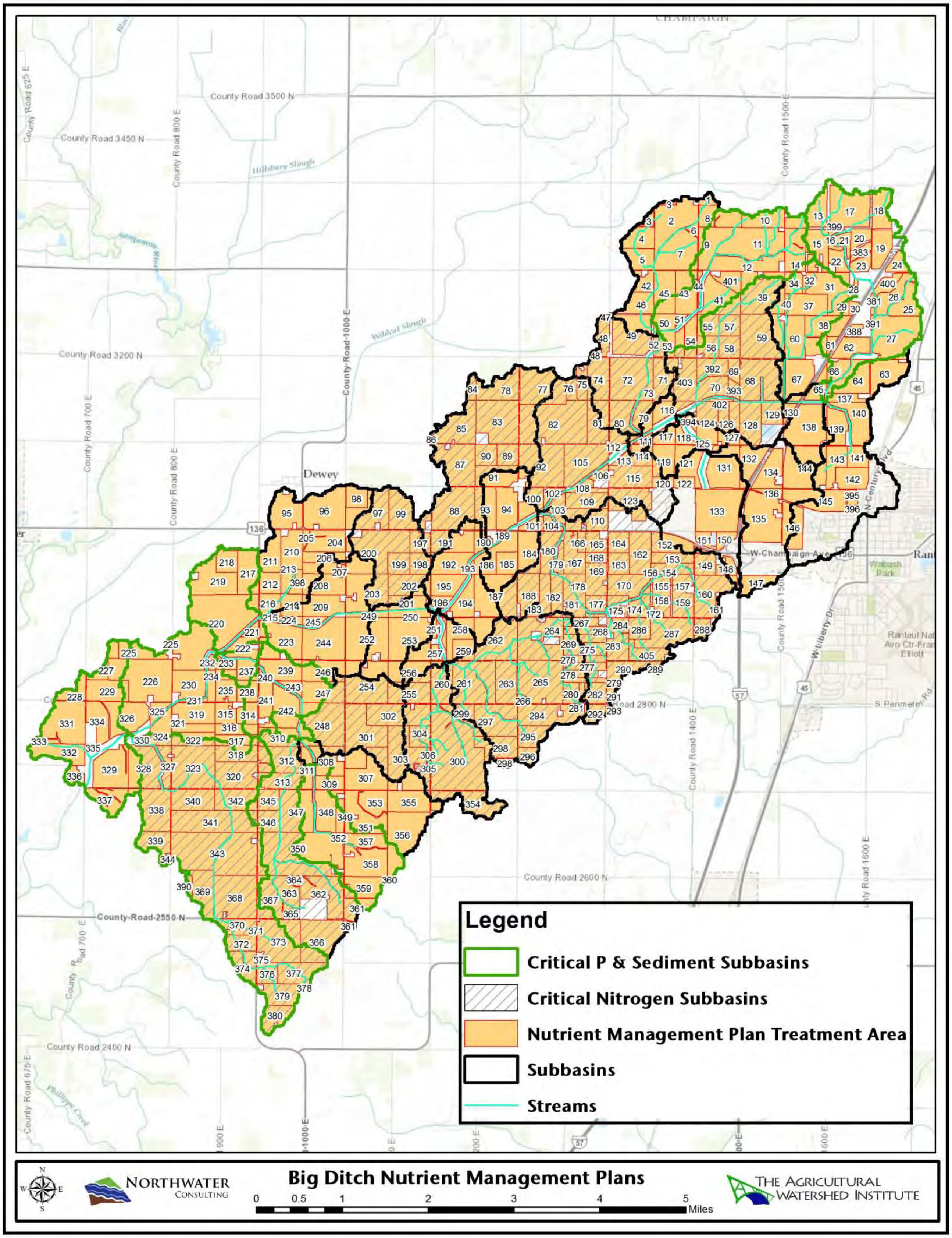


Figure 15 – Potential Basin-Wide Cover Crops/Tillage Management

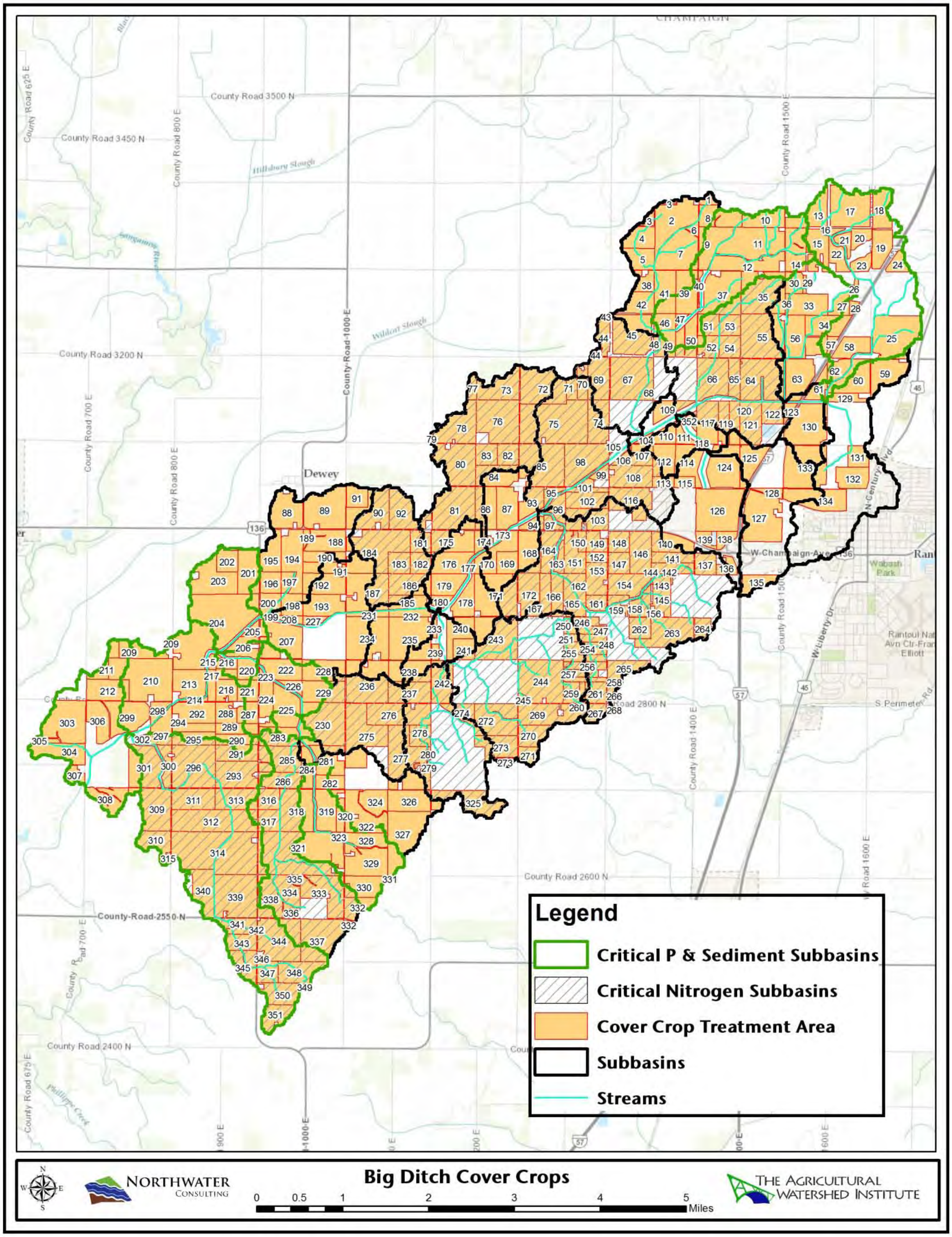
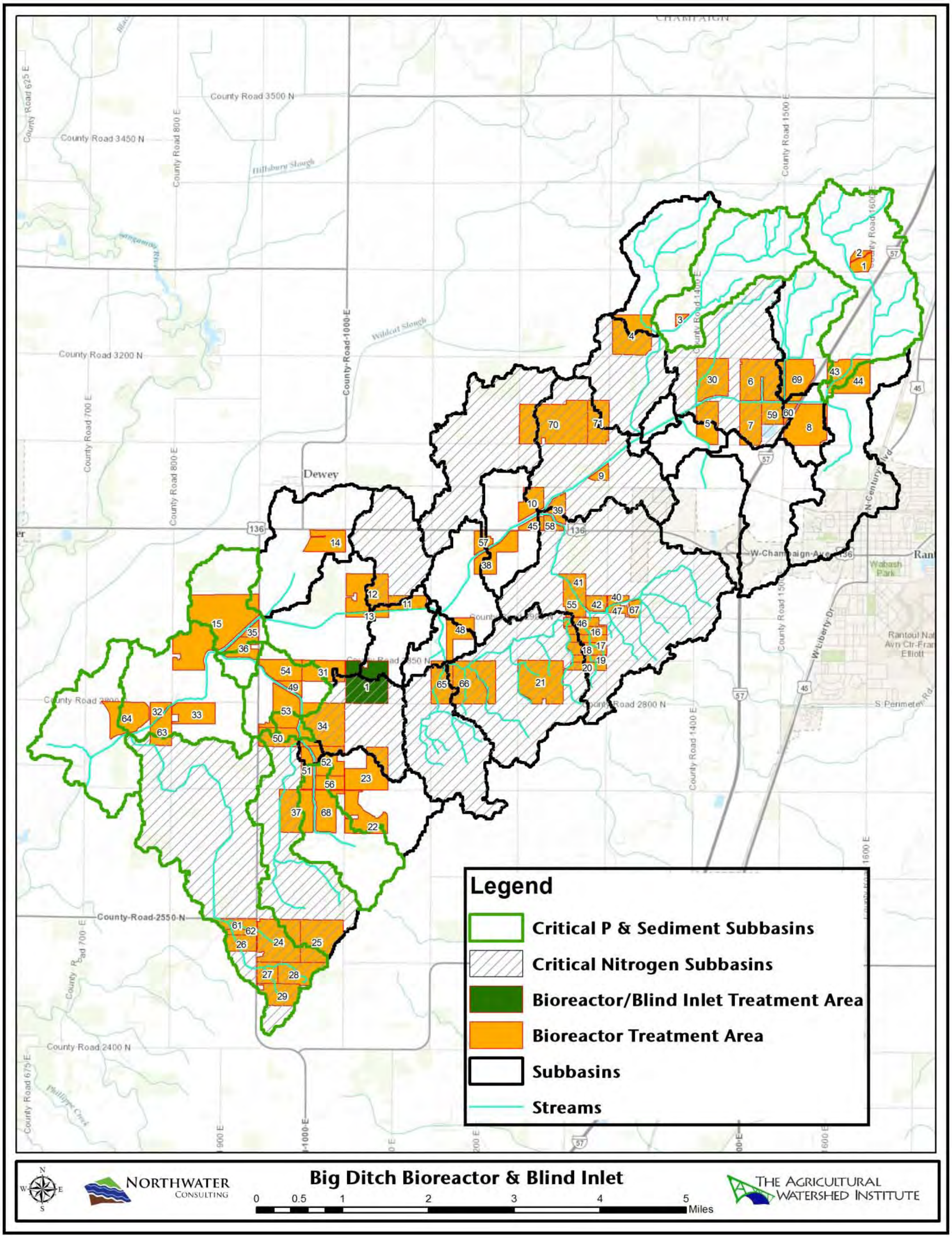


Figure 16 –Potential Basin-Wide Bioreactor & Bioreactor/Blind Inlet



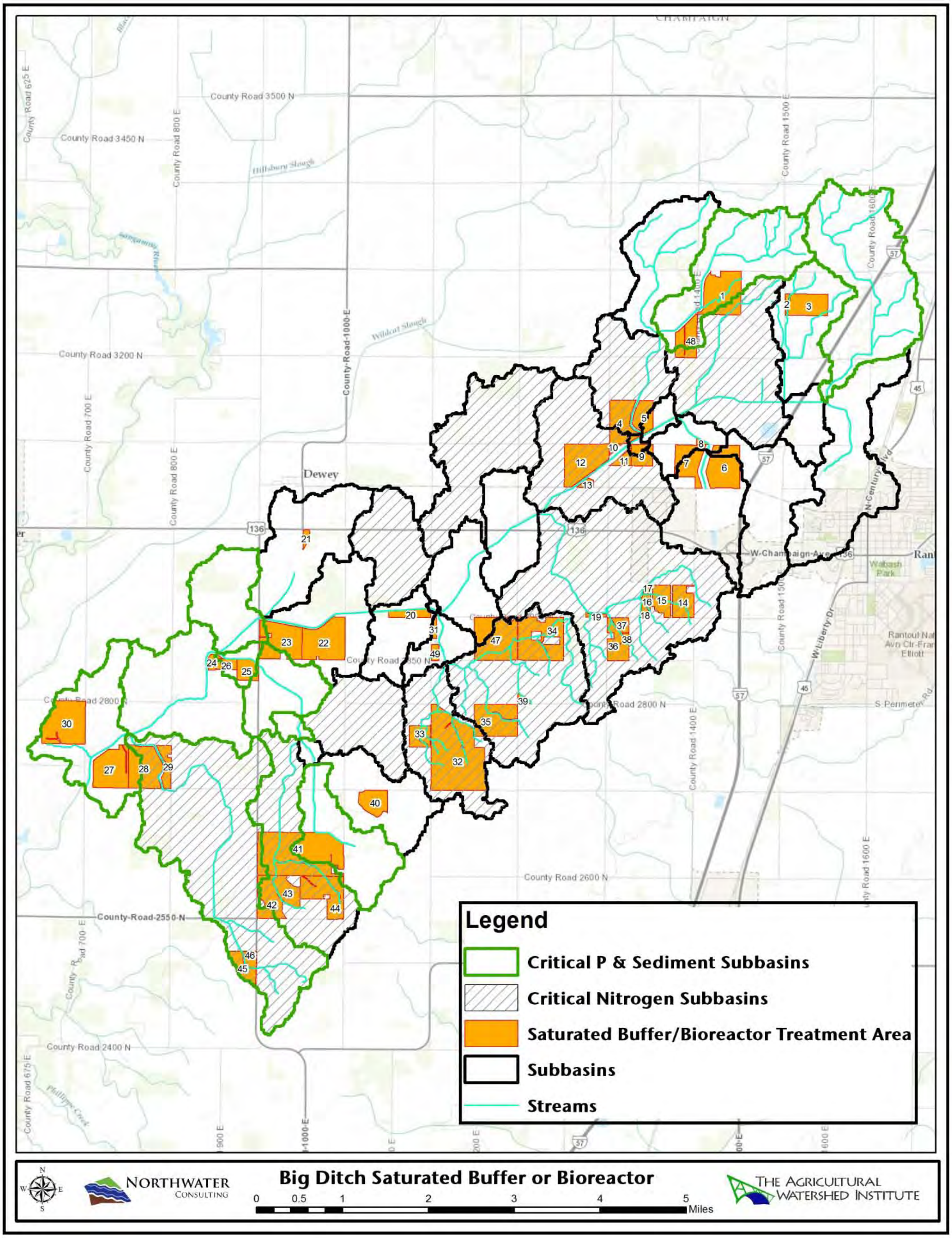
Saturated Buffers OR Denitrifying Bioreactors

Numerous basin-wide sites in the watershed are likely appropriate for both saturated buffers or 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 3,169 acres or 79 saturated buffer systems and 63 bioreactors. If implemented, these practices will result in annual load reductions of 24,422 lbs nitrogen, 2,640 lbs of phosphorus, and 1,127 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 Blind Inlet

A blind inlet is defined as an excavated earthen box with perforated collector tubing placed in the bottom and filled to the surface with rock or gravel. The rock is the inlet for surface water. 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 basin-wide site in the watershed is likely appropriate for both blind inlets or denitrifying bioreactors or a combination of both. 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 blind inlets and bioreactors are recommended for 151 acres or 3 systems. If implemented, these practices will result in annual load reductions of 805 lbs nitrogen, 92 lbs phosphorus, and 45 tons sediment. It is important to note that these results assume both practices are implemented. If blind inlets are not installed, there will be no reduction in sediment load. See Figure 16.

