Water Quality Trading Plan

City of Brodhead
Green County, Wisconsin
Revised June 2018

Prepared by:

MSA Professional Services, Inc.
2901 International Lane, Suite 300
Madison, Wisconsin 53704
Phone: (608) 242-7779
www.msa-ps.com

Project No. 09336027

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Abbreviations

Organization Abbreviations:

DLMRA	=	Decatur Lake Millrace Association
DOA	=	Wisconsin Department of Administration
DNR	=	Wisconsin Department of Natural Resources
LWCD	=	Green County Land & Water Conservation Department
LSRWA	=	Lower Sugar River Watershed Association
MSA	=	MSA Professional Services, Inc.
NRCS	=	Natural Resources Conservation Service
SWWRPC	=	Southwestern Wisconsin Regional Planning Commission
USGS	=	United States Geological Survey

Technical Abbreviations:

Al	=	Aluminum
BMP	=	Best Management Practice
EQIP	=	NRCS Environmental Quality Incentives Program
HUC	=	Hydrologic Unit Code (i.e. watershed identification code)
NMP	=	Nutrient Management Plan
PI	=	Phosphorus Index [lb/acre/year]
T	=	Annual Tolerable Soil Loss [tons/acre/year]
TMDL	=	Total Maximum Daily Load
TP	=	Total Phosphorus
WPDES	=	Wisconsin Pollutant Discharge Elimination System
WQBEL	=	Water Quality Based Effluent Limit
WQT	=	Water Quality Trading
WRAS	=	Watershed Rapid Assessment Survey
WWTF	=	Wastewater Treatment Facility

Unit Abbreviations:

ac	=	Acre
lb	=	Pound Mass
gpd	=	Gallons per Day
gpcd	=	Gallons per Capita per Day
MGD	=	Million Gallons per Day
mg/L	=	Milligrams per Liter
ppm	=	Parts per Million [mass basis]

Water Quality Model Abbreviations:

APLE-Lots	=	Annual Phosphorus Loss Estimator for Outdoor Cattle Lots
BARNY	=	Wisconsin Barnyard Runoff Model
EVAAL	=	Erosion Vulnerability Assessment for Agricultural Lands
PRESTO	=	Pollutant Load Ratio Estimator Tool
SnapPlus	=	Soil Nutrient Application Planner
SPARROW	=	Spatially Referenced Regression On Watershed Attributes
SWAT	=	Soil and Water Assessment Tool

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EXECUTIVE SUMMARY

Need for Project:

The City of Brodhead owns and operates a mechanical wastewater treatment facility (WWTF) that is required to meet new stringent water quality based effluent limits (WQBELs) for phosphorus. The City's current Wisconsin Pollutant Discharge Elimination System (WPDES) permit, which was reissued on November 1, 2012, includes a compliance schedule for meeting future phosphorus WQBELs of 0.3 mg/L (monthly average), 0.1 mg/L (6-month average), and 0.5 lb/day (6-month average). The new WQBELs are intended to protect the water quality of the Sugar River Millrace and other downstream surface waters. The proposed WQBELs cannot be achieved with the existing biological and chemical treatment processes utilized by the City. Therefore, the City of Brodhead must upgrade the existing WWTF to meet the proposed WQBELs or consider other feasible means of compliance.

Alternatives Considered:

The State of Wisconsin has provided several alternatives for wastewater permittees to achieve compliance with stringent phosphorus WQBELs. Potential alternatives which the City could consider for compliance are listed below:

1. Regional Wastewater Treatment with a Nearby Community
2. Wastewater Treatment and Groundwater Discharge
3. WWTF Tertiary Phosphorus Removal Upgrade
4. Adaptive Management
5. Water Quality Trading
6. Alternative Site Specific Limits
7. Multi-Discharger Variance
8. Economic Variance

Each of these alternatives were evaluated in the City of Brodhead's *Preliminary Compliance Alternatives Plan* (MSA, 2015). Based on the findings of the report, it was determined that Water Quality Trading (Alternative #5) is the most-cost effective alternative which the City of Brodhead can implement to comply with the proposed WQBELs for phosphorus.

Water Quality Trading:

Water Quality Trading is a phosphorus compliance alternative which allows wastewater permittees to implement best management practices (BMPs) within eligible watersheds in lieu of constructing WWTF upgrades to comply with the proposed phosphorus WQBELs. Water Quality Trading requires that the permittees offset the amount of phosphorus discharged by the WWTF in excess of the applicable WQBEL for phosphorus, including uncertainty factors known as "trade ratios" to promote water quality improvements. Phosphorus offsets are made by implementing trades with other point source dischargers of phosphorus or by implementing urban stormwater and/or agricultural BMPs within the watershed of the receiving water. Water Quality Trading is only allowed if a permittee can develop a binding written agreement with another permittee, person, and/or entity to reduce discharges of the traded pollutant and improve water quality.

Based on the analysis in this report, it has been determined that the City of Brodhead needs to generate 238 pounds of phosphorus credit per year in order to comply with the long term goals of Water Quality Trading. This assumes the WWTF can consistently achieve a phosphorus effluent concentration of 0.3 mg/L, which pilot testing has confirmed is feasible. The long term credit goal accounts for future increases in influent flow to the WWTF due to population and industrial growth over the next 20 years and includes a safety factor to allow for inherent variability in influent loadings and wastewater treatment performance.

The established action area for the Water Quality Trading Plan is shown in **Figure 1** and is focused on reducing nonpoint phosphorus loadings in the Searles Creek subwatershed (HUC 070900040601). This action area was established through local stakeholder and landowner meetings and through the evaluation of available water quality data and watershed models.

Recommended Plan:

The City and MSA have identified three private landowners in the Searles Creek subwatershed who are willing to establish legally binding agreements to reduce nonpoint sources of phosphorus. These landowners are referred to as Landowner A, Landowner B, and Landowner C in this report. Landowner A and Landowner B own property along the main branch of Searles Creek. Streambanks along both properties are actively eroding. Phosphorus credits are planned to be generated with both landowners by stabilizing the eroding banks and by installing in-stream structures to improve habitat conditions for aquatic and terrestrial species. Landowner A and Landowner B own approximately 0.8 and 0.4 miles of streambank along Searles Creek, respectively. Landowner C is a small dairy farm. The farm lacks sufficient long term manure storage which makes proper nutrient management of the farm's crop fields challenging. The farm also has several outdoor barnyards which lack clean water diversions and runoff collection and treatment infrastructure. Phosphorus credits are planned to be generated with Landowner C by:

- Installing a new waste storage facility with 180 days of storage or greater.
- Abandoning, revegetating, and developing a conservation easement for an existing earthen outdoor barnyard.
- Installing roof covers and roof gutters to prevent roof runoff from contacting manure deposited on outdoor barnyards.
- Installing waste reception tanks and waste transfer piping to capture and transfer runoff from outdoor barnyards to the new waste storage facility.
- Improving nutrient management of crop fields owned and operated by Landowner C.

The amount of credits which are expected to be generated by working with each landowner during the City's first permit term of Water Quality Trading are shown in **Table 1**. It is expected that the installation of BMPs for Landowners A, B, and C which include construction will be completed in the summer of 2019 prior to the City's deadline to comply with Water Quality Trading on October 31, 2019. Since these projects will not be completed until late summer, these projects will only generate partial credit during the year of 2019. The number of credits generated in 2019 as shown in **Table 1** assume only three months of credit will be generated. Nutrient management practices implemented by Landowner C are not expected to be fully implemented until the 2020 crop year which extends from approximately November 2019 through October 2020. Therefore, phosphorus reductions from improved nutrient management by Landowner C are not expected to generate credits until the year 2020. As shown, a total of 79.9 pounds of credit per year is expected to be generated in the year 2019 and approximately 390 pounds of credit per year is expected in the years 2020, 2021, and 2022. This greatly exceeds the City's long term goal of 238 pounds of credit per year needed to comply with Water Quality Trading. For the purposes of providing greater operational flexibility of the Brodhead WWTF, projects with all landowners are recommended for implementation by the City.

Table 1: Total amount of phosphorus credits generated in Permit Term #1 of WQT

Landowner ID	Phosphorus Credits Generated (lb/yr)				
	2018	2019[1]	2020	2021	2022
Landowner A - Streambank Improvements	0.0	34.7	137.5	137.5	137.5
Landowner B - Streambank Improvements	0.0	24.8	98.2	98.2	98.2
Landowner C - Farmstead Improvements	0.0	20.1	79.9	79.9	79.9
Landowner C - Crop Field Improvements	0.0	0.0	74.0	74.9	78.7
Total	**0.0**	**79.5**	**389.6**	**390.5**	**394.3**

[1]*Phosphorus credits generated in the year 2019 assume practices will be installed by September 30, 2019, and will generate only three months of credit in 2019.*

Estimated Implementation Costs and Potential External Funding Sources:

The estimated costs of implementing the improvements recommended in this Water Quality Trading plan are summarized in **Table 2**. As shown, the total capital cost for the project is estimated to be $971,000, and the total annual operation and maintenance (O&M) cost is estimated to be $42,000. This results in a total 20-year present worth of approximately $1.5 million. The 20-year present worth costs assume that annual O&M is sufficient to extend the design life of all trades up to 20 years.

Table 2: Estimated costs of implementing the Water Quality Trading Plan

Landowner ID	Capital Costs	Annual O&M Costs	20-year Present Worth
Landowner A	$ 380,000	$ 13,000	$ 555,000
Landowner B	$ 295,000	$ 9,000	$ 410,000
Landowner C	$ 296,000	$ 20,000	$ 569,000
Total	**$ 971,000**	**$ 42,000**	**$ 1,534,000**

It is important to note that the costs listed in **Table 2** for Landowners A & B represent the total estimated project costs for these landowners. The City intends to fully fund the capital and annual costs for these projects even if external funding is not available. Conversely, the cost estimate for Landowner C's project is only an estimate of the maximum amount of funding the City may contribute and therefore, does not represent the actual overall cost of the project. The financial contribution from the City to Landowner C's project may vary based on the amount of additional funding obtained from external sources. This may affect the number of credits generated. However, the City will sufficiently exceed the minimum long term credit goal of 238 pounds per year as long as "some" amount credit is generated as part of Landowner C's project.

Based on review of eligible financial aid programs for Water Quality Trading, the City plans to pursue funding for each landowner through the Natural Resources Conservation Service (NRCS) Environmental Quality Incentives Program (EQIP). NRCS EQIP is listed as an eligible funding source for Water Quality Trading programs according to Appendix B of DNR's draft *Agricultural Nonpoint Source Implementation Handbook for Adaptive Management and Water Quality Trading WPDES Permit Compliance Options* (2015). EQIP provides financial assistance to agricultural producers to help implement conservation practices that address natural resource concerns and improve soil, water, plant, animal, air, and related resources on agricultural land.

Project Schedule:

The anticipated implementation schedule for this Water Quality Trading Plan is summarized in **Table 3**. In order to accommodate this project schedule, the City of Brodhead should budget expenses for the next five years as shown in the cash flow summary presented in **Table 4**.

Table 3: Anticipated project implementation schedule

Proposed Action	Approximate Date
Submit Water Quality Trading Plan to DNR	July 31, 2017
Expiration of Brodhead's Current WDPES Permit	October 31, 2017
Submit Water Quality Trading Plan Revisions to DNR	June 11, 2018
Establishment of Trade Agreements with Landowners A, B, and C	July 31, 2018
Submit Engineering Plans, Specs, and Permits for Landowners A, B, and C to NRCS/DNR	October 31, 2018
Initiate Construction for Landowners A, B, and C	April 1, 2019
Submit Management Practice Registration Forms for Landowners A, B, and C to DNR	September 30, 2019
Achieve Compliance with Water Quality Trading	October 31, 2019

Note: Project implementation schedule subject to change based on timing of DNR approval of the Water Quality Trading Plan and reissuance of the City of Brodhead's WPDES Permit.

Table 4: Cash flow summary for the first WPDES permit term of Water Quality Trading

Year	Capital Costs	Annual O&M Costs	Total Annual Cost
2018	$154,000	$0	$154,000
2019	$817,000	$42,000	$859,000
2020	$0	$42,000	$42,000
2021	$0	$42,000	$42,000
2022	$0	$42,000	$42,000

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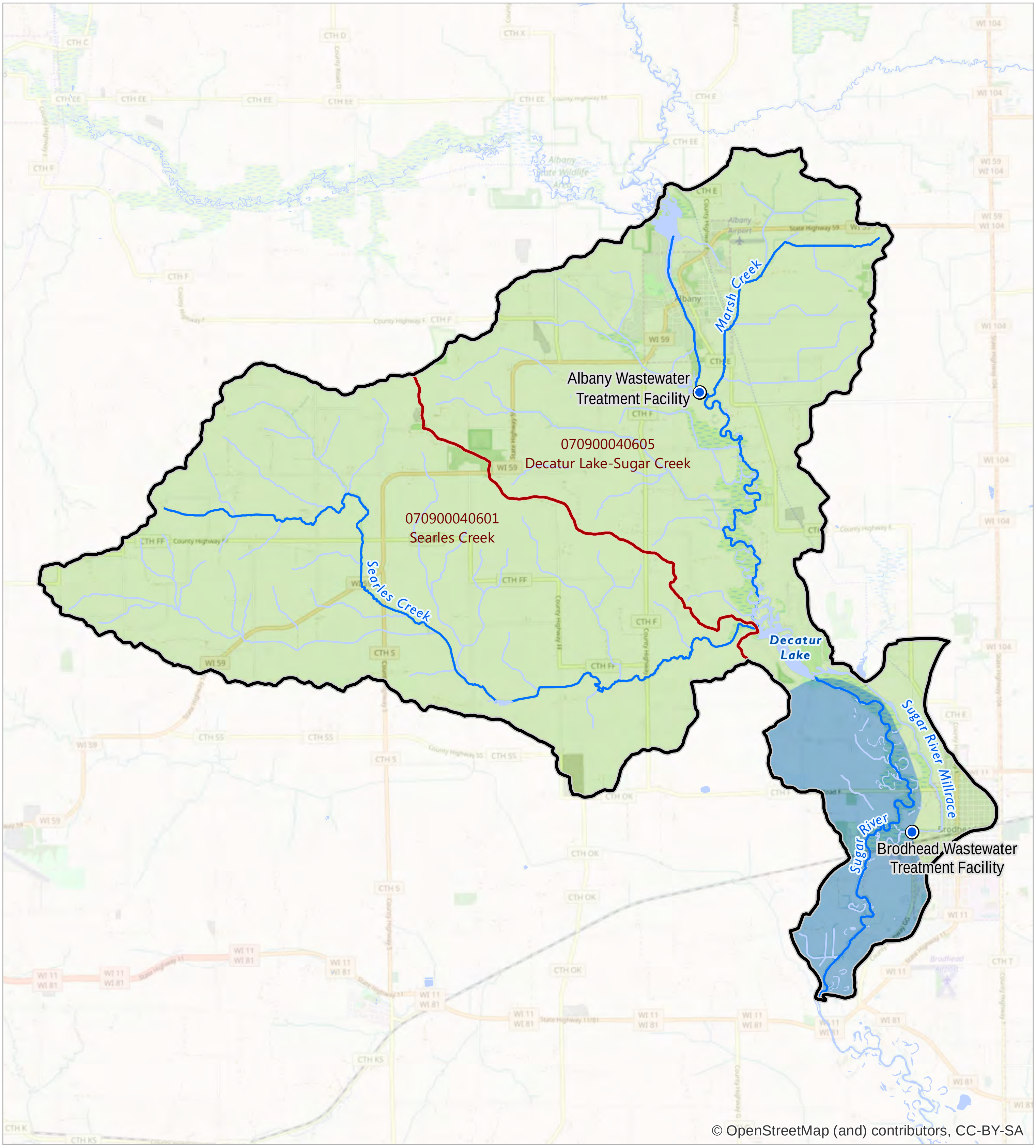

Figure 1
Final City of Brodhead WQT Action Area Overview Map

City of Brodhead
Green and Rock Counties, WI

Action Area, Final
HUC 12 Watershed
Wastewater Treatment Facility
Waterbody
Named River/Stream
Other River/Stream
Upstream Trading Area
Downstream Trading Area

Data Sources:
HUC 12 Watershed boundaries: WDNR
Wastewater Treatment Facilities: WDNR
Waterbodies and River/Streams: USGS NHD
Basemap: ESRI

0 0.75 1.5 Miles

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CHAPTER 1 – INTRODUCTION

1.1 BACKGROUND

The City of Brodhead (population 3,293) owns and operates a mechanical wastewater treatment facility (WWTF) that serves residential, commercial, and industrial users of the City's sanitary sewer system. The City is located along State Highway 11 near the eastern border of Green County, Wisconsin. The existing WWTF is located at 1700 11th Street, Brodhead, Wisconsin, in the NW ¼ of the SW ¼ of Section 25 and the NE ¼ of the SE ¼ of Section 26, T2N, R9E of Green County. **Figure 1-1** depicts the location of the City and the existing WWTF.

The existing WWTF continuously discharges treated effluent to the Sugar River Millrace, a branch of the Sugar River in the Sugar-Pecatonica River Basin. The City's current Wisconsin Pollutant Discharge Elimination System (WPDES) permit, which was reissued on November 1, 2012, includes a compliance schedule for meeting future water quality based effluent limits (WQBELs) of 0.3 mg/L (monthly average), 0.1 mg/L (6-month average), and 0.5 lb/day (6-month average) for total phosphorus. The new WQBELs are intended to protect the water quality of the Sugar River Millrace and other downstream surface waters. The proposed WQBELs are significantly more stringent than the WWTF's current interim phosphorus limit of 1.7 mg/L (monthly average), and the existing WWTF cannot comply with the WQBELs without significant treatment process upgrades. Therefore, the City of Brodhead must upgrade the existing WWTF to meet the proposed WQBELs or must consider other means of compliance. Based on the findings presented in the City of Brodhead's *Preliminary Compliance Alternatives Plan* (2015), it has been determined that the most cost-effective means of complying the proposed phosphorus limits is to pursue Water Quality Trading (WQT).

WQT is a phosphorus compliance alternative described in Wisconsin Statute 283.84 which allows a permittee to implement best management practices (BMPs) within eligible watersheds which are hydrologically connected to a permittee's wastewater outfall in lieu of constructing costly phosphorus removal upgrades (e.g. tertiary filtration or equivalent) at the WWTF to comply with the proposed WQBELs. WQT requires that the permittee offset the amount of phosphorus discharged by the WWTF in excess of the most stringent WQBEL (0.1 mg/L) for phosphorus. Phosphorus offsets are made by implementing trades with other point source dischargers of phosphorus or by implementing urban stormwater and/or agricultural BMPs within the watershed of the receiving water. Urban BMP options include stormwater infiltration practices, detention basins, and grassed swales. Rural/agricultural BMPs can include both hard practices (e.g. barnyard improvements such as clean water diversions and heavy use protection areas) and soft practices (e.g. nutrient management, reduced tillage, and filter strips).

WQT trading is only allowed if a permittee can develop a binding written agreement with another permittee, person, and/or entity to reduce discharges of the traded pollutant (e.g. phosphorus) and improve water quality. In order to promote the potential for improving water quality, an uncertainty factor known as a "trade ratio" is applied to the amount of phosphorus that must be offset by the discharger. The applicable trade ratios typically vary from 1.1 to 4 times the amount of phosphorus that would need to be removed at the WWTF to meet the WQBEL for phosphorus. Even though more phosphorus is required to be offset in order to comply with WQT, in many cases, such as for the City of Brodhead, BMP implementation is less costly than upgrading the WWTF to achieve compliance with stringent WQBELs for phosphorus.

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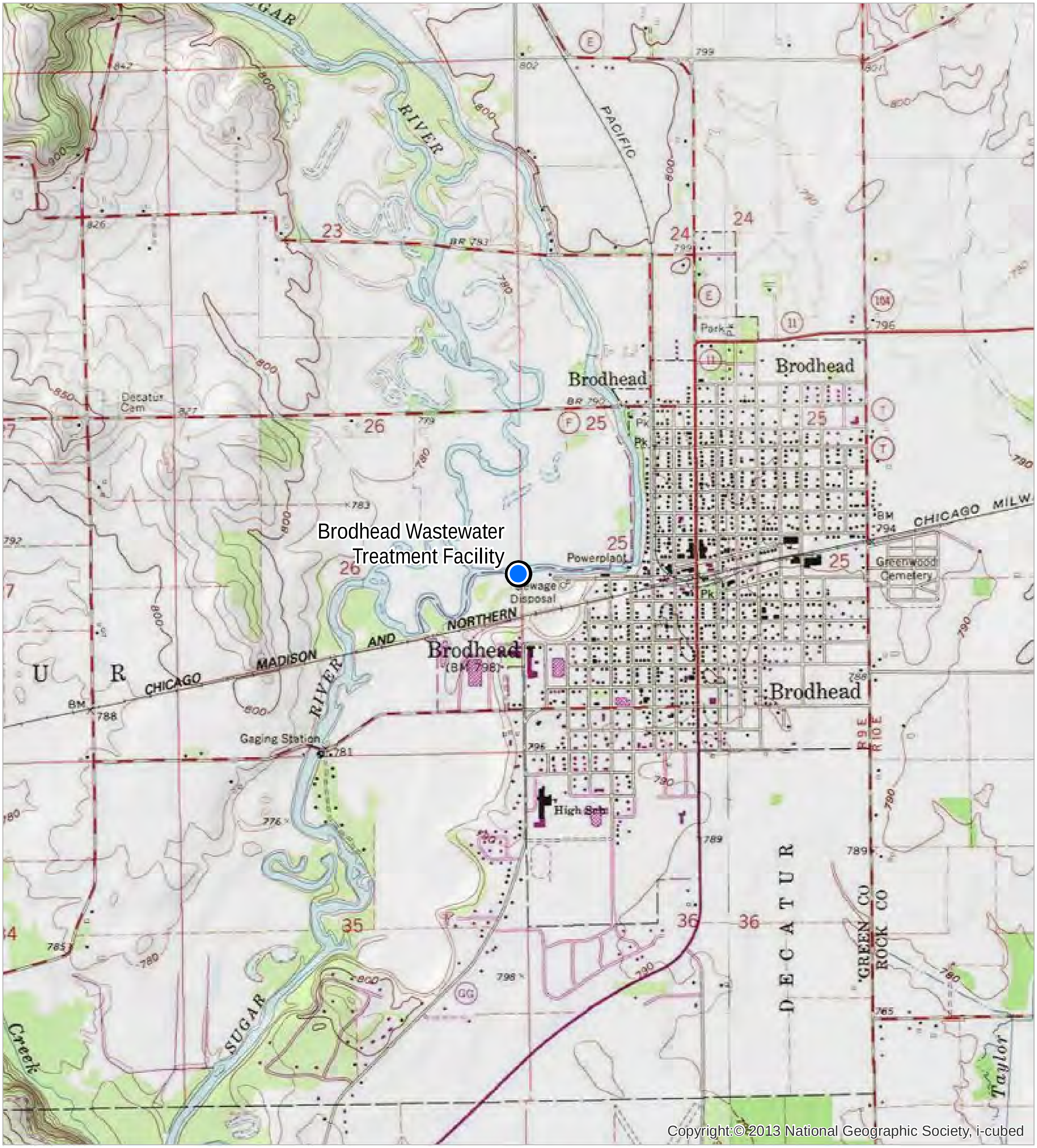

Figure 1-1

Brodhead Wastewater Treatment Facility Location Map

City of Brodhead
Green and Rock Counties, WI

Data Sources:
Basemap provided by ESRI, derived from USGS topographic maps.

Brodhead Wastewater Treatment Facility

N

0 1,000 2,000 Feet

MSA

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1.2 PURPOSE AND SCOPE

The purpose of this WQT Plan is to identify locations within the Sugar River Basin where BMPs can be implemented by the City of Brodhead to sufficiently offset the environmental impacts of phosphorus discharged by the Brodhead Wastewater Treatment Facility. The objectives of this WQT Plan are:

- to characterize the City of Brodhead's WPDES permit requirements for phosphorus and rational for selecting WQT for phosphorus compliance
- to determine the minimum phosphorus load reductions needed for the City of Brodhead to comply with WQT
- to identify eligible watersheds where BMPs can be implemented by the City of Brodhead and areas where improvements are needed most
- to identify partners who will be involved with the implementation of the City of Brodhead's WQT Plan and to establish the roles and responsibilities of each partner
- to identify BMPs which will be implemented by the City of Brodhead and to quantify phosphorus load reductions and implementation costs
- to establish processes the City of Brodhead will implement to inspect installed BMPs and repair failing BMPs
- to evaluate the overall financial impacts of WQT on the City of Brodhead and to identify eligible outside funding sources to offset costs of implementing BMPs
- to establish a schedule for BMP implementation which allows the City of Brodhead to comply with WPDES permit requirements

1.3 WASTEWATER FACILITY DESCRIPTION

The City of Brodhead owns and operates a mechanical WWTF which was commissioned in 1998. The WWTF treats residential, commercial, and industrial wastewater generated by users of the City's sanitary sewer system. In addition, the WWTF accepts septage and landfill leachate which is received at an on-site waste receiving station. A flow schematic of the WWTF is shown in **Figure 1-2**. The facility's wastewater treatment processes include mechanical screening, grit removal, biological phosphorus removal, extended aeration activated sludge, final clarification, and ultraviolet disinfection. The existing biological phosphorus removal process is capable of achieving effluent total phosphorus concentrations of 1 mg/L or less. The WWTF also has a chemical feed system for chemical phosphorus removal. This system is used currently used as a backup to the biological phosphorus removal process but could be utilized to further reduce the amount of phosphorus discharged by the WWTF. Waste sludge produced by the wastewater treatment process is stabilized by aerobic digestion and is stored in an on-site sludge storage tank. The existing sludge storage tank provides 180-days of sludge storage capacity. Sludge is biannually removed from the sludge storage tank and is land applied to agricultural fields by a licensed contractor. Overall, the existing WWTF is in good condition and able to maintain substantial compliance with existing WDPES permit limits.

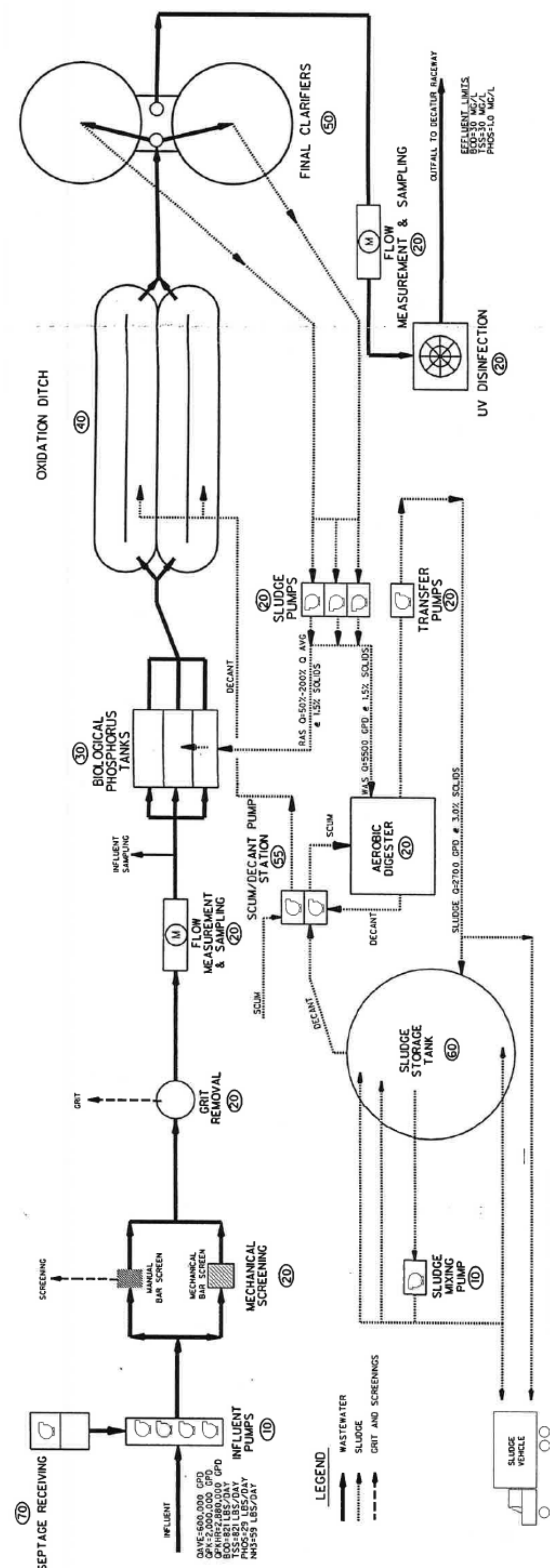

Figure 1-2: Brodhead Wastewater Treatment Facility flow schematic

1.4 WPDES PERMIT REQUIREMENTS

The current WPDES permit for the City of Brodhead Wastewater Treatment Facility was reissued on November 1, 2012, and was modified on June 1, 2015. The current permit will expire on October 31, 2017. A copy of the current WPDES permit is included in **Appendix A**. Current and future effluent phosphorus limits are summarized in **Table 1-1**. As shown, the current interim limit of 1.7 mg/L applies until October 31, 2021. After that date, the final water quality based effluent limits (WQBELs) become effective. These final limits include the very stringent WQBEL of 0.1 mg/L. As stated in Section 2.2.1.2 of the City's WPDES permit, the WWTF does not have to be upgraded to comply with the proposed WQBELs if the City chooses to comply with phosphorus requirements via WQT. Since a major wastewater facility upgrade will not be completed if the City pursues WQT, the length of the phosphorus compliance schedule would be shortened from 9 years to 7 years. Therefore, for the City to comply with WQT, all trades would need to be installed and effective prior to October 31, 2019.

Table 1-1: Summary of current and future effluent phosphorus limits for the Brodhead WWTF

Phosphorus Limit	Limit Type	Limit and Units	Notes
Interim Limit	Monthly Avg.	1.7 mg/L	Currently Effective
Final WQBEL	Monthly Avg.	0.3 mg/L	Effective October 31, 2021
Final WQBEL	6-Month Avg.	0.1 mg/L	Effective October 31, 2021
Final WQBEL	6-Month Avg.	0.5 lb/day	Effective October 31, 2021
Water Quality Trading	-	-	Effective October 31, 2019

1.5 SELECTION OF WATER QUALITY TRADING

In 2015, the City of Brodhead completed a *Preliminary Compliance Alternatives Plan* to determine the most cost-effective and environmentally beneficial alternative which could be implemented to achieve compliance with the proposed WQBELs for phosphorus. This report evaluated several possible compliance alternatives including:

1. Regional wastewater treatment with a nearby community
2. Wastewater treatment and groundwater discharge
3. WWTF Tertiary Phosphorus Removal Upgrade
4. Adaptive Management
5. Water Quality Trading
6. Alternative Site Specific Limits
7. Statewide "Multi-Discharger" Variance (Act 378)
8. Economic Variance

Based on the evaluation of the above alternatives, only a WWTF tertiary phosphorus removal upgrade (Alternative #3) and Water Quality Trading (Alternative #5) were determined to be feasible options for the City of Brodhead. The preliminary cost estimates for both of these alternatives, as presented in the *Preliminary Compliance Alternatives Plan*, are summarized in **Table 1-2**. As shown, even after preliminary analysis, WQT was determined to be significantly less costly than upgrading than the existing WWTF to achieve compliance with the stringent WQBEL of 0.1 mg/L. Additional evaluation of costs in 2016 prior to the drafting of this WQT Plan suggested that the 20-year present worth of WQT could be as low as $1.5 million if the City were able to further optimize phosphorus removal at the WWTF. Due to the anticipated cost savings, the City of Brodhead has elected to implement WQT to comply with WDPES permit requirements for phosphorus. The City of Brodhead submitted a *Notice of Intent to Conduct Water Quality Trading* to the Wisconsin Department of Natural Resources (DNR) in September 2016. A copy of the *Notice of Intent to Conduct Water Quality Trading* is included in **Appendix B** of this report.

Table 1-2: Estimated costs of phosphorus compliance for the City of Brodhead (MSA, 2015)

Alternative	Capital Costs	O&M Costs	20-year Present Worth
WWTF Tertiary Phosphorus Removal Upgrade	$4,200,000	$89,000	$5,290,000
Water Quality Trading	$1,200,000	$192,000	$3,671,000

CHAPTER 2 – LOAD REDUCTION REQUIREMENTS

2.1 GENERAL

This chapter describes existing and projected wastewater loading conditions at the Brodhead Wastewater Treatment Facility and estimates minimum phosphorus reductions needed for the City of Brodhead to comply with WQT. Much of this information was previously provided in the City of Brodhead *Preliminary Compliance Alternatives Plan* (MSA, 2015). For additional detail, refer to the *Preliminary Compliance Alternatives Plan*.

2.2 EXISTING CONDITIONS

This section describes historical influent and effluent wastewater loadings at the Brodhead Wastewater Treatment Facility. **Table 2-1** summarizes the WWTF's average annual influent and effluent flows and effluent total phosphorus concentrations and mass loads from 2009 to 2016. As shown, the average influent and effluent flows during the eight-year timeframe were 0.279 MGD and 0.264 MGD, respectively. Average effluent phosphorus concentrations and mass loads were 0.7 mg/L and 1.5 lb/day, respectively.

Table 2-1: Brodhead WWTF annual wastewater and phosphorus loads (2009-2016)

Year	Avg. Influent Flow (MGD)	Avg. Effluent Flow (MGD)	Avg. Effluent TP Conc. (mg/L)	Avg. Effluent TP Load (lb/day)
2009	0.338	0.350	0.7	2.0
2010	0.277	0.289	0.8	1.9
2011	0.232	0.228	0.9	1.8
2012	0.215	0.190	0.9	1.5
2013	0.293	0.275	0.7	1.6
2014	0.282	0.261	0.6	1.3
2015	0.267	0.232	0.5	1.0
2016	0.329	0.285	0.3	0.6
Avg.	**0.279**	**0.264**	**0.7**	**1.5**

It is important to note that the City of Brodhead has attempted to optimize phosphorus removal from the existing WWTF since the City's WPDES permit was reissued in 2012. Optimization has included influent phosphorus source control as well as biological and chemical treatment optimization. As shown in **Table 2-1** and in **Figure 2-1**, annual average effluent phosphorus loads have generally decreased throughout the analysis period. In fact, effluent phosphorus loads have been reduced by approximately 70% since 2009. This trend supports the conclusion that the City has been successful in optimizing the WWTF's phosphorus removal processes.

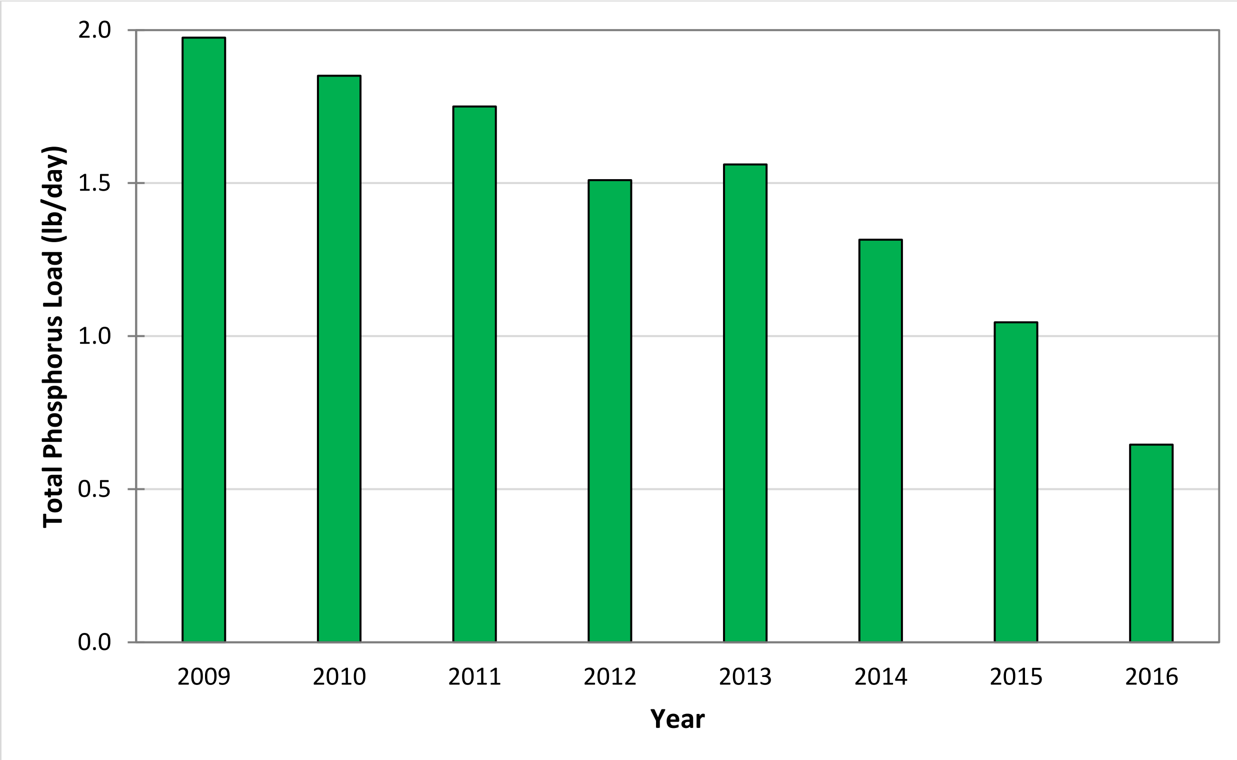

Figure 2-1: Brodhead WWTF average annual effluent total phosphorus loads (2009-2016)

2.3 POPULATION FORECASTING

The future population for the City of Brodhead was estimated by reviewing historical census data and population projections published by the State of Wisconsin Department of Administration (DOA) Demographics Service Center and the Southwestern Wisconsin Regional Planning Commission (SWWRPC). As shown in **Table 2-2**, population projections by the DOA suggest that the City population will increase to 3,555 people by 2030 and then decrease to 3,485 people by 2040. Alternatively, the projections by the SWWRPC suggest a more drastic increase in population to 3,860 people by 2030. For the purposes of this Water Quality Trading Plan, the projections developed by the DOA will be used to estimate future influent wastewater loadings at the WWTF (see **Figure 2-2**). The DOA's projections were chosen since they were developed more recently than the projections from the SWWRPC. The SWWRPC has agreed that DOA projections should be used to estimate future wastewater flows. Since the population is expected to decline after 2030, the maximum population of 3,555 people will be used for the purposes of estimating maximum 20-year design conditions. The WQT Plan projections represent an increase of 262 people (8%) above the current estimated population of 3,293.

Table 2-2: City of Brodhead population projections

Year	Historical Population (U.S. Census)	2013 DOA Projections	2005 SWWRPC Projections	WQT Plan Projections
1970	2,515	-	-	-
1980	3,153	-	-	-
1990	3,165	-	-	-
2000	3,180	-	-	-
2010	3,293	3,293	3,407	3,293
2015	-	3,325	-	3,325
2020	-	3,430	3,633	3,430
2025	-	3,505	-	3,505
2030	-	3,555	3,860	3,555
2035	-	3,545	-	3,545
2040	-	3,485	-	3,485

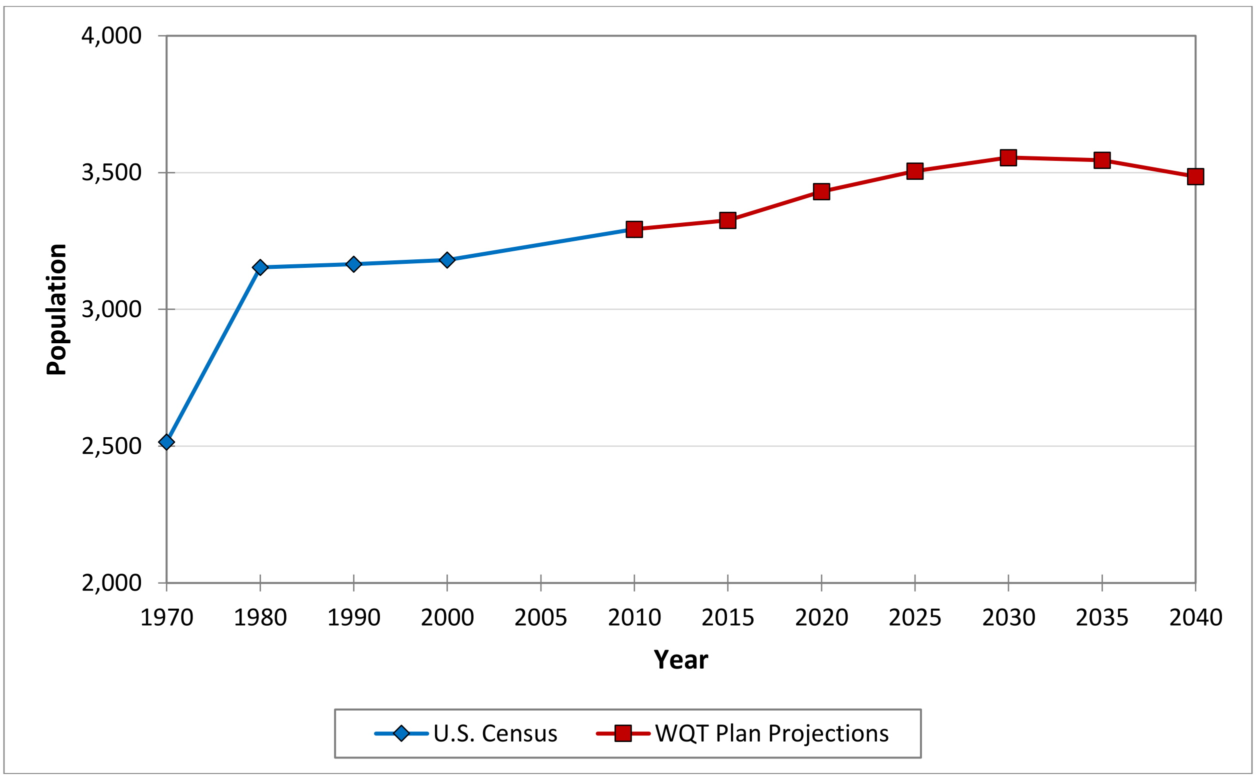

Figure 2-2: City of Brodhead 20-year population projections

2.4 Design Flow Projections

Average annual influent flows for the Brodhead WWTF were estimated for the start of WQT compliance in year 2019 and for maximum design conditions in year 2030. Design flows were estimated based upon historical influent flow data, population projections, and future development plans. As shown in **Table 2-3** and **Table 2-4**, the projected average annual design flows were estimating using the historical average domestic (residential and commercial) per capita wastewater baseflow of 55 gpcd and the projected population. Population estimates for the year 2019 were based on linear interpolation of the WQT Plan population projections in **Table 2-2**. Additional allowances were made to account for historical public authority and industrial baseflows, historical infiltration and inflow, and unplanned future industrial growth. Unplanned future industrial growth was projected to increase proportionally with population growth.

Table 2-3: Brodhead WWTF average annual design flow calculation for start of WQT compliance (2019)

2019 Design Population		3,409
Per Capita Domestic Baseflow (gpcd)	x	55
Domestic Baseflow (gpd)		187,500
Industrial & Public Authority (gpd)	+	12,000
Future Baseflow (without I/I or future industrial growth)		199,500
Average Annual I/I (gpd)	+	86,000
Average Daily Flow (gpd)		285,500
1.3% Unplanned Industrial Growth (gpd)	+	2,400
Average Annual Design Flow (gpd)		**287,900**

Table 2-4: Brodhead WWTF average annual design flow calculations at design conditions (2030)

2030 Design Population		3,555
Per Capita Domestic Baseflow (gpcd)	x	55
Domestic Baseflow (gpd)		195,500
Industrial & Public Authority (gpd)	+	12,000
Future Baseflow (without I/I or future industrial growth)		207,500
Average Annual I/I (gpd)	+	86,000
Average Daily Flow (gpd)		293,500
10% Unplanned Industrial Growth (gpd)	+	19,600
Average Annual Design Flow (gpd)		**313,100**

As shown **Table 2-3** and **Table 2-4**, the projected average annual design flow for 2019 is approximately 0.288 MGD (288,000 gpd) and for 2030 is approximately 0.313 MGD (313,000 gpd). These influent design flows will be used for the purposes of estimating the minimum number of phosphorus credits needed by the City of Brodhead at the start of compliance in 2019 and at peak design conditions in 2030.

Although the above design flows are reasonable estimates of future flow conditions, additional conservatism is recommended when estimating the minimum number of phosphorus credits which are needed by the City of Brodhead for WQT compliance. One risk of WQT is that unforeseen events could significantly impact the amount of phosphorus credits which are needed for the City to comply. For example, extreme precipitation events could lead to unexpected increases in effluent flow at the WWTF, treatment upsets could occur, and/or flooding could damage installed BMPs. Therefore, it is recommended that a safety factor be provided to account for unforeseen years of elevated flow. Based on the influent and effluent flow data in **Table 2-1**, the peak annual effluent flow of .350 MGD occurred in 2009. Comparing this with the historical average annual influent flow of 0.279 MGD, a peaking factor of 1.25 can be calculated (see **Equation 2-1**). It is recommended that this peaking factor be used as a safety factor when determining the minimum amount of phosphorus offsets needed by the City of Brodhead to comply with WQT.

Equation 2-1:

$$\text{Safety Factor} = \frac{\text{Peak Avg. Annual Effluent Flow}}{\text{Avg. Annnual Influent Flow}} = \frac{0.350\text{ MGD}}{0.279\text{ MGD}} = 1.25$$

2.5 MAXIMUM PHOSPHORUS REMOVAL CAPABILITIES OF BRODHEAD WWTF

In the winter of 2015 and the spring or 2016, operators of the Brodhead WWTF completed a chemical phosphorus removal pilot test to determine the maximum phosphorus removal capabilities of the existing WWTF. Optimization of phosphorus removal is an important aspect of WQT since reducing discharges of phosphorus from the WWTF allows the permittee to trade for less phosphorus in the watershed. In general, chemical phosphorus removal is less expensive and less risky than implementing BMPs with private landowners or trading phosphorus with other wastewater permittees. As stated, in Section 1.3 of this report, the City of Brodhead has historically only used the existing chemical phosphorus removal system as a backup to the biological phosphorus removal process, which is typically capable of achieving effluent total phosphorus concentrations of 1 mg/L or less. Therefore, there was potential that greater utilization of the existing chemical feed system would result in even smaller discharges of phosphorus.

The pilot testing which was completed by the City specifically evaluated if higher dosages of aluminum sulfate (alum), the existing chemical used for phosphorus removal at the Brodhead WWTF, would result in reduced effluent phosphorus concentrations. In late 2015, the City began adding alum at increasing dosages to determine the maximum amount which could be added prior to upsetting the existing biological phosphorus removal process.

A summary of data which was collected in 2016 during the pilot testing period is presented in **Figure 2-3**. Based on the data, the existing WWTF can likely achieve effluent phosphorus concentrations much lower than 1 mg/L. The data shows that the WWTF can likely achieve effluent phosphorus concentrations of less than 0.5 mg/L if alum is added at an Al:P molar ratio between 3 and 5 and less than 0.3 mg/L at Al:P molar ratios between 5 and 10. Conversely, the figure shows that alum addition above a molar ratio of 10 negatively impacts treatment performance, likely due to upsets to the biological phosphorus removal process. Based on these findings, alum addition at molar ratios greater than 10 are not recommended.

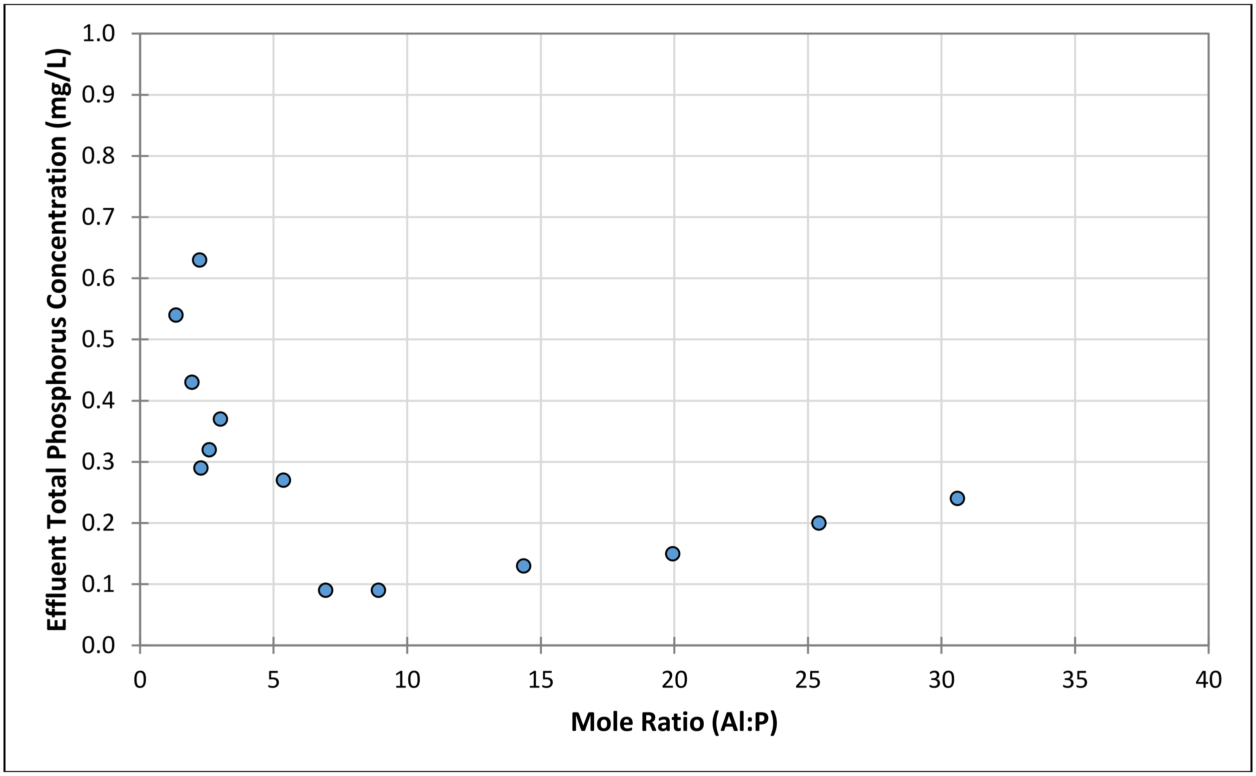

Figure 2-3: Brodhead WWTF chemical phosphorus removal pilot testing results (spring 2016)

Overall, the pilot testing suggests that it is reasonable to assume the WWTF can consistently achieve phosphorus concentrations of less than 0.3 mg/L with proper operation. This is corroborated by the fact that the average annual effluent phosphorus concentration discharged by the WWTF in 2016 was 0.3 mg/L, even though influent flows were elevated approximately 50,000 gpd (18%) above average conditions. In addition, the City has recently installed an orthophosphate analyzer that will automatically adjust the alum feed rate based on a target effluent phosphorus concentration. This will allow the City to achieve consistent effluent phosphorus concentrations despite daily, monthly, and seasonal variations in influent flow and phosphorus loadings. The orthophosphate analyzer will also enable the City to more cost-effectively utilize alum in the chemical phosphorus removal process. Based on the results of this pilot study, it will be assumed that the minimum effluent total phosphorus concentration that can be consistently achieved by the existing WWTF is 0.3 mg/L.

2.6 CURRENT & FUTURE PHOSPHORUS OFFSET REQUIREMENTS

Based on the projected design flows and phosphorus removal capabilities of the WWTF, the minimum amount of phosphorus credits that the City of Brodhead would need to generate to comply with WQT can be estimated. Using **Equation 2-2** below, the minimum number of credits needed by the City at the start of WQT compliance in 2019 and at maximum design conditions in 2030 were estimated. As shown, it is estimated that 219 lb credit/year is needed at the start of WQT compliance and 238 lb credit/year is needed at maximum design conditions. Since the long term phosphorus removal goal of 238 lb credit/yr is only 19 lb (approximately 9%) greater than the number of credits needed at start up, it is recommended that the City of Brodhead set the goal of generating greater than 238 lb credit/year during the first permit term of WQT. This would reduce the City's risk of noncompliance with WQT due to unforeseen influent loading events at the WWTF and would potentially allow for greater flexibility in regard to the WWTF's future target effluent phosphorus concentration.

Equation 2-2:

$$\mathbf{TP}_{\boldsymbol{min}} = \mathbf{Q}_{\mathbf{avg.}} \times \left(\mathbf{C}_{\mathbf{target}} - \mathbf{C}_{\mathbf{WQBEL}}\right) \times \mathbf{8.34} \times \mathbf{365}\,\frac{\mathbf{days}}{\mathbf{year}} \times \mathbf{SF}$$

Where:

$\mathrm{TP_{min}}$ = minimum phosphorus credits required $\left[\frac{\mathrm{lb}}{\mathrm{year}}\right]$

$\mathrm{Q_{avg.}}$ = projected average annual influent design flow [MGD]

$\mathrm{C_{target}}$ = target effluent phosphorus concentration $\left[\frac{\mathrm{mg}}{\mathrm{L}}\right]$

$\mathrm{C_{WQBEL}}$ = water quality based effluent limit for phosphorus $\left[\frac{\mathrm{mg}}{\mathrm{L}}\right]$

SF = safety factor

Minimum Phosphorus Credits Required at Start of WQT Compliance (2019):

$$\mathbf{TP}_{\boldsymbol{min}} = \mathbf{Q}_{\mathbf{avg.}} \times \left(\mathbf{C}_{\mathbf{target}} - \mathbf{C}_{\mathbf{WQBEL}}\right) \times \mathbf{8.34} \times \mathbf{365}\,\frac{\mathbf{days}}{\mathbf{year}} \times \mathbf{1.25}$$

$$= 0.288\ \mathrm{MGD} \times \left(0.3\,\frac{\mathrm{mg}}{\mathrm{L}} - 0.1\,\frac{\mathrm{mg}}{\mathrm{L}}\right) \times 8.34 \times 365\,\frac{\mathrm{days}}{\mathrm{year}} \times 1.25$$

$$= 219\ \frac{\mathrm{lb}}{\mathrm{year}}$$

Minimum Phosphorus Credits Required at Design Conditions (2030):

$$\mathbf{TP}_{\boldsymbol{min}} = \mathbf{Q}_{\mathbf{avg.}} \times \left(\mathbf{C}_{\mathbf{target}} - \mathbf{C}_{\mathbf{WQBEL}}\right) \times \mathbf{8.34} \times \mathbf{365}\,\frac{\mathbf{days}}{\mathbf{year}} \times \mathbf{1.25}$$

$$= 0.313\ \mathrm{MGD} \times \left(0.3\,\frac{\mathrm{mg}}{\mathrm{L}} - 0.1\,\frac{\mathrm{mg}}{\mathrm{L}}\right) \times 8.34 \times 365\,\frac{\mathrm{days}}{\mathrm{year}} \times 1.25$$

$$= 238\ \frac{\mathrm{lb}}{\mathrm{year}}$$

It is important to note that the minimum number of phosphorus credits needed for the City of Brodhead to comply with WQT, as calculated on the previous page, assumes compliance with WQT for an entire calendar year or 12-month period. In reality, the City of Brodhead will only be required to comply with WQT for two months in the year 2019 (November and December) since the final compliance date for WQT for the City is October 31, 2019. Therefore, the estimated number of credits needed in the year 2019 can be reduced to 36.6 lb/yr as shown below:

Minimum Phosphorus Credits Required in November and December 2019:

$$\mathbf{TP}_{\boldsymbol{min}} = \mathbf{Q}_{\mathbf{avg.}} \times \left(\mathbf{C}_{\mathbf{target}} - \mathbf{C}_{\mathbf{WQBEL}}\right) \times \mathbf{8.34} \times \frac{\#\ \mathbf{days}}{\mathbf{year}} \times \mathbf{1.25}$$

$$= 0.288\ \mathrm{MGD} \times \left(0.3\,\frac{\mathrm{mg}}{\mathrm{L}} - 0.1\,\frac{\mathrm{mg}}{\mathrm{L}}\right) \times 8.34 \times 61\,\frac{\mathrm{days}}{\mathrm{year}} \times 1.25$$

$$= 36.6\ \frac{\mathrm{lb}}{\mathrm{year}}$$

Using **Equation 2-2** and the design flow methodology presented in Section 2.4, the number of phosphorus credits needed by the City in each year of WQT compliance for the next 20 years have been estimated as shown in **Table 2-5**. These estimates are provided for informational purposes only, as final numbers will have to be recalculated in future years based on actual phosphorus loadings discharged by the WWTF.

Table 2-5: Projected annual amount of phosphorus credits needed by the City of Brodhead (2019 - 2037)

Permit Term	Year	Projected Population	Projected Flow (MGD)	Phosphorus Credits Needed[1] (lb/year)
#1	2018	3,388	0.284	-
	2019	3,409	0.288	36.6
	2020	3,430	0.291	222
	2021	3,445	0.294	224
	2022	3,460	0.297	226
#2	2023	3,475	0.299	228
	2024	3,490	0.302	230
	2025	3,505	0.304	232
	2026	3,515	0.306	233
	2027	3,525	0.308	234
#3	2028	3,535	0.310	236
	2029	3,545	0.311	237
	2030	3,555	0.313	238
	2031	3,553	0.313	238
	2032	3,551	0.313	238
#4	2033	3,549	0.313	238
	2034	3,547	0.313	238
	2035	3,545	0.312	238
	2036	3,533	0.312	237
	2037	3,521	0.311	237

[1] *Assumes WWTF can consistently achieve effluent phosphorus concentration of 0.3 mg/L or less and safety factor of 1.25.*

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CHAPTER 3 – WATERSHED INVENTORY

3.1 INITIAL STAKEHOLDER MEETINGS & PUBLIC OUTREACH

Prior to meeting with private landowners to develop partnerships to reduce phosphorus discharges, the City of Brodhead and MSA Professional Services, Inc. participated in several public outreach events to determine which areas of the upstream Sugar River Basin were in greatest need for water quality improvements. Two meetings were held with local stakeholders on January 20 and February 4, 2016. A list of the groups who participated in these stakeholder meetings is presented below:

- City of Brodhead Public Works Department & City Representatives
- MSA Professional Services, Inc. (MSA)
- Green County Land & Water Conservation Department (LWCD)
- Green County Highway Department
- Wisconsin Department of Natural Resources (DNR)
- Lower Sugar River Watershed Association (LSRWA)
- Decatur Lake Millrace Association (DLMRA)
- Local Landowners

At these meetings, stakeholders discussed previous experience in the upstream watershed and worked to identify partners who would be involved during the implementation of the WQT Plan. MSA also participated in the LSRWA's annual "Sugar River Watershed Summit" on April 9, 2016. At this meeting, staff from MSA gave a presentation to the general public regarding the concepts of WQT and the City's intentions to pursue WQT for phosphorus compliance. All three events were beneficial for shaping the direction of the WQT Plan.

3.2 EVALUATION OF EXISTING WATER QUALITY DATA AND WATERSHED MODELS

After meeting with local stakeholders and the general public, MSA began evaluating existing water quality data and watershed models to prioritize which areas of the watershed were in greatest need of improvements. At stakeholder meetings, participants were asked to evaluate the potential for phosphorus reductions in six Hydrologic Unit Code (HUC) 12 subwatersheds located upstream of the City of Brodhead's WWTF outfall. A map of these subwatersheds is presented in **Figure 3-1**. These watersheds were selected since they were located within the closest vicinity to the City of Brodhead.

Based on conversations at stakeholder meetings, it was determined that the LSRWA has been very active in monitoring water quality in the three HUC 12 subwatersheds located nearest to the City of Brodhead: the Searles Creek, Decatur Lake & Sugar Creek, and Norwegian Creek subwatersheds. The LSWA has developed a detailed qualitative ranking system known as the Watershed Rapid Assessment Survey (WRAS) to annually describe the ecological and hydrological conditions at many locations throughout the Lower Sugar River Watershed. Monitoring results from the 2011 LSRWA WRAS are presented in **Figure 3-2**. As shown, the monitoring results suggest that the Searles Creek subwatershed may have the poorest water quality and habitat conditions of the three subwatersheds. Searles Creek was also identified by members of the LSRWA and the DLMA during stakeholder meetings as an area to prioritize for improvement.

In order to validate the monitoring results from the LSRWA WRAS, MSA evaluated phosphorus loadings from subwatersheds using existing watershed models. MSA specifically evaluated phosphorus incremental yield losses (i.e. modeled phosphorus loss per watershed area) using the United States Geological Survey's (USGS) Spatially Referenced Regression On Watershed Attributes (SPARROW) model and the DNR's Pollutant Load Ratio Estimator Tool (PRESTO) model. Both of these models were selected for analysis since they are relatively easy to use and they make use of readily available data inputs to estimate watershed-scale phosphorus losses. Although SPARROW and PRESTO are somewhat rudimentary models and lack the sophisticated processes of other watershed models such as the Soil and Water Assessment Tool (SWAT) model, the goal of this modeling exercise was only to corroborate the results and recommendations of the LSRWA and DLMRA, and the time and expense of a more detailed modeling effort was not justifiable for this project.

Phosphorus incremental yield results from the SPARROW and PRESTO models are shown in **Figure 3-3** and **Figure 3-4**, respectively. As shown, both models support the conclusion that the Searles Creek subwatershed has the largest phosphorus losses per acre of the six identified HUC 12 subwatersheds. According to SPARROW, the estimated phosphorus losses for the Searles Creek subwatershed are approximately 0.58 lb/acre/year, and according to PRESTO, the estimated phosphorus losses are approximately 0.90 lb/acre/year. For reference, SPARROW results in **Figure 3-3** are based on the total phosphorus "incremental yield" metric in SPARROW, and PRESTO incremental yield results shown in **Figure 3-4** are based on the "most likely" non-point phosphorus load as calculated using *Multiple Regression #1*, the method in PRESTO which DNR has generally found to be the most accurate for estimating nonpoint source loadings of phosphorus throughout Wisconsin (see *PRESTO Documentation, Validation, & Analysis*, 2013). Overall, based on the review of the SPARROW and PRESTO outputs, the data from the LSRWA WRAS, and recommendations of LSRWA and DLMRA members at stakeholder meetings, it was assumed that the City of Brodhead should prioritize landowner engagement efforts in the Searles Creek subwatershed for the purposes of developing the WQT Plan.