Figure 17 – Potential Basin-Wide Saturated Buffer/Bioreactor



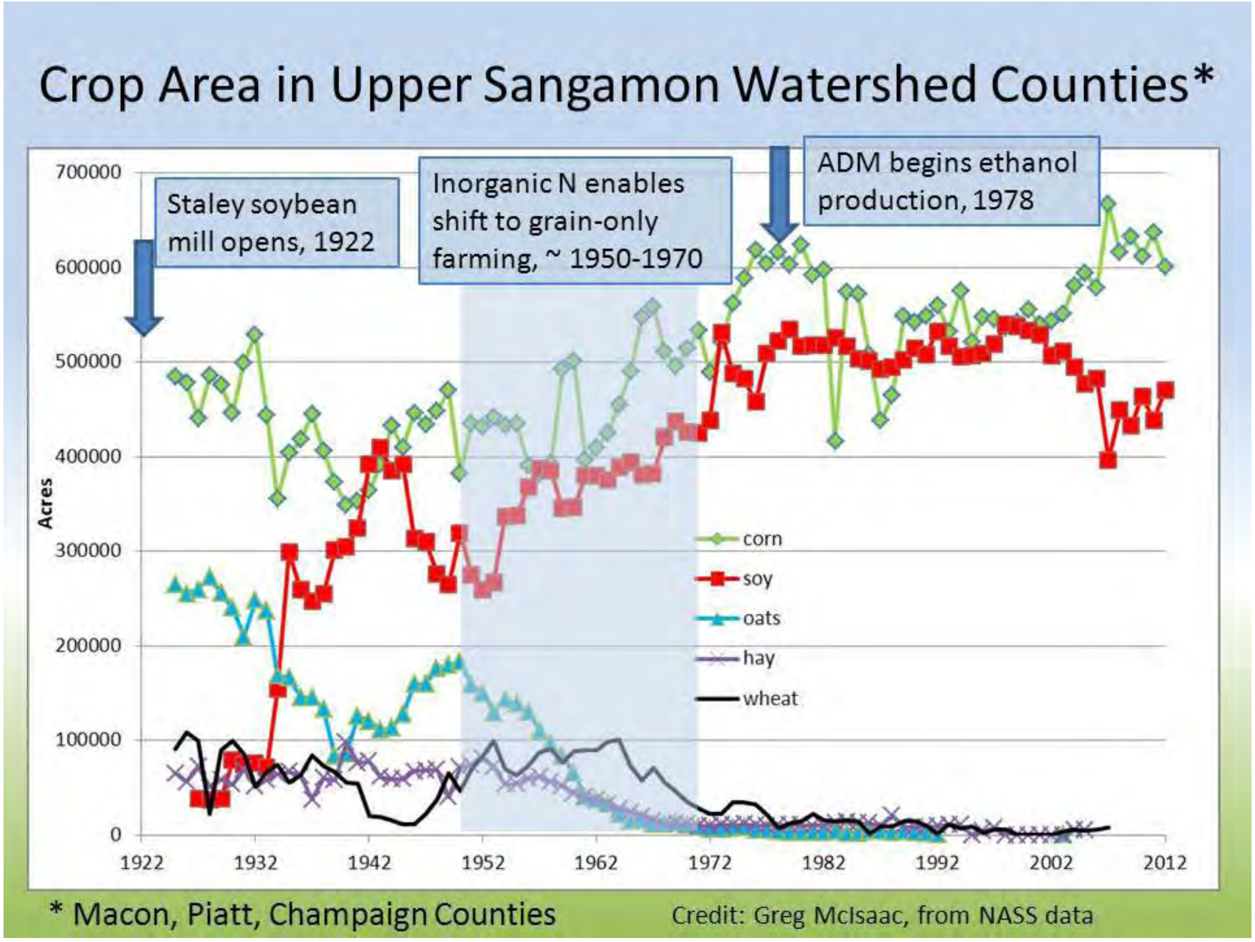
4.3 Cropping System Changes & Expected Load Reduction

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 those losses from row crops are high. Thus, converting highly erodible land (HEL) from row crop production to perennial crops is likely to provide greater reductions in sediment and phosphorus 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 Ditch 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 on 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 landuse 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% landuse 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 this figure does not include pasture, which if added to hayed acreage, would probably bring the total acres that were in perennial forage prior to 1960 to more than 10% of farmland.

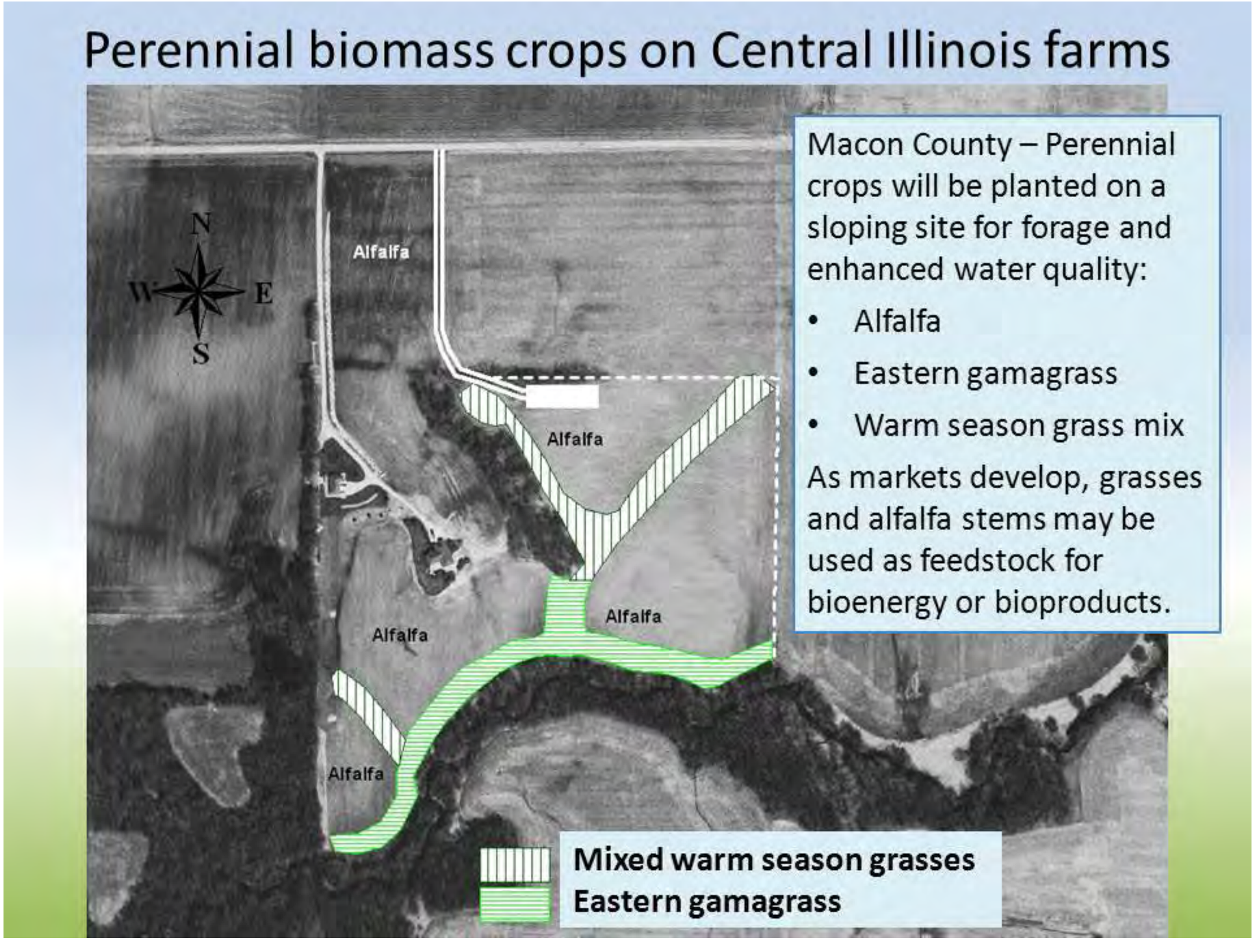
Figure 18 – Historical crop acreage in Upper Sangamon Watershed counties



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 do not require spring field operations for tillage or planting. 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 such 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 shown 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 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 Ditch watershed. There are 6,906 acres of cropped HEL land in Big Ditch watershed, as shown in Figure 20. Average annual P loss is 2.74 lbs/ac and sediment loss is 1.25 tons/ac from this HEL land, based on modeled results. Using 50% reduction from 6,906 treated acres, estimated load reductions from conversion of 691 acres of row crops to perennial biomass crops in contour strips or toe slope buffers are 9,461 lbs/yr of phosphorus and 4,316 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 16,596 acres in Big Ditch 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 16,596 treated acres with an average annual nitrate-N loss of 27 lbs/ac, estimated load reduction from conversion of 830 acres of row crops to harvestable seasonal wetlands is 179,237 lbs/yr of nitrogen.

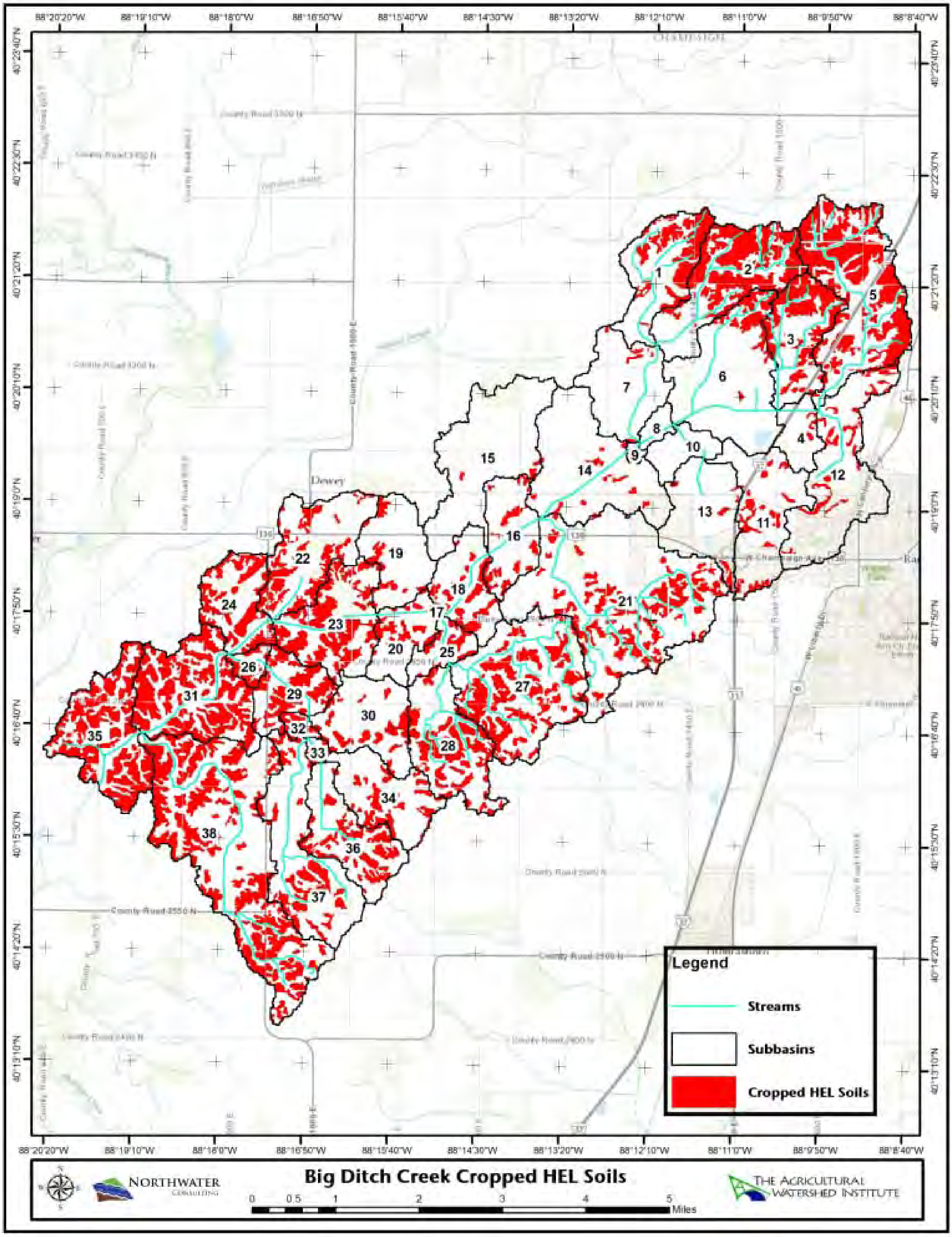
3) **Harvested saturated buffers or hillslopes:** Redirecting tile water to saturate/subirrigate the lower 5% of a field where perennial crops are grown may reduce nitrate loss from the tile drained area by 20%. We assumed this practice would be half as effective as a constructed wetland because it would 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 slopes. 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 1,521 acres and treat surface runoff or subsurface tile flow from a total of 23,502 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 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 strategically locating perennial crops at an annual monitoring cost of approximately $60,000.

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 Ditch watershed is 9,704 acres with average annual losses of 15.91 lbs/ac of nitrogen, 1.28 lbs/ac of phosphorus and 0.48 tons/ac of sediment. Assuming 10% conversion of this land to perennial crops and 90% load reduction for each parameter, this would result in 970 acres converted to perennials and annual load reductions of 13,890 lbs of nitrogen, 1,116 lbs of phosphorus, and 419 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. Champaign County (and 9 other 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 in Big Ditch 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 documentation.

- 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								
Wetland	16,596	$11,616,954	157,941	9,735	5,883	$74	$1,193	$1,975
Grassed Waterway	3,023	$98,237	26,685	2,391	1,490	$3.68	$41	$66
WASCB	16	$7,500	109	40	21	$69	$186	$361
Filter Strip	2,993	$11,974	27,868	3,430	1,856	$0.43	$3.49	$6.45
Field Border	929	$3,716	6,667	643	223	$0.56	$5.78	$17
Blind Inlet	79	$7,910	81	127	88	$98	$62	$90
Bioreactor	1,759	$175,923	8,797	3	0	$20	$51,197	N/A
Two-Stage Ditch	129	$13,080,208	879	40	12.03	$14,874	$327,614	$1,087,258
In Field BMP								
Cover Crop/ Tillage	2,248	$157,351	18,373	518	159	$8.56	$304	$989
Total	**27,773**	**$25,159,774**	**247,400**	**16,927**	**9,732**	**$102 (avg)**	**$1,486 (avg)**	**$2,585 (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	5,820	$582,044	44,924	6,340	3,002	$13	$92	$194
Saturated Buffer/Bioreactor	3,169	$316,933	24,422	2,640	1,127	$13	$120	$281
Drainage Water Management	8,962	$1,458,981	45,402	35	0	$32	$41,133	N/A
Blind Inlet/Bioreactor	151	$22,662	805	92	45.31	$28	$247	$500
Bioreactor	4,819	$722,892	24,051	9.40	0	$30	$76,943	N/A
In Field BMP								
Nutrient Management	23,242	$386,984	44,901	14,774	0	$8.62	$26	N/A
Cover Crop/ Tillage	20,896	$1,462,696	188,073	11,182	6,177	$7.78	$131	$237
Total	**67,060**	**$4,953,192**	**372,578**	**35,072**	**10,351**	**$13.29 (avg)**	**$141 (avg)**	**$479 (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	691	6,906	Not estimated	9,461	4,316
Harvested seasonal wetlands	830	16,596	179,237	Not estimated	Not estimated
Other converted areas	970	970	13,890	1,116	419
Total	**2,491**	**24,472**	**193,127**	**10,577**	**4,735**

6.0 Information & Education

The Champaign County Soil and Water Conservation District (SWCD) along with partners will continue to spread information by television, radio, newspaper, and direct mailings to the landowners and farmers in the watershed. The Champaign County SWCD will also continue to find good supporting material for information on ways to improve water quality as well as farming techniques.

The Champaign County SWCD is dedicated to fulfilling its charter by providing education to all. The Champaign County SWCD puts on field days, lectures, and toolshed meetings on different topics. The Champaign County SWCD already has cost-share programs in place with partners from the American Farm Land Trust (AFT) and Illinois Department of Agriculture (IDOA) to place cover crops into field rotations. The SWCD partners with IDOA and USDA Natural Resources Conservation Service (NRCS) to promote and put in place nutrient management plans, strip-till or no-till along with many other soil and nutrient saving programs.

Many more partners and groups such as Drainage Districts will play a large role in improving water quality in the water shed. Drainage Districts will have the power to implement two-stage ditches, water management control structures as well as bioreactors. Many more great topics can be covered to promote healthy soils and water such as:

- Drainage District meetings
- Cover Crop meetings and field days
- Pond care clinics
- Drainage meeting to cover bioreactors, tiling, wetlands, and drainage water management
- Meeting to introduce saturated buffers, promote filter strips, field boarders and pollinator CRP programs
- Other programs that could be promoted that can help with nutrient and sediment reduction are:
  - Two-stage drainage ditches
  - Windbreaks
  - Living winter fences
  - Crop rotations

  - Introducing different 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
- United States Environmental Protection Agency (USEPA)
- Illinois Environmental Protection Agency (IEPA)
- United States Army Corps of Engineers (USACE)
- United States Department of Agriculture (USDA)
  - Conservation Reserve Enhancement Program (CREP)
  - Environmental Quality Incentives Program (EQIP)
  - Conservation Stewardship Program (CSP)
  - Conservation Reserve Program (CRP)

The Champaign County SWCD will work with its partners including the AWI, IEPA, IDOA, AFT and many others to promote water quality and soil health.

AWI provides information, education, and outreach related to perennial crops and associated 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 Champaign 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 to find the needed measures to begin moving land owners and operators in the direction to improve soil health and water quality. This will mean a great deal of educational materials, cost-share programs, on-farm research and demonstrations, and related efforts throughout the next 20+ years.

In addition to promoting the “4Rs”, cover crops, and strip 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 the factors that cause producers to hold back on implementation of a practice can expedite change over to the improved soil healthy and water quality. As an example, Champaign County SWCD found that equipment cost was an impediment to adoption of strip till in the Salt Fork watershed.

New practices that will be demonstrated include bioreactors, drainage water management, and pollinator 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. AWI and the wastewater agencies of Decatur and Chicago are currently working with the Macon County SWCD 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. This same concept could be included in a 2015 Section 319 implementation grant application for Big Ditch in partnership with Champaign County SWCD. Between now and the 2015 date for Section 319 grant applications, identification of cooperators and assessment of design modifications to make bioreactors more acceptable to potential cooperators will be considered by AWI and CCSWCD.

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. AWI is collaborating with scientists from Argonne National Laboratory and University of Illinois to submit comments in response to a recent DOE 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 the Big Ditch 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. Champaign 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, nutrient management, filter strips, and waterways:** These practices will be a high priority for Champaign County SWCD and partners throughout the next five years. Equipment for strip till systems and other major expenses are expected to be included in a Section 319 implementation grant application to be submitted in 2015 or 2016 and implemented in the following years.
- **Bioreactors, drainage water management, and saturated buffers:** Over the next year, the willingness of local landowners and producers to adopt these practices will be assessed. The possibility of modifying bioreactor design to make this practice more readily acceptable to producers will be explored with Dr. Richard Cooke of University of Illinois and with NRCS, and local drainage contractors. Concurrently with this work by CCSWCD, AWI and partners will assess bioreactors and saturated buffers as potential technologies for inclusion in a Water Quality Trading system or Environmental Utility. Depending on the outcome of this effort, bioreactors and saturated buffers may be included by Champaign County SWCD in a Section 319 application or Conservation Innovation Grant application in 2015 or 2016 and implemented in following years.
- **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 CCSWCD, University of Illinois researchers, and other partners. Its broad components are:
    - Stakeholder engagement; outreach and technical/financial assistance to early adopters of perennial biomass crops.

- o 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.
- o Development and demonstration of landscape design concepts to optimize co-production of harvestable biomass and ecosystem services.

A plan reassessment in 2020 is intended to determine the extent to which implementation of practices and cropping systems has been successful and a determination of changes that may be 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 the Champaign County SWCD and AWI. Both are working hard on education to growers. During implementation of this plan, Champaign 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 Champaign County SWCD will work with land owners and farmers to push forward new agriculture ideas that promote good soil health and water quality. USDA and the Champaign County SWCD will continue to support our county with Technical Assistance for the installation of BMPs and farming techniques that will support the reduction of loss.

The Champaign 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:

- 60% of annual crop acres in the watershed are following the 4Rs of nutrient management, including in-season nitrogen application and reduced fall application.
- 80% of stream banks are protected with filter strips.
- 25% of annual row crop acres have adopted cover crops to reduce soil and nutrient losses between harvest and planting.

Champaign 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 2,400 acres.
- Drainage water management structures will be installed on tile systems draining 2,200 acres.

AWI will be the lead organization to demonstrate and promote perennial crops for co-production of harvested biomass and ecosystem services in collaboration with Champaign County SWCD, cooperating farmers and landowners, University of Illinois, and biomass supply chain businesses. Biomass markets are essential and ecosystem service payments are probably necessary to form the economic basis for wide adoption of perennial biomass crops. These are included as measurable milestones for perennial crops to be achieved by the 2020 plan review:

- Develop a biomass energy project or projects in the Rantoul—Champaign area that create a local market for at least 600 acres of perennial biomass crops (approximately 2,000 to 6,000 tons/year, depending on species grown).
- 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 buffers or hillsides concepts, including assessment of pollutant load reduction.
- 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.

9.0 Water Quality Monitoring Strategy

The purpose of the monitoring strategy for the Big Ditch 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.

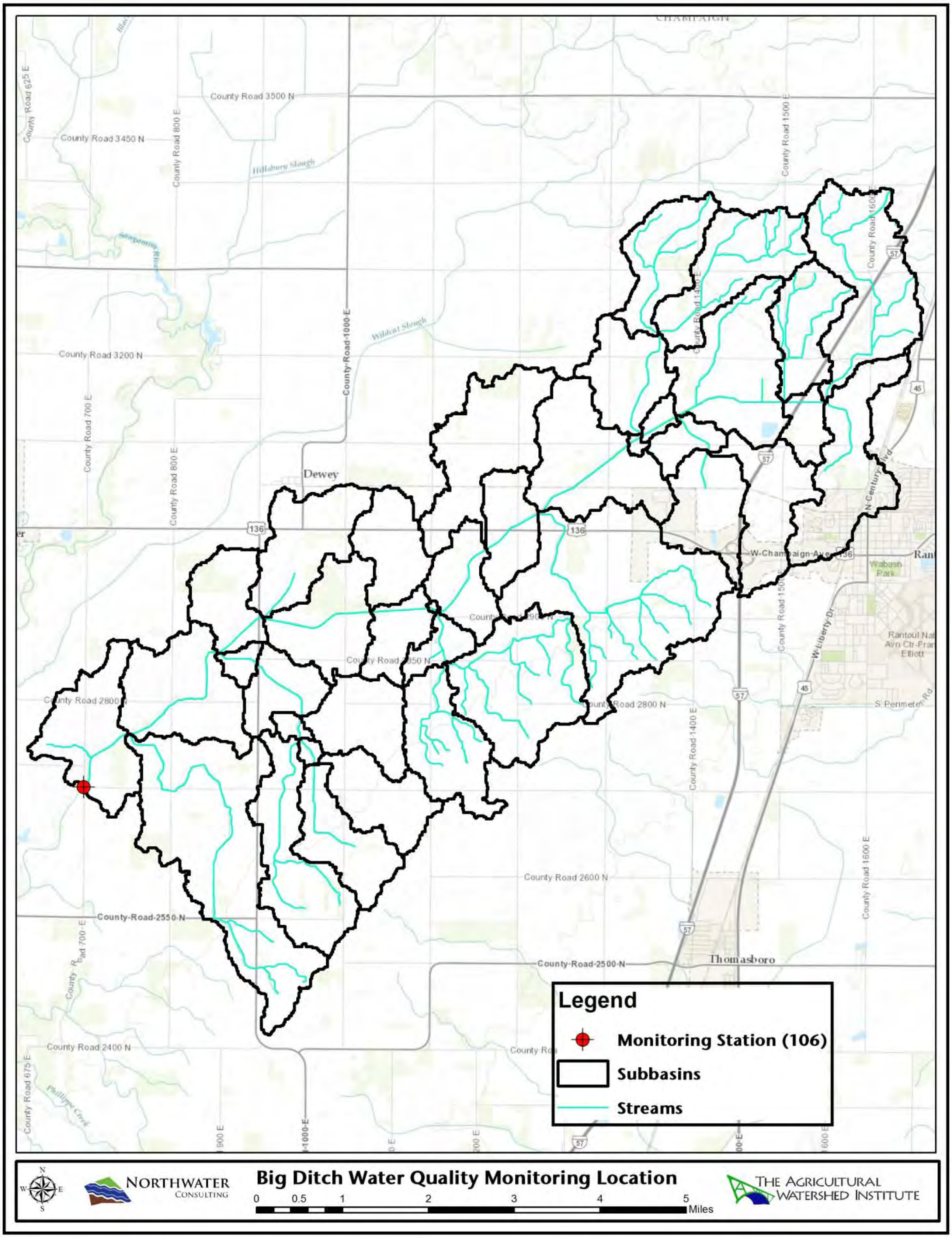
Monitoring environmental criteria as outlined in this strategy is an effective way to measure progress toward meeting water quality objectives. One potential problem with in-stream indicators is the issue of isolating dependent variables. There are likely many variables influencing the monitoring results, 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 April 1993 to September 2008 on Big Ditch (Station 106) on 700E Road (Figure 21) and was close to the watershed outlet. Given the historical data currently available, it is recommended that this station be reactivated and streamflow and nutrient monitoring resume, ideally, under direction from the 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 Ditch 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 18). 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, and Total Nitrogen should be analyzed considering flow volumes in order to make relative comparisons year to year, as concentrations of pollutants vary with flow volumes. The water quality monitoring results may also be used to calibrate the nonpoint source pollution load model and make revised annual loading estimates throughout implementation.

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

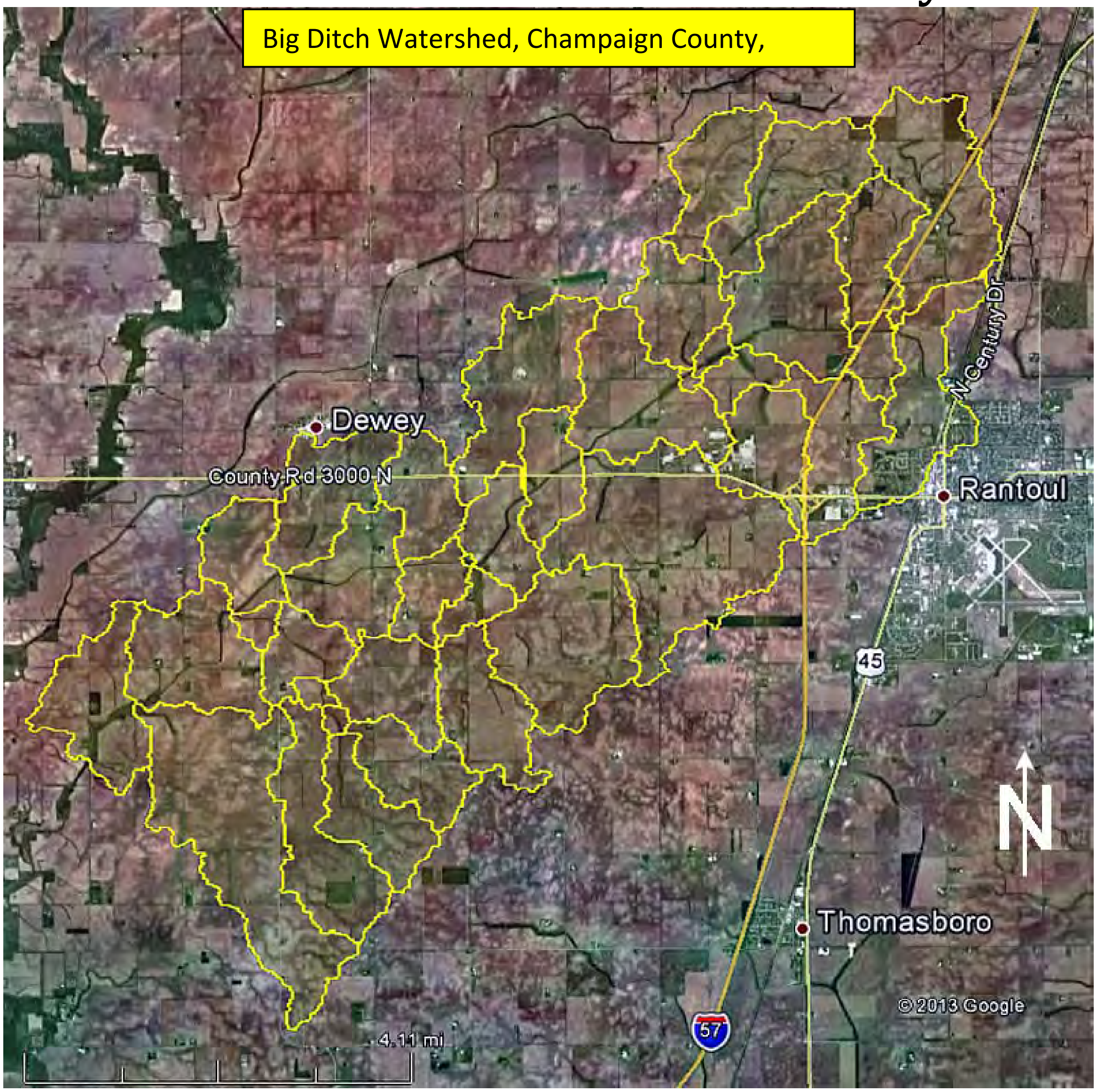
Monitoring	Definition	Benchmark Indicators
Fish Index of Biologic Integrity (IBI)	Index based on presence and populations of non-native and native fish species and their tolerance to degraded stream conditions.	**Exceptional** (50-60) **Very Good** (49-42) **Good** (41-34) **Fair** (33-27) **Poor** (26-17)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

Monitoring	Definition	Benchmark Indicators
		Very Poor (<17)
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 Ditch Watershed Resource Inventory

Big Ditch
Watershed Resource Inventory



THE AGRICULTURAL WATERSHED INSTITUTE

Prepared for submittal to the

Illinois Environmental Protection Agency

January 2014

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Executive Summary

This report contains a watershed resource inventory (WRI) for the Big Ditch watershed, Hydrologic Unit Code 071300060202 and a portion of HUC 071300060203, a tributary of Lake Decatur. This WRI includes the natural, human, and man-made resources in the Big Ditch watershed. The inventory attempts to identify current nutrient loadings and potential sources of those loadings in the Big Ditch 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

This report addresses the need for a comprehensive resource inventory of the Big Ditch watershed, Hydrologic Unit Codes 071300060202 and a portion of 071300060203, a tributary of Lake Decatur. The Main Ditch is 11.55 miles long and tributaries comprise 10.95 stream miles. This watershed drains 26,302 acres or about 41 square miles to Lake Decatur. The majority of the land is in cropland.