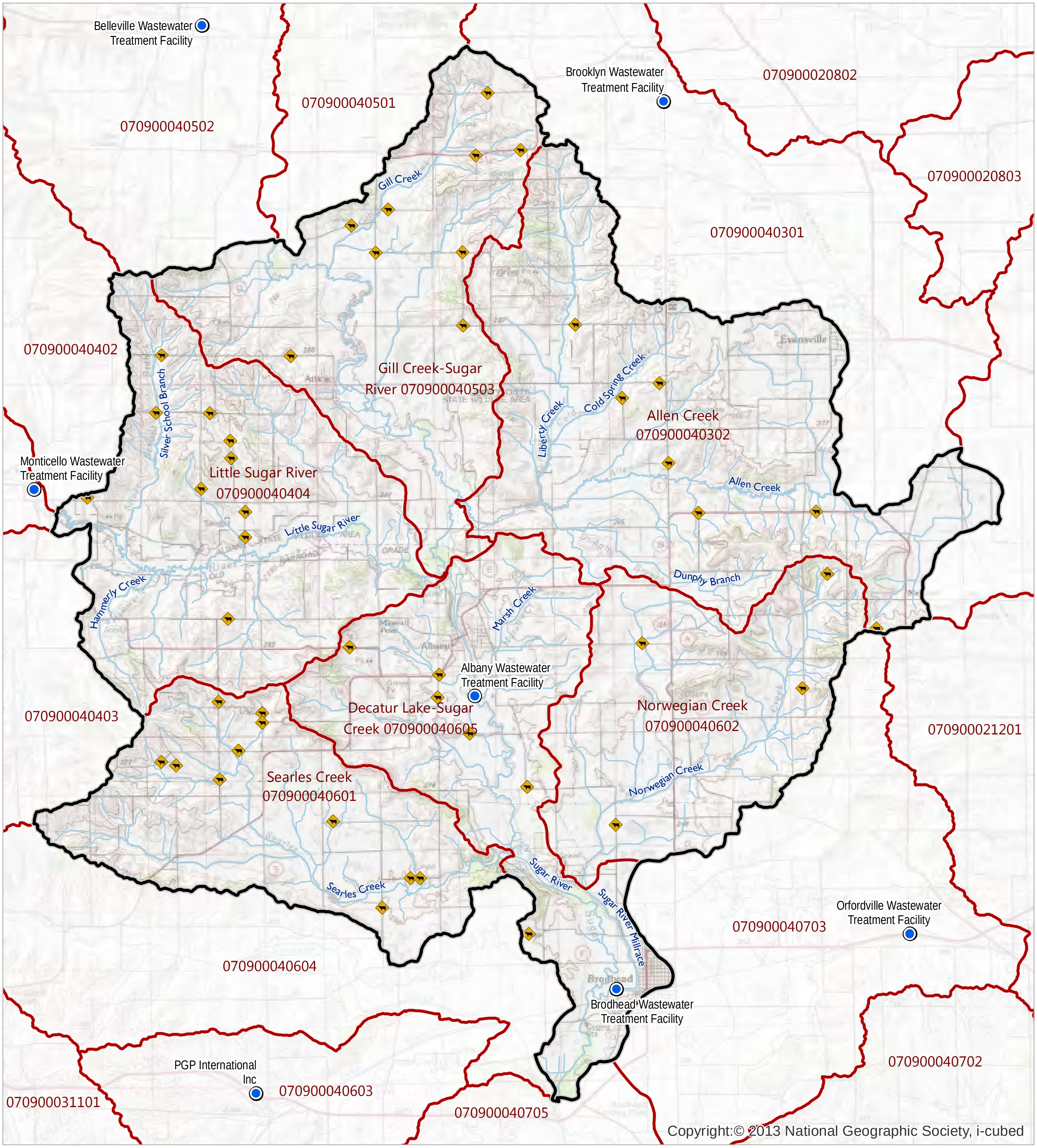

Figure 3-1
Preliminary WQT Action Area Discussed by Stakeholders

City of Brodhead
Green and Rock Counties, WI

Data Sources:
HUC 12 Watershed boundaries: WDNR
Flowline: WDNR
Wastewater Treatment Facility Surface Water Outfalls: WDNR
Dairy Producers: DATCP

Action Area
HUC 12 Watershed
Flowline
Wastewater Treatment Facility Surface Water Outfalls
DATCP Dairy Producers within Action Area

N
0 1.125 2.25 Miles

MSA

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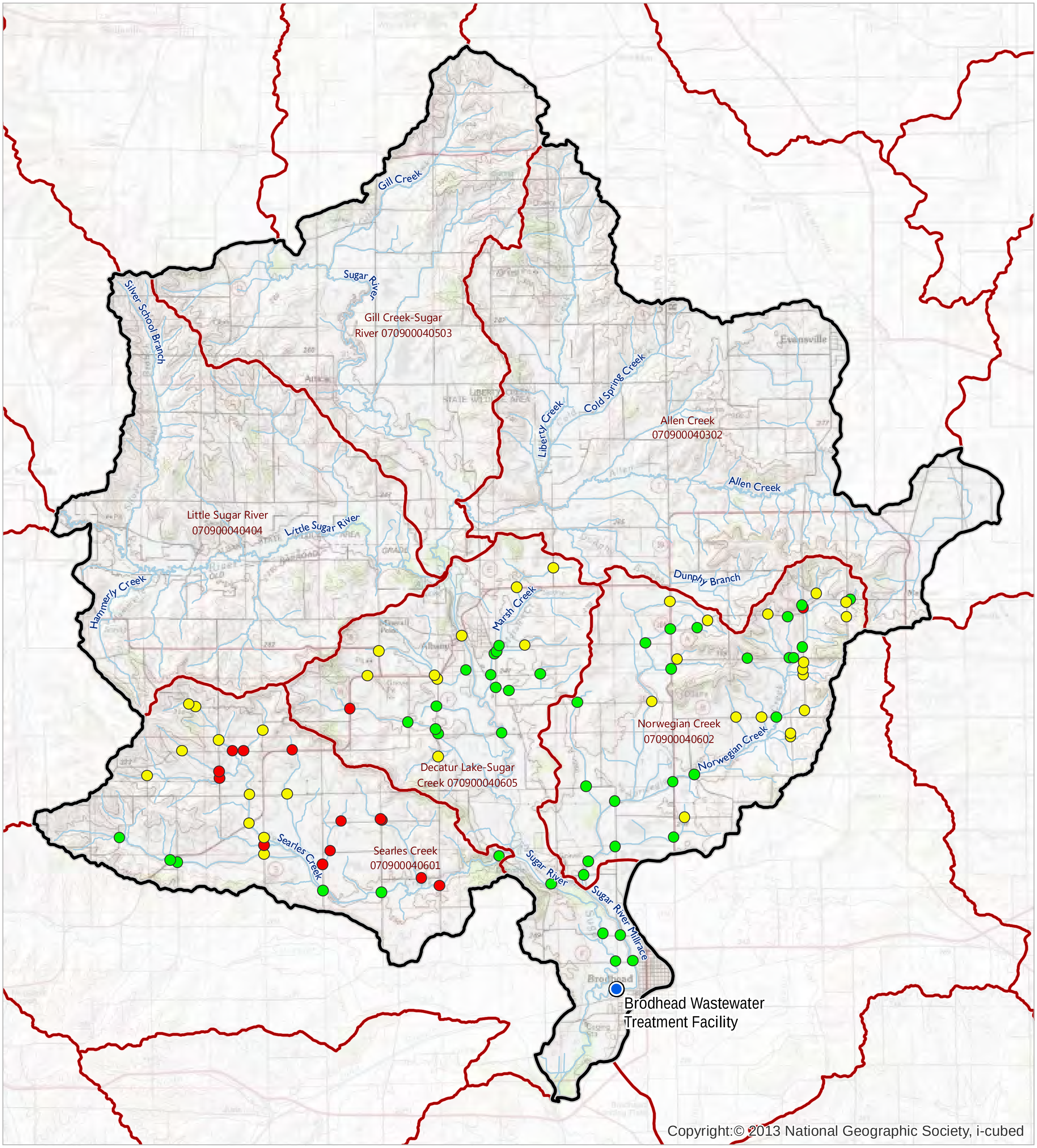

Figure 3-2

LSRWA Watershed Rapid Assessment Survey (WRAS) 2011 Monitoring Results

City of Brodhead
Green and Rock Counties, WI

Data Sources:
HUC 12 Watershed boundaries: WDNR
Flowline: WDNR
Watershed Rapid Assessment Survey (WRAS) Results: Lower Sugar River Watershed Association (2011).

Action Area
HUC 12 Watershed
Flowline
Brodhead Wastewater Treatment Facility

LSRWA WRAS Rating (2011)
Poor
Fair
Good

0 1.125 2.25 Miles

MSA

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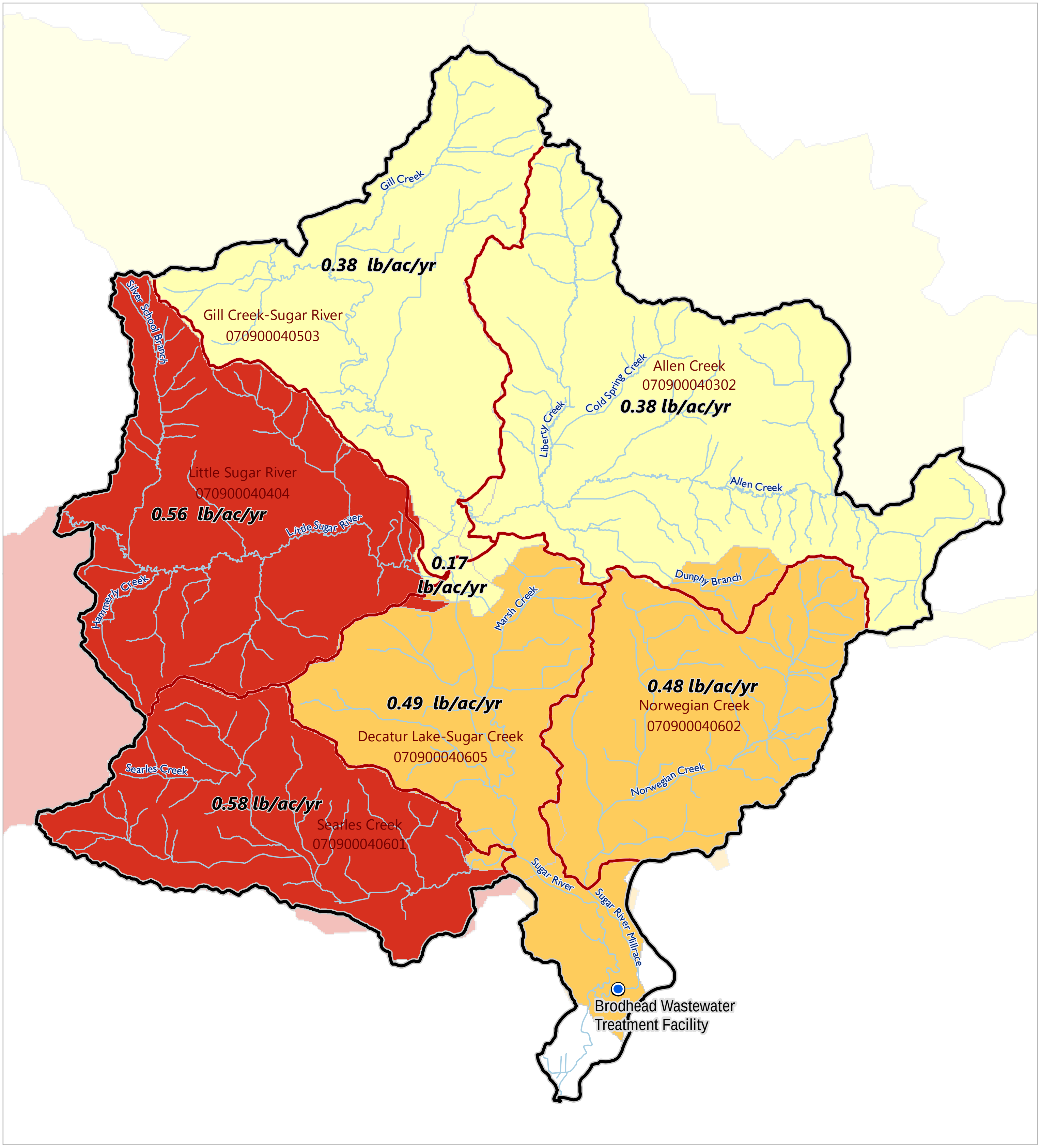

Figure 3-3
SPARROW Subwatershed Phosphorus Loading Results for Preliminary WQT Action Area

City of Brodhead
Green and Rock Counties, WI

Data Sources:
HUC 12 Watershed boundaries: WDNR
Stream/River: WDNR
TP Incremental Yield: USGS SPARROW Decision Support System

Action Area
HUC 12 Watershed
Stream/River

TP Incremental Yield (lb/ac/yr)
< 0.4
0.4 - 0.5
> 0.5

0 1.125 2.25 Miles

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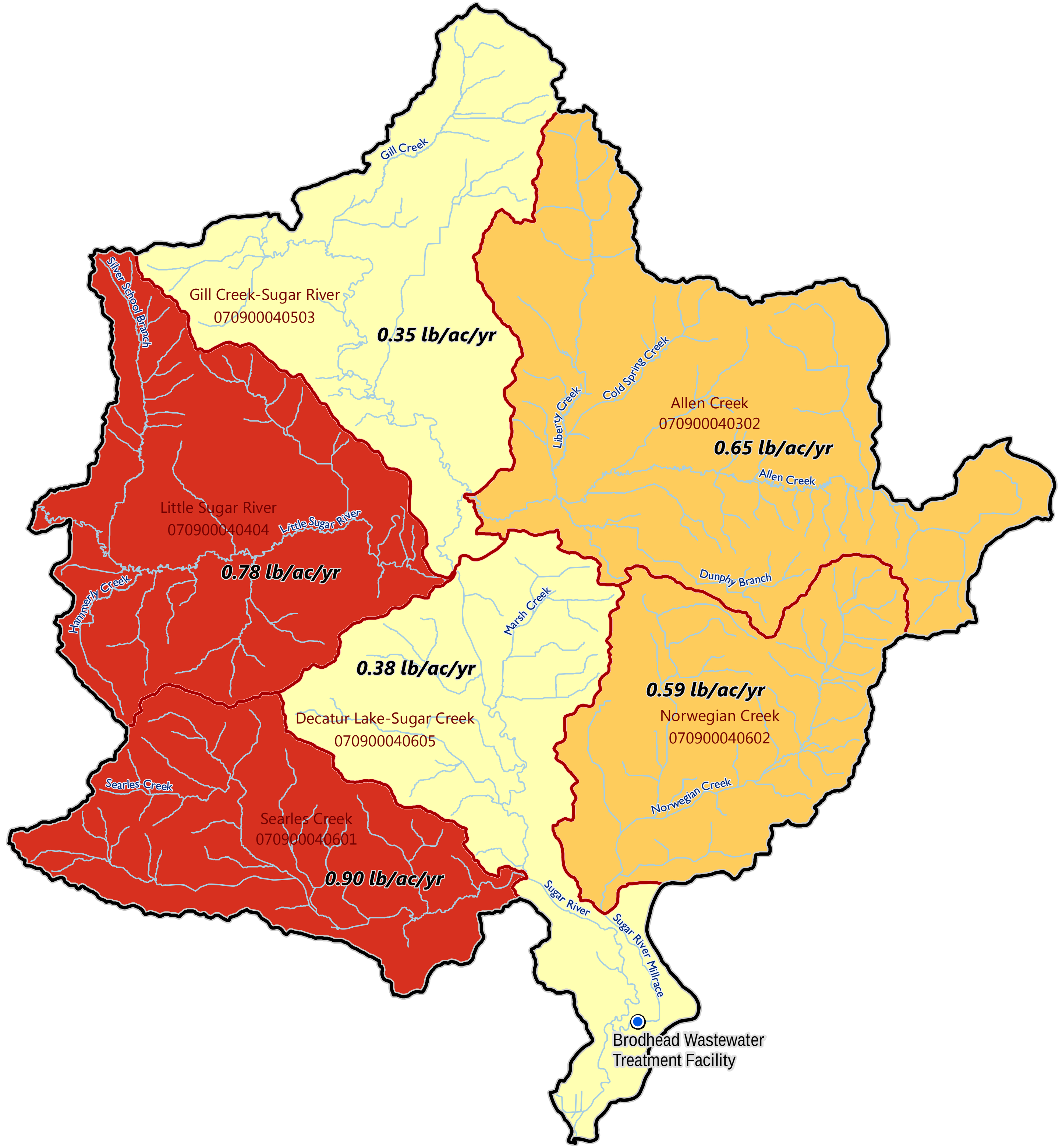

Figure 3-4

PRESTO Subwatershed Phosphorus Loading Results for Preliminary WQT Action Area

City of Brodhead
Green and Rock Counties, WI

Data Sources:
HUC 12 Watershed boundaries: WDNR
River/Stream: WDNR
TP Incremental Yield: WDNR Pollutant Load Ratio Estimation Tool (PRESTO)

Action Area
HUC 12 Watershed
River/Stream

TP Incremental Yield (lb/acre/yr)
< 0.50
0.50 - 0.75
> 0.75

0 1.125 2.25 Miles

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3.3 INITIAL LANDOWNER MEETINGS

Local stakeholders, the LSRWA Rapid Watershed Assessment Survey, and existing watershed models support the assumption that the greatest environmental benefit to the local upstream Sugar River Basin would be to improve the Searles Creek subwatershed. Knowing this, the City of Brodhead and MSA began initial site meetings with landowners within the Searles Creek subwatershed to determine local interest in participating in Brodhead's WQT Plan. Potential project sites were identified based on suggestions from stakeholders and based on windshield/desktop surveys of the subwatershed. Approximately six landowners were contacted between 2016 and 2017 to determine interest in working with the City and to identify potential projects which could be implemented to reduce phosphorus loadings to Searles Creek. Of the six landowners who were initially contacted, four expressed strong interest in the project and three have continued to work with the City of Brodhead to implement the WQT Plan.

3.4 ESTABLISHMENT OF THE FINAL WATER QUALITY TRADING ACTION AREA

Based on successful meetings with landowners, the City and MSA determined that the final action area of the WQT Plan will be the Searles Creek (HUC 070900040403) and the Decatur Lake & Sugar Creek (HUC 070900040605) subwatersheds. The Decatur Lake & Sugar Creek subwatershed is included in the final action area since a major portion of the City and the WWTF outfall are located within this HUC 12, and some of the participating landowners who live in the Searles Creek subwatershed own or operate land in the Decatur Lake & Sugar Creek subwatershed. All currently proposed trades are planned to be implemented within the two identified HUC 12 subwatersheds. Other subwatersheds may be considered in future WPDES permit terms as the WQT plan continues to be implemented.

A general overview map of the proposed final WQT action area is shown in **Figure 3-5**. This map identifies portions of the action area which are located upstream and downstream of Brodhead's WWTF outfall. Notable water bodies in the action area are also listed on the map, including the Sugar River, Decatur Lake, Sugar River Millrace, and Searles Creek. Each of these surface waters is hydrologically connected to the Brodhead WWTF outfall, and each is briefly described below:

1. Sugar River

   The Sugar River is classified as an exceptional resource water by the DNR and is known as a diverse warm water sport fishery (http://dnr.wi.gov/water/waterDetail.aspx?WBIC=875300). Riparian backwaters and wetlands are common along the Sugar River, providing valuable habitat for aquatic species and waterfowl. Despite adequate habitat conditions, many sections of the river, including the sections located within the action area, are registered on Wisconsin's impaired waters 303d list due to excessive levels of phosphorus. Phosphorus impairments in the Sugar River are likely due to a combination of wastewater discharges and non-point source loadings from agriculture and urban development.

2. Decatur Lake

   Decatur Lake is a manmade feature which was created in the mid-1800s when a large dam was built along the main branch of the Sugar River northwest of Brodhead to form a millpond (http://www.lsrwa.org/your-watershed/lower-sugar-river-subwatersheds/decatur-lake-sugar-creek-subwatershed/). Decatur Lake is a diverse warm water fishery similar to the upstream and downstream segments of the Sugar River, but the impoundment suffers from heavy incoming sediment loads from the Sugar River and also Searles Creek (http://dnr.wi.gov/water/waterDetail.aspx?key=4701075). Decatur Lake is impaired due to phosphorus and is registered on Wisconsin's 303d list.

3. Sugar River Millrace

   The Sugar River Millrace is also a manmade feature. The Millrace was constructed soon after the construction of the main dam on the Sugar River in the mid-1800s (http://www.lsrwa.org/your-watershed/lower-sugar-river-subwatersheds/decatur-lake-sugar-creek-subwatershed/). The 3.1-mile-long channel diverts water from Decatur Lake to the City of Brodhead. Similar to the upstream Sugar River and Decatur Lake, the Sugar River Millrace is registered on Wisconsin's impaired waters 303d list due to phosphorus.

4. Searles Creek

   Searles Creek is a small, low gradient tributary of the Sugar River which joins the Sugar River on the north end of Decatur Lake. The stream has been straightened in many sections for agricultural purposes and is generally considered to provide poor aquatic habitat for fish due heavy siltation of the channel bottom (http://dnr.wi.gov/water/waterDetail.aspx?WBIC=879500). The stream is managed as a warm water fishery, and the stream is currently registered on Wisconsin's 303d list due to sediment and total suspended solids. Searles Creek was included in an approved Total Maximum Daily Load (TMDL) study along with other streams in the Sugar-Pecatonica River Basin which are impaired due to sediment.

Additional maps of the proposed final WQT action area are shown in **Figure 3-6**, **Figure 3-7**, and **Figure 3-8**. These figures were created to help identify areas of the action area which might be prone to runoff and erosion. **Figure 3-6** is a topographic map of the action area which depicts the steep ridgelines that define and separate the Searles Creek and Decatur Lake & Sugar Creek subwatersheds. Land use in the action area is depicted in **Figure 3-7**. As shown, the primary land use in both subwatersheds is agriculture (e.g. cultivated crops and hay/pasture), especially in the less steep areas of the action area. The map also depicts the large number of wetlands and natural areas located along the main branch of the Sugar River and the forested ridges which separate the subwatersheds. Lastly, **Figure 3-8** highlights portions of the action area which may be most prone to erosion based on DNR's Erosion Vulnerability Assessment for Agricultural Lands (EVAAL) model. Unsurprisingly, the EVAAL model suggests that the steep, farmed ridges of the Searles Creek and Decatur Lake & Sugar Creek subwatersheds are likely the most vulnerable areas to potential erosion and phosphorus loss.

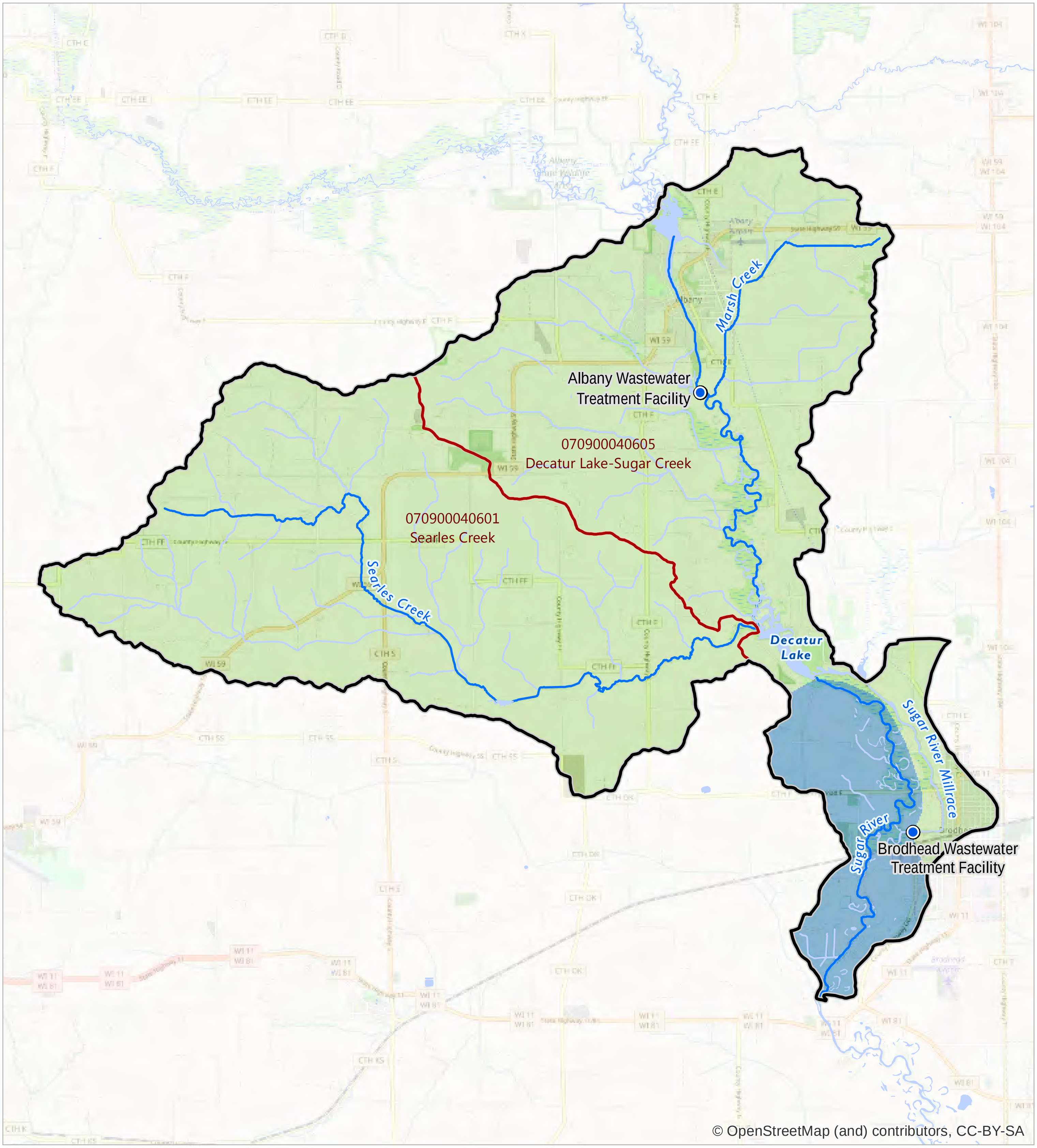

Figure 3-5
Final City of Brodhead WQT Action Area Overview Map

City of Brodhead
Green and Rock Counties, WI

Action Area, Final
HUC 12 Watershed
Wastewater Treatment Facility
Waterbody
Named River/Stream
Other River/Stream
Upstream Trading Area
Downstream Trading Area

Data Sources:
HUC 12 Watershed boundaries: WDNR
Wastewater Treatment Facilities: WDNR
Waterbodies and River/Streams: USGS NHD
Basemap: ESRI

0 0.75 1.5 Miles

MSA

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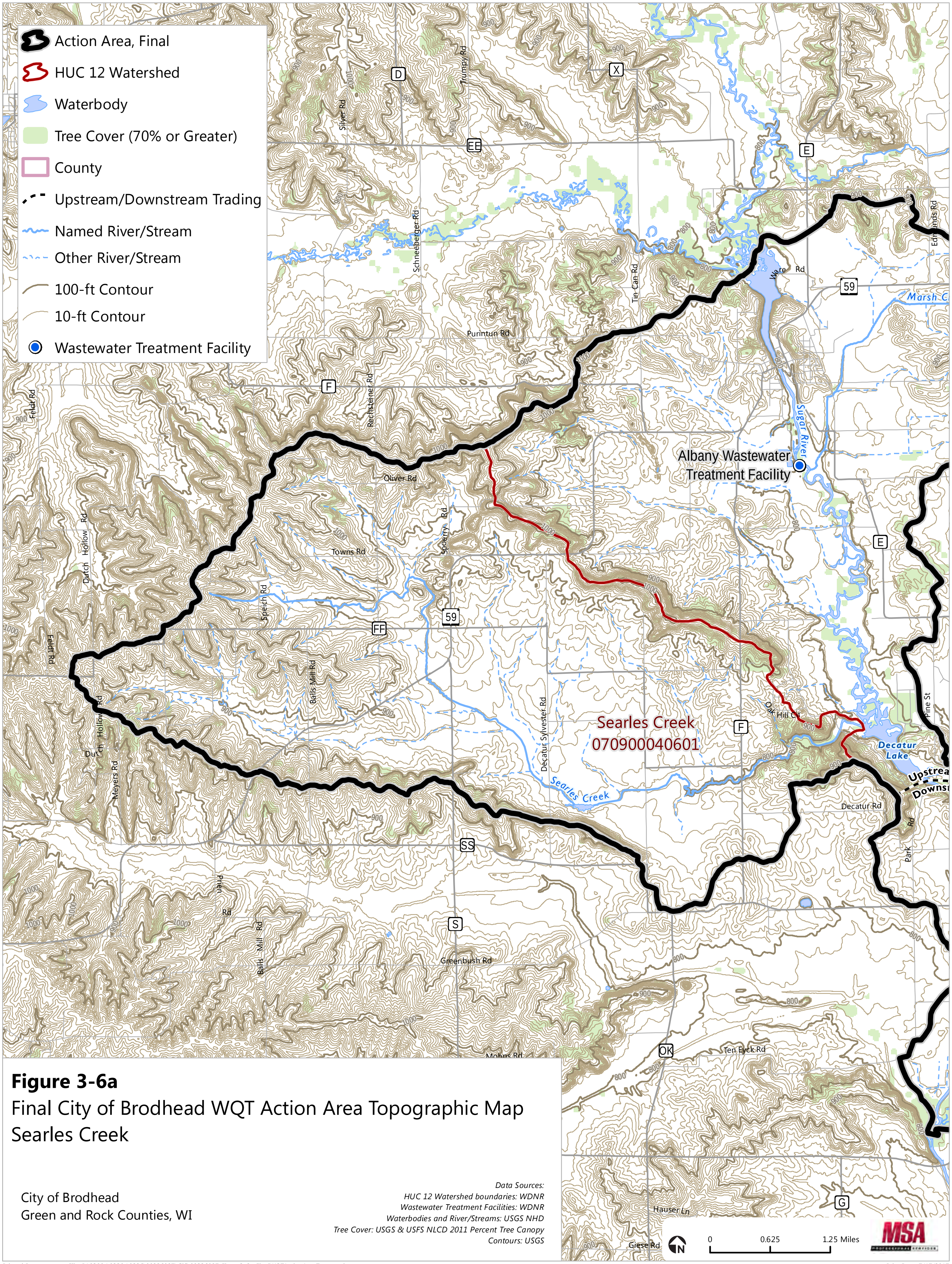

Figure 3-6a

Final City of Brodhead WQT Action Area Topographic Map
Searles Creek

City of Brodhead
Green and Rock Counties, WI

Data Sources:
HUC 12 Watershed boundaries: WDNR
Wastewater Treatment Facilities: WDNR
Waterbodies and River/Streams: USGS NHD
Tree Cover: USGS & USFS NLCD 2011 Percent Tree Canopy
Contours: USGS

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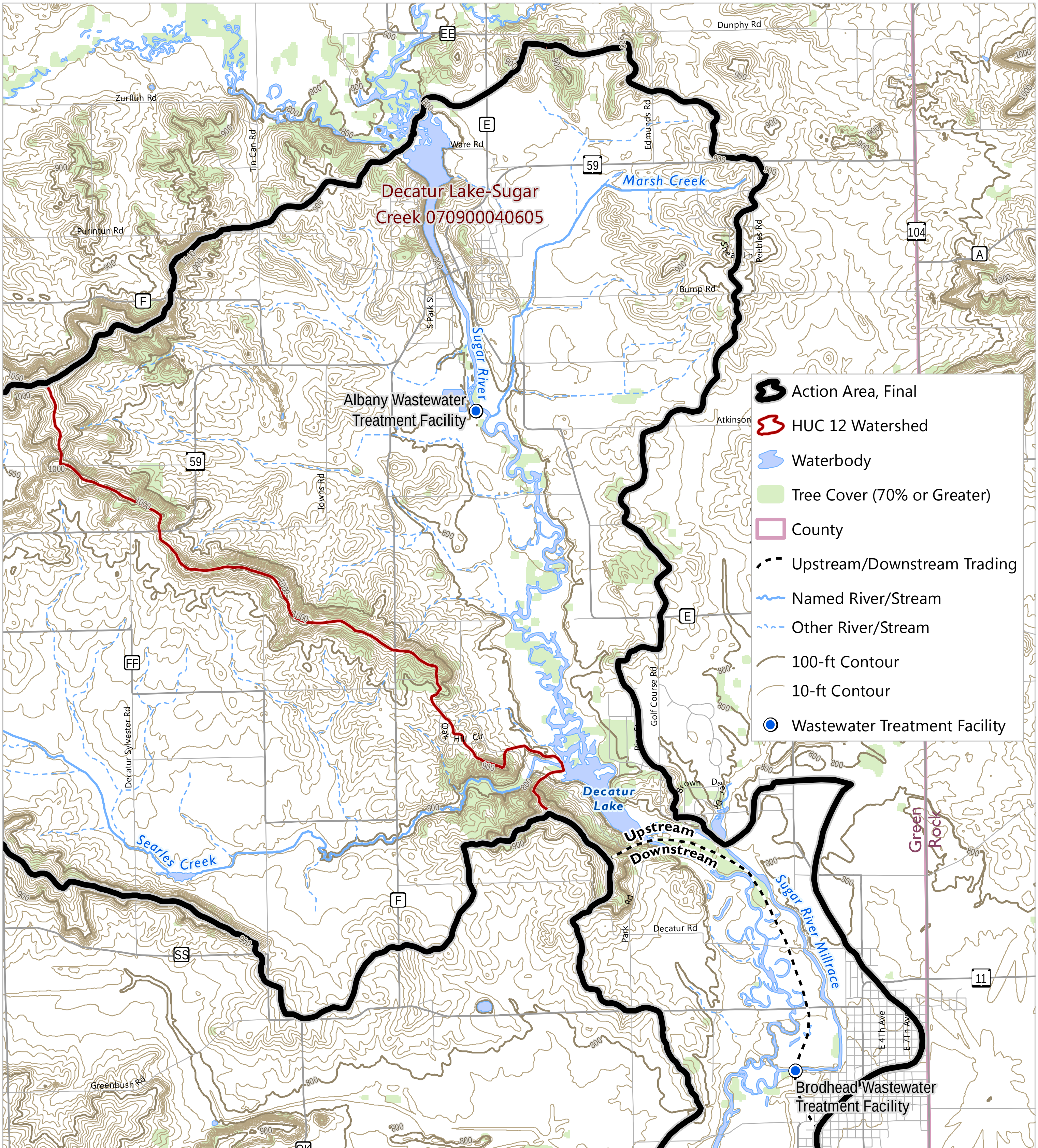

Figure 3-6b

Final City of Brodhead WQT Action Area Topographic Map

Decatur Lake-Sugar Creek

City of Brodhead
Green and Rock Counties, WI

Data Sources:
HUC 12 Watershed boundaries: WDNR
Wastewater Treatment Facilities: WDNR
Waterbodies and River/Streams: USGS NHD
Tree Cover: USGS & USFS NLCD 2011 Percent Tree Canopy
Contours: USGS
Hillshade: Green and Rock County LiDAR

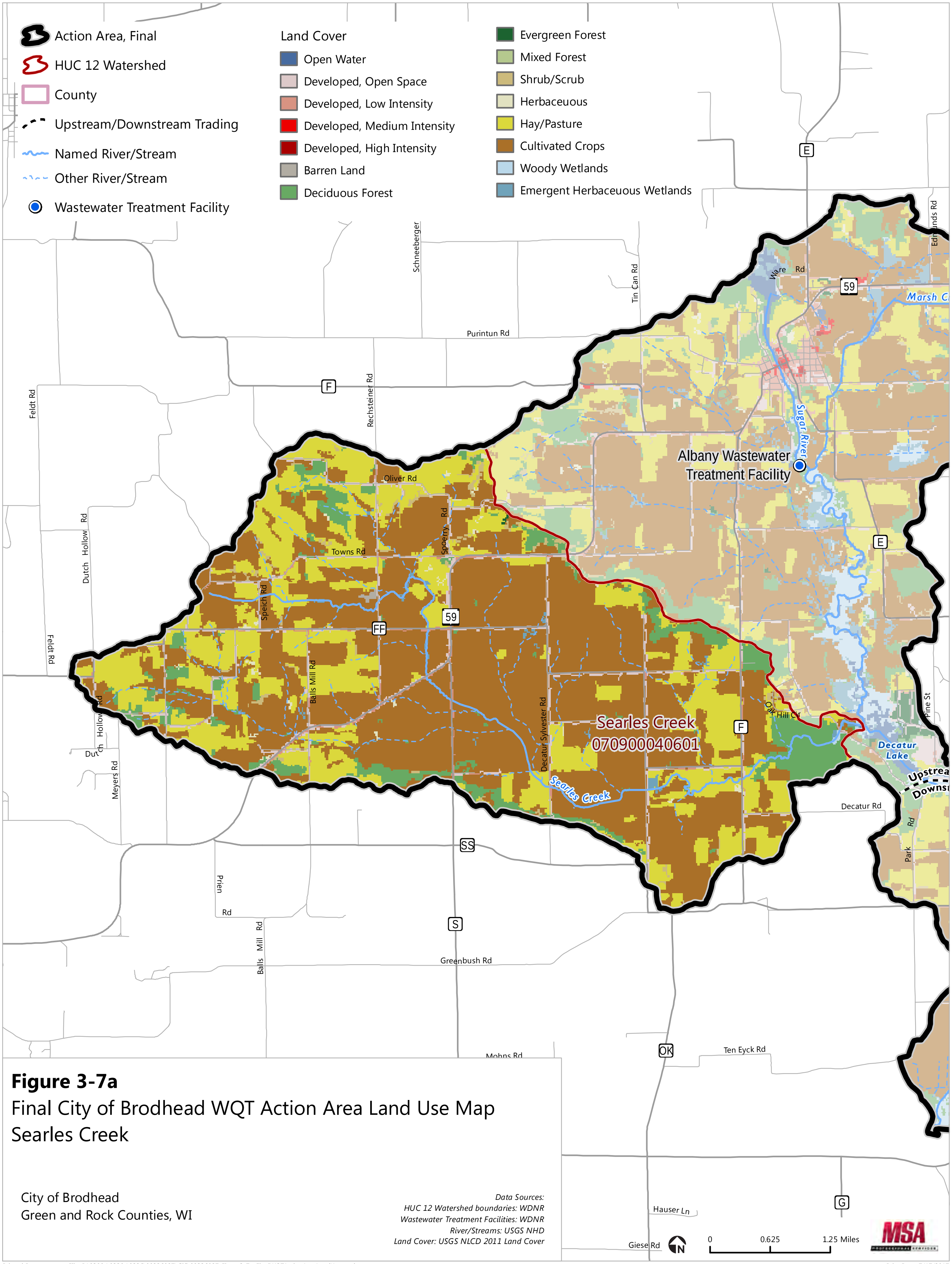

Figure 3-7a
Final City of Brodhead WQT Action Area Land Use Map
Searles Creek

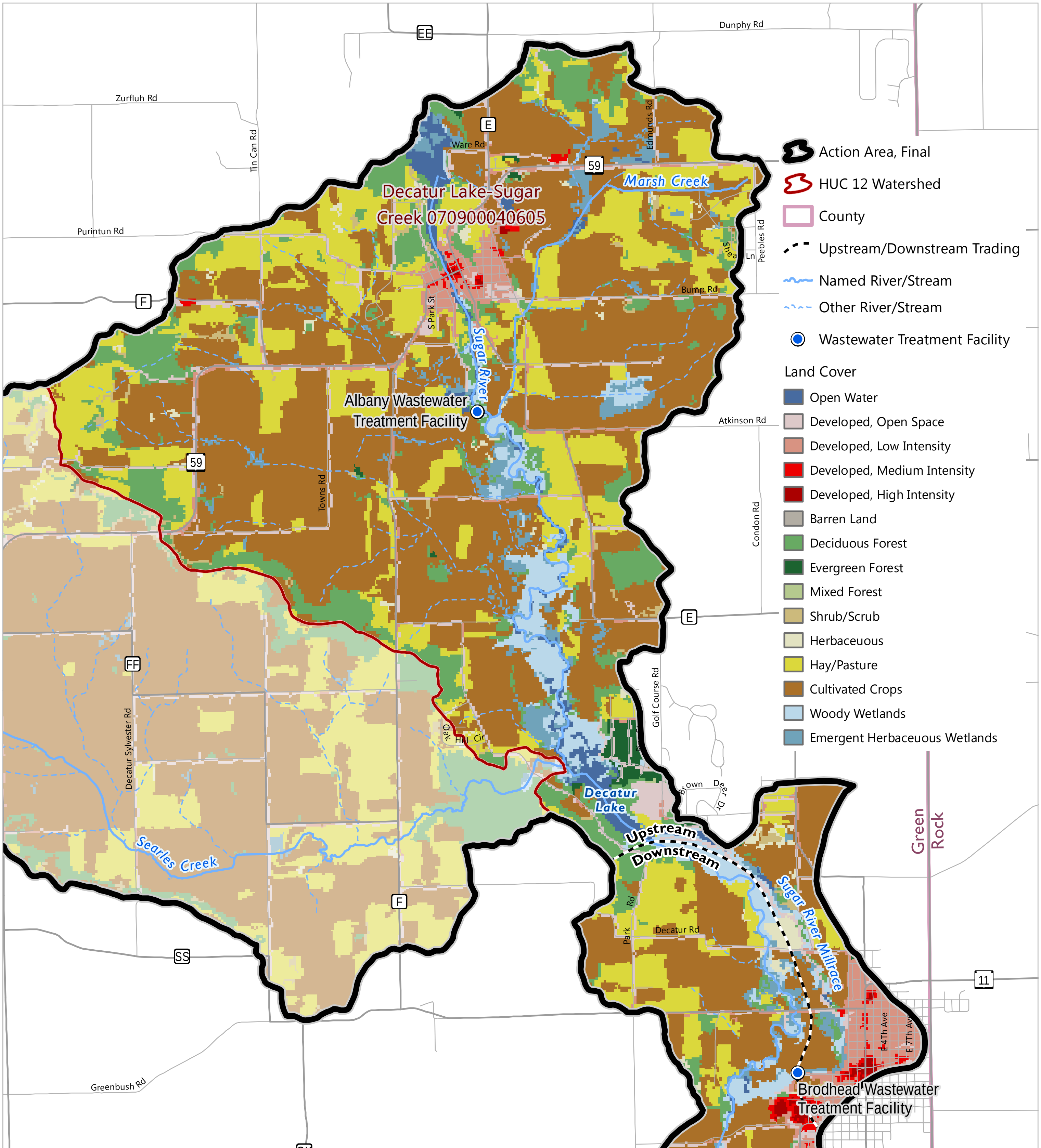

Figure 3-7b

Final City of Brodhead WQT Action Area Land Use Map
Decatur Lake-Sugar Creek

City of Brodhead
Green and Rock Counties, WI

Data Sources:
HUC 12 Watershed boundaries: WDNR
Wastewater Treatment Facilities: WDNR
River/Streams: USGS NHD
Land Cover: USGS NLCD 2011 Land Cover

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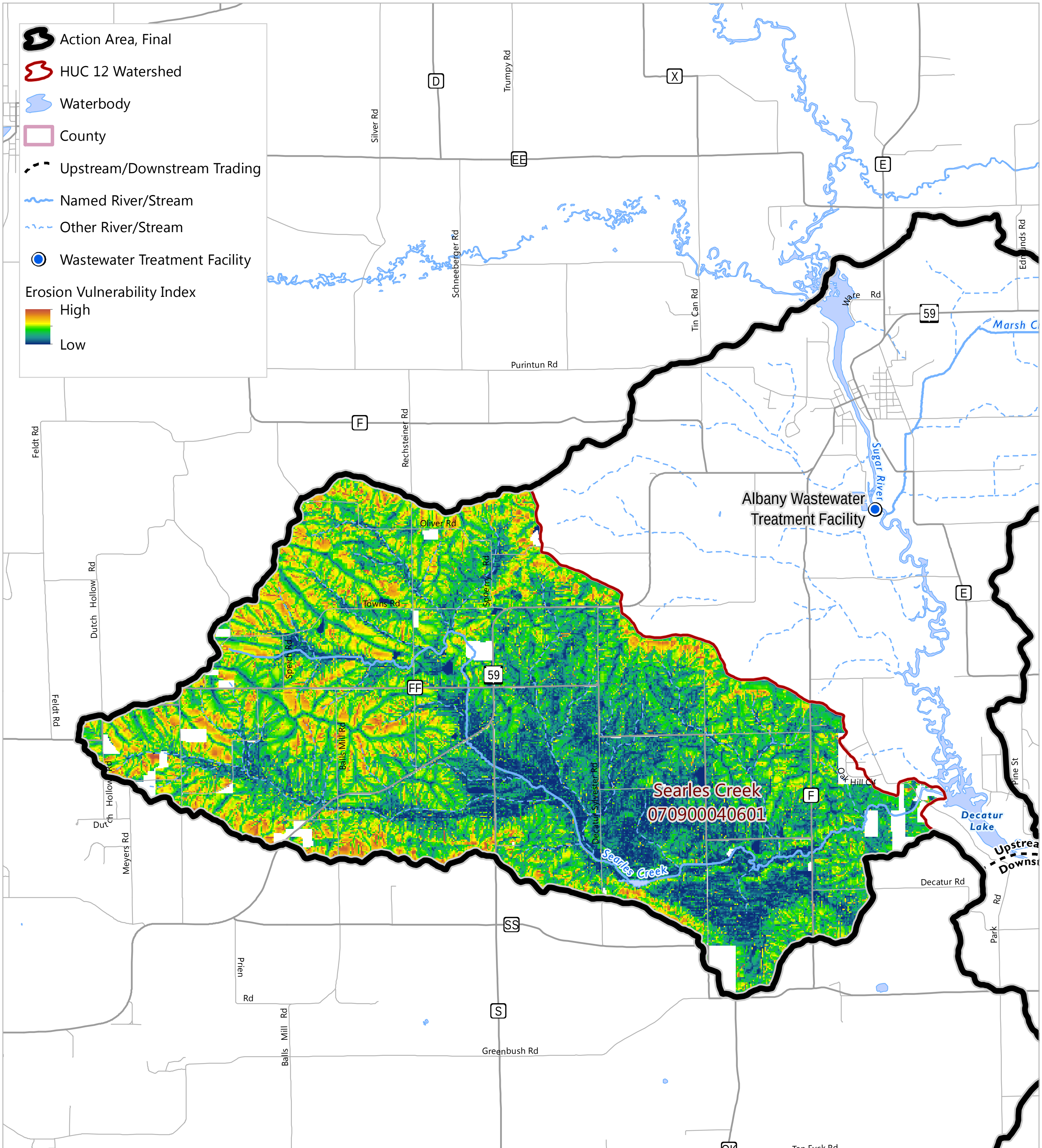

Figure 3-8a

Final City of Brodhead WQT Action Area EVAAL Map

Searles Creek

City of Brodhead
Green and Rock Counties, WI

Data Sources:
HUC 12 Watershed boundaries: WDNR
Wastewater Treatment Facilities: WDNR
River/Streams: USGS NHD
Erosion Vulnerability Index: Output from WDNR's EVAAL model

Hauser Ln
Giese Rd
N
0 0.625 1.25 Miles
G

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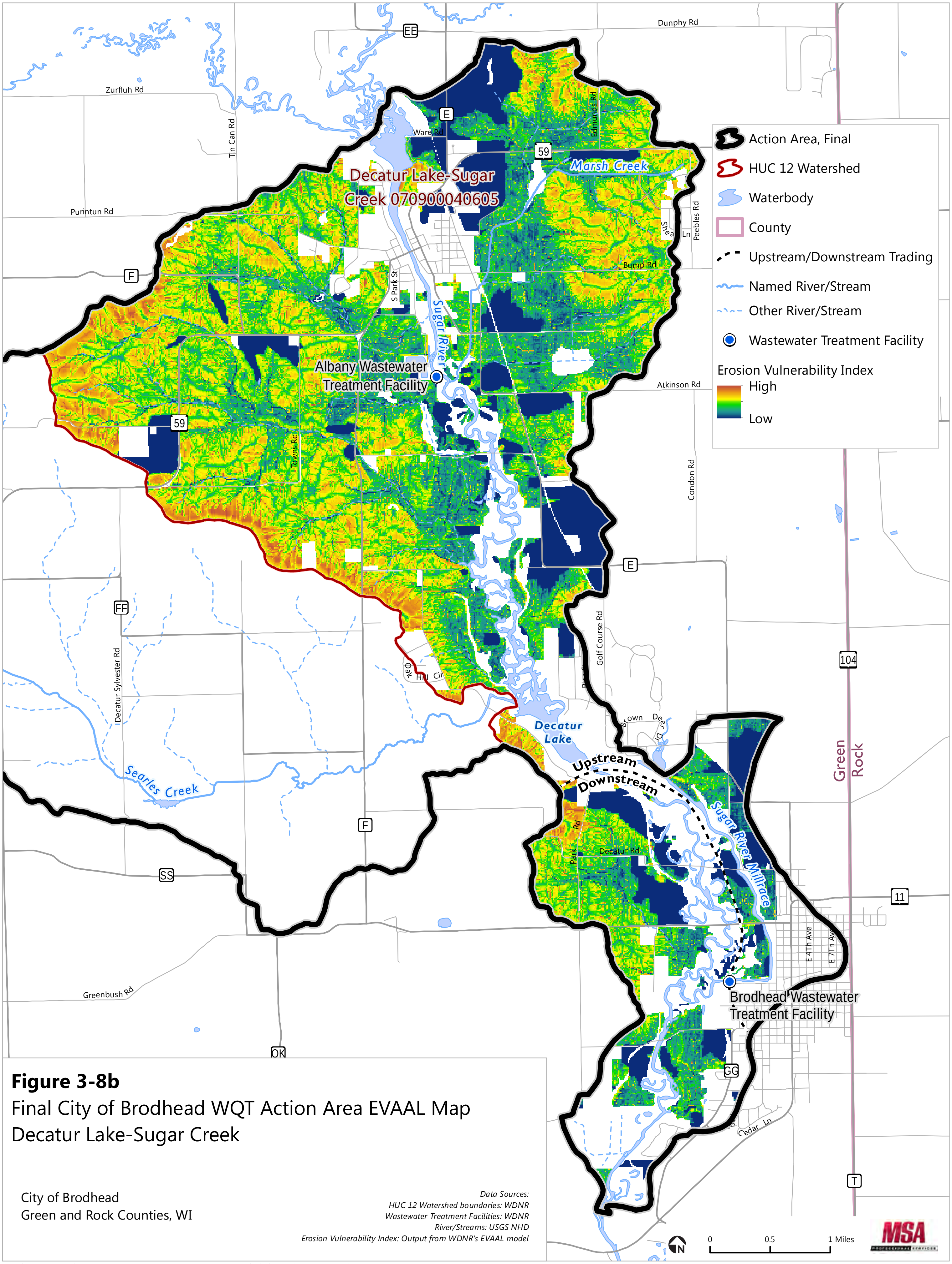

Figure 3-8b
Final City of Brodhead WQT Action Area EVAAL Map
Decatur Lake-Sugar Creek

City of Brodhead
Green and Rock Counties, WI

CHAPTER 4 – TRADING STRATEGY

4.1 ROLES AND RESPONSIBILITIES

Identifying the roles and responsibilities of partners is important to the success of this WQT Plan. As stated in Chapter 3, many local groups are actively interested in water quality improvements in the Brodhead WQT action area. Tapping into local knowledge, coordinating with governmental agencies, and reaching out to public and non-profit groups will improve relationships with local landowners and better leverage all of the available assets these groups have to offer. More importantly, a significant amount of coordination between consultants, regulatory agencies, and other partners will be needed for the City to successfully implement the WQT Plan. All proposed improvements must ultimately be designed, reviewed, permitted, funded, and constructed before phosphorus credits can be generated. Therefore, it is important to define which groups will be responsible for providing technical assistance, funding, and regulatory oversite for the future projects. **Table 4-1** below summarizes the roles and responsibilities of all partners who are anticipated to participate in the implementation of the Brodhead WQT Plan.

Table 4-1: Brodhead WQT Plan partner roles and responsibilities

Partner	Roles & Responsibilities
City of Brodhead	The City of Brodhead will be the lead partner in the Water Quality Trading project. All major project related decisions will be made or reviewed by the City. The City will provide a significant portion of financial assistance for the project related to technical assistance, BMP implementation, and BMP operational costs. The City will work with other partners to best leverage external funding sources, establish timelines for proposed projects, and identify possible opportunities for phosphorus reductions in the WQT action area.
MSA Professional Services, Inc. (MSA)	MSA will provide technical assistance to the City of Brodhead. Technical assistance will include services related to the operation of the City's wastewater treatment facility, engineering services related to BMP implementation and the quantification of phosphorus credits, annual reporting and inspections, and funding assistance as it pertains to grant proposals and cost-share applications.
Green County Land & Water Conservation Department (LWCD)	Green County LWCD has been supportive of the WQT planning efforts and will be an integral partner in the implementation of the WQT Plan. Green County LWCD will provide regulatory oversight for the project as well as technical assistance for BMP implementation which occurs in Green County. All BMPs which are implemented within Green County related to Brodhead's WQT Plan will be reviewed by Green County LWCD. The Green County LWCD will be relied on for making determinations regarding landowner compliance with Wisconsin's agricultural performance standards and manure management prohibitions which are listed in NR 151 and for reviewing future landowner compliance with these rules.

Table 4-1 (continued): Brodhead WQT Plan partner roles and responsibilities

Partner	Roles & Responsibilities
Natural Resources Conservation Service (NRCS)	NRCS may provide technical assistance and financial assistance for the WQT Plan. NRCS engineers and technicians may provide technical assistance for BMPs which are implemented in the rural/agricultural landscape of the proposed action area. NRCS programs such as the Environmental Quality Incentive Program (EQIP) will be considered to provide cost-share assistance to landowners who implement BMPs as part of the WQT Plan.
Wisconsin Department of Natural Resources (DNR)	The Wisconsin DNR will provide regulatory oversight for the WQT Plan. DNR will coordinate directly with the City of Brodhead regarding compliance with effluent limits at the wastewater treatment facility and progress with implementing the WQT Plan.
Lower Sugar River Watershed Association (LSRWA)	The LSRWA is a local conservation group that is interested in protecting land use, geographical features, environmental quality, historical heritage, and other characteristics important to preserving and promoting the quality of life in the Lower Sugar River Watershed. The LSRWA is actively involved with stream monitoring, funding/grant writing, and public outreach/education in the WQT action area. Insight from members of the LSRWA was very valuable to the City of Brodhead when prioritizing areas of the watershed to improve and when targeting landowners to participate in the WQT Plan.
Decatur Lake and Mill Race Association, Inc. (DLMRA)	The DLMRA is a local conservation group that is interested in protecting and improving water quality and recreational opportunities surrounding Decatur Lake and along the Sugar River Millrace. Insight from members of the DLMRA was very valuable to the City of Brodhead when prioritizing areas of the watershed to improve and when targeting landowners to participate in the WQT Plan.

Letters of support for the Brodhead WQT Plan from the Green County LWCD and the LSRWA can be found in **Appendix C**.

4.2 OVERVIEW OF POTENTIAL TRADING PROJECTS

As per DNR's *A Water Quality Trading How to Manual* (2013), compliance with WQT can involve the procurement of phosphorus credits with a number of different credit generators. For example, trading is allowed between point sources (i.e. trading with another upstream wastewater permittee) and nonpoint sources (i.e. trading with agricultural producers, private landowners, or municipal stormwater utilities). As such, the City and MSA preliminarily evaluated the potential for generating phosphorus credits by: 1) point to point source trading with upstream municipal WWTFs, 2) implementing stormwater infrastructure improvements in the City of Brodhead, and 3) implementing best management practices on private rural lands located outside of the City. A brief overview of the feasibility of each of these options is described below.

Potential for Point to Point Source Trading:

In general, point to point source trades should be considered prior to trading with nonpoint sources. There is less risk involved with point source trading because both the credit generator and credit user are regulated by a WPDES permit. In addition, point to point source trades generally have lower trade ratios than trades with nonpoint source credit generators.

Wastewater treatment facilities located upstream of the City of Brodhead which could potentially serve as credit generators for the City are listed below:

1. Albany Wastewater Treatment Facility
2. Belleville Wastewater Treatment Facility
3. Brooklyn Wastewater Treatment Facility
4. Madison Metropolitan Sewerage District Wastewater Treatment Facility
5. Monticello Wastewater Treatment Facility
6. Mount Horeb Wastewater Treatment Facility
7. New Glarus Wastewater Treatment Facility

A map of the location of each of these facilities is shown in **Figure 4-1**.

Unfortunately, in order to serve as a point source credit generator, the credit generator must accept a lower phosphorus effluent limit than the final water quality based effluent limit for that facility. To MSA's knowledge, all of the facilities listed above are also subject to stringent effluent phosphorus limits, and therefore, it is unlikely that any of these facilities would be willing to accept even lower limits in order to serve as a credit generator for the City of Brodhead. Overall, point to point source trading is not anticipated to be a feasible alternative for the City of Brodhead at this time. However, point source trading should continue to be evaluated in the future if opportunities become available.

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Figure 4-1
Potential Point Source Trading Partners in the Upstream Sugar River Basin

City of Brodhead
Green and Rock Counties, WI

Data Sources:
HUC 8 and 12 Watershed boundaries: WDNR
Wastewater Treatment Facility Surface Water Outfalls: WDNR
Basemap: ESRI

HUC 8 Sugar River Basin
HUC 12 Watersheds Upstream of Brodhead WWTF
Upstream WWTF Surface Water Outfalls within Sugar River Basin

0 2.125 4.25 Miles

MSA

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Potential for Stormwater Improvements in the City of Brodhead:

Generating trades by implementing stormwater improvements can also reduce risk when implementing WQT. These improvements are inherently less risky because the credits can be generated on land owned by the permittee and the permittee can have direct control of the operation and maintenance of the installed practices, instead of a private landowner. Stormwater improvements are also beneficial because these practices generally have relatively low trade ratios.

Due to the potential benefits, several stormwater improvements were considered within the City of Brodhead for the purposes of generating phosphorus credits. After preliminary evaluation, the most promising improvements appeared to be the construction of two wet detention ponds. The locations of the proposed wet detention ponds are shown in **Figure 4-2**. Unfortunately, both pond sites were deemed infeasible. The proposed site for Pond 1 was unfeasible since the City already had development plans for the proposed land parcel. In addition, due to the existing depth of the stormwater piping which would discharge to Pond 1, the pond would either need to be constructed unrealistically deep in the ground or major modifications would be needed to the existing storm sewer system. The proposed site for Pond 2 was deemed infeasible since the site was owned by a private landowner who had no interest in selling the property to the City for the purposes of developing a wet detention pond. Preliminary cost evaluations also suggested that the proposed stormwater improvements would also be more expensive than implementing best management practices with private landowners.

At this time, stormwater improvements are not anticipated to be feasible or cost effective practices for the City of Brodhead to generate phosphorus credits. However, if major stormwater infrastructure improvements are proposed within the City to manage existing stormwater issues in the future, the City should consider incorporating these improvements in the WQT Plan to capture any potential phosphorus credits that might be generated.

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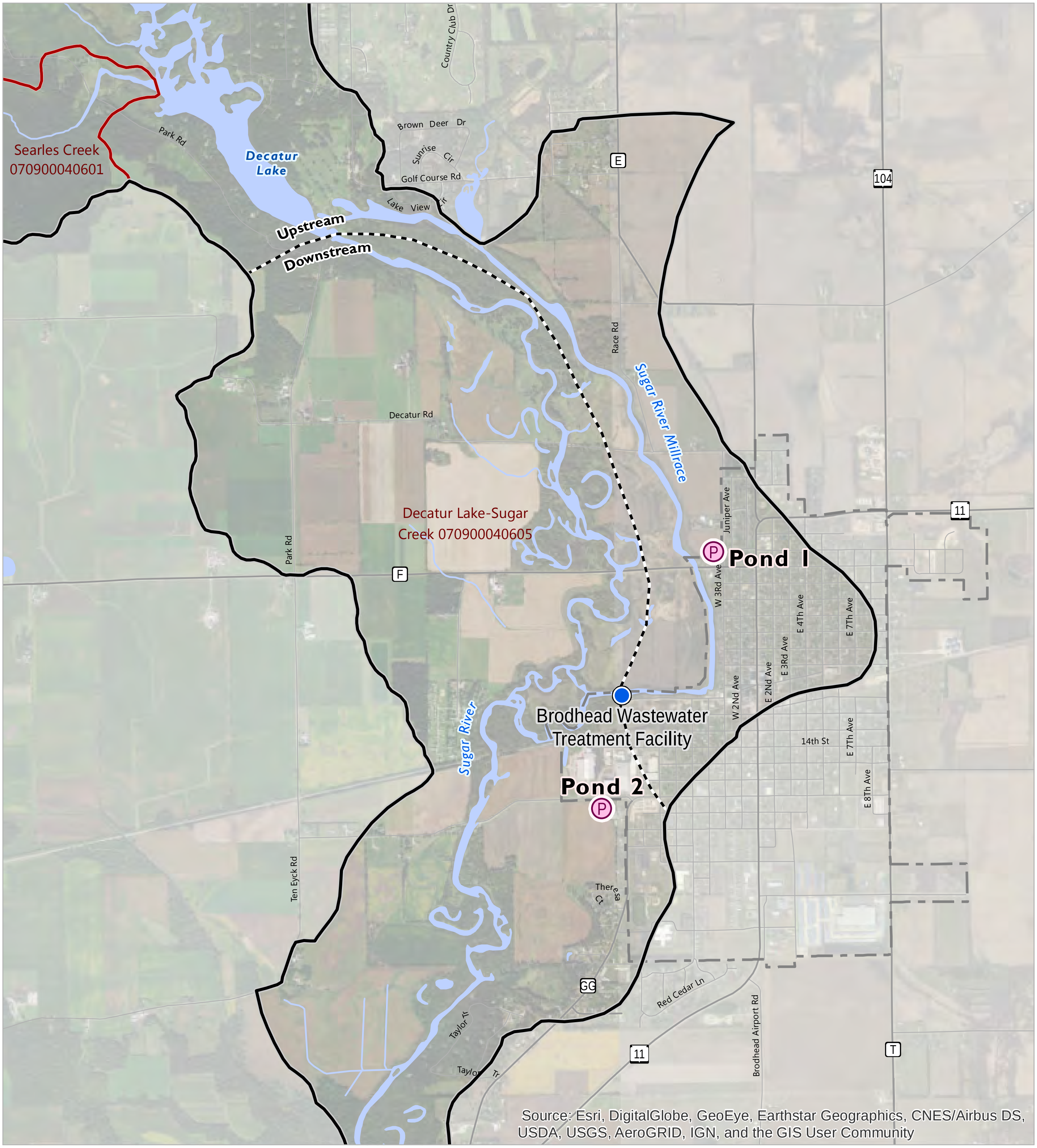

Figure 4-2
Potential Wet Detention Stormwater Pond Construction Locations

City of Brodhead
Green and Rock Counties, WI

Action Area, Final
HUC 12 Watershed
City of Brodhead
Waterbody
River/Stream
Upstream/Downstream Trading
Wastewater Treatment Facility
Proposed Stormwater Detention Basin

Data Sources:
HUC 12 Watershed boundaries: WDNR
Wastewater Treatment Facilities: WDNR
Waterbodies and River/Streams: USGS NHD
Municipal Boundary: Green and Rock Counties
Basemap: ESRI

N
0 0.25 0.5 Miles

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Potential for Trading with Landowners Outside of the City of Brodhead:

As described in Section 3.3 of this report, the City and MSA has identified three private landowners located in the Searles Creek subwatershed who are willing to establish legal agreements to become credit generators for the City of Brodhead. For the purposes of protecting landowner privacy, the three landowners will be referred hereinafter in this report as Landowner A, Landowner B, and Landowner C. Both Landowner A and Landowner B have interest in completing streambank protection and habitat improvements along Searles Creek. Landowner A owns approximately 0.8 miles of streambank along Searles Creek, and Landowner B owns approximately 0.4 miles of streambank along Searles Creek. Landowner C operates a small dairy farm and is interested in reducing contaminated runoff from existing outdoor feedlots, constructing long term (>180 day) waste storage, and improving nutrient management on owed and rented crop fields. Aerial photographs of each of these properties are shown in **Figures 4-3**, **4-4**, and **4-5**. Projects with each landowner have been determined to be feasible and cost effective, and projects with all three landowners are recommended for implementation to generate phosphorus credits for the City of Brodhead.