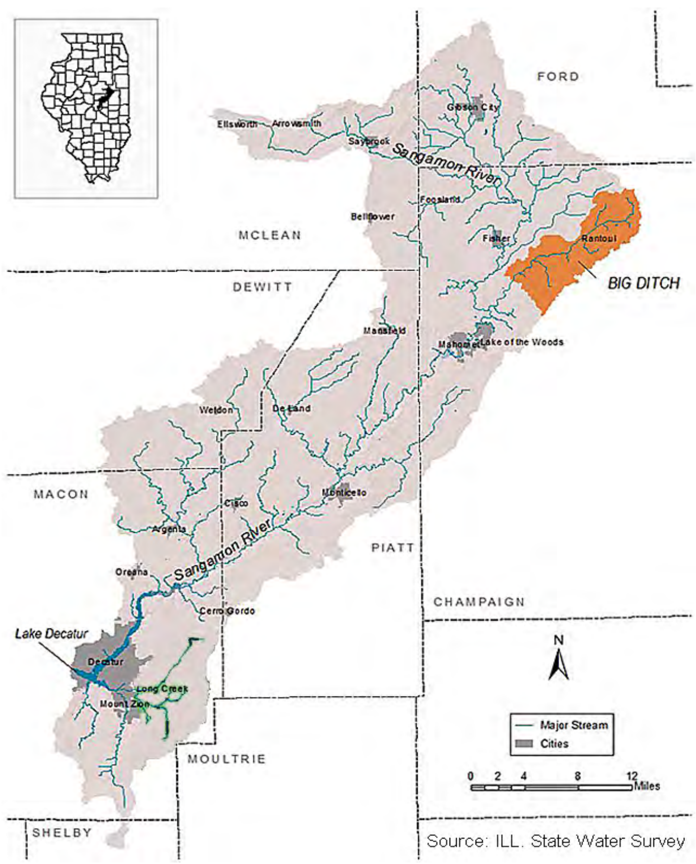

Fig. 1 - Location of the Big Ditch Watershed in the Lake Decatur Watershed

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 greatest change in elevation is along the drainage ways of the watershed and the Newton and Rantoul Moraines. The moraines form the northeast and southeast boundaries of this watershed. The areas of greatest elevation change will be the focus for BMP's addressing erosion and sedimentation issues.

Soil Classification

The predominant soils in this watershed are mollisol soil order, which are "soils of grassland ecosystems. They are characterized by a thick, dark surface horizon. This fertile surface horizon … results from the long-term addition of organic materials derived from plant roots."[1] Drummer silty clay loams, Raub silt loams, Ashkum silty clay loams, Wyanet silt loams and Varna silt loams are the highest percentage mollisols within this area. The Drummer, Raub and Ashkum soil series have little to no slope (0-2 %), a deep loess layer, low erodibility, a high shrink-swell potential and considered "best prime farmland" if properly drained. The Varna and Wyanet soil series in this watershed have slopes that vary from 2 – 16%, moderate to high erodibility and considered "prime farmland" if properly drained and erosion is controlled.[2]

Ashkum, Drummer, and Peotone soils are the hydric soils in the watershed, so they are poorly drained and subject to ponding during heavy rainfall.2

Another predominant soil is the Elliott silty clay loams, which are in the soil order, Alfisols. These soils are "moderately leached soils that have relatively high native fertility. These soils have mainly formed under forest and have a subsurface horizon in which clays have accumulated." The Elliott soil has a slope that varies from 2- 6 %, moderate erodibility and is considered "prime farmland" if properly drained and erosion is controlled.[3] At the lower end of Big Ditch, there are alluvial soils. These soils are in the floodplains and are frequently flooded.

Of the total 26,302 acres in this watershed soils with A, A/B, and B slopes comprise 19,175 acres, while C, C/D, and D slopes total 7,127 acres.

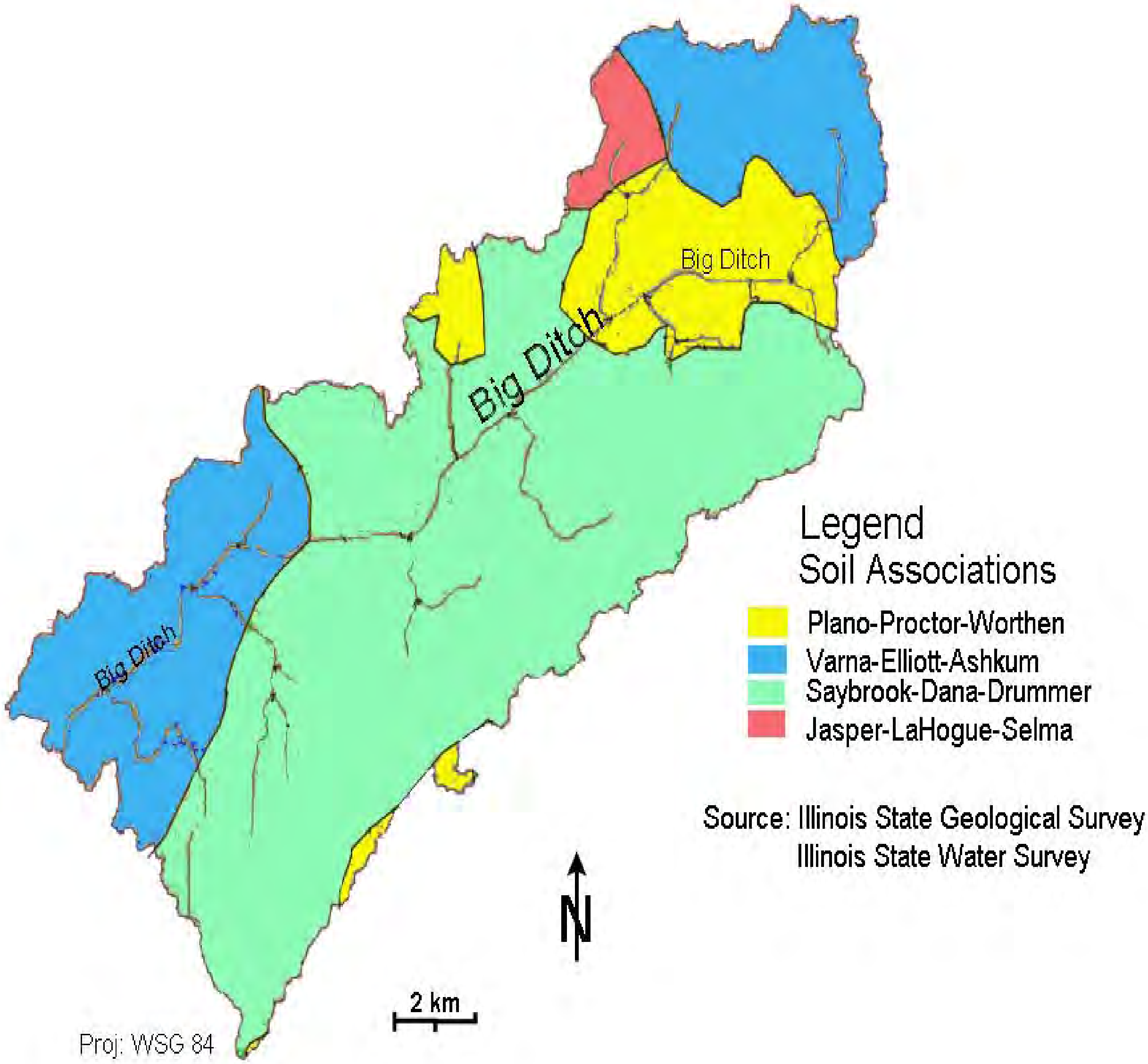

Fig. 2 - Soil Associations Map

Soil Unit	SOILS:	Hydric Rating	Hydrologic Soil Group	Highly Erodible	% Slope Range	Area [acres]	% Wat.Area
23A 23B2	Blount	Non Hydric	B	N Y	0 to 2 2 to 4	17.8	0.07
56B	Dana	Non Hydric	B	Potential	2 to 5	502.6	1.91
67A	Harpster	Hydric	B	N	0 to 2	51.3	0.20
91B2	Swygert	Non Hydric	C	Potential	2 to 4	17.9	0.07
102A	La Hogue	Non Hydric	B	N	0 to 2	91.6	0.35
125A	Selma	Hydric	B	N	0 to 2	48.6	0.18
146B2 146C2	Elliott	Non Hydric	C	Potential	2 to 4 4 to 6	2637.0	10.03
149A	Brenton	Non Hydric	B	N	0 to 2	941.6	3.58
152A	Drummer	Hydric	B	N	0 to 2	10092.8	38.37
153A	Pella	Hydric	B	N	0 to 2	74.0	0.28
154A	Flanagan	Non Hydric	B	N	0 to 2	29.9	0.11
171B	Catlin	Non Hydric	B	Potential	2 to 5	22.7	0.09
198A	Elburn	Non Hydric	B	N	0 to 2	6.9	0.03
206A	Thorp	Hydric	C	N	0 to 2	9.2	0.03
223B2 223C2 223D3	Varna	Non Hydric	C	Y	2 to 4 4 to 6 6 to 12	1525.9	5.80
232A	Ashkum	Hydric	C	N	0 to 2	2592.8	9.86
241D3	Chatsworth	Non Hydric	D	Y	6 to 12	1.4	0.01
330A	Peotone	Hydric	C/D	N	0 to 2	199.6	0.76
448B	Mona	Non Hydric	C	Potential	2 to 5	8.3	0.03
481A	Raub	Non Hydric	B	N	0 to 2	3997.4	15.20
490A	Odell	Non Hydric	B	N	0 to 2	61.4	0.23
530B	Ozaukee	Non Hydric	B	Y	2 to 4	4.7	0.02
533	Urban land		D			15.6	0.06
622B 622C2	Wyanet	Non Hydric	B	Potential Y	2 to 5 5 to 10	2505.4	9.53
623A	Kishwaukee	Non Hydric	B	N	0 to 2	72.2	0.27
663B	Clare	Non Hydric	B	Potential	2 to 5	319.2	1.21
687B 687C2	Penfield	Non Hydric	B	Potential Y	2 to 5 5 to 10	161.7	0.61
802B	Orthents	Non Hydric	C	N	N/A	119.5	0.45
3302A	Ambraw	Hydric	B	N	0 to 2	136.9	0.52
Water		WTR				36.5	0.14
TOTALS						26,302.4	100

Table A. Soils Classification for the Big Ditch Watershed

Soil Erosion

Soil erosion is one of "the leading stressors of water quality in Champaign County, coming from both agriculture and municipal sources."[4] It was observed during the April 2013 watershed survey that ditch bank erosion was minimal. There was some ephemeral erosion in areas of concentrated flows due to tillage.

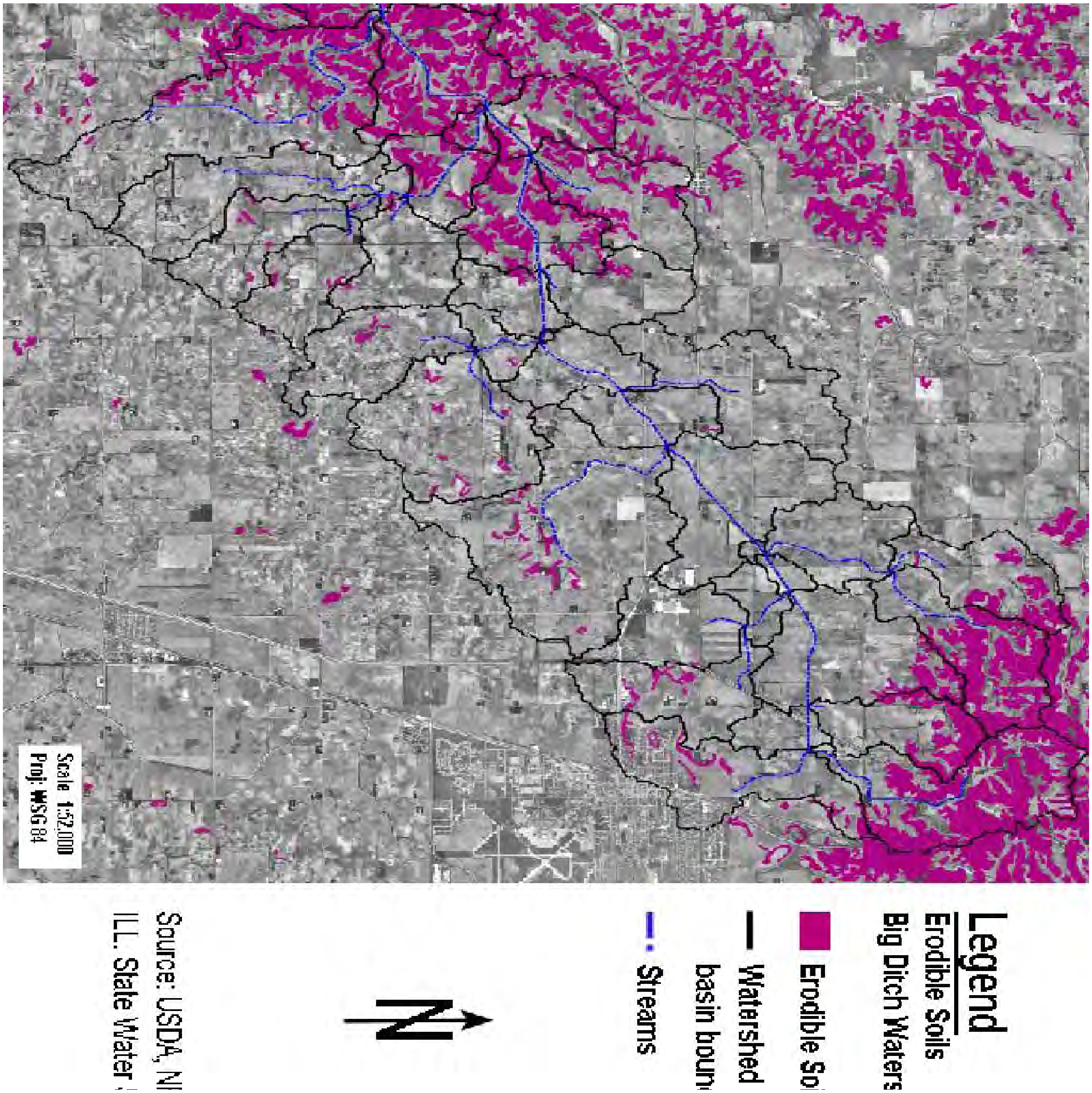

Fig. 3 - Location of Erodible Soils

Land Use/Cover

A review of the land use map shows that over 96% of land is used for agriculture. In 2013 about 66% of the farmland was in soybeans and 33% in corn. About 1% is used for other small grain crops such as winter wheat, and less than 1% is in pasture or hay production. Traditional moldboard tillage is rarely used and of the various forms of conservation tillage, probably over 90 % is chisel tilled and the balance strip tilled or no-tilled.[5] With leadership from the IL Fertilizer and Chemical Association, nitrogen fertilizers are typically custom applied at a rate no greater than 1.2 lbs/acre/bushel of corn removed. Application of other fertilizers and soil amendments is determined by soil testing and crop usage. There are no livestock operations.

Commercial and low-density urban development is found along the northeast edge of the watershed in the area of Rantoul. The 2004 Blue Ribbon Panel Report on Champaign County Environmental Concerns stated "Water quality in parts of most streams in Champaign County is impaired." It went on to recommend the following. "Develop positive incentives for protection of streams in each of our major watersheds." "Continue, and possibly increase, grant support for … conservation programs including stream bank and waterway habitat improvement on agricultural lands." "Encourage and sponsor development by the SWCD of "Management Plans" for each of the major watersheds ..." "Develop and enforce zoning, construction and health ordinances to provide appropriate setbacks and regulation for construction and prevention of pollution by rural residential sanitary and other point sources."[6]

Using the 2007 Revised Illinois Land Cover data (USDA-NASS) and GIS software (Quantum GIS), it was determined that the land in this watershed is 95% cropland, 4% urban and commercial, and 1% grass and woodland.[7]

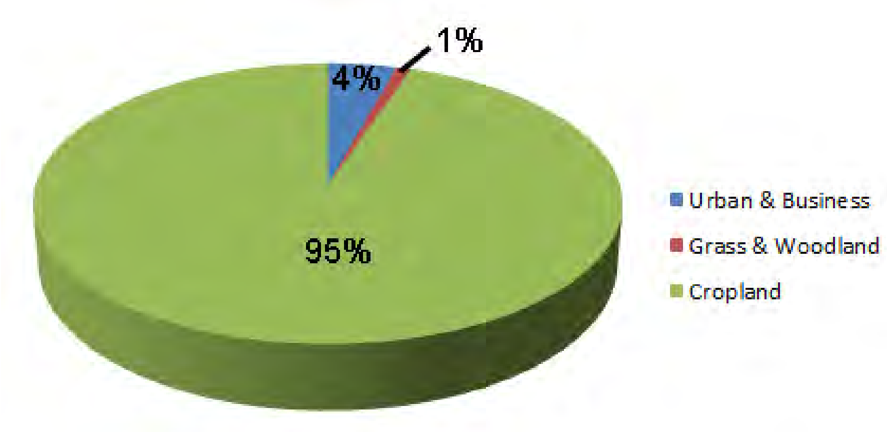

Fig. 4 - Land Use Chart

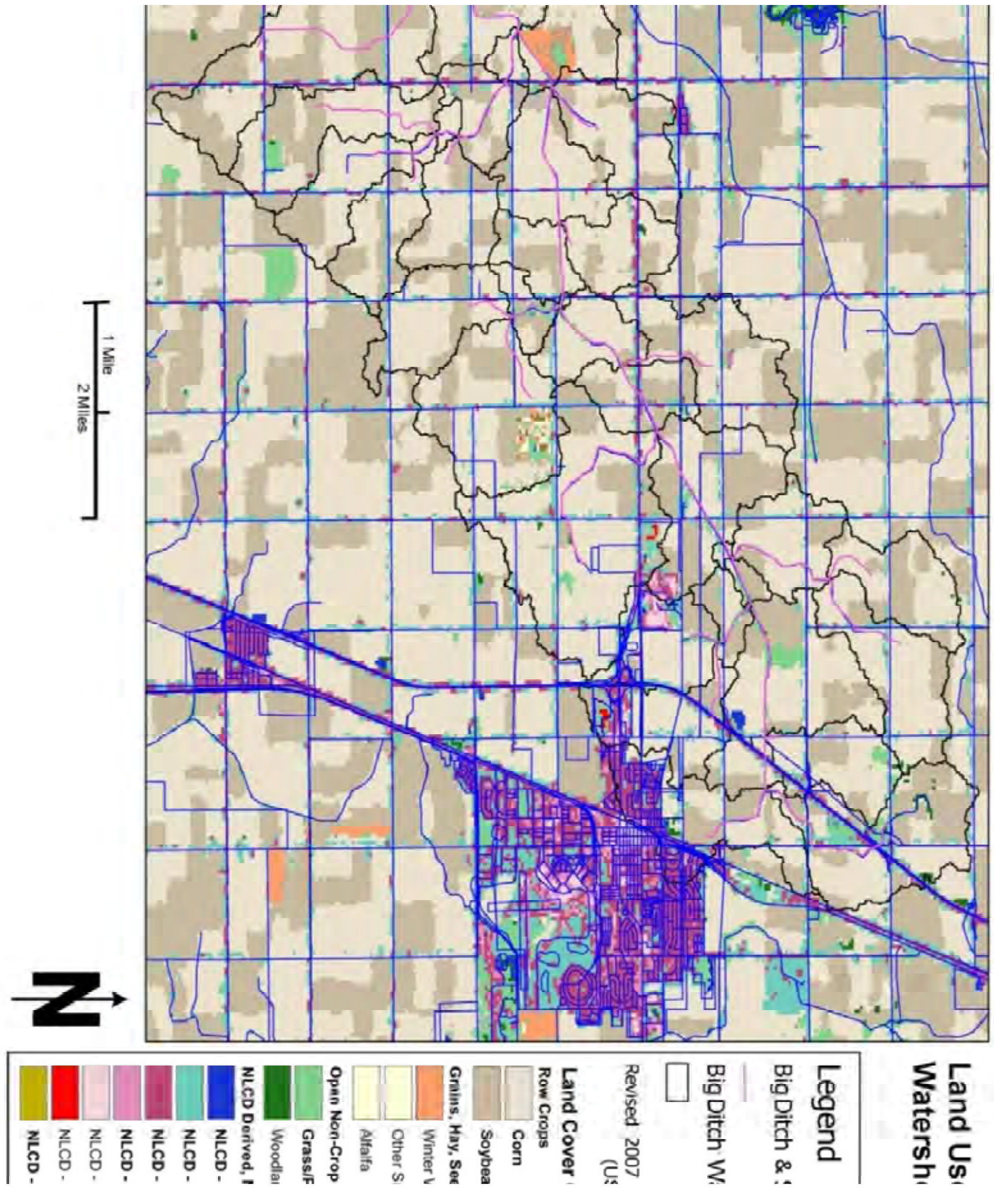

Fig. 5 - Land Use Map

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.

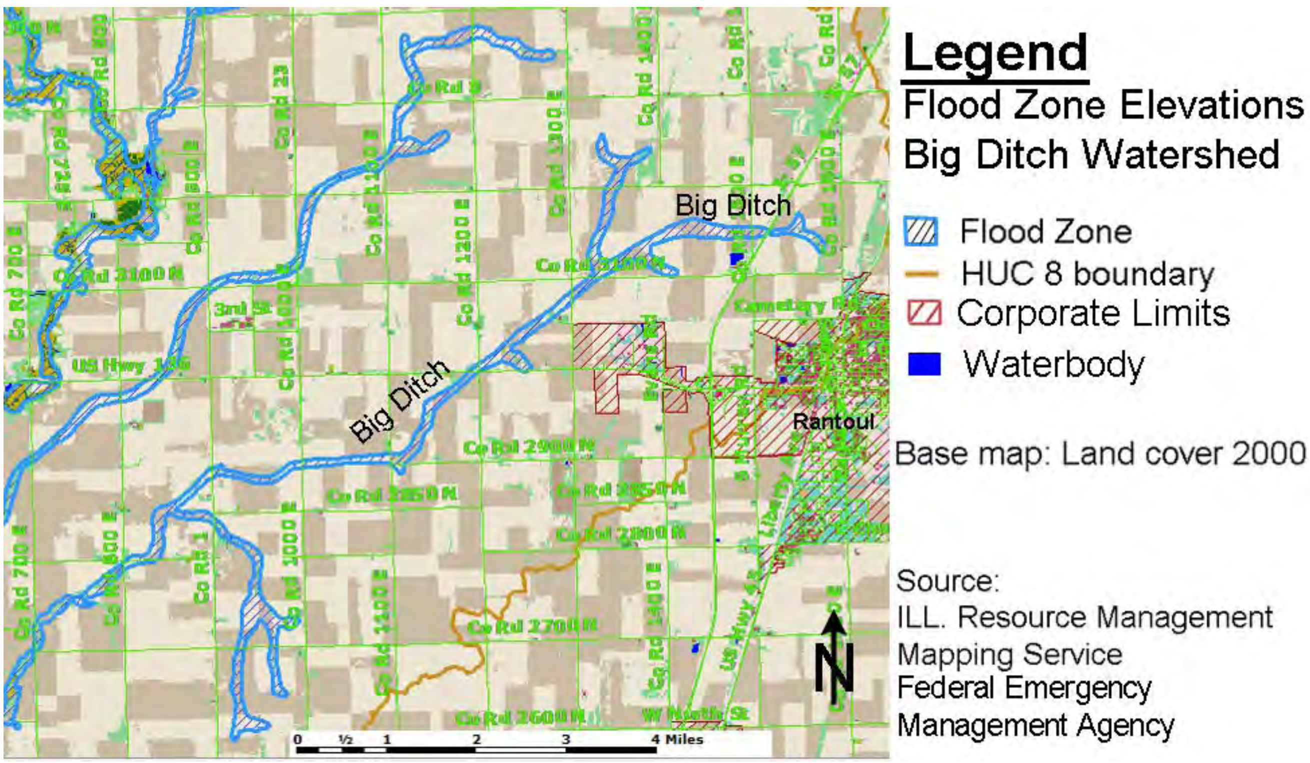

Fig. 6 - Floodplain Map

In our survey of this watershed, we noted that there is currently no residential or commercial development in the Big Ditch floodplains.

The following photos show views of this floodplain area.

Fig. 7 - Big Ditch and floodplain from the CR 700E Bridge. Note the filter strip conservation practice on both sides of the water body. This was a common sight within the watershed.

Fig. 8 - Floodplain and water body from the CR 1200E Bridge with filter strips.

Fig. 9 - Floodplain and water body from the CR 3100N bridge with filter strips.

Wetlands

According to the Champaign County Land Resource Management Plan, "the majority of existing wetlands in Champaign County consist of relatively small areas of less than one acre in size."[4]

Fig. 10 - This photo from the CR 700E Bridge shows the only small wetland that was easily visible from a road. It is on the far right above the culvert in Big Ditch.

In the following map, note the small size and scattered locations of the wetlands identified by the U.S. Fish & Wildlife Service wetland inventory. This fact was validated in the April 2013 watershed survey.

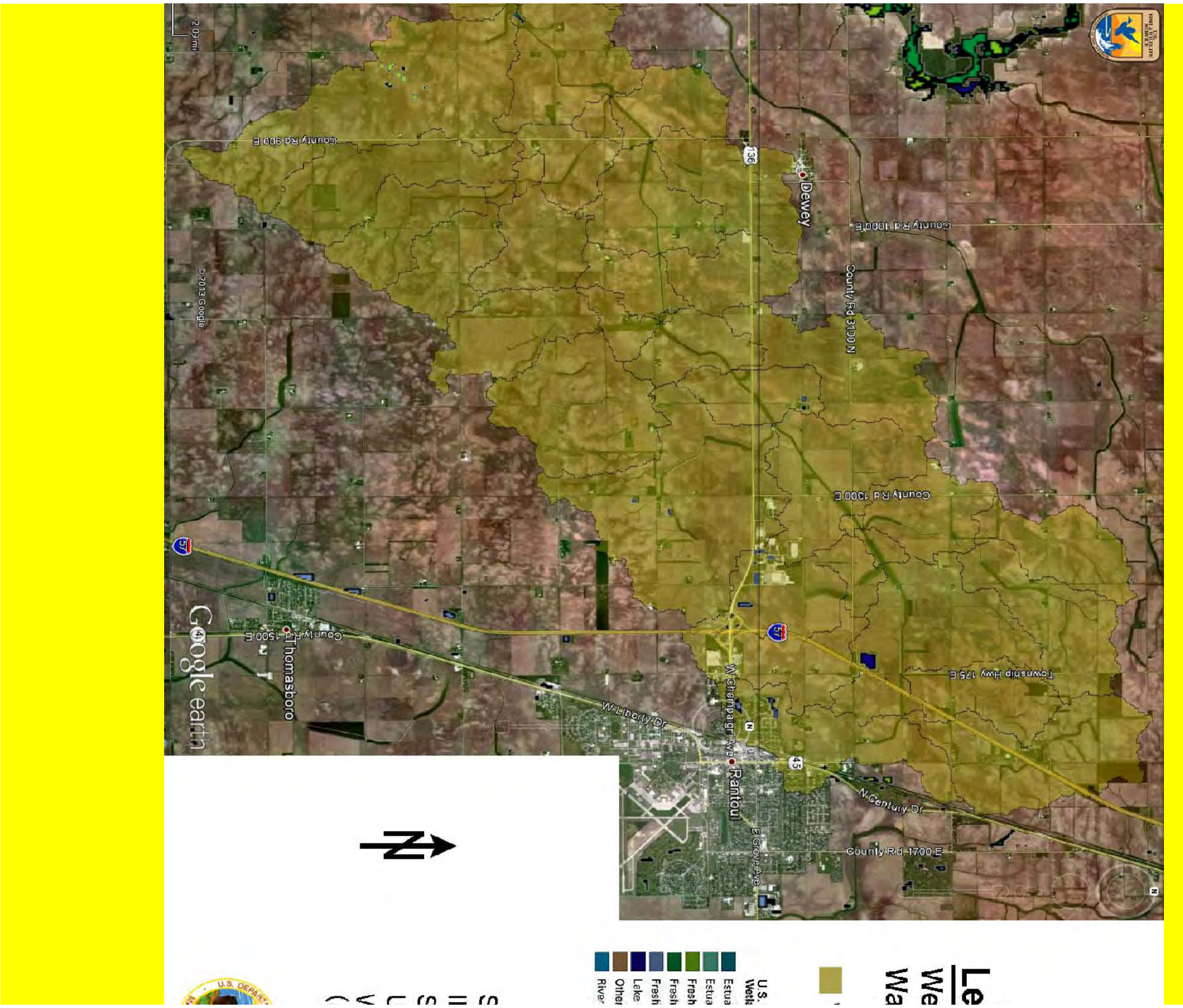

Fig. 11- Map of Wetlands and Water Bodies

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 in April 2013 showed the number of buffers along water bodies had held steady in the past six years.   An estimated 460 acres of grass and/or forests buffer strips are still in existence. Results from the April survey showed buffer strips of varying widths along the water bodies.

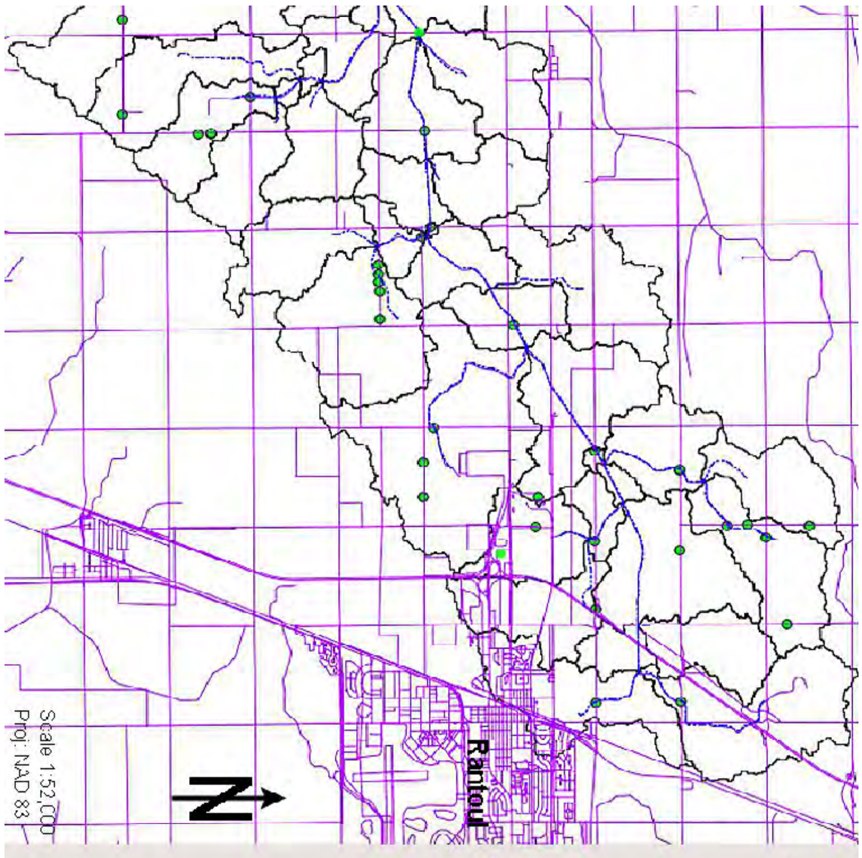

Fig. 12 - Map of Survey Site Locations

Groundwater Issues

Elevated levels of arsenic have been detected in the Glasford and Mahomet Aquifers, which lay under this watershed. "There is considerable spatial variability in the arsenic concentrations in both aquifers: wells less than a mile apart frequently has significantly different arsenic concentrations".[8]

In 2012, local newspapers reported that residents in and around this watershed were blaming irrigation wells for causing their residential wells to go dry. The Illinois State Water Survey is investigating this allegation.[9, 10]

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.