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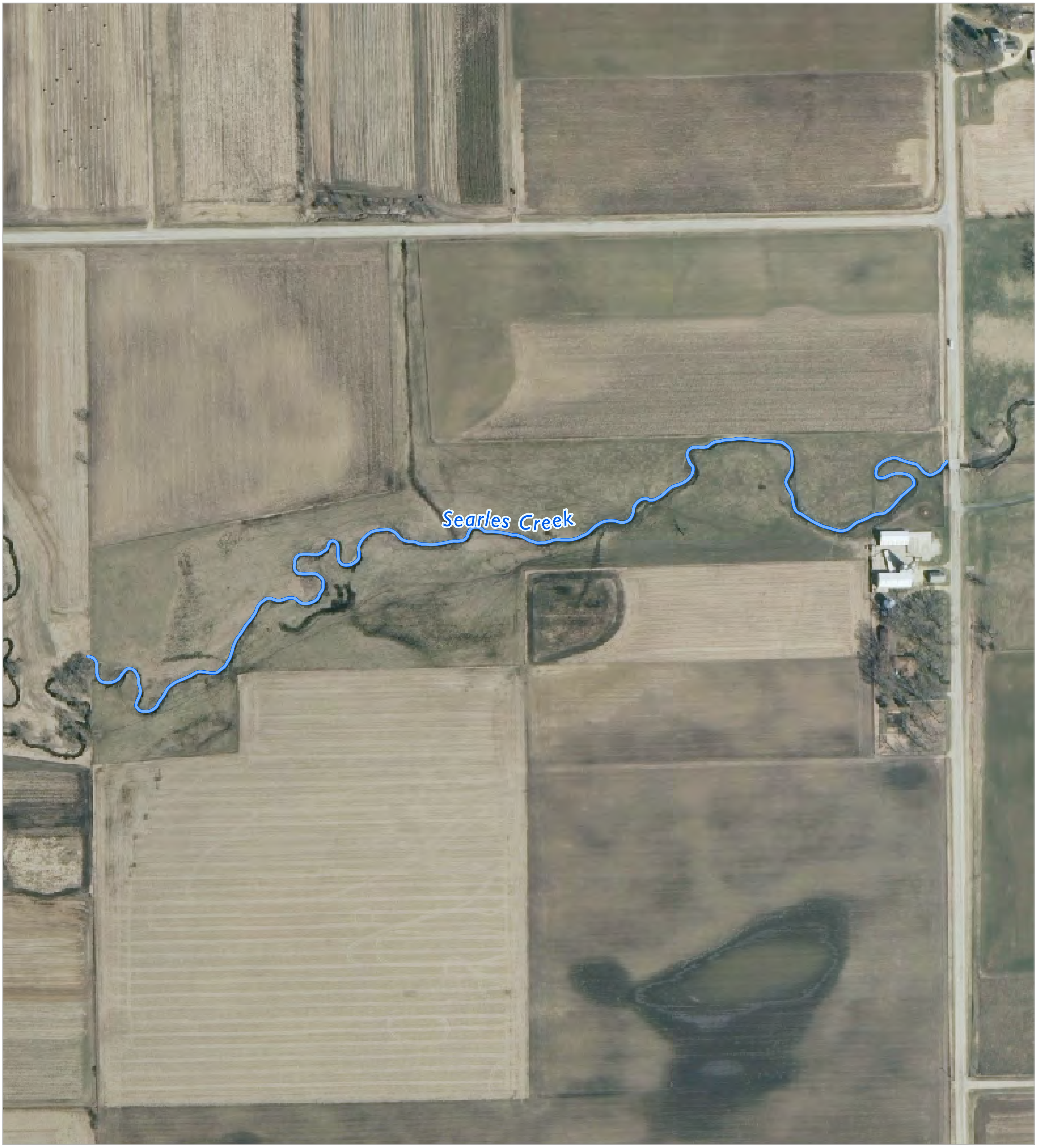

Figure 4-3
Proposed Streambank Protection and Habitat Improvement Project (Landowner A)

City of Brodhead
Green and Rock Counties, WI

Proposed Streambank Protection and Habitat Improvement Site

Data Sources:
Basemap: WROC (2010)

N

0 200 400 Feet

MSA

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Figure 4-4
Proposed Streambank Protection and Habitat Improvement Project (Landowner B)

City of Brodhead
Green and Rock Counties, WI

Proposed Streambank Protection and Habitat Improvement Site

Data Sources:
Basemap: WROC (2010)

0 100 200 Feet

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Figure 4-5
Proposed Farmstead and Nutrient Management Improvement Project
(Landowner C)

City of Brodhead
Green and Rock Counties, WI

Data Sources:
Basemap: MSA

0 50 100 Feet

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4.3 Trade Ratio Calculations

The effectiveness of all phosphorus trades are to some level uncertain, and thus, a "trade ratio" (i.e. safety factor) is needed to ensure that water quality improvements occur as a result of a trade. When calculating the number of phosphorus credits which are generated by a specific BMP, the amount of phosphorus which is removed by the BMP is divided by the applicable trade ratio as shown in **Equation 4-1**.

Equation 4-1:

$$\text{Phosphorus Credits}\left[\frac{\text{lb}}{\text{yr}}\right]=\frac{\text{Phosphorus Removed by BMP}\left[\frac{\text{lb}}{\text{yr}}\right]}{\text{Trade Ratio}}$$

The magnitude of a trade ratio is site specific and depends on a number of factors, such as the relative location of the trade in comparison to the wastewater treatment facility outfall, the perceived uncertainty of the BMP that is implemented, and if the implemented BMP provides any benefit to aquatic or wildlife habitat. In general, BMPs which are implemented upstream and within close vicinity of the wastewater outfall and which are perceived to be highly effective practices are assigned lower trade ratios. The general equation used to estimate the trade ratio for a given BMP is shown below:

Equation 4-2:

$$\text{Trade Ratio}=\text{Delivery}+\text{Downstream}+\text{Equivalency}+\text{Uncertainty}\ -\text{Habitat Adjustment}$$

A detailed description of each factor in **Equation 4-2** can be found in DNR's *A Water Quality Trading How to Manual* (2013). It is important to note that the minimum trade ratio for point to point source trades is 1.1:1 and the minimum trade ratio for point to nonpoint source trades is 1.2:1. Once a trade ratio is calculated using **Equation 4-2,** it must be compared to these minimum trade ratios.

For the purposes of this WQT Plan, all trades are expected to occur upstream of the wastewater treatment facility outfall. Since no trades are planned to be installed downstream of the outfall, the downstream factor is zero. An equivalency factor is also unnecessary since the traded pollutant is phosphorus. The habitat adjustment factor is also equal to zero since all anticipated trades which will provide habitat improvements include habitat adjustment as part of the uncertainty factor (e.g. streambank stabilization with aquatic habitat restoration). Thus, **Equation 4-2** can be simplified to only include the delivery factor and equivalency factor (see **Equation 4-3**).

Equation 4-3:

$$\text{Trade Ratio}=\text{Delivery}+\text{Uncertainty}$$

The delivery factor is needed whenever a trade is generated in a different HUC 12 than the permittee's wastewater outfall or when a lake or reservoir is located between the credit user and generator. In the case of Brodhead's WQT action area (see **Figure 3-5**), a delivery factor is needed for all trades which are located upstream of Decatur Lake in the Decatur Lake & Sugar Creek subwatershed (HUC 070900040605) and for all trades located in the Searles Creek subwatershed (HUC 070900040601). All trades located downstream of Decatur Lake in the Decatur Lake & Sugar Creek subwatershed would have a delivery factor of zero. The delivery factor is calculated using the phosphorus "delivery fraction" from the USGS SPARROW model as shown in **Equation 4-4**.

Equation 4-4:

$$\text{Delivery Factor} = \left(\frac{1}{\text{SPARROW Delivery Fraction}}\right) - 1$$

The SPARROW delivery fraction results for the contributing areas upstream of Decatur Lake in the Decatur Lake & Sugar Creek subwatershed and the Searles Creek subwatershed are both 0.97 as shown in **Figure 4-6** and **Figure 4-7**. Using **Equation 4-4,** the delivery factor for each of these portions of the WQT action is calculated to be 0.03. **Table 4-2** summarizes delivery factors for all possible trade locations in the Brodhead WQT action area (see **Figure 3-5**).

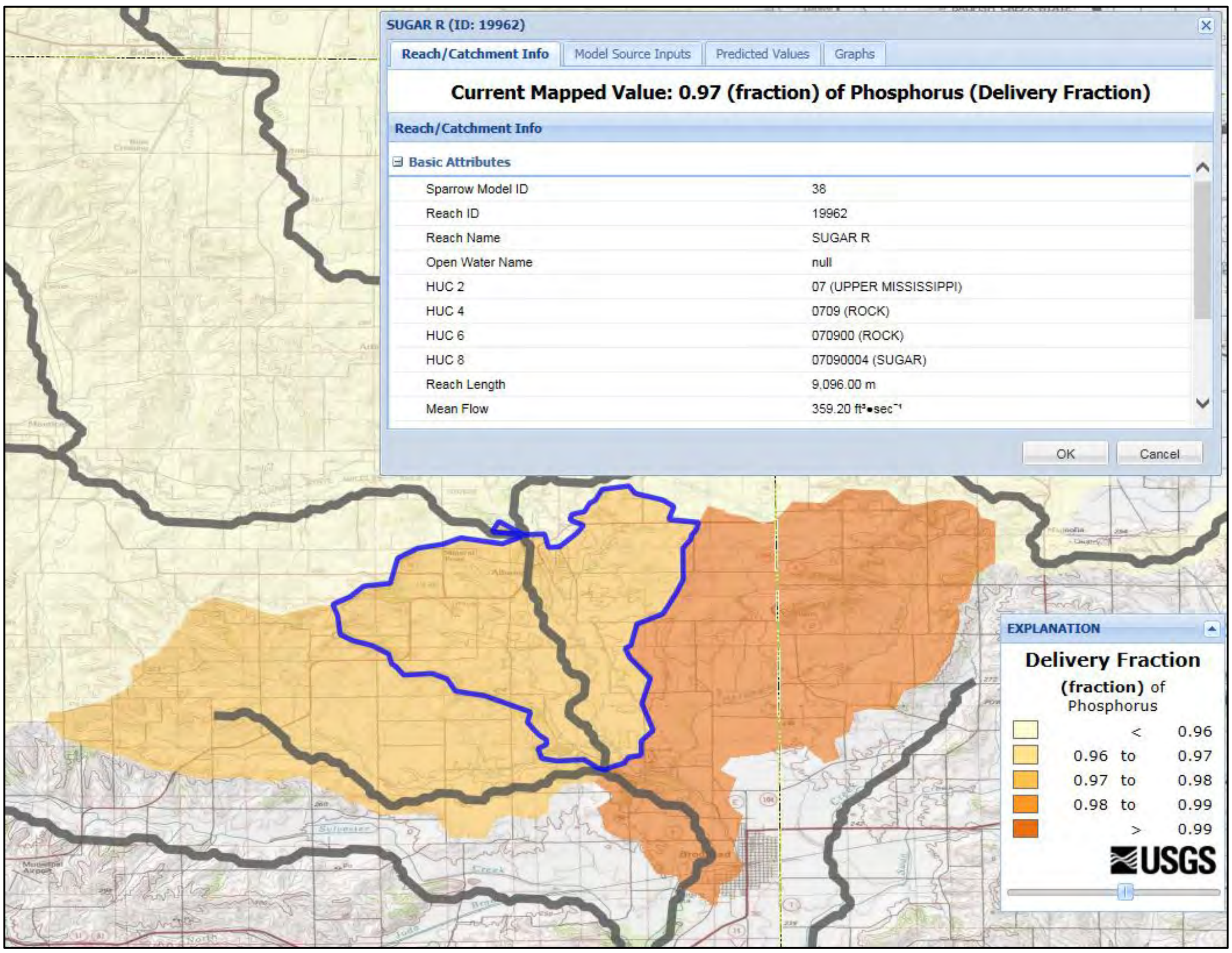

Figure 4-6: SPARROW delivery fraction result for the Decatur Lake & Sugar Creek subwatershed upstream of Decatur Lake

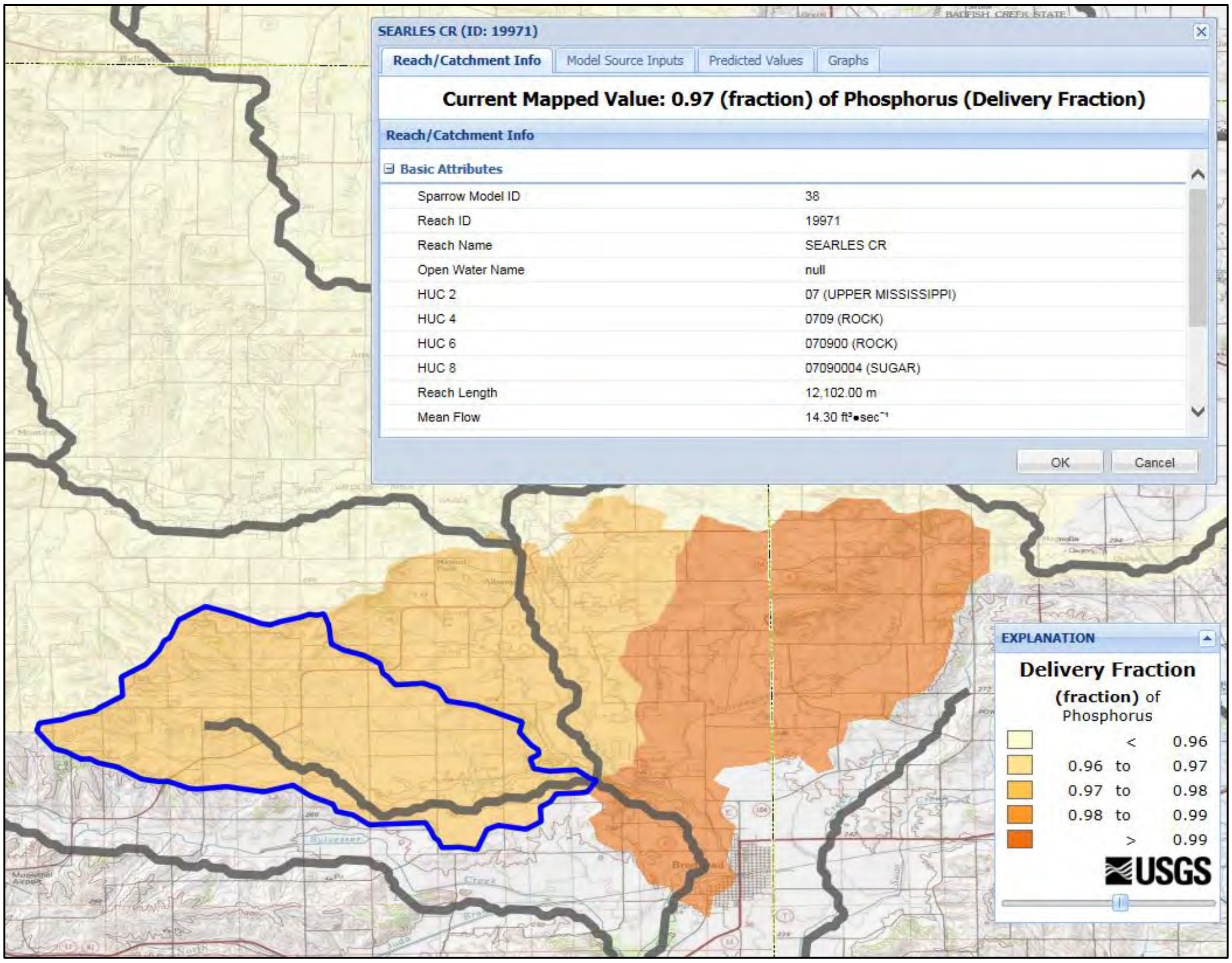

Figure 4-7: SPARROW delivery fraction result for the Searles Creek subwatershed

Delivery Fraction Calculations for Contributing Areas Upstream of Decatur Lake:

$$\text{Delivery Factor} = \left(\frac{1}{\text{SPARROW Delivery Fraction}}\right) - 1$$

$$= \left(\frac{1}{0.97}\right) - 1$$

$$= 0.03$$

Table 4-2: Possible delivery factors for trade locations in Brodhead WQT action area

HUC 12	Location of Trade	Delivery Factor
Decatur Lake & Sugar Creek	Downstream of Decatur Lake	0.00
Decatur Lake & Sugar Creek	Upstream of Decatur Lake	0.03
Searles Creek	Upstream of Decatur Lake	0.03

The uncertainty factor is needed for all point to nonpoint source trades. The uncertainty factor accounts for inaccuracies in water quality models which are used to quantify phosphorus load reductions from a management practice. Uncertainty factors for various management practices are listed in Appendix A of DNR's *A Water Quality Trading How to Manual* (2013). Management practices and associated uncertainty factors which are currently expected to be incorporated in the WQT Plan are listed in **Table 4-3**.

Table 4-3: Uncertainty Factors

Management Practice	Uncertainty Factor
Conservation Easement	1.0
Nutrient Management and Supporting Practice w/o Grassed Waterways[1]	2.0 or 3.0
Nutrient Management and Supporting Practice w/ Grassed Waterways	1.5
Production Area Diversion	2.0
Production Area Roof Runoff Structure	2.0
Sediment Control Basin	2.0
Streambank Stabilization w/o Habitat Restoration	3.0
Streambank Stabilization w/ Habitat Restoration[2]	2.0 or 3.0

[1]*The uncertainty factor for nutrient management and supporting practices is 3.0 and can be lowered to 2.0 if documentation can be provided to DNR to demonstrate the credit generator's adherence to the nutrient management plan. For fields without grassed waterways and identified as not needing grassed waterways to prevent gully erosion, the minimum uncertainty factor is 2.0.*

[2]*The uncertainty factor for streambank stabilization with habitat restoration is 2.0 if the improvements are made to a stream which is listed as impaired for phosphorus and the habitat improvement plan is approved by DNR. If streambank stabilization and habitat improvements are made to a stream which is not impaired, the uncertainty factor is 3.0.*

In summary, trade ratios for the management practices proposed in this WQT Plan can be estimated using **Equation 4-3** and the delivery factors and uncertainty factors listed in **Table 4-2** and **Table 4-3**, respectively. As previously mentioned, no trade ratios can be lower than the minimum allowable trade ratios for point to point (1.1:1) and point to nonpoint trades (1.2:1).

4.4 CREDIT THRESHOLDS

As per DNR's *A Water Quality Trading How to Manual* (2013), there are two types of credits which can be generated under a trading program: 1) interim credits and 2) long-term credits. Interim credits are only available for a short time period (≤ 5 years), and long term credits are available in perpetuity as long as the implemented practice is maintained. Whether an interim or long-term credit is generated by a management practice is dependent on the defined "credit thresholds" in the watershed where the management practice is implemented. The "credit threshold" is the amount of phosphorus reduction which must be removed before a "long-term" credit can be generated. Credit thresholds for phosphorus typically only apply in watersheds with an approved TMDL for phosphorus. Since there is not an approved TMDL for phosphorus in any of the streams located within the Brodhead WQT action area, credit thresholds currently do not apply to the management practices recommended by this WQT Plan. Therefore, all trades that reduce nonpoint source loads below the current level which are implemented by the City of Brodhead will be considered "long-term" credits and will generate credits throughout the maintained life of the management practice.

4.5 RECOMMENDED PROJECTS

As stated in Section 4.2, the City plans to generate credit by working with three private landowners: Landowner A, Landowner B, and Landowner C. This section briefly describes each project site, management practices which are planned to be implemented by each landowner, and the amount of credits which are estimated to be generated. More detailed write ups regarding credit calculations for each landowner are provided in **Appendix D**, **Appendix E**, and **Appendix F**.

Please note that all practices will be designed and maintained according to NRCS standards and design plans for all proposed practices will be sent to applicable regulatory agencies for review prior to implementation (e.g. Green County LWCD, NRCS, and DNR).

Landowner A

History of Project Site:

The project site is a streamside pasture. Vegetation is primarily grass with no trees. The pasture is annually rented to local farm operators, and the pasture is currently grazed by dairy heifers during the growing season. Streambanks along the site are actively eroding due to unstable banks and also due to localized cattle traffic and grazing. There is a drainage ditch which enters the property from the north, and several subsurface drain tiles outlet to Searles Creek on the project site. Runoff from neighboring fields is resulting in some gully erosion in areas where concentrated flow enters the stream. Bare eroding banks, slumps and slips, vegetative overhang, exposed roots, exposed drain tiles, and exposed fence posts all signify that streambank erosion is a major environmental resource concern for the site.

Project Location:

The project site is located along the main branch of Searles Creek in the Searles Creek subwatershed (HUC 070900040601) in Green County, Wisconsin. The site is approximately 2.0 stream miles upstream from Decatur Lake. A map of the project site is shown in **Figure 4-8**. This map displays the locations of 37 actively eroding streambanks which have been identified at the site.

Proposed BMPs:

BMPs which are planned to be implemented to address streambank erosion and improve habitat conditions for this site include the following:

- Bank Grading
- Riprap
- Livestock Crossings
- Fencing
- Grass Seeding
- Aquatic Habitat Improvements (see NRCS Riparian Habitat Guide)
    - Backwater Wetlands
    - Boulder Retards (Cover Rocks)
    - Cross Channel Logs
    - Escape Logs (Basking Logs)
    - Log Deflectors
    - LUNKER Structures
    - Rock Deflectors
    - Rock Vortex Weirs

Design Life:

10 to 20 years (with proper maintenance)

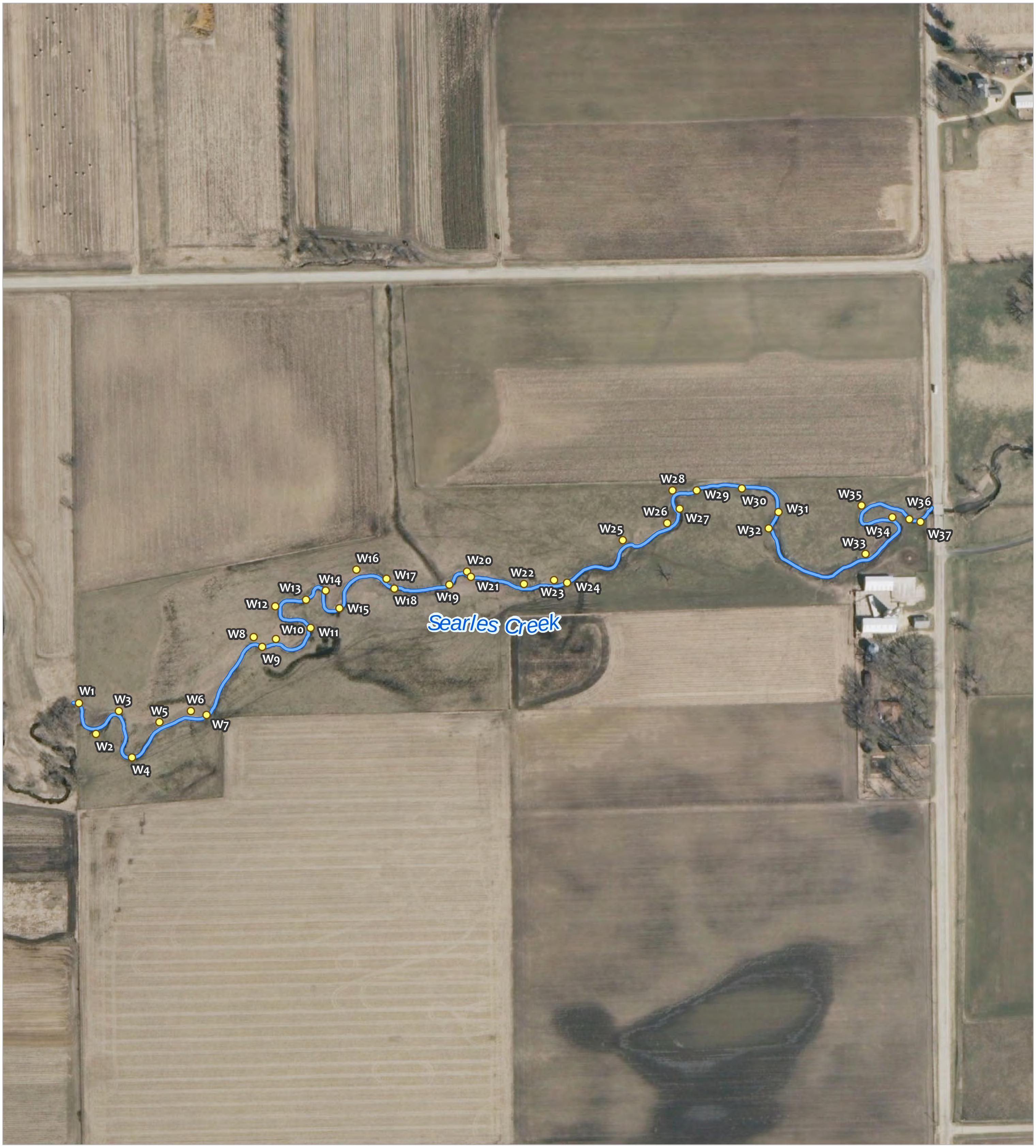

Figure 4-8

Map of actively eroding streambanks identified on property owned by Landowner A

City of Brodhead
Green and Rock Counties, WI

Proposed Streambank Protection and Habitat Improvement Site

Eroding Streambanks

Data Sources:
Basemap: WROC (2010)

0 200 400 Feet

MSA PROFESSIONAL SERVICES

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Applicable Standards:

- NRCS 342 - Critical Area Planting
- NRCS 382 - Fence
- NRCS 395 - Stream Habitat Improvement and Management
- NRCS 578 - Stream Crossing
- NRCS 580 - Streambank and Shoreline Protection

Permitting Requirements:

The project will require a wetland delineation, DNR streambank erosion control permit, and DNR construction site storm water permit.

Operation & Maintenance Plan:

Proposed items for the Operation and Maintenance Plan are listed below. Implementation of the Operation and Maintenance Plan for Landowner A will be shared by the landowner and the City of Brodhead, with the landowner responsible for meeting grazing requirements and the City providing aid as needed for normal observation and necessary maintenance and/or repairs for deteriorating or failing BMPs.

For the purposes of this Operation and Maintenance Plan, severe floods are defined as any hydrologic event resulting from a 24-hour cumulative precipitation in excess of 3.5 inches of rainfall (i.e., the 5-year 24-hour precipitation event based on the annual maximum time series as defined for Brodhead, WI, by NOAA Atlas 14, Volume 8, Version 2).

<u>Conditions for Riprap Placements</u>:

1. Check the riprap, plantings, and/or tree revetments at least once each year and immediately after severe floods. Rock removed or displaced shall be replaced as needed. Repair or replace any damaged or missing revetments.

2. Logs, trees, driftwood, and other debris lodged in or near the riprap shall be removed.

3. Check for sloughing, erosion, or damage to vegetative cover. Damaged areas shall be graded, shaped, and re-vegetated.

4. Repair any vandalism, vehicle, or livestock damage.

<u>Conditions for Stream Crossings</u>:

1. Maintain the roadway surface in good condition, including periodic grading, filling, or repair of the surface to maintain the road cross section.

2. Prevent ponding by grading to remove depressions and ruts.

3. Limit livestock and vehicle usage to periods that minimize damage.

4. Periodically replace livestock hoof contact material in channel crossings.

5. Repair any damage to earth or gravel fills.

Conditions for Stream Habitat Improvements:

1. Check all habitat structures at least once each year and immediately after severe floods. Repair any structure causing streambank or streambed instability.

Additional Conditions:

1. All repairs which include the streambank or streambed should be approved by DNR before implementing the repair in order to protect aquatic and terrestrial species and to determine if a permit is needed to complete the repair.

2. Maintain vegetated areas in adequate cover within the buffer area of the streambank. Three to four inches of plant residue will remain at all times during the grazing season. Livestock will not be placed into paddocks until the average paddock height is at least six to ten inches (or more) and they will be removed before damaging the forage resource and/or leaving the three to four inch minimum.

3. Clip and/or mechanically harvest vegetated areas, as needed, to control undesirable species and woody vegetation.

4. If fences are installed, they shall be maintained to prevent unauthorized human or livestock access to the stream.

Modeling Procedures:

Streambank erosion was estimated using the NRCS "Erosion Calculator (Direct Volume Method)" (NRCS Field Office Technical Guide, 2017). A total of 37 actively eroding streambanks were identified and sampled on the property. **Equation 4-5** was used to estimate phosphorus loss from each eroding streambank. The sum of the phosphorus loss from all eroding banks was used to estimate phosphorus credits for the site. Detailed modeling procedures are provided in **Appendix D**.

Equation 4-5:

$$\text{Streambank Phosphorus Loss} = \mathrm{L} \times \mathrm{H} \times \mathrm{R} \times \gamma_{\text{soil}} \times \mathrm{C}_{\text{TP}} \times \frac{1}{1{,}000{,}000}$$

Where:	L	=	length of eroding bank [ft]
	H	=	slope height of eroding bank [ft]
	R	=	annual lateral recession rate of eroding bank $\left[\frac{\text{ft}}{\text{yr}}\right]$
	γ_{soil}	=	soil bulk density $\left[\frac{\text{lb}}{\text{ft}^3}\right]$
	C_{TP}	=	soil total phosphorus concentration [ppm]

Trade Ratios Calculations:

$\text{Trade Ratio} = \text{Delivery} + \text{Uncertainty}$

$\text{Delivery Factor} = 0.03$ (see **Table 4-2** for Searles Creek HUC 12)

$\text{Uncertainty Factor} = 3.00$ (See **Table 4-3** for Streambank Stabilization w/ Habitat Restoration; Searles Creek is currently not considered to be impaired due to phosphorus according to DNR so the minimum uncertainty factor is 3.0)

$\text{Trade Ratio} = 0.03 + 3.00 = 3.03$

Credit Calculations:

$$\text{Phosphorus Credits} = \frac{\text{Phosphorus Removed by BMP}}{\text{Trade Ratio}}$$

$$= \frac{416.6\ \frac{\text{lb}}{\text{yr}}}{3.03}$$

$$= 137.5\ \frac{\text{lb}}{\text{yr}}$$

Estimated Cost:

The estimated costs for implementing the streambank stabilization repairs and habitat improvements for Landowner A are shown in **Table 4-4**. The City of Brodhead will cover all technical assistance, capital, and annual operation and maintenance (O&M) costs for Landowner A which are not funded by eligible government programs or other partners of the City. Annual operation and maintenance costs include annual repair funds to facilitate the maintenance and repair of BMPs in the future.

Table 4-4: Estimated costs for implementing BMPs for Landowner A

Capital Costs	Annual O&M Costs	20-year Present Worth
$ 380,000	$ 13,000	$ 555,000

Eligible Funding Sources:

The City and MSA plan to pursue funding for the project with Landowner A through the NRCS Environmental Quality Incentives Program (EQIP). NRCS EQIP is listed as an eligible funding source for Water Quality Trading programs according to Appendix B of DNR's draft *Agricultural Nonpoint Source Implementation Handbook for Adaptive Management and Water Quality Trading WPDES Permit Compliance Options* (2015). The project with Landowner A is not contingent on funding from EQIP.

Landowner B

History of Project Site:

The project site is a streamside pasture. Vegetation is primarily grass. However, the stream corridor is heavily wooded with trees and shrubs. The pasture is currently grazed by horses. Streambanks along the site are actively eroding due to unstable banks. A few areas of localized erosion from horse crossings are present. Many large trees have fallen in the stream and are causing additional erosion. Bare eroding banks, slumps and slips, vegetative overhang, exposed tree roots, and exposed fence posts are all present on the site, indicating that erosion is a major environmental resource concern.

Project Location:

Project site is located along the main branch of Searles Creek in the Searles Creek subwatershed (HUC 070900040601) in Green County, Wisconsin. The project site is approximately 1.6 stream miles upstream from Decatur Lake. A map of the project site is shown in **Figure 4-9**. This map displays the locations of 26 actively eroding streambanks which have been identified at the site.

Proposed BMPs:

BMPs which are planned to be implemented to address streambank erosion and improve habitat conditions for this site include the following:

- Clearing and Snagging
- Bank Grading
- Riprap
- Horse Crossings
- Fencing
- Grass Seeding
- Aquatic Habitat Improvements (see NRCS Riparian Habitat Guide)
    - Boulder Retards (Cover Rocks)
    - Cross Channel Logs
    - Escape Logs (Basking Logs)
    - Log Deflectors
    - LUNKER Structures
    - Rock Deflectors
    - Rock Vortex Weirs

Design Life:

10 to 20 years (with proper maintenance)

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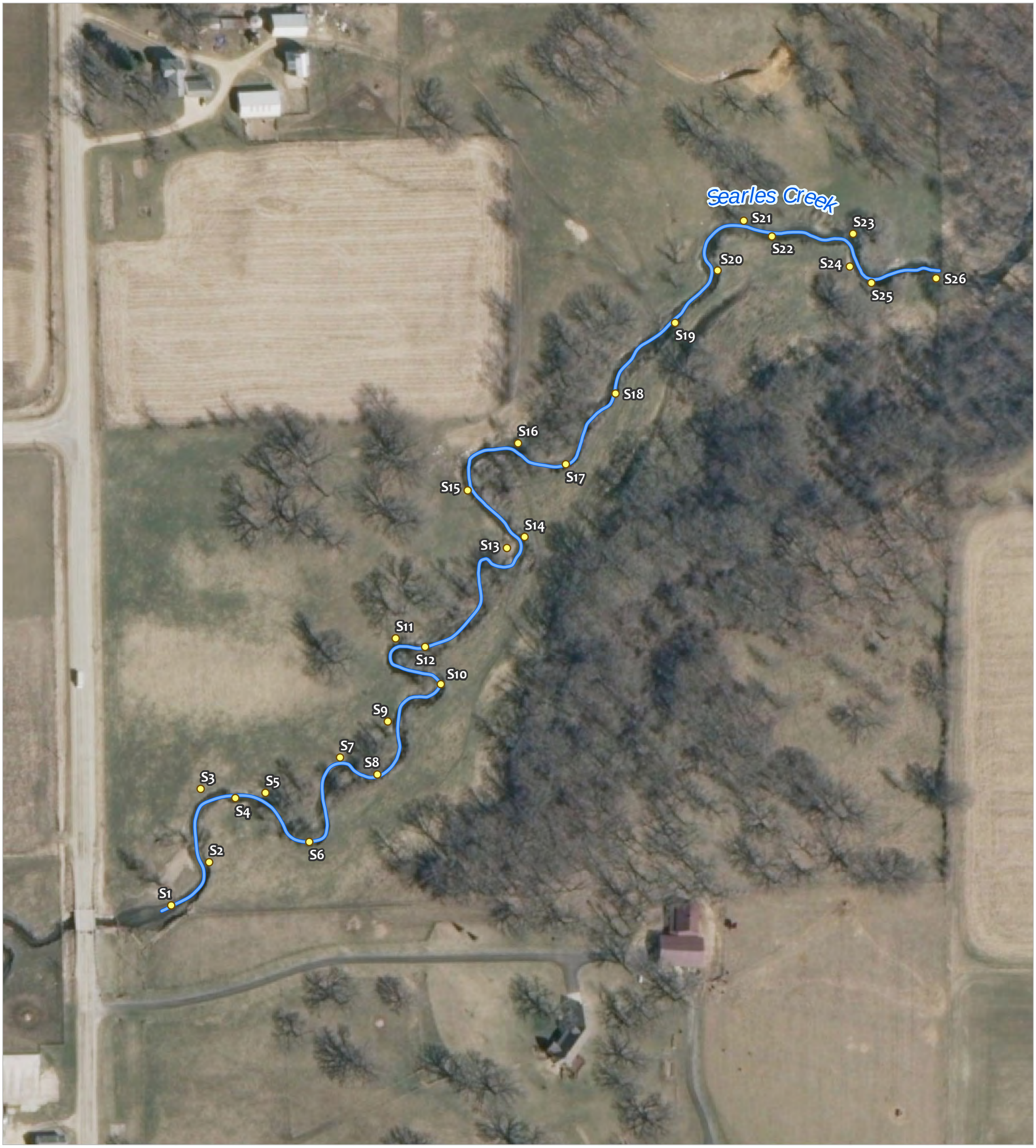

Figure 4-9

Map of actively eroding streambanks identified on property owned by Landowner B

City of Brodhead
Green and Rock Counties, WI

Proposed Streambank Protection and Habitat Improvement Site

Eroding Streambanks

Data Sources:
Basemap: WROC (2010)

0 100 200 Feet

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Applicable Standards:

- NRCS 326 - Clearing and Snagging
- NRCS 342 - Critical Area Planting
- NRCS 382 - Fence
- NRCS 395 - Stream Habitat Improvement and Management
- NRCS 578 - Stream Crossing
- NRCS 580 - Streambank and Shoreline Protection

Permitting Requirements:

The project will require a wetland delineation, DNR streambank erosion control permit, and DNR construction site storm water permit.

Operation & Maintenance Plan:

Proposed items for the Operation and Maintenance Plan are listed below. Implementation of the Operation and Maintenance Plan for Landowner B will be shared by the landowner and the City of Brodhead, with the landowner responsible for normal observation (excluding inspections by the City) and grazing requirements and the City providing aid as needed for necessary maintenance and/or repairs for deteriorating or failing BMPs.

For the purposes of this Operation and Maintenance Plan, severe floods are defined as any hydrologic event resulting from a 24-hour cumulative precipitation in excess of 3.5 inches of rainfall (i.e., the 5-year 24-hour precipitation event based on the annual maximum time series as defined for Brodhead, WI, by NOAA Atlas 14, Volume 8, Version 2).

Conditions for Riprap Placements:

1. Check the riprap, plantings, and/or tree revetments at least once each year and immediately after severe floods. Rock removed or displaced shall be replaced as needed. Repair or replace any damaged or missing revetments.

2. Logs, trees, driftwood, and other debris lodged in or near the riprap shall be removed.

3. Check for sloughing, erosion, or damage to vegetative cover. Damaged areas shall be graded, shaped, and re-vegetated.

4. Repair any vandalism, vehicle, or livestock damage.

Conditions for Stream Crossings:

1. Maintain the roadway surface in good condition, including periodic grading, filling, or repair of the surface to maintain the road cross section.

2. Prevent ponding by grading to remove depressions and ruts.

3. Limit livestock and vehicle usage to periods that minimize damage.

4. Periodically replace livestock hoof contact material in channel crossings.

5. Repair any damage to earth or gravel fills.

<u>Conditions for Stream Habitat Improvements</u>:

1. Check all habitat structures at least once each year and immediately after severe floods. Repair any structure causing streambank or streambed instability.

<u>Additional Conditions</u>:

1. All repairs which include the streambank or streambed should be approved by DNR before implementing the repair in order to protect aquatic and terrestrial species and to determine if a permit is needed to complete the repair.

2. Maintain vegetated areas in adequate cover within the buffer area of the streambank. Three to four inches of plant residue will remain at all times during the grazing season. Livestock will not be placed into paddocks until the average paddock height is at least six to ten inches (or more) and they will be removed before damaging the forage resource and/or leaving the three to four inch minimum.

3. Clip and/or mechanically harvest vegetated areas, as needed, to control undesirable species and woody vegetation.

4. If fences are installed, they shall be maintained to prevent unauthorized human or livestock access to the stream.

Modeling Procedures:

Streambank erosion was estimated using the NRCS "Erosion Calculator (Direct Volume Method)" (NRCS Field Office Technical Guide, 2017). A total of 26 actively eroding streambanks were identified and sampled on the property. **Equation 4-5** was used to estimate phosphorus loss from each eroding streambank. The sum of the phosphorus loss from all eroding banks was used to estimate phosphorus credits for the site. Detailed modeling procedures are provided in **Appendix D**.

Equation 4-5:

$$\text{Streambank Phosphorus Loss} = \mathrm{L} \times \mathrm{H} \times \mathrm{R} \times \gamma_{\text{soil}} \times \mathrm{C}_{\text{TP}} \times \frac{1}{1{,}000{,}000}$$

Where:

L	=	length of eroding bank [ft]
H	=	slope height of eroding bank [ft]
R	=	annual lateral recession rate of eroding bank $\left[\frac{\text{ft}}{\text{yr}}\right]$
γ_{soil}	=	soil bulk density $\left[\frac{\text{lb}}{\text{ft}^3}\right]$
C_{TP}	=	soil total phosphorus concentration [ppm]

Trade Ratios Calculations:

$\text{Trade Ratio} = \text{Delivery} + \text{Uncertainty}$

$\text{Delivery Factor} = 0.03$ (see **Table 4-2** for Searles Creek HUC 12)

$\text{Uncertainty Factor} = 3.00$ (See **Table 4-3** for Streambank Stabilization w/ Habitat Restoration; Searles Creek is currently not considered to be impaired due to phosphorus according to DNR so the minimum uncertainty factor is 3.0)

$\text{Trade Ratio} = 0.03 + 3.00 = 3.03$

Credit Calculations:

$$\text{Phosphorus Credits} = \frac{\text{Phosphorus Removed by BMP}}{\text{Trade Ratio}}$$

$$= \frac{297.4\ \frac{\text{lb}}{\text{yr}}}{3.03}$$

$$= 98.2\ \frac{\text{lb}}{\text{yr}}$$

Estimated Cost:

The estimated costs for implementing the streambank stabilization repairs and habitat improvements for Landowner B are shown in **Table 4-5**. The City of Brodhead will cover all technical assistance and capital costs for Landowner B which are not funded by eligible government programs or other partners of the City. Annual operation and maintenance costs include annual repair funds to facilitate the maintenance and repair of BMPs in the future.

Table 4-5: Estimated costs for implementing BMPs for Landowner B

Capital Costs	Annual O&M Costs	20-year Present Worth
$ 295,000	$ 9,000	$ 410,000

Eligible Funding Sources:

The City and MSA plan to pursue funding for the project with Landowner B through the NRCS Environmental Quality Incentives Program (EQIP). NRCS EQIP is listed as an eligible funding source for Water Quality Trading programs according to Appendix B of DNR's draft *Agricultural Nonpoint Source Implementation Handbook for Adaptive Management and Water Quality Trading WPDES Permit Compliance Options* (2015). The project with Landowner B is not contingent on funding from NRCS.

Landowner C

History of Project Site:

Project site includes the animal production area of a small dairy operation and crop fields owned and operated by the landowner. The animal production area of the farm includes four (4) outdoor barnyards, each with environmental resource concerns. The existing barnyards lack roof gutters to divert clean water and appropriate infrastructure to collect or treat the runoff and manure which are currently discharged offsite. Runoff from the animal production area leaves the farmstead as erosive concentrated flow. The primary concentrated flow path is intermittent and approximately 0.6 miles in length. Concentrated flow traverses a nearby field and enters a drainage ditch which discharges directly to Searles Creek.

Nutrient management is another major concern for this site. The farm has recently expanded, but the farm lacks long-term waste storage. The lack of long-term storage has made it difficult for the landowner to comply with nutrient management requirements (e.g. tolerable soil loss and phosphorus index requirements) on the farm's crop fields. The landowner owns approximately 70 acres of cropland. Another 111 acres of cropland is rented and operated by the landowner. The landowner applies manure to another 373 acres of ground, but cropping practices on these fields are controlled by other owners/operators. It is difficult for Landowner C to find farm operators who are willing to accept manure from the farm because Landowner C does not have long term waste storage and must haul manure weekly or biweekly, and many farm operators only want to apply manure during ideal times for crop production (e.g. spring and fall). As a result, excess manure has been applied to the crop fields owned by Landowner C, and manure applications in the winter to frozen or snow covered ground have been common.

Project Location:

The animal production area of the farm is located in the Searles Creek subwatershed (HUC 070900040601) in Green County, Wisconsin. The farmstead is approximately 0.4 miles north of Searles Creek. A map of the farmstead and the facility's four outdoor barnyards are shown in **Figure 4-10**.

All crop fields owned by the landowner are located in the Searles Creek subwatershed, and are located a similar distance from Searles Creek as the farmstead. **Table 4-6** lists the acreage and location of all crop fields that Landowner C owns, rents, or applies manure. Maps of these crop fields are shown in **Figure 4-11** through **Figure 4-18**. All of these fields are currently included in Landowner C's nutrient management plan (NMP). The landowner currently rents only one field in the eligible WQT action area (Field KO). The other fields the farmer rents and has explicit control of cropping practices are not located within eligible watersheds for the WQT plan. The landowner does not explicitly control cropping practices on fields listed as "manure only." Because of the location of rented fields and the lack of control of other fields which the landowner applies manure, phosphorus credits are currently only planned to be generated on the fields which Landowner C owns. Landowner C is currently working to develop a fully compliant nutrient management plan as part of an NRCS EQIP application that will be submitted in the fall of 2018. Therefore, some changes to the fields included in the nutrient management plan will be made between the time of this submittal and the time of management practice registration in the year 2019. The changes will eliminate the current uncertainty regarding Landowner C's compliance with nutrient management standards on fields listed as "manure only."

A site walkover of Landowner C's owned and rented crop fields was completed on May 24, 2017. The purpose of the walkover was to identify existing grassed waterways and to identify areas of gully erosion in fields. Existing grassed waterways are currently installed only on crop lands owned by Landowner C. These grassed waterways appear to be preventing gully erosion in areas of concentrated flow, but these waterways were not designed or built to NRCS design standards. Therefore, no credit will be taken to lower the uncertainty factor of the trade ratio when estimating the amount of phosphorus credits generated through improved nutrient management on the fields which have existing grassed waterways. Other fields rented by Landowner C do not have existing grassed waterways, but exhibited no signs of gully erosion during the site walkover. This was likely due to the presence of perennial crops and/or relatively high amounts of crop residue on these rented fields. A more detailed evaluation of Landowner C's crop fields is included in **Appendix F** of this report. The Appendix includes pictures from the site walkover and EVAAL modeling results.

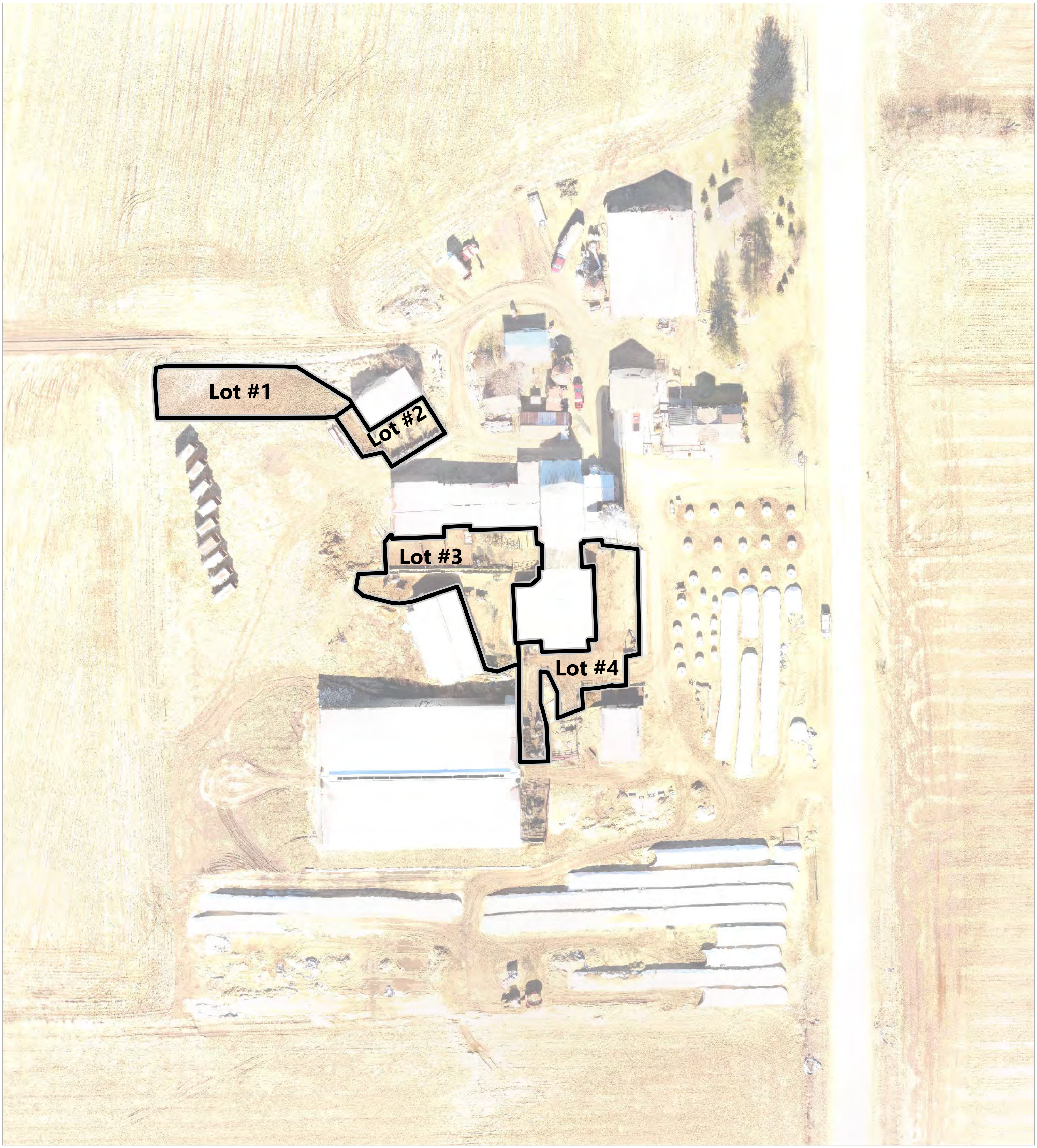

Figure 4-10
Map of barnyards operated by Landowner C

City of Brodhead
Green and Rock Counties, WI

Barnyard

Data Sources:
Basemap: MSA

0 50 100 Feet

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Table 4-6: List of all crop fields Landowner C owns, rents, and applies manure

Field ID	Acreage	HUC 12 Watershed	Management	Existing Grassed Waterways	Existing Gully Erosion
3	14.45	Searles Creek	Owned	Yes[1]	No
30	2.75	Searles Creek	Owned	Yes[1]	No
31	2.31	Searles Creek	Owned	Yes[1]	No
32.33	5.83	Searles Creek	Owned	Yes[1]	No
36	3.42	Searles Creek	Owned	Yes[1]	No
38	5.84	Searles Creek	Owned	Yes[1]	No
40	6.29	Searles Creek	Owned	Yes[1]	No
41	5.57	Searles Creek	Owned	Yes[1]	No
43	2.79	Searles Creek	Owned	Yes[1]	No
45	3.08	Searles Creek	Owned	Yes[1]	No
47	3.34	Searles Creek	Owned	Yes[1]	No
5	5.15	Searles Creek	Owned	Yes[1]	No
61-62	1.91	Searles Creek	Owned	Yes[1]	No
7.8	7.05	Searles Creek	Owned	Yes[1]	No
E1	88.90	Searles Creek	Manure Only	Not Reviewed	Not Reviewed
E2	74.20	Searles Creek	Manure Only	Not Reviewed	Not Reviewed
GA	18.80	Searles Creek	Manure Only	Not Reviewed	Not Reviewed
GO	39.00	Searles Creek	Manure Only	Not Reviewed	Not Reviewed
KL1	10.90	Searles Creek	Manure Only	Not Reviewed	Not Reviewed
KL2	22.30	Searles Creek	Manure Only	Not Reviewed	Not Reviewed
KL3	21.00	Searles Creek	Manure Only	Not Reviewed	Not Reviewed
KL4	20.40	Searles Creek	Manure Only	Not Reviewed	Not Reviewed
KL5	39.90	Searles Creek	Manure Only	Not Reviewed	Not Reviewed
KL6	37.90	Searles Creek	Manure Only	Not Reviewed	Not Reviewed
KO	22.80	Decatur Lake & Sugar Creek	Rented	No	No
SL2	7.80	Sylvester Creek	Rented	No	No
SL3	12.40	Sylvester Creek	Rented	No	No
SL	13.20	Sylvester Creek	Rented	No	No
T1	20.60	Taylor Creek	Rented	No	No
T2	18.20	Taylor Creek	Rented	No	No
T3	5.30	Taylor Creek	Rented	No	No
T4	10.70	Taylor Creek	Rented	No	No
Total	**554.08**				

[1]*Existing grassed waterways present but were not designed or constructed in accordance with NRCS standards. Although not designed to standard, no observable gully erosion was apparent when reviewed during field walkovers. Since these waterways are not designed to standard, the trade ratio uncertainty factor for these fields will currently be assumed to be not less than 3.0.*

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Figure 4-11

Map of crop fields 3-7.8 owned by Landowner C

City of Brodhead
Green and Rock Counties, WI

Data Sources:
Aerial: WROC (2010)

Grouped Parcels
FieldBoundaries
Grassed Waterway

0 290 580 Feet

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Figure 4-12

Map of crop fields E1-E2 used for manure application only by Landowner C

City of Brodhead
Green and Rock Counties, WI

Data Sources:
Aerial: WROC (2010)

Grouped Parcels

FieldBoundaries

Grassed Waterway

N

0 390 780 Feet

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Figure 4-13

Map of crop fields GA used for manure application only by Landowner C

City of Brodhead
Green and Rock Counties, WI

Data Sources:
Aerial: WROC (2010)

Grouped Parcels

FieldBoundaries

Grassed Waterway

N

0 190 380 Feet

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Figure 4-14

Map of crop fields GO used for manure application only by Landowner C

City of Brodhead
Green and Rock Counties, WI

Data Sources:
Aerial: WROC (2010)

Grouped Parcels

FieldBoundaries

Grassed Waterway

0 190 380 Feet

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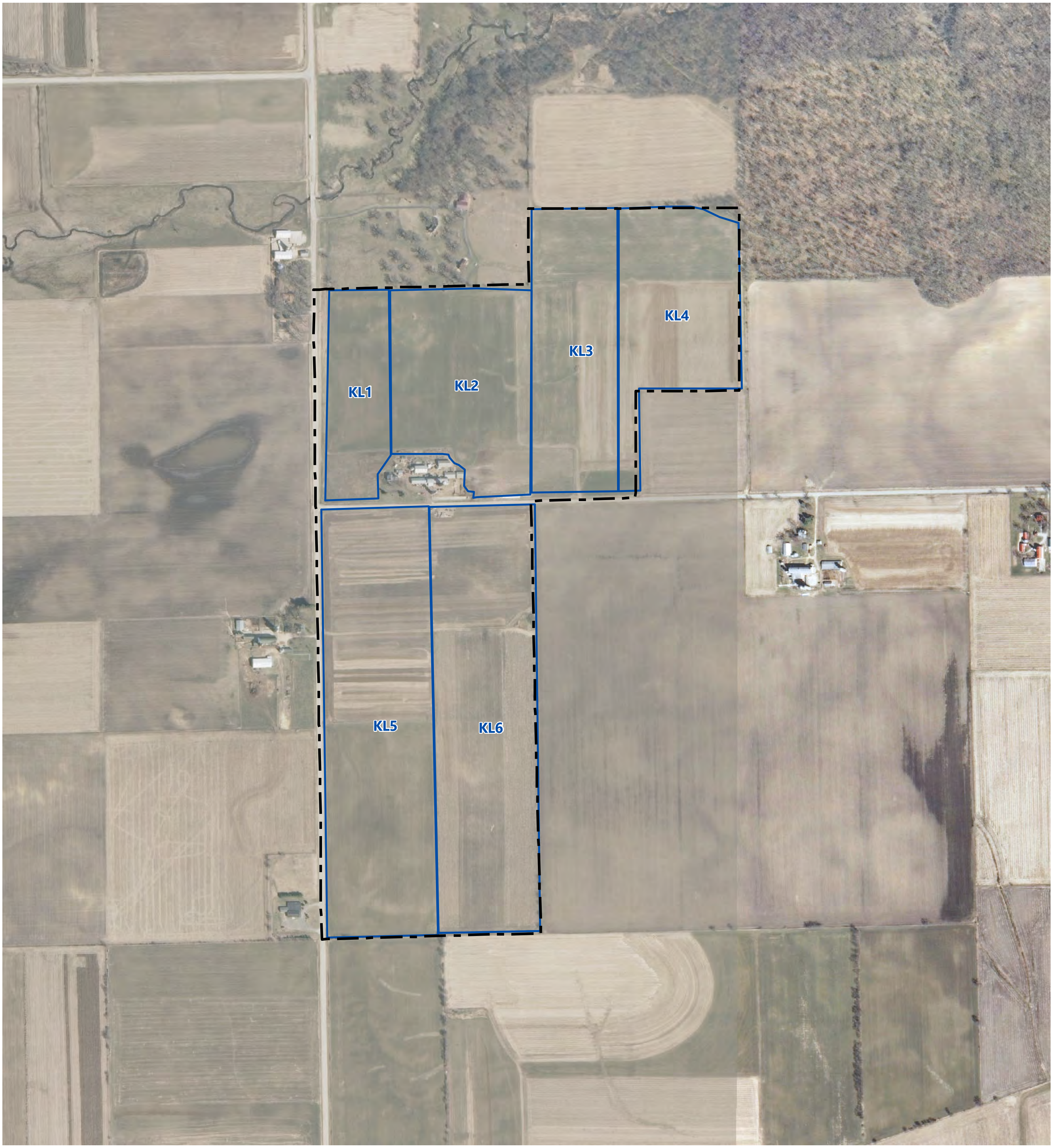

Figure 4-15

Map of crop fields KL1-KL6 used for manure application only by Landowner C

City of Brodhead
Green and Rock Counties, WI

Data Sources:
Aerial: WROC (2010)

Grouped Parcels
FieldBoundaries
Grassed Waterway

N 0 390 780 Feet

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Figure 4-16

Map of crop fields KO rented by Landowner C

City of Brodhead
Green and Rock Counties, WI

Data Sources:
Aerial: WROC (2010)

Grouped Parcels
FieldBoundaries
Grassed Waterway

0 190 380 Feet

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Figure 4-17

Map of crop fields SL-SL3 rented by Landowner C

City of Brodhead
Green and Rock Counties, WI

Data Sources:
Aerial: WROC (2010)

Grouped Parcels
FieldBoundaries
Grassed Waterway

N
0 490 980 Feet

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Figure 4-18

Map of crop fields T1-T4 rented by Landowner C

City of Brodhead
Green and Rock Counties, WI

Data Sources:
Aerial: WROC (2010)

Grouped Parcels

FieldBoundaries

Grassed Waterway

0 290 580 Feet

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Proposed BMPs:

BMPs which are planned to be implemented for this project include the following:

1. Farmstead Improvements

    - Livestock Exclusion
        i. removal of livestock and abandonment of “Lot #1”
        ii. establishment of permanent vegetative cover for “Lot #1”
        iii. establishment of a conservation easement for “Lot #1” to maintain the abandonment of “Lot #1” for the life of the project with the City of Brodhead

    - Clean Water Diversions for Outdoor Feedlots
        i. installation of roof gutters for buildings which drain to “Lot #3”
        ii. installation of a roof cover (122 ft x 116 ft) over “Lot #4” and roof gutters for buildings which drain to “Lot #4”

    - Waste Reception and Waste Transfer Piping for Outdoor Feedlots
        i. installation of a waste reception tank and waste transfer piping to collect feedlot runoff from “Lot #2” and transfer runoff to a new waste storage facility
        ii. installation of a waste reception tank and waste transfer piping to collect feedlot runoff from “Lot #3” and transfer runoff to a new waste storage facility
        iii. installation of a waste reception tank and waste transfer piping to collect manure from “Lot #4” and transfer manure to a new waste storage facility (please note this reception tank will be located inside the new roof cover for Lot #4 and will not be designed to collect runoff)

    - Waste Storage Facility
        i. installation of a concrete lined waste storage lagoon for the storage of greater than 180 days of manure, runoff, and direct precipitation
        ii. installation of permanent manure stacking pad to store solid bedded pack manure during winter months (120 days of manure storage)

2. Improved Nutrient Management of Crop Fields

    - Incorporation of reduced tillage (e.g., no-till) and cover crops to bring all crop fields Landowner C operates into compliance with tolerable soil loss and phosphorus index requirements as specified in NR 151.02 and NR 151.04.

    - Any other cropping practices Landowner C desires to implement to reduce phosphorus runoff from crop fields that can be simulated in SnapPlus.

Design Life:

Waste Storage and Barnyard Improvements: 10 to 20 years (with proper maintenance)

Nutrient Management: 1 year (nutrient management plan must be annually updated)

Applicable Standards:

- NRCS 313 - Waste Storage Facility
- NRCS 327 - Conservation Cover
- NRCS 329 - Residue and Tillage Management, No Till
- NRCS 340 - Cover Crop
- NRCS 367 - Roofs and Covers
- NRCS 558 - Roof Runoff Structure
- NRCS 590 - Nutrient Management
- NRCS 634 - Waste Transfer

Permitting Requirements:

The project will require an Animal Waste Storage Facility Permit from the Green County Land & Water Conservation Department for the construction of the proposed waste storage facility and permanent manure stacking pad. A Zoning Permit will be needed from the Green County Land Use & Zoning Department for the construction of the proposed roof cover over Lot #4. A Construction Site Storm Water Permit from the DNR will also be required.

Operation & Maintenance Plan:

Proposed items for the Operation and Maintenance Plan are listed below. Implementation of the Operation and Maintenance Plan for Landowner C will be shared by the landowner and the City of Brodhead, with the landowner responsible for normal observation (excluding annual inspections by the City), maintenance, and nutrient management planning and the City providing aid as needed for necessary maintenance and/or repairs for deteriorating or failing BMPs.

For the purposes of this Operation and Maintenance Plan, severe rainfall is defined as any 24-hour event with a cumulative precipitation in excess of 3.5 inches of rainfall (i.e., the 5-year 24-hour precipitation event based on the annual maximum time series as defined for Brodhead, WI, by NOAA Atlas 14, Volume 8, Version 2). Severe snowfall is defined as any 24-hr event with a cumulative snowfall depth in excess of 8.0 inches (i.e., the 5-year 24-hr snowfall event based on annual maximum daily snowfall data from Station USC00471078 for the years 1918 through 2017).

<u>Conditions for Waste Storage Facilities</u>:

1. Do not allow human entry into any enclosed structure without safety equipment including ladders and breathing apparatus. The American Society of Agricultural and Biological Engineers (ASABE) EP-470 standard states:

"Do not enter an under-floor (underground) covered storage or pumping station without using the proper respirator equipment. In addition, these safety practices are needed: (a) Shut off any manure pumps, (b) ventilate storage or pumping station at maximum rate, (c) test the storage or station air for O_2 level and toxic gas levels, (d) attach a safety harness and rope to the working person with at least one person standing by to help with a mechanical retrieval device, and have on hand an extra set of proper respirator equipment for the person standing by."

Fatal or serious inhalation hazards of gases including hydrogen sulfide (H_2S), carbon dioxide (CO_2), methane (CH_4), and ammonia (NH_3) may exist where manure gasses are generated through the handling of liquid or semi-solid manure through activities such as pumping, mixing, agitating, spreading, or cleaning-out.

Agitating open air manure storage facilities can be especially hazardous during high humidity and/or low wind conditions which may cause hydrogen sulfide gas to reside near the storage.

Use gas detection monitors to provide warnings of unsafe conditions.

The City of Brodhead is not responsible for any injury or loss of life as part of operation and maintenance of agricultural facilities.

2. Inspect storage facilities periodically. A thorough inspection of liners and concrete sumps, pits, walls, ramps, slats, and floors for separations and cracks, which would indicate potential failure, should be made each time the storage is emptied (minimum of once per year). Repair as needed.

3. Inspect the outlet of any artificial drainage system installed to lower a perched seasonal high water table adjacent to a waste storage facility. Monitor outlet for flow volume, odor, and color at least monthly, and 5 days after wet weather events. If flow is persistent after significant rainfall events or flow has odor and color indicative of liquid manure, block the gravity outlet and utilize a pump to remove the polluted liquids. Pump pollutants to an appropriate location (e.g., pump back to the storage structure or land apply per the nutrient management plan). Collect a grab sample and test for water quality parameters to help identify the source. After the repairs are completed and samples return negative results, the blockage may be removed.

4. Inspect pipes, pumps, manure pumps, valves, gates, etc. periodically (minimum of twice per year) to make sure they are functional, structurally sound, and not cracked, broken, and/or a safety hazard to the operator or livestock. Repair as needed.

5. Cut and remove weeds, shrubs, and trees from earthen structures. Control rodents. Mow embankments a minimum of twice per year. Good vegetative cover should be maintained on earth embankments. If vegetative cover is damaged, embankments should be re-vegetated as soon as possible. Keep machinery away from steep side slopes. Keep equipment operators informed of all potential hazards.

6. Maintain necessary safety features including proper fencing, warning signs, stop blocks, guard rails, covers, and similar items to provide warning and prevent unauthorized human or livestock entry. Repair as needed.

7. Contact the appropriate regulatory authority for approval prior to storing any off-farm waste material in a waste storage facility.

8. Additional recommendations:

   a. Hopper/Tank
      i. Avoid scraping dry or frozen manure into hopper.
      ii. Use only minimal amounts of bedding when pumps are used.
      iii. Maintain all lids, grates, and shields on openings to underground structures.

   b. Storage
      i. Begin filling facility early enough in fall to cover inlet pipe openings to avoid freezing.
      ii. Maintain the depth gauge that visually shows the following elevations: temporary bench mark (TBM), maximum operating level (MOL), and top of freeboard volume.
      iii. Begin emptying or drawdown according to the schedule in the nutrient management plan or sooner if the contents of the storage facility reach the maximum operating level (MOL).

   c. Emptying
      i. Immediately remove all foreign debris within the structure that may cause damage to pumps or agitators.
      ii. Agitate properly according to pump manufacturer's instructions.
      iii. Minimize odors by not mixing and spreading on humid days or days when wind is upwind of nearby neighbors.
      iv. Periodically remove solid accumulation on bottom of storage.

   d. Waste Utilization
      i. Manure application must comply with applicable state laws, local ordinances, and the nutrient management plan.

<u>Conditions for Waste Transfer</u>:

1. Maintain all pumps, agitators, pipes, valves, electrical, and mechanical equipment in good operating condition following the manufacturer's recommendations.