Community water supply wells in or near this watershed include those for Dewey and Rantoul. These wells are finished in the Mahomet Bedrock Valley Aquifer, a buried bedrock river valley which is considered to be semi-confined. Rantoul's public water supply provides water to 3400 services from 8 wells ranging from 125 to 300 feet deep which produce 1.4 million gallons per day. Illinois EPA determined that these wells were not susceptible to IOC, VOC, or SOC contamination. Capture zone maps have not been produced for either community since they are not considered to be vulnerable. The primary threats to these wells are abandoned wells and other routes for surface pollutants to bypass the soil and confining layers above the aquifer.[11] Neither Dewey nor Rantoul has adopted maximum setback zones, so their wells are protected by a 200 foot radius minimum setback under state law. Certain potential sources of contamination and routes such as abandoned wells are forbidden in these zones.[12] The Mahomet Aquifer Consortium, a multi-county regional groundwater protection committee, with technical backing of the Illinois State Water Survey, works to protect this aquifer.

Irrigation

Irrigation is present in this watershed and the number of irrigated fields is expected to increase, according to Champaign SWCD staff. The increasing presence of irrigation for agricultural use has some residents in the area of this watershed concerned about the availability of groundwater for their residential use. This issue was mentioned in the above section. According to local newspapers, the Illinois State Water Survey (ISWS) is investigating whether area irrigation wells are causing some residential wells to go dry.[9, 10]

Fig. 13 - Irrigation units near County Road 1100E in the watershed

A further complication to the ISWS investigation is the following information. "Irrigation withdrawals, particularly withdrawals for row-crop production, are largely unreported to the IWIP (Illinois Water Inventory Program). The principal reason for the lack of irrigation withdrawal reporting is the severe lack of water meters on irrigation pumps."[13]

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: 071300060202 and 071300060203, which drains the area above the County Road 700E crossing of Big Ditch.

Fig. 14 - Subsurface drainage outlet on a tributary of Big Ditch

Wildlife

There have been no wildlife surveys in this subwatershed, but there has been one completed within the larger Upper Sangamon watershed of which this watershed is a part.[13] The landscape with this watershed is highly agricultural with only narrow riparian areas for wildlife habitat. This has led to very fragmented habitat sites, which 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]

Priority Water Body

The 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.

Socio-Economic/Human Resources

This watershed is located in Champaign County, west of the Village of Rantoul. Within the watershed, farming is the largest business. Other major employers located within this watershed are Conair Corp., Eagle Wings Industries Inc., Jeld-Wen Windows & Doors, and a new Easton Bell Sports factory is being built. These businesses are located in an industrial park on the east side of the watershed.

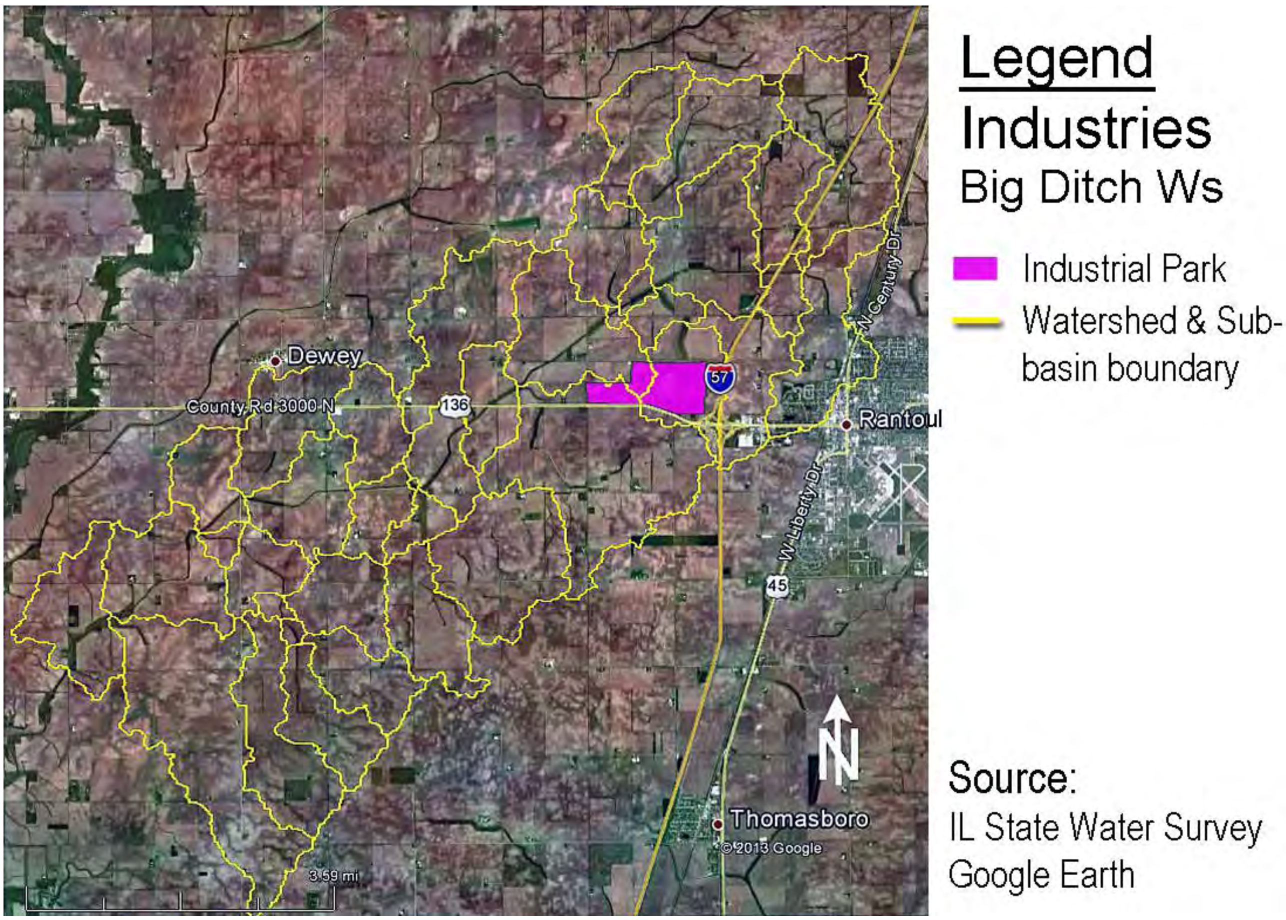

Fig. 15 - Location of Industrial Area in the Big Ditch Watershed

United States Census Bureau data for Champaign County shows that the median household income for the period, 2007-2011, was $44,462. This is below the state's median household income for the same period of $56,576.[16] This same census data show that the percent of people below the poverty level is 21.8%, whereas the state average is 13.1%.[17]

The high school graduation rate is higher within Champaign County than the state average and the percentage of people with a bachelor's degree or higher is above the state average.[18] There are three drainage districts in the watershed and they are all active. The districts are the Big Slough, Condit #1, and Lower Big Slough Drainage Districts.[19]

Municipal/Industrial Point Sources:

There is only one NPDES permitted site in this watershed. It is the Conair Corporation's NPDES permit # IL0074136 which limits discharges to a pH between 6 and 9, limits TSS to a 30 day average of 15mg/l. and a daily maximum of 30 mg/l., and limits total residual chlorine discharges to a maximum daily level of .05 mg/l.

Information from the USEPA shows that NPDES permit: IL0074136 has an "Activity Status" of "effective", the permit expires on September 30, 2016 and the "Receiving Waters" are an "unnamed ditch tributary to Big Ditch".[20]

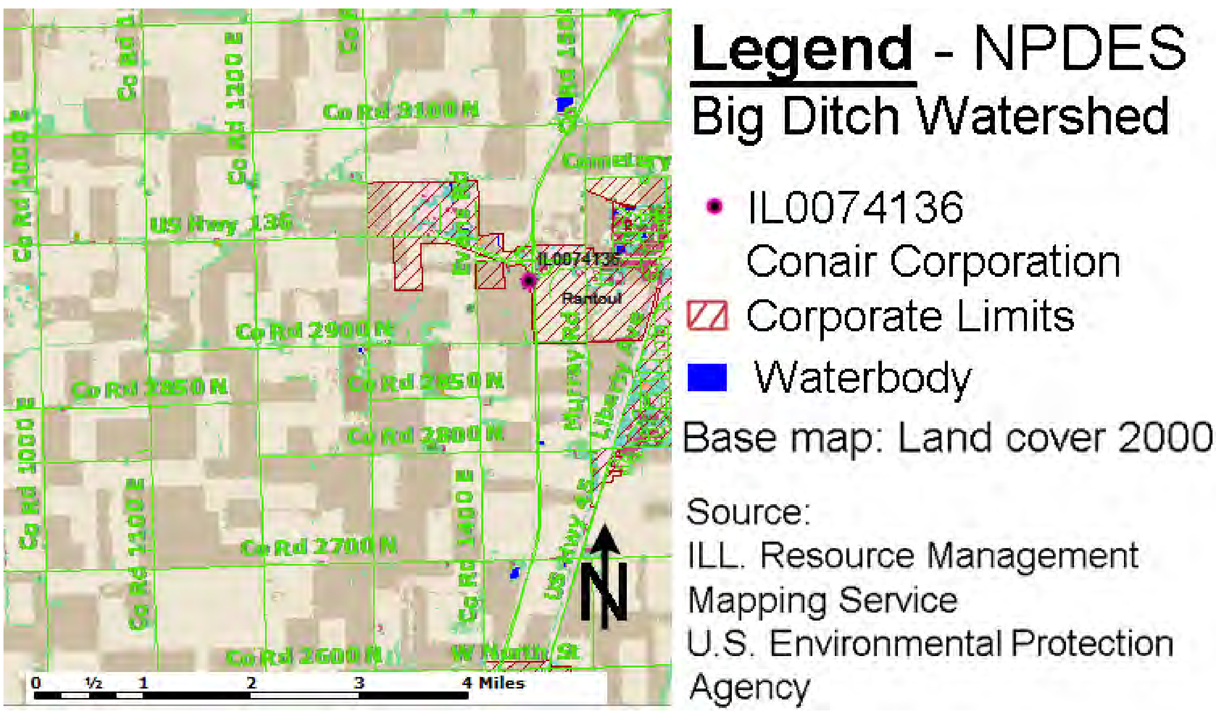

Fig. 16 - NPDES Site Location

Stormwater Management

The Champaign County Land Resource Management Plan states that "sediments and nutrients are the leading stressors of water quality in Champaign County…" and that "polluted storm water discharge" is one of the sources of this problem.[4]

This is mostly an agricultural land use watershed, but it does include commercial development and a small portion of the City of Rantoul along the northeast edge. During the April 2013 survey, it was noted that most commercial development had retention basins, but it could not be determined for all properties.

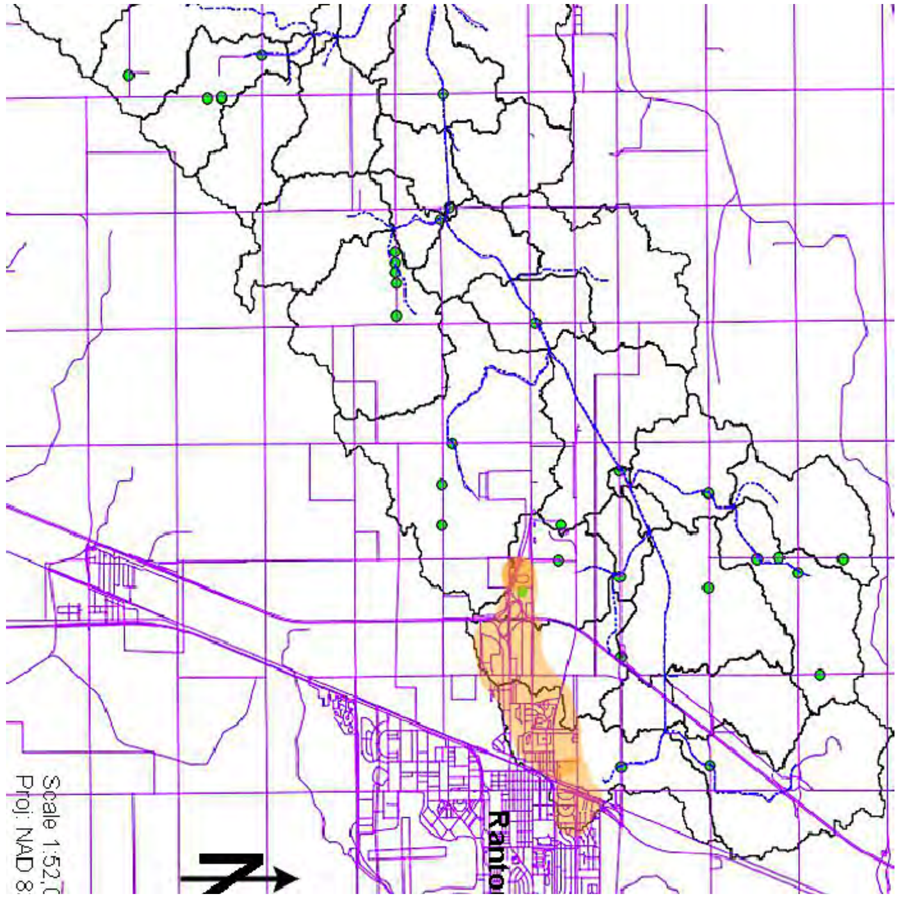

Fig. 17- Commercial and Residential Development Areas in the Big Ditch Watershed

Hydrologic Modifications

There have been numerous modifications to this watershed. A review of aerial photos shows that Big Ditch has been extensively channelized and straightened in the watershed.

Designated Uses

Big Ditch water body segment IL_EZU-01 has the designated use of General Use. According the "Illinois Integrated Water Quality Report and Section 303(d) List-2012", this segment is listed as impaired for Aquatic Life Use with dissolved oxygen, pH, and loss of instream cover as causes. This water body is a tributary of Lake Decatur, the public water supply of the City of Decatur, which has a designated use of Public and Food Processing Water Supplies Use.[21] Lake Decatur is classified as impaired due to total phosphorus, total suspended solids, turbidity, excessive algal growth, mercury, chlordane, PCBs, and. Big Ditch watershed has been monitored for nitrates in the stream water and results have shown levels above the nitrate-nitrogen MCL of 10 mg/l.[22] This watershed has been monitored for total phosphorus in its waters and results are shown in subsequent sections of this report. Sedimentation has been documented as a problem in this stream with its sediment yields part of 0.10 T/A/yr. sediment yield upstream of Monticello into Lake Decatur.[23]

For more information on water quality, see the Water Quality Data section.

Biological Indicators

In 2008 IEPA conducted an Intensive Basin Survey of the Upper Sangamon Watershed to determine the extent of the streams impairment to see if it would be subjected to the prioritization process. The Illinois EPA utilizes the Biological Stream Characterization (BSC) process developed in conjunction with Illinois Department of Natural Resources (IDNR) biologists to classify streams. The Index of Biotic Integrity (IBI) was designed to include a range of attributes of fish assemblages. Data obtained at a given site is evaluated in light of what might be expected at a similar un-impacted or relatively un-impacted stream located in a similar geographical region. An overall score is calculated and assigned to the site. The strength of IBI is its ability to integrate information from individual, population, community, zoo-geographic, and the ecosystem levels into a single ecologically based index of the quality of a water resource.[27] The findings of this intensive survey showed that Big Ditch had a limited to moderate aquatic resource value.