2. Make certain that all electrical equipment is properly grounded and wiring is in good working condition.

3. Maintain all safety equipment and shields on pumps, motors, electrical, and mechanical equipment.

4. All fencing, railings, grates, and/or warning signs shall be maintained to prevent unauthorized human or livestock entry.

5. Reception pits or hoppers should not be entered because they may contain noxious gases. When it becomes necessary for someone to enter a reception pit or hopper for repairs or maintenance, follow ASABE Standard 470.

6. Repair any vandalism, vehicular, or livestock damage to the system.

7. Repair spalls, cracks, and weathered areas in concrete surfaces.

8. Repair or replace rusted or damaged metal and protect with paint.

9. Operate system in a manner that minimizes odor and air drift.

10. Make sure that all valves and air vents are in place and set at the operating condition to provide protection to pipelines.

11. Maintain all screens and filters in good working condition. Repair or replace as needed.

12. Maintain the design depth of cover over pipelines.

13. Limit traffic over pipelines to designated sections that were designed for traffic loads.

14. Avoid travel by farm equipment over pipelines when the soil is saturated.

15. Avoid any subsoiling operation that may disturb pipelines.

16. Remove all foreign debris that hinders system operation.

17. Drain all system components in areas that are subject to freezing. If parts of the system cannot be drained, an anti-freeze solution shall be added. Thoroughly flush the system of anti-freeze solution before use.

18. If a pipeline is connected to a continuous flowing source, maintain flow through the pipeline to avoid freezing.

19. Repair damage to any outlets or appurtenances.

20. Inspect pipelines frequently for leaks during hot weather and repair leaks.

21. If clogging occurs in a transfer pipe, use installed cleanouts to clear any obstacles.

22. If clogging occurs, check manure pit dosing tank for debris. If dosing tank requires entrance, follow ASABE Standard 470.

<u>Conditions for Roofs and Roof Runoff Structures</u>:

1. Regularly inspect roofs and roof runoff structures, especially after severe rainfall or snowfall events.

2. Keep roofs and roof runoff structures clean and free of obstructions that reduce flow.

3. Repair or replace any damaged roofs or roof runoff structures to maintain design flow capacity of these structures.

Conditions for Conservation Easements:

1. Any land placed in a conservation easement shall remain in permanent grassed vegetation and shall not be disturbed by livestock grazing, tillage, or any other activity that would damage the vegetated cover.

2. Clip and/or mechanically harvest the vegetated area in the conservation easement, as needed, to control undesirable species and woody vegetation.

3. If fences are installed, they shall be maintained to prevent unauthorized human or livestock access to the land in the conservation easement.

Conditions for Nutrient Management Plan:

1. All crop fields which the Landowner C owns, rents, or applies nutrients must be incorporated into a nutrient management plan consistent with the NRCS 590 standard. All crop field management practices shall be documented using SnapPlus, Wisconsin's NRCS 590 nutrient management planning software. The SnapPlus database and nutrient management plan shall be annually updated to account for planned and actual cropping practices, including crop rotation, tillage practices, manure applications, commercial fertilizer applications, and other field amendments. The nutrient management plan must be approved by a Certified Crop Advisor (CCA) or similarly licensed professional and must be annually submitted to Green County Land & Water Conservation Department and the City of Brodhead for review and record keeping.

2. All fields in the nutrient management plan which Landowner C owns, rents, or otherwise control cropping practices shall have up to date soil testing completed in accordance with University of Wisconsin-Extension document *A2100 Sampling Soils for Testing*.

3. All grassed waterways and other conservation practices supporting the nutrient management plan must be implemented and maintained in accordance with applicable NRCS standards.

4. No application of manure, biosolids, or industrial wastes is allowed on snow-covered or frozen ground or on fields with high groundwater or tile drainage. Winter applications of manure on snow covered or frozen ground may be allowed but only in the case of an extreme emergency, such as the potential for overtopping the proposed waste storage facility. Temporary manure stacking in fields in accordance with the nutrient management plan and NRCS 318 standard shall be considered prior to an emergency winter application of manure to crop fields. Landowner C shall immediately notify the City of Brodhead of any emergency winter manure applications so that the City can notify the DNR of modifications to the amount of phosphorus credits generated by the City in the given crop year. Any winter manure applications, if deemed necessary, shall occur on fields which have been identified as appropriate for winter application based on the nutrient management plan and NRCS 590 standard. If any emergency winter manure applications are made to crop fields, Landowner C will be deemed ineligible for annual incentive payments for the given crop year.

Modeling Procedures:

Baseline and proposed barnyard conditions were modeled using the DNR's BARNY model. A detailed description of the modeling procedures and input and output data is presented in **Appendix E**. A total of four barnyards were modeled using BARNY. Annual edge-of-lot phosphorus loss was compared between existing baseline (pre-BMP) and post-BMP conditions to determine the amount of phosphorus reduction from the proposed barnyard improvements. The intent of the project is to construct infrastructure to attain "zero discharge" or near "zero discharge" from all the barnyards. To achieve this, Lot #1 will be abandoned, revegetated, and placed in a conservation easement; clean water diversions (roofs and/or roof gutters) will be installed for Lot #3 and Lot #4; and waste reception tanks and waste transfer piping for Lot #2, Lot #3, and Lot #4 will be installed to transfer manure and runoff to a newly constructed waste storage facility. To meet the conditions of "zero discharge" all roof runoff structures will be designed for a 25-yr 5-minute design storm as per the NRCS 558 standard and all waste reception tanks and waste transfer piping for Lots #2, #3, and #4 will be designed to store, collect, and transport runoff from the 25-yr 24-hr design storm as per the NRCS 634 standard. Only runoff from a small portion of Lot #4 (the southwest corner of Lot #4 directly east of the existing large freestall barn), where milking cows are transported from the existing freestall barn to the existing milking parlor, will not be collected after BMPs are installed. Therefore, Lots #1, #2, and #3 are planned to meet the conditions of "zero discharge" after completion of the project and only a small portion of Lot #4 is expected to go untreated.

Pre- and post-BMP edge-of-lot phosphorus losses for each barnyard are summarized in **Table 4-7**. As shown, a total of approximately 146 lb/yr of phosphorus loss could be prevented by implementing the proposed barnyard management practices.

It is important to note that phosphorus reductions shown in **Table 4-7** are only representative of the effects of abandoning lots, roofing lots or otherwise reducing lot area, and/or installing roof gutters to divert clean water. Please note that additional phosphorus loss is expected to be prevented (beyond what is stated in **Table 4-7**) by installing waste reception tanks and waste transfer piping to collect contaminated runoff to achieve "zero discharge" conditions for Lots #2 and #3. However, this additional phosphorus which is expected to be removed via runoff collection was not included in phosphorus credit calculations to provide more conservative estimates of available credits.

Table 4-7: Pre- and Post-BMP BARNY edge-of-lot phosphorus calculations

Barnyard ID	P Output Pre-BMP BARNY (lb/yr)	P Output Post-BMP BARNY (lb/yr)	P Reduction BARNY (lb/yr)	Proposed BMPs
Lot #1	22.9	0.0	22.9	Lot abandonment, critical area planting, and conservation easement
Lot #2	9.5	8.1	1.4	Reduce lot size, install waste reception tank, and install waste transfer piping
Lot #3	100.1	37.2	62.9	Reduce lot size, install roof runoff structures, install waste reception tank, and install waste transfer piping
Lot #4	63.7	4.5	59.2	Install roof cover (122' x 116'), install roof runoff structures, install waste reception tank, and install waste transfer piping
Total	**196.2**	**49.8**	**146.4**	**-**

Phosphorus reductions from improved crop land management practices were simulated using the "P Trade Report" in SnapPlus. SnapPlus modeling procedures are described in greater detail in **Appendix F**. The landowner plans to implement a combination of no-till and cover crops to reduce phosphorus losses from crop fields. **Table 4-8** summarizes estimated annual phosphorus loss reductions from the crop fields in the nutrient management plan for an 8-year crop rotation beginning in 2018 and ending in 2025. Additional years were not simulated since 8 years is already well beyond typical soil sampling requirements for nutrient management planning. Thus, the reductions in **Table 4-8** are only estimates and these estimates will need to be updated at the time of implementation of the proposed conservation practices and annually thereafter to more accurately calculate the number of phosphorus credits which are generated.

As **Table 4-8** suggests, nutrient management and supporting practices will annually reduce phosphorus losses from all the fields in the nutrient management plan by an average of approximately 479 lb/yr. Furthermore, the proposed nutrient management plan shows an overall net phosphorus reduction in each year of implementation, which suggests an overall environmental benefit to water quality.

Table 4-8: Phosphorus reductions estimated using the SnapPlus "P Trade Report"

Field ID	Phosphorus Reduction (lb/yr)								
	2018	2019	2020	2021	2022	2023	2024	2025	**Avg.**
3	65.7	70.8	72.2	73.3	74.2	75.2	77.3	78.1	**73.4**
30	-1.6	-0.9	2.6	6.4	8.9	9.9	7.5	4.1	**4.6**
31	-2.2	0.7	4.2	3.5	2.9	2.4	2.1	2.6	**2.0**
32.33	28.2	9.9	6.8	4.7	3.3	12.8	21.9	27.9	**14.4**
36	16.2	22.0	14.8	6.1	7.0	3.1	1.9	8.7	**10.0**
38	6.1	5.4	3.7	19.5	33.4	28.1	18.2	5.1	**14.9**
40	15.8	20.5	13.9	8.5	10.4	5.2	3.3	8.9	**10.8**
41	6.3	9.5	14.7	16.7	10.5	4.4	5.3	4.4	**9.0**
43	3.0	1.8	2.5	2.1	1.6	3.6	5.3	6.8	**3.3**
45	6.4	12.2	19.4	21.8	15.3	4.5	5.5	4.2	**11.2**
47	5.5	3.1	4.5	3.0	2.0	4.6	6.8	8.6	**4.8**
5	23.2	31.9	40.5	35.5	41.5	36.1	42.2	37.8	**36.1**
61-62	0.0	0.2	1.5	2.6	4.0	4.7	3.8	2.5	**2.4**
7.8	20.7	22.4	23.0	23.4	23.7	24.0	24.4	25.4	**23.4**
E1	-22.2	142.1	-198.5	110.4	-206.8	97.6	-212.7	85.3	**-25.6**
E2	11.2	244.0	-326.2	192.3	-341.2	175.4	-348.5	159.4	**-29.2**
GA	25.5	-5.5	89.1	5.3	94.3	8.2	97.3	10.2	**40.5**
GO	71.6	-34.4	212.5	-6.0	215.2	0.4	220.6	3.9	**85.5**
KL1	16.2	17.3	23.2	16.6	22.9	29.8	11.6	24.9	**20.3**
KL2	3.9	32.4	39.5	28.0	40.4	42.9	41.3	51.6	**35.0**
KL3	204.7	41.0	125.0	196.2	31.8	137.4	187.4	43.5	**120.9**
KL4	44.7	26.9	73.8	17.4	54.9	80.3	25.3	68.8	**49.0**
KL5	-11.6	-410.4	267.6	-344.2	257.8	-346.7	246.7	-314.6	**-81.9**
KL6	-17.8	117.7	-137.9	106.9	-144.3	101.0	-146.7	95.1	**-3.2**
KO	0.4	0.6	0.0	-0.6	-1.3	-1.6	-2.3	-2.9	**-1.0**
SL2	0.0	0.9	1.5	24.3	14.2	15.3	-2.3	1.3	**6.9**
SL3	20.6	-19.9	7.7	13.2	9.4	87.2	23.9	41.4	**22.9**
SL	13.2	21.7	-27.0	-8.7	-0.2	5.9	92.6	49.1	**18.3**
T1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
T2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
T3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
T4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Total	**554.0**	**383.9**	**374.3**	**577.8**	**285.9**	**651.8**	**459.7**	**541.9**	**478.7**

Trade Ratios Calculations:

Calculation for Abandonment of Barnyard Lot #1 with Conservation Easement:

$\text{Trade Ratio} = \text{Delivery} + \text{Uncertainty}$

$\text{Delivery Factor} = 0.03$ (see **Table 4-2** for Searles Creek HUC 12)

$\text{Uncertainty Factor} = 1.00$ (See **Table 4-3** for Conservation Easement)

$\text{Trade Ratio} = 0.03 + 1.00 = 1.03$ → 1.20 (minimum point to non-point trade ratio)

Calculation for Clean Water Diversions for Lot #2, Lot #3, and #4 and Roof Cover for Lot #4:

$\text{Trade Ratio} = \text{Delivery} + \text{Uncertainty}$

$\text{Delivery Factor} = 0.03$ (see **Table 4-2** for Searles Creek HUC 12)

$\text{Uncertainty Factor} = 2.00$ (See **Table 4-3** for Production Area Diversions and Production Area Roof Runoff Structures)

$\text{Trade Ratio} = 0.03 + 2.00 = 2.03$

Calculation for Nutrient Management and Supporting Practices without Grassed Waterways:

$\text{Trade Ratio} = \text{Delivery} + \text{Uncertainty}$

$\text{Delivery Factor} = 0.03$ (see **Table 4-2** for Searles Creek HUC 12)

$\text{Uncertainty Factor} = 3.00$ (See **Table 4-3** for Nutrient Management and Supporting Practice w/o Grassed Waterways)

$\text{Trade Ratio} = 0.03 + 3.00 = 3.03$

Credit Calculations:

Credit estimates for barnyard improvements are presented in **Table 4-9**. Credits were calculated with **Equation 4-1** using the phosphorus reduction estimates from **Table 4-7** and the applicable trade ratios for each lot. As shown, a total of 79.9 lb/yr of phosphorus credit could be generated by implementing BMPs to reduce phosphorus runoff from the barnyards operated by Landowner C.

Table 4-9: Phosphorus credits simulated for barnyards using BARNY

Barnyard ID	P Reduction BARNY (lb/yr)	Trade Ratio	P Credits (lb/yr)	Proposed BMPs
Lot #1	22.9	1.20	19.1	Lot abandonment, critical area planting, and conservation easement
Lot #2	1.4	2.03	0.7	Reduce lot size, install waste reception tank, and install waste transfer piping
Lot #3	62.9	2.03	31.0	Reduce lot size, install roof runoff structures, install waste reception tank, and install waste transfer piping
Lot #4	59.2	2.03	29.2	Install roof cover (122’ x 116’), install roof runoff structures, install waste reception tank, and install waste transfer piping
Total	**146.4**	**-**	**79.9**	**-**

Credit estimates for crop land improvements are presented in **Table 4-10**. As previously stated, phosphorus credits are only planned to be generated on the crop fields owned by the Landowner C since the majority of landowner’s rented fields are located in ineligible watersheds and the landowner currently does not control cropping practices for the fields which he currently only applies manure. This explains why fields which the landowner rents or only applies manure are excluded from the calculations shown in **Table 4-10**. As shown, improved nutrient management and supporting practices could potentially generate an average of 72.7 lb/yr of phosphorus credit. However, the amount of credit varies annually depending on the actual cropping practices implemented by Landowner C during each crop year.

Table 4-10: Phosphorus credits generated by implementing improved cropping practices

Field ID	Trade Ratio	Phosphorus Credits Generated (lb/yr)								
		2018	2019	2020	2021	2022	2023	2024	2025	**Avg.**
3	3.03	21.7	23.4	23.8	24.2	24.5	24.8	25.5	25.8	**24.2**
30	3.03	-0.5	-0.3	0.9	2.1	2.9	3.3	2.5	1.3	**1.5**
31	3.03	-0.7	0.2	1.4	1.1	1.0	0.8	0.7	0.9	**0.7**
32.33	3.03	9.3	3.3	2.2	1.6	1.1	4.2	7.2	9.2	**4.8**
36	3.03	5.4	7.3	4.9	2.0	2.3	1.0	0.6	2.9	**3.3**
38	3.03	2.0	1.8	1.2	6.4	11.0	9.3	6.0	1.7	**4.9**
40	3.03	5.2	6.7	4.6	2.8	3.4	1.7	1.1	2.9	**3.6**
41	3.03	2.1	3.1	4.8	5.5	3.5	1.5	1.7	1.5	**3.0**
43	3.03	1.0	0.6	0.8	0.7	0.5	1.2	1.8	2.2	**1.1**
45	3.03	2.1	4.0	6.4	7.2	5.1	1.5	1.8	1.4	**3.7**
47	3.03	1.8	1.0	1.5	1.0	0.7	1.5	2.2	2.8	**1.6**
5	3.03	7.7	10.5	13.4	11.7	13.7	11.9	13.9	12.5	**11.9**
61-62	3.03	0.0	0.1	0.5	0.9	1.3	1.6	1.3	0.8	**0.8**
7.8	3.03	6.8	7.4	7.6	7.7	7.8	7.9	8.1	8.4	**7.7**
E1	-	-	-	-	-	-	-	-	-	-
E2	-	-	-	-	-	-	-	-	-	-
GA	-	-	-	-	-	-	-	-	-	-
GO	-	-	-	-	-	-	-	-	-	-
KL1	-	-	-	-	-	-	-	-	-	-
KL2	-	-	-	-	-	-	-	-	-	-
KL3	-	-	-	-	-	-	-	-	-	-
KL4	-	-	-	-	-	-	-	-	-	-
KL5	-	-	-	-	-	-	-	-	-	-
KL6	-	-	-	-	-	-	-	-	-	-
KO	-	-	-	-	-	-	-	-	-	-
SL2	-	-	-	-	-	-	-	-	-	-
SL3	-	-	-	-	-	-	-	-	-	-
SL	-	-	-	-	-	-	-	-	-	-
T1	-	-	-	-	-	-	-	-	-	-
T2	-	-	-	-	-	-	-	-	-	-
T3	-	-	-	-	-	-	-	-	-	-
T4	-	-	-	-	-	-	-	-	-	-
Total	**3.03**	**63.8**	**69.2**	**74.0**	**74.9**	**78.7**	**72.2**	**74.5**	**74.2**	**72.7**

Estimated Cost:

The estimated costs for the City to implement the improvements for Landowner C are shown in **Table 4-11**. The City of Brodhead plans to cover 70% of all technical assistance costs and up to 70% of construction costs for barnyard improvements. Annual operation and maintenance costs include annual incentive payments for following the operation and maintenance plan and nutrient management plan as well as annual repair funds to facilitate the repair and maintenance of BMPs in the future.

Table 4-11: City's estimated Costs for implementing BMPs for Landowner C

Capital Costs	Annual O&M Costs	20-year Present Worth
$ 296,000	$ 20,000	$ 569,000

Eligible Funding Sources:

The City and MSA plan to pursue funding for the project with Landowner C through the NRCS Environmental Quality Incentives Program (EQIP). NRCS EQIP is listed as an eligible funding source for Water Quality Trading programs according to Appendix B of DNR's draft *Agricultural Nonpoint Source Implementation Handbook for Adaptive Management and Water Quality Trading WPDES Permit Compliance Options* (2015). The project with Landowner C is contingent on EQIP funding and the scale of barnyard improvements with this landowner are dependent on available funding.

4.6 Total Projected Credits

The total amount of phosphorus credits which are expected to be generated for the City of Brodhead by working with each landowner are summarized in **Table 4-12**. This table only summarizes the amount of credits which are expected to be generated throughout the first permit term of WQT. The City of Brodhead must achieve compliance with WQT prior to October 31, 2019. It is assumed that the streambank protection and habitat improvement projects for Landowners A and B will be completed by September 30, 2019. The farmstead improvements for Landowner C are also planned to be completed by September 30, 2019. Therefore, these projects are only expected to generate three months of credit in the year 2019. Phosphorus credits generated from applying conservation practices on Landowner C's crop fields are not expected to be fully implemented until the fall of 2019 after the construction of the proposed long term waste storage facility. Therefore, credits from Landowner C's crop fields are not expected to be realized until the 2020 crop year.

As shown in **Table 4-12**, 79.5 lb/yr of credit is estimated to be generated in the year 2019 and approximately 390 lb/yr of credit is estimated to be generated in the years 2020, 2021, and 2022. These values greatly exceed the expected minimum values needed for compliance with WQT. For example, only 36.6 lb/yr of credit was anticipated to be needed in the year 2019 and the long term credit goal at maximum design conditions is only 238 lb/yr. Therefore, WQT appears to be a feasible alternative to implement to comply with water quality based effluent limits for phosphorus at the City of Brodhead's WWTF.

Table 4-12: Total amount of phosphorus credits generated in Permit Term #1 of WQT

Landowner ID	Phosphorus Credits Generated (lb/yr)				
	2018	2019[1]	2020	2021	2022
Landowner A - Streambank Improvements	0.0	34.7	137.5	137.5	137.5
Landowner B - Streambank Improvements	0.0	24.8	98.2	98.2	98.2
Landowner C - Farmstead Improvements	0.0	20.1	79.9	79.9	79.9
Landowner C - Crop Field Improvements	0.0	0.0	74.0	74.9	78.7
Total	**0.0**	**79.5**	**389.6**	**390.5**	**394.3**

[1]Phosphorus credits generated in the year 2019 assume practices will be installed by September 30, 2019, and will generate only three months of credit in 2019.

It is important to note that although all the BMPs identified for each landowner in this WQT plan are not necessarily needed to comply with WQT, since excess credits appear to be available, projects with all landowners are recommended for implementation by the City of Brodhead. Additional credits could prove valuable in the event that any management practices fail due to poor management or severe weather events. Additional credits will also provide for greater operational flexibility of the Brodhead WWTF. For example, if more credits are generated than the minimum, the WWTF could potentially discharge effluent at a higher phosphorus concentration than 0.3 mg/L and the City could still comply with WQT. **Table 4-13** lists the number of credits needed for the City to comply with long term WQT goals at various average effluent total phosphorus concentrations. Based on the results in **Table 4-12** and **Table 4-13**, it may be reasonable for the City to maintain compliance with WQT if an effluent total phosphorus concentration of 0.4 mg/L is targeted.

Table 4-13: Phosphorus credits needed to comply with WQT based on effluent phosphorus concentration

Avg. Effluent TP Concentration (mg/L)	Minimum Phosphorus Credits Needed[1] (lb/yr)
0.3	238
0.4	357
0.5	476
0.6	596

[1]Assumes annual design influent flow of 0.313 MGD and a safety factor of 1.25.

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CHAPTER 5 – IMPLEMENTATION AND MONITORING REQUIREMENTS

5.1 LEGAL AGREEMENTS

The City of Brodhead is currently in the process of developing binding legal agreements with Landowner A, Landowner B, and Landowner C. All agreements will be binding for a minimum to 10 years, ideally to correspond with the first two WPDES permit terms of WQT compliance, each 5 years in length. Agreements will have a renewal clause to allow the agreements to be renewed for five years at the end of the contract term, provided BMPs are still in good condition and generating credits. Agreements will be recorded with the Green County Register of Deeds and will be transferred to new landowners in the event of ownership transition. Agreements will identify management practices which will be implemented on each landowner's property, the landowner's and the City's obligations for maintaining those management practices (e.g. operation and maintenance plans), and financial contributions from the City to pay for the implementation of the proposed practices. Legal agreements will also identify processes for repairing failing management practices. Operation and Maintenance Plans will be included in each legal agreement. The parties responsible for the implementation of the various components of the Operation and Maintenance Plan will be project specific, depending on the preference of the given landowner. In general, implementation of the Operation and Maintenance Plans will be shared by the Landowners and the City of Brodhead, with the landowners taking care of normal observation (excluding annual inspections by the City) and the City providing aid as needed in the case of deteriorating or failing BMPs.

5.2 CREDIT TRACKING

Credit tracking will be completed using a geographic information system (GIS) developed and maintained by MSA and the City of Brodhead. All BMPs which are implemented will be recorded spatially and stored in a geodatabase. This will reduce the possibility of credit calculation errors and prevent any "double" counting of credits by the City of Brodhead or another municipality. The only exception to this tracking process will be for cropland BMPs implemented as part of a nutrient management plan. In this case, all fields will be tracked using the online web site SnapMaps (http://snapmaps.snapplus.wisc.edu/) and the SnapPlus database for each cropland credit generator.

5.3 ANNUAL REVIEW PROCESS

All BMPs will be inspected periodically (a minimum of once per year) to determine if BMPs are functioning properly and to evaluate landowner compliance with operation and maintenance plan conditions. Annual inspections should occur at a time when compliance with the operation and maintenance plan can be easily established. For example, crop rotations and tillage practices can be easily identified in early summer after planting. Similarly, the establishment of cover crops can be identified in late fall. Compliance with grazing along streambank sites can be completed in summer during the grazing season, and any flood damage could likely be identified in late spring or early summer. Therefore, the number of reviews per year will be dependent on the practices which are implemented. The minimum number of inspections will be established on a case by case basis as per the legal agreement developed with each landowner.

Current draft legal agreements for all landowners specify a minimum of two planned inspections per year. Additional inspections may be triggered by severe weather events, if landowners express concerns regarding the condition of installed BMPs, or if any justified complaints are received by the City, Green County LWCD, NRCS, or DNR regarding properties engaged in a trade with the City of Brodhead.

The City or its agents will provide the findings of annual inspections to the Green County LWCD and the DNR for concurrence with findings. This will allow the Green County LWCD to track landowner compliance with NR 151 agricultural performance standards and manure management prohibitions and other applicable regulations and will allow the DNR to track the City of Brodhead's compliance with WPDES permit requirements. The findings of annual inspections will also be provided to local NRCS staff, if any of the implemented projects include contracts with NRCS.

The City acknowledges that in addition to annual reporting, the City will be required to certify on a monthly basis that nonpoint source management practices are installed and being operated/maintained in a manner consistent with applicable standards and the conditions specified in this Water Quality Trading Plan.

5.4 NR 151 Compliance Determinations

All compliance determinations with NR 151 agricultural performance standards and manure management prohibitions will be the responsibility of the Green County LWCD. All proposed practices will be reviewed by the Green County LWCD prior to implementation and the findings of annual inspections will be submitted to the Green County LWCD for concurrence with findings. This will enable the Green County LWCD to identify initial landowner compliance with NR 151 requirements and other regulations and will promote the County's ability to track future compliance with these rules.

5.5 Process for Mitigating Failing BMPs

The goal of the City and landowner partnership will be to quickly identify any failing BMPs and to repair or replace these BMPs as quickly as possible. The legal agreement with each landowner will provide processes for the City to aid the landowner in compliance with the proposed operation and maintenance plan conditions. The City will take a proactive approach to preventing failing BMPs and to repairing or replacing failing BMPs. Annual inspections will promote the possibility of identifying potential damage before a BMP fails. The City will also establish an annual equipment or BMP replacement fund to help pay for any repairs or technical services needed to maintain installed BMPs. In addition, the City plans to provide certain landowners an annual incentive payment, similar to Wisconsin's Farmland Preservation Program (https://datcp.wi.gov/Pages/Programs_Services/FarmlandPreservation.aspx), for landowner compliance with operation and maintenance plan conditoins. If any BMP is not maintained according to the operation and maintenance plan, based on the findings of annual inspections, the landowner will receive zero annual incentive payment from the City. The purpose of these incentive payments is to motivate the landowner to maintain compliance with operation and maintenance requirements and to promote the landowner's willingness to inform the City of any potentially damaged or failing BMPs.

The DNR will be notified promptly if a situation arises where a BMP is damaged or deteriorated and no longer generating the amount of credits initially intended. In the case of an extreme BMP failure which may endanger human or environmental health, the City will report noncompliance via telephone to the DNR's regional office within 24 hours. For all forms of noncompliance (extreme and minor), the City will provide a written report to the DNR Basin Engineer within 5 days after becoming aware of noncompliance, unless the DNR approves later submittal with the City's next scheduled monthly monitoring report. In any case of noncompliance, the City will provide the following:

- A description of the noncompliance and its cause
- The period of noncompliance (including exact dates and times)
- The steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance
- The length of time expected for noncompliance to continue if it has not already been corrected

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CHAPTER 6 – FINANCIAL ANALYSIS

6.1 WATER QUALITY TRADING IMPLEMENTATION COSTS

The estimated maximum amount of costs that the City of Brodhead would provide for implementing the projects recommended in this WQT are summarized in **Table 6-1**. As shown, the estimated capital cost for the City is $971,000, and the estimated total annual operation and maintenance (O&M) cost is $42,000. This results in a total 20-year present worth of approximately $1.5 million. Annual O&M costs include costs for establishing an equipment or BMP replacement fund, annual landowner incentive payments, and estimated annual inspection and reporting costs. Overall, WQT is anticipated to be significantly less costly than originally estimated in the Brodhead *Preliminary Compliance Alternatives Plan* as referenced in Section 1.5 of this report, and potentially costs could be further reduced if the City pursues funding from external sources or partners as referenced in Section 6.2. By implementing the recommendations in this plan, more credits are anticipated to be generated than required for the City to comply with WQT. Therefore, the implementation of WQT for phosphorus compliance by the City of Brodhead is expected to be a feasible and a cost-effective alternative.

Table 6-1: Estimated costs of implementing the Water Quality Trading Plan

Landowner ID	Capital Costs	Annual O&M Costs	20-year Present Worth[1]
Landowner A	$ 380,000	$ 13,000	$ 555,000
Landowner B	$ 295,000	$ 9,000	$ 410,000
Landowner C	$ 296,000	$ 20,000	$ 569,000
Total	**$ 971,000**	**$ 42,000**	**$ 1,534,000**

[1]*Assumes annual operation and maintenance is sufficient to extend the design life of BMPs up to 20 years.*

6.2 EXTERNAL FUNDING OPPORTUNITIES

Based on review of eligible financial aid programs for Water Quality Trading, the City and MSA plan to pursue funding for each landowner through the Natural Resources Conservation Service (NRCS) Environmental Quality Incentives Program (EQIP). NRCS EQIP is listed as an eligible funding source for Water Quality Trading programs according to Appendix B of DNR's draft *Agricultural Nonpoint Source Implementation Handbook for Adaptive Management and Water Quality Trading WPDES Permit Compliance Options* (2015). EQIP provides financial assistance to agricultural producers to plan and implement conservation practices that address natural resource concerns and improve soil, water, plant, animal, air, and related resources on agricultural land.

EQIP pays a specific flat rate for each eligible practice. Cost share rates are typically equivalent to 70 to 75 percent of eligible costs but may be greater or less than this target. Certain practices are only eligible for cost-share up to a maximum cost limit (e.g. riprap, waste storage, roofs and covers, etc.). Due to the scope of the projects recommended for each landowner, it is likely that the cost of some practices could exceed the maximum payment limit of EQIP. Therefore, it is unlikely that EQIP will actually provide 70 to 75 percent of the capital costs for the projects, and actual funding of total capital costs could be less than

50 percent. Therefore, even if funding is received from NRCS for the proposed projects, the City is still expected to be a major source of funding for the project.

All projects submitted to NRCS for EQIP funding are evaluated, prioritized, and ranked for funding after specified signup deadlines or “batching dates.” Signup deadlines for the EQIP program typically occur at least once every year, typically in the fall. Successful applications require the project to be “shovel ready.” Therefore, engineering plans and specifications and permits should be in hand at the time of application. Many practices also require a comprehensive nutrient management plan (CNMP) to be developed prior to the application deadline. The CNMP is an engineering and agronomic evaluation of a farm operation that identifies environmental resource concerns on the farm which could be remedied by practices funded by NRCS. Projects which receive funding from EQIP typically run 1 to 2 years in duration after the contract is approved. Because the City must comply with WQT by October 31, 2019, all projects should be submitted to NRCS in the fall of 2018 so that the projects can be completed in a timely manner prior to the final WQT compliance deadline.

Please note that the projects with Landowner A and Landowner B are not contingent on EQIP funding.

Due to the anticipated overall costs of the project with Landowner C, the size of the project is contingent on EQIP funding. Because the proposed improvements for this landowner include waste storage and waste transfer, a CNMP will be required prior to the EQIP application deadline. MSA is currently working with the landowner to develop the CNMP.

CHAPTER 7 – PROJECT IMPLEMENTATION SCHEDULE

7.1 IMPLEMENTATION SCHEDULE

The anticipated implementation schedule for this Water Quality Trading Plan is summarized in **Table 7-1**. Adherence to this schedule would allow the City of Brodhead to implement BMPs over about a 15 to 16 month period prior to the final WQT compliance deadline on October 31, 2021.

Table 7-1: Anticipated project implementation schedule

Proposed Action	Approximate Date
Submit Water Quality Trading Plan to DNR	July 31, 2017
Expiration of Brodhead's Current WDPES Permit	October 31, 2017
Submit Water Quality Trading Plan Revisions to DNR	June 11, 2018
Establishment of Trade Agreements with Landowners A, B, and C	July 31, 2018
Submit Engineering Plans, Specs, and Permits for Landowners A, B, and C to NRCS/DNR	October 31, 2018
Initiate Construction for Landowners A, B, and C	April 1, 2019
Submit Management Practice Registration Forms for Landowners A, B, and C to DNR	September 30, 2019
Achieve Compliance with Water Quality Trading	October 31, 2019

Note: Project implementation schedule subject to change based on timing of DNR approval of the Water Quality Trading Plan and reissuance of the City of Brodhead's WPDES Permit.

7.2 CASH FLOW SUMMARY FOR WQT PERMIT TERM #1

In order to accommodate the project schedule shown in **Table 7-1**, the City of Brodhead should budget expenses for the next five years as shown in the cash flow summary presented in **Table 7-2**. This cash flow summary includes anticipated capital costs and annual O&M costs. These costs assume that no funding is available from the NRCS to offset the capital costs of the projects with Landowners A and B and that NRCS EQIP funding is attained to allow for the full scope of work recommended for Landowner C.

Table 7-2: Cash flow summary for WQT Permit Term #1

Year	Capital Costs	Annual O&M Costs	Total Annual Cost
2018	$154,000	$0	$154,000
2019	$817,000	$42,000	$859,000
2020	$0	$42,000	$42,000
2021	$0	$42,000	$42,000
2022	$0	$42,000	$42,000

APPENDIX A

WPDES Permit

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WPDES PERMIT

STATE OF WISCONSIN
DEPARTMENT OF NATURAL RESOURCES

PERMIT TO DISCHARGE UNDER THE WISCONSIN POLLUTANT DISCHARGE ELIMINATION SYSTEM

CITY OF BRODHEAD

is permitted, under the authority of Chapter 283, Wisconsin Statutes, to discharge from a facility located at
1700 11th STREET, BRODHEAD, WISCONSIN
to
SUGAR RIVER – MILLRACE (LOWER SUGAR RIVER WATERSHED, SP11 – SUGAR-PECATONICA RIVER BASIN) IN GREEN COUNTY

in accordance with the effluent limitations, monitoring requirements and other conditions set forth in this permit.

The permittee shall not discharge after the date of expiration. If the permittee wishes to continue to discharge after this expiration date an application shall be filed for reissuance of this permit, according to Chapter NR 200, Wis. Adm. Code, at least 180 days prior to the expiration date given below.

State of Wisconsin Department of Natural Resources
For the Secretary

By ___________________________
Tim Ryan
Wastewater Field Supervisor

____
Date Permit Signed/Issued for Modification

PERMIT TERM: EFFECTIVE DATE - November 1, 2012 **EXPIRATION DATE - October 31, 2017**
EFFECTIVE DATE OF MODIFICATION: June 1, 2015

TABLE OF CONTENTS

1 Influent Requirements

1.1 Sampling Point(s)

Sampling Point Designation	
Sampling Point Number	**Sampling Point Location, WasteType/Sample Contents and Treatment Description (as applicable)**
701	Representative influent samples shall be collected at the headworks.

1.2 Monitoring Requirements

The permittee shall comply with the following monitoring requirements.

1.2.1 Sampling Point 701 - INFLUENT

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Continuous	Continuous	
BOD_5, Total		mg/L	3/Week	24-Hr Comp	
Suspended Solids, Total		mg/L	3/Week	24-Hr Flow Prop Comp	

2 Surface Water Requirements

2.1 Sampling Point(s)

Sampling Point Designation	
Sampling Point Number	**Sampling Point Location, WasteType/Sample Contents and Treatment Description (as applicable)**
001	Representative effluent samples shall be collected after the UV channel, prior to discharge to the Sugar River (millrace).

2.2 Monitoring Requirements and Effluent Limitations

The permittee shall comply with the following monitoring requirements and limitations.

2.2.1 Sampling Point (Outfall) 001 - EFFLUENT

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Continuous	Continuous	
BOD_5, Total	Weekly Avg	45 mg/L	3/Week	24-Hr Flow Prop Comp	
BOD_5, Total	Monthly Avg	30 mg/L	3/Week	24-Hr Flow Prop Comp	
Suspended Solids, Total	Weekly Avg	45 mg/L	3/Week	24-Hr Flow Prop Comp	
Suspended Solids, Total	Monthly Avg	30 mg/L	3/Week	24-Hr Flow Prop Comp	
Nitrogen, Ammonia (NH_3-N) Total	Daily Max	20 mg/L	3/Week	24-Hr Flow Prop Comp	Oct 1 through Apr 30
Nitrogen, Ammonia (NH_3-N) Total	Monthly Avg	19 mg/L	3/Week	24-Hr Flow Prop Comp	Apr 1 through Apr 30
Fecal Coliform	Geometric Mean	400 #/100 ml	Weekly	Grab	May 1 through Sep 30
pH Field	Daily Max	9.0 su	Daily	Grab	
pH Field	Daily Min	6.0 su	Daily	Grab	
Phosphorus, Total	Monthly Avg	1.7 mg/L	3/Week	24-Hr Flow Prop Comp	This is an interim limit. The final water quality based effluent limits are 0.1 mg/L (0.5 lbs/day) 6-month avg. & 0.3 mg/L monthly avg. that go into effect according to the Schedule at subsection 4.1. Also see subsections 2.2.1.1 through 2.2.1.3.

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Chloride		mg/L	Monthly	24-Hr Flow Prop Comp	Jan 1, 2016 - Dec 31, 2016 - Monitor Only

2.2.1.1 Phosphorus Water Quality Based Effluent Limitation(s)

The final water quality based effluent limits for phosphorus are **0.1 mg/L (0.5 lbs/day) as a six-month average and 0.3 mg/L as a monthly average** and go into effect **October 31, 2021** unless:

(A) As part of the application for the next reissuance, or prior to filing the application, the permittee submits either: 1.) a watershed adaptive management plan and a completed Watershed Adaptive Management Request Form 3200-139; or 2.) an application for water quality trading; or 3.) an application for a variance; or 4.) new information or additional data that supports a recalculation of the numeric limitation; and

(B) The Department modifies, revokes and reissues, or reissues the permit to incorporate a revised limitation before the expiration of the compliance schedule*.

Note: The permittee may also submit an application for a variance within 60 days of this permit reissuance, as noted in the permit cover letter, in accordance with s. 283.15, Stats.

If Adaptive Management or Water Quality Trading is approved as part of the permit application for the next reissuance or as part of an application for a modification or revocation and reissuance, the plan and specifications submittal, construction, and final effective dates for compliance with the total phosphorus WQBEL may change in the reissued or modified permit. In addition, the numeric value of the water quality based effluent limit may change based on new information (e.g. a TMDL) or additional data. If a variance is approved for the next reissuance, interim limits and conditions will be imposed in the reissued permit in accordance with s. 283.15, Stats., and applicable regulations. A permittee may apply for a variance to the phosphorus WQBEL at the next reissuance even if the permittee did not apply for a phosphorus variance as part of this permit reissuance.

Additional Requirements: If a water quality based effluent limit has taken effect in a permit, any increase in the limit is subject to s. NR 102.05(1) and ch. NR 207, Wis. Adm. Code. When a six-month average effluent limit is specified for Total Phosphorus the applicable averaging periods are May through October and November through April.

*Note: The Department will prioritize reissuances and revocations, modifications, and reissuances of permits to allow permittees the opportunity to implement adaptive management or nutrient trading in a timely and effective manner.

2.2.1.2 Alternative Approaches to Phosphorus WQBEL Compliance

Rather than upgrading its wastewater treatment facility to comply with WQBELs for total phosphorus, the permittee may use Water Quality Trading or the Watershed Adaptive Management Option, to achieve compliance under ch. NR 217, Wis. Adm. Code, provided that the permit is modified, revoked and reissued, or reissued to incorporate any such alternative approach. The permittee may also implement an upgrade to its wastewater treatment facility in combination with Water Quality Trading or the Watershed Adaptive Management Option to achieve compliance, provided that the permit is modified, revoked and reissued, or reissued to incorporate any such alternative approach. If the Final Compliance Alternatives Plan concludes that a variance will be pursued, the Plan shall provide information regarding the basis for the variance.

2.2.1.3 Submittal of Permit Application for Next Reissuance and Adaptive Management or Pollutant Trading Plan or Variance Application

The permittee shall submit the permit application for the next reissuance at least 6 months prior to expiration of this permit. If the permittee intends to pursue adaptive management to achieve compliance with the phosphorus water quality based effluent limitation, the permittee shall submit with the application for the next reissuance: a completed

Watershed Adaptive Management Request Form 3200-139, the completed Adaptive Management Plan and final plans for any system upgrades necessary to meet interim limits pursuant to s. NR 217.18, Wis. Adm. Code. If the permittee intends to pursue pollutant trading to achieve compliance, the permittee shall submit an application for water quality trading with the application for the next reissuance. If system upgrades will be used in combination with pollutant trading to achieve compliance with the final water quality-based limit, the reissued permit will specify a schedule for the necessary upgrades. If the permittee intends to seek a variance, the permittee shall submit an application for a variance with the application for the next reissuance.

3 Land Application Requirements

3.1 Sampling Point(s)

The discharge(s) shall be limited to land application of the waste type(s) designated for the listed sampling point(s) on Department approved land spreading sites or by hauling to another facility.

Sampling Point Designation	
Sampling Point Number	**Sampling Point Location, WasteType/Sample Contents and Treatment Description (as applicable)**
002	Aerobically digested, Liquid, Class B. Representative sludge samples shall be collected from the sludge storage tank.

3.2 Monitoring Requirements and Limitations

The permittee shall comply with the following monitoring requirements and limitations.

3.2.1 Sampling Point (Outfall) 002 - SLUDGE

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Radium 226 Dry Wt		pCi/g	Annual	Composite	
Solids, Total		Percent	Annual	Composite	
Arsenic Dry Wt	Ceiling	75 mg/kg	Annual	Composite	
Arsenic Dry Wt	High Quality	41 mg/kg	Annual	Composite	
Cadmium Dry Wt	Ceiling	85 mg/kg	Annual	Composite	
Cadmium Dry Wt	High Quality	39 mg/kg	Annual	Composite	
Copper Dry Wt	Ceiling	4,300 mg/kg	Annual	Composite	
Copper Dry Wt	High Quality	1,500 mg/kg	Annual	Composite	
Lead Dry Wt	Ceiling	840 mg/kg	Annual	Composite	
Lead Dry Wt	High Quality	300 mg/kg	Annual	Composite	
Mercury Dry Wt	Ceiling	57 mg/kg	Annual	Composite	
Mercury Dry Wt	High Quality	17 mg/kg	Annual	Composite	
Molybdenum Dry Wt	Ceiling	75 mg/kg	Annual	Composite	
Nickel Dry Wt	Ceiling	420 mg/kg	Annual	Composite	
Nickel Dry Wt	High Quality	420 mg/kg	Annual	Composite	
Selenium Dry Wt	Ceiling	100 mg/kg	Annual	Composite	
Selenium Dry Wt	High Quality	100 mg/kg	Annual	Composite	
Zinc Dry Wt	Ceiling	7,500 mg/kg	Annual	Composite	
Zinc Dry Wt	High Quality	2,800 mg/kg	Annual	Composite	
Nitrogen, Total Kjeldahl		Percent	Annual	Composite	
Nitrogen, Ammonium (NH_4-N) Total		Percent	Annual	Composite	
Phosphorus, Total		Percent	Annual	Composite	

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Phosphorus, Water Extractable		% of Tot P	Annual	Composite	
Potassium, Total Recoverable		Percent	Annual	Composite	

Other Sludge Requirements	
Sludge Requirements	**Sample Frequency**
List 3 Requirements – Pathogen Control: The requirements in List 3 shall be met prior to land application of sludge.	**Annual**
List 4 Requirements – Vector Attraction Reduction: The vector attraction reduction shall be satisfied prior to, or at the time of land application as specified in List 4.	**Annual**

3.2.1.1 Municipal Land Application Management Plan

If the permittee proposes to land apply sludge, a management plan shall be submitted for approval by the Department. The management plan shall be consistent with the requirements of this permit, and ss. NR 204.07 and NR 204.11, Wis. Code. At a minimum, the plan shall include adequate documentation to support proposed sites and landspreading rates. A description of how the sludge will be land applied and incorporated shall be included. Record keeping and tracking of site loadings shall also be described. Until the plan has been approved by the Department, no landspreading may occur. Applicable Department forms shall be included. Requests for landspreading site approvals shall also be included. Contact the Department for a plan outline.

3.2.1.2 List 2 Analysis

If the monitoring frequency for List 2 parameters is more frequent than "Annual" then the sludge may be analyzed for the List 2 parameters just prior to each land application season rather than at the more frequent interval specified.

3.2.1.3 Changes in Feed Sludge Characteristics

If a change in feed sludge characteristics, treatment process, or operational procedures occurs which may result in a significant shift in sludge characteristics, the permittee shall reanalyze the sludge for List 1, 2, 3 and 4 parameters each time such change occurs.

3.2.1.4 Multiple Sludge Sample Points (Outfalls)

If there are multiple sludge sample points (outfalls), but the sludges are not subject to different sludge treatment processes, then a separate List 2 analysis shall be conducted for each sludge type which is land applied, just prior to land application, and the application rate shall be calculated for each sludge type. In this case, List 1, 3, and 4 and PCBs need only be analyzed on a single sludge type, at the specified frequency. If there are multiple sludge sample points (outfalls), due to multiple treatment processes, List 1, 2, 3 and 4 and PCBs shall be analyzed for each sludge type at the specified frequency.

3.2.1.5 Sludge Which Exceeds the High Quality Limit

Cumulative pollutant loading records shall be kept for all bulk land application of sludge which does not meet the high quality limit for any parameter. This requirement applies for the entire calendar year in which any exceedance of

Table 3 of s. NR 204.07(5)(c), is experienced. Such loading records shall be kept for all List 1 parameters for each site land applied in that calendar year. The formula to be used for calculating cumulative loading is as follows:

[(Pollutant concentration (mg/kg) x dry tons applied/ac) ÷ 500] + previous loading (lbs/acre) = cumulative lbs pollutant per acre

When a site reaches 90% of the allowable cumulative loading for any metal established in Table 2 of s. NR 204.07(5)(b), the Department shall be so notified through letter or in the comment section of the annual land application report (3400-55).

3.2.1.6 Adm. Lists 1, 2, 3, and 4

List 1 **TOTAL SOLIDS AND METALS** See the Monitoring Requirements and Limitations table above for monitoring frequency and limitations for the List 1 parameters
Solids, Total (percent)
Arsenic, mg/kg (dry weight)
Cadmium, mg/kg (dry weight)
Copper, mg/kg (dry weight)
Lead, mg/kg (dry weight)
Mercury, mg/kg (dry weight)
Molybdenum, mg/kg (dry weight)
Nickel, mg/kg (dry weight)
Selenium, mg/kg (dry weight)
Zinc, mg/kg (dry weight)

List 2 **NUTRIENTS** See the Monitoring Requirements and Limitations table above for monitoring frequency for the List 2 parameters
Solids, Total (percent)
Nitrogen Total Kjeldahl (percent)
Nitrogen Ammonium (NH4-N) Total (percent)
Phosphorus Total as P (percent)
Phosphorus, Water Extractable (as percent of Total P)
Potassium Total Recoverable (percent)

List 3
PATHOGEN CONTROL FOR CLASS B SLUDGE

The permittee shall implement pathogen control as listed in List 3. The Department shall be notified of the pathogen control utilized and shall be notified when the permittee decides to utilize alternative pathogen control.

The following requirements shall be met prior to land application of sludge.

Parameter	Unit	Limit
Fecal Coliform*	MPN/gTS or CFU/gTS	2,000,000
OR, ONE OF THE FOLLOWING PROCESS OPTIONS		
Aerobic Digestion	Air Drying	
Anaerobic Digestion	Composting	
Alkaline Stabilization	PSRP Equivalent Process	

***** The Fecal Coliform limit shall be reported as the geometric mean of 7 discrete samples on a dry weight basis.

List 4
VECTOR ATTRACTION REDUCTION

The permittee shall implement any one of the vector attraction reduction options specified in List 4. The Department shall be notified of the option utilized and shall be notified when the permittee decides to utilize an alternative option.

One of the following shall be satisfied prior to, or at the time of land application as specified in List 4.

Option	Limit	Where/When it Shall be Met
Volatile Solids Reduction	≥38%	Across the process
Specific Oxygen Uptake Rate	≤1.5 mg O_2/hr/g TS	On aerobic stabilized sludge
Anaerobic bench-scale test	<17 % VS reduction	On anaerobic digested sludge
Aerobic bench-scale test	<15 % VS reduction	On aerobic digested sludge
Aerobic Process	>14 days, Temp >40°C and Avg. Temp > 45°C	On composted sludge
pH adjustment	>12 S.U. (for 2 hours) and >11.5 (for an additional 22 hours)	During the process
Drying without primary solids	>75 % TS	When applied or bagged
Drying with primary solids	>90 % TS	When applied or bagged
Equivalent Process	Approved by the Department	Varies with process
Injection	-	When applied
Incorporation	-	Within 6 hours of application

3.2.1.7 Daily Land Application Log

Daily Land Application Log		
Discharge Monitoring Requirements and Limitations The permittee shall maintain a daily land application log for biosolids land applied each day when land application occurs. The following minimum records must be kept, in addition to all analytical results for the biosolids land applied. The log book records shall form the basis for the annual land application report requirements**.**		
Parameters	**Units**	**Sample Frequency**
DNR Site Number(s)	Number	Daily as used
Outfall number applied	Number	Daily as used
Acres applied	Acres	Daily as used
Amount applied	As appropriate * /day	Daily as used
Application rate per acre	unit */acre	Daily as used
Nitrogen applied per acre	lb/acre	Daily as used
Method of Application	Injection, Incorporation, or surface applied	Daily as used

*gallons, cubic yards, dry US Tons or dry Metric Tons

4 Schedules

4.1 Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus

The permittee shall comply with the WQBELs for Phosphorus as specified. No later than 30 days following each compliance date, the permittee shall notify the Department in writing of its compliance or noncompliance. If a submittal is required, a timely submittal fulfills the notification requirement.

Required Action	Due Date
Preliminary Compliance Alternatives Plan: The permittee shall submit a preliminary compliance alternatives plan to the Department. If the plan concludes upgrading of the permittee's wastewater treatment facility is necessary to achieve final phosphorus WQBELs, the submittal shall include a preliminary engineering design report. If the plan concludes Adaptive Management will be used, the submittal shall include a completed Watershed Adaptive Management Request Form 3200-139 without the Adaptive Management Plan. If water quality trading will be undertaken, the plan must state that trading will be pursued.	10/31/2015
Final Compliance Alternatives Plan: The permittee shall submit a final compliance alternatives plan to the Department. If the plan concludes upgrading of the permittee's wastewater treatment is necessary to meet final phosphorus WQBELs, the submittal shall include a final engineering design report addressing the treatment plant upgrades, and a facility plan if required pursuant to ch. NR 110, Wis. Adm. Code. If the plan concludes Adaptive Management will be implemented, the submittal shall include a completed Watershed Adaptive Management Request Form 3200-139 and an engineering report addressing any treatment system upgrades necessary to meet interim limits pursuant to s. NR 217.18, Wis. Adm. Code. If the plan concludes water quality trading will be used, the submittal shall identify potential trading partners. Note: See 'Alternative Approaches to Phosphorus WQBEL Compliance' in the Surface Water section of this permit.	10/31/2016
Progress Report on Plans & Specifications: Submit progress report regarding the progress of preparing final plans and specifications. Note: See 'Alternative Approaches to Phosphorus WQBEL Compliance' in the Surface Water section of this permit.	10/31/2017
Final Plans and Specifications: Unless the permit has been modified, revoked and reissued, or reissued to include Adaptive Management or Water Quality Trading measures or to include a revised schedule based on factors in s. NR 217.17, Wis. Adm. Code, the permittee shall submit final construction plans to the Department for approval pursuant to s. 281.41, Stats., specifying treatment plant upgrades that must be constructed to achieve compliance with final phosphorus WQBELs, and a schedule for completing construction of the upgrades by the complete construction date specified below. (Note: Permit modification, revocation and reissuance, and reissuance are subject to s. 283.53(2), Stats.) Note: See 'Alternative Approaches to Phosphorus WQBEL Compliance' in the Surface Water section of this permit.	10/31/2018
Treatment Plant Upgrade to Meet WQBELs: The permittee shall initiate construction of the upgrades. The permittee shall obtain approval of the final construction plans and schedule from the	03/31/2019

Department pursuant to s. 281.41. Stats. Upon approval of the final construction plans and schedule by the Department pursuant to s. 281.41, Stats., the permittee shall construct the treatment plant upgrades in accordance with the approved plans and specifications. Note: See 'Alternative Approaches to Phosphorus WQBEL Compliance' in the Surface Water section of this permit.	
Construction Upgrade Progress Report #1: The permittee shall submit a progress report on construction upgrades. Note: See 'Alternative Approaches to Phosphorus WQBEL Compliance' in the Surface Water section of this permit.	03/31/2020
Construction Upgrade Progress Report #2: The permittee shall submit a progress report on construction upgrades. Note: See 'Alternative Approaches to Phosphorus WQBEL Compliance' in the Surface Water section of this permit.	03/31/2021
Complete Construction: The permittee shall complete construction of wastewater treatment system upgrades. Note: See 'Alternative Approaches to Phosphorus WQBEL Compliance' in the Surface Water section of this permit.	09/30/2021
Achieve Compliance: The permittee shall achieve compliance with final phosphorus WQBELs. Note: See 'Alternative Approaches to Phosphorus WQBEL Compliance' in the Surface Water section of this permit.	10/31/2021

1 Standard Requirements

NR 205, Wisconsin Administrative Code: The conditions in ss. NR 205.07(1) and NR 205.07(2), Wis. Adm. Code, are included by reference in this permit. The permittee shall comply with all of these requirements. Some of these requirements are outlined in the Standard Requirements section of this permit. Requirements not specifically outlined in the Standard Requirement section of this permit can be found in ss. NR 205.07(1) and NR 205.07(2).

1.1 Reporting and Monitoring Requirements

1.1.1 Monitoring Results

Monitoring results obtained during the previous month shall be summarized and reported on a Department Wastewater Discharge Monitoring Report. The report may require reporting of any or all of the information specified below under 'Recording of Results'. This report is to be returned to the Department no later than the date indicated on the form. A copy of the Wastewater Discharge Monitoring Report Form or an electronic file of the report shall be retained by the permittee.

Monitoring results shall be reported on an electronic discharge monitoring report (eDMR) or in a form approved by the department for reporting results of monitoring of sludge use or disposal practices.

If the permittee monitors any pollutant more frequently than required by this permit, the results of such monitoring shall be included on the Wastewater Discharge Monitoring Report.

The permittee shall comply with all limits for each parameter regardless of monitoring frequency. For example, monthly, weekly, and/or daily limits shall be met even with monthly monitoring. The permittee may monitor more frequently than required for any parameter.

An Electronic Discharge Monitoring Report Certification sheet shall be signed and submitted with each electronic Discharge Monitoring Report submittal. This certification sheet, which is not part of the electronic report form, shall be signed by a principal executive officer, a ranking elected official or other duly authorized representative and shall be mailed to the Department at the time of submittal of the electronic Discharge Monitoring Report. The certification sheet certifies that the electronic report form is true, accurate and complete.

1.1.2 Sampling and Testing Procedures

Sampling and laboratory testing procedures shall be performed in accordance with Chapters NR 218 and NR 219, Wis. Adm. Code and shall be performed by a laboratory certified or registered in accordance with the requirements of ch. NR 149, Wis. Adm. Code. Groundwater sample collection and analysis shall be performed in accordance with ch. NR 140, Wis. Adm. Code. The analytical methodologies used shall enable the laboratory to quantitate all substances for which monitoring is required at levels below the effluent limitation. If the required level cannot be met by any of the methods available in NR 219, Wis. Adm. Code, then the method with the lowest limit of detection shall be selected. Additional test procedures may be specified in this permit.

1.1.3 Recording of Results

The permittee shall maintain records which provide the following information for each effluent measurement or sample taken:

- the date, exact place, method and time of sampling or measurements;
- the individual who performed the sampling or measurements;
- the date the analysis was performed;
- the individual who performed the analysis;
- the analytical techniques or methods used; and
- the results of the analysis.

1.1.4 Reporting of Monitoring Results

The permittee shall use the following conventions when reporting effluent monitoring results:

- Pollutant concentrations less than the limit of detection shall be reported as < (less than) the value of the limit of detection. For example, if a substance is not detected at a detection limit of 0.1 mg/L, report the pollutant concentration as < 0.1 mg/L.

- Pollutant concentrations equal to or greater than the limit of detection, but less than the limit of quantitation, shall be reported and the limit of quantitation shall be specified.

- For purposes of calculating NR 101 fees, the 2 mg/l lower reporting limits for BOD_5 and Total Suspended Solids shall be considered to be limits of quantitation

- For the purposes of reporting a calculated result, average or a mass discharge value, the permittee may substitute a 0 (zero) for any pollutant concentration that is less than the limit of detection. However, if the effluent limitation is less than the limit of detection, the department may substitute a value other than zero for results less than the limit of detection, after considering the number of monitoring results that are greater than the limit of detection and if warranted when applying appropriate statistical techniques.

1.1.5 Compliance Maintenance Annual Reports

Compliance Maintenance Annual Reports (CMAR) shall be completed using information obtained over each calendar year regarding the wastewater conveyance and treatment system. The CMAR shall be submitted by the permittee in accordance with ch. NR 208, Wis. Adm. Code, by June 30, each year on an electronic report form provided by the Department.

In the case of a publicly owned treatment works, a resolution shall be passed by the governing body and submitted as part of the CMAR, verifying its review of the report and providing responses as required. Private owners of wastewater treatment works are not required to pass a resolution; but they must provide an Owner Statement and responses as required, as part of the CMAR submittal.

A separate CMAR certification document, that is not part of the electronic report form, shall be mailed to the Department at the time of electronic submittal of the CMAR. The CMAR certification shall be signed and submitted by an authorized representative of the permittee. The certification shall be submitted by mail. The certification shall verify the electronic report is complete, accurate and contains information from the owner's treatment works.

1.1.6 Records Retention

The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by the permit, and records of all data used to complete the application for the permit for a period of at least 3 years from the date of the sample, measurement, report or application. All pertinent sludge information, including permit application information and other documents specified in this permit or s. NR 204.06(9), Wis. Adm. Code shall be retained for a minimum of 5 years.

1.1.7 Other Information

Where the permittee becomes aware that it failed to submit any relevant facts in a permit application or submitted incorrect information in a permit application or in any report to the Department, it shall promptly submit such facts or correct information to the Department.

1.2 System Operating Requirements

1.2.1 Noncompliance Notification

- The permittee shall report the following types of noncompliance by a telephone call to the Department's regional office within 24 hours after becoming aware of the noncompliance:
  - any noncompliance which may endanger health or the environment;
  - any violation of an effluent limitation resulting from an unanticipated bypass;
  - any violation of an effluent limitation resulting from an upset; and
  - any violation of a maximum discharge limitation for any of the pollutants listed by the Department in the permit, either for effluent or sludge.

- A written report describing the noncompliance shall also be submitted to the Department's regional office within 5 days after the permittee becomes aware of the noncompliance. On a case-by-case basis, the Department may waive the requirement for submittal of a written report within 5 days and instruct the permittee to submit the written report with the next regularly scheduled monitoring report. In either case, the written report shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times; the steps taken or planned to reduce, eliminate and prevent reoccurrence of the noncompliance; and if the noncompliance has not been corrected, the length of time it is expected to continue.

NOTE: Section 292.11(2)(a), Wisconsin Statutes, requires any person who possesses or controls a hazardous substance or who causes the discharge of a hazardous substance to notify the Department of Natural Resources **immediately** of any discharge not authorized by the permit. The discharge of a hazardous substance that is not authorized by this permit or that violates this permit may be a hazardous substance spill. To report a hazardous substance spill, call DNR's 24-hour HOTLINE at **1-800-943-0003**

1.2.2 Flow Meters

Flow meters shall be calibrated annually, as per s. NR 218.06, Wis. Adm. Code.

1.2.3 Raw Grit and Screenings

All raw grit and screenings shall be disposed of at a properly licensed solid waste facility or picked up by a licensed waste hauler. If the facility or hauler are located in Wisconsin, then they shall be licensed under chs. NR 500-536, Wis. Adm. Code.

1.2.4 Sludge Management

All sludge management activities shall be conducted in compliance with ch. NR 204 "Domestic Sewage Sludge Management", Wis. Adm. Code.

1.2.5 Prohibited Wastes

Under no circumstances may the introduction of wastes prohibited by s. NR 211.10, Wis. Adm. Code, be allowed into the waste treatment system. Prohibited wastes include those:

- which create a fire or explosion hazard in the treatment work;
- which will cause corrosive structural damage to the treatment work;
- solid or viscous substances in amounts which cause obstructions to the flow in sewers or interference with the proper operation of the treatment work;
- wastewaters at a flow rate or pollutant loading which are excessive over relatively short time periods so as to cause a loss of treatment efficiency; and
- changes in discharge volume or composition from contributing industries which overload the treatment works or cause a loss of treatment efficiency.

1.2.6 Unscheduled Bypassing

Any unscheduled bypass or overflow of wastewater at the treatment works or from the collection system is prohibited, and the Department may take enforcement action against a permittee for such occurrences under s. 283.89, Wis. Stats., unless all of the following occur:

- The bypass was unavoidable to prevent loss of life, personal injury, or severe property damage.
- There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance.
- The permittee notifies the department of the unscheduled bypass or overflow. The permittee shall notify the department <u>within 24 hours</u> of initiation of the bypass or overflow occurrence by telephone, voicemail, fax or e-mail. <u>Within 5 days</u> of conclusion of the bypass or overflow occurrence, the permittee shall submit to the department in writing, all of the following information:
  - Reason the bypass or overflow occurred, or explanation of other contributing circumstances that resulted in the overflow event. If the overflow or bypass is associated with wet weather, provide data on the amount and duration of the rainfall or snow melt for each separate event.
  - Date the bypass or overflow occurred.
  - Location where the bypass or overflow occurred.
  - Duration of the bypass or overflow and estimated wastewater volume discharged.
  - Steps taken or the proposed corrective action planned to prevent similar future occurrences.
  - Any other information the permittee believes is relevant.

1.2.7 Scheduled Bypassing

Any construction or normal maintenance which results in a bypass of wastewater is prohibited unless authorized by the Department in writing. If the Department determines that there is significant public interest in the proposed action, the Department may schedule a public hearing or notice a proposal to approve the bypass. Each request shall specify the following minimum information:

- Proposed date of bypass.
- Estimated duration of the bypass.
- Alternatives to bypassing.
- Measures to mitigate environmental harm caused by the bypass.
- Estimated volume of the bypass.

1.2.8 Proper Operation and Maintenance

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control which are installed or used by the permittee to achieve compliance with the conditions of this permit. The wastewater treatment facility shall be under the direct supervision of a state certified operator as required in s. NR 108.06(2), Wis. Adm. Code. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training as required in ch. NR 114, Wis. Adm. Code, and adequate laboratory and process controls, including appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems only when necessary to achieve compliance with the conditions of the permit.

1.3 Surface Water Requirements

1.3.1 Permittee-Determined Limit of Quantitation Incorporated into this Permit

For pollutants with water quality-based effluent limits below the Limit of Quantitation (LOQ) in this permit, the LOQ calculated by the permittee and reported on the Discharge Monitoring Reports (DMRs) is incorporated by reference into this permit. The LOQ shall be reported on the DMRs, shall be the lowest quantifiable level practicable, and shall be no greater than the minimum level (ML) specified in or approved under 40 CFR Part 136 for the pollutant at the time this permit was issued, unless this permit specifies a higher LOQ.

1.3.2 Appropriate Formulas for Effluent Calculations

The permittee shall use the following formulas for calculating effluent results to determine compliance with average concentration limits and mass limits and total load limits:

Weekly/Monthly/Six-Month/Annual Average Concentration = the sum of all daily results for that week/month/six-month/year, divided by the number of results during that time period. [Note: When a six-month average effluent limit is specified for Total Phosphorus the applicable periods are May through October and November through April.]

Weekly Average Mass Discharge (lbs/day): Daily mass = daily concentration (mg/L) x daily flow (MGD) x 8.34, then average the daily mass values for the week.

Monthly Average Mass Discharge (lbs/day): Daily mass = daily concentration (mg/L) x daily flow (MGD) x 8.34, then average the daily mass values for the month.

Six-Month Average Mass Discharge (lbs/day): Daily mass = daily concentration (mg/L) x daily flow (MGD) x 8.34, then average the daily mass values for the six-month period. [Note: When a six-month average effluent limit is specified for Total Phosphorus the applicable periods are May through October and November through April.]

Annual Average Mass Discharge (lbs/day): Daily mass = daily concentration (mg/L) x daily flow (MGD) x 8.34, then average the daily mass values for the entire year.

Total Monthly Discharge: = monthly average concentration (mg/L) x total flow for the month (MG/month) x 8.34.

Total Annual Discharge: = sum of total monthly discharges for the calendar year.

1.3.3 Effluent Temperature Requirements

Weekly Average Temperature – The permittee shall use the following formula for calculating effluent results to determine compliance with the weekly average temperature limit (as applicable): Weekly Average Temperature = the sum of all daily maximum results for that week divided by the number of daily maximum results during that time period.

Cold Shock Standard – Water temperatures of the discharge shall be controlled in a manner as to protect fish and aquatic life uses from the deleterious effects of cold shock. ‘Cold Shock’ means exposure of aquatic organisms to a rapid decrease in temperature and a sustained exposure to low temperature that induces abnormal behavior or physiological performance and may lead to death.

Rate of Temperature Change Standard – Temperature of a water of the state or discharge to a water of the state may not be artificially raised or lowered at such a rate that it causes detrimental health or reproductive effects to fish or aquatic life of the water of the state.

1.3.4 Visible Foam or Floating Solids

There shall be no discharge of floating solids or visible foam in other than trace amounts.

1.3.5 Percent Removal

During any 30 consecutive days, the average effluent concentrations of BOD_5 and of total suspended solids shall not exceed 15% of the average influent concentrations, respectively. This requirement does not apply to removal of total suspended solids if the permittee operates a lagoon system and has received a variance for suspended solids granted under NR 210.07(2), Wis. Adm. Code.

1.3.6 Seasonal Disinfection

Disinfection shall be provided from May 1 through September 30 of each year. Monitoring requirements and the limitation for fecal coliforms apply only during the period in which disinfection is required. Whenever chlorine is used for disinfection or other uses, the limitations and monitoring requirements for residual chlorine shall apply. A dechlorination process shall be in operation whenever chlorine is used.

1.4 Land Application Requirements

1.4.1 Sludge Management Program Standards And Requirements Based Upon Federally Promulgated Regulations

In the event that new federal sludge standards or regulations are promulgated, the permittee shall comply with the new sludge requirements by the dates established in the regulations, if required by federal law, even if the permit has not yet been modified to incorporate the new federal regulations.

1.4.2 General Sludge Management Information

The General Sludge Management Form 3400-48 shall be completed and submitted prior to any significant sludge management changes.

1.4.3 Sludge Samples

All sludge samples shall be collected at a point and in a manner which will yield sample results which are representative of the sludge being tested, and collected at the time which is appropriate for the specific test.

1.4.4 Land Application Characteristic Report

Each report shall consist of a Characteristic Form 3400-49 and Lab Report, unless approval for not submitting the lab reports has been given. Both reports shall be submitted by January 31 following each year of analysis.

The permittee shall use the following convention when reporting sludge monitoring results: Pollutant concentrations less than the limit of detection shall be reported as < (less than) the value of the limit of detection. For example, if a substance is not detected at a detection limit of 1.0 mg/kg, report the pollutant concentration as < 1.0 mg/kg .

All results shall be reported on a dry weight basis.

1.4.5 Calculation of Water Extractable Phosphorus

When sludge analysis for Water Extractable Phosphorus is required by this permit, the permittee shall use the following formula to calculate and report Water Extractable Phosphorus:
Water Extractable Phosphorus (% of Total P) =
[Water Extractable Phosphorus (mg/kg, dry wt) ÷ Total Phosphorus (mg/kg, dry wt)] x 100

1.4.6 Monitoring and Calculating PCB Concentrations in Sludge

When sludge analysis for "PCB, Total Dry Wt" is required by this permit, the PCB concentration in the sludge shall be determined as follows.

Either congener-specific analysis or Aroclor analysis shall be used to determine the PCB concentration. The permittee may determine whether Aroclor or congener specific analysis is performed. Analyses shall be performed in accordance with the following provisions and Table EM in s. NR 219.04, Wis. Adm. Code.

- EPA Method 1668 may be used to test for all PCB congeners. If this method is employed, all PCB congeners shall be delineated. Non-detects shall be treated as zero. The values that are between the limit of detection and the limit of quantitation shall be used when calculating the total value of all congeners. All results shall be added together and the total PCB concentration by dry weight reported. **Note**: It is recognized that a number of the congeners will co-elute with others, so there will not be 209 results to sum.
- EPA Method 8082A shall be used for PCB-Aroclor analysis and may be used for congener specific analysis as well. If congener specific analysis is performed using Method 8082A, the list of congeners tested shall include at least congener numbers 5, 18, 31, 44, 52, 66, 87, 101, 110, 138, 141, 151, 153, 170, 180, 183, 187, and 206 plus any other additional congeners which might be reasonably expected to occur in the particular sample. For either type of analysis, the sample shall be extracted using the Soxhlet extraction (EPA Method 3540C) (or the Soxhlet Dean-Stark modification) or the pressurized fluid extraction (EPA Method 3545A). If Aroclor analysis is performed using Method 8082A, clean up steps of the extract shall be performed as necessary to remove interference and to achieve as close to a limit of detection of 0.11 mg/kg as possible. Reporting protocol, consistent with s. NR 106.07(6)(e), should be as follows: If all Aroclors are less than the LOD, then the Total PCB Dry Wt result should be reported as less than the highest LOD. If a single Aroclor is detected then that is what should be reported for the Total PCB result. If multiple Aroclors are detected, they should be summed and reported as Total PCBs. If congener specific analysis is done using Method 8082A, clean up steps of the extract shall be performed as necessary to remove interference and to achieve as close to a limit of detection of 0.003 mg/kg as possible for each congener. If the aforementioned limits of detection cannot be achieved after using the appropriate clean up techniques, a reporting limit that is achievable for the Aroclors or each congener for the sample shall be determined. This reporting limit shall be reported and qualified indicating the presence of an interference. The lab conducting the analysis shall perform as many of the following methods as necessary to remove interference:

3620C – Florisil	3611B - Alumina
3640A - Gel Permeation	3660B - Sulfur Clean Up (using copper shot instead of powder)
3630C - Silica Gel	3665A - Sulfuric Acid Clean Up

1.4.7 Land Application Report

Land Application Report Form 3400-55 shall be submitted by January 31, following each year non-exceptional quality sludge is land applied. Non-exceptional quality sludge is defined in s. NR 204.07(4), Wis. Adm. Code.

1.4.8 Other Methods of Disposal or Distribution Report

The permittee shall submit Report Form 3400-52 by January 31, following each year sludge is hauled, landfilled, incinerated, or when exceptional quality sludge is distributed or land applied.

1.4.9 Approval to Land Apply

Bulk non-exceptional quality sludge as defined in s. NR 204.07(4), Wis. Adm. Code, may not be applied to land without a written approval letter or Form 3400-122 from the Department unless the Permittee has obtained permission from the Department to self approve sites in accordance with s. NR 204.06 (6), Wis. Adm. Code. Analysis of sludge characteristics is required prior to land application. Application on frozen or snow covered ground is restricted to the extent specified in s. NR 204.07(3) (l), Wis. Adm. Code.

1.4.10 Soil Analysis Requirements

Each site requested for approval for land application must have the soil tested prior to use. Each approved site used for land application must subsequently be soil tested such that there is at least one valid soil test in the four years prior to land application. All soil sampling and submittal of information to the testing laboratory shall be done in accordance with UW Extension Bulletin A-2100. The testing shall be done by the UW Soils Lab in Madison or Marshfield, WI or at a lab approved by UW. The test results including the crop recommendations shall be submitted to the DNR contact listed for this permit, as they are available. Application rates shall be determined based on the crop nitrogen recommendations and with consideration for other sources of nitrogen applied to the site.

1.4.11 Land Application Site Evaluation

For non-exceptional quality sludge, as defined in s. NR 204.07(4), Wis. Adm. Code, a Land Application Site Request Form 3400-053 shall be submitted to the Department for the proposed land application site. The Department will evaluate the proposed site for acceptability and will either approve or deny use of the proposed site. The permittee may obtain permission to approve their own sites in accordance with s. NR 204.06(6), Wis. Adm. Code.

1.4.12 Class B Sludge: Fecal Coliform Limitation

Compliance with the fecal coliform limitation for Class B sludge shall be demonstrated by calculating the geometric mean of at least 7 separate samples. (Note that a Total Solids analysis must be done on each sample). The geometric mean shall be less than 2,000,000 MPN or CFU/g TS. Calculation of the geometric mean can be done using one of the following 2 methods.
Method 1:
Geometric Mean = $(X_1 \times X_2 \times X_3 \ldots \times X_n)^{1/n}$
Where X = Coliform Density value of the sludge sample, and where n = number of samples (at least 7)

Method 2:
Geometric Mean = antilog$[(X_1 + X_2 + X_3 \ldots + X_n) \div n]$
Where X = $\log_{10}$ of Coliform Density value of the sludge sample, and where n = number of samples (at least 7)
Example for Method 2

Sample Number	Coliform Density of Sludge Sample	$\log_{10}$
1	6.0×10^5	5.78
2	4.2×10^6	6.62
3	1.6×10^6	6.20
4	9.0×10^5	5.95
5	4.0×10^5	5.60
6	1.0×10^6	6.00
7	5.1×10^5	5.71

The geometric mean for the seven samples is determined by averaging the $\log_{10}$ values of the coliform density and taking the antilog of that value.

(5.78 + 6.62 + 6.20 + 5.95 + 5.60 + 6.00 + 5.71) ÷ 7 = 5.98
The antilog of 5.98 = 9.5×10^5

1.4.13 Vector Control: Volatile Solids Reduction

The mass of volatile solids in the sludge shall be reduced by a minimum of 38% between the time the sludge enters the digestion process and the time it either exits the digester or a storage facility. For calculation of volatile solids reduction, the permittee shall use the Van Kleeck equation or one of the other methods described in "Determination of Volatile Solids Reduction in Digestion" by J.B. Farrell, which is Appendix C of EPA's *Control of Pathogens in Municipal Wastewater Sludge* (EPA/625/R-92/013). The Van Kleeck equation is:

$$VSR\% = \frac{VS_{IN} - VS_{OUT}}{VS_{IN} - (VS_{OUT} \times VS_{IN})} \times 100$$

Where: VS_{IN} = Volatile Solids in Feed Sludge (g VS/g TS)

VS_{OUT} = Volatile Solids in Final Sludge (g VS/g TS)

VSR% = Volatile Solids Reduction, (Percent)

2 Summary of Reports Due

FOR INFORMATIONAL PURPOSES ONLY

Description	**Date**	**Page**
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Preliminary Compliance Alternatives Plan	October 31, 2015	10
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Final Compliance Alternatives Plan	October 31, 2016	10
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Progress Report on Plans & Specifications	October 31, 2017	10
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Final Plans and Specifications	October 31, 2018	10
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Treatment Plant Upgrade to Meet WQBELs	March 31, 2019	11
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Construction Upgrade Progress Report #1	March 31, 2020	11
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Construction Upgrade Progress Report #2	March 31, 2021	11
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Complete Construction	September 30, 2021	11
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Achieve Compliance	October 31, 2021	11
Compliance Maintenance Annual Reports (CMAR)	by June 30, each year	13
General Sludge Management Form 3400-48	prior to any significant sludge management changes	17
Characteristic Form 3400-49 and Lab Report	by January 31 following each year of analysis	17
Land Application Report Form 3400-55	by January 31, following each year non-exceptional quality sludge is land applied	18
Report Form 3400-52	by January 31, following each year sludge is hauled, landfilled, incinerated, or when exceptional quality sludge is distributed or land applied	19

Wastewater Discharge Monitoring Report	no later than the date indicated on the form	12

Report forms shall be submitted electronically in accordance with the reporting requirements herein. Any facility plans or plans and specifications for municipal, industrial, industrial pretreatment and non industrial wastewater systems shall be submitted to the Bureau of Water Quality, P.O. Box 7921, Madison, WI 53707-7921. All other submittals required by this permit shall be submitted to:
South Central Region, 3911 Fish Hatchery Road, Fitchburg, WI 53711-5397

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APPENDIX B

Notice of Intent to Conduct Water Quality Trading

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State of Wisconsin
Department of Natural Resources
101 South Webster Street
Madison WI 53707-7921
dnr.wi.gov

Notice of Intent to Conduct Water Quality Trading

Form 3400-206 (1/14)

Notice: Pursuant to s. 283.84, Wis. Stats., and ch. NR 217 Wis. Adm. Code, this form must be completed by any WPDES permittee that is using water quality trading as a method of complying with a permit limitation. Failure to complete this form would not result in penalties. Personal information collected will be used for administrative purposes and may be provided to requesters to the extent required by Wisconsin's Open Records Law (ss. 19.31 - 19.39, Wis. Stats.).

Applicant Information

Permittee Name	Permit Number	Facility Site Number
City of Brodhead	WI- 0021903	N/A

Facility Address	City	State	ZIP Code
P.O. Box 168, 1111 W. 2nd Ave.	Brodhead	WI	53520

Project Contact Name (if applicable)	Address	City	State	ZIP Code
Greg Gunderson, P.E, MSA	2901 International Ln., Suite 300	Madison	WI	53704

Project Name
City of Brodhead Water Quality Trading Project (Lower-Middle Sugar River Watershed)

Receiving Water Name	Parameter(s) being traded	HUC 12(s)
Sugar River (Millrace)	total phosphorus	070900040605

Is the permittee in a point or nonpoint source dominated watershed?
(See PRESTO results - http://dnr.wi.gov/topic/surfacewater/presto.html)

- ○ Point source dominated
- ◉ Nonpoint source dominated

Credit Generator Information

Credit generator type (select all that apply):

- ☐ Permitted Discharge (non-MS4/CAFO)
- ☒ Urban nonpoint source discharge
- ☐ Permitted MS4
- ☒ Agricultural nonpoint source discharge
- ☐ Permitted CAFO
- ☐ Other - Specify:

Are any of the credit generators in a different HUC 12 than the applicant?

- ◉ Yes; HUC 12: 070900040601-602-302-404-503-703
- ○ No
- ○ Unsure

Are any of the credit generators downstream of the applicant?

- ◉ Yes
- ○ No
- ○ Unsure

Will a broker/exchange be used to facilitate trade?

- ○ Yes; Name:
- ○ No
- ◉ Unsure

Point to Point Trades (Traditional Municipal / Industrial Discharge, MS4, CAFO)

Discharge Type	Permit Number	Name	Contact Address	Is the point source credit generator currently in compliance with their permit requirements?
○ Traditional ○ MS4 ○ CAFO				○ Yes ○ No ○ Unsure
○ Traditional ○ MS4 ○ CAFO				○ Yes ○ No ○ Unsure
○ Traditional ○ MS4 ○ CAFO				○ Yes ○ No ○ Unsure
○ Traditional ○ MS4 ○ CAFO				○ Yes ○ No ○ Unsure
○ Traditional ○ MS4 ○ CAFO				○ Yes ○ No ○ Unsure

Point to Nonpoint Trades (Non-permitted Agricultural, Non-Permitted Urban, etc.)

List the practices that will be used to generate credits:

Practices utilized will be evaluated during the development of the WQT plan. Potential practices include:

Urban Practices:
Detention Ponds
Bioretention for infiltration
infiltration basins/trenches
proprietary stormwater sedimentation devices
vegetated infiltration swales

Agricultural Practices:
Whole Field Management
Companion Crops (e.g. perennial vegetation)
Conservation Easements
Nutrient Management & Supporting Practices (e.g. mulch/no till, filter strips, grassed waterways, cover crops)
Production Area Practices (e.g. clean water diversion, heavy-use protection fencing, roofed barnyards)
Sediment Control Basins
Stream bank Stabilization & Shoreline Protection (w/ and w/o aquatic habitat restoration)
Wetland Restoration

Method for quantifying credits generated:
☐ Monitoring
☒ Modeling, Names: SLAMM,SnapPlus,RUSLE2,BARNY
☒ Other: or DNR-approved equivalent models

Projected date credits will be available: 10/31/21

The preparer certifies all of the following:

- I am familiar with the specifications submitted for this application, and I believe all applicable items in this checklist have been addressed.
- I have completed this document to the best of my knowledge and have not excluded pertinent information.

Signature of Preparer	Date Signed
[signature]	9/26/16

Authorized Representative Signature

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision. Based on my inquiry of those persons directly responsible for gathering and entering the information, the information is, to the best of my knowledge and belief, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signature of Authorized Representative	Date Signed
Richard R Vogel	9/27/2016

APPENDIX C

Letters of Support

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Green County
Land & Water Conservation Department

1627 4th Ave West
Monroe, WI 53566
608-325-4195

July 10, 2017

To Whom It May Concern:

The work that MSA is doing on behalf of the City of Brodhead to pursue trading phosphorus credits with local landowners instead of a multimillion dollar wastewater facility upgrade is supported by the Green County Land and Water Conservation Department.
The Green County LWCD has worked with operators in the trade agreement and will continue to support them when they update their nutrient management plan. We also have a good working relationship with the area farmers and plan to be involved in assisting them to help them achieve their goals for better water quality- whether it be navigating the process for county or federal cost sharing, survey the project resulting in a design and construction oversight. We will continue to pursue projects that enhance water quality in the Sugar River.

Sincerely,

Green County Land and Water Conservation Department

Todd Jenson Tonya Gratz Chris Newberry

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LSRWA

LOWER SUGAR RIVER
watershed • association

Dedicated to the care & enjoyment of our water resources

June 20, 2017

Douglas Pinnow, Mayor
City of Brodhead
Brodhead, WI 53520

Re: Letter of Support—City of Brodhead Water Quality Trading Plan

Dear Mayor Pinnow and Council,

On behalf of our membership, the Lower Sugar River Watershed Association (LSRWA) Board of Directors offers this letter in support of the City of Brodhead's Water Quality Trading Plan. We understand this plan is designed to offset nutrient inputs from the City's wastewater treatment facility on the Sugar River by working with agricultural landowners to more broadly implement water quality improvement projects in the basin.

As stakeholders in the Lower Sugar River Watershed, we believe our members and citizens in the surrounding watershed community and those downstream will benefit from the water quality improvement projects envisioned in the City's plan. We are encouraged that projects currently being proposed include those addressing streambank protection, habitat improvement, and on-farm improvements.

As is the case in many of our municipalities, run-off from our roof tops, streets, and other impervious surfaces flows directly into our local streams and rivers, with little opportunity to be cleansed of pollutants gathered along the way. Some property owners in Brodhead have implemented alternative stormwater management projects appropriate for municipal and residential settings that are also contributing to water quality improvements in the basin. These projects have employed deep-rooted native landscape plantings to intercept and filter rainfall and stormwater runoff, greatly enhancing stormwater infiltration into the soil and reducing volumes delivered to municipal storm sewers. Such projects may also be envisioned in the plan and can provide existing models for other landowners who want to participate in the water quality project to achieve similar benefits in support of the City's efforts. The cumulative effect of such small scale landscaping treatments throughout the community can have a positive impact on the City's stormwater infrastructure, as well as improve groundwater supplies and reduce flooding problems downstream.

We all have a stake in clean water!

The Lower Sugar River Watershed Association (LSRWA) has established a local, regional, and state-wide network of public and private partners and the capacity to support the City of Brodhead in their water quality efforts.

With partners, we have developed conservation programming and innovative citizen science public and in-school programming, including a qualitative Watershed Rapid Assessment Survey (WRAS) method initially deployed by 100 trained volunteers at 450 public stream crossings to assess, classify and map watershed health. The geospatial database developed as part of this project is used for expanding citizen-based and crowd-sourced data collections. WRAS data was used in part by the City of Brodhead to initially stratify and target Water Quality Trading projects.

LSRWA volunteers and partners Grande Cheese Company, Decatur Lake Mill Race Association, and Lake Winnetka Sugar River Improvement Association also collect chain-of-custody water quality samples as State of WI partners in monitoring impaired streams in the basin. This monitoring effort can be expanded to further support the City of Brodhead's efforts. The LSRWA website www.lsrwa.org provides information about its citizen science program, along with custom maps and other resource materials for public data-sharing, outreach and communication.

We all have a stake in clean water. As an organization dedicated to the care and enjoyment of our water resources, LSRWA applauds the City for encouraging best practices that will contribute to the health of our watershed resources and to the health of our community.

Very truly yours,

Susan Lehnhardt

Susan Lehnhardt, President
Lower Sugar River Association, Inc.
17921 Smith Road, P.O. Box 256
Brodhead, WI 53520

APPENDIX D

Streambank Erosion Modeling Overview

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APPENDIX D

STREAMBANK EROSION MODELING OVERVIEW

1.1 BACKGROUND

The City of Brodhead plans to generate phosphorus credits by completing approximately 1.2 miles of streambank stabilization and habitat improvements along Searles Creek. Two potential landowners have been identified to complete this work: Landowner A and Landowner B. Landowner A owns approximately 0.8 miles of streambank and Landowner B owns approximately 0.4 miles of streambank along Searles Creek. A total of 37 and 26 actively eroding streambanks were identified on the properties owned by Landowner A and Landowner B, respectively. Streambank erosion for each eroding bank was estimated using the process defined in the NRCS “Erosion Calculator” which uses the “Direct Volume Method” to estimate streambank erosion (NRCS Field Office Technical Guide, 2017). **Equation 1**, based on the Direct Volume Method, was used to estimate phosphorus loss from each eroding streambank. The sum of phosphorus loss from all eroding banks was used to estimate the amount of potential phosphorus credits which could be generated by stabilizing eroding streambanks.

Equation 1:

$$\text{Streambank Phosphorus Loss} = \mathrm{L} \times \mathrm{H} \times \mathrm{R} \times \gamma_{\mathrm{soil}} \times \mathrm{C_{TP}} \times \frac{1}{1{,}000{,}000}$$

Where:

Where:	L	=	length of eroding bank [ft]
	H	=	slope height of eroding bank [ft]
	R	=	annual lateral recession rate of eroding bank $\left[\frac{\mathrm{ft}}{\mathrm{yr}}\right]$
	γ_{soil}	=	soil bulk density $\left[\frac{\mathrm{lb}}{\mathrm{ft}^3}\right]$
	$\mathrm{C_{TP}}$	=	soil total phosphorus concentration [ppm]

1.2 METHODS

Estimating phosphorus loss using Direct Volume Method, requires the modeler to collect field data to estimate the eroding area of each bank (L x H), the annual lateral recession rate of each bank (R), the soil bulk density (γ_{soil}), and the total phosphorus concentration of soil (C_{TP}) eroded from each bank. The eroding area for each bank was determined by hand measuring the length and slope height of each bank. Length was measured along the top of each bank with a measuring wheel. The bank slope height was measured by pressing a tape measure along the surface of the eroding bank from the toe of slope in the channel to the top of the eroding bank (see example shown in **Figure 1**). Because each bank generally exhibits variability in slope height depending on where the measurements are taken, three representative slope heights were measured for each bank, each approximately the same distance apart. The average bank slope height was used to estimate phosphorus loss. In a few occasions, less than three slope heights were measured for specific banks when existing vegetation made it infeasible to collect an accurate measurement.

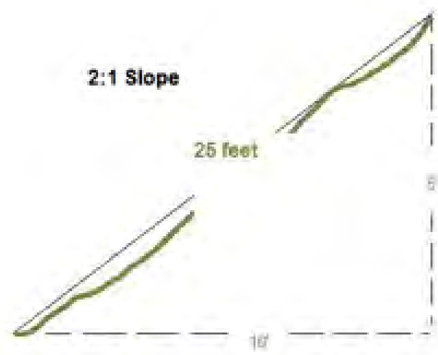

Figure 1: Example measurement of bank slope height. In this example, the bank slope height is 25 ft or the length of the hypotenuse (Source: NRCS Erosion Calculator).

Due to the timing of this study, it was not deemed feasible to directly measure annual lateral recession rates in the field, and historical survey records and high-definition aerial photographs were not available to the extent that annual lateral recession rates could be estimated based on historical records. Therefore, for the purposes of this study, annual lateral recession rates were estimated using the qualitative descriptions listed in **Table 1**. These qualitative descriptions are based on the values found in the NRCS "Erosion Calculator" (NRCS Field Office Technical Guide, 2017). Please note that numeric values for lateral recession rate in **Table 1** are based on the mid-point of the range of values defined for each category of erosion in the "Erosion Calculator." The mid-point of the range was selected to prevent arbitrary selection of lateral recession rates for a given erosion category. Also, an additional category "Moderate/Severe" was defined to account for eroding banks which were not well defined by the categories "Moderate" or "Severe" erosion. The lateral recession rate for the "Moderate/Severe" category was assumed to be 0.25 ft/yr based on the mid-point of the high range of the "Moderate" and the low range of the "Severe" category as defined in the "Erosion Calculator." Lastly, since the "Erosion Calculator" defines "Very Severe" as a lateral recession rate greater than 0.5 ft/yr, it was assumed that all lateral recession rates in this category were approximately 0.5 ft/yr.

Soil bulk densities were estimated using published data from Web Soil Survey (https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm) based on the mapped soil type in which each eroding bank was located. **Table 2** lists the soil bulk density for the three soil types which were mapped along the streambanks owned by Landowner A and Landowner B. This data was believed to be more representative than the typical soil unit weights based on soil texture listed in the "Erosion Calculator" (NRCS Field Office Technical Guide, 2017). The collection of soil samples for laboratory bulk density analysis was not completed since the collection of representative samples was determined to be infeasible. It would have been difficult to obtain soil bulk density samples which were representative of the entire soil profile of the eroding banks since portions of the sample would need to be collected below the water level of the stream. In addition, sampling for bulk density would have required trained and experienced field staff able to collect representative samples. Variability of bulk density across these large sites was also a concern. For these reasons, it is assumed that published values of bulk density from Web Soil Survey are sufficient for estimating phosphorus loss for this project.

Table 1: Lateral recession rate based on qualitative description of erosion.

Lateral Recession Rate (ft/yr)	Category	Description
0.03	Slight	Some bare bank but active erosion not readily apparent. Some rills but no vegetative overhang. No exposed tree roots.
0.13	Moderate	Bank is predominantly bare with some rills and vegetative overhang. Some exposed tree roots but no slumps or slips.
0.25	Moderate/Severe	Bank is predominantly bare with some rills and vegetative overhang. Some exposed tree roots and some slumps or slips.
0.40	Severe	Bank is bare with rills and severe vegetative overhang. Many exposed tree roots and some fallen trees and slumps or slips. Some changes in cultural features such as fence corners missing and realignment of roads or trails. Channel cross section becomes U-shaped as opposed to V-shaped.
> 0.50 ≈ 0.50	Very Severe	Bank is bare with gullies and severe vegetative overhang. Many fallen trees, drains and culverts eroding out and changes in cultural features as above. Massive slips or washouts common. Channel cross section is U-shaped and stream course may be meandering.

Table 2: Soil bulk densities for soil types mapped in the project area.

Soil Type	Bulk Density[1] (g/cm^3)	Bulk Density (lb/ft^3)
Ossian Silt Loam	1.33	83
Marshan Silt Loam	1.52	95
Orion Silt Loam	1.39	87

[1]*Bulk density based on representative physical soil properties published by Web Soil Survey for Green County, Wisconsin.*

Soil samples were collected from each eroding bank in order to estimate the total phosphorus concentration of the eroding soil. Soil samples were collecting using a 7/8" diameter soil probe. A total of 3 subsamples were collected at each location where bank slope height was measured, resulting in a total of 9 subsamples for each bank (see **Figure 2**). Subsamples at each slope height measurement location were taken from the top, middle, and bottom of the bank above the water level. All 9 subsamples for each bank were combined and mixed in a 5-gallon bucket and placed in a soil sample bag to form a single composite sample of approximately 2 cups of soil. All soil samples were sent to the University of Wisconsin Soil and Forage Analysis Laboratory in Marshfield, WI, and were analyzed for total leachable phosphorus.

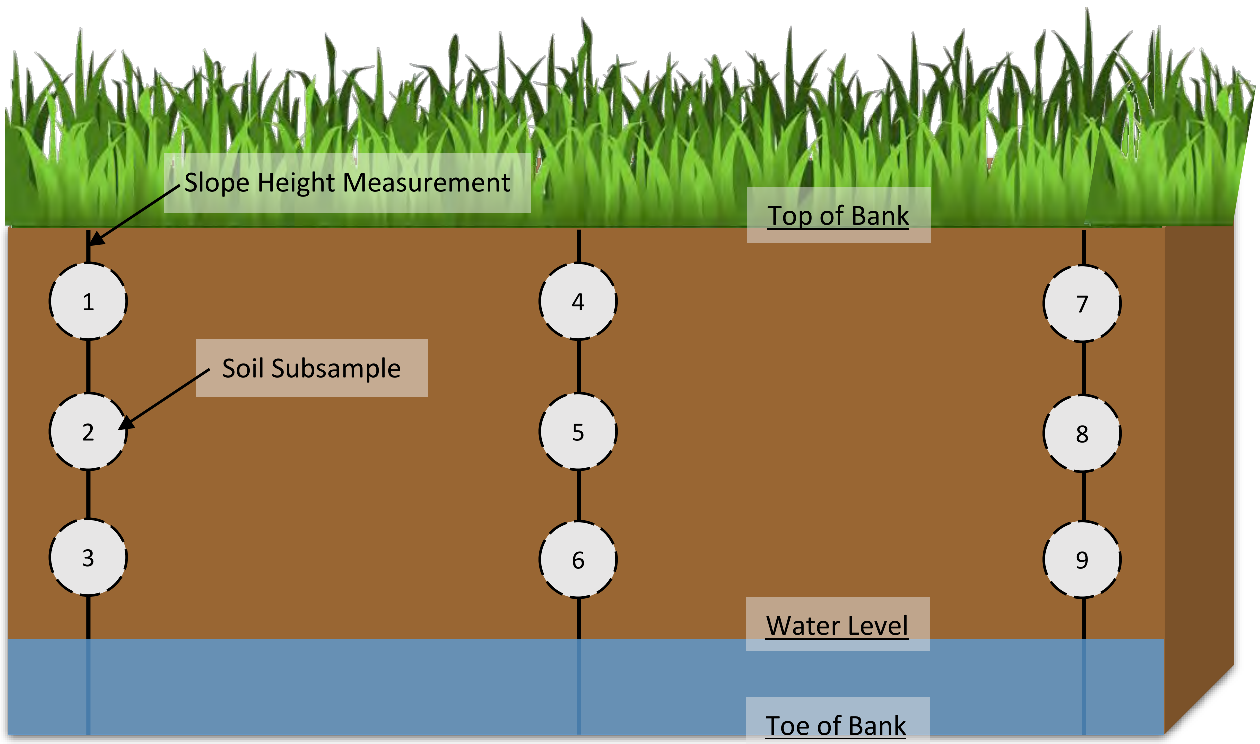

Figure 2: Diagram of soil sampling locations for a typical eroding bank

1.3 RESULTS FOR LANDOWNER A

A map of streambank sampling points for the property owned by Landowner A is shown in **Figure 3**. A total of 37 eroding streambanks were identified on this property. Photographs of each streambank are shown in **Figures 4** through **40.** The bank length, bank slope height, lateral recession rate, soil bulk density, soil total phosphorus concentration, and estimated phosphorus loss for each eroding streambank is listed in **Table 3**. Phosphorus credits were estimated by dividing the estimated phosphorus loss for each bank by a trade ratio of 3.03 (accounting for an uncertainty factor of 3.0 for streambank stabilization and habitat restoration and a deliver factor or 0.03 for the trades generated in the Searles Creek Watershed). A total of 416.6 lb/yr of phosphorus loss was estimated using **Equation 1**. Accounting for the trade ratio, a total of 137.5 lb/yr of phosphorus credits could be generated by stabilizing the eroding banks and improving habitat conditions on the property owned by Landowner A.

Figure 3

Map of proposed project site for Landowner A

Legend

- Streambank Sample Location
- Soils

Data Sources:
Tax Parcel Boundaries (Green County, 2016)
Soils (USDA-NRCS SSURGO)
Aerial Imagery (WROC, 2010)

MSA PROFESSIONAL SERVICES

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0 125 250 Feet

Table 3: Phosphorus credit calculations for Landowner A

Streambank ID	Bank Location (LBFD or RBFD)	Bank Length (ft)	Bank Slope Height (ft) #1	#2	#3	Avg.	Lateral Recession Rate Category	Lateral Recession Rate (ft/yr)	Soil Type	Soil Bulk Density (lb/ft^3)	Soil Total Phosphorus (ppm)	Estimated Phosphorus Loss (lb/yr)	Trade Ratio	Phosphorus Credits (lb/yr)
W1	LBFD	86	4.0	6.5	10.5	7.0	Moderate/Severe	0.25	Ossian Silt Loam	83	357	4.5	3.03	1.5
W2	RBFD	138	4.2	6.1	5.3	5.2	Very Severe	0.50	Marshan Silt Loam	95	598	20.4	3.03	6.7
W3	LBFD	147	6.1	8.5	6.8	7.1	Moderate/Severe	0.25	Marshan Silt Loam	95	445	11.1	3.03	3.7
W4	RBFD	141	9.2	9.9	9.0	9.4	Very Severe	0.50	Marshan Silt Loam	95	371	23.3	3.03	7.7
W5	LBFD	74	5.6	7.0	7.1	6.6	Moderate	0.13	Marshan Silt Loam	95	590	3.5	3.03	1.2
W6	LBFD	23	6.1	6.5	6.6	6.4	Moderate/Severe	0.25	Marshan Silt Loam	95	535	1.9	3.03	0.6
W7	RBFD	90	7.1	8.7	7.7	7.8	Severe	0.40	Marshan Silt Loam	95	484	13.0	3.03	4.3
W8	LBFD	66	7.8	9.2	7.6	8.2	Very Severe	0.50	Marshan Silt Loam	95	539	13.9	3.03	4.6
W9	RBFD	32	6.2	6.5	5.3	6.0	Moderate	0.13	Marshan Silt Loam	95	453	1.1	3.03	0.4
W10	LBFD	46	8.7	5.3	5.2	6.4	Moderate/Severe	0.25	Marshan Silt Loam	95	637	4.5	3.03	1.5
W11	RBFD	206	7.9	7.4	7.8	7.7	Very Severe	0.50	Marshan Silt Loam	95	733	55.3	3.03	18.3
W12	LBFD	154	6.7	8.9	7.9	7.8	Very Severe	0.50	Marshan Silt Loam	95	300	17.2	3.03	5.7
W13	RBFD	71	7.6	5.2	9.0	7.3	Very Severe	0.50	Marshan Silt Loam	95	506	12.4	3.03	4.1
W14	LBFD	68	6.3	8.8	6.8	7.3	Very Severe	0.50	Marshan Silt Loam	95	477	11.3	3.03	3.7
W15	RBFD	154	6.4	7.4	6.5	6.8	Very Severe	0.50	Marshan Silt Loam	95	563	27.9	3.03	9.2
W16	LBFD	83	7.0	5.4	8.2	6.9	Moderate/Severe	0.25	Marshan Silt Loam	95	320	4.3	3.03	1.4
W17	LBFD	13	9.2	6.3	5.5	7.0	Very Severe	0.50	Marshan Silt Loam	95	525	2.3	3.03	0.7
W18	RBFD	47	6.4	7.2	4.3	6.0	Moderate/Severe	0.25	Marshan Silt Loam	95	1,569	10.5	3.03	3.5
W19	RBFD	57	6.0	7.7	8.9	7.5	Very Severe	0.50	Orion Silt Loam	87	1,218	22.8	3.03	7.5
W20	LBFD	21	8.7	7.6	6.2	7.5	Moderate/Severe	0.25	Orion Silt Loam	87	1,405	4.8	3.03	1.6
W21	RBFD	54	9.4	6.5	5.5	7.1	Moderate	0.13	Orion Silt Loam	87	557	2.4	3.03	0.8
W22	LBFD	43	6.0	7.0	4.2	5.7	Moderate/Severe	0.25	Orion Silt Loam	87	435	2.3	3.03	0.8
W23	LBFD	50	5.9	7.5	7.4	6.9	Moderate/Severe	0.25	Orion Silt Loam	87	487	3.7	3.03	1.2
W24	RBFD	85	7.8	8.9	7.3	8.0	Moderate/Severe	0.25	Orion Silt Loam	87	337	5.0	3.03	1.6
W25	LBFD	73	8.4	6.0	6.8	7.1	Very Severe	0.50	Orion Silt Loam	87	652	14.6	3.03	4.8
W26	LBFD	47	4.6	5.2	4.5	4.8	Very Severe	0.50	Orion Silt Loam	87	488	4.8	3.03	1.6
W27	RBFD	61	10.5	7.3	5.9	7.9	Severe	0.40	Orion Silt Loam	87	360	6.0	3.03	2.0
W28	LBFD	98	8.1	8.1	9.6	8.6	Very Severe	0.50	Orion Silt Loam	87	627	23.0	3.03	7.6
W29	RBFD	46	5.4	5.1	7.1	5.9	Moderate/Severe	0.25	Orion Silt Loam	87	605	3.6	3.03	1.2
W30	RBFD	29	4.8	4.2	5.2	4.7	Moderate	0.13	Orion Silt Loam	87	680	1.1	3.03	0.3
W31	LBFD	169	8.2	7.7	8.7	8.2	Severe	0.40	Orion Silt Loam	87	266	12.8	3.03	4.2
W32	RBFD	46	4.2	5.4	5.4	5.0	Severe	0.40	Orion Silt Loam	87	331	2.7	3.03	0.9
W33	LBFD	45	4.0	3.6	6.1	4.6	Very Severe	0.50	Orion Silt Loam	87	443	4.0	3.03	1.3
W34	RBFD	141	6.6	3.6	4.4	4.9	Very Severe	0.50	Orion Silt Loam	87	393	11.7	3.03	3.9
W35	LBFD	187	8.4	12.0	7.3	9.2	Very Severe	0.50	Orion Silt Loam	87	618	46.4	3.03	15.3
W36	LBFD	44	5.3	4.8	5.5	5.2	Moderate/Severe	0.25	Orion Silt Loam	87	499	2.5	3.03	0.8
W37	RBFD	30	6.2	6.8	6.4	6.5	Very Severe	0.50	Orion Silt Loam	87	520	4.4	3.03	1.4
Total	-	**2,965**	-	-	-	-	-	-	-	-	-	**416.6**	-	**137.5**

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Figure 4: Photograph of Streambank W1

Figure 5: Photograph of Streambank W2

Figure 6: Photograph of Streambank W3

Figure 7: Photograph of Streambank W4

Figure 8: Photograph of Streambank W5

Figure 9: Photograph of Streambank W6

Figure 10: Photograph of Streambank W7

Figure 11: Photograph of Streambank W8

Figure 12: Photograph of Streambank W9

Figure 13: Photograph of Streambank W10

Figure 14: Photograph of Streambank W11

Figure 15: Photograph of Streambank W12

Figure 16: Photograph of Streambank W13

Figure 17: Photograph of Streambank W14

Figure 18: Photograph of Streambank W15

Figure 19: Photograph of Streambank W16

Figure 20: Photograph of Streambank W17

Figure 21: Photograph of Streambank W18

Figure 22: Photograph of Streambank W19

Figure 23: Photograph of Streambank W20

Figure 24: Photograph of Streambank W21

Figure 25: Photograph of Streambank W22

Figure 26: Photograph of Streambank W23

Figure 27: Photograph of Streambank W24

Figure 28: Photograph of Streambank W25

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Figure 29: Photograph of Streambank W26

Figure 30: Photograph of Streambank W27

Figure 31: Photograph of Streambank W28

Figure 32: Photograph of Streambank W29

Figure 33: Photograph of Streambank W30

Figure 34: Photograph of Streambank W31

Figure 35: Photograph of Streambank W32

Figure 36: Photograph of Streambank W33

Figure 37: Photograph of Streambank W34

Figure 38: Photograph of Streambank W35

Figure 39: Photograph of Streambank W36

Figure 40: Photograph of Streambank W37

1.4 RESULTS FOR LANDOWNER B

A map of streambank sampling points for the property owned by Landowner B is shown in **Figure 41**. A total of 26 eroding streambanks were identified on this property. Photographs of each streambank are shown in **Figures 42** through **67.** The bank length, bank slope height, lateral recession rate, soil bulk density, soil total phosphorus concentration, and estimated phosphorus loss for each eroding streambank is listed in **Table 4**. Phosphorus credits were estimated by dividing the estimated phosphorus loss for each bank by a trade ratio of 3.03 (accounting for an uncertainty factor of 3.0 for streambank stabilization and habitat restoration and a deliver factor or 0.03 for the trades generated in the Searles Creek Watershed). A total of 297.4 lb/yr of phosphorus loss was estimated using **Equation 1**. Accounting for the trade ratio, a total of 98.2 lb/yr of phosphorus credits could be generated by stabilizing the eroding banks and improving habitat conditions on the property owned by Landowner B.

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Figure 41

Map of proposed project site for Landowner B

Legend

Streambank Sample Location

Soils

Data Sources:
Tax Parcel Boundaries (Green County, 2016)
Soils (USDA-NRCS SSURGO)
Aerial Imagery (WROC, 2010)

0 75 150 Feet

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Table 4: Phosphorus Credit Calculations for Landonwer B

Streambank ID	Bank Location (LBFD or RBFD)	Bank Length (ft)	Bank Slope Height (ft) #1	#2	#3	Avg.	Lateral Recession Rate Category	Lateral Recession Rate (ft/yr)	Soil Type	Soil Bulk Density (lb/ft^3)	Soil Total Phosphorus (ppm)	Estimated Phosphorus Loss (lb/yr)	Trade Ratio	Phosphorus Credits (lb/yr)
S1	RBFD	57	3.6	4.7	5.7	4.7	Severe	0.40	Orion Silt Loam	87	376	3.5	3.03	1.1
S2	RBFD	63	8.8	6.8	9.2	8.3	Very Severe	0.50	Orion Silt Loam	87	515	11.7	3.03	3.9
S3	LBFD	117	6.7	9.1	6.3	7.4	Very Severe	0.50	Orion Silt Loam	87	437	16.4	3.03	5.4
S4	RBFD	23	5.4	6.8	4.0	5.4	Severe	0.40	Orion Silt Loam	87	459	2.0	3.03	0.7
S5	LBFD	17	6.0	-	-	6.0	Severe	0.40	Orion Silt Loam	87	616	2.2	3.03	0.7
S6	RBFD	134	8.7	9.3	8.6	8.9	Very Severe	0.50	Orion Silt Loam	87	415	21.5	3.03	7.1
S7	LBFD	74	8.7	8.2	8.1	8.3	Very Severe	0.50	Orion Silt Loam	87	481	12.9	3.03	4.3
S8	RBFD	133	9.5	9.5	11.3	10.1	Very Severe	0.50	Orion Silt Loam	87	1,619	94.6	3.03	31.2
S9	LBFD	50	6.7	-	-	6.7	Moderate	0.13	Orion Silt Loam	87	1,233	4.7	3.03	1.5
S10	RBFD	46	9.0	10.6	7.6	9.1	Moderate/Severe	0.25	Orion Silt Loam	87	1,438	13.0	3.03	4.3
S11	LBFD	38	5.3	8.1	-	6.7	Moderate	0.13	Orion Silt Loam	87	457	1.3	3.03	0.4
S12	RBFD	135	8.2	6.3	7.3	7.3	Very Severe	0.50	Orion Silt Loam	87	412	17.6	3.03	5.8
S13	LBFD	31	5.9	6.9	6.3	6.4	Very Severe	0.50	Orion Silt Loam	87	492	4.2	3.03	1.4
S14	RBFD	43	8.7	10.6	8.6	9.3	Very Severe	0.50	Orion Silt Loam	87	507	8.8	3.03	2.9
S15	LBFD	34	5.5	6.1	5.1	5.6	Severe	0.40	Orion Silt Loam	87	345	2.3	3.03	0.8
S16	LBFD	32	9.8	8.6	7.0	8.5	Moderate/Severe	0.25	Orion Silt Loam	87	575	3.4	3.03	1.1
S17	RBFD	144	8.8	8.5	10.6	9.3	Very Severe	0.50	Orion Silt Loam	87	352	20.5	3.03	6.8
S18	RBFD	81	8.0	7.7	6.0	7.2	Moderate	0.13	Orion Silt Loam	87	546	3.6	3.03	1.2
S19	RBFD	58	8.0	6.7	6.8	7.2	Very Severe	0.50	Orion Silt Loam	87	555	10.0	3.03	3.3
S20	RBFD	32	9.5	8.2	10.2	9.3	Very Severe	0.50	Orion Silt Loam	87	418	5.4	3.03	1.8
S21	LBFD	91	7.9	8.6	7.0	7.8	Very Severe	0.50	Orion Silt Loam	87	553	17.1	3.03	5.7
S22	RBFD	32	8.9	7.2	6.4	7.5	Very Severe	0.50	Orion Silt Loam	87	442	4.6	3.03	1.5
S23	LBFD	30	8.4	9.0	8.4	8.6	Very Severe	0.50	Orion Silt Loam	88	386	4.4	3.03	1.4
S24	RBFD	33	2.6	2.9	4.7	3.4	Moderate	0.13	Orion Silt Loam	87	609	0.8	3.03	0.3
S25	RBFD	64	7.3	9.3	8.4	8.3	Very Severe	0.50	Orion Silt Loam	87	361	8.4	3.03	2.8
S26	RBFD	21	7.1	6.7	5.2	6.3	Very Severe	0.50	Orion Silt Loam	87	436	2.5	3.03	0.8
Total	**-**	**1,613**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**297.4**	**-**	**98.2**

Figure 42: Photograph of Streambank S1

Figure 43: Photograph of Streambank S2

Figure 44: Photograph of Streambank S3

Figure 45: Photograph of Streambank S4

Figure 46: Photograph of Streambank S5

Figure 47: Photograph of Streambank S6

Figure 48: Photograph of Streambank S7

Figure 49: Photograph of Streambank S8

Figure 50: Photograph of Streambank S9

Figure 51: Photograph of Streambank S10

Figure 52: Photograph of Streambank S11

Figure 53: Photograph of Streambank S12

Figure 54: Photograph of Streambank S13

Figure 55: Photograph of Streambank S14

Figure 56: Photograph of Streambank S15

Figure 57: Photograph of Streambank S16

Figure 58: Photograph of Streambank S17

Figure 59: Photograph of Streambank S18

Figure 60: Photograph of Streambank S19

Figure 61: Photograph of Streambank S20

Figure 62: Photograph of Streambank S21

Figure 63: Photograph of Streambank S22

Figure 64: Photograph of Streambank S23

Figure 65: Photograph of Streambank S24

Figure 66: Photograph of Streambank S25

Figure 67: Photograph of Streambank S26

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APPENDIX E

Barnyard Modeling Overview

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APPENDIX E

BARNYARD MODELING OVERVIEW

1.1 BACKGROUND

The City of Brodhead plans to generate phosphorus credits by installing clean water diversions and runoff collection infrastructure for the barnyards operated by Landowner C. In order to quantify the number of credits which could be generated by implementing barnyard improvements, phosphorus losses from the barnyards must be quantified based on existing conditions and based on future improvements. Computer models are commonly used to estimate phosphorus losses from barnyards. In Wisconsin, two models which are commonly used include the DNR's BARNY model and the USDA's APLE-Lots model. There are advantages and disadvantages to using both models.

BARNY was developed in the 1970s and was most recently updated in 2005. Therefore, the model has been used for a long period. The major advantage of this model is that it accounts for the runoff of tributary areas (i.e. roofs and other lands that drain to the barnyard) when estimating phosphorus losses. This allows the user to estimate potential reductions in phosphorus loss due to the implementation of clean water diversions (e.g. roof gutters, earthen diversions, etc.) which prevent runoff from entering the barnyard. BARNY also allows the user to estimate reductions for other best management practices such as settling basins and buffers, which are designed to capture and treat runoff. The major disadvantage of BARNY is that the edge-of-lot phosphorus losses do not always accurately estimate actual losses from barnyards. In general, BARNY tends to overestimate losses from barnyards with small amounts of phosphorus loss and underestimate losses from barnyards with high phosphorus loss (Vadas et al., 2015). However, BARNY is still considered a reasonable model for estimating phosphorus losses from barnyards.

APLE-Lots was developed in 2015. The model uses innovative techniques which have been shown to more accurately estimate edge-of-lot phosphorus losses when compared to BARNY (Vadas et al., 2015). However, the model currently does not include procedures which allow the modeler to estimate potential phosphorus reductions from best management practices such as clean water diversions, settling basins, or buffers. Therefore, this model currently does not appear to be adequate for use in a Water Quality Trading framework since it can only be used to estimate baseline conditions for barnyards. In order to estimate phosphorus credits, it is essential to be able to model reductions caused by the implementation of best management practices. Thus, APLE-Lots was not used to model phosphorus credits for the purposes of this Water Quality Trading Plan.

Because the BARNY model can be used to estimate phosphorus reductions caused by the implementation of typical best management practices for barnyards, BARNY will be used to estimate phosphorus losses and credits for the barnyards operated by Landowner C. However, for comparison purposes, both APLE-Lots and BARNY were used to estimate baseline conditions. This was completed to determine if estimates using the BARNY model are realistic estimates of phosphorus losses from the modeled barnyards.

A total of four barnyards owned by Landowner C were modeled using BARNY and APLE-Lots. A map of each barnyard is shown in **Figure 1**, and pictures of each lot are shown in **Figure 2** through **Figure 6**. Lot #1 is a bare earthen exercise lot connected to Lot #2, a concrete lot used to house and feed young dairy heifers. Lot #3 is a concrete surfaced lot which houses heifers and dry cows. Lot #4 is a concrete surfaced lot which houses milking cows. Portions of Lots #2, #3, and #4 are covered by existing roofs without roof gutters. Lots #3 and #4 could be improved by installing roof gutters and downspouts to prevent roof runoff from contacting the lot surface. Lot #2 is a monoslope building so roof gutters are likely impractical. The contributing tributary area for Lot #1 includes portions of Lot #2 and the gravel driveway and building located south of Lot #2. The contributing tributary area for Lot #2 only includes the portion of the monoslope building roof which drains onto the lot, as the remaining contributing area is diverted by the feed bunks at the front of the lot. The contributing tributary areas for Lots #3 and #4 are primarily the roofs which drain to these lots. A small portion of an existing gravel driveway drains to the north end of Lot #4.

The ultimate goal for Landowner C's barnyards is to achieve a "zero discharge" condition or near "zero discharge" condition for each of the identified lots. Improvements proposed to achieve this goal are described below:

Lot #1:

Lot #1 is planned to be completely abandoned to generate phosphorus credits for the City of Brodhead. Abandonment will be completed by transferring animals from this lot to Lot #3. The abandoned lot will be seeded with grass to develop a permanent vegetated cover. Livestock will not be allowed to access the lot once the abandonment is complete. The vegetated lot will be placed in a conservation easement throughout the life of the binding legal agreement with the City of Brodhead. Since Lot #1 is planned to be completely abandoned and converted to permanent vegetation, it is assumed that the phosphorus credits generated from Lot #1 will be based on a trade ratio of 1.20:1 (Uncertainty Factor = 1.00 and Delivery Factor = 0.03, Minimum Trade Ratio = 1.20).

Lot #2:

To address concentrated runoff from Lot #2, a new waste/runoff reception tank is planned to be constructed. The new waste reception tank is planned to be installed on the southwest side of Lot #2, the side where runoff is currently discharged. To facilitate the capture of runoff, the portion of the lot on the southwest side, outside the open face of the monoslope building will be abandoned, reducing the size of the existing lot.

Reducing the size of the lot will effectively act as a clean water diversion since the area of the manure pack exposed to precipitation will be smaller. This effect was seen in the BARNY modeling results. Therefore, it is assumed that the phosphorus credits generated from Lot #2 due to the reduction in size of the lot will be based on a trade ratio of 2.03:1 (Uncertainty Factory = 2.0 and Delivery Factor = 0.03).

Waste transfer piping will be constructed to transfer runoff from the proposed waste reception tank to a newly constructed waste storage facility with greater than 180 days of storage. Since the waste reception tank and waste transfer piping will be designed to collect, store, and transport runoff from a 25-yr 24-hr design storm, it will be assumed that Lot #2 will achieve the conditions of "zero discharge". In order to conservatively estimate the total amount of phosphorus credits which are available for trading, no credit will be quantified for the additional phosphorus which is prevented from leaving the lot as concentrated runoff and which is instead captured in the waste storage facility.

Lot #3:

Runoff from Lot #3 will be addressed by reducing the size of the lot, installing roof gutters to divert clean water, and by installing a waste/runoff reception tank with associated waste transfer piping to transport runoff to a newly constructed waste storage facility. The lot size will be somewhat reduced by the installation of a new roof/building which is being constructed primarily to cover Lot #4. A small portion of the Lot #3 will also be abandoned on the west side. Roof gutters will be installed on all existing buildings which currently discharge roof runoff to the lot. Roof gutters will also be installed on the new roof which is planned to cover Lot #4. It is assumed that all phosphorus reductions due to the installation of clean water diversions (roof gutters and roof covers) and reduction in size of the lot will generate credits based on a trade ratio of 2.03:1 (Uncertainty Factor = 2.0 and Delivery Factor = 0.03).

The waste reception tank designed to capture runoff from Lot #3 will be installed on the south end of the lot near the northeast corner of the existing large freestall barn. The waste reception tank and waste transfer piping will be designed to collect, store, and transport runoff from a 25-yr 24-hr design storm to achieve the conditions of “zero discharge”. Similar to Lot #2, no credit will be quantified for the additional phosphorus which is prevented from leaving the lot as concentrated runoff and which is instead captured in the waste storage facility.

Lot #4:

Lot #4 is planned to be improved by installing a new roof cover (122 ft x 116 ft) over the existing lot. The new roof cover will reduce the lot size by approximately 87%. Only the southwest portion of the lot, directly east of the large freestall barn will remain open after construction of the new roof cover. This portion of the lot which will be used to transport milking cows from the freestall barn to the existing milking parlor is not planned for runoff collection. Therefore, this lot will not meet all the conditions of “zero discharge.”

Roof gutters are planned to be installed on the new building and the roofs of the existing buildings immediately north of Lot #4. These improvements will prevent all runoff from tributary areas from contacting the remaining open potion of Lot #4 once construction is complete. It is assumed that phosphorus reductions due to the installation of the new roof cover and roof gutters will generate credits based on a trade ratio of 2.03:1 (Uncertainty Factor = 2.0 and Delivery Factor = 0.03).

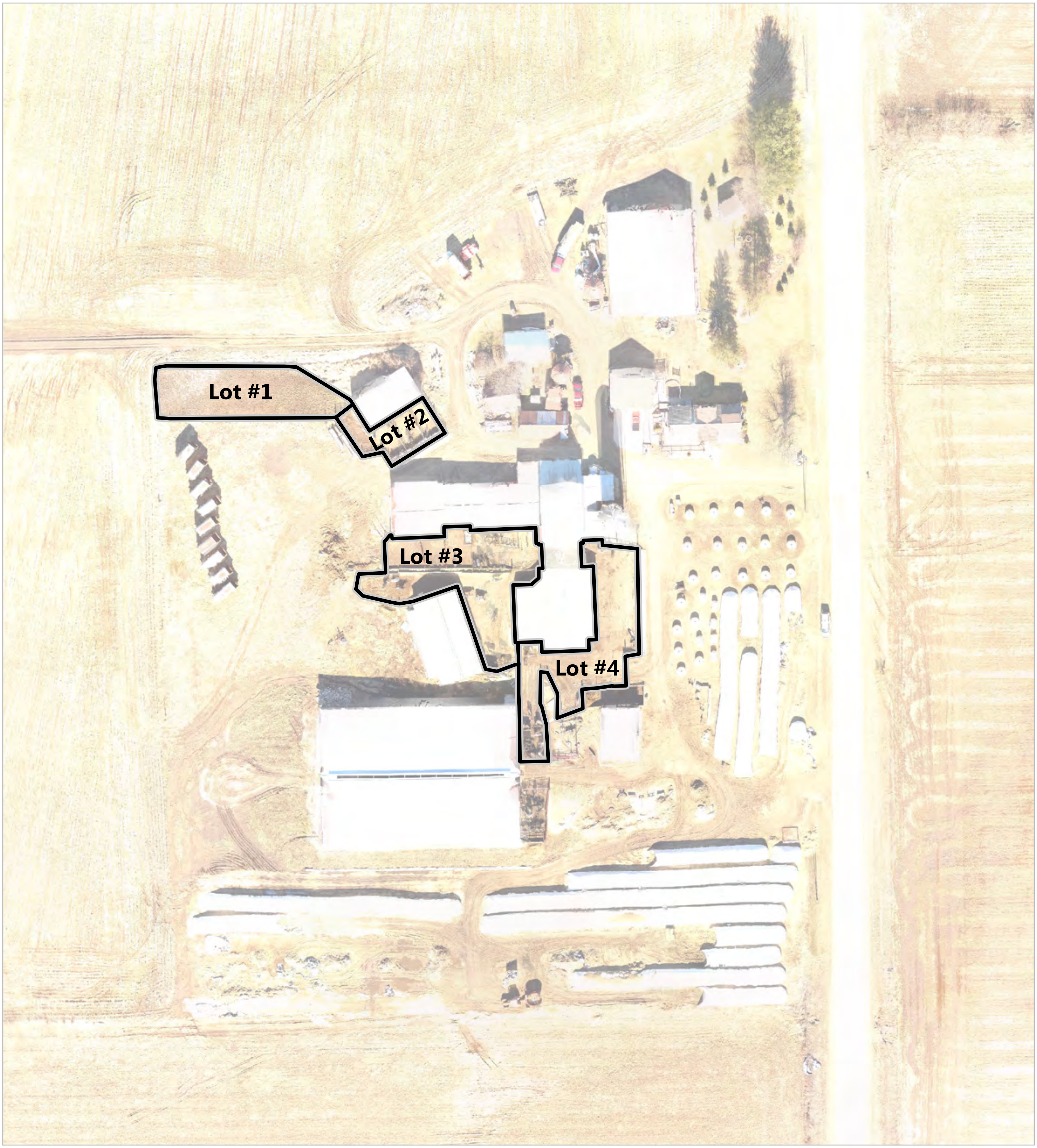

Figure 1
Map of barnyards operated by Landowner C

City of Brodhead
Green and Rock Counties, WI

Barnyard

Data Sources:
Basemap: MSA

0 50 100 Feet

MSA

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Figure 2: Photograph of Lot #1

Figure 3: Photograph of Lot #2

Figure 4: Photograph of Lot #3 (north end)

Figure 5: Photograph of Lot #3 (south end)

Figure 6: Photograph of Lot #4

1.2 METHODS

Input parameters for BARNY and APLE-Lots were estimated based on a walk over of the site and interviews with Landowner C. Input parameters for BARNY and APLE-Lots are shown below. Lot areas were estimated using measurements from aerial photographs and the results of a site survey. Because the landowner has made several recent modifications to the property, MSA staff used an Unmanned Aerial Vehicle (UAV) to develop a current aerial photograph of the property (see **Figure 1**). The UAV was also able to collect data to develop a 3-dimensional ground surface elevation model of the property. Building corners of the site were surveyed using a survey grade GPS. The resulting ground surface elevation model was used to estimate the tributary areas of each barnyard. Two soil samples were collected to determine the Mehlich 3 soil phosphorus concentration of Lot #1. Both samples were a composite sample of 10 soil cores which were collected in a "W-shaped" pattern across the lot as suggested in the University of Wisconsin-Extension document *A2100 Sampling Soils for Testing*. Both soil samples were sent to the University of Wisconsin Soil and Forage Analysis Lab in Marshfield, WI, for Mehlich 3 soil phosphorus analysis.

Input parameters for BARNY include:

- Closest City of Similar Climate (Madison, Appleton, Wausau, Eau Claire)
- Paved Lot Area
- Earth Lot Area
- Designed Settling Basin (yes or no)
- Number of Animals on Lot
- Type of Animal (Dairy or Beef)
- Average Animal Weight
- Lot Use (Heavy, Medium, or Light)
- Tributary Area of Roofs
- Tributary Area and Runoff Curve Number for Non-roofed Contributing Areas

Input parameters for APLE-Lots include:

- Mehlich 3 Soil Phosphorus Concentration (for earthen lots only)
- Lot Area
- Annual Precipitation
- Number of Cows per Day (number of animals x time on lot per day)
- Days Between Clean Outs
- Surface Type (paved or earth)
- Percent Vegetative Cover (for earthen lots only)

BARNY input parameters and edge-of-lot phosphorus losses for Lots #1, #2, #3, and #4 are shown in **Table 1** through **Table 4**, respectively. Screen captures of BARNY model results for each lot are also provided in **Figure 7** through **Figure 14** to verify the results. These tables and figures include inputs for baseline conditions (pre-BMP conditions) and projected conditions after BMP implementation (post-BMP conditions). Please note that phosphorus losses for the post-BMP conditions are only representative of the effects of abandoning lots, roofing lots or otherwise reducing lot area, and/or installing roof gutters to divert clean water. Therefore, these tables and figures do not account for the effects of installing waste reception tanks and waste transfer piping for Lots #2 and #3.