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 from industrial, agricultural and domestic sources.[15]

The following charts show some of the data collected pertaining to aquatic life during the 2008 intensive survey;

Common Name	BIOS Name	Qnty.	Native fish species	16
Yellow Bullhead	Ameiurus natalis	7	Native minnow species	8
Blackstripe Topminnow	Fundulus notatus	26	Native sucker species	0
Rock Bass	Ambloplites rupestris	1	Native sunfish species	4
Green Sunfish	Lepomis cyanellus	36	Benthic invertivore species	3
Bluegill	Lepomis Macrochirus	53	Intolerant species	0
Largemouth Bass	Micropterus Salmoides	12	Prop. specialist benthic invertivores	0.02
Johnny Darter	Etheostoma nigrum	6	Prop. geneneralist feeders	0.78
Blackside Darter	Percina maculata	1	Prop. mineral-substrate spawners	0.02
Red Shiner*Spotfin	Cyprinella lutrensis*C. spiloptera	10	Prop. tolerant species	0.31
			IBI Score	26
			2003 IBI Score	
			Change in score from 2003 to 2008	

Table B. Fish Species found at collection point in Big Ditch and IBI Score

Phylo-genic	Family	BIOS #	Taxon	Tolerance	Qnty.
1	Planariidae	6	Dugesia tigrina	6	1
3	Unidentified	31	Unidentified	10	28
22	Cambaridae	421	Orconectes virilis	5	1
29	Baetidae	507	Pseudocloeon propinquus gr.	4	1
31	Baetidae	515	Centroptilum sp.	2	1
37	Caenidae	602	Caenis sp.	6	8
54	Tricorythidae	599	Tricorythodes sp.	5	8
64	Coenagrionidae	857	Argia tibialis	5	2
79	Gomphidae	714	Dromogomphus spinosus	4	1
106	Leptoceridae	1473	Nectopsyche candida	3	5
107	Leptoceridae	1474	Nectopsyche diarina	3	3
119	Elmidae	1774	Dubiraphia sp.	5	28
123	Elmidae	1788	Stenelmis sp.	7	2
129	Hydrophilidae	1669	Hydrobius sp.	99.9	1
133	Ceratopogonidae	1939	Culicoides sp.	5	1
159	Corbiculidae	2497	Corbicula fluminae	4	4
161	Sphaeriidae	2494	Pisidium sp.	5	1
165	Chironomidae (Tanypodinae)	1966	Ablabesmyia mallochi	6	9
166	Chironomidae (Tanypodinae)	1969	Ablabesmyia peleensis	6	1
170	Chironomidae (Tanypodinae)	2241	Labrundia pilosella	4	2
174	Chironomidae (Tanypodinae)	1981	Pentaneura inconspicua	3	4
175	Chironomidae (Tanypodinae)	1982	Procladius sp.	8	6
177	Chironomidae (Tanypodinae)	1985	Thienemannimyia gr.	6	1
181	Chironomidae (Orthocladiinae)	2001	Cricotopus bicinctus	10	3
192	Chironomidae (Chironomini)	2019	Chironomus sp.	11	41
193	Chironomidae (Chironomini)	2026	Cryptochironomus sp.	8	3
194	Chironomidae (Chironomini)	2029	Cryptotendipes sp.	6	1
206	Chironomidae (Chironomini)	10012	Paracladopelma nereis	4	1
214	Chironomidae (Chironomini)	2061	Polypedilum halterale gr.	4	1
215	Chironomidae (Chironomini)	2062	Polypedilum illinoiense	5	117

Table C. Macroinvertebrates found at collection point in Big Ditch and IBI Score

219	Chironomidae (Chironomini)	2068	Stenochironomus sp.	3	1
220	Chironomidae (Chironomini)	2248	Stictochironomus devinctus	5	1
221	Chironomidae (Chironomini)	2197	Tribelos fuscicorne	4	4
225	Chironomidae (Tanytarsini)	2236	Cladotanytarsus species B	7	1
226	Chironomidae (Tanytarsini)	2506	Cladotanytarsus species H	7	1
229	Chironomidae (Tanytarsini)	2076	Paratanytarsus sp.	6	9
230	Chironomidae (Tanytarsini)	2077	Rheotanytarsus sp.	6	2
231	Chironomidae (Tanytarsini)	2078	Tanytarsus sp.	7	17

SAMPREPL	0	Scrap%	0.6329114
METHOD	H	ScoreRich	65.217391
SRVYTYP	1	ScoreColeo	40
richness	30	ScoreEphem	39.215686
ColeoCnt	2	ScoreIntol	44.444444
EphemCnt	4	ScoreMBI	68.852459
CntIntol	4	ScoreEPT	11.118714
MBIraw	6.8	ScoreScrape	2.0888165
EPT%	8.23	benthicIBI	38.705359

Table C. (continued) Macroinvertebrates found at collection point in Big Ditch and IBI Score

SAMPLING REACH		OTHER FEATURES	
Station Length - Fish (ft)	550	Shading (%)	1
Station Length - Habitat (ft)	550	Instream Cover Total (%)	0.59
Station Length - Macroinvertebrates (ft)	550	Boulders	0.00
SUBSTRATE (%)		Rock/Clay Ledge	0.00
Silt-Mud (<0.062mm)	5	Undercut Bank	0.00
Sand (0.062-2mm)	55	Submerged Tree Roots	0.00
Fine Gravel (0.08-0.3 inches)	15	Brush/Debris Jams	0.45
Medium Gravel (0.3-0.6 inches)	1	Logs	0.05
Coarse Gravel (0.6-2.5 inches)	1	Aquatic Vegetation	0.00
Small Cobble (2.5-5.0 inches)	0	Submerged Terrestrial Vegetation	0.09
Large Cobble (5.0-10.0 inches)	0	Other Cover	0.00
Boulder (>10 inches)	0	Depth of Sediment	-1
Bedrock	0	Depth of Sludge	0
Claypan - Compacted Soil	19	Water Color	clear
Plant Detritus	3	Water Odor	normal/none
Vegetation	1	PIBI	38.97
Submerged Logs	0	Notes	
Other	0		
HYDRAULIC FEATURES			
Stream Order	4	Air Temperature	27
Discharge (cfs)	5.6	Water Temperature	23.4
Mean Channel Width (ft)	55	Dissolved Oxygen mg/l	11.8
Mean Water Width (ft)	20	pH	8.2
Mean Velocity @Q (ft/sec)	0.6	Conductivity uS/cm	639
Mean Thalweg Velocity (ft/s)	0.5	Turbidity	2.8
Mean Depth of sample reach (ft)	0.6	Chlorophyll Filtered ml	740
Stream Stage	4	Bugs Fines	11
Water Level Trend	2	Bugs Coarse	0
Percent Pool	0	Bugs Detritus	1
Percent Riffle	0	Bugs Veg	0
Percent Run	100	Bugs Tree Roots	0
		Bugs Brush	6
		Bugs Sub Terr	2

Table D. Qualitative Habitat Evaluation Index (QHEI)

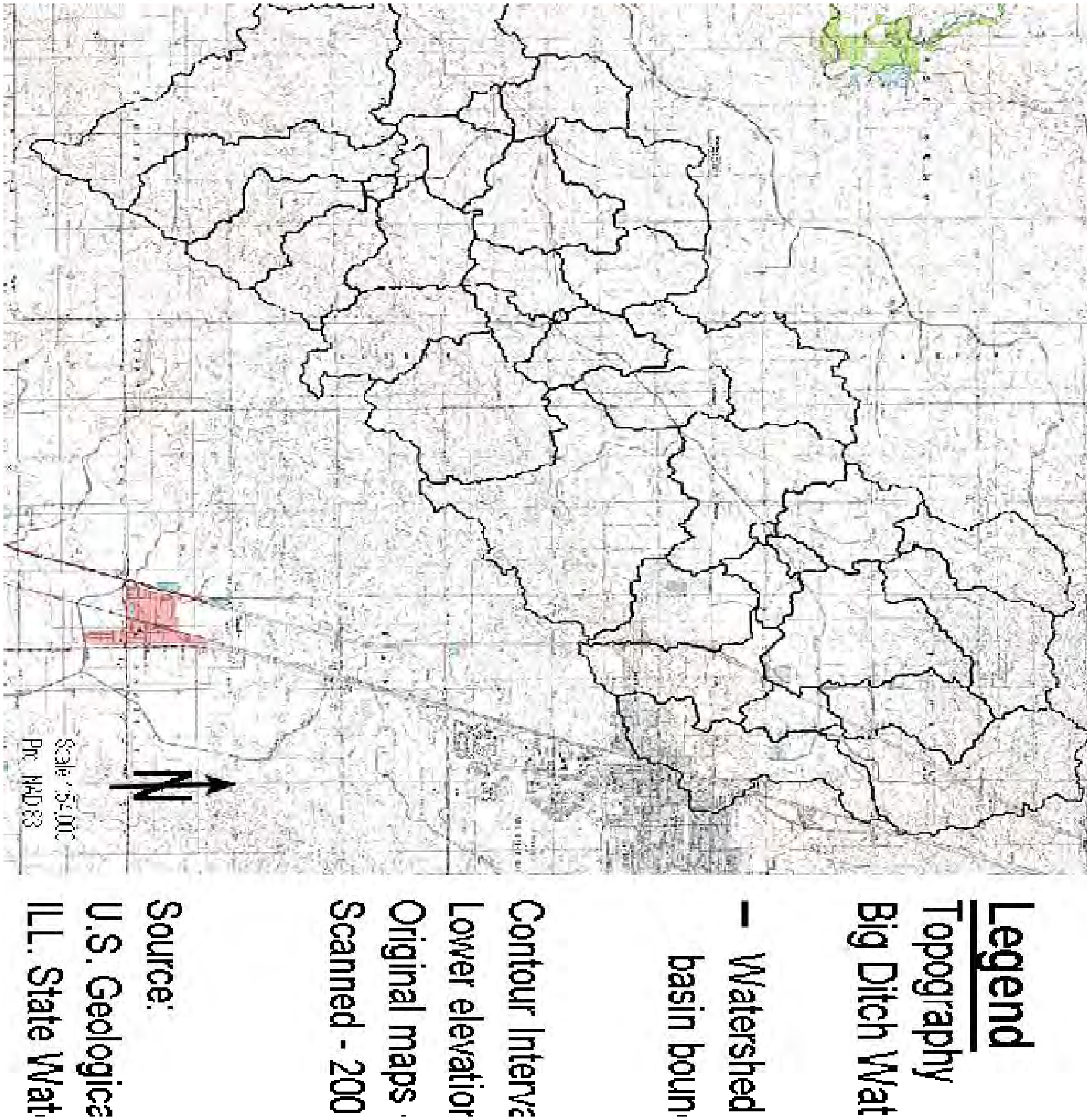

Fig. - 18 Topography Map of Big Ditch Watershed

Water Quality Data – Nitrate-N and Runoff

The Illinois State Water Survey from 7/21/1993 to 7/08/2003 and from 9/13/2005 to 9/30/2008 monitored this watershed. Over this period at the Big Ditch tributary (ISWS station #106), the annual nitrate-N minimum concentration varied from 0.02 to 4.88 mg/L, the annual nitrate-N mean concentration varied 4.98 to 12.4 mg/L and the annual nitrate-N maximum concentration varied from 11.02 to 25.02 mg/L.[22,25] All the nitrate-N sample concentrations for this site (ISWS station #106) can be found in Appendix E of "Hydrologic and Nutrient Monitoring of the Lake Decatur Watershed: Final Report 1993-2008" on pages A-231 to A-267.

The following graph shows the annual nitrate-N concentration data, please note that Big Ditch is the red "dash-dot" line.

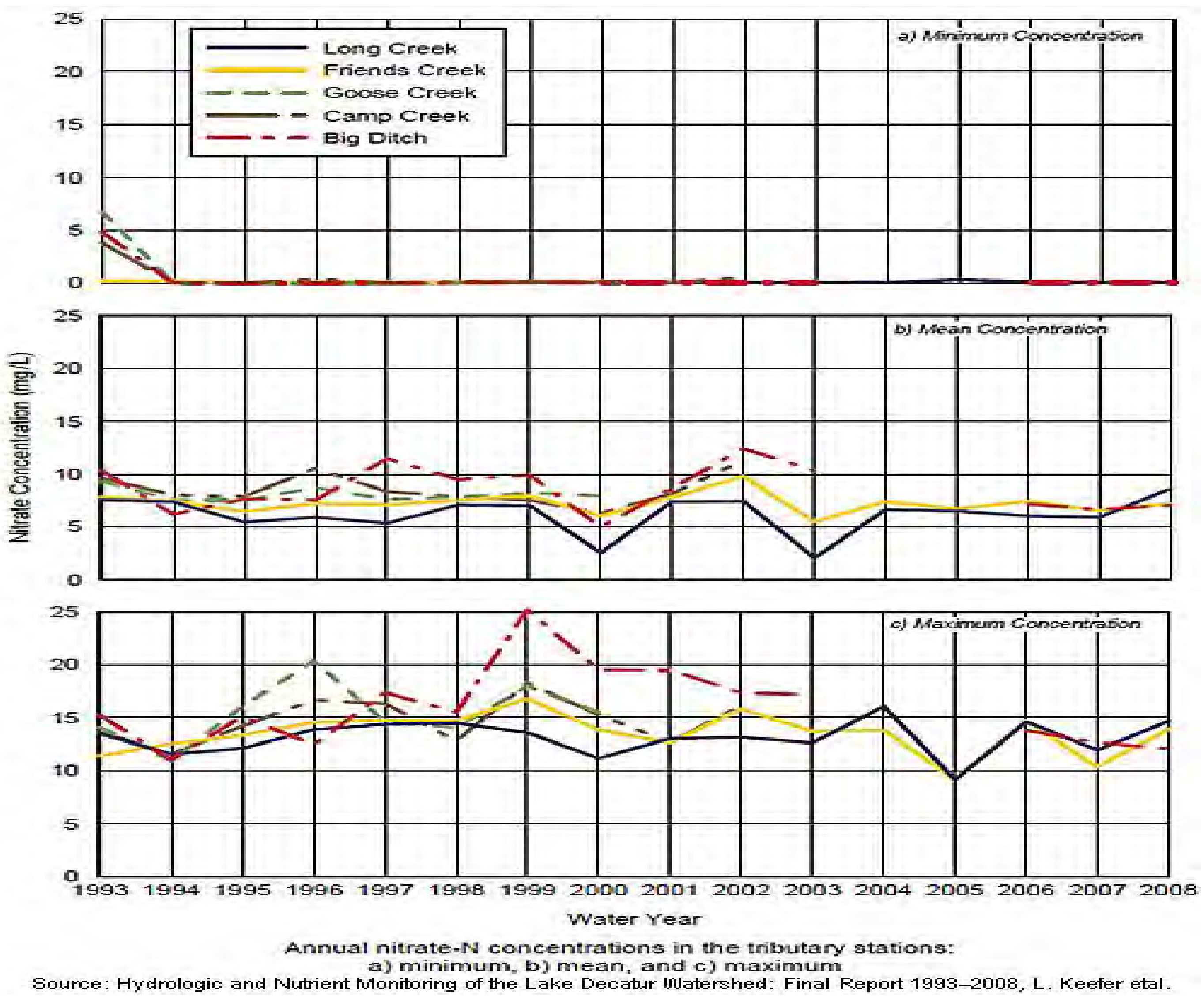

Fig. 19 - Annual Nitrate-N Concentration in the Tributary Stations

The Sangamon River at Monticello station (111) is operated by the USGS (05572000) with cooperative funding from the City of Decatur, and has a 100-year stream flow record (1908–2008) with a long-term mean annual stream flow of 424 cfs. Due to an extremely long stream flow record that represents more than half the watershed, the Monticello station is considered fairly representative of annual discharge into Lake Decatur. The greatest annual stream flow during the monitoring study was 1,052 cfs in WY (Water Year) 1993, over two-and-one-half times the long-term mean. This stream flow was the second highest recorded stream flow since 1908, and the WY2008 stream flow (867 cfs, twice the long-term mean) was the third highest recorded. It should be noted that the 10th and 11th highest recorded stream flow also occurred during the monitoring period for this study (WY1994 and 1998, respectively). The lowest stream flow during the monitoring period was WY2000 (112 cfs), and was the fourth lowest annual mean stream flow for the 100-year record. Based on this record, it appears that the monitoring period had some of the higher mean annual stream flows in the past 100 years.[22]

Summary of Rainfall, Stream Flow, Flow-Weighted Nitrate-N Concentration, and Nitrate-N Yield for the Sangamon River at Monticello (111) for WY1993-2008

Water year (Oct-Sept)	*Total annual rainfall (inches)*	*Annual mean Stream flow (1000 x cfs)*	*Annual runoff (inches)*	*Flow-weighted nitrate-N concentration (mg/L)*	*Annual nitrate-N yield (lb/ acre/yr)*
1993	51.5	1,052	*26.5	*10.3	*16
1994	34.4	677	17.1	5.9	23
1995	41.1	514	12.9	7.4	31
1996	36.7	312	7.9	8.4	24
1997	33.2	373	9.4	8.3	19
1998	43.0	677	17.1	9.4	36
1999	37.6	306	7.7	11.4	20
2000	31.5	112	2.8	8.8	6
2001	25.4	331	8.3	9.6	19
2002	41.2	666	16.8	10.8	41
2003	35.7	216	5.4	9.5	8
2004	1\31.2	600	15.2	8.1	28
2005	1\30.1	584	14.7	8.0	26
2006	1\26.2	238	6.0	9.0	12
2007	29.7	485	12.2	8.8	24
2008	+56.6	867	21.9	7.3	37
15-year mean (1993-2008)	36.6	501	12.6	8.8	23
Long-term mean (1908-2008)		424	10.5		

Notes:

* Data only for May-September 1993.