Table 1: BARNY inputs and edge-of-lot phosphorus loss for Lot #1

Parameter	Pre-BMP Conditions	Post-BMP Conditions
Closest City of Similar Climate	Madison	Madison
Paved Lot Area	0 ft^2	0 ft^2
Earth Lot Area	5,287 ft^2	5,287 ft^2
Designed Settling Basin	No	N/A
Lot Use	Heavy	N/A
Animals on Lot (Group #1)	18	0
Type of Animal (Group #1)	Dairy	N/A
Average Weight (Group #1)	600 lb	N/A
Animals on Lot (Group #2)	0	0
Type of Animal (Group #2)	N/A	N/A
Average Weight (Group #2)	N/A	N/A
Non-Roofed Tributary Area	7,827 ft^2	7,827 ft^2
Non-Roofed Area Curve Number	85	85
Roofed Tributary Area	1,265 ft^2	1,265 ft^2
Edge-of-Lot Phosphorus Loss	**22.9 lb/yr**	**0 lb/yr**

Pre-BMP Conditions LOT #1 (Based on BARNY)				
Farmer: Landowner C	Planner/Designer: AJS		Date:	3/31/18

	Input	Output		
			1 Madison	
			2 Appleton	
Closest City of similar climate:	1		3 Wausau	
			4 Eau Claire	
Paved lot area:	0		sq ft	
Earth lot area:	5,287		sq ft	Clear Data Cells
Animal Lot size:		5,287	sq ft	
Is there a designed settling basin?	2		Yes= 1; No= 2	

Animals on lot:	18	number		number	
Type of animal:	1				(Dairy = 1;Beef=2)
Ave. Animal Weight:	600	lbs		lbs	
Lot Use:	1				1= Heavy;2=Med;3= Light)

TRIBUTARY AREAS

Tributary area:	7,827	sq ft		sq ft	
Runoff Curve Number:	85			←	See RCN tab below for typical values
Roof Trib. area:	1,265	sq ft			
					22.9 lbs P per year at downstream lot edge

Figure 7: Screen capture of BARNY model for Lot #1 (Pre-BMP Conditions)

Post-BMP Conditions LOT #1 (Based on BARNY)

Farmer: Landowner C Planner/Designer: AJS Date: 3/31/18

	Input	Output		
				1 Madison
				2 Appleton
Closest City of similar climate:	1			3 Wausau
				4 Eau Claire
Paved lot area:	0		sq ft	
Earth lot area:	5,287		sq ft	Clear Data Cells
Animal Lot size:		5,287	sq ft	
Is there a designed settling basin?	2		Yes= 1; No= 2	

	Input		Output		
Animals on lot:	0	number		number	
Type of animal:	1				(Dairy = 1;Beef=2)
Ave. Animal Weight:	600	lbs		lbs	
Lot Use:	1				1= Heavy;2=Med;3= Light)

TRIBUTARY AREAS

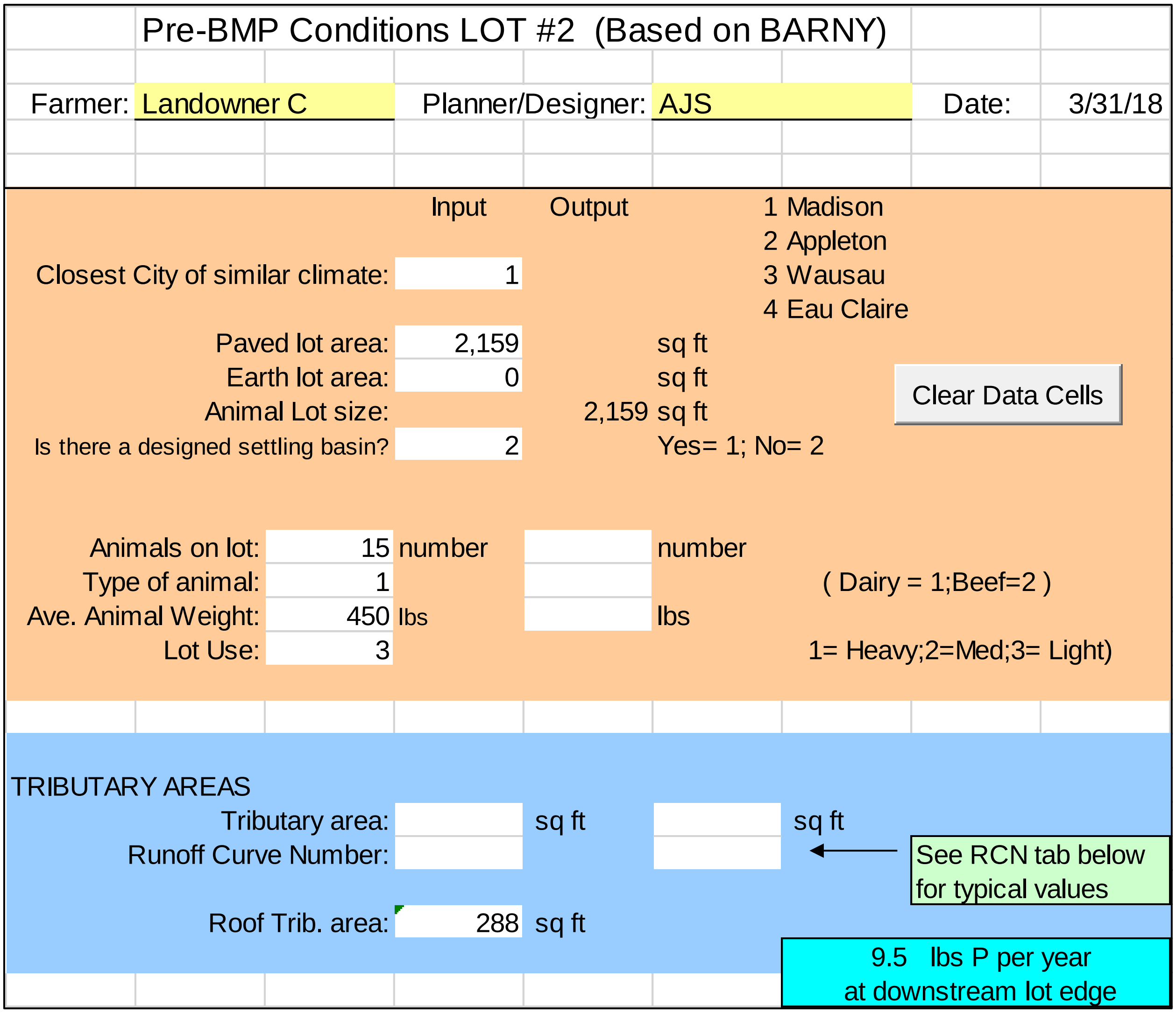
	Input		Output		
Tributary area:	7,827	sq ft		sq ft	
Runoff Curve Number:	85			←	See RCN tab below for typical values
Roof Trib. area:	1,265	sq ft			

0.0 lbs P per year
at downstream lot edge

Figure 8: Screen capture of BARNY model for Lot #1 (Post-BMP Conditions)

Table 2: BARNY inputs and edge-of-lot phosphorus loss for Lot #2

Parameter	Pre-BMP Conditions	Post-BMP Conditions
Closest City of Similar Climate	Madison	Madison
Paved Lot Area	2,159 ft^2	1,536 ft^2
Earth Lot Area	0 ft^2	0 ft^2
Designed Settling Basin	No	No
Lot Use	Light	Light
Animals on Lot (Group #1)	15	15
Type of Animal (Group #1)	Dairy	Dairy
Average Weight (Group #1)	450 lb	450 lb
Animals on Lot (Group #2)	0	0
Type of Animal (Group #2)	N/A	N/A
Average Weight (Group #2)	N/A	N/A
Non-Roofed Tributary Area	0 ft^2	0 ft^2
Non-Roofed Area Curve Number	N/A	N/A
Roofed Tributary Area	288 ft^2	288 ft^2
Edge-of-Lot Phosphorus Loss	**9.5 lb/yr**	**8.1 lb/yr**



Pre-BMP Conditions LOT #2 (Based on BARNY)

Farmer: Landowner C | Planner/Designer: AJS | Date: 3/31/18

	Input	Output		
				1 Madison
				2 Appleton
Closest City of similar climate:	1			3 Wausau
				4 Eau Claire
Paved lot area:	2,159		sq ft	
Earth lot area:	0		sq ft	Clear Data Cells
Animal Lot size:		2,159	sq ft	
Is there a designed settling basin?	2		Yes= 1; No= 2	

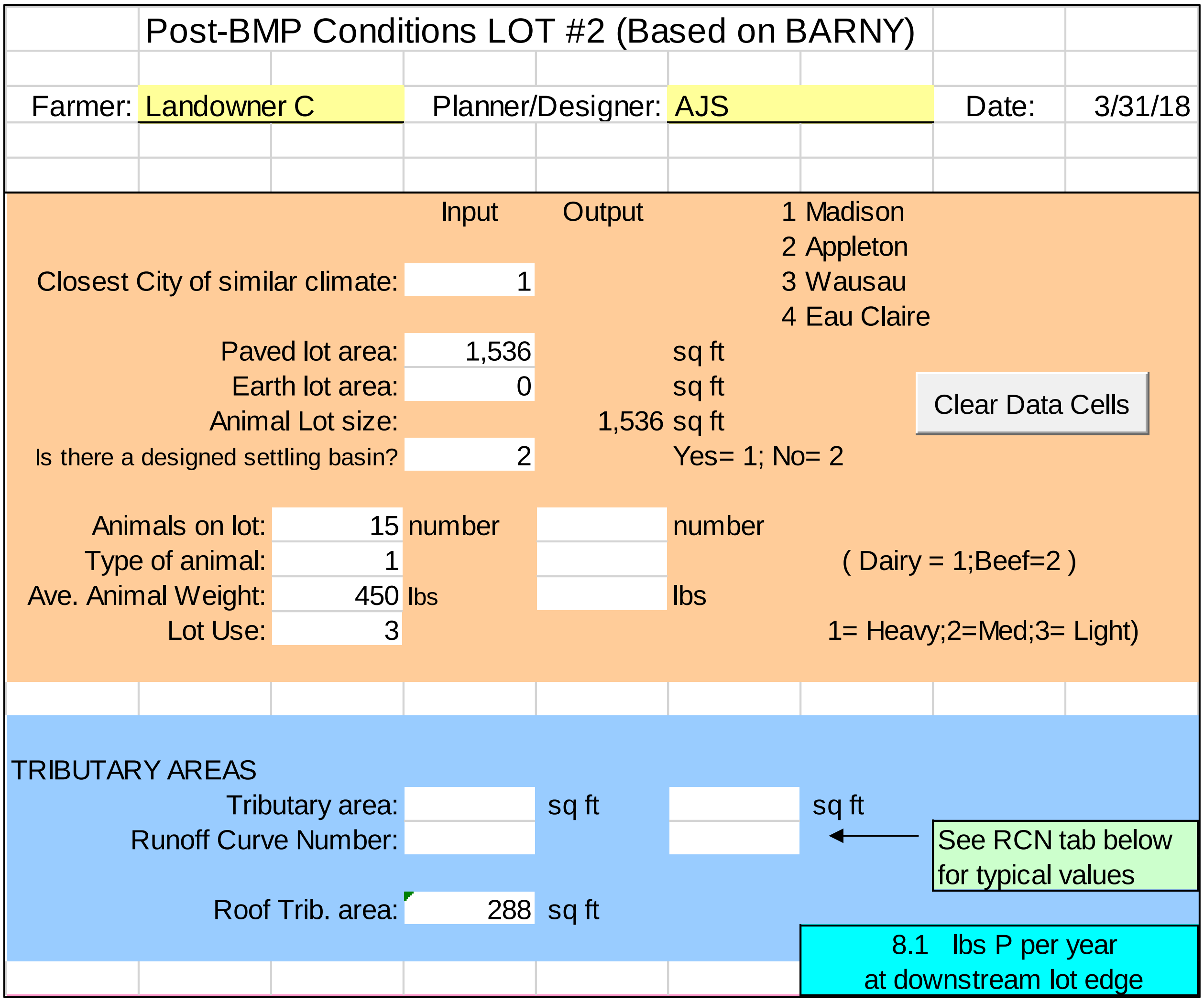
	Input		Output		
Animals on lot:	15	number		number	
Type of animal:	1				(Dairy = 1;Beef=2)
Ave. Animal Weight:	450	lbs		lbs	
Lot Use:	3				1= Heavy;2=Med;3= Light)

TRIBUTARY AREAS

Tributary area:		sq ft		sq ft
Runoff Curve Number:				See RCN tab below for typical values
Roof Trib. area:	288	sq ft		

9.5 lbs P per year
at downstream lot edge

Figure 9: Screen capture of BARNY model for Lot #2 (Pre-BMP Conditions)



Post-BMP Conditions LOT #2 (Based on BARNY)

Farmer: Landowner C Planner/Designer: AJS Date: 3/31/18

	Input	Output		
				1 Madison
				2 Appleton
Closest City of similar climate:	1			3 Wausau
				4 Eau Claire
Paved lot area:	1,536		sq ft	
Earth lot area:	0		sq ft	Clear Data Cells
Animal Lot size:		1,536	sq ft	
Is there a designed settling basin?	2		Yes= 1; No= 2	

Animals on lot:	15	number		number	
Type of animal:	1				(Dairy = 1;Beef=2)
Ave. Animal Weight:	450	lbs		lbs	
Lot Use:	3				1= Heavy;2=Med;3= Light)

TRIBUTARY AREAS

Tributary area:		sq ft		sq ft
Runoff Curve Number:				See RCN tab below for typical values
Roof Trib. area:	288	sq ft		

8.1 lbs P per year at downstream lot edge

Figure 10: Screen capture of BARNY model for Lot #2 (Post-BMP Conditions)

Table 3: BARNY inputs and edge-of-lot phosphorus loss for Lot #3

Parameter	Pre-BMP Conditions	Post-BMP Conditions
Closest City of Similar Climate	Madison	Madison
Paved Lot Area	7,825 ft^2	6,401 ft^2
Earth Lot Area	0 ft^2	0 ft^2
Designed Settling Basin	No	No
Lot Use	Heavy	Heavy
Animals on Lot (Group #1)	40	54
Type of Animal (Group #1)	Dairy	Dairy
Average Weight (Group #1)	800 lb	800 lb
Animals on Lot (Group #2)	45	45
Type of Animal (Group #2)	Dairy	Dairy
Average Weight (Group #2)	1,400 lb	1,400 lb
Non-Roofed Tributary Area	0 ft^2	0 ft^2
Non-Roofed Area Curve Number	N/A	N/A
Roofed Tributary Area	6,019 ft^2	0 ft^2
Edge-of-Lot Phosphorus Loss	**100.1 lb/yr**	**37.2 lb/yr**

Pre-BMP Conditions LOT #3 (Based on BARNY)					
Farmer:	Landowner C	Planner/Designer:	AJS	Date:	3/31/18

	Input		Output		
					1 Madison
					2 Appleton
Closest City of similar climate:	1				3 Wausau
					4 Eau Claire
Paved lot area:	7,825			sq ft	
Earth lot area:	0			sq ft	Clear Data Cells
Animal Lot size:			7,825	sq ft	
Is there a designed settling basin?	2			Yes= 1; No= 2	
Animals on lot:	40	number	45	number	
Type of animal:	1		1		(Dairy = 1;Beef=2)
Ave. Animal Weight:	800	lbs	1,400	lbs	
Lot Use:	1				1= Heavy;2=Med;3= Light)

TRIBUTARY AREAS					
Tributary area:	0	sq ft		sq ft	
Runoff Curve Number:				←	See RCN tab below for typical values
Roof Trib. area:	6,019	sq ft			
					100.1 lbs P per year at downstream lot edge

Figure 11: Screen capture of BARNY model for Lot #3 (Pre-BMP Conditions)

Post-BMP Conditions LOT #3 (Based on BARNY)

Farmer:	Landowner C	Planner/Designer:	AJS	Date: 3/31/18

	Input	Output		
				1 Madison
				2 Appleton
Closest City of similar climate:	1			3 Wausau
				4 Eau Claire
Paved lot area:	6,401		sq ft	
Earth lot area:	0		sq ft	Clear Data Cells
Animal Lot size:		6,401	sq ft	
Is there a designed settling basin?	2		Yes= 1; No= 2	

	Input		Output		
Animals on lot:	54	number	45	number	
Type of animal:	1		1		(Dairy = 1;Beef=2)
Ave. Animal Weight:	800	lbs	1,400	lbs	
Lot Use:	1				1= Heavy;2=Med;3= Light)

TRIBUTARY AREAS

Tributary area:	0	sq ft		sq ft	
Runoff Curve Number:				←	See RCN tab below for typical values
Roof Trib. area:	0	sq ft			
					37.2 lbs P per year at downstream lot edge

Figure 12: Screen capture of BARNY model for Lot #3 (Post-BMP Conditions)

Table 4: BARNY inputs and edge-of-lot phosphorus loss for Lot #4

Parameter	Pre-BMP Conditions	Post-BMP Conditions
Closest City of Similar Climate	Madison	Madison
Paved Lot Area	6,710 ft^2	904 ft^2
Earth Lot Area	0 ft^2	0 ft^2
Designed Settling Basin	No	No
Lot Use	Medium	Medium
Animals on Lot (Group #1)	85	85
Type of Animal (Group #1)	Dairy	Dairy
Average Weight (Group #1)	1,400 lb	1,400 lb
Animals on Lot (Group #2)	0	0
Type of Animal (Group #2)	N/A	N/A
Average Weight (Group #2)	N/A	N/A
Non-Roofed Tributary Area	174 ft^2	0 ft^2
Non-Roofed Area Curve Number	91	91
Roofed Tributary Area	3,894 ft^2	0 ft^2
Edge-of-Lot Phosphorus Loss	**63.7 lb/yr**	**4.5 lb/yr**

Pre-BMP Conditions LOT #4 (Based on BARNY)

Farmer: Landowner C | Planner/Designer: AJS | Date: 3/31/18

	Input	Output	
Closest City of similar climate:	1		1 Madison 2 Appleton 3 Wausau 4 Eau Claire
Paved lot area:	6,710		sq ft
Earth lot area:	0		sq ft
Animal Lot size:		6,710	sq ft
Is there a designed settling basin?	2		Yes= 1; No= 2

Clear Data Cells

	Input		Output		
Animals on lot:	85	number		number	
Type of animal:	1				(Dairy = 1;Beef=2)
Ave. Animal Weight:	1,400	lbs		lbs	
Lot Use:	2				1= Heavy;2=Med;3= Light)

TRIBUTARY AREAS

	Input		Output		
Tributary area:	174	sq ft		sq ft	
Runoff Curve Number:	91				See RCN tab below for typical values
Roof Trib. area:	3,894	sq ft			

63.7 lbs P per year at downstream lot edge

Figure 13: Screen capture of BARNY model for Lot #4 (Pre-BMP Conditions)

Post-BMP Conditions LOT #4 (Based on BARNY)				
Farmer:	Landowner C	Planner/Designer:	AJS	Date: 3/31/18

	Input	Output		
				1 Madison
				2 Appleton
Closest City of similar climate:	1			3 Wausau
				4 Eau Claire
Paved lot area:	904		sq ft	
Earth lot area:	0		sq ft	Clear Data Cells
Animal Lot size:		904	sq ft	
Is there a designed settling basin?	2		Yes= 1; No= 2	

Animals on lot:	85	number		number	
Type of animal:	1				(Dairy = 1;Beef=2)
Ave. Animal Weight:	1,400	lbs		lbs	
Lot Use:	2				1= Heavy;2=Med;3= Light)

TRIBUTARY AREAS

Tributary area:	0	sq ft		sq ft	
Runoff Curve Number:	91			←	See RCN tab below for typical values
Roof Trib. area:	0	sq ft			

4.5 lbs P per year at downstream lot edge

Figure 14: Screen capture of BARNY model for Lot #4 (Post-BMP Conditions)

Input parameters and modeled edge-of-lot phosphorus losses from the APLE-Lots model are shown in **Table 5**. Screen captures of model results are also shown in **Figure 15** through **Figure 18**. Please note that edge-of-lot phosphorus losses from the APLE-Lots model are in the units of lb/ac/yr not lb/yr like BARNY. In order to convert these losses into lb/yr, it is necessary to multiply the lot area (acres) by the annual rate of phosphorus loss (lb/ac/yr).

Table 5: APLE-Lots inputs and pre-BMP edge-of-lot phosphorus losses for Lots #1, #2, #3, #4

Parameter	Lot #1	Lot #2	Lot #3	Lot #4
Mehlich 3 Soil P	483	N/A	N/A	N/A
Lot Area	0.12 ac	0.05 ac	0.18 ac	0.15 ac
Annual Precipitation	36.75 in	36.75 in	36.75 in	36.75 in
Number of Milk Cows per Day	0	0	0	10.63
Number of Heifers per Day	6.75	4.22	20.00	0
Number of Dry Cows per Day	0	0	22.50	0
Number of Dairy Calves per Day	0	0	0	0
Days Between Clean Outs	365	10.5	10.5	10.5
Surface Type	Earth	Paved	Paved	Paved
Percent Lot Vegetative Cover	0 %	0 %	0 %	0 %
Edge-of-Lot Phosphorus Loss	**23.9 lb/yr**	**12.1 lb/yr**	**132.1 lb/yr**	**111.6 lb/yr**

APLE - Lots

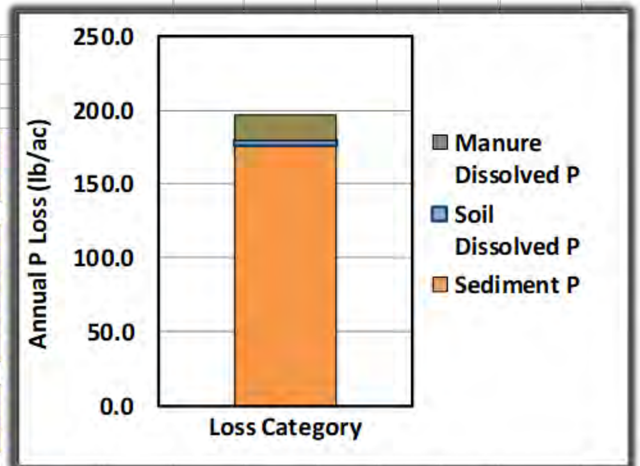
Annual P Loss Estimator for Cattle Lots

Fill-In Values

Mehlich 3 Soil P	ppm	483
Lot Area	Acres	0.12
Annual Precipitation	inches	36.75

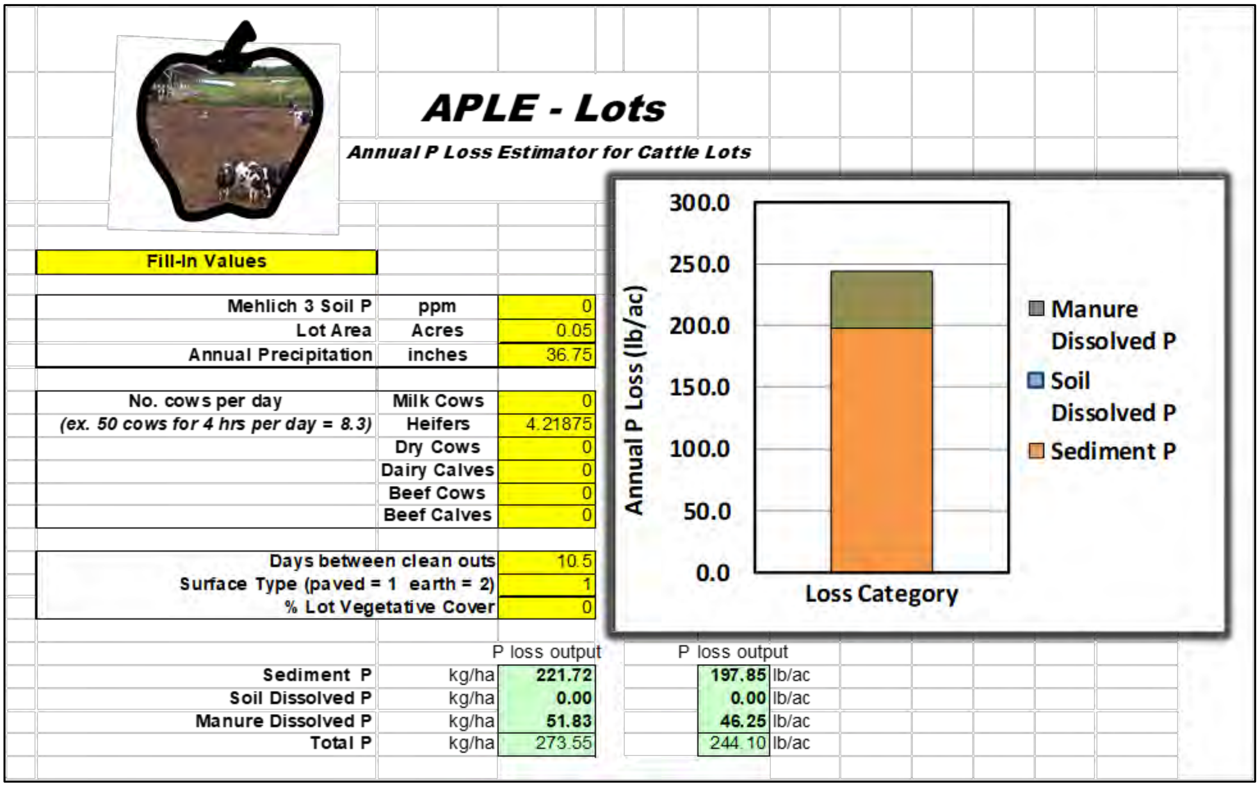
No. cows per day	Milk Cows	0
(ex. 50 cows for 4 hrs per day = 8.3)	Heifers	6.75
	Dry Cows	0
	Dairy Calves	0
	Beef Cows	0
	Beef Calves	0

Days between clean outs	365
Surface Type (paved = 1 earth = 2)	2
% Lot Vegetative Cover	0



		P loss output	P loss output	
Sediment P	kg/ha	196.85	175.66	lb/ac
Soil Dissolved P	kg/ha	4.35	3.88	lb/ac
Manure Dissolved P	kg/ha	19.64	17.53	lb/ac
Total P	kg/ha	220.85	197.08	lb/ac

Figure 15: Screen capture of APLE-Lots model for Lot #1 (Pre-BMP Conditions)



APLE - Lots

Annual P Loss Estimator for Cattle Lots

Fill-In Values

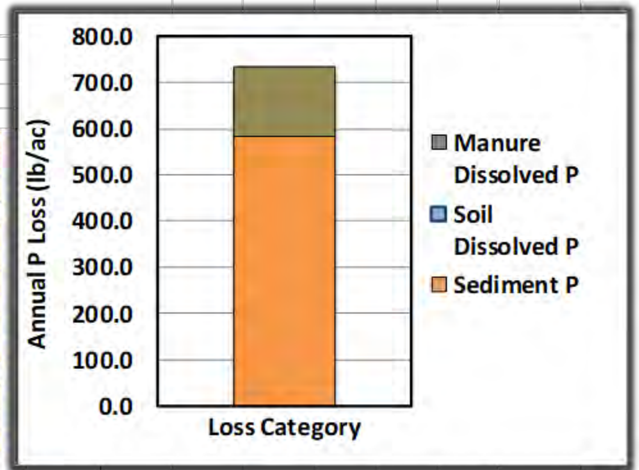
Mehlich 3 Soil P	ppm	0
Lot Area	Acres	0.05
Annual Precipitation	inches	36.75
No. cows per day *(ex. 50 cows for 4 hrs per day = 8.3)*	Milk Cows	0
	Heifers	4.21875
	Dry Cows	0
	Dairy Calves	0
	Beef Cows	0
	Beef Calves	0
Days between clean outs		10.5
Surface Type (paved = 1 earth = 2)		1
% Lot Vegetative Cover		0

		P loss output	P loss output	
Sediment P	kg/ha	221.72	197.85	lb/ac
Soil Dissolved P	kg/ha	0.00	0.00	lb/ac
Manure Dissolved P	kg/ha	51.83	46.25	lb/ac
Total P	kg/ha	273.55	244.10	lb/ac

Figure 16: Screen capture of APLE-Lots model for Lot #2 (Pre-BMP Conditions)

APLE - Lots

Annual P Loss Estimator for Cattle Lots



Fill-In Values

Mehlich 3 Soil P	**ppm**	0
Lot Area	**Acres**	0.18
Annual Precipitation	**inches**	36.75
No. cows per day	**Milk Cows**	0
(ex. 50 cows for 4 hrs per day = 8.3)	**Heifers**	20
	Dry Cows	22.5
	Dairy Calves	0
	Beef Cows	0
	Beef Calves	0
Days between clean outs		10.5
Surface Type (paved = 1 earth = 2)		1
% Lot Vegetative Cover		0

		P loss output	P loss output	
Sediment P	kg/ha	**653.64**	**583.27**	lb/ac
Soil Dissolved P	kg/ha	**0.00**	**0.00**	lb/ac
Manure Dissolved P	kg/ha	**170.64**	**152.27**	lb/ac
Total P	kg/ha	824.28	735.55	lb/ac

Figure 17: Screen capture of APLE-Lots model for Lot #3 (Pre-BMP Conditions)

APLE - Lots

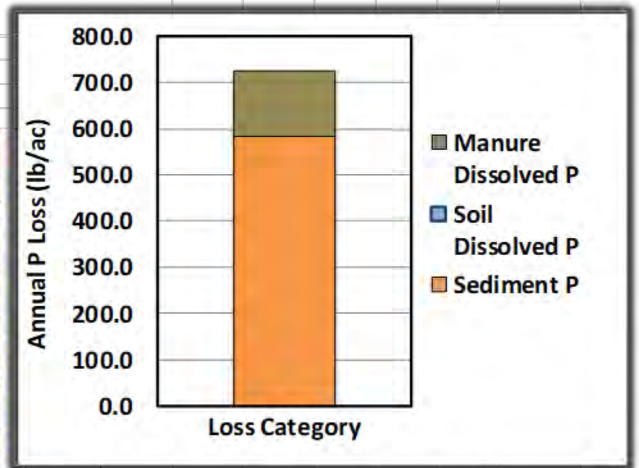
Annual P Loss Estimator for Cattle Lots

Fill-In Values

Mehlich 3 Soil P	**ppm**	0
Lot Area	**Acres**	0.15
Annual Precipitation	**inches**	36.75

No. cows per day	**Milk Cows**	10.625
(ex. 50 cows for 4 hrs per day = 8.3)	**Heifers**	0
	Dry Cows	0
	Dairy Calves	0
	Beef Cows	0
	Beef Calves	0

Days between clean outs	10.5
Surface Type (paved = 1 earth = 2)	1
% Lot Vegetative Cover	0



		P loss output	P loss output	
Sediment P	kg/ha	**652.60**	**582.35**	lb/ac
Soil Dissolved P	kg/ha	**0.00**	**0.00**	lb/ac
Manure Dissolved P	kg/ha	**159.27**	**142.12**	lb/ac
Total P	kg/ha	811.87	724.47	lb/ac

Figure 18: Screen capture of APLE-Lots model for Lot #4 (Pre-BMP Conditions)

1.3 RESULTS

A summary of the BARNY and APLE-Lots modeling results is shown in **Table 6**. Pre-BMP edge-of-lot phosphorus losses for both BARNY and APLE-Lots are graphically compared in **Figure 19**. Based on the results, it appears that BARNY may underestimate phosphorus loss for the two larger phosphorus exporting barnyards (Lots #3 and #4), similar to the findings of Vadas et al., 2015. This suggests that BARNY provides a more conservative estimate of phosphorus loss from the modeled barnyards, and therefore, using BARNY for the purposes of modeling phosphorus reductions should not overestimate the amount of credits which could be generated by Landowner C. This supports the conclusion that BARNY is an acceptable model for estimating phosphorus credits for Brodhead's WQT Plan.

As shown in **Table 6**, a total of 79.9 lb/yr of phosphorus credit is expected to be generated as a result of implementing the proposed barnyard improvements for Landowner C. Phosphorus credits were quantified by dividing the phosphorus reductions simulated in BARNY by the applicable trade ratio for each lot. It is important to note that the estimated phosphorus reductions in this table are only representative of the effects of abandoning lots, roofing lots or otherwise reducing lot area, and/or installing roof gutters to divert clean water. Therefore, the phosphorus reductions in this table do not account for the effects of installing waste reception tanks and waste transfer piping for Lots #2 and #3 to achieve "zero discharge" conditions. As previously stated, the additional phosphorus which is expected to be removed by achieving "zero discharge" for these lots was not included in phosphorus credit calculations to provide added conservative in the modeling results**.**

Table 6: Summary of BARNY and APLE-Lots modeling results

Barnyard ID	P Output Pre-BMP APLE-LOTS (lb/yr)	P Output Pre-BMP BARNY (lb/yr)	P Output Post-BMP BARNY (lb/yr)	P Reduction BARNY (lb/yr)	Trade Ratio	P Credits (lb/yr)	Proposed BMPs
Lot #1	23.9	22.9	0.0	22.9	1.20	19.1	Lot abandonment, critical area planting, and conservation easement
Lot #2	12.1	9.5	8.1	1.4	2.03	0.7	Reduce lot size, install waste reception tank, and install waste transfer piping
Lot #3	132.1	100.1	37.2	62.9	2.03	31.0	Reduce lot size, install roof runoff structures, install waste reception tank, and install waste transfer piping
Lot #4	111.6	63.7	4.5	59.2	2.03	29.2	Install roof cover (122' x 116'), install roof runoff structures, install waste reception tank, and install waste transfer piping
Total	**279.7**	**196.2**	**49.8**	**146.4**	**-**	**79.9**	**-**

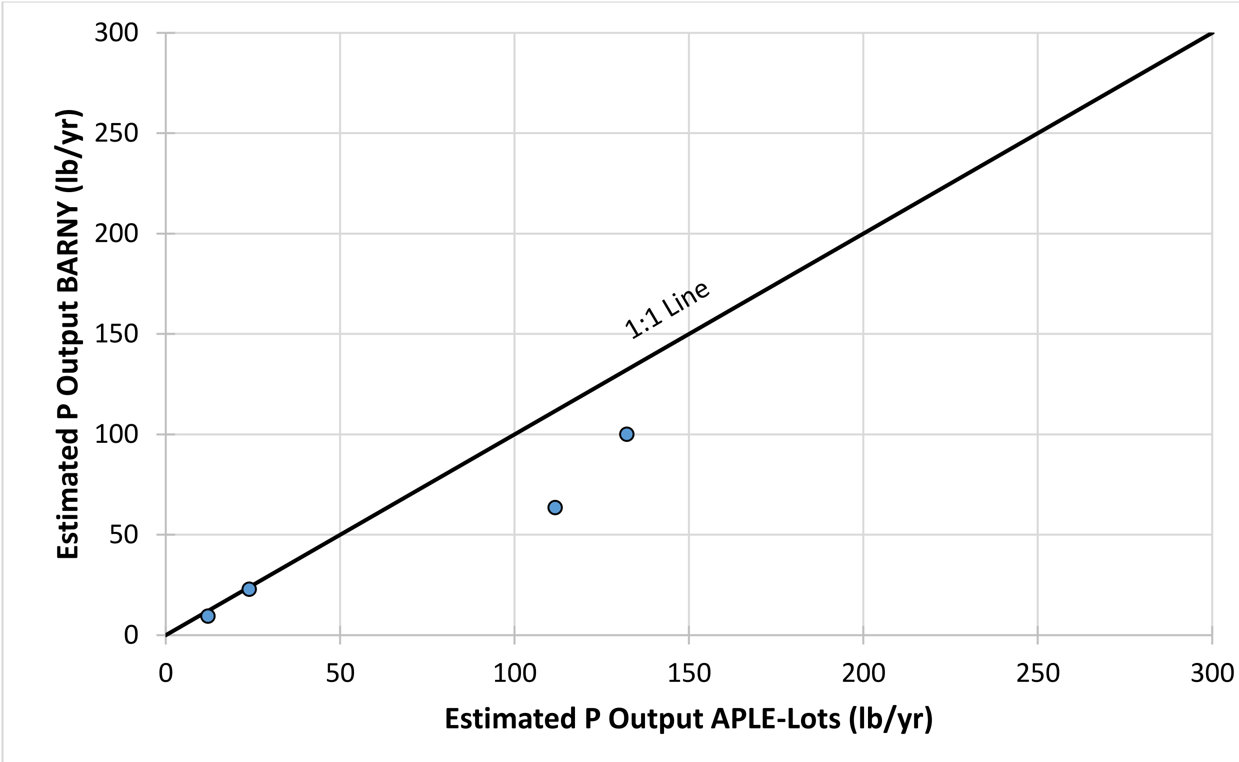


Figure 19: Graphical comparison of BARNY and APLE-Lots results for pre-BMP conditions

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APPENDIX F

SnapPlus Modeling Overview

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APPENDIX F

SNAPPLUS MODELING OVERVIEW

1.1 BACKGROUND

The City of Brodhead plans to generate phosphorus credits through improved nutrient management of crop lands owned and rented by Landowner C. The preferred method for quantifying phosphorus reductions from nutrient management and supporting practices is Wisconsin's SnapPlus model. SnapPlus (Soil Nutrient Application Planner) is a publically available computer software program that was developed by researchers at the University of Wisconsin - Madison Department of Soil Science. The model was specifically created to help agricultural producers, crop consultants, and regulators develop Nutrient Management Plans in accordance with Wisconsin's NRCS 590 Nutrient Management Standard. The purpose of a Nutrient Management Plan is to aid an agricultural producer in selecting the proper amount, source, placement, form, and timing of nutrient applications on their farm. The primary goals of Nutrient Management Planning are to optimize the economic return from nutrient applications, promote soil conservation, and to protect the water quality of nearby water resources.

Nutrient recommendations in SnapPlus are made on a field-by-field basis for N, P_2O_5, and K_2O using recommendations from the University of Wisconsin – Extension Publication A2809. Inputs to SnapPlus include field slope, soil type, soil sampling results, crop rotations, tillage practices, and manure and fertilizer applications. SnapPlus uses these inputs and incorporates several models, including the Revised Soil Loss Equation Version 2 (RUSLE2) and the Wisconsin Phosphorus Index (PI), to estimate average annual sediment and phosphorus loadings from crop fields and pastures. Specifically, SnapPlus can be used to model phosphorus reductions from reduced tillage practices, contour farming, contour strip cropping, contour buffer strips, edge-of-field filter strips, manure incorporation, cover crops, etc. Phosphorus reductions for BMPs are estimated using the "*P Trade Report*" in SnapPlus. The P Trade Report estimates the annual mass of phosphorus [lb/yr] which is likely to be transferred from the field to nearby surface waters based on a field's predominant soil type, soil test phosphorus concentration, crop rotation, tillage, and other nutrient management practices. The model only estimates losses from sheet and rill erosion. Losses from concentrated flow areas or gully erosion are not included in the calculations.

A list of fields which were modeled in SnapPlus are shown in **Table 1**. These are all the fields which Landowner C owns, rents, or otherwise applies manure. As shown, the landowner owns approximately 70 acres of cropland, rents another 111 acres, and applies manure to another 373 acres. The farm operator has been actively using SNAP-Plus to track field operations since 2016 and has worked with Green County LWCD to update the farm's SNAP-Plus model (see email from Green County LWCD at the end of this appendix). The farm's cropping system is typical of a dairy operation, and includes crops such as corn grain, corn silage, alfalfa, winter wheat, and soybeans. Tillage of fields is typically done in spring with a chisel plow.

Landowner C currently has difficulty complying with nutrient management requirements (e.g. tolerable soil loss and phosphorus index). Because the farm lacks long-term manure storage, it is difficult for Landowner C to find farm operators who are willing to accept manure from the farm because Landowner C must haul manure weekly or biweekly, and many farm operators only want to apply manure during ideal times for crop production (e.g. spring and fall). As a result, excess manure has been applied to the crop fields owned by Landowner C, and manure applications in the winter to frozen or snow covered ground have been common. Another issue is that Landowner C does not control cropping practices on fields in **Table 1** listed as "manure only." These fields are operated by other landowners. Because the landowner does not control these fields, "manure only" fields may not be properly modeled in SnapPlus due to the lack of sufficient soil test information or fertilizer application data. It is also uncertain if these fields comply with NRCS 590 standards. Because the landowner does not control these fields and the majority of the rented ground is located in ineligible watersheds for trading, the City of Brodhead currently only intends to generate phosphorus credits from the fields owned by Landowner C. Landowner C is currently working to develop a fully compliant nutrient management plan as part of an NRCS EQIP application that will be submitted in the fall of 2018. Therefore, some changes to the nutrient management plan will be made between the time of this submittal and the time of management practice registration in the year 2019. The changes will eliminate the current uncertainty regarding Landowner C's compliance with nutrient management standards on fields listed as "manure only."

Maps and pictures of crop fields currently included in Landowner C's nutrient management plan are shown in **Figure 1** through **Figure 25**. Maps of the crop fields indicate field boundaries, topographic information, the location of existing grassed waterways, locations where photos were taken during site walkovers, and EVAAL modeling results.

All fields owned and rented by the Landowner C were evaluated for gully erosion during a site walkover on May 24, 2017. During that walkover, no signs of gully erosion were present. This was an ideal time to evaluate fields for signs of gully erosion since planted row crops were not actively growing and rainfall had occurred each day for seven days prior to the walkover. Pictures taken at the time of the walkover are included with the maps of the crop fields below. Pictures were generally taken in areas most likely to exhibit gully erosion at each site based on topography. For comparison purposes, EVAAL modeling results for each field have been provided to evaluate the potential locations where gully erosion may be most likely to occur. Throughout the implementation of this WQT Plan these areas modeled as vulnerable to gully erosion will be annually inspected to verify that gully erosion does not occur and/or to identify locations where grassed waterways must be installed to prevent gully erosion. Fields listed as "manure only" in **Table 1** have not yet been reviewed for gully erosion since it is likely that some of these fields will not be included in Landowner C's nutrient management plan which is being developed for NRCS EQIP submittal in fall 2018. Please note that EVAAL modeling results for Fields T1, T2, T3, and T4 are not available since the EVAAL model was not developed for areas outside of the final WQT Action Area. Despite not having EVAAL data for these fields, Fields T1, T2, T3, and T4 are generally the flattest of all the fields currently incorporated in the nutrient management plan (slopes 0-2%) and are believed to be the least prone to gully erosion of all fields currently listed.

Table 1: List of all crop fields currently included in Landowner C's nutrient management plan

Field ID	Acreage	HUC 12 Watershed	Management	Existing Grassed Waterways	Existing Gully Erosion
3	14.45	Searles Creek	Owned	Yes[1]	No
30	2.75	Searles Creek	Owned	Yes[1]	No
31	2.31	Searles Creek	Owned	Yes[1]	No
32.33	5.83	Searles Creek	Owned	Yes[1]	No
36	3.42	Searles Creek	Owned	Yes[1]	No
38	5.84	Searles Creek	Owned	Yes[1]	No
40	6.29	Searles Creek	Owned	Yes[1]	No
41	5.57	Searles Creek	Owned	Yes[1]	No
43	2.79	Searles Creek	Owned	Yes[1]	No
45	3.08	Searles Creek	Owned	Yes[1]	No
47	3.34	Searles Creek	Owned	Yes[1]	No
5	5.15	Searles Creek	Owned	Yes[1]	No
61-62	1.91	Searles Creek	Owned	Yes[1]	No
7.8	7.05	Searles Creek	Owned	Yes[1]	No
E1	88.90	Searles Creek	Manure Only	Not Reviewed	Not Reviewed
E2	74.20	Searles Creek	Manure Only	Not Reviewed	Not Reviewed
GA	18.80	Searles Creek	Manure Only	Not Reviewed	Not Reviewed
GO	39.00	Searles Creek	Manure Only	Not Reviewed	Not Reviewed
KL1	10.90	Searles Creek	Manure Only	Not Reviewed	Not Reviewed
KL2	22.30	Searles Creek	Manure Only	Not Reviewed	Not Reviewed
KL3	21.00	Searles Creek	Manure Only	Not Reviewed	Not Reviewed
KL4	20.40	Searles Creek	Manure Only	Not Reviewed	Not Reviewed
KL5	39.90	Searles Creek	Manure Only	Not Reviewed	Not Reviewed
KL6	37.90	Searles Creek	Manure Only	Not Reviewed	Not Reviewed
KO	22.80	Decatur Lake & Sugar Creek	Rented	No	No
SL2	7.80	Sylvester Creek	Rented	No	No
SL3	12.40	Sylvester Creek	Rented	No	No
SL	13.20	Sylvester Creek	Rented	No	No
T1	20.60	Taylor Creek	Rented	No	No
T2	18.20	Taylor Creek	Rented	No	No
T3	5.30	Taylor Creek	Rented	No	No
T4	10.70	Taylor Creek	Rented	No	No
Total	**554.08**				

[1]*Existing grassed waterways present but were not designed or constructed in accordance with NRCS standards. Although not designed to standard, no observable gully erosion was apparent when reviewed during field walkovers. Since these waterways are not designed to standard, the trade ratio uncertainty factor for these fields will currently be assumed to be not less than 3.0.*

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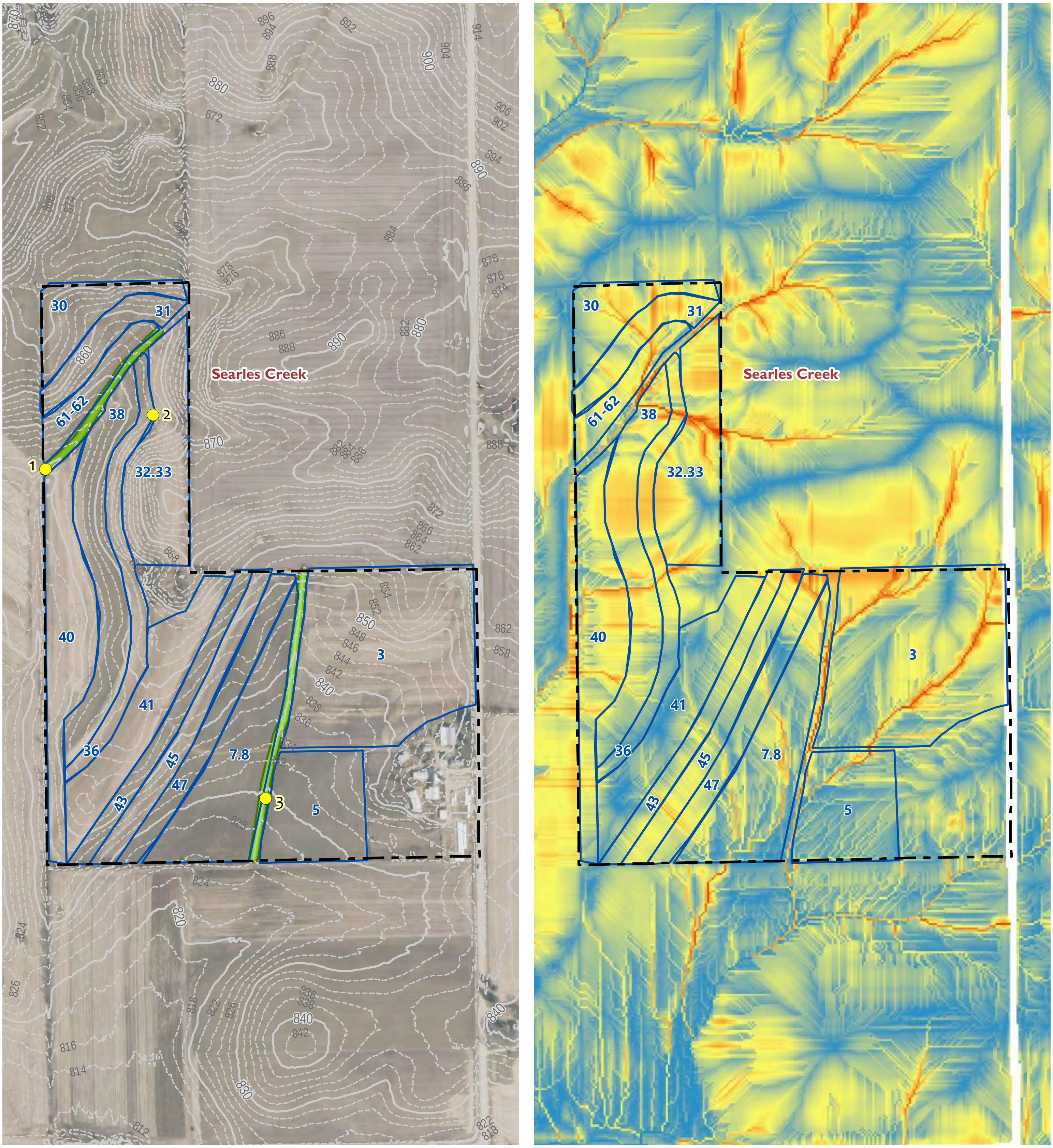

Figure 1

Map of crop fields 3-7.8 owned by Landowner C

City of Brodhead
Green and Rock Counties, WI

Data Sources:
Aerial: WROC (2010)

Grouped Parcels
FieldBoundaries
Grassed Waterway
HUC12 Watershed
Site Photo Location
10-ft contour
2-ft contour

EVAAL Results: Searless Creek
High
Low

EVAAL Results: Decatur Lake Sugar Creek
High
Low

0 290 580 Feet

MSA

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Figure 2: Photo of existing grassed waterway facing upslope at Site Photo Location #1 (see Figure 1)

Figure 3: Photo of existing grassed waterway facing downslope at Site Photo Location #1 (see Figure 1)

Figure 4: Photo of facing upslope at Site Photo Location #2 (see Figure 1)

Figure 5: Photo of facing downslope at Site Photo Location #2 (see Figure 1)

Figure 6: Photo of existing grassed waterway facing upslope at Site Photo Location #3 (see Figure 1)

Figure 7: Photo of existing grassed waterway facing downslope at Site Photo Location #3 (see Figure 1)

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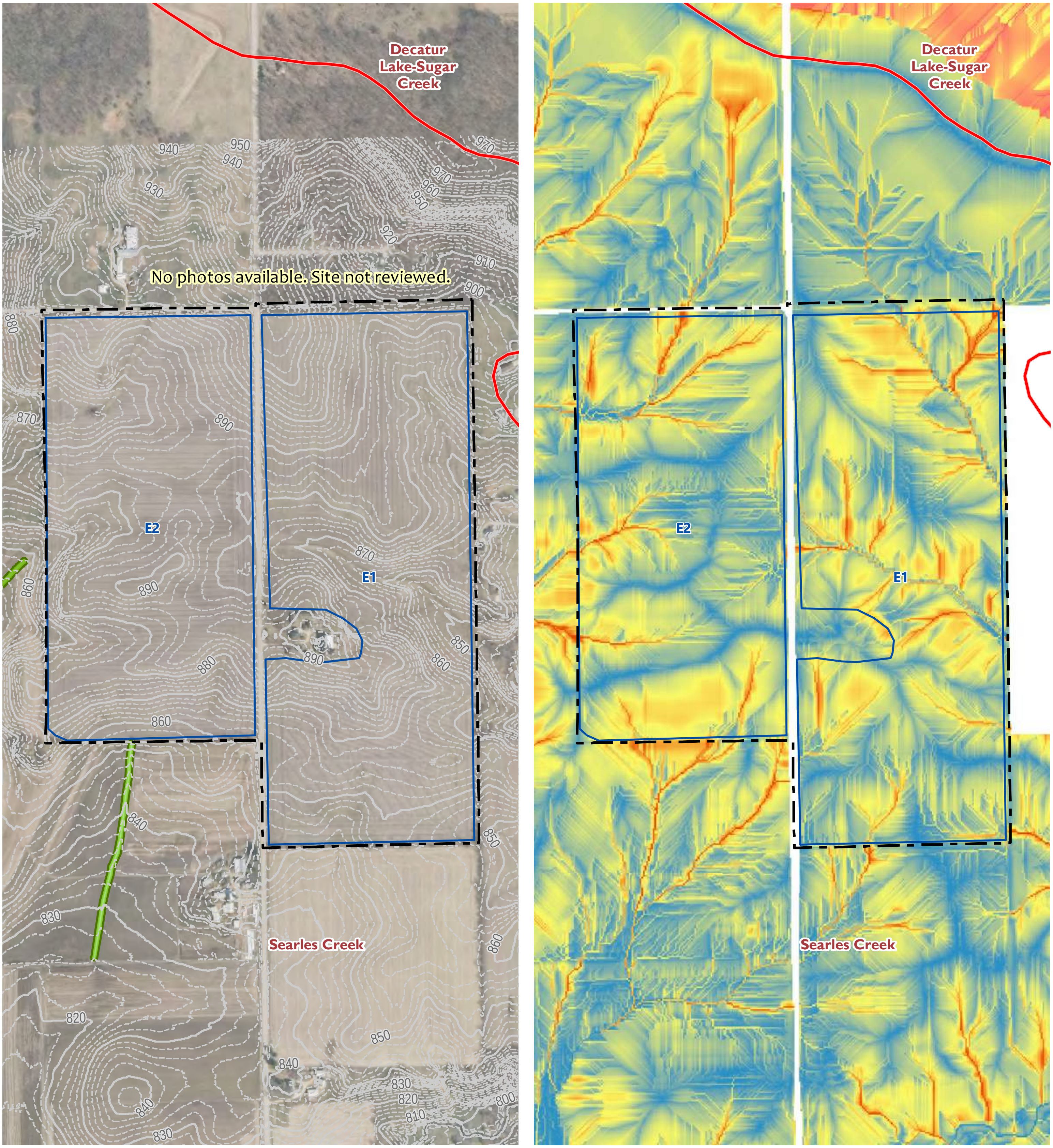

Figure 8

Map of crop fields E1-E2 used for manure application only by Landowner C

City of Brodhead
Green and Rock Counties, WI

Data Sources:
Aerial: WROC (2010)

Grouped Parcels
FieldBoundaries
Grassed Waterway
HUC12 Watershed
Site Photo Location
10-ft contour
2-ft contour

EVAAL Results: Searless Creek
High
Low

EVAAL Results: Decatur Lake Sugar Creek
High
Low

N
0 390 780 Feet

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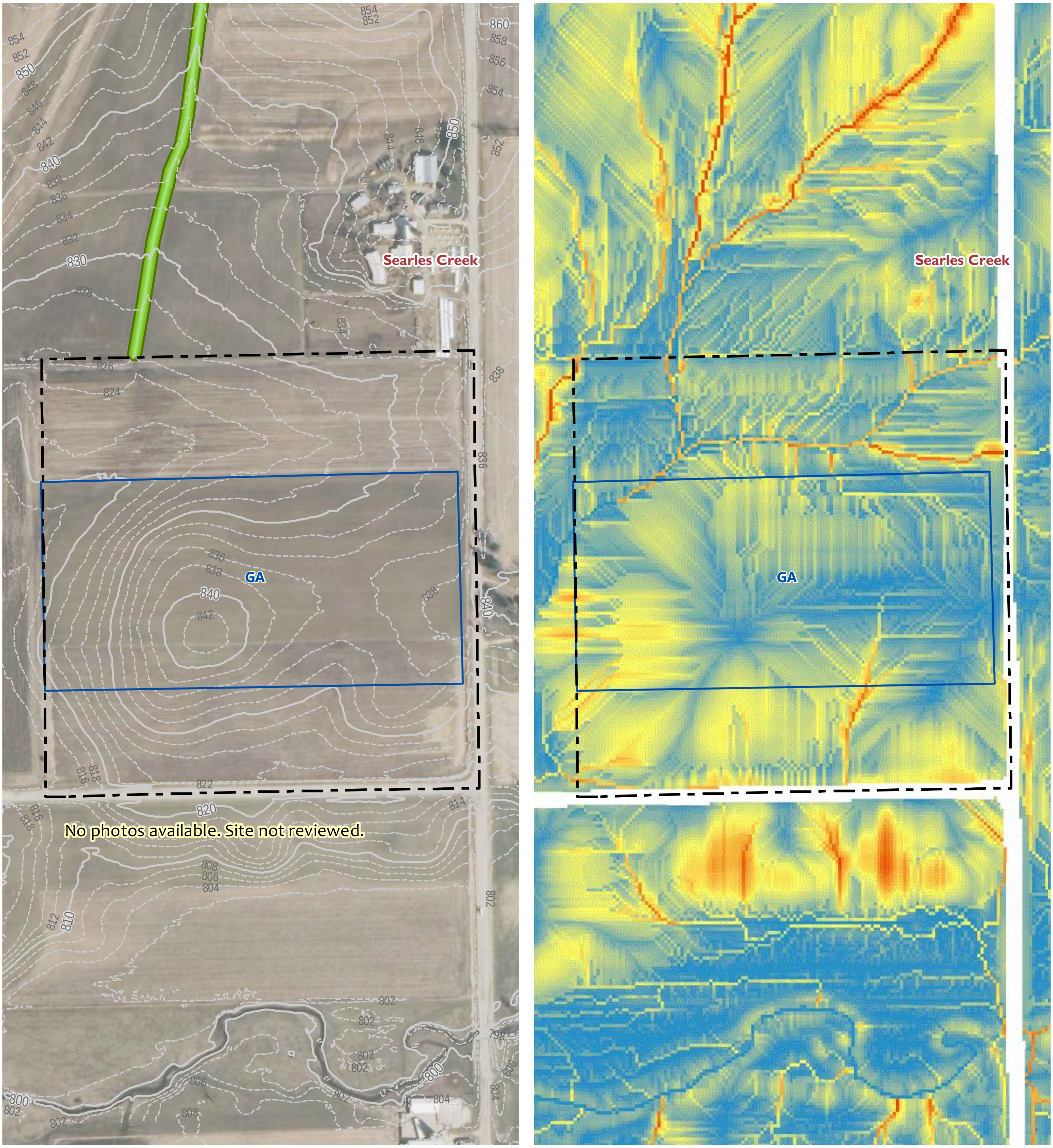

Figure 9

Map of crop fields GA used for manure application only by Landowner C

City of Brodhead
Green and Rock Counties, WI

Data Sources:
Aerial: WROC (2010)

Grouped Parcels
FieldBoundaries
Grassed Waterway
HUC12 Watershed
Site Photo Location
10-ft contour
2-ft contour

EVAAL Results: Searless Creek
High
Low

EVAAL Results: Decatur Lake Sugar Creek
High
Low

0 190 380 Feet

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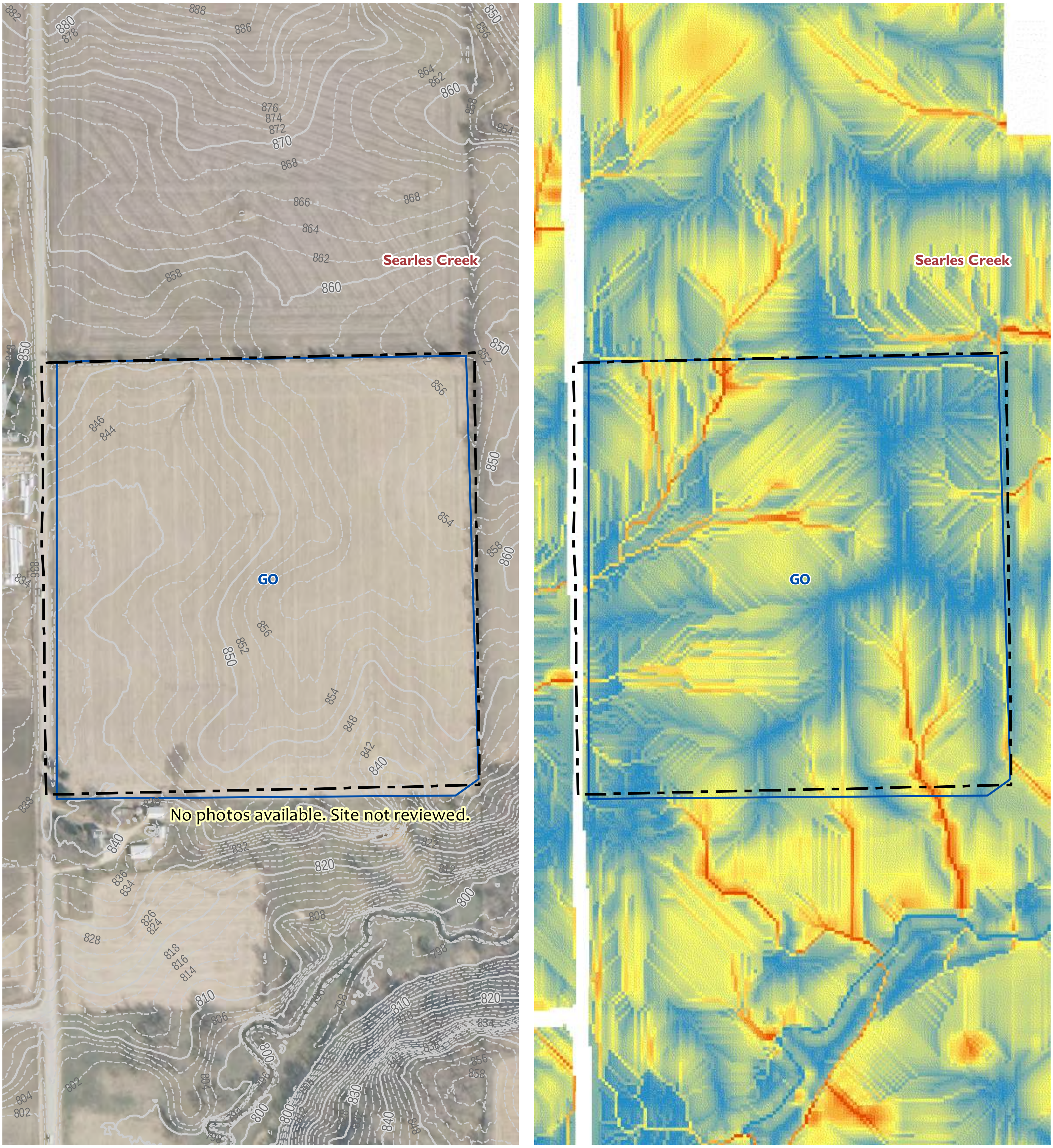

Figure 10

Map of crop fields GO used for manure application only by Landowner C

City of Brodhead
Green and Rock Counties, WI

Data Sources:
Aerial: WROC (2010)

Grouped Parcels
FieldBoundaries
Grassed Waterway
HUC12 Watershed
Site Photo Location
10-ft contour
2-ft contour

EVAAL Results: Searless Creek
High
Low

EVAAL Results: Decatur Lake Sugar Creek
High
Low

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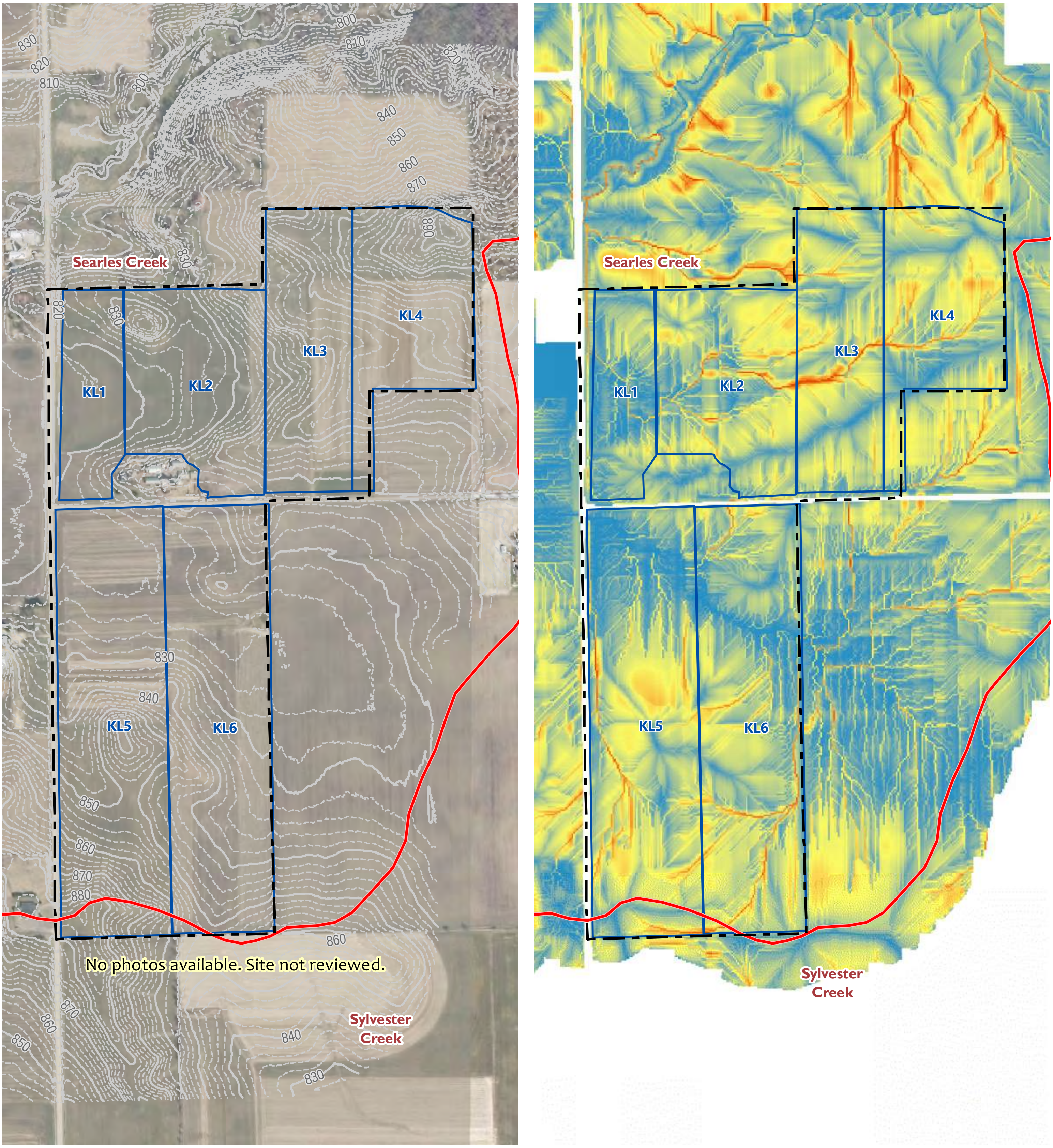

Figure 11

Map of crop fields KL1-KL6 used for manure application only by Landowner C

City of Brodhead
Green and Rock Counties, WI

Data Sources:
Aerial: WROC (2010)

Grouped Parcels
FieldBoundaries
Grassed Waterway
HUC12 Watershed
Site Photo Location
10-ft contour
2-ft contour

EVAAL Results: Searless Creek
High
Low

EVAAL Results: Decatur Lake Sugar Creek
High
Low

0 390 780 Feet

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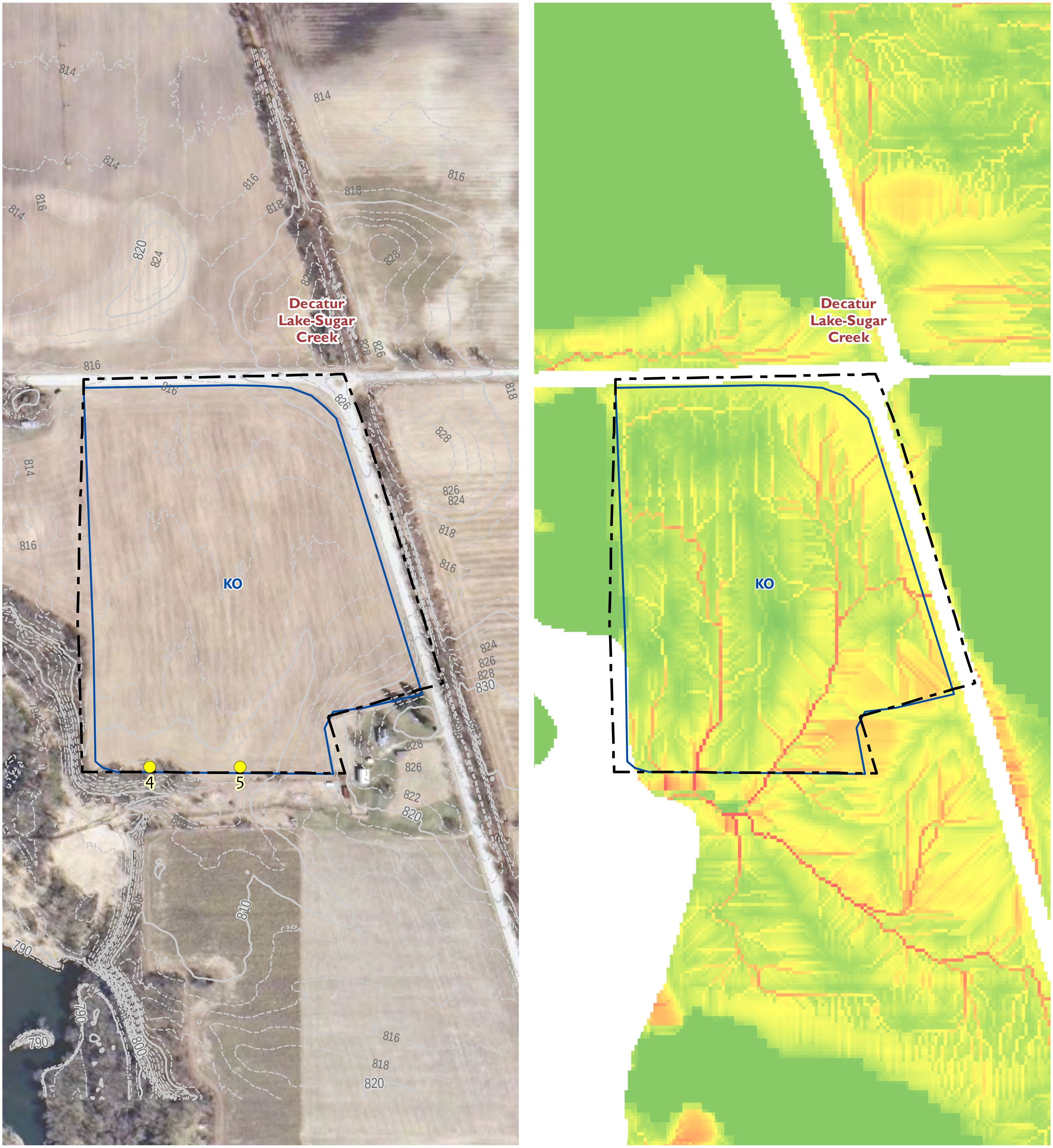

Figure 12

Map of crop fields KO rented by Landowner C

City of Brodhead
Green and Rock Counties, WI

Data Sources:
Aerial: WROC (2010)

Grouped Parcels
FieldBoundaries
Grassed Waterway
HUC12 Watershed
Site Photo Location
10-ft contour
2-ft contour

EVAAL Results: Searless Creek
High
Low

EVAAL Results: Decatur Lake Sugar Creek
High
Low

0 190 380 Feet

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Print Date: 3/30/2018

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Figure 13: Photo facing upslope at Site Photo Location #4 (see Figure 12)

Figure 14: Photo facing upslope at Site Photo Location #5 (see Figure 12)

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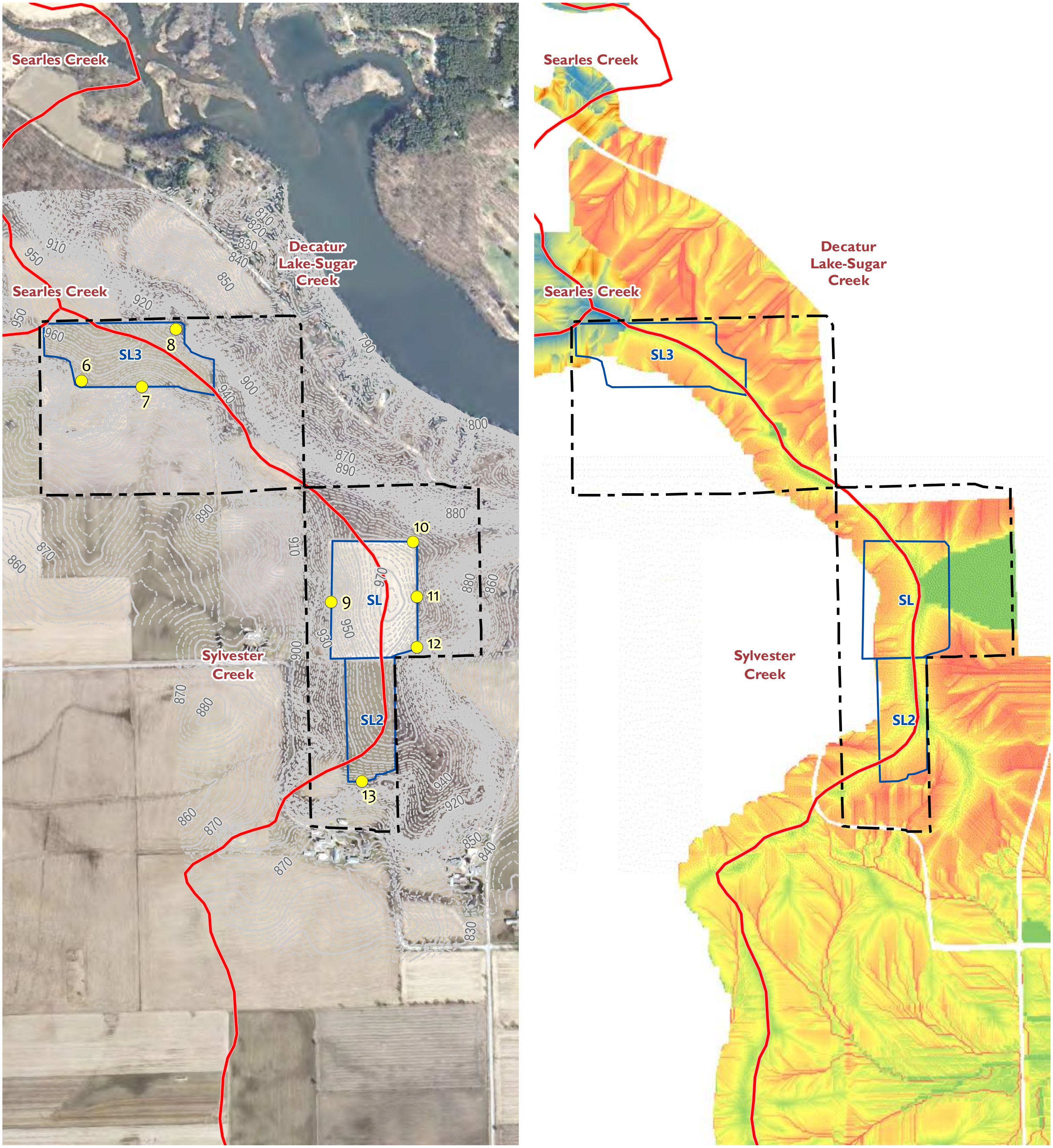

Figure 15

Map of crop fields SL-SL3 rented by Landowner C

City of Brodhead
Green and Rock Counties, WI

Data Sources:
Aerial: WROC (2010)

Grouped Parcels
FieldBoundaries
Grassed Waterway
HUC12 Watershed
Site Photo Location
10-ft contour
2-ft contour
EVAAL Results: Searless Creek
High
Low
EVAAL Results: Decatur Lake Sugar Creek
High
Low

0 490 980 Feet

MSA

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Figure 16: Photo facing upslope at Site Photo Location #6 (see Figure 15)

Figure 17: Photo facing upslope at Site Photo Location #7 (see Figure 15)

Figure 18: Photo facing upslope at Site Photo Location #8 (see Figure 15)

Figure 19: Photo facing upslope at Site Photo Location #9 (see Figure 15)

Figure 20: Photo facing upslope at Site Photo Location #10 (see Figure 15)

Figure 21: Photo facing upslope at Site Photo Location #11 (see Figure 15)

Figure 22: Photo facing upslope at Site Photo Location #12 (see Figure 15)

Figure 23: Photo facing upslope at Site Photo Location #13 (see Figure 15)

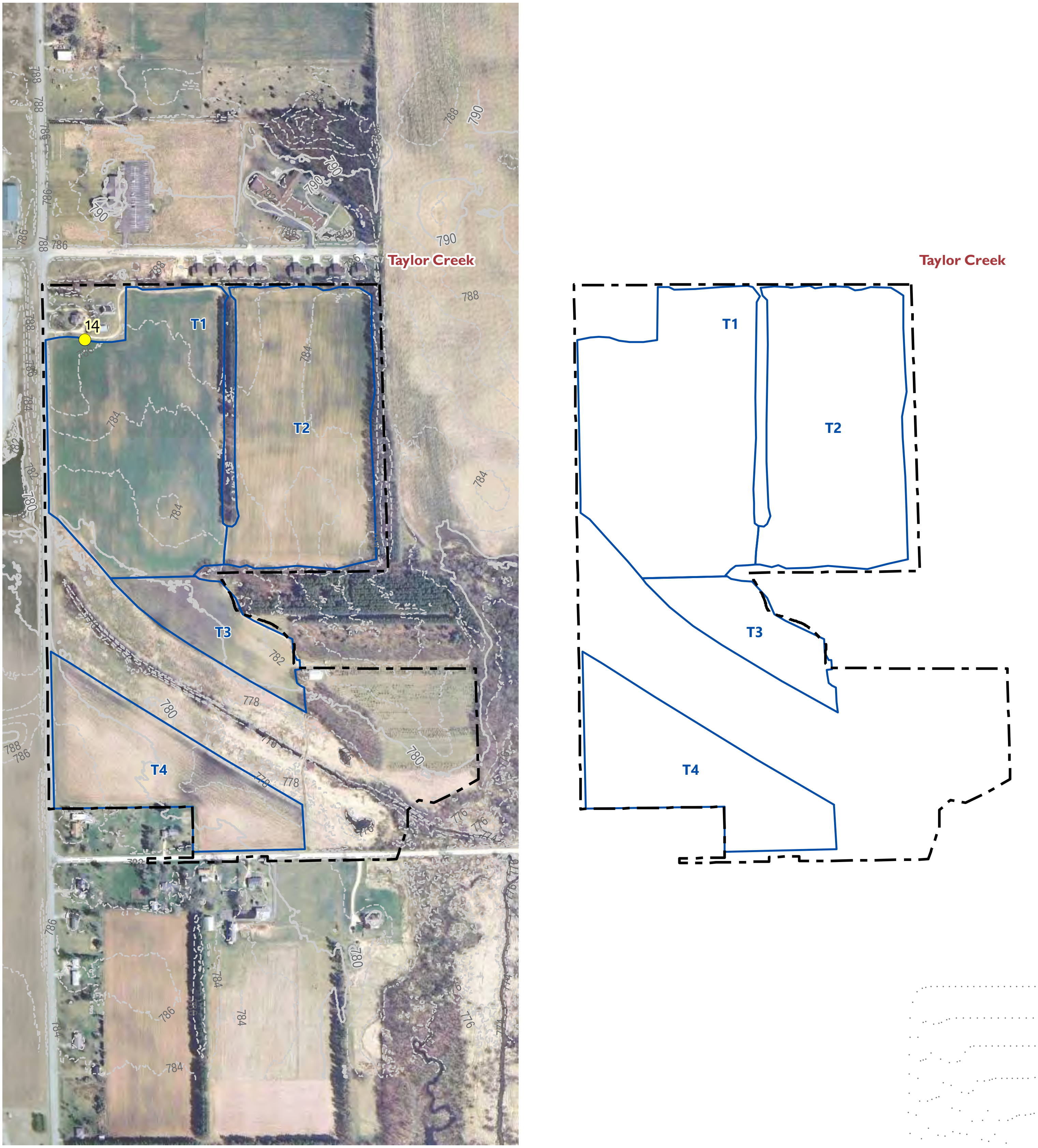

Figure 24

Map of crop fields T1-T4 rented by Landowner C

City of Brodhead
Green and Rock Counties, WI

Data Sources:
Aerial: WROC (2010)

Grouped Parcels
FieldBoundaries
Grassed Waterway
HUC12 Watershed
Site Photo Location
10-ft contour
2-ft contour

EVAAL Results: Searless Creek
High
Low

EVAAL Results: Decatur Lake Sugar Creek
High
Low

0 290 580 Feet

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Figure 25: Photo facing downslope at Site Photo Location #14 (see Figure 24)

1.2 METHODS

In order to estimate phosphorus reductions from nutrient management and supporting practices, it is necessary to estimate phosphorus losses for current baseline conditions (Pre-BMP conditions) and for conditions after BMPs are implemented (post-BMP conditions). Baseline conditions were created based on Landowner C's 2016 and 2017 cropping history. Post-BMP conditions were estimated assuming that no-till and cover crops would be incorporated into the future cropping system for the fields owned and rented by the landowner. Both no-till and cover crops will allow Landowner C to maintain compliance with tolerable soil and phosphorus index requirements. Pre- and post- BMP conditions were estimated for an 8-year crop rotation beginning in 2018 and ending in 2025. Additional years were not simulated since 8 years is already well beyond typical soil sampling requirements for nutrient management planning. Thus, the nutrient management plan will need to be updated in the future at the time of actual implementation of the proposed conservation practices and annually thereafter to more accurately calculate the number of phosphorus credits which are generated.

The SnapPlus "P Trade Report" was run for both pre-BMP and post-BMP conditions as shown in **Table 2** and **Table 3**, respectively. Phosphorus load reductions were estimated by subtracting the post-BMP conditions from the pre-BMP conditions. Phosphorus reductions are shown in **Table 4**. As shown, an average of approximately 479 lb/yr of phosphorus loss could be prevented if Landowner C incorporates no-till and cover cropping in the farm's crop rotation. The proposed nutrient management plan shows a net phosphorus reduction in every year of implementation, which suggests an overall environmental benefit to water quality.

Table 2: SnapPlus P Trade Report results for pre-BMP conditions

Field ID	Phosphorus Loss (lb/yr)								
	2018	2019	2020	2021	2022	2023	2024	2025	**Avg.**
3	122.8	128.5	129.7	130.4	131.0	131.5	132.1	132.7	**129.8**
30	3.1	2.6	4.5	7.1	9.2	10.1	7.7	5.2	**6.2**
31	1.7	2.4	5.4	7.2	7.9	6.1	4.1	3.1	**4.7**
32.33	41.5	24.4	21.2	9.7	4.7	16.2	33.1	42.3	**24.1**
36	20.7	31.0	25.6	16.3	14.7	5.6	2.6	10.7	**15.9**
38	13.7	12.3	7.6	26.4	50.5	48.4	41.5	26.3	**28.3**
40	22.3	31.4	26.9	21.2	20.9	9.3	5.0	12.1	**18.6**
41	13.3	15.5	24.2	26.7	21.5	14.1	12.9	7.3	**16.9**
43	11.5	8.0	7.6	4.2	2.5	5.1	9.0	11.3	**7.4**
45	12.6	17.5	28.5	31.4	25.9	13.5	12.3	6.3	**18.5**
47	15.2	11.0	10.4	5.9	3.6	7.1	12.3	15.4	**10.1**
5	67.3	70.4	71.0	71.3	71.5	71.8	72.0	72.2	**70.9**
61-62	1.7	1.4	2.3	2.9	4.1	4.8	3.9	2.9	**3.0**
7.8	46.6	49.0	49.5	49.7	50.0	50.2	50.4	50.6	**49.5**
E1	191.7	355.0	206.1	347.6	199.0	334.4	191.7	321.2	**268.3**
E2	300.0	568.6	317.1	557.6	308.0	540.2	298.7	523.0	**426.6**
GA	118.1	84.2	144.3	92.5	150.3	95.0	153.3	96.5	**116.8**
GO	314.4	180.0	322.2	182.7	323.4	185.4	328.3	188.2	**253.1**
KL1	25.9	33.8	43.3	26.9	39.3	50.2	22.2	41.7	**35.4**
KL2	25.3	59.2	52.6	50.7	68.7	56.4	64.6	80.1	**57.2**
KL3	411.3	93.4	234.4	358.7	82.0	241.8	364.4	94.9	**235.1**
KL4	70.5	77.4	140.7	44.3	111.2	157.6	54.2	120.3	**97.0**
KL5	594.5	188.2	480.2	180.8	467.3	175.8	455.5	206.5	**343.6**
KL6	73.7	200.4	78.1	197.8	75.0	191.5	71.9	185.3	**134.2**
KO	28.1	29.6	30.0	29.5	28.6	27.7	26.8	25.8	**28.3**
SL2	6.0	5.3	4.9	27.4	17.9	24.6	8.3	9.9	**13.0**
SL3	85.9	23.5	27.7	23.1	17.2	96.8	53.6	72.0	**50.0**
SL	64.7	85.9	23.8	28.1	23.4	17.2	99.5	54.8	**49.7**
T1	2.4	2.7	2.4	1.9	1.5	2.8	3.5	4.3	**2.7**
T2	3.6	2.9	2.4	2.1	3.3	4.3	4.6	3.1	**3.3**
T3	1.3	1.1	0.8	0.7	1.1	1.3	1.5	0.9	**1.1**
T4	2.3	2.0	2.4	1.2	1.1	0.7	0.4	0.3	**1.3**
Total	**2,713.6**	**2,398.4**	**2,527.7**	**2,563.7**	**2,336.2**	**2,597.6**	**2,601.8**	**2,426.9**	**2,520.7**

Table 3: SnapPlus P Trade Report results for post-BMP conditions

Field ID	Phosphorus Loss (lb/yr)								
	2018	2019	2020	2021	2022	2023	2024	2025	**Avg.**
3	57.1	57.6	57.5	57.1	56.8	56.3	54.8	54.6	**56.5**
30	4.7	3.4	1.9	0.7	0.3	0.2	0.2	1.1	**1.6**
31	3.9	1.7	1.2	3.7	5.0	3.7	1.9	0.5	**2.7**
32.33	13.3	14.5	14.5	5.0	1.4	3.5	11.2	14.4	**9.7**
36	4.4	8.9	10.8	10.2	7.7	2.4	0.7	2.0	**5.9**
38	7.6	6.9	3.9	6.9	17.2	20.3	23.4	21.1	**13.4**
40	6.5	10.9	13.0	12.8	10.4	4.1	1.7	3.2	**7.8**
41	7.0	6.1	9.5	10.0	11.0	9.7	7.6	2.8	**8.0**
43	8.4	6.2	5.0	2.1	0.9	1.5	3.6	4.5	**4.0**
45	6.2	5.3	9.1	9.6	10.6	9.0	6.8	2.1	**7.3**
47	9.7	7.9	5.9	2.9	1.6	2.5	5.5	6.8	**5.3**
5	44.1	38.5	30.5	35.8	30.1	35.6	29.8	34.4	**34.9**
61-62	1.6	1.2	0.7	0.3	0.1	0.1	0.1	0.4	**0.6**
7.8	26.0	26.6	26.5	26.4	26.3	26.2	26.0	25.2	**26.1**
E1	213.9	212.9	404.6	237.2	405.8	236.7	404.4	235.9	**293.9**
E2	288.8	324.6	643.3	365.2	649.1	364.8	647.2	363.6	**455.8**
GA	92.6	89.7	55.3	87.2	56.0	86.7	56.0	86.3	**76.2**
GO	242.8	214.4	109.7	188.7	108.2	185.0	107.7	184.3	**167.6**
KL1	9.6	16.5	20.2	10.3	16.4	20.4	10.6	16.7	**15.1**
KL2	21.4	26.8	13.2	22.8	28.2	13.5	23.3	28.5	**22.2**
KL3	206.5	52.3	109.4	162.4	50.2	104.3	177.0	51.4	**114.2**
KL4	25.8	50.6	66.9	26.9	56.3	77.4	28.9	51.4	**48.0**
KL5	606.1	598.6	212.6	525.0	209.5	522.5	208.8	521.1	**425.5**
KL6	91.6	82.7	216.0	90.8	219.3	90.6	218.6	90.2	**137.5**
KO	27.8	29.0	29.9	30.1	29.9	29.4	29.0	28.7	**29.2**
SL2	6.0	4.4	3.4	3.1	3.8	9.3	10.6	8.6	**6.1**
SL3	65.4	43.5	20.0	9.9	7.8	9.6	29.7	30.6	**27.1**
SL	51.4	64.2	50.8	36.8	23.5	11.3	6.8	5.7	**31.3**
T1	2.4	2.7	2.4	1.9	1.5	2.8	3.5	4.3	**2.7**
T2	3.6	2.9	2.4	2.1	3.3	4.3	4.6	3.1	**3.3**
T3	1.3	1.1	0.8	0.7	1.1	1.3	1.5	0.9	**1.1**
T4	2.3	2.0	2.4	1.2	1.1	0.7	0.4	0.3	**1.3**
Total	**2,159.6**	**2,014.5**	**2,153.3**	**1,985.9**	**2,050.3**	**1,945.8**	**2,142.1**	**1,885.0**	**2,042.0**

Table 4: Phosphorus reductions estimated using the SnapPlus P Trade Report

Field ID	Phosphorus Reduction (lb/yr)								
	2018	2019	2020	2021	2022	2023	2024	2025	**Avg.**
3	65.7	70.8	72.2	73.3	74.2	75.2	77.3	78.1	**73.4**
30	-1.6	-0.9	2.6	6.4	8.9	9.9	7.5	4.1	**4.6**
31	-2.2	0.7	4.2	3.5	2.9	2.4	2.1	2.6	**2.0**
32.33	28.2	9.9	6.8	4.7	3.3	12.8	21.9	27.9	**14.4**
36	16.2	22.0	14.8	6.1	7.0	3.1	1.9	8.7	**10.0**
38	6.1	5.4	3.7	19.5	33.4	28.1	18.2	5.1	**14.9**
40	15.8	20.5	13.9	8.5	10.4	5.2	3.3	8.9	**10.8**
41	6.3	9.5	14.7	16.7	10.5	4.4	5.3	4.4	**9.0**
43	3.0	1.8	2.5	2.1	1.6	3.6	5.3	6.8	**3.3**
45	6.4	12.2	19.4	21.8	15.3	4.5	5.5	4.2	**11.2**
47	5.5	3.1	4.5	3.0	2.0	4.6	6.8	8.6	**4.8**
5	23.2	31.9	40.5	35.5	41.5	36.1	42.2	37.8	**36.1**
61-62	0.0	0.2	1.5	2.6	4.0	4.7	3.8	2.5	**2.4**
7.8	20.7	22.4	23.0	23.4	23.7	24.0	24.4	25.4	**23.4**
E1	-22.2	142.1	-198.5	110.4	-206.8	97.6	-212.7	85.3	**-25.6**
E2	11.2	244.0	-326.2	192.3	-341.2	175.4	-348.5	159.4	**-29.2**
GA	25.5	-5.5	89.1	5.3	94.3	8.2	97.3	10.2	**40.5**
GO	71.6	-34.4	212.5	-6.0	215.2	0.4	220.6	3.9	**85.5**
KL1	16.2	17.3	23.2	16.6	22.9	29.8	11.6	24.9	**20.3**
KL2	3.9	32.4	39.5	28.0	40.4	42.9	41.3	51.6	**35.0**
KL3	204.7	41.0	125.0	196.2	31.8	137.4	187.4	43.5	**120.9**
KL4	44.7	26.9	73.8	17.4	54.9	80.3	25.3	68.8	**49.0**
KL5	-11.6	-410.4	267.6	-344.2	257.8	-346.7	246.7	-314.6	**-81.9**
KL6	-17.8	117.7	-137.9	106.9	-144.3	101.0	-146.7	95.1	**-3.2**
KO	0.4	0.6	0.0	-0.6	-1.3	-1.6	-2.3	-2.9	**-1.0**
SL2	0.0	0.9	1.5	24.3	14.2	15.3	-2.3	1.3	**6.9**
SL3	20.6	-19.9	7.7	13.2	9.4	87.2	23.9	41.4	**22.9**
SL	13.2	21.7	-27.0	-8.7	-0.2	5.9	92.6	49.1	**18.3**
T1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
T2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
T3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
T4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Total	**554.0**	**383.9**	**374.3**	**577.8**	**285.9**	**651.8**	**459.7**	**541.9**	**478.7**

1.3 PHOSPHORUS CREDIT RESULTS

Phosphorus credit estimates for nutrient management improvements on crop fields owned by Landowner C are presented in **Table 5**. As previously stated, phosphorus credits are currently only planned to be generated on the crop fields owned by the Landowner C since the majority of landowner's rented fields are located in ineligible watersheds and the landowner currently does not control cropping practices for the fields which are currently listed as manure application only. This is why fields which the landowner rents or only applies manure are excluded from the calculations shown in **Table 5**. Although these fields are not currently included in credit calculations, it is important to know that Landowner C will be required to implement and follow a fully compliant nutrient management plan **for all fields** as part of the binding agreement with the City of Brodhead. This nutrient management plan is currently under development for an NRCS EQIP application which will be submitted in the fall of 2018. As described in the main body of Brodhead's WQT Plan, it has been determined that a trade ratio of 3.03 (Uncertainty Factor = 3.00 and Delivery Factor = 0.03) is applicable to crop fields owned by Landowner C. Therefore, phosphorus credit estimates shown in **Table 5** were determined by dividing the phosphorus reductions shown in **Table 4** by the trade ratio of 3.03. As summarized in **Table 5**, improved nutrient management and supporting practices by Landowner C could potentially generate an average of 72.7 lb/yr of phosphorus credit during the 8-year analysis period. However, it is important to note that the actual amount of credit generated for the City of Brodhead will vary annually depending on the actual cropping practices implemented by Landowner C during each crop year.

Table 5: Phosphorus credits generated by implementing improved cropping practices

Field ID	Trade Ratio	Phosphorus Credits Generated (lb/yr)								
		2018	2019	2020	2021	2022	2023	2024	2025	**Avg.**
3	3.03	21.7	23.4	23.8	24.2	24.5	24.8	25.5	25.8	**24.2**
30	3.03	-0.5	-0.3	0.9	2.1	2.9	3.3	2.5	1.3	**1.5**
31	3.03	-0.7	0.2	1.4	1.1	1.0	0.8	0.7	0.9	**0.7**
32.33	3.03	9.3	3.3	2.2	1.6	1.1	4.2	7.2	9.2	**4.8**
36	3.03	5.4	7.3	4.9	2.0	2.3	1.0	0.6	2.9	**3.3**
38	3.03	2.0	1.8	1.2	6.4	11.0	9.3	6.0	1.7	**4.9**
40	3.03	5.2	6.7	4.6	2.8	3.4	1.7	1.1	2.9	**3.6**
41	3.03	2.1	3.1	4.8	5.5	3.5	1.5	1.7	1.5	**3.0**
43	3.03	1.0	0.6	0.8	0.7	0.5	1.2	1.8	2.2	**1.1**
45	3.03	2.1	4.0	6.4	7.2	5.1	1.5	1.8	1.4	**3.7**
47	3.03	1.8	1.0	1.5	1.0	0.7	1.5	2.2	2.8	**1.6**
5	3.03	7.7	10.5	13.4	11.7	13.7	11.9	13.9	12.5	**11.9**
61-62	3.03	0.0	0.1	0.5	0.9	1.3	1.6	1.3	0.8	**0.8**
7.8	3.03	6.8	7.4	7.6	7.7	7.8	7.9	8.1	8.4	**7.7**
E1	-	-	-	-	-	-	-	-	-	-
E2	-	-	-	-	-	-	-	-	-	-
GA	-	-	-	-	-	-	-	-	-	-
GO	-	-	-	-	-	-	-	-	-	-
KL1	-	-	-	-	-	-	-	-	-	-
KL2	-	-	-	-	-	-	-	-	-	-
KL3	-	-	-	-	-	-	-	-	-	-
KL4	-	-	-	-	-	-	-	-	-	-
KL5	-	-	-	-	-	-	-	-	-	-
KL6	-	-	-	-	-	-	-	-	-	-
KO	-	-	-	-	-	-	-	-	-	-
SL2	-	-	-	-	-	-	-	-	-	-
SL3	-	-	-	-	-	-	-	-	-	-
SL	-	-	-	-	-	-	-	-	-	-
T1	-	-	-	-	-	-	-	-	-	-
T2	-	-	-	-	-	-	-	-	-	-
T3	-	-	-	-	-	-	-	-	-	-
T4	-	-	-	-	-	-	-	-	-	-
Total	**3.03**	**63.8**	**69.2**	**74.0**	**74.9**	**78.7**	**72.2**	**74.5**	**74.2**	**72.7**

1.4 SnapPlus Model Data

In order to support DNR's review of phosphorus credit calculations for nutrient management and supporting practices for crop fields owned and operated by Landowner C, SnapPlus inputs and P-trade report outputs for both pre- and post-BMP conditions are provided in the following section. In addition, email correspondence from Green County LWCD regarding the SnapPlus modeling process is provided below:

Andrew Skog

From: Gratz, Tonya - NRCS-CD, Monroe, WI <Tonya.Gratz@wi.nacdnet.net>
Sent: Tuesday, July 25, 2017 3:00 PM
To: Andrew Skog
Subject: [Landowner C] [redacted] crop practices

Andrew,
I have reviewed and worked with [Landowner C] [redacted] on their Nutrient Management Plan. The initial year was 2016 and there were many areas that they were alerted to that needed improvement to meet the full standard of 590 (2005). The practices that they have entered into SNAPPlus are realistic and attainable. [redacted] continues to update the NMP as they experiment with different cropping practices to meet their forage needs and reduce soil loss. They are committed to doing right by the environment.

Tonya Gratz
Conservation Technician
Green County Land and Water Conservation Dept.

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SnapPlus Soil Test Report

Reported For	Landowner C Pre-BMP (Fields 3-SL)
Printed	2018-04-02
Plan Completion/Update Date	2017-02-10
SnapPlus Version 16.3 built on 2016-10-31	
C:\SnapPlus2\MySnapPlusData \Riemer_Farms2018manure_no_storageAJS.snapDb	

Prepared for:
Landowner C Pre-BMP (Fields 3-SL)
attn:Landowner C

			Predominant					Samples				in ppm			
Field Name	Subfarm	Acres	Soil Map Symbol	Soil Name	Soil Test Date	Soil Test Lab	Lab Number	Rec. #	Actual #	pH	OM%	P	K	S	CEC
3		14.45	SyB2	SYLVESTER	2015-11-13	AgSource	768330	**3**	**3**	7.4	4.2	94	203	0	0
30		2.75	SyC2	SYLVESTER	2015-11-13	AgSource	768330	**1**	**1**	7.3	4.1	27	67	0	0
31		2.31	SyC2	SYLVESTER	2015-11-13	AgSource	768330	**1**	**1**	7.3	3.8	19	60	0	0
32.33		5.83	SyC2	SYLVESTER	2015-11-13	AgSource	768330	**1**	**2**	7.3	3.4	33	113	0	0
36		3.42	SyC2	SYLVESTER	2015-11-13	AgSource	768330	**1**	**1**	7.3	3.9	38	83	0	0
38		5.84	SyC2	SYLVESTER	2015-11-13	AgSource	768330	**1**	**2**	7.4	4.0	68	125	0	0
40		6.29	TbB	TAMA	2015-11-13	AgSource	768330	**1**	**1**	7.3	4.2	51	79	0	0
41		5.57	SyB2	SYLVESTER	2015-11-13	AgSource	768330	**1**	**1**	7.3	3.8	41	73	0	0
43		2.79	SyB2	SYLVESTER	2015-11-13	AgSource	768330	**1**	**1**	7.4	3.8	53	146	0	0
45		3.08	NoC2	NORTHFIELD	2015-11-13	AgSource	768330	**1**	**1**	7.3	4.0	41	70	0	0
47		3.34	SyB2	SYLVESTER	2015-11-13	AgSource	768330	**1**	**1**	7.4	4.1	78	144	0	0
5		5.15	TbB	TAMA	2015-11-13	AgSource	768330	**1**	**1**	7.2	4.7	294	393	0	0
61-62		1.91	TbB	TAMA	2015-11-13	AgSource	768330	**1**	**1**	7.2	3.8	20	51	0	0
7.8		7.05	TbB	TAMA	2015-11-13	AgSource	768330	**1**	**2**	7.3	4.5	143	223	0	0
E1		88.9	SyB2	SYLVESTER	2017-02-19			**18**	**1**	6.8	2.0	101	100	0	0
E2		74.2	SyC2	SYLVESTER	2017-02-19			**15**	**1**	6.8	2.0	101	100	0	0

			Predominant					Samples				in ppm			
Field Name	Subfarm	Acres	Soil Map Symbol	Soil Name	Soil Test Date	Soil Test Lab	Lab Number	Rec. #	Actual #	pH	OM%	P	K	S	CEC
GA		18.8	SyB2	SYLVESTER	2017-02-10			**4**	**1**	6.8	2.0	101	100	0	0
GO		39	SyB2	SYLVESTER	2017-02-10			**8**	**1**	6.8	2.0	101	100	0	0
K1		10.9	StA	STRONGHURST	2016-05-19			**2**	**1**	6.9	3.2	35	160	0	0
K2		22.3	HvA	HUNTSVILLE	2016-03-17			**4**	**1**	6.9	3.2	35	160	0	0
K3		21	SyC2	SYLVESTER	2016-03-16			**4**	**1**	6.9	3.2	35	160	0	0
K4		20.4	SyB2	SYLVESTER	2016-03-17			**4**	**1**	6.9	3.2	35	160	0	0
K5		39.9	OkC2	OCKLEY	2016-03-10			**8**	**1**	6.9	3.2	35	160	0	0
K6		37.9	TbB	TAMA	2016-03-17			**8**	**1**	6.9	3.2	35	160	0	0
KO		22.8	OcA	OCKLEY	2017-02-19			**5**	**1**	6.8	2.0	101	100	0	0
SL		13.2	NgC2	NEWGLARUS	2017-02-13			**3**	**1**	6.8	2.0	101	100	0	0
SL2		7.8	PgB2	PALSGROVE	2017-02-19			**2**	**1**	6.8	2.0	101	100	0	0
SL3		12.4	NgC2	NEWGLARUS	2017-02-19			**2**	**1**	6.8	2.0	101	100	0	0

Crop Year Soil Test Needed

Field Name	Soil Test Date	2016	2017	2018	2019	2020	2021	2022	2023
3	2015-11-13					X			
30	2015-11-13					X			
31	2015-11-13					X			
32.33	2015-11-13					X			
36	2015-11-13					X			
38	2015-11-13					X			
40	2015-11-13					X			
41	2015-11-13					X			
43	2015-11-13					X			
45	2015-11-13					X			

Field Name	Soil Test Date	2016	2017	2018	2019	2020	2021	2022	2023
47	2015-11-13					X			
5	2015-11-13					X			
61-62	2015-11-13					X			
7.8	2015-11-13					X			
E1	2017-02-19						X		
E2	2017-02-19						X		
GA	2017-02-10						X		
GO	2017-02-10						X		
K1	2016-05-19					X			
K2	2016-03-17					X			
K3	2016-03-16					X			
K4	2016-03-17					X			
K5	2016-03-10					X			
K6	2016-03-17					X			
KO	2017-02-19						X		
SL	2017-02-13						X		
SL2	2017-02-19						X		
SL3	2017-02-19						X		

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SnapPlus Soil Test Report

Reported For	Landowner C Pre-BMP (T1-T4)
Printed	2018-04-02
Plan Completion/Update Date	2014-05-28
SnapPlus Version 16.3 built on 2016-10-31	
C:\SnapPlus2\MySnapPlusData\Popanz_Riemer_2016_AJS.snapDb	

Prepared for:
Landowner C Pre-BMP (T1-T4)
attn:Landowner C

			Predominant					Samples				in ppm			
Field Name	Subfarm	Acres	Soil Map Symbol	Soil Name	Soil Test Date	Soil Test Lab	Lab Number	Rec. #	Actual #	pH	OM%	P	K	S	CEC
T1		20.6	DcA	DICKMAN	2014-05-22	AgSource	744950	**4**	**5**	7.2	1.2	64	106	0	6
T2		18.2	DcA	DICKMAN	2014-05-22	AgSource	744950	**4**	**4**	7.1	0.8	90	98	0	5
T3		5.3	Me	MAUMEE	2014-05-22	AgSource	744950	**1**	**2**	6.6	1.5	72	73	0	5
T4		10.7	DcA	DICKMAN	2014-05-22	AgSource	744950	**2**	**3**	6.5	1.4	29	82	0	5

Crop Year Soil Test Needed

Field Name	Soil Test Date	2014	2015	2016	2017	2018	2019	2020
T1	2014-05-22					X		
T2	2014-05-22					X		
T3	2014-05-22					X		
T4	2014-05-22					X		

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SnapPlus Narrative and Crops Report

Starting Year	**2018**
Reported For	**Landowner C Pre-BMP (Fields 3-SL)**
Printed	**2018-04-02**
Plan Completion/Update Date:	**2017-02-10**
SnapPlus Version 16.3 built on 2016-10-31	
C:\SnapPlus2\MySnapPlusData \Riemer_Farms2018manure_no_storageAJS.snapDb	

Prepared for:
Landowner C Pre-BMP (Fields 3-SL)
attn:Landowner C

Farm has 28 fields totalling 499.3 acres
Farm Narrative: None
Concentrated Flow Notes: None

Field Name	Acres	2018	2019	2020	2021	2022	2023	2024	2025
3	14.4	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre
30	2.8	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa (1st cut) to Corn grain No Till 171-190 bu/acre	Winter wheat (grain +straw) to Late-Direct Seeded Legume Forage Chisel Plow, disked 61-80 bu/acre/ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre
31	2.3	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Alfalfa (1st cut) to Corn grain No Till 171-190 bu/acre	Winter wheat (grain +straw) to Late-Direct Seeded Legume Forage Chisel Plow, disked 61-80 bu/acre/ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre
32.33	5.8	Winter wheat (grain +straw) to Late-Direct Seeded Legume Forage Chisel Plow, disked 41-60 bu/acre/ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop no till 20.1-25 ton/acre	Corn silage Spring Chisel, no disk 20.1-25 ton/acre

Field Name	Acres	2018	2019	2020	2021	2022	2023	2024	2025
36	3.4	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop no till 20.1-25 ton/acre	Corn silage Spring Chisel, no disk 20.1-25 ton/acre	Winter wheat (grain +straw) to Late-Direct Seeded Legume Forage Chisel Plow, disked 41-60 bu/acre/ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop no till 20.1-25 ton/acre
38	5.8	Alfalfa None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop no till 20.1-25 ton/acre	Corn silage Spring Chisel, no disk 20.1-25 ton/acre	Winter wheat (grain +straw) to Late-Direct Seeded Legume Forage Chisel Plow, disked 41-60 bu/acre/ton/acre	Alfalfa None 4.6-5.5 ton/acre
40	6.3	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop no till 20.1-25 ton/acre	Corn silage Spring Chisel, no disk 20.1-25 ton/acre	Winter wheat (grain +straw) to Late-Direct Seeded Legume Forage Chisel Plow, disked 41-60 bu/acre/ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop no till 20.1-25 ton/acre
41	5.6	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop no till 20.1-25 ton/acre	Corn silage Spring Chisel, no disk 20.1-25 ton/acre	Winter wheat (grain +straw) to Late-Direct Seeded Legume Forage Chisel Plow, disked 41-60 bu/acre/ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre
43	2.8	Winter wheat (grain +straw) to Late-Direct Seeded Legume Forage Chisel Plow, disked 41-60 bu/acre/ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop no till 20.1-25 ton/acre	Corn silage Spring Chisel, no disk 20.1-25 ton/acre
45	3.1	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop no till 20.1-25 ton/acre	Corn silage Spring Chisel, no disk 20.1-25 ton/acre	Winter wheat (grain +straw) to Late-Direct Seeded Legume Forage Chisel Plow, disked 41-60 bu/acre/ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre

Field Name	Acres	2018	2019	2020	2021	2022	2023	2024	2025
47	3.3	Winter wheat (grain +straw) to Late-Direct Seeded Legume Forage Chisel Plow, disked 41-60 bu/acre/ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop no till 20.1-25 ton/acre	Corn silage Spring Chisel, no disk 20.1-25 ton/acre
5	5.2	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre
61-62	1.9	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa (1st cut) to Corn grain No Till 171-190 bu/acre	Winter wheat (grain +straw) to Late-Direct Seeded Legume Forage Chisel Plow, disked 61-80 bu/acre/ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre
7.8	7	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre
E1	88.9	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Spring Cultivation 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Spring Cultivation 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Spring Cultivation 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Spring Cultivation 171-190 bu/acre
E2	74.2	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Spring Cultivation 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Spring Cultivation 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Spring Cultivation 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Spring Cultivation 171-190 bu/acre
GA	18.8	Corn grain Spring Cultivation 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Spring Cultivation 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Spring Cultivation 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Spring Cultivation 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre

Field Name	Acres	2018	2019	2020	2021	2022	2023	2024	2025
GO	39	Corn grain Spring Cultivation 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Spring Cultivation 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Spring Cultivation 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Spring Cultivation 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre
K1	10.9	Winter wheat (grain) Fall Chisel, no disk 41-60 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Winter wheat (grain) Fall Chisel, no disk 41-60 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Winter wheat (grain) Fall Chisel, no disk 41-60 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre
K2	22.3	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Winter wheat (grain) Fall Chisel, no disk 41-60 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Winter wheat (grain) Fall Chisel, no disk 41-60 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre
K3	21	Corn grain Fall Chisel, no disk 171-190 bu/acre	Winter wheat (grain) Fall Chisel, no disk 41-60 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Winter wheat (grain) Fall Chisel, no disk 41-60 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Winter wheat (grain) Fall Chisel, no disk 41-60 bu/acre
K4	20.4	Winter wheat (grain) Fall Chisel, no disk 41-60 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Winter wheat (grain) Fall Chisel, no disk 41-60 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Winter wheat (grain) Fall Chisel, no disk 41-60 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre
K5	39.9	Corn grain Fall Chisel, no disk 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre
K6	37.9	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre
KO	22.8	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre	Corn silage to small grain cover crop Spring Chisel, no disk, cover crop disked 20.1-25 ton/acre

Field Name	Acres	2018	2019	2020	2021	2022	2023	2024	2025
SL	13.2	Soybeans 15-20 inch row Spring Chisel, no disk 46-55 bu/acre	Oats w/ Alfalfa Seeding Spring Spring Chisel, disked 30-60 bu/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa (1st cut) to Corn grain Spring Chisel, disked 151-170 bu/acre	Soybeans 15-20 inch row Spring Chisel, no disk 46-55 bu/acre
SL2	7.8	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa (1st cut) to Corn grain Spring Chisel, disked 151-170 bu/acre	Soybeans 15-20 inch row Spring Chisel, no disk 46-55 bu/acre	Oats w/ Alfalfa Seeding Spring Spring Chisel, disked 30-60 bu/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre
SL3	12.4	Oats w/ Alfalfa Seeding Spring Spring Chisel, disked 30-60 bu/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa (1st cut) to Corn grain Spring Chisel, disked 151-170 bu/acre	Soybeans 15-20 inch row Spring Chisel, no disk 46-55 bu/acre	Oatlage w/ Alfalfa Seeding Spring Spring Chisel, disked 2.0-3.5 ton/acre

Summary by Crop:
NOTE: Yields calculated using the midpoint of the SnapPlus yield goal range for each crop.

Crops Grouped By Category		2018	2019	2020	2021	2022	2023	2024	2025
Alfalfa (1st cut) to Corn grain	Acres bu		2 361	5 903	8 1,284		12 1,926	13 2,087	
Alfalfa	Acres ton	18 91	37 187	45 227	38 192	42 212	29 146	23 116	21 106
Alfalfa (grassy, yr 3+)	Acres ton	11 56	6 30	6 30	12 61	12 61	10 51	10 51	9 45
Corn silage	Acres ton		10 226		9 203		6 135		12 271
Winter wheat (grain +straw) to Late-Direct Seeded Legume Forage	Acres bu/ton	12 606		12 846	5 353	9 455		6 303	
Corn silage to small grain cover crop	Acres ton	59 1,330	58 1,308	58 1,308	55 1,240	55 1,240	61 1,376	61 1,376	59 1,330

Crops Grouped By Category		2018	2019	2020	2021	2022	2023	2024	2025
Corn grain	Acres bu	119 21,480	223 40,252	129 23,285	222 40,071	120 21,660	232 41,876	119 21,480	223 40,252
Soybeans 15-20 inch row	Acres bu	237 14,339	129 7,805	222 13,431	120 7,260	240 14,520	119 7,200	236 14,278	142 8,591
Winter wheat (grain)	Acres bu	31 1,566	21 1,061	22 1,111	31 1,566	21 1,061	22 1,111	31 1,566	21 1,061
Oats w/ Alfalfa Seeding Spring	Acres bu	12 540	13 585				8 360		
Oatlage w/ Alfalfa Seeding Spring	Acres ton								12 33

SnapPlus Narrative and Crops Report

Starting Year	**2018**
Reported For	**Landowner C Pre-BMP (T1-T4)**
Printed	**2018-04-02**
Plan Completion/Update Date:	**2014-05-28**
SnapPlus Version 16.3 built on 2016-10-31	
C:\SnapPlus2\MySnapPlusData\Popanz_Riemer_2016_AJS.snapDb	

Prepared for:
Landowner C Pre-BMP (T1-T4)
attn:Landowner C

Farm has 4 fields totalling 54.8 acres
Farm Narrative: None
Concentrated Flow Notes: None

Field Name	Acres	2018	2019	2020	2021	2022	2023	2024	2025
T1	20.6	Alfalfa None 2.6-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre	Corn grain Spring vertical tillage 111-130 bu/acre	Soybeans 15-20 inch row Spring vertical tillage 36-45 bu/acre	Oatlage w/ Alfalfa Seeding Spring Fall Chisel, disked 2.0-3.5 ton/acre
T2	18.2	Alfalfa None 2.6-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre	Corn grain Spring vertical tillage 111-130 bu/acre	Soybeans 15-20 inch row Spring vertical tillage 36-45 bu/acre	Oatlage w/ Alfalfa Seeding Spring Fall Chisel, disked 2.0-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre
T3	5.3	Alfalfa None 2.6-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre	Corn grain Spring vertical tillage 111-130 bu/acre	Soybeans 15-20 inch row Spring vertical tillage 36-45 bu/acre	Oatlage w/ Alfalfa Seeding Spring Fall Chisel, disked 2.0-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre
T4	10.7	Corn grain Spring vertical tillage 111-130 bu/acre	Soybeans 15-20 inch row Spring vertical tillage 36-45 bu/acre	Oatlage w/ Alfalfa Seeding Spring Fall Chisel, disked 2.0-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre

Summary by Crop:
NOTE: Yields calculated using the midpoint of the SnapPlus yield goal range for each crop.

Crops Grouped By Category		2018	2019	2020	2021	2022	2023	2024	2025
Alfalfa	Acres ton	44 134	44 134	44 134	55 168	31 95	11 34	11 34	34 104
Corn grain	Acres bu	11 1,326				24 2,892	21 2,531		
Oatlage w/ Alfalfa Seeding Spring	Acres ton			11 30				24 66	21 58
Soybeans 15-20 inch row	Acres bu		11 446				24 972	21 851	

SnapPlus Field Data and 590 Assessment Plan

Reported For	**Landowner C Pre-BMP (Fields 3-SL)**
Printed	**2018-04-02**
Plan Completion/Update Date	**2017-02-10**
SnapPlus Version 16.3 built on 2016-10-31	
C:\SnapPlus2\MySnapPlusData \Riemer_Farms2018manure_no_storageAJS.snapDb	

Prepared for:
Landowner C Pre-BMP (Fields 3-SL)
attn:Landowner C

Field Data: 499 Total Acres Reported.

Field Name	SubFarm	FSA Trct	FSA Fld	Acres	County	Critical Soil Series & Symbol	F. Slp %	F.Slp Len ft	Below Field Slope To Water %	Dist.To Water ft	N/Fld Res	Contour/ Filters	Irrig	Tiled	Rotation	Tillage	Report Period	Field "T" t/ac	Rot Avg Soil Loss t/ac	SCI	Rot Avg PI	Soil Test P ppm	Rot P2O5 Bal lb/ac	P2O5 Bal Target lb/ac
7.8				7	Green	SYLVESTER SyB2	4	200	0 - 2	1001 - 5000		On contour / No	No	No	Csl+cv-Csl+cv-Csl+cv-Csl+cv-Csl+cv-Csl+cv-Csl+cv-Csl+cv	SCND/Dcvr-SCND/Dcvr-SCND/Dcvr-SCND/Dcvr-SCND/Dcvr-SCND/Dcvr-SCND/Dcvr-SCND/Dcvr	2018-2025	**3**	**2.2**	**0.1**	**7**	143	80	-160

Field Name	SubFarm	FSA Trct	FSA Fld	Acres	County	Critical Soil Series & Symbol	F. Slp %	F.Slp Len ft	Below Field Slope To Water %	Dist.To Water ft	N/Fld Res	Contour/ Filters	Irrig	Tiled	Rotation	Tillage	Report Period	Field "T" t/ac	Rot Avg Soil Loss t/ac	SCI	Rot Avg PI	Soil Test P ppm	Rot P2O5 Bal lb/ac	P2O5 Bal Target lb/ac
3				14.4	Green	SYLVESTER SyB2	4	200	2.1 - 6	1001 - 5000		No / No	No	No	Csl+cv-Csl+cv-Csl+cv-Csl+cv-Csl+cv-Csl+cv-Csl+cv-Csl+cv	SCND/Dcvr-SCND/Dcvr-SCND/Dcvr-SCND/Dcvr-SCND/Dcvr-SCND/Dcvr-SCND/Dcvr-SCND/Dcvr	2018-2025	**3**	**3.3**	**0.0**	**9**	94	80	0
32.33				5.8	Green	NORTHFIELD NoC2	9	200	0 - 2	1001 - 5000	R %	On contour / No	No	No	[Wwg+s-Fs]-A-A-Ag-Ag-Csl+cv-Csl+cv-Csl	CP-None-None-None-None-SCND/NTcvr-SCND/NTcvr-SCND	2018-2025	**2**	**2.3**	**0.4**	**4**	33	16	-
5				5.2	Green	TAMA TbB	4	250	0 - 2	1001 - 5000		No / No	No	No	Csl+cv-Csl+cv-Csl+cv-Csl+cv-Csl+cv-Csl+cv-Csl+cv-Csl+cv	SCND/Dcvr-SCND/Dcvr-SCND/Dcvr-SCND/Dcvr-SCND/Dcvr-SCND/Dcvr-SCND/Dcvr-SCND/Dcvr	2018-2025	**5**	**3.4**	**0.0**	**14**	294	80	-160

Field Name	SubFarm	FSA Trct	FSA Fld	Acres	County	Critical Soil Series & Symbol	F. Slp %	F.Slp Len ft	Below Field Slope To Water %	Dist.To Water ft	N/Fld Res	Contour/ Filters	Irrig	Tiled	Rotation	Tillage	Report Period	Field "T" t/ac	Rot Avg Soil Loss t/ac	SCI	Rot Avg PI	Soil Test P ppm	Rot P2O5 Bal lb/ac	P2O5 Bal Target lb/ac
30				2.8	Green	NORTHFIELD NoD2	13	150	0 - 2	1001 - 5000	R %	On contour / No	No	No	A-A-[F-Cg]-[Wwg+s-Fs]-A-A-A-A	None-None-NT-CP-None-None-None-None	2018-2025	**2**	**1.4**	**0.6**	**4**	27	94	-
31				2.3	Green	NORTHFIELD NoD2	13	150	0 - 2	1001 - 5000	R %	On contour / No	No	No	Ag-[F-Cg]-[Wwg+s-Fs]-A-A-A-A-A	None-NT-CP-None-None-None-None-None	2018-2025	**2**	**1.3**	**0.6**	**3**	19	94	-
36				3.4	Green	SYLVESTER SyC2	9	200	0 - 2	1001 - 5000	R %	On contour / No	No	No	Csl+cv-Csl-[Wwg+s-Fs]-A-A-Ag-Ag-Csl+cv	SCND/NTcvr-SCND-CP-None-None-None-None-SCND/NTcvr	2018-2025	**3**	**2.5**	**0.4**	**5**	38	20	-
38				5.8	Green	SYLVESTER SyC2	9	200	0 - 2	1001 - 5000	%	On contour / No	No	No	A-Ag-Ag-Csl+cv-Csl+cv-Csl-[Wwg+s-Fs]-A	None-None-None-SCND/NTcvr-SCND/NTcvr-SCND-CP-None	2018-2025	**3**	**2.5**	**0.4**	**5**	68	20	0
40				6.3	Green	SYLVESTER SyC2	9	200	0 - 2	1001 - 5000	%	On contour / No	No	No	Csl+cv-Csl-[Wwg+s-Fs]-A-A-Ag-Ag-Csl+cv	SCND/NTcvr-SCND-CP-None-None-None-None-SCND/NTcvr	2018-2025	**3**	**2.5**	**0.4**	**5**	51	20	0

Field Name	SubFarm	FSA Trct	FSA Fld	Acres	County	Critical Soil Series & Symbol	F. Slp %	F.Slp Len ft	Below Field Slope To Water %	Dist.To Water ft	N/Fld Res	Contour/ Filters	Irrig	Tiled	Rotation	Tillage	Report Period	Field "T" t/ac	Rot Avg Soil Loss t/ac	SCI	Rot Avg PI	Soil Test P ppm	Rot P2O5 Bal lb/ac	P2O5 Bal Target lb/ac
41				5.6	Green	SYLVESTER SyB2	4	200	0 - 2	1001 - 5000	%	On contour / No	No	No	Ag-Csl +cv-Csl +cv-Csl-[Wwg+s-Fs]-A-A-Ag	None-SCND/NT cvr-SCND/NT cvr-SCND-CP-None-None-None	2018-2025	**3**	**1.1**	**0.5**	**3**	41	16	-
43				2.8	Green	NORTHFIELD NoC2	9	200	0 - 2	1001 - 5000	R %	On contour / No	No	No	[Wwg+s-Fs]-A-A-Ag-Ag-Csl +cv-Csl +cv-Csl	CP-None-None-None-None-SCND/NT cvr-SCND/NT cvr-SCND	2018-2025	**2**	**2.3**	**0.4**	**5**	53	16	0
45				3.1	Green	NORTHFIELD NoC2	9	200	0 - 2	1001 - 5000	R %	On contour / No	No	No	Ag-Csl +cv-Csl +cv-Csl-[Wwg+s-Fs]-A-A-Ag	None-SCND/NT cvr-SCND/NT cvr-SCND-CP-None-None-None	2018-2025	**2**	**2.5**	**0.4**	**5**	41	120	-
47				3.3	Green	NORTHFIELD NoC2	9	200	0 - 2	1001 - 5000	R %	On contour / No	No	No	[Wwg+s-Fs]-A-A-Ag-Ag-Csl +cv-Csl +cv-Csl	CP-None-None-None-None-SCND/NT cvr-SCND/NT cvr-SCND	2018-2025	**2**	**2.3**	**0.4**	**5**	78	16	0
61-62				1.9	Green	SYLVESTER SyB2	4	200	0 - 2	1001 - 5000		On contour / No	No	No	A-A-[F-Cg]-[Wwg +s-Fs]-A-A-A-A	None-None-NT-CP-None-None-None-None	2018-2025	**3**	**0.4**	**0.7**	**2**	20	94	-

Field Name	SubFarm	FSA Trct	FSA Fld	Acres	County	Critical Soil Series & Symbol	F. Slp %	F.Slp Len ft	Below Field Slope To Water %	Dist.To Water ft	N/Fld Res	Contour/ Filters	Irrig	Tiled	Rotation	Tillage	Report Period	Field "T" t/ac	Rot Avg Soil Loss t/ac	SCI	Rot Avg PI	Soil Test P ppm	Rot P2O5 Bal lb/ac	P2O5 Bal Target lb/ac
E1				88.9	Green	NORTHFIELD NoC2	9	200	2.1 - 6	1001 - 5000	R+ %	No / No	No	No	Sg15-Cg-Sg15-Cg-Sg15-Cg-Sg15-Cg	FCND-SFC-FCND-SFC-FCND-SFC-FCND-SFC	2018-2025	**2**	**6.6**	**0.0**	**6**	101	-480	-120
E2				74.2	Green	NORTHFIELD NoC2	9	200	0 - 2	1001 - 5000	R+ %	No / No	No	No	Sg15-Cg-Sg15-Cg-Sg15-Cg-Sg15-Cg	FCND-SFC-FCND-SFC-FCND-SFC-FCND-SFC	2018-2025	**2**	**6.6**	**0.0**	**5**	101	-480	-120
GA				18.8	Green	NORTHFIELD NoC2	9	200	2.1 - 6	1001 - 5000	R %	No / No	No	No	Cg-Sg15-Cg-Sg15-Cg-Sg15-Cg-Sg15	SFC-FCND-SFC-FCND-SFC-FCND-SFC-FCND	2018-2025	**2**	**6.3**	**0.1**	**11**	101	240	-120
GO				39	Green	SYLVESTER SyB2	4	200	2.1 - 6	1001 - 5000	+ %	No / No	No	No	Cg-Sg15-Cg-Sg15-Cg-Sg15-Cg-Sg15	SFC-FCND-SFC-FCND-SFC-FCND-SFC-FCND	2018-2025	**3**	**2.8**	**0.4**	**7**	101	240	-120
K1				10.9	Green	TAMA TbB	4	250	2.1 - 6	1001 - 5000	%	No / No	No	No	Wwg-Sg15-Cg-Wwg-Sg15-Cg-Wwg-Sg15	FCND-FCND-FCND-FCND-FCND-FCND-FCND-FCND	2018-2025	**5**	**2.3**	**0.6**	**5**	35	403	-

Field Name	SubFarm	FSA Trct	FSA Fld	Acres	County	Critical Soil Series & Symbol	F. Slp %	F.Slp Len ft	Below Field Slope To Water %	Dist.To Water ft	N/Fld Res	Contour/ Filters	Irrig	Tiled	Rotation	Tillage	Report Period	Field "T" t/ac	Rot Avg Soil Loss t/ac	SCI	Rot Avg PI	Soil Test P ppm	Rot P2O5 Bal lb/ac	P2O5 Bal Target lb/ac
K2				22.3	Green	SYLVESTER SyC2	9	200	2.1 - 6	1001 - 5000	R %	No / No	No	No	Sg15-Cg-Wwg-Sg15-Cg-Wwg-Sg15-Cg	FCND-FCND-FCND-FCND-FCND-FCND-FCND-FCND	2018-2025	**3**	**5.3**	**0.5**	**10**	35	562	-
K3				21	Green	NORTHFIELD NoC2	9	200	2.1 - 6	1001 - 5000	R+ %	No / No	No	No	Cg-Wwg-Sg15-Cg-Wwg-Sg15-Cg-Wwg	FCND-FCND-FCND-FCND-FCND-FCND-FCND-FCND	2018-2025	**2**	**5.2**	**0.2**	**9**	35	293	-
K4				20.4	Green	ELKMOUND ElC2	9	200	2.1 - 6	1001 - 5000	R+ %	No / No	No	No	Wwg-Sg15-Cg-Wwg-Sg15-Cg-Wwg-Sg15	FCND-FCND-FCND-FCND-FCND-FCND-FCND-FCND	2018-2025	**2**	**4**	**0.4**	**7**	35	373	-
K5				39.9	Green	OCKLEY OkC2	9	200	0 - 2	1001 - 5000	%	No / No	No	No	Cg-Sg15-Cg-Sg15-Cg-Sg15-Cg-Sg15	FCND-FCND-FCND-FCND-FCND-FCND-FCND-FCND	2018-2025	**4**	**10.4**	**-0.4**	**8**	35	-456	-
K6				37.9	Green	FAYETTE FbB2	4	200	0 - 2	1001 - 5000	%	No / No	No	No	Sg15-Cg-Sg15-Cg-Sg15-Cg-Sg15-Cg	FCND-FCND-FCND-FCND-FCND-FCND-FCND-FCND	2018-2025	**4**	**5.2**	**0.0**	**5**	35	-480	-

Field Name	SubFarm	FSA Trct	FSA Fld	Acres	County	Critical Soil Series & Symbol	F. Slp %	F.Slp Len ft	Below Field Slope To Water %	Dist.To Water ft	N/Fld Res	Contour/ Filters	Irrig	Tiled	Rotation	Tillage	Report Period	Field "T" t/ac	Rot Avg Soil Loss t/ac	SCI	Rot Avg PI	Soil Test P ppm	Rot P2O5 Bal lb/ac	P2O5 Bal Target lb/ac
KO				22.8	Green	OCKLEY OeA	1	250	0 - 2	1001 - 5000	%	No / No	No	No	Csl+cv-Csl+cv-Csl+cv-Csl+cv-Csl+cv-Csl+cv-Csl+cv-Csl+cv	SCND/Dcvr-SCND/Dcvr-SCND/Dcvr-SCND/Dcvr-SCND/Dcvr-SCND/Dcvr-SCND/Dcvr-SCND/Dcvr	2018-2025	**4**	**1**	**0.1**	**1**	101	-640	-160
SL				13.2	Green	NEWGLARUS NgC2	9	150	2.1 - 6	1001 - 5000	R %	No / No	No	No	Sg15-OgAs-A-A-A-[F-Cg]-Sg15	SCND-SCD-None-None-None-None-SCD-SCND	2018-2025	**2**	**4.7**	**0.2**	**5**	101	-480	-120
SL2				7.8	Green	NEWGLARUS NgC2	9	150	2.1 - 6	1001 - 5000	%	No / No	No	No	A-A-A-[F-Cg]-Sg15-OgAs-A-A	None-None-None-SCD-SCND-SCD-None-None	2018-2025	**2**	**3.1**	**0.4**	**3**	101	-505	-126
SL3				12.4	Green	NEWGLARUS NgC2	9	150	6.1 - 12	1001 - 5000	%	No / No	No	No	OgAs-A-A-A-[F-Cg]-Sg15-OfAs	SCD-None-None-None-None-SCD-SCND-SCD	2018-2025	**2**	**3.4**	**0.3**	**4**	101	-470	-118

Crop Abbreviations

Abbreviation	Crop
[F-Cg]	Alfalfa (1st cut) to Corn grain
[Wwg+s-Fs]	Winter wheat (grain+straw) to Late-Direct Seeded Legume Forage
A	Alfalfa
Ag	Alfalfa (grassy, yr 3+)
Cg	Corn grain
Csl	Corn silage
Csl+cv	Corn silage to small grain cover crop
OfAs	Oatlage w/ Alfalfa Seeding Spring
OgAs	Oats w/ Alfalfa Seeding Spring
Sg15	Soybeans 15-20 inch row
Wwg	Winter wheat (grain)

Tillage Abbreviations

Abbreviation	Tillage
CP	Chisel Plow, disked
FCND	Fall Chisel, no disk
None	None
NT	No Till
SCD	Spring Chisel, disked
SCND	Spring Chisel, no disk
SCND/Dcvr	Spring Chisel, no disk, cover crop disked
SCND/NTcvr	Spring Chisel, no disk, cover crop no till
SFC	Spring Cultivation

Restriction Legend

Code	Description of Code
S	Field is in SWQMA
D	Drinking water well within 50 feet of field.
C	Conduit to groundwater within 200 feet upslope of field.
L	Local restrictions on nutrient applications.
%	Slope restriction for winter applications
P	High permeability N restricted soils
R	N restricted soils with less than 20 inches to bedrock
W	N restricted soils with less than 12 inches to apparent water table
+	This map unit may have any of the N restrictive features, however an on-site investigation is needed to identify which restrictions may actually be present.