1\ Average of precipitation from Gibson City, Urbana, Clinton, and Rantoul weather stations.

\+ Some data from CoCoRas precipitation database.

Source: Hydrologic and Nutrient Monitoring of Lake Decatur Watershed: Final Report 1993-2008, L. Keefer etal.

Table E. Summary of Rainfall, Stream Flow, Flow-Weighted Nitrate-N Concentration, and Nitrate-N Yield the Sangamon River at Monticello (111).

WY2008 stream flow (867 cfs, twice the long-term mean) was the third highest recorded. It should be noted that the 10th and 11th highest recorded stream flow also occurred during the monitoring period for this study (WY1994 and 1998, respectively). The lowest stream flow during the monitoring period was WY2000 (112 cfs), and was the fourth lowest annual mean stream flow for the 100-year record. Based on this record, it appears that the monitoring period had some of the higher mean annual stream flows in the past 100 years. [22]

The flow-weighted nitrate-N concentrations at Monticello (111) decreased from 10.3 to 5.9 mg/L then steadily increased to 11.4 mg/L in WY1999. There was a slight drop and then rise to 10.8 mg/L in WY2002, but then nitrate-N steadily decreased to 7.3 mg/L over the remainder of the monitoring period. The 15-year mean annual flow-weighted nitrate-N concentration is 8.8 mg/L. [22]

The yield into Lake Decatur was computed using the Long Creek, Friends Creek, and Monticello annual nitrate-N yield data and weighting them based on watershed area. This allows for a reasonable approximation of the nitrate-N delivered to Lake Decatur. The 15-year mean annual nitrate-N yield is 23 lb/acre. During the monitoring period the annual yields varied from 7 lb/acre (WY2003) to 42 lb/acre (WY2008). [22]

The maximum nitrate concentrations were examined for different flow intervals for Lake Decatur (Table 14) and compared to the 10 mg-N/L target to estimate the percent reduction needed to meet the water quality target. In Lake Decatur a reduction of 13%-28% in nitrate loading is required to meet the TMDL target over the range of flows observed in the river. No reduction is needed during low flow conditions.[14]

Other data from "Hydrologic and Nutrient Monitoring of the Lake Decatur Watershed: Final Report 1993-2008" shows an annual runoff of 9.5 inches of water per year from this watershed. This is a contributing factor to the sediment and siltation problem of Lake Decatur, which is the drinking water source for the City of Decatur.[22]

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)."[23]

This 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.[14]

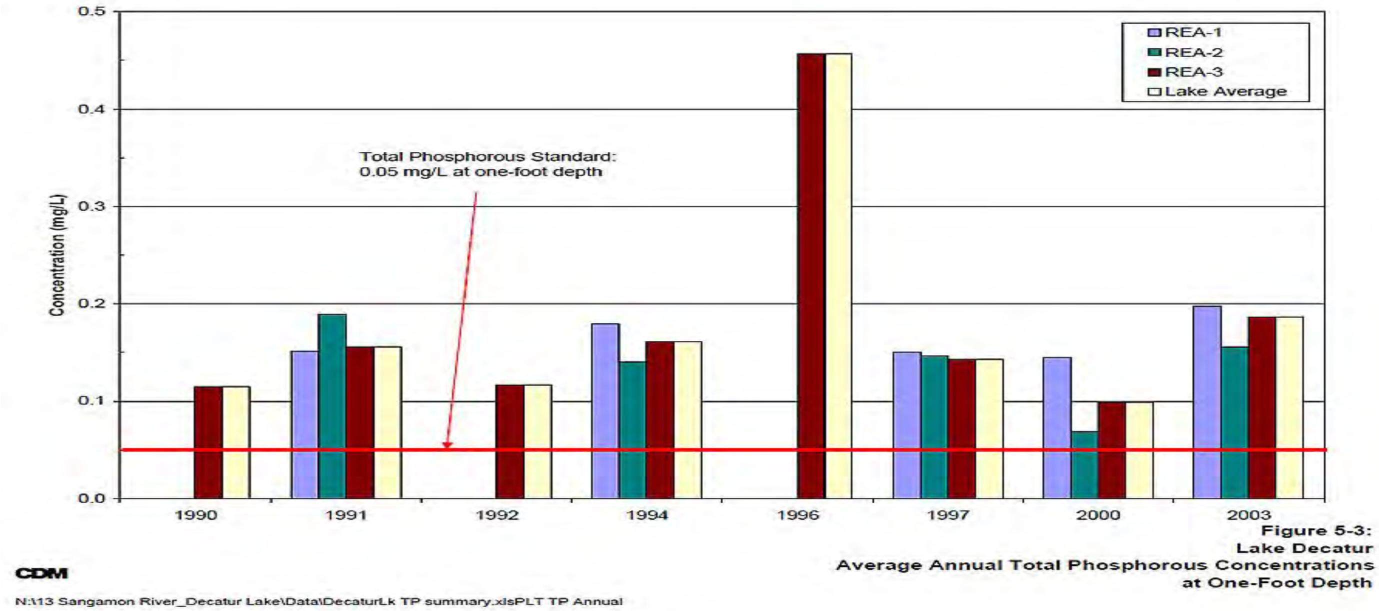

Fig. 20 - Lake Decatur Average Annual Total Phosphorous Concentrations

The water quality model BATHTUB was applied to determine that the maximum phosphorus load that will maintain compliance with the phosphorus standard is 954 kg/month (31.4 kg-P/day) between July and August, with the total load not to exceed 1,908 kg over this period. This allowable load corresponds to an approximately 74% reduction from existing phosphorus loads.[14]

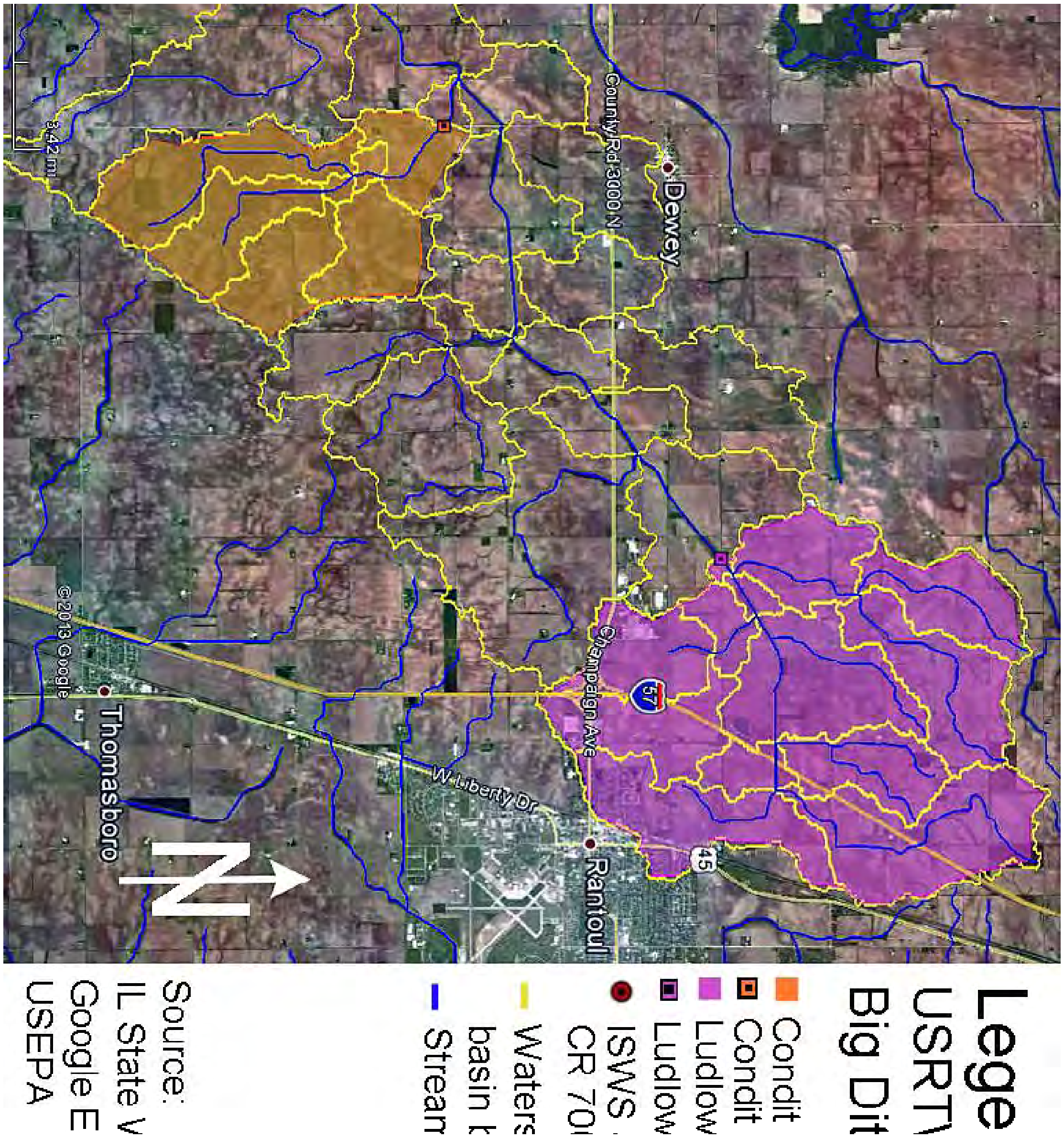

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Fig. 21 - Location of USRTWP Sites

Water Quality Data – Condit & Ludlow Sub-watershed Nutrient Study

The villages of Condit and Ludlow, located in subwatersheds of the Big Ditch watershed were part of the Upper Sangamon River Targeted Watershed Project (USRTWP). The goal of the USRTWP study was to determine if water quality would improve by reducing nutrient discharges from agricultural areas by incorporating market-based implementation mechanisms. This paired-watershed project studied several management strategies to reduce nutrient losses at the watershed level. Condit (population 223) was the Treatment subwatershed with 3,487 acres and Ludlow (population 222) was the Control subwatershed with 8,858 acres.[25]

Nitrogen fertilizer management: This part of the study was intended to test the hypothesis that optimum application rates can increase expected net farm income while also reducing nutrient losses at a watershed scale. To assess water quality response to changes in nitrogen application rates, water quality was monitored by ISWS for two sets of paired sub-watersheds in the Upper Sangamon River Watershed.

Annual Mean, Minimum, and Maximum Nitrogen Concentrations for WY2006–2008

Station	*Nitrate - N (NO^-_3 - N)*								
	Water year 2006			*Water year 2007*			*Water year 2008*		
	Min	*Mean*	*Max*	*Min*	*Mean*	*Max*	*Min*	*Mean*	*Max*
211^C	0.29	9.86	19.00	1.81	6.04	8.67	0.20	7.79	16.65
212^T	0.87	**12.96**	**19.26**	6.74	**10.43**	**17.17**	1.39	**9.75**	**15.82**
102	0.65	7.12	14.67	0.23	6.54	10.36	0.06	6.87	13.95
223^C	0.07	7.21	12.64	0.07	6.11	13.67	1.28	6.02	13.87
222^T	0.07	**11.14**	**17.16**	0.07	**10.30**	**16.59**	0.07	**10.32**	**16.99**
106	0.07	6.87	13.81	0.07	6.66	12.66	0.07	7.13	14.81

^C – Control watershed; ^T ***– Treatment watershed***

- Upper Sangamon River Watershed Monitoring Data for the USEPA Targeted Watershed Study: 2005–2008

Table F. Annual Mean, Minimum and Maximum Nitrogen Concentrations

"Producers in the control watershed were asked to report on their yield history and nitrogen application rate, with no expectation that they would make any changes in their customary nitrogen application rate. Producers in the treatment watershed were asked for their yield history. As condition of receiving the incentive payments for soil testing and variable rate phosphorus application, these producers were asked to apply N at a rate no higher than the rate based on the University of Illinois proven-yield recommendation." The results on this study in this watershed were inconclusive.[26]

Phosphorus fertilizer management: "This component assessed economic and water quality benefits of soil testing and variable rate technology for management of phosphorus."

Annual Mean, Minimum, and Maximum Phosphorus Concentrations for WY2006–2008

Station	*Total phosphorus (t-P)*								
	Water year 2006			*Water year 2007*			*Water year 2008*		
	Min	*Mean*	*Max*	*Min*	*Mean*	*Max*	*Min*	*Mean*	*Max*
223^C	0.05	0.34	2.71	0.05	0.30	1.58	0.04	0.58	5.81
222^T	**0.05**	**0.20**	**1.00**	**0.05**	**0.24**	**1.82**	**0.05**	**0.65**	**5.00**

^C – Control watershed; ^T ***– Treatment watershed***

- Upper Sangamon River Watershed Monitoring Data for the USEPA Targeted Watershed Study: 2005–2008

Table G. Annual Mean, Minimum, and Maximum Phosphorus Concentration for WY2006-2008

"The project was designed to …see if phosphorus levels in the water could be reduced by limiting the use of phosphorus fertilizer to no more than the University of Illinois recommendations. The second goal was to see if the use of variable rate technology (VRT) could be profitable for the producers and limit the use of phosphorus fertilizer to the areas in the fields that needed it." "The differences in fertilizer use and water quality would then be measured."[25]

“In summary, through the use of grid soil sampling and VRT spreading, the producers in the treatment watershed used an average of 59.6 pounds per acre less P_2O_5 than the U of I recommendations. Producers in the control watershed used an average of 40 pounds more P_2O_5 per acre than the U of I recommendations.” In two of the three study years the mean total phosphorus concentrations in receiving streams were lower in the treatment watershed, but not in all three years of the study.[26]

Existing Best Management Practices

The April 2013 survey of this watershed yields the following evaluation of existing BMP’s by Tim McMahon, a certified professional in erosion and sediment control (CPESC).

A significant number of grass waterways, grade stabilization structures, and filter strips exist throughout Big Ditch Sub Watershed. In areas were filter strips have been removed an adequate grass buffer is still being maintained (see figures 22-24). Ditch bank erosion is minimal and most likely is because the Big Slough Drainage District has done an excellent job maintaining the ditch yearly. However, there is a need for maintenance on a majority of the existing grass waterways (see figure 25).

Strip-till and No-till seem to be the dominate tillage practice in this watershed. Some ephemeral erosion was present in areas of concentrated flows due to tillage and due to the soil profile being saturated causing no soil structure. Areas such as these would benefit from the use of cover crops to help stabilize the soil profile (see figure 26-27).

Some urban construction in the upper reach of Big Ditch had proper BMP’s in place and appeared to be properly maintained.

Fig. 22 - Grassed waterway

Fig. 23 - Filter strip to the left and narrow grass buffer to the right

Fig. 24 - Drop notch structure at the base of a grassed waterway

Fig. 25 - Water flowing down the side of grassed waterway not able to flow into waterway except at its base

Fig. 26 - Water flowing through a No-till field of standing corn stalks. Notice how the stalks have spread out and slowed the flow off the water to reduce its erosive power.

Fig. 27 - A field of untilled soybean stubble and you could see the remains of the previous corn crop under the soybean residue (No-Till Residue & Tillage Management)

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