SnapPlus Field Data and 590 Assessment Plan

Reported For	Landowner C Pre-BMP (T1-T4)
Printed	2018-04-02
Plan Completion/Update Date	2014-05-28
SnapPlus Version 16.3 built on 2016-10-31	
C:\SnapPlus2\MySnapPlusData\Popanz_Riemer_2016_AJS.snapDb	

Prepared for:
Landowner C Pre-BMP (T1-T4)
attn:Landowner C

Field Data: 55 Total Acres Reported.

Field Name	SubFarm	FSA Trct	FSA Fld	Acres	County	Critical Soil Series & Symbol	F. Slp %	F.Slp Len ft	Below Field Slope To Water %	Dist.To Water ft	N/Fld Res	Contour/ Filters	Irrig	Tiled	Rotation	Tillage	Report Period	Field "T" t/ac	Rot Avg Soil Loss t/ac	SCI	Rot Avg PI	Soil Test P ppm	Rot P2O5 Bal lb/ac	P2O5 Bal Target lb/ac
T1				20.6	Rock	BILLETT BIA	1	250	0 - 2	1001 - 5000	WP C	No / No	No	No	A-A-A-A-A-Cg-Sg15-OfAs	None-None-None-None-None-SVT-SVT-FCD	2018-2025	**3**	**0.3**	**0.6**	**0**	64	-305	0
T2				18.2	Rock	BILLETT BIA	1	250	0 - 2	1001 - 5000	P	No / No	No	No	A-A-A-A-Cg-Sg15-OfAs-A	None-None-None-None-SVT-SVT-FCD-None	2018-2025	**3**	**0.3**	**0.6**	**0**	90	-305	0
T3				5.3	Rock	DICKMAN DcA	1	250	0 - 2	1001 - 5000	WP	No / No	No	No	A-A-A-A-Cg-Sg15-OfAs-A	None-None-None-None-SVT-SVT-FCD-None	2018-2025	**3**	**0.2**	**0.6**	**0**	72	-305	0
T4				10.7	Rock	DICKMAN DcA	1	250	0 - 2	1001 - 5000	P C	No / No	No	No	Cg-Sg15-OfAs-A-A-A-A-A	SVT-SVT-FCD-None-None-None-None-None	2018-2025	**3**	**0.2**	**0.6**	**0**	29	-305	-

Crop Abbreviations

Abbreviation	Crop
A	Alfalfa
Cg	Corn grain
OfAs	Oatlage w/ Alfalfa Seeding Spring
Sg15	Soybeans 15-20 inch row

Tillage Abbreviations

Abbreviation	Tillage
FCD	Fall Chisel, disked
None	None
SVT	Spring vertical tillage

Restriction Legend

Code	Description of Code
S	Field is in SWQMA
D	Drinking water well within 50 feet of field.
C	Conduit to groundwater within 200 feet upslope of field.
L	Local restrictions on nutrient applications.
%	Slope restriction for winter applications
P	High permeability N restricted soils
R	N restricted soils with less than 20 inches to bedrock
W	N restricted soils with less than 12 inches to apparent water table
+	This map unit may have any of the N restrictive features, however an on-site investigation is needed to identify which restrictions may actually be present.

SnapPlus Application Summary Report

Starting Year	**2018**
Reported For	**Landowner C Pre-BMP (Fields 3-SL)**
Printed	**2018-04-02**
Plan Completion/Update Date:	**2017-02-10**
SnapPlus Version 16.3 built on 2016-10-31	
C:\SnapPlus2\MySnapPlusData \Riemer_Farms2018manure_no_storageAJS.snapDb	

Prepared for:
Landowner C Pre-BMP (Fields 3-SL)
attn:Landowner C

Annual Manure Production And Use By Source

Total Value = $ Value of all nutrients, incorporated including S.

Source		2018	2019	2020	2021	2022	2023	2024
Dairy Liquid	Production (Gallons) Used (Gallons) Analysis Date Analysis (N/Ninc/Ninj-P2O5-K2O) Dry Matter (%) Total Value	0 0 - 4/6/7-3-11 2 0.00	0 0 - 4/6/7-3-11 2 0.00	0 0 - 4/6/7-3-11 2 0.00	0 0 - 4/6/7-3-11 2 0.00	0 0 - 4/6/7-3-11 2 0.00	0 0 - 4/6/7-3-11 2 0.00	0 0 - 4/6/7-3-11 2 0.00
Dairy Slurry	Production (Gallons) Used (Gallons) Analysis Date Analysis (N/Ninc/Ninj-P2O5-K2O) Dry Matter (%) Total Value	2,064,988 2,055,520 - 7/10/12-6-17 6 0.00	2,236,172 2,272,623 - 7/10/12-6-17 6 0.00	2,407,358 2,466,623 - 7/10/12-6-17 6 0.00	2,524,158 2,580,623 - 7/10/12-6-17 6 0.00	2,640,958 2,581,723 - 7/10/12-6-17 6 0.00	2,640,958 2,578,800 - 7/10/12-6-17 6 0.00	2,640,958 2,627,700 - 7/10/12-6-17 6 0.00
Dairy Solid	Production (Tons) Used (Tons) Analysis Date Analysis (N/Ninc/Ninj-P2O5-K2O) Dry Matter (%) Total Value	992 1,456 - 2/3/3-3-6 33 0.00	1,118 840 - 2/3/3-3-6 33 0.00	1,243 1,115 - 2/3/3-3-6 33 0.00	1,243 436 - 2/3/3-3-6 33 0.00	1,243 1,020 - 2/3/3-3-6 33 0.00	1,243 1,115 - 2/3/3-3-6 33 0.00	1,243 1,115 - 2/3/3-3-6 33 0.00

Application Results Reported For Farm All

Source		2025
Dairy Liquid	Production (Gallons) Used (Gallons) Analysis Date Analysis (N/Ninc/Ninj-P2O5-K2O) Dry Matter (%) Total Value	-
Dairy Slurry	Production (Gallons) Used (Gallons) Analysis Date Analysis (N/Ninc/Ninj-P2O5-K2O) Dry Matter (%) Total Value	2,640,958 2,644,400 - 7/10/12-6-17 6 0.00
Dairy Solid	Production (Tons) Used (Tons) Analysis Date Analysis (N/Ninc/Ninj-P2O5-K2O) Dry Matter (%) Total Value	1,243 1,883 - 2/3/3-3-6 33 0.00

Annual Pounds Of Available N, P2O5 And K2O Applied From Manure and Fertilizer.

		2018	2019	2020	2021	2022	2023	2024
Produced from Manure (lb)	Ninj P2O5 K2O	27,756 15,366 41,057	30,188 16,771 44,723	32,617 18,173 48,383	34,019 18,874 50,369	35,420 19,575 52,354	35,420 19,575 52,354	35,420 19,575 52,354
Total Available Manure Nutrients Applied (lb)	N P2O5 K2O	17,319 16,701 43,698	17,582 16,148 43,668	19,490 18,137 48,616	18,930 16,784 46,480	20,106 18,543 50,003	20,282 18,818 50,530	20,624 19,111 51,361
Total Fertilizer Nutrients Applied (lb)	N P2O5 K2O	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0
Total Crop Removal (lb)	P2O5 K2O	28,520 49,689	31,749 51,023	29,550 53,510	31,533 50,172	29,104 53,861	32,121 49,649	29,145 50,127
Nutrient Balance (Applied - Crop removal, lb)	P2O5 K2O	-11,819 -5,991	-15,601 -7,355	-11,413 -4,894	-14,749 -3,692	-10,561 -3,858	-13,303 881	-10,034 1,234

Annual Pounds Of Available N, P2O5 And K2O Applied From Manure and Fertilizer.		
		2025
Produced from Manure (lb)	Ninj P2O5 K2O	35,420 19,575 52,354
Total Available Manure Nutrients Applied (lb)	N P2O5 K2O	22,277 21,515 56,253
Total Fertilizer Nutrients Applied (lb)	N P2O5 K2O	0 0 0
Total Crop Removal (lb)	P2O5 K2O	31,098 46,897
Nutrient Balance (Applied - Crop removal, lb)	P2O5 K2O	-9,582 9,356

SnapPlus Application Summary Report

Starting Year	**2018**
Reported For	**Landowner C Pre-BMP (T1-T4)**
Printed	**2018-04-02**
Plan Completion/Update Date:	**2014-05-28**
SnapPlus Version 16.3 built on 2016-10-31	
C:\SnapPlus2\MySnapPlusData\Popanz_Riemer_2016_AJS.snapDb	

Prepared for:
Landowner C Pre-BMP (T1-T4)
attn:Landowner C

Annual Manure Production And Use By Source

Total Value = $ Value of all nutrients, incorporated including S.

Source	

Application Results Reported For Farm All

Annual Pounds Of Available N, P2O5 And K2O Applied From Manure and Fertilizer.								
		2018	2019	2020	2021	2022	2023	2024
Produced from Manure (lb)	Ninj P2O5 K2O	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0
Total Available Manure Nutrients Applied (lb)	N P2O5 K2O	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0
Total Fertilizer Nutrients Applied (lb)	N P2O5 K2O	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0
Total Crop Removal (lb)	P2O5 K2O	2,246 8,313	2,085 8,527	2,085 9,222	2,192 9,864	2,310 6,457	2,060 3,940	1,751 5,879
Nutrient Balance (Applied - Crop removal, lb)	P2O5 K2O	-2,246 -8,313	-2,085 -8,527	-2,085 -9,222	-2,192 -9,864	-2,310 -6,457	-2,060 -3,940	-1,751 -5,879

Annual Pounds Of Available N, P2O5 And K2O Applied From Manure and Fertilizer.		
		2025
Produced from Manure (lb)	Ninj P2O5 K2O	0 0 0
Total Available Manure Nutrients Applied (lb)	N P2O5 K2O	0 0 0
Total Fertilizer Nutrients Applied (lb)	N P2O5 K2O	0 0 0
Total Crop Removal (lb)	P2O5 K2O	1,986 8,628
Nutrient Balance (Applied - Crop removal, lb)	P2O5 K2O	-1,986 -8,628

SnapPlus P Trade Report

Reported For	Landowner C Pre-BMP (Fields 3-SL)
Printed	2018-04-02
Plan Completion/Update Date	2017-02-10
SnapPlus Version 16.3 built on 2016-10-31	
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Prepared for:
Landowner C Pre-BMP (Fields 3-SL)
attn:Landowner C

The P Trade Report estimates the annual pounds of phosphorus (P) in surface runoff from cropland entering surface waters. These P loss calculations are based on a field's soil test P concentration, crops, tillage, nutrient management practices and estimates of average runoff and sheet and rill erosion for the predominant soil type. Losses from concentrated flow channel or gully erosion with a field are not included in these calculations. Field runoff losses are calculated for each year as **PTP** (lb P/field/yr). Fields are only included if there are at least 2 years of crops before the selected start year. Before using this report as part of a Water Quality Trade activity, phosphorus losses (PTP) must be converted into ‘P credits’ according to DNR guidance.

For more information go to **http://dnr.wi.gov/** and type keyword: **Water Quality Trading**

Questions? Please contact DNRphosphorus@wisconsin.gov

This report was developed for Wisconsin DNR Water Quality Trading and Adaptive Management purposes and cannot be used to demonstrate compliance with NR 151 or NRCS 590 NM plan requirements.

P Trade Report				PTP							
Field Name	Soil Series	Soil Symbol	Acres	2018	2019	2020	2021	2022	2023	2024	2025
3	SYLVESTER	SyB2	14	123	128	130	130	131	132	132	133
30	NORTHFIELD	SyC2	3	3	3	5	7	9	10	8	5
31	NORTHFIELD	SyC2	2	2	2	5	7	8	6	4	3
32.33	NORTHFIELD	SyC2	6	42	24	21	10	5	16	33	42
36	SYLVESTER	SyC2	3	21	31	26	16	15	6	3	11
38	SYLVESTER	SyC2	6	14	12	8	26	51	48	42	26
40	SYLVESTER	TbB	6	22	31	27	21	21	9	5	12

P Trade Report				PTP							
Field Name	Soil Series	Soil Symbol	Acres	2018	2019	2020	2021	2022	2023	2024	2025
41	SYLVESTER	SyB2	6	13	16	24	27	22	14	13	7
43	NORTHFIELD	SyB2	3	11	8	8	4	3	5	9	11
45	NORTHFIELD	NoC2	3	13	17	28	31	26	13	12	6
47	NORTHFIELD	SyB2	3	15	11	10	6	4	7	12	15
5	TAMA	TbB	5	67	70	71	71	72	72	72	72
61-62	SYLVESTER	TbB	2	2	1	2	3	4	5	4	3
7.8	SYLVESTER	TbB	7	47	49	49	50	50	50	50	51
E1	NORTHFIELD	SyB2	89	192	355	206	348	199	334	192	321
E2	NORTHFIELD	SyC2	74	300	569	317	558	308	540	299	523
GA	NORTHFIELD	SyB2	19	118	84	144	93	150	95	153	96
GO	SYLVESTER	SyB2	39	314	180	322	183	323	185	328	188
K1	TAMA	StA	11	26	34	43	27	39	50	22	42
K2	SYLVESTER	HvA	22	25	59	53	51	69	56	65	80
K3	NORTHFIELD	SyC2	21	411	93	234	359	82	242	364	95
K4	ELKMOUND	SyB2	20	71	77	141	44	111	158	54	120
K5	OCKLEY	OkC2	40	595	188	480	181	467	176	456	206
K6	FAYETTE	TbB	38	74	200	78	198	75	192	72	185
KO	OCKLEY	OcA	23	28	30	30	29	29	28	27	26
SL	NEWGLARUS	NgC2	13	65	86	24	28	23	17	99	55
SL2	NEWGLARUS	PgB2	8	6	5	5	27	18	25	8	10
SL3	NEWGLARUS	NgC2	12	86	24	28	23	17	97	54	72
Total			**499**	**2,704**	**2,390**	**2,520**	**2,558**	**2,329**	**2,588**	**2,592**	**2,418**

SnapPlus P Trade Report

Reported For	Landowner C Pre-BMP (T1-T4)
Printed	2018-04-02
Plan Completion/Update Date	2014-05-28
SnapPlus Version 16.3 built on 2016-10-31	
C:\SnapPlus2\MySnapPlusData\Popanz_Riemer_2016_AJS.snapDb	

Prepared for:
Landowner C Pre-BMP (T1-T4)
attn:Landowner C

The P Trade Report estimates the annual pounds of phosphorus (P) in surface runoff from cropland entering surface waters. These P loss calculations are based on a field's soil test P concentration, crops, tillage, nutrient management practices and estimates of average runoff and sheet and rill erosion for the predominant soil type. Losses from concentrated flow channel or gully erosion with a field are not included in these calculations. Field runoff losses are calculated for each year as **PTP** (lb P/field/yr). Fields are only included if there are at least 2 years of crops before the selected start year. Before using this report as part of a Water Quality Trade activity, phosphorus losses (PTP) must be converted into ‘P credits’ according to DNR guidance.

For more information go to **http://dnr.wi.gov/** and type keyword: **Water Quality Trading**

Questions? Please contact DNRphosphorus@wisconsin.gov

This report was developed for Wisconsin DNR Water Quality Trading and Adaptive Management purposes and cannot be used to demonstrate compliance with NR 151 or NRCS 590 NM plan requirements.

P Trade Report				PTP							
Field Name	Soil Series	Soil Symbol	Acres	2018	2019	2020	2021	2022	2023	2024	2025
T1	BILLETT	DcA	21	2	3	2	2	1	3	4	4
T2	BILLETT	DcA	18	4	3	2	2	3	4	5	3
T3	DICKMAN	Me	5	1	1	1	1	1	1	1	1
T4	DICKMAN	DcA	11	2	2	2	1	1	1	0	0
Total			**55**	**10**	**9**	**8**	**6**	**7**	**9**	**10**	**9**

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SnapPlus Narrative and Crops Report

Starting Year	**2018**
Reported For	**Landowner C Post_BMP (Fields 3-SL)**
Printed	**2018-04-02**
Plan Completion/Update Date:	**2017-02-10**
SnapPlus Version 16.3 built on 2016-10-31	
C:\SnapPlus2\MySnapPlusData \Riemer_Farms2018manure_with_storageAJS.snapDb	

Prepared for:
Landowner C Post_BMP (Fields 3-SL)
attn:Landowner C

Farm has 28 fields totalling 499.3 acres
Farm Narrative: None
Concentrated Flow Notes: None

Field Name	Acres	2018	2019	2020	2021	2022	2023	2024	2025
3	14.4	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre
30	2.8	Alfalfa Seeding Fall No Till 3.6-4.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 5.6-6.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Alfalfa (1st cut) to Sorghum-sudangrass No Till 5-7 ton/acre	Winter Triticale (forage) to Sorghum-sudangrass No Till 2.0-3.5/5-7 ton/acre/ton/acre
31	2.3	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Alfalfa (1st cut) to Sorghum-sudangrass No Till 5-7 ton/acre	Winter Triticale (forage) to Sorghum-sudangrass No Till 2.0-3.5/5-7 ton/acre/ton/acre	Alfalfa Seeding Fall No Till 3.6-4.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 5.6-6.5 ton/acre
32.33	5.8	Oatlage w/ Alfalfa Seeding Spring No Till 2.0-3.5 ton/acre	Alfalfa Seeding Fall No Till 3.6-4.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage No Till 20.1-25 ton/acre

Field Name	Acres	2018	2019	2020	2021	2022	2023	2024	2025
36	3.4	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage No Till 20.1-25 ton/acre	Winter Triticale (forage) to Sorghum-sudangrass No Till 2.0-3.5/5-7 ton/acre/ton/acre	Alfalfa Seeding Fall No Till 3.6-4.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre
38	5.8	Alfalfa None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage No Till 20.1-25 ton/acre	Winter Triticale (forage) to Sorghum-sudangrass No Till 2.0-3.5/5-7 ton/acre/ton/acre	Alfalfa Seeding Fall No Till 3.6-4.5 ton/acre
40	6.3	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage No Till 20.1-25 ton/acre	Winter Triticale (forage) to Sorghum-sudangrass No Till 2.0-3.5/5-7 ton/acre/ton/acre	Alfalfa Seeding Fall No Till 3.6-4.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre
41	5.6	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage No Till 20.1-25 ton/acre	Winter Triticale (forage) to Sorghum-sudangrass No Till 2.0-3.5/5-7 ton/acre/ton/acre	Alfalfa Seeding Fall No Till 3.6-4.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre
43	2.8	Winter Triticale (forage) to Sorghum-sudangrass No Till 2.0-3.5/5-7 ton/acre/ton/acre	Alfalfa Seeding Fall No Till 3.6-4.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage No Till 20.1-25 ton/acre
45	3.1	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage No Till 20.1-25 ton/acre	Winter Triticale (forage) to Sorghum-sudangrass No Till 2.0-3.5/5-7 ton/acre/ton/acre	Alfalfa Seeding Fall No Till 3.6-4.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre

Field Name	Acres	2018	2019	2020	2021	2022	2023	2024	2025
47	3.3	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 5.6-6.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage No Till 20.1-25 ton/acre
5	5.2	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn grain to small grain cover crop No Till, cover crop no till 191-210 bu/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn grain to small grain cover crop No Till, cover crop no till 191-210 bu/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn grain to small grain cover crop No Till, cover crop no till 191-210 bu/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn grain to small grain cover crop No Till, cover crop no till 191-210 bu/acre
61-62	1.9	Alfalfa Seeding Fall No Till 3.6-4.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 5.6-6.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Alfalfa (1st cut) to Sorghum-sudangrass No Till 5-7 ton/acre	Winter Triticale (forage) to Sorghum-sudangrass No Till 2.0-3.5/5-7 ton/acre/ton/acre
7.8	7	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre
E1	88.9	Corn grain Spring Cultivation 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Spring Cultivation 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Spring Cultivation 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Spring Cultivation 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre
E2	74.2	Corn grain Spring Cultivation 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Spring Cultivation 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Spring Cultivation 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Spring Cultivation 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre
GA	18.8	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Spring Cultivation 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Spring Cultivation 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Spring Cultivation 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Spring Cultivation 171-190 bu/acre

Field Name	Acres	2018	2019	2020	2021	2022	2023	2024	2025
GO	39	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Spring Cultivation 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Spring Cultivation 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Spring Cultivation 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Spring Cultivation 171-190 bu/acre
K1	10.9	Winter wheat (grain) Fall Chisel, no disk 41-60 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Winter wheat (grain) Fall Chisel, no disk 41-60 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Winter wheat (grain) Fall Chisel, no disk 41-60 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre
K2	22.3	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Winter wheat (grain) Fall Chisel, no disk 41-60 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Winter wheat (grain) Fall Chisel, no disk 41-60 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre
K3	21	Corn grain Fall Chisel, no disk 171-190 bu/acre	Winter wheat (grain) Fall Chisel, no disk 41-60 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Winter wheat (grain) Fall Chisel, no disk 41-60 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Winter wheat (grain) Fall Chisel, no disk 41-60 bu/acre
K4	20.4	Winter wheat (grain) Fall Chisel, no disk 41-60 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Winter wheat (grain) Fall Chisel, no disk 41-60 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Winter wheat (grain) Fall Chisel, no disk 41-60 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre
K5	39.9	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre
K6	37.9	Corn grain Fall Chisel, no disk 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre	Corn grain Fall Chisel, no disk 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre
KO	22.8	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre	Corn silage to small grain cover crop No Till, cover crop no till 20.1-25 ton/acre

Field Name	Acres	2018	2019	2020	2021	2022	2023	2024	2025
SL	13.2	Alfalfa (1st cut) to Sorghum-sudangrass No Till 5-7 ton/acre	Winter Triticale (forage) to Sorghum-sudangrass No Till 2.0-3.5/5-7 ton/acre/ton/acre	Alfalfa Seeding Fall No Till 3.6-4.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 5.6-6.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre
SL2	7.8	Alfalfa None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 5.6-6.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Alfalfa (1st cut) to Sorghum-sudangrass No Till 5-7 ton/acre	Winter Triticale (forage) to Sorghum-sudangrass No Till 2.0-3.5/5-7 ton/acre/ton/acre	Alfalfa Seeding Fall No Till 3.6-4.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre
SL3	12.4	Alfalfa None 4.6-5.5 ton/acre	Alfalfa None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 5.6-6.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Alfalfa (grassy, yr 3+) None 4.6-5.5 ton/acre	Alfalfa (1st cut) to Sorghum-sudangrass No Till 5-7 ton/acre	Winter Triticale (forage) to Sorghum-sudangrass No Till 2.0-3.5/5-7 ton/acre/ton/acre	Alfalfa Seeding Fall No Till 3.6-4.5 ton/acre

Summary by Crop:
NOTE: Yields calculated using the midpoint of the SnapPlus yield goal range for each crop.

Crops Grouped By Category		2018	2019	2020	2021	2022	2023	2024	2025
Alfalfa (1st cut) to Sorghum-sudangrass	Acres ton	13 78		2 12		8 48	12 72	5 30	
Winter Triticale (forage) to Sorghum-sudangrass	Acres ton/ton	3 8/18	13 36/78	10 28/60	2 6/12	9 25/54	8 22/48	18 50/108	5 14/30
Alfalfa	Acres ton	29 146	20 101	17 86	13 66	23 116	2 10	11 56	8 40
Alfalfa (grassy, yr 3+)	Acres ton	11 56	16 81	26 131	37 187	29 146	28 141	23 116	24 145
Alfalfa Seeding Fall	Acres ton	5 20	9 36	13 53	10 41	2 8	9 36	8 32	18 73

Crops Grouped By Category		2018	2019	2020	2021	2022	2023	2024	2025
Corn silage	Acres ton		10 226		9 203		6 135		12 271
Oatlage w/ Alfalfa Seeding Spring	Acres ton	6 17							
Corn grain to small grain cover crop	Acres bu		5 1,003		5 1,003		5 1,003		5 1,003
Corn silage to small grain cover crop	Acres ton	59 1,330	53 1,195	58 1,308	50 1,128	55 1,240	56 1,263	61 1,376	54 1,218
Corn grain	Acres bu	222 40,071	120 21,660	232 41,876	119 21,480	223 40,252	129 23,285	222 40,071	120 21,660
Soybeans 15-20 inch row	Acres bu	120 7,260	232 14,036	119 7,200	223 13,492	129 7,805	222 13,431	120 7,260	232 14,036
Winter wheat (grain)	Acres bu	31 1,566	21 1,061	22 1,111	31 1,566	21 1,061	22 1,111	31 1,566	21 1,061

SnapPlus Narrative and Crops Report

Starting Year	**2018**
Reported For	**Landowner C Post-BMP (T1-T4)**
Printed	**2018-04-02**
Plan Completion/Update Date:	**2014-05-28**
SnapPlus Version 16.3 built on 2016-10-31	
C:\SnapPlus2\MySnapPlusData\Popanz_Riemer_2016_AJS.snapDb	

Prepared for:
Landowner C Post-BMP (T1-T4)
attn:Landowner C

Farm has 4 fields totalling 54.8 acres
Farm Narrative: None
Concentrated Flow Notes: None

Field Name	Acres	2018	2019	2020	2021	2022	2023	2024	2025
T1	20.6	Alfalfa None 2.6-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre	Corn grain Spring vertical tillage 111-130 bu/acre	Soybeans 15-20 inch row Spring vertical tillage 36-45 bu/acre	Oatlage w/ Alfalfa Seeding Spring Fall Chisel, disked 2.0-3.5 ton/acre
T2	18.2	Alfalfa None 2.6-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre	Corn grain Spring vertical tillage 111-130 bu/acre	Soybeans 15-20 inch row Spring vertical tillage 36-45 bu/acre	Oatlage w/ Alfalfa Seeding Spring Fall Chisel, disked 2.0-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre
T3	5.3	Alfalfa None 2.6-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre	Corn grain Spring vertical tillage 111-130 bu/acre	Soybeans 15-20 inch row Spring vertical tillage 36-45 bu/acre	Oatlage w/ Alfalfa Seeding Spring Fall Chisel, disked 2.0-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre
T4	10.7	Corn grain Spring vertical tillage 111-130 bu/acre	Soybeans 15-20 inch row Spring vertical tillage 36-45 bu/acre	Oatlage w/ Alfalfa Seeding Spring Fall Chisel, disked 2.0-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre	Alfalfa None 2.6-3.5 ton/acre

Summary by Crop:
NOTE: Yields calculated using the midpoint of the SnapPlus yield goal range for each crop.

Crops Grouped By Category		2018	2019	2020	2021	2022	2023	2024	2025
Alfalfa	Acres ton	44 134	44 134	44 134	55 168	31 95	11 34	11 34	34 104
Corn grain	Acres bu	11 1,326				24 2,892	21 2,531		
Oatlage w/ Alfalfa Seeding Spring	Acres ton			11 30				24 66	21 58
Soybeans 15-20 inch row	Acres bu		11 446				24 972	21 851	

SnapPlus Field Data and 590 Assessment Plan

Reported For	Landowner C Post_BMP (Fields 3-SL)
Printed	2018-04-02
Plan Completion/Update Date	2017-02-10
SnapPlus Version 16.3 built on 2016-10-31	
C:\SnapPlus2\MySnapPlusData \Riemer_Farms2018manure_with_storageAJS.snapDb	

Prepared for:
Landowner C Post_BMP (Fields 3-SL)
attn:Landowner C

Field Data: 499 Total Acres Reported.

Field Name	SubFarm	FSA Trct	FSA Fld	Acres	County	Critical Soil Series & Symbol	F. Slp %	F.Slp Len ft	Below Field Slope To Water %	Dist.To Water ft	N/Fld Res	Contour/ Filters	Irrig	Tiled	Rotation	Tillage	Report Period	Field "T" t/ac	Rot Avg Soil Loss t/ac	SCI	Rot Avg PI	Soil Test P ppm	Rot P2O5 Bal lb/ac	P2O5 Bal Target lb/ac
7.8				7	Green	SYLVESTER SyB2	4	200	0 - 2	1001 - 5000		On contour / No	No	No	Csl+cv-Csl+cv-Csl+cv-Csl+cv-Csl+cv-Csl+cv-Csl+cv-Csl+cv	NT/NTcvr-NT/NTcvr-NT/NTcvr-NT/NTcvr-NT/NTcvr-NT/NTcvr-NT/NTcvr-NT/NTcvr	2018-2025	**3**	**1.4**	**0.5**	**4**	143	-304	-160
3				14.4	Green	SYLVESTER SyB2	4	200	2.1 - 6	1001 - 5000		No / No	No	No	Csl+cv-Csl+cv-Csl+cv-Csl+cv-Csl+cv-Csl+cv-Csl+cv-Csl+cv	NT/NTcvr-NT/NTcvr-NT/NTcvr-NT/NTcvr-NT/NTcvr-NT/NTcvr-NT/NTcvr-NT/NTcvr	2018-2025	**3**	**2.1**	**0.5**	**4**	94	-304	0
32.33				5.8	Green	NORTHFIELD NoC2	9	200	0 - 2	1001 - 5000	R %	On contour / No	No	No	OfAs-Asls-A-Ag-Ag-Csl+cv-Csl+cv-Csl	NT-NT-None-None-None-NT/NTcvr-NT/NTcvr-NT	2018-2025	**2**	**1.9**	**0.6**	**2**	33	-395	-

Field Name	SubFarm	FSA Trct	FSA Fld	Acres	County	Critical Soil Series & Symbol	F. Slp %	F.Slp Len ft	Below Field Slope To Water %	Dist.To Water ft	N/Fld Res	Contour/ Filters	Irrig	Tiled	Rotation	Tillage	Report Period	Field "T" t/ac	Rot Avg Soil Loss t/ac	SCI	Rot Avg PI	Soil Test P ppm	Rot P2O5 Bal lb/ac	P2O5 Bal Target lb/ac
5				5.2	Green	TAMA TbB	4	250	0 - 2	1001 - 5000		No / No	No	No	Csl+cv-Cg +cv-Csl +cv-Cg +cv-Csl +cv-Cg +cv-Csl +cv-Cg+cv	NT/NTcvr-NT/NTcvr-NT/NTcvr-NT/NTcvr-NT/NTcvr-NT/NTcvr-NT/NTcvr-NT/NTcvr	2018-2025	**5**	**1.5**	**0.8**	**6**	294	-284	-155
30				2.8	Green	NORTHFIELD NoD2	13	150	0 - 2	1001 - 5000	R %	On contour / No	No	No	Asls-A-A-Ag-Ag-Ag-[F-SGf]-[TTwf-SGf]	NT-None-None-None-None-None-NT-NT	2018-2025	**2**	**1.1**	**0.7**	**1**	27	-625	-
31				2.3	Green	NORTHFIELD NoD2	13	150	0 - 2	1001 - 5000	R %	On contour / No	No	No	Ag-Ag-[F-SGf]-[TTwf-SGf]-Asls-A-A-Ag	None-None-NT-NT-NT-None-None-None	2018-2025	**2**	**1.1**	**0.7**	**1**	19	-625	-
36				3.4	Green	SYLVESTER SyC2	9	200	0 - 2	1001 - 5000	R %	On contour / No	No	No	Csl+cv-Csl-[TTwf-SGf]-Asls-A-Ag-Ag-Csl+cv	NT/NTcvr-NT-NT-NT-None-None-None-NT/NTcvr	2018-2025	**3**	**1.8**	**0.6**	**2**	38	-491	-
38				5.8	Green	SYLVESTER SyC2	9	200	0 - 2	1001 - 5000	%	On contour / No	No	No	A-Ag-Ag-Csl+cv-Csl+cv-Csl-[TTwf-SGf]-Asls	None-None-None-NT/NTcvr-NT/NTcvr-NT-NT-NT	2018-2025	**3**	**1.8**	**0.6**	**2**	68	-485	0
40				6.3	Green	SYLVESTER SyC2	9	200	0 - 2	1001 - 5000	%	On contour / No	No	No	Csl+cv-Csl-[TTwf-SGf]-Asls-A-Ag-Ag-Csl+cv	NT/NTcvr-NT-NT-NT-None-None-None-NT/NTcvr	2018-2025	**3**	**1.8**	**0.6**	**2**	51	-479	0

Field Name	SubFarm	FSA Trct	FSA Fld	Acres	County	Critical Soil Series & Symbol	F. Slp %	F.Slp Len ft	Below Field Slope To Water %	Dist.To Water ft	N/Fld Res	Contour/ Filters	Irrig	Tiled	Rotation	Tillage	Report Period	Field "T" t/ac	Rot Avg Soil Loss t/ac	SCI	Rot Avg PI	Soil Test P ppm	Rot P2O5 Bal lb/ac	P2O5 Bal Target lb/ac
41				5.6	Green	SYLVESTER SyB2	4	200	0 - 2	1001 - 5000	%	On contour / No	No	No	Ag-Csl+cv-Csl+cv-Csl-[TTwf-SGf]-Asls-A-Ag	None-NT/NTcvr-NT/NTcvr-NT-NT-NT-None-None	2018-2025	**3**	**0.8**	**0.7**	**1**	41	-479	-
43				2.8	Green	NORTHFIELD NoC2	9	200	0 - 2	1001 - 5000	R %	On contour / No	No	No	[TTwf-SGf]-Asls-A-Ag-Ag-Csl+cv-Csl+cv-Csl	NT-NT-None-None-None-NT/NTcvr-NT/NTcvr-NT	2018-2025	**2**	**1.8**	**0.6**	**2**	53	-479	0
45				3.1	Green	NORTHFIELD NoC2	9	200	0 - 2	1001 - 5000	R %	On contour / No	No	No	Ag-Csl+cv-Csl+cv-Csl-[TTwf-SGf]-Asls-A-Ag	None-NT/NTcvr-NT/NTcvr-NT-NT-NT-None-None	2018-2025	**2**	**1.8**	**0.6**	**2**	41	-485	-
47				3.3	Green	NORTHFIELD NoC2	9	200	0 - 2	1001 - 5000	R %	On contour / No	No	No	A-A-A-Ag-Ag-Csl+cv-Csl+cv-Csl	None-None-None-None-None-NT/NTcvr-NT/NTcvr-NT	2018-2025	**2**	**1.6**	**0.6**	**2**	78	-454	0
61-62				1.9	Green	SYLVESTER SyB2	4	200	0 - 2	1001 - 5000		On contour / No	No	No	Asls-A-A-Ag-Ag-Ag-[F-SGf]-[TTwf-SGf]	NT-None-None-None-None-None-NT-NT	2018-2025	**3**	**0.3**	**0.8**	**0**	20	-625	-
E1				88.9	Green	NORTHFIELD NoC2	9	200	2.1 - 6	1001 - 5000	R %	No / No	No	No	Cg-Sg15-Cg-Sg15-Cg-Sg15-Cg-Sg15	SFC-FCND-SFC-FCND-SFC-FCND-SFC-FCND	2018-2025	**2**	**6.4**	**0.1**	**7**	101	-144	-120

Field Name	SubFarm	FSA Trct	FSA Fld	Acres	County	Critical Soil Series & Symbol	F. Slp %	F.Slp Len ft	Below Field Slope To Water %	Dist.To Water ft	N/Fld Res	Contour/ Filters	Irrig	Tiled	Rotation	Tillage	Report Period	Field "T" t/ac	Rot Avg Soil Loss t/ac	SCI	Rot Avg PI	Soil Test P ppm	Rot P2O5 Bal lb/ac	P2O5 Bal Target lb/ac
E2				74.2	Green	NORTHFIELD NoC2	9	200	0 - 2	1001 - 5000	R %	No / No	No	No	Cg-Sg15-Cg-Sg15-Cg-Sg15-Cg-Sg15	SFC-FCND-SFC-FCND-SFC-FCND-SFC-FCND	2018-2025	**2**	**6.4**	**0.1**	**6**	101	-144	-120
GA				18.8	Green	NORTHFIELD NoC2	9	200	2.1 - 6	1001 - 5000	R %	No / No	No	No	Sg15-Cg-Sg15-Cg-Sg15-Cg-Sg15-Cg	FCND-SFC-FCND-SFC-FCND-SFC-FCND-SFC	2018-2025	**2**	**6.4**	**0.1**	**7**	101	-144	-120
GO				39	Green	SYLVESTER SyB2	4	200	2.1 - 6	1001 - 5000	R %	No / No	No	No	Sg15-Cg-Sg15-Cg-Sg15-Cg-Sg15-Cg	FCND-SFC-FCND-SFC-FCND-SFC-FCND-SFC	2018-2025	**3**	**2.8**	**0.3**	**4**	101	-144	-120
K1				10.9	Green	TAMA TbB	4	250	2.1 - 6	1001 - 5000	%	No / No	No	No	Wwg-Sg15-Cg-Wwg-Sg15-Cg-Wwg-Sg15	FCND-FCND-FCND-FCND-FCND-FCND-FCND-FCND	2018-2025	**5**	**1.9**	**0.7**	**2**	35	25	-
K2				22.3	Green	SYLVESTER SyC2	9	200	2.1 - 6	1001 - 5000	R %	No / No	No	No	Sg15-Cg-Wwg-Sg15-Cg-Wwg-Sg15-Cg	FCND-FCND-FCND-FCND-FCND-FCND-FCND-FCND	2018-2025	**3**	**5**	**0.5**	**5**	35	-44	-

Field Name	SubFarm	FSA Trct	FSA Fld	Acres	County	Critical Soil Series & Symbol	F. Slp %	F.Slp Len ft	Below Field Slope To Water %	Dist.To Water ft	N/Fld Res	Contour/ Filters	Irrig	Tiled	Rotation	Tillage	Report Period	Field "T" t/ac	Rot Avg Soil Loss t/ac	SCI	Rot Avg PI	Soil Test P ppm	Rot P2O5 Bal lb/ac	P2O5 Bal Target lb/ac
K3				21	Green	NORTHFIELD NoC2	9	200	2.1 - 6	1001 - 5000	R %	No / No	No	No	Cg-Wwg-Sg15-Cg-Wwg-Sg15-Cg-Wwg	FCND-FCND-FCND-FCND-FCND-FCND-FCND-FCND	2018-2025	**2**	**3.9**	**0.6**	**4**	35	32	-
K4				20.4	Green	ELKMOUND ElC2	9	200	2.1 - 6	1001 - 5000	R %	No / No	No	No	Wwg-Sg15-Cg-Wwg-Sg15-Cg-Wwg-Sg15	FCND-FCND-FCND-FCND-FCND-FCND-FCND-FCND	2018-2025	**2**	**3.2**	**0.7**	**4**	35	124	-
K5				39.9	Green	OCKLEY OkC2	9	200	0 - 2	1001 - 5000	%	No / No	No	No	Sg15-Cg-Sg15-Cg-Sg15-Cg-Sg15-Cg	FCND-FCND-FCND-FCND-FCND-FCND-FCND-FCND	2018-2025	**4**	**10**	**-0.3**	**9**	35	-228	-
K6				37.9	Green	FAYETTE FbB2	4	200	0 - 2	1001 - 5000	%	No / No	No	No	Cg-Sg15-Cg-Sg15-Cg-Sg15-Cg-Sg15	FCND-FCND-FCND-FCND-FCND-FCND-FCND-FCND	2018-2025	**4**	**4.9**	**0.1**	**5**	35	-156	-
KO				22.8	Green	OCKLEY OeA	1	250	0 - 2	1001 - 5000	P %	No / No	No	No	Csl+cv-Csl+cv-Csl+cv-Csl+cv-Csl+cv-Csl+cv-Csl+cv-Csl+cv	NT/NTcvr-NT/NTcvr-NT/NTcvr-NT/NTcvr-NT/NTcvr-NT/NTcvr-NT/NTcvr-NT/NTcvr	2018-2025	**4**	**0.7**	**0.6**	**1**	101	-304	-160

Field Name	SubFarm	FSA Trct	FSA Fld	Acres	County	Critical Soil Series & Symbol	F. Slp %	F.Slp Len ft	Below Field Slope To Water %	Dist.To Water ft	N/Fld Res	Contour/ Filters	Irrig	Tiled	Rotation	Tillage	Report Period	Field "T" t/ac	Rot Avg Soil Loss t/ac	SCI	Rot Avg PI	Soil Test P ppm	Rot P2O5 Bal lb/ac	P2O5 Bal Target lb/ac
SL				13.2	Green	NEWGL ARUS NgC2	9	150	2.1 - 6	1001 - 5000	R %	No / No	No	No	[F-SGf]-[TTwf-SGf]-Asls-A-A-Ag-Ag-Ag	NT-NT-NT-None-None-None-None-None	2018-2025	**2**	**0.9**	**0.7**	**1**	101	-625	-156
SL2				7.8	Green	NEWGL ARUS NgC2	9	150	2.1 - 6	1001 - 5000	%	No / No	No	No	A-Ag-Ag-Ag-[F-SGf]-[TTwf-SGf]-Asls-A	None-None-None-None-NT-NT-NT-None	2018-2025	**2**	**0.9**	**0.7**	**1**	101	-625	-156
SL3				12.4	Green	NEWGL ARUS NgC2	9	150	6.1 - 12	1001 - 5000	%	No / No	No	No	A-A-Ag-Ag-Ag-[F-SGf]-[TTwf-SGf]-Asls	None-None-None-None-None-NT-NT-NT	2018-2025	**2**	**0.9**	**0.7**	**1**	101	-625	-156

Crop Abbreviations

Abbreviation	Crop
[F-SGf]	Alfalfa (1st cut) to Sorghum-sudangrass
[TTwf-SGf]	Winter Triticale (forage) to Sorghum-sudangrass
A	Alfalfa
Ag	Alfalfa (grassy, yr 3+)
Asls	Alfalfa Seeding Fall
Cg	Corn grain
Cg+cv	Corn grain to small grain cover crop
Csl	Corn silage
Csl+cv	Corn silage to small grain cover crop

Tillage Abbreviations

Abbreviation	Tillage
FCND	Fall Chisel, no disk
None	None
NT	No Till
NT/NTcvr	No Till, cover crop no till
SFC	Spring Cultivation

OfAs	Oatlage w/ Alfalfa Seeding Spring
Sg15	Soybeans 15-20 inch row
Wwg	Winter wheat (grain)

Restriction Legend

Code	Description of Code
S	Field is in SWQMA
D	Drinking water well within 50 feet of field.
C	Conduit to groundwater within 200 feet upslope of field.
L	Local restrictions on nutrient applications.
%	Slope restriction for winter applications
P	High permeability N restricted soils
R	N restricted soils with less than 20 inches to bedrock
W	N restricted soils with less than 12 inches to apparent water table
+	This map unit may have any of the N restrictive features, however an on-site investigation is needed to identify which restrictions may actually be present.

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SnapPlus Field Data and 590 Assessment Plan

Reported For	Landowner C Post-BMP (T1-T4)
Printed	2018-04-02
Plan Completion/Update Date	2014-05-28
SnapPlus Version 16.3 built on 2016-10-31	
C:\SnapPlus2\MySnapPlusData\Popanz_Riemer_2016_AJS.snapDb	

Prepared for:
Landowner C Post-BMP (T1-T4)
attn:Landowner C

Field Data: 55 Total Acres Reported.

Field Name	SubFarm	FSA Trct	FSA Fld	Acres	County	Critical Soil Series & Symbol	F. Slp %	F.Slp Len ft	Below Field Slope To Water %	Dist.To Water ft	N/Fld Res	Contour/ Filters	Irrig	Tiled	Rotation	Tillage	Report Period	Field "T" t/ac	Rot Avg Soil Loss t/ac	SCI	Rot Avg PI	Soil Test P ppm	Rot P2O5 Bal lb/ac	P2O5 Bal Target lb/ac
T1				20.6	Rock	BILLETT BIA	1	250	0 - 2	1001 - 5000	WP C	No / No	No	No	A-A-A-A-A-Cg-Sg15-OfAs	None-None-None-None-None-SVT-SVT-FCD	2018-2025	**3**	**0.3**	**0.6**	**0**	64	-305	0
T2				18.2	Rock	BILLETT BIA	1	250	0 - 2	1001 - 5000	P	No / No	No	No	A-A-A-A-Cg-Sg15-OfAs-A	None-None-None-None-SVT-SVT-FCD-None	2018-2025	**3**	**0.3**	**0.6**	**0**	90	-305	0
T3				5.3	Rock	DICKMAN DcA	1	250	0 - 2	1001 - 5000	WP	No / No	No	No	A-A-A-A-Cg-Sg15-OfAs-A	None-None-None-None-SVT-SVT-FCD-None	2018-2025	**3**	**0.2**	**0.6**	**0**	72	-305	0
T4				10.7	Rock	DICKMAN DcA	1	250	0 - 2	1001 - 5000	P C	No / No	No	No	Cg-Sg15-OfAs-A-A-A-A-A	SVT-SVT-FCD-None-None-None-None-None	2018-2025	**3**	**0.2**	**0.6**	**0**	29	-305	-

Crop Abbreviations

Abbreviation	Crop
A	Alfalfa
Cg	Corn grain
OfAs	Oatlage w/ Alfalfa Seeding Spring
Sg15	Soybeans 15-20 inch row

Tillage Abbreviations

Abbreviation	Tillage
FCD	Fall Chisel, disked
None	None
SVT	Spring vertical tillage

Restriction Legend

Code	Description of Code
S	Field is in SWQMA
D	Drinking water well within 50 feet of field.
C	Conduit to groundwater within 200 feet upslope of field.
L	Local restrictions on nutrient applications.
%	Slope restriction for winter applications
P	High permeability N restricted soils
R	N restricted soils with less than 20 inches to bedrock
W	N restricted soils with less than 12 inches to apparent water table
+	This map unit may have any of the N restrictive features, however an on-site investigation is needed to identify which restrictions may actually be present.

SnapPlus Application Summary Report

Starting Year	**2018**
Reported For	**Landowner C Post_BMP (Fields 3-SL)**
Printed	**2018-04-02**
Plan Completion/Update Date:	**2017-02-10**
SnapPlus Version 16.3 built on 2016-10-31	
C:\SnapPlus2\MySnapPlusData \Riemer_Farms2018manure_with_storageAJS.snapDb	

Prepared for:
Landowner C Post_BMP (Fields 3-SL)
attn:Landowner C

Annual Manure Production And Use By Source

Total Value = $ Value of all nutrients, incorporated including S.

Source		2018	2019	2020	2021	2022	2023	2024
Dairy Liquid	Production (Gallons) Used (Gallons) Analysis Date Analysis (N/Ninc/Ninj-P2O5-K2O) Dry Matter (%) Total Value	0 0 - 4/6/7-3-11 2 0.00	0 0 - 4/6/7-3-11 2 0.00	0 0 - 4/6/7-3-11 2 0.00	0 0 - 4/6/7-3-11 2 0.00	0 0 - 4/6/7-3-11 2 0.00	0 0 - 4/6/7-3-11 2 0.00	0 0 - 4/6/7-3-11 2 0.00
Dairy Slurry	Production (Gallons) Used (Gallons) Analysis Date Analysis (N/Ninc/Ninj-P2O5-K2O) Dry Matter (%) Total Value	2,064,988 2,146,500 - 7/10/12-6-17 6 0.00	2,236,172 2,283,190 - 7/10/12-6-17 6 0.00	2,407,358 2,497,600 - 7/10/12-6-17 6 0.00	2,524,158 2,532,640 - 7/10/12-6-17 6 0.00	2,640,958 2,620,730 - 7/10/12-6-17 6 0.00	2,640,958 2,698,620 - 7/10/12-6-17 6 0.00	2,640,958 2,667,770 - 7/10/12-6-17 6 0.00
Dairy Solid	Production (Tons) Used (Tons) Analysis Date Analysis (N/Ninc/Ninj-P2O5-K2O) Dry Matter (%) Total Value	992 998 - 2/3/3-3-6 33 0.00	1,118 1,119 - 2/3/3-3-6 33 0.00	1,243 1,221 - 2/3/3-3-6 33 0.00	1,243 1,231 - 2/3/3-3-6 33 0.00	1,243 1,228 - 2/3/3-3-6 33 0.00	1,243 1,224 - 2/3/3-3-6 33 0.00	1,243 1,221 - 2/3/3-3-6 33 0.00

Application Results Reported For Farm All

Source		2025
Dairy Liquid	Production (Gallons) Used (Gallons) Analysis Date Analysis (N/Ninc/Ninj-P2O5-K2O) Dry Matter (%) Total Value	0 0 - 4/6/7-3-11 2 0.00
Dairy Slurry	Production (Gallons) Used (Gallons) Analysis Date Analysis (N/Ninc/Ninj-P2O5-K2O) Dry Matter (%) Total Value	2,640,958 2,585,320 - 7/10/12-6-17 6 0.00
Dairy Solid	Production (Tons) Used (Tons) Analysis Date Analysis (N/Ninc/Ninj-P2O5-K2O) Dry Matter (%) Total Value	1,243 1,276 - 2/3/3-3-6 33 0.00

Annual Pounds Of Available N, P2O5 And K2O Applied From Manure and Fertilizer.

		2018	2019	2020	2021	2022	2023	2024
Produced from Manure (lb)	Ninj P2O5 K2O	27,756 15,366 41,057	30,188 16,771 44,723	32,617 18,173 48,383	34,019 18,874 50,369	35,420 19,575 52,354	35,420 19,575 52,354	35,420 19,575 52,354
Total Available Manure Nutrients Applied (lb)	N P2O5 K2O	24,711 15,872 42,476	27,132 17,056 45,528	29,452 18,649 49,785	29,901 18,887 50,438	30,665 19,408 51,920	31,588 19,864 53,221	31,200 19,670 52,678
Total Fertilizer Nutrients Applied (lb)	N P2O5 K2O	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0
Total Crop Removal (lb)	P2O5 K2O	31,938 54,268	30,484 58,045	32,451 55,344	29,430 55,451	32,455 56,691	30,976 58,906	32,552 56,242
Nutrient Balance (Applied - Crop removal, lb)	P2O5 K2O	-16,066 -11,792	-13,428 -12,517	-13,803 -5,559	-10,543 -5,014	-13,047 -4,771	-11,113 -5,685	-12,882 -3,564

Annual Pounds Of Available N, P2O5 And K2O Applied From Manure and Fertilizer.		
		2025
Produced from Manure (lb)	Ninj P2O5 K2O	35,420 19,575 52,354
Total Available Manure Nutrients Applied (lb)	N P2O5 K2O	30,669 19,338 51,603
Total Fertilizer Nutrients Applied (lb)	N P2O5 K2O	0 0 0
Total Crop Removal (lb)	P2O5 K2O	29,787 55,020
Nutrient Balance (Applied - Crop removal, lb)	P2O5 K2O	-10,449 -3,417

SnapPlus Application Summary Report

Starting Year	**2018**
Reported For	**Landowner C Post-BMP (T1-T4)**
Printed	**2018-04-02**
Plan Completion/Update Date:	**2014-05-28**
SnapPlus Version 16.3 built on 2016-10-31	
C:\SnapPlus2\MySnapPlusData\Popanz_Riemer_2016_AJS.snapDb	

Prepared for:
Landowner C Post-BMP (T1-T4)
attn:Landowner C

Annual Manure Production And Use By Source

Total Value = $ Value of all nutrients, incorporated including S.

Source	

Application Results Reported For Farm All

Annual Pounds Of Available N, P2O5 And K2O Applied From Manure and Fertilizer.

		2018	2019	2020	2021	2022	2023	2024
Produced from Manure (lb)	Ninj P2O5 K2O	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0
Total Available Manure Nutrients Applied (lb)	N P2O5 K2O	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0
Total Fertilizer Nutrients Applied (lb)	N P2O5 K2O	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0
Total Crop Removal (lb)	P2O5 K2O	2,246 8,313	2,085 8,527	2,085 9,222	2,192 9,864	2,310 6,457	2,060 3,940	1,751 5,879
Nutrient Balance (Applied - Crop removal, lb)	P2O5 K2O	-2,246 -8,313	-2,085 -8,527	-2,085 -9,222	-2,192 -9,864	-2,310 -6,457	-2,060 -3,940	-1,751 -5,879

Annual Pounds Of Available N, P2O5 And K2O Applied From Manure and Fertilizer.		
		2025
Produced from Manure (lb)	Ninj P2O5 K2O	0 0 0
Total Available Manure Nutrients Applied (lb)	N P2O5 K2O	0 0 0
Total Fertilizer Nutrients Applied (lb)	N P2O5 K2O	0 0 0
Total Crop Removal (lb)	P2O5 K2O	1,986 8,628
Nutrient Balance (Applied - Crop removal, lb)	P2O5 K2O	-1,986 -8,628

SnapPlus P Trade Report

Reported For	Landowner C Post_BMP (Fields 3-SL)
Printed	2018-04-02
Plan Completion/Update Date	2017-02-10
SnapPlus Version 16.3 built on 2016-10-31	
C:\SnapPlus2\MySnapPlusData \Riemer_Farms2018manure_with_storageAJS.snapDb	

Prepared for:
Landowner C Post_BMP (Fields 3-SL)
attn:Landowner C

The P Trade Report estimates the annual pounds of phosphorus (P) in surface runoff from cropland entering surface waters. These P loss calculations are based on a field's soil test P concentration, crops, tillage, nutrient management practices and estimates of average runoff and sheet and rill erosion for the predominant soil type. Losses from concentrated flow channel or gully erosion with a field are not included in these calculations. Field runoff losses are calculated for each year as **PTP** (lb P/field/yr). Fields are only included if there are at least 2 years of crops before the selected start year. Before using this report as part of a Water Quality Trade activity, phosphorus losses (PTP) must be converted into 'P credits' according to DNR guidance.

For more information go to **http://dnr.wi.gov/** and type keyword: **Water Quality Trading**

Questions? Please contact DNRphosphorus@wisconsin.gov

This report was developed for Wisconsin DNR Water Quality Trading and Adaptive Management purposes and cannot be used to demonstrate compliance with NR 151 or NRCS 590 NM plan requirements.

P Trade Report				PTP							
Field Name	Soil Series	Soil Symbol	Acres	2018	2019	2020	2021	2022	2023	2024	2025
3	SYLVESTER	SyB2	14	57	58	57	57	57	56	55	55
30	NORTHFIELD	SyC2	3	5	3	2	1	0	0	0	1
31	NORTHFIELD	SyC2	2	4	2	1	4	5	4	2	0
32.33	NORTHFIELD	SyC2	6	13	15	14	5	1	3	11	14
36	SYLVESTER	SyC2	3	4	9	11	10	8	2	1	2
38	SYLVESTER	SyC2	6	8	7	4	7	17	20	23	21
40	SYLVESTER	TbB	6	7	11	13	13	10	4	2	3

P Trade Report				PTP							
Field Name	Soil Series	Soil Symbol	Acres	2018	2019	2020	2021	2022	2023	2024	2025
41	SYLVESTER	SyB2	6	7	6	10	10	11	10	8	3
43	NORTHFIELD	SyB2	3	8	6	5	2	1	2	4	5
45	NORTHFIELD	NoC2	3	6	5	9	10	11	9	7	2
47	NORTHFIELD	SyB2	3	10	8	6	3	2	2	5	7
5	TAMA	TbB	5	44	39	31	36	30	36	30	34
61-62	SYLVESTER	TbB	2	2	1	1	0	0	0	0	0
7.8	SYLVESTER	TbB	7	26	27	27	26	26	26	26	25
E1	NORTHFIELD	SyB2	89	214	213	405	237	406	237	404	236
E2	NORTHFIELD	SyC2	74	289	325	643	365	649	365	647	364
GA	NORTHFIELD	SyB2	19	93	90	55	87	56	87	56	86
GO	SYLVESTER	SyB2	39	243	214	110	189	108	185	108	184
K1	TAMA	StA	11	10	17	20	10	16	20	11	17
K2	SYLVESTER	HvA	22	21	27	13	23	28	14	23	29
K3	NORTHFIELD	SyC2	21	207	52	109	162	50	104	177	51
K4	ELKMOUND	SyB2	20	26	51	67	27	56	77	29	51
K5	OCKLEY	OkC2	40	606	599	213	525	209	522	209	521
K6	FAYETTE	TbB	38	92	83	216	91	219	91	219	90
KO	OCKLEY	OcA	23	28	29	30	30	30	29	29	29
SL	NEWGLARUS	NgC2	13	51	64	51	37	24	11	7	6
SL2	NEWGLARUS	PgB2	8	6	4	3	3	4	9	11	9
SL3	NEWGLARUS	NgC2	12	65	43	20	10	8	10	30	31
Total			**499**	**2,150**	**2,006**	**2,145**	**1,980**	**2,043**	**1,937**	**2,132**	**1,876**

SnapPlus P Trade Report

Reported For	**Landowner C Post-BMP (T1-T4)**
Printed	**2018-04-02**
Plan Completion/Update Date	**2014-05-28**
SnapPlus Version 16.3 built on 2016-10-31	
C:\SnapPlus2\MySnapPlusData\Popanz_Riemer_2016_AJS.snapDb	

Prepared for:
Landowner C Post-BMP (T1-T4)
attn:Landowner C

The P Trade Report estimates the annual pounds of phosphorus (P) in surface runoff from cropland entering surface waters. These P loss calculations are based on a field's soil test P concentration, crops, tillage, nutrient management practices and estimates of average runoff and sheet and rill erosion for the predominant soil type. Losses from concentrated flow channel or gully erosion with a field are not included in these calculations. Field runoff losses are calculated for each year as **PTP** (lb P/field/yr). Fields are only included if there are at least 2 years of crops before the selected start year. Before using this report as part of a Water Quality Trade activity, phosphorus losses (PTP) must be converted into 'P credits' according to DNR guidance.

For more information go to **http://dnr.wi.gov/** and type keyword: **Water Quality Trading**

Questions? Please contact DNRphosphorus@wisconsin.gov

This report was developed for Wisconsin DNR Water Quality Trading and Adaptive Management purposes and cannot be used to demonstrate compliance with NR 151 or NRCS 590 NM plan requirements.

P Trade Report				PTP							
Field Name	**Soil Series**	**Soil Symbol**	**Acres**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
T1	BILLETT	DcA	21	2	3	2	2	1	3	4	4
T2	BILLETT	DcA	18	4	3	2	2	3	4	5	3
T3	DICKMAN	Me	5	1	1	1	1	1	1	1	1
T4	DICKMAN	DcA	11	2	2	2	1	1	1	0	0
Total			**55**	**10**	**9**	**8**	**6**	**7**	**9**	**10**	**9**

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APPENDIX G

Water Quality Trading Checklist

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State of Wisconsin
Department of Natural Resources
101 South Webster Street
Madison WI 53707-7921
dnr.wi.gov

Water Quality Trading Checklist

Form 3400-208 (1/14)

Notice: Pursuant to s. 283.84, Wis. Stats., this form must be completed by any WPDES permittee that intends to pursue pollutant trading as a method of complying with a permit limitation. Failure to complete this form would not result in penalties. Personal information collected will be used for administrative purposes and may be provided to requesters to the extent required by Wisconsin's Open Records Law (ss. 19.31 - 19.39, Wis. Stats.).

Applicant Information

Permittee Name	Permit Number	Facility Site Number
City of Brodhead	WI- 0021903	N/A

Facility Address	City	State	ZIP Code
P.O. BOX 168, 1111 West 2nd Avenue	Brodhead	WI	53520

Project Contact Name (if applicable)	Address	City	State	ZIP Code
Andrew Skog, P.E., MSA	1230 South Boulevard	Baraboo	WI	53913

Project Name
City of Brodhead Water Quality Trading Plan

Receiving Water Name	Parameter(s) being traded	HUC 12(s)
Sugar River Millrace	Total Phosphorus	070900040601, 070900040605

Credit Generator Information

Credit generator type (select all that apply):

- ☐ Permitted Discharge (non-MS4CAFO)
- ☐ Permitted MS4
- ☐ Permitted CAFO
- ☐ Urban nonpoint source discharge
- ☒ Agricultural nonpoint source discharge
- ☐ Other - Specify:

Are any of the credit generators in a different HUC 12 than the applicant?
- ◉ Yes; HUC 12: 070900040601
- ○ No

Are any of the credit generators downstream of the applicant?
- ○ Yes
- ◉ No

Will a broker/exchange be used to facilitate trade?
- ○ Yes *(include description and contact information in WQT plan)*
- ◉ No

Point to Point Trades (Traditional Municipal / Industrial, MS4, CAFO)

Are each of the point source credit generators identified in this section in compliance with their WDPES permit requirements?
- ○ Yes
- ○ No

Discharge Type	Permit Number	Name	Contact Information	Trade Agreement Number
○ Traditional ○ MS4 ○ CAFO				
○ Traditional ○ MS4 ○ CAFO				
○ Traditional ○ MS4 ○ CAFO				
○ Traditional ○ MS4 ○ CAFO				
○ Traditional ○ MS4 ○ CAFO				

Point to Point Trades (Traditional Municipal / Industrial, MS4, CAFO) *cont.*

Does plan have a narrative that describes:			Plan Section
a. Summary of discharge and existing treatment including optimization	◯ Yes	◯ No	
b. Amount of credit being generated	◯ Yes	◯ No	
c. Timeline for credits and agreements	◯ Yes	◯ No	
d. Method for quantifying credits	◯ Yes	◯ No	
e. Tracking and verification procedures	◯ Yes	◯ No	
f. Location of credit generator in proximity to receiving water and credit user	◯ Yes	◯ No	
g. Other: ______________________	◯ Yes	◯ No	

Point to Nonpoint Trades (Non-Permitted Urban, Agricultural, Other)

Discharge Type	Practices Used to Generate Credits	Method of Quantification	Trade Agreement Number	Have the practice(s) been formally registered?
◯ Urban NPS ◉ Agricultural NPS ◯ Other	Streambank Stabilization with Aquatic Habitat	NRCS Erosion Calculator Direct Volume Method	Landowner A	◯ Yes ◉ No ◯ Only in part
◯ Urban NPS ◉ Agricultural NPS ◯ Other	Streambank Stabilization with Aquatic Habitat	NRCS Erosion Calculator Direct Volume Method	Landowner B	◯ Yes ◉ No ◯ Only in part
◯ Urban NPS ◉ Agricultural NPS ◯ Other	Production Area Pract., Nutrient Management	BARNY, SnapPlus	Landowner C	◯ Yes ◉ No ◯ Only in part
◯ Urban NPS ◯ Agricultural NPS ◯ Other				◯ Yes ◯ No ◯ Only in part
◯ Urban NPS ◯ Agricultural NPS ◯ Other				◯ Yes ◯ No ◯ Only in part
◯ Urban NPS ◯ Agricultural NPS ◯ Other				◯ Yes ◯ No ◯ Only in part
◯ Urban NPS ◯ Agricultural NPS ◯ Other				◯ Yes ◯ No ◯ Only in part
◯ Urban NPS ◯ Agricultural NPS ◯ Other				◯ Yes ◯ No ◯ Only in part

Does plan have a narrative that describes:			Plan Section
a. Description of existing land uses	◉ Yes	◯ No	Chapter 4
b. Management practices used to generate credits	◉ Yes	◯ No	Chapter 4
c. Amount of credit being generated	◉ Yes	◯ No	Chapter 4
d. Description of applicable trade ratio per agreement/management practice	◉ Yes	◯ No	Chapter 4
e. Location where credits will be generated	◉ Yes	◯ No	Chapter 4
f. Timeline for credits and agreements	◉ Yes	◯ No	Chapter 7
g. Method for quantifying credits	◉ Yes	◯ No	Chapter 4

Does plan have a narrative that describes:			Plan Section
h. Tracking procedures	(●) Yes	( ) No	Chapter 5
i. Conditions under which the management practices may be inspected	(●) Yes	( ) No	Chapter 5
j. Reporting requirements should the management practice fail	(●) Yes	( ) No	Chapter 5
k. Operation and maintenance plan for each management practice	(●) Yes	( ) No	Chapter 4
l. Location of credit generator in proximity to receiving water and credit user	(●) Yes	( ) No	Chapter 4
m. Practice registration documents, if available	( ) Yes	(●) No	
n. History of project site(s)	(●) Yes	( ) No	Chapter 4
o. Other: ______	( ) Yes	( ) No	

The preparer certifies all of the following:

- I am familiar with the specifications submitted for this application, and I believe all applicable items in this checklist have been addressed.
- I have completed this document to the best of my knowledge and have not excluded pertinent information.
- I certify that the information in this document is true to the best of my knowledge.

Signature of Preparer	Date Signed
Andrew Skoog	07/31/2017

Authorized Representative Signature

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision. Based on my inquiry of those persons directly responsible for gathering and entering the information, the information is, to the best of my knowledge and belief, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signature of Authorized Representative	Date Signed
[signature]	7/31/17